SDLP2.0

Developer's manual

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Revision History

Version	Date	Author	Description
0.1	December 19, 2013	Vyacheslav Plachkov, E. Bratanova	Initial version
0.2	March 19, 2014	Bratanova Elena	SDLP2.0 update

Introduction

SDLP developer's manual provides a description of the SDLP2.0 technology and instructions for profiles and mobile applications development.

Definitions, acronyms and abbreviations

API	Application programming interface
DLL	Dynamic-link library
HMI	Human-machine interface
HU	Head unit
MD	Mobile device
PM	Profile Manager
SDL	Smart Device Link
SDLP	Smart Device Link Profiles (SDL with profile management layer)

SDLP technology overview

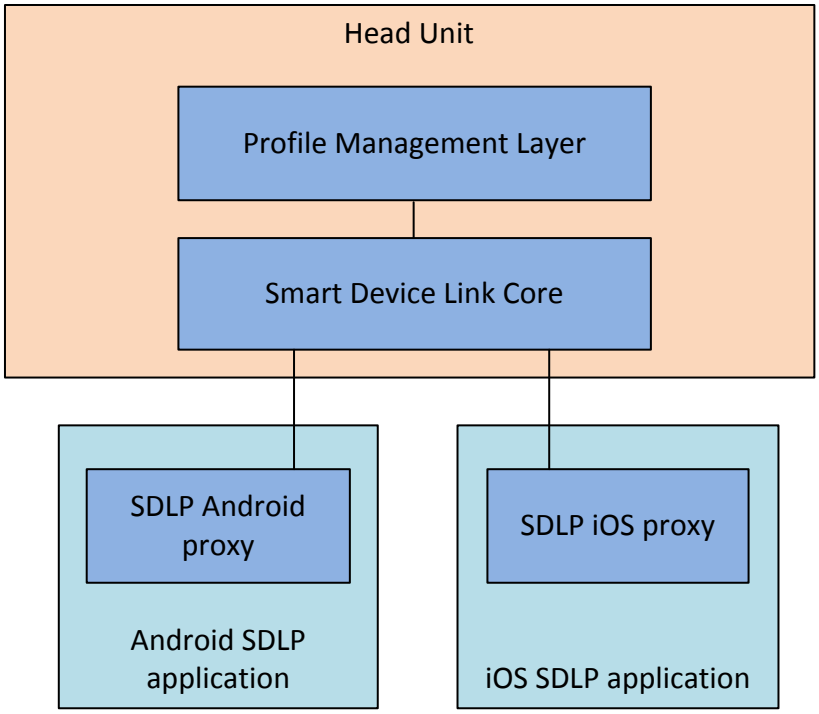
SDLP – universal multifunctional connectivity technology designed to connect mobile and automotive (in-vehicle infotainment - IVI) systems. It is based on the Smart Device Link (SDL) – the open-source technology developed by Ford Motor Company and released in GENIVI repository[1]. SDLP2.0 is based on SDL2.0. SDL provides access to the HMI layer of IVI systems through JSON RPC interface. SDLP extends this interface to provide extra functionality. This functionality is designed to add an extensible profile management layer. The layer allows extending of the head unit HMI with profiles. A profile is an updateable dynamic-link entity that contains executable code and has message-based communication interface for mobile applications and HMI.

[1] http://git.projects.genivi.org/?p=smartdevicelink.git

SDLP high-level architecture

In a very high-level point of view the SDLP technology consists of 4 modules:

- Smart Device Link core;
- Profile management layer with extensible profiles;
- SDLP Android proxy;
- SDLP iOS proxy.



Smart Device Link Core provides functionality of head unit part of SDL technology. This module is responsible for:

- Transport management;
- Mobile device connection handling;
- Connection with HMI to provide interface of HMI (SDL HMI RPC) for mobile devices;
- Connection with profile manager to provide interface of profile manager for mobile devices;
- Smart device Link Core contains demo HMI component based on HTML.

SDLCore

Building and installation

SDLP2.0 source code is available on GitHub.

Available open source code includes all the functionality of SDL2.0, its demo HMI, profile management layer and a set of sample profiles. Build instructions are available[2].

Profile management layer

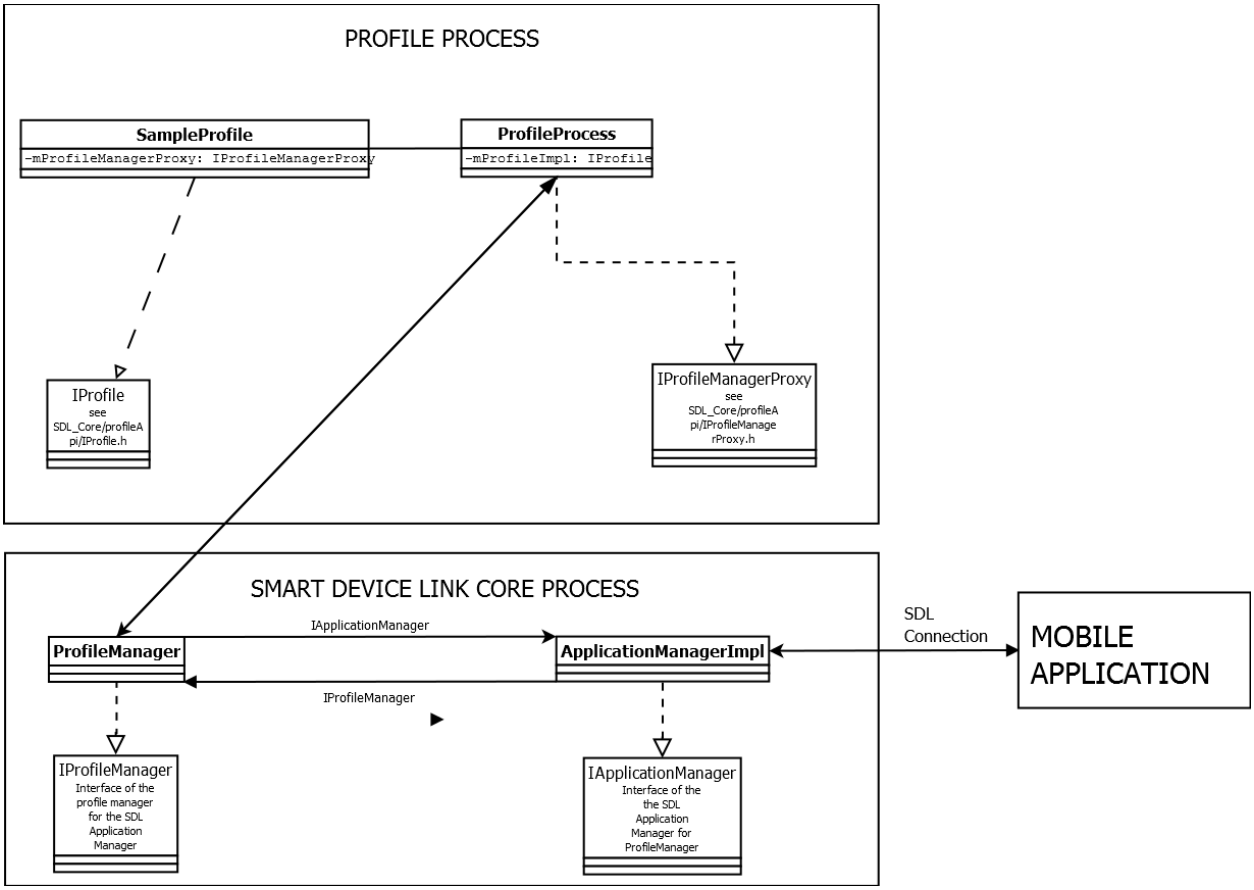
Profile management layer is extensible module of SDLP. It has profile manager component and a set of profiles, which could be extended. Head unit system has a means to add new profiles without necessity to flash head unit software. This feature is not mandatory - technology only provides a mechanism that implements it.

Profile is a key concept of SDLP designed to extend head unit functionality. Profile is a dynamic-link library that implements an interface to handle events from the mobile phone and the HMI. Public SDLP repository contains a set of sample profiles[3].

Profile Manager is a system component responsible for profiles loading/unloading, updating and handling connection with mobile applications provided by the SDL core transport mechanisms. Profile manager creates a separate process for execution of each profile. This technical solution allows developers to add new functionality in a safer way. The SDLP framework provides an interface for profile developers to interact with mobile applications and the HMI.

Profile management layer class diagram is shown on the following diagram:

[2] See SDL_Core/doc/install.txt
[3] See the "profiles" folder.

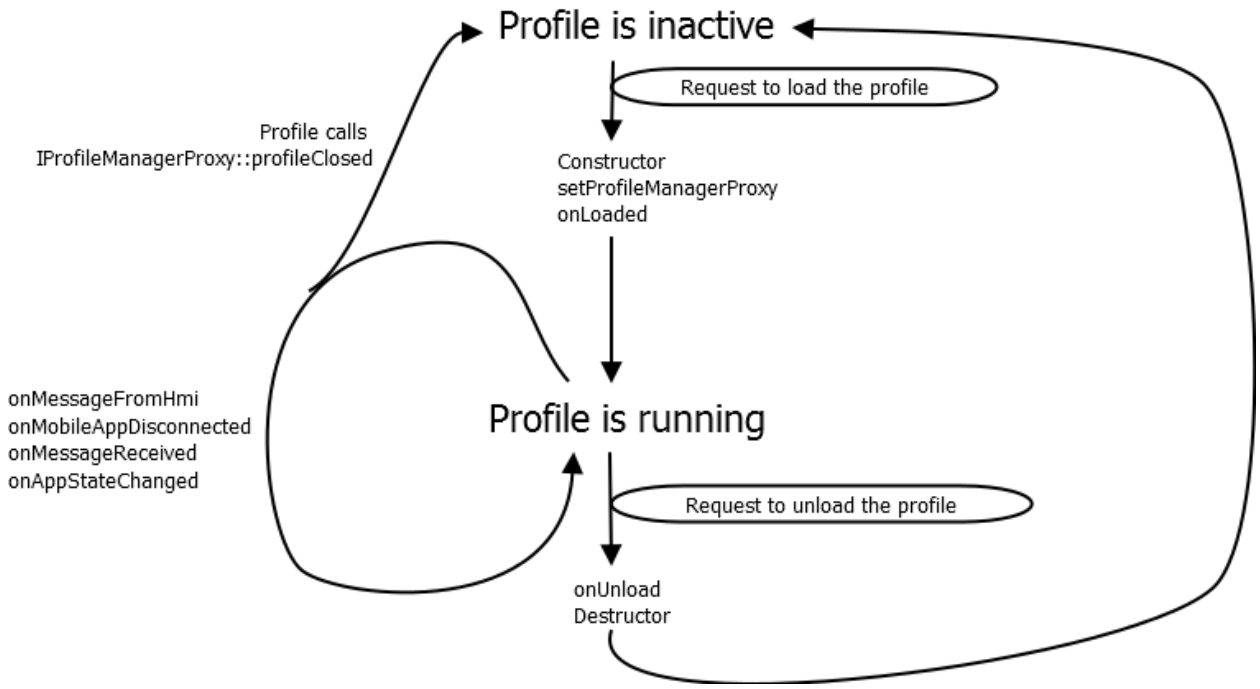


Profile

General profile lifecycle has the following stages:

1. Profile is not installed on the head unit (optional, it could be preinstalled).
2. A request to add profile is sent by a mobile application (optional, installs profile onto head unit).
3. A request to load profile is sent by a mobile application.

See the diagram below.



Each profile inherits the `IProfile` interface provided by the SDLP[4].

This class is a base interface for profiles. It provides a set of callbacks for incoming actions handling.

`onMessageReceived` – a message has been sent from a mobile application. Parameters: appID – the id of the application that has sent the message (can be used to send a response); data and dataSize – contents and length of the message.

`onAppStateChanged` – mobile application state has been changed. Mobile application states: foreground, background and lock screen. This message is **not** sent from the mobile app automatically, so mobile app developers should send it manually if their profile-app logic requires so.

`onLoaded` – informs the profile that it has been created and initialized (given a IProfileManagerProxy instance via `setProfileManagerProxy`). The appID parameter is the ID of the application that has requested the load. `onLoaded` is called only once; if a profile has

[4] SDL_Core/profileApi/IProfile.h

been loaded and another application tries to load it again (while it is still loaded), the `onLoaded` callback will not be called, and application will receive the **IN_USE** result code.

`onUnload` – informs that a mobile application (its ID provided) has requested the profile to be unloaded. After this callback the ProfileProcess is closed. To close the ProfileProcess without a request from a mobile app, use the `profileClosed` callback of the `IProfileManagerProxy`.

`onMessageFromHmi` – called when the Headunit HMI sends a message to the profile. Parameters are: application name (can be used to send a response); data and dataSize (contents and size of the message). Contents of the message depend on the HMI implementation[5].

`onMobileAppDisconnected` – callback called when system loses a link with a mobile application. In general it means that mobile application

`setProfileManagerProxy` – system uses this callback to pass profile pointer to profile manager proxy. This proxy allows profile developer to send messages into mobile applications and get access to standard HMI interface provided by the SDLP technology.

Profile manager proxy

Profile manager proxy class is an interface provided by the SDLP system to the profile developer to interact with mobile applications and the HMI layer. This interface is located in `IProfileManagerProxy.h`[6]; it provides the following methods:

`sendProfileToAppMessage` – send a message to a connected mobile application (destination mobile application is determined by the appID parameter).

[5] HMI developers may use the provided zmq Sender and Receiver sockets (see SDL_Core/src/components/utils/zmq/zmq_socket/ and SDL_Core/src/components/profile_manager/include/profile_manager/appman_hmi_protocol) for communication with profiles. A SenderZmqSocket should be connected to the FROM_APPMAN address, and a ReceiverZmqSocket – to the TO_APPMAN address. NsProfileManager::ProfilesAppsMessages should be used to serialize/deserialize communication.

[6] SDL_Core/profileApi/IProfileManagerProxy.h

`broadcastProfileToAppMessage` – send a message to all connected mobile applications that have communicated (sent a message, a load request, a mobile app state notification) with this profile instance.

`profileClosed` – stop the ProfileProcess (the IProfile instance will be destroyed). After the ProfileProcess has stopped, all connected mobile applications that have communicated with this profile instance will be notified.

`sendHmiRequest` – send a message to the head unit HMI (contents depend on profile and HMI implementations).

Sample profile

A sample profile is given in appendix B. This code shows basic steps to develop a profile. This code uses functions described above and has comments that explain chief points.

SDLP benefits

SDL provides fixed HMI RPC API for mobile application developers, but the profile management mechanism introduced in SDLP allows creating additional API of the head unit.

This technical solution makes it possible for OEMs to provide access to some additional functions, for example: access to the internal file storage for media or another data, additional diagnostic information, free-form communication with the HMI (and not a fixed set of requests like in basic SDL), etc. Another point is that a profile could contain some part of internal business logic of the mobile application – if mobile apps for both platforms (iOS and Android) are developed, some parts of their internal logic may be moved to the profile, thus removing the necessity of coding similar things twice – in Java and Objective-C.

SDLP Android proxy

The aim of this section is to help Android-developers create their own applications that use SDLP-profiles with full support of Wi-Fi transport adapter. It'll contain main steps and tips necessary to do this. SDLP Android proxy code is available at the Github public repository[7].

Android permissions required for SDLP-enabled mobile applications

Developers need to add the following permissions to their application's AndroidManifest.xml.

- To use Bluetooth connectivity: android.permission.BLUETOOTH and android.permission.BLUETOOTH_ADMIN;
- Wi-Fi basic functionality (without device discovery): android.permission.INTERNET;
- Wi-Fi with discovery: android.permission.INTERNET, android.permission.ACCESS_WIFI_STATE and optionally (some devices require it) android.permission.CHANGE_WIFI_MULTICAST_STATE.

TCP/IP Connectivity

TCP/IP: Wi-Fi, USB

SDLP provides a means to use Wi-Fi/USB to connect a mobile device to head unit. USB works when the phone has personal hotspot turned on and plugged into the headunit.

Device discovery

To start device discovery, create an instance of `com.smartdevicelink.tcpdiscovery.TcpDiscoverer`, provide a listener and call `performSearch` (non-blocking, will return immediately)

TcpDiscoverer's listeners:

- `com.smartdevicelink.tcpdiscovery.TcpDiscovererCallbackDefaultImplDelegate` – when a listener implementing this interface is provided to the `TcpDiscoverer`, upon finishing discovery, if any devices are found, it will display a popup with list of found devices and will wait for user to pick one of them or dismiss the popup.
- `com.smartdevicelink.tcpdiscovery.TcpDiscovererCallback` could be used to get information about found devices, if the mobile app developer wants some non-standard behavior (when he doesn't want a popup to be shown).

[7] SDL_Android/SmartDeviceLinkProxyAndroid

Using overview

Profile Manager proxy listener

Interface `com.smartdevicelink.proxy.interfaces.IProfileManagerListener` allows applications that use profile mechanisms instead of standard SDL HMI JSON RPC to get notifications about link up and link down events. These events are called instead of standard `onHmiStatus`, `onProxyClosed` and `onError` events. A developer can use the standard `com.smartdevicelink.proxy.interfaces.IProxyListenerALM` instead, if he wants to use the standard SDL RPC as well as communicate with profiles.

```
public interface IProfileManagerListener extends IProxyListenerProfileManager {
    /**
     * Called instead of the onOnHmiStatus callback
     */
    public void onLinkUp();

    /**
     * Called instead of onProxyClosed or onError
     */
    public void onLinkDown();
}
```

`IProfileManagerListener` inherits a set of events from the `com.smartdevicelink.proxy.interfaces.IProxyListenerProfileManager` interface:

```
    // ************************ responses **********************//
    public void onAddProfileResponse(AddProfileResponse response);
    public void onRemoveProfileResponse(RemoveProfileResponse response);
    public void onLoadProfileReponse(LoadProfileResponse response);
    public void onUnloadProfileResponse(UnloadProfileResponse response);
    public void onSendMessageToProfileResponse(SendAppToProfileMessageResponse response);
    public void onAppStateChangedResponse(AppStateChangedResponse response);

    // ************************ notifications **********************//

    public void onProfileClosed(OnProfileClosed notification);
    public void onReceiveMessageFromProfile(OnSendProfileToAppMessage notification);
```

See table below for description of requests, responses and notifications.

SmartDeviceLinkProxyALM class

com.smartdevicelink.proxy.SmartDeviceLinkProxyALM class is the main class used to call SDLP RPC methods.

It implements and inherits all main methods that are necessary to interact with smart device link core including SDLP RPC. So it provides profile management functionality for mobile apps developers:

- `loadProfile(String profileId, Integer correlationID)`
- `unloadProfile(String profileId, Integer correlationID)`
- `addProfile(String profileId, byte[] profileBinData, Integer correlationID)`
- `removeProfile(String profileId, Integer correlationID)`
- `appStateChanged(String profileId, MobileAppState state, Integer correlationID)`
- `sendAppToProfileMessage(String profileId, byte[] message, Integer correlationID)`

`loadProfile` requests the Profile Manager to load a DLL that matches given profileID.

`unloadProfile` requests the Profile Manager to terminate this profile's process.

`addProfile` method is designed to extend head unit dynamically by sending a new profile library as binary data.

`removeProfile` request to remove this profile's DLL from the head unit.

`appStateChanged` method is designed profile about application state change.

`sendAppToProfileMessage` request is a way to transmit messages from mobile application to running profile. This method is the most frequently used until the profile is active.

Responses on profile requests

`LoadProfileResponse` codes:

- INVALID_ID – no profile with given ID in system;
- IN_USE – profile with given ID has already been loaded;
- GENERIC_ERROR – other error on load profile;
- SUCCESS – profile has been loaded.

`UnloadProfileResponse` codes:

- INVALID_ID – profile is not active or does not exist

- SUCCESS – profile has been unloaded

`AddProfileResponse` codes:

- IN_USE – Profile with given ID is currently active;
- INVALID_DATA – wrong order of received data frames with profile;
- SUCCESS – profile has been added to the system.

`RemoveProfileResponse` codes:

- IN_USE – Profile with given ID is currently active;
- INVALID_ID – profile with given ID does not exist;
- SUCCESS – profile has been removed from the system.

`SendAppToProfileResponse` codes:

- INVALID_ID – profile is not active or does not exist;
- SUCCESS – message received by profile

`AppStateChangedResponse` codes:

- INVALID_ID – profile is not active of does not exist;
- SUCCESS – message received by profile.

See the table in Appendix D for comparison with iOS and some additional comments.

SDLP iOS proxy

Main classes overview

SDLProxy – proxy of SmartDeviceLinkCore running in the Headunit; is used for establishing connection, sending requests to the HU, and receiving responses and notifications from the HU

SDLProxyFactory – can be used to instantiate a *SDLProxy* (depending on the method that was used means of connecting to the HU will differ)

SDLProxyListener – protocol for callbacks (notifications and responses) from SDL Core running in the Headunit. All callbacks are posted to the main queue.

SDLRpcRequestFactory – provides convenience methods for creating and initializing RPC requests that then may be send to the SDL Core

SDLTcpDiscoverer – may be used to obtain list of IP addresses of devices with SDL Core processes running in the same WiFi network

How to use

Building application with the SmartDeviceLink framework

Add the library project to the same XCode workspace where your application is. Drag and drop the SmartDeviceLink onto your project. In your project's Target Settings (Build Phases) add the following libraries to "Link Binary With Libraries": *QuartzCore*, *ExternalAccessory*. Generate the framework files (follow this link for instructions). Add the generated `SmartDeviceLink.framework` to your project's dependencies.

Proxy creation – connectivity options

If you intend to use USB as transport, use *SDLProxyFactory*'s `buildProxyWithListener:` (HU must have the Apple authentication chip; our implementation of SDL Core does not have the capabilities to accept such connection).
If you intend to use TCP/IP over WiFi or USB as transport, use *SDLProxyFactory*'s `buildProxyWithListener:tcpIPAddress:tcpPort:`. To obtain IP address and port of the HU *SDLTcpDiscoverer* may be used (see below). To use USB for the TCP/IP connection, mobile phone's personal hotspot should be enabled and the phone should be plugged into the headunit. This:

- Does not require the head unit to have the Apple auth chip
- Won't work with devices running iOS7 and newer (until libimobiledevice has been fixed)

TCP/IP discovery

SDLTcpDiscoverer may be used to obtain list of IP addresses of devices with SDL Core processes running in the same WiFi network. To use it, you should create a class conforming to one of the protocols:

1. ***SDLTcpDiscovererListener*** – one of the following callbacks will be received after the observed *SDLTcpDiscoverer* instance has finished searching: `onFoundDevices:` with list of *SDLTcpDiscoveredDevice* instances (ip, port, hostname and unique id of the device running SDL Core may be obtained from them), or `onFoundNothing` if no headunits had been found.
2. ***SDLTcpDiscovererDefaultListenerDelegate*** – a standard way of handling device discovery is provided: after searching, if some devices have been found, a popup window with list of hostnames and a dismiss button is displayed, and user may either pick one of them or dismiss the popup. `onUserSelectedDeviceWithIP:tcpPort:` is called if the user has clicked one of the items in the displayed list of discovered devices. If the user has clicked the dismiss button, `onUserCanceledAlert` will be called (then you may, for example, stop device discovery, or restart it). If the observed *SDLTcpDiscoverer* instance has found nothing, `onFoundNothing` will be called. Additionally, the method `dismissButtonTitle` may be implemented – the value returned from it will be displayed in the dismiss button and may reflect what will happen when the user click it (like "Stop searching" or "Search again")

To perform device discovery, one should create an instance of *SDLTcpDiscoverer* (either with `initWithListener:` and an implementation of *SDLTcpDiscovererListener*, or `initWithDefaultListener:` and an implementation of *SDLTcpDiscovererDefaultListenerDelegate*) and call `performSearch`. Discovery is done on a background thread (`performSearch` returns immediately, the discovery process itself takes about two seconds). All callbacks are posted to the main queue.

Proxy usage

After an instance of SDLProxy has been created, it will try to establish connection with an SDL Core process. After establishing connection `onProxyOpened` will be called in all registered listeners (in addition to the SDLProxyListener implementation that is mandatory to create an instance of *SDLProxy*, more listeners may be registered with *SDLProxy*'s `addDelegate:`). At that moment one of the listeners should send a *SDLRegisterAppInterface* request (IMPORTANT: if it has not been sent, one second after establishing connection it will be closed). After your listeners have received a `onRegisterAppInterfaceResponse:` callback, you may use SDLP fully (load profiles, bind buttons, etc.). If connection between the phone and HU has been broken, `onProxyClosed` will be called.

Responses are associated with requests by a correlation ID (int number).

The following requests may be used for profile management purposes:

- ***SDLLoadProfile*** – request to load a profile by its name
- ***SDLUnloadProfile*** – request to unload a profile by its name
- ***SDLAddProfile*** – request to add a profile *.so to the system. Use only *SDLRPCRequestFactory*'s `buildAddProfileWithName:rawData:correlationID:` or `buildAddProfileForEmbeddedPath:profileName:correlationID:` (the first parameter is the name of a *.so file that is included into your Xcode project as a resource) to obtain an array of *SDLAddProfile* requests containing data of the profile. The first SDLAddProfile in the array will have a correlation ID that has been passed to the building method, and the last one will have (passedCorrelationID + ([resultArray count] – 1)). You should store the correlation ID of the last request part, and when you receive a response to it, you may load the profile (if it has been added successfully).
- ***SDLRemoveProfile*** – request to delete a profile library file from the system
- ***SDLSendAppToProfileMessage*** – request to send some data to a profile
- **SDLAppStateChanged** – request to inform a profile that the mobile application state has changed (for example when it went to foreground or background)

Now we will take a closer look at the part of the *SDLProxyListener* protocol that is related to profile management:

`-(void) onOnProfileToAppMessage: (SDLOnProfileToAppMessage*) notification` – called when a profile sends a message to your application (from the notification you can get the name of the profile and the message either as *NSData* or *NSString*)

`-(void) onOnProfileUnloaded: (SDLOnProfileUnloaded*)notification` – called when a profile process dies (you will receive this notification only if you have sent some requests (like a load request, or a message) related to this profile beforehand)

`-(void) onAddProfileResponse: (SDLAddProfileResponse*) response` – received as a response to a *SDLAddProfile* request. Possible result codes: IN_USE (profile with the same name has been already loaded), INVALID_DATA (SDLAddProfile requests has been sent in incorrect order), SUCCESS.

`-(void) onAppStateChangedResponse: (SDLAppStateChangedResponse*) response` – response to a *SDLAppStateChanged* request. Possible result codes: INVALID_ID (profile with the name specified in request has not been loaded), SUCCESS

`-(void) onLoadProfileResponse: (SDLLoadProfileResponse*) response` – response to *SDLLoadProfile*. Possible result codes: INVALID_ID (no *.so file for profile with this name in system – time to send some SDLAddProfile requests), IN_USE (profile has already been loaded prior to this request and may be used), GENERIC_ERROR (when a profile process cannot be

started due to some system error in HU), SUCCESS (profile has been loaded and may be used)

`-(void) onRemoveProfileResponse: (SDLLoadProfileResponse*) response` – response to *SDLRemoveProfile*. Result codes: IN_USE (profile is currently loaded, cannot remove its *.so file), INVALID_ID (there was no file for this profile), SUCCESS (profile library has been removed)

`-(void) onUnloadProfileResponse: (SDLUnloadProfileResponse*) response` – response to *SDLUnloadProfile*. Results: INVALID_ID (the profile has not been loaded, so nothing has been unloaded), SUCCESS (unload request has been passed to this profile's process). Please note that receiving this response with SUCCESS code does not mean that the profile has stopped – it may take some time for it to unload, and you will receive `onOnProfileUnloaded:` when that happens.

`-(void) onSendAppToProfileMessageResponse: (SDLSendAppToProfileMessageResponse*) response` – response to *SDLSendAppToProfile* message. Result codes: INVALID_ID (a profile with the name specified has not been loaded), SUCCESS (message has been passed to the profile). Please note that it is not a "response" per se – it does not carry any payload, and if the profile sends you any response to your message, you will receive it with `onOnProfileToAppMessage:`. See the table in appendix D for comparison with the Android proxy.

Simple sample

```
#import <Foundation/Foundation.h>
#import "SDLProxy.h"
#import "SDLTcpDiscoverer.h"

@protocol SDLLogicListener
- (void) onProfilesReady;
- (void) onReceiveData:(NSData*)data fromProfile:(NSString*)profileName;
@end

@interface SDLLogicBase : NSObject<SDLProxyListener,
     SDLTcpDiscovererDefaultListenerDelegate>
@property (weak) id<SDLLogicListener> delegate;
+ (id) createInstance: (NSArray*)profilesToLoad
     withAppInterfaceName:(NSString*)appInterfaceName;
+ (id) getInstance;
- (void) sendData:(NSData*)data toProfile:(NSString*)profileName;
@end
```

Upon creation (`createInstance:withAppInterfaceName:` - the first parameter should be a *NSArray* with *NSString*s containing names of profiles that should be loaded, the second one is the name of your application that may be displayed in headunit HMI's list of apps) *SDLLogic* tries to discover a HU and connect to it. After connection has been established, it will try to load all profiles from the list. If some profiles are not present in the headunit, it is expected that their

binaries are present in the phone, and *SDLLogic* will try to send them and then attempt to load again. After all profiles have been loaded, delegate's `onProfilesReady` will be called. If one of the profiles sends data to the application, delegate's `onReceiveData:fromProfile:` will be invoked with the message from the profile and that profile's name.
An example of use is in appendix C.

Appendix A

Build instructions

```
* Introduction
  ================
  smartDeviceLinkCore is an application which manages the transport, connection
and communication between a head unit and mobile device.
  Software version 1.0

* OS and Hardware
  =========
  Ubuntu 12.04.01 LTS 32-bit OS on the PC with USB-dongle
  Application has been tested using 2 types of USB-dongle:
  D-Link DBT-122
  STLab B-121mini

* External components
  ===================
  Run the setup_env.sh script to install all necessary dependencies.

* Build application
  =================
  We support "out of sources" concept for build.
  It means all generated by build tools files will be stored in separate folder.

  1. Create directory outside of SDLP project directory.
  For example "build" folder in the same folder with SDLP git repo folder which
has a name "git_repo":
  mkdir build
  You will have folders structure like this:
  /home/projects/SDLP
  |--build
  |--git_repo
     |--SDL_Core
        |--doc
        |--src
        |--DoxyFile
        \--CMakeLists.txt
     |--SDL_Android
     |--SDL_iOS
     |--profiles
  Enter build folder:
  cd build

  2. Create build configuration using cmake:
  2.1 For Debug configuration
  cmake ../git_repo
  2.2 For Release configuration, run:
  cmake -DCMAKE_BUILD_TYPE=Release ../git_repo

  3. Make project:
  make
  Ready to use release application smartDeviceLinkCore will be in
build/src/appMain/smartDeviceLinkCore

  4. Additionally it could be installed into build/bin folder
  make install
```

```
  Ready to use release application will be in build/bin/

  Running application
  ====================
  If you want to use Bluetooth:
   Plug USB-dongle in.
   Switch Bluetooth on a mobile device ON and make the device discoverable.
   Pair mobile device with PC using Ubuntu tools.
   Device should contain SDLP compatible application installed.
  If you want to use Wi-Fi:
   Connect device to the head unit Wi-Fi network.
  Start application with command:
  ./smartDeviceLinkCore
  Application starts to search devices and starts HMI in chromium-browser.
  In case HMI has not been started please start web-based HMI manually in browser
opening SDL_Core/src/components/HMI/index.html.
  SmartDeviceLinkCore is searching Bluetooth devices with a correspondibg service.
  Go to info menu in HMI and press App button.
  Press change Devices button.
  Select the device from a list.
  Application opens all available ports on devices and starts communication.
  Returning to the App menu all applications will be shown in a list.


* SDLP Profiles examples
  =====================
  Open directory git_repo/profiles/.
  This folder has structure like this:
    profiles:
       |--TestEchoProfile
       |--TestSendingProfile
  TestEchoProfile folder contains profile  designed to test profile functionality.
  This profile with mobile test application provide echo client-server test
system.
  TestSendingMsgProfile folder contains profile designed to test message
transmission between HU and mobile application functionality.

* Android
  =======
  SDLP Android part is located in SDL_Android folder. It contains SDLP Android
proxy library and SDLP tester application.
    SDL_Android
       |--SmartDeviceLinkProxyAndroid  - contains SDLP Android proxy
       |--SmartDeviceLinkTester        - contains SDLP tester application
  SDLP Android proxy library is designed to be used in SDLP-enabled application to
interact with SDLP core. SDLP tester application is designed to test SDLP
functionality.

* iOS
  ===
  SDLP iOS part is located in SDL_iOS folder. It contains SDLP iOS proxy and SDLP
iOS tester application and SDLP Profiles Tester.

    SDL_iOS
       |--SmartDeviceLink       - contains SDLP iOS proxy
       |--SmartDeviceLinkTester - contains SDLP tester application
       |--ProfilesTester        - contains SDLP Profiles tester application
```

Appendix B

Sample profile header file

SampleProfile.h[8]

```
#ifndef TESTECHOPROFILE_H

#define TESTECHOPROFILE_H


#include "Logger.hpp"


#include "IProfile.h"


class TestEchoProfile : public NsProfileManager::IProfile

{


public:


    TestEchoProfile();


    ~TestEchoProfile();


    // From IProfile


    virtual void onMessageReceived(const int appId, const char * data, const int dataSize);


    /**

     * @brief onAppStateChanged Mobile application state changes handling

     * @param state Mobile application state
```

[8] Sample profile header file: profiles/TestEchoProfile/include/TestEchoProfile.h

```
     * @param appId Application id
     */
    virtual void onAppStateChanged(const int appId, const NsProfileManager::MobileAppState
state);


    /**
     * @brief onLoaded - first callback - will be called right after creation with app id
     * that requested the load. ProfileManagerProxy is set already and can be used.
     * @param appId Application id
     */
    virtual void onLoaded(const int appId);
    /**
     * @brief onUnload Unloading profile handling
     * @param appId Application id
     */
    virtual void onUnload(const int appId);


    /**
     * Called when a notification from the HMI comes.
     * Pointer to the data shouldn't be held onto, as it is deallocated after method exit
     * @return true if the data received may be deleted
     */
    virtual void onMessageFromHmi(std::string const& applicationName, const char * data, const
int dataSize) {}


    /**
     * @brief setProfileManagerProxy Set profile callbacks
     * @param callbacks Profile callbacks
```

```
     */

    virtual void onMobileAppDisconnected(const int appID) {}

    /**
     * @brief setProfileCallbacks Set profile callbacks
     * @param callbacks Profile callbacks
     */
    virtual void setProfileManagerProxy(NsProfileManager::IProfileManagerProxy * callbacks);

private:
    NsProfileManager::IProfileManagerProxy * mCallbacks;
    std::string mName;
    static Logger mLogger;
    int mAppId;

};

#endif //TESTECHOPROFILE_H
```

Sample profile source file

SampleProfile.cpp[9]

```
#include "TestEchoProfile.h"


using namespace NsProfileManager;


Logger TestEchoProfile::mLogger = Logger::getInstance(
        LOG4CPLUS_TEXT("SDL.TestEchoProfile"));


#define LOADMSG "KONICHIWA! WATASHI WA EKO!!!"


extern "C" IProfile *CreateProfile()
{
    return new TestEchoProfile;
}


extern "C" void DestroyProfile(IProfile *profile)
{
    delete profile;
}


TestEchoProfile::TestEchoProfile()
    : mCallbacks(NULL),
      mName("TestEchoProfile"),
      mAppId(0)
```

[9] Sample profile source file: profiles/TestEchoProfile/src/TestEchoProfile.cpp

```
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);
}

TestEchoProfile::~TestEchoProfile()
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);
}

void TestEchoProfile::onMessageReceived(const int appId, const char *data, const int dataSize)
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);

    LOG4CPLUS_INFO(mLogger, "Message received : " + std::string(data, dataSize));
    LOG4CPLUS_INFO(mLogger, "Message received : dataSize = " << dataSize);
    LOG4CPLUS_INFO(mLogger, "Message received : appId = " << appId);

    mCallbacks->sendProfileToAppMessage(appId, data, dataSize);
}

void TestEchoProfile::onAppStateChanged(const int appId, const MobileAppState state)
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);
    std::string response;
    if (mCallbacks)
    {
        switch (state)
```

```
        {
        case MOBILE_APP_BACKGROUND:
            LOG4CPLUS_INFO(mLogger, "MOBILE_APP_BACKGROUND received");
            response = "MOBILE_APP_BACKGROUND";
            break;
        case MOBILE_APP_FOREGROUND:
            LOG4CPLUS_INFO(mLogger, "MOBILE_APP_FOREGROUND received");
            response = "MOBILE_APP_FOREGROUND";
            break;
        case MOBILE_APP_LOCK_SCREEN:
            LOG4CPLUS_INFO(mLogger, "MOBILE_APP_LOCK_SCREEN received");
            response = "MOBILE_APP_LOCK_SCREEN";
            break;
        default:
            return;
        }
        mCallbacks->sendProfileToAppMessage(appId, response.c_str(), response.size());
    }
}

void TestEchoProfile::onUnload(const int appId)
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);
}

void TestEchoProfile::onLoaded(const int appId)
{
```

```
        LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);
        if (mCallbacks)
        {
                mAppId = appId;
        }
}

void TestEchoProfile::setProfileManagerProxy(IProfileManagerProxy *callbacks)
{
    LOG4CPLUS_TRACE_METHOD(mLogger, __PRETTY_FUNCTION__);

    if (callbacks)
    {
        mCallbacks = callbacks;
    }
}
```

Appendix C

iOS example

```
#import "SDLLogicBase.h"
#import "SDLProxy.h"
#import "SDLTcpDiscoverer.h"
#import "SDLProxyFactory.h"
#import "SBJSON.h"

static SDLLogicBase * instance;

@interface SDLLogicBase ()
{
    SDLProxy * mProxy;
    // name of application that may be displayed in headuint's HMI
    NSString * mName;
    SDLTcpDiscoverer * mDiscoverer;
    // correlation ID of latest request sent to HU
    int mCorrelationID;
    // counter of profiles that have yet to be loaded - when it reaches 0 system is
     ready
    int mCounter;
    // list of names of profiles that should be loaded
    NSMutableArray * mProfilesToLoad;
    // maps correlation id of the last SDLAddProfile request to profile name
    NSMutableDictionary * mAddProfileRequests;
    // maps correlation id of SDLLoadProfile request to profile name
    NSMutableDictionary * mLoadProfileRequests;

}
- (id) initWithProfiles: (NSArray*) profiles name: (NSString*)name;
- (void) showPopUpMessage:(NSString*)msg;
@end

@implementation SDLLogicBase

- (void) showPopUpMessage:(NSString *)msg
{
    UIAlertView * alert  = [[UIAlertView alloc] initWithTitle:@"SDL" message:msg
     delegate:nil cancelButtonTitle:@"Dismiss" otherButtonTitles:nil];
    [alert show];
}

- (id) initWithProfiles:(NSArray*)profiles name:(NSString*)name
{
    self = [super init];
    if (self)
    {
        mCorrelationID = 100;
        mDiscoverer = [[SDLTcpDiscoverer alloc] initWithDefaultListener:self];
```

```
        mName = name;
        mAddProfileRequests = [[NSMutableDictionary alloc] initWithCapacity:
      [profiles count]];
        mLoadProfileRequests = [[NSMutableDictionary alloc] initWithCapacity:
      [profiles count] ];
        mProfilesToLoad = [[NSMutableArray alloc] initWithArray: profiles];
        mCounter = [mProfilesToLoad count];
        [mDiscoverer performSearch];
    }
    return self;
}

+ (id) getInstance
{
    @synchronized([SDLLogicBase class])
    {
        if (instance == nil)
        {
            [NSException raise: @"Instance not created!" format:nil];
        }
        return instance;
    }
}

+ (id) createInstance: (NSArray*)profilesToLoad
     withAppInterfaceName:(NSString*)appInterfaceName
{
    @synchronized([SDLLogicBase class])
    {
        if (instance == nil)
        {
            instance = [[SDLLogicBase alloc] initWithProfiles:profilesToLoad
     name:appInterfaceName];
        }
        return instance;
    }
}

-(void)onFoundNothing
{
    [mDiscoverer performSearch];
}

-(void)onUserCanceledAlert
{
    [mDiscoverer performSearch];
}

-(void)onUserSelectedDeviceWithIP:(NSString *)ipaddress tcpPort:(NSString *)port
{
    NSLog(@"onUserSelectedDeviceWithIP: %@, %@", ipaddress, port);
```

```
    mProxy = [SDLProxyFactory buildProxyWithListener: self
                                        tcpIPAddress: ipaddress
                                             tcpPort: port];
}

-(NSString*) dismissButtonTitle
{
    return @"Continue searching";
}

-(void) onRegisterAppInterfaceResponse:(SDLRegisterAppInterfaceResponse*) response
{
    for (id object in mProfilesToLoad)
    {
        SDLLoadProfile *req = [SDLRPCRequestFactory buildLoadProfileWithName:object

     correlationID:@(mCorrelationID)];
        [mLoadProfileRequests setObject: object forKey:@(mCorrelationID)];
        mCorrelationID ++;
        [mProxy sendRPCRequest:req];
    }
}

-(void) onProxyOpened
{
    NSLog(@"onProxyOpened");
    SDLRegisterAppInterface* regRequest = [SDLRPCRequestFactory
     buildRegisterAppInterfaceWithAppName:mName];
    regRequest.isMediaApplication = @(NO);
    [mProxy sendRPCRequest:regRequest];
}



-(void) onProxyClosed
{
    NSLog(@"onProxyClosed");
    [mProxy dispose];
    mProxy = nil;
    mCounter = [mProfilesToLoad count];
    [self showPopUpMessage: @"Connection with HU has been lost!"];
    [mDiscoverer performSearch];
}

-(void) onOnProfileToAppMessage: (SDLOnProfileToAppMessage*) notification
{
    [[self delegate] onReceiveData:[notification messageData]
     fromProfile:[notification profileName]];
}
```

```
-(void) onOnProfileUnloaded:(SDLOnProfileUnloaded *)notification
{
    NSLog(@"Profile Unloaded! trying to reload");
    mCounter = [mProfilesToLoad count];
    for (id object in mProfilesToLoad)
    {
        SDLLoadProfile *req = [SDLRPCRequestFactory buildLoadProfileWithName:object

     correlationID:@(mCorrelationID)];
        [mLoadProfileRequests setObject: object forKey:@(mCorrelationID)];
        mCorrelationID ++;
        [mProxy sendRPCRequest:req];
    }
}



-(void) onAddProfileResponse: (SDLAddProfileResponse*) response
{
    NSString * profileName = [mAddProfileRequests objectForKey: [response
     correlationID]];
    if (profileName != nil)
    {
        SDLLoadProfile *req = [SDLRPCRequestFactory
     buildLoadProfileWithName:profileName


     correlationID:@(mCorrelationID)];
        [mLoadProfileRequests setObject: profileName forKey:@(mCorrelationID)];
        mCorrelationID ++;
        [mProxy sendRPCRequest:req];
        [mAddProfileRequests removeObjectForKey: [response correlationID]];
    }
}


-(void) onLoadProfileResponse: (SDLLoadProfileResponse*) response
{
    NSString * profileName = [mLoadProfileRequests objectForKey: [response
     correlationID]];
    NSLog(@"profile: %@", profileName);
    if ([response isSuccess] || [[response resultCode] isEqual: [SDLResult IN_USE]])
    {
        mCounter --;
        if (mCounter == 0)
        {
            [self showPopUpMessage: @"Connection established!"];
            [[self delegate] onProfilesReady];
        }
    }
    else if ([[response resultCode] isEqual: [SDLResult INVALID_ID]])
```

```
    {
        NSLog(@"No profile binary on HU, sending");
        NSArray * addProfile = [SDLRPCRequestFactory
     buildAddProfileForEmbeddedPath:[NSString stringWithFormat: @"lib%@.so",
     profileName]

     profileName:profileName

     correlationID:@(mCorrelationID)];
        mCorrelationID += [addProfile count] - 1;
        [mAddProfileRequests setObject: profileName forKey:@(mCorrelationID)];
        mCorrelationID ++;
        for (id request in addProfile) {
            [mProxy sendRPCRequest: request];
        }
    }
    else
    {
        NSLog(@"Unexpected result: %@", [response resultCode]);
        assert(false);
    }
    [mLoadProfileRequests removeObjectForKey: [response correlationID]];
}

- (void) sendData:(NSData *)data toProfile:(NSString *)profileName
{
    if (mCounter != 0)
    {
        [self showPopUpMessage: @"No connection to HU"];
        return;
    }
    SDLSendAppToProfileMessage * req = [SDLRPCRequestFactory
     buildSendAppToProfileMessageWithName:profileName rawData:data
     correlationID:@(mCorrelationID++)];
    [mProxy sendRPCRequest: req];
}
```

@end

Appendix D

Android and iOS proxies cheat sheet

Request description	Android proxy[10] method	Android response callback	iOS request class[11]	iOS response callback	Result codes description
Add profile – add profile's DLL to the system. The library's binary data should be split in multiple packets and sent in multiple requests.	public Integer **addProfile**(String profileId, byte[] profileBinData, Integer correlationID)[12]	onAddProfileResponse	SDLAddProfile[13]	onAddProfileResponse:	**IN_USE** – profile is currently loaded, unload it first and then try again **INVALID_DATA** – profile binary pieces are sent in incorrect order **SUCCESS** – profile binary piece has been appended successfully (if it was the last one, the profile may now be loaded)
Load profile – create this profile's instance and prepare it for communication.	public void **loadProfile**(String profileId, Integer correlationID)	onLoadProfileResponse	SDLLoadProfile	onLoadProfileResponse:	**INVALID_ID** – profile library is not present in system **IN_USE** – profile has been loaded already and is ready for communication **GENERIC_ERROR** – something went wrong during the ProfileProcess creation **SUCCESS** – profile has been loaded successfully and is ready for communication
Send message to profile	public void **sendAppToProfileMessage**(String profileId, byte[] message, Integer correlationID)	onSendMessageToProfileResponse	SDLSendAppToProfileMessage	onSendAppToProfileMessageResponse:	**SUCCESS** – data has been delivered to the profile instance. The response does not carry any actual response data from the profile, data from the profile is received with the onProfileToAppMessage notification. **INVALID_ID** – the profile is not loaded
Send mobile app state to profile – this is not sent automatically.	public void **appStateChanged**(String profileId, MobileAppState state,	onAppStateChangedResponse	SDLAppStateChanged	onAppStateChangedResponse:	**INVALID_ID** – the profile is not loaded **SUCCESS** – notification has been delivered to the

[10] SmartDeviceLinkProxy/SmartDeviceLinkProxyALM

[11] Pass instances to proxy's sendRPCRequest. May be instantiated not directly, but using SDLRPCRequestsFactory

[12] The returned value is the correlation ID of the last AddProfile request sent. After response to it, the profile can be loaded (in case of success).

[13] Use ONLY SDLRPCRequestFactory's `buildAddProfileWithName:rawData:correlationID:` or `buildAddProfileForEmbeddedPath:profileName:correlationID:` (the first parameter is the name of a *.so file that is included into your Xcode project as a resource) to obtain an *NSArray* of *SDLAddProfile* requests containing data of the profile. The first *SDLAddProfile* in the array will have a correlation ID that has been passed to the building method, and the last one will have (passedCorrelationID + ([resultArray count] – 1)).

Developers should sent it manually if their profile-mobile app logic requires so.	Integer correlationID)				profile
Unload profile – destroy running instance of this profile	public void **unloadProfile**(String profileId, Integer correlationID)	onUnloadProfileResponse	SDLUnloadProfile	onUnloadProfileResponse:	**SUCCESS** – request to die has been delivered to this profile's process. Profile may stop not immediately, wait for the onProfileClosed notification to be sure. **INVALID_ID** - the profile is not loaded.
Remove profile – delete this profile's library from the system (after successful remove, all requests to load this profile will fail, until it has been loaded again)	public void **removeProfile**(String profileId, Integer correlationID)	onRemoveProfileResponse	SDLRemoveProfile	onRemoveProfileResponse:	**IN_USE** – the profile is currently active, unload it first and then try to remove again **INVALID_ID** – profile is not present in system, nothing has changed **SUCCESS** – profile library has been successfully removed

Notification description	**Android callback**	**iOS callback**	**Comments**
Profile closed – sent to all mobile applications that have ever communicated with this profile instance (tried to load it, sent messages or mobile app states)	public void **onProfileClosed(** OnProfileClosed notification**);**	-(void) **onOnProfileUnloaded**: (SDLOnProfileUnloaded*)	After this notification profile is considered inactive, and may be: • Loaded • Added • Removed Such operations as: • Send mobile app state changed notification • Unload the profile • Send message to the profile will fail while the profile is in this state.
Message from profile – profile may either sent it to one specific mobile application, or to all applications, that have ever communicated with it.	public void **onReceiveMessageFromProfile(** OnSendProfileToAppMessage notification**);**	-(void) **onOnProfileToAppMessage**: (SDLOnProfileToAppMessage*)	The notification contains data from the profile.