

Set Top Box - SOP

Flash Mapping:

Factory Data -> Boot -> Loader -> DataFs -> Kernel -> RootFs

- The factory data includes the individual identifiers like serial number, MAC adresse.... It also includes the keys needed for the secured features from the STB like HDCP keys to protect HDMI, keys for DRM and CAS.. These data should not be modified once on the field so this partition is switched to ReadOnly or stored in OTP.
- The Boot is in charge of the sw images authentication and sw images launch.
- The Loader is in charge of the module which can upgrade the other partition from the flash : kernel / rootfs and sometimes a second stage loader or a secured sw image.
- The DataFs is the only partition in ReadWrite on the field. It is used to store data, files used by SOP and the application.
- The kernel – linux
- The rootfs includes SOP, the drivers, the librairies (libc and other), the binaries needed by SOP and the drivers and finally the application.

The boot process:

Boot -> Loader -> kernel -> Init (Sah processes + Custom processes)

STB SW Architecture:

De bas vers haut::

* **HW Platform -> Drivers -> OS -> Middleware -> Application**

- Entre Driver/OS: **Platform API**
- Entre OS/Middleware: **Middleware API**
- Entre Middleware/Application: **Application API**

Message bus integration:

- The bus used for IPC is GBUS based on DBUS.
- In addition to integrating SOP modules from HGW the PCB bus is also used and a PCB bridge has been developed and integrated.

Network configuration:

SOP supports the network standards useful for Typical IPTV architecture

- **DHCP Client:**
 - Can be easily customized for a specific customer
- **NTP (Network Time Protocol):**
 - The STB synchronizes its clock and then adjusts time thanks to the information of the NTP Server.
 - The use of NTP servers could be mandatory for a cardless DRM solution and to display the hour on the front panel.
- **DNS (Domain Names System)**
- **HTTP**
 - HTTP protocol is used by the browser to retrieve pages from the web portal
 - It is used for configuration and communication with servers for the SI
 - HTTPS is supported for simple or mutual authentication

STB <- ethernet -> HGW

IPTV Live:

IGMP

- This protocol is used to join leave ... multicast streams (typically IPTV live stream)
- Compliant with the IGMP V2 and V3 technology

UDP/RTP

- Used for streaming Live or VOD content
- RTP is mandatory for FEC, Fast zapping
- RTCP is used in addition for retransmission solution

HTTP

- It is used for adaptive streaming (Smoothstreaming/HLS/DASH)
- Used for http media file from the web
- Used to retrieve DRM keys
- Https support

VOD:

RTSP

- A RTSP client is embedded in SOP STB Edition
- RTSP is used to communicate with the major VOD Servers in the market

Remote management

TR069

- SOP embeds a TR069 Stack compliant with TR069 standard
- It permits to remotely manage the STB software
 - can be used for software upgrade (generally customized per project)
 - enable to access TR106 DataModel
 - Some customized parameters can be added

SOP webservice

- SOP embeds a http webserver
- It permits to expose all SOP api with following syntax :
 - Web Service APIs are invoked through HTTP POST requests sent to service ws to the SOP.

HAL Hardware Abstraction Layer

- BSP, Board Support Package is delivered by the chipset vendor based on the targeted chipset and reference design. It provides the gcc toolchain, the Linux Kernel ported on Chipset CPU, generic devices (like eth, tty, rtc, evdev, uinput...), low level drivers (SDK), standards libraries like DirectFB, OpenGL (and EGL), Gstreamer and a basic rootfs.
- CSSP, ChipSet Support Package is the result of the common work Softathome/Chipset vendor in order to provide the expected HAL interface for the device/drivers which drive the chipset ressources. Based on HAL1.9, it represents the following HAL devices : AUDIO, AVOS, CRYPTO, DMX, FEIP, MEMTRANS, CA, STC, VBI, VIDEO.
- The CSSP evaluation is done using the H3TA test tool and tests with a validated SOP release. Expected results for a qualified

CSSP is to get an 80% score to HT3A and P0 tests passed with SOP.

- M-CSSP (Manufacturer ChipSet Support Package) represents the CSSP ported and adapted by the STB vendor on the targeted STB + sw image download in flash. In addition the STB vendor adds devices/drivers specifics to the STB hardware. It provides the expected HAL interface and generally includes the following HAL devices : AVM, CERT, DOWNLOAD, FE, FPANEL, NVM, POWER, SC, SECU, STBInfo + bootloader.

HAL API:

- ioctl: Control device.
- Open: open device.
- Close: close device.
- mmap: mmap defined a memory area available to the user space.
- read: read from the file descriptor.
- write:

QoS

- The QoS can be monitored using TR069 and some parameters in the data model relevant from the IP traffic
- Moreover it is possible to integrate with a SOP third party QoS client in charge of the data collection and push on servers for analysis and statistics.

Browser Specification

- Application language depends on the rendering engine used. SOP STB Edition can embed a flash player and a Javascript browser.

MACHBLUE Flash Player:

- MachBlue (provided by Bluestreak) is a Flash Player which runs on embedded devices

Webkit – SOP Browser1

- Webkit is based on an open source web browser,supporting a large subset of W3C standards: HTML, CSS, DOM, Javascript...

SOP browser1.1 add video tag support

SOP browser2 based on Qt-webkit

- Softathome SDK

Softathome provides a set of API useful for developing applications on the Set Top Box

- These APIs are available in Javascript or Actionscript or web services or native C language.

SOP feature VS service operator:

- A feature is a functionality available in SOP. The functionality can be activated by default by SOP or under the application control.
 - A service operator is something requested by the operator and useful for the end user. It generally requires a set of features from SOP + some additional features from the ecosystem.
- ==> The goal for SoftAtHome is to provide SOP features allowing the operator to deploy service which will generate revenue.
- Example of service operator : Live, SVOD, TVOD, content redistribution, remote scheduling records...
 - Example of SOP feature : service plan, html browser, WAN enabler, CAS gateway, Time management...
 - To access IPTV live, SOP should provides :
 - The service plan allows installation of the channel identifiers and parameters in the STB. This is the result from the service discovery.
 - The SI engine which allows to filter and parse the requested DVB tables (PAT/PMT and to filter audio and video PID).
 - This feature in link with the user setting allows users to select the appropriate audio and subtitles tracks.
 - The CAS gateway and client to descramble the components.
 - The output manager in link with the user setting and the CAS gateway to configure the audio and video output format and the protection.
 - The TimeManager to get the date & time from the network and set it to the SetTopBox.
 - The Browser to display zapping info banner

Main features added in SOP v2

- Flash player support
- Upnp/DLNA stack for DMS/DMR/DMC and DMP with mandatory formats
- Multistream PVR => Watch and record feature on IP
- SoftAHome Bus client interface used to communicate with the RGW (for caller-id/wifi scheduling).

Main features added in SOP v2.5

- Satellite support (installation-channel lineup creation/zapping/EPG...)
- Timeshift over NAND flash
- API for browser/flash player support => used to port Galio HTML/JS browser
- API for DRM support + DRM manager => used for MS WDRM-PD
- Transfer manager for progressive VOD
- additional picture, audio and video formats supported.

Main features added in SOP v2.6

- Support new browser/new flash player on top of browser API
- Support of 3D functionalities/ especially video projection in 3D
- New remote management implementation with STB data model
- CAS infrastructure

Main features added in SOP v3.0 (end 2009)

- PVR architecture in order to remove HDD devices from HAL.
- PIP/PAP

SOP Inter-Process Communication

Two Communication Bus are used:

- D-BUS for services and third-party openness
 - PCB for data model and integrated front ends
- Both D-BUS and PCB provide Client and Plug-In capability, possibly from one single component
 - A wrapper on top of D-BUS is used to handle serializing and multi-thread support
 - A bridge between PCB and D-BUS handles function calls and events, with nearly transparent communication

SOP Network Manager

- Network Manager provides IP connectivity informations
- It handles multiple IP interfaces (Eth+Wifi)
- Can provide Wifi Extender functionality
- Several Wifi chipset vendors supported

SOP Storage Manager

- Multi-device management for eSATA, USB and Flash storage devices
- Dynamically configurable Timeshift buffer and Records target storage
- Multiple USB devices PVR functionality
- Storage Manager provides the TR140-compliant data model of storage capabilities available on the box at runtime (and supports hotplug)

SOP Output Manager

- Porting Layer of chipset SDK A/V output interfaces
- Enable multi- application rendering
- Share Output config (HDMI, SPDIF, RCA, Analog)
- HDMI CEC control

SOP Output Manager Role:

Configure audio / video outputs and mix of all the sources sent to these outputs in a multiple application environment:

- an application can connect the source(s) it uses to have their content rendered on STB outputs.
- Standalone process exposing Gbus/DBus API

SOP Resources Manager:

- Multi-process hardware resources usage for media processing Virtual resources management
- Conflicts resolution helper for « main app » (arbitrer)
- Supports multiple simultaneous records PVR (configurable number)
- Open to third party apps integration

Resources Manager works:

==> Service B owns a resource that service A wants to reserve:

- RMS (Resources Manager) gathers informations on which resources are used, by which feature
- Supported resources: front ends, demux, memory interface with kernel, crypto, CAS, decoder, etc.

==> If B is a service in the background, it will be requested to release resource without MasterUX being notified

SOP Player:

- Universal Player supporting a wide range of media transport technologies:
 - Broadcast DVB-T/S/C
 - Multicast DVB-IP
 - RTP/RTSP
 - Http + Adaptive
 - Streaming HLS, MSS, DASH
- PiP, multi-track, trick modes
- Multiple content protection supported, incl. DTCP-IP for Home Redistribution
- Hardware integration for decoding and security

SOP PVR:

- Multiple simultaneous records (configurable)
- Time-based or Event-based scheduling
- PVR on USB (multiple storage support)
- Simple SDK APIs for recording lists (broadcast series, operator-edited, or personal)
- Record redistribution on the LAN
- Record metadata enriched with EIT-PF

SOP PVR works:

- RL(record list) manager exposes app-friendly APIs for rich Record Scheduling service (atomic record, series, personal list, conflicts).
- Record Scheduler multiple record timelines (validated up to 4, depending on hardware capacity) and handles conflicts.
- Metadatas provide full informations on records (done, scheduled, failed)
- Metadatas store all EIT-PF related to the record.
- Event-based Record Scheduling is updated with EPG changes.
- Event-based Record Scheduling is updated with EPG changes.
- Recorder handles conflicts (with other services) at record time, relying on Resources Manager
- Records can be stored on various storage devices: Metadata files and APIs are consistent with currently mounted device, while scheduling files are stored on STB

PVR high level features list:

- Multiple parallel records (configurable, validated up to 4)
- Manual records (by Time or from EPG) and automatic records (PodcastTV, EPG based series & recurrent)
- PodcastTV is a powerful tool for
 - operator to push/advertise record/content in the STB
 - customer for easy programming according to its area of interest
- Multiple parallel records & automatic records -> STB becomes a full time recording machine, therefore SOP features
 - conflict management tools: scheduling optimization, priority, alternative instance (re-run), user exclusion
 - storage management tools: auto-deletion rules, best effort storage
- Last minute change
- Late recording
- PVR on USB

SOP Service Plan

- Service Plan Installation provides APIs for IP loading, NIT installation or Scanning (DTT and DTH)
 - DVB-IP, DVB-T, DVB-S and DVB-C are supported
 - Scanning and customized features are implemented as add-ons
- Service Plan Provides Service Plan information APIs to UI, Player, Recorder, Streamer and Media Server exposing TV Live streams on the LAN.

SOP Modular Upgrade

Principle:

- upgrade package authenticated by the firmware (maintaining the chain of trust) but not by the boot code (as for the firmware)
- Upgrade end-to-end signaling & downloading adapted to Operator need (can be, but not limited to, TR069)

Design:

- Pre-defined hooks in original firmware to use new versions of binaries, libraries or config. file from downloaded upgrade package
- Upgrade package format:
 - SquashFS file system (small size, read-only for security)
 - Package information for versioning & platform dependency check
 - Signed package for security (signing key in firmware)
- Packages dependencies management on the back end

SOP Web Services

SOP SDK APIs exposed through and http front ends

- Full or partial SDK exposure, configurable
- SOP events transmission (requires subscription)

SOP Media Center

- Access any content in the home, and play it on the STB
 - Expose USB, eSATA contents on the LAN
- Control STB from an open platform app (Android, iOS) using proprietary app or unmanaged DLNA app
 - DLNA DMR or Web APIs
- Use STB as Media Server or Renderer
 - Stream media from/to the STB
- UPnP and DLNA standards support
 - Media Player
 - Media Controller
 - Media Server
 - Media Renderer