

**Primary Distribution in unified
profiles and bitrates
(Mezzanine)**

**V1.0 / March 4, 2021
+ addendum
June 29, 2022**

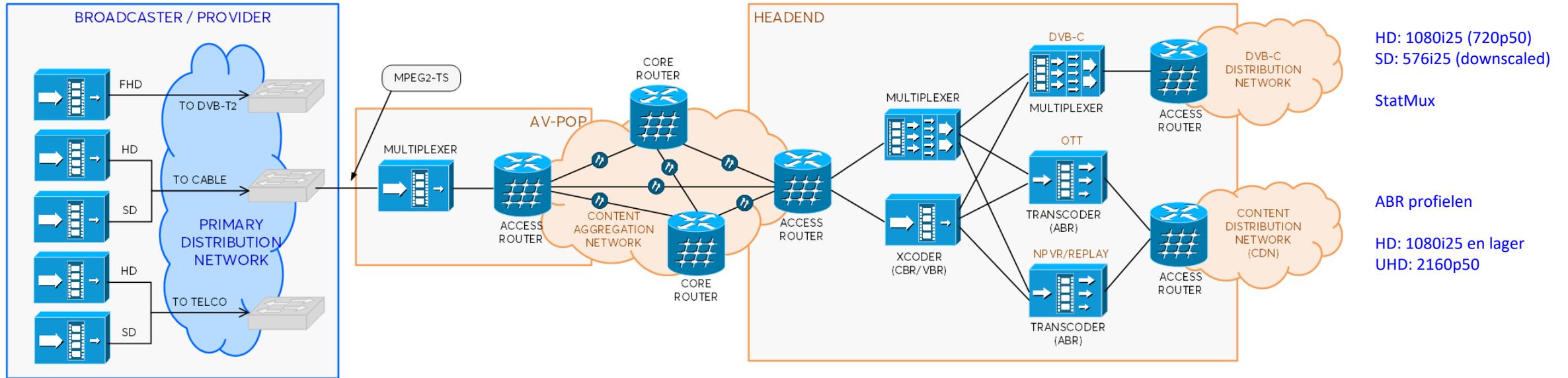


Primary Distribution in unified profiles and bitrates (Mezzanine)

Summary

- ◆ Full HD Preferred 1080p50 (10 bits), AVC Hi10P @L4.2, 30-50 Mb/s
Legacy 1080i25 (8 bits), AVC HP@L4, 25 Mb/s
- ◆ Basic HD 720p50 (8 bits), AVC HP@L4, 8 Mb/s
NOTE: Basic HD is preferred Mezzanine for local broadcasters (NLPO)
NOTE: For all HD profiles low delay encoding is preferred when possible
- ◆ UHD 4K 2160p50 (10/12 bits), HEVC MT@L5.1, 25-50 Mb/s
2K 1080p50 (10 bits), AVC Hi10P@L4.2, 30-50 Mb/s
NOTE: UHD is considered next-level mezzanine (no timetable yet)
NOTE: HDR , HFR, WCG to be discussed

Current situation at VodafoneZiggo



◆ Pre-compressed constant bitrate;

◆ Cascaded transcoding with additional latency and quality degradation.

Current situation, Pro's and Con's (VodafoneZiggo)

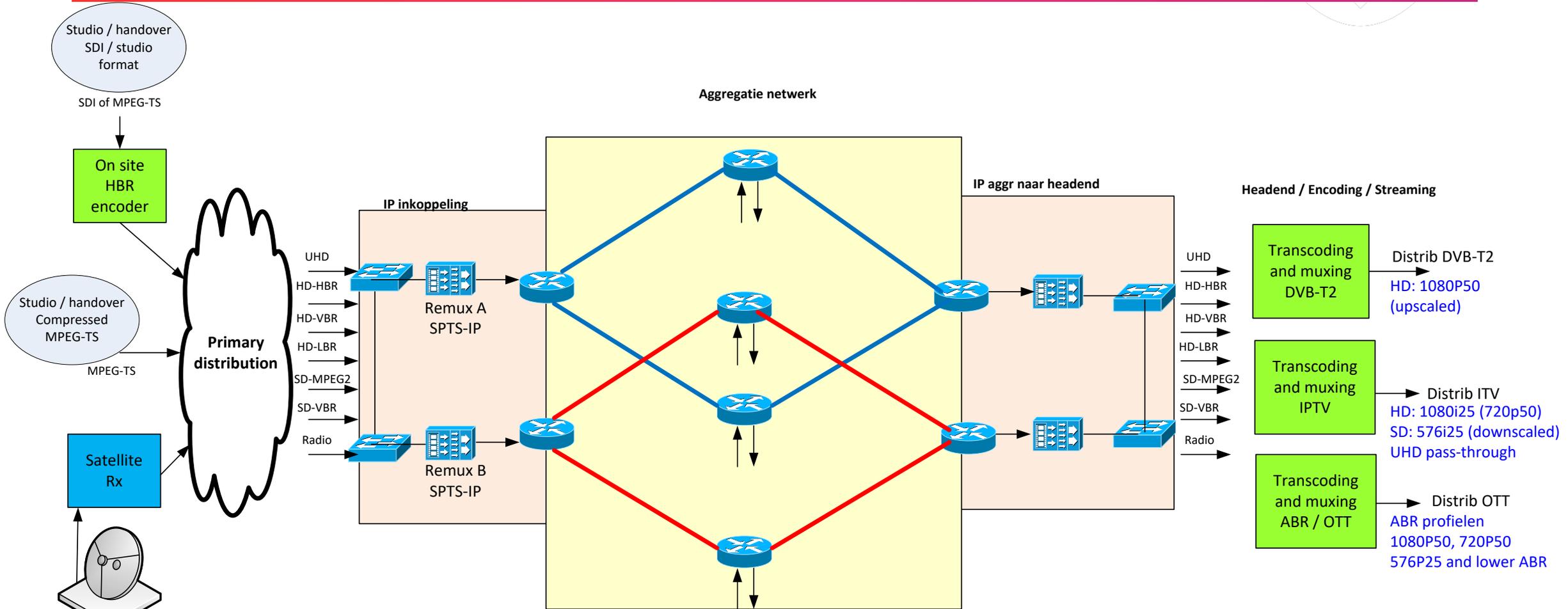
Broadcasters

- ◆ Separate outputs for DVB-C, DVB-T, Telco's and OTT;
- ◆ Constant bitrate (CBR) preferred above constant quality (VBR) encoding
- ◆ Multiple profiles: HD (AVC) and SD (MPEG-2) with fixed bitrates;
- ◆ Urge to simplify playout with HD (UHD) profile only;

Operator (VodafoneZiggo)

- ◆ Cascaded transcoding with additional latency and quality degradation;
- ◆ Non-linear profiles derived from DVB-C profiles;
- ◆ SD (MPEG-2 and AVC) required for support of legacy receivers;
- ◆ Preference for higher quality sources to improve quality for end-users with low-latency.

Current situation for KPN



Current situation, Pro's and Con's (KPN)

Broadcaster

- ◆ Multiple delivery profiles with different quality;
- ◆ Multiple profiles: HD (AVC) and SD (MPEG-2) with fixed bitrates (Preference for HD);
- ◆ Urge to simplify playout with high quality HD (UHD) profile only;

Operator (KPN)

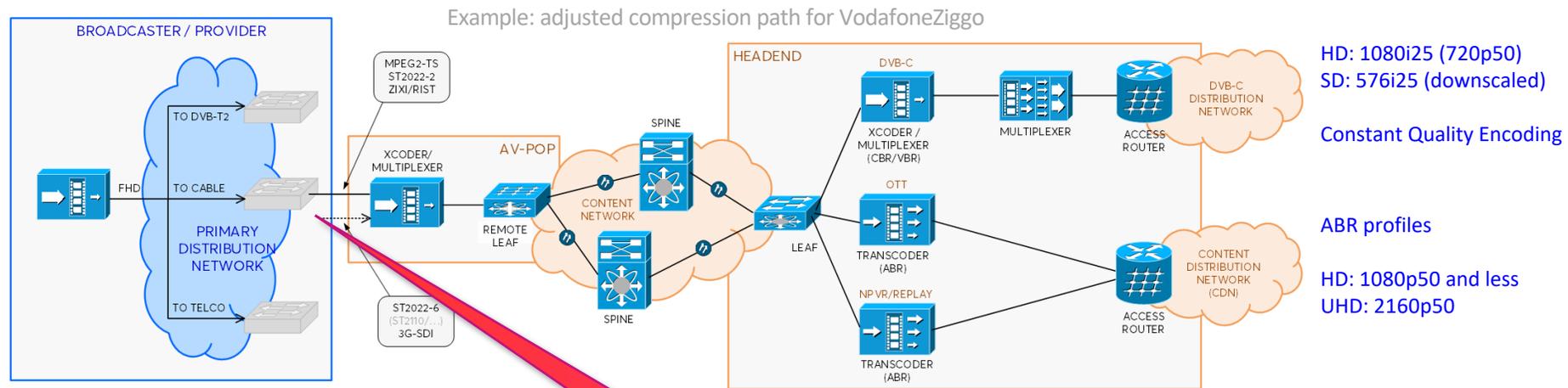
- ◆ Transcoding is common practice. Remuxing has less delay;
- ◆ Additional end-to-end latency and quality degradation;
- ◆ Preference for higher aggregation quality: Low-latency HD-HBR, 25 Mb/s, 1080i25
- ◆ Higher quality is more than welcome: Low-latency HD-HBR, 25-50 Mb/s, 1080p50 for DVB-T2 and OTT distribution.

**Primary Distribution in
unified profiles (Mezzanine)**

Proposal



"One source fits all" - Mezzanine delivery profiles



- ◆ Full HD Preferred 1080p50 (10 bits), AVC Hi10P @L4.2, 30-50 Mb/s
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NOTE: UHD is considered next-level mezzanine (no timetable yet)
NOTE: HDR, HFR en WCG to be discussed

What's in it for me? Broadcasters and Operators...

For the Broadcasters

- ◆ 'Mezzanine' high quality delivery profiles;
- ◆ Simplification of compression platform;
- ◆ Delivers only HD to all operators. Operator scales down to SD when required;
- ◆ Technical specifications are uniform, simple and clear;
- ◆ Mezzanine is preferred. Less than mezzanine will remain acceptable!



For the Operators

- ◆ Less degradation after transcoding and therefore higher quality for the end-user;
- ◆ Opportunity to reduce latency through the whole distribution chain;
- ◆ Simplification of content aggregation;
- ◆ Utilize bandwidth more efficiently by use of Constant Quality (VBR) transcoding;
- ◆ Distribution of compressed non-mezzanine delivery formats must be continued.

What's in it for me? Broadcast chain and the viewer...

For the Broadcast Chain

- ◆ Workflow for future "enhancements";
- ◆ Less format conversions to assure quality throughout the whole chain;
- ◆ Reduction of end-to-end delay (latency);
- ◆ Downscaling to lower profiles on the edge, close to the end-user;
- ◆ Agreements with Operators emphasized on Quality instead of Bitrate.

For the end-user at home

- ◆ Receiving the most optimal quality fitting for his/her devices, subscription and operator;
- ◆ Addresses the Operator for the experienced quality;
- ◆ Encounters less end-to-end delay when enjoying their content. Especially with LIVE events;
- ◆ Quality of non-mezzanine delivery profiles remains as is.

Local Public Broadcasters (NLPO)

- ◆ There are simply too many local broadcasters for distribution in Full HD, resulting in congestion on the delivery network. Therefore distribution of local broadcasters limited to 720p50.
- ◆ The 'mezzanine' profile for public local broadcasters is:
 - Basic HD: 720p50 (8 bits), AVC HP@L4, 8-10 Mb/s**
- ◆ Distribution profiles and bitrates to be defined by the Operators (in consultation with NLPO) related to distribution capacity and capabilities;
- ◆ Further investigation and discussions between all involved parties required.

Next level Mezzanine (towards UHD)

- ◆ No timetable yet
- ◆ The 'mezzanine' profile for UHD broadcast is expected to be:
 - 4K: 2160p50 (10/12 bits), HEVC MT@L5.1, 25-50 Mb/s**
 - 2K: 1080p50 (10/12 bits), AVC Hi10P @L4.2, 30-50 Mb/s**
- ◆ Discussion on UHD-HDR: current preferences differ and multiple standards (HLG, HDR10, HDR10+ etc)
 - ◆ KPN prefers HLG over HDR10 due to better downconversion to SDR and reception issues using HDR10 with some of the end users.
 - ◆ VodafoneZiggo prefers HDR10 over HLG,
 - ◆ High bitrate and 12bits profile would allow operator to choose HDR-profile best fitting

Addendum to
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V1.1 / June 29, 2022

Next level Mezzanine (towards UHD)

Ziggo, Canal Digitaal, KPN and a few smaller operators gained experience in the distribution of linear UHD signals in the past years.

The following specification is an interim guidance which will provide a good picture quality on the majority of available displays. Objective must be to provide an 'excellent' image quality at all times. The end-user will notice the difference.

Three common UHD profiles identified for re-distribution:

- ◆ 4K SDR (2160p50), BT.2020
- ◆ 4K HDR (2160p50), BT.2020, HLG or HDR10
- ◆ 2K HDR (1080p50), BT.2020 , HLG or HDR10

Note: HLG provides backward compatibility for first generation 4K 'non HDR' displays.

4K SDR: 2160p50, BT.2020, SDR

(re-distribution)

| Video | |
|---------------------|---------------|
| Spatial resolution | 3840 x 2160 |
| Color resolution | 4:2:0 |
| Temporal resolution | 50 frames/s |
| Luminance bit depth | 10 bits |
| Color space | ITU-R BT 2020 |
| EOTF | Gamma |

| Audio | |
|---------------|--------------------------|
| Stereo | MPEG-1/L2 (optional AAC) |
| Multi channel | Dolby AC3 (optional AAC) |

| Video encoding | |
|----------------|------------------------------|
| Codec | MPEG ITU rec. H.265 (2/18) |
| Profile | Main10@L5.1 |
| GOP size | approx. 1 second, closed GOP |
| Bitrate (Max.) | 22 Mbit/s |

| Primary distribution | |
|----------------------|--|
| System | MPEG-2 Transport Stream ETSI TS 101 154 V2.4.1 (2018-02) |
| Encapsulation | Max. bitrate for a single UHD channel in that stream is: 23,5 MBit/s |

4K HDR: 2160p50, BT.2020, HDR

(re-distribution)

| Video | |
|---------------------|---------------|
| Spatial resolution | 3840 x 2160 |
| Color resolution | 4:2:0 |
| Temporal resolution | 50 frames/s |
| Luminance bit depth | 10 bits |
| Color space | ITU-R BT 2020 |
| EOTF | HLG or HDR10 |

| Audio | |
|---------------|--------------------------|
| Stereo | MPEG-1/L2 (optional AAC) |
| Multi channel | Dolby AC3 (optional AAC) |

| Video encoding | |
|----------------|------------------------------|
| Codec | MPEG ITU rec. H.265 (2/18) |
| Profile | Main10@L5.1 |
| GOP size | approx. 1 second, closed GOP |
| Bitrate (Max.) | 22 Mbit/s |

| Primary distribution | |
|----------------------|---|
| System | MPEG-2 Transport Stream ETSI TS 101 154 V2.4.1 (2018-02) |
| Encapsulation | Max. bitrate for a single UHD channel in that stream is: 23,5 MBit/s |

2K HDR: 1080p50, BT.2020, HDR (re-distribution)

| Video | |
|---------------------|---------------|
| Spatial resolution | 1920 x 1080 |
| Color resolution | 4:2:0 |
| Temporal resolution | 50 frames/s |
| Luminance bit depth | 10 bits |
| Color space | ITU-R BT 2020 |
| EOTF | HLG or HDR10 |

| Audio | |
|---------------|--------------------------|
| Stereo | MPEG-1/L2 (optional AAC) |
| Multi channel | Dolby AC3 (optional AAC) |

| Video encoding | |
|----------------|---------------------------------|
| Codec | MPEG ITU rec. H.265 (2/18) |
| Profile | Main@L5.1 |
| GOP size | approx. 1 second, closed GOP |
| Bitrate (Max.) | 16 Mbit/s (target is 12 Mbit/s) |

| Primary distribution | |
|----------------------|---|
| System | MPEG-2 Transport Stream ETSI TS 101 154 V2.4.1 (2018-02) |
| Encapsulation | Max. bitrate for a single UHD channel in that stream is: 18,5 MBit/s |