June 2018 @qualcomm_tech

Qualcomm

enTV Rel-14: A Transport System for Next Generation Broadcaster Services

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OUTLINE

Qualcomm Perspective

Problems and Challenges

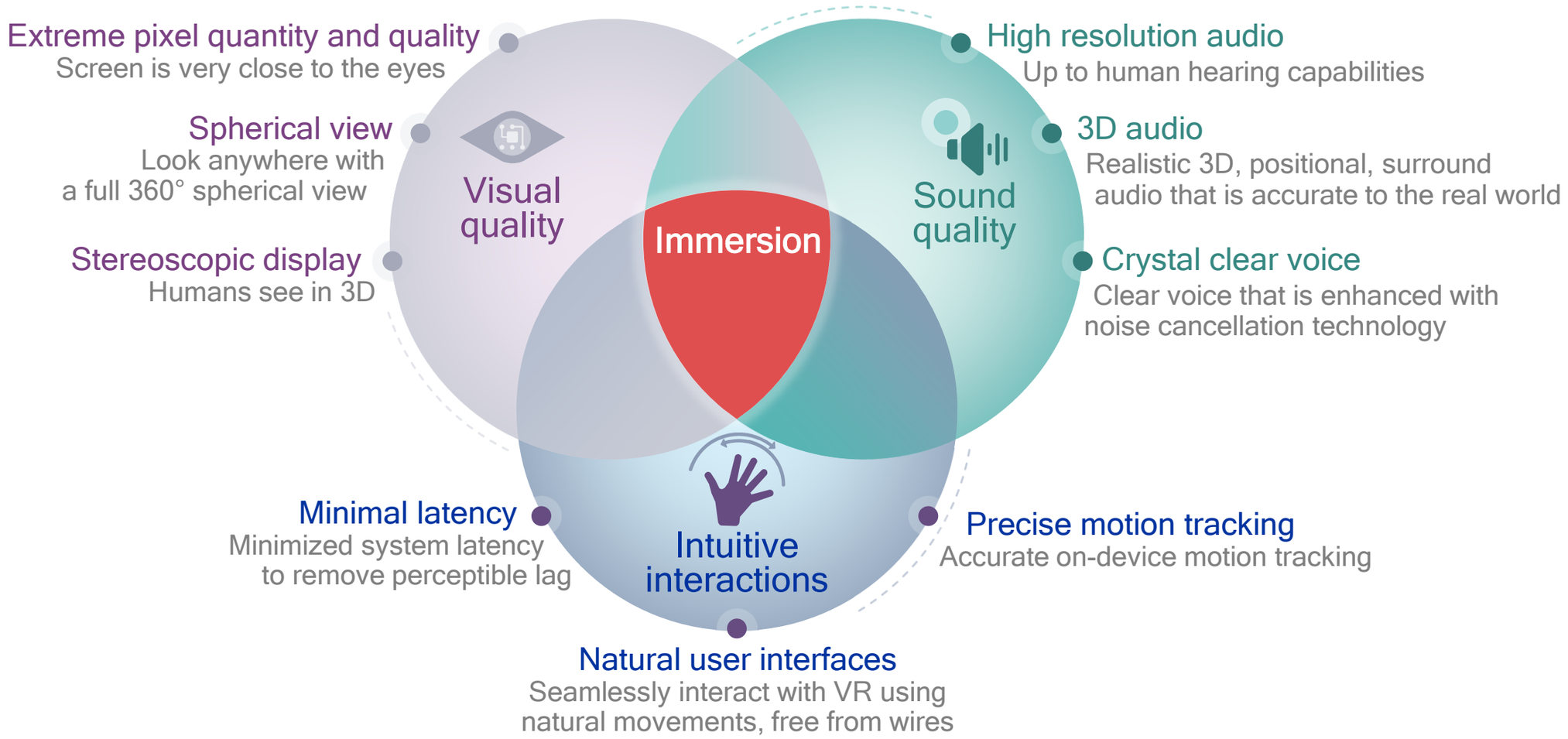
Standardisation efforts

- 3GPP enTV
- Outside 3GPP:
  - DASH-IF
  - Low-Latency DASH
  - CMAF and CTA WAVE
  - DVB-I

Summary

We want to immerse you

Immersion is enabled by different components that work together



Learn more about our vision for the future of VR: www.qualcomm.com/VR

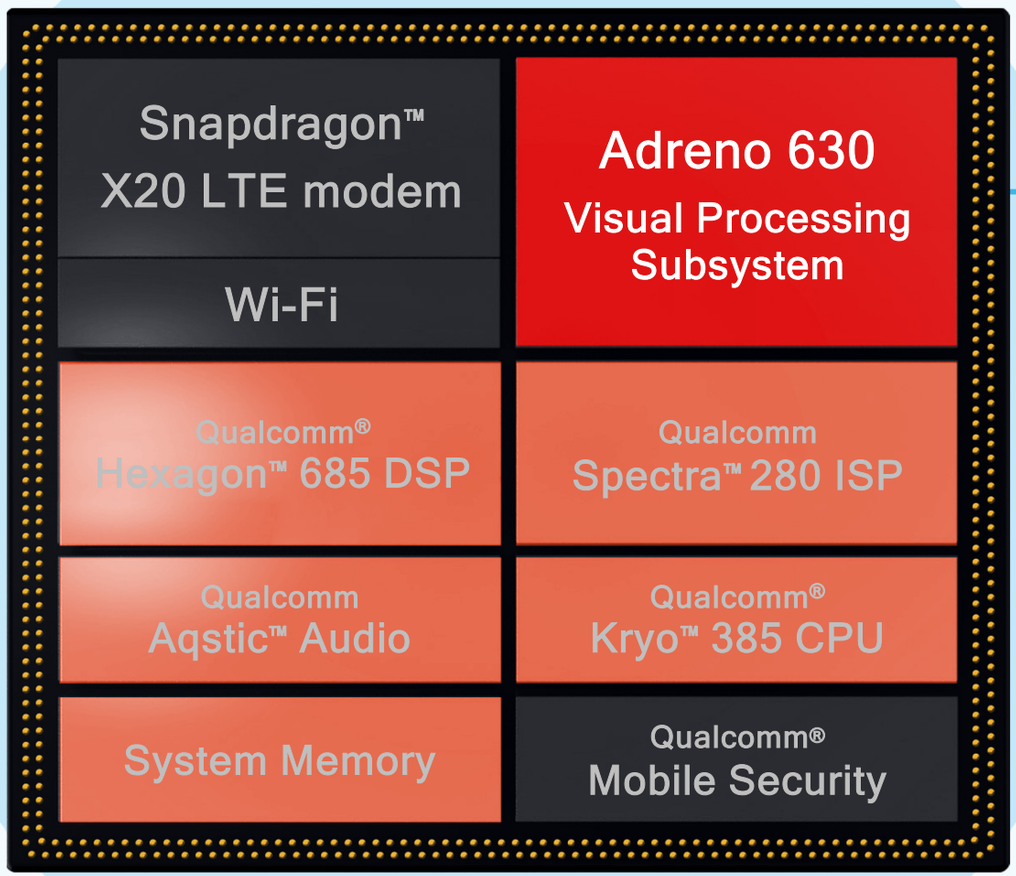
Snapdragon 845

Multimedia/XR/AR

Computer vision, image processing, sensor processing, graphics, video processing, location, and cloud interaction

Benefits

- Integrated and optimized
- Enhanced battery life
- Thermal efficiency
- Standardized implementation
- Mass market cost
- Variety of use cases and industry support



Entire SoC is used!

Peak Download Speed: 1.2 Gbps

Peak Upload Speed: 150 Mbps

Ultra HD Premium video playback and encoding @ 4K (3840x2160) 60fps, 10bit HDR, Rec 2020 color gamut

eXtended Reality (XR)

Sensors

Qualcomm® Snapdragon™ Neural Processing Engine (NPE) SDK

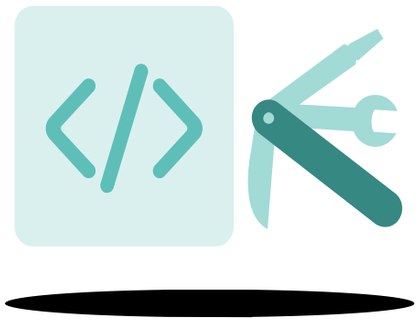
*Compared to Snapdragon 835

Supporting Tangible Efforts

Qualcomm® Snapdragon™ 835/845 Mobile Multimedia/XR Platform

Snapdragon 835/845

Purpose-built mobile processor for superior XR experiences

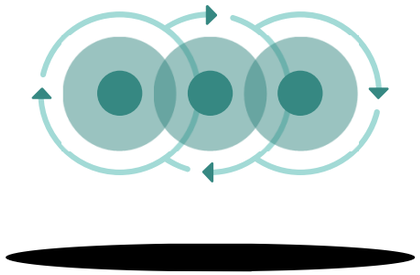


Snapdragon XR SDK

Easy developer access to Snapdragon accelerated XR libraries that simplify application development

HMD Accelerator Program

Reference designs, working with ODMs and technical support to commercialize XR HMDs quickly



Platform and Ecosystem support

Working with multiple content, technology and platform companies
Standardization

SOME PROBLEMS AND CHALLENGES

Replicating and maintaining existing linear TV Broadcast Services

Enabling broadcast-grade linear TV service on the Internet

Making media more interactive and immersive

Enabling monetization of media services

Making services accessible on many different devices and platforms

Ensuring an end-to-end work flow with all enablers in place

Proprietary services vs. standardized approach – how many standards do you need?

Approaches:

- Standardization
- Identifying commercial Demand
- Global efforts and standards
- End-to-end workflows and ecosystems
- Supporting implementations by test, trials, open source, conformance and reference tools

eMBMS

Since Rel-9
(MBMS since Rel-6)

MBMS/LTE eMBMS/enTV History

Building upon a strong 3GPP technology foundation

3GPP Rel-14 (completed)

eMBMS defined for LTE starting in Rel-8/Rel-9[1], improving coverage and efficiency

eMBMS enhancements in Rel-12 include MOOD[2] and expansion to MCPTT[3]

Enabling terrestrial broadcast and expanding to new services; Meeting 7/10 5G Broadcast requirements[4] in Rel-14

Target market focused on Cellular operators

Target market expanded to Broadcasters

Rel-14 enTV

Completed in June 2017

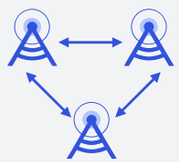
Terrestrial broadcast for next-gen digital TV delivery

enTV[1] – part of 3GPP Rel-14 – meets terrestrial TV broadcast requirements

Radio access enhancements

Longer range

New 1-symbol numerology with longer 200us CP[2] to support 15 km ISD[3]



More broadcast capacity

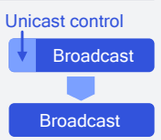
Supports dedicated broadcast network with 100% eMBMS carrier allocation

More deployment flexibility

Single network for mobile and fixed devices with enhanced support for rooftop reception

Better efficiency

New subframe design reduces overhead in dedicated broadcast transmissions



Rel-14 enTV

System layer enhancements

Receive only mode

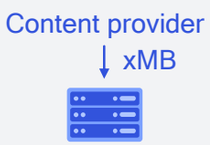
Delivery of free-to-air content to devices without SIM/service subscription

Transport only service

TV broadcasters can deliver content in native format without transcoding

Standardized interface

Content providers can deliver media over LTE with a unified framework



Shared broadcast

Multiple operators can serve users on a common broadcast carrier

System architecture

MBMS Architecture Enhancements for TV service in Rel-14

Optimized resource utilization, new service types, new device modes, open external interfaces

Standardized xMB interface towards the (TV) content provider

- Unified framework for service type negotiations and agreements with content providers
- Enable dynamic service/session establishment
- Extendable to other types of content and content providers (V2X etc.)

Transport-only service

- Provide pass-through MBMS bearer service type
- Enable TV broadcasters to provide the content via MBMS in the native format without transcoding
- Simple receiver design
- Use MBMS network as common delivery platform for different content types and services

Receive Only mode, Receive Only mode with independent unicast

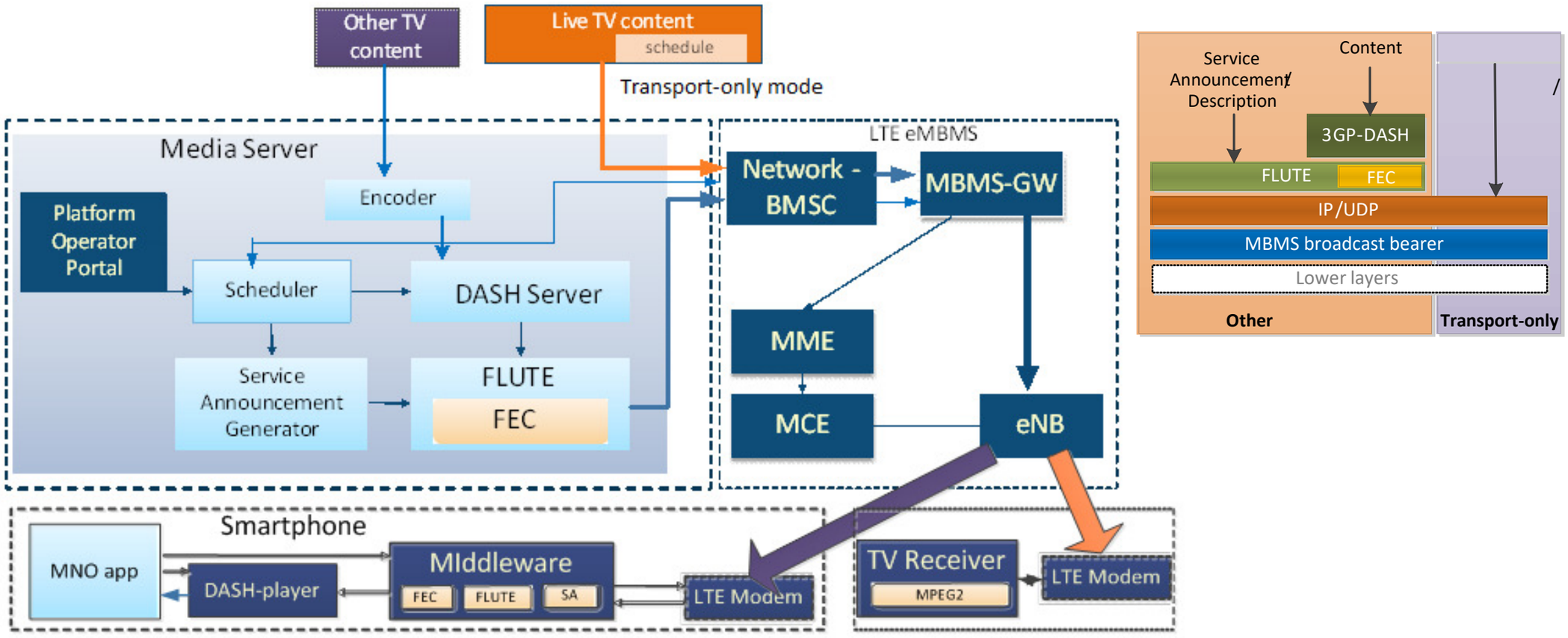
- Receive Only mode: enable devices without SIM card or 3GPP subscription
- Expand the reach of MBMS into traditional TV receivers
- Enable Free-to-Air content broadcast over MBMS
- Receive Only mode with independent unicast: enable interactive services feeding off of TV live broadcast
- Opportunity for more cost-effective data plans for mobile TV (bundled plans)

Shared MBMS Broadcast

- Operators can aggregate their MBMS networks into a shared MBMS content distribution platform
- Avoid broadcasting the same content at the same time over different networks
- Improve coverage, bandwidth efficiency

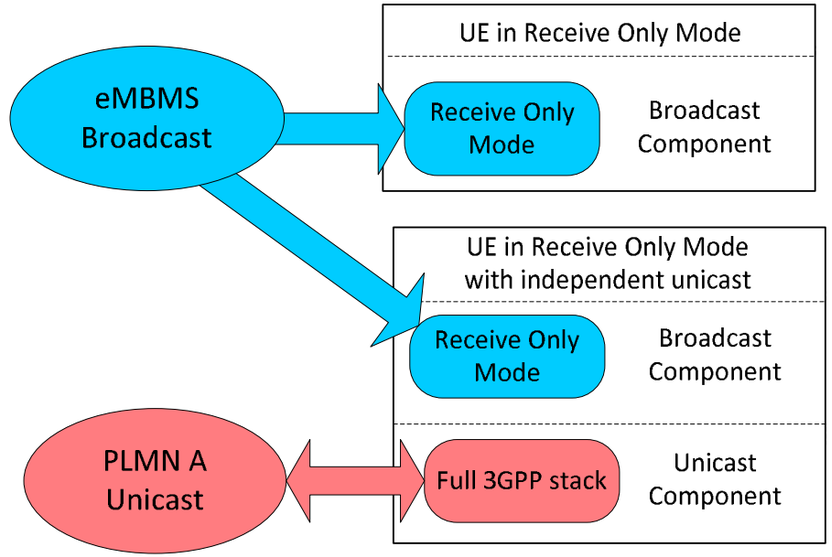
Transport-only service type

3GPP MBMS network as common content delivery platform



Transport-only mode provides pass-through MBMS bearer

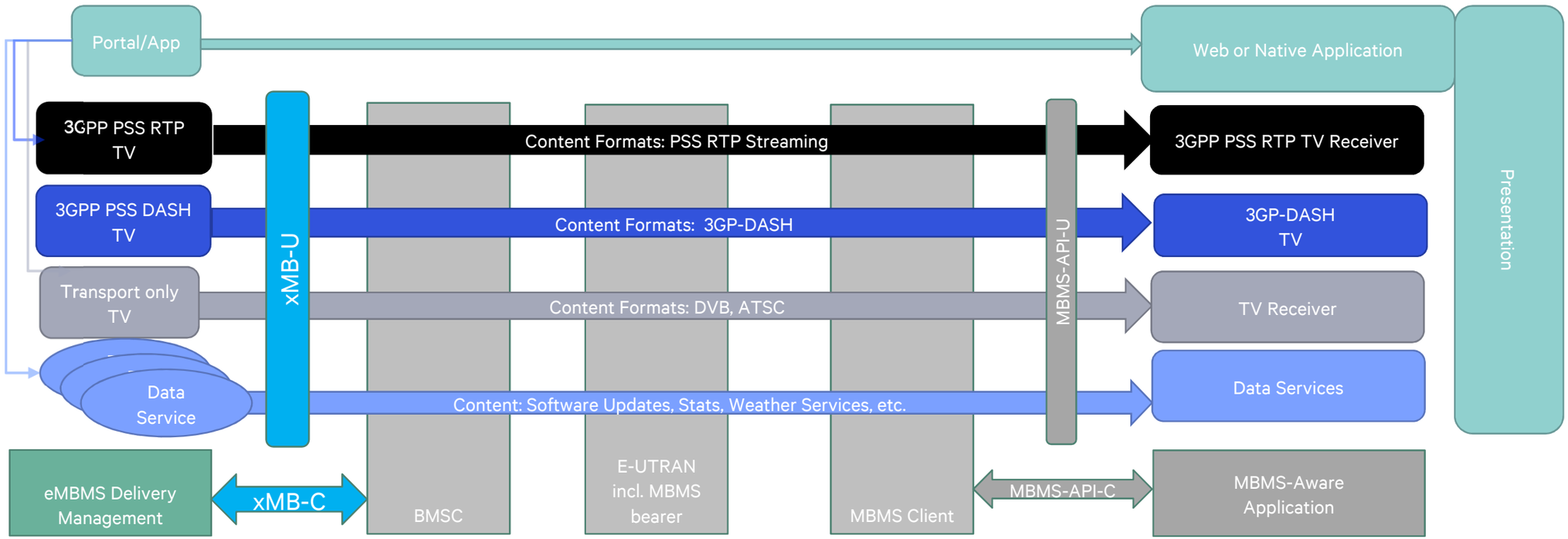
Receive Only Mode



- ROM device:
  - No subscription, does not need USIM, no registration, anonymous reception
  - Only capable of MBMS reception
  - Equivalent to legacy TV receiver
  - Enables Free-to-Air TV services
- ROM with independent unicast
  - Enables wide range of interactive/hybrid services
- Features
  - From the content provider point of view, it is one device (with two modes of operation)
  - From the network operator point of view, it is two independent devices
  - ROM service is broadcast on the reserved range of TMGI

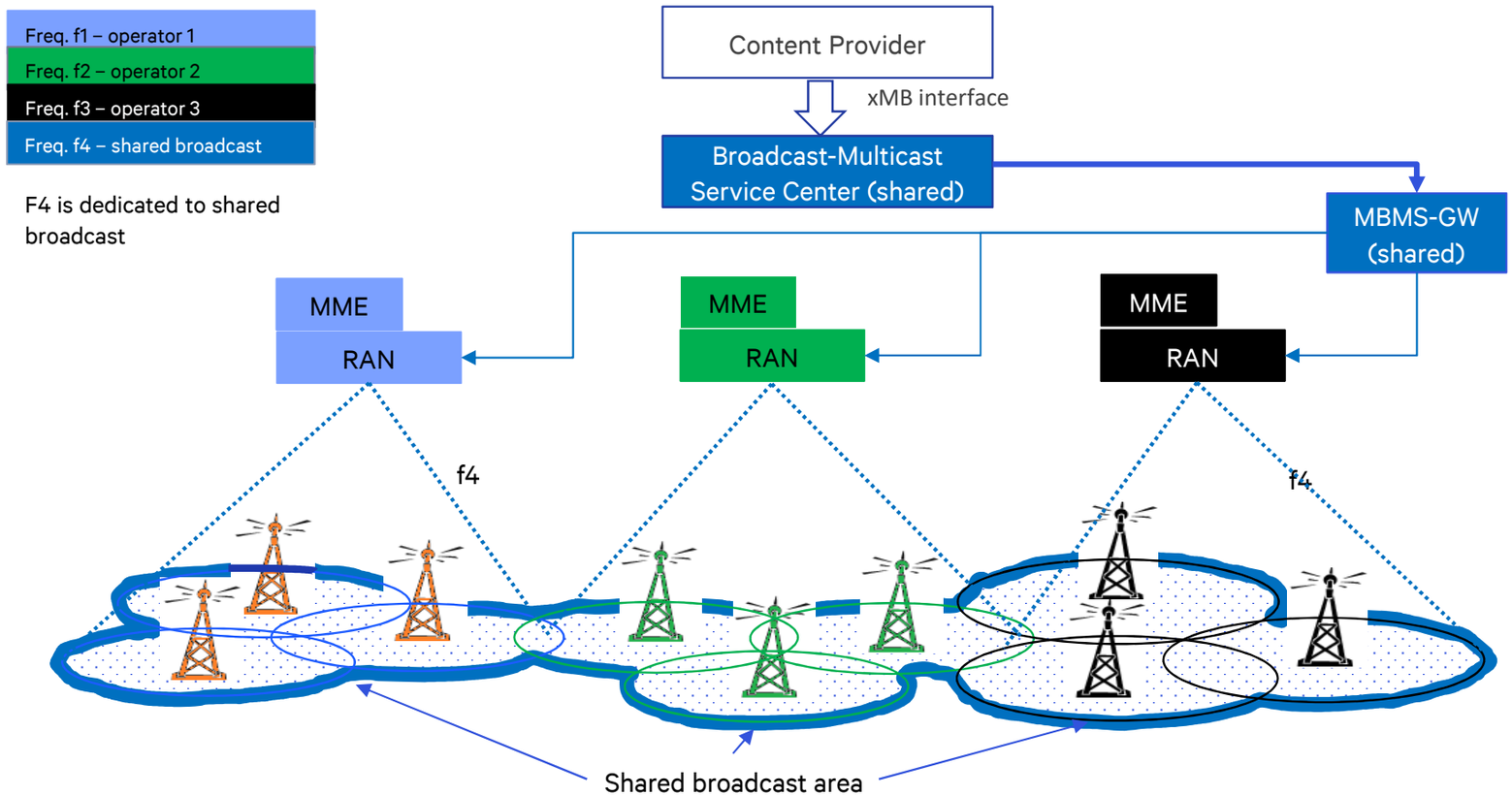
ROM devices, ROM devices with independent unicast

Standardized xMB interface towards content provider



- xMB interface is a RESTful API providing a unified framework for dynamic service/session type negotiation and establishment
- Offers various session types (application, streaming, file transfer, transport-only)

Shared MBMS Broadcast



Shared MBMS broadcast allows operators to pool their MBMS broadcast resources to improve coverage and bandwidth efficiency

3GPP upper layer references (Release 14)

- 3GPP TS 23.246 MBMS Architecture (Annex D and Annex E)
- 3GPP TS 26.346 MBMS Protocols and Codecs
- 3GPP TS 26.347 MBMS APIs and URL
- 3GPP TS 29.116 xMB Interface
- 3GPP TS 24.117 TV Service Configuration Management Object
- 3GPP TS 24.116 Stage 3 aspects of MBMS service for Receive Only Mode
- 3GPP TR26.917: 3GPP-based TV Services

Radio access

Radio Access Enhancements for MBMS in Release 14

Support of new deployment and device types, and dedicated broadcast carrier

Support of larger inter-site distance

- Larger cyclic prefix (**200us**) designed to cover 15km ISD.
- Target spectral efficiency of **2bps/Hz** with rooftop antennas.
- Introduction of an intermediate numerology with **33us** CP.

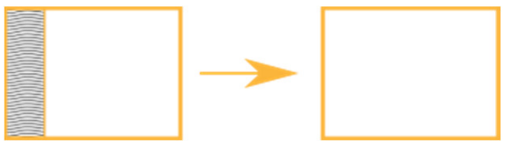
Dedicated or mixed MBMS carrier

- **Mixed unicast/broadcast** from same carrier.
- Up to **100% MBMS allocation.**
- **Self-contained** system information and sync signals for dedicated carrier.

Different types of devices

- Enhanced support for **rooftop reception, handheld devices and car-mounted antenna.**
- Multiple numerologies (15kHz, 7.5kHz and 1.25kHz) designed for different deployment/mobility scenarios

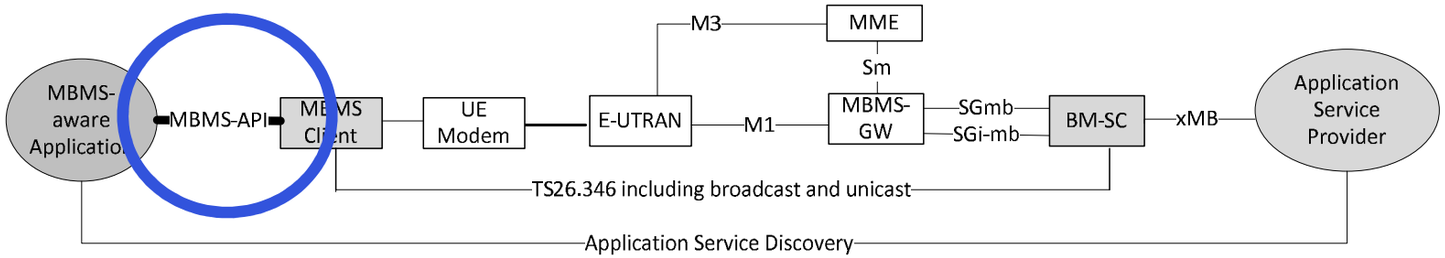
New subframe type

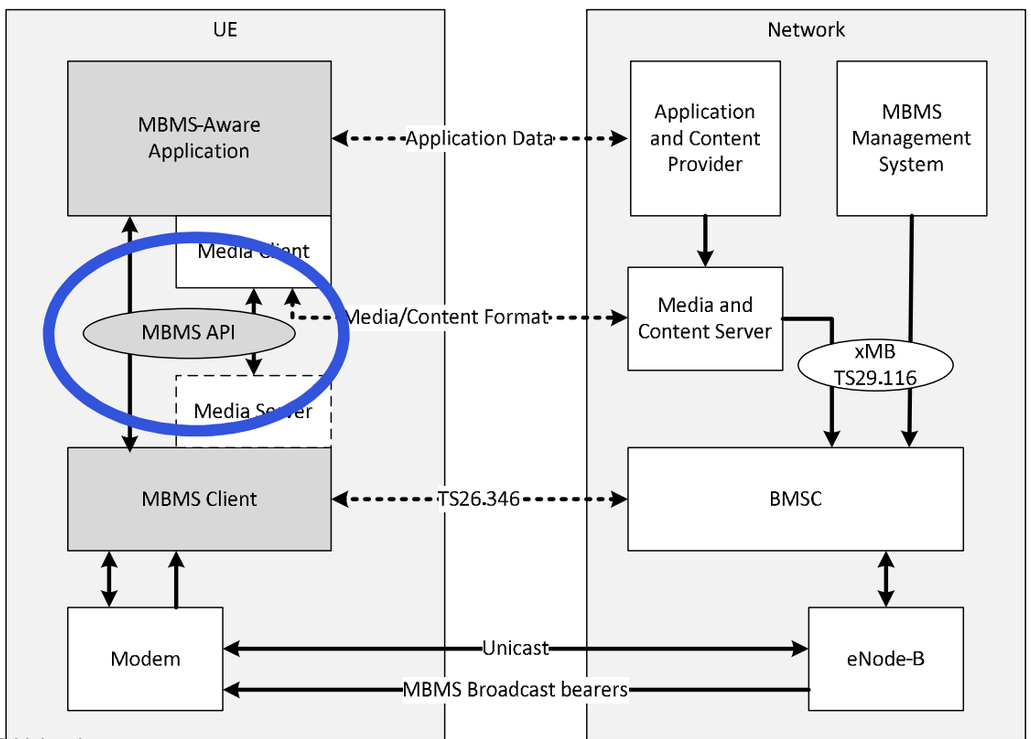


- New type of MBSFN subframe without **unicast control region.**
- Reduces overhead in MBMS transmissions with respect to previous releases.

Service layer

TS 26.347: MBMS API and URL

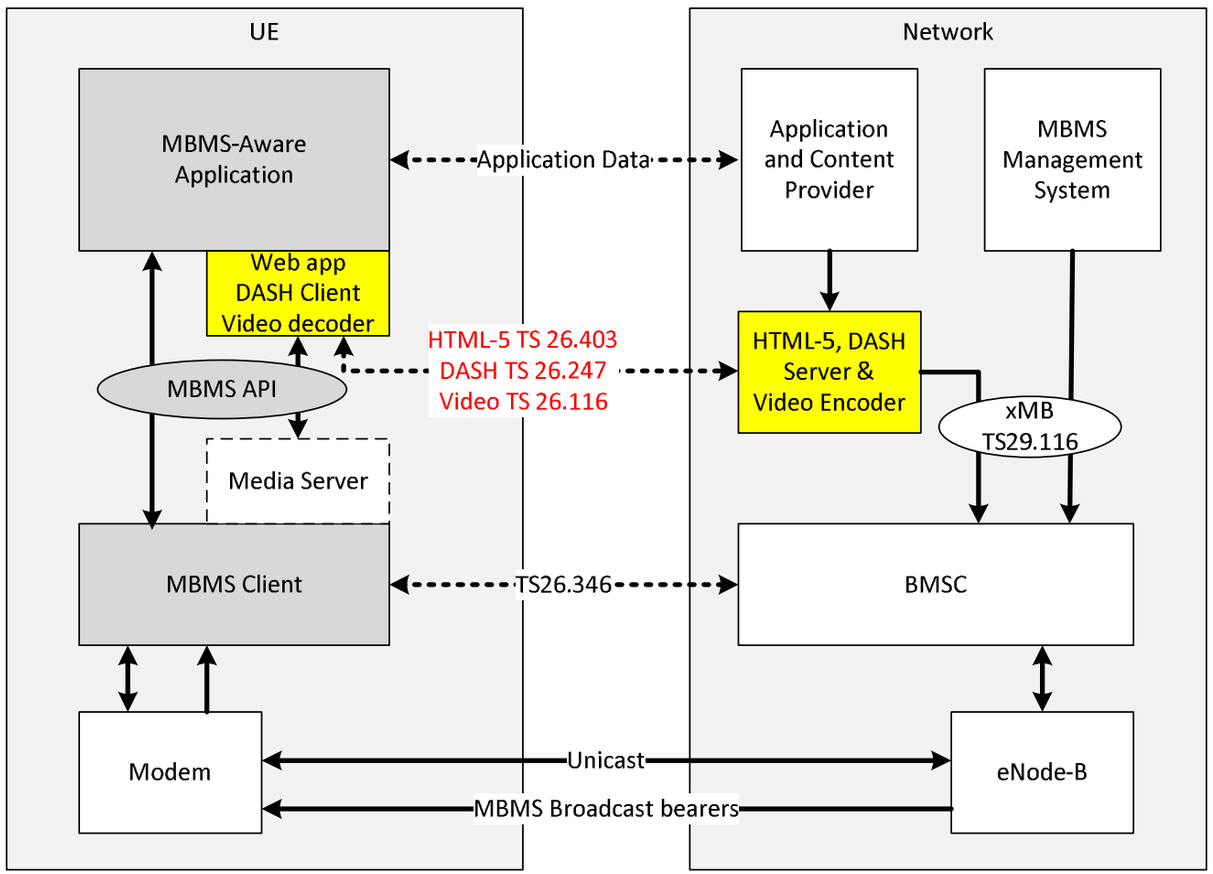




- MBMS User Services in TS26.346 provide (too) many features
- Content can be accessed through well-defined APIs,
  - application communicates with the MBMS client to discover services and serve existing media players.
- Architecture
  - supports distribution of existing TV services (e.g. DVB),
  - enables new capabilities to support dynamic bc/uc handoff, consumption reporting, etc.
- APIs may be implemented within a device or as network interface, i.e. MBMS service terminates in a gateway (➔ media server)
- https://developer.android.com/reference/android/telephony/mbms/package-summary

HTML-5, DASH and TV Video Profiles (Rel-13)

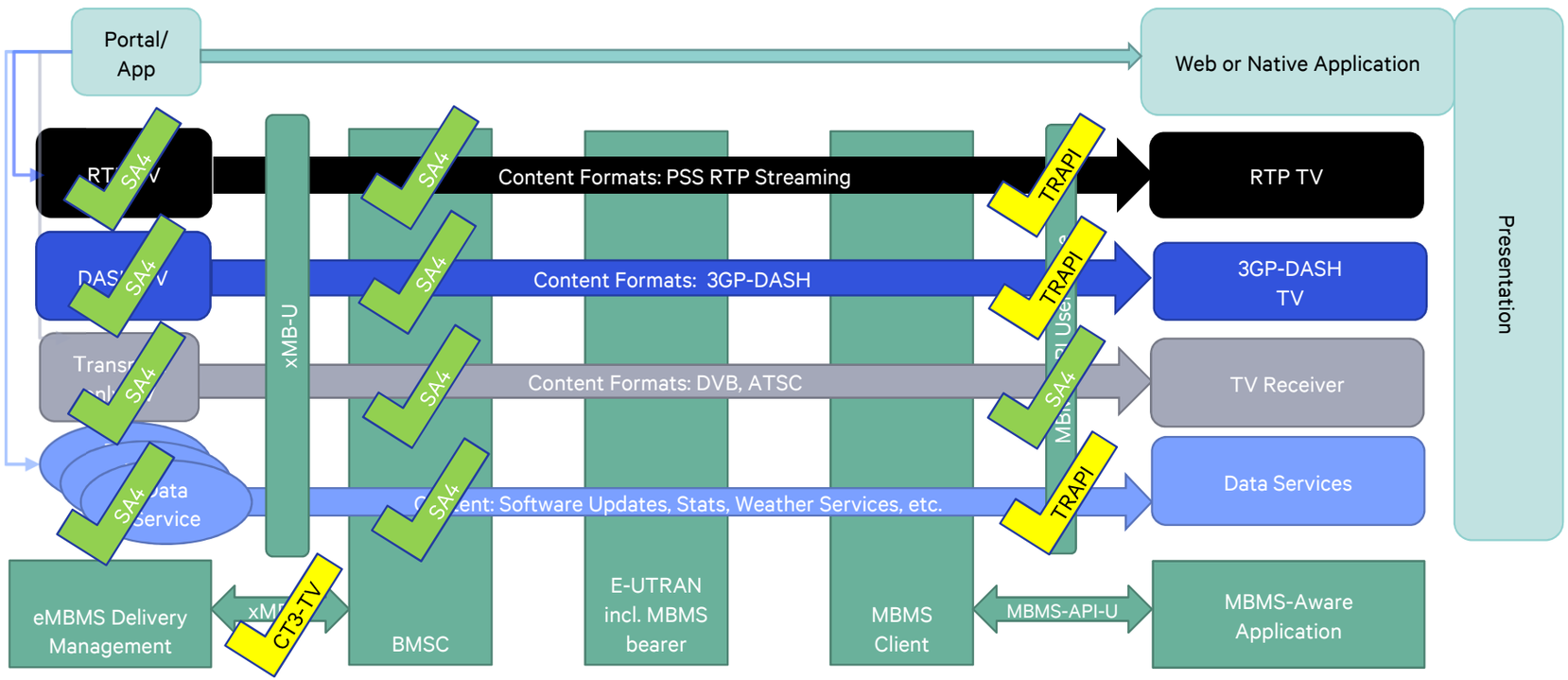
Distribution Formats for hybrid services, web-centric and enables TV Video Experiences



- DASH Enhancements
  - Alignment with industry profiles and technologies to enable cross-domain deployments including Live and Ad Insertion
  - DVB-DASH aligned
- TV video profile
  - Consistent set of video profiles HD and UHD distribution aligned with DVB AVC
  - DVB UHD-1 phase 1
- HTML-5 profile
  - Media-centric profile aligned with TV industry adding for example MSE and EME APIs
- Further Extensions in Rel-15

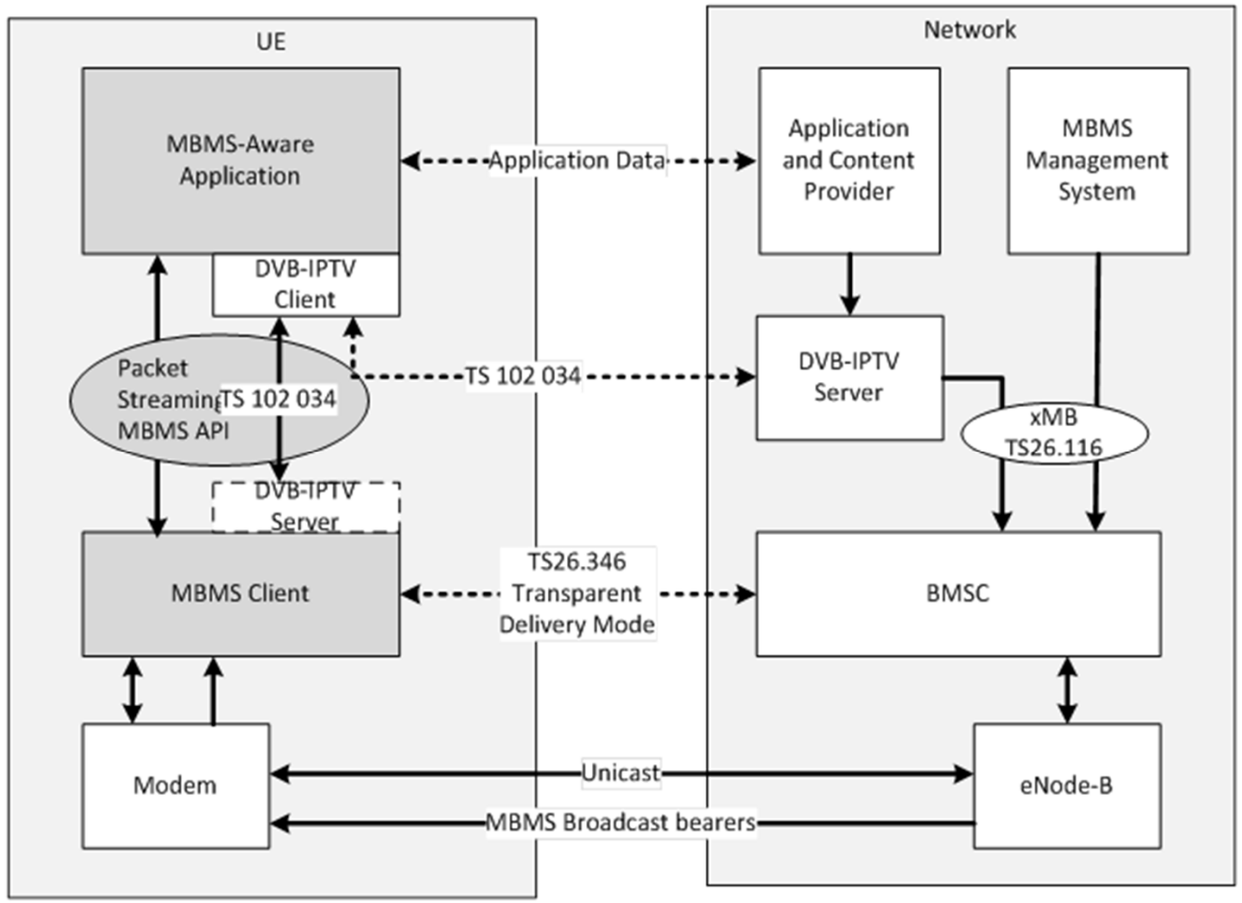
Completed Work in SA4/CT3 for Rel-14

- Transparent Delivery Mode for External ADU flows
  - Permits usage as MBMS Service as well as for external usage
  - Session Description and Transport Protocol
  - Service Announcement Profile
- Service API for Transparent Mode
  - Permits service discovery from an Application for Transparent MBMS Services
- Receive Only Mode (ROM) services (and ROM-UEs)
  - TMGIs correspond to a reserved range of values
  - Service Announcement is sent on this channel
- File Manifest for File Download Service



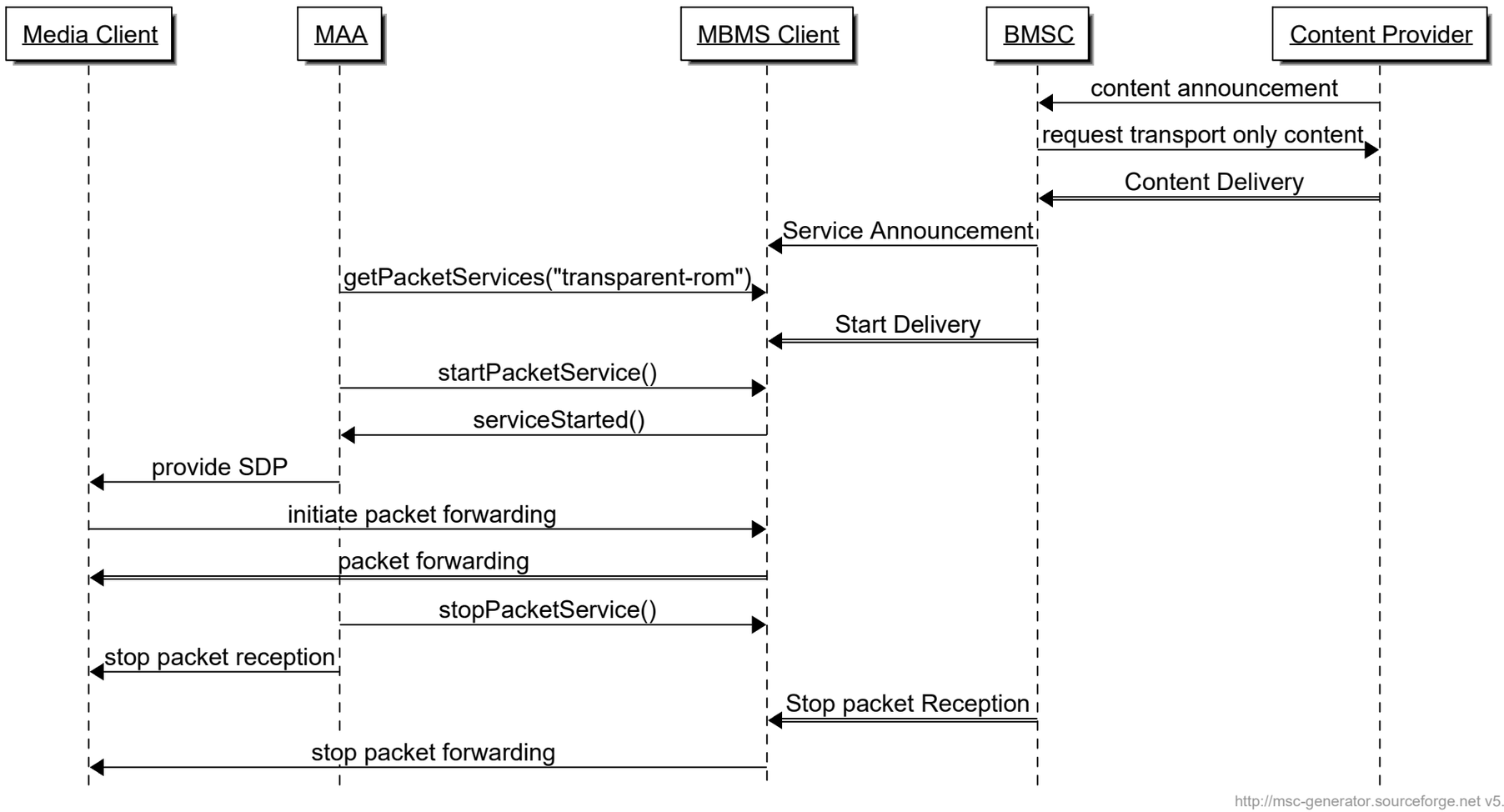
Example

```
v=0
o=ghost 2890844526 2890842807 IN IP4 192.168.10.10
s=3GPP MBMS Transport-only SDP Example
i=Example of MBMS transport-only SDP file
u=http://www.infoserver.example.com/ae600
e=ghost@mailserver.example.com
c=IN IP6 FF1E:03AD::7F2E:172A:1E24
t=3034423619 3042462419
b=AS:8000000
a=mbms-mode:broadcast 123869108302929 1
_
a=source-filter: incl IN IP6 * 2001:210:1:2:240:96FF:FE25:8EC9
m=video 4002 UDP/RTP/AVP 96
b=TIAS:4000000
a=mbms-framing-header:0 2
a=rtpmap:100 MP2T/90000
m=video 4002 RTP/AVP 98
b=TIAS:4000000
a=rtpmap:100 MP2T/90000
a=mbms-framing-trailer:0 2
```

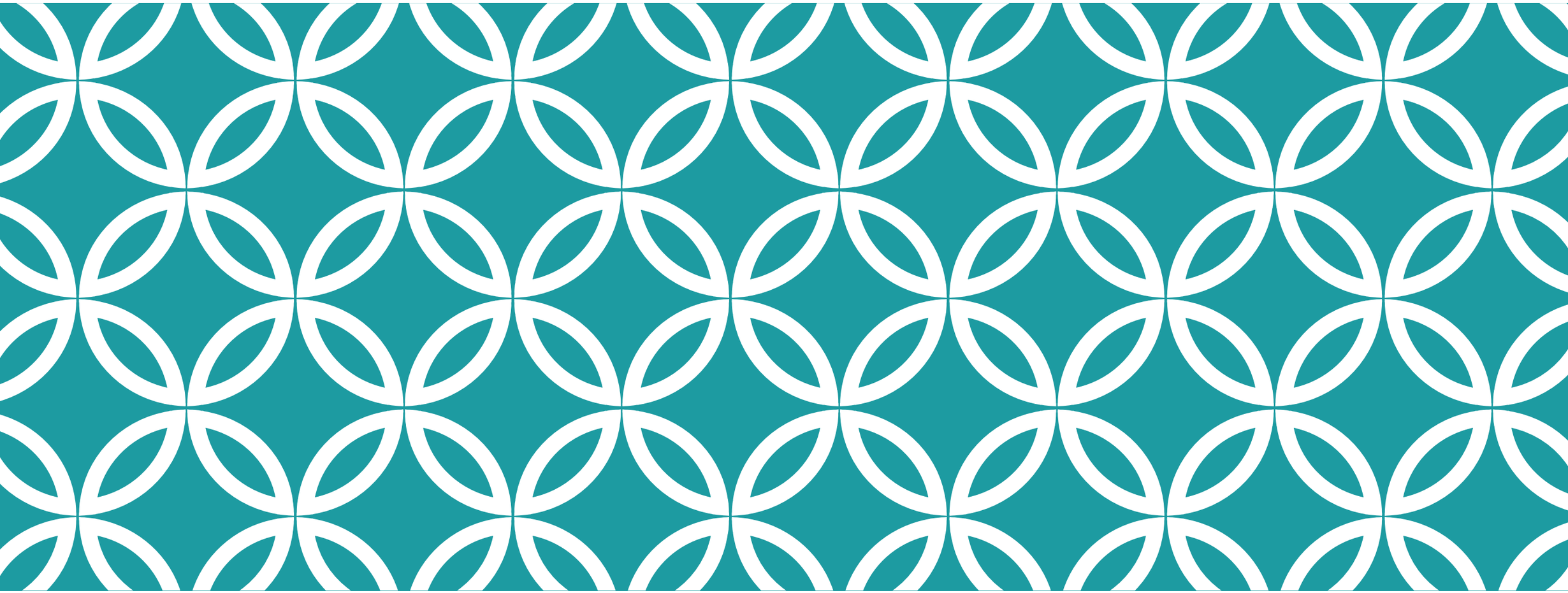


2 DVB IPTV MPEG-2 TS over as MBMS User Service

Example Call flow



Outside 3GPP



DASH-IF

CONTINUING TO SUPPORT DASH ADOPTION . . .

Founded in 2012 after MPEG-DASH completion, DASH-IF addresses

- Interoperability
- Promotion
- Supporting other SDOs and our members

for interoperable deployment of massively scalable Internet Streaming Services

Charter Members

Adobe, Akamai, cisco, COMCAST, DOLBY, ERICSSON, Microsoft, NETFLIX, QUALCOMM, SAMSUNG, XPERI

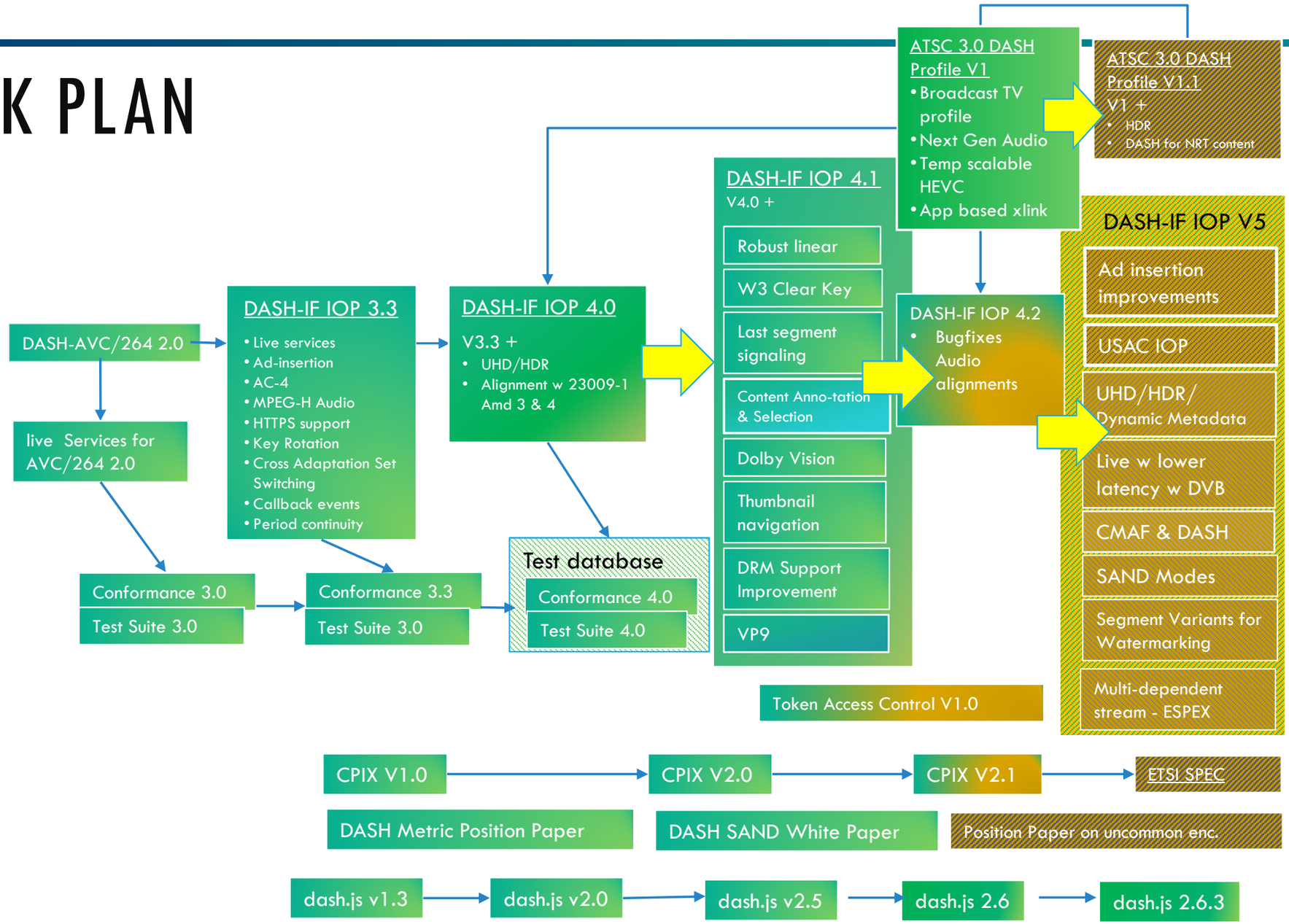
Associate Members

axinom, BITMOVIN, broadpeak, DVEO, epic labs, erlab technology, eurofins Digital Testing, INKA, JWPLAYER, mediamelonmovingIMAGE24, MUX, NEXSTREAMING, NIMBLE STREAMER, nomor research, THEOplayer, Packet Ship, realeyes, Rebaca, ripple networks, Solekai Systems, sorenson media, SQUADEO, StreamOne, STREAMROOT, The Autism Channel, Unified Streaming, VisualOn, VUALTO

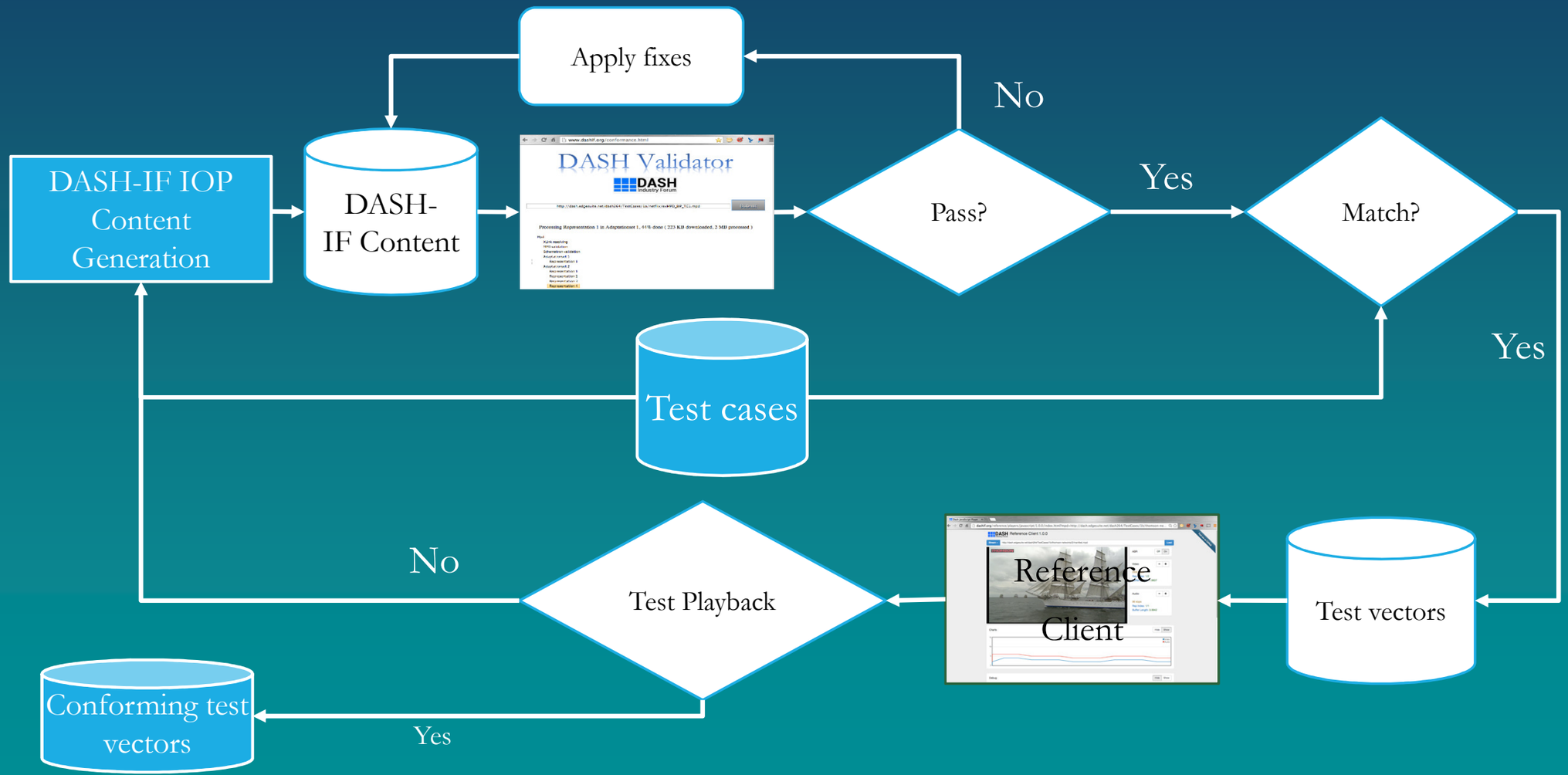
Contributor Members

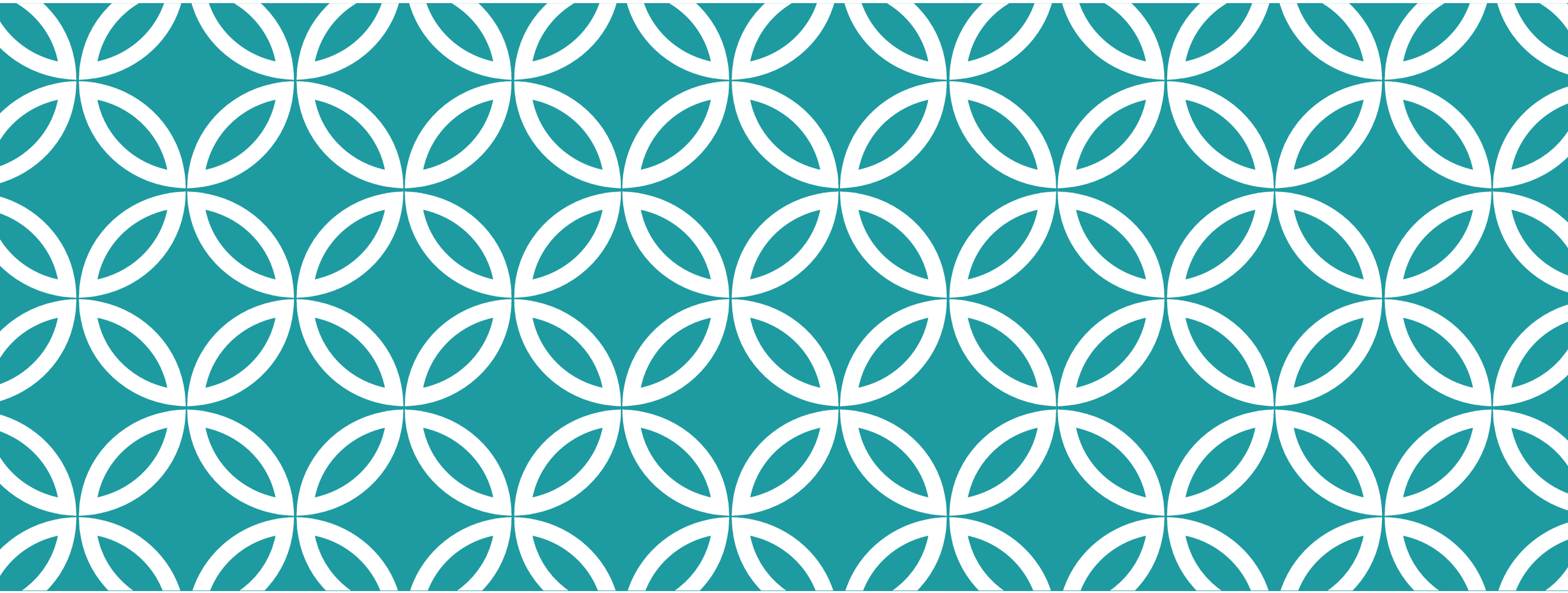
ARRIS, brightcove, CableLabs, castLabs, Connected Home Academy, digital primates, EBU, edgeware, ELEMENTAL, EZDRM, Fraunhofer USA, Google, Haivision, harmonic, HUAWEI, hulu, intel, INTERDIGITAL, IIJ Internet Initiative Japan, irdeto, Kaltura, LG, maxdome, MEDIAEXCEL, MEDIATEK, NAGRA KUDELSKI, NeuLion, NOKIA, SONY, SPB TV, technicolor, TNO, Turner, verimatrix, verizon digital media services, viaccess-orca, VIMOND, VUBIQUITY

WORK PLAN


DASH-AVC/264 2.0
live Services for AVC/264 2.0
DASH-IF IOP 3.3
• Live services
• Ad-insertion
• AC-4
• MPEG-H Audio
• HTTPS support
• Key Rotation
• Cross Adaptation Set Switching
• Callback events
• Period continuity
DASH-IF IOP 4.0
V3.3 +
• UHD/HDR
• Alignment w 23009-1 Amd 3 & 4
Conformance 3.0
Test Suite 3.0
Conformance 3.3
Test Suite 3.0
Test database
Conformance 4.0
Test Suite 4.0
ATSC 3.0 DASH Profile V1
• Broadcast TV profile
• Next Gen Audio
• Temp scalable HEVC
• App based xlink
ATSC 3.0 DASH Profile V1.1
V1 +
• HDR
• DASH for NRT content
DASH-IF IOP 4.1
V4.0 +
Robust linear
W3 Clear Key
Last segment signaling
Content Anno-tation & Selection
Dolby Vision
Thumbnail navigation
DRM Support Improvement
VP9
DASH-IF IOP 4.2
• Bugfixes
Audio alignments
DASH-IF IOP V5
Ad insertion improvements
USAC IOP
UHD/HDR/ Dynamic Metadata
Live w lower latency w DVB
CMAF & DASH
SAND Modes
Segment Variants for Watermarking
Multi-dependent stream - ESPEX
Token Access Control V1.0
CPIX V1.0
CPIX V2.0
CPIX V2.1
ETSI SPEC
DASH Metric Position Paper
DASH SAND White Paper
Position Paper on uncommon enc.
dash.js v1.3
dash.js v2.0
dash.js v2.5
dash.js 2.6
dash.js 2.6.3

TEST VECTOR GENERATION HIGH-LEVEL FRAMEWORK AND DASH-IF ASSETS





LOW-LATENCY DASH

KEY FUNCTIONS AND PERFORMANCE INDICATORS

Random Access and Start-up Delay

End-to-End Latency

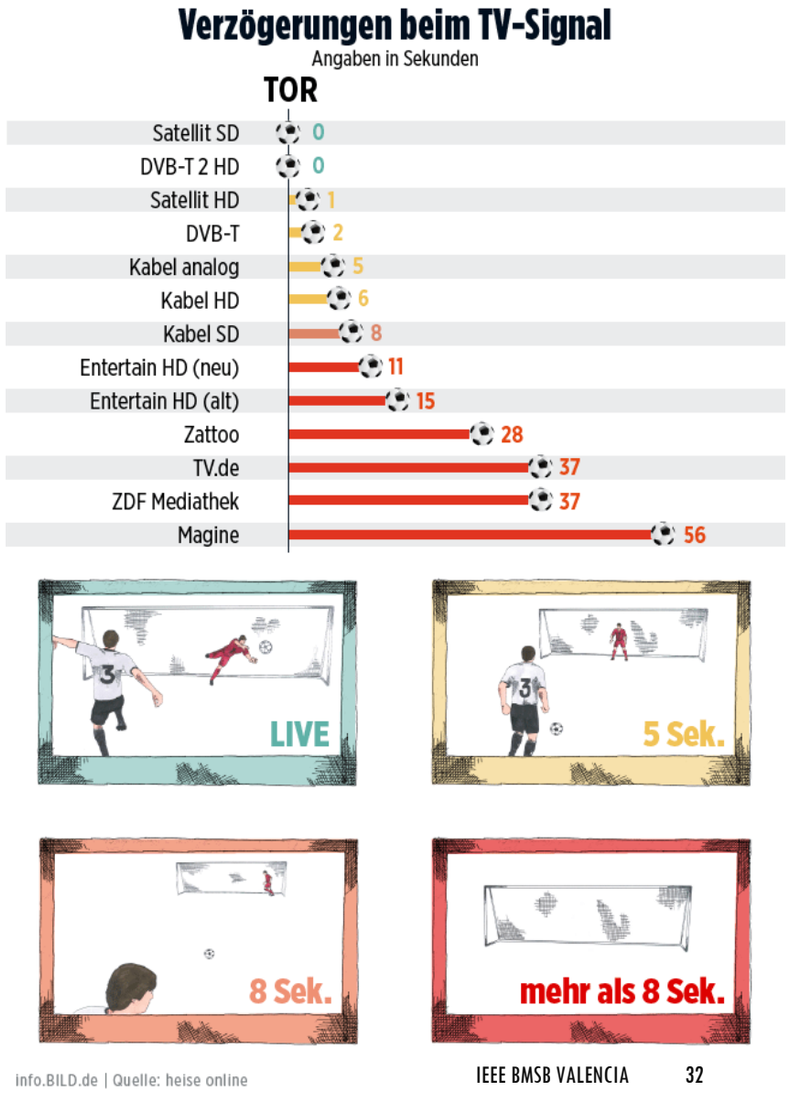
Compression Efficiency

Network Efficiency and Scalability

- Number of Requests
- Number of Invalid Requests

Robustness to Errors

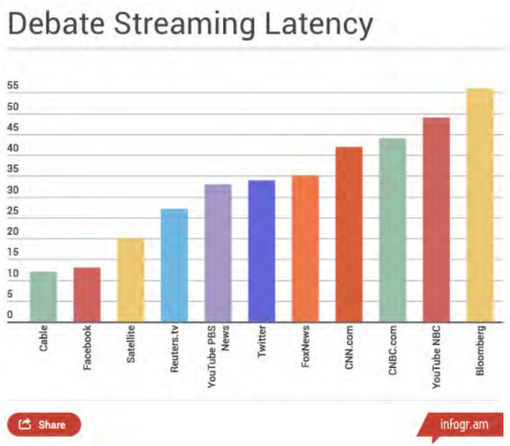
Note: Not all apply for all services, but may be relevant



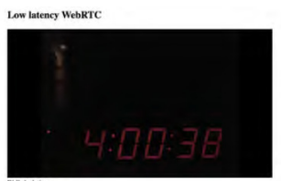
SOME DVB WORLD 2017 SLIDES

Live Stream Latency

- Data taking during Nov 16 presidential debates in the US.
- Good opportunity to compare latency as the event was carried by most major broadcasters.



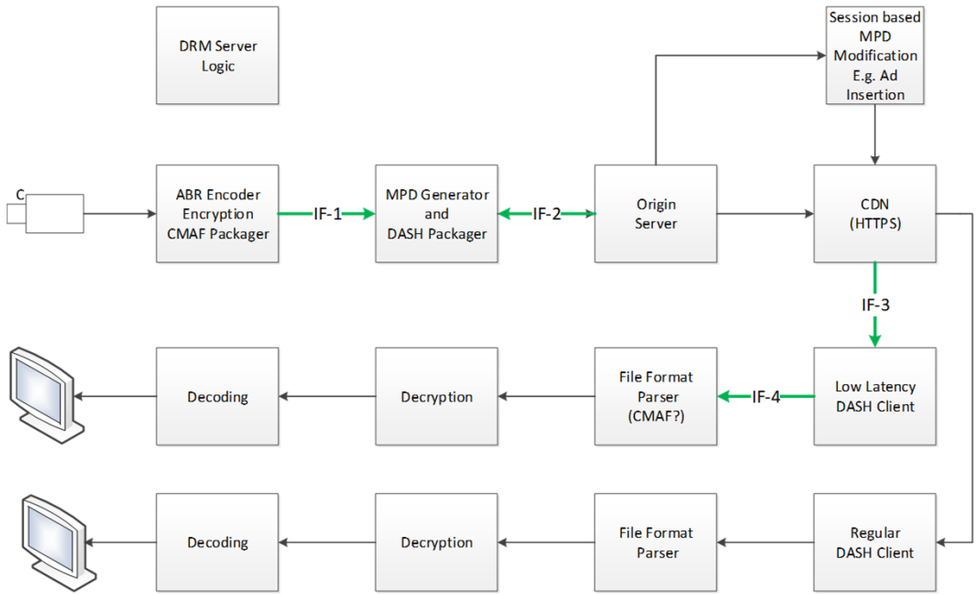
Adios 45s!



STATUS OF THE WORK IN DASH-IF AND DVB

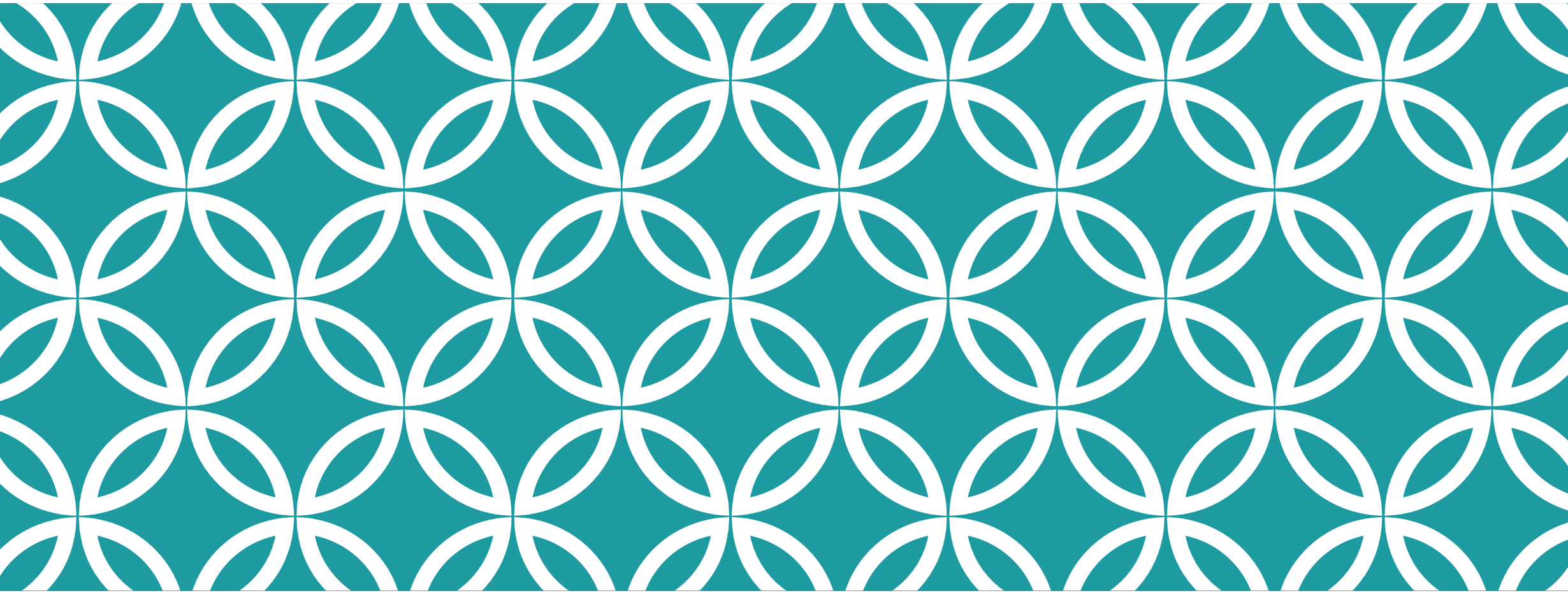
DVB

- Completion of use cases (together with DASH-IF) and Commercial Requirements for Low-Latency DASH
  - Encoder to Screen Latency of 3.5 seconds
  - Live Edge Start-up Delay in the order of 1 second or less
  - presentation of a media time at a specific wall-clock time within 500ms tolerance
  - updated DVB-DASH specification shall be completed by Q4/2018
- Technical work just started with outreach to DASH-IF



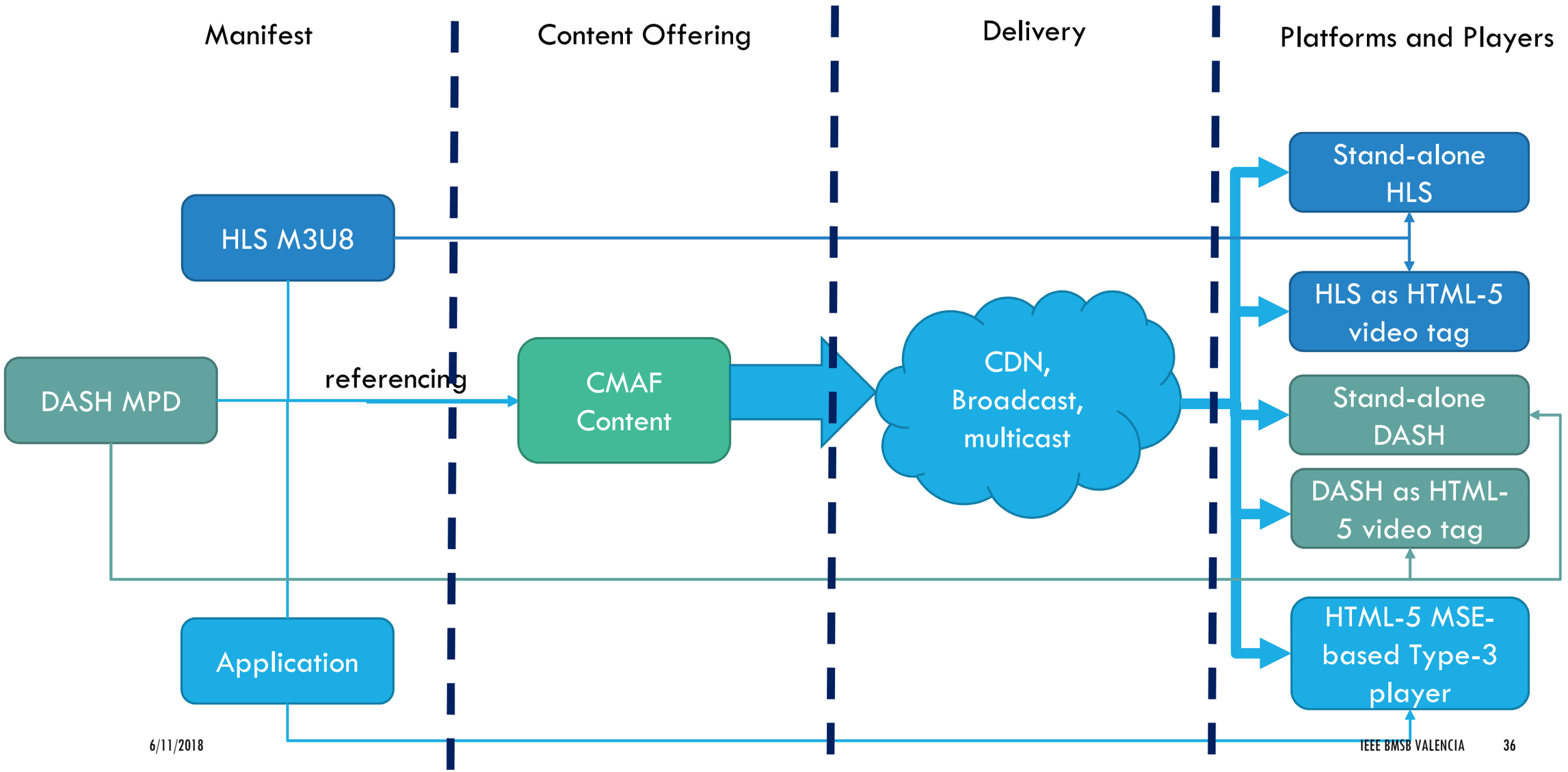
DASH-IF

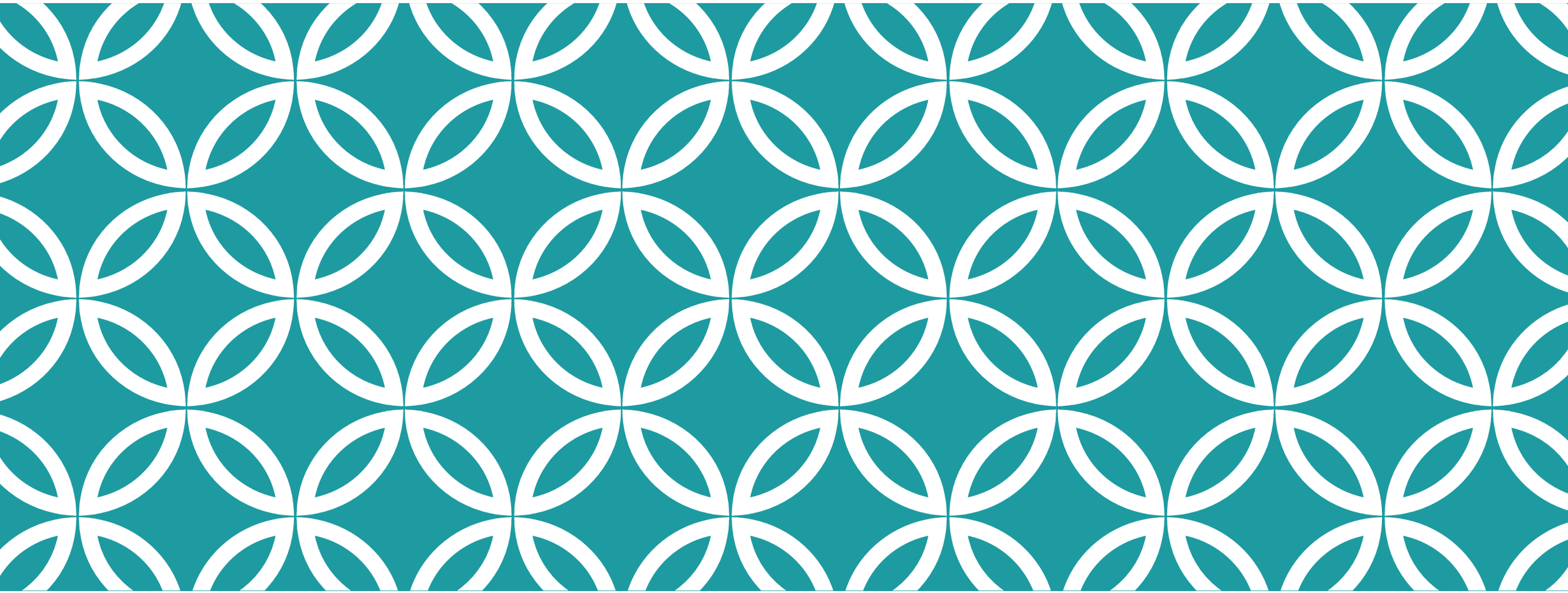
- In the progress of drafting guidelines for Low-Latency DASH
- Context of real service operation issues: Program changes, ad insertion, operational problems, scalability
- Guidelines include
  - Interface between Encoder and DASH Packager assuming CMAF packaging
  - DASH Packager Operation including MPD generation and MPD updates, as well as segment generation for simple, live and broadcast client
  - Client Implementation Guidelines and requirements: buffers, ABR logic, etc.
- Development of test, reference and conformance tools



CMAF AND CTA WAVE

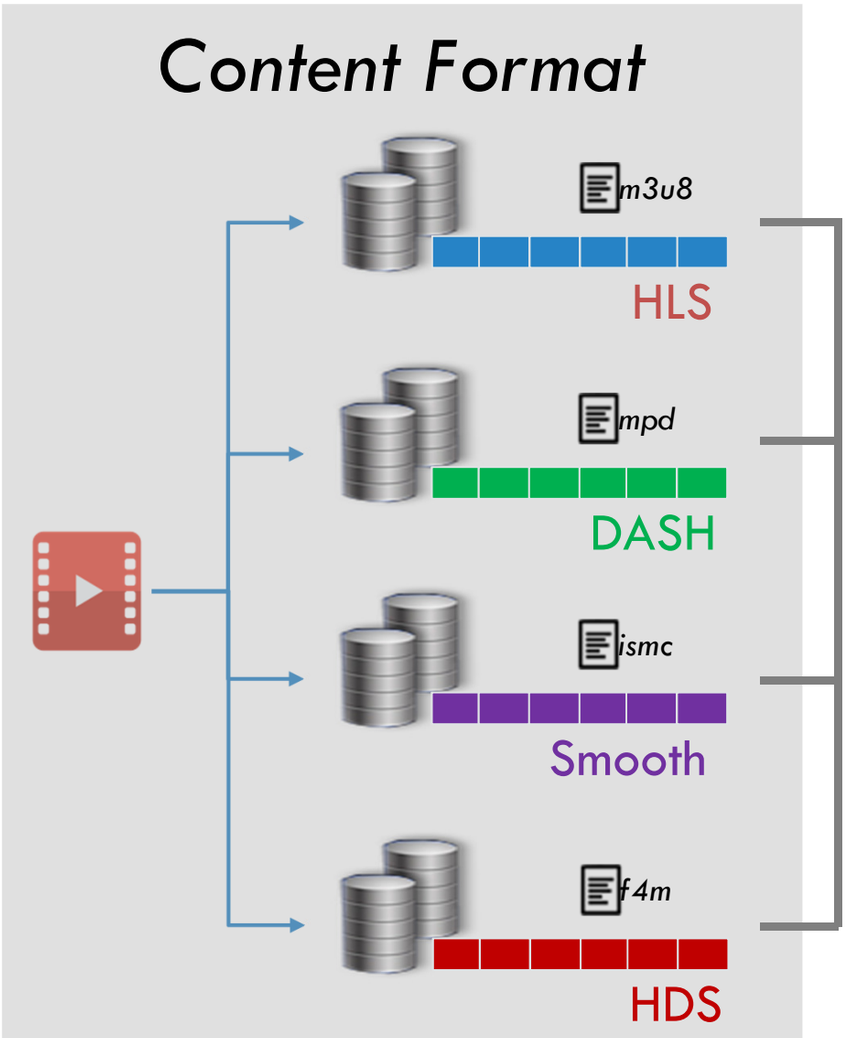
DIFFERENT PLAYERS – SINGLE ENCODING AND COMMON DELIVERY





CTA WAVE

COMMERCIAL OTT VIDEO ISSUES: CONTENT FORMAT ISSUES



Each asset copied to multiple media formats

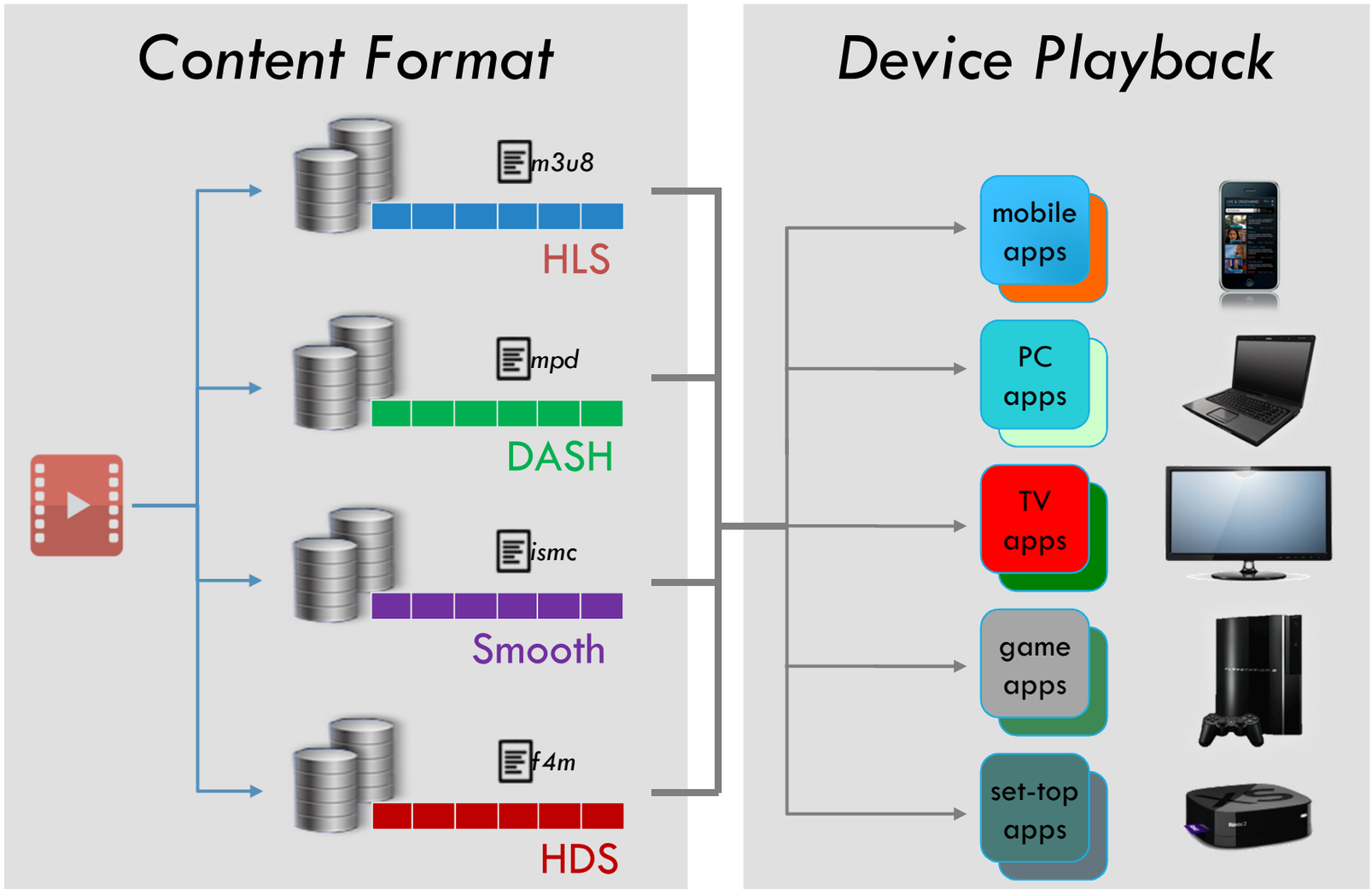
- different video codecs
- different audio codecs
- Regional frame rates

Cost to content creators and distributors

Inefficiencies in content delivery networks (CDNs)

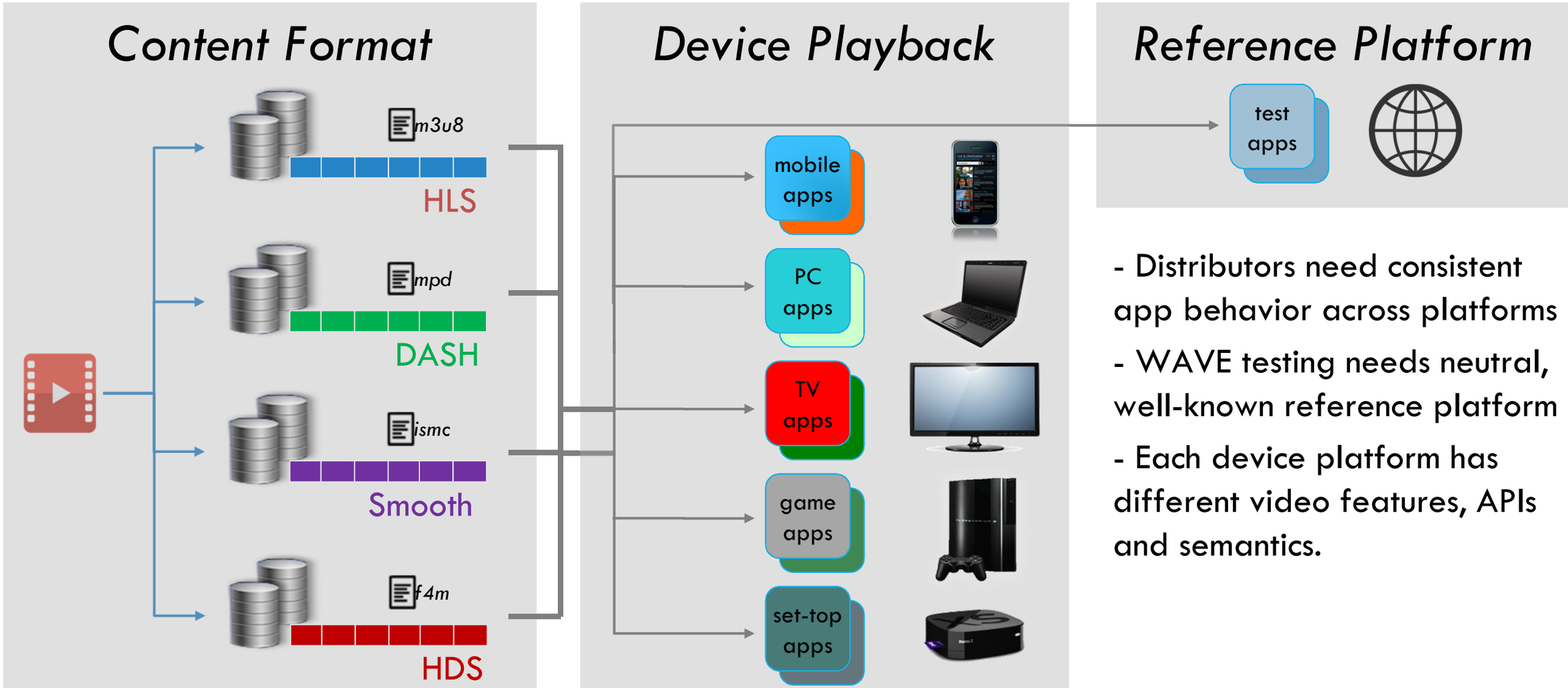
Storage costs

COMMERCIAL OTT VIDEO ISSUES: DEVICE PLAYBACK ISSUES



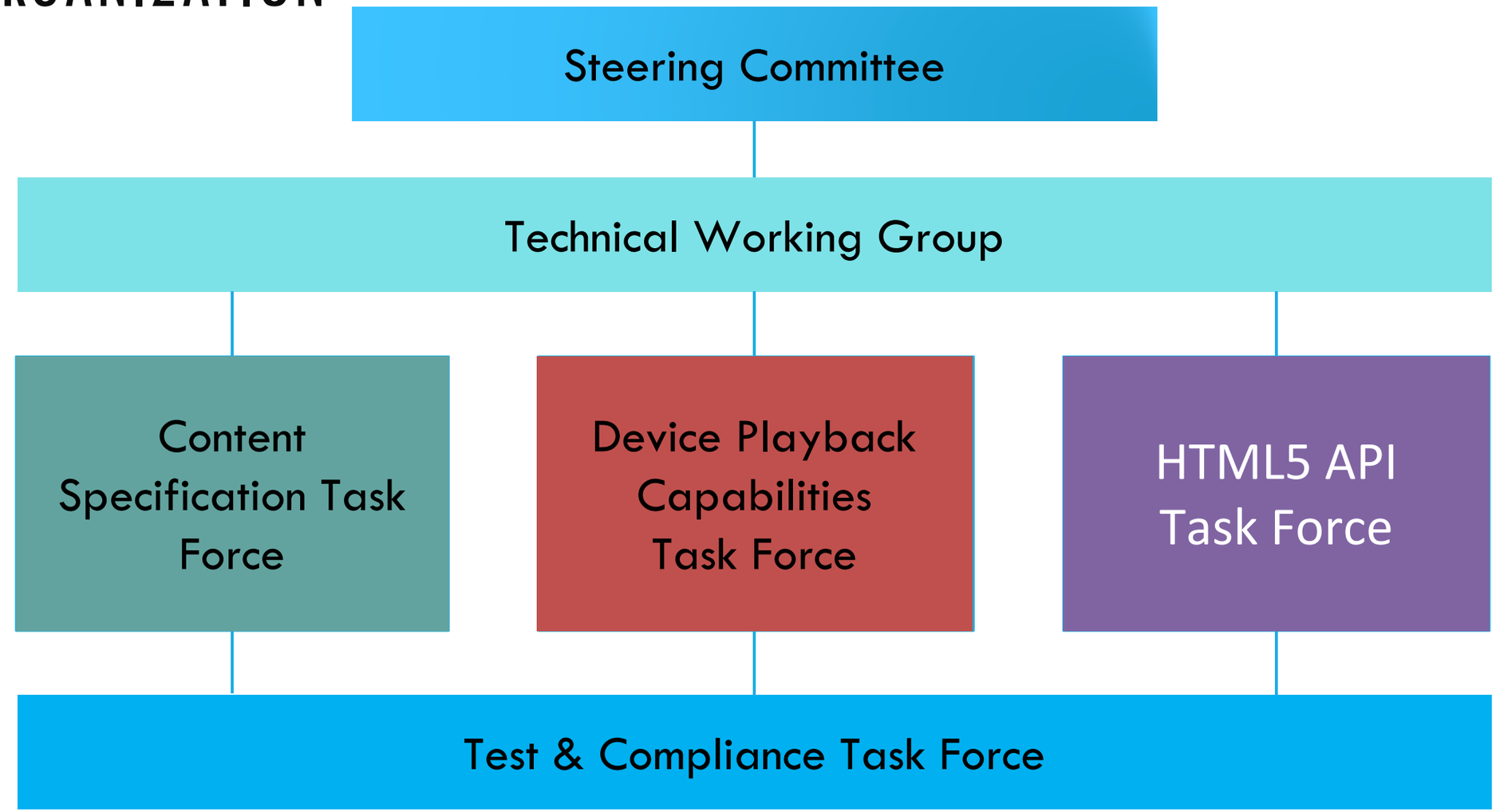
- Switching bitrate glitches
- Codec incompatibility
- Scaling display issues
- Partial profile support
- Long-term playback instability
- Audio discontinuities
- Request protocol deficiencies
- Memory problems
- CPU weakness
- Variable HDR support
- Unknown capabilities
- Ad splicing problems

COMMERCIAL OTT VIDEO ISSUES: REFERENCE PLATFORM ISSUES



- Distributors need consistent app behavior across platforms
- WAVE testing needs neutral, well-known reference platform
- Each device platform has different video features, APIs and semantics.

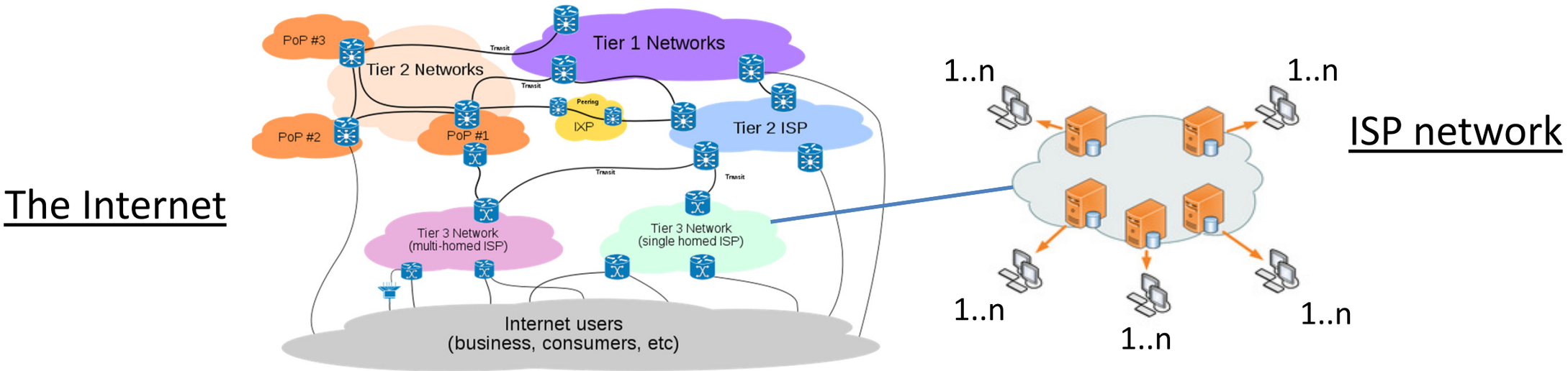
WAVE ORGANIZATION



DVB INTERNET SERVICES (DVB-I)

DVB-I, the mission…

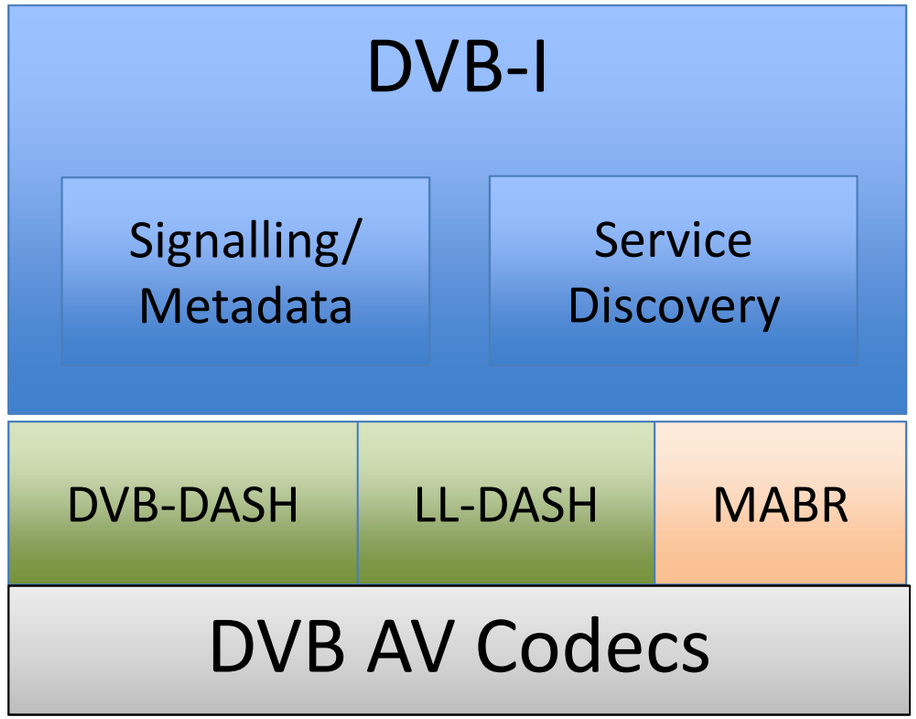
- DVB-I, where the “I” stands for “Internet”
  - In the context of audio-visual services, “The Internet” is used for “Over-The-Top” (OTT) delivery
  - Well, “The Internet”, as in “CDN overlaid, edge assisted, adaptive delivery, media cloud”



- …To enable DVB services to be discovered and consumed by devices with basic Internet connectivity, principally a non-managed broadband connection and HTTP access, providing a similar user proposition to that of a DVB broadcast service

DVB-I, the vision

- ***Harnessing foundation technologies to provide a complete DVB solution for live OTT delivery:***
  - DVB-DASH (ABR – adaptive bit-rate)
    - ETSI TS 103 285
  - Low-latency DASH (LL-DASH)
    - Technical work started
  - Multicast ABR (MABR) - within suitably capable operator networks
    - Technical work ongoing
    - Reference Architecture published
      - DVB blue book A176



- ***Potential synergies with other ongoing DVB work items:***
  - Targeted Advertising
  - Home Broadcast

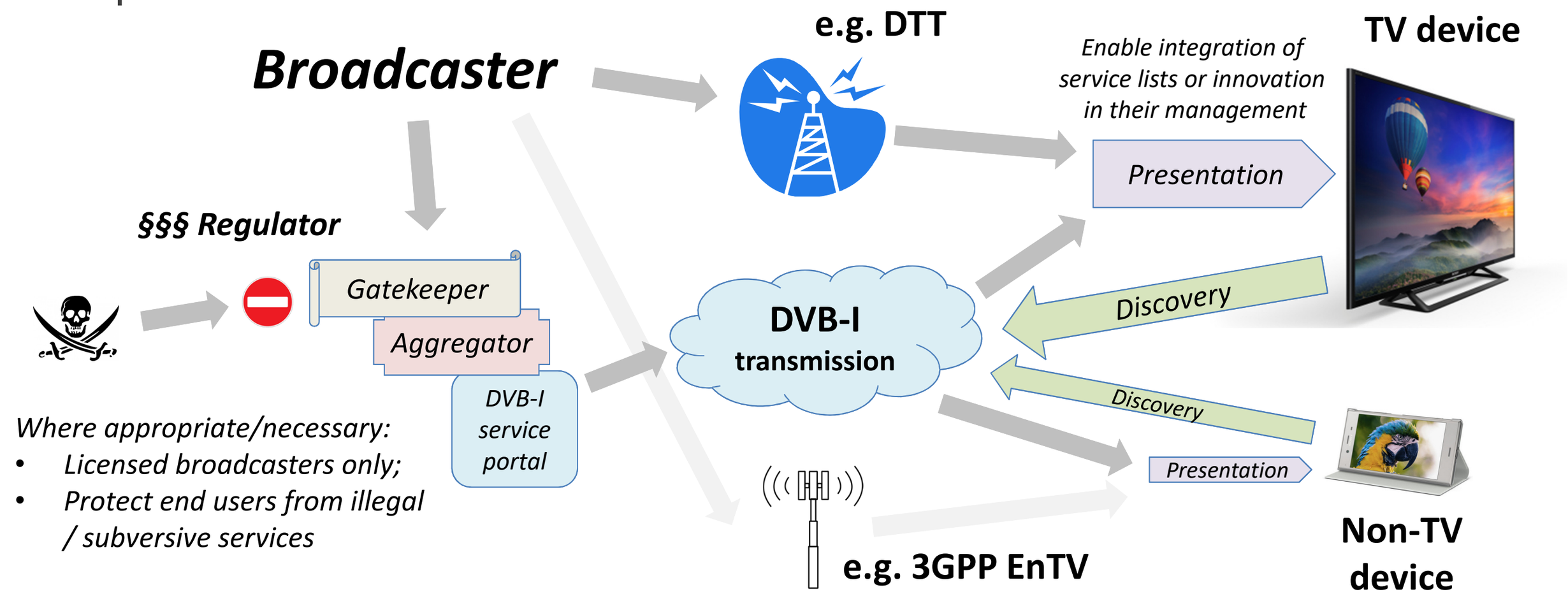
- ***Potential liaison activities:***

HbbTV

DASH Industry Forum

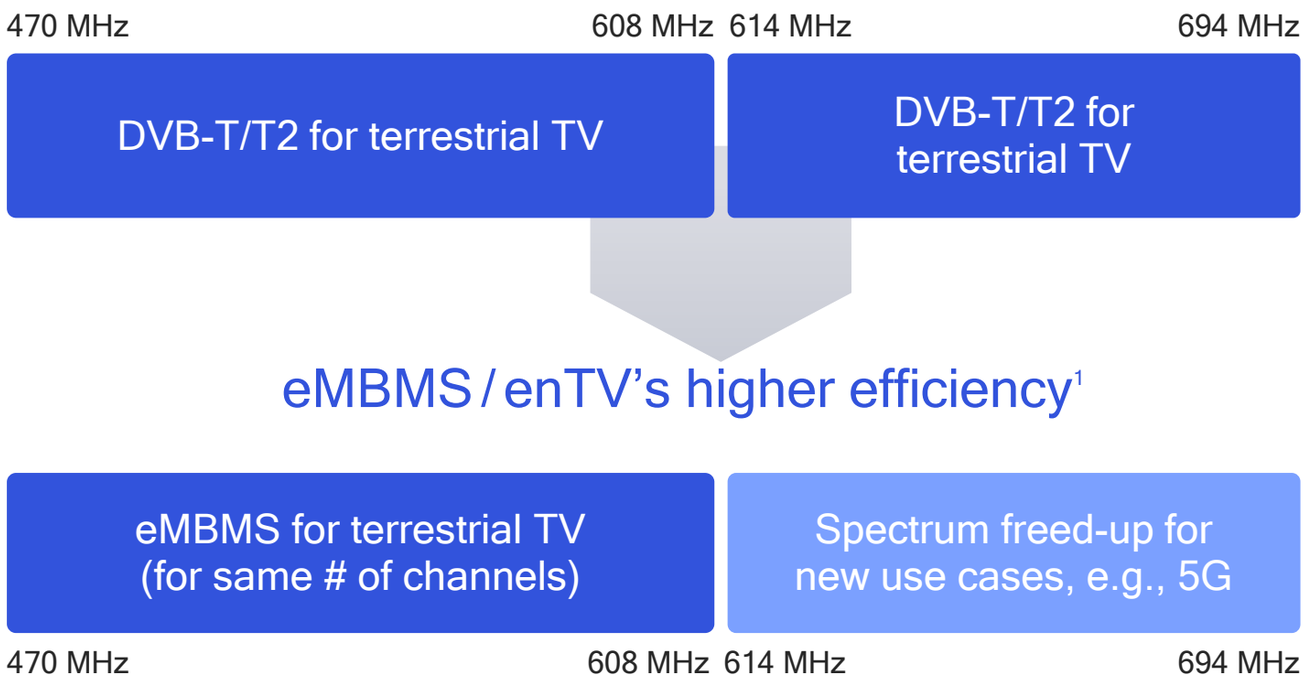
DVB-I, the vision

- Functional overview; likely roles and elements of the DVB-I specification



enTV – a strong candidate for next-gen digital TV

Targeting deployments in re-farmed 700 MHz (e.g. Europe)



Meeting all EU digital TV broadcast requirements

Regulation compliant

Allows frequency reuse and adheres to ITU-GE-06 to protect existing DTT[2] services

Wide-area coverage

Provides at least 50% edge coverage[3] for fixed TV and 95% area coverage for mobile TV

Diverse services

Supports free-to-air content delivery, paid media[4] streaming, as well as applications

Diverse deployments

Supports fixed (e.g., rooftop) and mobile (e.g., smartphone) receptions in a common spectrum allocation

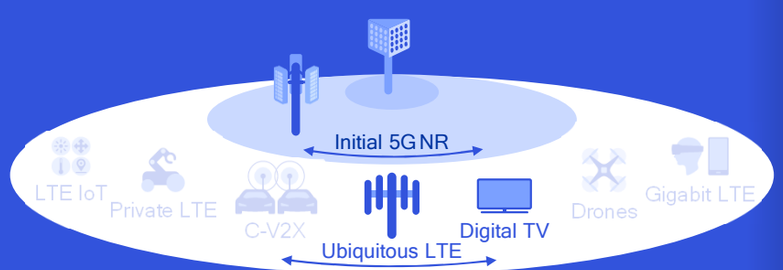
LTE eMBMS/enTV is the 5G Broadcast solution

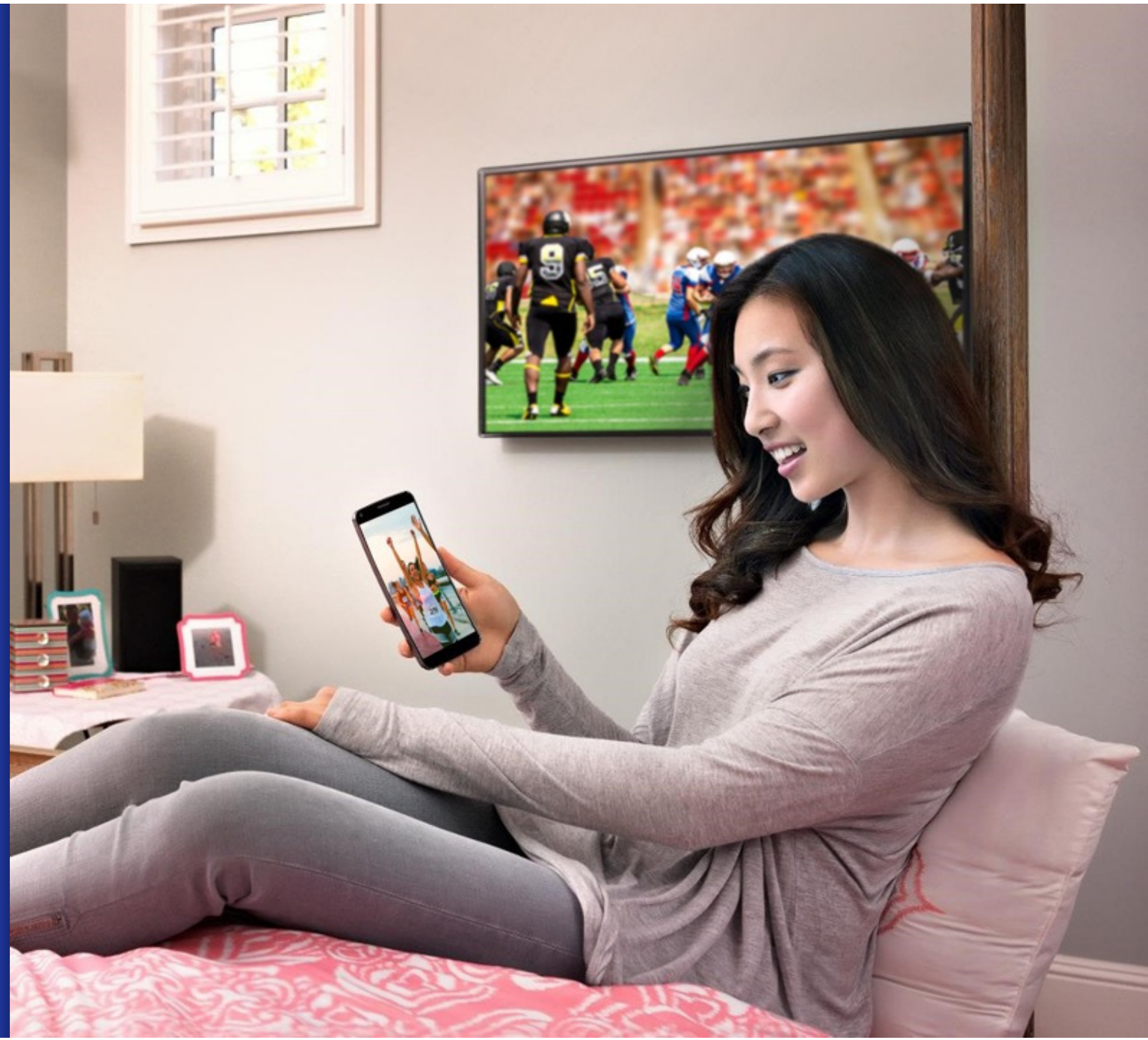
High spectrum efficiency

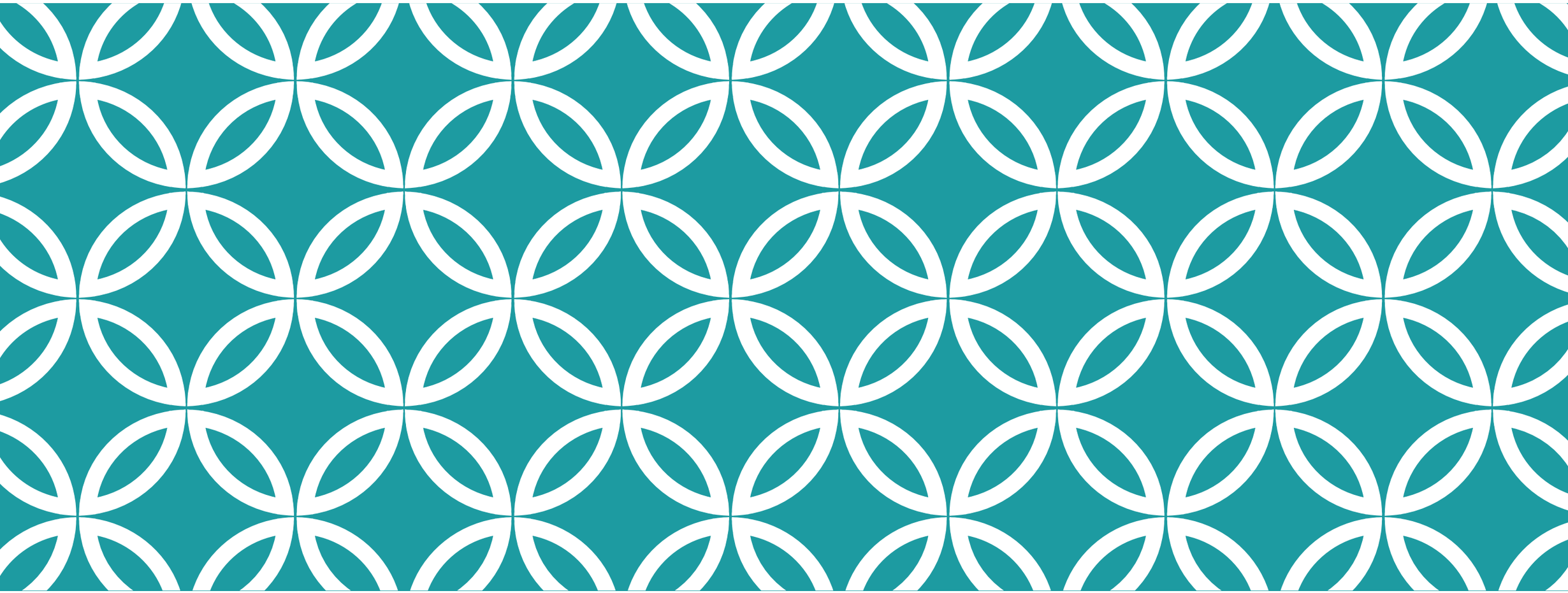
Scalable capacity

For next-gen digital TV delivery

Meets 5G broadcast requirements







SUMMARY

SUMMARY

Standards remain relevant for the TV Grade Media moving to new devices and experiences, but different approaches necessary

No longer vertical services, but individual enablers

APIs, testing, reference implementations, modular designs

JOIN THE EFFORTS

Qualcomm & al. related event on May 16, 2018

https://www.qualcomm.com/videos/5g-broadcast-evolution-based-entv-3gpp

05/15/2018 | 04:37pm CEST

-- MTV, Yle, Elisa, Nokia, ENENSYS, Bittium and Qualcomm set to demonstrate TV broadcasting over cellular networks at the Nokia Headquarters in Espoo --

London, United Kingdom-- -- Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated (NASDAQ: QCOM), Nokia, MTV, Elisa, ENENSYS Technologies, Bittium and Yle, today announced that they will showcase the new opportunities that the evolution to 5G broadcast enables for next-generation terrestrial TV delivery. The demonstration will show that wireless networking technologies are now ready to deliver highly customizable, mass-market broadcast services more efficiently, such as live media content to consumers. The live demonstration is scheduled to take place at the Nokia Executive Experience Center in Espoo, Finland from 12 - 3 p.m. EEST on May 16, 2018.

The demonstration will also show how the ongoing development of cellular based broadcast technology enables convergent, in-home delivery of the same content on both large TV screens and mobile devices. The technical theme of the event is the broadcast functionality used by media content distributors, presented by Nokia, ENENSYS and Qualcomm Technologies. Elisa is involved as an operator as well as a content producer, together with MTV and Yle. This event is an early proof point of the potential of 5G media distribution to the entire end-to-end TV broadcasting ecosystem, comprising of: "end device, mobile network operator, TV broadcaster, and content provider".

Qualcomm

5G Broadcast Evolution based on enTV in 3GPP

Publish Date: May 11, 2018

Length: 3:08

Qualcomm

Thank you!

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