WPEFramework (Thunder)

1.Repos:

Repo Name	URL	Comment
WPEFramework	https://github.com/WebPlatformForEmbedded/WPEFramework	Main repo for Thunder/WPEFramework
WPEFrameworkPlugins	https://github.com/WebPlatformForEmbedded/WPEFrameworkPlugins	Various WPEFramework plugins
Lightning SDK	https://github.com/WebPlatformForEmbedded/Lightning	WPE UI Framework (JS & WebGL library for developing web apps)
WPEReferenceUX	https://github.com/WebPlatformForEmbedded/WPEReferenceUX	Sample UI/Demo app which demonstrates WPEFramework and Lightning use
WPEPluginLauncher	https://github.com/WebPlatformForEmbedded/WPEPluginLauncher	Plugin to "Launch" linux applications and scripts

2. WPEFramework

WPEFramework provides a unified web-based interface with a consistent navigation model. In this model, plugins (custom or generic) are controlled and queried, through the WPEFramework application.

The main responsibilities of WPEFramework application are:

- Modular loading and unloading of plugins.
- Plugin process localization. In or out-of-process communicating with the framework over a lightweight RPC communication channel.
- Runtime enabling/disabling of tracing information within the plugins and the WPEFramework application.
- Light-weight implementation of the HTTP [RFC2616] specification.
- Light-weight implementation of the WebSocket [RFC6455] specification.

Each instance of a plugin in the WPE id identified by a name. This name is referred to as *Callsign* of the plugin. The callsign must be unique in the context of all configured plugins.

3. HTTP Restful API

All request and response bodies should use the JSON format for data.

3.1 Methods

Method	Function
GET	Retrieve information from WPEFramework or a plugin
POST	Update new information or new objects at WPEFramework or a plugin
PUT	Update new information or new objects at WPEFramework or a plugin

DELETE	Delete information at WPEFramework or a plugin

3.2 Web API Path

All WPEFramework commands start with the “Service” prefix followed by the Plugin name:

```
(GET|POST|PUT|DELETE) /Service/<PluginName>[/OptionalPaths] HTTP/1.1
```

3.3 Examples

Retrieve the list of all active plugins:

```
curl -X GET http://192.168.1.122:9998/Service/Controller
```

Deactivate OCDM plugin:

```
curl -X PUT http://192.168.1.122:9998/Service/Controller/Deactivate/OCDM
```

Send a Scan command to the WIFI controller plugin:

```
curl -X PUT http://192.168.1.122:9998/Service/WifiControl/Scan
```

Update the WebktiBrowser config:

```
curl -X POST http://192.168.1.122:9998/Service/WebKitBrowser/Config --data "config.json"
```

4. WebSockets for events & notifications

The architecture of the WPEFramework offers event based feedback to clients. This functionality is realized using web socket connections to a plugin. Over these web socket connections, the plugin will notify the client on the other side of the web socket of events specific to the plugin.

The syntax for opening a web socket to the plugin is equal to the syntax of the RESTfull API:

```
Request: ws://<IP Address and port of WPEFramework>/Service/<Callsign>
protocol: notification

In Javascript, the socket would be opened like:
socket = new WebSocket("ws://192.168.1.122:9998/Service/Controller", "notification");
```

using wscat tool: (shows notification for OCDM plugin being deacticated)

```
09:23 $ wscat -c ws://192.168.1.122:9998/Service/Controller -s notification --no-color
connected (press CTRL+C to quit)
< {"callsign":"OCDM","state":"deactivated","reason":"Requested"}
< {"subsystems":{"Decryption":false}}
>
```

Using the *Controller* callsign, one can listen to all the notifications. If a specific plugin callsign is used when opening the websocket connection, only events from that plugin will be received.

5. Filesystem installation (config files & shared libs)

5.1 Config files

Config files are stored under /etc/WPEFramework:

```
root@pacexi5:/etc/WPEFramework# find .
.
./config.json
./plugins
./plugins/OCDM.json
./plugins/DeviceInfo.json
./plugins/Tracing.json
./plugins/Monitor.json
```

config.json is the main configuration file for the WPEframework and port number and network interface for the main HTTP API are set here:

```
    "version":"1.0.0000000",
    "port":9998,
    "binding":"0.0.0.0",
    "ipv6":false,
    "idletime":180,
    "persistentpath":"/opt",
    "datapath":"/usr/share/WPEFramework",
    "systempath":"/usr/lib/wpeframework/plugins",
    "proxystubpath":"/usr/lib/wpeframework/proxystubs",
    "redirect":"/Service/Controller/UI",
```

Each plugin has a json config file under /etc/WPEFramework/plugins. For example, OCDM plugin config file OCDM.json:

```
   root@pacexi5:/etc/WPEFramework# cat plugins/OCDM.json
   {
    "locator":"libWPEFrameworkOCDM.so",
    "classname":"OCDM",
    "precondition":[
    "Provisioning"
    ],
    "autostart":true,
    "configuration":{
    "outofprocess":true,
    "mapping":[
    {
    "key":"com.youtube.playready",
    "system":"PlayReady"
    },
    {
    "key":"com.microsoft.playready",
    "system":"PlayReady"
    },
    {
    "key":"com.widevine.alpha",
    "system":"WideVine"
    }
    ]
```

Generic plugin properties like preconditions, autostart and outofprocess are set here as well as plugin specific ones. In this case, supported KeySystems (DRMs) are listed in the config file.

5.2 Executables

Two executables are installed in /usr/bin:

```
   /usr/bin/WPEFramework-1.0.0000000
   /usr/bin/WPEProcess -> WPEProcess-1.0.0000000 (each out-of-process plugin will run in a seperate WPEProcess)
   /usr/bin/WPEProcess-1.0.0000000
   /usr/bin/WPEFramework -> WPEFramework-1.0.0000000 (main WPEFramework process, started with systemd, Controller
and in-process plugins run in this process)
```

5.3 Shared libs

wpeframework core libraries are in /usr/lib:

```
   root@pacexi5:/usr/lib# ls -l libWPEFramework*
   libWPEFrameworkCore.so -> libWPEFrameworkCore.so.1
   libWPEFrameworkCore.so.1 -> libWPEFrameworkCore.so.1.0.0000000
   libWPEFrameworkCore.so.1.0.0000000
   libWPEFrameworkCryptalgo.so -> libWPEFrameworkCryptalgo.so.1
   libWPEFrameworkCryptalgo.so.1 -> libWPEFrameworkCryptalgo.so.1.0.0000000
   libWPEFrameworkCryptalgo.so.1.0.0000000
   libWPEFrameworkPlugins.so -> libWPEFrameworkPlugins.so.1
   libWPEFrameworkPlugins.so.1 -> libWPEFrameworkPlugins.so.1.0.0000000
   libWPEFrameworkPlugins.so.1.0.0000000
   libWPEFrameworkProtocols.so -> libWPEFrameworkProtocols.so.1
   libWPEFrameworkProtocols.so.1 -> libWPEFrameworkProtocols.so.1.0.0000000
   libWPEFrameworkProtocols.so.1.0.0000000
   libWPEFrameworkTracing.so -> libWPEFrameworkTracing.so.1
   libWPEFrameworkTracing.so.1 -> libWPEFrameworkTracing.so.1.0.0000000
   libWPEFrameworkTracing.so.1.0.0000000

OCDM library is also part of WPEFramework:

   root@pacexi5:/usr/lib# ls -l libocdm.so*
   libocdm.so -> libocdm.so.1
   libocdm.so.1 -> libocdm.so.1.0.0000000
   libocdm.so.1.0.0000000
```

Plugin shared libs are located in /usr/lib/wpeframework:

```
root@pacexi5:/usr/lib/wpeframework# find .
./plugins/libWPEFrameworkMonitor.so
./plugins/libWPEFrameworkOCDM.so
./plugins/libWPEFrameworkWebKitBrowser.so
./plugins/libWPEFrameworkTraceControl.so
./plugins/libWPEFrameworkDeviceInfo.so
./proxystubs
./proxystubs/libWPEFrameworkInterfaces.so.1.0.0000000
./proxystubs/libWPEFrameworkInterfaces.so
./proxystubs/libWPEFrameworkProxyStubs.so.1
./proxystubs/libWPEFrameworkProxyStubs.so.1.0.0000000
./proxystubs/libWPEFrameworkInterfaces.so.1
./proxystubs/libWPEFrameworkProxyStubs.so
```

6. Memory Usage

WPEFramework runs as a systemd service. The main process is named WPEFramework and runs the main controller plugin as well as the other in-process plugins (such as monitor, tracing etc).

The out-of-process plugins such as OCDM plugin run in seperate "*WPEProcess*" processes. For example, in a configuration with Trace, Monitor and DeviceInfo in-process plugins and OCDM out-of-process plugin, the following processes are present:

```
root@pacexi5:/etc/WPEFramework# ps ax | grep -i wpe

11317 ? Ssl 0:00 /usr/bin/WPEFramework -b
11340 ? Sl 0:00 WPEProcess -a /usr/bin/ -c OCDMImplementation -d /usr/share/WPEFramework/OCDM/ -i 85 -l
libWPEFrameworkOCDM.so -m /usr/lib/wpeframework/proxystubs/ -p /opt/OCDM/ -r /tmp/communicator -s /usr/lib
/wpeframework/plugins/
```

Top command output:

```
PID   USER PR NI  VIRT  RES  SHR S %CPU %MEM   TIME+  COMMAND
25712 root 20 0 105156 3040 2432 S  0.3  0.5 0:00.08 WPEFramework
25737 root 20 0 322284 6120 5064 S  0.0  1.1 0:00.19 WPEProcess
```

The main WPEFramework process "WPEFramework" uses ~**3MB** RES memory with monitor, trace and deviceinfo plugins enabled. WPEProcess (OCDM) plugin is using **6MB** (in idle state, it uses more when there are active DRM sessions).

7. Disk space usage

Plugins: (Monitor, OCDM,TraceControl,DeviceInfo, WebkitBrowser) use about **409KB** of file space:

```
root@pacexi5:/usr/lib/wpeframework# du -ah
75.0K ./plugins/libWPEFrameworkMonitor.so
103.0K ./plugins/libWPEFrameworkOCDM.so
104.0K ./plugins/libWPEFrameworkWebKitBrowser.so
67.0K ./plugins/libWPEFrameworkTraceControl.so
59.0K ./plugins/libWPEFrameworkDeviceInfo.so
409.0K ./plugins
```

Core shared libraries use about **600KB** of file space:

```
root@pacexi5:/usr/lib# du -ah libWPEFramework*.so.1.0.0000000
146.0K libWPEFrameworkCore.so.1.0.0000000
34.0K libWPEFrameworkCryptalgo.so.1.0.0000000
152.0K libWPEFrameworkPlugins.so.1.0.0000000
162.0K libWPEFrameworkProtocols.so.1.0.0000000
39.0K libWPEFrameworkTracing.so.1.0.0000000

67.0K libocdm.so.1.0.0000000
```

ProxyStubs use an additional of **207KB**:

```
root@pacexi5:/usr/lib/wpeframework/proxystubs# du -ah
143.0K ./libWPEFrameworkInterfaces.so.1.0.0000000
63.0K ./libWPEFrameworkProxyStubs.so.1.0.0000000
```

Executables use **367KB**:

```
root@pacexi5:/usr/bin# du -ah WPE*
276.0K WPEFramework-1.0.0000000
91.0K WPEProcess-1.0.0000000
```

8. WebKitBrowser plugin & rdkbrowser2

WebKitBrowserPlugin allows WPEFramework clients to launch WPE instances, set the URL, suspend&resume browser processes. It works similar to rdkbrowser2 but instead of the rtRemote interface, HTTP API is used.

Further Reading:

- Common structure of RDK Services
- How to Make a Thunder Nano Service
- Splitting out-of-container rdkservices/thunderplugin .so for memory reduction and expected container security split