Skyworth
RDK Proposition

Contents

RDK

SKYWORTH

What is RDK?

Reference Design Kit, is a fully modular, portable, and customizable open source software solution that standardizes core functions used in video, broadband and IoT devices.

Advantages of RDK

Whole Home Solution

RDK provides a unified PLATFORM for Broadband, Video, IoT and streaming devices.

Your Data, Your UX

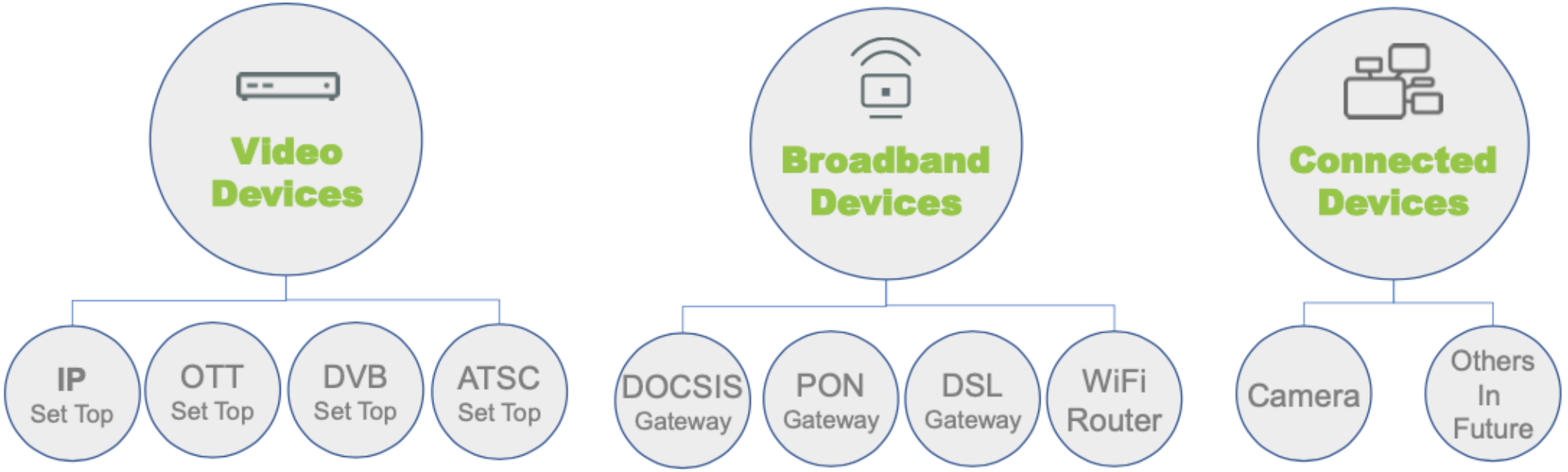
Data powers the next generation UX. With RDK, you control the data for your UX.

Proven Stability & Scale

A deployed user footprint of 50+ million DEVICES WORLDWIDE.

RDK Devices supported?

RDK **standardizes** core functions for **video, broadband & connected devices**



RDK

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Why do operators choose RDK?

Freedom

Open Source code enables operator control of software & choice of OEMs

Efficiency

Royalty free software; eliminates redundant development on common features

Operator Driven

Developed by operators, for operators; includes features such as real-time feature control, device telemetry & secure code download

Community

RDK users contribute new improvements & the entire RDK community benefits

Innovation

RDK scale attracts new innovation & ensures a healthy ecosystem

RDK

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What is the scale of RDK?

430+

Technology Companies

Driving innovation

50%+

Operator Growth

CAGR since inception

60M+

RDK Devices Deployed

7M+

RDK Code Downloads

by community per month

RDK

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Pains of Pay-TV Operators

Content Aggregation

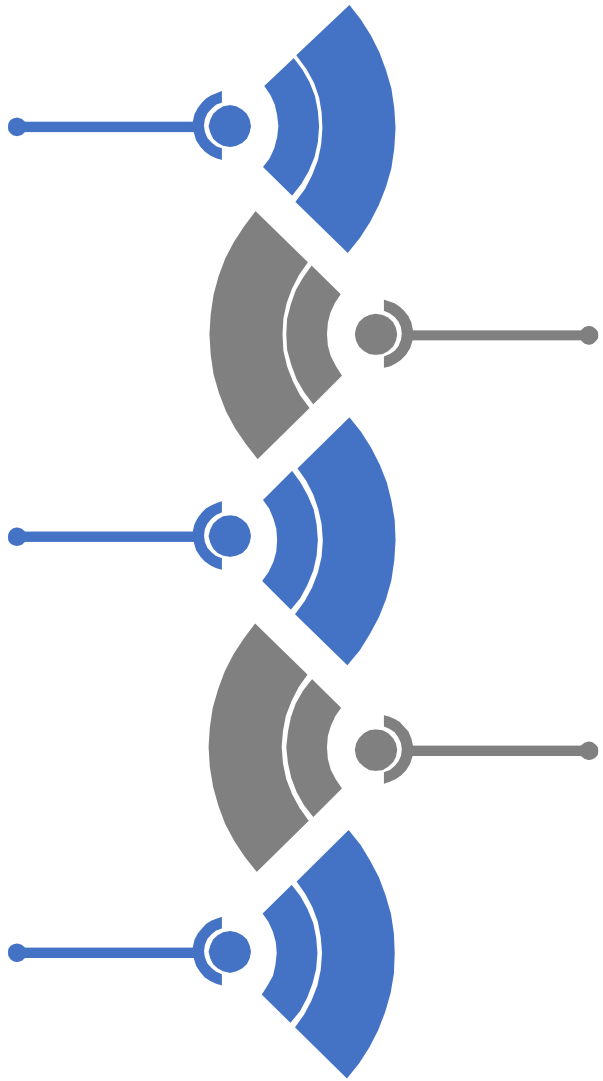
Youtube, Netflix, Prime Video, Disney+
Local App … ...

Personalized Experience

Viewing hour on small screen overtakes big screen. How to compete?

Enrich Services

8K, TV Gaming(Stadia), IoT etc.



Limited Choice of Chipset

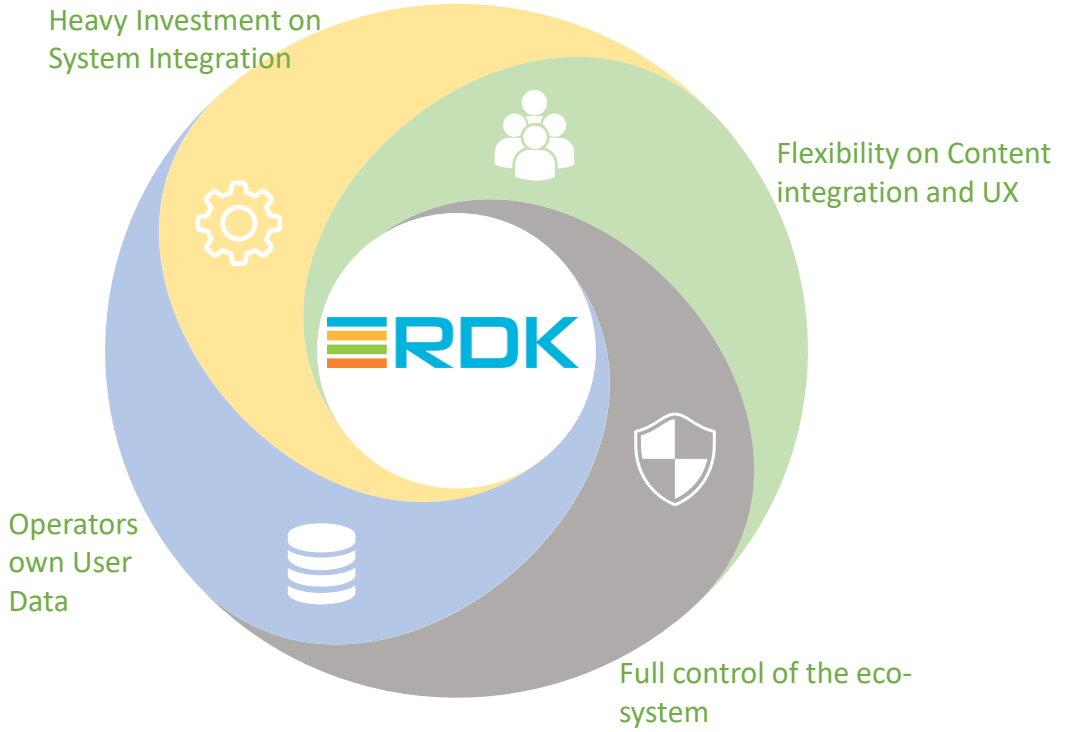
No ideal chipset partner. Significant gap between BCM and other chipset vendor

Difficult Choice on Platform

Linux, Androidtv, RDK, AOSP

Operator’s view of ATV vs RDK

Now and Before



Future

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Operators on RDK

Selected RDK as Strategic OS

Very Likely to select RDK

Potentially Select RDK

Who is involved

RDK

** This list represents a **select sample** of RDK partners, more partner choices are available.*

Skyworth RDK Status

- Accepted as a licensee November 2019
- Video Accelerator project – 905X2 OTT STB
  - RDK4.0
  - Thunder Services Application Framework
  - Irdeto Keys and Credentials
  - Available Now
- Parallel Port of RDK Service - Firebolt
- In progress 905X4 AV1 OTT Porting
- In progress 905X4/C2 Hybrid Porting with CAS

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Case Study 1

- 4K OTT STB
- Amlogic S905X2 SoC
- RDK Video Accelerator
- Metrological Thunder Framework
- Operator Developed UI
- Netflix, YouTube, Amazon Prime, Operator Apps
- OpenCDMi Multi DRM (PlayReady & Widevine)
- Dolby MS12 V2.4
- Irdeto Keys and Credentials
- ***In trials now***

An operator with a subscriber base of 19.5 million viewers wanted to launch a standard alone OTT service, based on the RDK Video Accelerator.

Skyworth developed a RDK Video Accelerator product based on the Amlogic S905X2 and successfully brought the product to trials within 6 months

SKYWORTH

Case study 2

- 4K OTT STB
- Amlogic S905X2 SoC
- RDK Reference App
- Spark Applications
- Youtube Cobalt 2020
- OpenCDMi Multi DRM (PlayReady & Widevine)
- Proof of Concept Complete Q1 2020

An operator with a large European subscriber base was looking for an alternative to Broadcom silicon to create a more cost effective RDK solution.

Skyworth developed a proof of concept based on the Amlogic S905X2 SoC showing the reference app and YouTube.

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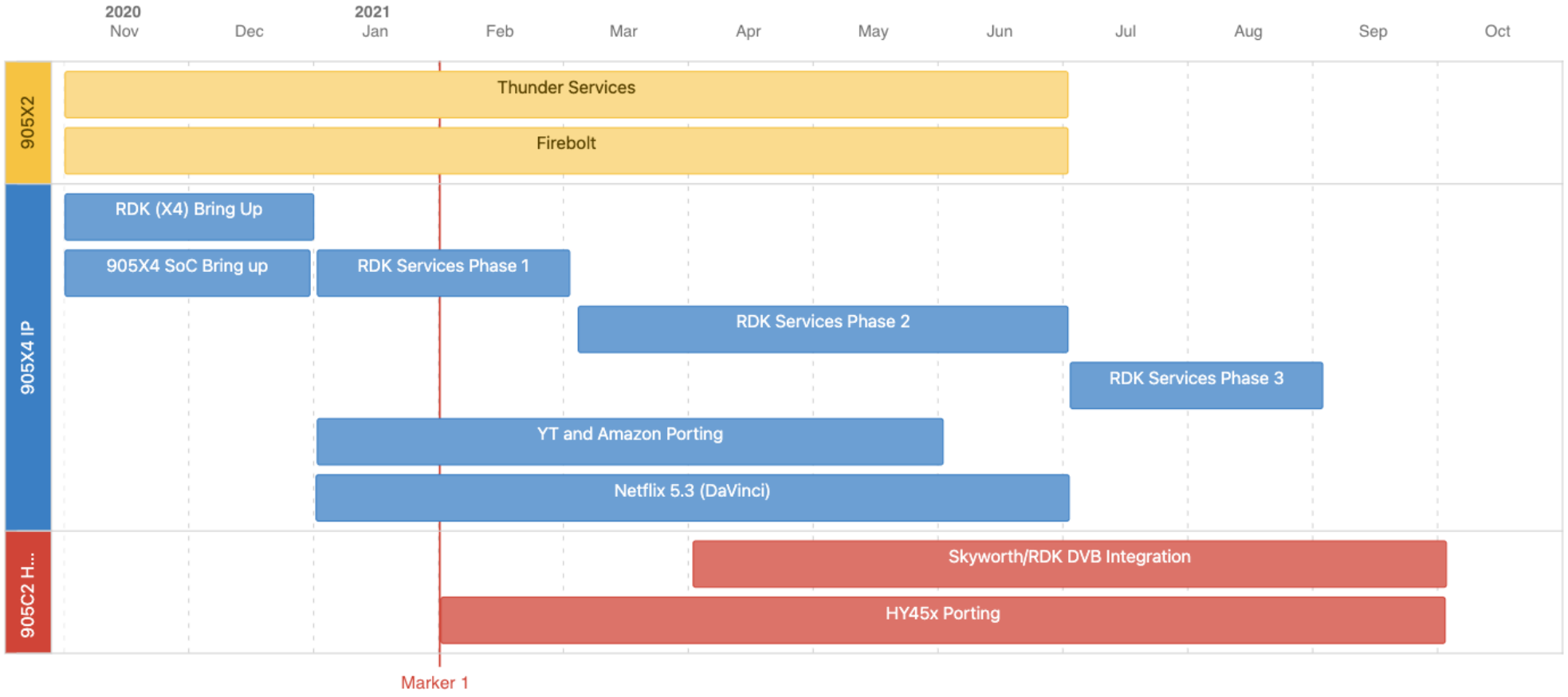
Skyworth RDK Roadmap

Next steps on the RDK roadmap – 1) 905X4 and 2) Hybrid/DVB Integration



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905X4 Migration

- 4K OTT STB
- Amlogic S905X4 & C2 SoC
- RDK DVB Stack
- RDK Video Accelerator
- Metrological Thunder Framework
- Hybrid Partner UI
- Netflix, YouTube, Amazon Prime, Operator Apps
- OpenCDMi Multi DRM (PlayReady & Widevine)
- Dolby MS12 V2.4 and Dolby Vision

Skyworth is integrating the RDK stack onto its 905X4 IP platform from its stable 905X2 solution.

Goal: Bring 905X4 to same level of stability as 905X2

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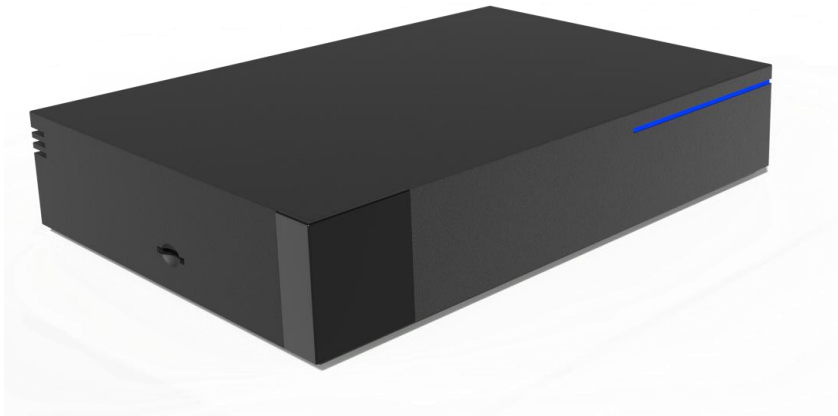
Hybrid Integration

- 4K OTT STB
- Amlogic S905X4/ C2 SoC
- RDK DVB Stack
- VMX/Irdeto/Nagra/Synamedia CAS
- Sony DVB-T/C/S Demod
- RDK Video Accelerator
- Metrological Thunder Framework (Firebolt)
- Hybrid Partner UI
- Netflix, YouTube, Amazon Prime, Operator Apps
- OpenCDMi Multi DRM (PlayReady & Widevine)
- Dolby MS12 V2.4 and Dolby Vision

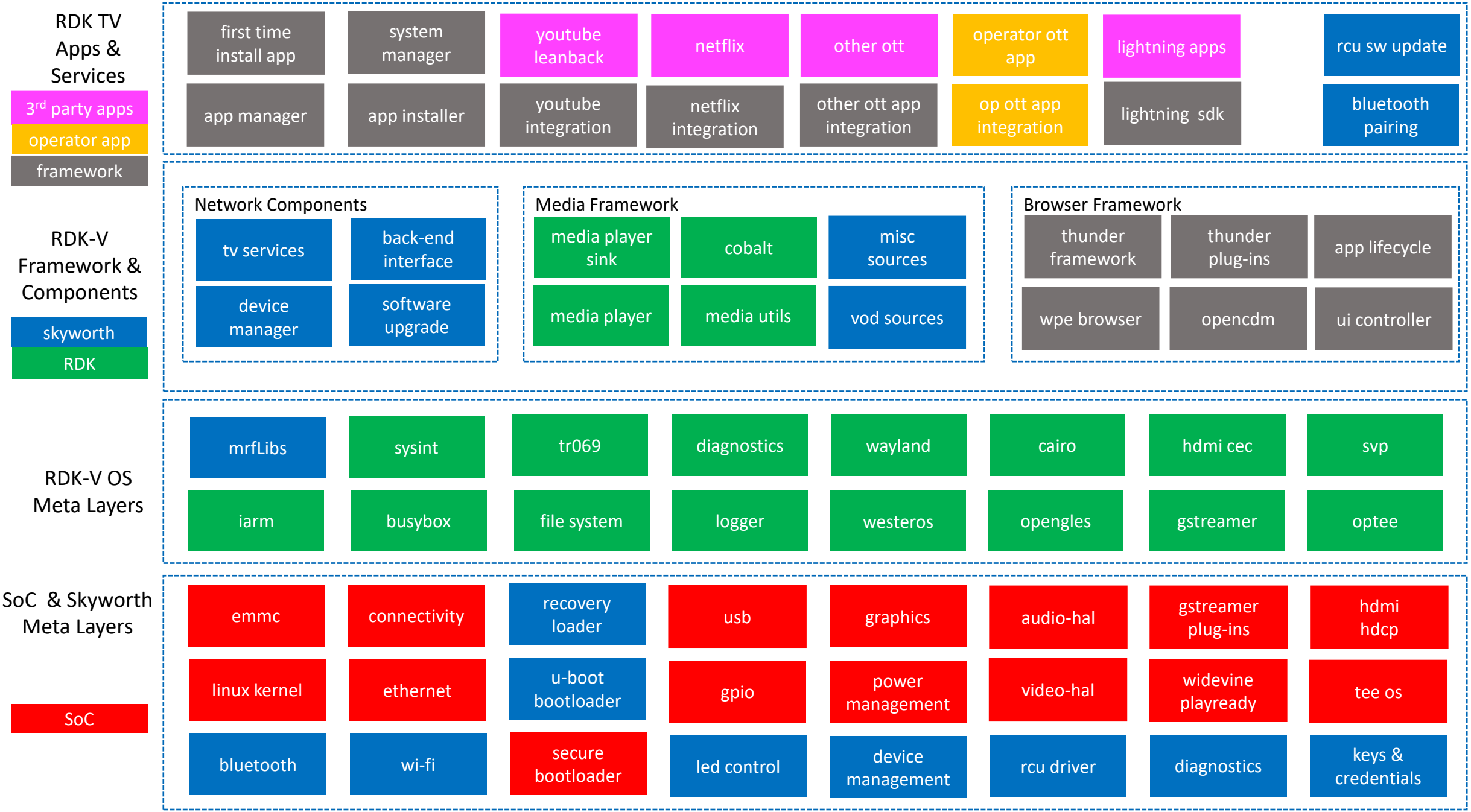
Skyworth is integrating the RDK DVB stack onto its 905X4 DVB-T/C Hybrid platform.

Goal: Bring up a free to air hybrid stack on Skyworth hardware to prepare for a CAS integration

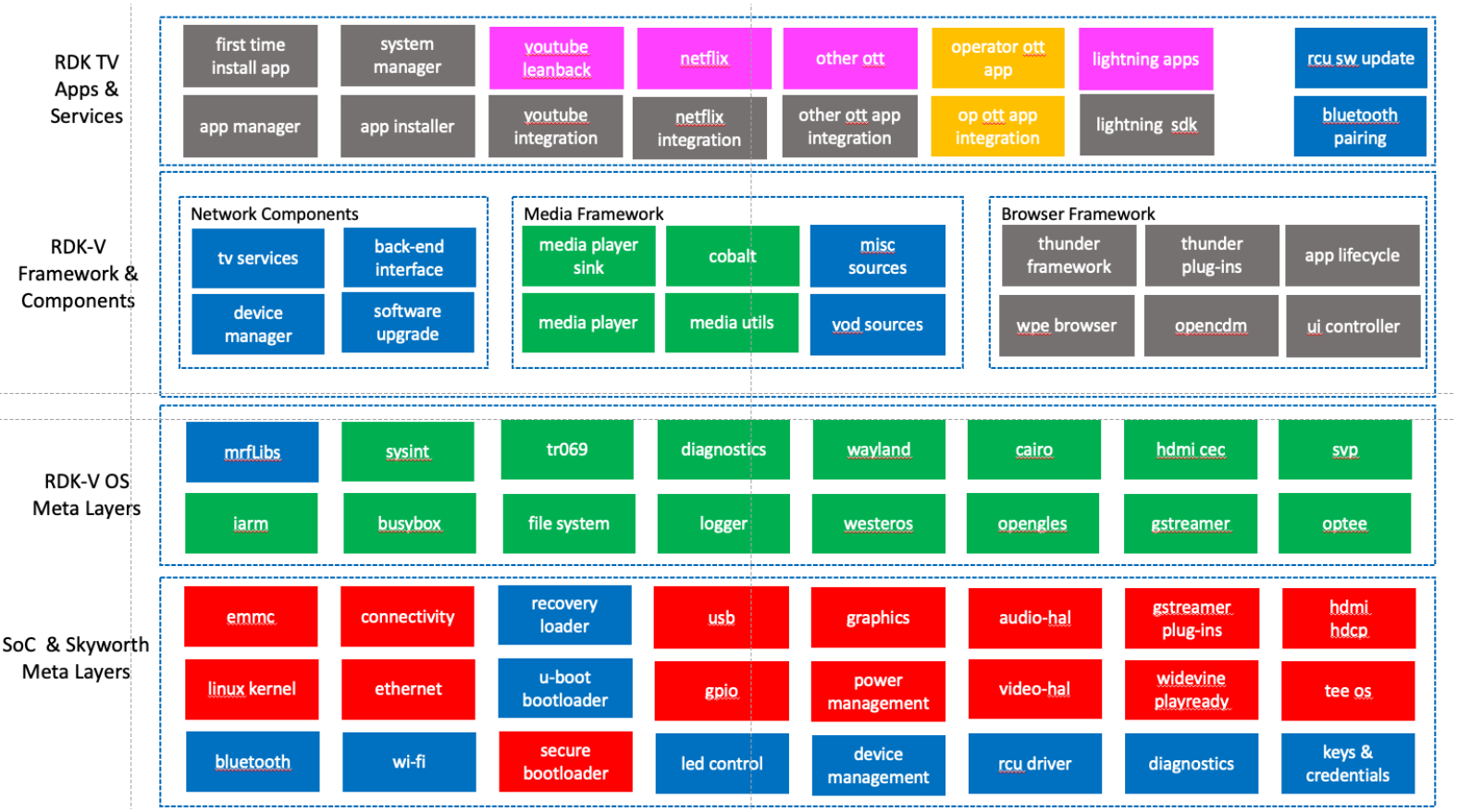


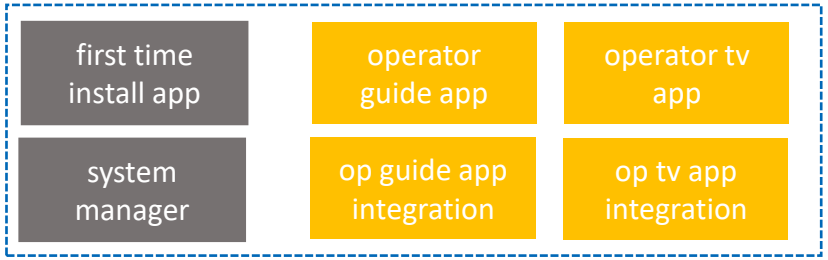
RDK Stack High Level View - OTT/IP Architecture

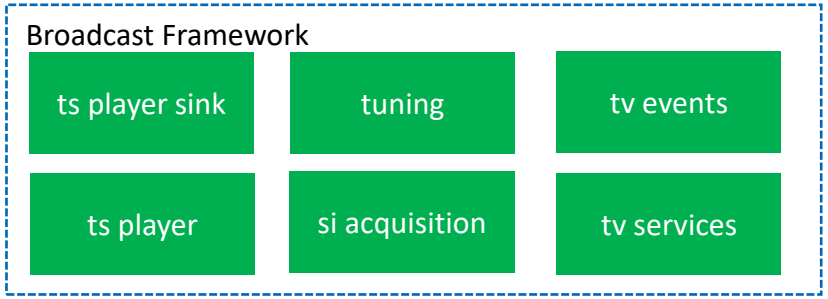
RDK Stack - OTT/IP Architecture - Thunder architecture

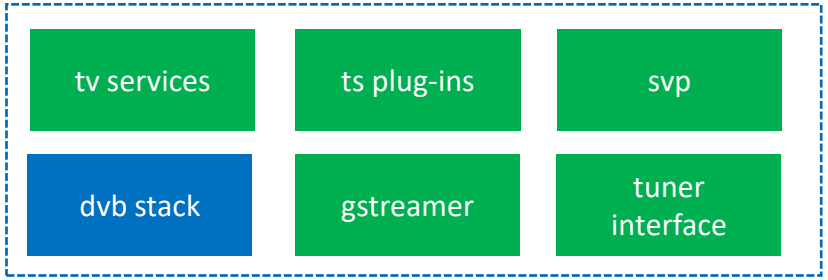


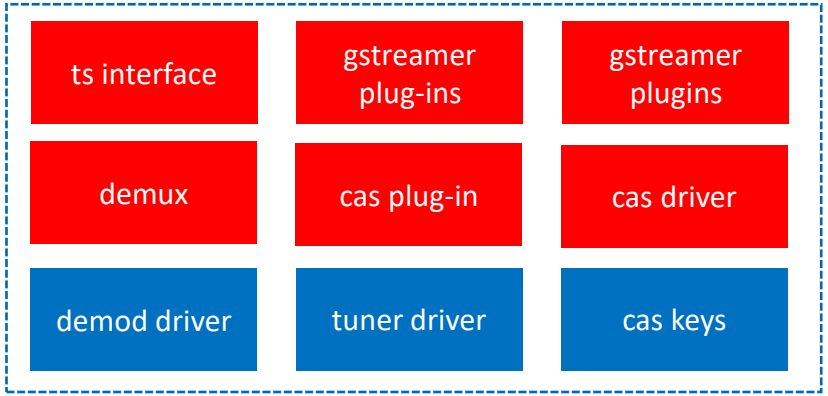
Hybrid Architecture – additional components







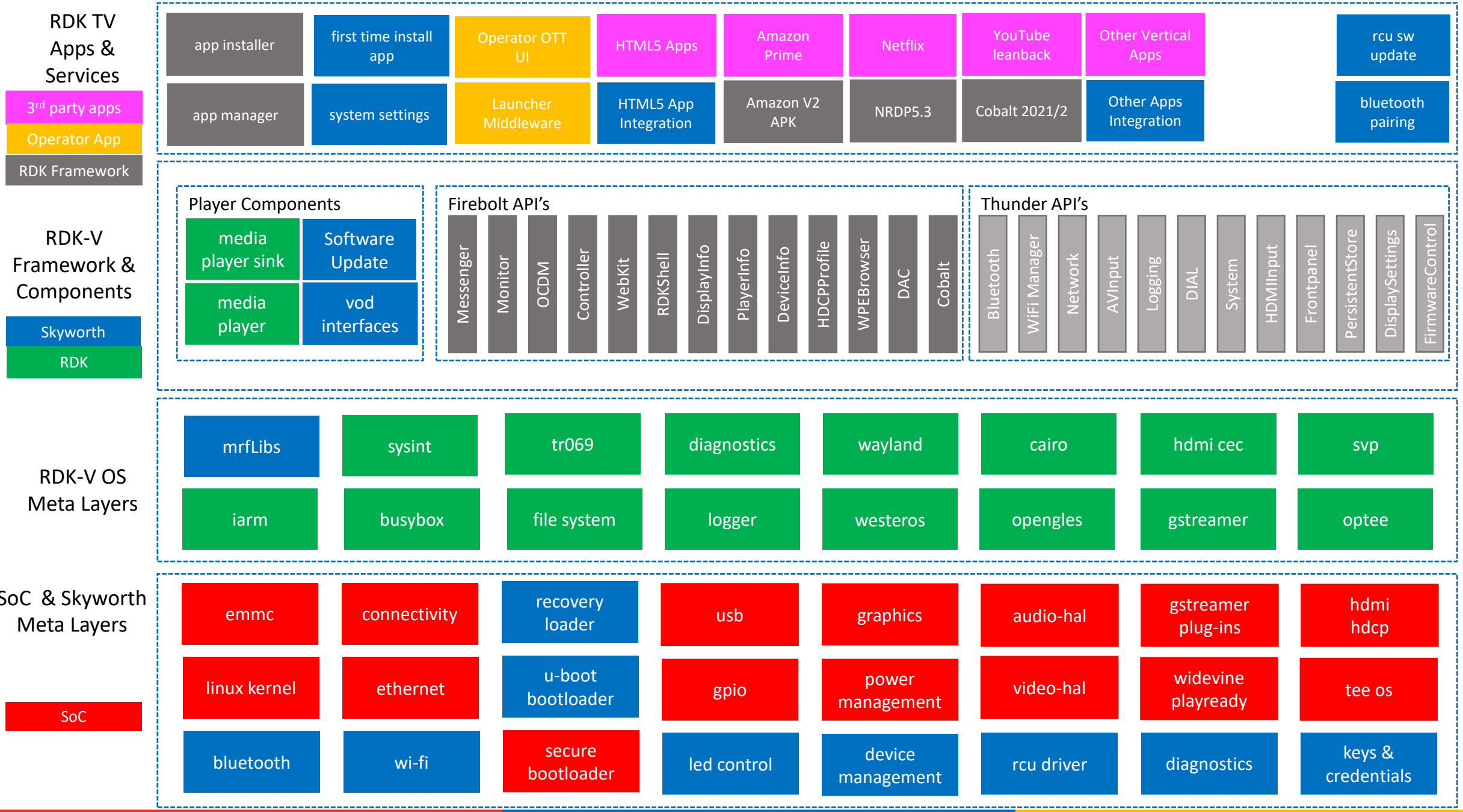




+ DVB Services

+ Skyworth DVB Stack

RDK Stack - OTT/IP Architecture – RDK Services



User Interface

Skyworth RDK UI
Partnering with 3SS and DotScreen
Operator Self Build

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User Interface Options

For user interface development as well as providing it's own launcher and UI, Skyworth partners with experienced TV UI developers, these are the choices for UI development :-

1. Skyworth UI – Internal Development
2. DotScreen - https://dotscreen.com/
3. 3SS - https://3ss.tv/

SKYWORTH

11-August-2019 12:30

What's On Now

Spider-man - CCBN

Most Watching

Try"Alexa, show me family films"

SKYWORTH

11-August-2019 12:30

- Home
- Live TV
- What's on
- APP
- MyAcount

- Notification
- Settings

What's On Now

Spider-man - CCBN

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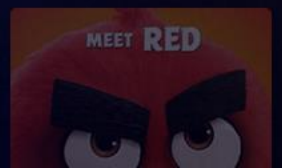

SKYWORTH

11-August-2019 12:30

- Home
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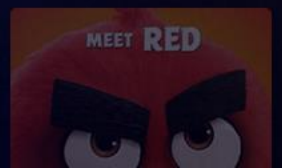


SKYWORTH

11-August-2019 12:30

Home

Live TV

What's on

APP

My Acount

Notification

Settings

NETFLIX

Netflix Online Video 351461 Downloaded

Favorite APP Row

YouTube

facebook

amazon

CNN

24_DOC - HBO

APP Recommend YOUTUBE

Try"Alexa, show me family films"

SKYWORTH

11-August-2019 12:30

- Home
- Live TV
- What's on
- APP
- My Acount

Press “OK” button to open Settings menu.

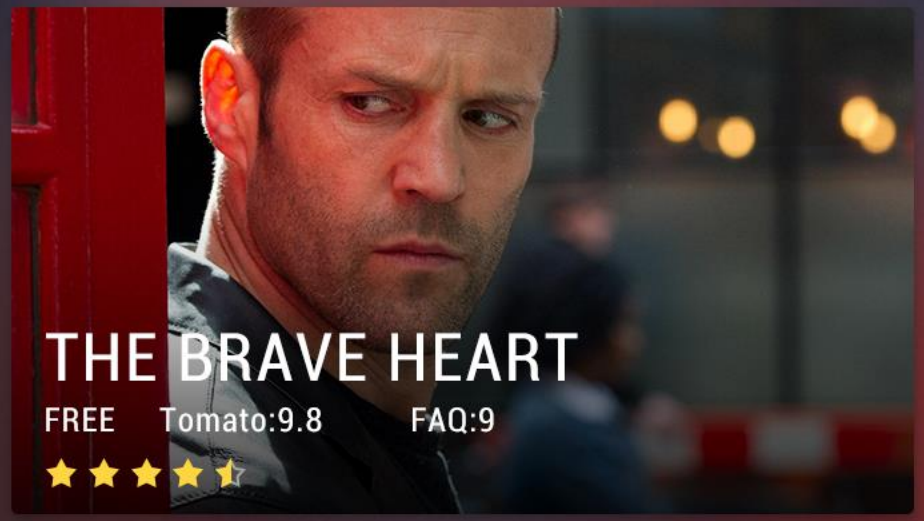
- Notification
- Settings

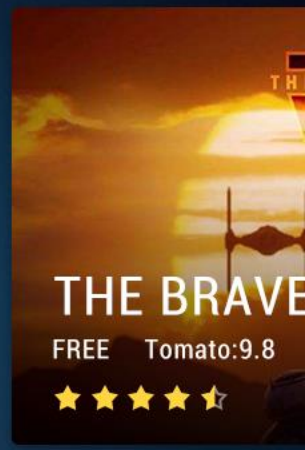
SKYWORTH

11-August-2019 12:30

- Home
- Live TV
- What's on
- APP
- My Acount

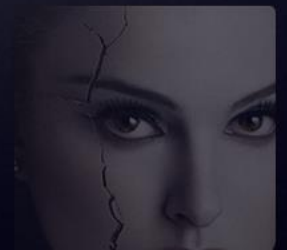
- Notification
- Settings



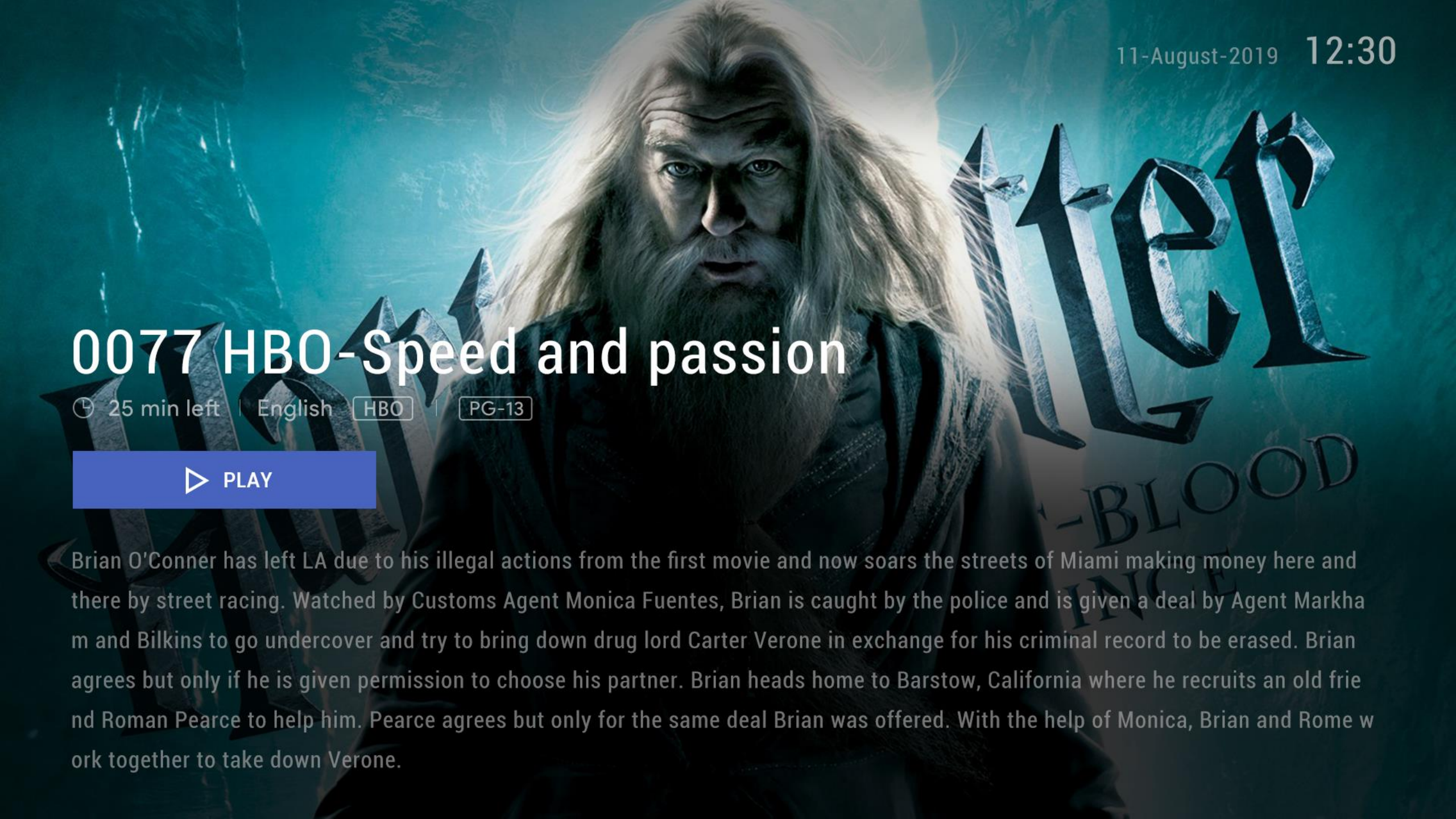


What's On Now

Most Watching



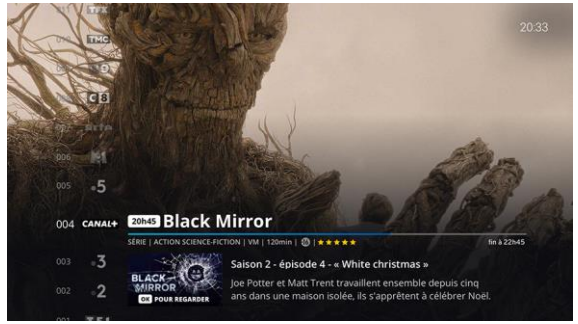
Try"Alexa, show me family films"


11-August-2019
12:30
0077 HBO-Speed and passion
25 min left | English HBO | PG-13
PLAY
Brian O'Conner has left LA due to his illegal actions from the first movie and now soars the streets of Miami making money here and there by street racing. Watched by Customs Agent Monica Fuentes, Brian is caught by the police and is given a deal by Agent Markham and Bilkins to go undercover and try to bring down drug lord Carter Verone in exchange for his criminal record to be erased. Brian agrees but only if he is given permission to choose his partner. Brian heads home to Barstow, California where he recruits an old friend Roman Pearce to help him. Pearce agrees but only for the same deal Brian was offered. With the help of Monica, Brian and Rome work together to take down Verone.

DOTSCREEN UI and features examples 1/4

Zapping

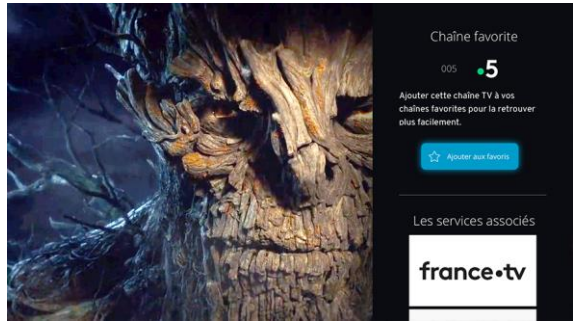
Info banner



Virtual zapping

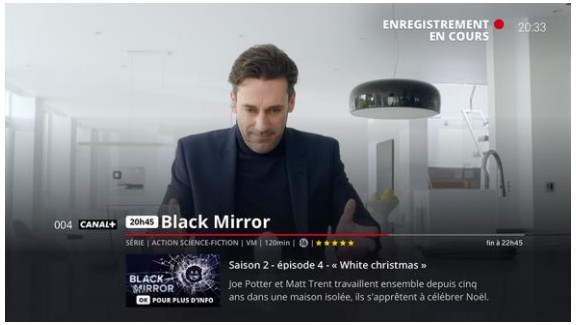
Channels list

Notifications / Reminders

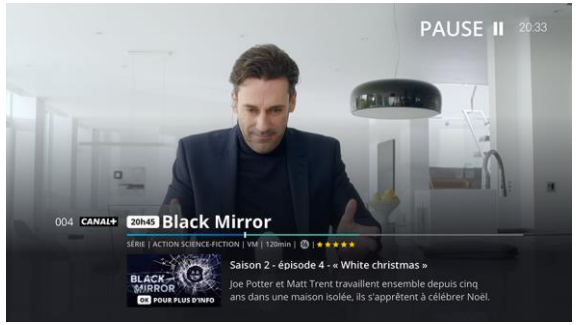


Add channel to favorites

DOTSCREEN UI and features examples 2/4



Instant recording

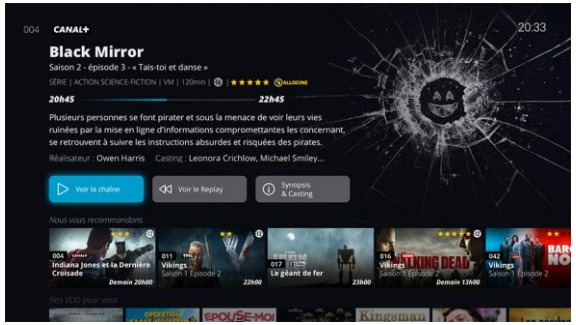


Time shifting / Rolling

Fast subscription process

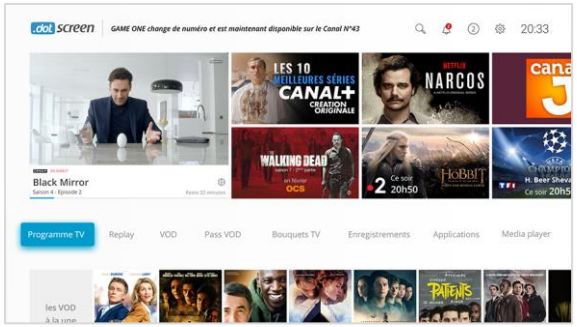
Alert message

Parental control

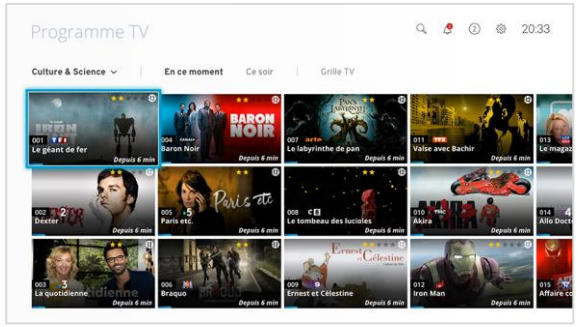


Content dashboard
(Live, VOD)

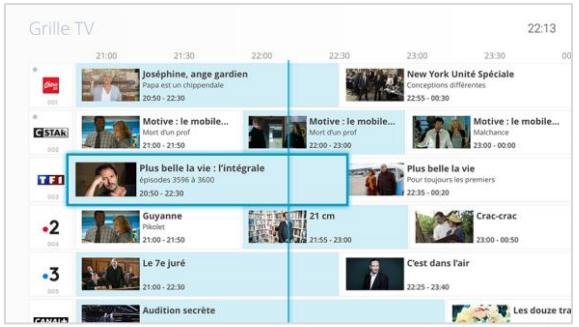
DOTSCREEN UI and features examples 3/4



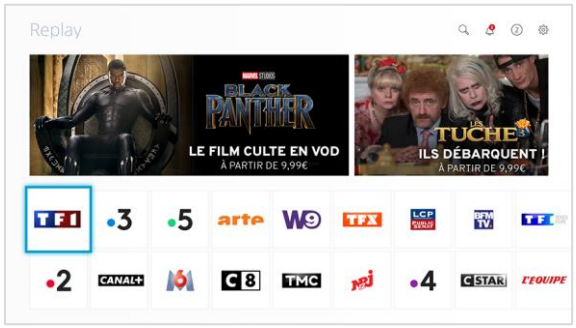
Portal / launcher



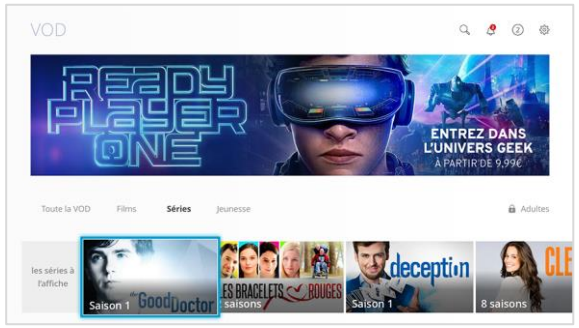
TV mosaïc



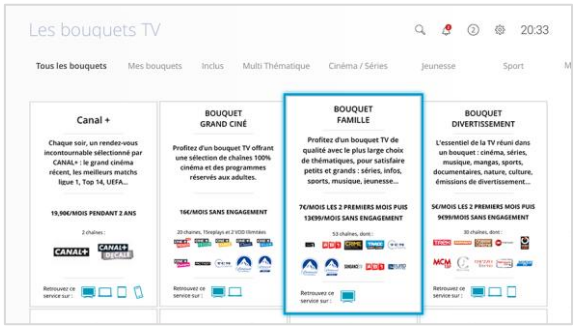
TV grid



Catch up

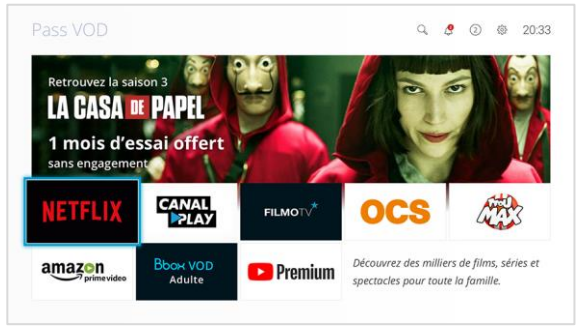


VOD

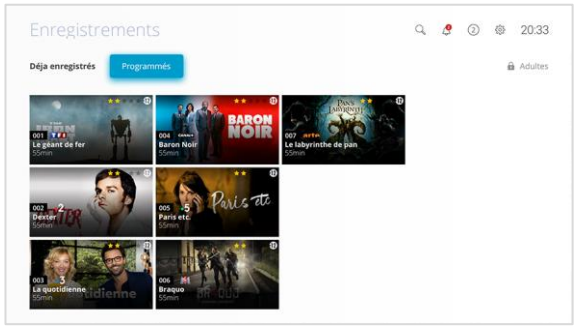


Customer care

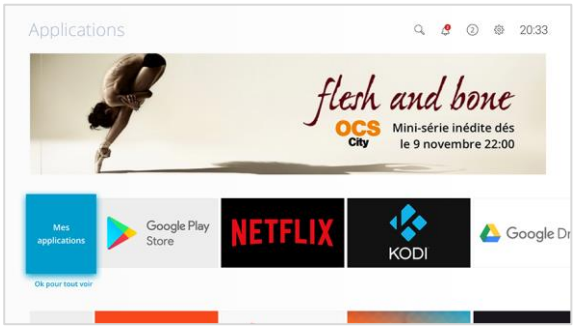
DOTSCREEN UI and features examples 4/4



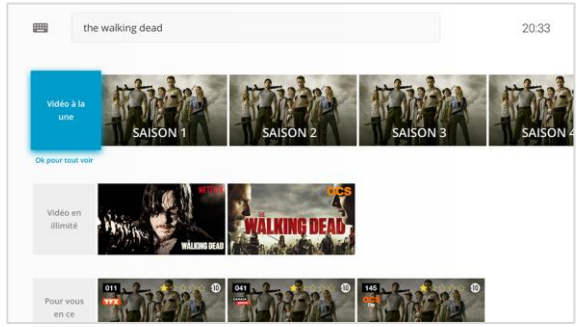
VOD services



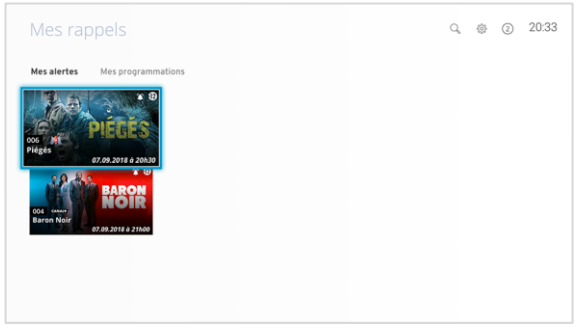
My content



Application store



Search (Voice & Keyboard)



Notification center

On demand player

RDK OTA Update

Components for in field software update

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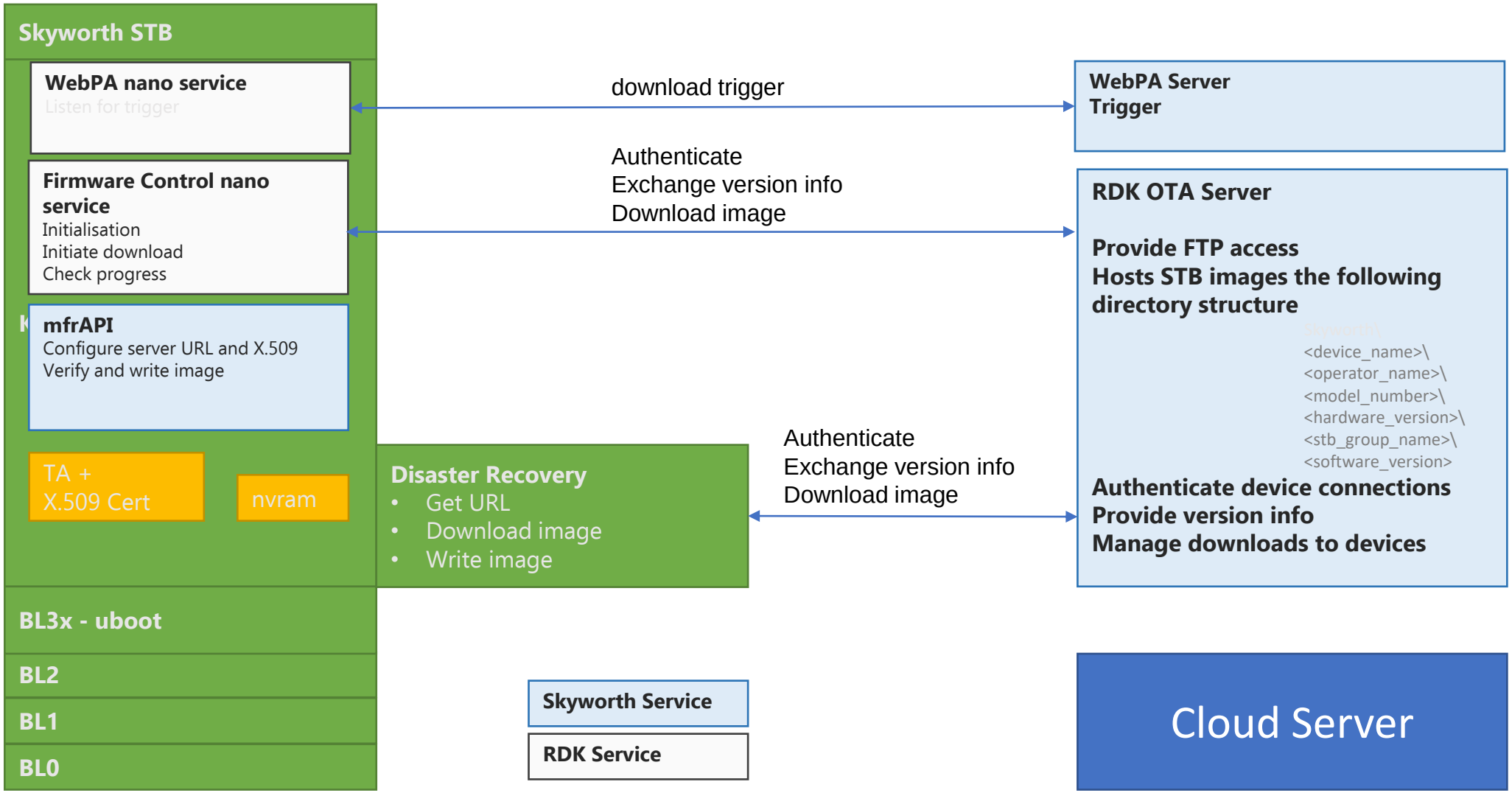
RDK OTA Updater

- Skyworth provides the cloud hosted OTA server
- The OTA server hosts software updates for multiple STB devices
- The OTA server only serves updates to securely connected STB devices
- OTA updates can be configured to update arbitrary groups of device (for field trial and managed OTA roll outs)
- The OTA server provides simple user access for operators to manage roll out plans
- OTA update images are signed and encrypted
- OTA updates can be triggered or polled

OTA System Architecture



RDK Security

Mutual Authentication to secure Hybrid and OTT STB’s

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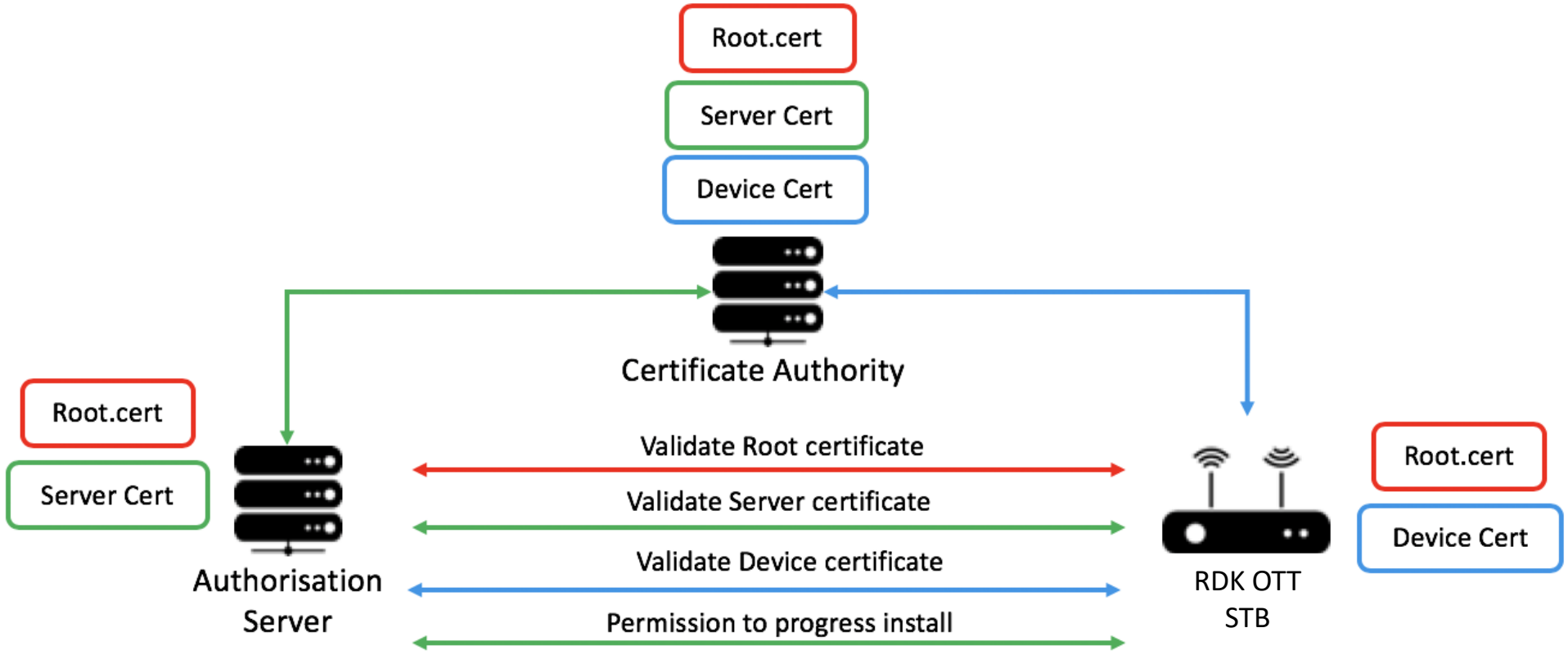
Device Authentication & Provisioning

- ✓ Cloud based security solution to validate and authorise operator devices
- ✓ Uses mutual (2-way) TLS authentication with X.509 certificates for server and clients
- ✓ Helps prevent intrusion by cloned devices into operator back office
- ✓ Helps prevent hijacking of operator devices by clone / black hat servers
- ✓ Helps prevent Man in the Middle (MITM) attacks
- ✓ Defence mechanism to detect and disable device upon root hack attempt
- ✓ Provisions device for future phase secure analytics and remote management

Device Authentication & Provisioning



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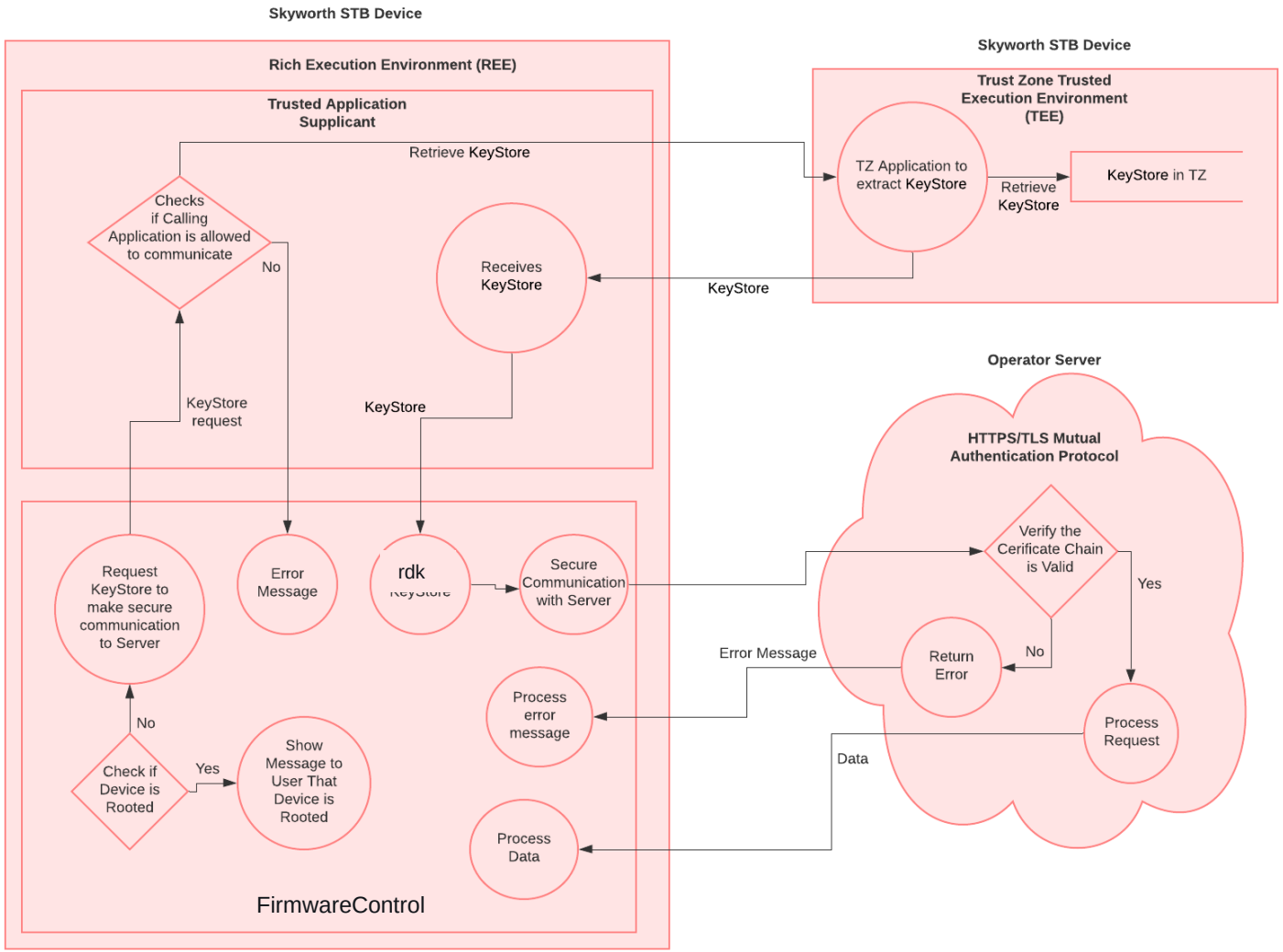
RDK STB Secure Communications

- STB contains an X.509 certificate uniquely provisioned in the Trust Zone in each device at production
- STB application requests Trust Zone Supplicant to retrieve the certificate
- The certificate is used to establish a TLS connection to the server
- The server validates the certificate and if valid establishes a mutually authenticated connection

OTA Server Authentication Workflow



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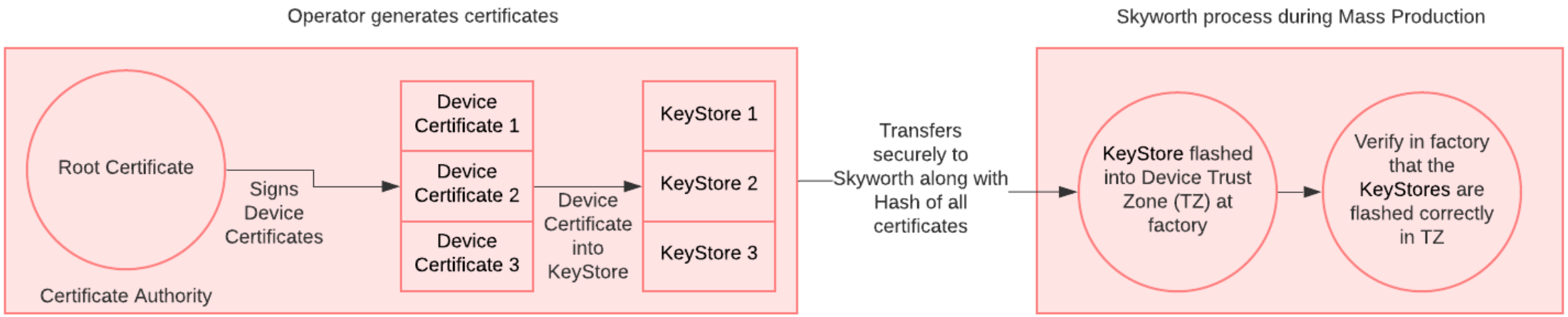
STB Side Application Process

1. User Application (UA) makes a request to Trust Zone Supplicant (TZS) to retrieve the KeyStore (KS)
2. TZS will verify if the requestor is authorized and if not, it will return error back to UA
3. TZS will make a request to Trust Zone Application (TZA) to extract KS
4. TZA will return the KS to TZS
5. TZS passes the KS to UA
6. UA makes a HTTPS / TLS request using the KS to OTA Server (OS)
7. OTA will verify the Device Certificate and once validated, it will allow the communication, otherwise it will result in HTTP Status code 401

Certificate Management



Remote Management

Managing Customer Experience Remotely

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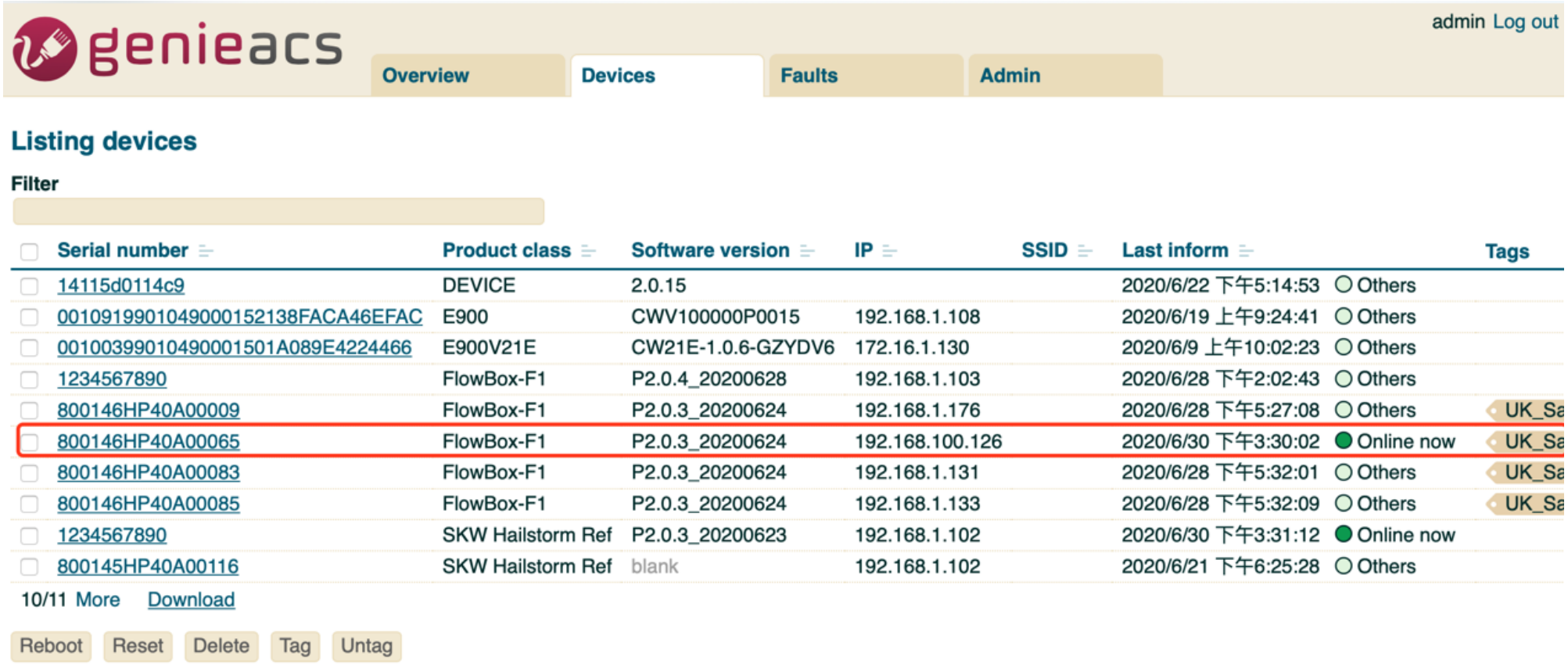
TR-069

- ✓ TR-069 and TR-135 data models are supported in RDK core components
- ✓ Data model would be extended by Skyworth
- ✓ Integration with Nokia (Telekom Argentina) and Axiros (Telekom Malaysia) ACS systems
- ✓ Basic data models are supported in Skyworth STB client library…
  - ❖ Device.Deviceinfo.
  - ❖ Device.Time.
  - ❖ Device.LAN.
  - ❖ Device.ManagementServer.
  - ❖ Device.LAN.IPPingDiagnostics.
  - ❖ STBService..Capabilities.DRM.
  - ❖ STBService..Capabilities.ServiceMonitoring.
  - ❖ STBService..Components.AudioDecoder..
  - ❖ STBService..Components.VideoDecoder..
  - ❖ STBService..AVStreams.

SKYWORTH

TR-069

- ✓ STB client library tested with open source Genie ACS
- ✓ Example dashboard display…



Deploying RDK

SKYWORTH

Development Approach

Platform Development

- SoC RDK Release
- Skyworth Platform Layer Porting
- User Interface Development
- Skyworth DRM/CAS Porting
- Skyworth Bootloader Development

Test, Integrate, Deploy

- Skyworth/Operator RDK component integration
- TDK Testing
- DRM/CAS Testing
- OTT Application Integration and Test
- System Integration

3) Update and Upgrade

- Triage, Track & Resolve Defects
- Implement CR's and Features
- Test, Integrate and Deploy

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Choices for Software & Services

- System Integration Services Provided by **Skyworth**
- SoC RDK implementation ported by **Skyworth** to platform
- STB Build managed by **Skyworth**
- User Interface provided by 1) **Skyworth**, 2) **Skyworth Partner** or 3) **Operator** - managed by Skyworth
- User Experience defined by **Operator** and implemented by UI provider
- OTA Download server and Bootloader developed by **Skyworth**
- Device Authentication server and client provided by **Skyworth**
- DVB Stack provided by **Skyworth** for Hybrid solution – some operators may choose other vendors
- TR-069 and TR-135 client library shall be provided by **RDK** with **Skyworth** customisation - option
- CAS supplied by **CAS Vendor** and integrated by **Skyworth**
- App Store or App Hosting provided by O**perator** or P**artner** or **Skyworth**
- Third Party Apps (Netflix, Prime Video, Disney+, etc) certification supported by **Skyworth**
- Commercial agreement with Disney+, Netflix, Amazon, etc to be managed directly by **operator**

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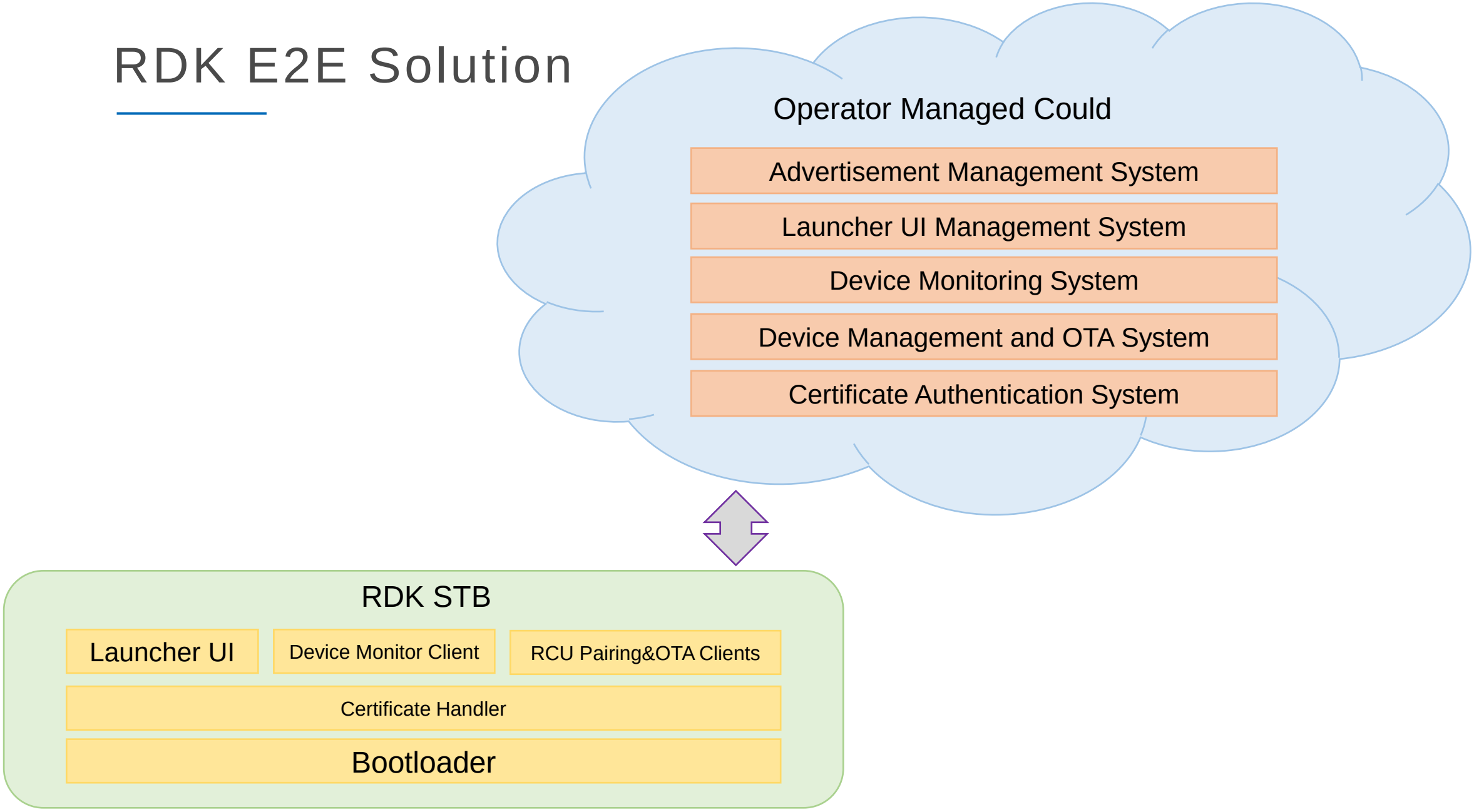
RDK E2E Solution



DaVinci

To be added when we can talk publicly about it

Contents

- System Integration
- Way of Working

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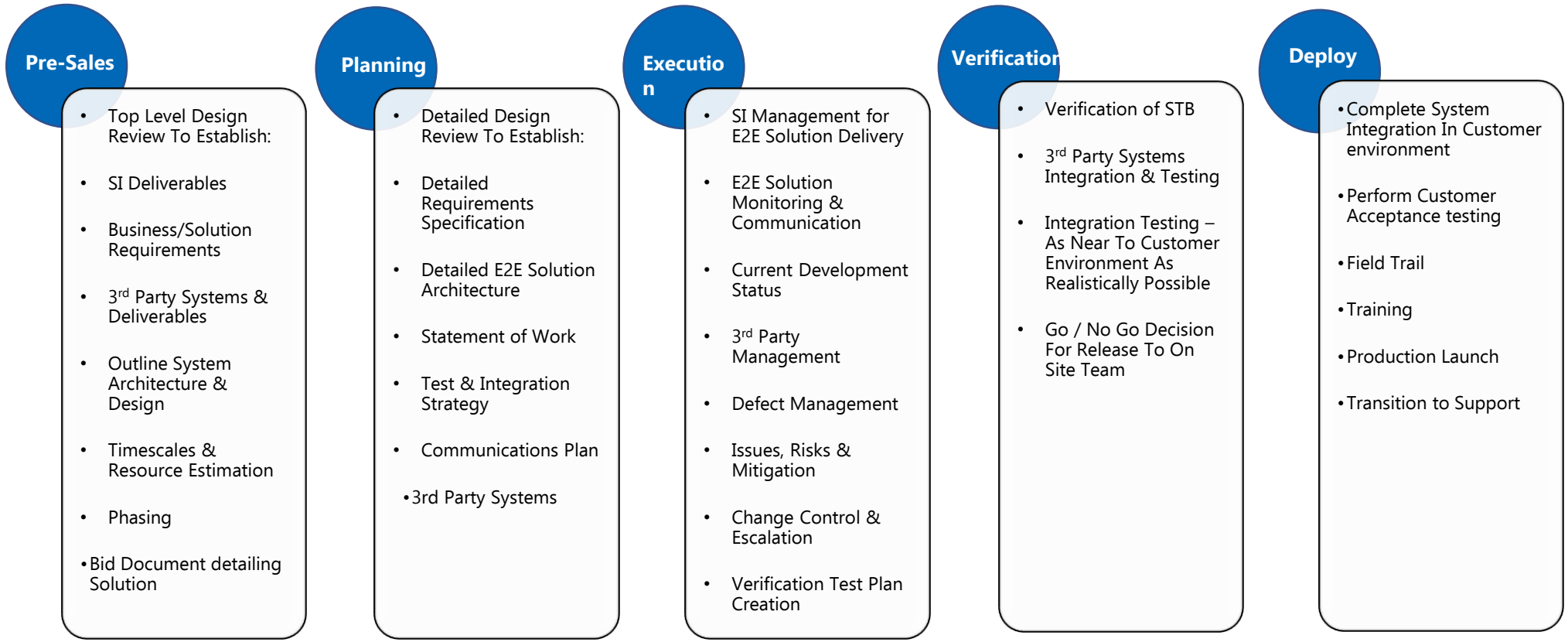
System Integration

System Integration – General Process



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SI Approach

Role	Description and Responsibility
Programme Management	Overall management of the in scope work streams for the system integration; STB integration, head-end systems integration and deployment on the customer network
Solution Architect	Responsible for defining the in scope solution architecture of the project; including head-end systems, middleware, user interface, CAS and STB box.
System Engineer	**Responsible for the engineering effort to integrate the in scope sub systems, offsite and onsite defect management, build system management, software release management, deployment of releases on Head-End and CPE's.**
Test Engineer	**Responsible for the readiness for defining and executing the in scope System ATP's.**

*Resourcing is variable over solution project cycle

SI Case Study

- E2E Solution Architects
- Created Overall Business Requirements
- Management of Internal Senior Management Steering Committee
- Management of 3rd Parties – STB Vendor, SMS Vendor, CAS Vendor & internal suppliers
- Managed Workflows & Reports
  - STB, CAS, SMS, Application
- Defect Management & Triage
- Setup STB SQA Verification environment in operator premises
- Test Management & Verification

Customer name under strict NDA

A Middle East FTA operator wanted to move to a CAS based pay TV solution.

Skyworth was prime Systems Integrator for this which delivered a STB, CAS based head end and SMS solution.

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Ways of Working

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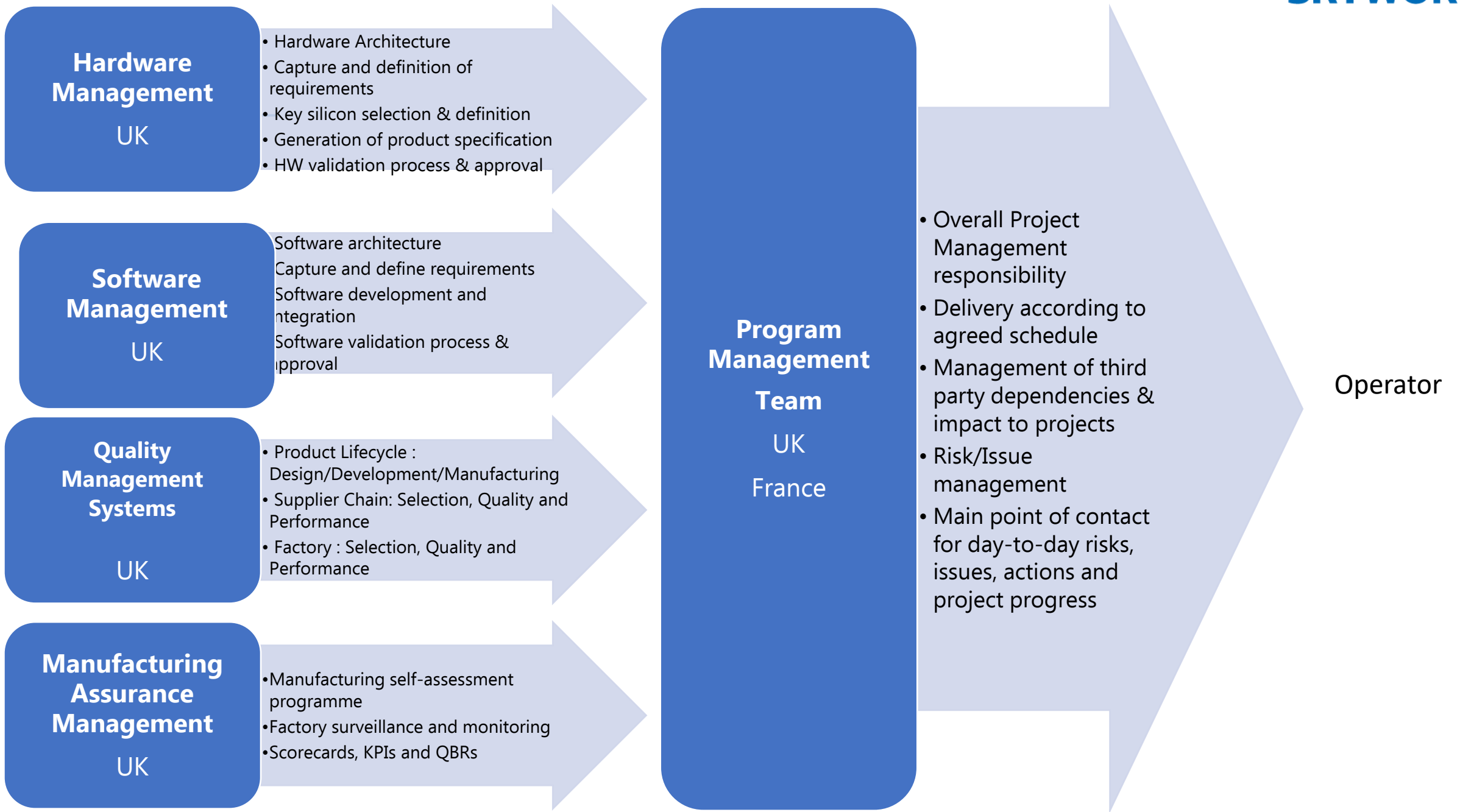
Hardware Engineering Shenzhen	• Schematic & layout capture • Hardware testing and validation • Pre-certification & approvals testing • Mechanical design	**Hardware Management** UK
Software Engineering Shenzhen	• Software development • Silicon Vendor Integration • Bug fixing & issue management	**Software Management** UK
Quality Shenzhen	• Supplier quality management • Supporting procurement of test equipment • Supporting EMS quality plans	**Quality Management Systems** UK
Manufacturing Assurance Shenzhen	• Global on-site EMS support • NPI & Technical delivery	**Manufacturing Assurance Management** UK

•Hardware Architecture •Capture and definition of requirements •Key silicon selection & definition •Generation of product specification •Hardware validation process & approval
• Software architecture • Software validation process & approval • Test Automation
•Product Lifecycle : Design/Development/Manufacturing •Supplier Chain: Selection, Quality and Performance •Factory : Selection, Quality and Performance
• Manufacturing self-assessment programme • Factory surveillance and monitoring • Scorecards, KPIs and QBRs


Hardware Management
UK
• Hardware Architecture
• Capture and definition of requirements
• Key silicon selection & definition
• Generation of product specification
• HW validation process & approval
Software Management
UK
Software architecture
Capture and define requirements
Software development and ntegration
Software validation process & pproval
Quality Management Systems
UK
• Product Lifecycle : Design/Development/Manufacturing
• Supplier Chain: Selection, Quality and Performance
• Factory : Selection, Quality and Performance
Manufacturing Assurance Management
UK
•Manufacturing self-assessment programme
•Factory surveillance and monitoring
•Scorecards, KPIs and QBRs
Program Management Team
UK
France
• Overall Project Management responsibility
• Delivery according to agreed schedule
• Management of third party dependencies & impact to projects
• Risk/Issue management
• Main point of contact for day-to-day risks, issues, actions and project progress
Operator

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Project Governance

Kick Off

- All Party Meeting
- Statement of Work
- Project Plan
- Product Specification
- Quality & Test Plan
- Project Risks
- Jira Action Tracker
- Jira Defect Tracker
- Dependencies Identified

Development

- Monthly Senior Management Stakeholder Steerco
- Weekly Status Report
- Weekly Stakeholder Project Review
- Hardware QA Gate Reviews
- Weekly Defect Triage Meeting
- Change Request Management
- Update Risk Register
- Update Jira Action Tracker
- Update Jira Defect Tracker

Production

- Customer Sign Off
- NPI Checklist Signed Off
- Lessons Learnt Review


Thank You