Native IP over Broadcast Bearers

- DVB-T2

Copenhagen | May 25th 2022

By Kenneth Wenzel, Open Channel

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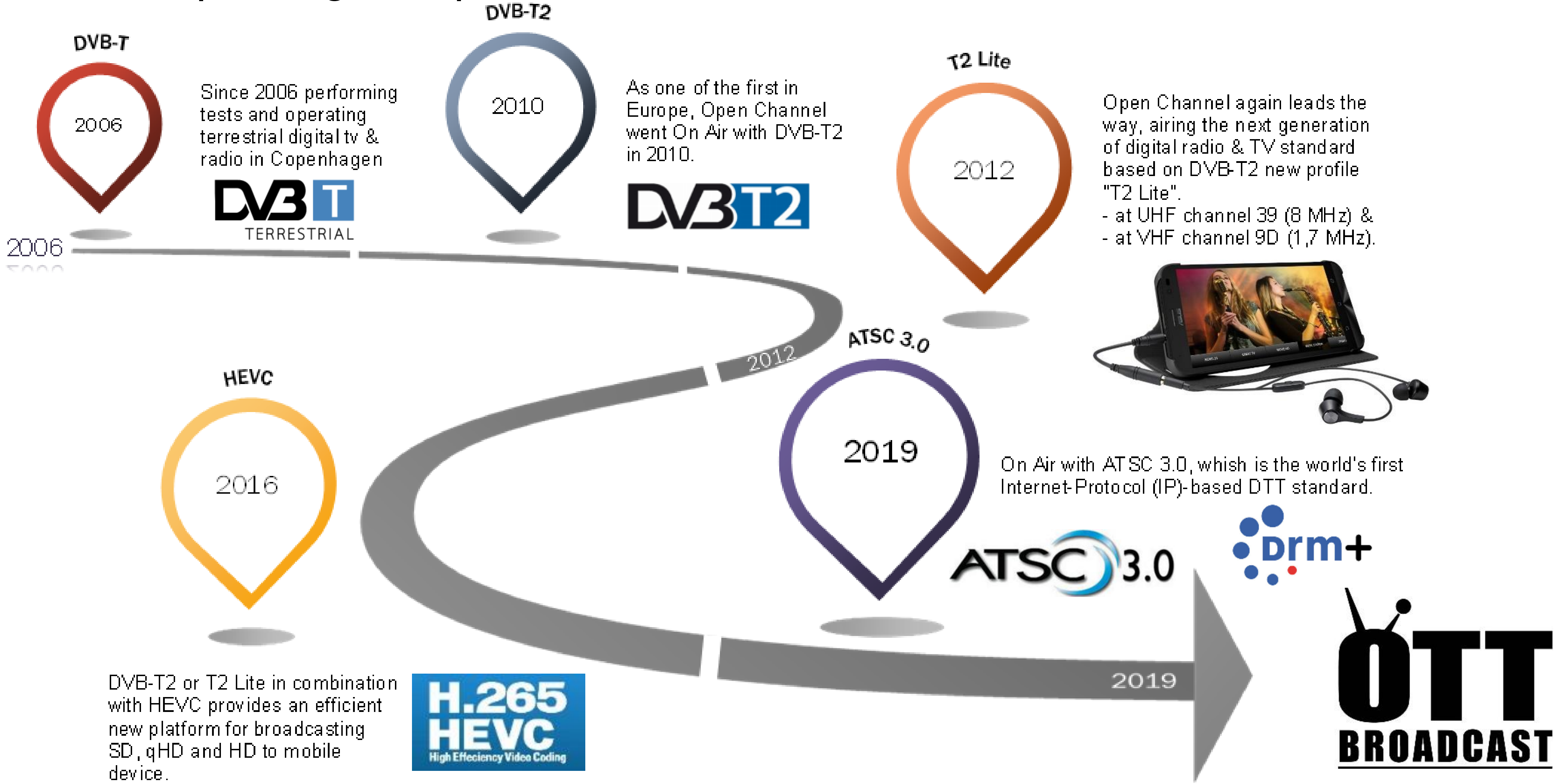
About | Open Channel

- An independent Danish DTT network operator and
- has since 2006 been performing tests and operating terrestrial digital TV & radio in Copenhagen. Specialists in DRM+, DVB-T2 and ATSC 3.0



About | Mediathand

- Pioneers in over-the-top (OTT) streaming
- Mediathand's software defined Television-as-a-service offers a fast-track to easily, economically and securely deploy any Broadcast, IP/OTT stream to any screen, anywhere, any time.
- Can help our customer's monetise all of their media assets providing access to new revenue streams, higher picture quality and with significant cost reductions.
- Is a TV and media technology company embracing all challenges in the entire ecosystem from 'glass to glass' incl. acquisition, contribution, processing distribution and seamless playback on any device.
- Offer highest quality at the lowest bitrates with industry-grade reliability over any distribution technology.
- Is located on the campus of the old famous Nokia Development Labs, now Aalborg University of Copenhagen, where mediathand operates in the centre of Danish telecommunication and media technology research.

Copenhagen Testbed | IP Natively over DVB-x2 / ATSC 3.0

- In 2010, **Open Channel** was among the first movers to launch and operate a DVB-T2 platform. Now, partnering with another Danish company, **mediathand**, we are the first in Europe in 2019 to go on air with **ATSC 3.0**, in a 6 MHz channel at 587 MHz in Copenhagen.
- This OTT Broadcast trial is designed to explore the opportunities for service operators to define requirements for carrying OTT-type audiovisual services, using IP over broadcast bearer technologies as **DVB-T2, DVB-S2, CBRS, BFWA and 5G**, complementing existing delivery using the internet.
- Along with our partners, we demonstrate how players from both the web and broadcast world can realize some of the many technical and business opportunities emerging from the convergence happening in the global broadcast industry today.

Frederikskaj 12 A.C. Meyers Vænge 15

ATSC 3.0 DVB T2 DVB S2

Copenhagen Testbed | Participant

Broadcaster

- FRANCE 24
- BAUER
- TV STORBYEN
- KKR TV
- SES

R&D

- Open CHANNEL
- mediathand
- STEINWURF The FEC Experts
- CADAMI
- AALBORG UNIVERSITY COPENHAGEN
- [illegible]

Equipment

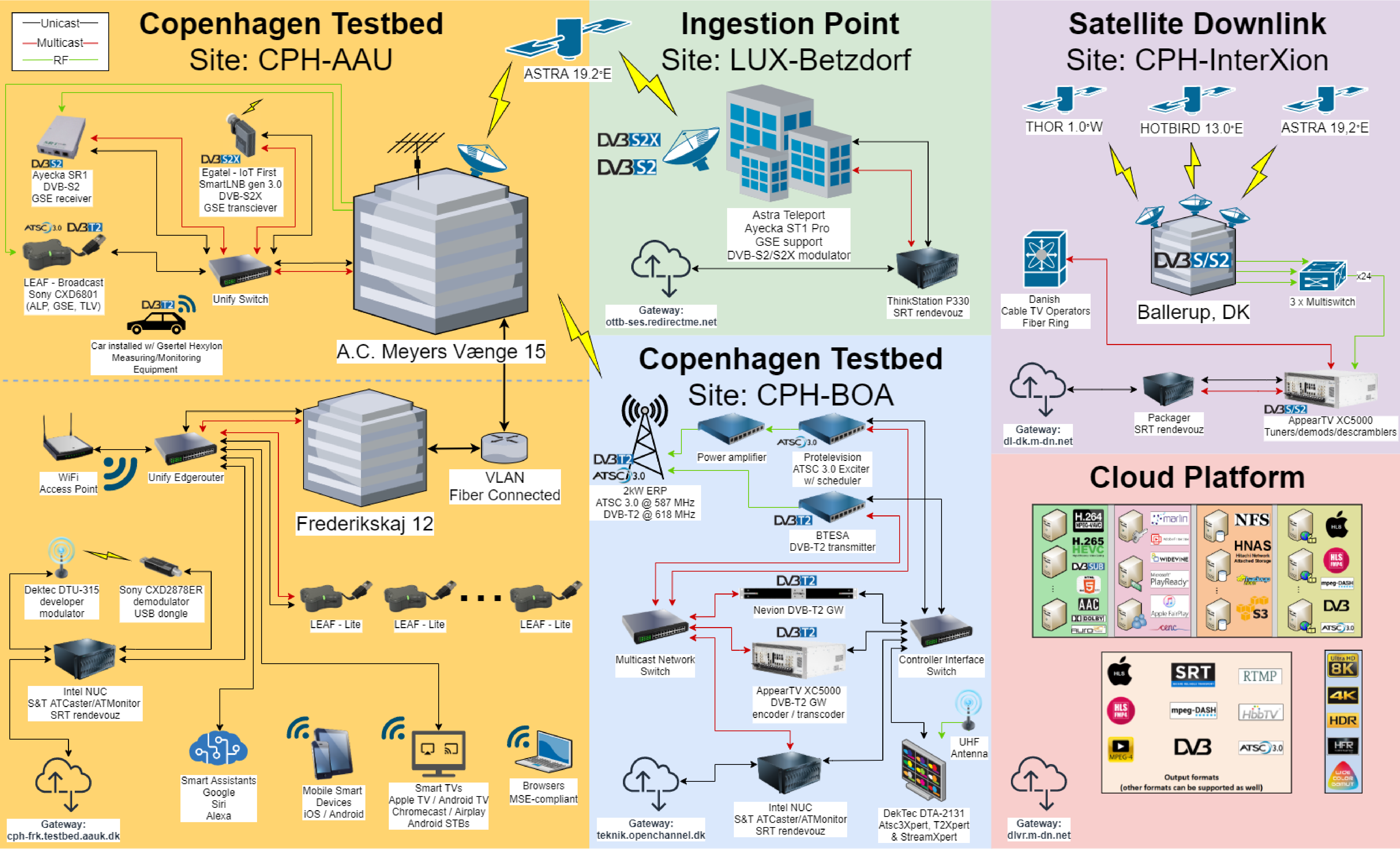
- PRO TELEVISION TECHNOLOGIES
- BTESA BROAD TELECOM
- albentia systems
- s&t Strategy & Technology Ltd
- Appear TV
- nevion
- Qbit
- Exir Broadcasting
- KATHREIN
- BORCH TEKNIK A/S

Monitoring

- DekTec
- GSERTEL
- COMM-connect
- PROGIRA

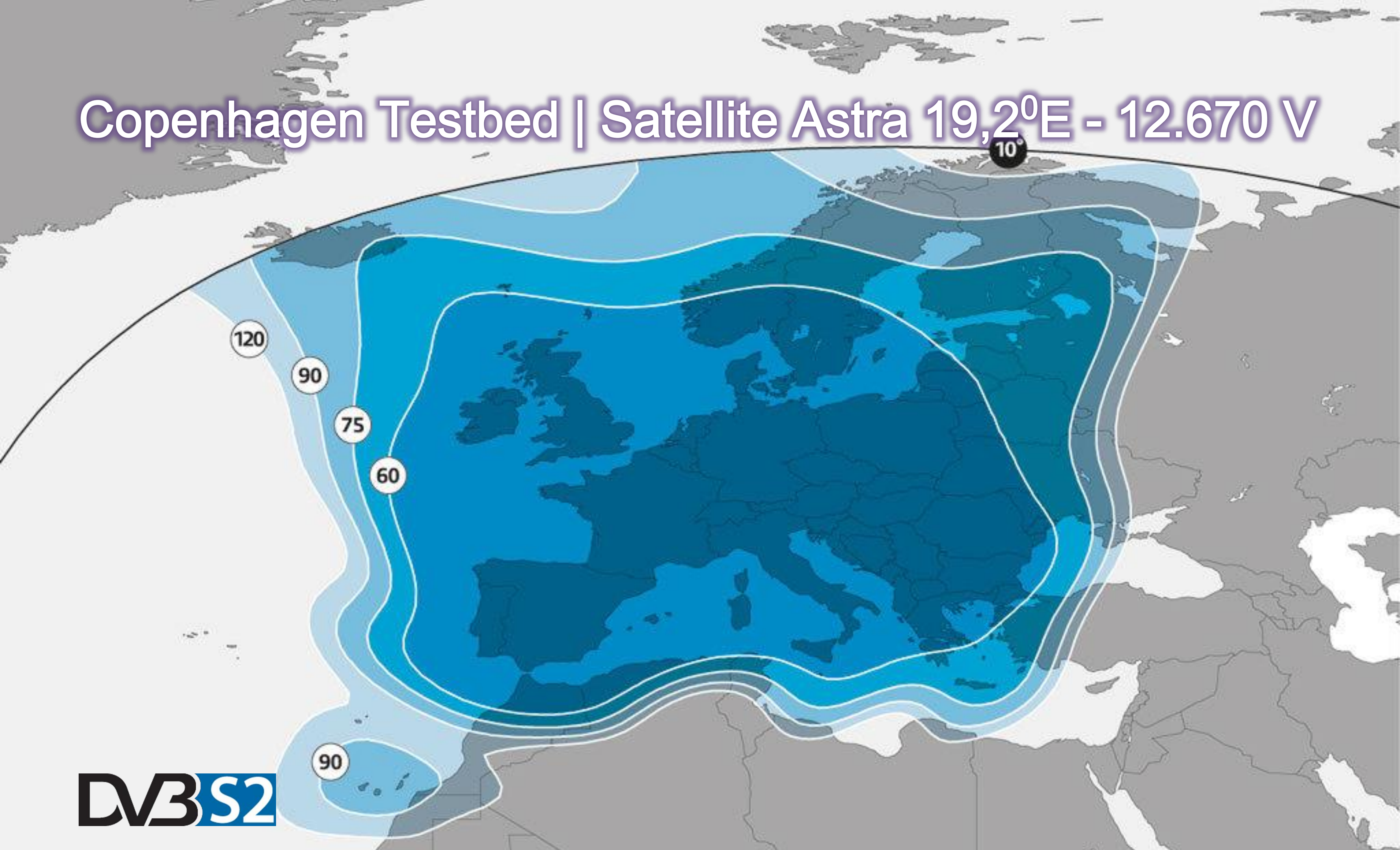
Receiver & Chip

- SONY
- NXP



Unicast
Multicast
RF
Copenhagen Testbed
Site: CPH-AAU
ASTRA 19.2°E
Ingestion Point
Site: LUX-Betzdorf
Satellite Downlink
Site: CPH-InterXion
Ayecka SR1
DVB-S2
GSE receiver
Egatel - IoT First
SmartLNB gen 3.0
DVB-S2X
GSE transciever
LEAF - Broadcast
Sony CXD6801
(ALP, GSE, TLV)
Unify Switch
Car installed w/ Gsertel Hexylon
Measuring/Monitoring
Equipment
A.C. Meyers Vænge 15
DVB-S2X
DVB-S2
Astra Teleport
Ayecka ST1 Pro
GSE support
DVB-S2/S2X modulator
Gateway:
ottb-ses.redirectme.net
ThinkStation P330
SRT rendevouz
THOR 1.0°W
HOTBIRD 13.0°E
ASTRA 19,2°E
Danish
Cable TV Operators
Fiber Ring
Ballerup, DK
3 x Multiswitch
x24
Gateway:
dl-dk.m-dn.net
Packager
SRT rendevouz
AppearTV XC5000
Tuners/demods/descramblers
WiFi
Access Point
Unify Edgerouter
VLAN
Fiber Connected
Frederikskaj 12
Copenhagen Testbed
Site: CPH-BOA
2kW ERP
ATSC 3.0 @ 587 MHz
DVB-T2 @ 618 MHz
Power amplifier
Protelevision
ATSC 3.0 Exciter
w/ scheduler
BTESA
DVB-T2 transmitter
Cloud Platform
Dektec DTU-315
developer
modulator
Sony CXD2878ER
demodulator
USB dongle
LEAF - Lite
LEAF - Lite
LEAF - Lite
Nevion DVB-T2 GW
Multicast Network
Switch
AppearTV XC5000
DVB-T2 GW
encoder / transcoder
Controller Interface
Switch
UHF
Antenna
Intel NUC
S&T ATCaster/ATMonitor
SRT rendevouz
Smart Assistants
Google
Siri
Alexa
Mobile Smart
Devices
iOS / Android
Smart TVs
Apple TV / Android TV
Chromecast / Airplay
Android STBs
Browsers
MSE-compliant
Gateway:
cph-frk.testbed.aauk.dk
Gateway:
teknik.openchannel.dk
Intel NUC
S&T ATCaster/ATMonitor
SRT rendevouz
DekTec DTA-2131
Atsc3Xpert, T2Xpert
& StreamXpert
H.264
H.265
HEVC
AAC
NFS
HNAS
S3
SRT
RTMP
mpeg-DASH
HbbTV
Output formats
(other formats can be supported as well)
8K
4K
HDR
HFR
Gateway:
dlvr.m-dn.net

Copenhagen Testbed | Satellite Astra 19,2^{0}E - 12.670 V



Copenhagen Testbed | DTT frequency

- Antenna Position: BOA (TDC / YouSee Tower)
- Address: Borups Allé 43, 2200 Copenhagen, DK

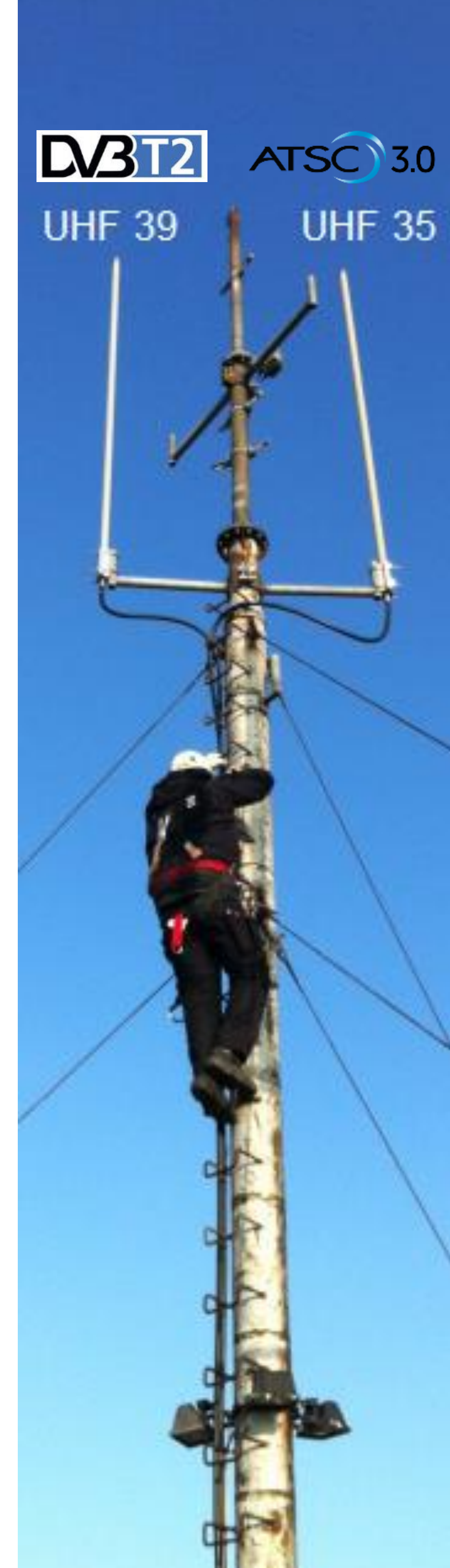
- Coordinates: Longitude (WGS 84) 012E32 23
Latitude (WGS 84) 55N41 30

- Antenna Height: 97 meters
- Elevation: 8 meters

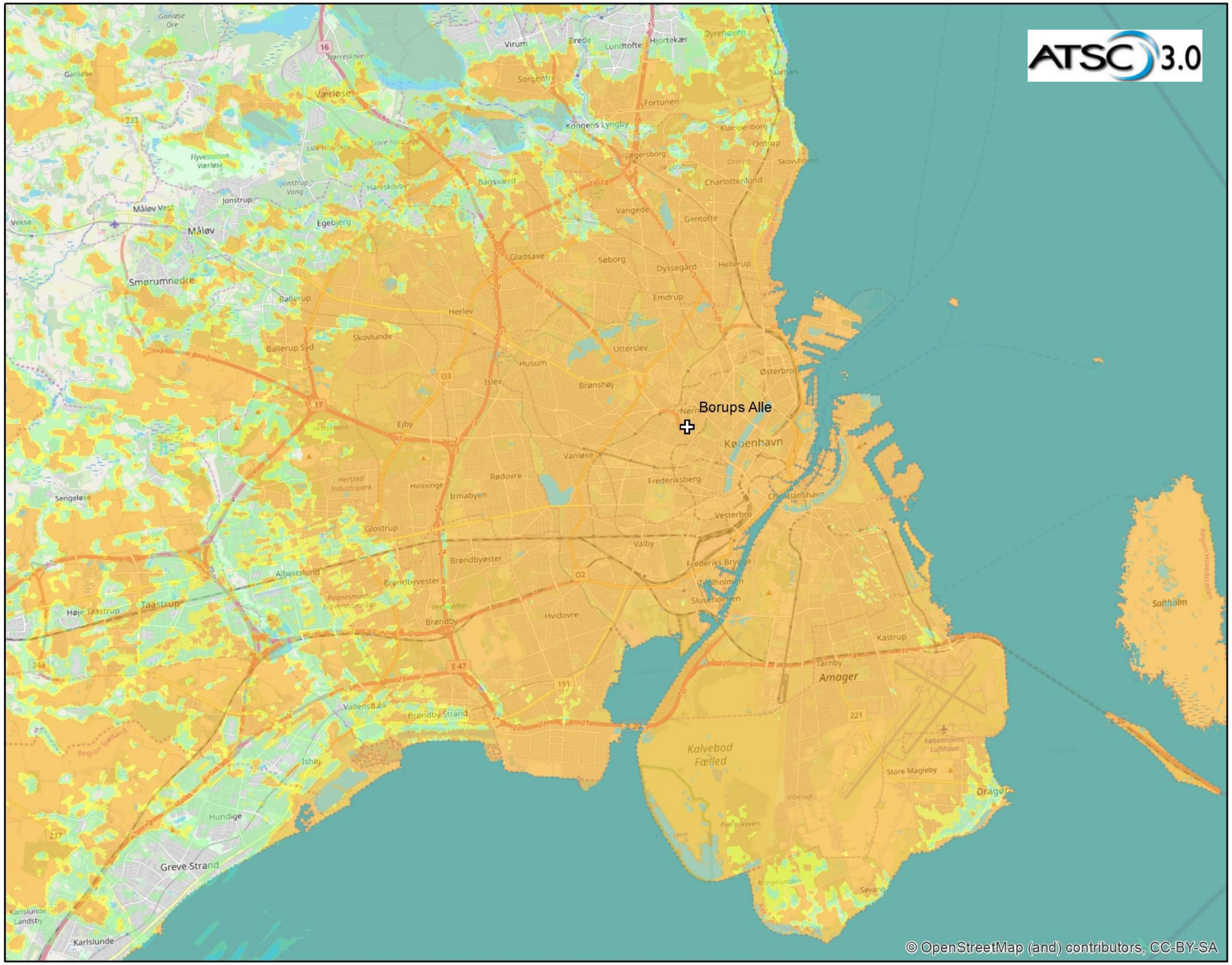
- Polarization: Vertical polarization

- Transmission power: 2 kWatt ERP omni-directional

- ATSC 3.0 frequency: 587 MHz (6 MHz BW – US Channel 33)
- DVB-T2 frequency: 618 MHz (8 MHz BW – EU Channel 39)



Borups Alle ATSC 3.0 2 kW - Mobile coverage



9 | 4.5 | 0 | 9 Kilometers

1 = 150 000

PROGIRA plan

Coverage probability

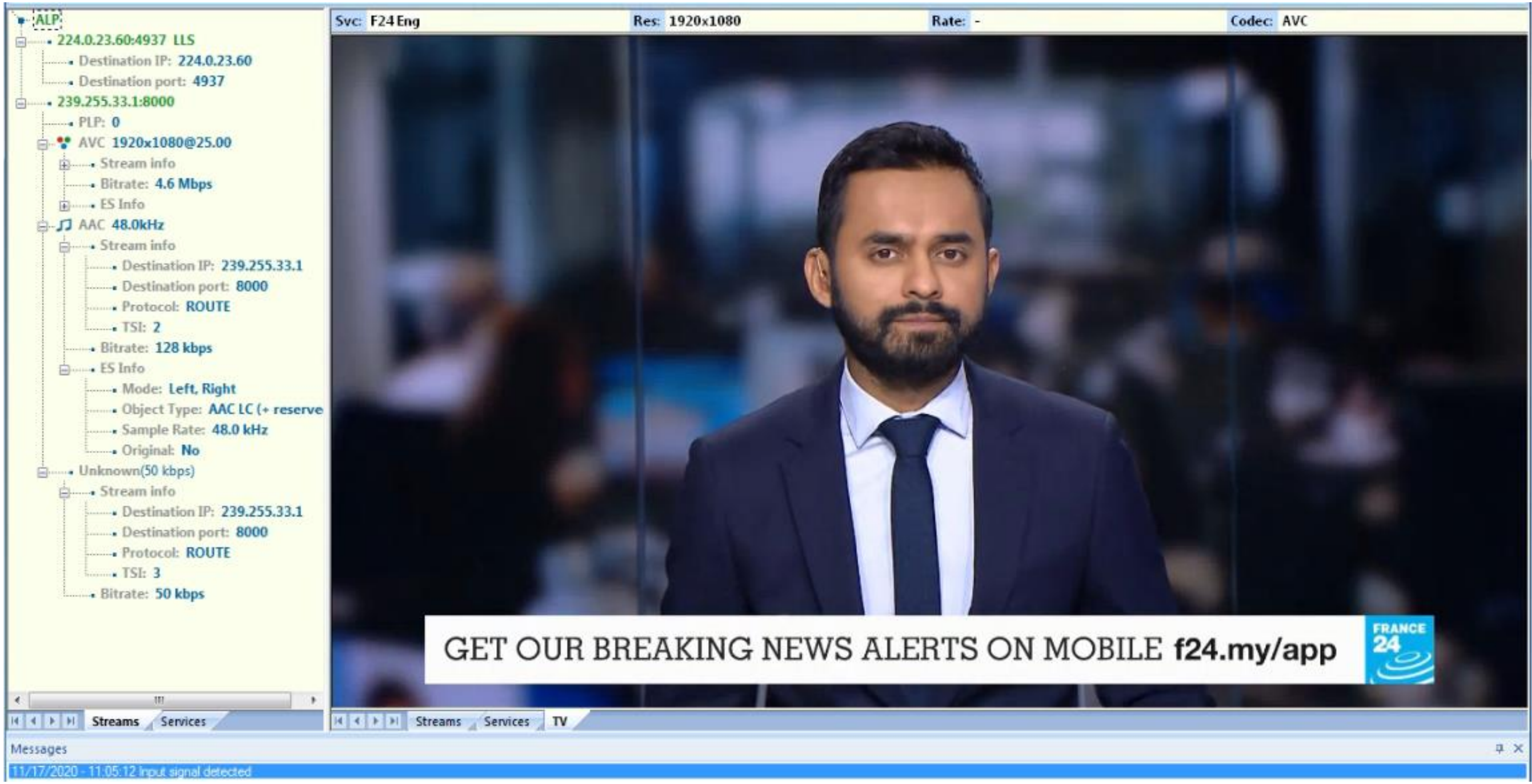
- 0.70 - 0.90
- 0.90 - 0.95
- 0.95 - 1

Mobile coverage (ATSC 3.0 Portable outdoor, Coverage probability)
Calculation date: 2020-01-20 14:01:27

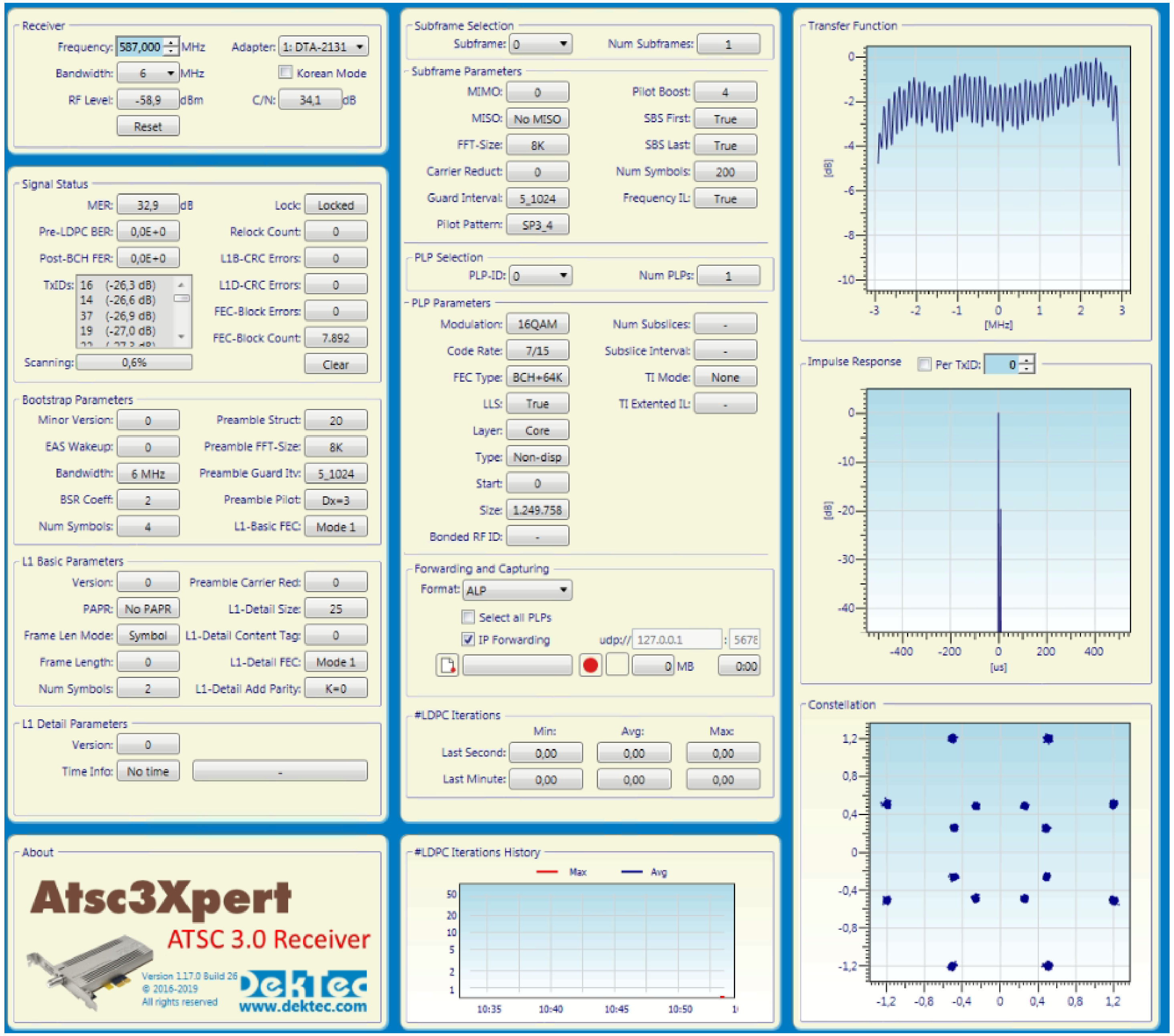
SYSTEM
Profile: Normal
FFT size: 8K
System bandwidth (MHz): 6
Bandwidth option: 0 - 100%
Modulation: 64-NUQAM
Code rate: 8/15
Outer code: CRC
LDPC frame length: 64800
Guard interval: GI5_1024 (148µs)
Scattered pilot pattern: SP3_4
Scattered pilot boost: 4
Multi antenna type: SISO
TDMA sub frame: False
Frame length: 250
PAPR reduction: None
Channel bonding: None
Backstop noise (dB): -38
Net bit rate (Mbit/s): 14.82
Required C/N (dB):
Rice: 11.45
Rayleigh: 13.60
EPT
EPT model: NONE
RECEIVER
Frequency (MHz): 586
Channel: 35
Receiving condition: Portable outdoor
SFN synch method: First Tx
Guard interval model: Tf
Noise figure (dB): 7.0
Man-made noise margin (dB):
Built-up area (dB): 0
Other (dB): 0
Antenna gain (dBd): -3
Feeder loss (dB): 0
Amplifier gain (dB): 0
Antenna height (m): 1.5
Impl. margin (dB): 0
Tuner type: Silicon
Receive lower LDM level: False
PROPAGATION
Outdoor standard deviation (dB): 5.5
Field strength correlation: 0
CALCULATION
Method: Log-normal
Max number of interferers: 3
Consider receiver overload: False
Raster type: Coverage probability
Minimum field strength (dBµV/m)
Emin: 47.7
Emed at 1.5 m, 95 % of locations: 56.8
Emed at 10 m, 95 % of locations: 73.4

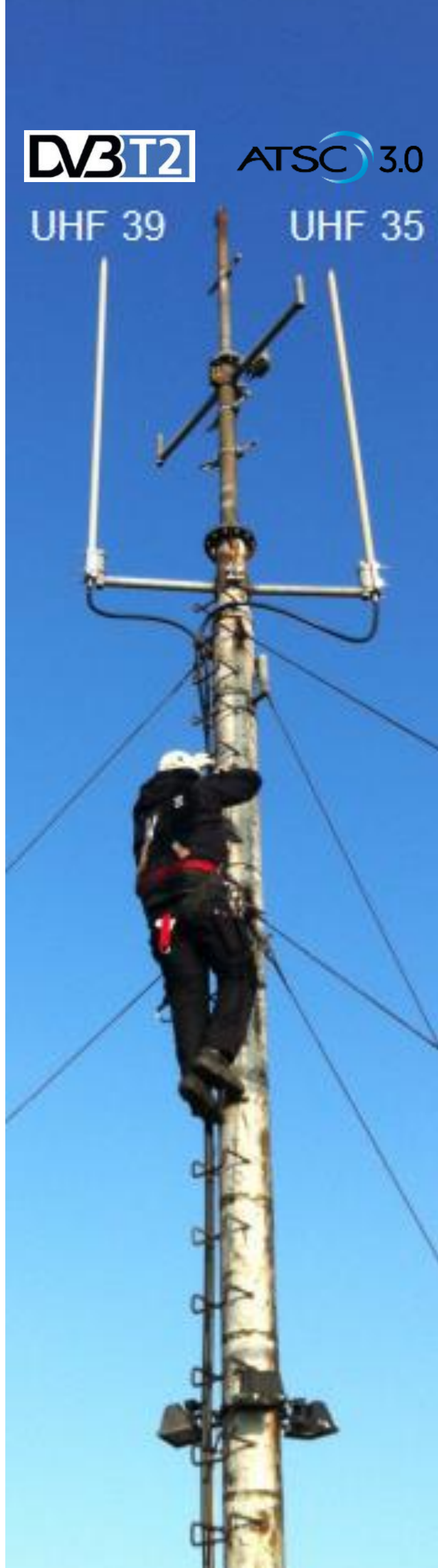
INPUT FS FOR WANTED TX
Borups Alle - ATSC 3.0 Test (50% 1.5m)

Copenhagen Testbed | ATSC 3.0 PLP0 France 24 HD

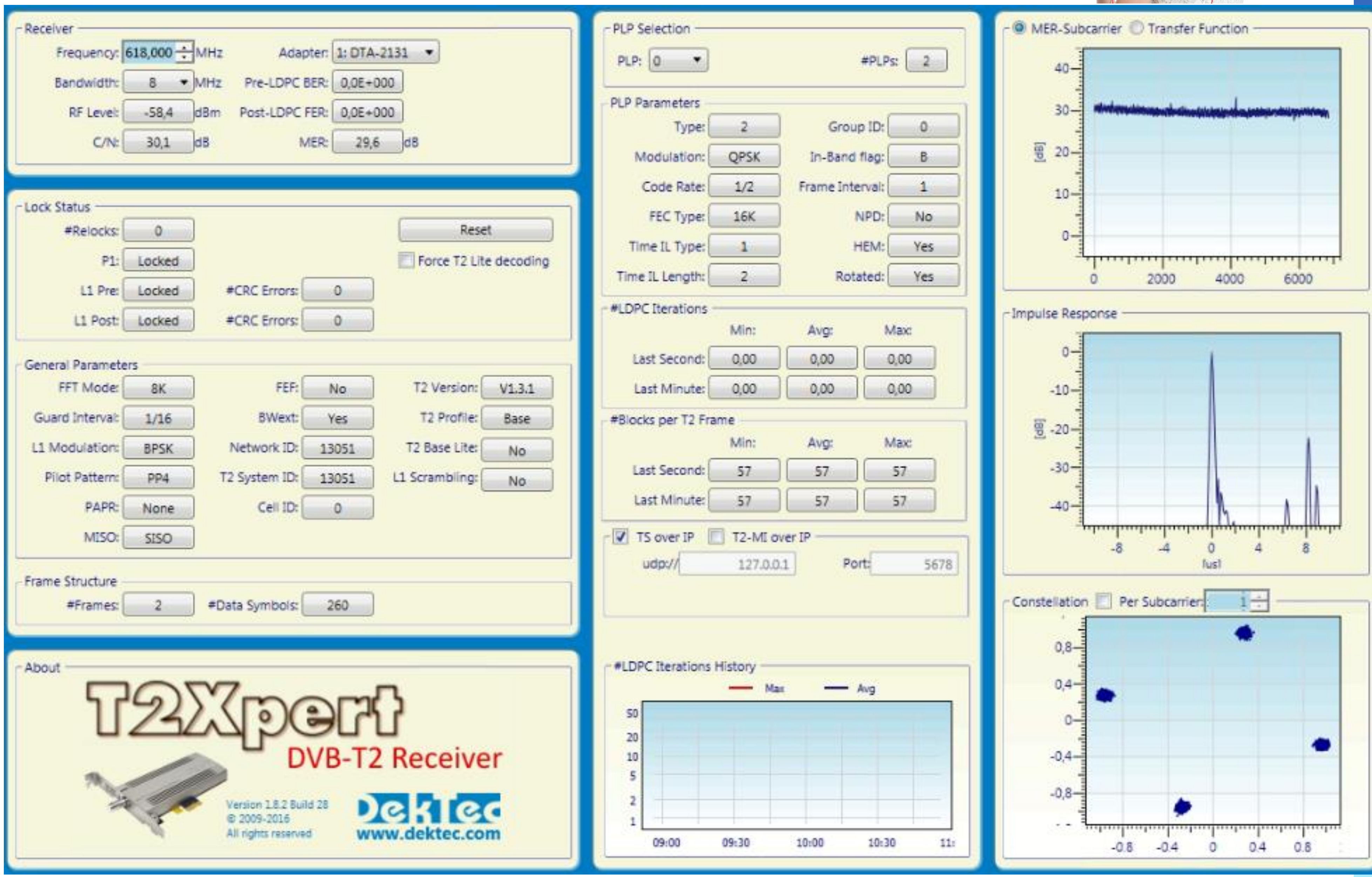


Copenhagen Testbed | ATSC 3.0 PLP0

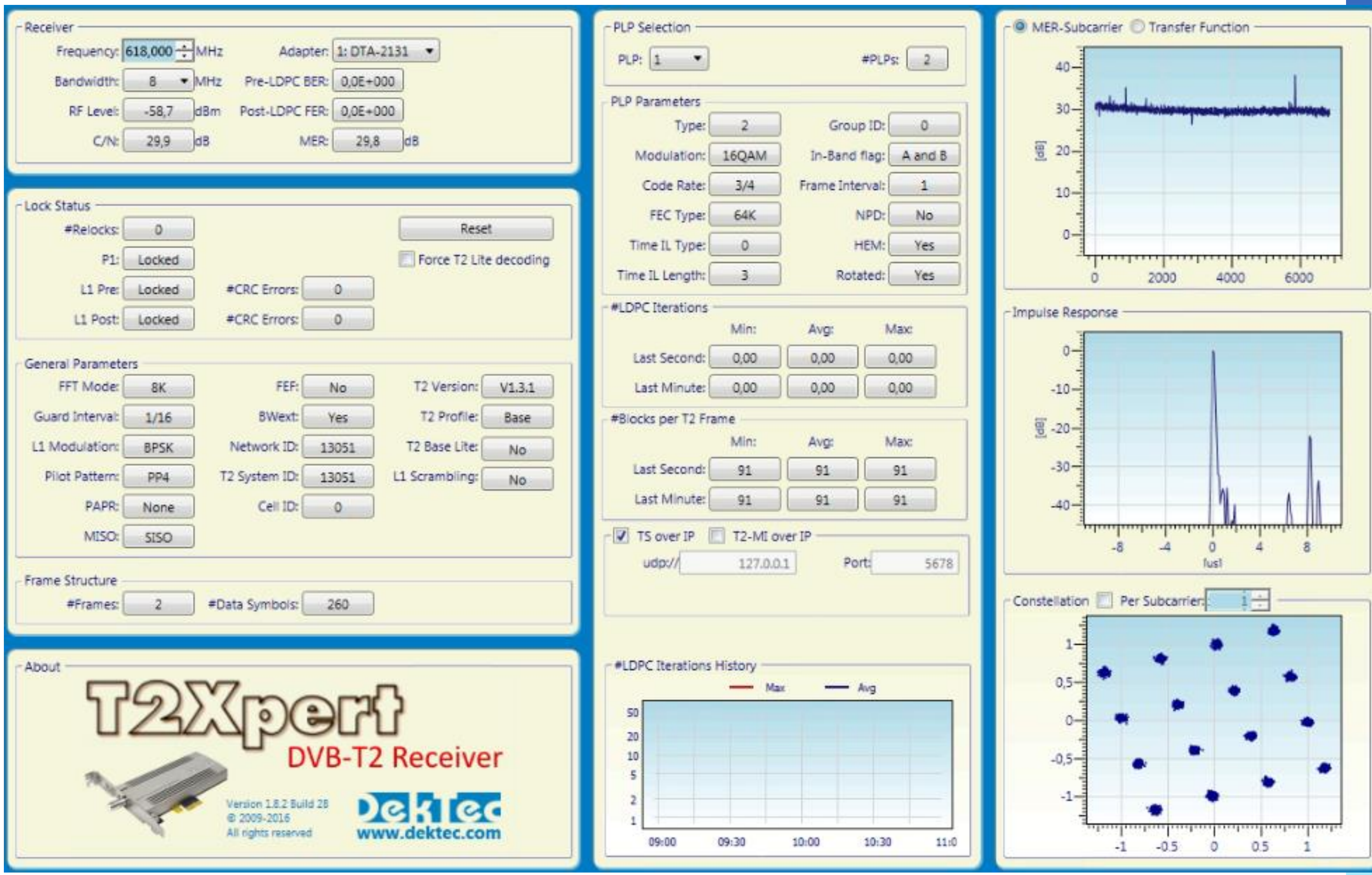




Copenhagen Testbed | DVB-T2 PLP0

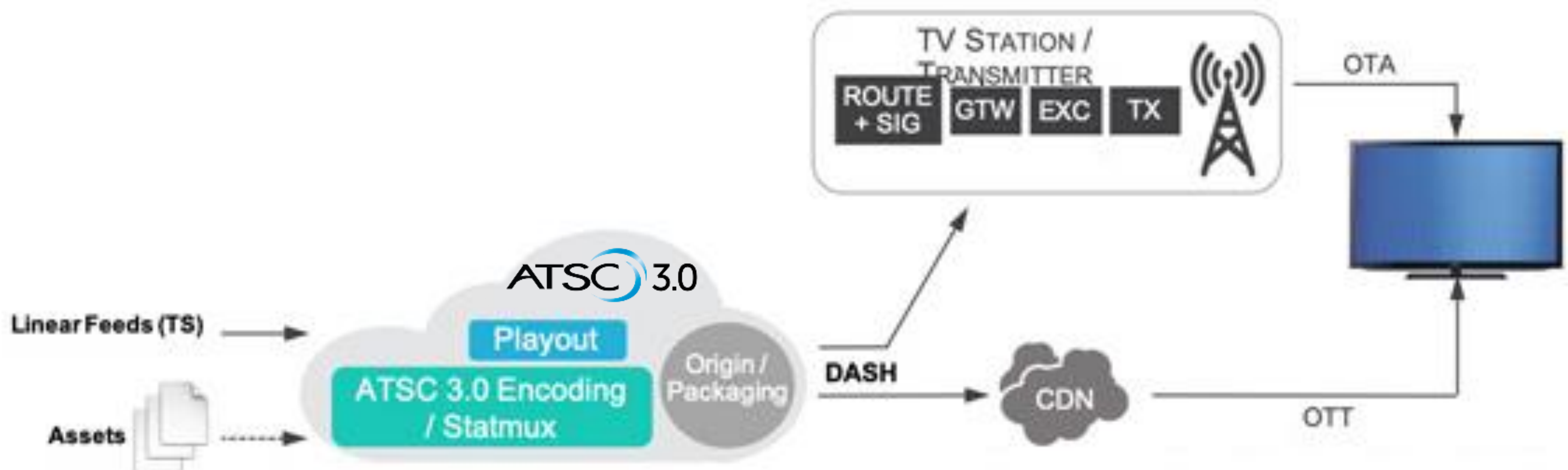


Copenhagen Testbed | DVB-T2 PLP1



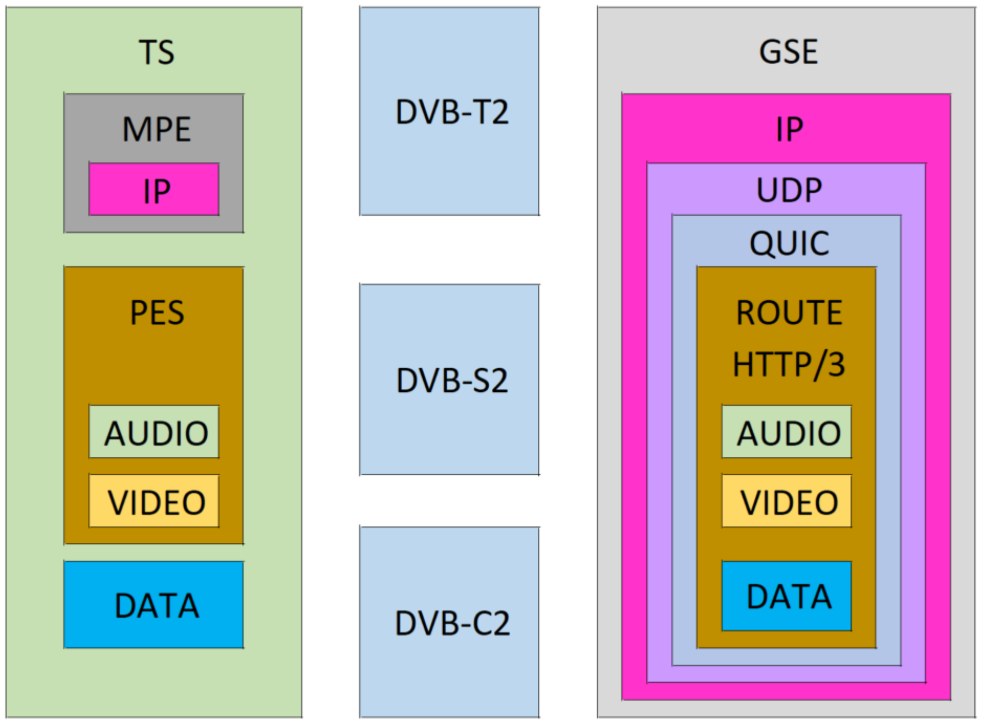
GSE | Native IP over broadcast bearers

- Using IP in broadcast does have obvious advantages and has also begun to pick up technical and commercial momentum beside ATSC 3.0 with DVB-I and various multicast adaptive bitrate (mABR) technologies.
  - ATSC 3.0 for example is based on native IP over ALP and uses the DASH delivery protocol for OTA channels. DASH allows broadcasters to feed both the broadcast OTA delivery chain using ROUTE for transmission over an IP network, and the OTT delivery chain using the HTTP adaptive streaming format.



GSE | Native IP over DVB-x2

- IP natively over DVB-x2 has existed for a long time with the help of Generic Stream Encapsulation (GSE), whereas in the ATSC 3.0 standard uses ALP encapsulation.
- At a conceptual level, GSE and ALP are very similar. (For completeness, ISDB also has a TLV format which is similar). The main point is to have a variable frame length. The ALP standard is the most efficient of the three, although from the point of view of the operator, the difference is very small.
- GSE has been part of the DVB-x2 standard from the very beginning, but has not yet been utilized and implemented in consumer products. GSE have so far only been used with some professional satellite IP trunking applications.

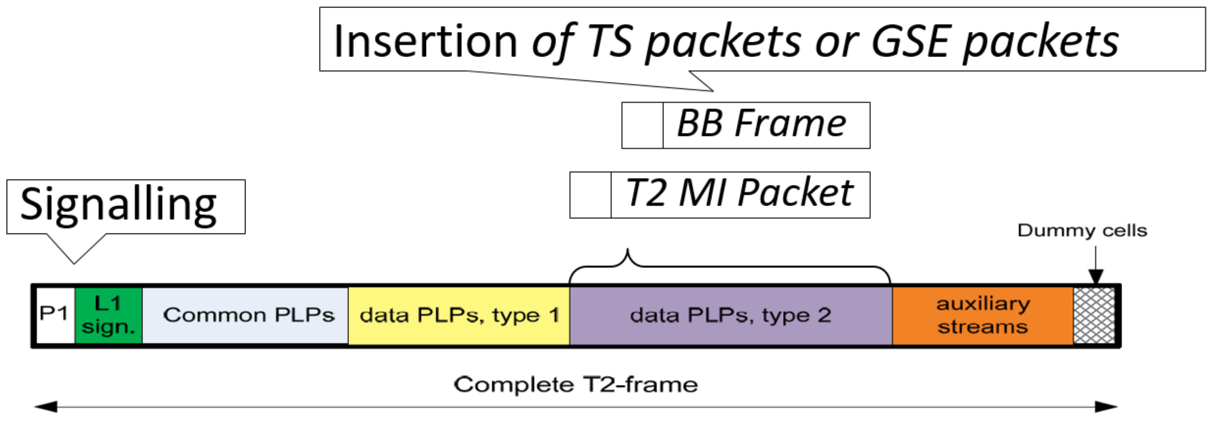


GSE | DVB-T2 PLP Payload Type

- Generic Stream Encapsulation (DVB-GSE) protocol (ETSI TS 102 606) conceptually is at the same level as the MPEG Transport Stream (TS).
- A GSE stream shall be characterized by variable length packets or constant length packets, as signalled within GSE packet headers, and shall be signalled in the BBHEADER by TS/GS field

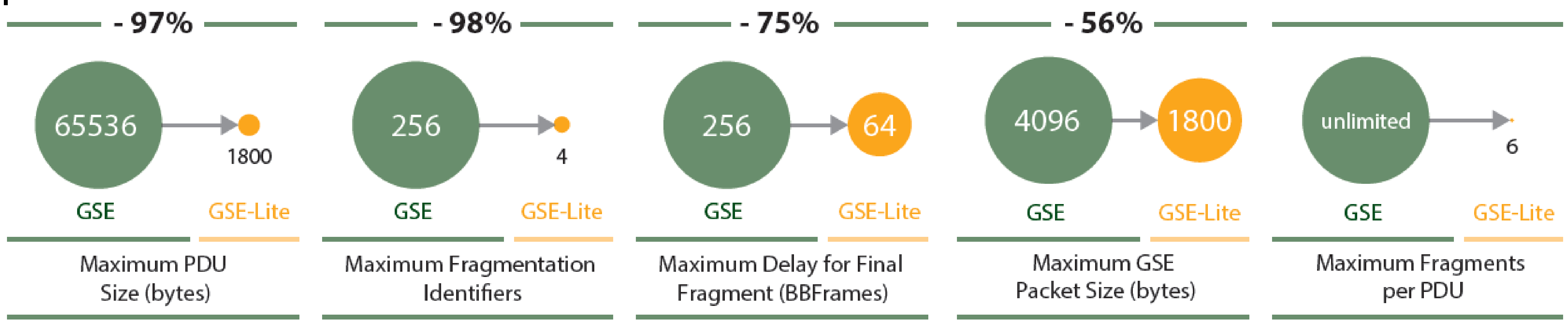
Table 31: Signalling format for the PLP_PAYLOAD_TYPE field

Value	Payload type
00000	GFPS
00001	GCS
00010	GSE
00011	TS
00100 to 11111	Reserved for future use



GSE | DVB-GSE-Lite

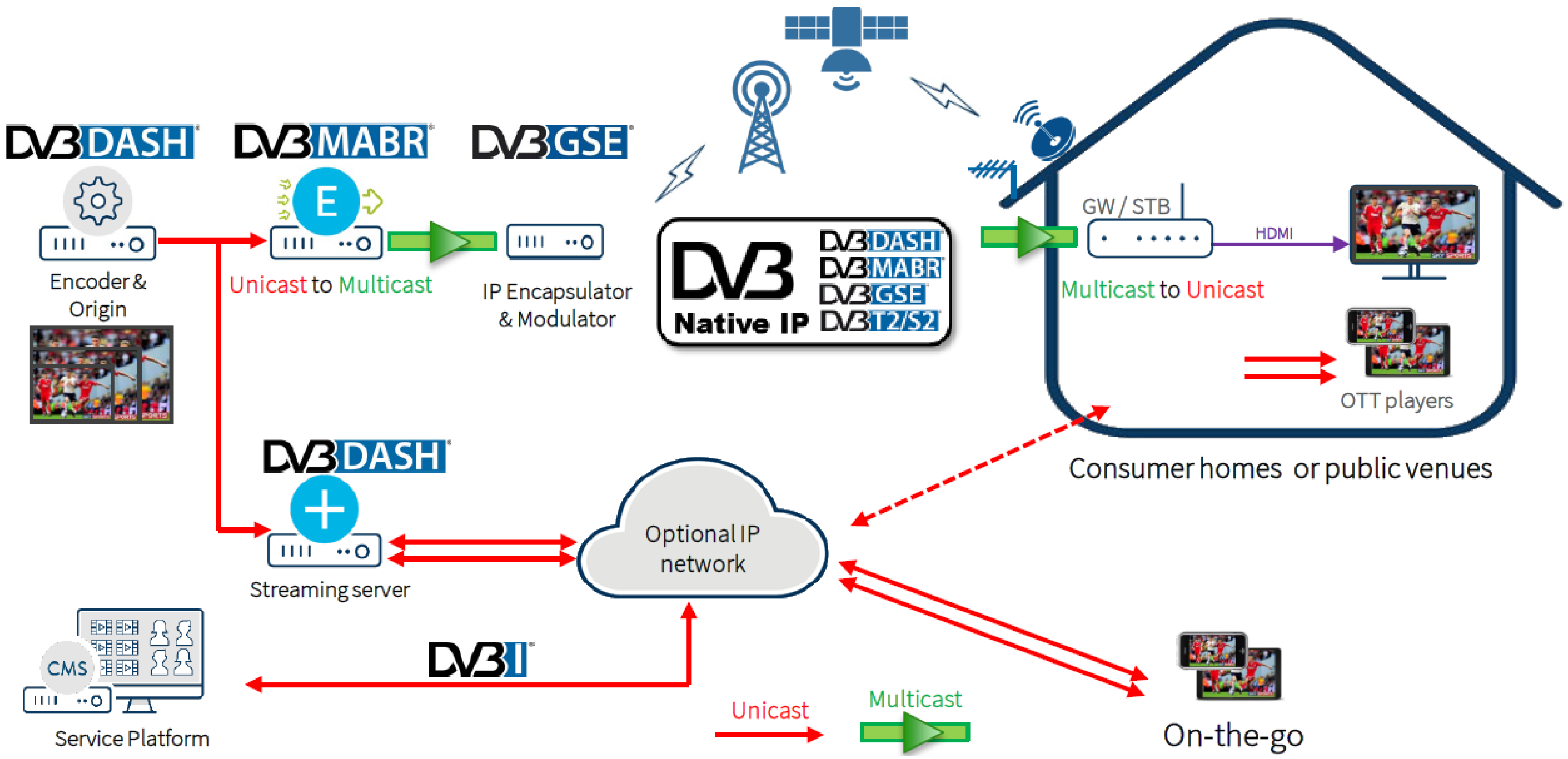
- To reduce the memory and processing requirements at both the transmitter and the receiver, the DVB-GSE-Lite profile has therefore been conceived to provide a simple yet completely functional sub-set of DVB-GSE.
- The DVB-GSE-Lite profile (ETSI TS 102 606-1) has been designed with IP traffic in mind, but it retains many of the generic features of the full GSE profile.



- As shown in the diagram, the DVB-GSE-Lite profile defines restrictions on five parameters of the GSE protocol. The cap on the PDU and GSE packet sizes, together with the two fragmentation restrictions, leads to a reduction of the memory footprint to some 7.2 Kbyte.

GSE | Native IP leverages existing DVB solutions

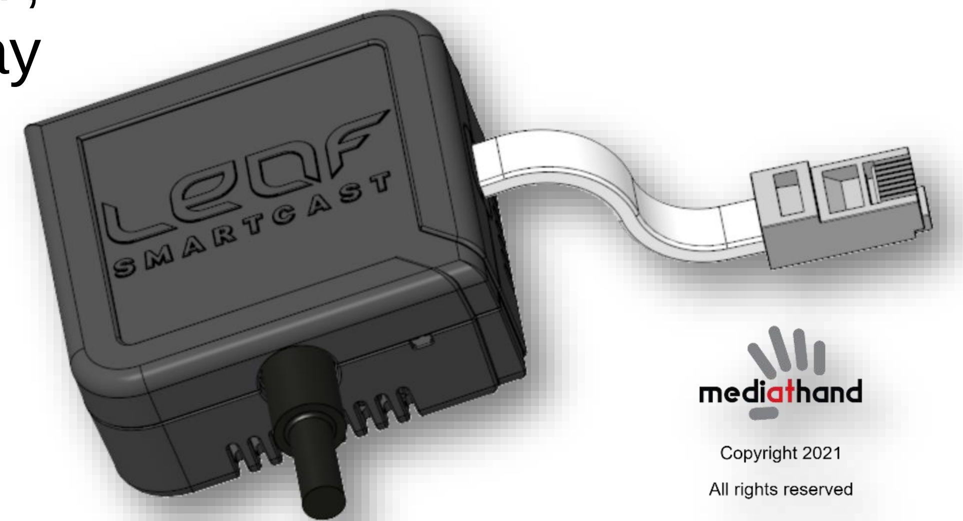
- The DVB-NIP specification has been published as DVB BlueBook A180



2021

GSE | New generation Home Gateway dongle

- In order to interpret the OTT-B services over DTT, a new generation small form factor home gateway dongle (55mm x 55mm) named “LEAF – SmartCast” device by mediathand is under development.

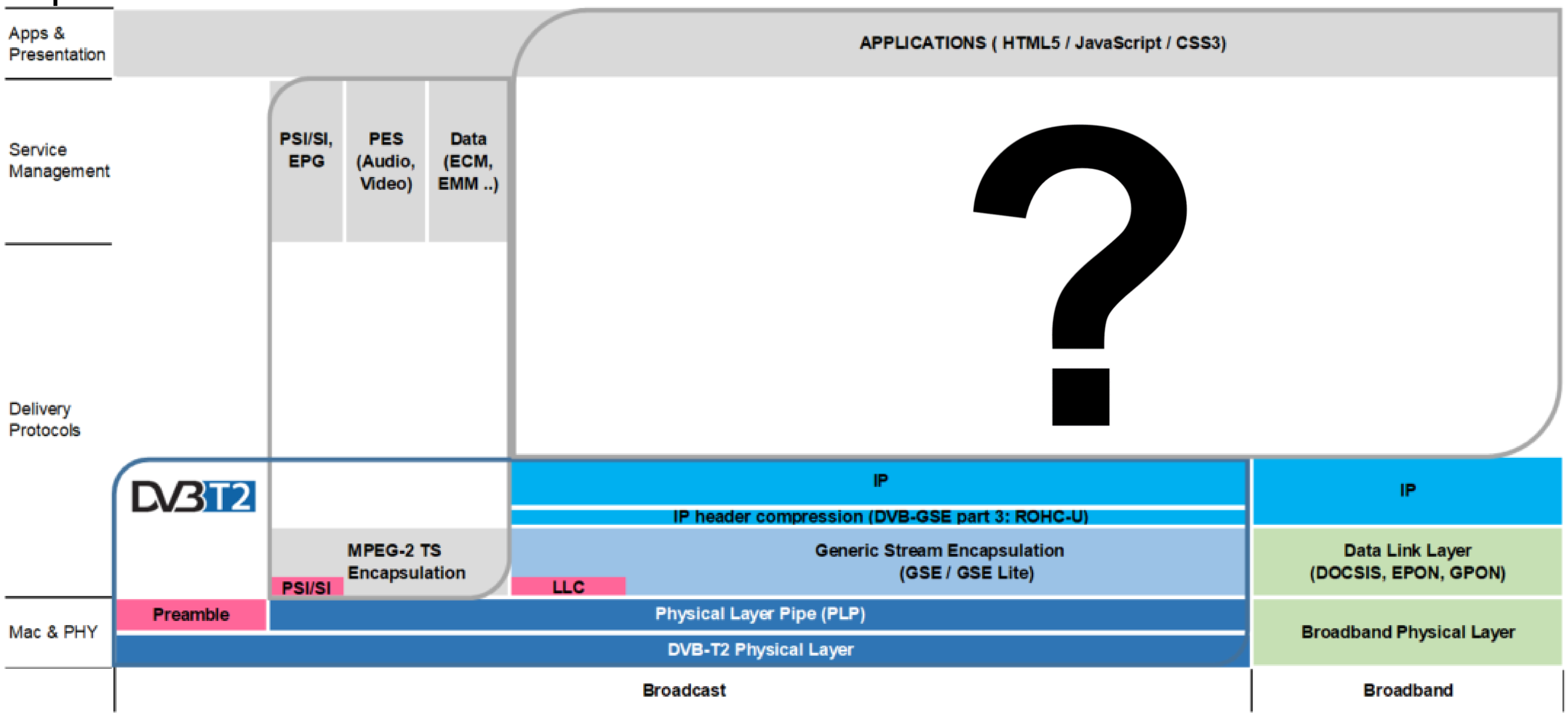


- The device is connected in-home to the router/switch using an ethernet interface.
- Though looking somewhat like a Chromecast, it is very different.
- This device features a variant with a terrestrial multi-demodulator chip Sony 6801GL (ATSC3.0 ALP, DVB-T2 GSE, ISDB TLV) and a version without demodulator for IPTV infrastructures e.g. with DVB-mABR support.
- The device transcasts any mABR to unicast requests and is able to cache and serve any data content like live feeds, apps, VoD content, emergency messages, app updates and much more. More Info: https://bit.ly/3z5O8ox

ATSC 3.0 DVB T2

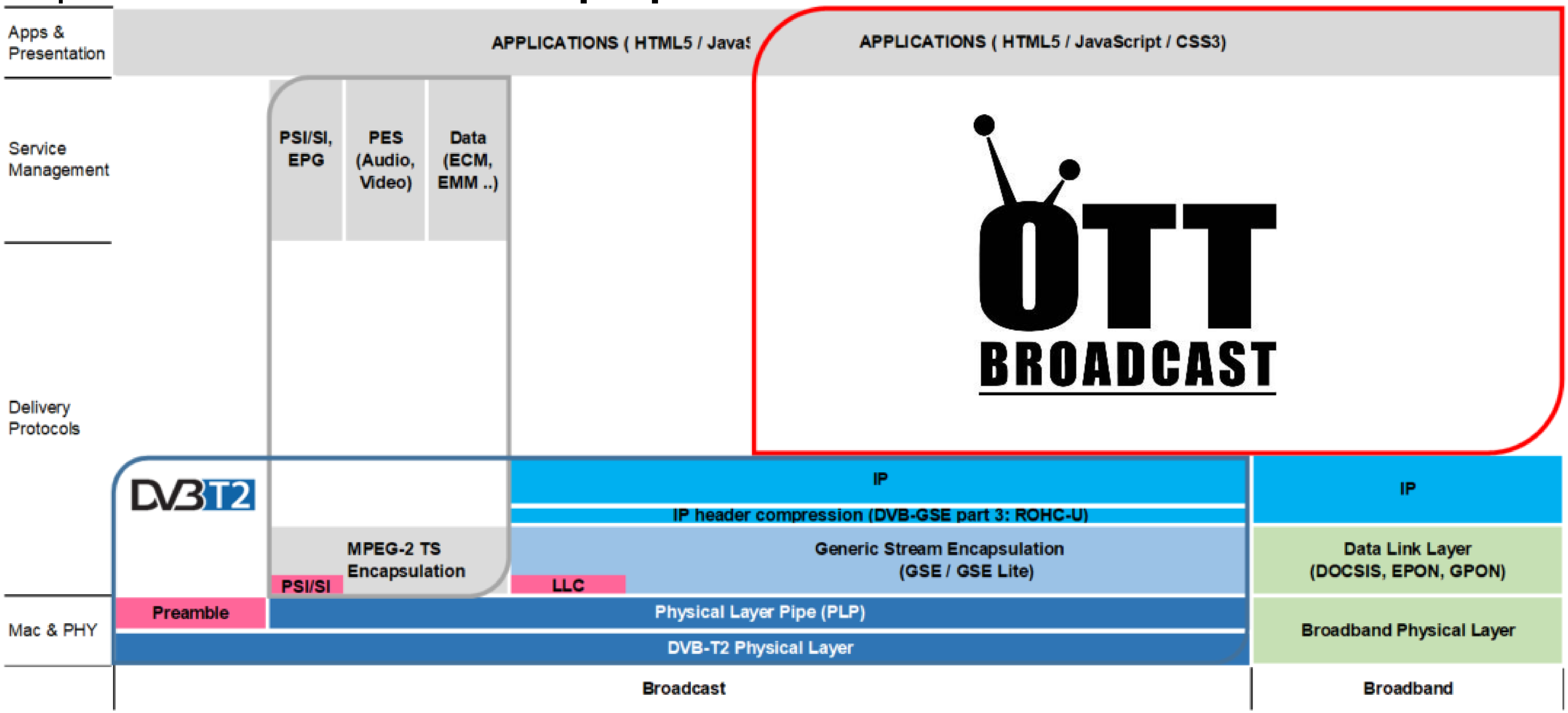
Protocol Stack | DVB-T2 standard

- For TS, a suite of DVB specs exists, allowing you to build an end-2-end system.
- For GSE, the DVB work stops at the IP layer. What happens on top of IP is still up to be define.



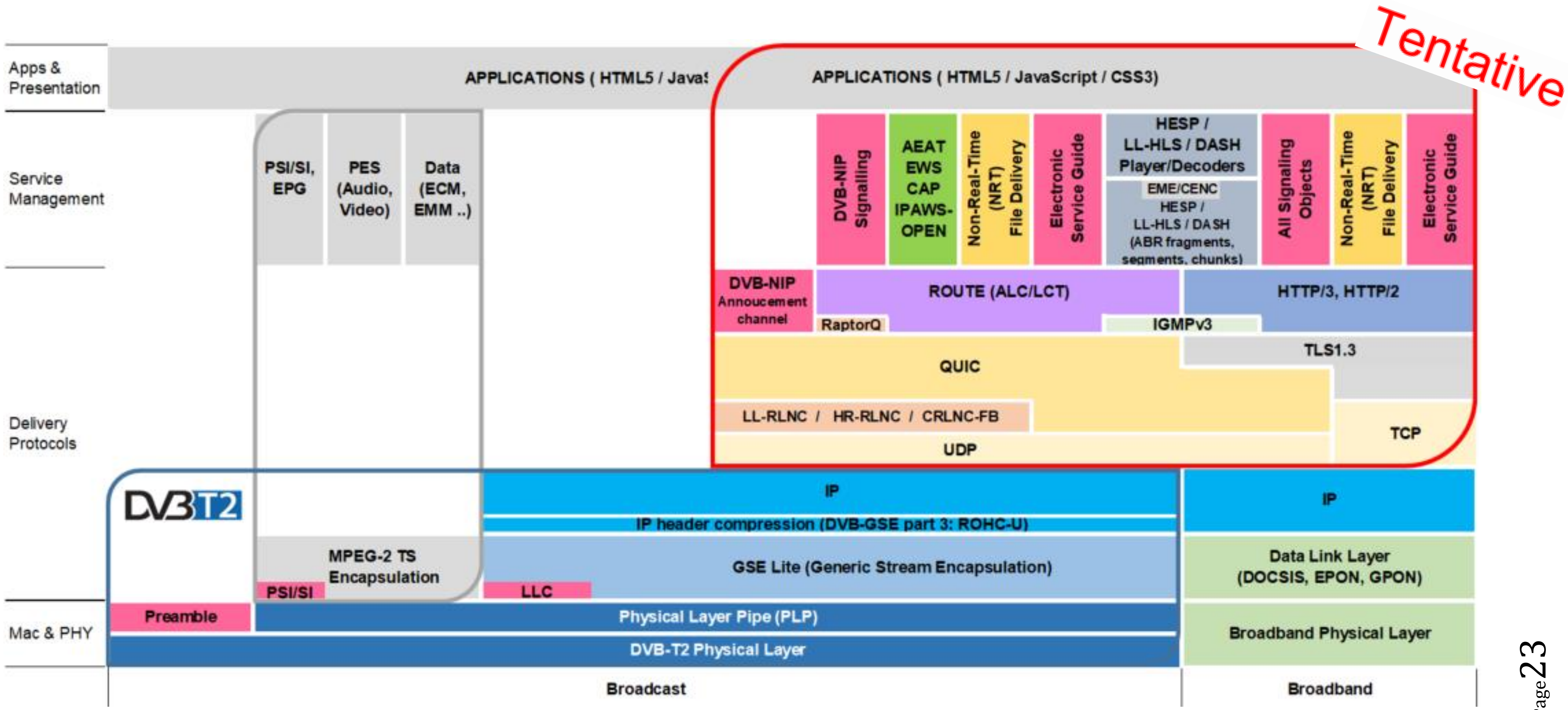
Protocol Stack | DVB-T2 standard

- For TS, a suite of DVB specs exists, allowing you to build an end-2-end system.
- For GSE, the DVB work stops at the IP layer. What happens on top of IP is still up to be define. **We have a proposal that we have name OTT Broadcast.**



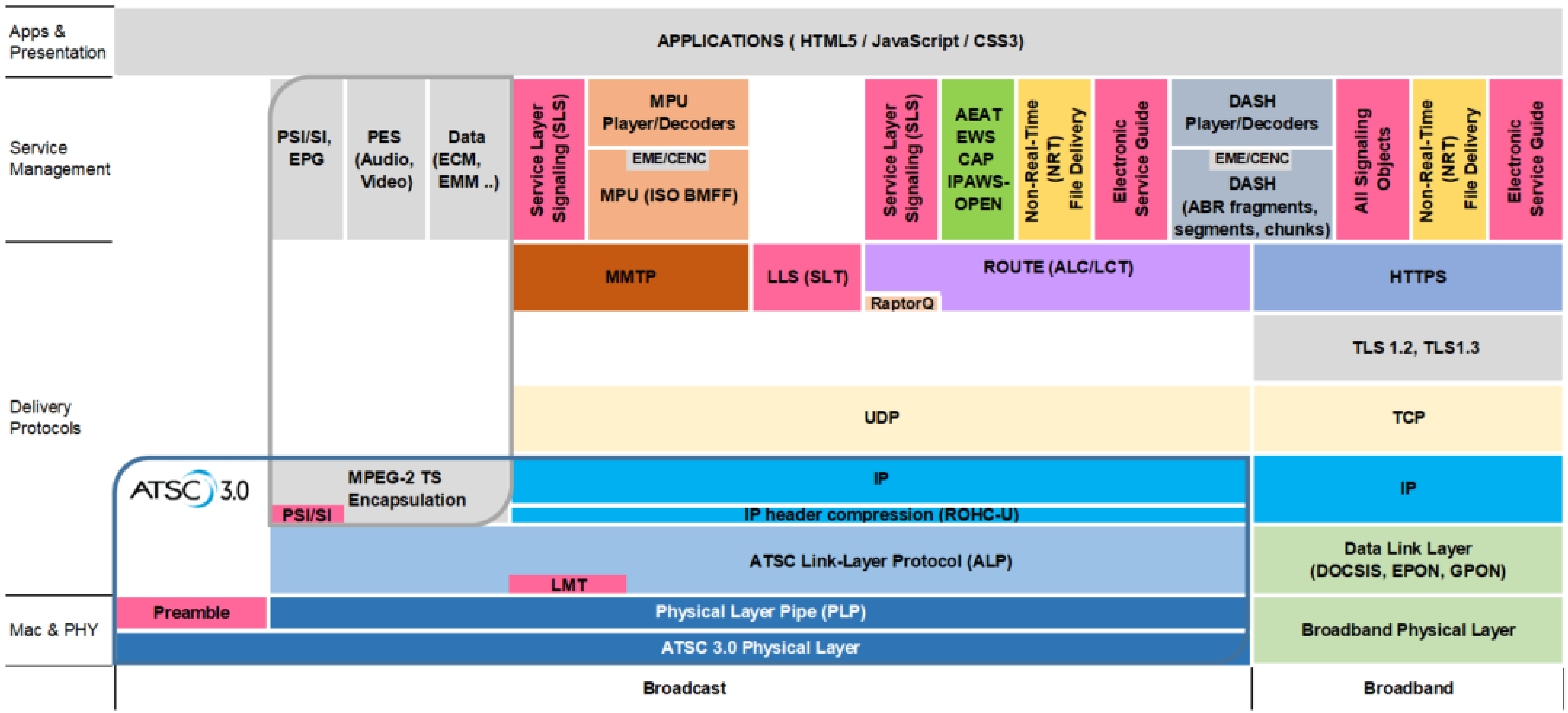
Protocol Stack | OTT Broadcast specification

- OTT Broadcast Profile over DVB-T2 - marked with red frame.
- Same profile applies for DVB-S2X



Protocol Stack | ATSC 3.0 standard

- The new American DTT standard
- ATSC 3.0 Protocol stack (MPEG2 TS is optional in NextGenTV specification)



Protocol Stack | OTT Broadcast profile over 5G Broadcast

- OTT Broadcast Profile over 5G Broadcast - marked with red frame
- In preparation

Protocol | Overview

- Native IP over **GSE**(/ALP/TLV) replacing MPEG-2 transport streams (TS)
- **LL-HLS / DASH-LL** (normal and chunk based for low latency)
- **ROUTE** (Real-time Object delivery over Unidirectional Transport) protocol was developed as a replacement for / the evolution of FLUTE.
- **QUIC** (Quick UDP Internet Connection) for a more modern, reliable and secure transport layer network protocol
- **RLNC** (Random Linear Network Coding) in all cases in order to improve the performance of latency sensitive applications running over both unicast and broadcast links. RLNC unique sliding window encoding and decoding allows better reliability, using less repair, and offering lower latency than legacy FEC codes.
- **TLS1.3** (Transport Layer Security) provides critical latency improvements for connection establishment over previous versions.
- **HTTP/3** third major version of the Hypertext Transfer Protocol

Protocol | Low-Latency HLS

- The newest addition to low latency streaming is an updated specification from Apple, specifying a low latency mode, to the most commonly used HTTP streaming technology, called LL-HLS, which is announced to be supported by Apple's Safari from iOS version 14 (Sep 16th 2020) and macOS 11 (fall 2020) along with support for HTTP/3 using QUIC.
- The HTTP Live Streaming (HLS) protocol delivers live and on-demand content streams. Historically, HLS has favoured stream reliability over latency.
- Low-Latency HLS extends the protocol to enable low-latency video streaming while maintaining scalability. The new low-latency mode lowers video latencies over public networks into the range of standard television broadcasts.
- So far only one applied production reference server with full support for LL-HLS exists. This solution is developed by mediathand.

Protocol | DASH with Low Latency

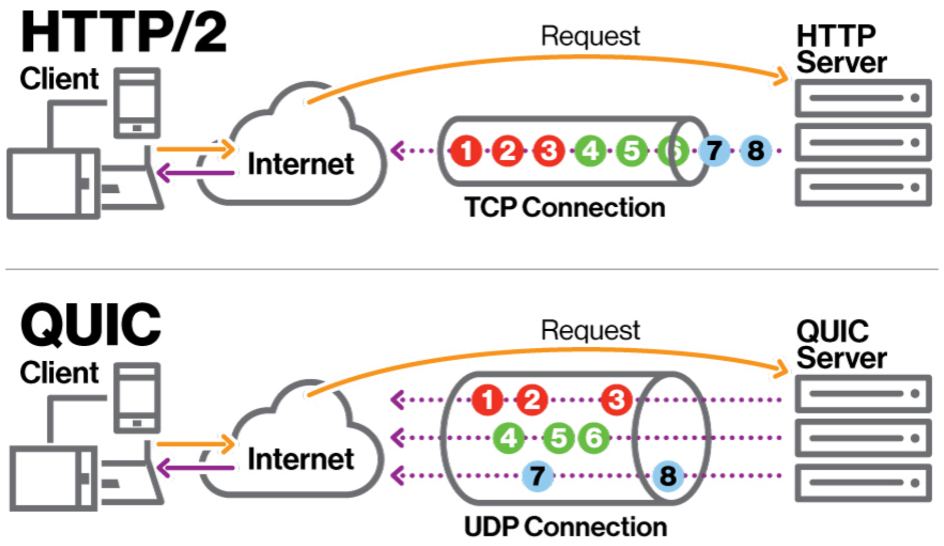
- HTTP Adaptive Streaming is one of the most popular techniques for delivering the audio-video content over IP and the most commonly known standard for low-latency HTTP Adaptive Streaming is DASH Industry Forum’s (DASH-IF) DASH-LL.
- ETSI TS 103 285 V1.3.1 (2020-02) is the latest revision of the DVB-DASH specification for the streaming of DVB services over IP-based networks.
- It addresses the need to reduce the delays experienced when watching live OTT content. The Commercial Requirements for low latency stated that the specification should support an encoder-to-screen latency of 3.5 seconds when used over a high-performance network connection.
- Much of the latency introduced in streaming services is due to the length of the segments used and lack of confidence in the delivery network. Players only start when they have more than one segment buffered and tend to buffer several segments. For low latency, segments are broken into smaller chunks.

Protocol | ROUTE

- ROUTE (Real-time Object delivery over Unidirectional Transport) protocol was developed as a replacement for / the evolution of FLUTE.
- ROUTE enables real-time content delivery supporting all existing use cases for both live and non-real-time (NRT) including ESG.
- DVB MABR DVB Multicast Adaptive Bit Rate – TS 103 769 V1.1.1, Nov 2020 – will allow broadcasters and network operators to work together to optimise IP-based delivery to a large number of receivers simultaneously
  - ROUTE has been adopted in a modified version by the DVB consortium to be one of the protocols supporting DVB mABR architecture. The modified version of ROUTE has a special focus on live linear media streaming applications based on live DASH and especially with support for low-latency live DASH.
  - The mABR reference architecture used in the Copenhagen OTT-B platform is a hybrid of the mABR architecture defined by the DVB consortium combining parts of the ATSC 3.0 A/311 specification.

Protocol | QUIC

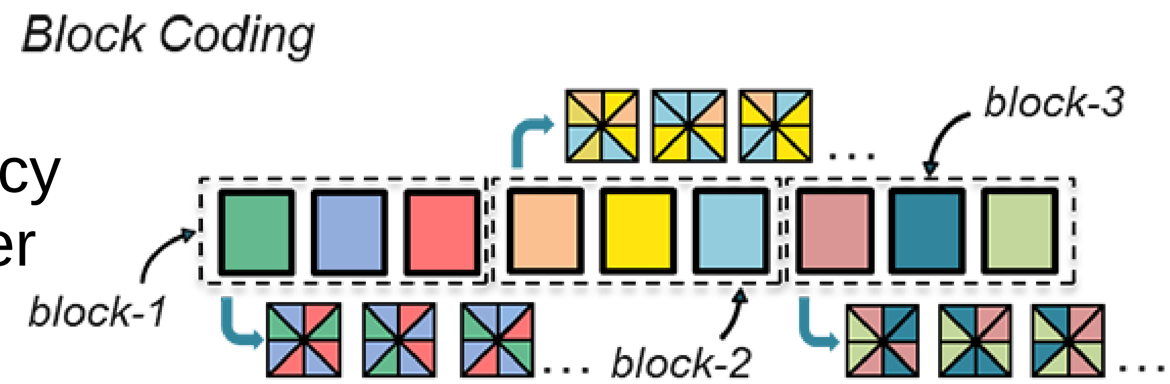
- QUIC (Quick UDP Internet Connection) is a new encrypted transport layer network protocol.
- QUIC was designed to make HTTP traffic more secure, efficient, and faster. Theoretically, QUIC has taken all the best qualities of TCP connections and TLS encryption and implemented it on UDP.
  - Removing the three-way handshake delay created by TCP, QUIC is able to efficiently deliver data to the client and server once the connection is established.
  - QUIC does this by using multiple data streams within a connection so that data can be spread across them. This means that delay or loss of data on one stream does not impact data delivery on another.



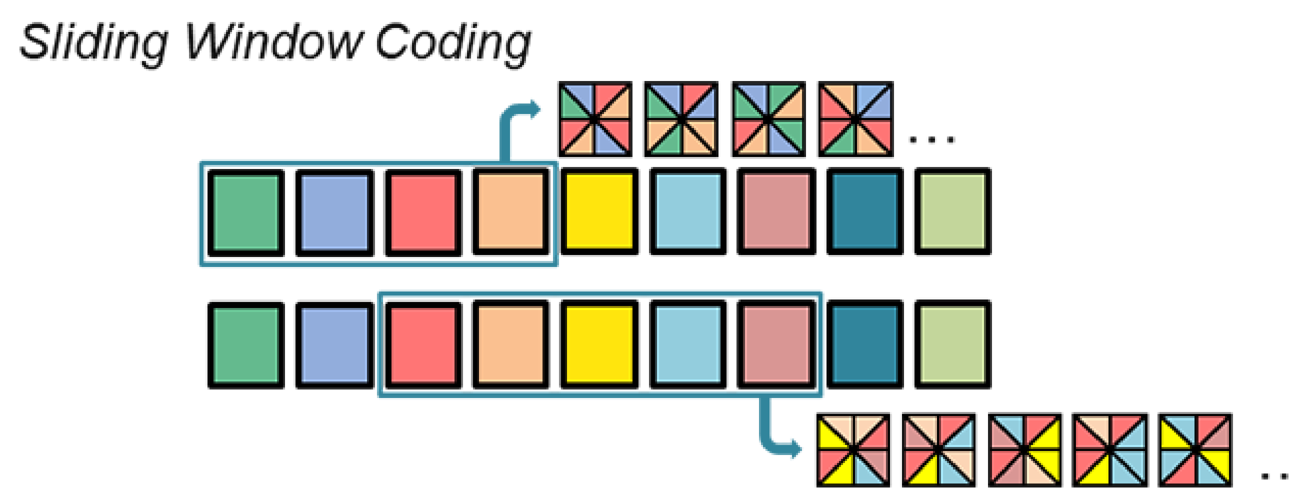
- Google is one of QUIC's leading adopters. It's enabled by default on Google Chrome and Opera 16, Google search, Gmail, Youtube.

Protocol | RLNC (Random Linear Network Coding)

- Random Linear Network Coding (RLNC), in all cases in order to improve the performance of latency sensitive applications running over both unicast and broadcast links.



RLNC unique **sliding window** en**coding** and decoding allows better reliability, using less repair, and offering lower latency than legacy FEC codes.



- In block coding, packet blocks are usually predefined. The illustration shows blocks with a fixed number of packets. RLNC can generate redundancy (i.e., coded packets) from each block independently.

Protocol | RLNC (Random Linear Network Coding)

- Note that, for each block, and contrary to legacy block codes, all packets in a block need not be present for RLNC to start generating useful coded packets. This means that redundancy can be generated before the block is complete. This technique is termed **on-the-fly coding** and allows for removing coding delays at transmit buffers.
- The problem with block codes is their rigidity: blocks do not overlap and are often fixed in size. As a result, packets from a given block cannot be passed to higher layers, (e.g., the application layer), as reliable goodput before a sufficient number of original or coded packets is received. This creates a lower limit in latency and decoding complexity that may affect delay-sensitive applications such as streaming or control.
- RLNC enables a more flexible technique called sliding window coding. Sliding window coding removes the limitation of fixed blocks by creating a variable-sized sliding window. Coded packets associated to a given sliding window position and size can be inserted in the stream.

Protocol | RLNC vs Traditional Codes

- The key differences between RLNC and other, traditional codes are captured in the below table:
- Rateless = fountain codes = Raptor etc, Block codes = R&S, LDPC etc

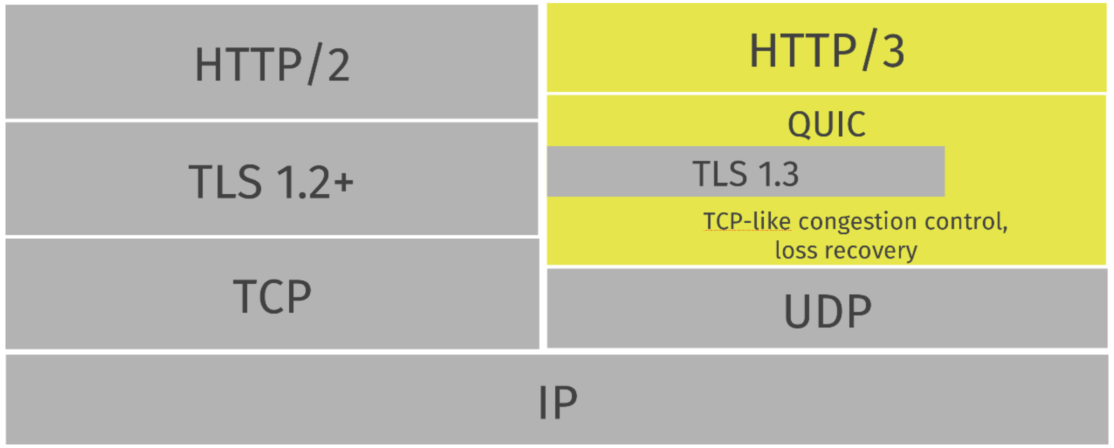
Code Capabilities	RLNC	Rateless Codes	Block Codes	Characteristics/Benefits
Erasure correction	✓	✓	✓	Corrects for missing or corrupted data packets
Code is carried within each packet	✓	✗	✗	Eliminates tracking overhead
Completely distributed operation	✓	✗	✗	Enables stateless management
De-code using both unencoded and coded packets	✓	✗	✗	No forklift upgrade; adds implementation tunability
Able to generate valid codes from coded or unencoded packets	✓	✗	✗	Gradual implementation; no forklift
Composability without decoding (adding incremental redundancy)	✓	✗	✗	Enables addition of redundancy when and where needed
Encode data in a sliding window	✓	✗	✗	Flexible integration with protocols for greater efficiency

Protocol | Enhancing Security with TLS 1.3

- TLS stands for Transport Layer Security.
- TLS provides secure communication between web browsers and servers. The connection itself is secure because symmetric cryptography is used to encrypt the data transmitted. The keys are uniquely generated for each connection and are based on a shared secret negotiated at the beginning of the session, also known as a TLS handshake.
- TLS 1.3 provides critical latency improvements for connection establishment over previous versions. Absent packet loss, most new connections can be established and secured within a single round trip; on subsequent connections between the same client and server, the client can often send application data immediately, that is, using a zero round trip setup.
- TLS 1.3 can acts as a security component of QUIC.

Protocol | HTTP/3

- HTTP/3 is the upcoming third major version of the Hypertext Transfer Protocol used to exchange information on the World Wide Web.
- HTTP/3 uses QUIC, a transport layer network protocol developed where user space congestion control is used over the User Datagram Protocol (UDP), where HTTP/1.1 and HTTP/2 use TCP.



- OTT-B introduce next-generation application protocol HTTP/3 with QUIC as the primary transport protocol in the implementation of the industry leading content delivery architecture mABR based on IP Multicast.
- The solution is designed to operate on a Copenhagen test-bed fully supporting HTTP/3 Server Push techniques for increased health of live streaming buffers and complete end-to-end transport security with TLS 1.3.

Protocol | CAP v1.2 (Common Alerting Protocol)

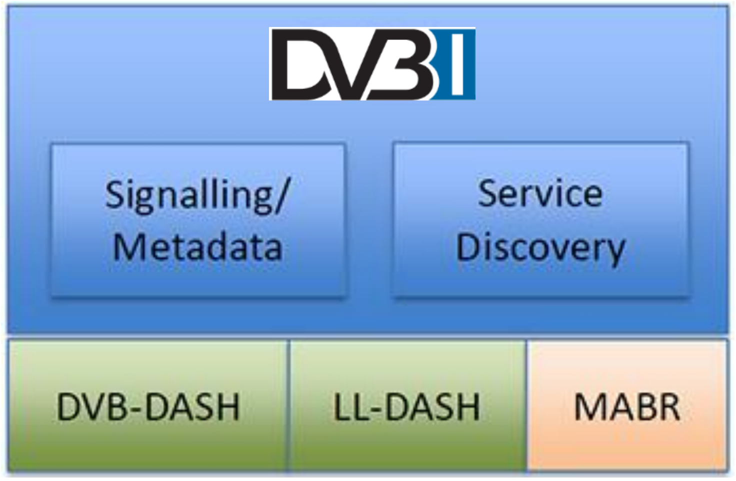
- The Common Alerting Protocol (CAP) is a simple but general format for exchanging all-hazard emergency alerts and public warnings over all kinds of networks.
- CAP allows a consistent warning message to be disseminated simultaneously over many different warning systems, thus increasing warning effectiveness while simplifying the warning task.
- CAP also facilitates the detection of emerging patterns in local warnings of various kinds, such as might indicate an undetected hazard or hostile act. And CAP provides a template for effective warning messages based on best practices identified in academic research and real-world experience.
- Compatible with DVB-EWS, ATSC3.0 AEAS, the AWARN group's work, US IPAWS project and many more initiatives.

JSON - JavaScript Object Notation

- OTT-B is compliant with existing popular smart CE devices like AI assistants (Siri, Google Assistant, Alexa), smart TVs, smartphones (iOS/Android), tablets, STBs (AndroidTV / AppleTV), and caster devices (Chromecast / GoogleCast / Airplay) using a very lightweight reference implementation.
  - Service unification will happen in the cloud transforming DVB-I based services from XML to JSON
  - Part service unification will happen in the cloud and part in the home gateway transforming joining IP based services from XML to JSON
- Service unification will be managed in the cloud, transforming DVB-I XML to OTT-B compliant JSON.
  - The transformation is similar to the DVB-I reference implementation by Sofia Digital, yet they focus on the player part.
- OTT-B specifies an open specification and reference implementation server-side to further transforming services based on OMA-BCAST, TV-A, CAP, AEA, ATSC 3.0 etc. as they are all XML in their foundation.

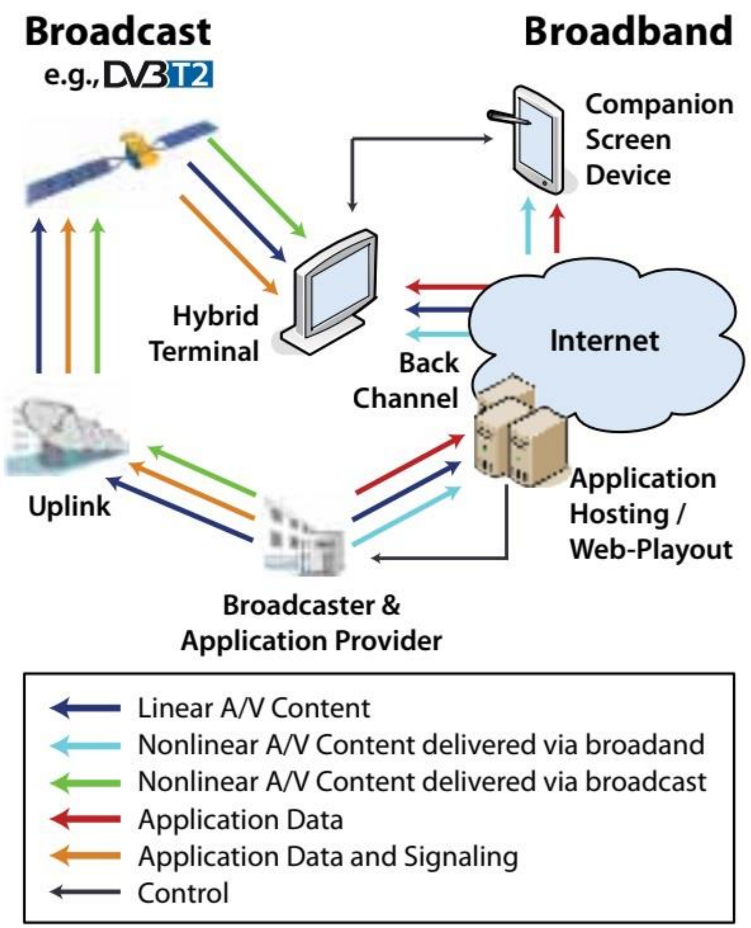
DVB-I Service Discovery & Programme Metadata

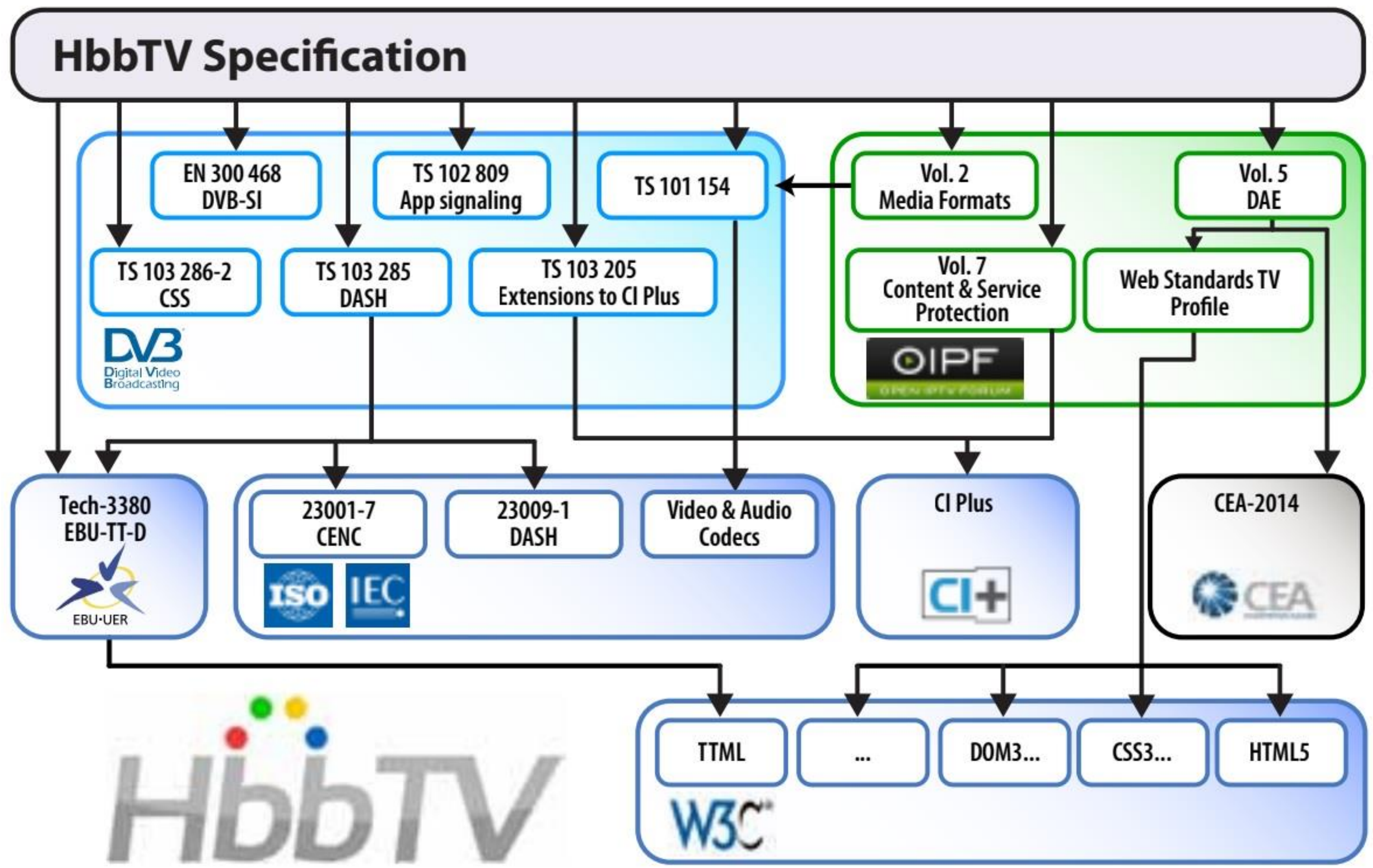
- The DVB-I specification defines a DVB-I Service Lists, a means for IP-connected devices to find curated sets of linear television services that may be delivered through broadband or IP-enabled broadcast mechanisms.
- DVB-I also defines the methods to retrieve electronic programme data for those services, which can be integrated into a single coherent offering that is accessed through a consistent user interface.
- Where both broadband and broadcast connections are available, devices can present an integrated list of services and content – users don't have to know or care whether a service arrives via broadband or broadcast.
- The DVB-I specification;
  ETSI TS 103 770 v1.1.1 (2020-11)



HbbTV | v2.0.2 (T2 107 796 V1.5.1)

- HbbTV aims to deliver both broadcast e.g. DVB-T2, DVB-S2, DVB-C and broadband services through connected TVs and set-top boxes. As an open standard, HbbTV reaches viewers across different platforms.





HbbTV | Privileged OpApp

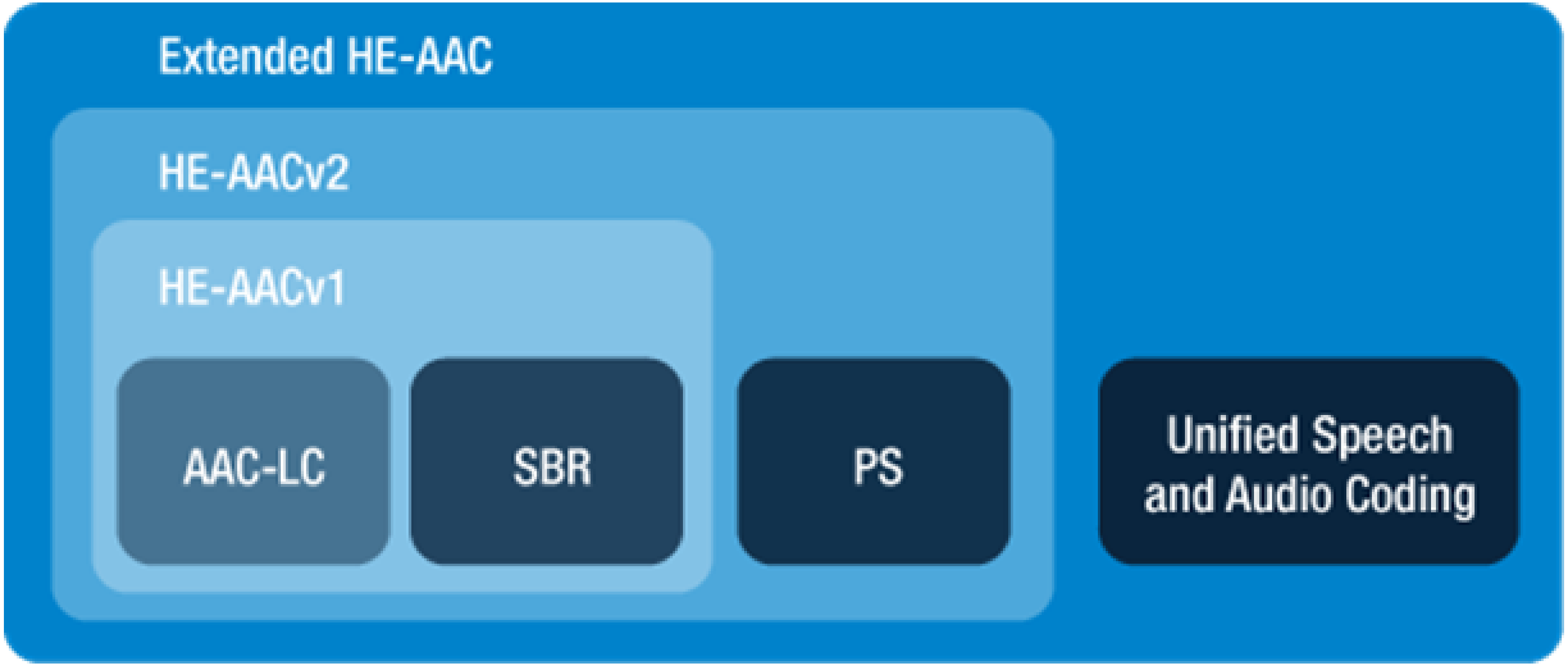
- Runs directly on a TV
- Replaces some of the UI, providing a branded Operator experience. Can, e.g., use P+/P- to change channels; display channel change banners
- Assumes a bilateral agreement between Operator and TV maker
- Understood to act as a “Source”
  - Like any other Source that could provide TV channels (e.g., Cable, Sat or HDMI)
  - May persist over a power cycle – turn on the TV and you’re in the App again.
- Can easily integrate live TV with on-demand offerings, like an STB would
- Supports IP multicast if the TV does

HbbTV | Operator-Specific OpApp

- Intended for “non-initialised”, white-label STBs
- Replaces (virtually) all of the UI on the STB to “instantiate” that STB for a particular Operator
- Like “Privileged”, assumes a bilateral agreement
- Close to Privileged; differences are in access to more settings and controls. And OpApp is responsible for everything that happens on the box

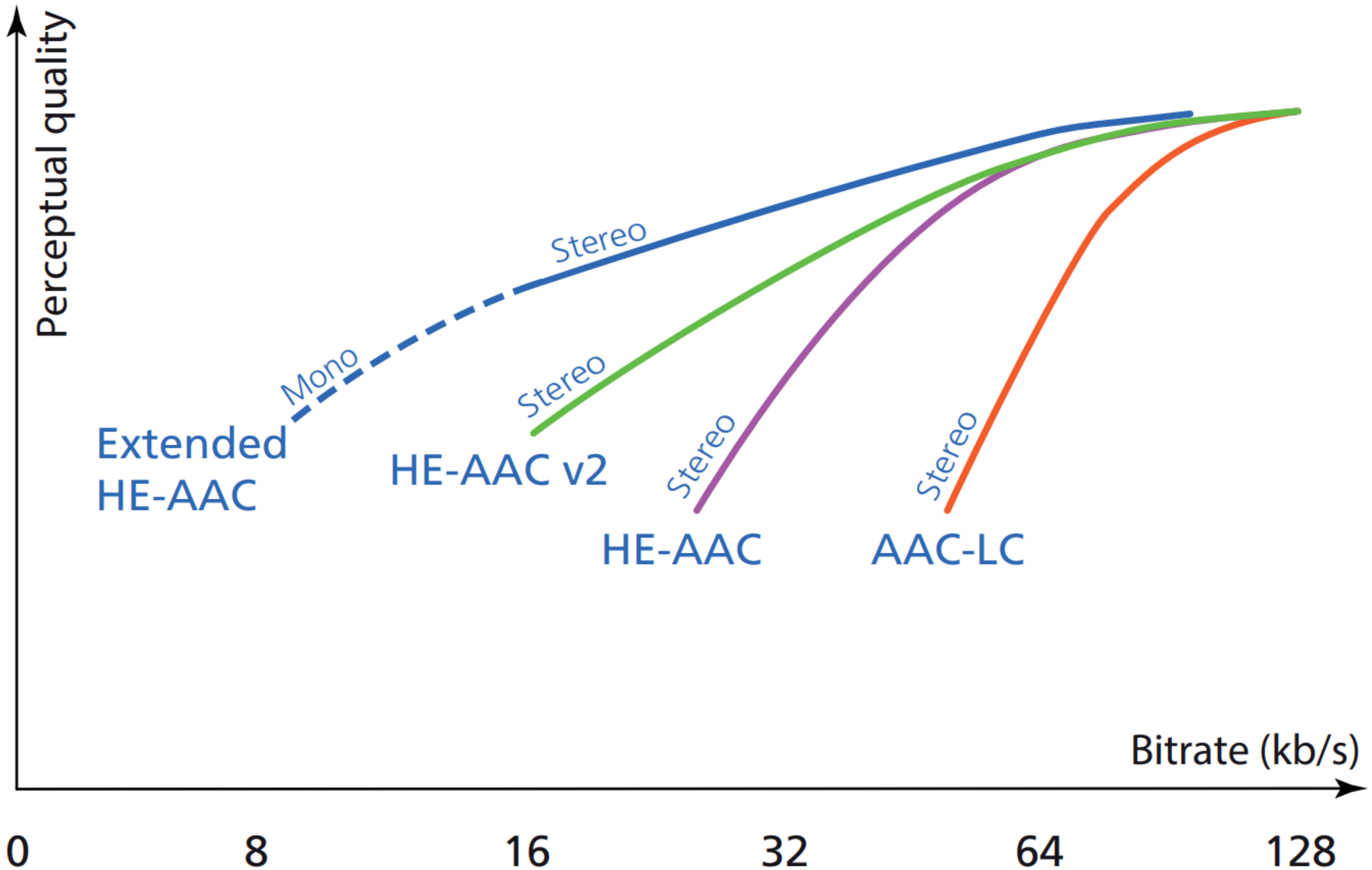
Codec | Digital Radio – xHE AAC Audio Codec

- The new Extended HE-AAC (xHE-AAC) audio codec, which combines HE-AACv2, and Unified Speech and Audio Coding (USAC).



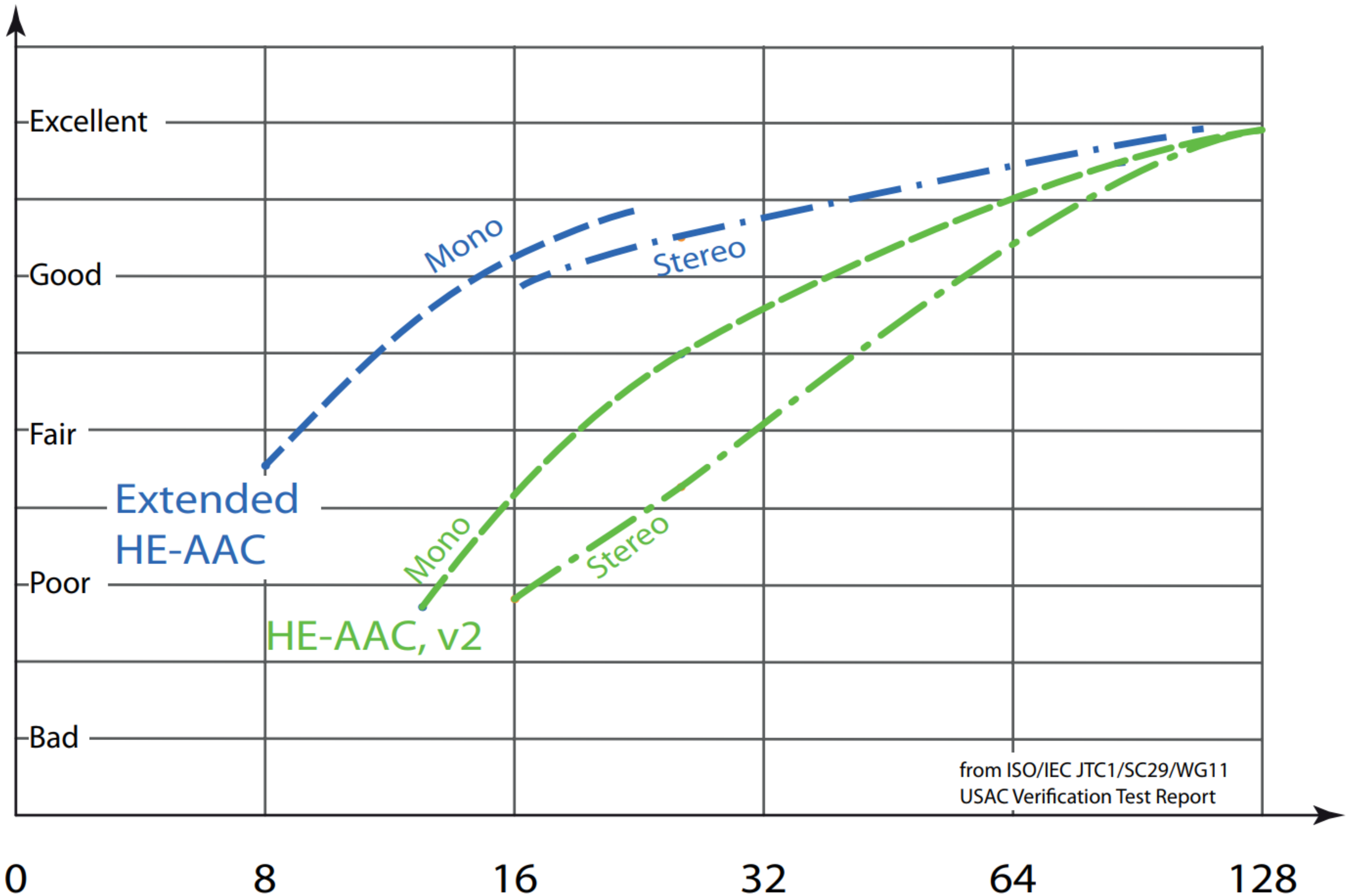
Codec | Digital Radio – Perceived Audio Quality

- Extended HE-AAC – Bridging the gap between speech and audio coding



Codec | Digital Radio – Speech Perceived Quality

- Extended HE-AAC – Bridging the gap between speech and audio coding



Codec | Video codec

- H.264, HEVC, AV1, and VVC

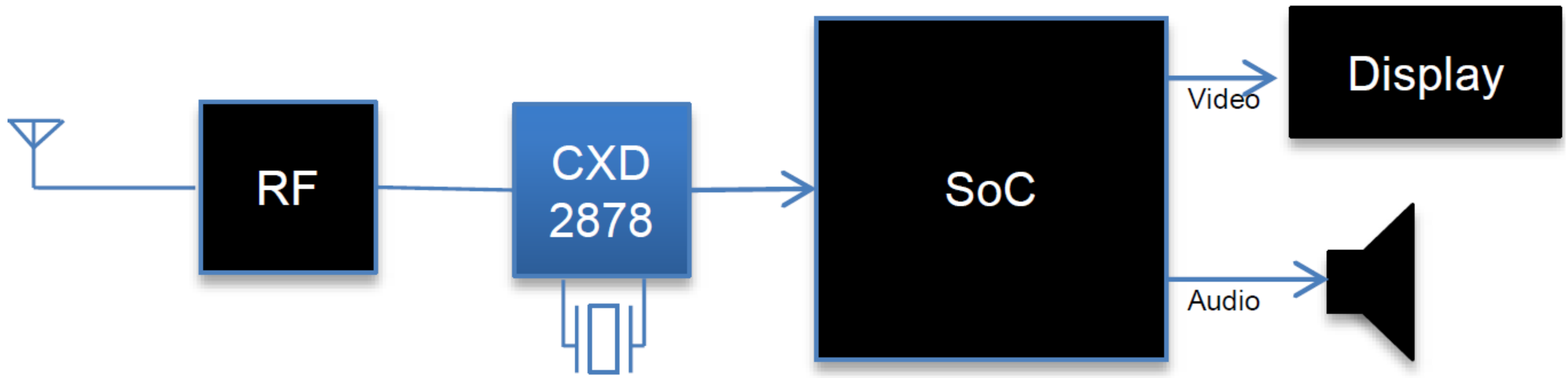
	H.264 MPEG-4/AVC	H.265 High Efficiency Video Coding	AV1	VVC
Licensing	Easy	Complex	Royalty Free	Not Defined
Deployment	2006	2014	2020	2020+
Deployed Devices	>10Billion	>2Billion	NA	NA
Live Deployment Environment	Appliance SW Cloud	Appliance SW Cloud	Cloud	Cloud

Codec | AV1 video codec

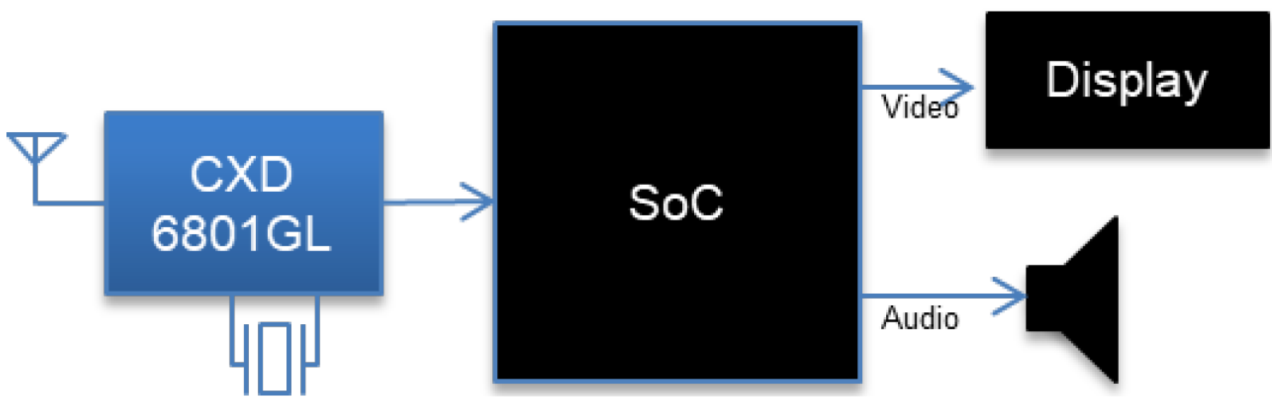
- AOMedia Video 1 (AV1) is an open, royalty-free video coding format designed for video transmissions over the Internet.
- AV1 is 30% better than H.265

Chip | Low cost Sony chip solution for DTT

- Sony CXD2878 demodulator (LSI)
  - support **ATSC3.0**/1.0 & **DVB-T2**/T/C2/C/S2/S, ISDB-T/C-S, J.83A/B/C, J.382

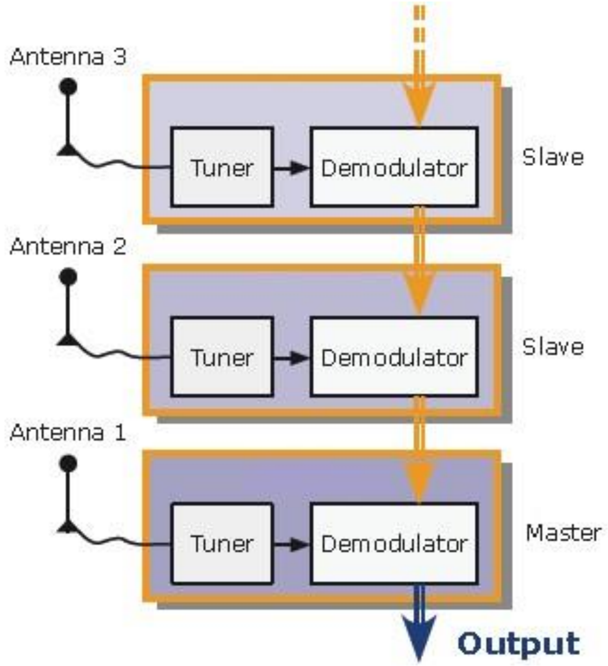


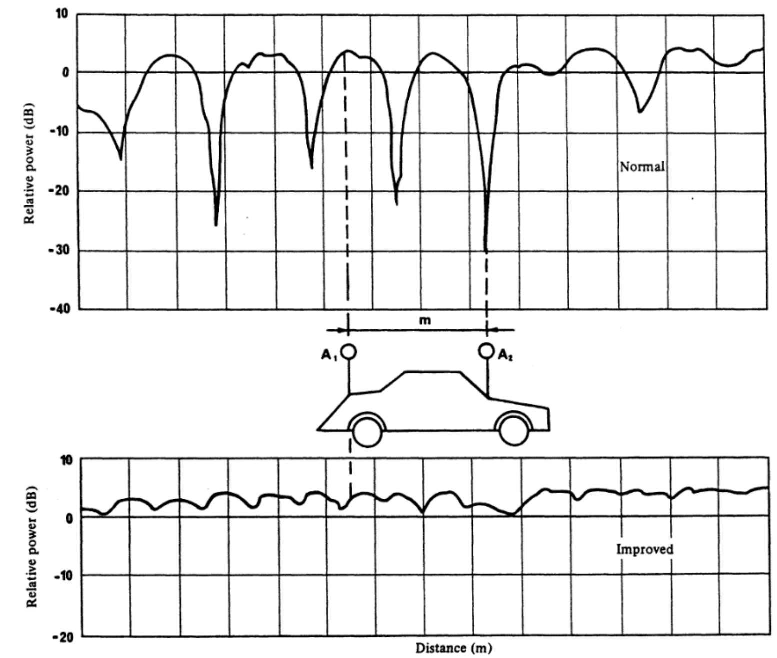
- CXD6801GL is a Tuner One Package IC integrated RF tuner and demodulator
  - support **ATSC3.0**/1.0 & **DVB-T2**/T/C2/C, ISDB-T/C, J.83A/B/C



ATSC 3.0 DVB T2

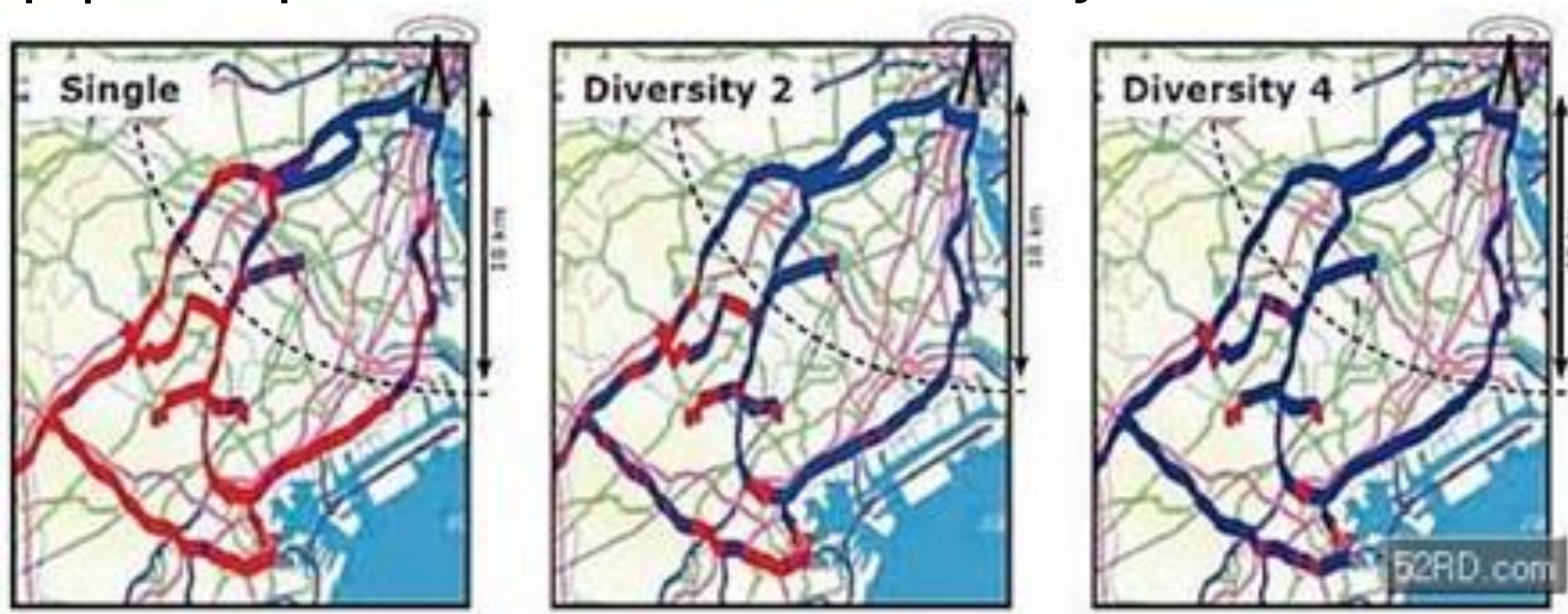
Chip | Reception Mode - MRC diversity





- MRC Diversity increases sensitivity that could triple the coverage area and offers better indoor reception. It also improves Doppler Effect handling (reception at higher speed).
- It is especially useful where robust reception can be very difficult to achieve.

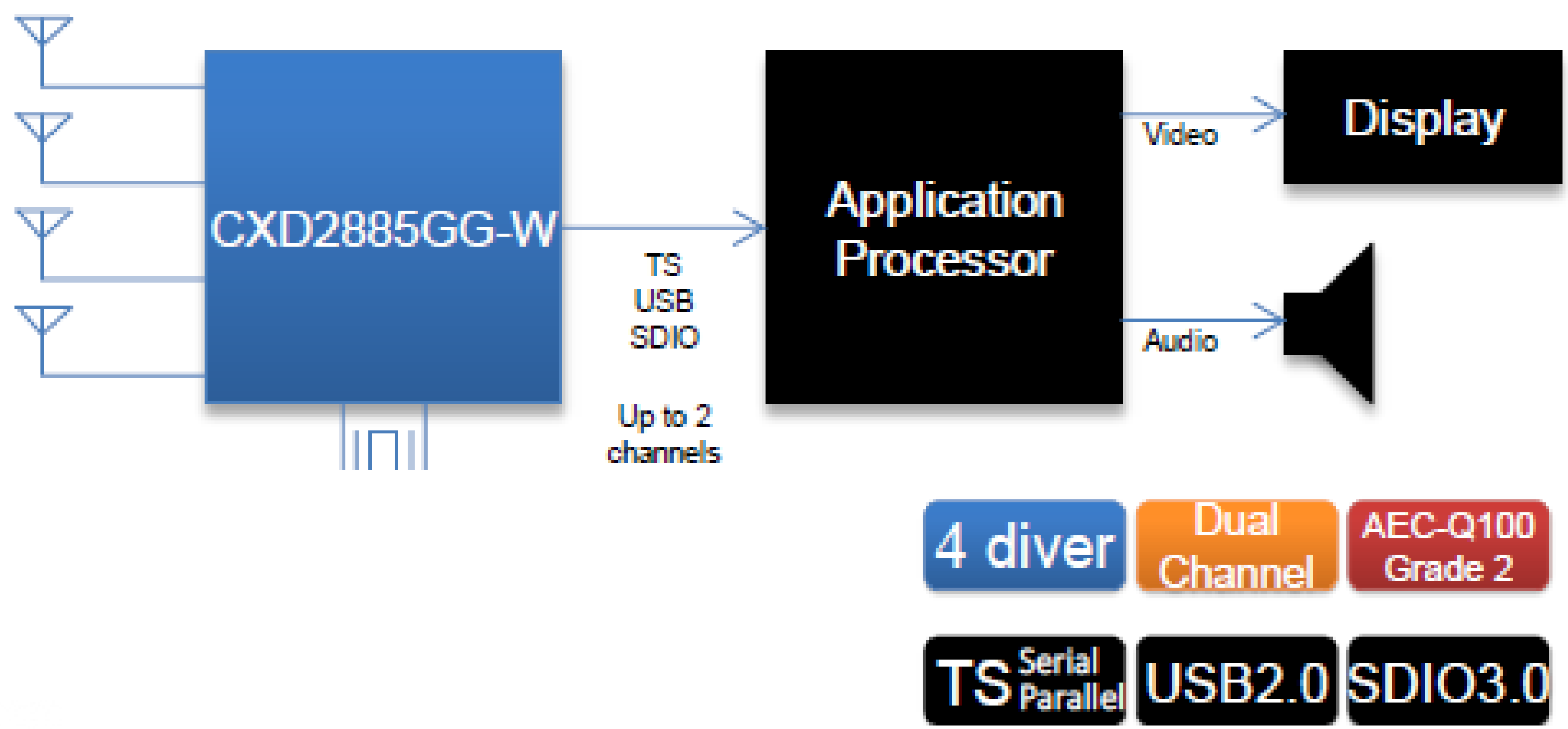
Chip | Reception Mode - MRC diversity-2



- According to Faurecia Automotive, a two-antenna MRC system can achieve a sensitivity improvement (increase in SNR) of up to 3 to 8 dB.
  - › If channels are fully correlated the sensitivity gain is always equal to 3 dB.
  - › If channels are fully uncorrelated, then the sensitivity gain in the car will be at the order of ~4½ - 6 dB for time interleaver standards as DVB-T2.

Chip | Sony Automotive TV Tuner Device

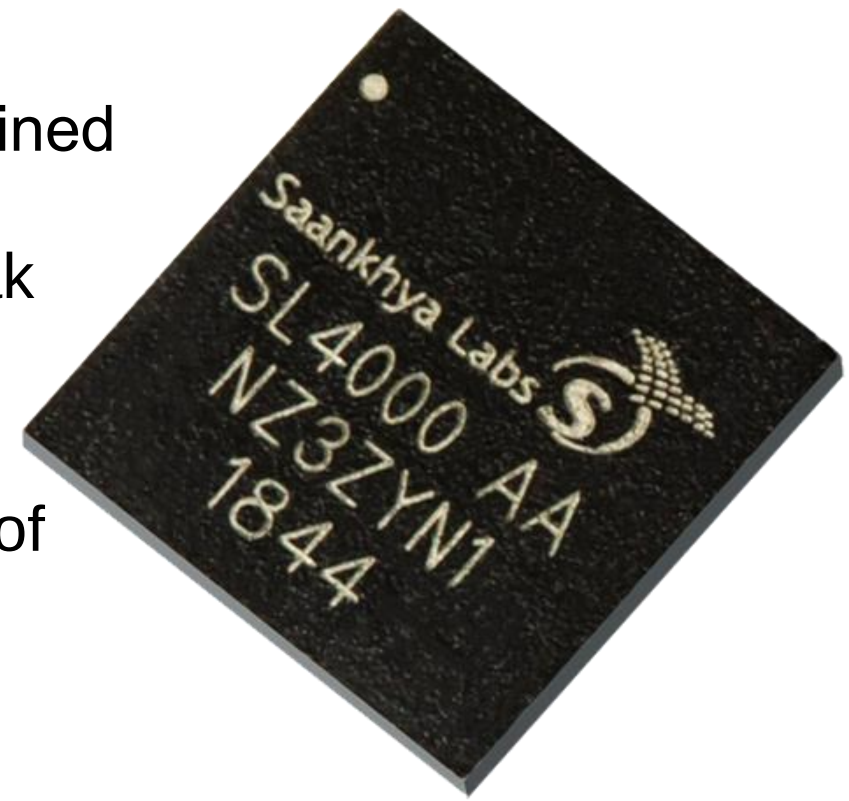
- Sony CXD2885GG-W is a high performance 4-diversity MRC multi-standard tuner LSI suitable for world wide applications. The latest ATSC3.0 demodulation algorithms are incorporated in an optimized single package, low bill of materials solution. AEC-Q100 is applied to the reliability tests.
  - support **ATSC3.0**, **DVB-T2/-T** & ISDB-T



2019

Chip | New One-chip SDR solution for mobile device

- Saankhya Labs' SL4000, is a compact multi standard Mobile DTV for reception of live TV on handheld devices.
- The single chip solution simplifies the front-end design and reduces the Bill of Materials (BOM) by integrating the UHF RF tuner, crystal, baseband DTV demodulator (**ATSC 3.0** & **DVB-T2**/-T etc.), FEC decoder, de-interleaver memory and Analog to Digital Converter (ADC).
- Leveraging Saankhya Labs' proven Software Defined Radio (SDR) architecture SL4000 achieves clear reception without the annoying picture/audio break ups in high speed trains or in skyscraper cities.
- SL4000 also supports also ATSC 3.0 Advanced Emergency Alert to aid and assist in deployment of Advanced Warning and Response network infrastructure across the world.



Receiver | New DTT smartphone reference design

- First reference design ATSC 3.0 smartphone based on the Qualcomm Snapdragon 665 chip, as well as a mid-range smartphone that will work on the AT&T and T-Mobile networks in the US.
- Sinclair has through its subsidiary ONE Media, been working with Saankhya Labs to develop the compact multi standard Mobile DTV Receiver SL4000.
- The ATSC 3.0 smartphone, built by Borqs Technologies has an embedded UHF broadcast antenna and receiver along with all the features of a mid-range phone.
- Sinclair will initially sell the phones for around $150.

Thanks!

@WenzelKenneth

#DVBT2 #T2Lite #ATSC3.0

#5GBroadcast

#Digitalradio #DRM+

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About | Kenneth Wenzel

Kenneth Wenzel is an independent consultant who provide advice and training worldwide to a wide range of Network operators, Broadcasters and Public authorities - Covering DVB-T2, ASTC 3.0, 5G Broadcast & DRM standards, Network planning, Network design, Network architecture and Measurements, Acquisition and Installation.

In addition, Kenneth Wenzel is also the senior project manager and director of Open Channel, which is an independent Danish DTT network operator, where he and his team are performing tests and operating terrestrial digital radio & TV in Greater Copenhagen since 2006 in collaboration with the broadcast industry.

Kenneth Wenzel is the editor/manager of the DVB-T2, ATSC 3.0 & 5G Broadcast group on LinkedIn.

He is an innovator and entrepreneur in the digital radio & TV space, working with new technologies. Testing, developing and operating on the forefront of DRM+, DVB-T2 as well as related platforms such as ATSC 3.0, WiMAX and LTE/5G/5G broadcast.

Kenneth Wenzel holds a Master of Science in Engineering (M.Sc. Eng.) from The Technical University of Denmark (DTU). He has also studied in France. One-year high school and a year at the Ecole Centrale Paris, a French grand école in engineering and science.