sdl

# Android Guides

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# Installation

In order to build your app on a SmartDeviceLink (SDL) Core, the SDL software development kit (SDK) must be installed in your app. The following steps will guide you through adding the SDL SDK to your workspace and configuring the environment.

> **NOTE**
>
> The SDL SDK is currently supported on Android 4.1 (Jelly Bean) and above.

# Install SDL SDK

Each SDL Android library release is published to MavenCentral. By adding a few lines in their app's gradle script, developers can compile with the latest SDL Android release.

To gain access to the MavenCentral repository, make sure your app's `build.gradle` file includes the following:

```
repositories {
    mavenCentral()
}
```

## Gradle Build

To compile with a release of SDL Android, include the following line in your app's `build.gradle` file,

```
dependencies {
    implementation 'com.smartdevicelink:sdl_android:{version}'
}
```

and replace `{version}` with the desired release version in format of `x.x.x`. The list of releases can be found here.

## Examples

To compile release 5.5.0, use the following line:

```
dependencies {
    implementation 'com.smartdevicelink:sdl_android:5.5.0'
}
```

To compile the latest minor release of major version 5, use:

```
dependencies {
    implementation 'com.smartdevicelink:sdl_android:5.+'
}
```

To Find more information on installation, read our README.

# SDK Configuration

## 1. Get an App Id

An app id is required for production level apps. The app id gives your app special permissions to access vehicle data. If your app does not need to access vehicle data, a dummy app id (i.e. creating a fake id like "1234") is sufficient during the development stage. However, you must get an app id before releasing the app to the public.

To obtain an app id, sign up at smartdevicelink.com.

## 2. Add Required System Permissions

Some permissions are required to be granted to the SDL app in order for it to work properly. In the AndroidManifest file, we need to ensure we have the following system permissions:

- Internet - Used by the mobile library to communicate with a SDL Server
- Bluetooth - Primary transport for SDL communication between the device and the vehicle's head-unit
- Access Network State - Required to check if WiFi is enabled on the device
- Foreground Service - Required for SDL to run services in the foreground for applications targeting Android P (API Level 28) or higher

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.BLUETOOTH"/>
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"
/>
    <uses-permission android:name="android.permission.FOREGROUND_SERVICE" />

</manifest>
```

**NOTE**

If the app is targeting Android S (API Level 31) or higher, the Android Manifest file also needs to include the following permission to allow the app to be notified of Bluetooth Connections:

This permission is a runtime permission and will require the user to grant the permission.

```
<uses-permission
android:name="android.permission.BLUETOOTH_CONNECT"
    tools:targetApi="31"/>
```

# 3. Add Required SDL Queries

If targeting Android R (API Level 30) or higher, it is required to add the SDL specific entries into the app's `queries` tag in the `AndroidManifest.xml`. If the tag already exists, just the intents need to be added. If the tag does not yet exist in the manifest, they can be added after the permissions are declared but before the `application` tag is opened.

```
<queries>
   <intent>
      <action android:name="com.smartdevicelink.router.service" />
   </intent>
   <intent>
      <action android:name="sdl.router.startservice" />
   </intent>
</queries>
```

The SDL Android library uses these queries to determine which app should host the router service, what apps to notify when there's an SDL connection, etc. As will be seen in the next sections, these intents are used in the intent filters for the `SdlRouterService` and the `SdlBroadcastReceiver`.

# Integration Basics

In this guide, we exclusively use Android Studio. We are going to set-up a bare-bones application so you get started using SDL.

> **NOTE**
>
> The SDL Mobile library supports Android 4.1 (API Level 16) or higher.

# SmartDeviceLink Service

A SmartDeviceLink Service should be created to manage the lifecycle of the SDL session. The `SdlService` should build and start an instance of the `SdlManager` which will automatically connect with a head unit when available. This `SdlManager` will handle sending and receiving messages to and from SDL after it is connected.

> **NOTE**
>
> Please be aware that using an Activity to host the SDL implementation will not work. Android 10 has restrictions on starting activities from the background and that is how the SDL library will start the supplied component. SDL apps should only use a foreground service to host the SDL implementation.

Create a new service and name it appropriately, for this guide we are going to call it `SdlService`.

```
public class SdlService extends Service {
    //...
}
```

If you created the service using the Android Studio template then the service should have been added to your `AndroidManifest.xml`. If not, then service needs to be defined in the manifest:

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

        <service
        android:name=".SdlService"
        android:enabled="true"
        android:foregroundServiceType='connectedDevice'/>

    </application>

</manifest>
```

> **NOTE**
>
> Android API 31 now requires any Service that will be started from an external source to explicitly set the exported flag to true ( `exported=true` ).
> You can set this flag if you wish to allow the active Router Service to start your SdlService while your app is in the background.
>
> If you do not wish to set this flag for your SdlService you can still start your SdlService while your app is in the foreground.

## Entering the Foreground

Because of Android Oreo's requirements, it is mandatory that services enter the foreground for long running tasks. The first bit of integration is ensuring that happens in the `onCreate` method of the `SdlService` or similar. Within the service that implements the SDL lifecycle you will need to add a call to start the service in the foreground. This will include creating a notification to sit in the status bar tray. This information and icons should be relevant for what the service is doing/going to do. If you already start your service in the foreground, you can ignore this section.

```
@Override
public void onCreate() {
    super.onCreate();
    //...
    if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
        NotificationChannel channel = new NotificationChannel("channelId",
"channelName", NotificationManager.IMPORTANCE_DEFAULT);
        NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
        if (notificationManager != null) {
            notificationManager.createNotificationChannel(channel);
            Notification serviceNotification = new Notification.Builder(this,
channel.getId())
                    .setContentTitle(...)
                    .setSmallIcon(...)
                    .setContentText(...)
                    .setChannelId(channel.getId())
                    .build();
            startForeground(FOREGROUND_SERVICE_ID, serviceNotification);
        }
    }
}
```

**NOTE**

The sample code checks if the OS is of Android Oreo or newer to start a foreground service. It is up to the app developer if they wish to start the notification in previous versions.

## Exiting the Foreground

It's important that you don't leave your notification in the notification tray as it is very confusing to users. So in the `onDestroy` method in your service, simply call the `stopForeground` method.

```
@Override
public void onDestroy(){
    //...
    if(Build.VERSION.SDK_INT>=Build.VERSION_CODES.O){
        NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
        if(notificationManager!=null){ //If this is the only notification on your channel
            notificationManager.deleteNotificationChannel(* Notification Channel*);
        }
        stopForeground(true);
    }
}
```

## Implementing SDL Manager

In order to correctly connect to an SDL enabled head unit developers need to implement methods for the proper creation and disposing of an `SdlManager` in our `SdlService`.

> **NOTE**
>
> An instance of SdlManager cannot be reused after it is closed and properly disposed of. Instead, a new instance must be created. Only one instance of SdlManager should be in use at any given time.

> **MUST**
>
> `SdlManagerListener` method: `onSystemInfoReceived` auto generates in Android Studio to returns false. This will cause your app to not connect. You must change it to true or implement logic to check system info to see if you wish for your app to connect to that system.

```
public class SdlService extends Service {

    //The manager handles communication between the application and SDL
    private SdlManager sdlManager = null;

    //...

    @Override
    public int onStartCommand(Intent intent, int flags, int startId) {

        if (sdlManager == null) {
            MultiplexTransportConfig transport = new MultiplexTransportConfig(this,
APP_ID, MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);

            // The app type to be used
            Vector<AppHMIType> appType = new Vector<>();
            appType.add(AppHMIType.MEDIA);

            // The manager listener helps you know when certain events that pertain to
the SDL Manager happen
            SdlManagerListener listener = new SdlManagerListener() {

                @Override
                public void onStart() {
                    // After this callback is triggered the SdlManager can be used to interact
with the connected SDL session (updating the display, sending RPCs, etc)
                }

                @Override
                public void onDestroy() {
                    SdlService.this.stopSelf();
                }

                @Override
                public void onError(String info, Exception e) {
                }

                @Override
                public LifecycleConfigurationUpdate
managerShouldUpdateLifecycle(Language language, Language hmiLanguage) {
                    return null;
                }

                @Override
                public boolean onSystemInfoReceived(SystemInfo systemInfo) {
                    // Check the SystemInfo object to ensure that the connection to the
device should continue
                    return true;
                }
            };

            // Create App Icon, this is set in the SdlManager builder
```

```
            SdlArtwork appIcon = new SdlArtwork(ICON_FILENAME,
FileType.GRAPHIC_PNG, R.mipmap.ic_launcher, true);

            // The manager builder sets options for your session
            SdlManager.Builder builder = new SdlManager.Builder(this, APP_ID,
APP_NAME, listener);
            builder.setAppTypes(appType);
            builder.setTransportType(transport);
            builder.setAppIcon(appIcon);
            sdlManager = builder.build();
            sdlManager.start();
        }

        return START_STICKY;
    }
}
```

The `onDestroy()` method from the `SdlManagerListener` is called whenever the manager detects some disconnect in the connection, whether initiated by the app, by SDL, or by the device's connection.

### MUST

The `sdlManager` must be shutdown properly in the `SdlService.onDestroy()` callback using the method `sdlManager.dispose()`.

## OPTIONAL SDLMANAGER BUILDER PARAMETERS

### APP ICON

This is a custom icon for your application. Please refer to Adaptive Interface Capabilities for icon sizes.

```
builder.setAppIcon(appIcon);
```

### APP TYPE

The app type is used by car manufacturers to decide how to categorize your app. Each car manufacturer has a different categorization system. For example, if you set your app type as media, your app will also show up in the audio tab as well as the apps tab of Ford's SYNC® 3 head unit. The app type options are: default, communication, media (i.e. music/podcasts/radio), messaging, navigation, projection, information, and social.

```
Vector<AppHMIType> appHMITypes = new Vector<>();
appHMITypes.add(AppHMIType.MEDIA);

builder.setAppTypes(appHMITypes);
```

#### NOTE

Navigation and projection applications both use video and audio byte streaming. However, navigation apps require special permissions from OEMs, and projection apps are only for internal use by OEMs.

### SHORT APP NAME

This is a shortened version of your app name that is substituted when the full app name will not be visible due to character count constraints. You will want to make this as short as possible.

```
builder.setShortAppName(shortAppName);
```

### TEMPLATE COLORING

You can customize the color scheme of your initial template on head units that support this feature using the `builder`. For more information, see the Customizing the Template guide section.

## LOCK SCREEN CONFIGURATION

A lock screen is used to prevent the user from interacting with the app on the smartphone while they are driving. When the vehicle starts moving, the lock screen is activated. Similarly, when the vehicle stops moving, the lock screen is removed. You must implement a lock screen in your app for safety reasons. Any application without a lock screen will not get approval for release to the public.

The SDL SDK can take care of the lock screen implementation for you, automatically using your app logo and the connected vehicle logo. If you do not want to use the default lock screen, you can implement your own custom lock screen.

```
LockScreenConfig lockScreenConfig = new LockScreenConfig();
builder.setLockScreenConfig(lockScreenConfig);
```

You should also declare the `SDLLockScreenActivity` in your manifest. For more information, please refer to the Adding the Lock Screen section.

## SDLSECURITY

Some OEMs may want to encrypt messages passed between your SDL app and the head unit. If this is the case, when you submit your app to the OEM for review, they will ask you to add a security library to your SDL app. See the Encryption section.

## FILE MANAGER CONFIGURATION

The file manager configuration allows you to configure retry behavior for uploading files and images. The default configuration attempts one re-upload, but will fail after that.

```
FileManagerConfig fileManagerConfig = new FileManagerConfig();
fileManagerConfig.setArtworkRetryCount(2);
fileManagerConfig.setFileRetryCount(2);

builder.setFileManagerConfig(fileManagerConfig);
```

## LANGUAGE

The desired language to be used on display/HMI of connected module can be set.

```
builder.setLanguage(Language.EN_US);
```

### LISTENING FOR RPC NOTIFICATIONS AND EVENTS

You can listen for specific events using `SdlManager`'s builder `setRPCNotificationListeners`. The following example shows how to listen for HMI Status notifications. Additional listeners can be added for specific RPCs by using their corresponding `FunctionID` in place of the `ON_HMI_STATUS` in the following example and casting the `RPCNotification` object to the correct type.

```
Map<FunctionID, OnRPCNotificationListener> onRPCNotificationListenerMap = new
HashMap<>();
onRPCNotificationListenerMap.put(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnHMIStatus onHMIStatus = (OnHMIStatus) notification;
        if (onHMIStatus.getHmiLevel() == HMILevel.HMI_FULL &&
onHMIStatus.getFirstRun()){
            // first time in HMI Full
        }
    }
});
builder.setRPCNotificationListeners(onRPCNotificationListenerMap);
```

You can also use `addOnRPCNotificationListener` when creating an `SdlManagerListener` object. The following example shows how to set up the listener in the `onStart()` method of an `SdlManagerListener` object.

```
@Override
public void onStart() {
    // HMI Status Listener
    sdlManager.addOnRPCNotificationListener(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
        @Override
        public void onNotified(RPCNotification notification) {
            OnHMIStatus onHMIStatus = (OnHMIStatus) notification;
            if (onHMIStatus.getWindowID() != null && onHMIStatus.getWindowID() !=
PredefinedWindows.DEFAULT_WINDOW.getValue()) {
                return;
            }
            if (onHMIStatus.getHmiLevel() == HMILevel.HMI_FULL &&
onHMIStatus.getFirstRun()) {
                // first time in HMI Full
            }
        }
    });
}
```

### HASH RESUMPTIONS

Set a `hashID` for your application that can be used over connection cycles (i.e. loss of connection, ignition cycles, etc.).

```
builder.setResumeHash(hashID);
```

## DETERMINING SDL SUPPORT

You have the ability to determine a minimum SDL protocol and a minimum SDL RPC version that your app supports. You can also check the connected vehicle type and disconnect if the vehicle module is not supported. We recommend not setting these values until your app is ready for production. The OEMs you support will help you configure correct values during the application review process.

### BLOCKING BY VERSION

If a head unit is blocked by protocol version, your app icon will never appear on the head unit's screen. If you configure your app to block by RPC version, it will appear and then quickly disappear. So while blocking with `minimumProtocolVersion` is preferable, `minimumRPCVersion` allows you more granular control over which RPCs will be present.

```
builder.setMinimumProtocolVersion(new Version("3.0.0"));
builder.setMinimumRPCVersion(new Version("4.0.0"));
```

### BLOCKING BY VEHICLE TYPE

If you are blocking by vehicle type and you are connected over RPC v7.1+, your app icon will never appear on the head unit's screen. If you are connected over RPC v7.0 or below, it will appear and then quickly disappear. To implement this type of blocking, you need to set up the `SDLManagerListener`. You will then implement logic in `onSystemInfoReceived` method and return `true` if you want to continue the connection and `false` if you wish to disconnect.

# SmartDeviceLink Router Service

The `SdlRouterService` will listen for a connection with an SDL enabled module. When a connection happens, it will alert all SDL enabled apps that a connection has been established and they should start their SDL services.

We must implement a local copy of the `SdlRouterService` into our project. The class doesn't need any modification, it's just important that we include it. We will extend the `com.smartdevicelink.transport.SdlRouterService` in our class named `SdlRouterService`:

**NOTE**

Do not include an import for `com.smartdevicelink.transport.SdlRouterService`. Otherwise, we will get an error for `'SdlRouterService' is already defined in this compilation unit`.

```
public class SdlRouterService extends
com.smartdevicelink.transport.SdlRouterService {
   //Nothing to do here
}
```

**MUST**

The local extension of the `com.smartdevicelink.transport.SdlRouterService` must be named `SdlRouterService`.

**MUST**

Make sure this local class `SdlRouterService.java` is in the same package of `SdlReceiver.java` (described below)

If you created the service using the Android Studio template then the service should have been added to your `AndroidManifest.xml` otherwise the service needs to be added in the manifest. Because we want our service to be seen by other SDL enabled apps, we need to set `android:exported="true"`. The system may issue a lint warning because of this, so we can suppress that using `tools:ignore="ExportedService"`.

NOTE

Android API 29 adds a new attribute foregroundServiceType to specify the type of foreground service.
Starting with Android API 29 please include `android:foregroundServiceType='connectedDevice'` to the service tag for SdlRouterService in your AndroidManifest.xml

MUST

The `SdlRouterService` must be placed in a separate process with the name `com.smartdevicelink.router`. If it is not in that process during its start up it will stop itself.

## Intent Filter

```
<intent-filter>
   <action android:name="com.smartdevicelink.router.service"/>
</intent-filter>
```

The new versions of the SDL Android library rely on the `com.smartdevicelink.router.service` action to query SDL enabled apps that host router services. This allows the library to determine which router service to start.

MUST

This `intent-filter` MUST be included.

# Metadata

## ROUTER SERVICE VERSION

```
<meta-data android:name="sdl_router_version"
android:value="@integer/sdl_router_service_version_value" />
```

Adding the `sdl_router_version` metadata allows the library to know the version of the router service that the app is using. This makes it simpler for the library to choose the newest router service when multiple router services are available.

## CUSTOM ROUTER SERVICE

```
<meta-data android:name="sdl_custom_router" android:value="false" />
```

> **NOTE**
>
> This is only for specific OEM applications, therefore normal developers do not need to worry about this.

Some OEMs choose to implement custom router services. Setting the `sdl_custom_router` metadata value to `true` means that the app is using something custom over the

default router service that is included in the SDL Android library. Do not include this `meta-data` entry unless you know what you are doing.

The final router service entry in the `AndroidManifest.xml` file should look like the following:

```
<service
    android:name=".SdlRouterService"
    android:enabled="true"
    android:exported="true"
    android:foregroundServiceType="connectedDevice"
    android:process="com.smartdevicelink.router">

    <intent-filter>
        <action android:name="com.smartdevicelink.router.service" />
    </intent-filter>

    <meta-data
        android:name="sdl_router_version"
        android:value="@integer/sdl_router_service_version_value" />
</service>
```

# SmartDeviceLink Broadcast Receiver

The Android implementation of the `SdlManager` relies heavily on the OS's bluetooth and USB intents. When the phone is connected to SDL and the router service has sent a connection intent, the app needs to create an `SdlManager`, which will bind to the already connected router service. As mentioned previously, the `SdlManager` cannot be re-used. When a disconnect between the app and SDL occurs, the current `SdlManager` must be disposed of and a new one created.

The SDL Android library has a custom broadcast receiver named `SdlBroadcastReceiver` that should be used as the base for your `BroadcastReceiver`. It is a child class of Android's `BroadcastReceiver` so all normal flow and attributes will be available. Two abstract methods will be automatically populate the class, we will fill them out soon.

Create a new `SdlBroadcastReceiver` and name it appropriately, for this guide we are going to call it `SdlReceiver`:

```
public class SdlReceiver extends SdlBroadcastReceiver {

    @Override
    public void onSdlEnabled(Context context, Intent intent) {
        //...

    }

    @Override
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
        //...
    }
}
```

**MUST**

SdlBroadcastReceiver must call super if `onReceive` is overridden

```
    @Override
    public void onReceive(Context context, Intent intent) {
        super.onReceive(context, intent);
        //your code here
    }
```

If you created the `BroadcastReceiver` using the Android Studio template then the service should have been added to your `AndroidManifest.xml` otherwise the receiver needs to be defined in the manifest. Regardless, the manifest needs to be edited so that the `SdlBroadcastReceiver` needs to respond to the following intents:

- android.bluetooth.device.action.ACL_CONNECTED
- sdl.router.startservice

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

        <receiver
            android:name=".SdlReceiver"
            android:exported="true"
            android:enabled="true">

            <intent-filter>
                <action android:name="android.bluetooth.device.action.ACL_CONNECTED"
/>
                <action android:name="sdl.router.startservice" />
            </intent-filter>

        </receiver>

    </application>

</manifest>
```

**NOTE**

The intent `sdl.router.startservice` is a custom intent that will come from the `SdlRouterService` to tell us that we have just connected to an SDL enabled piece of hardware.

**MUST**

SdlBroadcastReceiver has to be exported, or it will not work correctly

Next, we want to make sure we supply our instance of the `SdlBroadcastService` with our local copy of the `SdlRouterService`. We do this by simply returning the class object in the

method `defineLocalSdlRouterClass`:

```
public class SdlReceiver extends SdlBroadcastReceiver {
  @Override
   public void onSdlEnabled(Context context, Intent intent) {

   }

   @Override
   public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
      //Return a local copy of the SdlRouterService located in your project
      return com.company.mySdlApplication.SdlRouterService.class;
   }
}
```

We want to start the `SdlManager` when an SDL connection is made via the `SdlRouterService`. We do this by taking action in the `onSdlEnabled` method:

### MUST

Apps must start their service in the foreground as of Android API 26 and as of Android API 31 the service must be started from a foreground context.

Either you will need to ensure the app is in the foreground when you start the SdlService or you will need to start the SdlService from a foreground context.

The intent received in onSdlEnabled will have a PendingIntent extra that will allow you start the SdlService from the context of the active SdlRouterService.

```
public class SdlReceiver extends SdlBroadcastReceiver {

  @Override
   public void onSdlEnabled(Context context, Intent intent) {
      DebugTool.logInfo(TAG, "SDL Enabled");
      intent.setClass(context, SdlService.class);

      // Starting with Android S SdlService needs to be started from a foreground
context.
      // We will check the intent for a pendingIntent parcelable extra
      // This pendingIntent allows us to start the SdlService from the context of the
active router service which is in the foreground
      if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.S) {
         if (intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA)
!= null) {
            PendingIntent pendingIntent = (PendingIntent)
intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA);
            try {
               pendingIntent.send(context, 0, intent);
            } catch (PendingIntent.CanceledException e) {
               e.printStackTrace();
            }
         }
      } else if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
         // SdlService needs to be foregrounded in Android O and above
         // This will prevent apps in the background from crashing when they try to
start SdlService
         // Because Android O doesn't allow background apps to start background
services

         context.startForegroundService(intent);
      } else {
         context.startService(intent);
      }
   }

   @Override
   public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
      //Return a local copy of the SdlRouterService located in your project
      return com.company.mySdlApplication.SdlRouterService.class;
   }
}
```

> **NOTE**
>
> The `onSdlEnabled` method will be the main start point for our SDL connection session. We define exactly what we want to happen when we find out we are connected to SDL enabled hardware.

There is now an overridable method, `getSdlServiceName` in the `SdlBroadcastReceiver` class. This method is used by the `SdlBroadcastReceiver` to catch possible foreground exceptions.

When the app tries to start the `SdlService`, if the service does not enter the foreground within a set amount of time (this time is designated by the Android operating system) an exception will be thrown and the app may encounter an ANR.

The `SdlBroadcasterReceiver` can catch this exception and prevent the ANR but will need to know the name of the class that throws the exception.

By default the `getSdlServiceName` method will return "SdlService". If your app uses a name other than "SdlService" you will need to override `getSdlServiceName` in the `SdlReceiver` class to return the correct name.

```
//...
@Override
public String getSdlServiceName() {
    return SDL_SERVICE_CLASS_NAME;
}
//...
```

## Main Activity

Now that the basic connection infrastructure is in place, we should add methods to start the `SdlService` when our application starts. In `onCreate()` in your main activity, you need to call a method that will check to see if there is currently an SDL connection made. If

there is one, the `onSdlEnabled` method will be called and we will follow the flow we already set up:

```
public class MainActivity extends Activity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        //If we are connected to a module we want to start our SdlService
        SdlReceiver.queryForConnectedService(this);
    }
}
```

# Where to Go From Here

You should now be able to connect to a head unit or emulator. For more guidance on connecting, see Connecting to an Infotainment System. To start building your app, learn about designing your interface. Please also review the best practices for building an SDL app.

# Connecting to an Infotainment System

In order to view your SDL app, you must connect your device to a head unit that supports SDL Core. If you do not have access to a head unit, we recommend using the Manticore web-based emulator for testing how your SDL app reacts to real-world vehicle events, on-screen interactions and voice recognition.

You will have to configure different connection types based on whether you are connecting to a head unit or an emulator. When connecting to a head unit, you must configure a `Mult`

`iplex` connection. Likewise, when connecting to an emulator, a `TCP` connection must be configured.

# Connecting to an Emulator

To connect to an emulator such as Manticore or a local Ubuntu SDL Core-based emulator you must implement a TCP connection when configuring your SDL app.

## Getting the IP Address and Port

### GENERIC SDL CORE

To connect to a virtual machine running the Ubuntu SDL Core-based emulator, you will use the IP address of the Ubuntu OS and `12345` for the port. You may have to enable port forwarding on your virtual machine if you want to connect using a real device instead of a simulated device.

### MANTICORE

Once you launch an instance of Manticore, you will be given an IP address and port number that you can use to configure your TCP connection.

## Setting the IP Address and Port

```
// Set the SdlManager.Builder transport
builder.setTransportType(new TCPTransportConfig(<PORT>, <IP ADDRESS>, false));
```

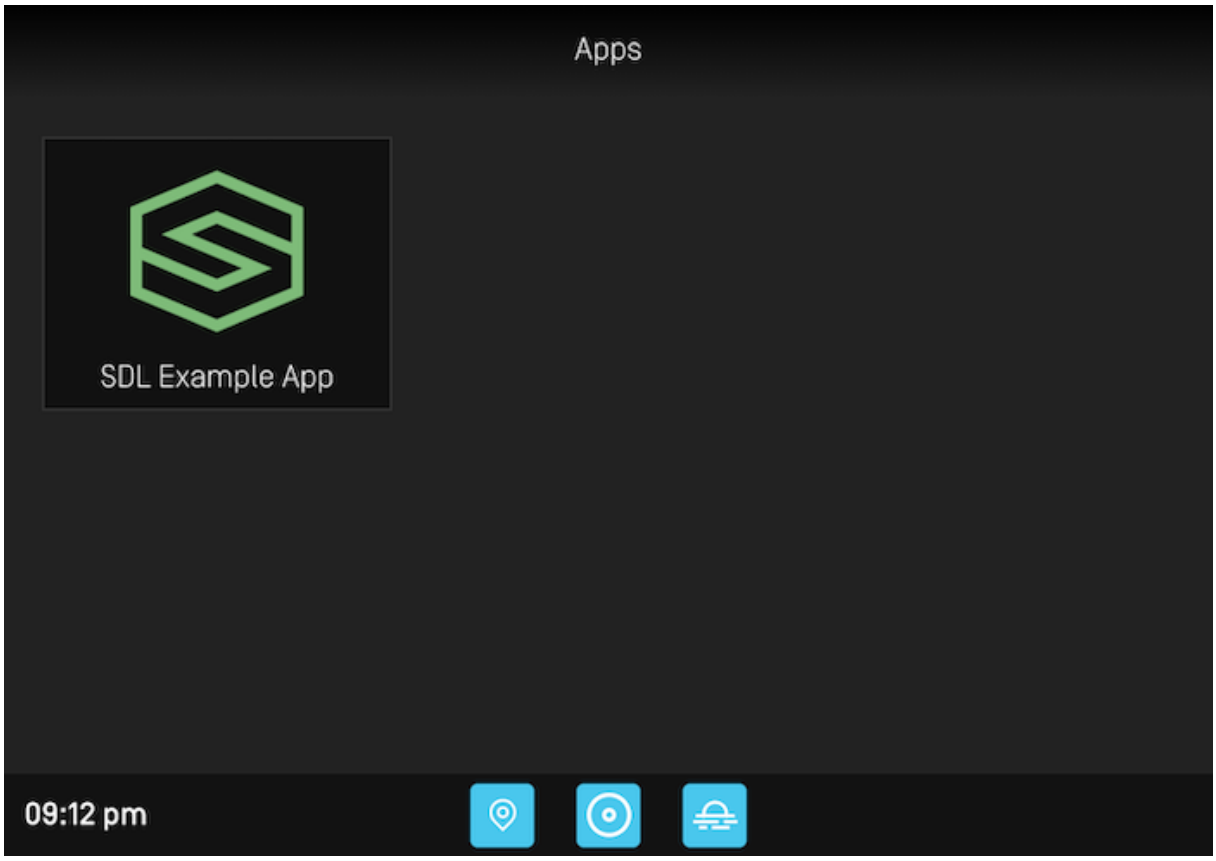
# Connecting to a Head Unit

To connect your device directly to a production vehicle head unit or Test Development Kit (TDK), make sure to implement a `Multiplex` connection. Then connect the device using a USB cord or, if the head unit supports it, Bluetooth.

```
// Set the SdlManager.Builder transport
builder.setTransportType(new MultiplexTransportConfig(context, <APP ID>));
```

# Running the SDL App

Build and run the project in Android Studio, targeting the device or simulator that you want to test your app with. Your app should compile and launch on your device of choosing. If your connection configuration is setup correctly, you should see your SDL app icon appear on the HMI screen:




To open your app, click on your app's icon in the HMI.

This is the main screen of your SDL app. If you get to this point, your SDL app is working.

### Troubleshooting

If you are having issues with connecting to an emulator or head unit, please see our troubleshooting tips in the Example Apps section of the guide.

# Adding the Lock Screen

The lock screen is a vital part of your SDL app because it prevents the user from using the phone while the vehicle is in motion. SDL takes care of the lock screen for you. If you prefer your own look, but still want the recommended logic that SDL provides for free, you can also set your own custom lock screen.

# Configure the Lock Screen Activity

You must declare the `SDLLockScreenActivity` in your manifest. To do so, simply add the following to your app's `AndroidManifest.xml` if you have not already done so:

```
<activity
android:name="com.smartdevicelink.managers.lockscreen.SDLLockScreenActivity"
            android:launchMode="singleTop"/>
```

**MUST**

This manifest entry must be added for the lock screen feature to work.

# Using the Provided Lock Screen

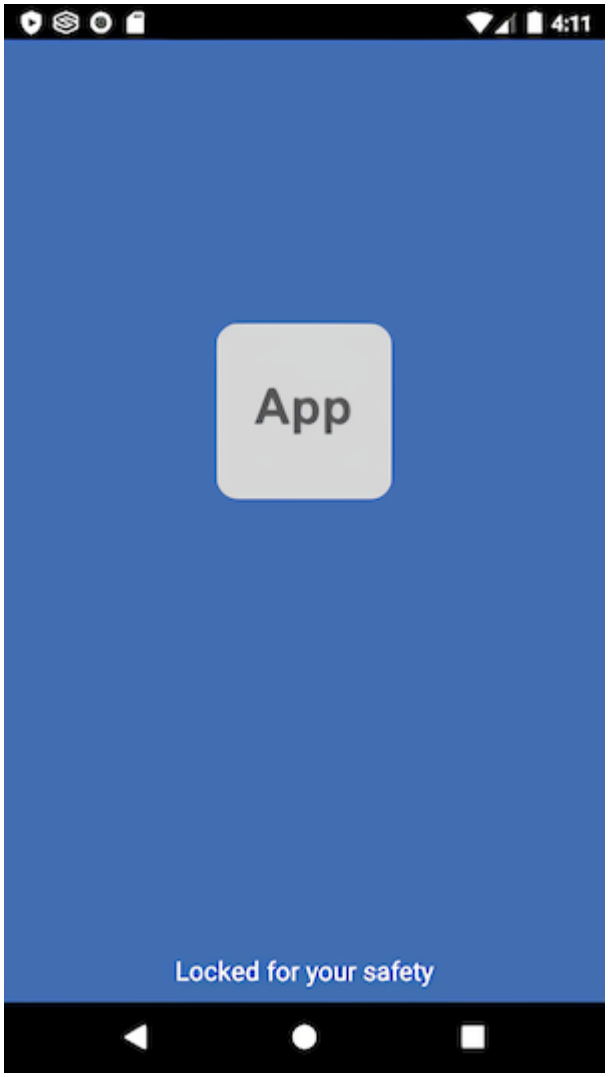
If you have implemented the `SdlManager` and defined the `SDLLockScreenActivity` in your manifest, you have a working default lockscreen configuration.

# Customizing the Default Lock Screen

It is possible to customize the background color and app icon in the default provided lockscreen. If you choose not to set your own app icon the library will use the SDL logo.

When customizing your lock screen please define a `LockScreenConfig` and set it using the builder for your `SdlManager`.

```
LockScreenConfig lockScreenConfig = new LockScreenConfig();
builder.setLockScreenConfig(lockScreenConfig);
```




## Custom Background Color

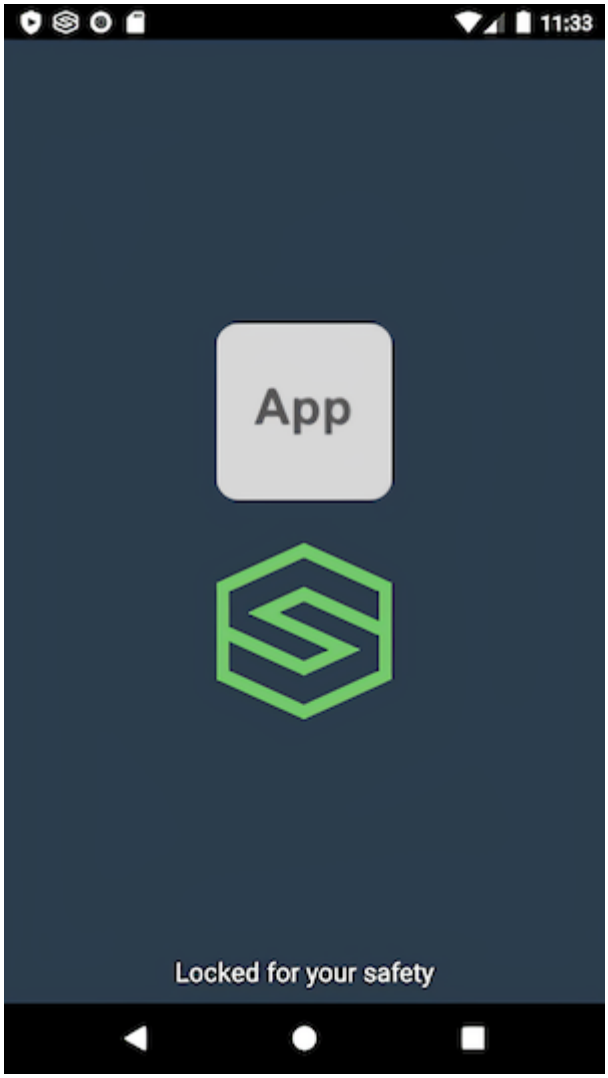
```
lockScreenConfig.setBackgroundColor(resourceColor); // For example,
getResources().getColor(R.color.black) or Color.parseColor("#000000");
```

## Custom App Icon

```
lockScreenConfig.setAppIcon(appIconInt); // For example, R.drawable.lockscreen
icon
```

## Showing the OEM Logo

The default lock screen handles retrieving and setting the OEM logo from head units that support this feature.




This feature can be disabled on the default lock screen by setting `showDeviceLogo` to false.

```
lockScreenConfig.showDeviceLogo(false);
```

# Creating a Custom Lock Screen

If you would like to use your own lock screen instead of the one provided by the library, but still use the logic we provide, you can use a new initializer within `LockScreenConfig`.

```
lockScreenConfig.setCustomView(customViewInt);
```

# Customizing the Lock Screen State

In SDL Android v4.10, a new parameter `displayMode` has been added to the `LockScreenConfig` to control the state of the lock screen and the older boolean parameters have been deprecated.

| DISPLAYMODE | DESCRIPTION |
| --- | --- |
| never | The lock screen should never be shown. This should almost always mean that you will build your own lock screen |
| requiredOnly | The lock screen should only be shown when it is required by the head unit |
| optionalOrRequired | The lock screen should be shown when required by the head unit or when the head unit says that its optional, but *not* in other cases, such as before the user has interacted with your app on the head unit |
| always | The lock screen should always be shown after connection |

## Disabling the Lock Screen

Please note that a lock screen will be required by most OEMs. You can disable the lock screen manager, but you will then be required to implement your own logic for showing and hiding the lock screen. This is not recommended as the `LockScreenConfig` adheres to most OEM lock screen requirements. However, if you must create a lock screen manager from scratch, the library's lock screen manager can be disabled via the `LockScreenConfig` as follows:

```
LockScreenConfig lockScreenConfig = new LockScreenConfig();
lockScreenConfig.setDisplayMode(LockScreenConfig.DISPLAY_MODE_NEVER);
```

## Making the Lock Screen Always On

The lock screen manager is configured to dismiss the lock screen when it is safe to do so. To always have the lock screen visible when the device is connected to the head unit, simply update the lock screen configuration.

```
LockScreenConfig lockScreenConfig = new LockScreenConfig();
lockScreenConfig.setDisplayMode(LockScreenConfig.DISPLAY_MODE_ALWAYS);
```

## Enabling User Lockscreen Dismissal (Passenger Mode)

Starting in RPC v6.0+ users may now have the ability to dismiss the lock screen by swiping the lock screen down. Not all OEMs support this new feature. A dismissible lock screen is enabled by default if the head unit enables the feature, but you can disable it manually as well.

To disable this feature, set `LockScreenConfig`s `enableDismissGesture` to false.

```
LockScreenConfig lockScreenConfig = new LockScreenConfig();
lockScreenConfig.enableDismissGesture(false);
```

# Using Android Open Accessory Protocol

Incorporating AOA into an SDL enabled app allows it to create and register an SDL session over USB. This guide will assume the app has already integrated the SDL library as laid out in the previous guides. AOA connections are sent through the `SDLRouterService` to bypass an Android limitation of only one app being able to be used through the AOA intent.

Prerequisites:

- Installation guide
- SDK Configuration guide
- Integration Basics guide

We will add or make changes to:

- Android Manifest **(of your app)**
- SdlService *(optional)*

# Prerequisites

The Installation, SDK Configuration, and Integration Basics guides must be completed before enabling the use of the AOA USB transport. The remainder of the guide will assume all steps will be followed.

# Android Manifest

To use the AOA protocol, you must specify so in your app's Manifest with:

```
<uses-feature android:name="android.hardware.usb.accessory"/>
```

**MUST**

This feature will not work without including this line!

The SDL Android library houses a `USBAccessoryAttachmentActivity` that you need to add between your Manifest's `<application>...</application>` tags:

```
<activity
android:name="com.smartdevicelink.transport.USBAccessoryAttachmentActivity"
    android:launchMode="singleTop"
    android:exported=true>
    <intent-filter>
        <action
android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />
    </intent-filter>

    <meta-data
        android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED"
        android:resource="@xml/accessory_filter" />
</activity>
```

**MUST**

Android API 31 now requires any activity with an intent filter to explicitly set the exported flag to true ( `exported=true` ).

**NOTE**

The accessory_filter.xml file is included with the SDL Android Library

# Media Apps

Media applications do not register over AOA since by default there are no audio streaming methods available.
To get media applications to register, when creating the connection you need to set flag requiresAudioSupport to false:

```
MultiplexTransportConfig multiplexTransportConfig = new
MultiplexTransportConfig(getBaseContext(), APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);
multiplexTransportConfig.setRequiresAudioSupport(false);
```

# SmartDeviceLink Service

As long as the app doesn't require high bandwidth, it shouldn't matter which transport is being connected. A multiplex transport should be used like the one that follows:

```
@Override
    public int onStartCommand(Intent intent, int flags, int startId) {

        if (sdlManager == null) {
            MultiplexTransportConfig transport = new MultiplexTransportConfig(this,
APP_ID, MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);

            SdlManagerListener listener = new SdlManagerListener() {
                //...
            };

            // ...

            builder.setTransportType(transport);
            sdlManager = builder.build();
            sdlManager.start();
        }
        ...
    }
```

## Using only USB / AOA

The new `MultiplexingConfig` allows for apps to be able to connect via Bluetooth and USB as primary transports. If you want your app to only use USB / AOA, then you should specifically only set that as the only allowed primary transport.

When defining your transport, also pass in a custom list that only contains the USB:

```
List<TransportType> multiplexPrimaryTransports = Arrays.asList(TransportType.USB);

MultiplexTransportConfig transport = new MultiplexTransportConfig(this, appId,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_MED);

transport.setPrimaryTransports(multiplexPrimaryTransports);
```

## Multiple Transports

Since the `SdlRouterService` now handles both bluetooth and AOA/USB connections, an app will be connected to the transport that connects first if the app includes it in their transport config. If a module supports secondary transports, the second transport to be connected of bluetooth or USB will be available as well as potentially TCP. This means even though the app might register over bluetooth, if USB or TCP are available those transports will be available for high bandwidth services. For more information please see the Multiple Transport Guide.

# Multiple Transports (Protocol v5.1+)

The multiple transports feature allows apps to carry their SDL session over multiple transports. The first transport that the app connects with is referred to as the primary transport and a transport connected at a later point is the secondary transport. For example, apps can register over Bluetooth or USB as a primary transport, then connect

over WiFi when necessary (ex. to allow video/audio streaming) as a secondary transport. This feature is supported on connections with protocol version 5.1+, which is supported on SDL Android 4.7+ and SDL Core 5.0+.

# Primary Transports

On head units that support multiple transports, the primary transport will be used for RPC communication while the secondary transport will be used for high bandwidth services such as streaming video data for navigation applications. If no high-bandwidth secondary transport is present, the primary transport will be used for all needed services that the transport supports.

## Supporting specific primary transports

Whether your app supports both Bluetooth and/or USB connections is determined by what you set as acceptable primary transports. By default, both USB and Bluetooth are supported and should be kept unless there is a specific reason otherwise. If you list multiple primary transports and one disconnects, if another included transport is available the app will automatically attempt to connect and register to it.

```
List<TransportType> multiplexPrimaryTransports = Arrays.asList(TransportType.USB,
TransportType.BLUETOOTH);
MultiplexTransportConfig mtc = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);
mtc.setPrimaryTransports(multiplexPrimaryTransports);
```

If you only want to use Bluetooth or USB, simply pass in a list with the one you want.

NOTE

For the best compatibility we suggest supporting both primary transports.

## Requiring High Bandwidth

Certain app types will require a high bandwidth transport to be available, which could be either primary or secondary transports. If this is the case, an app will only be registered if a high bandwidth transport is either connected or available to connect.

If this is the case for your app you can set the `setRequiresHighBandwidth` flag to `true`:

```
MultiplexTransportConfig mtc = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);

mtc.setRequiresHighBandwidth(true);
```

## High bandwidth app with low bandwidth support

While some app's main integration requires high bandwidth, it is possible to support a low bandwidth integration for better visibility. As an example, a navigation app might require high bandwidth transport to stream their map view but could provide a low bandwidth integration that displays turn-by-turn directions. Another simple low bandwidth integration could simply be displaying a message that instructs the user to connect USB or WiFi to enable the app. In this case the app should set the requires high bandwidth flag to false, as it is by default.

```
MultiplexTransportConfig mtc = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);

mtc.setRequiresHighBandwidth(false);
```

# Secondary Transports

Secondary transports must be enabled by the module to which the app is connecting. In addition to Bluetooth and USB (which are primary transports), TCP over WiFi is a

supported secondary transport.

Setting secondary transports that your app supports is similar to setting the primary transports:

```
List<TransportType> multiplexPrimaryTransports = Arrays.asList(TransportType.USB,
TransportType.BLUETOOTH);
List<TransportType> multiplexSecondaryTransports =
Arrays.asList(TransportType.TCP, TransportType.USB, TransportType.BLUETOOTH);
MultiplexTransportConfig mtc = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);
mtc.setPrimaryTransports(multiplexPrimaryTransports);
mtc.setSecondaryTransports(multiplexSecondaryTransports);
```

By default, all three transports are set as supported secondary transports.

# Adapting to the Head Unit Language

Since a head unit can support multiple languages, you may want to add support for more than one language to your SDL app. The SDL library allows you to check which language is currently used by the head unit. If desired, the app's name and the app's text-to-speech (TTS) name can be customized to reflect the head unit's current language. If your app name is not part of the current lexicon, you should tell the VR system how a native speaker will pronounce your app name by setting the TTS name using phonemes from either the Microsoft SAPI phoneme set or from the LHPLUS phoneme set.

# Setting the Default Language

The initial configuration of the `SdlManager` requires a default language when setting the `Builder`. If not set, the SDL library uses American English (*EN_US*) as the default

language. The connection will fail if the head unit does not support the `language` set in the `Builder`. The `RegisterAppInterface` response RPC will return `INVALID_DATA` as the reason for rejecting the request.

## What if My App Does Not Support the Head Unit Language?

If your app does not support the current head unit language, you should decide on a default language to use in your app. All text should be created using this default language. Unfortunately, your VR commands will probably not work as the VR system will not recognize your users' pronunciation.

## Checking the Current Head Unit Language

After starting the `SDLManager` you can check the `sdlManager.getRegisterAppInterfaceResponse()` property for the head unit's `language` and `hmiDisplayLanguage`. The `language` property gives you the current VR system language; `hmiDisplayLanguage` the current display text language.

```
Language headUnitLanguage =
sdlManager.getRegisterAppInterfaceResponse().getLanguage();
Language headUnitHMILanguage =
sdlManager.getRegisterAppInterfaceResponse().getHmiDisplayLanguage();
```

# Updating the SDL App Name

To customize the app name for the head unit's current language, implement the following steps:

1. Set the default `language` in the `Builder`.
2. Implement the `sdlManagerListener`'s `managerShouldUpdateLifecycle(Language language, Language hmiLanguage)` method. If the module's current HMI language or voice recognition (VR) language is different from the app's default language, the

listener will be called with the module's current HMI and/or VR language. Return a `LifecycleConfigurationUpdate` with the new `appName` and/or `ttsName`.

```
@Override
public LifecycleConfigurationUpdate managerShouldUpdateLifecycle(Language
language, Language hmiLanguage) {
    boolean isNeedUpdate = false;
    String appName = APP_NAME;
    String ttsName = APP_NAME;
    switch (language) {
        case ES_MX:
            isNeedUpdate = true;
            ttsName = APP_NAME_ES;
            break;
        case FR_CA:
            isNeedUpdate = true;
            ttsName = APP_NAME_FR;
            break;
        default:
            break;
    }
    switch (hmiLanguage) {
        case ES_MX:
            isNeedUpdate = true;
            appName = APP_NAME_ES;
            break;
        case FR_CA:
            isNeedUpdate = true;
            appName = APP_NAME_FR;
            break;
        default:
            break;
    }
    if (isNeedUpdate) {
        Vector<TTSChunk> chunks = new Vector<>(Collections.singletonList(new
TTSChunk(ttsName, SpeechCapabilities.TEXT)));
        return new LifecycleConfigurationUpdate(appName, null, chunks, null);
    } else {
        return null;
    }
}
```

# Understanding Permissions

While creating your SDL app, remember that just because your app is connected to a head unit it does not mean that the app has permission to send the RPCs you want. If your app does not have the required permissions, requests will be rejected. There are three important things to remember in regards to permissions:

1. You may not be able to send a RPC when the SDL app is closed, in the background, or obscured by an alert. Each RPC has a set of `hmiLevel`s during which it can be sent.
2. For some RPCs, like those that access vehicle data or make a phone call, you may need special permissions from the OEM to use. This permission is granted when you submit your app to the OEM for approval. Each OEM decides which RPCs it will restrict access to, so it is up you to check if you are allowed to use the RPC with the head unit.
3. Some head units may not support all RPCs.

# HMI Levels

When your app is connected to the head unit you will receive notifications when the SDL app's HMI status changes. Your app can be in one of four different `hmiLevel` s:

| HMI LEVEL | WHAT DOES THIS MEAN? |
| --- | --- |
| NONE | The user has not yet opened your app, or the app has been killed. |
| BACKGROUND | The user has opened your app, but is currently in another part of the head unit. |
| LIMITED | This level only applies to media and navigation apps (i.e. apps with an `appType` of `MEDIA` or `NAVIGATION`). The user has opened your app, but is currently in another part of the head unit. The app can receive button presses from the play, seek, tune, and preset buttons. |
| FULL | Your app is currently in focus on the screen. |

Be careful with sending user interface related RPCs in the `NONE` and `BACKGROUND` levels; some head units may reject RPCs sent in those states. We recommended that you wait until your app's `hmiLevel` enters `FULL` to set up your app's UI.

To get more detailed information about the state of your SDL app check the current system context. The system context will let you know if a menu is open, a VR session is in progress, an alert is showing, or if the main screen is unobstructed. You can find more information about the system context below.

## Monitoring the HMI Level

Monitoring HMI Status is possible through an `OnHMIStatus` notification that you can subscribe to via the `SdlManager.Builder` 's `setRPCNotificationListeners` .

```
Map<FunctionID, OnRPCNotificationListener> onRPCNotificationListenerMap = new
HashMap<>();
onRPCNotificationListenerMap.put(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnHMIStatus onHMIStatus = (OnHMIStatus) notification;
        if (onHMIStatus.getHmiLevel() == HMILevel.HMI_FULL &&
onHMIStatus.getFirstRun()){
            // first time in HMI Full
        }
    }
});
builder.setRPCNotificationListeners(onRPCNotificationListenerMap);
```

# Permission Manager

The PermissionManager allows developers to easily query whether specific RPCs are allowed or not in the current state of the app. It also allows a listener to be added for RPCs or their parameters so that if there are changes in their permissions, the app will be notified.

## Checking Current Permissions of a Single RPC

```
boolean allowed =
sdlManager.getPermissionManager().isRPCAllowed(FunctionID.SHOW);

// You can also check if a permission parameter is allowed
boolean parameterAllowed =
sdlManager.getPermissionManager().isPermissionParameterAllowed(FunctionID.GET
 GetVehicleData.KEY_RPM);
```

## Checking Current Permissions of a Group of RPCs

You can also retrieve the status of a group of RPCs. First, you can retrieve the permission status of the group of RPCs as a whole: whether or not those RPCs are all allowed, all

disallowed, or some are allowed and some are disallowed. This will allow you to know, for example, if a feature you need is allowed based on the status of all the RPCs needed for the feature.

```
List<PermissionElement> permissionElements = new ArrayList<>();
permissionElements.add(new PermissionElement(FunctionID.SHOW, null));
permissionElements.add(new PermissionElement(FunctionID.GET_VEHICLE_DATA,
Arrays.asList(GetVehicleData.KEY_RPM, GetVehicleData.KEY_SPEED)));

int groupStatus =
sdlManager.getPermissionManager().getGroupStatusOfPermissions(permissionElem


switch (groupStatus) {
    case PermissionManager.PERMISSION_GROUP_STATUS_ALLOWED:
        // Every permission in the group is currently allowed
        break;
    case PermissionManager.PERMISSION_GROUP_STATUS_DISALLOWED:
        // Every permission in the group is currently disallowed
        break;
    case PermissionManager.PERMISSION_GROUP_STATUS_MIXED:
        // Some permissions in the group are allowed and some disallowed
        break;
    case PermissionManager.PERMISSION_GROUP_STATUS_UNKNOWN:
        // The current status of the group is unknown
        break;
}
```

The previous snippet will give a quick generic status for all permissions together. However, if you want to get a more detailed result about the status of every permission or parameter in the group, you can use the `getStatusOfPermissions` method.

```
List<PermissionElement> permissionElements = new ArrayList<>();
permissionElements.add(new PermissionElement(FunctionID.SHOW, null));
permissionElements.add(new PermissionElement(FunctionID.GET_VEHICLE_DATA,
Arrays.asList(GetVehicleData.KEY_RPM, GetVehicleData.KEY_AIRBAG_STATUS)));

Map<FunctionID, PermissionStatus> status =
sdlManager.getPermissionManager().getStatusOfPermissions(permissionElements);

if (status.get(FunctionID.GET_VEHICLE_DATA).getIsRPCAllowed()){
    // GetVehicleData RPC is allowed
}

if
(status.get(FunctionID.GET_VEHICLE_DATA).getAllowedParameters().get(GetVehicle
{
    // rpm parameter in GetVehicleData RPC is allowed
}
```

## Observing Permissions

If desired, you can set a listener for a group of permissions. The listener will be called when the permissions for the group changes. If you want to be notified when the permission status of any of RPCs in the group change, set the `groupType` to `PERMISSIO N_GROUP_TYPE_ANY`. If you only want to be notified when all of the RPCs in the group are allowed, or go from allowed to some/all not allowed, set the `groupType` to `PERMISS ION_GROUP_TYPE_ALL_ALLOWED`.

```
List<PermissionElement> permissionElements = new ArrayList<>();
permissionElements.add(new PermissionElement(FunctionID.SHOW, null));
permissionElements.add(new PermissionElement(FunctionID.GET_VEHICLE_DATA,
Arrays.asList(GetVehicleData.KEY_RPM, GetVehicleData.KEY_AIRBAG_STATUS)));

UUID listenerId =
sdlManager.getPermissionManager().addListener(permissionElements,
PermissionManager.PERMISSION_GROUP_TYPE_ANY, new
OnPermissionChangeListener() {
    @Override
    public void onPermissionsChange(@NonNull Map<FunctionID, PermissionStatus>
updatedPermissionStatuses, @NonNull int updatedGroupStatus) {
        if
(updatedPermissionStatuses.get(FunctionID.GET_VEHICLE_DATA).getIsRPCAllowed(
 {
            // GetVehicleData RPC is allowed
        }

        if
(updatedPermissionStatuses.get(FunctionID.GET_VEHICLE_DATA).getAllowedParam
{
            // rpm parameter in GetVehicleData RPC is allowed
        }
    }
});
```

## Stopping Observation of Permissions

When you set up the listener, you will get a unique id back. Use this id to unsubscribe to the permissions at a later date.

```
sdlManager.getPermissionManager().removeListener(listenerId);
```

# Additional HMI State Information

If you want more detail about the current state of your SDL app you can monitor the audio playback state as well as get notifications when something blocks the main screen of

your app.

## Audio Streaming State

The Audio Streaming State informs your app whether or not the driver will be able to hear your app's audio. It will be either `AUDIBLE`, `NOT_AUDIBLE`, or `ATTENUATED`.

You will get these notifications when an alert pops up, when you start recording the in-car audio, when voice recognition is active, when another app takes audio control, when a navigation app is giving directions, etc.

| AUDIO STREAMING STATE | WHAT DOES THIS MEAN? |
| --- | --- |
| AUDIBLE | Any audio you are playing will be audible to the user |
| ATTENUATED | Some kind of audio mixing is occurring between what you are playing, if anything, and some system level audio or navigation application audio. |
| NOT_AUDIBLE | Your streaming audio is not audible. This could occur during a `VRSESSION` System Context. |

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnHMIStatus status = (OnHMIStatus) notification;
        AudioStreamingState streamingState = status.getAudioStreamingState();
    }
});
```

## System Context

The System Context informs your app if there is potentially a blocking HMI component while your app is still visible. An example of this would be if your application is open and you display an alert. Your app will receive a system context of `ALERT` while it is presented on the screen, followed by `MAIN` when it is dismissed.

| SYSTEM CONTEXT STATE | WHAT DOES THIS MEAN? |
| --- | --- |
| MAIN | No user interaction is in progress that could be blocking your app's visibility. |
| VRSESSION | Voice recognition is currently in progress. |
| MENU | A menu interaction is currently in-progress. |
| HMI_OBSCURED | The app's display HMI is being blocked by either a system or other app's overlay (another app's alert, for instance). |
| ALERT | An alert that you have sent is currently visible. |

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnHMIStatus status = (OnHMIStatus) notification;
        SystemContext systemContext = status.getSystemContext();
    }
});
```

# Checking Supported Features

New features are always being added to SDL, however, you or your users may be connecting to modules that do not support the newest features. If your SDL app attempts to use an unsupported feature your request will be ignored by the module.

When you are implementing a feature you should always assume that some modules your users connect to will not support the feature or that the user may have disabled permissions for this feature on their head unit. The best way to deal with unsupported features is to check if the feature is available before attempting to use it and to handle error responses.

## Checking the System Capability Manager

The easiest way to check if a feature is supported is to query the library's System Capability Manager. For more details on how get this information, please see the Adaptive Interface Capabilities guide.

## Handling RPC Error Responses

When you are trying to use a feature, you can watch for an error response to the RPC request you sent to the module. If the response contains an error, you may be able to check the `result` enum to determine if the feature is disabled. If the response that comes back is of the type `GenericResponse`, the module doesn't understand your request.

```
request.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (!response.getSuccess()) {
            // The request was not successful, check the response.getResultCode() and
response.getInfo() for more information.
        } else {
            // The request was successful
        }
    }
});
sdlManager.sendRPC(request);
```

## Checking if a Feature is Supported by Version

When you connect successfully to a head unit, SDL will automatically negotiate the maximum SDL RPC version supported by both the module and your SDL SDK. If the feature you want to support was added in a version less than or equal to the version returned by the head unit, then your head unit may support the feature. Remember that the module may still disable the feature, or the user may still have disabled permissions for the feature in some cases. It's best to check if the feature is supported through the System Capability Manager first, but you may also check the negotiated version to know if the head unit was built before the feature was designed.

Throughout these guides you may see headers that contain text like "RPC 6.0+". That means that if the negotiated version is 6.0 or greater, then SDL supports the feature but the above caveats may still apply.

```
SdlMsgVersion rpcSpecVersion =
sdlManager.getRegisterAppInterfaceResponse().getSdlMsgVersion();
```

# Setting Security Level for Multiplexing

When connecting to Core via Multiplex transport, your SDL app will use a Router Service housed within your app or another SDL enabled app.

To help ensure the validity of the Router Service, you can select the security level explicitly when you create your Multiplex transport in your app's SdlService:

```
int securityLevel = FLAG_MULTI_SECURITY_MED;

BaseTransportConfig transport = new MultiplexTransportConfig(context, appId,
securityLevel);
```

If you create the transport without specifying the security level, it will be set to `FLAG_MULTI_SECURITY_MED` by default.

# Security Levels

| SECURITY FLAG | MEANING |
| --- | --- |
| `FLAG_MULTI_SECURITY_OFF` | Multiplexing security turned off. All router services are trusted. |
| `FLAG_MULTI_SECURITY_LOW` | Multiplexing security will be minimal. Only trusted router services will be used. Trusted router list will be obtained from server. List will be refreshed every 20 days or during next connection session if an SDL enabled app has been installed or uninstalled. |
| `FLAG_MULTI_SECURITY_MED` | Multiplexing security will be on at a normal level. Only trusted router services will be used. Trusted router list will be obtained from server. List will be refreshed every 7 days or during next connection session if an SDL enabled app has been installed or uninstalled. |
| `FLAG_MULTI_SECURITY_HIGH` | Multiplexing security will be very strict. Only trusted router services installed from trusted app stores will be used. Trusted router list will be obtained from server. List will be refreshed every 7 days or during next connection session if an SDL enabled app has been installed or uninstalled. |

# Applying to the Trusted Router Service Database

For an Android application to be added to the Trusted Router Service database, the application will need to be registered on the SDL Developer Portal and certified by the SDLC. For more information on registration, please see this guide.

Any Android application that is certified by the SDLC will be added to the Trusted Router Service database; there are no additional steps required as it is part of the certification process.

Please consult the Trusted Router Service FAQs if you have any additional questions.

# Proguard Guidelines

SmartDeviceLink and its dependent libraries are open source and not intended to be obfuscated. When using Proguard in an app that integrates SmartDeviceLink, it is necessary to follow these guidelines.

## Required Proguard Rules

Apps that are code shrinking a release build with Proguard typically have a section resembling this snippet in their `build.gradle`:

```
android {
    buildTypes {
        release {
            minifyEnabled true
            proguardFiles getDefaultProguardFile('proguard-android.txt'),
                    'proguard-rules.pro'
        }
    }
    ...
}
```

Developers using Proguard in this manner should be sure to include the following lines in their `proguard-rules.pro` file:

```
-keep class com.smartdevicelink.** { *; }
-keep class com.livio.** { *; }
# Video streaming apps must add the following line
-keep class ** extends com.smartdevicelink.streaming.video.SdlRemoteDisplay { *; }
```

> **NOTE**
>
> Failure to include these Proguard rules may result in a failed build or cause issues during runtime.

# Example Apps

This guide takes you through the steps needed to get the sample project, *Hello Sdl*, connected a module.

To get the example app, download or clone the sdl_java_suite. The *Hello Sdl Android* app is a package within the SDL Android library. Open the `sdl_java_suite/android` project using "Open an existing Android Studio project" in Android Studio. We will use Android Studio throughout this guide as it is the official IDE for Android development.

## Build Flavors

*Hello Sdl Android* has been built with different build flavors that allow you to quickly connect the app to an emulator or hardware. You can choose your flavor in the **Build**

**Variant** menu. To open the menu, select **Build > Select Build Variant**. A small window will appear on the bottom left of your IDE that allows you to choose a flavor.

There are many flavors to choose from but for now we will only be concerned with the debug build variants:

- `multi` - Multiplexing - Bluetooth, USB, TCP (as secondary transport)
- `multi_high_bandwidth` - Multiplexing for apps that require a high bandwidth transport
- `tcp` - Transmission Control Protocol - Only used for debugging purposes

You will mainly be dealing with `multi` build variants if connecting to TDK, or `tcp` if connecting to Manticore or another emulator.

# Connecting to an Infotainment System

## Emulator

You can use a simulated or a real device to connect the example app to an emulator. To connect the example app to Manticore or another emulator, make sure you are using `tcp Debug` build flavor. You must update the IP address and port number in the *Hello Sdl Android* project so it knows where your emulator is running. Please check the Connecting to an Infotainment System guide for more detailed instructions on how to get the emulator's IP address and port number.

1. In the main Java folder of *Hello Sdl Android*, open up `SdlService.java`.
2. At the top of this file, locate the variable declaration for `DEV_MACHINE_IP_ADDRESS` and change it to your emulator's IP address. Set the `TCP_PORT` to your emulator's port number.

```
private static final String DEV_MACHINE_IP_ADDRESS = "192.168.1.78"; // Update
private static final int TCP_PORT = 12345; // Update
```

3. Make sure the emulator is running, then build and run the app on a real device or a simulated device. The SDL app should show up on the HMI.

## Head Unit

You need a real device to connect the example app to production or debug hardware. To connect the example app via Bluetooth or USB, all you need to do to is select the `multi_sec_offDebug` build flavor and then run the app on an Android device. You can find more information about the USB transport in the Using AOA Protocol guide.

If using the Bluetooth transport, make sure to first pair your Android phone to the hardware before attempting to connect your SDL app.

# Troubleshooting

If your app compiles and but does not show up on the HMI, there are a few things you should check:

## TCP Debug Transport

1. Make sure that you have changed the IP in `SdlService.java` to match the machine running SDL Core. Being on the same network is also important.
2. If you are sure that the IP is correct and it is still not showing up, make sure the Build Flavor that is running is `tcpDebug`.
3. If the two above don't work, make sure there is no firewall blocking the incoming port `12345` on the machine or VM running SDL Core. Also, make sure your firewall allows that outgoing port.
4. There are different network configurations needed for different virtualization software (VirtualBox, VMware, etc). Make sure yours is set up correctly. Or use Manticore.

## Bluetooth

1. Make sure the build flavor `multi_sec_offDebug` is selected.
2. Ensure your phone is properly paired with the TDK

3. Make sure Bluetooth is turned on - on both the TDK and your phone
4. Make sure apps are enabled on the TDK (in settings)

# Additional Examples

For more examples go to the SmartDeviceLink Examples GitHub organization. Download or clone any of these projects.

The examples available include the example weather app, example navigation app, and the SDL Capabilities app.

The example weather app uses the OpenWeather API to implement a basic connected weather app with SDL UI. This example showcases multiple screens for different weather forecast types, displaying hourly and daily weather in popup menus, and showing weather alerts with SDL Alerts.

The example navigation app uses the MapBox API to create a basic video streaming map app. The example navigation app can be used as a reference for developers who want to create their own navigation app.

The SDL Capabilities app showcases various capabilities of SDL.

**NOTE**

Some examples require obtaining API tokens from third parties for data and services. For all of these examples follow the setup instructions as outlined in their **README.md**.

# Adaptive Interface Capabilities

Since each car manufacturer has different user interface style guidelines, the number of lines of text, soft and hard buttons, and images supported will vary between different types of head units. The system will send information to your app about its capabilities for various user interface elements. You should use this information to create the user interface of your SDL app.

You can access these properties on the `sdlManager.getSystemCapabilityManager()` instance.

# System Capability Manager Properties

| PARAMETERS | DESCRIPTION | RPC VERSION |
| --- | --- | --- |
| SystemCapabilityType.DISPLAYS | Specifies display related information. The primary display will be the first element within the array. Windows within that display are different places that the app could be displayed (such as the main app window and various widget windows). | RPC v6.0+ |
| SystemCapabilityType.HMI_ZONE | Specifies HMI Zones in the vehicle. There may be a HMI available for back seat passengers as well as front seat passengers. | RPC v1.0+ |
| SystemCapabilityType.SPEECH | Contains information about TTS capabilities on the SDL platform. Platforms may support text, SAPI phonemes, LH PLUS phonemes, pre-recorded speech, and silence. | RPC v1.0+ |
|  | Currently only available in the SDL_iOS and SDL JavaScript libraries | RPC v3.0+ |
| SystemCapabilityType.VOICE_RECOGNITION | The voice-recognition capabilities of the connected SDL platform. The platform may be able to recognize spoken text in the current language. | RPC v1.0+ |
| SystemCapabilityType.AUDIO_PASSTHROUGH | Describes the sampling rate, bits per sample, and audio types available. | RPC v2.0+ |

| PARAMETERS | DESCRIPTION | RPC VERSION |
| --- | --- | --- |
| SystemCapabilityType.PCM_STREAMING | Describes different audio type configurations for the audio PCM stream service, e.g. {8kHz,8-bit,PCM}. | RPC v4.1+ |
| SystemCapabilityType.HMI | Returns whether or not the app can support built-in navigation and phone calls. | RPC v3.0+ |
| SystemCapabilityType.APP_SERVICES | Describes the capabilities of app services including what service types are supported and the current state of services. | RPC v5.1+ |
| SystemCapabilityType.NAVIGATION | Describes the built-in vehicle navigation system's APIs. | RPC v4.5+ |
| SystemCapabilityType.PHONE_CALL | Describes the built-in phone calling capabilities of the IVI system. | RPC v4.5+ |
| SystemCapabilityType.VIDEO_STREAMING | Describes the abilities of the head unit to video stream projection applications. | RPC v4.5+ |
| SystemCapabilityType.REMOTE_CONTROL | Describes the abilities of an app to control built-in aspects of the IVI system. | RPC v4.5+ |
| SystemCapabilityType.SEAT_LOCATION | Describes the positioning of each seat in a vehicle | RPC v6.0+ |

## Deprecated Properties

The following properties are deprecated on SDL Android 4.10 because as of RPC v6.0 they are deprecated. However, these properties will still be filled with information. When connected on RPC <6.0, the information will be exactly the same as what is returned in the `RegisterAppInterfaceResponse` and `SetDisplayLayoutResponse`. However, if connected on RPC >6.0, the information will be converted from the newer-style display information, which means that some information will not be available.

| PARAMETERS | DESCRIPTION |
| --- | --- |
| SystemCapabilityType.DISPLAY | Information about the HMI display. This includes information about available templates, whether or not graphics are supported, and a list of all text fields and the max number of characters allowed in each text field. |
| SystemCapabilityType.BUTTON | A list of available buttons and whether the buttons support long, short and up-down presses. |
| SystemCapabilityType.SOFTBUTTON | A list of available soft buttons and whether the button support images. Also, information about whether the button supports long, short and up-down presses. |
| SystemCapabilityType.PRESET_BANK | If returned, the platform supports custom on-screen presets. |

## Image Specifics

Images may be formatted as PNG, JPEG, or BMP. You can find which image types and resolutions are supported using the system capability manager.

Since the head unit connection is often relatively slow (especially over Bluetooth), you should pay attention to the size of your images to ensure that they are not larger than they

need to be. If an image is uploaded that is larger than the supported size, the image will be scaled down by Core.

```
ImageField field =
sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getIma

ImageResolution resolution = field.getImageResolution();
```

## EXAMPLE IMAGE SIZES

Below is a table with example image sizes. Check the `SystemCapabilityManager` for the exact image sizes desired by the system you are connecting to. The connected system should be able to scale down larger sizes, but if the image you are sending is much larger than desired, then performance will be impacted.

| IMAGENAME | USED IN RPC | DETAILS | SIZE | TYPE |
| --- | --- | --- | --- | --- |
| softButtonImage | Show | Image shown on softbuttons on the base screen | 70x70px | png, jpg, bmp |
| choiceImage | CreateInteractionChoiceSet | Image shown in the manual part of an performInteraction either big (ICON_ONLY) or small (LIST_ONLY) | 70x70px | png, jpg, bmp |
| choiceSecondaryImage | CreateInteractionChoiceSet | Image shown on the right side of an entry in (LIST_ONLY) performInteraction | 35x35px | png, jpg, bmp |
| vrHelpItem | SetGlobalProperties | Image shown during voice interaction | 35x35px | png, jpg, bmp |
| menuIcon | SetGlobalProperties | Image shown on the “More…” button | 35x35px | png, jpg, bmp |
| cmdIcon | AddCommand | Image shown for commands in the "More…" menu | 35x35px | png, jpg, bmp |

| IMAGENAME | USED IN RPC | DETAILS | SIZE | TYPE |
| --- | --- | --- | --- | --- |
| appIcon | SetAppIcon | Image shown as Icon in the "Mobile Apps" menu | 70x70px | png, jpg, bmp |
| graphic | Show | Image shown on the base screen as cover art | 185x185px | png, jpg, bmp |

# Querying and Subscribing System Capabilities

Capabilities that can be updated can be queried and subscribed to using the `SystemCapabilityManager`.

## Determining Support for System Capabilities

You should check if the head unit supports your desired capability before subscribing to or updating the capability.

```
boolean navigationSupported =
sdlManager.getSystemCapabilityManager().isCapabilitySupported(SystemCapabilityTy
```

## Manual Querying for System Capabilities

Most head units provide features that your app can use: making and receiving phone calls, an embedded navigation system, video and audio streaming, as well as supporting app services. To pull information about this capability, use the `SystemCapabilityManager` to

query the head unit for the desired capability. If a capability is unavailable, the query will return `null`.

```
sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.APP_
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        AppServicesCapabilities servicesCapabilities = (AppServicesCapabilities)
capability;
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
}, false);
```

## Subscribing to System Capabilities (RPC v5.1+)

In addition to getting the current system capabilities, it is also possible to subscribe for updates when the head unit capabilities change. Since this information must be queried from Core you must implement the `OnSystemCapabilityListener`.

> **NOTE**
>
> If `supportsSubscriptions == false`, you can still subscribe to capabilities, however, you must manually poll for new capability updates using `getCapability(type, listener, forceUpdate)` with `forceUpdate` set to `true`. All subscriptions will be automatically updated when that method returns a new value.
>
> The `DISPLAYS` type can be subscribed on all SDL versions.

### CHECKING IF THE HEAD UNIT SUPPORTS SUBSCRIPTIONS

```
boolean supportsSubscriptions =
sdlManager.getSystemCapabilityManager().supportsSubscriptions();
```

### SUBSCRIBE TO A CAPABILITY

```
sdlManager.getSystemCapabilityManager().addOnSystemCapabilityListener(SystemC
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        AppServicesCapabilities servicesCapabilities = (AppServicesCapabilities)
capability;
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
});
```

# Main Screen Templates

Each head unit manufacturer supports a set of user interface templates. These templates determine the position and size of the text, images, and buttons on the screen. Once the app has connected successfully with an SDL enabled head unit, a list of supported templates is available on `sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getTemplatesAvailable()`.

# Change the Template

To change a template at any time, use `ScreenManager.changeLayout()`. This guide requires SDL Java Suite version 5.0. If using an older version, use the `SetDisplayLayout` RPC.

> **NOTE**
>
> When changing the layout, you may get an error or failure if the update is "superseded." This isn't technically a failure, because changing the layout has not yet been attempted. The layout or batched operation was cancelled before it could be completed because another operation was requested. The layout change will then be inserted into the future operation and completed then.

```
TemplateConfiguration templateConfiguration = new
TemplateConfiguration().setTemplate(PredefinedLayout.GRAPHIC_WITH_TEXT.toStrir

sdlManager.getScreenManager().changeLayout(templateConfiguration, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            DebugTool.logInfo(TAG, "Layout set successfully");
        } else {
            DebugTool.logInfo(TAG, "Layout not set successfully");
        }
    }
});
```

Template changes can also be batched with text and graphics updates:

```
sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setTextField1("Line of Text");
sdlManager.getScreenManager().changeLayout(templateConfiguration, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        // This listener will be ignored, and will use the CompletionListener sent in
commit.
    }
});
sdlManager.getScreenManager().setPrimaryGraphic(sdlArtwork);
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            DebugTool.logInfo(TAG, "The data and template have been set successfully");
        }
    }
});
```

When changing screen layouts and template data (for example, to show a weather hourly data screen vs. a daily weather screen), it is recommended to encapsulate these updates into a class or method. Doing so is a good way to keep SDL UI changes organized. A fully-formed example of this can be seen in the example weather app. Below is a generic example.

# Screen Change Example Code

This example code creates an interface that can be implemented by various "screens" of your SDL app. This is a recommended design pattern so that you can separate your code to only involve the data models you need. This is just a simple example and your own needs may be different.

## Screen Change Example Interface

All screens will need to have access to the `ScreenManager` object and a function to display the screen. Therefore, it is recommended to create a generic interface for all

screens to follow. For the example below, the `CustomSDLScreen` protocol requires an initializer with the parameters `SDLManager` and a `showScreen` method.

```
public class CustomSdlScreen {
    protected SdlManager sdlManager;

    public CustomSdlScreen(SdlManager sdlManager) {
        this.sdlManager = sdlManager;
    }

    public void showScreen() {
        // stub
    }
}
```

## Screen Change Example Implementations

The following example code shows a few implementations of the example screen changing protocol. A good practice for screen classes is to keep screen data in a view model. Doing so will add a layer of abstraction for exposing public properties and commands to the screen.

For the example below, the `HomeScreen` class will inherit the `CustomSDLScreen` interface and will have a property of type `HomeDataViewModel`. The screen manager will change its text fields based on the view model's data. In addition, the home screen will also create a navigation button to open the `ButtonSDLScreen` when pressed.

```
public class HomeSdlScreen extends CustomSdlScreen {
    private ButtonSdlScreen buttonScreen;
    // An example of your data model that will feed data to the SDL screen's UI
    private HomeDataViewModel homeDataViewModel;

    public HomeSdlScreen(SdlManager sdlManager) {
        super(sdlManager);

        buttonScreen = new ButtonSdlScreen(sdlManager);
        homeDataViewModel = new HomeDataViewModel();
    }

    public void showScreen() {
        // Batch Updates
        sdlManager.getScreenManager().beginTransaction();
        // Change template to Graphics With Text and Soft Buttons
        TemplateConfiguration templateConfiguration = new
TemplateConfiguration().setTemplate(PredefinedLayout.GRAPHIC_WITH_TEXT.toStrir

        sdlManager.getScreenManager().changeLayout(templateConfiguration, new
CompletionListener() {
            @Override
            public void onComplete(boolean success) {}
        });

        // Assign text fields to view model data

sdlManager.getScreenManager().setTextField1(homeDataViewModel.getText1());

sdlManager.getScreenManager().setTextField2(homeDataViewModel.getText2());

sdlManager.getScreenManager().setTextField3(homeDataViewModel.getText3());

sdlManager.getScreenManager().setTextField4(homeDataViewModel.getText4());
        // Create and assign a button to navigate to the ButtonSdlScreen
        SoftButtonState textState = new SoftButtonState("ButtonSdlScreenState",
"Button Screen", null);
        SoftButtonObject navigationButton = new SoftButtonObject("ButtonSdlScreen",
Collections.singletonList(textState), textState.getName(), new
SoftButtonObject.OnEventListener() {
            @Override
            public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
                buttonScreen.showScreen();
            }

            @Override
            public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
            }
        });
```

```
sdlManager.getScreenManager().setSoftButtonObjects(Collections.singletonList(navi

        sdlManager.getScreenManager().commit(new CompletionListener() {
            @Override
            public void onComplete(boolean success) {}
        });
    }
}
```

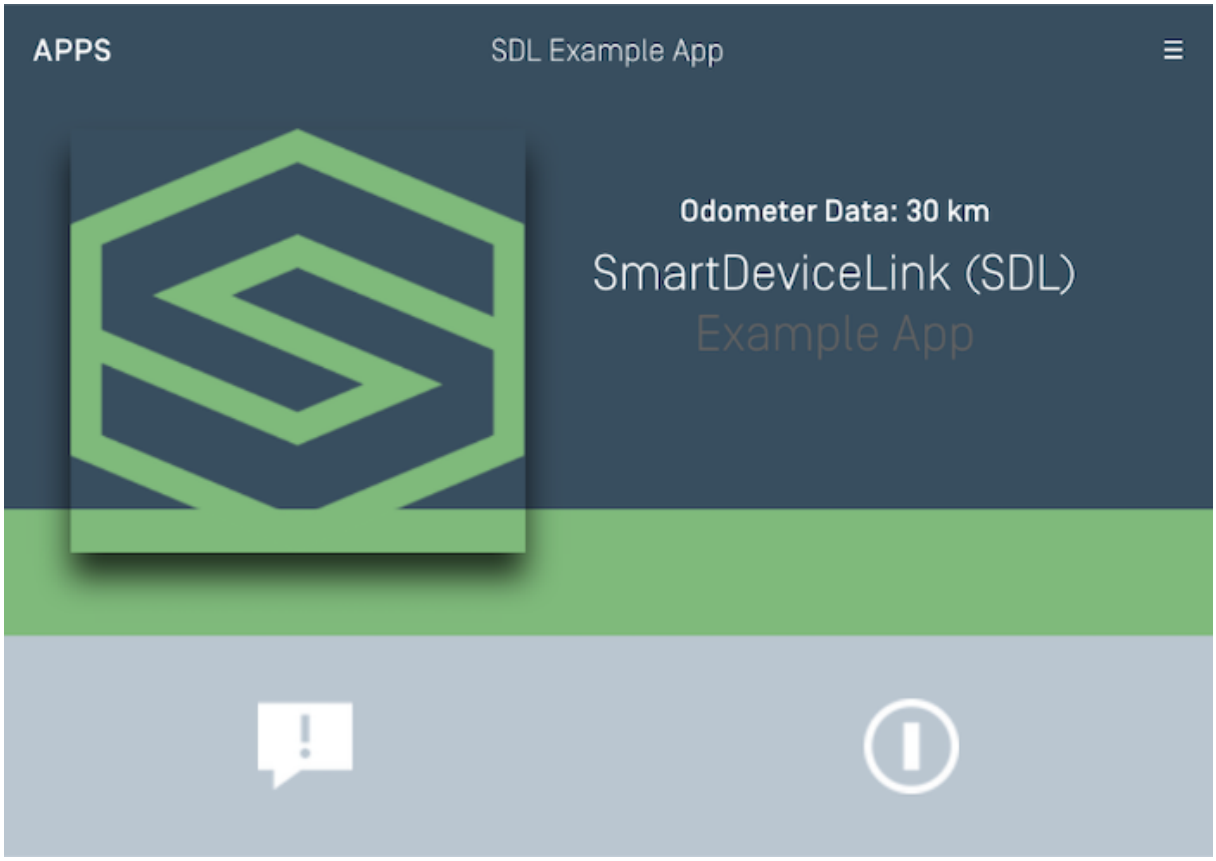
The `ButtonSDLScreen` follows the same patterns as the `HomeSDLScreen` but has minor implementation differences. The screen's view model `ButtonDataViewModel` contains properties unique to the `ButtonSDLScreen` such as text fields and an array of soft button objects. It also changes the template configuration to tiles only.

```
public class ButtonSdlScreen extends CustomSdlScreen {
    private ButtonDataViewModel buttonDataViewModel;

    public ButtonSdlScreen(SdlManager sdlManager) {
        super(sdlManager);

        buttonDataViewModel = new ButtonDataViewModel();
    }

    public void showScreen() {
        sdlManager.getScreenManager().beginTransaction();
        TemplateConfiguration templateConfiguration = new
TemplateConfiguration().setTemplate(PredefinedLayout.TILES_ONLY.toString());
        sdlManager.getScreenManager().changeLayout(templateConfiguration, new
CompletionListener() {
            @Override
            public void onComplete(boolean success) {}
        });

sdlManager.getScreenManager().setSoftButtonObjects(buttonDataViewModel.getBut

        sdlManager.getScreenManager().commit(new CompletionListener() {
            @Override
            public void onComplete(boolean success) {}
        });
    }
}
```

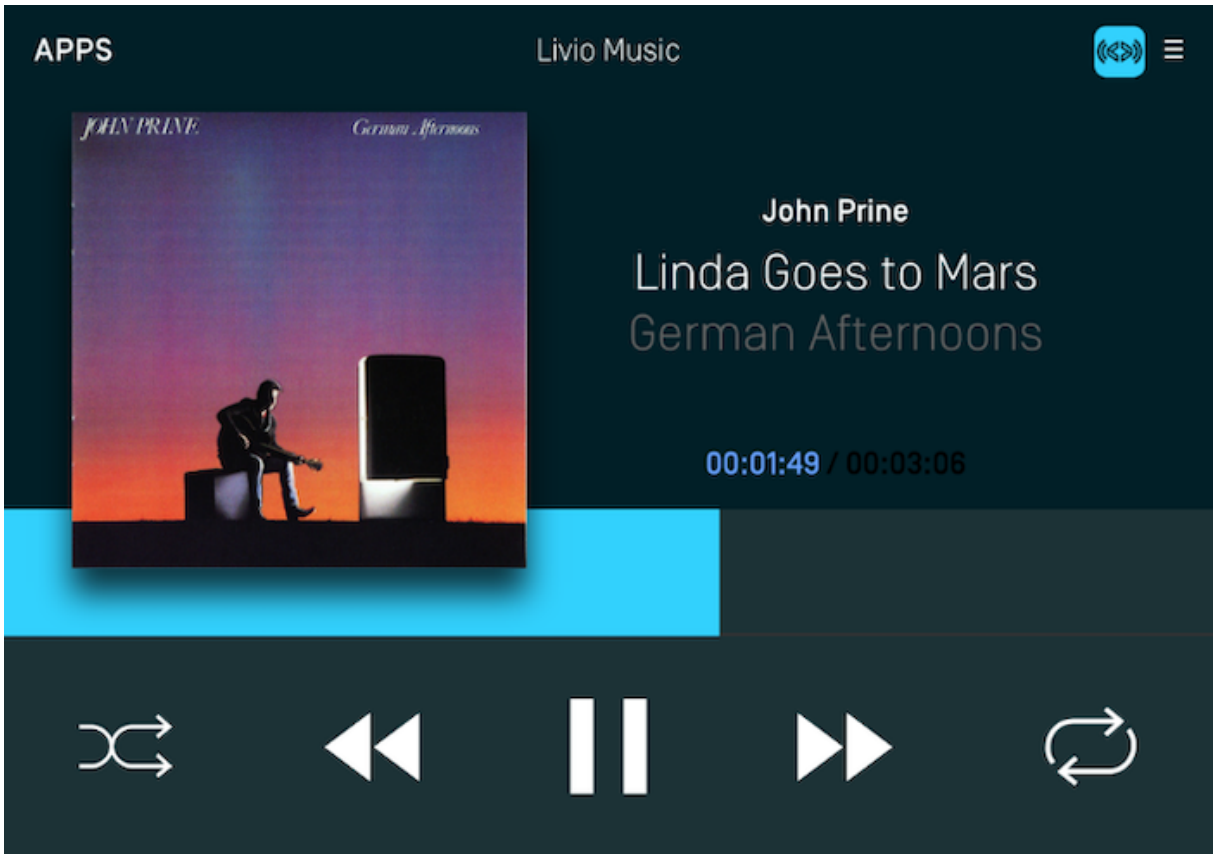
# Available Templates

There are fifteen standard templates to choose from, however some head units may only support a subset of these templates. The following examples show how templates will appear on the Generic HMI and Ford's SYNC® 3 HMI.

## MEDIA



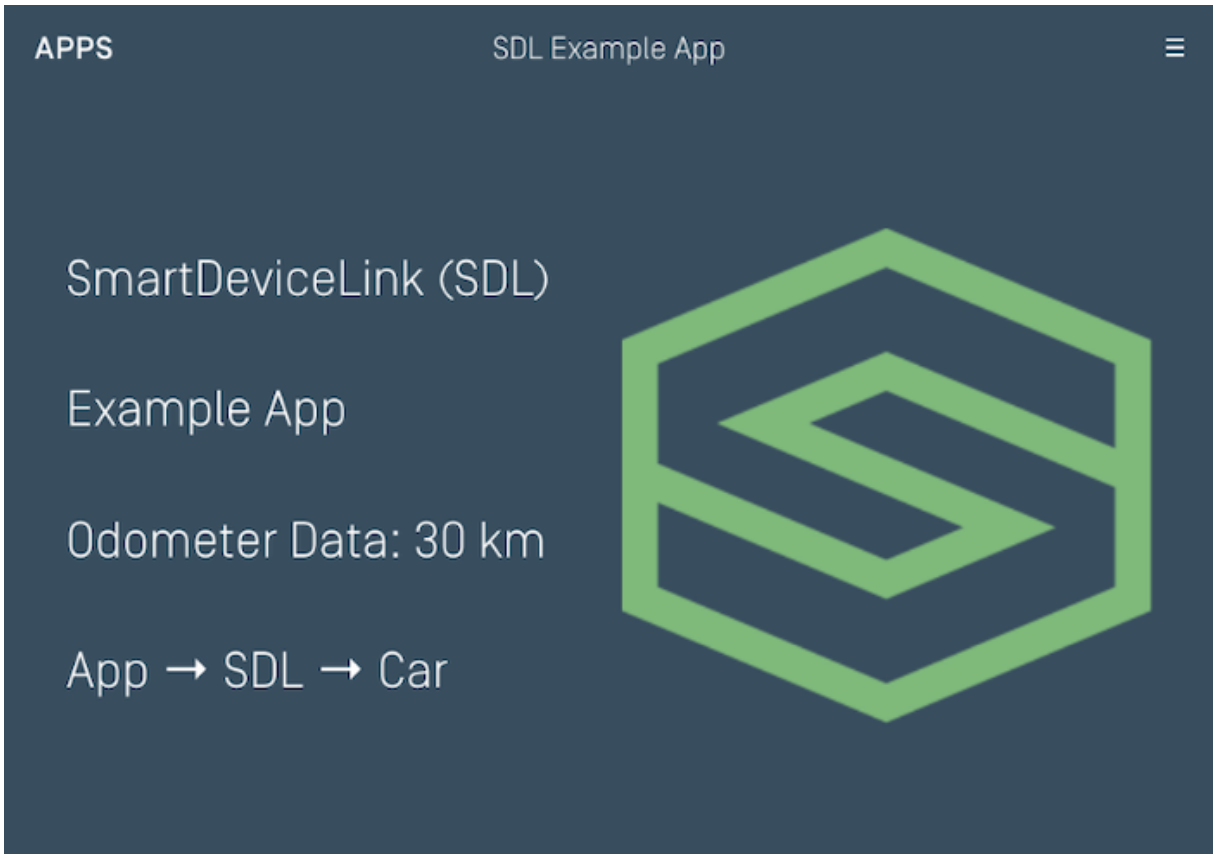

## MEDIA (WITH A PROGRESS BAR)


APPS
Livio Music
JOHN PRINE
German Afternoons
John Prine
Linda Goes to Mars
German Afternoons
00:01:49 / 00:03:06

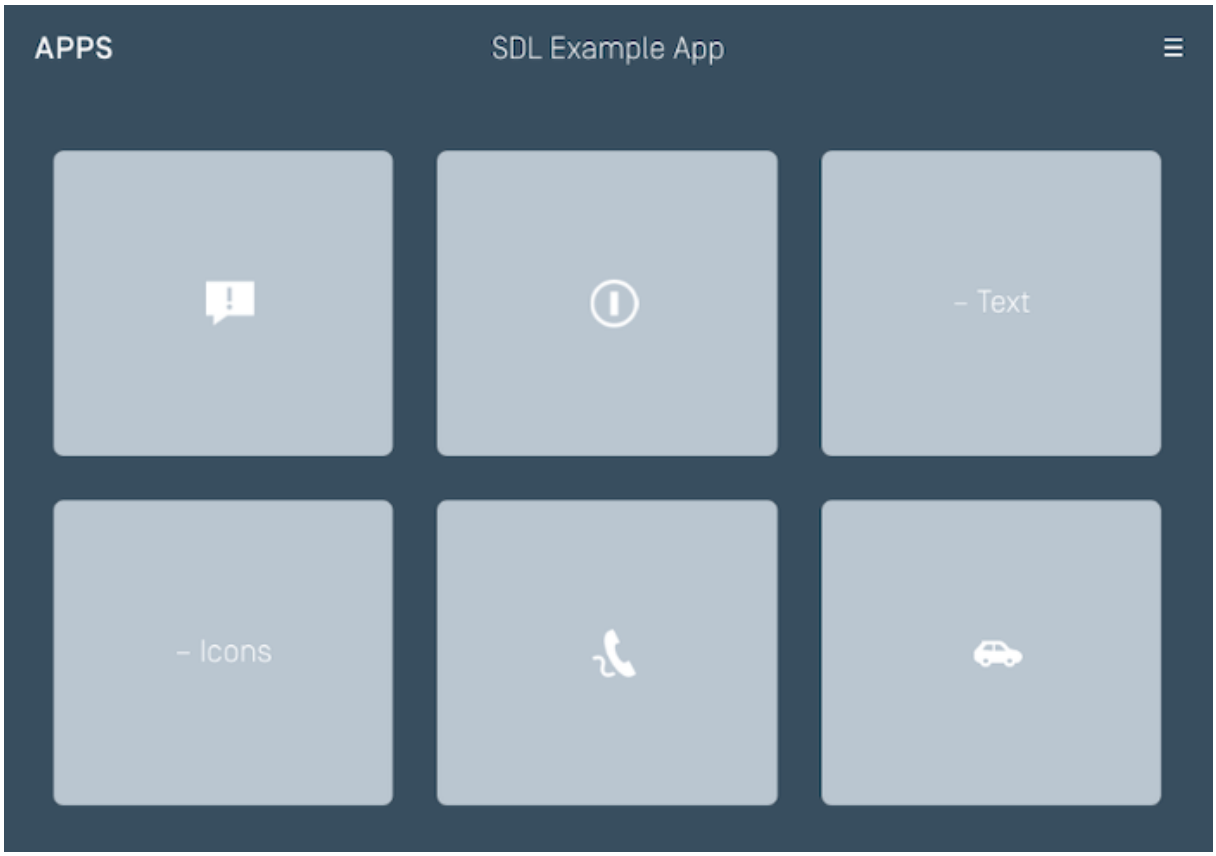
## NON-MEDIA

## GRAPHIC WITH TEXT

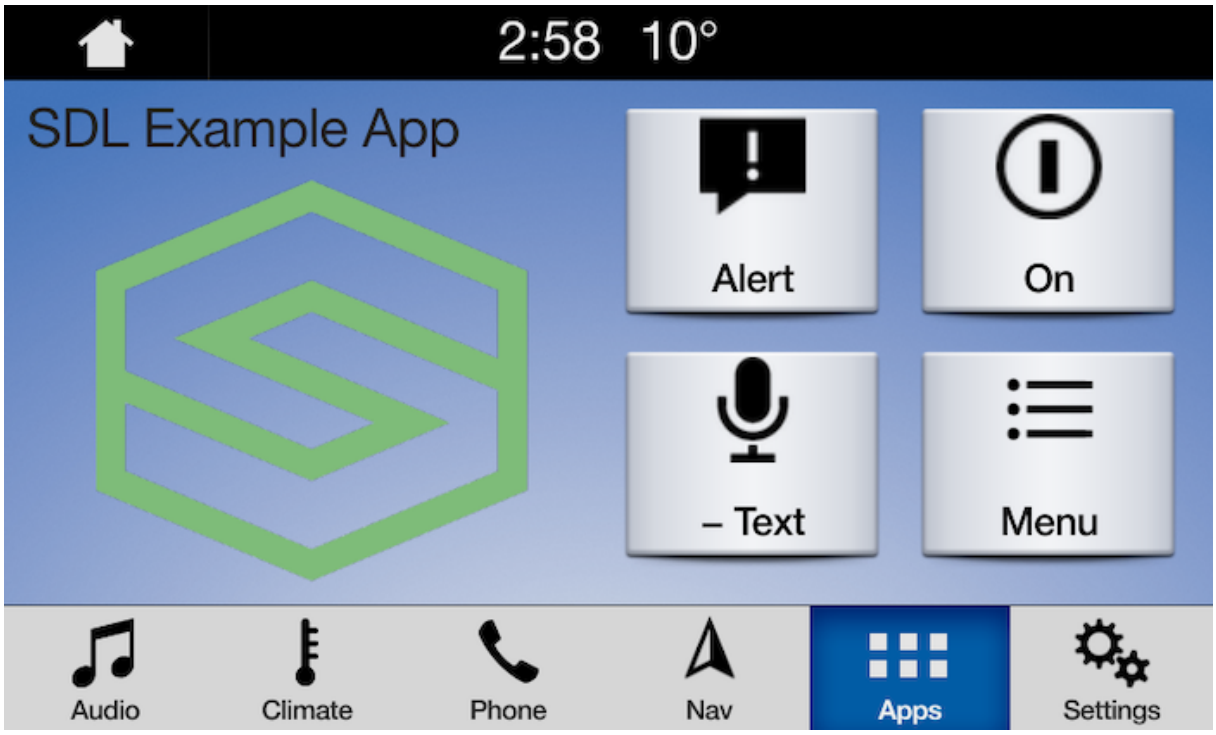
## TEXT WITH GRAPHIC


APPS
SDL Example App
SmartDeviceLink (SDL)
Example App
Odometer Data: 30 km
App → SDL → Car

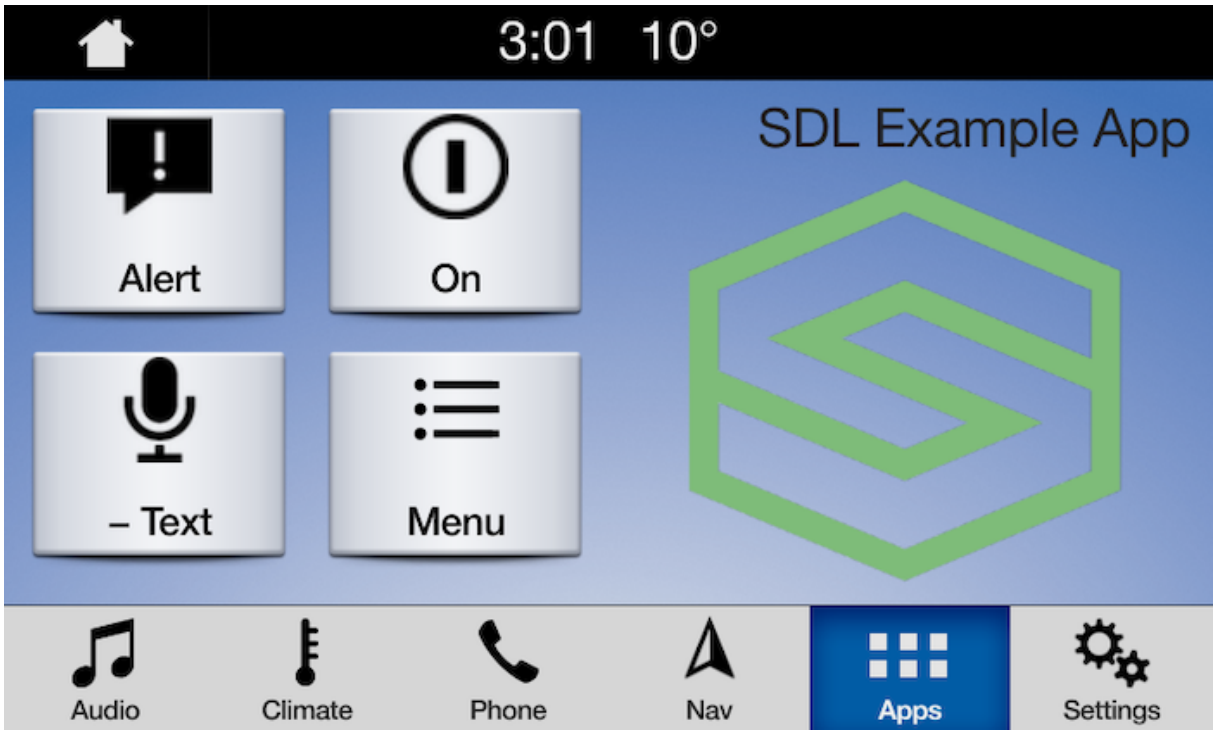
## TILES ONLY



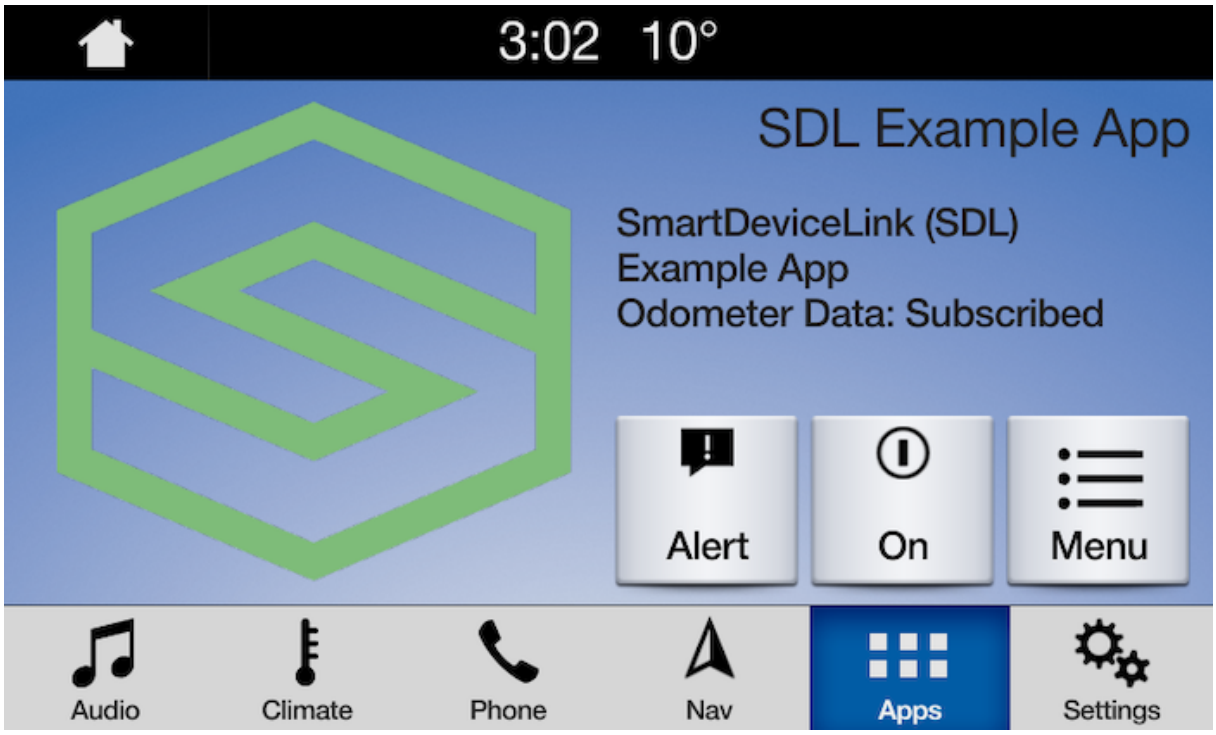

## GRAPHIC WITH TILES



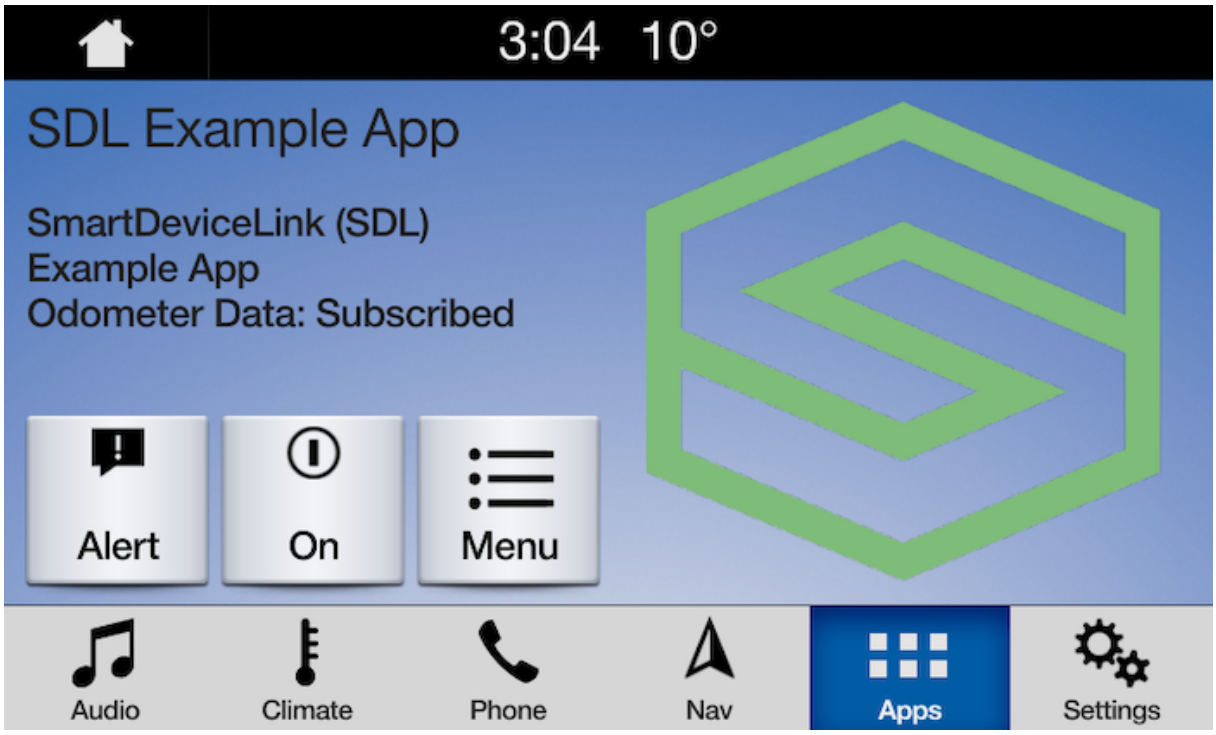

## TILES WITH GRAPHIC




## GRAPHIC WITH TEXT AND SOFT BUTTONS

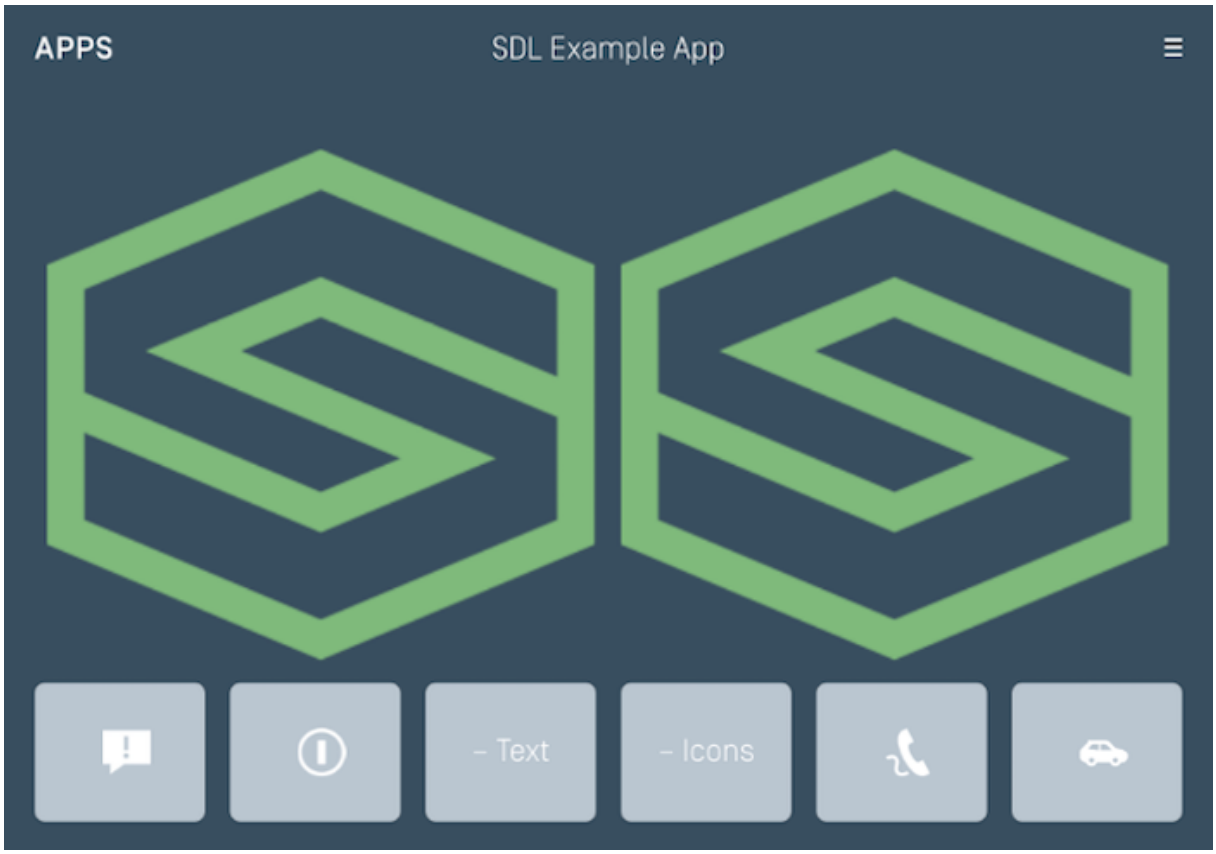



## TEXT AND SOFT BUTTONS WITH GRAPHIC

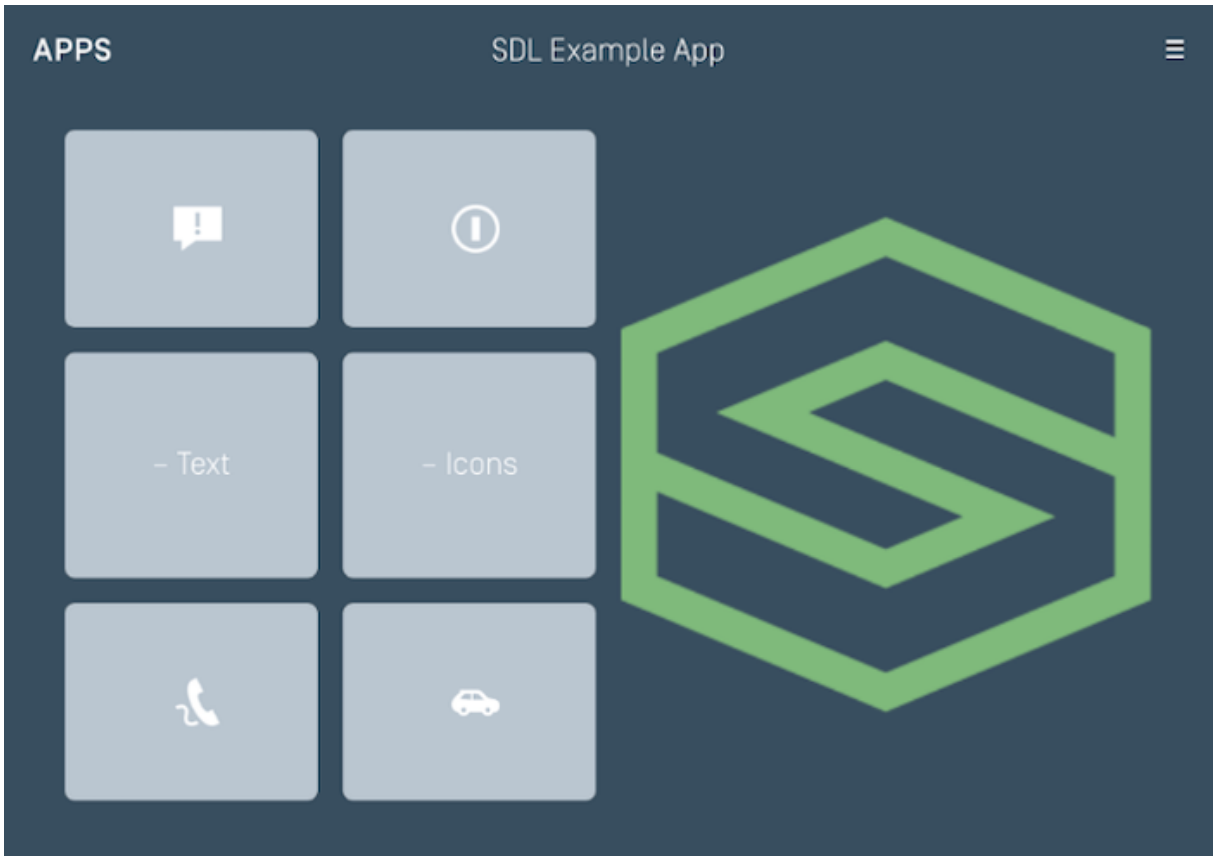



## GRAPHIC WITH TEXT BUTTONS

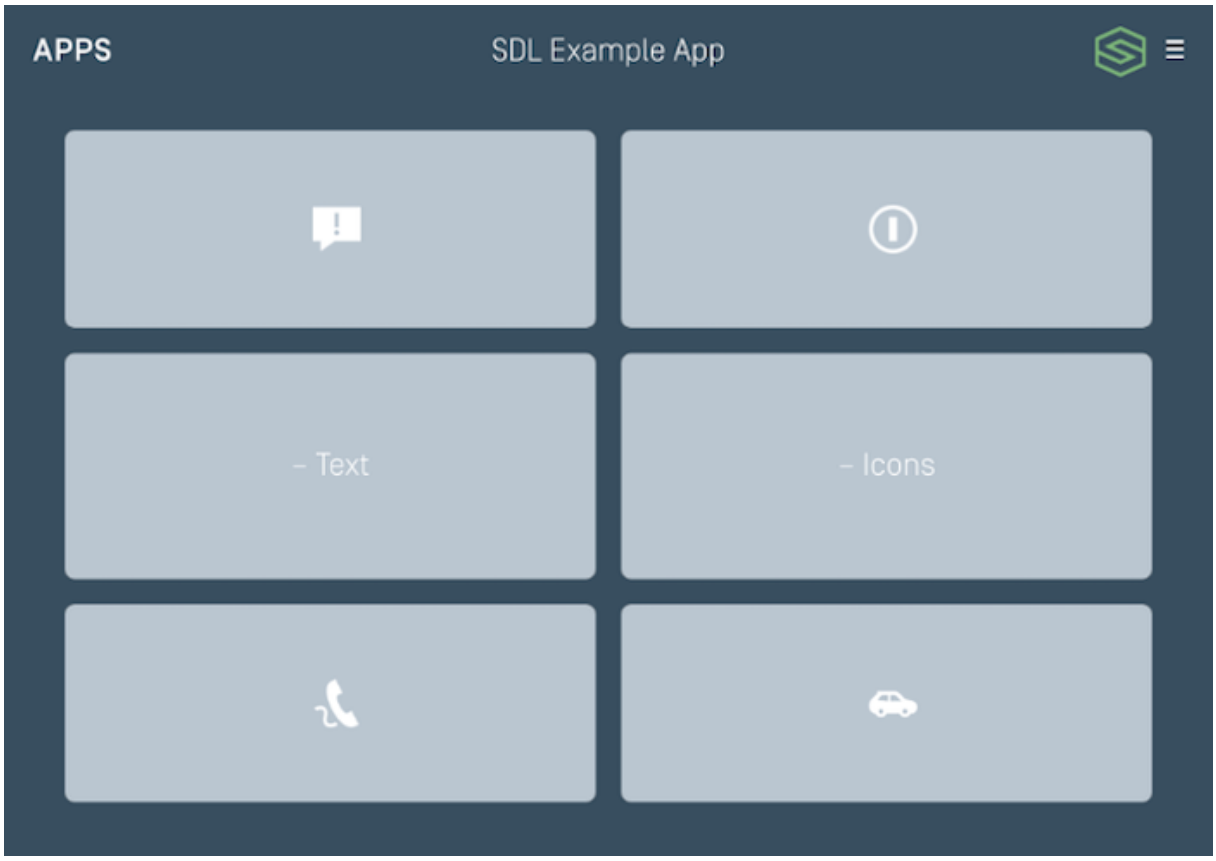
## DOUBLE GRAPHIC WITH SOFT BUTTONS




## TEXT BUTTONS WITH GRAPHIC




## TEXT BUTTONS ONLY




## LARGE GRAPHIC WITH SOFT BUTTONS

## LARGE GRAPHIC ONLY

# Template Text

You can easily display text, images, and buttons using the `ScreenManager`. To update the UI, simply give the manager your new data and (optionally) sandwich the update between the manager's `beginTransaction()` and `commit()` methods.

## Text Fields

| SCREENMANAGER PARAMETER NAME | DESCRIPTION |
| --- | --- |
| textField1 | The text displayed in a single-line display, or in the upper display line of a multi-line display |
| textField2 | The text displayed on the second display line of a multi-line display |
| textField3 | The text displayed on the third display line of a multi-line display |
| textField4 | The text displayed on the bottom display line of a multi-line display |
| mediaTrackTextField | The text displayed in the in the track field; this field is only valid for media applications |
| textAlignment | The text justification for the text fields; the text alignment can be left, center, or right |
| textField1Type | The type of data provided in textField1 |
| textField2Type | The type of data provided in textField2 |
| textField3Type | The type of data provided in textField3 |
| textField4Type | The type of data provided in textField4 |
| title | The title of the displayed template |

# Showing Text

```
sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setTextField1("Line 1 of Text");
sdlManager.getScreenManager().setTextField2("Line 2 of Text");
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});
```

### Removing Text

To remove text from the screen simply set the screen manager property to `null`.

```
sdlManager.getScreenManager().setTextField1(null);
sdlManager.getScreenManager().setTextField2(null);
```

# Template Images

You can easily display text, images, and buttons using the `ScreenManager`. To update the UI, simply give the manager your new data and (optionally) sandwich the update between the manager's `beginTransaction()` and `commit()` methods.

### Image Fields

| SCREENMANAGER PARAMETER NAME | DESCRIPTION |
| --- | --- |
| primaryGraphic | The primary image in a template that supports images |
| secondaryGraphic | The second image in a template that supports multiple images |

# Showing Images

## Creating an SDLArtwork

Create an `SdlArtwork` object which can be manually uploaded or set into the `ScreenManager` and automatically uploaded. An `SdlArtwork` includes information about whether the image should be persisted between vehicle startups, whether the image is a template image and should be re-colored, and more.

```
SdlArtwork sdlArtwork = new SdlArtwork("artworkName", FileType.GRAPHIC_PNG, R.resourceID, true);
```

## Setting Primary Graphic

```
sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setPrimaryGraphic(sdlArtwork);
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});
```

## Removing Images

To remove an image from the screen you just need to set the screen manager property to `null`.

```
sdlManager.getScreenManager().setPrimaryGraphic(null);
```

## Overwriting Images

When a file is to be uploaded to the module, the library checks if a file with the same name has already been uploaded to module and skips the upload if it can. For cases where an image by the same name needs to be re-uploaded, the `SdlArtwork` / `SdlFile`'s `overwrite` property should be used. Setting `overwrite` to `true` before passing the image to a `ScreenManager` method such as `setPrimaryGraphic()` and `setSecondaryGraphic()` will force the image to be re-uploaded. This includes methods such as `preloadChoices()` where the arguments passed in contain images.

> **NOTE**
>
> Please note that many production modules on the road do not refresh the HMI with the new image if the file name has not changed. If you want the image to refresh on the screen immediately, we suggest using two image names and toggling back and forth between the names each time you update the image.
>
> This issue may also extend to menus, alerts, and other UI features even if they're not on-screen at the time. Because of these issues, we do not recommend that you try to overwrite an image. Instead, you can delete an image file using the `SdlFileManager` and re-upload it once the deletion completes, or you may use a different file name.

# Templating Images (RPC v5.0+)

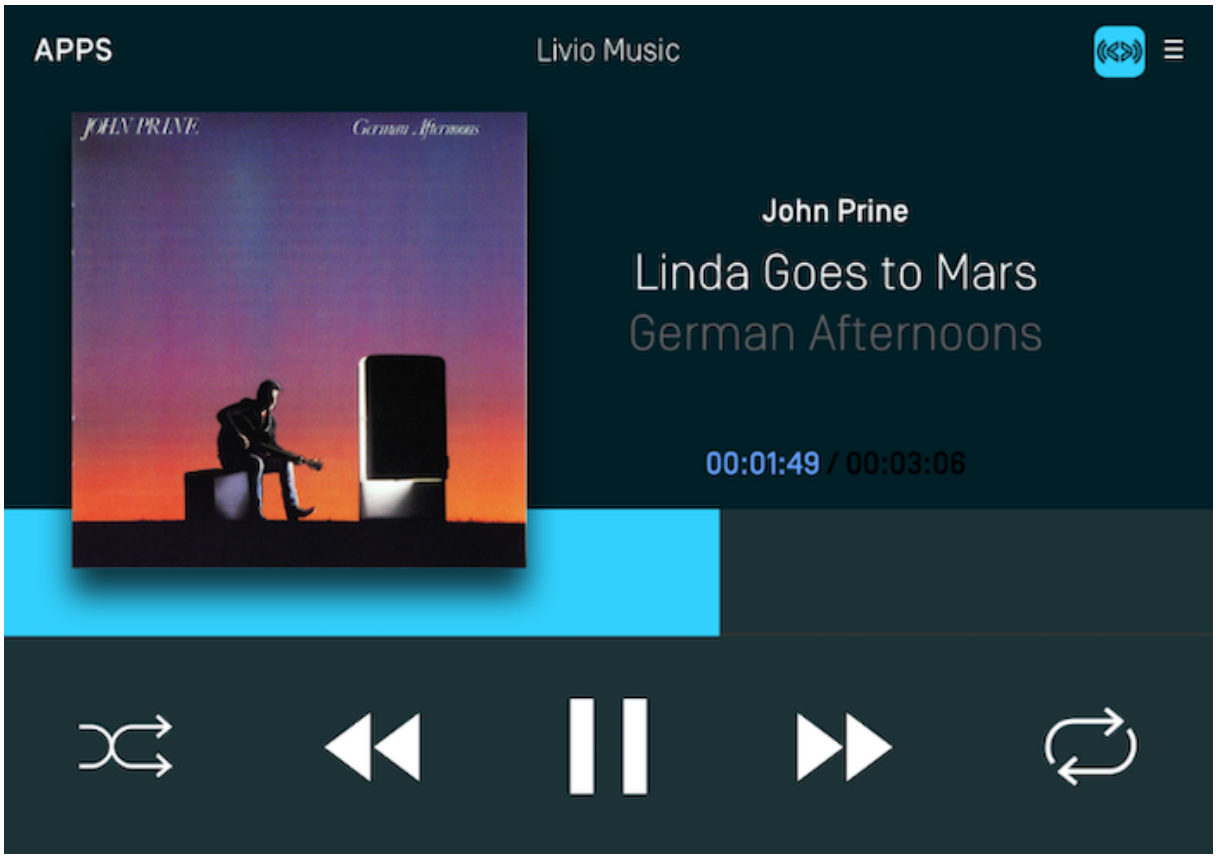
Templated images are tinted by Core so the image is visible regardless of whether your user has set the head unit to day or night mode. For example, if a head unit is in night mode with a dark theme (see Customizing the Template section for more details on how to customize theme colors), then your templated images will be displayed as white. In the day theme, the image will automatically change to black.

Soft buttons, menu icons, and primary / secondary graphics can all be templated. Images that you wish to template must be PNGs with a transparent background and only one color for the icon. Therefore, templating is only useful for things like icons and not for images that must be rendered in a specific color.

## Templated Images Example

In the screenshots below, the shuffle and repeat icons have been templated. In night mode, the icons are tinted white and in day mode the icons are tinted black.

NIGHT MODE


APPS
Livio Music
JOHN PRINE
German Afternoons
John Prine
Linda Goes to Mars
German Afternoons
00:01:49 / 00:03:06

DAY MODE

```
SdlArtwork image = new SdlArtwork("<#ArtworkName#>", FileType.GRAPHIC_PNG,
image, true);
image.setTemplateImage(true);
```

# Static Icons

Static icons are pre-existing images on the remote system that you may reference and use in your own application. Each OEM will design their own custom static icons but you can get an overview of the available icons from the icons designed for the open source Generic HMI. Static icons are fully supported by the screen manager via an `SdlArtwork` initializer. Static icons can be used in primary and secondary graphic fields, soft button image fields, and menu icon fields.

```
SdlArtwork staticIconArt = new SdlArtwork(StaticIconName.ALBUM);
```

# Template Custom Buttons

You can easily create and update custom buttons (called Soft Buttons in SDL) using the `ScreenManager`. To update the UI, simply give the manager your new data and (optionally) sandwich the update between the manager's `beginTransaction()` and `commit()` methods.

# Soft Button Fields

| SCREENMANAGER PARAMETER NAME | DESCRIPTION |
| --- | --- |
| softButtonObjects | An array of buttons. Each template supports a different number of soft buttons |

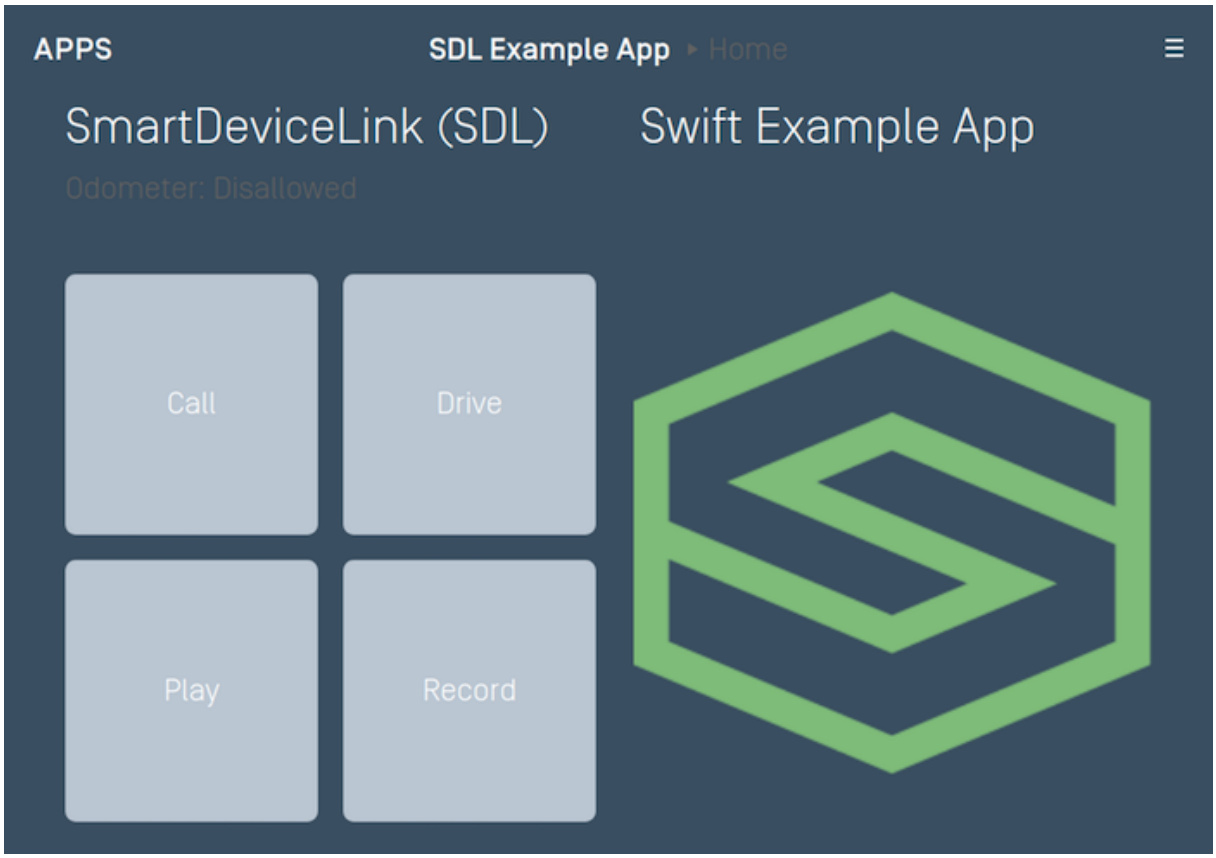
# Creating Soft Buttons

To create a soft button using the `ScreenManager`, you only need to create a custom name for the button and provide the text for the button's label and/or an image for the button's icon. If your button cycles between different states (e.g. a button used to set the repeat state of a song playlist can have three states: repeat-off, repeat-one, and repeat-all), you can create all the states on initialization.

There are three different ways to create a soft button: with only text, with only an image, or with both text and an image. If creating a button with an image, we recommend that you

template the image so its color works well with both the day and night modes of the head unit. For more information on templating images please see the Template Images guide.

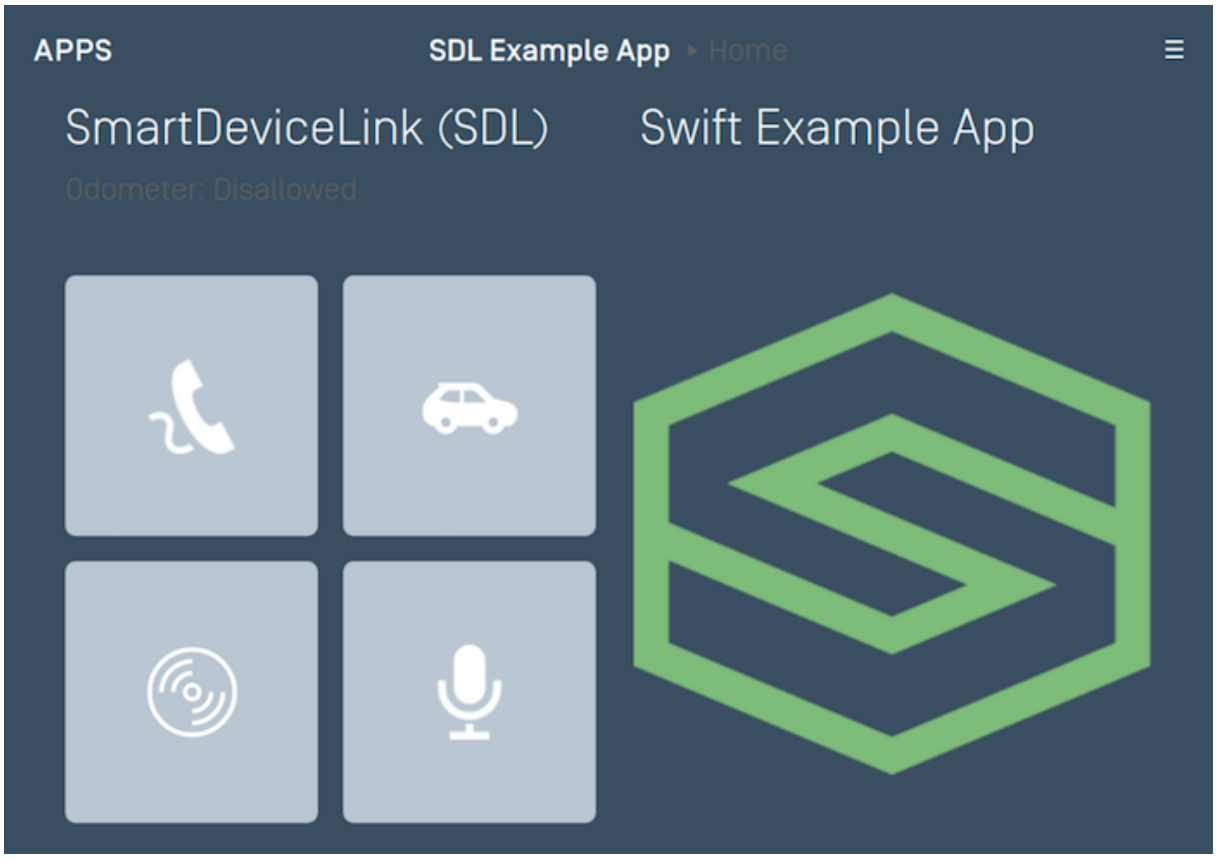
## Text Only Soft Buttons



```
SoftButtonState textState1 = new SoftButtonState("<#State Name1#>", "<#Button
Label Text1#>", null);
SoftButtonState textState2 = new SoftButtonState("<#State Name2#>", "<#Button
Label Text2#>", null);
List<SoftButtonState> stateList1 = Arrays.asList(textState1, textState2);
SoftButtonObject softButtonObject1 = new SoftButtonObject("softButtonObject1",
stateList1, textState1.getName(), new SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
        softButtonObject.transitionToNextState();
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

SoftButtonState textState3 = new SoftButtonState("<#State Name3#>", "<#Button
Label Text3#>", null);
SoftButtonObject softButtonObject2 = new SoftButtonObject("softButtonObject2",
Collections.singletonList(textState3), textState1.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setSoftButtonObjects(Arrays.asList(softButtonObjec
 softButtonObject2));
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});
```

## Image Only Soft Buttons

You can use the `SystemCapabilityManager` to check if the HMI supports soft buttons with images. If you send image-only buttons to a HMI that does not support images, then the library will not send the buttons as they will be rejected by the head unit. If all your soft buttons have text in addition to images, the library will send the text-only buttons if the head unit does not support images.

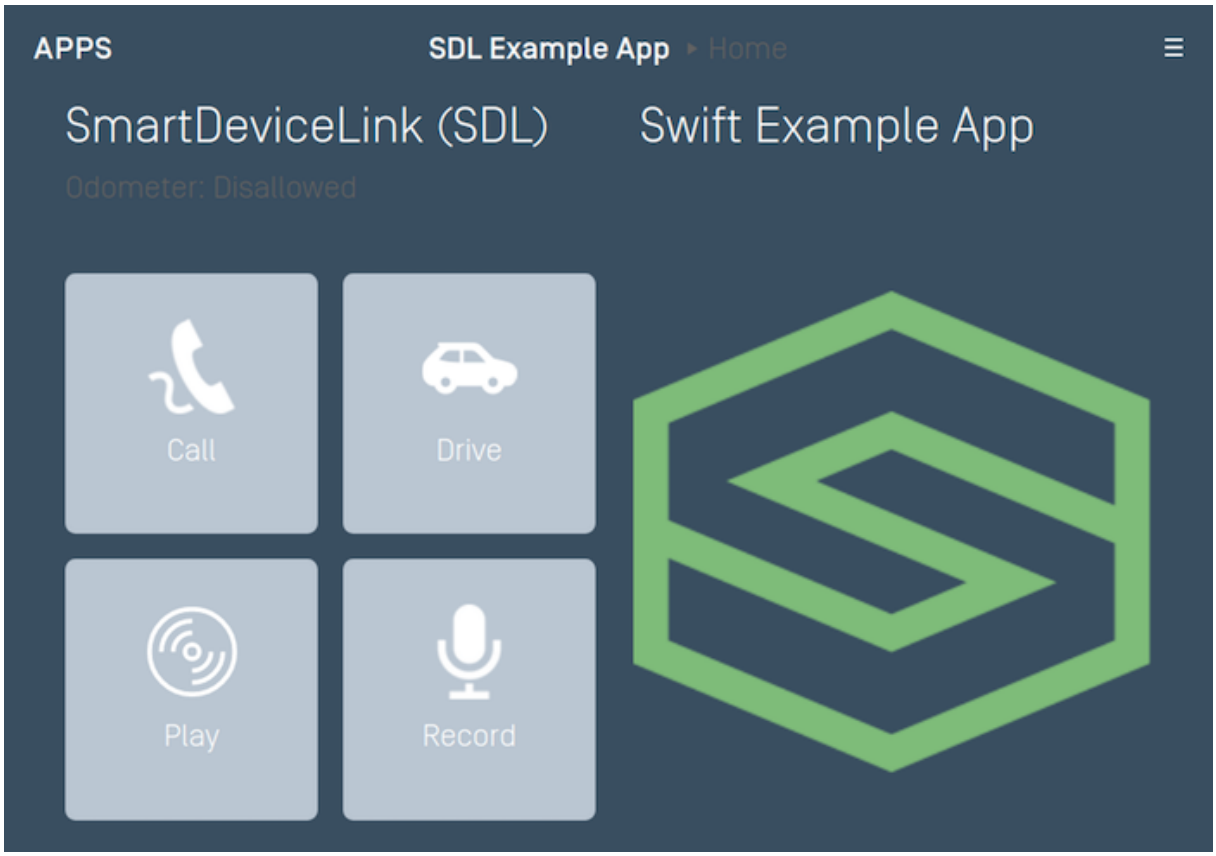



```
List<SoftButtonCapabilities> softButtonCapabilitiesList =
sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getSo

boolean imageSupported = (!softButtonCapabilitiesList.isEmpty()) ?
softButtonCapabilitiesList.get(0).getImageSupported() : false;
```

Once you know that the HMI supports images in soft buttons you can create and send the image-only soft buttons.

```
SoftButtonState imageState1 = new SoftButtonState("<#State Name1#>", null,
sdlArtwork1);
SoftButtonState imageState2 = new SoftButtonState("<#State Name2#>", null,
sdlArtwork2);
SoftButtonObject softButtonObject1 = new SoftButtonObject("softButtonObject1",
Arrays.asList(imageState1, imageState2), imageState1.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
        softButtonObject.transitionToNextState();
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

SoftButtonState imageState3 = new SoftButtonState("<#State Name3#>", null,
sdlArtwork3);
SoftButtonObject softButtonObject2 = new SoftButtonObject("softButtonObject2",
Collections.singletonList(imageState3), imageState3.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setSoftButtonObjects(Arrays.asList(softButtonObjec
 softButtonObject2));
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});
```

## Image and Text Soft Buttons


APPS
SDL Example App
Home
SmartDeviceLink (SDL)
Swift Example App
Odometer: Disallowed
Call
Drive
Play
Record

```
SoftButtonState textAndImageState1 = new SoftButtonState("<#State Name1#>", "
<#Button Label Text1#>", sdlArtwork1);
SoftButtonState textAndImageState2 = new SoftButtonState("<#State Name2#>", "
<#Button Label Text2#>", sdlArtwork2);
SoftButtonObject softButtonObject1 = new SoftButtonObject("softButtonObject1",
Arrays.asList(textAndImageState1, textAndImageState2),
textAndImageState1.getName(), new SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
        softButtonObject.transitionToNextState();
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

SoftButtonState textAndImageState3 = new SoftButtonState("<#State Name3#>", "
<#Button Label Text3#>", sdlArtwork3);
SoftButtonObject softButtonObject2 = new SoftButtonObject("softButtonObject2",
Collections.singletonList(textAndImageState3), textAndImageState3.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setSoftButtonObjects(Arrays.asList(softButtonObjec
 softButtonObject2));
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});
```

## Highlighting a Soft Button

When a button is highlighted its background color will change to indicate that it has been selected.

## HIGHLIGHT ON

## HIGHLIGHT OFF

```
SoftButtonState softButtonState1 = new SoftButtonState("Soft Button State Name",
"On", sdlArtwork);
softButtonState1.setHighlighted(true);
SoftButtonState softButtonState2 = new SoftButtonState("Soft Button State Name 2",
"Off", sdlArtwork);
softButtonState2.setHighlighted(false);
SoftButtonObject softButtonObject = new SoftButtonObject("softButtonObject",
Arrays.asList(softButtonState1, softButtonState2), softButtonState1.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
        softButtonObject.transitionToNextState();
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});
```

# Updating Soft Button States

When the soft button state needs to be updated, simply tell the `SoftButtonObject` to transition to the next state. If your button states do not cycle in a predictable order, you can also tell the soft button which state to transition to by passing the `stateName` of the new soft button state.

```
SoftButtonState state1 = new SoftButtonState("<#State1 Name#>", "<#Button1 Label
Text#>", sdlArtwork);
SoftButtonState state2 = new SoftButtonState("<#State2 Name#>", "<#Button2 Label
Text#>", sdlArtwork);

SoftButtonObject softButtonObject = new SoftButtonObject("softButtonObject",
Arrays.asList(state1, state2), state1.getName(), new
SoftButtonObject.OnEventListener() {
    @Override
    public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
    }

    @Override
    public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
    }
});

sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setSoftButtonObjects(Collections.singletonList(soft

sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        DebugTool.logInfo(TAG, "ScreenManager update complete: " + success);
    }
});

// Transition to a new state
SoftButtonObject retrievedSoftButtonObject =
sdlManager.getScreenManager().getSoftButtonObjectByName("softButtonObject");
retrievedSoftButtonObject.transitionToNextState();
```

# Deleting Soft Buttons

To delete soft buttons, simply pass the screen manager a new array of soft buttons. To delete all soft buttons, simply pass the screen manager an empty array.

```
sdlManager.getScreenManager().setSoftButtonObjects(Collections.EMPTY_LIST);
```

# Using RPCs

You can also send soft buttons manually using the `Show` RPC. Note that if you do so, you must not mix the `ScreenManager` soft buttons and manually sending the `Show` RPC. Additionally, the `ScreenManager` takes soft button ids 0 - 10000. Ensure that if you use custom RPCs, that the soft button ids you use are outside of this range.

# Template Subscription Buttons

This guide shows you how to subscribe and react to "subscription" buttons. Subscription buttons are used to detect when the user has interacted with buttons located in the car's center console or steering wheel. A subscription button may also show up as part of your template, however, the text and/or image used in the button is determined by the template and is (usually) not customizable.

In the screenshot below, the pause, seek left and seek right icons are subscription buttons. Once subscribed to, for example, the seek left button, you will be notified when the user selects the seek left button on the HMI or when they select the seek left button on the car's center console and/or steering wheel.

# Types of Subscription Buttons

There are three general types of subscriptions buttons: audio related buttons only used for media apps, navigation related buttons only used for navigation apps, and general buttons, like preset buttons and the OK button, that can be used with all apps. Please note that if your app type is not `MEDIA` or `NAVIGATION`, your attempt to subscribe to media-only or navigation-only buttons will be rejected.

| BUTTON | APP TYPE | RPC VERSION |
| --- | --- | --- |
| Ok | All | v1.0+ |
| Preset 0-9 | All | v1.0+ |
| Search | All | v1.0+ |
| Play / Pause | Media only | v5.0+ |
| Seek left | Media only | v1.0+ |
| Seek right | Media only | v1.0+ |
| Tune up | Media only | v1.0+ |
| Tune down | Media only | v1.0+ |
| Center Location | Navigation only | v6.0+ |
| Zoom In | Navigation only | v6.0+ |
| Zoom Out | Navigation only | v6.0+ |
| Pan Up | Navigation only | v6.0+ |
| Pan Up-Right | Navigation only | v6.0+ |
| Pan Right | Navigation only | v6.0+ |
| Pan Down-Right | Navigation only | v6.0+ |
| Pan Down | Navigation only | v6.0+ |

| BUTTON | APP TYPE | RPC VERSION |
| --- | --- | --- |
| Pan Down-Left | Navigation only | v6.0+ |
| Pan Left | Navigation only | v6.0+ |
| Pan Up-Left | Navigation only | v6.0+ |
| Toggle Tilt | Navigation only | v6.0+ |
| Rotate Clockwise | Navigation only | v6.0+ |
| Rotate Counter-Clockwise | Navigation only | v6.0+ |
| Toggle Heading | Navigation only | v6.0+ |

# Subscribing to Subscription Buttons

You can easily subscribe to subscription buttons using the `ScreenManager`. Simply tell the manager which button to subscribe and you will be notified when the user selects the button.

## Subscribe with a Listener

Once you have subscribed to the button, the listener will be called when the button has been selected. If there is an error subscribing to the button the error message will be returned in the `error` parameter.

```
OnButtonListener playPauseButtonListener = new OnButtonListener() {
    @Override
    public void onPress(ButtonName buttonName, OnButtonPress buttonPress) {

    }

    @Override
    public void onEvent(ButtonName buttonName, OnButtonEvent buttonEvent) {

    }

    @Override
    public void onError(String info) {

    }
};

sdlManager.getScreenManager().addButtonListener(ButtonName.PLAY_PAUSE,
playPauseButtonListener);
```

# Unsubscribing from Subscription Buttons

To unsubscribe to a subscription button, simply tell the `ScreenManager` which button name and listener object to unsubscribe.

```
sdlManager.getScreenManager().removeButtonListener(ButtonName.PLAY_PAUSE,
playPauseButtonListener);
```

# Media Buttons

The play/pause, seek left, seek right, tune up, and tune down subscribe buttons can only be used if the app type is `MEDIA`. Depending on the OEM, the subscribed button could show up as an on-screen button in the `MEDIA` template, work as a physical button on the car

console or steering wheel, or both. For example, Ford's SYNC® 3 HMI will add the play/pause, seek right, and seek left soft buttons to the media template when you subscribe to those buttons. However, those buttons will also trigger when the user uses the seek left / seek right buttons on the steering wheel.

If desired, you can change the style of the play/pause button image between a play, stop, or pause icon by updating the audio streaming indicator, and you can also set the style of the next/previous buttons between a track or time seek style. See the Media Clock guide for more information.

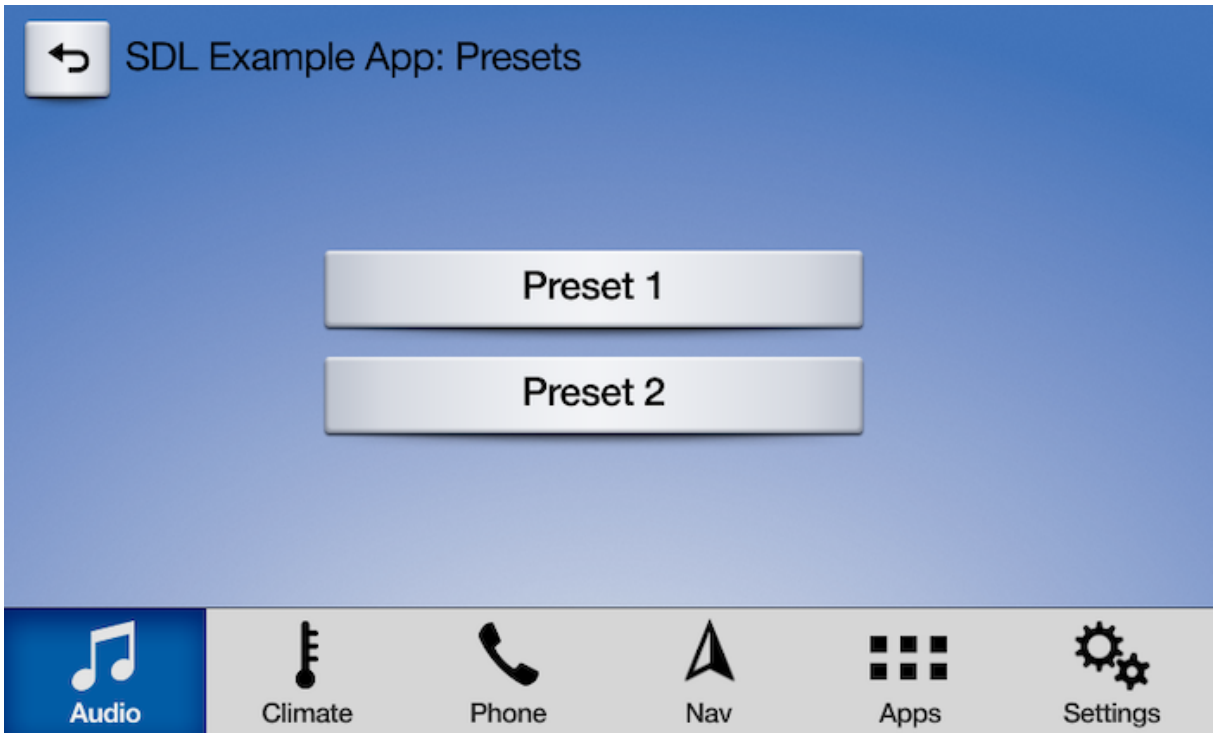
**NOTE**

Before library v.4.7 and RPC v5.0, `Ok` and `PlayPause` were combined into `Ok`. Subscribing to `Ok` will, in v4.7+, also subscribe you to `PlayPause`. This means that for the time being, *you should not simultaneously subscribe to `Ok` and `PlayPause`*. In a future major version, this will change. For now, only subscribe to either `Ok` or `PlayPause` and the library will execute the right action based on the connected head unit.

```
sdlManager.getScreenManager().addButtonListener(ButtonName.PLAY_PAUSE, new
OnButtonListener() {
    @Override
    public void onPress (ButtonName buttonName, OnButtonPress buttonPress) {
        switch (buttonPress.getButtonPressMode()) {
            case SHORT:
                // The user short pressed the button
            case LONG:
                // The user long pressed the button
        }
    }

    @Override
    public void onEvent (ButtonName buttonName, OnButtonEvent buttonEvent) { }

    @Override
    public void onError (String info) {
        // There was an error subscribing to the button
    }
});
```

# Preset Buttons

All app types can subscribe to preset buttons. Depending on the OEM, the preset buttons may be added to the template when subscription occurs. Preset buttons can also be physical buttons on the console that will notify the subscriber when selected. An OEM may support only template buttons or only hard buttons or they may support both template and hard buttons. The screenshot below shows how the Ford SYNC® 3 HMI displays the preset buttons on the HMI.




## Checking if Preset Buttons are Supported

You can check if a HMI supports subscribing to preset buttons, and if so, how many preset buttons are supported, by checking the system capability manager.

```
Integer numOfCustomPresetsAvailable =
sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getNu
```

## Subscribing to Preset Buttons

```
OnButtonListener onButtonListener = new OnButtonListener() {
    @Override
    public void onPress(ButtonName buttonName, OnButtonPress buttonPress) {
        switch (buttonName) {
            case PRESET_1:
                // The user short or long pressed the preset 1 button
                break;
            case PRESET_2:
                // The user short or long pressed the preset 2 button
                break;
        }
    }

    @Override
    public void onEvent (ButtonName buttonName, OnButtonEvent buttonEvent) { }

    @Override
    public void onError (String info) {
        // There was an error subscribing to the button
    }
};

sdlManager.getScreenManager().addButtonListener(ButtonName.PRESET_1,
onButtonListener);
sdlManager.getScreenManager().addButtonListener(ButtonName.PRESET_2,
onButtonListener);
```

# Navigation Buttons

Head units supporting RPC v6.0+ may support subscription buttons that allow your user to drag and scale the map using hard buttons located on car's center console or steering wheel. Subscriptions to navigation buttons will only succeed if your app's type is `NAVIGATION`. If subscribing to these buttons succeeds, you can remove any buttons of your own from your map screen. If subscribing to these buttons fails, you can display buttons of your own on your map screen.

## Subscribing to Navigation Buttons

```
sdlManager.getScreenManager().addButtonListener(ButtonName.NAV_PAN_UP, new
OnButtonListener() {
    @Override
    public void onPress (ButtonName buttonName, OnButtonPress buttonPress) {
        switch (buttonPress.getButtonPressMode()) {
            case SHORT:
                // The user short pressed the button
            case LONG:
                // The user long pressed the button
        }
    }

    @Override
    public void onEvent (ButtonName buttonName, OnButtonEvent buttonEvent) { }

    @Override
    public void onError (String info) {
        // There was an error subscribing to the button
    }
});
```

# Main Menu

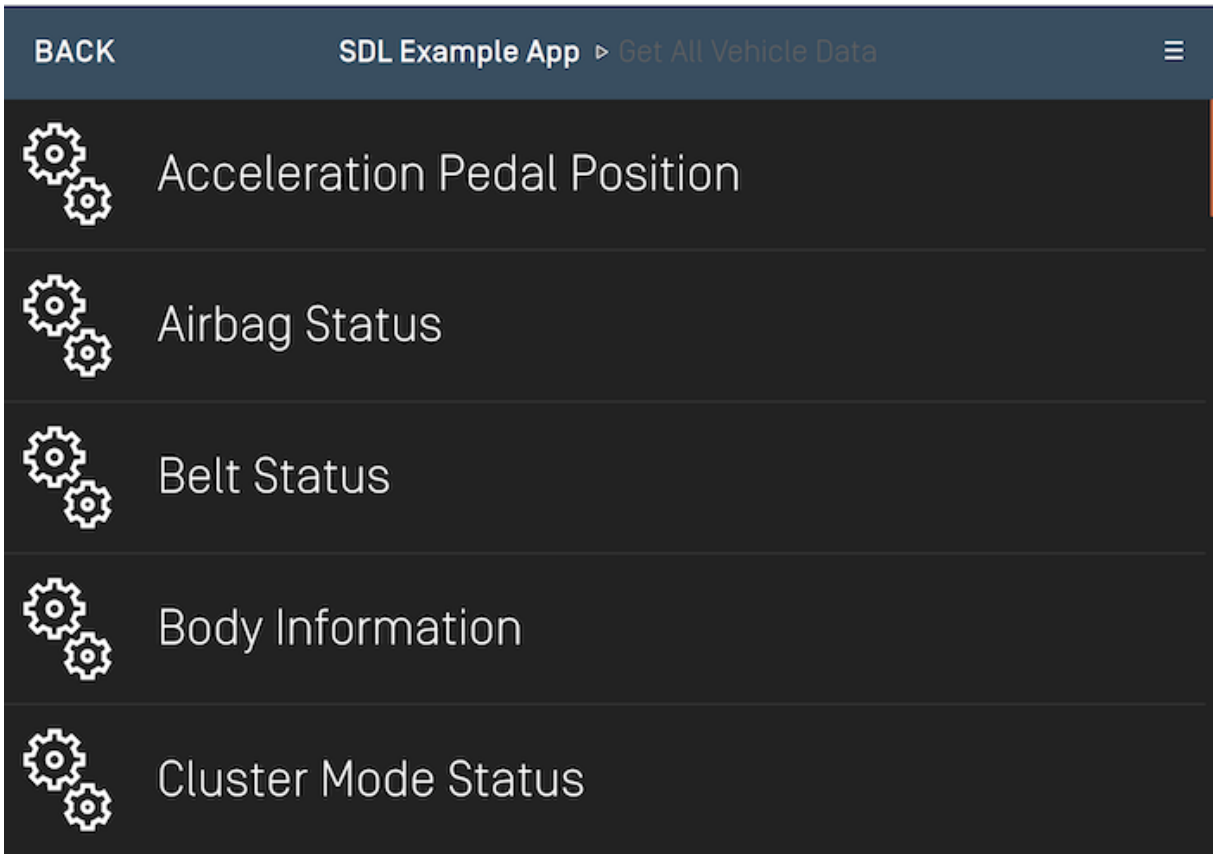
You have two different options when creating menus. One is to simply add items to the default menu available in every template. The other is to create a custom menu that pops up when needed. You can find more information about these popups in the Popup Menus section. This guide will cover using the default menu / menu button.

> **NOTE**
>
> Every template has a main menu button. The position of this button varies between templates and cannot be removed from the template. Some OEMs may format certain templates to not display the main menu button if you have no menu items (such as the navigation map view).

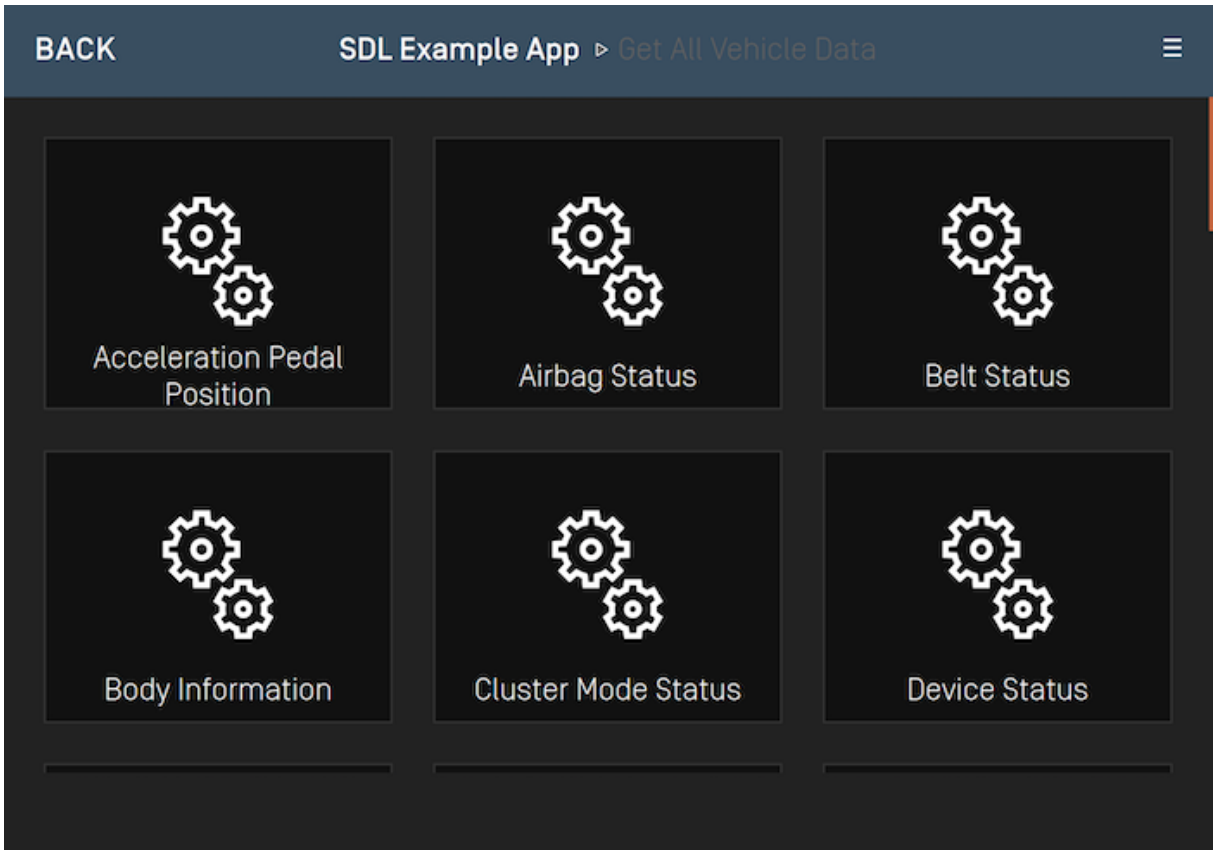
# Setting the Menu Layout (RPC v6.0+)

On some newer head units, you may have the option to display menu items as a grid of tiles instead of the default list layout. To determine if the head unit supports the tiles layout, check the `SystemCapabilityManager`'s `getDefaultMainWindowCapability().getMenuLayoutsAvailable()` property after successfully connecting to the head unit. To set the menu layout using the screen manager, you will need to set the `ScreenManager.menuConfiguration` property.

## LIST MENU LAYOUT




## GRID MENU LAYOUT



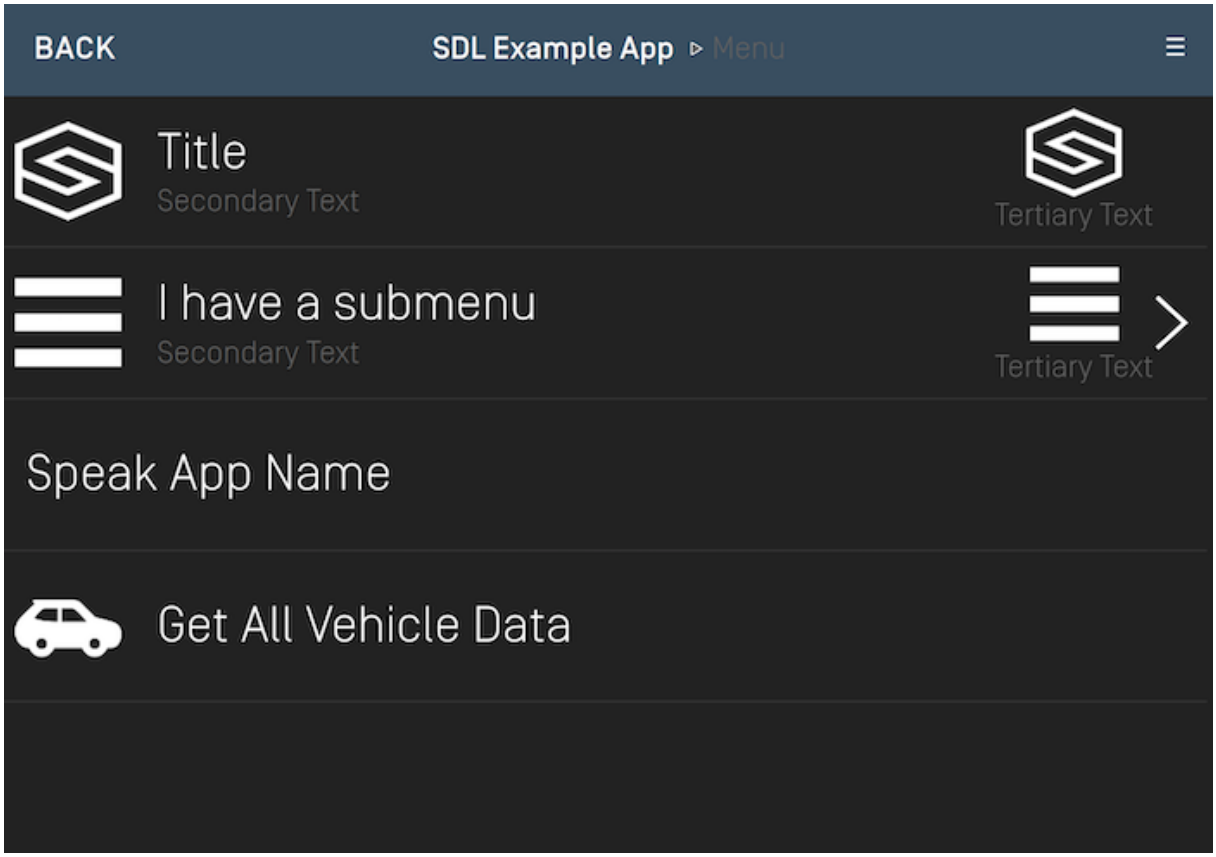

```
MenuLayout mainMenuLayout = MenuLayout.TILES;
MenuLayout submenuLayout = MenuLayout.LIST;
MenuConfiguration menuConfiguration = new MenuConfiguration(mainMenuLayout,
submenuLayout);
sdlManager.getScreenManager().setMenuConfiguration(menuConfiguration);
```

# Adding Menu Items

The best way to create and update your menu is to the use the Screen Manager API. The screen manager contains two menu related properties: `menu`, and `voiceCommands`. Setting an array of `MenuCell`s into the `menu` property will automatically set and update your menu and submenus, while setting an array of `VoiceCommand`s into the `voiceCommands` property allows you to use "hidden" menu items that only contain voice

recognition data. The user can then use the IVI system's voice engine to activate this command even though it will not be displayed within the main menu.

To find out more information on how to create `voiceCommands` see the related documentation.



**NOTE**

Head units supporting RPC v7.1+ may support displaying `secondaryText`, `tertiaryText`, and `secondaryArtwork`. This gives the user a richer experience by displaying more data. Attempting to set this data on head units that do not support RPC 7.1+ will result in that data not being displayed to the user.

To determine if the head unit supports displaying these fields, you can check the `SystemCapabilityManager`'s `getDefaultMainWindowCapability().getTextFields()` / `getDefaultMainWindowCapability().getImageFields()` properties after successfully connecting to the head unit. Then check those arrays for objects with the related text / image field names.

```
// Create the menu cell
MenuCell cell = new MenuCell("Cell text", "Secondary Text", "Tertiary Text", null, null,
Collections.singletonList("cell text"), new MenuSelectionListener() {
    @Override
    public void onTriggered(TriggerSource trigger) {
        // Menu item was selected, check the `triggerSource` to know if the user used
touch or voice to activate it
        // Handle the Cell's Selection
    }
});

sdlManager.getScreenManager().setMenu(Collections.singletonList(cell));
```

## Adding Submenus

Adding a submenu is as simple as adding subcells to a `MenuCell`. The submenu is automatically displayed when selected by the user. Currently menus only support one layer of subcells. In RPC v6.0+ it is possible to set individual submenus to use different layouts such as tiles or lists.

```
// Create the inner menu cell
MenuCell innerCell = new MenuCell("inner menu cell", "secondary text", "tertiary test",
null, null,Collections.singletonList("inner menu cell"), new MenuSelectionListener() {
    @Override
    public void onTriggered(TriggerSource trigger) {
        // Menu item was selected, check the `triggerSource` to know if the user used
touch or voice to activate it
        // Handle the cell's selection
    }
});

// Create and set the submenu cell
MenuCell cell = new MenuCell("cell", "secondary text", "tertiary text",
MenuLayout.LIST, null, null, Collections.singletonList(innerCell));

sdlManager.getScreenManager().setMenu(Collections.singletonList(cell));
```

## Menu Item Artwork

Artworks will be automatically handled when using the screen manager API. First, a "non-artwork" menu will be displayed, then, when the artworks have finished uploading, the "artwork-ified" menu will be displayed. If you are doing this manually with RPCs, you will have to upload artworks using the file manager yourself and send the correct menu when they are ready.

## Deleting and Changing Menu Items

The screen manager will intelligently handle deletions for you. If you want to show new menu items, simply set a new array of menu cells. If you want to have a blank menu, set an empty array. On supported systems, the library will calculate the optimal adds / deletes to create the new menu. If the system doesn't support this sort of dynamic updating, the entire list will be removed and re-added.

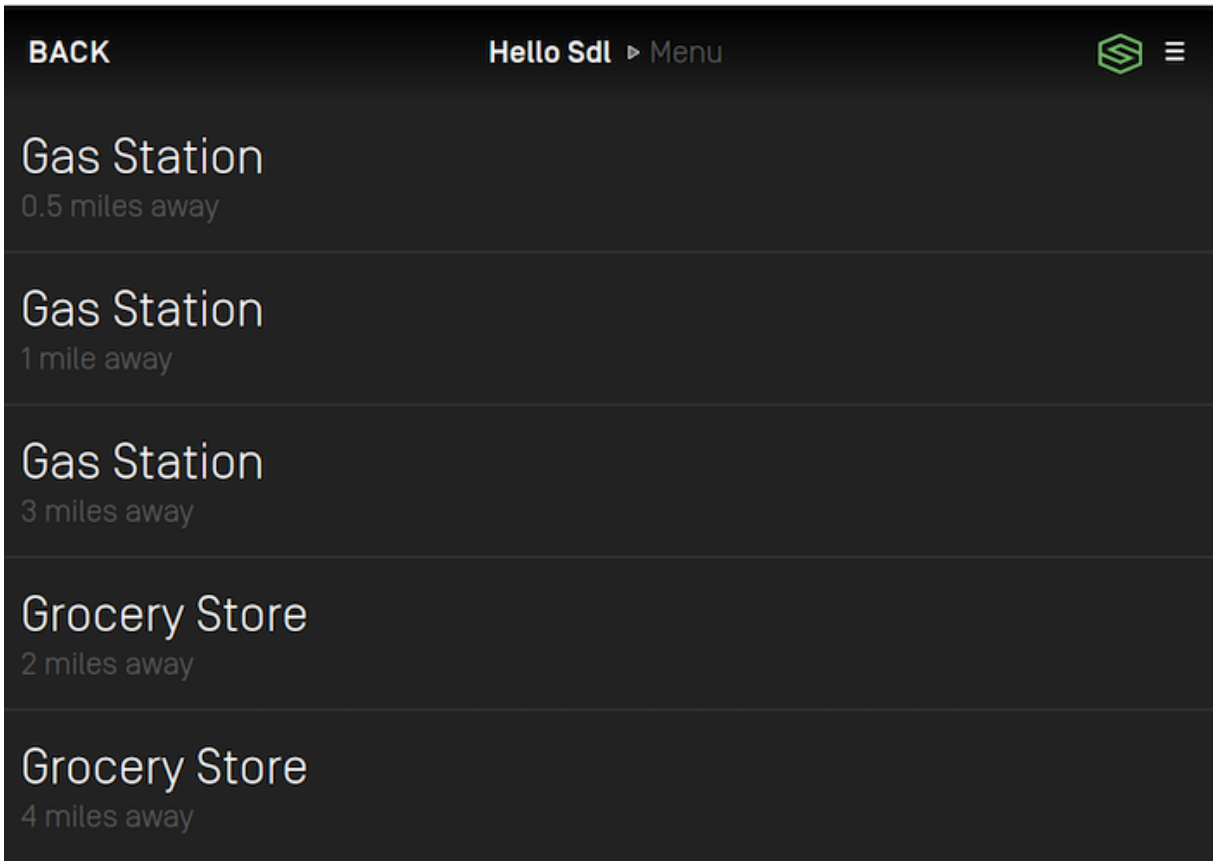
If you are doing this manually, you must use the `DeleteCommand` and `DeleteSubMenu` RPCs, passing the `cmdID`s you wish to delete.

## Duplicate Menu Titles

Starting with SDL v5.1+ menu cells and sub-menu cells no longer require unique titles in order to be presented. For example, if you are trying to display points of interest as a list you can now have multiple locations with the same name but are not the same location. You cannot present multiple cells that are exactly the same. They must have some property that makes them different, such as `secondaryText` or an artwork.

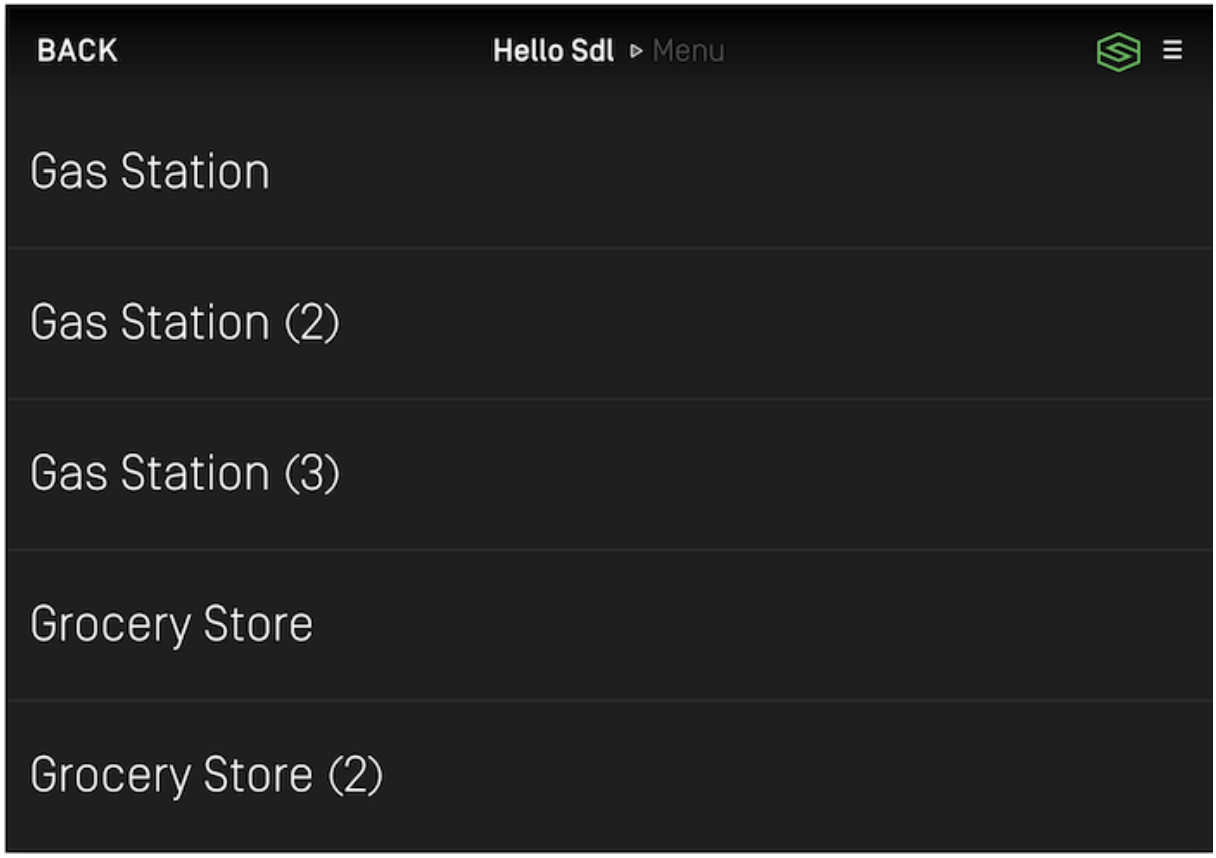
### RPC V7.1+ CONNECTIONS

The titles on the menu will be displayed as provided even if there are duplicate titles.




### RPC V7.0 AND BELOW CONNECTIONS

The titles on the menu will have a number appended to them when there are duplicate titles.




# Using RPCs

The `AddCommand` RPC can be used to add items to the root menu or to a submenu. Each `AddCommand` RPC must be sent with a unique id, a voice-recognition command, and a set of menu parameters. The menu parameters include the menu name, the position of the item in the menu, and the id of the menu item's parent. If the menu item is being added to the root menu, then the parent id is 0. If it is being added to a submenu, then the parent id is the submenu's id.

To create a submenu using RPCs, you must use a `AddSubMenu` RPC with a unique id. When a response is received from the SDL Core, check if the submenu was added successfully. If it was, send an `AddCommand` RPC for each item in the submenu.

> **NOTE**
>
> You should not mix usage of the `ScreenManager` menu features and menu RPCs described above. You must use either one system or the other, but not both.

# Popup Menus

SDL supports modal menus. The user can respond to the list of menu options via touch, voice (if voice recognition is supported by the head unit), or by keyboard input to search or filter the menu.

There are several UX considerations to take into account when designing your menus. The main menu should not be updated often and should act as navigation for your app. Popup menus should be used to present a selection of options to your user.

# Presenting a Popup Menu

Presenting a popup menu is similar to presenting a modal view to request input from your user. It is possible to chain together menus to drill down, however, it is recommended to do so judiciously. Requesting too much input from a driver while they are driving is distracting and may result in your app being rejected by OEMs.

| LAYOUT MODE | FORMATTING DESCRIPTION |
| --- | --- |
| Present as Icon | A grid of buttons with images |
| Present Searchable as Icon | A grid of buttons with images along with a search field in the HMI |
| Present as List | A vertical list of text |
| Present Searchable as List | A vertical list of text with a search field in the HMI |

## Creating Cells

A `ChoiceCell` is similar to a `RecyclerView` without the ability to configure your own UI. We provide several properties on the `ChoiceCell` to set your data, but the layout itself is determined by the manufacturer of the head unit.

> **NOTE**
>
> On many systems, including VR commands will be *exponentially* slower than not including them. However, including them is necessary for a user to be able to respond to your prompt with their voice.

```
ChoiceCell cell = new ChoiceCell("cell1 text", Collections.singletonList("cell1"), null);
ChoiceCell fullCell = new ChoiceCell("cell2 text", "cell2 secondaryText", "cell2
tertiaryText", Collections.singletonList("cell2"), image1Artwork, image2Artwork);
```

## Preloading Cells

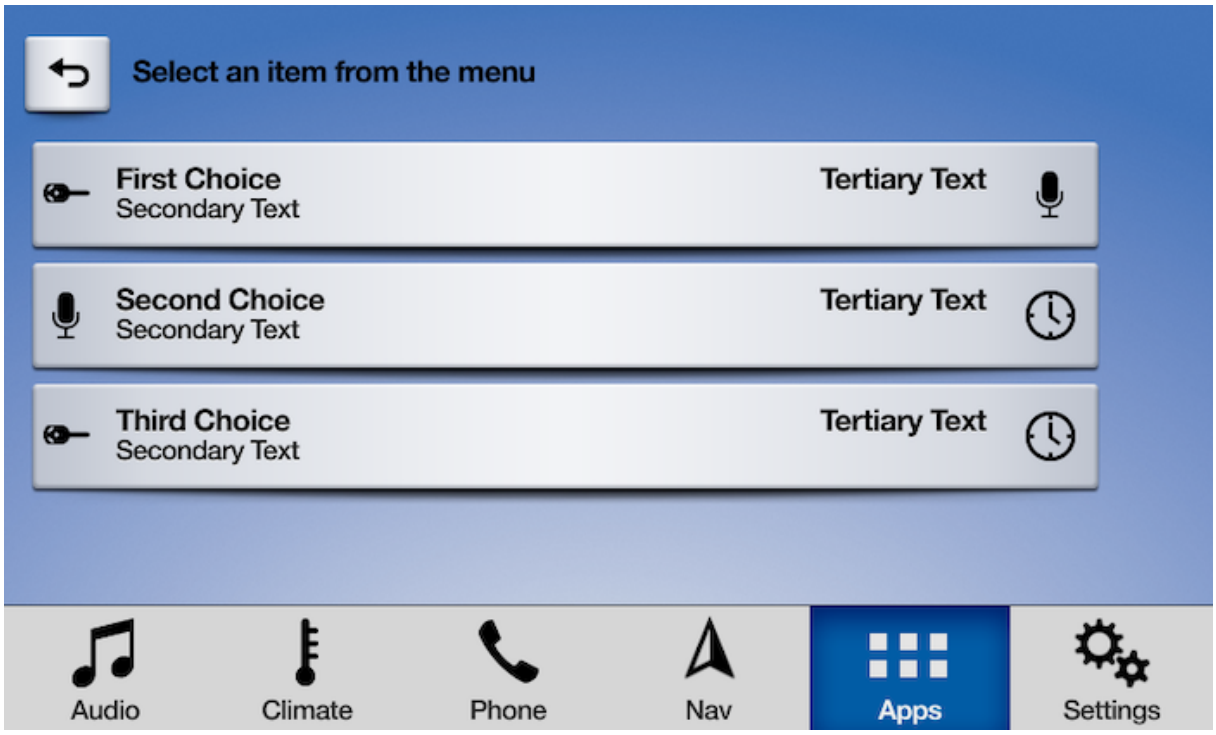
If you know the content you will show in the popup menu long before the menu is shown to the user, you can "preload" those cells in order to speed up the popup menu presentation at a later time. Once you preload a cell, you can reuse it in multiple popup menus without having to send the cell content to Core again.

```
sdlManager.getScreenManager().preloadChoices(Arrays.asList(cell, fullCell), new
CompletionListener() {
    @Override
    public void onComplete(boolean b) {
        // code
    }
});
```

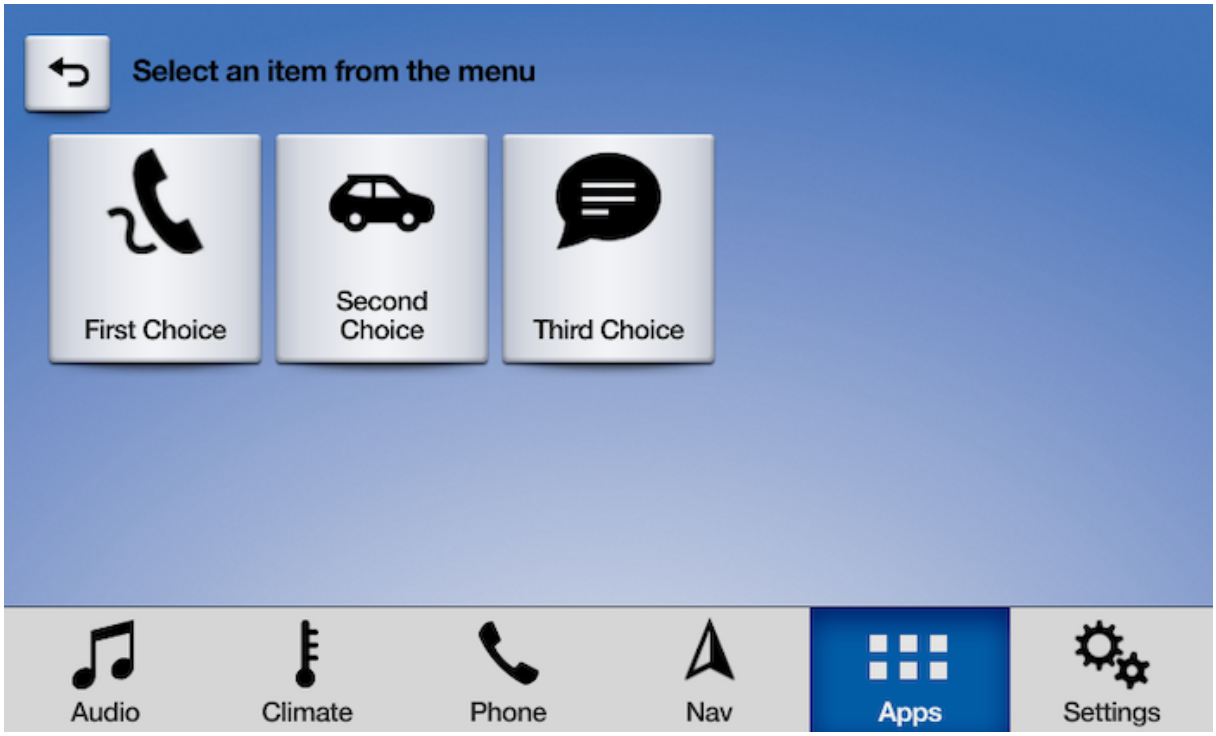
## Presenting a Menu

To show a popup menu to the user, you must present the menu. If some or all of the cells in the menu have not yet been preloaded, calling the `present` API will preload the cells and then present the menu once all the cells have been uploaded. Calling `present` without preloading the cells can take longer than if the cells were preloaded earlier in the app's lifecycle especially if your cell has voice commands. Subsequent menu presentations using the same cells will be faster because the library will reuse those cells (unless you have deleted them).

### MENU - LIST


Select an item from the menu
First Choice
Secondary Text
Tertiary Text
Second Choice
Secondary Text
Tertiary Text
Third Choice
Secondary Text
Tertiary Text
Audio
Climate
Phone
Nav
Apps
Settings

## MENU - ICON


Select an item from the menu
First Choice
Second Choice
Third Choice
Audio
Climate
Phone
Nav
Apps
Settings

> **NOTE**
>
> When you preload a cell, you **do not** need to maintain a reference to it. If you reuse a cell with the same properties that has already been preloaded (or previously presented), the cell will automatically be reused.

## CREATING A CHOICE SET

In order to present a menu, you must bundle together a bunch of `ChoiceCell`s into an `ChoiceSet`.

> **NOTE**
>
> If the `ChoiceSet` contains an invalid set of `ChoiceCell`s, presenting the `ChoiceSet` will fail. This can happen, for example, if you have duplicate title text or if some, but not all choices have voice commands.

Some notes on various parameters (full documentation is available as API documentation on this website):

- Title: This is the title of the menu when presented
- Listeners: You must implement this listener interface to receive callbacks based on the user's interaction with the menu
- Layout: You may present your menu as a set of tiles (like a `GridView`) or a list (like a `RecyclerView`). If you are using tiles, it's recommended to use artworks on each item.

```
ChoiceSet choiceSet = new ChoiceSet("ChoiceSet Title", Arrays.asList(cell, fullCell),
new ChoiceSetSelectionListener() {
    @Override
    public void onChoiceSelected(ChoiceCell choiceCell, TriggerSource triggerSource,
int rowIndex) {
        // You will be passed the `cell` that was selected, the manner in which it was
selected (voice or text), and the index of the cell that was passed.
        // handle selection
    }

    @Override
    public void onError(String error) {
        // handle error
    }
});
```

## PRESENTING THE MENU WITH A MODE

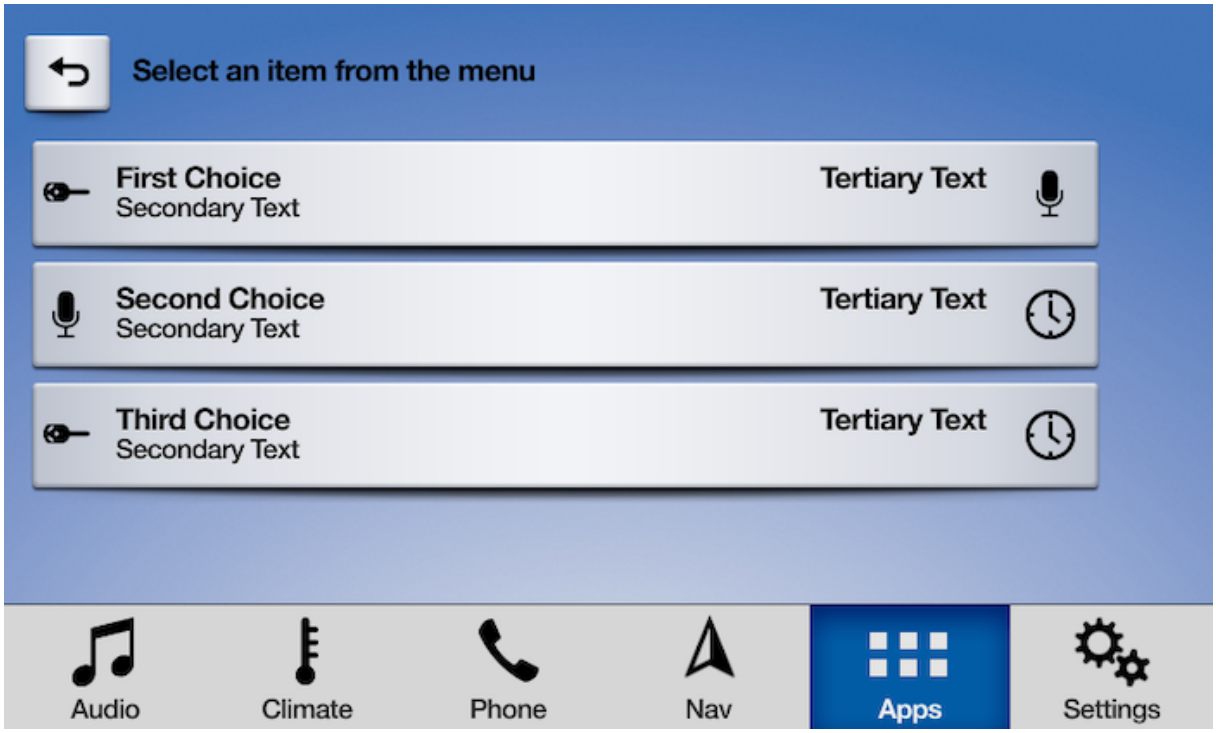
Finally, you will present the menu. When you do so, you must choose a `mode` to present it in. If you have no `vrCommands` on the choice cell you should choose `manualOnly`. If `vrCommands` are available, you may choose `voiceRecognitionOnly` or `both`.

You may want to choose this based on the trigger source leading to the menu being presented. For example, if the menu was presented via the user touching the screen, you may want to use a `mode` of `manualOnly` or `both`, but if the menu was presented via the user speaking a voice command, you may want to use a `mode` of `voiceRecognitionOnly` or `both`.

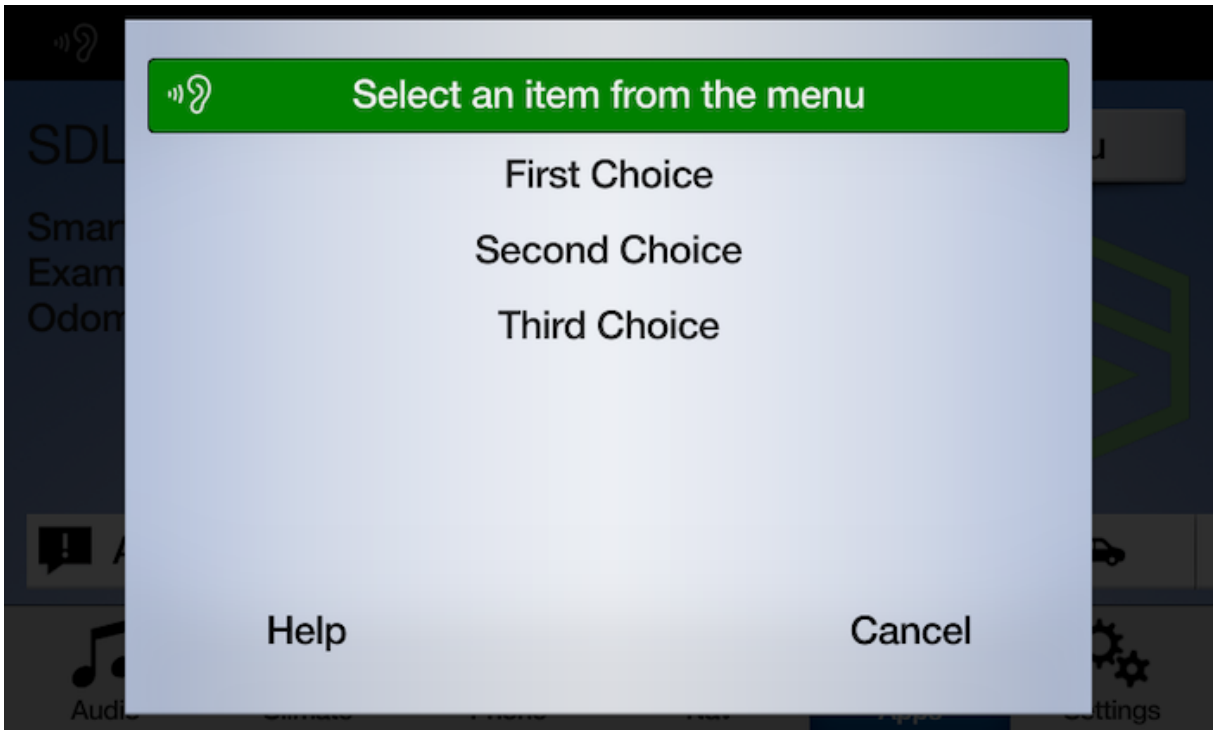
It may seem that the answer is to always use `both`. However, remember that you must provide `vrCommand`s on all cells to use `both`, which is exponentially slower than not providing `vrCommand`s (this is especially relevant for large menus, but less important for smaller ones). Also, some head units may not provide a good user experience for `both`.

| INTERACTION MODE | DESCRIPTION |
| --- | --- |
| Manual only | Interactions occur only through the display |
| VR only | Interactions occur only through text-to-speech and voice recognition |
| Both | Interactions can occur both manually or through VR |

## MENU - MANUAL ONLY MODE




## MENU - VOICE ONLY MODE

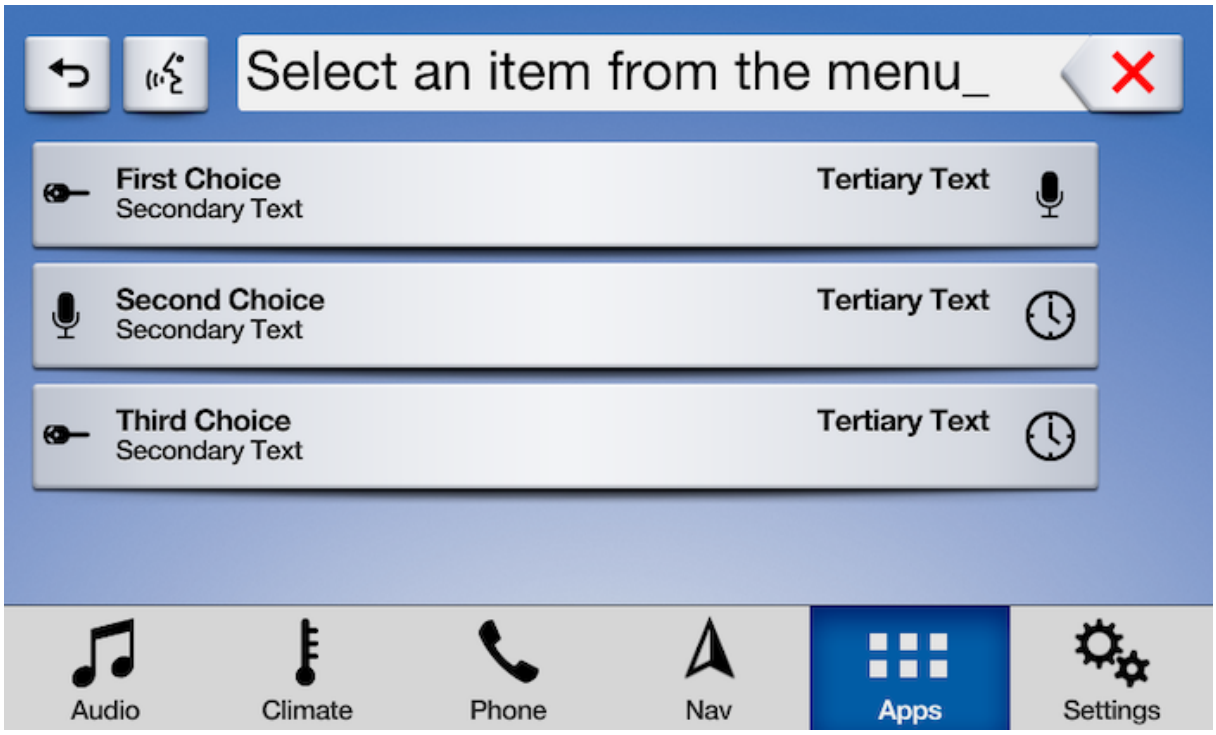



```
sdlManager.getScreenManager().presentChoiceSet(choiceSet,
InteractionMode.MANUAL_ONLY);
```

## Presenting a Searchable Menu

In addition to presenting a standard menu, you can also present a "searchable" menu, that is, a menu with a keyboard input box at the top. For more information on implementing the keyboard callbacks, see the Popup Keyboards guide.

### MENU WITH SEARCH




```
sdlManager.getScreenManager().presentSearchableChoiceSet(choiceSet,
InteractionMode.MANUAL_ONLY, keyboardListener);
```

## Deleting Cells

You can discover cells that have been preloaded on `sdlManager.getScreenManager().getPreloadedChoices()`. You may then pass an array of cells to delete from the remote system. Many times this is not necessary, but if you have deleted artwork used by cells, for example, you should delete the cells as well.

```
sdlManager.getScreenManager().deleteChoices(<List of choices to delete>);
```

## Dismissing the Popup Menu (RPC v6.0+)

You can dismiss a displayed choice set before the timeout has elapsed by sending a `CancelInteraction` request. If you presented the choice set using the screen manager, you can dismiss the choice set by calling `cancel` on the `ChoiceCell` object that you presented.

> **NOTE**
>
> If connected to older head units that do not support this feature, the cancel request will be ignored, and the choice set will persist on the screen until the timeout has elapsed or the user dismisses it by making a selection.

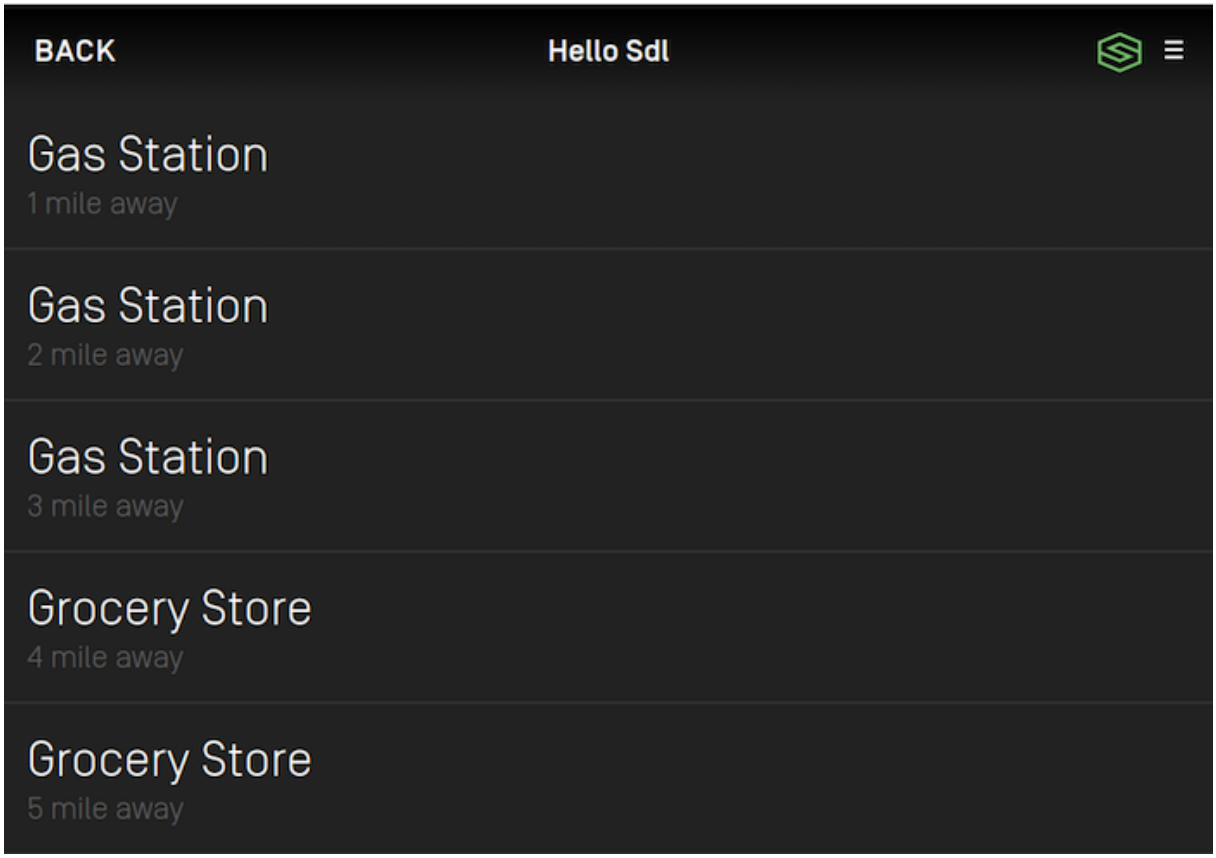
```
choiceSet.cancel();
```

## Duplicate Cell Titles

Starting with SDL v5.1+ choice cells no longer require unique titles in order to be presented. For example, if you are trying to display points of interest as a list you can now have multiple locations with the same name but are not the same location. You cannot present multiple cells that are exactly the same. They must have some property that makes them different, such as `secondaryText` or an artwork.

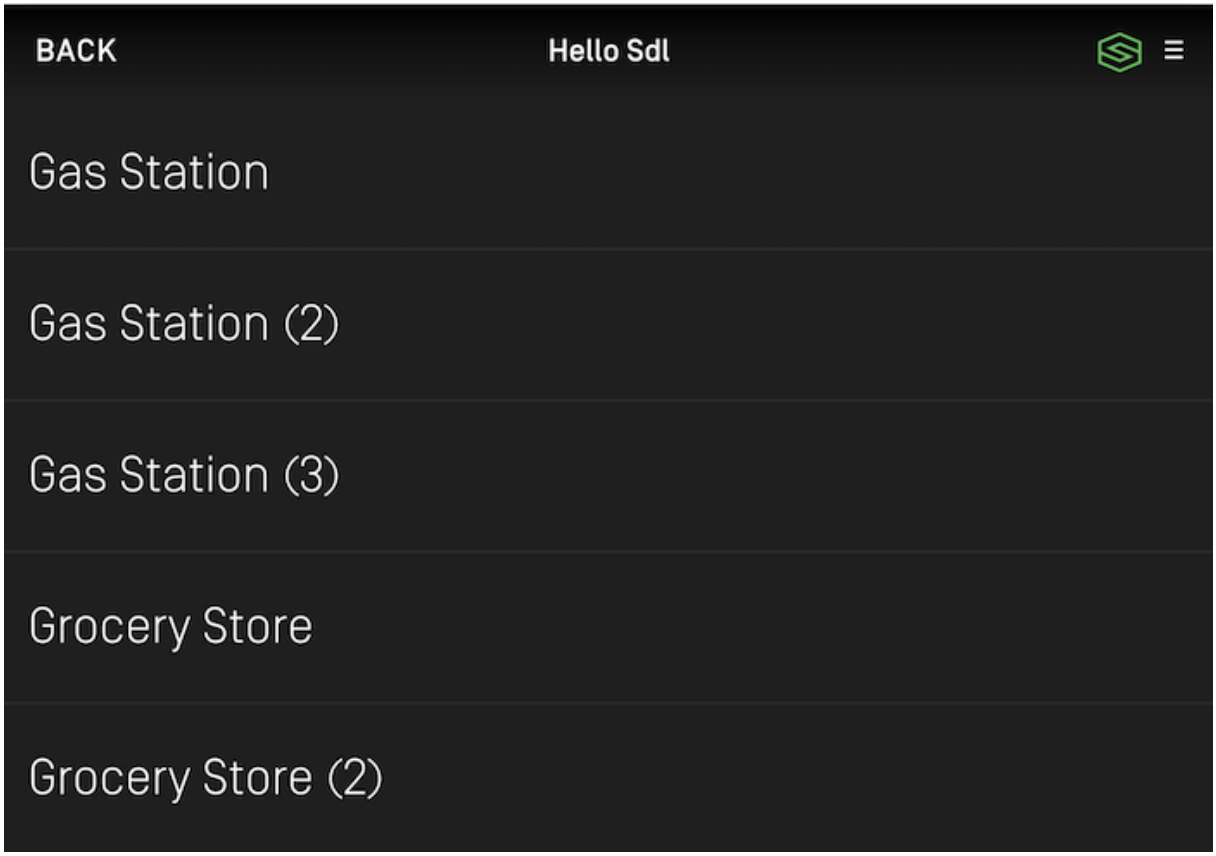
### RPC V7.1+ CONNECTIONS

The titles on the choice set will be displayed as provided even if there are duplicate titles.




### RPC V7.0 AND BELOW CONNECTIONS

The titles on the choice set will have a number appended to them when there are duplicate titles.




# Using RPCs

If you don't want to use the `ScreenManager`, you can do this manually using the `Choice`, `CreateInteractionChoiceSet`, and `PerformInteraction`. You will need to create `Choice`s, bundle them into `CreateInteractionChoiceSet`s. As this is no longer a recommended course of action, we will leave it to you to figure out how to manually do it.

Note that if you do manually create a `PerformInteraction` and want to set a cancel id, the `ScreenManager` takes cancel ids 0 - 10000. Any cancel id you set must be outside of that range.

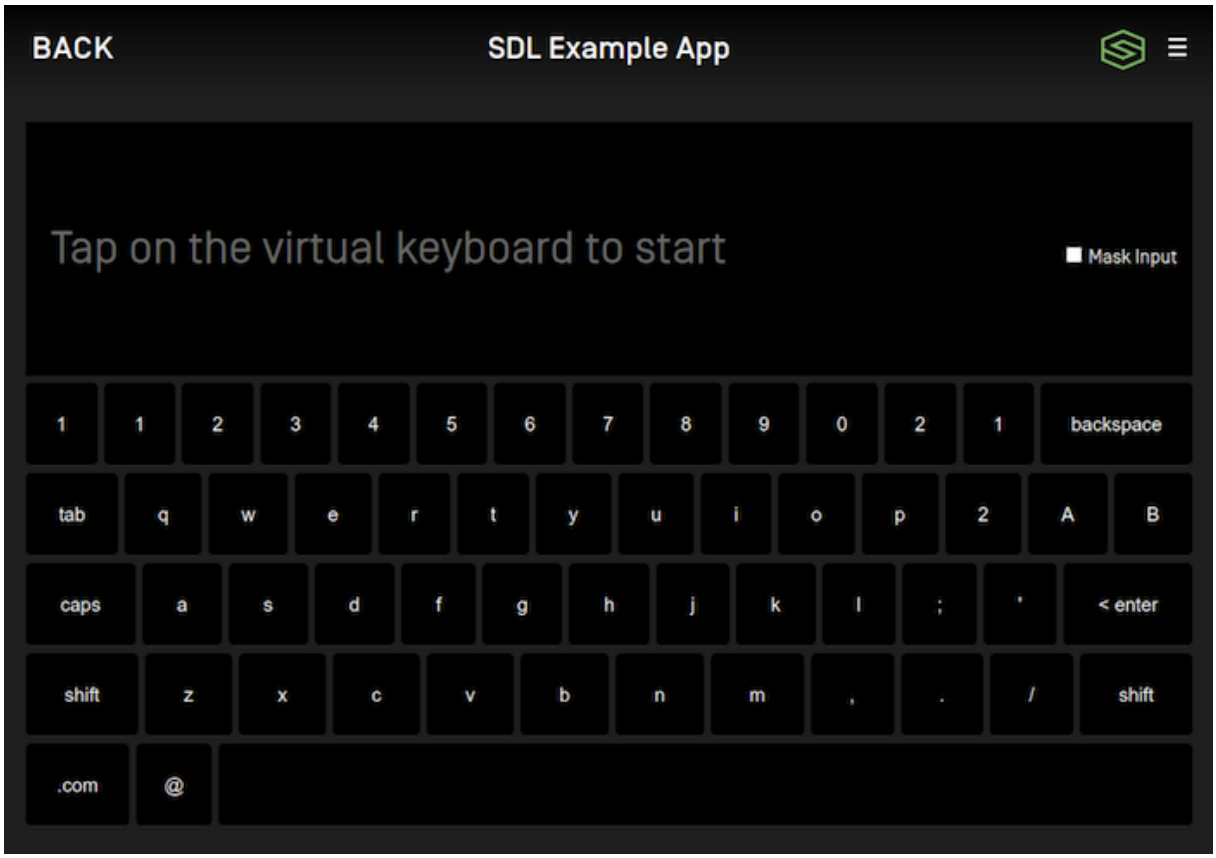
# Popup Keyboards

Presenting a keyboard or a popup menu with a search field requires you to implement the `KeyboardListener`. Note that the `initialText` in the keyboard case often acts as "placeholder text" and not as true initial text.

# Presenting a Keyboard

You should present a keyboard to users when your app contains a "search" field. For example, in a music player app, you may want to give the user a way to search for a song or album. A keyboard could also be useful in an app that displays nearby points of interest, or in other situations.

> **NOTE**
>
> Keyboards are unavailable for use in many countries when the driver is distracted. This is often when the vehicle is moving above a certain speed, such as 5 miles per hour. This will be automatically managed by the system. Your keyboard may be disabled or an error returned if the driver is distracted.




```
int cancelId = sdlManager.getScreenManager().presentKeyboard("Initial text", null,
keyboardListener);
```

## Implementing the Keyboard Listener

Using the `KeyboardListener` involves implementing several methods:

```
KeyboardListener keyboardListener = new KeyboardListener() {
    @Override
    public void onUserDidSubmitInput(String inputText, KeyboardEvent event) {
        switch (event) {
            case ENTRY_VOICE:
                // The user decided to start voice input, you should start an AudioPassThru
session if supported
                break;
            case ENTRY_SUBMITTED:
                // The user submitted some text with the keyboard
                break;
            default:
                break;
        }
    }

    @Override
    public void onKeyboardDidAbortWithReason(KeyboardEvent event) {
        switch (event) {
            case ENTRY_CANCELLED:
                // The user cancelled the keyboard interaction
                break;
            case ENTRY_ABORTED:
                // The system aborted the keyboard interaction
                break;
            default:
                break;
        }
    }

    @Override
    public void updateAutocompleteWithInput(String currentInputText,
KeyboardAutocompleteCompletionListener
keyboardAutocompleteCompletionListener) {
        // Check the input text and return a list of autocomplete results

keyboardAutocompleteCompletionListener.onUpdatedAutoCompleteList(updatedAut

    }

    @Override
    public void updateCharacterSetWithInput(String currentInputText,
KeyboardCharacterSetCompletionListener
keyboardCharacterSetCompletionListener) {
        // Check the input text and return a set of characters to allow the user to enter
    }

    @Override
    public void onKeyboardDidSendEvent(KeyboardEvent event, String
currentInputText) {
        // This is sent upon every event, such as keypresses, cancellations, and aborting
    }
```

```
    @Override
    public void onKeyboardDidUpdateInputMask(KeyboardEvent event) {
        switch (event) {
            case INPUT_KEY_MASK_ENABLED:
                // The user enabled input key masking
                break;
            case INPUT_KEY_MASK_DISABLED:
                // The user disabled input key masking
                break;
            default:
                break;
        }
    }
};
```

## Configuring Keyboard Properties

You can change default keyboard properties by updating `sdlManager.getScreenManager().setKeyboardConfiguration()`. If you want to change the keyboard configuration for only one keyboard session and keep the default keyboard configuration unchanged, you can pass a single-use `KeyboardProperties` to `presentKeyboard()`.

### KEYBOARD LANGUAGE

You can modify the keyboard language by changing the keyboard configuration's `language`. For example, you can set an `EN_US` keyboard. It will default to `EN_US` if not otherwise set.

```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setLanguage(Language.EN_US);

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

### LIMITED CHARACTER LIST

You can modify the keyboard to enable only some characters by responding to the `updateCharacterSetWithInput` listener method or by changing the keyboard configuration before displaying the keyboard. For example, you can enable only "a", "b" , and "c" on the keyboard. All other characters will be greyed out (disabled).

```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setLimitedCharacterList(Arrays.asList("a", "b", "c"));

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

## AUTOCOMPLETE LIST

You can modify the keyboard to allow an app to pre-populate the text field with a list of suggested entries as the user types by responding to the `updateAutocompleteWithInput` listener method or by changing the keyboard configuration before displaying the keyboard. For example, you can display recommended searches "test1", "test2", and "test3" if the user types "tes".

### NOTE

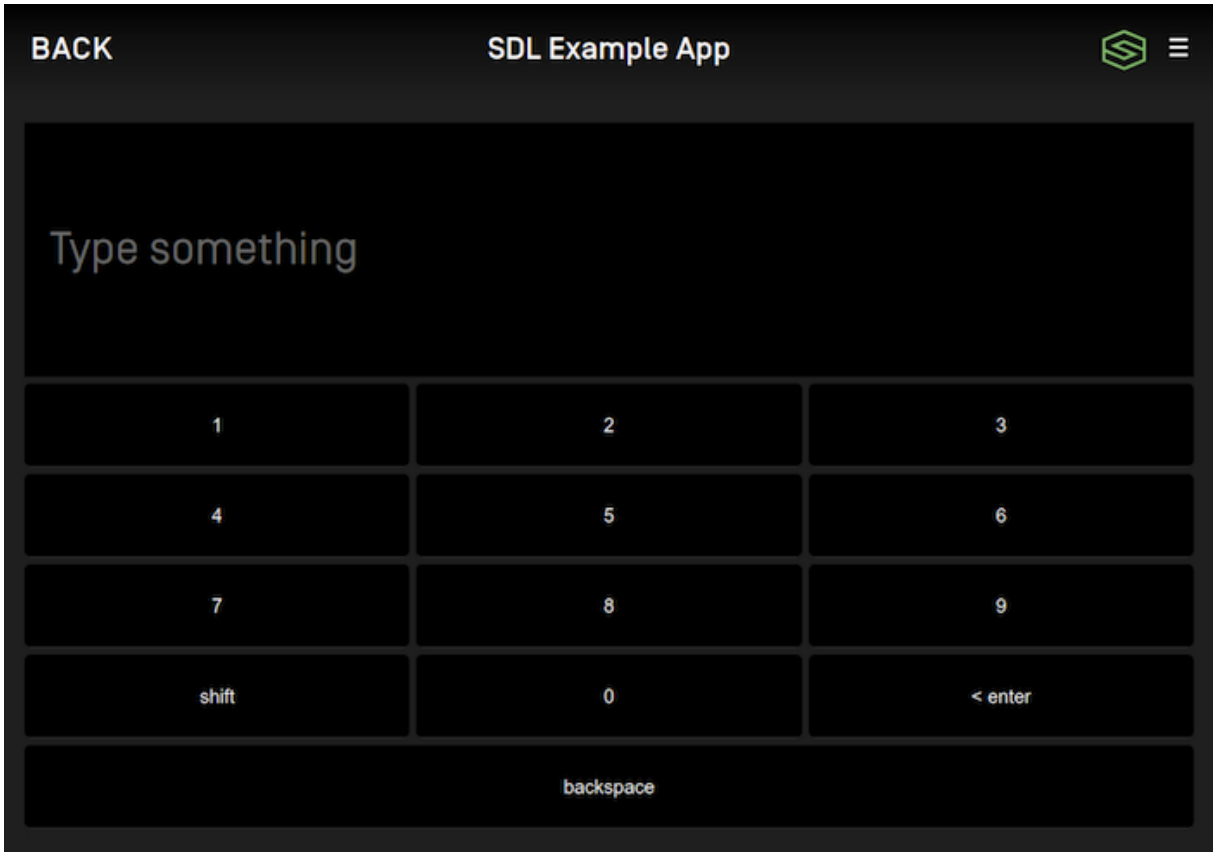
A list of autocomplete results is only available on RPC 6.0+ connections. On connections < RPC 6.0, only the first item will be available to the user.

```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setAutoCompleteList(Arrays.asList("test1", "test2", "test3"));

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

## KEYBOARD LAYOUT

You can modify the keyboard layout by changing the keyboard configuration's `keyboardLayout`. For example, you can set a `NUMERIC` keyboard. It will default to `QWERTY` if not otherwise set.

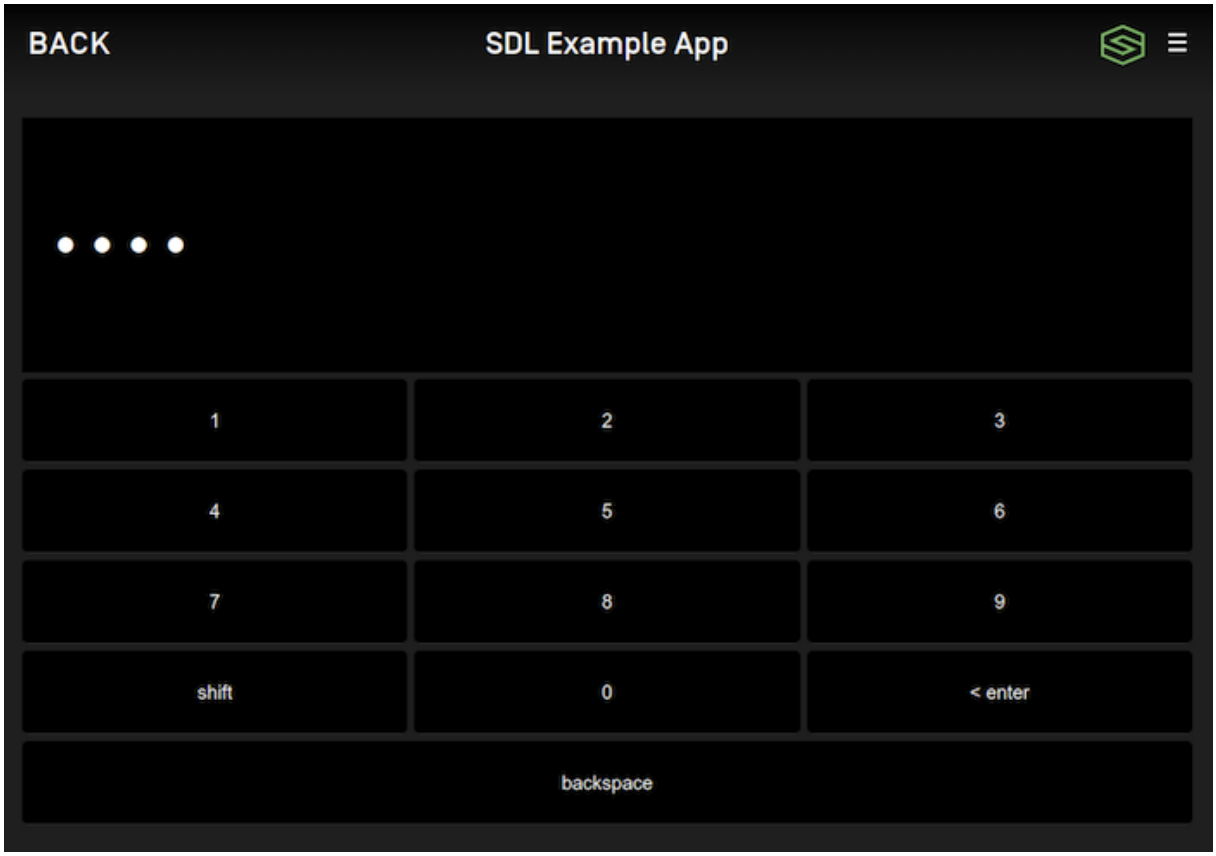
> **NOTE**
>
> The numeric keyboard layout is only available on RPC 7.1+. See the section Checking Keyboard Capabilities to determine if this layout is available.



```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setKeyboardLayout(KeyboardLayout.NUMERIC);

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

## INPUT MASKING (RPC 7.1+)

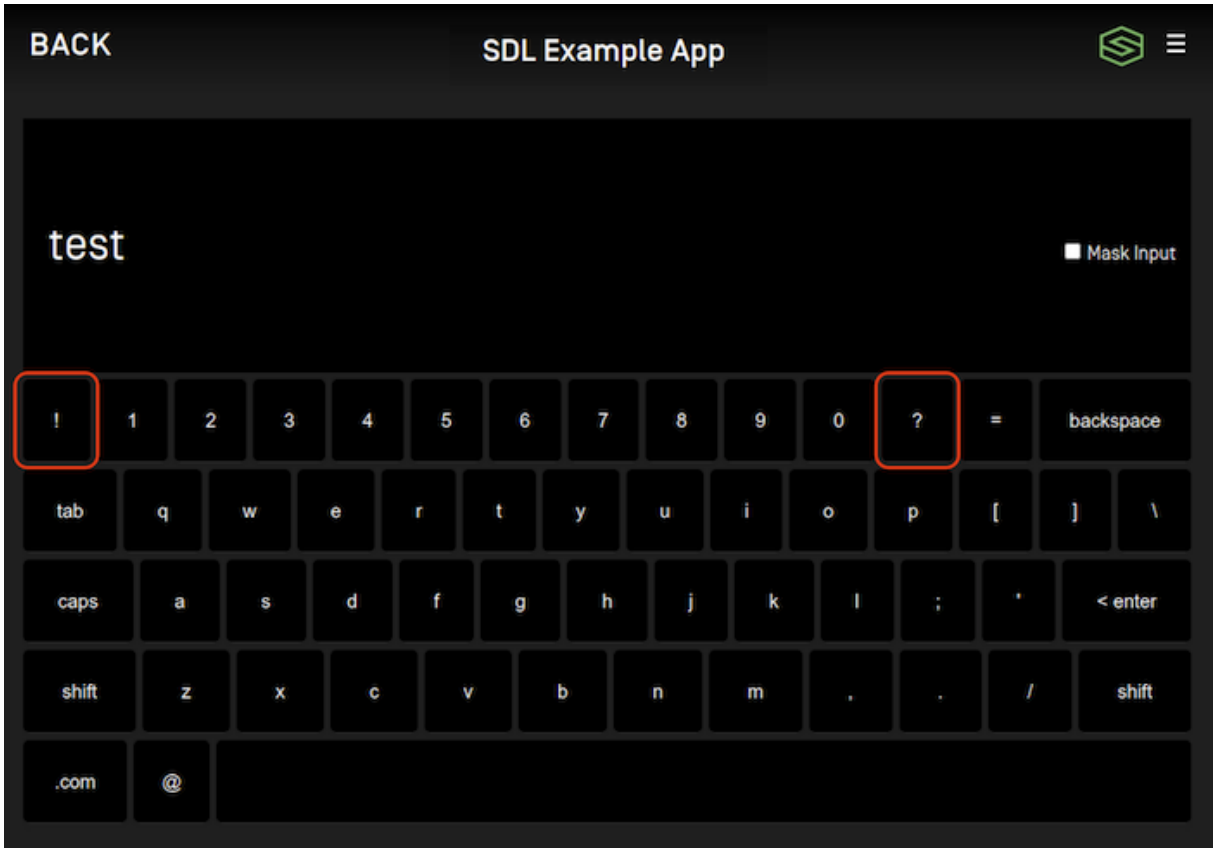
You can modify the keyboard to mask the entered characters by changing the keyboard configuration's `maskInputCharacters`.




```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setKeyboardLayout(KeyboardLayout.NUMERIC)
        .setMaskInputCharacters(KeyboardInputMask.ENABLE_INPUT_KEY_MASK);

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

## CUSTOM KEYS (RPC 7.1+)

Each keyboard layout has a number of keys that can be customized to your app's needs. For example, you could set two of the customizable keys in `QWERTY` layout to be "!" and "?" as seen in the image below. The available number and location of these custom keys is determined by the connected head unit. See the section Checking Keyboard Capabilities to determine how many custom keys are available for any given layout.




```
KeyboardProperties keyboardConfiguration = new KeyboardProperties()
        .setKeyboardLayout(KeyboardLayout.QWERTY)
        .setCustomKeys(Arrays.asList("!", "?"));

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardConfiguration);
```

## Checking Keyboard Capabilities (RPC v7.1+)

Each head unit may support different keyboard layouts and each layout can support a different number of custom keys. Head units may not support masking input. If you want to know which keyboard features are supported on the connected head unit, you can check the `KeyboardCapabilities`:

```
WindowCapability windowCapability =
sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability();
KeyboardCapabilities keyboardCapabilities =
windowCapability.getKeyboardCapabilities();

// List of layouts and number of custom keys supported by each layout
List<KeyboardLayoutCapability> keyboardLayouts =
keyboardCapabilities.getSupportedKeyboards();

// Boolean represents whether masking is supported or not
boolean maskInputSupported =
keyboardCapabilities.getMaskInputCharactersSupported();
```

## Dismissing the Keyboard (RPC v6.0+)

You can dismiss a displayed keyboard before the timeout has elapsed by sending a `CancelInteraction` request. If you presented the keyboard using the screen manager, you can dismiss the choice set by calling `dismissKeyboard` with the `cancelID` that was returned (if one was returned) when presenting.

> **NOTE**
>
> If connected to older head units that do not support this feature, the cancel request will be ignored, and the keyboard will persist on the screen until the timeout has elapsed or the user dismisses it by making a selection.

```
```

```
sdlManager.getScreenManager().dismissKeyboard(cancelId);
```

# Using RPCs

If you don't want to use the `ScreenManager`, you can do this manually using the `PerformInteraction` RPC request. As this is no longer a recommended course of action, we will leave it to you to figure out how to manually do it.

Note that if you do manually create a `PerformInteraction` and want to set a cancel id, the `ScreenManager` takes cancel ids 0 - 10000. Any cancel id you set must be outside of that range.

# Alerts and Subtle Alerts

SDL supports two types of alerts: a large popup alert that typically takes over the whole screen and a smaller subtle alert that only covers a small part of screen.

# Checking if the Module Supports Alerts

Your SDL app may be restricted to only being allowed to send an alert when your app is open (i.e. the `hmiLevel` is non-`NONE`) or when it is the currently active app (i.e. the `hmiLevel` is `FULL`). Subtle alert is a new feature (RPC v7.0+) and may not be supported on all modules.

```
boolean isAlertAllowed =
sdlManager.getPermissionManager().isRPCAllowed(FunctionID.ALERT);
boolean isSubtleAlertAllowed =
sdlManager.getPermissionManager().isRPCAllowed(FunctionID.SUBTLE_ALERT);
```

# Alerts

An alert is a large pop-up window showing a short message with optional buttons. When an alert is activated, it will abort any SDL operation that is in-progress, except the already-in-progress alert. If an alert is issued while another alert is still in progress the newest alert will wait until the current alert has finished.

Depending on the platform, an alert can have up to three lines of text, a progress indicator (e.g. a spinning wheel or hourglass), and up to four soft buttons.

### ALERT WITH NO SOFT BUTTONS

> **NOTE**
>
> If no soft buttons are added to an alert some modules may add a default "cancel" or "close" button.

### ALERT WITH SOFT BUTTONS

## Creating the AlertView

Use the `AlertView` to set all the properties of the alert you want to present.

> **NOTE**
>
> An `AlertView` must contain at least either `text`, `secondaryText` or `audio` for the alert to be presented.

## TEXT

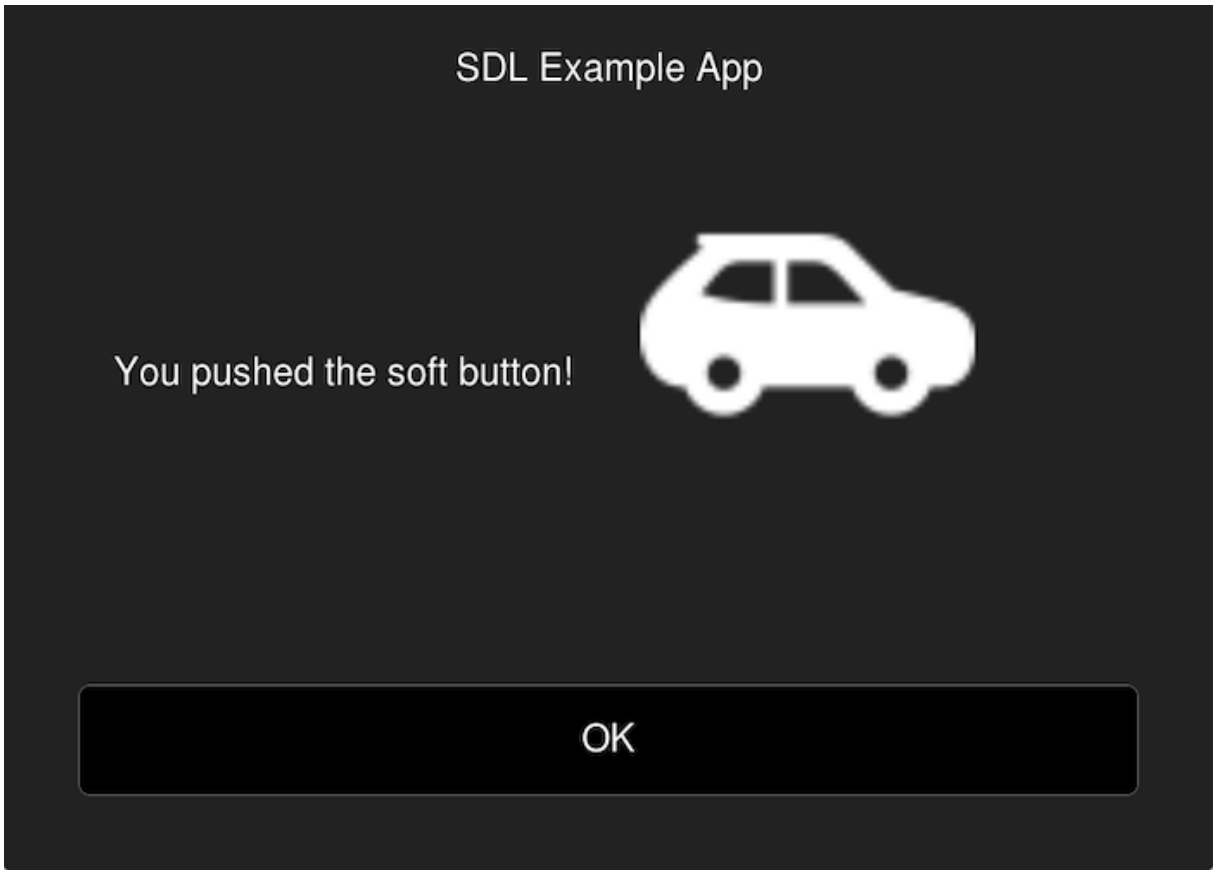
```
AlertView.Builder builder = new AlertView.Builder();
builder.setText("Text");
builder.setSecondaryText("Secondary Text");
builder.setAudio(AlertAudioData);
AlertView alertView = builder.build();
```

## BUTTONS

```
alertView.setSoftButtons(List<SoftButtonObject>);
```

## ICON

An alert can include a custom or static (built-in) image that will be displayed within the alert.




```
alertView.setIcon(SdlArtwork);
```

## TIMEOUTS

An optional timeout can be added that will dismiss the alert when the duration is over. Typical timeouts are between 3 and 10 seconds. If omitted, a default of 5 seconds is used.

```
// 5 seconds
alertView.setTimeout(5);
```

## PROGRESS INDICATOR

Not all modules support a progress indicator. If supported, the alert will show an animation that indicates that the user must wait (e.g. a spinning wheel or hourglass, etc). If omitted, no progress indicator will be shown.

```
alertView.setShowWaitIndicator(true);
```

## TEXT-TO-SPEECH

An alert can also speak a prompt or play a sound file when the alert appears on the screen. This is done by creating an `AlertAudioData` object and setting it in the `AlertView`

> **NOTE**
>
> On Manticore, using alerts with audio (Text-To-Speech or Tones) work best in Google Chrome, Mozilla Firefox, or Microsoft Edge. Alerts with audio does not work in Apple Safari at this time.

```
AlertAudioData alertAudioData = new AlertAudioData("Text to Speak");
alertView.setAudio(alertAudioData);
```

`AlertAudioData` can also play an audio file.

```
AlertAudioData alertAudioData = new AlertAudioData(sdlFile);
alertView.setAudio(alertAudioData);
```

You can also play a combination of audio files and text-to-speech strings. The audio will be played in the order you add them to the `AlertAudioData` object.

```
AlertAudioData alertAudioData = new AlertAudioData(sdlFile);
List<String> textToSpeech = new ArrayList<>();
textToSpeech.add("Text to speak");
alertAudioData.addSpeechSynthesizerStrings(textToSpeech);
```

### PLAY TONE

To play a notification sound when the alert appears, set `playTone` to `true`.

```
AlertAudioData alertAudioData = new AlertAudioData("Text to Speak");
alertAudioData.setPlayTone(true);
```

## Showing the Alert

```
AlertView alertView = builder.build();
sdlManager.getScreenManager().presentAlert(alertView, new
AlertCompletionListener() {
    @Override
    public void onComplete(boolean success, Integer tryAgainTime) {
        if(success){
            // Alert was presented successfully
        }
    }
});
```

## Canceling/Dismissing the Alert

You can cancel an alert that has not yet been sent to the head unit.

On systems with RPC v6.0+ you can dismiss a displayed alert before the timeout has elapsed. This feature is useful if you want to show users a loading screen while performing a task, such as searching for a list for nearby coffee shops. As soon as you have the search results, you can cancel the alert and show the results.

> **NOTE**
>
> If connected to older head units that do not support this feature, the cancel request will be ignored, and the alert will persist on the screen until the timeout has elapsed or the user dismisses the alert by selecting a button.

> **NOTE**
>
> Canceling the alert will only dismiss the displayed alert. If the alert has audio, the speech will play in its entirety even when the displayed alert has been dismissed. If you know you will cancel an alert, consider setting a short audio message like "searching" instead of "searching for coffee shops, please wait."

```
alertView.cancel();
```

## Using RPCs

You can also use RPCs to present alerts. You need to use the `Alert` RPC to do so. Note that if you do so, you must avoid using soft button ids 0 - 10000 and cancel ids 0 - 10000 because these ranges are used by the `ScreenManager`.

# Subtle Alerts (RPC v7.0+)

A subtle alert is a notification style alert window showing a short message with optional buttons. When a subtle alert is activated, it will not abort other SDL operations that are in-progress like the larger pop-up alert does. If a subtle alert is issued while another subtle alert is still in progress the newest subtle alert will simply be ignored.

Touching anywhere on the screen when a subtle alert is showing will dismiss the alert. If the SDL app presenting the alert is not currently the active app, touching inside the subtle alert will open the app.

Depending on the platform, a subtle alert can have up to two lines of text and up to two soft buttons.

> **NOTE**
>
> Because `SubtleAlert` is not currently supported in the `ScreenManager`, you need to be careful when setting soft buttons or cancel ids to ensure that they do not conflict with those used by the `ScreenManager`. The `ScreenManager` takes soft button ids 0 - 10000 and cancel ids 0 - 10000. Ensure that if you use custom RPCs that the soft button ids and cancel ids are outside of this range.

### SUBTLE ALERT WITH NO SOFT BUTTONS

SUBTLE ALERT WITH SOFT BUTTONS

## Creating the Subtle Alert

The following steps show you how to add text, images, buttons, and sound to your subtle alert. Please note that at least one line of text or the "text-to-speech" chunks must be set in order for your subtle alert to work.

### TEXT

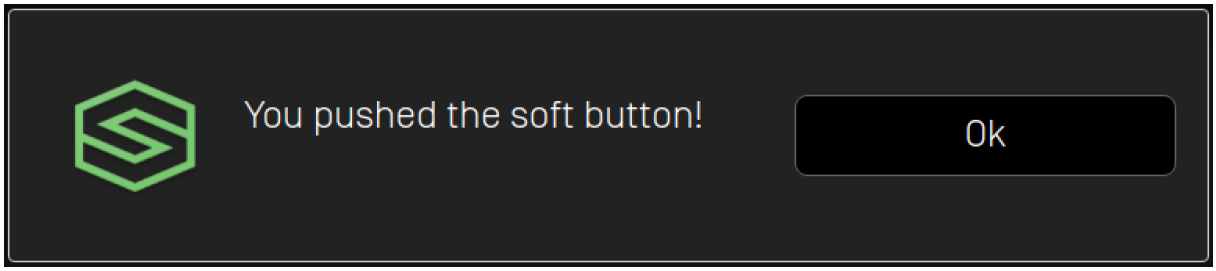
```
SubtleAlert subtleAlert = new SubtleAlert()
    .setAlertText1("Line 1")
    .setAlertText2("Line 2")
    .setCancelID(cancelId);
```

## BUTTONS

```
// Soft buttons
final int softButtonId = 10001; // Set it to any unique ID
SoftButton okButton = new SoftButton(SoftButtonType.SBT_TEXT, softButtonId);
okButton.setText("OK");

// Set the softbuttons(s) to the subtle alert
subtleAlert.setSoftButtons(Collections.singletonList(okButton));

// This listener is only needed once, and will work for all of soft buttons you send
with your subtle alert
sdlManager.addOnRPCNotificationListener(FunctionID.ON_BUTTON_PRESS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnButtonPress onButtonPress = (OnButtonPress) notification;
        if (onButtonPress.getCustomButtonID() == softButtonId){
            DebugTool.logInfo(TAG, "Ok button pressed");
        }
    }
});
```

## ICON

A subtle alert can include a custom or static (built-in) image that will be displayed within the subtle alert. Before you add the image to the subtle alert, make sure the image is uploaded to the head unit using the `FileManager`. Once the image is uploaded, you can show the alert with the icon.



```
subtleAlert.setAlertIcon(new Image("artworkName", ImageType.DYNAMIC));
```

### TIMEOUTS

An optional timeout can be added that will dismiss the subtle alert when the duration is over. Typical timeouts are between 3 and 10 seconds. If omitted, a default of 5 seconds is used.

```
subtleAlert.setDuration(5000);
```

### TEXT-TO-SPEECH

A subtle alert can also speak a prompt or play a sound file when the subtle alert appears on the screen. This is done by setting the `ttsChunks` parameter.

```
subtleAlert.setTtsChunks(Collections.singletonList(new TTSChunk("Text to Speak",
SpeechCapabilities.TEXT)));
```

The `ttsChunks` parameter can also take a file to play/speak. For more information on how to upload the file please refer to the Playing Audio Indications guide.

```
TTSChunk ttsChunk = new TTSChunk(sdlFile.getName(), SpeechCapabilities.FILE);
subtleAlert.setTtsChunks(Collections.singletonList(ttsChunk));
```

## Showing the Subtle Alert

```
// Handle RPC response
subtleAlert.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
      if (response.getSuccess()){
        DebugTool.logInfo(TAG, "Subtle Alert was shown successfully");
      }
    }
});
sdlManager.sendRPC(subtleAlert);
```

## Checking if the User Dismissed the Subtle Alert

If desired, you can be notified when the user tapped on the subtle alert by registering for the `OnSubtleAlertPressed` notification.

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_SUBTLE_ALERT_PRESSED
 new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        // The subtle alert was pressed
    }
});
```

## Dismissing the Subtle Alert

You can dismiss a displayed subtle alert before the timeout has elapsed.

> **NOTE**
>
> Canceling the subtle alert will only dismiss the displayed alert. If you have set the `ttsChunk` property, the speech will play in its entirety even when the displayed subtle alert has been dismissed. If you know you will cancel a subtle alert, consider setting a short `ttsChunk`.

There are two ways to dismiss a subtle alert. The first way is to dismiss a specific subtle alert using a unique `cancelID` assigned to the subtle alert. The second way is to dismiss whichever subtle alert is currently on-screen.

## DISMISSING A SPECIFIC SUBTLE ALERT

```
// `cancelID` is the ID that you assigned when creating and sending the alert
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SUBTLE_ALERT.getId(), cancelID);
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Subtle alert was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

## DISMISSING THE CURRENT SUBTLE ALERT

```
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SUBTLE_ALERT.getId());
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Subtle Alert was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

# Media Clock

The media clock is used by media apps to present the current timing information of a playing media item such as a song, podcast, or audiobook.

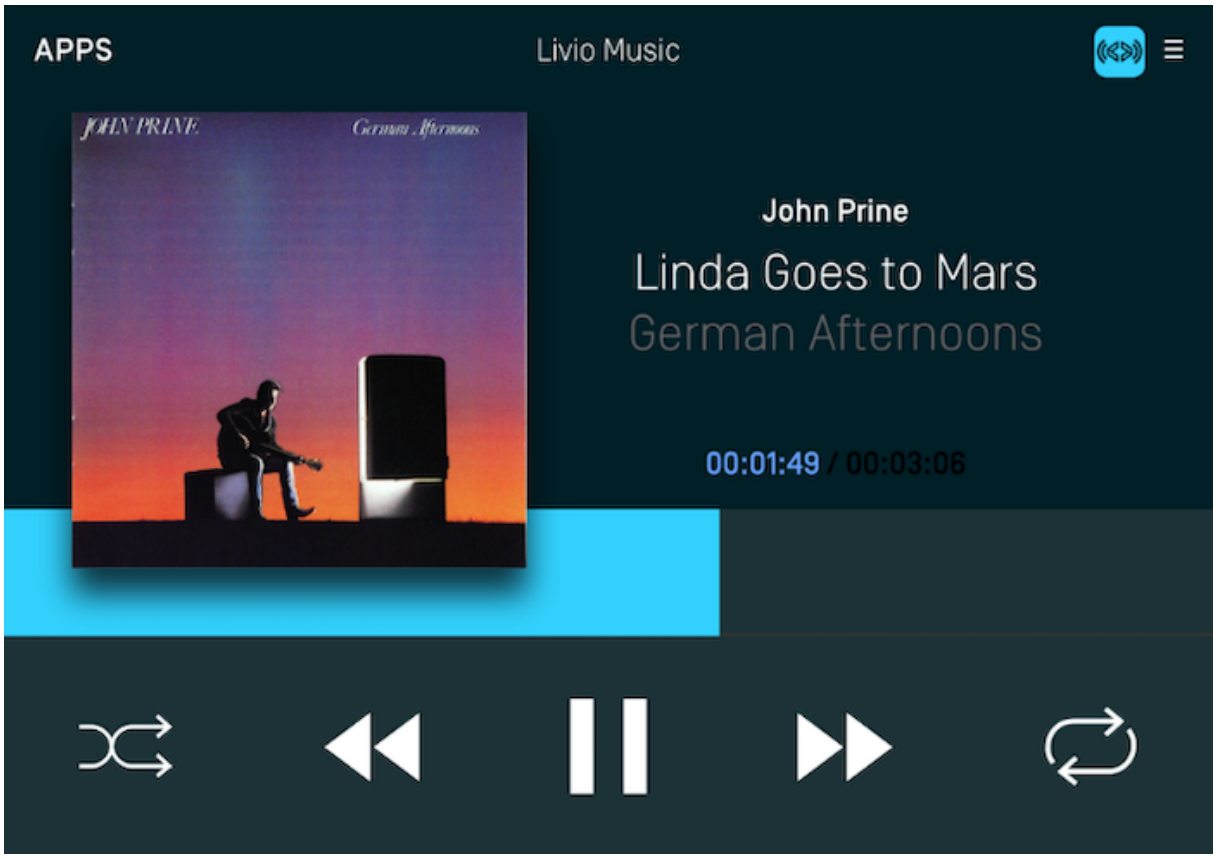
The media clock consists of three parts: the progress bar, a current position label and a remaining time label. In addition, you may want to update the play/pause button icon to reflect the current state of the audio or the media forward / back buttons to reflect if it will skip tracks or time.

**NOTE**

Media clock operations require the HMI status to be `FULL`. More information on how to monitor the HMI status can be found in the Understanding Permissions guide.

**NOTE**

Ensure your app has an `appType` of media and you are using the media template before implementing this feature.




# Counting Up

In order to count up using the timer, you will need to set a start time that is less than the end time. The "bottom end" of the media clock will always start at `0:00` and the "top end" will be the end time you specified. The start time can be set to any position between 0 and the end time. For example, if you are starting a song at `0:30` and it ends at `4:13` the media clock timer progress bar will start at the `0:30` position and start incrementing up

automatically every second until it reaches `4:13`. The current position label will start counting upwards from `0:30` and the remaining time label will start counting down from `3:43`. When the end is reached, the current time label will read `4:13`, the remaining time label will read `0:00` and the progress bar will stop moving.

The play / pause indicator parameter is used to update the play / pause button to your desired button type. This is explained below in the section "Updating the Audio Indicator"

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().countUpFromStartTimeInterval(30, 253,
AudioStreamingIndicator.PAUSE);
sdlManager.sendRPC(mediaClock);
```

# Counting Down

Counting down is the opposite of counting up (I know, right?). In order to count down using the timer, you will need to set a start time that is greater than the end time. The timer bar moves from right to left and the timer will automatically count down. For example, if you're counting down from `10:00` to `0:00`, the progress bar will be at the leftmost position and start decrementing every second until it reaches `0:00`.

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().countDownFromStartTimeInterval(600, 0,
AudioStreamingIndicator.PAUSE);
sdlManager.sendRPC(mediaClock);
```

# Pausing & Resuming

When pausing the timer, it will stop the timer as soon as the request is received and processed. When a resume request is sent, the timer begins again at the paused time as

soon as the request is processed. You can update the start and end times using a pause command to change the timer while remaining paused.

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().pauseWithPlayPauseIndicator(AudioStreamingIndicator.PLAY)

sdlManager.sendRPC(mediaClock);
```

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().resumeWithPlayPauseIndicator(AudioStreamingIndicator.PAU

sdlManager.sendRPC(mediaClock);
```

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().updatePauseWithNewStartTimeInterval(60, 240,
AudioStreamingIndicator.PLAY);
sdlManager.sendRPC(mediaClock);
```

# Clearing the Timer

Clearing the timer removes it from the screen.

```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().clearWithPlayPauseIndicator(AudioStreamingIndicator.PLAY);
sdlManager.sendRPC(mediaClock);
```

# Setting the Play / Pause Button Style (RPC v5.0+)

The audio indicator is, essentially, the play / pause button. You can tell the system which icon to display on the play / pause button to correspond with how your app works. For example, if audio is currently playing you can update the play/pause button to show the pause icon. On older head units, the audio indicator shows an icon with both the play and pause indicators and the icon can not be updated.

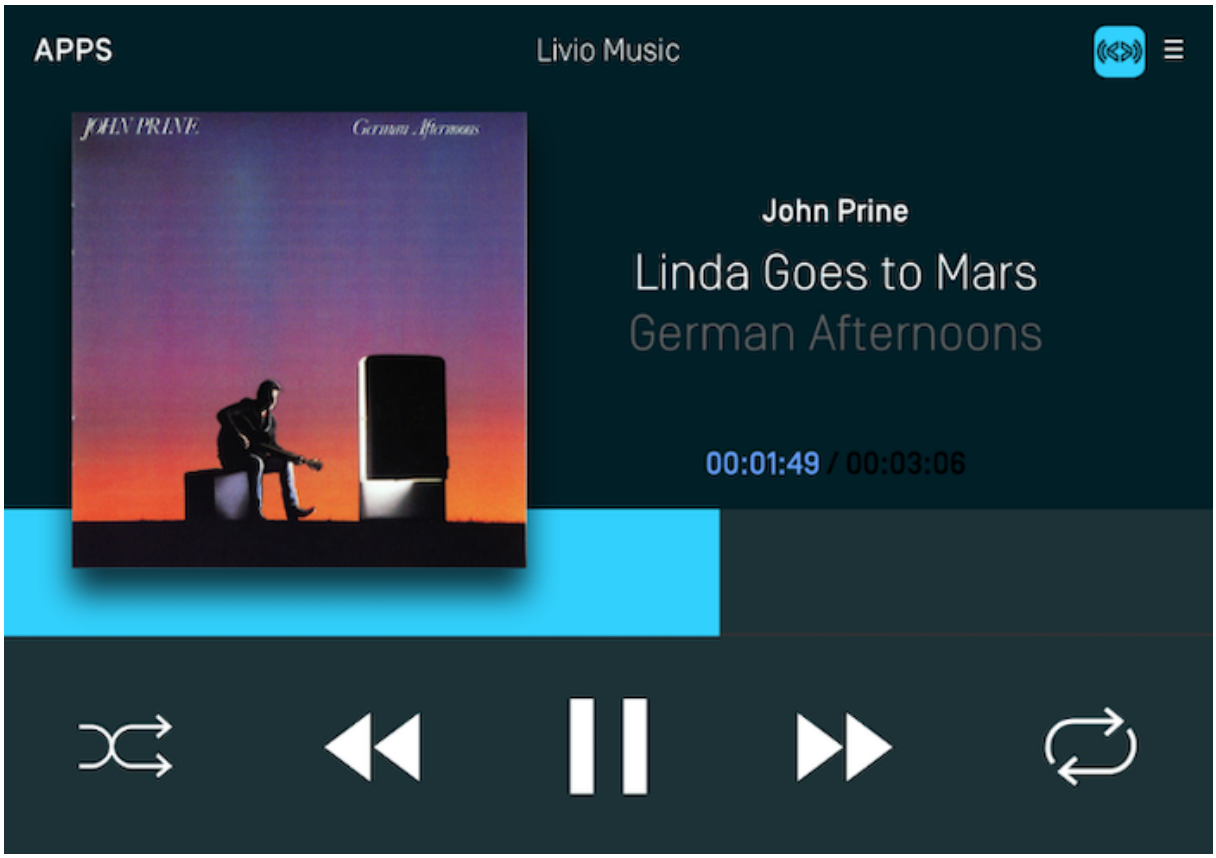
For example, a radio app will probably want two button states: play and stop. A music app, in contrast, will probably want a play and pause button. If you don't send any audio indicator information, a play / pause button will be displayed.

# Setting The Media Forward / Back Button Style (RPC v7.1+)

As of RPC v7.1, you can set the style of the media forward / back buttons to show icons for skipping time (in seconds) forward and backward instead of skipping tracks. The skipping time style is common in podcast & audiobook media apps.

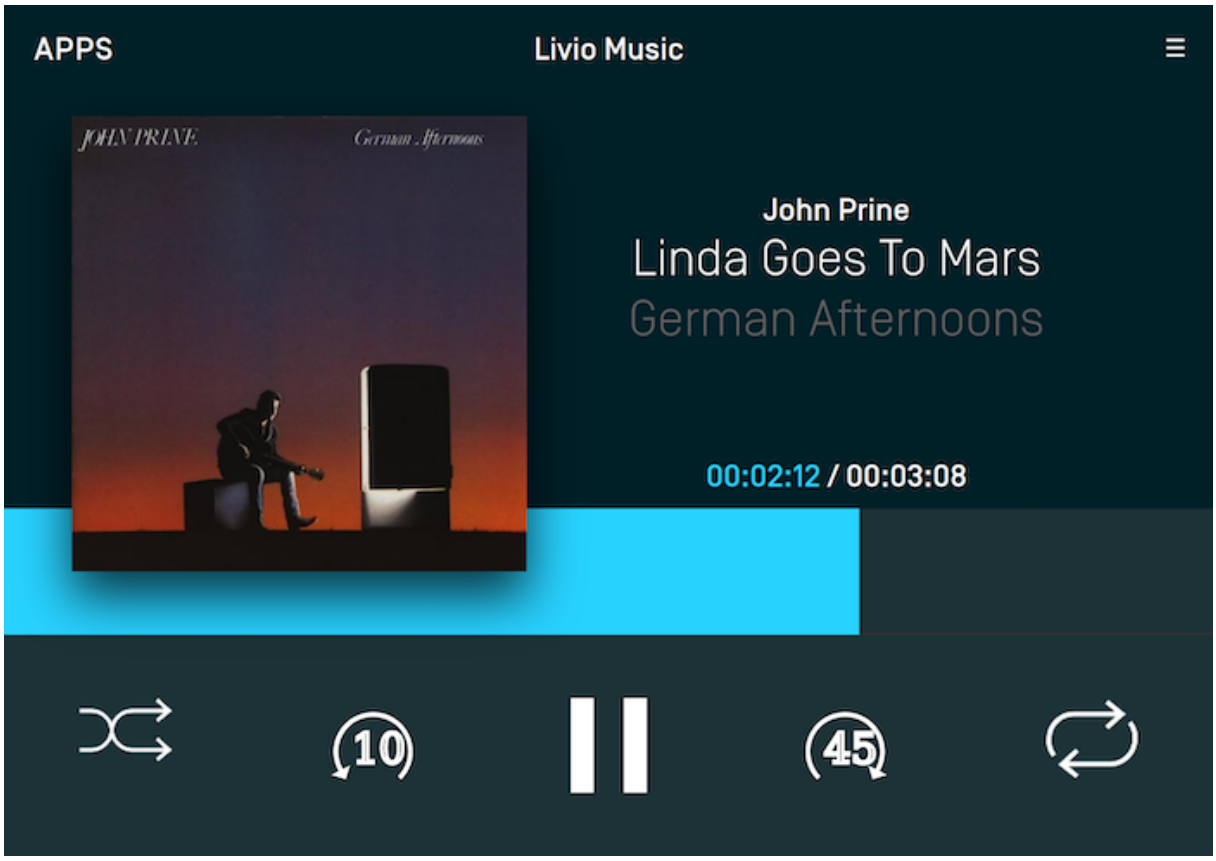
When you set the skip indicator style, you can set type `TRACK`, which is the default style that shows "skip forward" and "skip back" indicators. This is the only style available on RPC < 7.1 connections. You can also set the new type `TIME`, which will allow you to set the number of seconds and display indicators for skipping forward and backward in time.

## Track Style




```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().countUpFromStartTimeInterval(0, 300,
AudioStreamingIndicator.PAUSE);
SeekStreamingIndicator trackStyle = new
SeekStreamingIndicator(SeekIndicatorType.TRACK);
mediaClock.setForwardSeekIndicator(trackStyle);
mediaClock.setBackSeekIndicator(trackStyle);
sdlManager.sendRPC(mediaClock);
```

## Time Style




```
SetMediaClockTimer mediaClock = new
SetMediaClockTimer().countUpFromStartTimeInterval(0, 300,
AudioStreamingIndicator.PAUSE);
SeekStreamingIndicator seek45Style = new
SeekStreamingIndicator(SeekIndicatorType.TIME);
seek45Style.setSeekTime(45);
SeekStreamingIndicator seek10Style = new
SeekStreamingIndicator(SeekIndicatorType.TIME);
seek10Style.setSeekTime(10);
mediaClock.setForwardSeekIndicator(seek45Style);
mediaClock.setBackSeekIndicator(seek10Style);
sdlManager.sendRPC(mediaClock);
```

# Adding Custom Playback Rate (RPC v7.1+)

Many audio apps that support podcasts and audiobooks allow the user to adjust the audio playback rate.
As of RPC v7.1, you can set the rate that the audio is playing at to ensure the media clock accurately reflects the audio.

For example, a user can play a podcast at 125% speed or at 75% speed.

```
//Play Audio at 50% or half speed
SetMediaClockTimer mediaClockSlow = new
SetMediaClockTimer().countUpFromStartTimeInterval(30, 253,
AudioStreamingIndicator.PAUSE);
mediaClockSlow.setCountRate(0.5f);
sdlManager.sendRPC(mediaClockSlow);

//Play Audio at 200% or double speed
SetMediaClockTimer mediaClockFast = new
SetMediaClockTimer().countUpFromStartTimeInterval(30, 253,
AudioStreamingIndicator.PAUSE);
mediaClockFast.setCountRate(2.0f);
sdlManager.sendRPC(mediaClockFast);
```

**NOTE**

`CountRate` has a default value of 1.0, and the `CountRate` will be reset to 1.0 if any `SetMediaClockTimer` request does not have the parameter set. To ensure that you maintain the correct `CountRate` in your application make sure to set the parameter in all `SetMediaClockTimer` requests (including when sending a RESUME request).

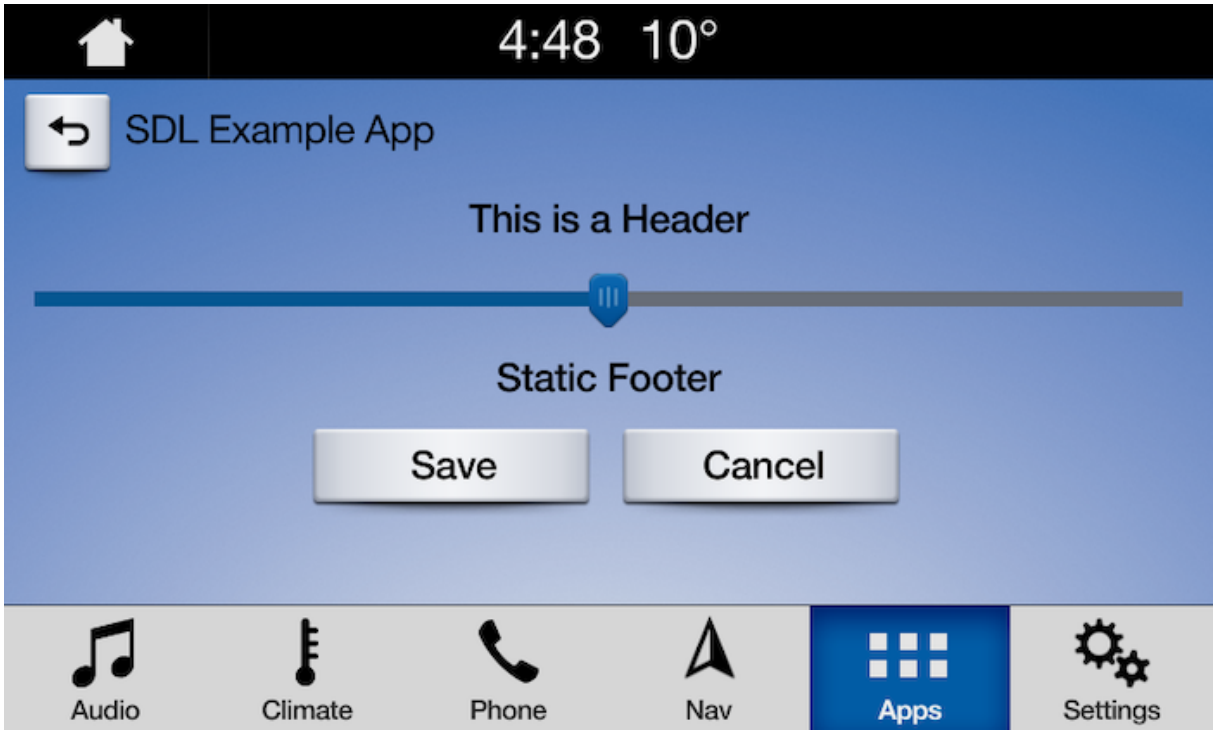
# Slider

A `Slider` creates a full screen or pop-up overlay (depending on platform) that a user can control. There are two main `Slider` layouts, one with a static footer and one with a dynamic footer.

> **NOTE**
>
> The slider will persist on the screen until the timeout has elapsed or the user dismisses the slider by selecting a position or canceling.

A slider popup with a static footer displays a single, optional, footer message below the slider UI. A dynamic footer can show a different message for each slider position.

# Slider UI



## DYNAMIC SLIDER IN POSITION 1

## DYNAMIC SLIDER IN POSITION 2

# Creating the Slider

```
Slider slider = new Slider();
```

## Ticks

The number of selectable items on a horizontal axis.

```
// Must be a number between 2 and 26
slider.setNumTicks(5);
```

## Position

The initial position of slider control (cannot exceed numTicks).

```
// Must be a number between 1 and 26
slider.setPosition(1);
```

## Header

The header to display.

```
// Max length 500 chars
slider.setSliderHeader("This is a Header");
```

## Static Footer

The footer will have the same message across all positions of the slider.

```
// Max length 500 chars
slider.setSliderFooter(Collections.singletonList("Static Footer"));
```

## Dynamic Footer

This type of footer will have a different message displayed for each position of the slider. The footer is an optional parameter. The footer message displayed will be based off of the slider's current position. The footer array should be the same length as `numTicks` because each footer must correspond to a tick value. Or, you can pass `null` to have no footer at all.

```
// Array length 1 - 26, Max length 500 chars
slider.setSliderFooter(Arrays.asList("Footer 1","Footer 2","Footer 3"));
```

## Cancel ID

An ID for this specific slider to allow cancellation through the `CancelInteraction` RPC. The `ScreenManager` takes cancel ids 0 - 10000, so ensure any cancel id that you set is outside of that range.

```
slider.setCancelID(10045);
```

# Show the Slider

```
slider.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            SliderResponse sliderResponse = (SliderResponse) response;
            DebugTool.logInfo(TAG, "Slider Position Set: " +
sliderResponse.getSliderPosition());
        }
    }
});
sdlManager.sendRPC(slider);
```

# Dismissing a Slider (RPC v6.0+)

You can dismiss a displayed slider before the timeout has elapsed by dismissing either a specific slider or the current slider.

> **NOTE**
>
> If connected to older head units that do not support this feature, the cancel request will be ignored, and the slider will persist on the screen until the timeout has elapsed or the user dismisses by selecting a position or canceling.

## Dismissing a Specific Slider

```
// `cancelID` is the ID that you assigned when creating the slider
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SLIDER.getId(), cancelID);
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Slider was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

### Dismissing the Current Slider

```
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SLIDER.getId());
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Slider was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

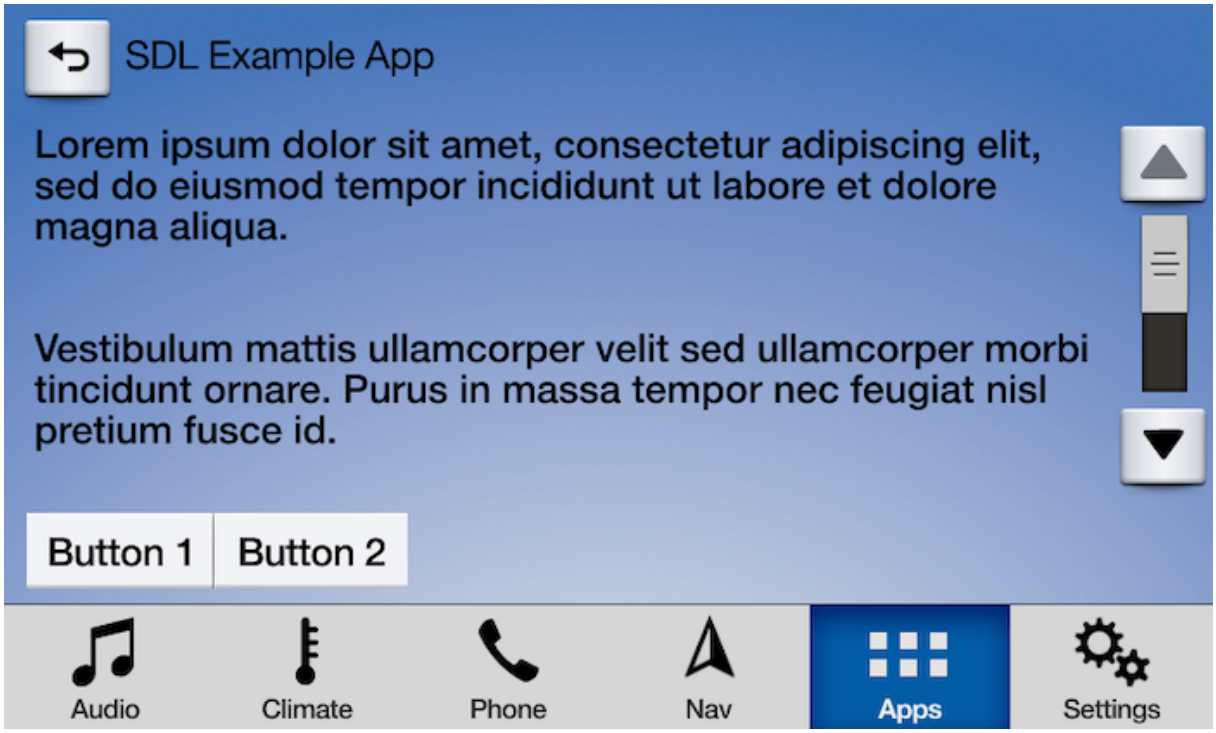
# Scrollable Message

A `ScrollableMessage` creates an overlay containing a large block of formatted text that can be scrolled. It contains a body of text, a message timeout, and up to eight soft buttons. To display a scrollable message in your SDL app, you simply send a `ScrollableMessage` RPC request.

NOTE

The message will persist on the screen until the timeout has elapsed or the user dismisses the message by selecting a soft button or cancelling (if the head unit provides cancel UI).

# Scrollable Message UI




# Creating the Scrollable Message

Currently, you can only create a scrollable message view to display on the screen using RPCs.

### NOTE

The `ScreenManager` uses soft button ids 0 – 10000. Ensure that if you use custom RPCs—such as this one—that the soft button ids you use are outside of this range (i.e. > 10000).

```
// Create Message To Display
String scrollableMessageText = "Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua.Vestibulum mattis ullamcorper velit sed ullamcorper morbi tincidunt ornare. Purus in massa tempor nec feugiat nisl pretium fusce id. Pharetra convallis posuere morbi leo urna molestie at elementum eu. Dictum sit amet justo donec enim diam.";

// Create SoftButtons
SoftButton softButton1 = new SoftButton(SoftButtonType.SBT_TEXT, 10001);
softButton1.setText("Button 1");

SoftButton softButton2 = new SoftButton(SoftButtonType.SBT_TEXT, 10002);
softButton2.setText("Button 2");

// Create SoftButton Array
List<SoftButton> softButtonList = Arrays.asList(softButton1, softButton2);

// Create ScrollableMessage Object
ScrollableMessage scrollableMessage = new ScrollableMessage()
    .setScrollableMessageBody(scrollableMessageText)
    .setTimeout(50000)
    .setSoftButtons(softButtonList);

// Set cancelId
scrollableMessage.setCancelID(cancelId);

// Send the scrollable message
sdlManager.sendRPC(scrollableMessage);
```

To listen for `OnButtonPress` events for `SoftButton`s, we need to add a listener that listens for their Id's:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_BUTTON_PRESS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnButtonPress onButtonPress = (OnButtonPress) notification;
        switch (onButtonPress.getCustomButtonID()){
            case 10001:
                DebugTool.logInfo(TAG, "Button 1 Pressed");
                break;
            case 10002:
                DebugTool.logInfo(TAG, "Button 2 Pressed");
                break;
        }
    }
});
```

# Dismissing a Scrollable Message (RPC v6.0+)

You can dismiss a displayed scrollable message before the timeout has elapsed. You can dismiss a specific scrollable message, or you can dismiss the scrollable message that is currently displayed.

> **NOTE**
>
> If connected to older head units that do not support this feature, the cancel request will be ignored, and the scrollable message will persist on the screen until the timeout has elapsed or the user dismisses the message by selecting a button.

## Dismissing a Specific Scrollable Message

```
// `cancelID` is the ID that you assigned when creating and sending the alert
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SCROLLABLE_MESSAGE.getId(), cancelID);
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Scrollable message was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

### Dismissing the Current Scrollable Message

```
CancelInteraction cancelInteraction = new
CancelInteraction(FunctionID.SCROLLABLE_MESSAGE.getId());
cancelInteraction.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            DebugTool.logInfo(TAG, "Scrollable message was dismissed successfully");
        }
    }
});
sdlManager.sendRPC(cancelInteraction);
```

# Customizing the Template

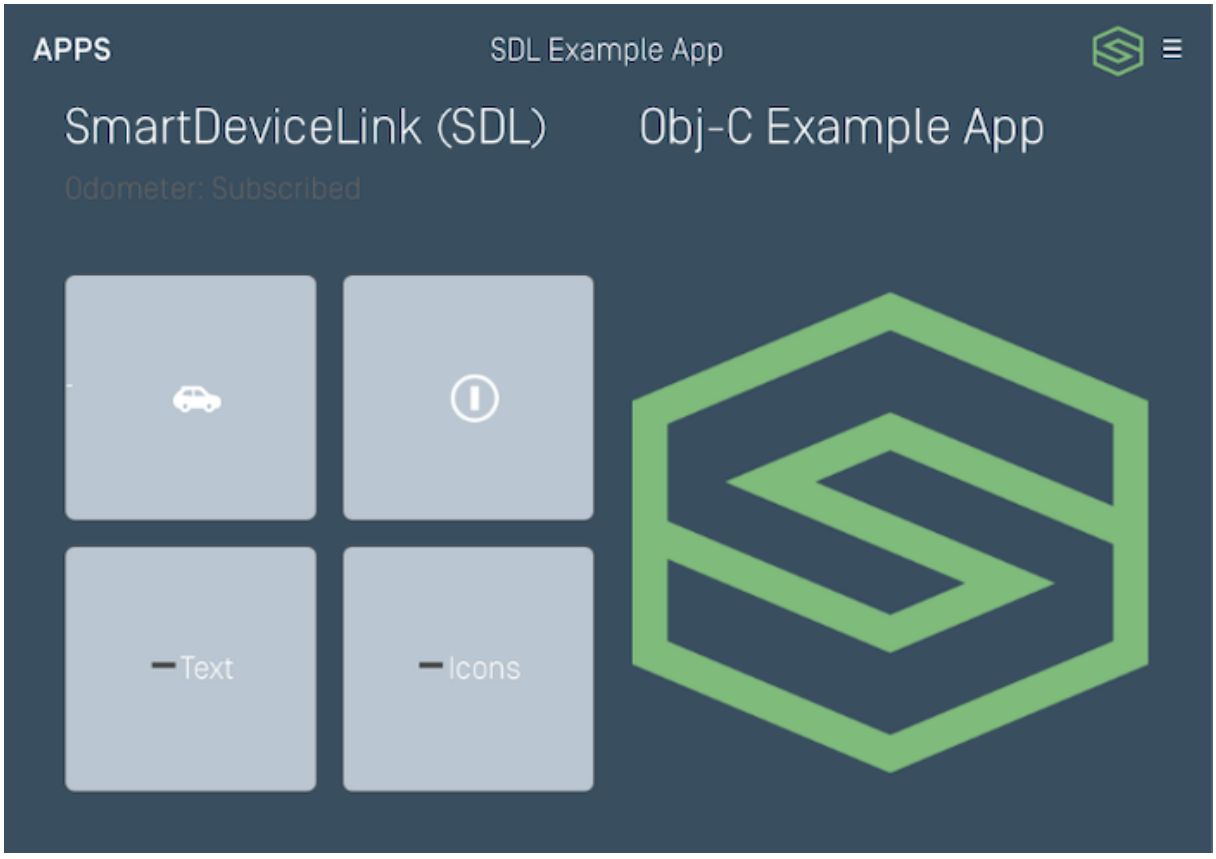
You have the ability to customize the look and feel of the template. How much customization is available depends on the RPC version of the head unit you are connected with as well as the design of the HMI.

# Customizing Template Colors (RPC v5.0+)

You can customize the color scheme of your app using template coloring APIs.

## Customizing the Default Layout

You can change the template colors of the initial template layout in the `lifecycleConfiguration`.



```
// Set color schemes
RGBColor green = new RGBColor(126, 188, 121);
RGBColor white = new RGBColor(249, 251, 254);
RGBColor grey = new RGBColor(186, 198, 210);
RGBColor darkGrey = new RGBColor(57, 78, 96);

TemplateColorScheme dayColorScheme = new TemplateColorScheme()
    .setBackgroundColor(white)
    .setPrimaryColor(green)
    .setSecondaryColor(grey);
builder.setDayColorScheme(dayColorScheme);

TemplateColorScheme nightColorScheme = new TemplateColorScheme()
    .setBackgroundColor(white)
    .setPrimaryColor(green)
    .setSecondaryColor(darkGrey);
builder.setNightColorScheme(nightColorScheme);
```

NOTE

You may only change the template coloring once per template; that is, you cannot call `changeLayout`, `SetDisplayLayout` or `Show` for the template you are already on and expect the color scheme to update.

## Customizing Future Layouts

You can change the template color scheme when you change layouts. This guide requires SDL Java Suite version 5.0. If using an older version, use `SetDisplayLayout` (any RPC version) or `Show` (RPC v6.0+) request.

```
// Set color schemes
RGBColor green = new RGBColor(126, 188, 121);
RGBColor white = new RGBColor(249, 251, 254);
RGBColor grey = new RGBColor(186, 198, 210);
RGBColor darkGrey = new RGBColor(57, 78, 96);

TemplateColorScheme dayColorScheme = new TemplateColorScheme()
    .setBackgroundColor(white)
    .setPrimaryColor(green)
    .setSecondaryColor(grey);

TemplateColorScheme nightColorScheme = new TemplateColorScheme()
    .setBackgroundColor(white)
    .setPrimaryColor(green)
    .setSecondaryColor(darkGrey);

TemplateConfiguration templateConfiguration = new TemplateConfiguration()
    .setTemplate(PredefinedLayout.GRAPHIC_WITH_TEXT.toString())
    .setDayColorScheme(dayColorScheme)
    .setNightColorScheme(nightColorScheme);

sdlManager.getScreenManager().changeLayout(templateConfiguration, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            // Color set with template change
        } else {
            // Color and template not changed
        }
    }
});
```

# Customizing the Menu Title and Icon

You can also customize the title and icon of the main menu button that appears on your template layouts. The menu icon must first be uploaded with a specific name through the file manager; see the Uploading Images section for more information on how to upload your image.

```
// The image must be uploaded before referencing the image name here
SetGlobalProperties setGlobalProperties = new SetGlobalProperties()
    .setMenuTitle("customTitle")
    .setMenuIcon(image);

setGlobalProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()){
            // Success
        }
    }
});
sdlManager.sendRPC(setGlobalProperties);
```

# Customizing the Keyboard (RPC v3.0+)

If you present keyboards in your app – such as in searchable interactions or another custom keyboard – you may wish to customize the keyboard for your users. The best way to do this is through the `ScreenManager`. For more information presenting keyboards, see the Popup Keyboards section.

# Setting Keyboard Properties

You can modify the language of the keyboard to change the characters that are displayed.

```
KeyboardProperties keyboardProperties = new KeyboardProperties()
    .setLanguage(Language.HE_IL) // Set to Israeli Hebrew
    .setKeyboardLayout(KeyboardLayout.AZERTY); // Set to AZERTY

sdlManager.getScreenManager().setKeyboardConfiguration(keyboardProperties);
```

# Other Properties

While there are other keyboard properties available on `KeyboardProperties`, these will be overridden by the screen manager. The `keypressMode` must be a specific configuration for the screen manager's callbacks to work properly. The `limitedCharacterList`, `autoCompleteText`, and `autoCompleteList` will be set on a per-keyboard basis when calling `sdlManager.getScreenManager.presentKeyboard(...)`, should custom keyboard properties be set.

# Customizing Help Prompts

On some head units it is possible to display a customized help menu or speak a custom command if the user asks for help while using your app. The help menu is commonly used to let users know what voice commands are available, however, it can also be customized to help your user navigate the app or let them know what features are available.

# Configuring the Help Menu

You can customize the help menu with your own title and/or menu options. If you don't customize these options, then the head unit's default menu will be used.

If you wish to use an image, you should check the `sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getImageFields();` for an `imageField.name` of `vrHelpItem` to see if that image is supported. If `vrHelpItem` is in the `imageFields` array, then it can be used. You will then need to upload the image using the file manager before using it in the request. See the Uploading Images section for more information.

```
SetGlobalProperties setGlobalProperties = new SetGlobalProperties();
setGlobalProperties.setVrHelpTitle("What Can I Say?");

VrHelpItem item1 = new VrHelpItem("Show Artists", 1);
item1.setImage(image); // a previously uploaded image or null

VrHelpItem item2 = new VrHelpItem("Show Albums", 2);
item2.setImage(image); // a previously uploaded image or null

setGlobalProperties.setVrHelp(Arrays.asList(item1, item2));
setGlobalProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // The help menu is updated
    }
});
sdlManager.sendRPC(setGlobalProperties);
```

# Configuring the Help Prompt

On head units that support voice recognition, a user can request assistance by saying "Help." In addition to displaying the help menu discussed above a custom spoken text-to-speech response can be spoken to the user.

```
SetGlobalProperties setGlobalProperties = new SetGlobalProperties();
setGlobalProperties.setHelpPrompt(Collections.singletonList(new TTSChunk("Your
custom help prompt", SpeechCapabilities.TEXT)));
setGlobalProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            // The help prompt is updated
        } else {
            // Handle Error
        }
    }
});
sdlManager.sendRPC(setGlobalProperties);
```

# Configuring the Timeout Prompt

If you display any sort of popup menu or modal interaction that has a timeout – such as an alert, interaction, or slider – you can create a custom text-to-speech response that will be spoken to the user in the event that a timeout occurs.

```
SetGlobalProperties setGlobalProperties = new SetGlobalProperties();
setGlobalProperties.setTimeoutPrompt(Collections.singletonList(new
TTSChunk("Your custom help prompt", SpeechCapabilities.TEXT)));
setGlobalProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            // The timeout prompt is updated
        } else {
            // Handle Error
        }
    }
});
sdlManager.sendRPC(setGlobalProperties);
```

# Clearing Help Menu and Prompt Customizations

You can also reset your customizations to the help menu or spoken prompts. To do so, you will send a `ResetGlobalProperties` RPC with the fields that you wish to clear.

```
// Reset the help menu
ResetGlobalProperties resetGlobalProperties = new
ResetGlobalProperties(Arrays.asList(GlobalProperty.VRHELPITEMS,
GlobalProperty.VRHELPTITLE));

// Reset the menu icon and title
ResetGlobalProperties resetGlobalProperties = new
ResetGlobalProperties(Arrays.asList(GlobalProperty.MENUICON,
GlobalProperty.MENUNAME));

// Reset spoken prompts
ResetGlobalProperties resetGlobalProperties = new
ResetGlobalProperties(Arrays.asList(GlobalProperty.HELPPROMPT,
GlobalProperty.TIMEOUTPROMPT));

// To send any one of these, use the typical format:
resetGlobalProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            // The global properties are reset
        } else {
            // Handle Error
        }
    }
});
sdlManager.sendRPC(resetGlobalProperties);
```

# Playing Spoken Feedback

Since your user will be driving while interacting with your SDL app, speech phrases can provide important feedback to your user. At any time during your app's lifecycle you can send a speech phrase using the `Speak` request and the head unit's text-to-speech (TTS) engine will produce synthesized speech from your provided text.

When using the `Speak` RPC, you will receive a response from the head unit once the operation has completed. From the response you will be able to tell if the speech was completed, interrupted, rejected or aborted. It is important to keep in mind that a speech request can interrupt another ongoing speech request. If you want to chain speech

requests you must wait for the current speech request to finish before sending the next speech request.

> **NOTE**
>
> On Manticore, spoken feedback works best in Google Chrome, Mozilla Firefox, or Microsoft Edge. Spoken feedback does not work in Apple Safari at this time.

# Creating the Speak Request

The speech request you send can simply be a text phrase, which will be played back in accordance with the user's current language settings, or it can consist of phoneme specifications to direct SDL's TTS engine to speak a language-independent, speech-sculpted phrase. It is also possible to play a pre-recorded sound file (such as an MP3) using the speech request. For more information on how to play a sound file please refer to Playing Audio Indications.

## Getting the Supported Speech Capabilities

Once you have successfully connected to the module, you can access supported speech capabilities properties on the `sdlManager.getSystemCapabilityManager()` instance.

```
sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.SPEE
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        List<SpeechCapabilities> speechCapabilities = (List<SpeechCapabilities>)
capability;
    }

    @Override
    public void onError(String info) {
        // Handle error
    }
}, false);
```

Below is a list of commonly supported speech capabilities.

| SPEECH CAPABILITY | DESCRIPTION |
| --- | --- |
| Text | Text phrases |
| SAPI Phonemes | Microsoft speech synthesis API |
| File | A pre-recorded sound file |

## Creating Different Types of Speak Requests

Once you know what speech capabilities are supported by the module, you can create the speak requests.

### TEXT PHRASE

```
TTSChunk ttsChunk = new TTSChunk("hello", SpeechCapabilities.TEXT);
List<TTSChunk> ttsChunkList = Collections.singletonList(ttsChunk);
Speak speak = new Speak(ttsChunkList);
```

### SAPI PHONEMES PHRASE

```
TTSChunk ttsChunk = new TTSChunk("h eh - l ow 1",
SpeechCapabilities.SAPI_PHONEMES);
List<TTSChunk> ttsChunkList = Collections.singletonList(ttsChunk);
Speak speak = new Speak(ttsChunkList);
```

# Sending the Speak Request

```
speak.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        SpeakResponse speakResponse = (SpeakResponse) response;
        if (!speakResponse.getSuccess()){
            switch (speakResponse.getResultCode()){
                case DISALLOWED:
                    DebugTool.logInfo(TAG, "The app does not have permission to use the
speech request");
                    break;
                case REJECTED:
                    DebugTool.logInfo(TAG, "The request was rejected because a higher
priority request is in progress");
                    break;
                case ABORTED:
                    DebugTool.logInfo(TAG, "The request was aborted by another higher
priority request");
                    break;
                default:
                    DebugTool.logInfo(TAG, "Some other error occurred");
            }
            return;
        }
        DebugTool.logInfo(TAG, "Speech was successfully spoken");
    }
});
sdlManager.sendRPC(speak);
```

# Playing Audio Indications (RPC v5.0+)

You can pass an uploaded audio file's name to `TTSChunk`, allowing any API that takes a text-to-speech parameter to pass and play your audio file. A sports app, for example, could play a distinctive audio chime to notify the user of a score update alongside an `Alert` request.

NOTE

On Manticore, audio indications work best in Google Chrome, Mozilla Firefox, or Microsoft Edge. Audio indications do not work in Apple Safari at this time.

# Uploading the Audio File

The first step is to make sure the audio file is available on the remote system. To upload the file use the `FileManager`.

```
SdlFile audioFile = new SdlFile("Audio file name", FileType.AUDIO_MP3, fileUri, true);
sdlManager.getFileManager().uploadFile(audioFile, new CompletionListener() {
    @Override
    public void onComplete(boolean success) {

    }
});
```

For more information about uploading files, see the Uploading Files guide.

# Using the Audio File

Now that the file is uploaded to the remote system, it can be used in various RPCs, such as `Speak`, `Alert`, and `AlertManeuver`. To use the audio file in an alert, you simply need to construct a `TTSChunk` referring to the file's name.

```
Alert alert = new Alert()
    .setAlertText1("Alert Text 1")
    .setAlertText2("Alert Text 2")
    .setDuration(5000)
    .setTtsChunks(Arrays.asList(new TTSChunk("Audio file name",
SpeechCapabilities.FILE)));
sdlManager.sendRPC(alert);
```

# Setting Up Voice Commands

Voice commands are global commands available anywhere on the head unit to users of your app. Once the user has opened your SDL app (i.e. your SDL app has left the HMI state of `NONE`) they have access to the voice commands you have setup. Your app will be notified when a voice command has been triggered even if the SDL app has been backgrounded.

**NOTE**

The head unit manufacturer will determine how these voice commands are triggered, and some head units will not support voice commands.

**NOTE**

On Manticore, voice commands are viewed and activated by a tab in the right hand section, not through a microphone.

You have the ability to create voice command shortcuts to your Main Menu cells which we highly recommended that you implement. Global voice commands should be created for functions that you wish to make available as voice commands that are **not** available as menu cells. We recommend creating global voice commands for common actions such as the actions performed by your Soft Buttons.

# Creating Voice Commands

To create voice commands, you simply create and set `VoiceCommand` objects to the `voiceCommands` List on the screen manager.

```
VoiceCommand voiceCommand = new
VoiceCommand(Collections.singletonList("Command One"), new
VoiceCommandSelectionListener() {
    @Override
    public void onVoiceCommandSelected() {
        // Handle the VoiceCommand's Selection
    }
});

sdlManager.getScreenManager().setVoiceCommands(Collections.singletonList(voice
```

## Unsupported Voice Commands

The library automatically filters out empty strings and whitespace-only strings from a voice command's list of strings. For example, if a voice command has the following list values: `[" ", "CommandA", "", "Command A"]` the library will filter it to: `["CommandA", "Command A"]`.

If you provide a list of voice commands which only contains empty string and whitespace-only strings across all of the voice commands, the upload request will be aborted and the previous voice commands will remain available.

## Duplicate Strings in Voice Commands

## DUPLICATES BETWEEN DIFFERENT COMMANDS

Voice commands that are sent with duplicate strings in different voice commands, such as:

```
{
        Command1: ["Command A", "Command B"],
        Command2: ["Command B", "Command C"],
        Command3: ["Command D", "Command E"]
}
```

Then the manager will abort the upload request. The previous voice commands will remain available.

## DUPLICATES IN THE SAME COMMAND

If any individual voice command contains duplicate strings, they will be reduced to one. For example, if the voice commands to be sent are:

```
{
        Command1: ["Command A", "Command A", "Command B"],
        Command2: ["Command C", "Command D"]
}
```

Then the manager will strip the duplicates to:

```
{
        Command1: ["Command A", "Command B"],
        Command2: ["Command C", "Command D"]
}
```

# Deleting Voice Commands

To delete previously set voice commands, you just have to set an empty List to the `voiceCommands` List on the screen manager.

```
sdlManager.getScreenManager().setVoiceCommands(Collections.
<VoiceCommand>emptyList());
```

> **NOTE**
>
> Setting voice command strings composed only of whitespace characters will be considered invalid (e.g. `" "`) and your request will be aborted by the module.

# Using RPCs

If you wish to do this without the aid of the screen manager, you can create `AddCommand` objects without the `menuParams` parameter to create global voice commands.

# Getting Microphone Audio

Capturing in-car audio allows developers to interact with users by requesting raw audio data provided to them from the car's microphones. In order to gather the raw audio from the vehicle, you must leverage the `PerformAudioPassThru` RPC.

SDL does not support automatic speech cancellation detection, so if this feature is desired, it is up to the developer to implement. The user may press an "OK" or "Cancel" button, the dialog may timeout, or you may close the dialog with `EndAudioPassThru`.

> **NOTE**
>
> SDL does not support an open microphone. However, SDL is working on wake-word support in the future. You may implement a voice command and start an audio pass thru session when that voice command occurs.

> **NOTE**
>
> Manticore does not currently support the `PerformAudioPassThru` RPC used for getting microphone audio.

# Starting Audio Capture

Before you start an audio capture session you need to find out what audio pass thru capabilities the module supports. You can then use that information to start an audio pass thru session.

## Getting the Supported Capabilities

You must use a sampling rate, bit rate, and audio type supported by the module. Once you have successfully connected to the module, you can access these properties on the `sdlManager.getSystemCapabilityManager` instance.

```
sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.AUDI
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        List<AudioPassThruCapabilities> audioPassThruCapabilities =
(List<AudioPassThruCapabilities>) capability;
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
}, false);
```

The module may return one or multiple supported audio pass thru capabilities. Each capability will have the following properties:

| AUDIO PASS THRU CAPABILITY | PARAMETER NAME | DESCRIPTION |
|---|---|---|
| Sampling Rate | samplingRate | The sampling rate |
| Bits Per Sample | bitsPerSample | The sample depth in bits |
| Audio Type | audioType | The audio type |

## Sending the Audio Capture Request

To initiate audio capture, first construct a `PerformAudioPassThru` request.

```
TTSChunk initialPrompt = new TTSChunk("Ask me What's the weather? or What's 1 plus 2?", SpeechCapabilities.TEXT);

PerformAudioPassThru audioPassThru = new PerformAudioPassThru()
    .setAudioPassThruDisplayText1("Ask me \"What's the weather?\"")
    .setAudioPassThruDisplayText2("or \"What's 1 + 2?\"")
    .setInitialPrompt(Arrays.asList(initialPrompt))
    .setSamplingRate(SamplingRate._22KHZ)
    .setMaxDuration(7000)
    .setBitsPerSample(BitsPerSample._16_BIT)
    .setAudioType(AudioType.PCM)
    .setMuteAudio(false);
audioPassThru.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse (int correlationId, RPCResponse response) {
        switch (response.getResultCode()) {
            case SUCCESS:
                // The audio pass thru ended successfully. Process the audio data
            case ABORTED:
                // The audio pass thru was aborted by the user. You should cancel any usage of the audio data.
            default:
                // Some other error occurred. Handle the error.
        }
    }
});

sdlManager.sendRPC(audioPassThru);
```

## Gathering Audio Data

SDL provides audio data as fast as it can gather it and sends it to the developer in chunks. In order to retrieve this audio data, the developer must observe the `OnAudioPassThru` notification.

> **NOTE**
>
> This audio data is only the current chunk of audio data, so the app is in charge of saving previously retrieved audio data.

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_AUDIO_PASS_THRU, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnAudioPassThru onAudioPassThru = (OnAudioPassThru) notification;
        byte[] dataRcvd = onAudioPassThru.getAPTData();
        // Do something with current audio data
    }
});
```

### FORMAT OF AUDIO DATA

The format of audio data is described as follows:

- It does not include a header (such as a RIFF header) at the beginning.
- The audio sample is in linear PCM format.
- The audio data includes only one channel (i.e. monaural).
- For bit rates of 8 bits, the audio samples are unsigned. For bit rates of 16 bits, the audio samples are signed and are in little-endian.

# Ending Audio Capture

`PerformAudioPassThru` is a request that works in a different way than other RPCs. For most RPCs, a request is followed by an immediate response, with whether that RPC was successful or not. This RPC, however, will only send out the response when the audio pass thru has ended.

Audio capture can be ended four ways:

1. The audio pass thru has timed out.
    - If the audio pass thru surpasses the timeout duration, this request will be ended with a `resultCode` of `SUCCESS`. You should handle the audio pass thru as though it was successful.

2. The audio pass thru was closed due to user pressing "Cancel" (or other head-unit provided cancellation button).
    - If the audio pass thru was displayed, and the user pressed the "Cancel" button, you will receive a `resultCode` of `ABORTED`. You should ignore the audio pass thru.
3. The audio pass thru was closed due to user pressing "Done" (or other head-unit provided completion button).
    - If the audio pass thru was displayed and the user pressed the "Done" button, you will receive a `resultCode` of `SUCCESS`. You should handle the audio pass thru as though it was successful.
4. The audio pass thru was ended due to a request from the app for it to end.
    - If the audio pass thru was displayed, but you have established on your own that you no longer need to capture audio data, you can send an `EndAudioPassThru` RPC. You will receive a `resultCode` of `SUCCESS`. Depending on the reason that you sent the `EndAudioPassThru` RPC, you can choose whether or not to handle the audio pass thru as though it were successful. See Manually Stopping Audio Capture below for more details.

## Manually Stopping Audio Capture

To force stop audio capture, simply send an `EndAudioPassThru` request. Your `PerformAudioPassThru` request will receive response with a `resultCode` of `SUCCESS` when the audio pass thru has ended.

```
EndAudioPassThru endAudioPassThru = new EndAudioPassThru();
endAudioPassThru.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse (int correlationId, RPCResponse response) {
        if (!response.getSuccess()) {
            // There was an error sending the end audio pass thru
            return;
        }

        // The end audio pass thru was sent successfully
    }
});

sdlManager.sendRPC(endAudioPassThru);
```

# Handling the Response

To process the response received from an ended audio capture, make sure that you are listening to the `PerformAudioPassThru` response. If the response has a successful result, all of the audio data for the audio pass thru has been received and is ready for processing.

# Batch Sending RPCs

There are two ways to send multiple requests to the head unit: concurrently and sequentially. Which method you should use depends on the type of RPCs being sent. Concurrently sent requests might finish in a random order and should only be used when none of the requests in the group depend on the response of another, such as when subscribing to several hard buttons. Sequentially sent requests only send the next request in the group when a response has been received for the previously sent RPC. Requests should be sent sequentially when you need to know the result of a previous request before sending the next, like when sending the several different requests needed to create a menu.

Both methods have optional listener that is specific to them, the `OnMultipleRequestListener`. This listener will provide more information than the normal `OnRPCResponseListener`.

# Sending Concurrent Requests

When you send multiple RPCs concurrently, it will not wait for the response of the previous RPC before sending the next one. Therefore, there is no guarantee that responses will be returned in order, and you will not be able to use information sent in a previous RPC for a later RPC.

```
SubscribeButton subscribeButtonLeft = new
SubscribeButton(ButtonName.SEEKLEFT);
SubscribeButton subscribeButtonRight = new
SubscribeButton(ButtonName.SEEKRIGHT);
sdlManager.sendRPCs(Arrays.asList(subscribeButtonLeft, subscribeButtonLeft), new
OnMultipleRequestListener() {
    @Override
    public void onUpdate(int remainingRequests) {

    }

    @Override
    public void onFinished() {

    }

    @Override
    public void onResponse(int correlationId, RPCResponse response) {

    }
});
```

# Sending Sequential Requests

Requests sent sequentially are sent in a set order. The next request is only sent when a response has been received for the previously sent request.

The code example below shows how to create a perform interaction choice set. When creating a perform interaction choice set, the `PerformInteraction` RPC can only be sent after the `CreateInteractionChoiceSet` RPC has been registered by Core, which is why the requests must be sent sequentially.

```
int choiceId = 111, choiceSetId = 222;
Choice choice = new Choice(choiceId, "Choice title");
CreateInteractionChoiceSet createInteractionChoiceSet = new
CreateInteractionChoiceSet(choiceSetId, Collections.singletonList(choice));
PerformInteraction performInteraction = new PerformInteraction("Initial Text",
InteractionMode.MANUAL_ONLY, Collections.singletonList(choiceSetId));
sdlManager.sendSequentialRPCs(Arrays.asList(createInteractionChoiceSet,
performInteraction), new OnMultipleRequestListener() {
    @Override
    public void onUpdate(int i) {

    }

    @Override
    public void onFinished() {

    }

    @Override
    public void onResponse(int i, RPCResponse rpcResponse) {

    }
});
```

# Retrieving Vehicle Data

You can use the `GetVehicleData` and `SubscribeVehicleData` RPC requests to get vehicle data. Each vehicle manufacturer decides which data it will expose and to whom they will expose it. Please check the response from Core to find out which data you will have permission to access. Additionally, be aware that the user may have the ability to disable vehicle data access through the settings menu of their head unit. It may be possible to access vehicle data when the `hmiLevel` is `NONE` (i.e. the user has not

opened your SDL app) but you will have to request this permission from the vehicle manufacturer.

> **NOTE**
>
> You will only have access to vehicle data that is allowed to your `appName` and `appId` combination. Permissions will be granted by each OEM separately. See Understanding Permissions for more details.

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Acceleration Pedal Position | accPedalPosition | Accelerator pedal position (percentage depressed) | | |
| Airbag Status | airbagStatus | Status of each of the airbags in the vehicle: yes, no, no event, not supported, fault | | |
| Belt Status | beltStatus | The status of each of the seat belts: no, yes, not supported, fault, or no event | | |
| Body Information | bodyInformation | Door ajar status for each door. Roof status. Trunk & hood Status. The Ignition status. The ignition stable status. The park brake active status | | |
| Climate Data | climateData | Information about cabin temperature, atmospheric pressure, and external temperature | RPC v7.1+ | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Cloud App Vehicle Id | cloudAppVehicleID | The id for the vehicle when connecting to cloud applications | RPC v5.1+ | |
| Cluster Mode Status | clusterModeStatus | Whether or not the power mode is active. The power mode qualification status: power mode undefined, power mode evaluation in progress, not defined, power mode ok. The car mode status: normal, factory, transport, or crash. The power mode status: key out, key recently out, key approved, post accessory, accessory, post ignition, ignition on, running, crank | | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Device Status | deviceStatus | Contains information about the smartphone device. Is voice recognition on or off, has a bluetooth connection been established, is a call active, is the phone in roaming mode, is a text message available, the battery level, the status of the mono and stereo output channels, the signal level, the primary audio source, whether or not an emergency call is currently taking place | | |
| Driver Braking | driverBraking | The status of the brake pedal: yes, no, no event, fault, not supported | | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| E-Call Information | eCallInfo | Information about the status of an emergency call | | |
| Electronic Parking Brake Status | electronicParkingBrakeStatus | The status of the electronic parking brake. Available states: closed, transition, open, drive active, fault | RPC v5.0+ | |
| Emergency event | emergencyEvent | The type of emergency: frontal, side, rear, rollover, no event, not supported, fault. Fuel cutoff status: normal operation, fuel is cut off, fault. The roll over status: yes, no, no event, not supported, fault. The maximum change in velocity. Whether or not multiple emergency events have occurred | | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Engine Oil Life | engineOilLife | The estimated percentage (0% - 100%) of remaining oil life of the engine | RPC v5.0+ | |
| Engine Torque | engineTorque | Torque value for engine (in Nm) on non-diesel variants | | |
| External Temperature | externalTemperature | The external temperature in degrees celsius | | RPC v7.1 |
| Fuel Level | fuelLevel | The fuel level in the tank (percentage) | | RPC v7.0 |
| Fuel Level State | fuelLevel_State | The fuel level state: Unknown, Normal, Low, Fault, Alert, or Not Supported | | RPC v7.0 |
| Fuel Range | fuelRange | The estimate range in KM the vehicle can travel based on fuel level and consumption. As of RPC 7.0, this also contains Fuel Level and Fuel Level State information. | RPC v5.0+ | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Gear Status | gearStatus | Includes information about the transmission, the user's selected gear, and the actual gear of the vehicle. | RPC v7.0+ | |
| GPS | gps | Longitude and latitude, current time in UTC, degree of precision, altitude, heading, speed, satellite data vs dead reckoning, and supported dimensions of the GPS | | |
| Hands Off Steering | handsOffSteering | Status of hands on steering wheels capability | RPC v7.0+ | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Head Lamp Status | headLampStatus | Status of the head lamps: whether or not the low and high beams are on or off. The ambient light sensor status: night, twilight 1, twilight 2, twilight 3, twilight 4, day, unknown, invalid | | |
| Instant Fuel Consumption | instantFuelConsumption | The instantaneous fuel consumption in microlitres | | |
| My Key | myKey | Information about whether or not the emergency 911 override has been activated | | |
| Odometer | odometer | Odometer reading in km | | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| PRNDL | prndl | The selected gear the car is in: park, reverse, neutral, drive, sport, low gear, first, second, third, fourth, fifth, sixth, seventh or eighth gear, unknown, or fault | | RPC v7.0 |
| RPM | rpm | The number of revolutions per minute of the engine | | |
| Seat Occupancy | seatOccupancy | The status of the seats that show whether each seat is occupied and belted or not | RPC v7.1+ | |
| Speed | speed | Speed in KPH | | |
| Stability Control Status | stabilityControlsStatus | Status of the vehicle's stability control and trailer sway control | RPC v7.0+ | |
| Steering Wheel Angle | steeringWheelAngle | Current angle of the steering wheel (in degrees) | | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Tire Pressure | tirePressure | Tire status of each wheel in the vehicle: normal, low, fault, alert, or not supported. Warning light status for the tire pressure: off, on, flash, or not used | | |
| Turn Signal | turnSignal | The status of the turn signal. Available states: off, left, right, both | RPC v5.0+ | |
| VIN | vin | The Vehicle Identification Number | | |
| Window Status | windowStatus | An array of window locations and approximate position | RPC v7.0+ | |

| VEHICLE DATA | PARAMETER NAME | DESCRIPTION | RPC VERSION | DEPRECATED |
|---|---|---|---|---|
| Wiper Status | wiperStatus | The status of the wipers: off, automatic off, off moving, manual interaction off, manual interaction on, manual low, manual high, manual flick, wash, automatic low, automatic high, courtesy wipe, automatic adjust, stalled, no data exists | | |

# One-Time Vehicle Data Retrieval

To get vehicle data a single time, use the `GetVehicleData` RPC.

```
GetVehicleData vdRequest = new GetVehicleData()
    .setGearStatus(true);
vdRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            GearStatus gearStatus = ((GetVehicleDataResponse)
response).getGearStatus();
            DebugTool.logInfo("SdlService", "GearStatus: " + gearStatus.toString());
        } else {
            DebugTool.logInfo("SdlService", "GetVehicleData was rejected.");
        }
    }
});
sdlManager.sendRPC(vdRequest);
```

# Subscribing to Vehicle Data

Subscribing to vehicle data allows you to get notifications whenever new data is available. You should not rely upon getting this data in a consistent manner. New vehicle data is available roughly every second but notification timing can vary between modules.

**First**, you should add a notification listener for the `OnVehicleData` notification:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_VEHICLE_DATA, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnVehicleData onVehicleDataNotification = (OnVehicleData) notification;
        if (onVehicleDataNotification.getGearStatus() != null) {
            DebugTool.logInfo("SdlService", "GearStatus was updated to: " +
onVehicleDataNotification.getGearStatus());
        }
    }
});
```

**Second**, send the `SubscribeVehicleData` request:

```
SubscribeVehicleData subscribeRequest = new SubscribeVehicleData()
        .setGearStatus(true);
subscribeRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            DebugTool.logInfo("SdlService", "Successfully subscribed to vehicle data.");
        } else {
            DebugTool.logInfo("SdlService", "Request to subscribe to vehicle data was
rejected.");
        }
    }
});
sdlManager.sendRPC(subscribeRequest);
```

**Third**, the `onNotified` method will be called when there is an update to the subscribed vehicle data.

# Unsubscribing from Vehicle Data

We suggest that you only subscribe to vehicle data as needed. To stop listening to specific vehicle data use the `UnsubscribeVehicleData` RPC.

```
UnsubscribeVehicleData unsubscribeRequest = new UnsubscribeVehicleData()
        .setGearStatus(true); // unsubscribe to GearStatus data
unsubscribeRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            DebugTool.logInfo("SdlService", "Successfully unsubscribed to vehicle data.");
        } else {
            DebugTool.logInfo("SdlService", "Request to unsubscribe to vehicle data was
rejected.");
        }
    }
});
sdlManager.sendRPC(unsubscribeRequest);
```

# OEM-Specific Vehicle Data

OEM applications can access additional vehicle data published by their systems that is not available via the SDL vehicle data APIs. This data is accessed using the same SDL vehicle data RPCs, but instead of requesting a certain type of SDL-specified data, you must request data using a custom vehicle data name. The type of object returned is up to the OEM and must be parsed manually.

> **NOTE**
>
> This feature is only for OEM-created applications and is not permitted for 3rd-party use.

## Requesting One-Time OEM-Specific Vehicle Data

Below is an example of requesting a custom piece of vehicle data with the name `OEM-X-Vehicle-Data`. To adapt this for subscriptions instead, you must look at the section **Subscribing to Vehicle Data** above and adapt the example for subscribing to custom vehicle data based on what you see in the examples below.

```
GetVehicleData vdRequest = new GetVehicleData()
    .setOEMCustomVehicleData("OEM-X-Vehicle-Data", true);
vdRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            Object CustomData = ((GetVehicleDataResponse)
response).getOEMCustomVehicleData("OEM-X-Vehicle-Data");
        } else {
            DebugTool.logInfo("SdlService", "GetVehicleData was rejected.");
        }
    }
});
sdlManager.sendRPC(vdRequest);
```

# Remote Control Vehicle Features

The remote control framework allows apps to control modules such as climate, radio, seat, lights, etc., within a vehicle. Newer head units can support multi-zone modules that

allow customizations based on seat location.

> **NOTE**
>
> If you are using this feature in your app, you will most likely need to request permission from the vehicle manufacturer. Not all head units support the remote control framework and only the newest head units will support multi-zone modules.

# Why Use Remote Control?

Consider the following scenarios:

- A radio application wants to use the in-vehicle radio tuner. It needs the functionality to select the radio band (AM/FM/XM/HD/DAB), tune the radio frequency or change the radio station, as well as obtain general radio information for decision making.
- A climate control application needs to turn on the AC, control the air circulation mode, change the fan speed and set the desired cabin temperature.
- A user profile application wants to remember users' favorite settings and apply it later automatically when the users get into the same/another vehicle.

## Supported Modules

Currently, the remote control feature supports these modules:

| REMOTE CONTROL MODULES | RPC VERSION |
| --- | --- |
| Climate | v4.5+ |
| Radio | v4.5+ |
| Seat | v5.0+ |
| Audio | v5.0+ |
| Light | v5.0+ |
| HMI Settings | v5.0+ |

The following table lists which items are in each control module.

## CLIMATE

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Climate Enable | climateEnable | on, off | Get/Set/Notification | Enabled to turn on the climate system, Disabled to turn off the climate system. All other climate items need climate enabled to work. | Since v6.0 |
| Current Cabin Temperature | currentTemperature | N/A | Get/Notification | Read only, value range depends on OEM | Since v4.5 |
| Desired Cabin Temperature | desiredTemperature | N/A | Get/Set/Notification | Value range depends on OEM | Since v4.5 |
| AC Setting | acEnable | on, off | Get/Set/Notification | | Since v4.5 |
| AC MAX Setting | acMaxEnable | on, off | Get/Set/Notification | | Since v4.5 |
| Air Recirculation Setting | circulateAirEnable | on, off | Get/Set/Notification | | Since v4.5 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Auto AC Mode Setting | autoModeEnable | on, off | Get/Set/Notification | | Since v4.5 |
| Defrost Zone Setting | defrostZone | front, rear, all, none | Get/Set/Notification | | Since v4.5 |
| Dual Mode Setting | dualModeEnable | on, off | Get/Set/Notification | | Since v4.5 |
| Fan Speed Setting | fanSpeed | 0%-100% | Get/Set/Notification | | Since v4.5 |
| Ventilation Mode Setting | ventilationMode | upper, lower, both, none | Get/Set/Notification | | Since v4.5 |
| Heated Steering Wheel Enabled | heatedSteeringWheelEnable | on, off | Get/Set/Notification | | Since v5.0 |
| Heated Windshield Enabled | heatedWindshieldEnable | on, off | Get/Set/Notification | | Since v5.0 |
| Heated Rear Window Enabled | heatedRearWindowEnable | on, off | Get/Set/Notification | | Since v5.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Heated Mirrors Enabled | heatedMirrorsEnable | on, off | Get/Set/Notification | | Since v5.0 |

## RADIO

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Radio Enabled | radioEnable | true, false | Get/Set/Notification | Read only, all other radio control items need radio enabled to work | Since v4.5 |
| Radio Band | band | AM, FM, XM | Get/Set/Notification | | Since v4.5 |
| Radio Frequency | frequencyInteger / frequencyFraction | 0-1710, 0-9 | Get/Set/Notification | Value range depends on band | Since v4.5 |
| Radio RDS Data | rdsData | RdsData struct | Get/Notification | Read only | Since v4.5 |
| Available HD Channels | availableHdChannels | Array size 0-8, values 0-7 | Get/Notification | Read only | Since v6.0, replaces availableHDs |
| Available HD Channels (DEPRECATED) | availableHDs | 1-7 (Deprecated in v6.0) (1-3 before v5.0) | Get/Notification | Read only | Since v4.5, updated in v5.0, deprecated in v6.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Current HD Channel | hdChannel | 0-7 (1-3 before v.5.0) (1-7 between v.5.0-6.0) | Get/Set/Notification | | Since v4.5, updated in v5.0, updated in v6.0 |
| Radio Signal Strength | signalStrength | 0-100% | Get/Notification | Read only | Since v4.5 |
| Signal Change Threshold | signalStrengthThreshold | 0-100% | Get/Notification | Read only | Since v4.5 |
| Radio State | state | Acquiring, acquired, multicast, not_found | Get/Notification | Read only | Since v4.5 |
| SIS Data | sisData | SisData struct | Get/Notification | Read only | Since v5.0 |

## SEAT

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Seat Heating Enabled | heatingEnabled | true, false | Get/Set/Notification | Indicates whether heating is enabled for a seat | Since v5.0 |
| Seat Cooling Enabled | coolingEnabled | true, false | Get/Set/Notification | Indicates whether cooling is enabled for a seat | Since v5.0 |
| Seat Heating level | heatingLevel | 0-100% | Get/Set/Notification | Level of the seat heating | Since v5.0 |
| Seat Cooling level | coolingLevel | 0-100% | Get/Set/Notification | Level of the seat cooling | Since v5.0 |
| Seat Horizontal Position | horizontalPosition | 0-100% | Get/Set/Notification | Adjust a seat forward/backward, 0 means the nearest position to the steering wheel, 100% means the furthest position from the steering wheel | Since v5.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Seat Vertical Position | verticalPosition | 0-100% | Get/Set/Notification | Adjust seat height (up or down) in case there is only one actuator for seat height, 0 means the lowest position, 100% means the highest position | Since v5.0 |
| Seat-Front Vertical Position | frontVerticalPosition | 0-100% | Get/Set/Notification | Adjust seat front height (in case there are two actuators for seat height), 0 means the lowest position, 100% means the highest position | Since v5.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Seat-Back Vertical Position | backVertical Position | 0-100% | Get/Set/Notification | Adjust seat back height (in case there are two actuators for seat height), 0 means the lowest position, 100% means the highest position | Since v5.0 |
| Seat Back Tilt Angle | backTiltAngle | 0-100% | Get/Set/Notification | Backrest recline, 0 means the angle that back top is nearest to the steering wheel, 100% means the angle that back top is furthest from the steering wheel | Since v5.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Head Support Horizontal Position | headSupportHorizontalPosition | 0-100% | Get/Set/Notification | Adjust head support forward/backward, 0 means the nearest position to the front, 100% means the furthest position from the front | Since v5.0 |
| Head Support Vertical Position | headSupportVerticalPosition | 0-100% | Get/Set/Notification | Adjust head support height (up or down), 0 means the lowest position, 100% means the highest position | Since v5.0 |
| Seat Massaging Enabled | massageEnabled | true, false | Get/Set/Notification | Indicates whether massage is enabled for a seat | Since v5.0 |
| Massage Mode | massageMode | MassageModeData struct | Get/Set/Notification | List of massage mode of each zone | Since v5.0 |

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Massage Cushion Firmness | massageCushionFirmness | MassageCushionFirmness struct | Get/Set/Notification | List of firmness of each massage cushion | Since v5.0 |
| Seat memory | memory | SeatMemoryAction struct | Get/Set/Notification | Seat memory | Since v5.0 |

## AUDIO

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Audio Volume | volume | 0%-100% | Get/Set/Notification | The audio source volume level | Since SDL v5.0 |
| Audio Source | source | PrimaryAudioSource enum | Get/Set/Notification | Defines one of the available audio sources | Since SDL v5.0 |
| Keep Context | keepContext | true, false | Set only | Controls whether the HMI will keep the current application context or switch to the default media UI/APP associated with the audio source | Since SDL v5.0 |
| Equalizer Settings | equalizerSettings | EqualizerSettings struct | Get/Set/Notification | Defines the list of supported channels (band) and their current/desired settings on HMI | Since SDL v5.0 |

## LIGHT

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Light State | lightState | Array of LightState struct | Get/Set/Notification | | Since SDL v5.0 |

## HMI SETTINGS

| CONTROL ITEM | RPC ITEM NAME | VALUE RANGE | TYPE | COMMENTS | RPC VERSION CHANGES |
|---|---|---|---|---|---|
| Display Mode | displayMode | Day, Night, Auto | Get/Set/Notification | Current display mode of the HMI display | Since SDL v5.0 |
| Distance Unit | distanceUnit | Miles, Kilometers | Get/Set/Notification | Distance Unit used in the HMI (for maps/tracking distances) | Since SDL v5.0 |
| Temperature Unit | temperatureUnit | Fahrenheit, Celsius | Get/Set/Notification | Temperature Unit used in the HMI (for temperature measuring systems) | Since SDL v5.0 |

# Remote Control Button Presses

The remote control framework also allows mobile applications to send simulated button press events for the following common buttons in the vehicle.

| RC MODULE | CONTROL BUTTON |
| --- | --- |
| **Climate** | AC |
| | AC MAX |
| | RECIRCULATE |
| | FAN UP |
| | FAN DOWN |
| | TEMPERATURE UP |
| | TEMPERATURE DOWN |
| | DEFROST |
| | DEFROST REAR |
| | DEFROST MAX |
| | UPPER VENT |
| | LOWER VENT |
| **Radio** | VOLUME UP |
| | VOLUME DOWN |
| | EJECT |
| | SOURCE |

| RC MODULE | CONTROL BUTTON |
| --- | --- |
| | SHUFFLE |
| | REPEAT |

# Integration

For remote control to work, the head unit must support SDL RPC v4.4+. In addition, your app's `appHMIType` must include `REMOTE_CONTROL`.

## Multiple Modules (RPC v6.0+)

Each module type can have multiple modules in RPC v6.0+. In previous versions, only one module was available for each module type. A specific module is controlled using the unique id assigned to the module. When sending remote control RPCs to a RPC v6.0+ head unit, the `moduleInfo.moduleId` must be stored and provided to control the desired module. If no `moduleId` is set, the HMI will use the default module of that module type. When connected to <6.0 systems, the `moduleInfo` struct will be `null`, and only the default module will be available for control.

## Getting Remote Control Module Information

Prior to using any remote control RPCs, you must check that the head unit has the remote control capability. As you will encounter head units that do *not* support remote control, or head units that do not give your application permission to read and write remote control data, this check is important.

> **NOTE**
>
> This check can be performed once your SDL app has left the HMI state of `NONE`. More information on how to monitor the HMI status can be found in the Understanding Permissions guide.

When connected to head units supporting RPC v6.0+, you should save this information for future use. The `moduleId` contained within the `moduleInfo` struct on each capability is necessary to control that module.

```
sdlManager.getSystemCapabilityManager().addOnSystemCapabilityListener(SystemC
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        RemoteControlCapabilities remoteControlCapabilities =
(RemoteControlCapabilities) capability;
        // Save the remote control capabilities
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
});
```

## GETTING MODULE DATA LOCATION AND SERVICE AREAS (RPC V6.0+)

With the saved remote control capabilities struct you can get the location of the each module and the area that it services. This will map to the `grid` graphic below. This information is useful for creating a custom UI.

> **NOTE**
>
> This data is only available when connected to SDL RPC v6.0+ systems. On previous systems, only one module per module type was available, so the module's location didn't matter. You will not be able to build a custom UI for those cases and should use a generic UI instead.

```
// Get the first climate module's information
ClimateControlCapabilities firstClimateModule =
remoteControlCapabilities.getClimateControlCapabilities().get(0);

String climateModuleId = firstClimateModule.getModuleInfo().getModuleId();
Grid climateModuleLocation =
firstClimateModule.getModuleInfo().getModuleLocation();
```

You can also get an array of seats in the `SeatLocationCapability.seats` array. Each `SeatLocation` object within the `seats` array will have a `grid` parameter. The `grid` will tell you the location of that particular seat in the vehicle (See the graphic below).

```
sdlManager.getSystemCapabilityManager().addOnSystemCapabilityListener(SystemC
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        SeatLocationCapability seatLocationCapability = (SeatLocationCapability)
capability;
        if (seatLocationCapability.getSeats() != null &&
seatLocationCapability.getSeats().size() > 0){
            List<SeatLocation> seats = seatLocationCapability.getSeats();
                // Save seat location capabilities
        }
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
});
```

## The Grid

The `grid` system starts with the front left corner of the bottom level of the vehicle being `(col=0, row=0, level=0)`. For example, assuming a vehicle manufactured for sale in the United States with three seats in the backseat, `(0, 0, 0)` would be the drivers' seat. The front passenger location would be at `(2, 0, 0)` and the rear middle seat would be at `(1, 1, 0)`. The `colspan` and `rowspan` properties tell you how many rows and columns that module or seat takes up. The `level` property tells you how many decks the vehicle has (i.e. a double-decker bus would have 2 levels).

Col+
Row+
(0,0,0)
(2,0,0)
(0,1,0)
(2,1,0)

| | COL=0 | COL=1 | COL=2 |
|---|---|---|---|
| row=0 | driver's seat: {col=0, row=0, level=0, colspan=1, rowspan=1, levelspan=1} | | front passenger's seat : {col=2, row=0, level=0, colspan=1, rowspan=1, levelspan=1} |
| row=1 | rear-left seat : {col=0, row=1, level=0, colspan=1, rowspan=1, levelspan=1} | rear-middle seat : {col=1, row=1, level=0, colspan=1, rowspan=1, levelspan=1} | rear-right seat : {col=2, row=1, level=0, colspan=1, rowspan=1, levelspan=1} |

## Getting Module Data

Seat location does not affect the ability to get data from a module. Once you know you have permission to use the remote control feature and you have `moduleId`s (when connected to RPC v6.0+ systems), you can retrieve the data for any module. The following code is an example of how to subscribe to the data of a climate module.

When connected to head units that only support RPC versions older than v6.0, there can only be one module for each module type (e.g. there can only be one climate module, light module, radio module, etc.), so you will not need to pass a `moduleId`.

### SUBSCRIBING TO MODULE DATA

You can either subscribe to module data or receive it one time. If you choose to subscribe to module data you will receive continuous updates on the vehicle data you have subscribed to.

> **NOTE**
>
> Subscribing to the `OnInteriorVehicleData` notification must be done before sending the `GetInteriorVehicleData` request.

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_INTERIOR_VEHICLE_DATA
 new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnInteriorVehicleData onInteriorVehicleData = (OnInteriorVehicleData)
notification;
        if (onInteriorVehicleData != null){
            // NOTE: If you subscribe to multiple modules, all the data will be sent here.
You will have to
            // split it out based on
`onInteriorVehicleData.getModuleData().getModuleType()` yourself.
            // Code
        }
    }
});
```

After you subscribe to the `InteriorVehicleDataNotification` you must also subscribe to the module you wish to receive updates for. Subscribing to a module will send a notification when that particular module is changed.

RPC < v6.0

```
GetInteriorVehicleData getInteriorVehicleData = new
GetInteriorVehicleData(ModuleType.CLIMATE)
    .setSubscribe(true);
getInteriorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // This can now be used to retrieve data
        <#Code#>
    }
});
sdlManager.sendRPC(getInteriorVehicleData);
```

RPC v6.0+

```
GetInteriorVehicleData getInteriorVehicleData = new
GetInteriorVehicleData(ModuleType.CLIMATE)
    .setModuleId(moduleID)
    .setSubscribe(true);
getInteriorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // This can now be used to retrieve data
        // Code
    }
});
sdlManager.sendRPC(getInteriorVehicleData);
```

After you subscribe to the `InteriorVehicleDataNotification` you must also subscribe to the module you wish to receive updates for. Subscribing to a module will send a notification when that particular module is changed.

## GETTING ONE-TIME DATA

To get data from a module without subscribing send a `GetInteriorVehicleData` request with the `subscribe` flag set to `false`.

RPC < v6.0

```
GetInteriorVehicleData interiorVehicleData = new
GetInteriorVehicleData(ModuleType.CLIMATE);
interiorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // This can now be used to retrieve data
        // Code
    }
});
sdlManager.sendRPC(interiorVehicleData);
```

RPC 6.0+

```
GetInteriorVehicleData interiorVehicleData = new
GetInteriorVehicleData(ModuleType.CLIMATE)
    .setModuleId("<#ModuleID#>");
interiorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // This can now be used to retrieve data
        // Code
    }
});
sdlManager.sendRPC(interiorVehicleData);
```

## Setting Module Data

Not only do you have the ability to get data from these modules, but, if you have the right permissions, you can also set module data.

### SETTING THE USER'S SEAT (RPC V6.0+)

Before you attempt to take control of any module, you should have your user select their seat location as this affects which modules they have permission to control. You may wish to show the user a map or list of all available seats in your app in order to ask them where they are located. See Getting Module Data Location and Service Areas for information useful in creating a custom UI showing module location and service area. The following example is only meant to show you how to access the available data and not how to build your UI/UX.

When the user selects their seat, you must send an `SetGlobalProperties` RPC with the appropriate `userLocation` property in order to update that user's location within the vehicle (The default seat location is `Driver`).

```
SetGlobalProperties seatLocation = new SetGlobalProperties()
    .setUserLocation(selectedSeat);
seatLocation.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Seat location updated
    }
});
sdlManager.sendRPC(seatLocation);
```

## GETTING CONSENT TO CONTROL A MODULE (RPC V6.0+)

Some OEMs may wish to ask the driver for consent before a user can control a module. The `GetInteriorVehicleDataConsent` RPC will alert the driver in some OEM head units if the module is not free (another user has control) and `allowMultipleAccess` (multiple users can access/set the data at the same time) is `true`. The `allowMultipleAccess` property is part of the `moduleInfo` in the module object.

Check the `allowed` property in the `GetInteriorVehicleDataConsentResponse` to see what modules can be controlled. Note that the order of the `allowed` array is 1-1 with the `moduleIds` array you passed into the `GetInteriorVehicleDataConsent` RPC.

### NOTE

You should always try to get consent before setting any module data. If consent is not granted you should not attempt to set any module's data.

```
GetInteriorVehicleDataConsent getInteriorVehicleDataConsent = new
GetInteriorVehicleDataConsent(moduleType, moduleIDs);
getInteriorVehicleDataConsent.setOnRPCResponseListener(new
OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        GetInteriorVehicleDataConsentResponse
getInteriorVehicleDataConsentResponse =
(GetInteriorVehicleDataConsentResponse) response;
        List<Boolean> allowed =
getInteriorVehicleDataConsentResponse.getAllowances();
        // Allowed is an array of true or false values
    }
});
sdlManager.sendRPC(getInteriorVehicleDataConsent);
```

## CONTROLLING A MODULE

Below is an example of setting climate control data. It is likely that you will not need to set all the data as in the code example below. When connected to RPC v6.0+ systems, you must set the `moduleId` in `SetInteriorVehicleData.setModuleData`. When connected to < v6.0 systems, there is only one module per module type, so you must only pass the type of the module you wish to control.

When you received module information above in **Getting Remote Control Module Information** on RPC v6.0+ systems, you received information on the `location` and `serviceArea` of the module. The permission area of a module depends on that `serviceArea`. The `location` of a module is like the `seats` array: it maps to the `grid` to tell you the physical location of a particular module. The `serviceArea` maps to the grid to show how far that module's scope reaches.

For example, a radio module usually serves all passengers in the vehicle, so its service area will likely cover the entirety of the vehicle grid, while a climate module may only cover a passenger area and not the driver or the back row. If a `serviceArea` is not included, it is assumed that the `serviceArea` is the same as the module's `location`. If neither is included, it is assumed that the `serviceArea` covers the whole area of the vehicle. If a user is not sitting within the `serviceArea`'s `grid`, they will not receive permission to control that module (attempting to set data will fail).

RPC < v6.0

```
Temperature temp = new Temperature(TemperatureUnit.FAHRENHEIT, 74.1f);

ClimateControlData climateControlData = new ClimateControlData()
    .setAcEnable(true)
    .setAcMaxEnable(true)
    .setAutoModeEnable(false)
    .setCirculateAirEnable(true)
    .setCurrentTemperature(temp)
    .setDefrostZone(DefrostZone.FRONT)
    .setDualModeEnable(true)
    .setFanSpeed(2)
    .setVentilationMode(VentilationMode.BOTH)
    .setDesiredTemperature(temp);

ModuleData moduleData = new ModuleData(ModuleType.CLIMATE)
    .setClimateControlData(climateControlData);

SetInteriorVehicleData setInteriorVehicleData = new
SetInteriorVehicleData(moduleData);
setInteriorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Code
    }
});
sdlManager.sendRPC(setInteriorVehicleData);
```

RPC 6.0+

```
Temperature temp = new Temperature(TemperatureUnit.FAHRENHEIT, 74.1f);

ClimateControlData climateControlData = new ClimateControlData()
    .setAcEnable(true)
    .setAcMaxEnable(true)
    .setAutoModeEnable(false)
    .setCirculateAirEnable(true)
    .setCurrentTemperature(temp)
    .setDefrostZone(DefrostZone.FRONT)
    .setDualModeEnable(true)
    .setFanSpeed(2)
    .setVentilationMode(VentilationMode.BOTH)
    .setDesiredTemperature(temp);

ModuleData moduleData = new ModuleData(ModuleType.CLIMATE)
    .setModuleId(moduleId)
    .setClimateControlData(climateControlData);

SetInteriorVehicleData setInteriorVehicleData = new
SetInteriorVehicleData(moduleData);
setInteriorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Code
    }
});
sdlManager.sendRPC(setInteriorVehicleData);
```

## BUTTON PRESSES

Another unique feature of remote control is the ability to send simulated button presses to the associated modules, imitating a button press on the hardware itself. Simply specify the module, the button, and the type of press you would like to simulate.

RPC < 6.0

```
ButtonPress buttonPress = new ButtonPress(ModuleType.CLIMATE,
ButtonName.EJECT, ButtonPressMode.SHORT);
buttonPress.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Code
    }
});
sdlManager.sendRPC(buttonPress);
```

RPC 6.0+

```
ButtonPress buttonPress = new ButtonPress(ModuleType.CLIMATE,
ButtonName.EJECT, ButtonPressMode.SHORT)
    .setModuleId("<#ModuleID#>");
buttonPress.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Code
    }
});
sdlManager.sendRPC(buttonPress);
```

## RELEASING THE MODULE (RPC V6.0+)

When the user no longer needs control over a module, you should release the module so other users can control it. If you do not release the module, other users who would otherwise be able to control the module may be rejected from doing so.

```
ReleaseInteriorVehicleDataModule releaseInteriorVehicleDataModule = new
ReleaseInteriorVehicleDataModule(<#ModuleType#>)
    .setModuleId(moduleID);
releaseInteriorVehicleDataModule.setOnRPCResponseListener(new
OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Module Was Released
    }
});
sdlManager.sendRPC(releaseInteriorVehicleDataModule);
```

# Creating an App Service (RPC v5.1+)

App services is a powerful feature enabling both a new kind of vehicle-to-app communication and app-to-app communication via SDL.

App services are used to publish navigation, weather and media data (such as temperature, navigation waypoints, or the current playlist name). This data can then be used by both the vehicle head unit and, if the publisher of the app service desires, other SDL apps.

Vehicle head units may use these services in various ways. One app service for each type will be the "active" service to the module. For media, for example, this will be the media app that the user is currently using or listening to. For navigation, it would be a navigation app that the user is using to navigate. For weather, it may be the last used weather app, or a user-selected default. The system may then use that service's data to perform various actions (such as navigating to an address with the active service or to display the temperature as provided from the active weather service).

An SDL app can also subscribe to a published app service. Once subscribed, the app will be sent the new data when the app service publisher updates its data. To find out more about how to subscribe to an app service check out the Using App Services guide.

Subscribed apps can also send certain RPCs and generic URI-based actions (see the section Supporting Service RPCs and Actions below) to your service.

Currently, there is no high-level API support for publishing an app service, so you will have to use raw RPCs for all app service related APIs.

Using an app service is covered in another guide.

# App Service Types

Apps are able to declare that they provide an app service by publishing an app service manifest. Three types of app services are currently available and more will be made available over time. The currently available types are: Media, Navigation, and Weather. An app may publish multiple services (one for each of the different service types) if desired.

# Publishing an App Service

Publishing a service is a multi-step process. First, you need to create your app service manifest. Second, you will publish your app service to the module. Third, you will publish the service data using `OnAppServiceData`. Fourth, you must listen for data requests and respond accordingly. Fifth, if your app service supports handling of RPCs related to your service you must listen for these RPC requests and handle them accordingly. Sixth, optionally, you can support URI-based app actions. Finally, if necessary, you can you update or delete your app service manifest.

## 1. Creating an App Service Manifest

The first step to publishing an app service is to create an `AppServiceManifest` object. There is a set of generic parameters you will need to fill out as well as service type specific parameters based on the app service type you are creating.

```
AppServiceManifest manifest = new
AppServiceManifest(AppServiceType.MEDIA.toString())
    .setServiceName("My Media App") // Must be unique across app services.
    .setServiceIcon(new Image("Service Icon Name", ImageType.DYNAMIC)) //
Previously uploaded service icon. This could be the same as your app icon.
    .setAllowAppConsumers(true) // Whether or not other apps can view your data in
addition to the head unit. If set to `false` only the head unit will have access to this
data.
    .setRpcSpecVersion(new SdlMsgVersion(5,0)) // An *optional* parameter that
limits the RPC spec versions you can understand to the provided version *or below*.
    .setHandledRpcs(List<FunctionID>) // If you add function ids to this *optional*
parameter, you can support newer RPCs on older head units (that don't support those
RPCs natively) when those RPCs are sent from other connected applications.
    .setMediaServiceManifest(mediaManifest); // Covered Below
```

## CREATING A MEDIA SERVICE MANIFEST

Currently, there's no information you have to provide in your media service manifest! You'll just have to create an empty media service manifest and set it into your general app service manifest.

```
MediaServiceManifest mediaManifest = new MediaServiceManifest();
manifest.setMediaServiceManifest(mediaManifest);
```

## CREATING A NAVIGATION SERVICE MANIFEST

You will need to create a navigation manifest if you want to publish a navigation service. You will declare whether or not your navigation app will accept waypoints. That is, if your app will support receiving *multiple* points of navigation (e.g. go to this McDonalds, then this Walmart, then home).

```
NavigationServiceManifest navigationManifest = new NavigationServiceManifest();
navigationManifest.setAcceptsWayPoints(true);
manifest.setNavigationServiceManifest(navigationManifest);
```

### CREATING A WEATHER SERVICE MANIFEST

You will need to create a weather service manifest if you want to publish a weather service. You will declare the types of data your service provides in its `WeatherServiceData`.

```
WeatherServiceManifest weatherManifest = new WeatherServiceManifest()
    .setCurrentForecastSupported(true)
    .setMaxMultidayForecastAmount(10)
    .setMaxHourlyForecastAmount(24)
    .setMaxMinutelyForecastAmount(60)
    .setWeatherForLocationSupported(true);
manifest.setWeatherServiceManifest(weatherManifest);
```

## 2. Publish Your Service

Once you have created your service manifest, publishing your app service is simple.

```
PublishAppService publishServiceRequest = new PublishAppService()
    .setAppServiceManifest(manifest);
publishServiceRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            // Use the response
        } else {
            // Error Handling
        }

    }
});
sdlManager.sendRPC(publishServiceRequest);
```

Once you have your publish app service response, you will need to store the information provided in its `appServiceRecord` property. You will need the information later when you want to update your service's data.

### WATCHING FOR APP RECORD UPDATES

As noted in the introduction to this guide, one service for each type may become the "active" service. If your service is the active service, your `AppServiceRecord` parameter `serviceActive` will be updated to note that you are now the active service.

After the initial app record is passed to you in the `PublishAppServiceResponse`, you will need to be notified of changes in order to observe whether or not you have become the active service. To do so, you will have to observe the new `SystemCapabilityType.APP_SERVICES` using `GetSystemCapability` and `OnSystemCapabilityUpdated`.

For more information, see the Using App Services guide and go to the **Getting and Subscribing to Services** section.

## 3. Update Your Service's Data

After your service is published, it's time to update your service data. First, you must send an `onAppServiceData` RPC notification with your updated service data. RPC notifications

are different than RPC requests in that they will not receive a response from the connected head unit .

> **NOTE**
>
> You should only update your service's data when you are the active service; service consumers will only be able to see your data when you are the active service.

First, you will have to create an `MediaServiceData` , `NavigationServiceData` or `WeatherServiceData` object with your service's data. Then, add that service-specific data object to an `AppServiceData` object. Finally, create an `OnAppServiceData` notification, append your `AppServiceData` object, and send it.

## MEDIA SERVICE DATA

```
MediaServiceData mediaData = new MediaServiceData()
    .setMediaTitle("Some media title")
    .setMediaArtist("Some media artist")
    .setMediaAlbum("Some album")
    .setMediaImage(new Image("Some image", ImageType.DYNAMIC))
    .setPlaylistName("Some playlist")
    .setIsExplicit(true)
    .setTrackPlaybackProgress(45)
    .setTrackPlaybackDuration(90)
    .setQueuePlaybackProgress(45)
    .setQueuePlaybackDuration(150)
    .setQueueCurrentTrackNumber(2)
    .setQueueTotalTrackCount(3);

AppServiceData appData = new AppServiceData()
    .setServiceID(myServiceId)
    .setServiceType(AppServiceType.MEDIA.toString())
    .setMediaServiceData(mediaData);

OnAppServiceData onAppData = new OnAppServiceData();
onAppData.setServiceData(appData);

sdlManager.sendRPC(onAppData);
```

## NAVIGATION SERVICE DATA

```
final SdlArtwork navInstructionArt = new SdlArtwork("turn", FileType.GRAPHIC_PNG,
image, true);

sdlManager.getFileManager().uploadFile(navInstructionArt, new CompletionListener()
{
    @Override
    public void onComplete(boolean success) {
        if (success){
            Coordinate coordinate = new Coordinate(42f,43f);

            LocationDetails locationDetails = new LocationDetails();
            locationDetails.setCoordinate(coordinate);

            // Make sure the image is uploaded to the system before publishing your data
            NavigationInstruction navigationInstruction = new
NavigationInstruction(locationDetails, NavigationAction.TURN);
            navigationInstruction.setImage(navInstructionArt.getImageRPC());

            DateTime dateTime = new DateTime()
                .setHour(2)
                .setMinute(3)
                .setSecond(4);

            NavigationServiceData navigationData = new
NavigationServiceData(dateTime);

navigationData.setInstructions(Collections.singletonList(navigationInstruction));

            AppServiceData appData = new AppServiceData()
                .setServiceID(myServiceId)
                .setServiceType(AppServiceType.NAVIGATION.toString())
                .setNavigationServiceData(navigationData);

            OnAppServiceData onAppData = new OnAppServiceData();
            onAppData.setServiceData(appData);

            sdlManager.sendRPC(onAppData);
        }
    }
});
```

## WEATHER SERVICE DATA

```
final SdlArtwork weatherImage = new SdlArtwork("sun", FileType.GRAPHIC_PNG,
image, true);

sdlManager.getFileManager().uploadFile(weatherImage, new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            // Make sure the image is uploaded to the system before publishing your data
            WeatherData weatherData = new WeatherData();
            weatherData.setWeatherIcon(weatherImage.getImageRPC());

            Coordinate coordinate = new Coordinate(42f, 43f);

            LocationDetails locationDetails = new LocationDetails();
            locationDetails.setCoordinate(coordinate);

            WeatherServiceData weatherServiceData = new
WeatherServiceData(locationDetails);

            AppServiceData appData = new AppServiceData()
                .setServiceID(myServiceId)
                .setServiceType(AppServiceType.WEATHER.toString())
                .setWeatherServiceData(weatherServiceData);

            OnAppServiceData onAppData = new OnAppServiceData();
            onAppData.setServiceData(appData);

            sdlManager.sendRPC(onAppData);
        }
    }
});
```

## 4. Handling App Service Subscribers

If you choose to make your app service available to other apps, you will have to handle requests to get your app service data when a consumer requests it directly.

Handling app service subscribers is a two step process. First, you must setup listeners for the subscriber. Then, when you get a request, you will either have to send a response to the subscriber with the app service data or if you have no data to send, send a response with a relevant failure result code.

### LISTENING FOR REQUESTS

First, you will need to setup a listener for `GetAppServiceDataRequest`. Then, when you get the request, you will need to respond with your app service data. Therefore, you will need to store your current service data after the most recent update using `OnAppServiceData` (see the section Update Your Service's Data).

```
sdlManager.addOnRPCRequestListener(FunctionID.GET_APP_SERVICE_DATA, new
OnRPCRequestListener() {
    @Override
    public void onRequest(RPCRequest request) {
        GetAppServiceData getAppServiceData = (GetAppServiceData) request;

        // Send a response
        GetAppServiceDataResponse response = new GetAppServiceDataResponse();
        response.setSuccess(true);
        response.setCorrelationID(getAppServiceData.getCorrelationID());
        response.setResultCode(Result.SUCCESS);
        response.setInfo("<#Use to provide more information about an error#>");
        response.setServiceData(appServiceData);
        sdlManager.sendRPC(response);
    }
});
```

# Supporting Service RPCs and Actions

## 5. Service RPCs

Certain RPCs are related to certain services. The chart below shows the current relationships:

| MEDIA | NAVIGATION | WEATHER |
| --- | --- | --- |
| ButtonPress (OK) | SendLocation | |
| ButtonPress (SEEKLEFT) | GetWayPoints | |
| ButtonPress (SEEKRIGHT) | SubscribeWayPoints | |
| ButtonPress (TUNEUP) | OnWayPointChange | |
| ButtonPress (TUNEDOWN) | | |
| ButtonPress (SHUFFLE) | | |
| ButtonPress (REPEAT) | | |

When you are the active service for your service's type (e.g. media), and you have declared that you support these RPCs in your manifest (see the section Creating an App Service Manifest), then these RPCs will be automatically routed to your app. You will have to set up listeners to be aware that they have arrived, and you will then need to respond to those requests.

```
AppServiceManifest manifest = new
AppServiceManifest(AppServiceType.MEDIA.toString());
...
manifest.setHandledRpcs(Collections.singletonList(FunctionID.BUTTON_PRESS.getI
```

```
sdlManager.addOnRPCRequestListener(FunctionID.BUTTON_PRESS, new
OnRPCRequestListener() {
    @Override
    public void onRequest(RPCRequest request) {
        ButtonPress buttonPress = (ButtonPress) request;

        ButtonPressResponse response = new ButtonPressResponse();
        response.setSuccess(true);
        response.setResultCode(Result.SUCCESS);
        response.setCorrelationID(buttonPress.getCorrelationID());
        response.setInfo("<#Use to provide more information about an error#>");
        sdlManager.sendRPC(response);
    }
});
```

## 6. Service Actions

App actions are the ability for app consumers to use the SDL services system to send URIs to app providers in order to activate actions on the provider. Service actions are *schema-less*, i.e. there is no way to define the appropriate URIs through SDL. If you already provide actions through your app and want to expose them to SDL, or if you wish to start providing them, you will have to document your available actions elsewhere (such as your website).

In order to support actions through SDL services, you will need to observe and respond to the `PerformAppServiceInteraction` RPC request.

```
// Perform App Services Interaction Request Listener
sdlManager.addOnRPCRequestListener(FunctionID.PERFORM_APP_SERVICES_INTER
 new OnRPCRequestListener() {
    @Override
    public void onRequest(RPCRequest request) {
        PerformAppServiceInteraction performAppServiceInteraction =
(PerformAppServiceInteraction) request;

        // If you have multiple services, this will let you know which of your services is
being addressed
        serviceID = performAppServiceInteraction.getServiceID();

        // The URI sent by the consumer. This must be something you understand
        String serviceURI = performAppServiceInteraction.getServiceUri();

        // A result you want to send to the consumer app.
        PerformAppServiceInteractionResponse response = new
PerformAppServiceInteractionResponse()
            .setServiceSpecificResult("Some Result");
        response.setCorrelationID(performAppServiceInteraction.getCorrelationID());
        response.setInfo("<#Use to provide more information about an error#>");
        response.setSuccess(true);
        response.setResultCode(Result.SUCCESS);
        sdlManager.sendRPC(response);
    }
});
```

# Updating Your Published App Service

Once you have published your app service, you may decide to update its data. For example, if you have a free and paid tier with different amounts of data, you may need to upgrade or downgrade a user between these tiers and provide new data in your app service manifest. If desired, you can also delete your app service by unpublishing the service.

## 7. Updating a Published App Service Manifest (RPC v6.0+)

```
AppServiceManifest manifest = new
AppServiceManifest(AppServiceType.WEATHER.toString());
manifest.setWeatherServiceManifest(weatherServiceManifest);

PublishAppService publishServiceRequest = new PublishAppService(manifest);
sdlManager.sendRPC(publishServiceRequest);
```

### 8. Unpublishing a Published App Service Manifest (RPC v6.0+)

```
UnpublishAppService unpublishAppService = new UnpublishAppService("<#The
serviceID of the service to unpublish>");
sdlManager.sendRPC(unpublishAppService);
```

# Using App Services (RPC v5.1+)

App services is a powerful feature enabling both a new kind of vehicle-to-app communication and app-to-app communication via SDL.

App services are used to publish navigation, weather and media data (such as temperature, navigation waypoints, or the current playlist name). This data can then be used by both the vehicle head unit and, if the publisher of the app service desires, other SDL apps. Creating an app service is covered in another guide.

Vehicle head units may use these services in various ways. One app service for each type will be the "active" service to the module. For media, for example, this will be the media app that the user is currently using or listening to. For navigation, it would be a navigation app that the user is using to navigate. For weather, it may be the last used weather app, or a user-selected default. The system may then use that service's data to perform various actions (such as navigating to an address with the active service or to display the temperature as provided from the active weather service).

An SDL app can also subscribe to a published app service. Once subscribed, the app will be sent the new data when the app service publisher updates its data. This guide will cover subscribing to a service. Subscribed apps can also send certain RPCs and generic URI-based actions (see the section Sending an Action to a Service Provider, below) to your service.

Currently, there is no high-level API support for using an app service, so you will have to use raw RPCs for all app service related APIs.

# Getting and Subscribing to Services

Once your app has connected to the head unit, you will first want to be notified of all available services and updates to the metadata of all services on the head unit. Second, you will narrow down your app to subscribe to an individual app service and subscribe to its data. Third, you may want to interact with that service through RPCs, or fourth, through service actions.

## 1. Getting and Subscribing to Available Services

To get information on all services published on the system, as well as on changes to published services, you will use the `SystemCapabilityManager`.

JAVA

```
// Grab the capability once
sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.APP_
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        AppServicesCapabilities servicesCapabilities = (AppServicesCapabilities)
capability;
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
}, false);
...

// Subscribe to app service capability updates
sdlManager.getSystemCapabilityManager().addOnSystemCapabilityListener(SystemC
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        AppServicesCapabilities servicesCapabilities = (AppServicesCapabilities)
capability;
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
});
```

## CHECKING THE APP SERVICE CAPABILITY

Once you've retrieved the initial list of app service capabilities or an updated list of app service capabilities, you may want to inspect the data to find what you are looking for. Below is example code with comments explaining what each part of the app service capability is used for.

### JAVA

```
// This array contains all currently available app services on the system
List<AppServiceCapability> appServices = servicesCapabilities.getAppServices();

if (appServices!= null && appServices.size() > 0) {
    for (AppServiceCapability anAppServiceCapability : appServices) {
        // This will tell you why a service is in the list of updates
        ServiceUpdateReason updateReason =
anAppServiceCapability.getUpdateReason();

        // The app service record will give you access to a service's generated id, which
can be used to address the service directly (see below), it's manifest, used to see
what data it supports, whether or not the service is published (it always will be here),
and whether or not the service is the active service for its service type (only one
service can be active for each type)
        AppServiceRecord serviceRecord =
anAppServiceCapability.getUpdatedAppServiceRecord();
    }
}
```

## 2. Getting and Subscribing to a Service Type's Data

Once you have information about all of the services available, you may want to view or subscribe to a service type's data. To do so, you will use the `GetAppServiceData` RPC.

Note that you will currently only be able to get data for the *active* service of the service type. You can attempt to make another service the active service by using the `PerformApServiceInteraction` RPC, discussed below in Sending an Action to a Service Provider.

JAVA

```
// Get service data once
GetAppServiceData getAppServiceData = new
GetAppServiceData(AppServiceType.MEDIA.toString())
    .setSubscribe(true); // Subscribe to future updates if you want them
getAppServiceData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response != null){
            GetAppServiceDataResponse serviceResponse =
(GetAppServiceDataResponse) response;
            MediaServiceData mediaServiceData =
serviceResponse.getServiceData().getMediaServiceData();
        }
    }
});
sdlManager.sendRPC(getAppServiceData);

...

// Unsubscribe from updates
GetAppServiceData unsubscribeServiceData = new
GetAppServiceData(AppServiceType.MEDIA.toString())
    .setSubscribe(false);
sdlManager.sendRPC(unsubscribeServiceData);
```

# Interacting with a Service Provider

Once you have a service's data, you may want to interact with a service provider by sending RPCs or actions.

## 3. Sending RPCs to a Service Provider

Only certain RPCs are available to be passed to the service provider based on their service type. See the Creating an App Service guide **Supporting Service RPCs and Actions** section for a chart detailing which RPCs work with which service types. The RPC can only be sent to the active service of a specific service type, not to any inactive service.

Sending an RPC works exactly the same as if you were sending the RPC to the head unit system. The head unit will simply route your RPC to the appropriate app automatically.

> **NOTE**
>
> Your app may need special permissions to use the RPCs that route to app service providers.

```
ButtonPress buttonPress = new ButtonPress()
    .setButtonPressMode(ButtonPressMode.SHORT)
    .setButtonName(ButtonName.OK)
    .setModuleType(ModuleType.AUDIO);
buttonPress.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Use the response
    }
});
sdlManager.sendRPC(buttonPress);
```

## 4. Sending an Action to a Service Provider

Actions are generic URI-based strings sent to any app service (active or not). You can also use actions to request to the system that they make the service the active service for that service type. Service actions are *schema-less*, i.e. there is no way to define the appropriate URIs through SDL. The service provider must document their list of available actions elsewhere (such as their website).

```
PerformAppServiceInteraction performAppServiceInteraction = new
PerformAppServiceInteraction("sdlexample://x-callback-url/showText?x-
source=MyApp&text=My%20Custom%20String", previousServiceId, appId);
performAppServiceInteraction.setOnRPCResponseListener(new
OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        // Use the response
    }
});
sdlManager.sendRPC(performAppServiceInteraction);
```

## 5. Getting a File from a Service Provider

In some cases, a service may upload an image that can then be retrieved from the module. First, you will need to get the image name from the `AppServiceData` (see point 2 above). Then you will use the image name to retrieve the image data.

```
WeatherServiceData weatherServiceData = appServiceData.getWeatherServiceData();
if (weatherServiceData == null || weatherServiceData.getCurrentForecast() == null ||
weatherServiceData.getCurrentForecast().getWeatherIcon() == null) {
    // The image doesn't exist, exit early
    return;
}
String currentForecastImageName =
weatherServiceData.getCurrentForecast().getWeatherIcon().getValue();

GetFile getFile = new GetFile(currentForecastImageName)
    .setAppServiceId(serviceId);
getFile.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        GetFileResponse getFileResponse = (GetFileResponse) response;
        byte[] fileData = getFileResponse.getBulkData();
        SdlArtwork sdlArtwork = new SdlArtwork(fileName, FileType.GRAPHIC_PNG,
fileData, false);
        // Use the sdlArtwork
    }
});
sdlManager.sendRPC(getFile);
```

# Calling a Phone Number

The `DialNumber` RPC allows you make a phone call via the user's phone. In order to dial a phone number you must be sure that the device is connected via Bluetooth (even if your device is also connected using a USB cord) for this request to work. If the phone is not connected via Bluetooth, you will receive a result of `REJECTED` from the module.

# Checking Your App's Permissions

`DialNumber` is an RPC that is usually restricted by OEMs. As a result, a module may reject your request if your app does not have the correct permissions. Your SDL app may also be restricted to only being allowed to making a phone call when your app is open (i.e. the `hmiLevel` is non-`NONE`) or when it is the currently active app (i.e. the `hmiLevel` is `FULL`).

```
UUID listenerId =
sdlManager.getPermissionManager().addListener(Arrays.asList(new
PermissionElement(FunctionID.DIAL_NUMBER, null)),
PermissionManager.PERMISSION_GROUP_TYPE_ANY, new
OnPermissionChangeListener() {
    @Override
    public void onPermissionsChange(@NonNull Map<FunctionID, PermissionStatus>
allowedPermissions, int permissionGroupStatus) {
        if (permissionGroupStatus !=
PermissionManager.PERMISSION_GROUP_TYPE_ALL_ALLOWED) {
            // Your app does not have permission to send the `DialNumber` request for
its current HMI level
            return;
        }

        // Your app has permission to send the `DialNumber` request for its current HMI
level
    }
});
```

# Checking if the Module Supports Calling a Phone Number

Since making a phone call is a newer feature, there is a possibility that some legacy modules will reject your request because the module does not support the `DialNumber` request. Once you have successfully connected to the module, you can check the module's capabilities via the `sdlManager.getSystemCapabilityManager` as shown in the example below. Please note that you only need to check once if the module supports

calling a phone number, however you must wait to perform this check until you know that the SDL app has been opened (i.e. the `hmiLevel` is non-`NONE`).

> **NOTE**
>
> If you discover that the module does not support calling a phone number or that your app does not have the right permissions, you should disable any buttons, voice commands, menu items, etc. in your app that would send the `DialNumber` request.

```
private void isDialNumberSupported(final OnCapabilitySupportedListener
capabilitySupportedListener) {
    // Check if the module has phone capabilities
    if
(!sdlManager.getSystemCapabilityManager().isCapabilitySupported(SystemCapability
 {
        capabilitySupportedListener.onCapabilitySupported(false);
        return;
    }

    // Legacy modules (pre-RPC Spec v4.5) do not support system capabilities, so for
versions less than 4.5 we will assume `DialNumber` is supported if
`isCapabilitySupported()` returns true
    SdlMsgVersion sdlMsgVersion =
sdlManager.getRegisterAppInterfaceResponse().getSdlMsgVersion();
    if (sdlMsgVersion == null) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }
    Version rpcSpecVersion = new Version(sdlMsgVersion);
    if (rpcSpecVersion.isNewerThan(new Version(4, 5, 0)) < 0) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }

    // Retrieve the phone capability

sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.PHO
 new OnSystemCapabilityListener() {
        @Override
        public void onCapabilityRetrieved(Object capability) {
            PhoneCapability phoneCapability = (PhoneCapability) capability;
            capabilitySupportedListener.onCapabilitySupported(phoneCapability != null ?
phoneCapability.getDialNumberEnabled() : false);
        }

        @Override
        public void onError(String info) {
            capabilitySupportedListener.onError(info);
        }
    }, false);
}

public interface OnCapabilitySupportedListener {
    void onCapabilitySupported(Boolean supported);
    void onError(String info);
}
```

# Sending a DialNumber Request

Once you know that the module supports dialing a phone number and that your SDL app has permission to send the `DialNumber` request, you can create and send the request.

> **NOTE**
>
> `DialNumber` strips all characters except for `0` - `9`, `*`, `#`, `,`, `;`, and `+`.

```
DialNumber dialNumber = new DialNumber()
    .setNumber("1238675309");
dialNumber.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        Result result = response.getResultCode();
        if(result.equals(Result.SUCCESS)){
            // `DialNumber` successfully sent
        }else if(result.equals(Result.REJECTED)){
            // `DialNumber` was rejected. Either the call was sent and cancelled or there
is no device connected
        }else if(result.equals(Result.DISALLOWED)){
            // Your app is not allowed to use `DialNumber`
        }
    }
});

sdlManager.sendRPC(dialNumber);
```

## Dial Number Responses

The `DialNumber` request has three possible responses that you should expect:

1. `SUCCESS` - The request was successfully sent, and a phone call was initiated by the user.
2. `REJECTED` - This can mean either:

- The user rejected the request to make the phone call.
- The phone is not connected to the module via Bluetooth.

3. `DISALLOWED` - Your app does not have permission to use the `DialNumber` request.

# Setting the Navigation Destination

The `SendLocation` RPC gives you the ability to send a GPS location to the active navigation app on the module.

When using the `SendLocation` RPC, you will not have access to any information about how the user interacted with this location, only if the request was successfully sent. The request will be handled by the module from that point on using the active navigation system.

# Checking Your App's Permissions

The `SendLocation` RPC is restricted by most OEMs. As a result, a module may reject your request if your app does not have the correct permissions. Your SDL app may also be restricted to only being allowed to send a location when your app is open (i.e. the `hmiLevel` is non-`NONE`) or when it is the currently active app (i.e. the `hmiLevel` is `FULL`).

```
UUID listenerId =
sdlManager.getPermissionManager().addListener(Arrays.asList(new
PermissionElement(FunctionID.SEND_LOCATION, null)),
PermissionManager.PERMISSION_GROUP_TYPE_ANY, new
OnPermissionChangeListener() {
    @Override
    public void onPermissionsChange(@NonNull Map<FunctionID, PermissionStatus>
allowedPermissions, @NonNull int permissionGroupStatus) {
        if (permissionGroupStatus !=
PermissionManager.PERMISSION_GROUP_TYPE_ALL_ALLOWED) {
            // Your app does not have permission to send the `SendLocation` request for
its current HMI level
            return;
        }

        // Your app has permission to send the `SendLocation` request for its current
HMI level
    }
});
```

# Checking if the Module Supports Sending a Location

Since some modules will not support sending a location, you should check if the module supports this feature before trying to use it. Once you have successfully connected to the module, you can check the module's capabilities via the `sdlManager.getSystemCapabilityManager()` as shown in the example below. Please note that you only need to check once if the module supports sending a location, however you must wait to perform this check until you know that the SDL app has been opened (i.e. the `hmiLevel` is non-`NONE`).

**NOTE**

If you discover that the module does not support sending a location or that your app does not have the right permissions, you should disable any buttons, voice commands, menu items, etc. in your app that would send the `SendLocation` request.

```
private void isSendLocationSupported(final OnCapabilitySupportedListener
capabilitySupportedListener) {
    // Check if the module has navigation capabilities
    if
(!sdlManager.getSystemCapabilityManager().isCapabilitySupported(SystemCapability
 {
        capabilitySupportedListener.onCapabilitySupported(false);
        return;
    }

    // Legacy modules (pre-RPC Spec v4.5) do not support system capabilities, so for
versions less than 4.5 we will assume `SendLocation` is supported if
`isCapabilitySupported()` returns true
    SdlMsgVersion sdlMsgVersion =
sdlManager.getRegisterAppInterfaceResponse().getSdlMsgVersion();
    if (sdlMsgVersion == null) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }
    Version rpcSpecVersion = new Version(sdlMsgVersion);
    if (rpcSpecVersion.isNewerThan(new Version(4, 5, 0)) < 0) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }

    // Retrieve the navigation capability

sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.NAVI
 new OnSystemCapabilityListener() {
        @Override
        public void onCapabilityRetrieved(Object capability) {
            NavigationCapability navigationCapability = (NavigationCapability) capability;
            capabilitySupportedListener.onCapabilitySupported(navigationCapability !=
null ? navigationCapability.getSendLocationEnabled() : false);
        }

        @Override
        public void onError(String info) {
            capabilitySupportedListener.onError(info);
        }
    }, false);
}

public interface OnCapabilitySupportedListener {
    void onCapabilitySupported(Boolean supported);
    void onError(String info);
}
```

# Using Send Location

To use the `SendLocation` request, you must at minimum include the longitude and latitude of the location.

```
SendLocation sendLocation = new SendLocation()
    .setLatitudeDegrees(42.877737)
    .setLongitudeDegrees(-97.380967)
    .setLocationName("The Center")
    .setLocationDescription("Center of the United States");

OasisAddress address = new OasisAddress()
    .setSubThoroughfare("900")
    .setThoroughfare("Whiting Dr")
    .setLocality("Yankton")
    .setAdministrativeArea("SD")
    .setPostalCode("57078")
    .setCountryCode("US-SD")
    .setCountryName("United States");

sendLocation.setAddress(address);
sendLocation.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        Result result = response.getResultCode();
        if(result.equals(Result.SUCCESS)){
            // `SendLocation` successfully sent
        }else if(result.equals(Result.INVALID_DATA)){
            // `SendLocation` was rejected. The request contained invalid data
        }else if(result.equals(Result.DISALLOWED)){
            // Your app is not allowed to use `SendLocation`
        }
    }
});

sdlManager.sendRPC(sendLocation);
```

# Checking the Result of Send Location

The `SendLocation` request has three possible responses that you should expect:

1. `SUCCESS` - Successfully sent.
2. `INVALID_DATA` - The request contains invalid data and was rejected.
3. `DISALLOWED` - Your app does not have permission to use the `SendLocation` request.

# Getting the Navigation Destination (RPC v4.1+)

The `GetWayPoints` and `SubscribeWayPoints` RPCs are designed to allow you to get the navigation destination(s) from the active navigation app when the user has activated in-car navigation.

# Checking Your App's Permissions

Both the `GetWayPoints` and `SubscribeWayPoints` RPCs are restricted by most OEMs. As a result, a module may reject your request if your app does not have the correct permissions. Your SDL app may also be restricted to only being allowed to get waypoints when your app is open (i.e. the `hmiLevel` is non-`NONE`) or when it is the currently active app (i.e. the `hmiLevel` is `FULL`).

```
UUID listenerId =
sdlManager.getPermissionManager().addListener(Arrays.asList(new
PermissionElement(FunctionID.GET_WAY_POINTS, null), new
PermissionElement(FunctionID.SUBSCRIBE_WAY_POINTS, null)),
PermissionManager.PERMISSION_GROUP_TYPE_ANY, new
OnPermissionChangeListener() {
    @Override
    public void onPermissionsChange(@NonNull Map<FunctionID, PermissionStatus>
allowedPermissions, @NonNull int permissionGroupStatus) {
        PermissionStatus getWayPointPermissionStatus =
allowedPermissions.get(FunctionID.GET_WAY_POINTS);
        if (getWayPointPermissionStatus != null &&
getWayPointPermissionStatus.getIsRPCAllowed()) {
            // Your app has permission to send the `GetWayPoints` request for its current
HMI level
        } else {
            // Your app does not have permission to send the `GetWayPoints` request for
its current HMI level
        }

        PermissionStatus subscribeWayPointsPermissionStatus =
allowedPermissions.get(FunctionID.SUBSCRIBE_WAY_POINTS);
        if (subscribeWayPointsPermissionStatus != null &&
subscribeWayPointsPermissionStatus.getIsRPCAllowed()) {
            // Your app has permission to send the `SubscribeWayPoints` request for its
current HMI level
        } else {
            // Your app does not have permission to send the `SubscribeWayPoints`
request for its current HMI level
        }
    }
});
```

# Checking if the Module Supports Waypoints

Since some modules will not support getting waypoints, you should check if the module supports this feature before trying to use it. Once you have successfully connected to the module, you can check the module's capabilities via the `sdlManager.getSystemCapabilityManager()` as shown in the example below. Please note that you only need to check once if the module supports getting waypoints, however you must wait to perform this check until you know that the SDL app has been opened (i.e. the `hmiLevel` is non-`NONE`).

**NOTE**

If you discover that the module does not support getting navigation waypoints or that your app does not have the right permissions, you should disable any buttons, voice commands, menu items, etc. in your app that would send the `GetWayPoints` or `SubscribeWayPoints` requests.

```
private void isGetWaypointsSupported(final OnCapabilitySupportedListener
capabilitySupportedListener) {
    // Check if the module has navigation capabilities
    if
(!sdlManager.getSystemCapabilityManager().isCapabilitySupported(SystemCapability
 {
        capabilitySupportedListener.onCapabilitySupported(false);
        return;
    }

    // Legacy modules (pre-RPC Spec v4.5) do not support system capabilities, so for
versions less than 4.5 we will assume `GetWayPoints` and `SubscribeWayPoints` are
supported if `isCapabilitySupported()` returns true
    SdlMsgVersion sdlMsgVersion =
sdlManager.getRegisterAppInterfaceResponse().getSdlMsgVersion();
    if (sdlMsgVersion == null) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }
    Version rpcSpecVersion = new Version(sdlMsgVersion);
    if (rpcSpecVersion.isNewerThan(new Version(4, 5, 0)) < 0) {
        capabilitySupportedListener.onCapabilitySupported(true);
        return;
    }

    // Retrieve the navigation capability

sdlManager.getSystemCapabilityManager().getCapability(SystemCapabilityType.NAVI
 new OnSystemCapabilityListener() {
        @Override
        public void onCapabilityRetrieved(Object capability) {
            NavigationCapability navigationCapability = (NavigationCapability) capability;
            capabilitySupportedListener.onCapabilitySupported(navigationCapability !=
null ? navigationCapability.getWayPointsEnabled() : false);
        }

        @Override
        public void onError(String info) {
            capabilitySupportedListener.onError(info);
        }
    }, false);
}

public interface OnCapabilitySupportedListener {
    void onCapabilitySupported(Boolean supported);
    void onError(String info);
}
```

# Subscribing to Waypoints

To subscribe to the navigation waypoints, you will have to set up your callback for whenever the waypoints are updated, then send the `SubscribeWayPoints` RPC.

```
// You can subscribe any time before SDL would send the notification (such as when you call `sdlManager.start` or at initialization of your manager)
sdlManager.addOnRPCNotificationListener(FunctionID.ON_WAY_POINT_CHANGE, new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnWayPointChange onWayPointChangeNotification = (OnWayPointChange) notification;
        // Use the waypoint data
    }
});

// After SDL has started your connection, at whatever point you want to subscribe, send the subscribe RPC
SubscribeWayPoints subscribeWayPoints = new SubscribeWayPoints();
subscribeWayPoints.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse rpcResponse) {
        if (rpcResponse.getSuccess()){
            // You are now subscribed
        } else {
            // Handle the errors
        }
    }
});

sdlManager.sendRPC(subscribeWayPoints);
```

## Unsubscribing from Waypoints

To unsubscribe from waypoint data, you must send the `UnsubscribeWayPoints` RPC.

```
UnsubscribeWayPoints unsubscribeWayPoints = new UnsubscribeWayPoints();
unsubscribeWayPoints.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse rpcResponse) {
        if (rpcResponse.getSuccess()){
            // You are now unsubscribed
        } else {
            // Handle the errors
        }
    }
});

sdlManager.sendRPC(unsubscribeWayPoints);
```

# One-Time Waypoints Request

If you only need waypoint data once without an ongoing subscription, you can use `GetWayPoints` instead of `SubscribeWayPoints`.

```
GetWayPoints getWayPoints = new GetWayPoints();
getWayPoints.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse rpcResponse) {
        if (rpcResponse.getSuccess()){
            GetWayPointsResponse getWayPointsResponse = (GetWayPointsResponse) rpcResponse;
            // Use the waypoint data
        } else {
            // Handle the errors
        }
    }
});

sdlManager.sendRPC(getWayPoints);
```

# Uploading Files

In almost all cases, you will not need to handle uploading images because the screen manager API will do that for you. There are some situations, such as VR help-lists and turn-by-turn directions, that are not currently covered by the screen manager so you will have manually upload the image yourself in those cases. For more information about uploading images, see the Uploading Images guide.

# Uploading an MP3 Using the File Manager

The `FileManager` uploads files and keeps track of all the uploaded files names during a session. To send data with the file manager you need to create either a `SdlFile` or `SdlArtwork` object. Both `SdlFile`s and `SdlArtwork`s can be created with a `Uri`, `byte[]`, or `resourceId`.

```
SdlFile audioFile = new SdlFile("File Name", FileType.AUDIO_MP3, mp3Data, true);
sdlManager.getFileManager().uploadFile(audioFile, new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            // File upload successful
        }
    }
});
```

# Batching File Uploads

If you want to upload a group of files, you can use the `FileManager` batch upload methods. Once all of the uploads have completed you will be notified if any of the uploads failed.

```
sdlManager.getFileManager().uploadFiles(sdlFileList, new
MultipleFileCompletionListener() {
    @Override
    public void onComplete(Map<String, String> errors) {

    }
});
```

# File Persistence

`SdlFile` and its subclass `SdlArtwork` support uploading persistent files, i.e. files that are not deleted when the car turns off. Persistence should be used for files that will be used every time the user opens the app. If the file is only displayed for short time the file should not be persistent because it will take up unnecessary space on the head unit. You can check the persistence via:

```
Boolean isPersistent = file.isPersistent();
```

**NOTE**

Be aware that persistence will not work if space on the head unit is limited. The `FileManager` will always handle uploading images if they are non-existent.

# Overwriting Stored Files

If a file being uploaded has the same name as an already uploaded file, the new file will be ignored. To override this setting, set the `SdlFile`'s `overwrite` property to `true`.

```
file.setOverwrite(true);
```

# Checking the Amount of File Storage Left

To find the amount of file storage left for your app on the head unit, use the `FileManager`'s `bytesAvailable` property.

```
int bytesAvailable = sdlManager.getFileManager().getBytesAvailable();
```

# Checking if a File Has Already Been Uploaded

You can check out if an image has already been uploaded to the head unit via the `FileManager`'s `remoteFileNames` property.

```
Boolean fileIsOnHeadUnit =
sdlManager.getFileManager().getRemoteFileNames().contains("Name Uploaded As");
```

# Deleting Stored Files

Use the file manager's delete request to delete a file associated with a file name.

```
sdlManager.getFileManager().deleteRemoteFileWithName("Name Uploaded As", new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {

    }
});
```

# Batch Deleting Files

```
sdlManager.getFileManager().deleteRemoteFilesWithNames(remoteFiles, new
MultipleFileCompletionListener() {
    @Override
    public void onComplete(Map<String, String> errors) {

    }
});
```

# Uploading Images

> **NOTE**
>
> If you use the `ScreenManager`, image uploading for template graphics, soft buttons, and menu items is handled for you behind the scenes. However, you will still need to manually upload your images if you need images in an alert, VR help lists, turn-by-turn directions, or other features not currently covered by the `ScreenManager`.

You should be aware of these four things when using images in your SDL app:

1. You may be connected to a head unit that does not have the ability to display images.
2. You must upload images from your mobile device to the head unit before using them in a template.
3. Persistent images are stored on a head unit between sessions. Ephemeral images are destroyed when a session ends (i.e. when the user turns off their vehicle).
4. Images can not be uploaded when the app's `hmiLevel` is `NONE`. For more information about permissions, please review Understanding Permissions.

# Checking if Graphics are Supported

Before uploading images to a head unit you should first check if the head unit supports graphics. If not, you should avoid uploading unnecessary image data. To check if graphics are supported, check the `getCapability()` method of a valid `SystemCapabilityManager` obtained from `sdlManager.getSystemCapabilityManager()` to find out the display capabilities of the head unit.

```
List<ImageField> imageFields =
sdlManager.getSystemCapabilityManager().getDefaultMainWindowCapability().getIma

boolean imagesSuported = (imageFields.size() > 0);
```

# Uploading an Image Using the File Manager

The `FileManager` uploads files and keeps track of all the uploaded files names during a session. To send data with the `FileManager`, you need to create either a `SdlFile` or `SdlArtwork` object. Both `SdlFile`s and `SdlArtwork`s can be created with a `Uri`, `byte[]`, or `resourceId`.

```
SdlArtwork artwork = new SdlArtwork("image_name", FileType.GRAPHIC_PNG, image, false);
sdlManager.getFileManager().uploadFile(artwork, new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success){
            // Image Upload Successful
        }
    }
});
```

## Batch File Uploads, Persistence, etc.

Similar to other files, artworks can be persistent, batched, overwrite, etc. See Uploading Files for more information.

# Creating an OEM Cloud App Store (RPC v5.1+)

SDL allows OEMs to offer an app store that lets users browse and install remote cloud apps. If the cloud app requires users to login with their credentials, the app store can use an authentication token to automatically login users after their first session.

> **NOTE**
>
> An OEM app store can be a mobile app or a cloud app.

# User Authentication

App stores can handle user authentication for the installed cloud apps. For example, users can log in after installing a cloud app using the app store. After that, the app store will save an authentication token for the cloud app in the local policy table. Then, the cloud app can retrieve the authentication token from the local policy table and use it to authenticate a user with the application. If desired, an optional parameter, `CloudAppVehicleID`, can be used to identify the head unit.

# Setting and Getting Cloud App Properties

An OEM's app store can manage the properties of a specific cloud app by setting and getting its `CloudAppProperties`. This table summarizes the properties that are included in `CloudAppProperties`:

| PARAMETER NAME | DESCRIPTION |
| --- | --- |
| appID | appID for the cloud app |
| nicknames | List of possible names for the cloud app. The cloud app will not be allowed to connect if its name is not contained in this list |
| enabled | If true, cloud app will be displayed on HMI |
| authToken | Used to authenticate the user, if the app requires user authentication |
| cloudTransportType | Specifies the connection type Core should use. Currently Core supports WS and WSS , but an OEM can implement their own transport adapter to handle different values |
| hybridAppPreference | Specifies the user preference to use the cloud app version, mobile app version, or whichever connects first when both are available |
| endpoint | Remote endpoint for websocket connections |

**NOTE**

Only trusted app stores are allowed to set or get `CloudAppProperties` for other cloud apps.

## Setting Cloud App Properties

App stores can set properties for a cloud app by sending a `SetCloudAppProperties` request to Core to store them in the local policy table. For example, in this piece of code, the app store can set the `authToken` to associate a user with a cloud app after the user logs in to the app by using the app store:

```
CloudAppProperties cloudAppProperties = new CloudAppProperties("<appId>");
cloudAppProperties.setAuthToken("<auth token>");
SetCloudAppProperties setCloudAppProperties = new
SetCloudAppProperties(cloudAppProperties);
setCloudAppProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            DebugTool.logInfo("SdlService", "Request was successful.");
        } else {
            DebugTool.logInfo("SdlService", "Request was rejected.");
        }
    }
});
sdlManager.sendRPC(setCloudAppProperties);
```

## Getting Cloud App Properties

To retrieve cloud properties for a specific cloud app from local policy table, app stores can send `GetCloudAppProperties` and specify the `appId` for that cloud app as in this example:

```
GetCloudAppProperties getCloudAppProperties = new GetCloudAppProperties("
<appId>");
getCloudAppProperties.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (response.getSuccess()) {
            DebugTool.logInfo("SdlService", "Request was successful.");
            GetCloudAppPropertiesResponse getCloudAppPropertiesResponse =
(GetCloudAppPropertiesResponse) response;
            CloudAppProperties cloudAppProperties =
getCloudAppPropertiesResponse.getCloudAppProperties();
            // Use cloudAppProperties
        } else {
            DebugTool.logInfo("SdlService", "Request was rejected.");
        }
    }
});
sdlManager.sendRPC(getCloudAppProperties);
```

### GETTING THE CLOUD APP ICON

Cloud app developers don't need to add any code to download the app icon. The cloud app icon will be automatically downloaded from the url provided by the policy table and sent to Core to be later displayed on the HMI.

# Getting the Authentication Token

When users install cloud apps from an OEM's app store, they may be asked to login to that cloud app using the app store. After logging in, app store can save the `authToken` in the local policy table to be used later by the cloud app for user authentication.
A cloud app can retrieve its `authToken` from local policy table after starting the RPC service. The `authToken` can be used later by the app to authenticate the user:

```
String authToken = sdlManager.getAuthToken();
```

# Getting CloudAppVehicleID (Optional)

The `CloudAppVehicleID` is an optional parameter used by cloud apps to identify a head unit. The content of `CloudAppVehicleID` is up to the OEM's implementation. Possible values could be the VIN or a hashed VIN.
The `CloudAppVehicleID` value can be retrieved as part of the `GetVehicleData` RPC. To find out more about how to retrieve `CloudAppVehicleID`, check out the Retrieving Vehicle Data section.

# Encryption

Some OEMs may want to encrypt messages passed between your SDL app and the head unit. If this is the case, when you submit your app to the OEM for review, they will ask you to add a security library to your SDL app. It is also possible to encrypt messages even if the OEM does not require encryption. In this case, you will have to work with the OEM to get a security library. This section will show you how to add the security library to your SDL app and configure optional encryption.

# When Encryption is Needed

## OEM Required Encrypted RPCs

OEMs may want to encrypt all or some of the RPCs being transmitted between your SDL app and SDL Core. The library will handle encrypting and decrypting RPCs that are required to be encrypted.

## OEM Required Encrypted Video and Audio

OEMs may want to encrypt video and audio streaming. Information on how to set up encrypted video and audio streaming can be found in Video Streaming for Navigation Apps

> Introduction. The library will handle encrypting the video and audio data sent to the head unit.

## Optional Encryption

You may want to encrypt some or all of the RPCs you send to the head unit even if the OEM does not require that they be protected. In that case you will have to manually configure the payload protection status of every RPC that you send. Please note that if you require that an RPC be encrypted but there is no security manager configured for the connected head unit, then the RPC will not be sent by the library.

**NOTE**

For optional encryption to work, you must work with each OEM to obtain their proprietary security library.

# Creating the Encryption Configuration

Each OEM that supports SDL will have their own proprietary security library. You must add all required security libraries in the encryption configuration when you are configuring the SDL app.

```
List<Class<? extends SdlSecurityBase>> secList = new ArrayList<>();
secList.add(OEMSdlSecurity.class);
builder.setSdlSecurity(secList, serviceEncryptionListener);
```

# Getting the Encryption Status

Since it can take a few moments to set up the encryption manager, you must wait until you know that setup has completed before sending encrypted RPCs. If your RPC is sent before setup has completed, your RPC will not be sent. You can implement the `ServiceEncryptionListener`, which is set in `Builder.setSdlSecurity`, to get updates to the encryption manager state.

```
ServiceEncryptionListener serviceEncryptionListener = new
ServiceEncryptionListener() {
    @Override
    public void onEncryptionServiceUpdated(@NonNull SessionType serviceType,
boolean isServiceEncrypted, @Nullable String error) {
        if (isServiceEncrypted) {
            // Encryption manager can encrypt
        }
    }
};
```

# Setting Optional Encryption

If you want to encrypt a specific RPC, you must configure the payload protected status of the RPC before you send it to the head unit. In order to send RPCs with optional encryption you must call `startRPCEncryption` on the `sdlManager` to make sure the encryption manager gets started correctly. The best place to put `startRPCEncryption` is in the successful callback of the `SdlManagerListener`'s `onStart` method.

```
sdlManager.startRPCEncryption();
```

Then, once you know the encryption manager has started successfully via encryption manager state updates to your `ServiceEncryptionListener` object, you can start to send encrypted RPCs by setting `setPayloadProtected` to `true`.

```
GetVehicleData getVehicleData = new GetVehicleData()
    .setGps(true);
getVehicleData.setPayloadProtected(true);

sdlManager.sendRPC(getVehicleData);
```

# OEM Exclusive Apps

The Android library can prevent apps from starting their `SdlRouterService` based on if they support the vehicle type if the connection is over Bluetooth.

> **NOTE**
>
> If older apps are installed that use a version less than SDL Android 4.12.0, on the first connection to the vehicle an OEM app may host the `SdlRouterService` but on subsequent connections, it may pass it off to another app.

> **NOTE**
>
> This does not work over AOA connections.

# Create file for supported vehicle types and add to Android Manifest

To implement this feature, you will need to define an XML file for supported vehicles called `supported_vehicle_type.xml` in `res/xml` directory of the project, and add it as metaData for `SdlRouterService` in its `AndroidManifest`. If an app defines a `vehicle-type` element, then it should always have a `make` attribute; all other attributes are optional. However, if you want to use `modelYear` or `trim`, you should define `make` and `model` attributes as well. The Java Suite app library will check only the defined attributes. The below example shows a valid vehicle type resource file.

```
<?xml version="1.0" encoding="utf-8"?>

<resource>
    <!-- Vehicle filter for vehicle make-->
    <vehicle-type
        make="SDL"/>
    <!-- Vehicle filter for vehicle make, model and model year-->
    <vehicle-type
        make="SDL"
        model="Generic"
        modelYear="2021"/>
    <!-- Vehicle filter for vehicle make, model and trim-->
    <vehicle-type
        make="SDL"
        model="Generic"
        trim="SE"/>
</resource>
```

Add supported vehicle type file as metaData for `SdlRouterService` in AndroidManifest

```
<meta-data
    android:name="@string/sdl_oem_vehicle_type_filter_name"
    android:resource="@xml/supported_vehicle_type" />
```

# Prevent app from connecting to unsupported vehicles

Apps can still receive an intent to start when `SDL` is enabled from other apps. To prevent an OEM app from starting their `SdlService`, vehicle type can be retrieved in `SdlReceiver.onSdlEnabled` and the app can choose not to start `SdlService` if the vehicle is not supported.

```
@Override
public void onSdlEnabled(Context context, Intent intent) {
    intent.setClass(context, SdlService.class);

    VehicleType vehicleType = null;
    if (intent.hasExtra(TransportConstants.VEHICLE_INFO_EXTRA)) {
        vehicleType =
intent.getParcelableExtra(TransportConstants.VEHICLE_INFO_EXTRA);
    }

    VehicleType vehicleType1 = new
VehicleType().setMake("SDL").setModel("Generic").setModelYear("2021");
    VehicleType vehicleType2 = new
VehicleType().setMake("SDL").setModel("Generic").setTrim("SE");
    List<VehicleType> supportedVehicleList = Arrays.asList(vehicleType1,
vehicleType2);

    if (vehicleType != null &&
SdlAppInfo.checkIfVehicleSupported(supportedVehicleList, vehicleType)) {
        if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
            context.startForegroundService(intent);
        } else {
            context.startService(intent);
        }
    }
}
```

# Introduction

Mobile navigation allows map partners to easily display their maps as well as present visual and audio turn-by-turn prompts on the head unit.

Navigation apps have different behavior on the head unit than normal applications. The main differences are:

- Navigation apps don't use base screen templates. Their main view is the video stream sent from the device.
- Navigation apps can send audio via a binary stream. This will attenuate the current audio source and should be used for navigation commands.
- Navigation apps can receive touch events from the video stream.

> **NOTE**
>
> In order to use SDL's Mobile Navigation feature, the app must have a minimum requirement of Android 4.4 (SDK 19). This is due to using Android's provided video encoder.

# Configuring a Module to Stream

In order to view the stream, you need a head unit to connect with that supports streaming. If this is a physical module created by an OEM, such as a Ford TDK, you may need special permissions from that OEM to test streaming. Physical modules often have strict permissions and/or encryption requirements to stream.

The alternative is to stream over TCP to open-source Core. For more details on setting up open-source Core and an HMI, see the Install and Run guide, and to set up video streaming for that Core and HMI, see the Audio and Video Streaming guide. We recommend using the built-in Generic_HMI server streaming instead of GStreamer socket or pipe streaming.

# Configuring a Navigation App

The basic connection setup is similar for all apps. Please follow the Integration Basics guide for more information.

In order to create a navigation app an `appHMIType` of `NAVIGATION` must be set in the `SdlManager`'s `Builder`.

The second difference is the ability to call the `setSdlSecurity(List<Class<? extends SdlSecurityBase>> secList)` method from the `SdlManager.Builder` if connecting to an implementation of Core that requires secure video and audio streaming. This method requires an array of security libraries, which will extend the `SdlSecurityBase` class. These security libraries are provided by the OEMs themselves, and will only work for that OEM. There is no general catch-all security library.

```
SdlManager.Builder builder = new SdlManager.Builder(this, APP_ID, APP_NAME,
listener);

Vector<AppHMIType> hmiTypes = new Vector<AppHMIType>();
hmiTypes.add(AppHMIType.NAVIGATION);
builder.setAppTypes(hmiTypes);

// Add security managers if Core requires secure video & audio streaming
List<Class<? extends SdlSecurityBase>> secList = new ArrayList<>();
secList.add(OEMSdlSecurity.class);
builder.setSdlSecurity(secList, serviceEncryptionListener);

MultiplexTransportConfig mtc = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);
mtc.setRequiresHighBandwidth(true);
builder.setTransportType(mtc);

sdlManager = builder.build();
sdlManager.start();
```

**MUST**

When compiling your app for production, make sure to include all possible OEM security managers that you wish to support.

# Keyboard Input

To present a keyboard (such as for searching for navigation destinations), you should use the `ScreenManager`'s keyboard presentation feature. For more information, see the Popup Keyboards guide.

# Navigation Subscription Buttons

Head units supporting RPC v6.0+ may support navigation-specific subscription buttons for the navigation template. These subscription buttons allow your user to manipulate the map using hard buttons located on car's center console or steering wheel. It is important to support these subscription buttons in order to provide your user with the expected in-car navigation user experience. This is especially true on head units that don't support touch input as there will be no other way for your user to manipulate the map. See Template Subscription Buttons for a list of these navigation buttons.

# When to Cancel Your Route

Between your navigation app, other navigation apps, and embedded navigation, only one route should be in progress at a time. To know when the embedded navigation or another navigation app has started a route, create a navigation service and when your service becomes inactive, your app should cancel any active route.

```
sdlManager.getSystemCapabilityManager().addOnSystemCapabilityListener(SystemC
 new OnSystemCapabilityListener() {
    @Override
    public void onCapabilityRetrieved(Object capability) {
        AppServicesCapabilities appServicesCapabilities = (AppServicesCapabilities)
capability;
        if (appServicesCapabilities.getAppServices() != null &&
appServicesCapabilities.getAppServices().size() > 0) {
            for (AppServiceCapability appServiceCapability :
appServicesCapabilities.getAppServices()) {
                if
(appServiceCapability.getUpdatedAppServiceRecord().getServiceManifest().getServic
 {
                    boolean serviceActive =
appServiceCapability.getUpdatedAppServiceRecord().getServiceActive();
                    if (!serviceActive) {
                        //Cancel your active route
                    }
                }
            }
        }
    }

    @Override
    public void onError(String info) {
        // Handle Error
    }
});
```

# Video Streaming (RPC v4.5+)

One of the most powerful features provided by SDL is the ability to stream an interactive Android layout directly to a vehicle's heads up display. The following guide explains the basics of this functionality.

# SDL Remote Display

The `SdlRemoteDisplay` base class provides the easiest way to start streaming using SDL. The `SdlRemoteDisplay` is extended from Android's `Presentation` class with modifications to work with other aspects of the SDL Android library.

> **NOTE**
>
> It is recommended that you extend this as a local class within the service that has the `SdlManager` instance.

Extending this class gives developers a familiar, native experience to handle layouts and events on screen.

> **NOTE**
>
> You must have a valid and approved application ID from an OEM in order receive user input from a remote display.

The following example uses a simple layout containing a single button:

**Inside SdlService.java:**

```
//...

//This class should be nested in SdlService or another class containing the
application's SdlManager instance
public static class MyDisplay extends SdlRemoteDisplay{
    public MyDisplay(Context context, Display display) {
        super(context, display);
    }

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);

        setContentView(R.layout.stream);

        Button button = findViewById(R.id.button);

        button.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                DebugTool.logInfo(TAG, "Button Clicked");
            }
        });
    }
}

//...
```

**res/layout/stream.xml:**

```
<?xml version="1.0" encoding="utf-8"?>
<RelativeLayout xmlns:android="http://schemas.android.com/apk/res/android"
  android:layout_width="match_parent"
  android:layout_height="match_parent">

  <Button
    android:id="@+id/button"
    android:layout_width="wrap_content"
    android:layout_height="wrap_content"
    android:layout_centerInParent="true" />

</RelativeLayout>
```

> **NOTE**
>
> If you are obfuscating the code in your app, make sure to exclude your class that extends `SdlRemoteDisplay`. For more information on how to do that, you can check Proguard Guidelines.

# Managing the Stream

The `VideoStreamManager` can be used to start streaming a remote display after the `SdlManager` has successfully been started. This is performed by calling the method `startRemoteDisplayStream(Context context, final Class<? extends SdlRemoteDisplay> remoteDisplay, final VideoStreamingParameters parameters, final boolean encrypted, VideoStreamingRange supportedLandscapeStreamingRange, VideoStreamingRange supportedPortraitStreamingRange)`.

**Inside SdlService.java:**

```
//...

if (sdlManager.getVideoStreamManager() != null) {
    sdlManager.getVideoStreamManager().start(new CompletionListener() {
        @Override
        public void onComplete(boolean success) {
            if (success) {
                sdlManager.getVideoStreamManager().startRemoteDisplayStream(
                    getApplicationContext(),
                    MyDisplay.class,
                    null,
                    false,
                    null,
                    null
                );
            } else {
                DebugTool.logError(TAG, "Failed to start video streaming manager");
            }
        }
    });
}

//...
```

## Ending the Stream

When the `HMIStatus` is back to `HMI_NONE` it is time to stop the stream. This is accomplished through a method `stopStreaming()`.

**Inside SdlService.java:**

```
//...

/*
 OnRPCNotificationListeners are commonly used to perform tasks at specific HMI levels
 In this case, it is used to end streaming at HMI_NONE
*/
Map<FunctionID, OnRPCNotificationListener> onRPCNotificationListenerMap = new HashMap<>();
onRPCNotificationListenerMap.put(FunctionID.ON_HMI_STATUS, new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnHMIStatus status = (OnHMIStatus) notification;

        if (status != null && status.getHmiLevel() == HMILevel.HMI_NONE) {
            //Stop the stream
            if (sdlManager.getVideoStreamManager() != null && sdlManager.getVideoStreamManager().isStreaming()) {
                sdlManager.getVideoStreamManager().stopStreaming();
            }
        }
    }
});

//...

/*
 builder refers to an instance of SdlManager.Builder
 The line below needs to be placed after builder is created and before builder.build() is called
*/
builder.setRPCNotificationListeners(onRPCNotificationListenerMap);

//...
```

## Handling HMI Scaling (RPC v6.0+)

If the HMI scales the video stream, you will have to handle scaling the projected view, touches, and haptic rectangles yourself (this is all handled for you behind the scenes in the `VideoStreamManager` API). To find out if the HMI scales the video stream, you must for query and check the `VideoStreamingCapability` for the `scale` property. Please check the Adaptive Interface Capabilities section for more information on how to query for this property using the system capability manager. For information on manually handling haptic rectangles, refer to the Haptic Input guide.

## Video Streaming Parameters (SDL v5.1+)

Starting with SDL version 5.1+ the `VideoStreamingParameters` you provide will automatically be aligned with the `VideoStreamingCapabilities` provided by the HMI.
If the HMI provides the scale or resolution in the `VideoStreamingCapabilities` the video stream will use that scale or resolution. Otherwise, the scale or resolution you defined in the `VideoStreamingParameters` will be used.
If the HMI provides the bitrate or preferred frame rate in the `VideoStreamingCapabilities` and they are also defined in the `VideoStreamingParamerters` you provided, the smaller bitrate or preferred frame rate will be used.

## Video Framerate

Starting with SDL v5.1, the video stream manager works behind the scene to create a consistent video stream that matches the framerate set in `VideoStreamingParameters`. This is the now the default behavior but you have the option to revert to the old behavior by setting the `stableFrameRate` flag to `false` in the `VideoStreamingParameters`.

```
VideoStreamingParameters params = new VideoStreamingParameters();
//Turn on use of stable frame rate
params.setStableFrameRate(true);
//Set the frame rate that you would wish to stream at
params.setFrameRate(30);
```

## Supporting Different Video Streaming Window Sizes (RPC v7.1+)

Some HMIs support multiple view sizes and may resize your SDL app's view during video streaming (i.e. to a collapsed view, split screen, preview mode or picture-in-picture). By default, your app will support all the view sizes and the `VideoStreamManager` will resize the video stream when the HMI notifies the app of the updated screen size.
If you wish to support only some screen sizes, you can configure the two `VideoStreamingRange` parameters when starting your video stream using the `startRemoteDisplay` method. One range is for landscape orientations and one range is for portrait orientations. In these `VideoStreamingRange` parameters you can define different view sizes that you wish to support in the event that the HMI resizes the view during the stream.

In the `VideoStreamingRange` you will define a minimum and maximum resolution, minimum diagonal, and a minimum and maximum aspect ratio. Any values you do not wish to use should be set to `null`.
If you want to support all possible landscape or portrait sizes you can simply pass `null` for `supportedLandscapeStreamingRange`, `supportedPortraitStreamingRange`, or both. If you wish to only support landscape orientation or only support portrait orientation you "disable" the range by passing a `VideoStreamingRange` with all 0 values set.

```
/*
 This VideoStreamingRange represents a disabled range
 It can be passed if you do not wish to support landscape orientation or portrait orientation
*/
final VideoStreamingRange disabledRange = new VideoStreamingRange(new Resolution(0, 0),
    new Resolution(0, 0), 0.0, 0.0, 0.0);

/*
 This VideoStreamingRange represents that we will support any resolution between 500x200 and 800x400
 In this case, it does not directly restrict the diagonal size or aspect ratio
*/
final VideoStreamingRange landscapeRange = new VideoStreamingRange(new Resolution(500, 200),
    new Resolution(800, 400), null, null, null);
/*
 This VideoStreamingRange represents that we will support any aspect ratio between 1.0 and 2.5
 In this case, the resolution and diagonal size are not directly restricted
*/
final VideoStreamingRange portraitRange = new VideoStreamingRange(null, null, null, 1.0, 2.5);

if (sdlManager.getVideoStreamManager() != null) {
    sdlManager.getVideoStreamManager().start(new CompletionListener() {
        @Override
        public void onComplete(boolean success) {
            if (success) {
                sdlManager.getVideoStreamManager().startRemoteDisplayStream(
                    getApplicationContext(),
                    MyDisplay.class,
                    null,
                    false,
                    landscapeRange,
                    portraitRange
                );
            } else {
                DebugTool.logError(TAG, "Failed to start video streaming manager");
            }
        }
    });
}
```

> **NOTE**
>
> If you disable both the `supportedLandscapeStreamingRange` and `supportedPortraitStreamingRange`, video will not stream.

If the HMI resizes the view during the stream, the video stream will automatically restart with the new size and the `onViewResized` method you defined in your presentation class will be notified of the new screen size.

```
public static class MyDisplay extends SdlRemoteDisplay{
    public MyDisplay(Context context, Display display) {
        super(context, display);
    }

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        //...
    }

    //onViewResized is added in SDL v5.1+
    @Override
    public void onViewResized(int width, int height) {
        DebugTool.logInfo(TAG, "Remote view new width and height ("+ width + ", " +
height + ")");
        //Update presentation based on new resolution
    }
}
```

# Audio Streaming

A navigation app can stream raw audio to the head unit. This audio data is played immediately. If audio is already playing, the current audio source will be attenuated and your audio will play. Raw audio must be played with the following parameters:

- **Format**: PCM
- **Sample Rate**: 16k
- **Number of Channels**: 1
- **Bits Per Second (BPS)**: 16 bits per sample / 2 bytes per sample

To stream audio from a SDL app, use the `AudioStreamingManager` class. A reference to this class is available from the `SdlManager` s `audioStreamManager` property.

## Audio Stream Manager

The `AudioStreamManager` will help you to do on-the-fly transcoding and streaming of your files in mp3 or other formats, or prepare raw PCM data to be queued and played.

## Starting the Audio Manager

To stream audio, we call `sdlManager.getAudioStreamManager().start()` which will start the manager. When that callback returns with a success, call `sdlManager.getAudioStreamManager().startAudioStream()`. Once this callback returns successfully you can send and play audio.

```
if (sdlManager.getAudioStreamManager() == null) {
    // Handle the failure
    return;
}

sdlManager.getAudioStreamManager().start(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (!success) {
            // Failed to start audio streaming manager
            return;
        }
        sdlManager.getAudioStreamManager().startAudioStream(false, new
CompletionListener() {
            @Override
            public void onComplete(boolean success) {
                if (!success) {
                    // Failed to start audio stream
                    return;
                }
                // Push Audio Source
            }
        });
    }
});
```

## PLAYING FROM FILE

```
//Push from Uri Audio Source
sdlManager.getAudioStreamManager().pushAudioSource(audioSourceUri, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            DebugTool.logInfo(TAG, "Audio Uri played successfully!");
        } else {
            DebugTool.logInfo(TAG, "Audio Uri failed to play!");
        }
    }
});

//Push from Raw Audio Source
sdlManager.getAudioStreamManager().pushResource(R.raw.exampleMp3, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            DebugTool.logInfo(TAG, "Audio file played successfully!");
        } else {
            DebugTool.logInfo(TAG, "Audio file failed to play!");
        }
    }
});
```

## PLAYING FROM DATA

```
//Push from ByteBuffer Audio Source
sdlManager.getAudioStreamManager().pushBuffer(byteBuffer, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {
            DebugTool.logInfo(TAG, "Buffer played successfully!");
        } else {
            DebugTool.logInfo(TAG, "Buffer failed to play!");
        }
    }
});
```

### STOPPING THE AUDIO STREAM

When the stream is complete, or you receive `HMI_NONE`, you should stop the stream by calling:

```
sdlManager.getAudioStreamManager().stopAudioStream(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        // do something once the stream is stopped
    }
});
```

# Supporting Haptic Input (RPC v4.5+)

SDL now supports "haptic" input: input from something other than a touch screen. This could include trackpads, click-wheels, etc. These kinds of inputs work by knowing which views on the screen are touchable and focusing / highlighting on those areas when the user moves the trackpad or click wheel. When the user selects within a view, the center of that area will be "touched".

> **NOTE**
>
> Currently, there are no RPCs for knowing which view is highlighted, so your UI will have to remain static (i.e. you should not create a scrolling menu in your SDL app).

# Automatic Focusable Rectangles

SDL has support for automatically detecting focusable views within your UI and sending that data to the head unit. You will still need to tell SDL when your UI changes so that it can re-scan and detect the views to be sent.

The easiest way to use this is by taking advantage of SDL's Presentation class. This will automatically check if the capability is available and instantiate the manager for you. All you have to do is set your layout:

```
public static class MyPresentation extends SdlRemoteDisplay {

    public MyPresentation(Context context, Display display) {
        super(context, display);
    }

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.haptic_layout);
        LinearLayout videoView = (LinearLayout) findViewById(R.id.cat_view);
        videoView.setOnTouchListener(new View.OnTouchListener() {
            @Override
            public boolean onTouch(View view, MotionEvent motionEvent) {
                // ...Update something on the ui

                MyPresentation.this.invalidate();

                return false;
            }
        });
    }
}
```

This will go through your view that was passed in and then find and send the rects to the head unit for use. When your UI changes, call `invalidate()` from your class that extends `SdlRemoteDisplay`.

# Manual Focusable Rects

It is also possible that you may want to create your own rects instead of using the automated methods in the Presentation class. It is important that if sending this data yourself that you also use the `SystemCapabilityManager` to check if you are on a head unit that supports this feature. If the capability is available, it is easy to build the area you want to become selectable:

```
public void sendHapticData() {
    Rectangle rectangle = new Rectangle()
        .setX((float) 1.0)
        .setY((float) 1.0)
        .setWidth((float) 1.0)
        .setHeight((float) 1.0);

    HapticRect hapticRect = new HapticRect()
        .setId(123)
        .setRect(rectangle);

    ArrayList<HapticRect> hapticArray = new ArrayList<HapticRect>();
    hapticArray.add(0, hapticRect);

    SendHapticData sendHapticData = new SendHapticData();
    sendHapticData.setHapticRectData(hapticArray);

    sdlManager.sendRPC(sendHapticData);
}
```

Each `SendHapticData` RPC should contain the entirety of all clickable areas to be accessed via haptic controls.

# Displaying Turn Directions

While your app is navigating the user, you will also want to send turn by turn directions. This is useful for if your app is in the background or if the user is in the middle of a phone call, and gives the system additional information about the next maneuver the user must make.

When your navigation app is guiding the user to a specific destination, you can provide the user with visual and audio turn-by-turn prompts. These prompts will be presented even

when your SDL app is backgrounded or a phone call is ongoing.
While your app is navigating the user, you will also want to send turn by turn directions. This is useful if your app is in the background or if the user is in the middle of a phone call, and gives the system additional information about the next maneuver the user must make.

To create a turn-by-turn direction that provides both a visual and audio cues, a combination of the `ShowConstantTBT` and `AlertManeuver` RPCs must should be sent to the head unit.

> **NOTE**
>
> If the connected device has received a phone call in the vehicle, the `AlertManeuver` is the only way for your app to inform the user of the next turn.

## Visual Turn Directions

The visual data is sent using the `ShowConstantTBT` RPC. The main properties that should be set are `navigationText1`, `navigationText2`, and `turnIcon`. A best practice for navigation apps is to use the `navigationText1` as the direction to give (i.e. turn right) and `navigationText2` to provide the distance to that direction (i.e. 3 mi.).

## Audio Turn Directions

The audio data is sent using the `AlertManeuver` RPC. When sent, the head unit will speak the text you provide (e.g. In 3 miles turn right).

# Sending Audio and Visual Turn Directions

```
ShowConstantTbt turnByTurn = new ShowConstantTbt()
    .setNavigationText1("Turn Right")
    .setNavigationText2("3 mi")
    .setTurnIcon(turnIcon);
turnByTurn.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (!response.getSuccess()){
            DebugTool.logError(TAG, "onResponse: Error sending TBT");
            return;
        }

            AlertManeuver alertManeuver = new AlertManeuver()
                .setTtsChunks(Collections.singletonList(new TTSChunk("In 3 miles turn
right", SpeechCapabilities.TEXT)));
            alertManeuver.setOnRPCResponseListener(new OnRPCResponseListener() {
                @Override
                public void onResponse(int correlationId, RPCResponse response) {
                    if (!response.getSuccess()){
                        DebugTool.logError(TAG, "onResponse: Error sending AlertManeuver");
                    }
                }
            });
            sdlManager.sendRPC(alertManeuver);
        }
    });
sdlManager.sendRPC(turnByTurn);
```

Remember when sending a `Image`, that the image must first be uploaded to the head unit with the `FileManager`.

# Clearing the Turn Directions

To clear a navigation direction from the screen, send a `ShowConstantTbt` with the `maneuverComplete` property set to true. This will also clear the accompanying `AlertManeuver`.

```
ShowConstantTbt turnByTurn = new ShowConstantTbt()
    .setManeuverComplete(true);
turnByTurn.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (!response.getSuccess()){
            DebugTool.logError(TAG, "onResponse: Error sending TBT");
        }
    }
});
sdlManager.sendRPC(turnByTurn);
```

# Video Streaming Menu

When building a video-streaming navigation application, you can choose to create a custom menu using your own UI or use the built-in SDL menu system. The SDL menu allows you to display a menu structure so users can select menu options or submenus. For more information about the SDL menu system, see menus. It's recommended to use the built-in SDL menu system to have better performance, automatic driver distraction support - such as list limitations and text sizing, and more.

To open the SDL built-in menu from your video streaming UI, see 'Opening the Built-In Menu' below.

# Opening the Built-In Menu

The Show Menu RPC allows you to open the menu programmatically. That way, you can open the menu from your own UI.

## Show Top Level Menu

To show the top level menu use `sdlManager.screenManager.openMenu`.

```
sdlManager.getScreenManager().openMenu();
```

## Show Sub-Menu

You can also open the menu directly to a sub-menu. This is further down the tree than the top-level menu. To open a sub-menu, pass a cell that contains sub-cells. If the cell has no sub-cells the method call will fail.

> **NOTE**
>
> The sub-cell you use in `openSubMenu` must be included in `sdlManager.screenManager.menu` array. If it is not included in the array, the method call will fail.

```
sdlManager.getScreenManager().openSubMenu(cellWithSubCells);
```

# Close Application

If you choose to not use the built-in SDL menu system and instead want to use your own menu UI, you need to have a way for users to close your application. This should be done through a menu option in your UI that sends the `CloseApplication` RPC.

> **NOTE**
>
> This RPC is unnecessary if you are using `OpenMenu` because OEMs will take care of providing a close button into your menu themselves.

```
CloseApplication closeApplication = new CloseApplication();
sdlManager.sendRPC(closeApplication);
```

# Configuring SDL Logging

SDL Java Suite has a built-in logging framework that is designed to make debugging easier. It provides many of the features common to other 3rd party logging frameworks for java and can be used by your own app as well. We recommend that your app's integration with SDL provide logging using this framework rather than any other 3rd party framework your app may be using or `System.out.print`. This will consolidate all SDL related logs into a common format and to a common destination.

# Enabling the DebugTool

To make sure that log messages are displayed, you should enable the SDL Debug Tool:

```
DebugTool.enableDebugTool();
```

If you don't want the messages to be logged, you can disable the Debug Tool anytime:

```
DebugTool.disableDebugTool();
```

> **NOTE**
>
> If you use SDL Debug Tool to log messages without enabling the DebugTool nothing wrong will happen. It will simply not display the log messages. This gives the develop control on whether the logs should be displayed or not.

## Logging messages

The SDL debug tool can be used to log messages with different log levels. The log level defines how serious the log message is. This table summarizes when to use each log level:

| LOG LEVEL | WHEN TO USE |
| --- | --- |
| Info | Use this to post useful information to the log |
| Warning | Use this when you suspect something shady is going on |
| Error | Use this when bad stuff happens |

To log an info message:

```
DebugTool.logInfo(TAG, "info message goes here");
```

To log a warning message:

```
DebugTool.logWarning(TAG, "warning message goes here");
```

To log an error message:

```
DebugTool.logError(TAG, "error message goes here");
```

If you want to log error message with exception, you can add the exception as a second parameter to the `logError` method:

```
DebugTool.logError(TAG, "error message goes here", new SdlException("Sdl connection failed", SdlExceptionCause.SDL_CONNECTION_FAILED));
```

## Filtering logs

The log level defines which logs will be logged to the target outputs. For example, if you set the log level filter in `Logcat` to `Warning`, all error, and warning logs will be logged, but info level logs will not be logged.

| LOGLEVEL | VISIBLE LOGS |
| --- | --- |
| Error | error |
| Warning | error and warning |
| Info | error, warning, and info |

# Updating to 4.4 (Upgrading To Multiplexing)

This guide is to help developers get setup with the SDL Android library 4.4. Upgrading apps to utilize the multiplexing transport flow will require us to do a few steps. This guide will assume the SDL library is already integrated into the app.

We will make changes to:

- SdlService
- SdlRouterService **(new)**
- SdlBroadcastReceiver
- MainActivity

# SmartDeviceLink Service

The SmartDeviceLink proxy object instantiation needs to change to the new constructor. We also need to check for a boolean extra supplied through the intent that started the service.

The old instantiation should look similar to this:

```
proxy = new SdlProxyALM(this, APP_NAME, true, APP_ID);
```

The new constructor should look like this

```
public class SdlService extends Service implements IProxyListenerALM {

   //...

    @Override
    public int onStartCommand(Intent intent, int flags, int startId) {
        boolean forceConnect = intent !=null &&
intent.getBooleanExtra(TransportConstants.FORCE_TRANSPORT_CONNECTED,
false);
        if (proxy == null) {
            try {
                //Create a new proxy using Bluetooth transport
                //The listener, app name,
                //whether or not it is a media app and the applicationId are supplied.
                proxy = new SdlProxyALM(this.getBaseContext(),this, APP_NAME, true,
APP_ID);
            } catch (SdlException e) {
                //There was an error creating the proxy
                if (proxy == null) {
                //Stop the SdlService
                    stopSelf();
                }
            }
        }else if(forceConnect){
            proxy.forceOnConnected();
        }

        //use START_STICKY because we want the SDLService to be explicitly started
and stopped as needed.
        return START_STICKY;
    }
```

Notice we now gather the extra boolean from the intent and add to our if-else statement. If the proxy is not null, we need to check if the supplied boolean extra is true and if so, take action.

```
if (proxy == null) {
   //...
}else if(forceConnect){
    proxy.forceOnConnected();
}
```

# SmartDeviceLink Router Service (New)

The SdlRouterService will listen for a bluetooth connection with an SDL enabled module. When a connection happens, it will alert all SDL enabled apps that a connection has been established and they should start their SDL services.

We must implement a local copy of the SdlRouterService into our project. The class doesn't need any modification, it's just important that we include it. We will extend the `com.smartdevicelink.transport.SdlRouterService` in our class named `SdlRouterService`:

> **NOTE**
>
> Do not include an import for `com.smartdevicelink.transport.SdlRouterService`. Otherwise, we will get an error for `'SdlRouterService' is already defined in this compilation unit`.

```
public class SdlRouterService extends
com.smartdevicelink.transport.SdlRouterService {
//Nothing to do here
}
```

**MUST**

The local extension of the `com.smartdevicelink.transport.SdlRouterService` must be named `SdlRouterService`.

**MUST**

Make sure this local class (SdlRouterService.java) is in the same package of SdlReceiver.java (described below)

If you created the service using the Android Studio template then the service should have been added to your `AndroidManifest.xml` otherwise the service needs to be added in the manifest. Because we want our service to be seen by other SDL enabled apps, we need to set `android:exported="true"`. The system may issue a lint warning because of this, so we can suppress that using `tools:ignore="ExportedService"`. Once added, it should be defined like below:

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

    ...

        <service
            android:name="com.company.mySdlApplication.SdlRouterService"
            android:exported="true"
            android:process="com.smartdevicelink.router"
            tools:ignore="ExportedService">
        </service>

    </application>

    ...

</manifest>
```

MUST

The `SdlRouterService` must be placed in a separate process with the name `com.smartdevicelink.router`. If it is not in that process during its start up it will stop itself.

# SmartDeviceLink Broadcast Receiver

The SmartDeviceLink Android Library now includes a base BroadcastReceiver that needs to be used. It's called `SdlBroadcastReceiver`. Our old BroadcastReceiver will just need to extend this class instead of the Android BroadcastReceiver. Two abstract methods will be automatically populate the class, we will fill them out soon.

```
public class SdlReceiver extends SdlBroadcastReceiver {

    @Override
    public void onSdlEnabled(Context context, Intent intent) {...}

    @Override
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {...}

}
```

Next, we want to make sure we supply our instance of the SdlBroadcastService with our local copy of the SdlRouterService. We do this by simply returning the class object in the method defineLocalSdlRouterClass:

```
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
        //Return a local copy of the SdlRouterService located in your project
        return com.company.mySdlApplication.SdlRouterService.class;
    }
```

We want to start the SDL Proxy when an SDL connection is made via the `SdlRouterService`. This is likely code included on the `onReceive` method call previously. We do this by taking action in the onSdlEnabled method:

**NOTE**

The actual package definition for the SdlRouterService might be different. Just make sure to return your local copy and not the class object from the library itself.

```
public class SdlReceiver extends SdlBroadcastReceiver {

    @Override
    public void onSdlEnabled(Context context, Intent intent) {
        //Use the provided intent but set the class to the SdlService
        intent.setClass(context, SdlService.class);
        context.startService(intent);

    }


    @Override
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
        //Return a local copy of the SdlRouterService located in your project.
        return com.company.mySdlApplication.SdlRouterService.class;
    }
}
```

### NOTE

The `onSdlEnabled` method will be the main start point for our SDL connection session. We define exactly what we want to happen when we find out we are connected to SDL enabled hardware.

### MUST

SdlBroadcastReceiver must call super if `onReceive` is overridden

```
@Override
public void onReceive(Context context, Intent intent) {
    super.onReceive(context, intent);
    //your code here
}
```

Now we need to add two extra intent actions to or our intent filter for the SdlBroadcastReceiver:

- android.bluetooth.adapter.action.STATE_CHANGED
- **sdl.router.startservice**

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

        ...

        <receiver
            android:name=".SdlReceiver"
            android:exported="true"
            android:enabled="true">

            <intent-filter>
                <action android:name="android.bluetooth.device.action.ACL_CONNECTED"
/>
                <action
android:name="android.bluetooth.device.action.ACL_DISCONNECTED"/>
                <action
android:name="android.bluetooth.adapter.action.STATE_CHANGED"/>
                <action android:name="android.media.AUDIO_BECOMING_NOISY" />
                <action android:name="sdl.router.startservice" />
            </intent-filter>

        </receiver>

    </application>

...

</manifest>
```

MUST

SdlBroadcastReceiver has to be exported, or it will not work correctly

## Main Activity

Our previous MainActivity class probably looked similar to this:

```
```

```
public class MainActivity extends Activity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        // Start the SDLService
        Intent sdlServiceIntent = new Intent(this, SdlService.class);
        startService(sdlServiceIntent);
    }
}
```

However now instead of starting the service every time we launch the application we can do a query that will let us know if we are connected to SDL enabled hardware or not. If we are, the `onSdlEnabled` method in our SdlBroadcastReceiver will be called and the proper flow should start. We do this by removing the intent creation and startService call and instead replace them with a single call to `SdlReceiver.queryForConnectedService(Context)` .

```
public class MainActivity extends Activity {

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);

        //If we are connected to a module we want to start our SdlService
        SdlReceiver.queryForConnectedService(this);
    }
}
```

# Updating from 4.4 to 4.5

This guide is to help developers get setup with the SDL Android library 4.5. It is assumed that the developer is already updated to 4.4 of the library. There are a few very important

changes that we need to make to the integration to keep things working well. The first is a few new additions to the AndroidManifest.xml and the `SdlRouterService` entry. Next, we have to prepare for Android Oreo's push towards foreground services.

We will make changes to:

- AndroidManifest.xml
- SdlService
- SdlBroadcastReceiver

# AndroidManifest.xml Updates

Assuming the manifest was up to date with version 4.4 requirements we need to add an intent-filter and a meta-data item. The entire entry should look as follows:

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

    ...

        <service
            android:name="com.company.mySdlApplication.SdlRouterService"
            android:exported="true"
            android:process="com.smartdevicelink.router"
            tools:ignore="ExportedService">
            <intent-filter>
                <action android:name="com.smartdevicelink.router.service"/>
            </intent-filter>
            <meta-data android:name="sdl_router_version"
android:value="@integer/sdl_router_service_version_value" />
        </service>

    </application>

    ...

</manifest>
```

## Intent Filter

```
<intent-filter>
   <action android:name="com.smartdevicelink.router.service"/>
</intent-filter>
```

The new versions of the SDL Android library rely on the `com.smartdevicelink.router.service` action to query SDL enabled apps that host router services. This allows the library to determine which router service to start.

**MUST**

This `intent-filter` MUST be included.

## Metadata

### ROUTER SERVICE VERSION

```
<meta-data android:name="sdl_router_version"
android:value="@integer/sdl_router_service_version_value" />
```

Adding the `sdl_router_version` metadata allows the library to know the version of the router service that the app is using. This makes it simpler for the library to choose the newest router service when multiple router services are available.

### CUSTOM ROUTER SERVICE

```
<meta-data android:name="sdl_custom_router" android:value="false" />
```

> **NOTE**
>
> This is only for specific OEM applications, therefore normal developers do not need to worry about this.

Some OEMs choose to implement custom router services. Setting the `sdl_custom_router` metadata value to `true` means that the app is using something custom over the default router service that is included in the SDL Android library. Do not include this `meta-data` entry unless you know what you are doing.

# Android Oreo's Push To Foreground Services

Previous versions of Android allowed our SDL app partners to start their SDL services in the background and attach themselves to the foregrounded SDL router service. Android Oreo (API 26) has changed that. Due to new OS limitations, apps must start their SDL service in the foreground.

## What do I need to do?

There are a few changes to make, one in the `SdlBroadcastReceiver` and the other in the `SdlService` (or which service the proxy is implemented).

## SDLBROADCASTRECEIVER

### PREVIOUS VERSION

```
@Override
public void onSdlEnabled(Context context, Intent intent) {
    Log.d(TAG, "SDL Enabled");
    intent.setClass(context, SdlService.class);
    context.startService(intent);
}
```

### SAMPLE UPDATE

```
@Override
public void onSdlEnabled(Context context, Intent intent) {
    Log.d(TAG, "SDL Enabled");
    intent.setClass(context, SdlService.class);
    if(Build.VERSION.SDK_INT < Build.VERSION_CODES.O) {
        context.startService(intent);
    }else{
        context.startForegroundService(intent);
    }

}
```

This means the app will start the SDL service in the background if we are on a device that uses Android N or earlier. If the app is running on Android Oreo or newer, the service will make a promise to the OS that the service will move into the foreground. If the service doesn't explicitly move into the foreground an exception will be thrown.

## SDLSERVICE (OR SIMILAR)

Within the `SdlService` class or similar you will need to add a call to start the service in the foreground. This will include creating a notification to sit in the status bar tray. This information and icons should be relevant for what the service is doing/going to do. If you already start your service in the foreground, you can ignore this section.

```
public void onCreate() {
    super.onCreate();
    ...

    NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
     notificationManager.createNotificationChannel(...);
     Notification serviceNotification = new Notification.Builder(this, *Notification
Channel*)
         .setContentTitle(...)
         .setSmallIcon(....)
         .setLargeIcon(...)
         .setContentText(...)
         .setChannelId(channel.getId())
         .build();
     startForeground(id, serviceNotification);
}
```

## EXITING THE FOREGROUND

It's important that you don't leave you notification in the notification tray as it is very confusing to users. So in the `onDestroy` method in your service, simply call the `stopForeground` method.

```
@Override
public void onDestroy(){
    //...
    if(Build.VERSION.SDK_INT>=Build.VERSION_CODES.O){
        NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
        if(notificationManager!=null){ //If this is the only notification on your channel
            notificationManager.deleteNotificationChannel(* Notification Channel*);
        }
        stopForeground(true);
    }
}
```

# Notification Suggestions

We realize that pushing a notification to the notification tray is not ideal for any apps, but with Android's push for more transparency to users it's important that we don't try to workaround that. Android is getting stricter with their guidelines and could potentially prevent apps from being released if they are found to be not adhering to these rules.

## THE CORRECT WAY

The right way to handle the new foreground service requirement is to simply push a full-fledged notification to the notification tray.

How to do it

```
    @Override
    public void onCreate() {
        super.onCreate();
        ...
        if(Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
            NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
            NotificationChannel channel = new NotificationChannel("MyApp", "SdlService",
NotificationManager.IMPORTANCE_DEFAULT);
            notificationManager.createNotificationChannel(channel);
            Notification serviceNotification = new Notification.Builder(this,
channel.getId())
                    .setContentTitle("MyApp is connected through SDL")
                    .setSmallIcon(R.drawable.ic_launcher_foreground)
                    .build();
            startForeground(id, serviceNotification);
        }
    }
```

## THE NOT SO CORRECT WAY

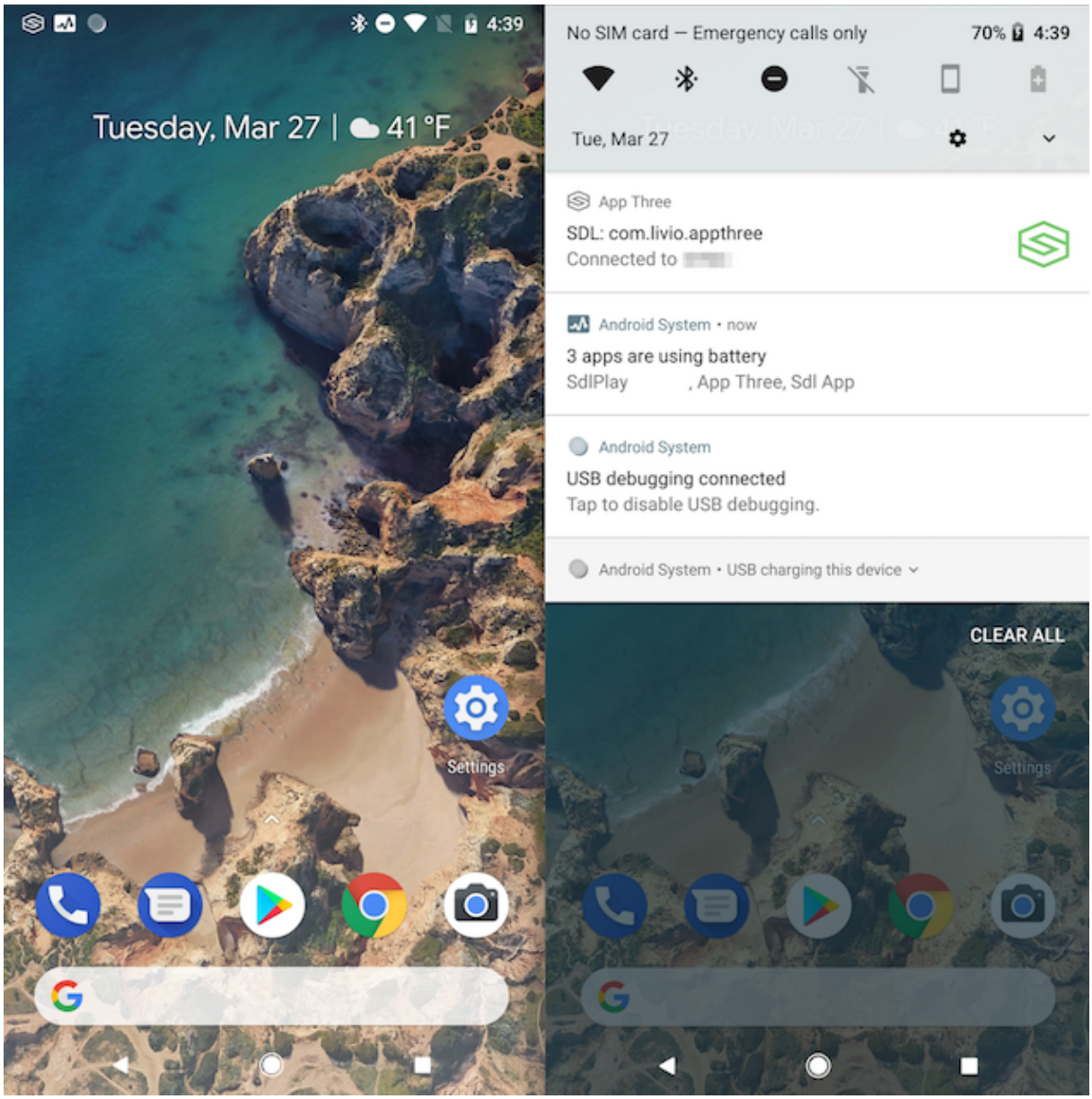
Currently Android Oreo allows a notification to be used that has not declared a notification channel. This results in the notification icon not actually appearing on its own. Instead it is grouped together into the notification channel that reads "# apps are using battery" from the Android System. This is likely to prevent breaking changes from apps that have not

updated their integration to Android Oreo, however, we fully anticipate this to be changed in the future so it is not recommended.

### How to do it

```
@Override
public void onCreate() {
    super.onCreate();
    ...
    if(Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
        Notification serviceNotification = new Notification.Builder(this, "NoChannel")
                .setContentTitle("MyApp is connected through SDL")
                .setSmallIcon(R.drawable.ic_launcher_foreground)
                .build();
        startForeground(id, serviceNotification);
    }
}
```

### How it looks



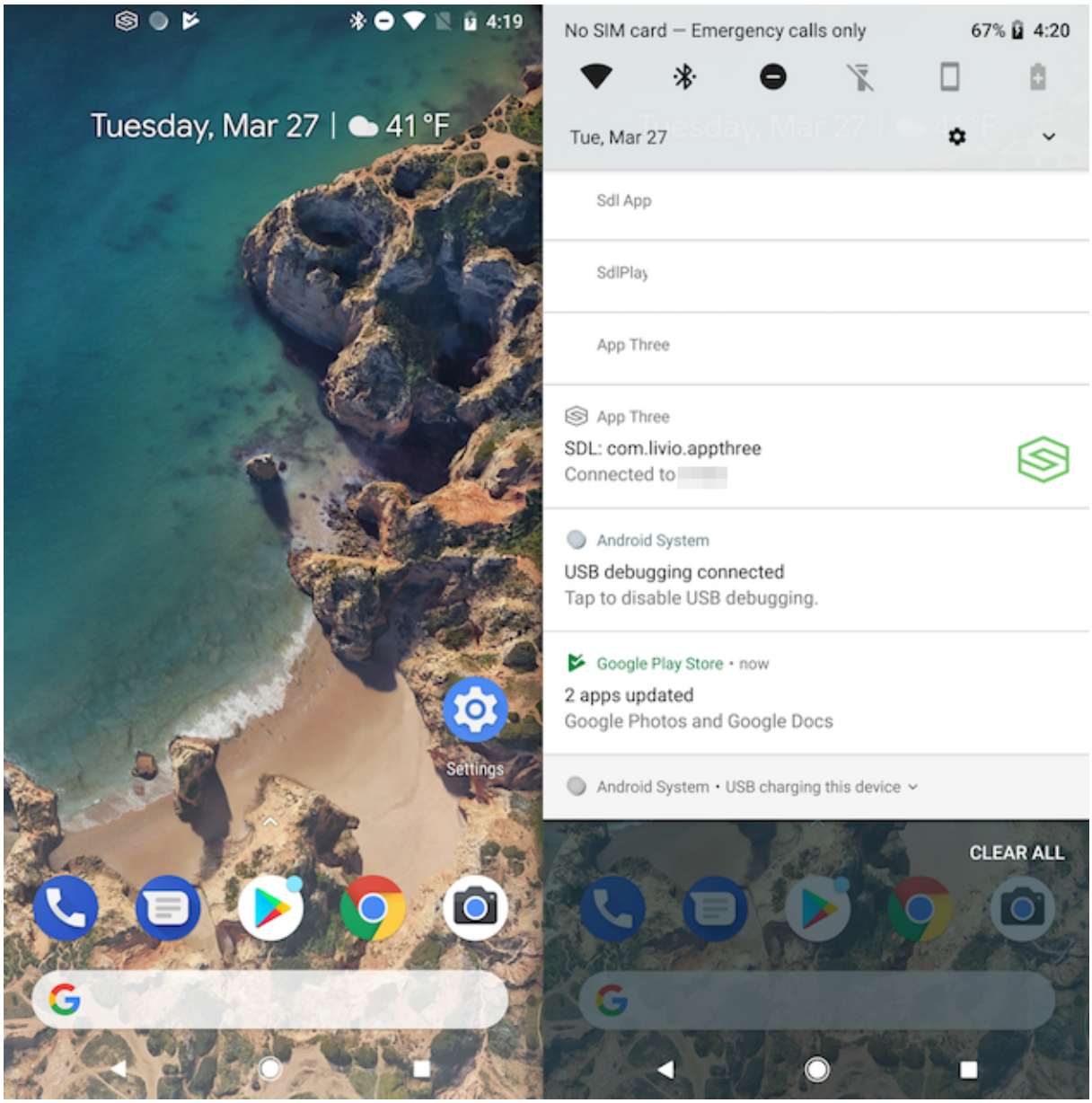

## THE ABSOLUTELY NOT CORRECT WAY

It is possible to create a somewhat invisible notification. This will appear to just be blank space in the notification tray. With adding minimal content to the notification when the user pulls down the tray it will have a very small footprint on the screen. However, this is completely disingenuous to the user and should not be considered a solution. Android will most likely see this as bad behavior and could prevent you from releasing your app or even remove your app from the play store with a ban included. Don't do this.

How to do it

```
    @Override
    public void onCreate() {
        super.onCreate();
        ...
        if(Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
            NotificationManager notificationManager = (NotificationManager)
getSystemService(Context.NOTIFICATION_SERVICE);
            NotificationChannel channel = new NotificationChannel("MyApp", "SdlService",
NotificationManager.IMPORTANCE_DEFAULT);
            notificationManager.createNotificationChannel(channel);
            Notification serviceNotification = new Notification.Builder(this,
channel.getId())
                    .setSmallIcon(R.drawable.sdl_tray_invis)
                    .build();
            startForeground(id, serviceNotification);
        }
    }
```

How it looks




# Updating from 4.5 to 4.6

This guide is to help developers get setup with the SDL Android library 4.6. It is assumed that the developer is already updated to 4.5 of the library. There are a few important changes that we need to make to the integration to keep things working well. The first is removing some of the BroadcastReceiver's intent filters in `AndroidManifest.xml` that are now unnecessary. Secondly, the gradle integration of our library should now use `impleme`

ntation instead of compile. Lastly, the RPCRequestFactory class has been deprecated and constructors with mandatory parameters have been added for each RPC class.

We will make changes to:

- AndroidManifest.xml
- build.gradle
- any usage of RPCRequestFactory

# AndroidManifest.xml Updates

Assuming the manifest was up to date with version 4.5, we can now remove some of the intent-filters ( ACL_DISCONNECTED , STATE_CHANGED , AUDIO_BECOMING_NOISY ) for your app's BroadcastReceiver. The BroadcastReceiver section of the manifest should look as follows:

```
<manifest xmlns:android="http://schemas.android.com/apk/res/android"
    package="com.company.mySdlApplication">

    <application>

        ...

        <receiver
            android:name=".SdlReceiver"
            android:exported="true"
            android:enabled="true">

            <intent-filter>
                <action android:name="android.bluetooth.device.action.ACL_CONNECTED"
/>
                <action android:name="sdl.router.startservice" />
            </intent-filter>

        </receiver>

    </application>

...

</manifest>
```

# Gradle Update

The previous way of including the library via `compile` should now use `implementation`. The dependencies section of your app's `build.gradle` file should now appear as:

```
dependencies {
    implementation 'com.smartdevicelink:sdl_android:4.+'
}
```

# Deprecation of RPCRequestFactory

The RPCRequestFactory has been deprecated in 4.6. To build RPC requests, developers should use the constructors in the desired RPC request class. For example, instead of using `RPCRequestFactory.buildAddCommand(...)` to build an `AddCommand` request, try the following:

```
AddCommand addCommand = new AddCommand(100);
addCommand.setMenuParams(new MenuParams("Skip"));
proxy.sendRPCRequest(addCommand);
```

# Updating from 4.6 to 4.7

## Overview

This guide is to help developers get setup with the SDL Android library version 4.7. It is assumed that the developer is already updated to 4.6 of the library. This version includes the addition of the SdlManagers and a re-working of the transports which greatly enhances the use of the `SdlRouterService`, along with adding the functionality for secondary transports on supporting versions of SDL Core.

In this guide we will be focusing on the transitioning from the proxy, which implemented `SdlProxyALM` into using the `SdlManager` system, which includes specialized sub-managers that you can interact with through the `SdlManager`. We will follow the naming convention of the guides, highlighting the previous way of implementing SDL and showing the new ways of implementing it.

> **NOTE**
>
> Moving from the `SdlProxyALM` implementation to the `SdlManager` API will require you to manually subscribe to the notifications and responses that you wish to receive instead of all of the notifications and responses being passed through the `IProxyListenerALM` interface.

# Integration Basics

The `SdlService` class will contain a great deal of changes as it acts as the main bridge to SDL functionality. There are going to be two main differences with how this class was set up in 4.6 versus 4.7.

## Removal of IProxyListenerALM

Previously, your `SdlService` had to implement the `IProxyListenerALM` interface. This often added many unnecessary lines of code to the class due to the need to override all of its functions. The need to do this has been removed in 4.7 with the inclusion of the `SdlManager` APIs. Developers now only have to add the listeners they need.

### 4.6:

```
public class SdlService extends Service implements IProxyListenerALM {

    // The proxy handles communication between the application and SDL
    private SdlProxyALM proxy = null;

    //...

    @Override
    public void someListener(){}
    //...
}
```

### 4.7: THE REQUIREMENT TO IMPLEMENT `IPROXYLISTENERALM` IS REMOVED:

```
public class SdlService extends Service {

    // The SdlManager exposes the APIs needed to communicate between the
application and SDL
    private SdlManager sdlManager = null;

    //...
}
```

After removing `IProxyListenerALM` from the `SdlService`, all of its previously overridden functions will need to be removed. If your app used any of these callback methods, it will help to document which ones they were, as you will need to add in the listeners that you need using the `SdlManager`'s `addOnRPCNotificationListener`.

> **NOTE**
>
> When you start using the managers, you have to make sure that your app subscribes to notifications before sending the corresponding RPC requests and subscriptions or else some notifications may be missed.

## Creation of SdlManager

As we no longer want to directly instantiate `SdlProxyALM`, we need to instantiate the `SdlManager` instead. This is best done using the `SdlManager.Builder` class using your application's details and configurations. In order to receive life cycle events from the `SdlManager`, an `SdlManagerListener` must be provided. The new code should resemble the following:

```
public class SdlService extends Service {

    //The manager handles communication between the application and SDL
    private SdlManager sdlManager = null;

    //...

    @Override
    public int onStartCommand(Intent intent, int flags, int startId) {

        if (sdlManager == null) {
            MultiplexTransportConfig transport = new MultiplexTransportConfig(this,
APP_ID, MultiplexTransportConfig.FLAG_MULTI_SECURITY_OFF);

            // The app type to be used
            Vector<AppHMIType> appType = new Vector<>();
            appType.add(AppHMIType.MEDIA);

            // The manager listener helps you know when certain events that pertain to
the SDL Manager happen
            SdlManagerListener listener = new SdlManagerListener() {

                @Override
                public void onStart() {
                    // RPC listeners and other functionality can be called once this callback
is triggered.
                }

                @Override
                public void onDestroy() {
                    SdlService.this.stopSelf();
                }

                @Override
                public void onError(String info, Exception e) {
                }
            };

            // Create App Icon, this is set in the SdlManager builder
            SdlArtwork appIcon = new SdlArtwork(ICON_FILENAME,
FileType.GRAPHIC_PNG, R.mipmap.ic_launcher, true);

            // The manager builder sets options for your session
            SdlManager.Builder builder = new SdlManager.Builder(this, APP_ID,
APP_NAME, listener);
            builder.setAppTypes(appType);
            builder.setTransportType(transport);
            builder.setAppIcon(appIcon);
            sdlManager = builder.build();
            sdlManager.start();
        }
```

```
    //...
}
```

Once you receive the `onStart` callback from `SdlManager`, you can add in your listeners and start adding UI elements. There will be more about adding the UI elements later. The last example in this section will be about adding specific listeners. Because we removed the `IProxyListenerALM` implementation, you will have to set listeners for the needs of your app.

## Listening for RPC notifications and events

We can listen for specific events using `SdlManager`'s `addOnRPCNotificationListener`. These listeners can be added either in the `onStart()` callback of the `SdlManagerListener` or after it has been triggered. The following example shows how to listen for HMI Status notifications. Additional listeners can be added for specific RPCs by using their corresponding `FunctionID` in place of the `ON_HMI_STATUS` in the following example and casting the `RPCNotification` object to the correct type.

#### EXAMPLE OF A LISTENER FOR HMI STATUS:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_HMI_STATUS, new
OnRPCNotificationListener() {
        @Override
        public void onNotified(RPCNotification notification) {
            OnHMIStatus status = (OnHMIStatus) notification;
            if (status.getHmiLevel() == HMILevel.HMI_FULL && ((OnHMIStatus)
notification).getFirstRun()) {
                // first time in HMI Full
            }
        }
    });
```

## Sending RPCs

There are new method names and locations that mimic previous functionality for sending RPCs. These methods are located in the `SdlManager` and have the new names of `send`

`RPC`, `sendRPCs`, and `sendSequentialRPCs`.

4.6:

```
// single RPC
proxy.sendRPCRequest(request);

// multiple RPCs, non-sequential
proxy.sendRequests(rpcs, new OnMultipleRequestListener() {
    //...
});

// multiple RPCs, sequential
proxy.sendSequentialRequests(rpcs, new OnMultipleRequestListener() {
    //...
});
```

In 4.7, we use the `SdlManager` to send the requests.

4.7:

```
// single RPC
sdlManager.sendRPC(request);

// multiple RPCs, non-sequential
sdlManager.sendRPCs(rpcs, new OnMultipleRequestListener() {
    //...
});

// multiple RPCs, sequential
sdlManager.sendSequentialRPCs(rpcs, new OnMultipleRequestListener() {
    //...
});
```

## Using AOA Protocol

If your app uses USB to connect to SDL, this update provides a very useful enhancement. AOA connections now work with the `SdlRouterService`. This means that multiple USB apps can be connected to the head unit at once.

## SDLBROADCASTRECEIVER

Since the AOA transport will now use the multiplexing feature, it is important that your app correctly adds functionality for the `SdlRouterService`. This starts in the `SdlBroadcastReciever`.

### 4.6:

```
public class SdlReceiver extends com.smartdevicelink.SdlBroadcastReceiver {

    @Override
    public void onSdlEnabled(Context context, Intent intent) {
        //Use the provided intent but set the class to your SdlService
        intent.setClass(context, SdlService.class);
        context.startService(intent);
    }

    @Override
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
         return null;
    }

}
```

### 4.7:

```
public class SdlReceiver extends com.smartdevicelink.SdlBroadcastReceiver {

    @Override
    public void onSdlEnabled(Context context, Intent intent) {
        //Use the provided intent but set the class to your SdlService
        intent.setClass(context, SdlService.class);
        context.startService(intent);
    }

    @Override
    public Class<? extends SdlRouterService> defineLocalSdlRouterClass() {
        // define your local router service. For example:
        return com.sdl.hellosdlandroid.SdlRouterService.class;
    }

}
```

## SDLROUTERSERVICE

The `SdlRouterService` will listen for a connection with an SDL enabled module. When a connection happens, it will alert all SDL enabled apps that a connection has been established and they should start their SDL services.

### 4.6:

(No implementation required).

### 4.7:

We must implement a local copy of the `SdlRouterService` into our project. The class doesn't need any modification, it's just important that we include it. We will extend the `com.smartdevicelink.transport.SdlRouterService` in our class named `SdlRouterService`:

> **NOTE**
>
> Do not include an import for `com.smartdevicelink.transport.SdlRouterService`. Otherwise, we will get an error for `'SdlRouterService' is already defined in this compilation unit`.

```
public class SdlRouterService extends
com.smartdevicelink.transport.SdlRouterService {
//Nothing to do here
}
```

> **MUST**

The local extension of the `com.smartdevicelink.transport.SdlRouterService` must be named `SdlRouterService`.

**MUST**

Make sure this local class (SdlRouterService.java) is in the same package of SdlReceiver.java

## SDLSERVICE

4.6:

```
transport = new USBTransportConfig(getBaseContext(), (UsbAccessory)
intent.getParcelableExtra(UsbManager.EXTRA_ACCESSORY), false, false);
```

4.7:

```
MultiplexTransportConfig transport = new MultiplexTransportConfig(this, APP_ID,
MultiplexTransportConfig.FLAG_MULTI_SECURITY_MED);
```

### ADDITIONAL CONFIGURATIONS:

If your app requires high bandwidth transport, you can now specify that:

```
transport.setRequiresHighBandwidth(true);
```

**NOTE**

If your app only works when a high bandwidth transport is available, you should set `setRequiresHighBandwidth` to `true`. You cannot be certain that all core implementations support multiple transports. You could also set `TransportType.USB` as your only supported primary transport

Since the `SdlRouterService` now works with multiple transports, you can set your own configuration, for example:

```
static final List<TransportType> multiplexPrimaryTransports =
Arrays.asList(TransportType.USB, TransportType.BLUETOOTH);
static final List<TransportType> multiplexSecondaryTransports =
Arrays.asList(TransportType.TCP, TransportType.USB, TransportType.BLUETOOTH);

//...

transport.setPrimaryTransports(multiplexPrimaryTransports);
transport.setSecondaryTransports(multiplexSecondaryTransports);
```

**NOTE**

Multiple transports only work on supported versions of SDL Core.

## ANDROIDMANIFEST

4.6

```
    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"
/>

    <uses-feature android:name="android.hardware.usb.accessory"/>

    <service
        android:name=".SdlService"
        android:enabled="true"/>


    <receiver
        android:name=".SdlReceiver"
        android:enabled="true"
        android:exported="true"
        tools:ignore="ExportedReceiver">
        <intent-filter>
         <action android:name="com.smartdevicelink.USB_ACCESSORY_ATTACHED"/>
<!--For AOA -->
          <action android:name="sdl.router.startservice" />
        </intent-filter>
    </receiver>

    <activity
android:name="com.smartdevicelink.transport.USBAccessoryAttachmentActivity"
        android:launchMode="singleTop">
        <intent-filter>
            <action
android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />
        </intent-filter>

        <meta-data
            android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED"
            android:resource="@xml/accessory_filter" />
    </activity>
```

4.7

```
    <uses-permission android:name="android.permission.INTERNET" />
    <uses-permission android:name="android.permission.BLUETOOTH"/>
    <uses-permission android:name="android.permission.ACCESS_NETWORK_STATE"
/>
    <uses-permission android:name="android.permission.FOREGROUND_SERVICE" />

    <uses-feature android:name="android.hardware.usb.accessory"/>


        <service
        android:name=".SdlService"
        android:enabled="true"/>

    <service
        android:name="com.company.mySdlApplication.SdlRouterService"
        android:exported="true"
        android:process="com.smartdevicelink.router"
       tools:ignore="ExportedService">
       <intent-filter>
        <action android:name="com.smartdevicelink.router.service"/>
       </intent-filter>
       <meta-data android:name="sdl_router_version"
android:value="@integer/sdl_router_service_version_value" />
    </service>
    <receiver
        android:name=".SdlReceiver"
       android:enabled="true"
       android:exported="true"
       tools:ignore="ExportedReceiver">
       <intent-filter>
        <action android:name="com.smartdevicelink.USB_ACCESSORY_ATTACHED"/>
<!--For AOA -->
          <action android:name="android.bluetooth.device.action.ACL_CONNECTED" />
          <action android:name="sdl.router.startservice" />
       </intent-filter>
    </receiver>

    <activity
android:name="com.smartdevicelink.transport.USBAccessoryAttachmentActivity"
        android:launchMode="singleTop">
       <intent-filter>
           <action
android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />
       </intent-filter>

       <meta-data
           android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED"
          android:resource="@xml/accessory_filter" />
    </activity>
```

# Lock Screen

There has been a major overhaul for lock screens in 4.7. Complicated lock screen setups are no longer required due to the addition of the `LockScreenManager`. Instead of going over the previous lock screen tutorial and then writing another one I will give brief instructions on how to either continue using your lock screen implementation, or upgrading to the new managed system. This review is brief, it is recommended that you look at the full lock screen guide.

## USING YOUR CURRENT IMPLEMENTATION

If you would like to keep your current lock screen implementation, but would like to use the `SdlManager` for its other functionalities, you must disable the `LockScreenManager`. (This is not recommended as the new `LockScreenManager` takes care of a lot of boiler plate code and reduces possible errors).

### DISABLING THE LOCK SCREEN MANAGER:

To disable, create a `LockScreenConfig` object and set it in the `SdlManager.Builder` in your `SdlService.java` class.

```
lockScreenConfig.setEnabled(false);
//...
builder.setLockScreenConfig(lockScreenConfig);
```

## USING THE NEW LOCKSCREENMANAGER

If you want SDL to handle the lock screen logic for you, it is simple. You will remove the classes that currently handle your lock screen, and set the variables you want for your new lock screen as defined in the lock screen guide. This simple addition is handled during the instantiation of the `SdlManager` within `SdlService.java`.

## LOCK SCREEN ACTIVITY

You must declare the `SDLLockScreenActivity` in your manifest. To do so, simply add the following to your app's `AndroidManifest.xml` if you have not already done so:

```
<activity
android:name="com.smartdevicelink.managers.lockscreen.SDLLockScreenActivity"
            android:launchMode="singleTop"/>
```

**MUST**

This manifest entry must be added for the lock screen feature to work.

## CONFIGURATIONS

The default configurations should work for most app developers and is simple to get up and running. However, it is easy to perform deeper configurations to the lock screen for your app. Below are the options that are available to customize your lock screen which builds on top of the logic already implemented in the `LockScreenManager`.

There is a setter in the `SdlManager.Builder` that allows you to set a `LockScreenConfig` by calling `builder.setLockScreenConfig(lockScreenConfig)`. The following options are available to be configured with the `LockScreenConfig`.

In order to to use these features, create a `LockScreenConfig` object and set it using `SdlManager.Builder` before you build `SdlManager`.

### Custom Background Color

In your `LockScreenConfig` object, you can set the background color to a color resource that you have defined in your `Colors.xml` file:

```
lockScreenConfig.setBackgroundColor(resourceColor); // For example, R.color.black
```

### Custom App Icon

In your `LockScreenConfig` object, you can set the resource location of the drawable icon you would like displayed:

```
lockScreenConfig.setAppIcon(appIconInt); // For example,
R.drawable.lockscreen_icon
```

### Showing The Device Logo

This sets whether or not to show the connected device's logo on the default lock screen. The logo will come from the connected hardware if set by the manufacturer. When using a Custom View, the custom layout will have to handle the logic to display the device logo or not. The default setting is false, but some OEM partners may require it.

In your `LockScreenConfig` object, you can set the boolean of whether or not you want the device logo shown, if available:

```
lockScreenConfig.showDeviceLogo(true);
```

### Setting A Custom Lock Screen View

If you'd rather provide your own layout, it is easy to set. In your `LockScreenConfig` object, you can set the reference to the custom layout to be used for the lock screen. If this is set, the other customizations described above will be ignored:

```
lockScreenConfig.setCustomView(customViewInt);
```

# Displaying Information

## Setting text:

Previously, to set text fields, the developer had to create a `Show` RPC, set the text fields, and then send the PRC. It was also the developer's responsibility to make sure that they set only the lines of text that are supported by the template. In 4.7, the `ScreenManager` can be used and handles such logic internally. If a specific text field is not supported, it will be automatically hyphenated with other texts to make sure that everything is displayed correctly.

### 4.6:

```
Show show = new Show();
show.setMainField1("Hello, this is MainField1.");
show.setMainField2("Hello, this is MainField2.");
show.setMainField3("Hello, this is MainField3.");
show.setMainField4("Hello, this is MainField4.");
show.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (((ShowResponse) response).getSuccess()) {
            Log.i("SdlService", "Successfully showed.");
        } else {
            Log.i("SdlService", "Show request was rejected.");
        }
    }
});
proxy.sendRPCRequest(show);
```

### 4.7:

```
sdlManager.getScreenManager().beginTransaction();
sdlManager.getScreenManager().setTextField1("Hello, this is MainField1.");
sdlManager.getScreenManager().setTextField2("Hello, this is MainField2.");
sdlManager.getScreenManager().setTextField3("Hello, this is MainField3.");
sdlManager.getScreenManager().setTextField4("Hello, this is MainField4.");
sdlManager.getScreenManager().commit(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        Log.i(TAG, "ScreenManager update complete: " + success);

    }
});
```

## Setting images:

Previously, to set an image, the developer had to upload the image using the `PutFile` RPC. When it is uploaded, a `Show` RPC was then created and sent to display the image. In 4.7, the `ScreenManager` handles uploading the image and sending the RPCs internally.

4.6:

```
Image image = new Image();
image.setImageType(ImageType.DYNAMIC);
image.setValue("appImage.jpeg"); // a previously uploaded filename using PutFile
RPC

Show show = new Show();
show.setGraphic(image);
show.setCorrelationID(CorrelationIdGenerator.generateId());
show.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if (((ShowResponse) response).getSuccess()) {
            Log.i("SdlService", "Successfully showed.");
        } else {
            Log.i("SdlService", "Show request was rejected.");
        }
    }
});
proxy.sendRPCRequest(show);
```

4.7:

```
SdlArtwork sdlArtwork = new SdlArtwork("appImage.jpeg", FileType.GRAPHIC_JPEG,
R.drawable.appImage, true);
sdlManager.getScreenManager().setPrimaryGraphic(sdlArtwork);
```

## Using soft buttons:

Previously, to add a soft button with an image the developer had to upload the image by sending a `PutFile` RPC, and after the image is uploaded, creating a `SoftButton` object,

then creating a `Show` RPC. They would then need to set the button in the RPC, and then send the request. In 4.7, the `ScreenManager` takes care of sending the RPCs. The developer just has to create `softButtonObject`, add a state to it, then use the `ScreenManager` to set soft button objects.

### 4.6:

```
Image cancelImage = new Image();
cancelImage.setImageType(ImageType.DYNAMIC);
cancelImage.setValue("cancel.jpeg"); // a previously uploaded filename using PutFile RPC

List<SoftButton> softButtons = new ArrayList<>();

SoftButton cancelButton = new SoftButton();
cancelButton.setType(SoftButtonType.SBT_IMAGE);
cancelButton.setImage(cancelImage);
cancelButton.setSoftButtonID(1);

softButtons.add(cancelButton);

Show show = new Show();
show.setSoftButtons(softButtons);
proxy.sendRPCRequest(show);
```

### 4.7:

```
SoftButtonState softButtonState = new SoftButtonState("state1", "cancel", new SdlArtwork("cancel.jpeg", FileType.GRAPHIC_JPEG, R.drawable.cancel, true));
SoftButtonObject softButtonObject = new SoftButtonObject("object", Collections.singletonList(softButtonState), softButtonState.getName(), null);
sdlManager.getScreenManager().setSoftButtonObjects(Collections.singletonList(soft
```

Receiving button events on previous versions of SDL had to be done using `onOnButtonEvent` and `onOnButtonPress` callbacks from the `IProxyListenerALM` interface. The id had to be checked to know the exact button that received the event. In 4.7, it is much cleaner: a listener can be added to the `SoftButtonObject`, so the developer can easily tell when and which soft button received the event.

4.6:

```
@Override
public void onOnButtonEvent(OnButtonEvent notification) {
   Log.i(TAG, "onOnButtonEvent: ");

   if (notification.getButtonName() == CUSTOM_BUTTON){
       int ID = notification.getCustomButtonName();
       Log.i(TAG, "Button event received for button " + ID);
   }
}

@Override
public void onOnButtonPress(OnButtonPress notification) {
   Log.i(TAG, "onOnButtonPress: ");

   if (notification.getButtonName() == CUSTOM_BUTTON){
       int ID = notification.getCustomButtonName();
       Log.i(TAG, "Button press received for button " + ID);
   }
}
```

4.7:

```
softButtonObject.setOnEventListener(new SoftButtonObject.OnEventListener() {
   @Override
   public void onPress(SoftButtonObject softButtonObject, OnButtonPress
onButtonPress) {
       Log.i(TAG, "OnButtonPress: ");
   }

   @Override
   public void onEvent(SoftButtonObject softButtonObject, OnButtonEvent
onButtonEvent) {
       Log.i(TAG, "OnButtonEvent: ");
   }
});
```

## Receiving Subscribe Buttons Events

Previously, your `SdlService` had to implement `IProxyListenerALM` interface which means your `SdlService` class had to override all of the `IProxyListenerALM` callback

methods including `OnButtonEvent` and `OnButtonPress`.

### 4.6

```
@Override
public void onOnHMIStatus(OnHMIStatus notification) {
   if(notification.getHmiLevel() == HMILevel.HMI_FULL && notification.getFirstRun())
{
       SubscribeButton subscribeButtonRequest = new SubscribeButton();
       subscribeButtonRequest.setButtonName(ButtonName.SEEKRIGHT);
       proxy.sendRPCRequest(subscribeButtonRequest);
   }
}

@@Override
public void onOnButtonEvent(OnButtonEvent notification) {
   switch(notification.getButtonName()){
          case OK:
             break;
          case SEEKLEFT:
             break;
          case SEEKRIGHT:
             break;
          case TUNEUP:
             break;
          case TUNEDOWN:
             break;
       }
}

@Override
public void onOnButtonPress(OnButtonPress notification) {
       switch(notification.getButtonName()){
          case OK:
             break;
          case SEEKLEFT:
             break;
          case SEEKRIGHT:
             break;
          case TUNEUP:
             break;
          case TUNEDOWN:
             break;
       }
}
```

In 4.7 and the new manager APIs, in order to receive the `OnButtonEvent` and `OnButtonPress` notifications, your app must add a `OnRPCNotificationListener` using the `SdlManager`'s method `addOnRPCNotificationListener`. This will subscribe the app to any notifications of the provided type, in this case `ON_BUTTON_EVENT` and `ON_BUTTON_PRESS`. The listener should be added before sending the corresponding RPC request/subscription or else some notifications may be missed.

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_BUTTON_EVENT, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnButtonPress onButtonPressNotification = (OnButtonPress) notification;
        switch (onButtonPressNotification.getButtonName()) {
            case OK:
                break;
            case SEEKLEFT:
                break;
            case SEEKRIGHT:
                break;
            case TUNEUP:
                break;
            case TUNEDOWN:
                break;
        }
    }
});

sdlManager.addOnRPCNotificationListener(FunctionID.ON_BUTTON_PRESS, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnButtonPress onButtonPressNotification = (OnButtonPress) notification;
        switch (onButtonPressNotification.getButtonName()) {
            case OK:
                break;
            case SEEKLEFT:
                break;
            case SEEKRIGHT:
                break;
            case TUNEUP:
                break;
            case TUNEDOWN:
                break;
        }
    }
});

SubscribeButton subscribeButtonRequest = new SubscribeButton();
subscribeButtonRequest.setButtonName(ButtonName.SEEKRIGHT);
sdlManager.sendRPC(subscribeButtonRequest);
```

## Changing The Template:

Previously, developers had to pass a string that represents the name of the template to `SetDisplayLayout`. In 4.7, a new `PredefinedLayout` enum is introduced to hold all possible values for the templates.

4.6:

```
SetDisplayLayout setDisplayLayoutRequest = new SetDisplayLayout();
setDisplayLayoutRequest.setDisplayLayout("GRAPHIC_WITH_TEXT");
try{
    proxy.sendRPCRequest(setDisplayLayoutRequest);
}catch (SdlException e){
    e.printStackTrace();
}
```

4.7:

```
SetDisplayLayout setDisplayLayoutRequest = new SetDisplayLayout();
setDisplayLayoutRequest.setDisplayLayout(PredefinedLayout.GRAPHIC_WITH_TEXT.


sdlManager.sendRPC(setDisplayLayoutRequest);
```

# Uploading Files and Graphics

SDL Android 4.7 introduces the `FileManager`, which is accessible through the `SdlManager`. Previous methods of uploading files and performing their functions still work, but now there are a set of convenience methods that do a lot of the boilerplate work for you.

Check out the Uploading Files and Uploading Images for code examples and detailed explanations.

## SDL File and SDL Artwork

New to version 4.7 of the SDL Android library are `SdlFile` and `SdlArtwork` objects. These have been created in parallel with the `FileManager` to help streamline SDL workflow. `SdlArtwork` is an extension of `SdlFile` that pertains only to graphic specific file types, and its use case is similar. For the rest of this document, `SdlFile` will be described, but everything also applies to `SdlArtwork`.

## CREATION

One of the hardest parts about getting a file into SDL was the boilerplate code needed to convert the file into a byte array that was used by the head unit. Now, you can instantiate a `SdlFile` with:

### A RESOURCE ID

```
new SdlFile(@NonNull String fileName, @NonNull FileType fileType, int id, boolean persistentFile)
```

### A URI

```
new SdlFile(@NonNull String fileName, @NonNull FileType fileType, Uri uri, boolean persistentFile)
```

And last but not least

### A BYTE ARRAY

```
new SdlFile(@NonNull String fileName, @NonNull FileType fileType, byte[] data, boolean persistentFile)
```

without the need to implement the methods needed to do the conversion of data yourself.

## Uploading a File

Uploading a file with the `FileManager` is a simple process. With an instantiated `SdlManager`,
you can simply call:

```
sdlManager.getFileManager().uploadFile(sdlFile, new CompletionListener() {
    @Override
    public void onComplete(boolean success) {

    }
});
```

# Getting Vehicle Data and Subscribing to Notifications

Previously, your `SdlService` had to implement `IProxyListenerALM` interface which means your `SdlService` class had to override all of the `IProxyListenerALM` callback methods including `onOnVehicleData`.

4.6:

```
@Override
public void onOnHMIStatus(OnHMIStatus notification) {
    if(notification.getHmiLevel() == HMILevel.HMI_FULL && notification.getFirstRun())
{
        SubscribeVehicleData subscribeRequest = new SubscribeVehicleData();
        subscribeRequest.setPrndl(true);
        subscribeRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
            @Override
            public void onResponse(int correlationId, RPCResponse response) {
                if(response.getSuccess()){
                    Log.i("SdlService", "Successfully subscribed to vehicle data.");
                }else{
                    Log.i("SdlService", "Request to subscribe to vehicle data was rejected.");
                }
            }
        });
        try {
            proxy.sendRPCRequest(subscribeRequest);
        } catch (SdlException e) {
            e.printStackTrace();
        }
    }
}

@Override
public void onOnVehicleData(OnVehicleData notification) {
    PRNDL prndl = notification.getPrndl();
    Log.i("SdlService", "PRNDL status was updated to: " prndl.toString());
}
```

In 4.7 and the new manager APIs, in order to receive the `OnVehicleData` notifications, your app must add a `OnRPCNotificationListener` using the `SdlManager`'s method `addOnRPCNotificationListener`. This will subscribe the app to any notifications of the provided type, in this case `ON_VEHICLE_DATA`. The listener should be added before sending the corresponding RPC request/subscription or else some notifications may be missed.

### 4.7:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_VEHICLE_DATA, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnVehicleData onVehicleDataNotification = (OnVehicleData) notification;
        if (onVehicleDataNotification.getPrndl() != null) {
            Log.i("SdlService", "PRNDL status was updated to: " +
onVehicleDataNotification.getPrndl());
        }
    }
});


SubscribeVehicleData subscribeRequest = new SubscribeVehicleData();
subscribeRequest.setPrndl(true);
subscribeRequest.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if(response.getSuccess()){
            Log.i("SdlService", "Successfully subscribed to vehicle data.");
        }else{
            Log.i("SdlService", "Request to subscribe to vehicle data was rejected.");
        }
    }
});
sdlManager.sendRPC(subscribeRequest);
```

# Getting In-Car Audio

## Subscribing to AudioPassThru Notifications

Previously, your `SdlService` had to implement `IProxyListenerALM` interface which means your `SdlService` class had to override all of the `IProxyListenerALM` callback methods including `onOnAudioPassThru`.

4.6:

```
@Override
public void onOnHMIStatus(OnHMIStatus notification) {
    if(notification.getHmiLevel() == HMILevel.HMI_FULL && notification.getFirstRun())
{
        PerformAudioPassThru performAPT = new PerformAudioPassThru();
        performAPT.setAudioPassThruDisplayText1("Ask me \"What's the weather?\"");
        performAPT.setAudioPassThruDisplayText2("or \"What's 1 + 2?\"");
        performAPT.setInitialPrompt(TTSChunkFactory.createSimpleTTSChunks("Ask
me What's the weather? or What's 1 plus 2?"));
        performAPT.setSamplingRate(SamplingRate._22KHZ);
        performAPT.setMaxDuration(7000);
        performAPT.setBitsPerSample(BitsPerSample._16_BIT);
        performAPT.setAudioType(AudioType.PCM);
        performAPT.setMuteAudio(false);
        proxy.sendRPCRequest(performAPT);
    }
}

@Override
public void onOnAudioPassThru(OnAudioPassThru notification) {
    byte[] dataRcvd = notification.getAPTData();
    processAPTData(dataRcvd); // Do something with audio data
}
```

In 4.7 and the new manager APIs, in order to receive the `OnAudioPassThru` notifications, your app must add a `OnRPCNotificationListener` using the `SdlManager`'s method `addOnRPCNotificationListener`. This will subscribe the app to any notifications of the provided type, in this case `ON_AUDIO_PASS_THRU`. The listener should be added before sending the corresponding RPC request/subscription or else some notifications may be missed.

### 4.7:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_AUDIO_PASS_THRU, new
OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnAudioPassThru onAudioPassThru = (OnAudioPassThru) notification;
        byte[] dataRcvd = onAudioPassThru.getAPTData();
        processAPTData(dataRcvd); // Do something with audio data
    }
});

PerformAudioPassThru performAPT = new PerformAudioPassThru();
performAPT.setAudioPassThruDisplayText1("Ask me \"What's the weather?\"");
performAPT.setAudioPassThruDisplayText2("or \"What's 1 + 2?\"");
performAPT.setInitialPrompt(TTSChunkFactory.createSimpleTTSChunks("Ask me
What's the weather? or What's 1 plus 2?"));
performAPT.setSamplingRate(SamplingRate._22KHZ);
performAPT.setMaxDuration(7000);
performAPT.setBitsPerSample(BitsPerSample._16_BIT);
performAPT.setAudioType(AudioType.PCM);
performAPT.setMuteAudio(false);
sdlManager.sendRPC(performAPT);
```

# Mobile Navigation

## Video Streaming:

Previously, developers had to make sure that the app was in HMI_FULL before starting the video stream, In 4.7, after the `SdlManager` has called its `onStart` method, the developer can start video streaming in `VideoStreamingManager.start()` 's `CompletionListener`. The `VideoStreamingManager` will take care of starting the video when the app becomes ready.

### 4.6:

```
    if(notification.getHmiLevel().equals(HMILevel.HMI_FULL)){
        if (notification.getFirstRun()) {
            proxy.startRemoteDisplayStream(getApplicationContext(), MyDisplay.class,
null, false);
        }
    }

}
```

4.7:

```
sdlManager.getVideoStreamManager().start(new CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        if (success) {

sdlManager.getVideoStreamManager().startRemoteDisplayStream(getApplicationCor
 MyDisplay.class, null, false);
        }
    }
});
```

## Audio Streaming

With the addition of the `AudioStreamingManager`, which is accessed through `SdlManag er`, you can now use `mp3` files in addition to `raw`. The `AudioStreamingManager` also handles `AudioStreamingCapabilities` for you, so your stream will use the correct capabilities for the connected head unit. We suggest that for any audio streaming that this is now used. Below is the difference in streaming from 4.6 to 4.7

4.6

```
 private void startAudioStream(){

        final InputStream is = getResources().openRawResource(R.raw.audio_file);

        AudioStreamingParams audioParams = new AudioStreamingParams(44100, 1);
        listener = proxy.startAudioStream(false, AudioStreamingCodec.LPCM,
audioParams);
        if (listener != null){
            try {
                listener.sendAudio(readToByteBuffer(is), -1);

            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }

    private void stopAudioStream(){
        proxy.endAudioStream();
    }

    static ByteBuffer readToByteBuffer(InputStream inStream) throws IOException {
        byte[] buffer = new byte[8000];
        ByteArrayOutputStream outStream = new ByteArrayOutputStream(8000);
        int read;
        while (true) {
            read = inStream.read(buffer);
            if (read == -1)
                break;
            outStream.write(buffer, 0, read);
        }
        ByteBuffer byteData = ByteBuffer.wrap(outStream.toByteArray());
        return byteData;
    }
```

4.7

```
if (sdlManager.getAudioStreamManager() != null) {
    Log.i(TAG, "Trying to start audio streaming");
    sdlManager.getAudioStreamManager().start(new CompletionListener() {
        @Override
        public void onComplete(boolean success) {
            if (success) {
                sdlManager.getAudioStreamManager().startAudioStream(false, new
CompletionListener() {
                    @Override
                    public void onComplete(boolean success) {
                        if (success) {
                            Resources resources = getApplicationContext().getResources();
                            int resourceId = R.raw.audio_file;
                            Uri uri = new Uri.Builder()
                            .scheme(ContentResolver.SCHEME_ANDROID_RESOURCE)
                            .authority(resources.getResourcePackageName(resourceId))
                            .appendPath(resources.getResourceTypeName(resourceId))
                            .appendPath(resources.getResourceEntryName(resourceId))
                            .build();
                            sdlManager.getAudioStreamManager().pushAudioSource(uri, new
CompletionListener() {
                                @Override
                                public void onComplete(boolean success) {
                                    if (success) {
                                        Log.i(TAG, "Audio file played successfully!");
                                    } else {
                                        Log.i(TAG, "Audio file failed to play!");
                                    }
                                }
                            });
                        } else {
                            Log.d(TAG, "Audio stream failed to start!");
                        }
                    }
                });
            } else {
                Log.i(TAG, "Failed to start audio streaming manager");
            }
        }
    });
}
```

# Checking Permissions:

Previously, it was not easy to check if specific permission had changed. Developers had to keep checking `onOnHMIStatus` and `onOnPermissionsChange` callbacks and manually check the responses to see if the permission is allowed. In 4.7, the `PermissionManager` implements all of this logic internally. It keeps a cached copy of the callback responses whenever an update is received. So developer can call `isRPCAllowed()` any time to know if a permission is allowed. It also makes it very simple to add a listener.

### 4.6:

```
@Override
public void onOnHMIStatus(OnHMIStatus notification) {
    hmiLevel = notification.getHmiLevel();
    if (checkShowPermission(FunctionID.SHOW.toString(), hmiLevel,
permissionItems)){
        // Show RPC is allowed
    }
}

@Override
public void onOnPermissionsChange(OnPermissionsChange notification) {
    permissionItems = notification.getPermissionItem();
    if (checkShowPermission(FunctionID.SHOW.toString(), hmiLevel,
permissionItems)){
        // Show RPC is allowed
    }
}

private boolean checkShowPermission(String rpcName, HMILevel hmiLevel,
List<PermissionItem> permissionItems){
    PermissionItem permissionItem = null;
    for (PermissionItem item : permissionItems) {
        if (rpcName.equals(item.getRpcName())){
            permissionItem = item;
            break;
        }
    }
    if (hmiLevel == null || permissionItem == null ||
permissionItem.getHMIPermissions() == null ||
permissionItem.getHMIPermissions().getAllowed() == null){
            return false;
    } else if (permissionItem.getHMIPermissions().getUserDisallowed() != null){
        return permissionItem.getHMIPermissions().getAllowed().contains(hmiLevel)
&& !permissionItem.getHMIPermissions().getUserDisallowed().contains(hmiLevel);
    } else {
        return permissionItem.getHMIPermissions().getAllowed().contains(hmiLevel);
    }
}
```

#### 4.7:

To check if a permission is allowed:

```
boolean allowed =
sdlManager.getPermissionManager().isRPCAllowed(FunctionID.SHOW);
```

To setup a permission listener:

```
List<PermissionElement> permissionElements = Collections.singletonList(new
PermissionElement(FunctionID.SHOW, null));
UUID listenerId =
sdlManager.getPermissionManager().addListener(permissionElements,
PermissionManager.PERMISSION_GROUP_TYPE_ANY, new
OnPermissionChangeListener() {
    @Override
    public void onPermissionsChange(@NonNull Map<FunctionID, PermissionStatus>
allowedPermissions, @NonNull int permissionGroupStatus) {
        if (allowedPermissions.get(FunctionID.SHOW).getIsRPCAllowed()) {
            // Show RPC is allowed
        }
    }
});
```

For more information about `PermissionManager`, you can check this page.

## Handling a Language Change

Previously, to let your app reconnect after the user changes the head unit language, your app had to send an intent in the `onProxyClosed` callback. That intent should be received by `SdlReceiver` to start the `SdlService`. The `SdlReceiver` part did not change so we will only cover the changes in sending the intent which was done in previous versions as the following:

```
@Override
public void onProxyClosed(String info, Exception e, SdlDisconnectedReason reason)
{
    stopSelf();
    if(reason.equals(SdlDisconnectedReason.LANGUAGE_CHANGE)){
        Intent intent = new
Intent(TransportConstants.START_ROUTER_SERVICE_ACTION);
        intent.putExtra(SdlReceiver.RECONNECT_LANG_CHANGE, true);
        sendBroadcast(intent);
    }
}
```

In 4.7, the app has to send the intent in a `ON_LANGUAGE_CHANGE` notification listener as the following:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_LANGUAGE_CHANGE,
new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        SdlService.this.stopSelf();
        Intent intent = new
Intent(TransportConstants.START_ROUTER_SERVICE_ACTION);
        intent.putExtra(SdlReceiver.RECONNECT_LANG_CHANGE, true);
        AndroidTools.sendExplicitBroadcast(context, intent, null);
    }
});
```

For more information about handling language changes please visit this page.

# Remote Control

## Subscribing to OnInteriorVehicleData Notifications

Previously, your `SdlService` had to implement `IProxyListenerALM` interface which means your `SdlService` class had to override all of the `IProxyListenerALM` callback methods including `onOnInteriorVehicleData`.

### 4.6:

```
@Override
public void onOnHMIStatus(OnHMIStatus notification) {
    if(notification.getHmiLevel() == HMILevel.HMI_FULL && notification.getFirstRun())
{
        GetInteriorVehicleData interiorVehicleData = new GetInteriorVehicleData();
        interiorVehicleData.setModuleType(ModuleType.RADIO);
        interiorVehicleData.setSubscribe(true);
        interiorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener()
{
                @Override
                public void onResponse(int correlationId, RPCResponse response) {
                    GetInteriorVehicleData getResponse = (GetInteriorVehicleData)
response;
                    //This can now be used to retrieve data
                }
        });
        proxy.sendRPCRequest(interiorVehicleData);
    }
}

@Override
public void onOnInteriorVehicleData(OnInteriorVehicleData response) {
    //Perform action based on notification
}
```

In 4.7 and the new manager APIs, in order to receive the `OnInteriorVehicleData` notifications, your app must add a `OnRPCNotificationListener` using the `SdlManager`'s method `addOnRPCNotificationListener`. This will subscribe the app to any notifications of the provided type, in this case `ON_INTERIOR_VEHICLE_DATA`. The listener should be added before sending the corresponding RPC request/subscription or else some notifications may be missed.

### 4.7:

```
sdlManager.addOnRPCNotificationListener(FunctionID.ON_INTERIOR_VEHICLE_DATA
 new OnRPCNotificationListener() {
    @Override
    public void onNotified(RPCNotification notification) {
        OnInteriorVehicleData onInteriorVehicleData = (OnInteriorVehicleData)
notification;
        //Perform action based on notification
    }
});

GetInteriorVehicleData interiorVehicleData = new GetInteriorVehicleData();
interiorVehicleData.setModuleType(ModuleType.RADIO);
interiorVehicleData.setSubscribe(true);
interiorVehicleData.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        GetInteriorVehicleData getResponse = (GetInteriorVehicleData) response;
        //This can now be used to retrieve data
    }
});
sdlManager.sendRPC(interiorVehicleData);
```

# Upgrading to 4.9

# Overview

This guide is to help developers get setup with the SDL Java library version 4.9. It is assumed that the developer is already updated to at least version 4.7 or 4.8 of the library.

The full release notes are published here.

The main differences between the previous release and this are mainly additive, including 3 new managers which we will describe briefly. Additionally, we have fixed an issue where symlinks were not working on Windows machines by creating a gradle task that builds them for you. Additionally, we have added the ability to pass a buffer to the AudioStreamManager to play raw data.

# Voice Command Manager

The voice command manager is accessed via the `ScreenManager`. It allows for an easy way to create global voice commands for your application. These are not supposed to be a replacement for menu voice commands, but rather an easy way to trigger main events in your application, similar to something you might use a `SoftButton` for. These commands, once sent, will be available on the system as voice commands for the duration of the session.

An example is as follows:

```
List<String> list1 = Collections.singletonList("Command One");
List<String> list2 = Collections.singletonList("Command two");

VoiceCommand voiceCommand1 = new VoiceCommand(list1, new
VoiceCommandSelectionListener() {
    @Override
    public void onVoiceCommandSelected() {
        Log.i(TAG, "Voice Command 1 triggered");
    }
});

VoiceCommand voiceCommand2 = new VoiceCommand(list2, new
VoiceCommandSelectionListener() {
    @Override
    public void onVoiceCommandSelected() {
        Log.i(TAG, "Voice Command 2 triggered");
    }
});

sdlManager.getScreenManager().setVoiceCommands(Arrays.asList(voiceCommand1
```

# Menu Manager

Menus have now become simpler with the `MenuManager`, which is accessed via the `ScreenManager`. The cells, called `MenuCell`'s contain 2 constructors. One is for a cell itself,

and the other is a cell that contains a sub-menu. Note that currently SmartDeviceLink (SDL) only supports sub-menus to the depth of 1.

`MenuCell`s contain a `MenuSelectionListener` which informs you that the cell has been triggered, so that you might perform an action based on the cell selected. Note that you can add images and voice commands to menu cells.

**NOTE**

When submitting a list of Menu cells, or adding a list of sub cells to a menu cell, the order in which the cells will appear from top to bottom will be the order in which they are in the list.

Example use:

```
// SUB MENU CELLS FOR MAIN MENU CELL 2

// Sub cells are just normal cells
MenuCell subCell1 = new MenuCell("SubCell 1",null, null, new
MenuSelectionListener() {
    @Override
    public void onTriggered(TriggerSource trigger) {
        Log.i(TAG, "Sub cell 1 triggered. Source: "+ trigger.toString());
    }
});

MenuCell subCell2 = new MenuCell("SubCell 2",null, null, new
MenuSelectionListener() {
    @Override
    public void onTriggered(TriggerSource trigger) {
        Log.i(TAG, "Sub cell 2 triggered. Source: "+ trigger.toString());
    }
});

// THE MAIN MENU CELLS

// normal cell
MenuCell mainCell1 = new MenuCell("Test Cell 1 (speak)", null, null, new
MenuSelectionListener() {
    @Override
    public void onTriggered(TriggerSource trigger) {
        Log.i(TAG, "Test cell 1 triggered. Source: "+ trigger.toString());
    }
});

// sub menu parent cell
MenuCell mainCell2 = new MenuCell("Test Cell 3 (sub menu)", null,
Arrays.asList(subCell1,subCell2));

// Send the entire menu off to be created
sdlManager.getScreenManager().setMenu(Arrays.asList(mainCell1, mainCell2));
```

# Choice Set Manager

Previously it required a lot of code to use `PerformInteraction`s with SDL. To alleviate some of this pain, we have introduced the Choice Set Manager which is accessible via the `ScreenManager`. Because the Choice Set Manager covers so many items, we will do a brief overview here. You may continue to the Popup Menus section for more detailed information.

There are 2 main use cases for using this manager, one is to display a choice set, and the other is to display a keyboard.

## Choice Set

Displaying a choice set is achieved by creating some `ChoiceCell`s. If you know what your choices will be, we recommend using the `preloadChoices` method. This will ensure your `ChoiceSet` is ready to be displayed when you want to display it, and your user is not kept waiting. You can preload cells as follows:

```
// create some choice cells
ChoiceCell cell1 = new ChoiceCell("Item 1");
ChoiceCell cell2 = new ChoiceCell("Item 2");
ChoiceCell cell3 = new ChoiceCell("Item 3");

// create the array of choice cells
choiceCellList = Arrays.asList(cell1,cell2,cell3);

// pre-load the cells on the head unit
sdlManager.getScreenManager().preloadChoices(choiceCellList, null);
```

> **NOTE**
>
> You will want to reference this array of cells when presenting your choice set later (even if you add more cells). This is why we are setting this list to a variable for now.

Once you are ready to present the Choice Set, you can do so by:

```
ChoiceSet choiceSet = new ChoiceSet("Choose an Item from the list",
choiceCellList, new ChoiceSetSelectionListener() {
    @Override
    public void onChoiceSelected(ChoiceCell choiceCell, TriggerSource triggerSource,
int rowIndex) {
        // do something with the selection
    }

    @Override
    public void onError(String error) {
        Log.e(TAG, "There was an error showing the perform interaction: "+ error);
    }
});
sdlManager.getScreenManager().presentChoiceSet(choiceSet,
InteractionMode.MANUAL_ONLY);
```

## Displaying A Keyboard

There is now also an easy way to display a keyboard, and listen for key events. You simply need a `KeyboardListener` object.

```
KeyboardListener keyboardListener = new KeyboardListener() {
    @Override
    public void onUserDidSubmitInput(String inputText, KeyboardEvent event) {

    }

    @Override
    public void onKeyboardDidAbortWithReason(KeyboardEvent event) {

    }

    @Override
    public void updateAutocompleteWithInput(String currentInputText,
KeyboardAutocompleteCompletionListener
keyboardAutocompleteCompletionListener) {

    }

    @Override
    public void updateCharacterSetWithInput(String currentInputText,
KeyboardCharacterSetCompletionListener
keyboardCharacterSetCompletionListener) {

    }

    @Override
    public void onKeyboardDidSendEvent(KeyboardEvent event, String
currentInputText) {

    }
};
```

You can note that two of the methods contain a `KeyboardAutocompleteCompletionListener` and a `KeyboardCharacterSetCompletionListener`. These listeners allow you to show auto completion text and to modify the available keys, respectively, on supported head units.

To actually display the keyboard, call:

```
sdlManager.getScreenManager().presentKeyboard("initialText", null,
keyboardListener);
```

The `null` parameter in this example is a `KeyboardProperties` object that you can optionally pass in to modify the keyboard for this request.

# Audio Stream Buffer

We now have the option to send `ByteBuffer`s to the `AudioStreamManager` to be played.

```
sdlManager.getAudioStreamManager().pushBuffer(byteBuffer, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {
        // do something once the buffer is played
    }
});
```

# Symlinks in Windows

With the creation of the Java Suite, we had the need to share base files between the Android and the JavaSE and JavaEE projects. To allow the Android project to read these base files, we created symlinks to allow the files to be seen from within the project. However, symlinks work differently on Mac / Linux machines than they do on Windows.

To fix this, we created a gradle task to create the Windows symlinks. Simply call:

```
gradle buildWindowSymLinks
```

from Android Studio's terminal.

> **NOTE**
>
> You will need administrator privileges and Python installed to execute this task.

# Upgrading to 5.0

## Overview

This guide is to help developers get setup with the SDL Java library version 5.0. It is assumed that the developer is already updated to at least version 4.11 or 4.12 of the library.

The full release notes are published here.

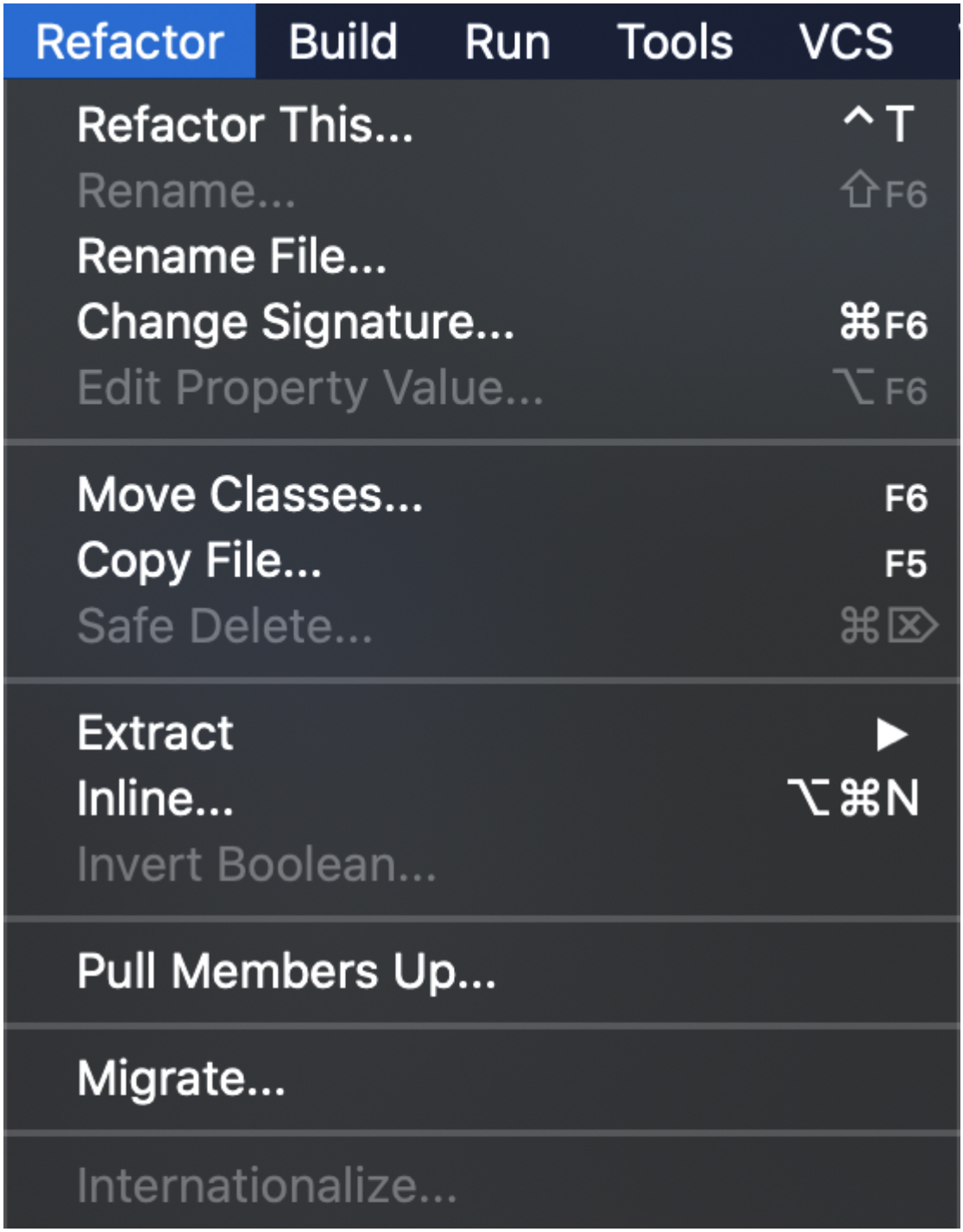
## New minimum SDK

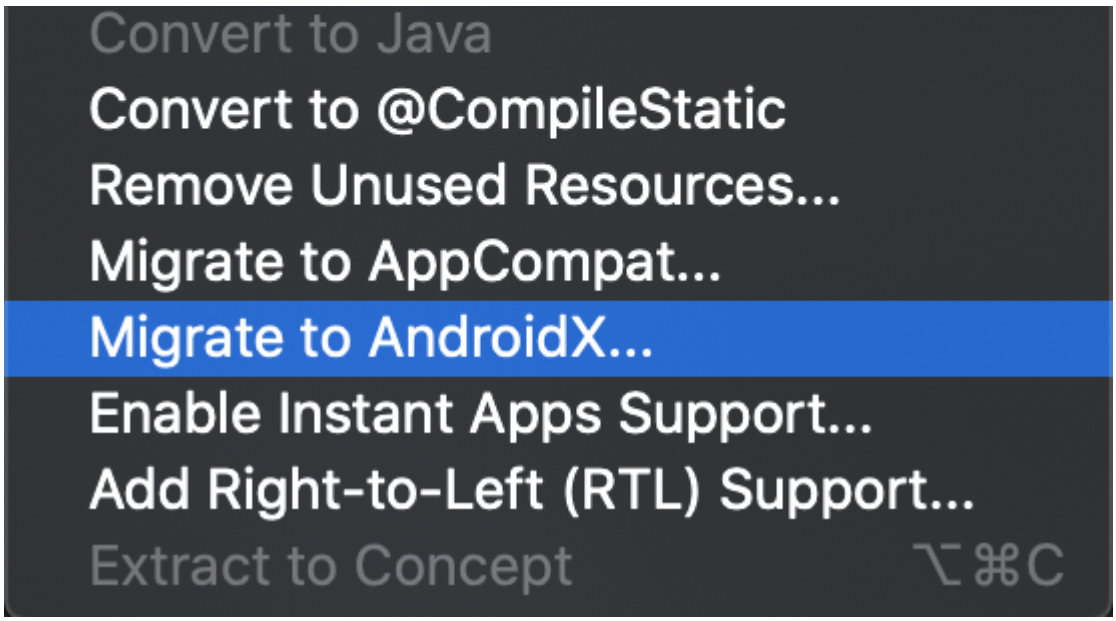
SDL now has a new minimum required SDK version of 16. You can change the minimum SDK version in the apps build.gradle file by changing minSdkVersion to 16. An example:

```
defaultConfig {
    applicationId "com.sdl.mobileweather"
    minSdkVersion 16
    targetSdkVersion 26
    versionCode 27
    versionName "1.7.15"
    testInstrumentationRunner "android.support.test.runner.AndroidJUnitRunner"
}
```

# AndroidX

SDL now uses AndroidX. To migrate your app to use AndroidX, In Android Studio or IntelliJ, click on Refactor, then Migrate to AndroidX.






NOTE

To migrate to AndroidX you must set the `compileSdkVersion` to 28 in the apps build.gradle file

# Import changes

Some classes have moved packages, and imports may need to be changed.

## Example:

OnSystemCapabilityListener has moved packages from:
`import com.smartdevicelink.proxy.interfaces.OnSystemCapabilityListener;`
to
`import com.smartdevicelink.managers.lifecycle.OnSystemCapabilityListener;`

# SdlManagerListener changes

In 4.12 a new managerShouldUpdateLifecycle method was added and the old managerShouldUpdateLifecycle method was deprecated. In 5.0 the deprecated method was removed. More detail can be found here.

Before:

```
SdlManagerListener listener = new SdlManagerListener() {
    @Override
    public void onStart() {
    }

    @Override
    public void onDestroy() {
    }

    @Override
    public void onError(String info, Exception e) {
    }

    @Override
    public LifecycleConfigurationUpdate managerShouldUpdateLifecycle(Language
language, Language hmiLanguage) {
        return null;
    }

    @Override
    public LifecycleConfigurationUpdate managerShouldUpdateLifecycle(Language
language) {
        return null;
    }
};
```

Now:

```
SdlManagerListener listener = new SdlManagerListener() {
    @Override
    public void onStart() {
    }

    @Override
    public void onDestroy() {
    }

    @Override
    public void onError(String info, Exception e) {
    }

    @Override
    public LifecycleConfigurationUpdate managerShouldUpdateLifecycle(Language
language, Language hmiLanguage) {
        return null;
    }
};
```

# Sending RPC's listener updates

When sending RPC's with a listener, onError has been removed from `OnMultipleRequestListener.java` and `OnRPCResponseListener.java`. Instead of onError getting called, onResponse will be called whether its a success or not.

OnRPCResponseListener Before:

```
subscribeButtonLeft.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {

    }

    @Override
    public void onError(int correlationId, Result resultCode, String info) {
        // Handle Error
    }
});
```

OnRPCResponseListener Now:

```
subscribeButtonLeft.setOnRPCResponseListener(new OnRPCResponseListener() {
    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if(response.getSuccess()){
            // Add if statement to check success
        }
    }
});
```

OnMultipleRequestListener Before:

```
sdlManager.sendRPCs(Arrays.asList(subscribeButtonLeft, subscribeButtonRight),
new OnMultipleRequestListener() {
    @Override
    public void onUpdate(int remainingRequests) {

    }

    @Override
    public void onFinished() {

    }

    @Override
    public void onError(int correlationId, Result resultCode, String info) {

    }

    @Override
    public void onResponse(int correlationId, RPCResponse response) {

    }
});
```

OnMultipleRequestListener Now:

```
sdlManager.sendRPCs(Arrays.asList(subscribeButtonLeft, subscribeButtonRight),
new OnMultipleRequestListener() {
    @Override
    public void onUpdate(int remainingRequests) {

    }

    @Override
    public void onFinished() {

    }

    @Override
    public void onResponse(int correlationId, RPCResponse response) {
        if(response.getSuccess()){
            // Add if statement to check success
        }

    }
});
```

# Use Multiplex instead of legacy BT & USB

`BTTransportConfig.java` and `USBTransportConfig` have been removed from the library. You should use `MultiplexBluetoothTransport.java` and `MultiplexUsbTransport.java` instead.

# ScreenManager Template Management

You can now use the ScreenManager to change screen templates and day/night color schemes. See Main Screen Templates for more detail.

Example:

```
TemplateConfiguration configuration = new
TemplateConfiguration().setTemplate(Template).setDayColorScheme(DayColorSchen

sdlManager.getScreenManager().changeLayout(configuration, new
CompletionListener() {
    @Override
    public void onComplete(boolean success) {

    }
});
```

# Chainable RPC setters

Rpc setters are now chainable. Before you had to either use a constructor that took all parameters or set everyone individually. Now you can chain them together.

Before:

```
Alert alert = new Alert();
alert.setAlertText1("text1");
alert.setDuration(5000);
alert.setPlayTone(true);
```

Now:

```
Alert alert = new Alert().setAlertText1("text1").setDuration(5000).setPlayTone(true);
```

# New DebugTool methods

There is a new way of logging information in debug mode. Before for example, we would use Log.e to log errors, now we use the DebugTool.logError.

`Log.i` to `DebugTool.logInfo`
`Log.w` to `DebugTool.logWarning`
`Log.e` to `DebugTool.logError`

Before:

```
Log.e(TAG, "There is an error");
```

Now:

```
DebugTool.logError(TAG, "There is an error");
```

> **NOTE**
>
> In JavaSE you must use the DebugTool, the old log methods will not work.

# TTSChunkFactory removal

`TTSChunkFactory.java` was removed. To create a voice command you should now use `TTSChunk` An example of creating and sending a voice command:

Before:

```
Speak msg = new Speak(TTSChunkFactory.createSimpleTTSChunks("Voice
Message to speak"));
sdlManager.sendRPC(msg);
```

Now:

```
Speak msg = new Speak(Collections.singletonList(new TTSChunk("Voice Message
to speak", SpeechCapabilities.TEXT)));
sdlManager.sendRPC(msg);
```

# CharacterSets

Existing `CharacterSet` sets were not standards-compliant and are deprecated. New character sets have been added and will be used in future head units to describe text fields.

# Upgrading to 5.1

# Overview

This guide is to help developers get setup with the SDL Java library version 5.1. It is assumed that the developer is already updated to at least version 5.0 of the library.

The full release notes are published here.

# Maven Central

Starting with SDL Java library version 5.1 the release will be published to Maven Central instead of JCenter.

To gain access to the Maven Central repository, make sure your app's `build.gradle` file includes the following:

```
repositories {
    mavenCentral()
}
```

# SdlManagerListener changes

In 5.1 a new onSystemInfoReceived method was added to the SdlManagerListener. More detail can be found here

**MUST**

`SdlManagerListener` method: `onSystemInfoReceived` auto generates in Android Studio to returns false. This will cause your app to not connect. You must change it to true or implement logic to check system info to see if you wish for your app to connect to that system.

```
SdlManagerListener listener = new SdlManagerListener() {
    @Override
    public void onStart() {
    }

    @Override
    public void onDestroy() {
    }

    @Override
    public void onError(String info, Exception e) {
    }

    @Override
    public LifecycleConfigurationUpdate managerShouldUpdateLifecycle(Language
language, Language hmiLanguage) {
        return null;
    }

    @Override
    public boolean onSystemInfoReceived(SystemInfo systemInfo) {
        //Check the SystemInfo object to ensure that the connection to the device
should continue
        return true;
    }
};
```

# Alert View

In 5.1 rather than sending an Alert RPC we now recommend sending an AlertView through the ScreenManagers presentAlert method. More detail can be found here

Before:

```
 private void showAlert(String text) {
        Alert alert = new Alert();
        alert.setAlertText1(text);
        alert.setDuration(5000);
        sdlManager.sendRPC(alert);
}
```

Now:

```
 private void showAlert(String text) {
        AlertView.Builder builder = new AlertView.Builder();
        builder.setText(text);
        builder.setTimeout(5);
        AlertView alertView = builder.build();
        sdlManager.getScreenManager().presentAlert(alertView, new
AlertCompletionListener() {
            @Override
            public void onComplete(boolean success, Integer tryAgainTime) {
                Log.i(TAG, "Alert presented: "+ success);
            }
        });
}
```

# SDLRemoteDisplay

In 5.1 a new `onViewResized` method was added to the `SDLRemoteDisplay` class that you will need to implement in your presentation class. More detail can be found here.

Before:

```
public static class MyDisplay extends SdlRemoteDisplay{
    public MyDisplay(Context context, Display display) {
        super(context, display);
    }

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        //...
    }
}
```

Now:

```
```

```
public static class MyDisplay extends SdlRemoteDisplay{
    public MyDisplay(Context context, Display display) {
        super(context, display);
    }

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        //...
    }

    @Override
    public void onViewResized(int width, int height) {
        DebugTool.logInfo(TAG, "Remote view new width and height ("+ width + ", " +
height + ")");
        //Update presentation based on new resolution
    }
}
```

# Upgrading to 5.4

# Overview

This guide is to help developers get set up with the SDL Java Suite library version 5.4.0. It is assumed that the developer is already updated to at least version 5.3.1 of the library.

The full release notes are published here.

SDL Java Suite library version 5.4.0 adds support for Android 12.

# AndroidManifest Exported Flag

Starting in Android 12, any activities, services, or broadcast receivers that use intent filters will need to explicitly declare the `android:exported` attribute for the given app components. The SdlRouterService and SdlReceiver should already have the exported

attribute defined and set to true, but the USBAccessoryAttachmentActivity will now also require this attribute to be set. Any activity that had an intent-filter would have a default exported value of true. Now we need to explicitly set it.

```
<activity
    android:name="com.smartdevicelink.transport.USBAccessoryAttachmentActivity"
    android:exported="true" <!--New Addition-->
    android:launchMode="singleTop">
    <intent-filter>
        <action
android:name="android.hardware.usb.action.USB_ACCESSORY_ATTACHED" />
    </intent-filter>
    <!-- ... -->
</activity>
```

# Bluetooth Runtime Permissions

Starting in Android 12, for the library to be able to connect to the HMI over Bluetooth, app developers will need to request the new `BLUETOOTH_CONNECT` runtime permission.

This means the permission will need to be listed in the `AndroidManifest.xml` file.

```
<uses-permission android:name="android.permission.BLUETOOTH_CONNECT"
    tools:targetApi="31"/>
```

The developer will also need to request this permission from the user as it is a runtime permission.

```
//MainActivity.java

//.....

private static final int REQUEST_CODE = 200;


@Override
protected void onCreate(Bundle savedInstanceState) {

    //......

    if (android.os.Build.VERSION.SDK_INT >= Build.VERSION_CODES.S &&
!checkPermission()) {
        requestPermission();
        return;
    }

    //We are either not targeting Android 12+ or permissions are granted so we can try
to start out SdlService
    SdlReceiver.queryForConnectedService(this);

    //.....

}

private boolean checkPermission() {
    return PackageManager.PERMISSION_GRANTED ==
ContextCompat.checkSelfPermission(getApplicationContext(),
BLUETOOTH_CONNECT);
}

private void requestPermission() {
    ActivityCompat.requestPermissions(this, new String[]{BLUETOOTH_CONNECT},
REQUEST_CODE);
}

@Override
public void onRequestPermissionsResult(int requestCode, @NonNull String[]
permissions, @NonNull int[] grantResults) {
    switch (requestCode) {
        case REQUEST_CODE:
            if (grantResults.length > 0) {
                boolean btConnectGranted = grantResults[0] ==
PackageManager.PERMISSION_GRANTED;

                if (btConnectGranted) {
                    //Bluetooth permissions have been granted by the user so we can try to
start out SdlService.
                    SdlReceiver.queryForConnectedService(this);
                }
            }
```

```
            break;
        }
    }

    //.....
```

# Starting Services from the Foreground

Starting with Android 12, apps cannot start services from the background. In order to allow the library to work as intended, the library will now need to start the "SdlService" from the context of the active router service.

To achieve this there are a few changes that will be required in your application.

First to allow your "SdlService" to be started from an external source (the active router service may belong to another app), you will need to export the service in your `AndroidManifest.xml`.

```
<service
    android:name="com.sdl.hellosdlandroid.SdlService"
    android:exported="true" <!--New Addition-->
    android:foregroundServiceType="connectedDevice">
</service>
```

Second in the `SdlReceiver.onSdlEnabled()` method the received intent will now have a PendingIntent extra when your service should be started.

You will need to get the PendingIntent extra and send the PendingIntent with the intent of the service that you intend to start.

The PendingIntent will start the service from the context of the active router service (which is running in the foreground).

```

```

```
//Retrieve, Update, and Send the PendingIntent
@Override
public void onSdlEnabled(Context context, Intent intent) {
    DebugTool.logInfo(TAG, "SDL Enabled");
    intent.setClass(context, SdlService.class);

    if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.S) {
        if (intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA) !=
null) {
            PendingIntent pendingIntent = (PendingIntent)
intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA);
            try {
                //Here we are allowing the RouterService that is in the Foreground to start
the SdlService on our behalf
                pendingIntent.send(context, 0, intent);
            } catch (PendingIntent.CanceledException e) {
                e.printStackTrace();
            }
        }
    } else {
        // SdlService needs to be foregrounded in Android O and above
        // This will prevent apps in the background from crashing when they try to start
SdlService
        // Because Android O doesn't allow background apps to start background
services
        if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
            context.startForegroundService(intent);
        } else {
            context.startService(intent);
        }
    }
}
```

## ALTERNATIVE METHOD TO AVOID EXPORTING THE SDLSERVICE

If you do not wish to export your "SdlService" class then the library will not be able to start the service and there is no way to start the service from the background.

However you can start your own "SdlService" while your app is in a foreground context. To achieve this you will need a way to track if your app is in the foreground. While your app is in the foreground you can start your "SdlService" as you normally would.

```
//MainActivity, Application, or where appropriate

//...
private androidx.lifecycle.LifecycleObserver lifecycleObserver;

@Override
protected void onCreate(Bundle savedInstanceState) {
    try {
        lifecycleObserver = new androidx.lifecycle.LifecycleObserver() {

@androidx.lifecycle.OnLifecycleEvent(androidx.lifecycle.Lifecycle.Event.ON_START)
            public void onMoveToForeground() {
                SdlReceiver.setIsForeground(true);
            }


@androidx.lifecycle.OnLifecycleEvent(androidx.lifecycle.Lifecycle.Event.ON_STOP)
            public void onMoveToBackground() {
                SdlReceiver.setIsForeground(false);
            }
        };

        if (androidx.lifecycle.ProcessLifecycleOwner.get() != null) {

androidx.lifecycle.ProcessLifecycleOwner.get().getLifecycle().addObserver(lifecycleOl

        }
    } catch (Exception e) {
        e.printStackTrace();
    }
}

@Override
protected void onDestroy() {
    super.onDestroy();
    try {
        if (androidx.lifecycle.ProcessLifecycleOwner.get() != null && lifecycleObserver !=
null) {

androidx.lifecycle.ProcessLifecycleOwner.get().getLifecycle().removeObserver(lifecyc

        }
    } catch (Exception e) {
        e.printStackTrace();
    }

    lifecycleObserver = null;
}
//...
```

```
//SdlReceiver.java

//...
private static boolean isForeground;

public static void setIsForeground(boolean status) {
    isForeground = status;
}

@Override
    public void onSdlEnabled(Context context, Intent intent) {
        DebugTool.logInfo(TAG, "SDL Enabled");
        intent.setClass(context, SdlService.class);

        if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.S) {
            if (isForeground) {
                context.startForegroundService(intent);
            } else {
                if
(intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA) != null) {
                    PendingIntent pendingIntent = (PendingIntent)
intent.getParcelableExtra(TransportConstants.PENDING_INTENT_EXTRA);
                    try {
                        pendingIntent.send(context, 0, intent);
                    } catch (PendingIntent.CanceledException e) {
                        e.printStackTrace();
                    }
                }
            }
        } else {
            // SdlService needs to be foregrounded in Android O and above
            // This will prevent apps in the background from crashing when they try to
start SdlService
            // Because Android O doesn't allow background apps to start background
services
            if (Build.VERSION.SDK_INT >= Build.VERSION_CODES.O) {
                context.startForegroundService(intent);
            } else {
                context.startService(intent);
            }
        }
    }
//...
```

# SdlService Class Name

There is now an overridable method, `getSdlServiceName` in the `SdlBroadcastReceiver` class. This method is used by the `SdlBroadcastReceiver` to catch a possible foreground exception.

When the app tries to start the `SdlService`, if the service does not enter the foreground within a set amount of time (this time is designated by the Android operating system), an exception will be thrown and the app may encounter an ANR.

The `SdlBroadcasterReceiver` can catch this exception and prevent the ANR but will need to know the name of the class that throws the exception.

By default the `getSdlServiceName` method will return "SdlService". If your app uses a name other than "SdlService" you will need to override `getSdlServiceName` in the `SdlReceiver` class to return the correct name.

```
//...
@Override
public String getSdlServiceName() {
    return SDL_SERVICE_CLASS_NAME;
}
//...
```

# Known Corner Case

When the user connects their device over USB and the user has not been granted Bluetooth Permissions the user will be presented with a notification which will help navigate the user to grant Bluetooth Permissions for the app.

Once the permissions are granted the Router Service will open the Bluetooth connection.

If the user then revokes these permissions, the Android operating system will kill the application running the Router Service and the Router Service process, and none of the service's callbacks will be called. Even though the Router Service has been killed, the HMI will still show the previously connected apps.

Unplugging the USB cable will remove the apps from the HMI.

# Does the SDL Java Suite library work with Kotlin?

The library has not been fully tested when being referenced from a Kotlin environment. Everything should work as expected, but if you find errors please report them to the github.

# Are there any currently known issues with Kotlin?

Even though Kotlin is compatible with Java, Kotlin has more strict rules for access modifiers than Java. For that reason, you may see this warning when using `SdlManager`'s `Builder` class:

```
Type BaseSdlManager.Builder! is inaccessible in this context due to: public open class Builder defined in com.smartdevicelink.managers.BaseSdlManager
```

While the warning is present, the functionality should continue to work in Kotlin. However, as a workaround, developers can create a Java class `SdlManagerFactory` that can be accessed from Kotlin code with a static method to create an `SdlManager` instance and handle all the builder code there. This will prevent the warning from the Kotlin side.

```
public class SdlManagerFactory {

    public static SdlManager createSdlManager(Context context, String appID, String
appName, SdlManagerListener listener, Vector<AppHMIType> appTypes, SdlArtwork
appIcon) {
        SdlManager.Builder builder = new SdlManager.Builder(context, appID, appName,
listener);
        builder.setAppTypes(appTypes);
        builder.setTransportType(new MultiplexTransportConfig(context, appID));
        builder.setAppIcon(appIcon);
        return builder.build();
    }
}
```

Then from the Kotlin side:

```
sdlManager = SdlManagerFactory.createSdlManager(this, APP_ID, APP_NAME,
listener, appTypes, appIcon);
```

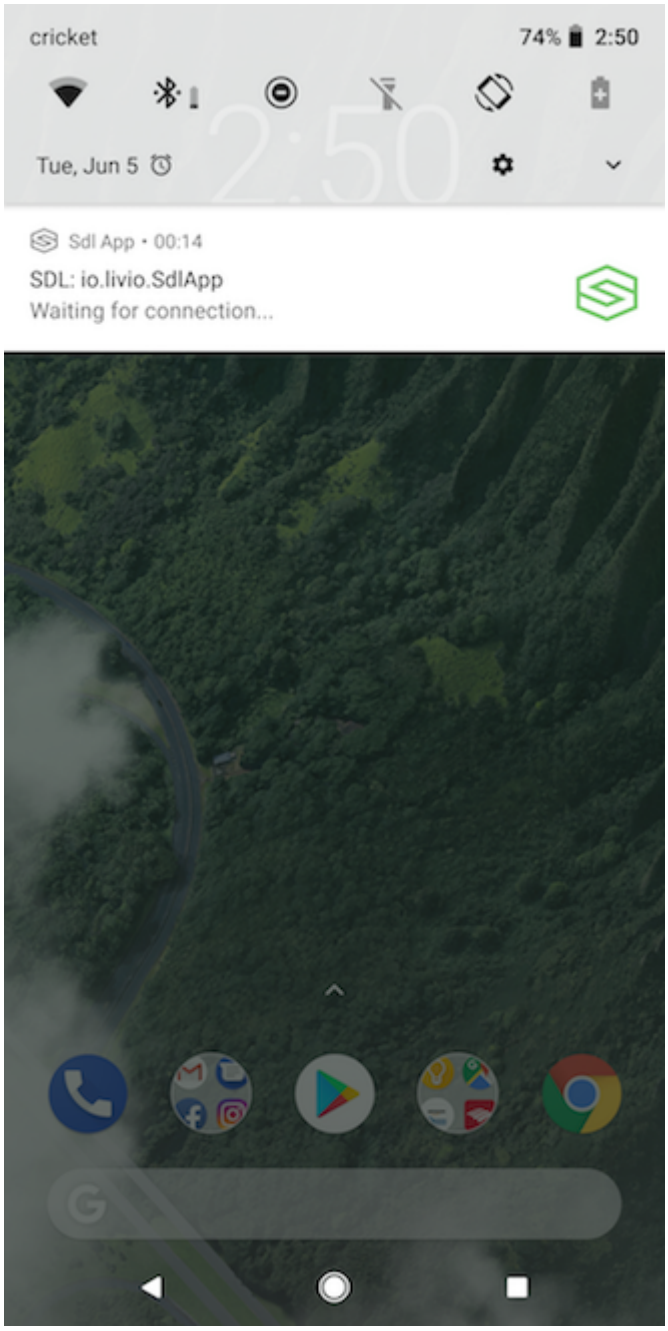
# What is SDL?

SmartDeviceLink (SDL) connects in-vehicle infotainment systems to smartphone apps. SDL allows automakers to provide highly integrated connected experiences and allows users to operate smartphone apps through the in-vehicle infotainment screen and, if equipped, voice recognition system.

# Why do you see SDL notifications?

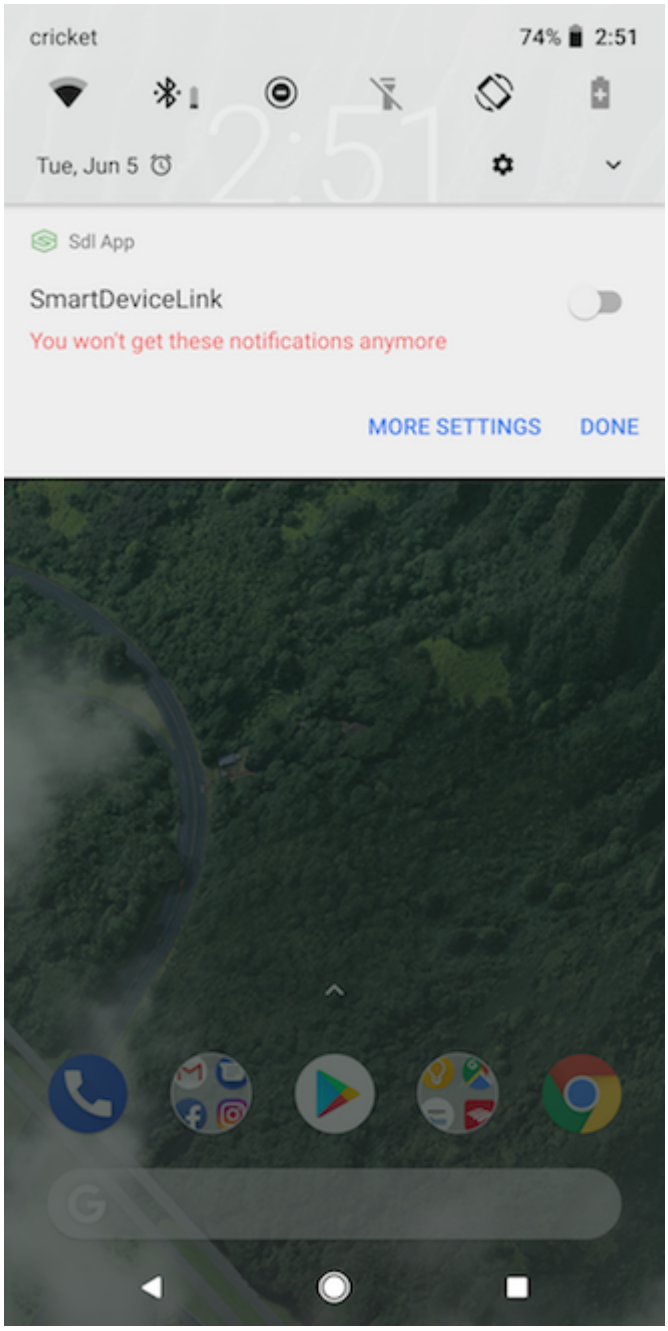
If you see a notification similar to the one in the screenshot below, that means you are using an app that has an SDL integration that allows it to push content to cars that

support SDL. However, if your car doesn't support SDL, you can simply hide the notification.




# How do you hide the notifications?

If you would like to hide the notification, you can simply long click on the notification and disable it as shown in the following screenshot.




# What is the Android Router Service?

The Android OS has limitations around the availability of certain transports (Bluetooth RFCOMM channels, single app AOA/USB permissions). Therefore, SmartDeviceLink (SDL) introduced a service that operates as a router, using a single transport pipe and extending it to many different bound apps. The router service is part of the required integration to become SDL enabled and can be hosted by any of the SDL enabled apps on a phone. Some OEMs might choose to have their own companion app that always hosts a router service for their specific hardware.

# What is a Trusted Router Service?

Since information is being shared through the Android router service it is important that the app hosting the router service can be trusted. This is done through a certification process and a back-end server that maintains a database of apps that can act as a Trusted Router Service. The SmartDeviceLink Consortium (SDLC) will verify the integration of SDL apps to ensure there is no malicious activity. If the app is certified, it will be added to the Trusted Router Service database and be able to act as a Trusted Router Service.

# How do I add my app to the SDL Trusted Router Service database?

For an Android application to be added to the Trusted Router Service database, the application will need to be registered on the SDL Developer Portal and certified by the SDLC. For more information on registration, please see this guide. Any Android application that is certified by the SDLC will be added to the Trusted Router Service database; there are no additional steps required as it is part of the certification process.

# How do I know if an app is hosting a Trusted Router Service?

Each app will retrieve and cache a list of Trusted Router Services from the back-end server. Based on that app's security levels, they will perform checks against the currently running router service, and if trusted it will bind to the Trusted Router Service. If not, the app will attempt to use its own local transport.

# Multiple Processes

The SmartDeviceLink Android library uses multiple processes and there are some items that should be understood about why that is necessary and precautions to take while handling that situation.

## Why does the router service run in its own process?

The router service is designed to live outside the normal lifecycle of the app integrating the SDL framework. The different process allows a level of security to cut off access to the hosting application's data because Android allocates a different memory space for the router service process to run. It also allows the router service to not interfere with the hosting application's runtime; this means if the router service unexpectedly stops or crashes, it will not take down the hosting app. This relationship also works in the opposite direction, which is important to maintain a good user experience when apps are connected through a router service.

## Content providers and multiple processes

Android content providers have a unique lifecycle that does not work in the expected flow. Content providers are actually started before the `Application` class and following `Activities`, `Services`, etc. Some libraries use this to know when their code/module can

initialize and always be ready for the entire lifecycle of the application. This is found with many Google libraries (Firebase, Jetpack, etc).

The issue is that, by default, content providers are only attached to and initialized for the main process. This means, when the main process starts the content provider will be started, but if a different process other than the main process is started the content provider will not be started. So if the app has its first start from a component that is designed to run in a different process, the content provider won't be ready by the time those components start up; this includes the `Application` instance for that process.

## Why is this a problem?

The issue occurs when there is code in a developer's custom `Application` class that assumes the content provider or module using the content provider lifecycle has already been initialized, but an instance of that child `Application` class is created for a process outside of the main process.

For example:

```
public class MyApplication extends Application {


    @Override
    public void onCreate() {
        super.onCreate();

         ModuleUsingContentProviderForInit.doSomething();

    }
}
```

If an instance of this extended `Application` class is created outside the main process before the main process has started, this application will crash with a runtime exception. This can happen when components that use a different process are started directly instead of the app itself being launched by the user directly. The SDL library does this to provide a seamless connection for apps to head units without the requirement of user interaction.

## Workaround

Depending on the module that uses a content provider for initialization, it could be possible to start/initialize it from the `onCreate` method of the extended `Application` class. It should be noted that the module would then need to be set up for a multiple process environment, which is not always the case.

If the module can't be initialized in this way, then the `Application` child class will need to keep a flag that prevents code from executing that would cause errors.

For SDL the solution can be as follows:

```
public class MyApplication extends Application {

    private static final String ROUTER_SERVICE_PROCESS =
"com.smartdevicelink.router";

    boolean isSdlProcessFlag = false;

    @Override
    public void onCreate() {
        super.onCreate();

        isSdlProcessFlag = isSdlProcess();
        if (isSdlProcessFlag) {
          //This application instance is running in the SDL process
            return;
        }

        ModuleUsingContentProviderForInit.doSomething();

    }

    /**
    *
    * @return if this process is the SDL router service process
    */
    private boolean isSdlProcess(){
        int myPid = android.os.Process.myPid();
        ActivityManager am =
(ActivityManager)this.getSystemService(ACTIVITY_SERVICE);
        if (am == null || am.getRunningAppProcesses() == null) {
            return false;
        }

        for (ActivityManager.RunningAppProcessInfo processInfo :
am.getRunningAppProcesses()) {
            if (processInfo != null && processInfo.pid == myPid) {
                return ROUTER_SERVICE_PROCESS.equals(processInfo.processName);
            }
        }
        return false;
    }
}
```

> **NOTE**
>
> If other callback methods in your `Application` class are used, they must also check this flag to prevent unintended behavior.

The use of this flag can help prevent errors when extending the `Application` class that assume it always has the main process started first. This solution could be modified to change the flag to monitor if this is the main process or not very easily.

## Custom Application classes instance for each process

While the documentation on this is a little scarce, the Android OS creates a new instance of the supplied `Application` class for each process that is started in your app. This means your custom `Application` class needs to be ready to run on different processes. The previous example is a good sample that can prevent code from executing in your custom class that is only intended to run on the main process.