NMOS **A**dvanced **S**treaming **A**rchitecture

AES3 Audio and more ...

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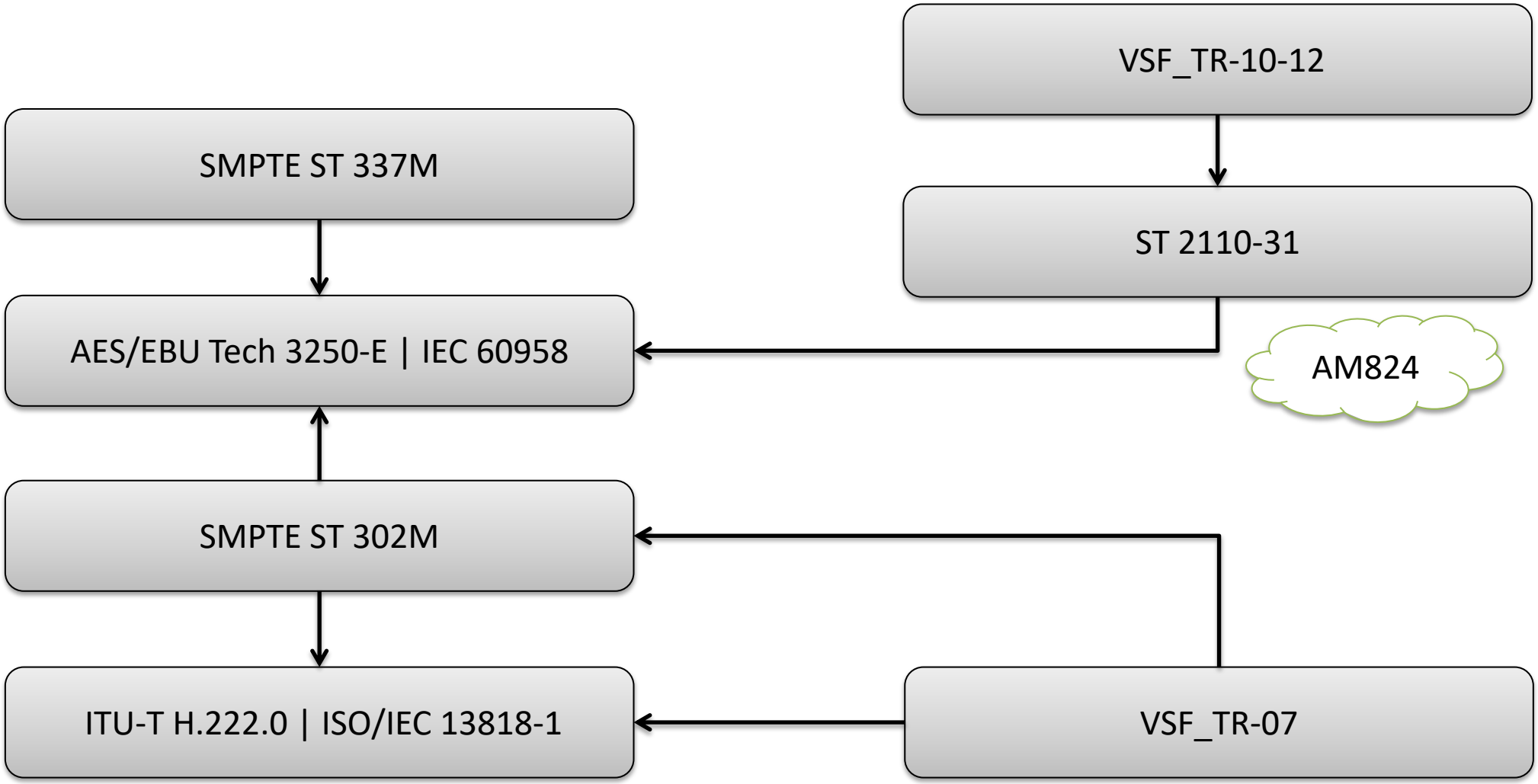
v0.1

Public GitHub Repository

- https://github.com/alabou/NMOS-MatroxOnly
  - README.md

  - NMOS With AES3.md
  - NMOS With AAC.md
  - NMOS With IPMX.md
  - NMOS With H.222.0.md

Standards


VSF_TR-10-12
SMPTE ST 337M
ST 2110-31
AES/EBU Tech 3250-E | IEC 60958
AM824
SMPTE ST 302M
ITU-T H.222.0 | ISO/IEC 13818-1
VSF_TR-07

AES/EBU => AES3 Stream

32 bit per sub-frame

sub-frame (20 to 24 bits)

sub-frame (16 to 20 bits)

frame

Restrictions over IP:

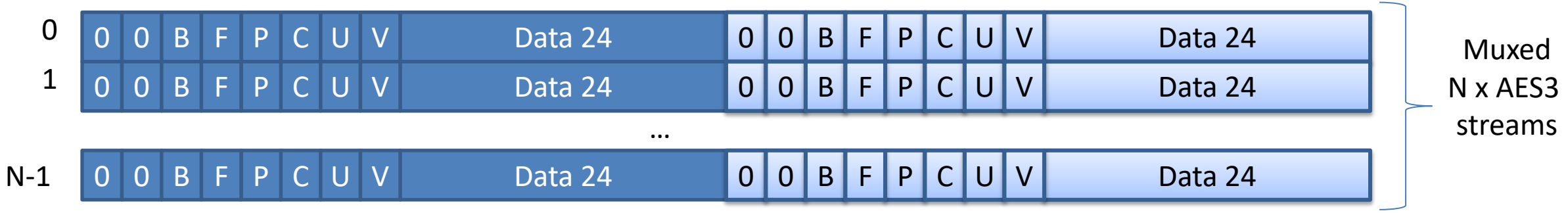
- standard implementation of the channel status as per section 7.2.2 of AES3 where only the byte 0, 1, 2 and 23 may have a non-zero value.
- unspecified, two-channel or stereoscopic channel modes only

ST 2110-31 => AM824 Stream

32 bit per sub-frame

sub-frame (16 to 24 bits)

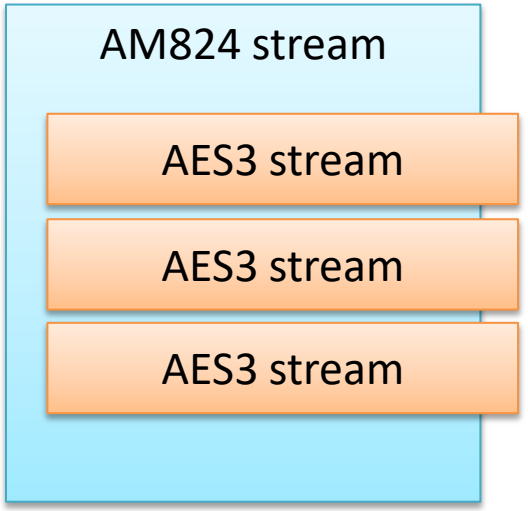
frame



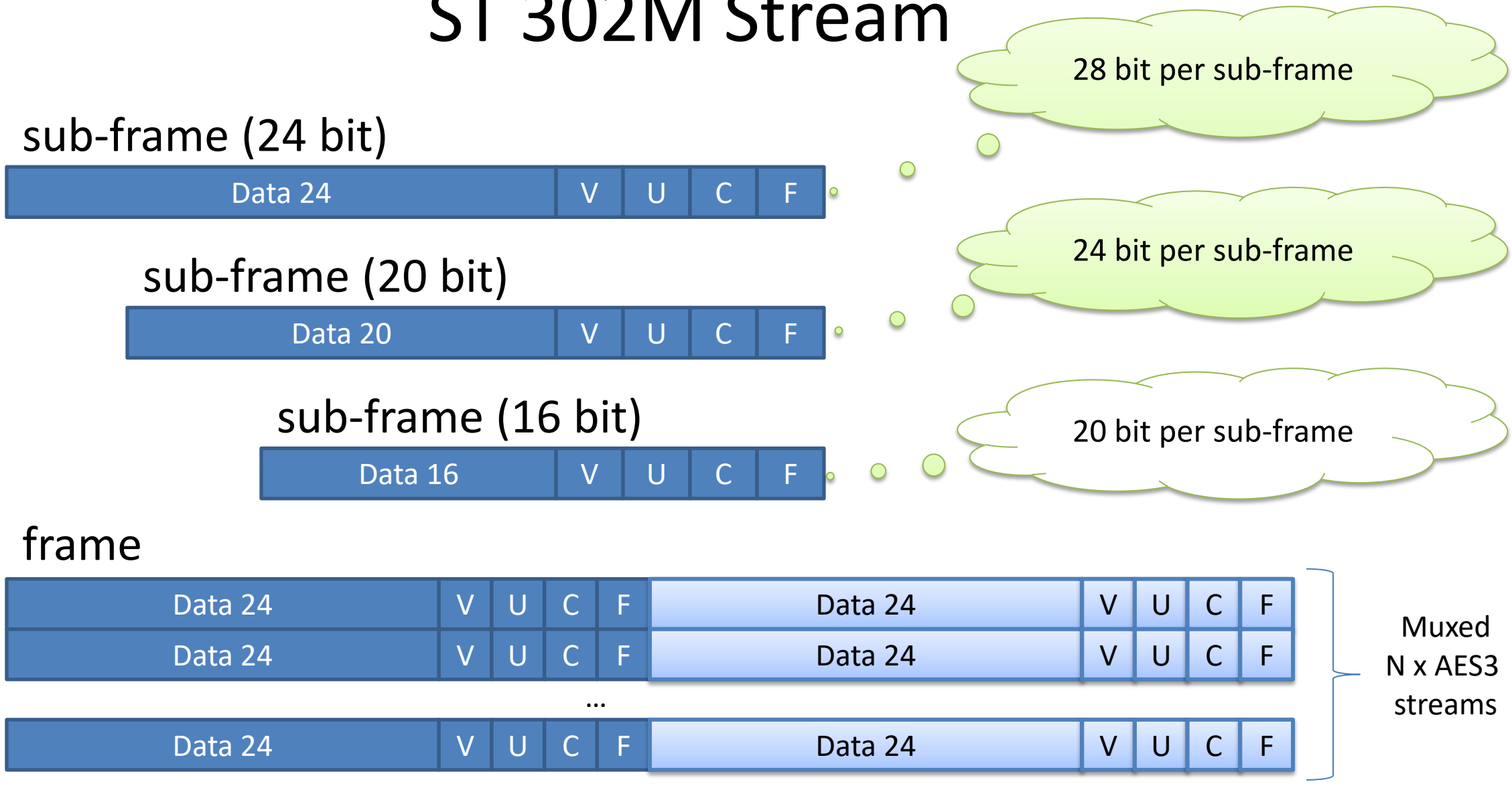
Two sub-frames are always 64 bit (8 bytes)

AM824 Stream

- Multiplexes multiple AES3 Streams
  - Per AM824 Stream
    - Maximum 3-40 AES3 stereo Streams
    - According to ptime and sampling rate (see ST 2110-31)
- SDP channel_order parameter
  - Provides channels to audio layer mapping



ST 302M Stream



Two sub-frames are always a multiple of 8 bit (5, 6 or 7 bytes)

ST 302M Stream

- Multiplexes multiple AES3 Streams
  - Maximum 4 => 8 channels
    - Per MPEG2-TS elementary stream
- 48 KHz sampling rate
- Total number of channels
  - SUM of channels of each audio layer => SumOfChannels
- audio_layers
  - one layer per MPEG2-TS elementary stream
    - channel_identification parameter

      $\Rightarrow$ first channel of an elementary stream out of SumOfChannels

Modeling in NMOS with AM824 Streams

- Assuming AES3 “standard implementation” over IP
  - AES3 stream Channel Status (section 7.2.2 of AES3)
    - bytes 0, 1, 2 and 23 are allowed to be non-zero, all other bytes are 0
      - Only one coded audio stream
      - Only one linear PCM stereo stream
- AM824 Stream
  - Comprises multiple AES3 Streams as per ST 2110-31
    - Over RTP (linear PCM and/or coded audio)
    - AES3 count = channel_count / 2 (opaque and fully described)
  - Comprises multiple AES3 Streams as per ST 302M
    - Over MPEG2-TS (linear PCM and/or coded audio)
    - AES3 count = channel_count / 2 (opaque)
  - audio_layers = groups in SDP channel-order parameter

Modeling in NMOS with AM824 Streams

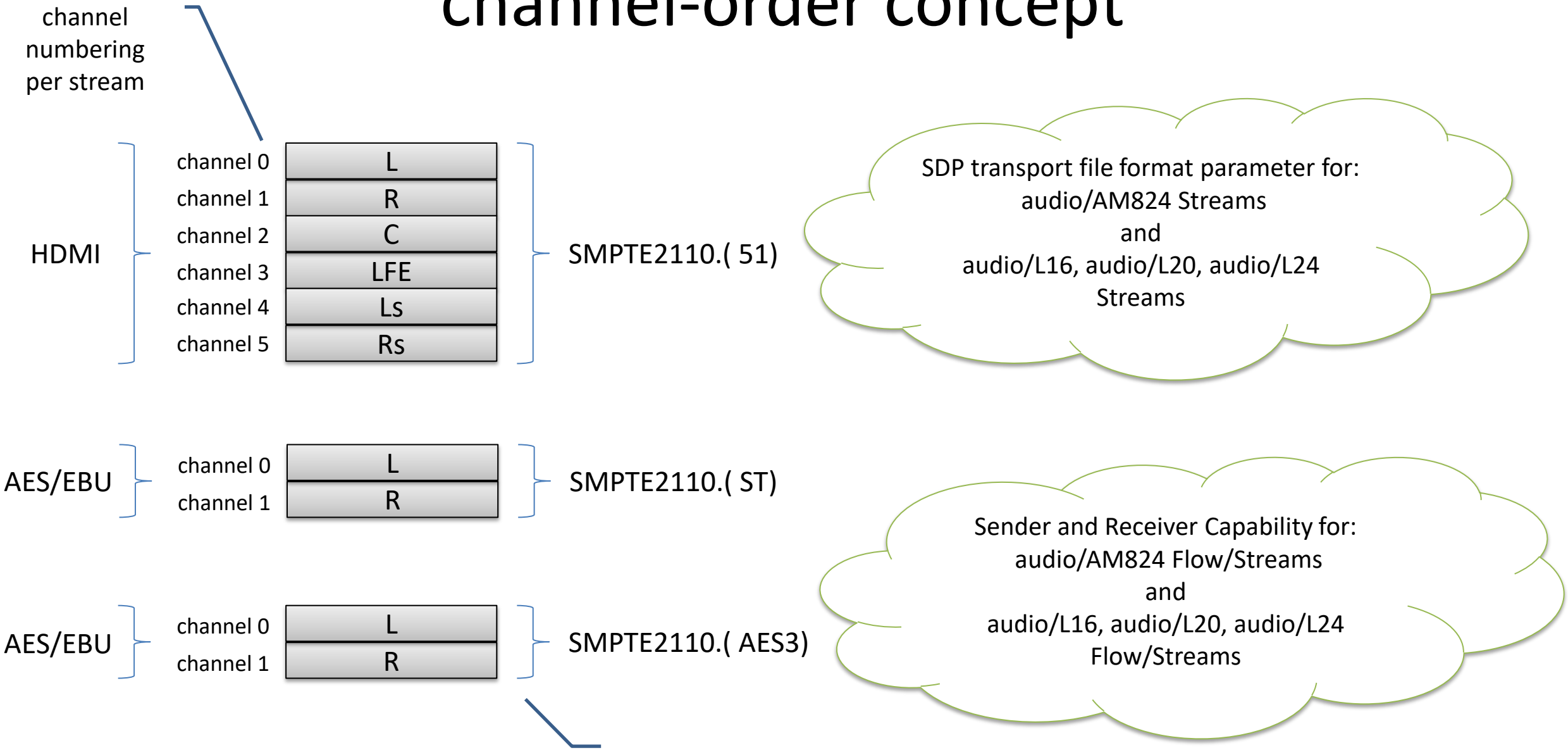
- media_type
  - application/AM824 => fully-described
    - mux Flow/Stream
  - audio/AM824 => opaque
    - audio Flow/Stream
    - audio sub-Flow/sub-Stream

- In an SDP transport file
  - audio/AM824 => ALWAYS
  - channel-order => ALWAYS

Modeling in NMOS with AM824 Streams

- AES/EBU interface
  - An AES3 Stream
    - May have enhanced functionalities (more than what is allowed over IP)
      - Multiple non-linear streams [1, 6]
    - On input => AES/EBU stream **converted** to AM824 Stream
      - Opaque or Fully Described
      - May or not keep the AES/EBU interface sample rate
    - On output => AM824 Stream **converted** to AES/EBU
      - Opaque or Fully Described
      - May or not keep the AM824 Stream sample rate

channel-order concept



channel-order concept

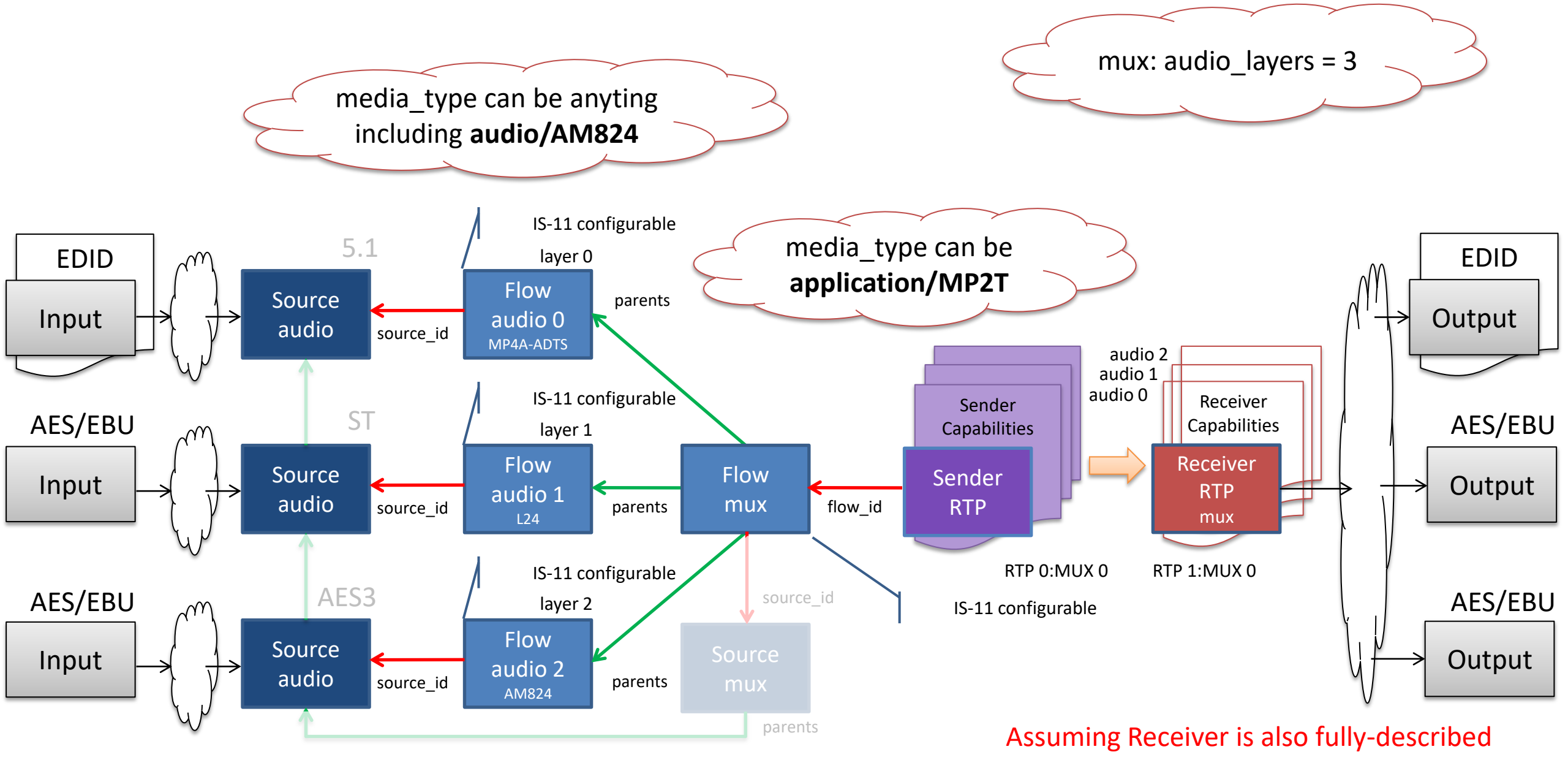
- ST, 51 and 71 are linear PCM groups of 2, 6 and 8 channels
  - embedded as multiple AES3 Streams => 2 channels per linear AES Stream

- AES3 is non-linear coded audio group
  - embedded as an AES3 Stream => 2 channels per non-linear AES stream

AES3 over MPEG2-TS

- An MPEG2-TS mux Stream
  - N audio layers => each layer could be
    - 1 coded audio (ex. audio/MP4A-ADTS)
    - 1 PCM audio (ex. audio/L24)
      - Produce channels/2 embedded linear PCM AES3 Streams
    - 1 opaque AM824 Stream (ex. audio/AM824)
      - MAY have channels/2 embedded AES3 Streams
        - » linear PCM and/or non-linear
  - ST 302M
    - Aggregate the AES3 Streams from PCM and AM824
      - audio_layers or channel-order ordering

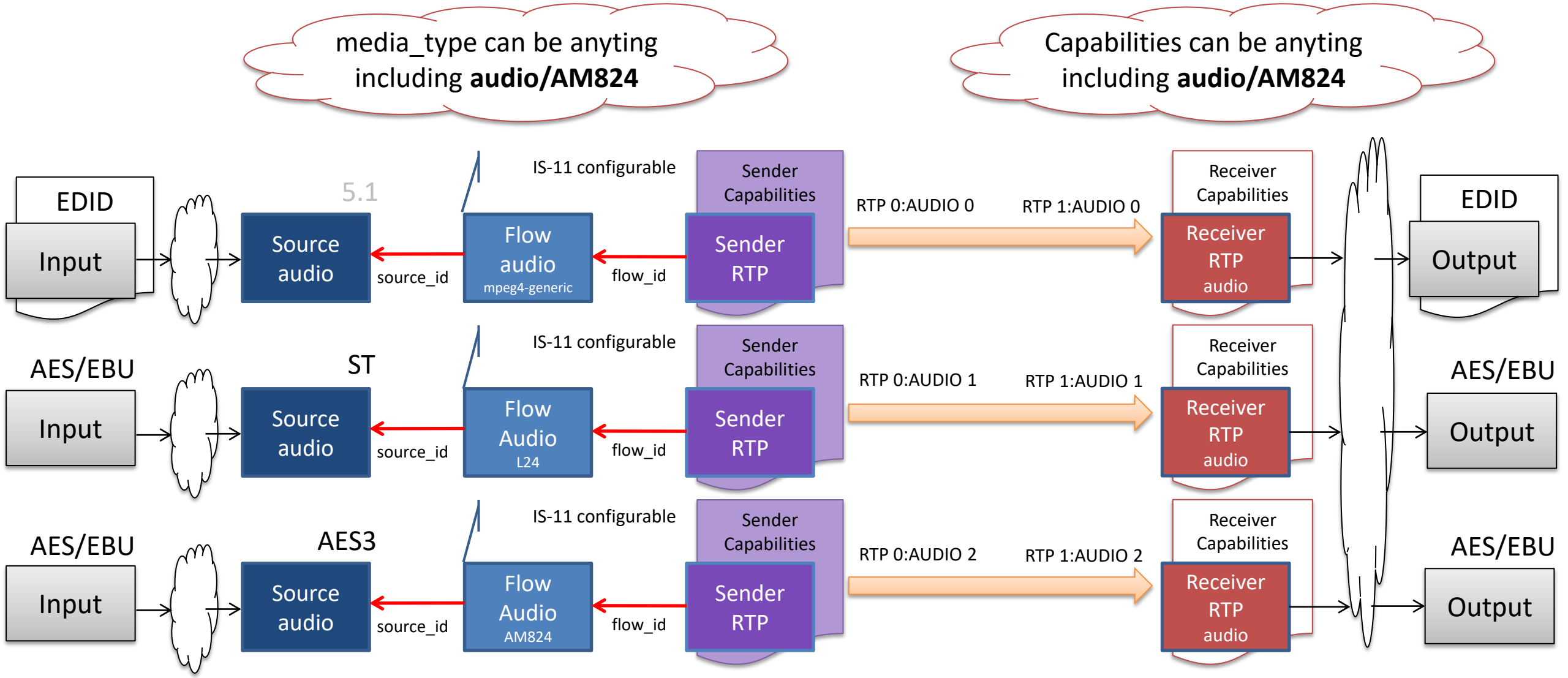
Fully-described MPEG2-TS Multiplexed Audio sub-Streams



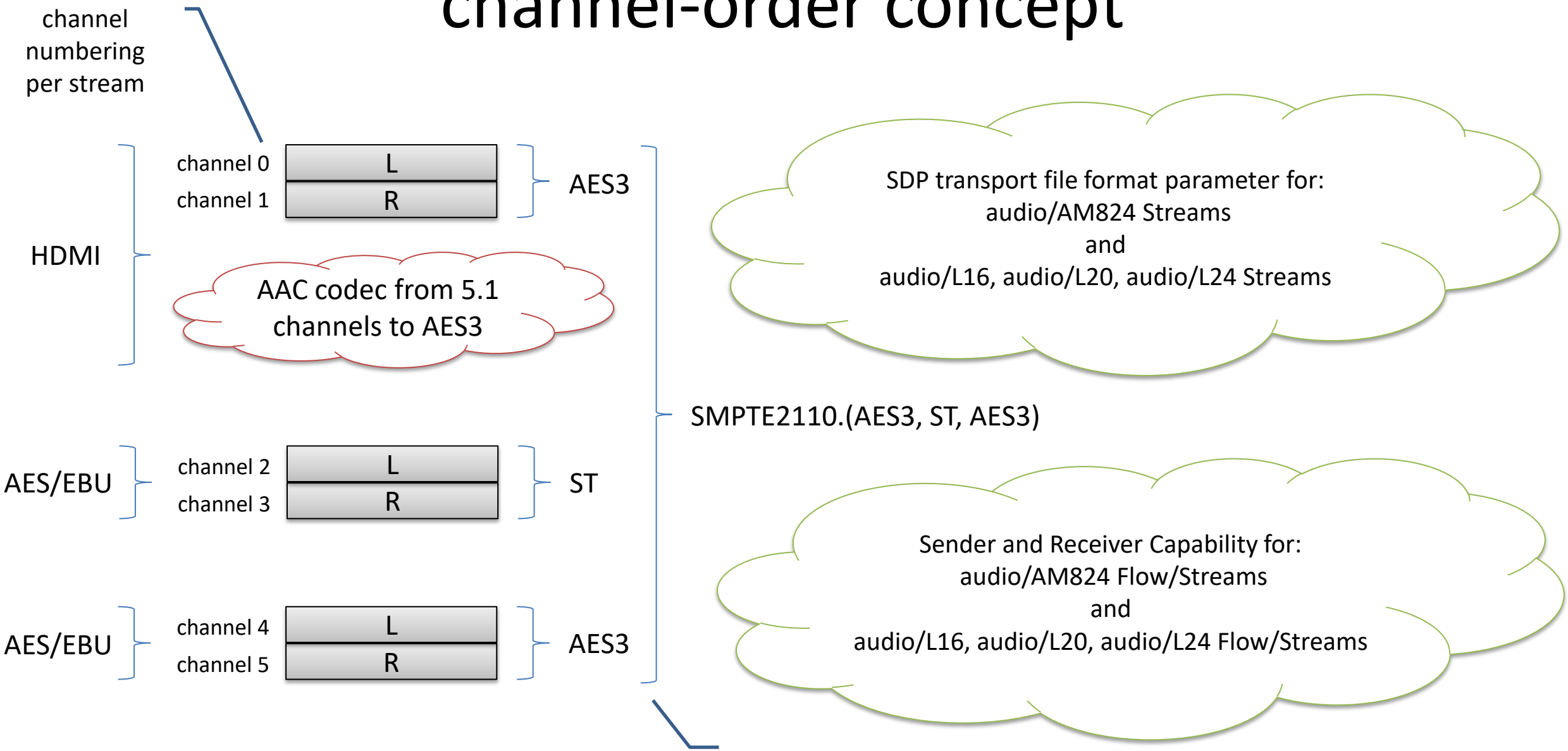
AES3 over RTP (not RFC 2250)

- An RTP audio or mux Stream
  - 1 coded audio (ex. audio/mpeg4-generic)
  - 1 PCM audio (ex. audio/L24)
  - 1 opaque AM824 Stream (ex. audio/AM824)
    - MAY have channels/2 embedded AES3 Streams
      - linear PCM and/or non-linear
  - 1 fully described AM824 Stream (ex. application/AM824)
    - MAY have audio_layers sub-streams => each layer could be
      - 1 PCM audio (ex. audio/L24)
        - » Produce channels/2 linear PCM AES3 Streams
      - 1 coded audio (ex. audio/MP4A-ADTS)
        - » Produce one non-linear AES3 Stream
  - ST 2110-31
    - Aggregate the AES3 Streams from PCM and coded audio
      - audio layers or channel-order ordering

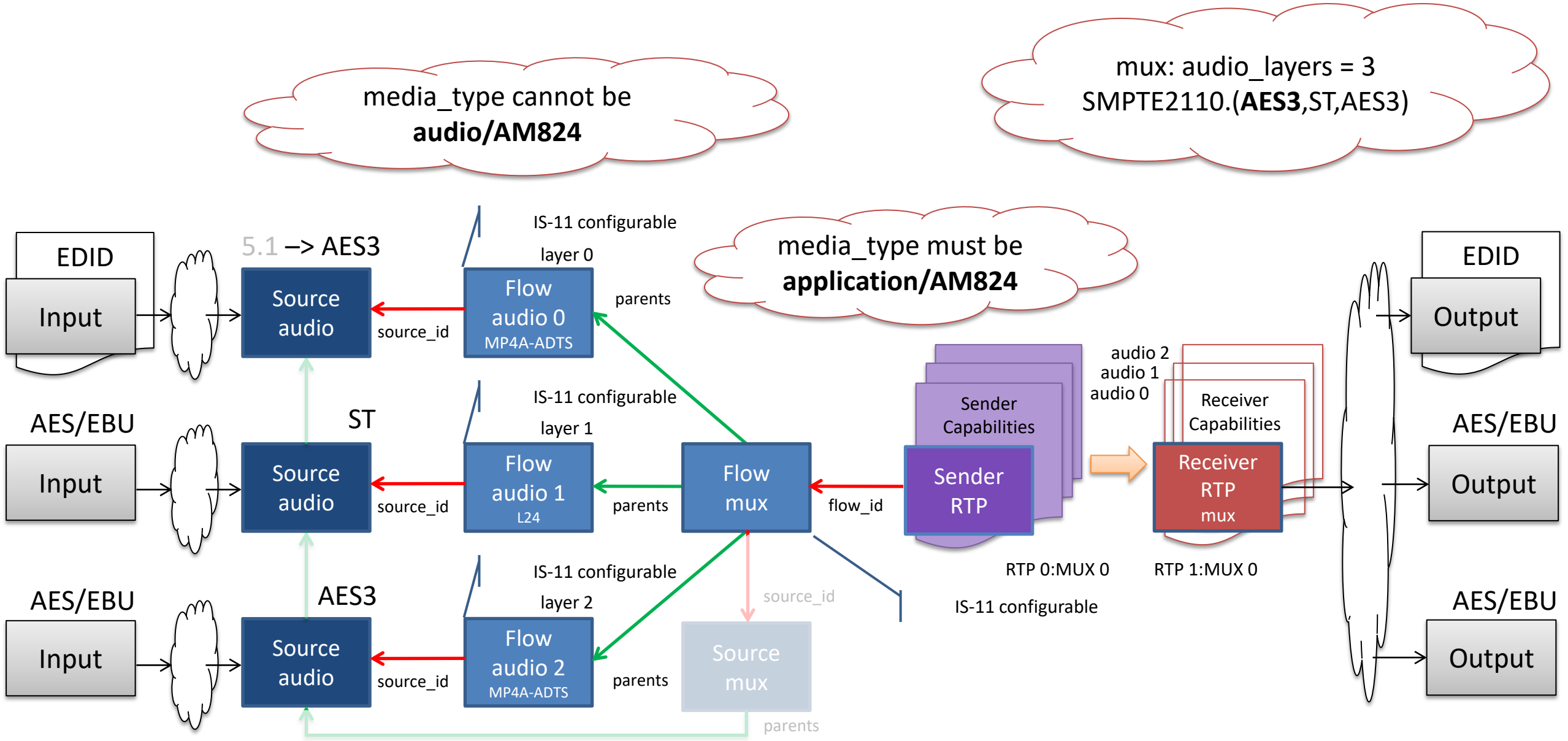
Independent Audio Streams



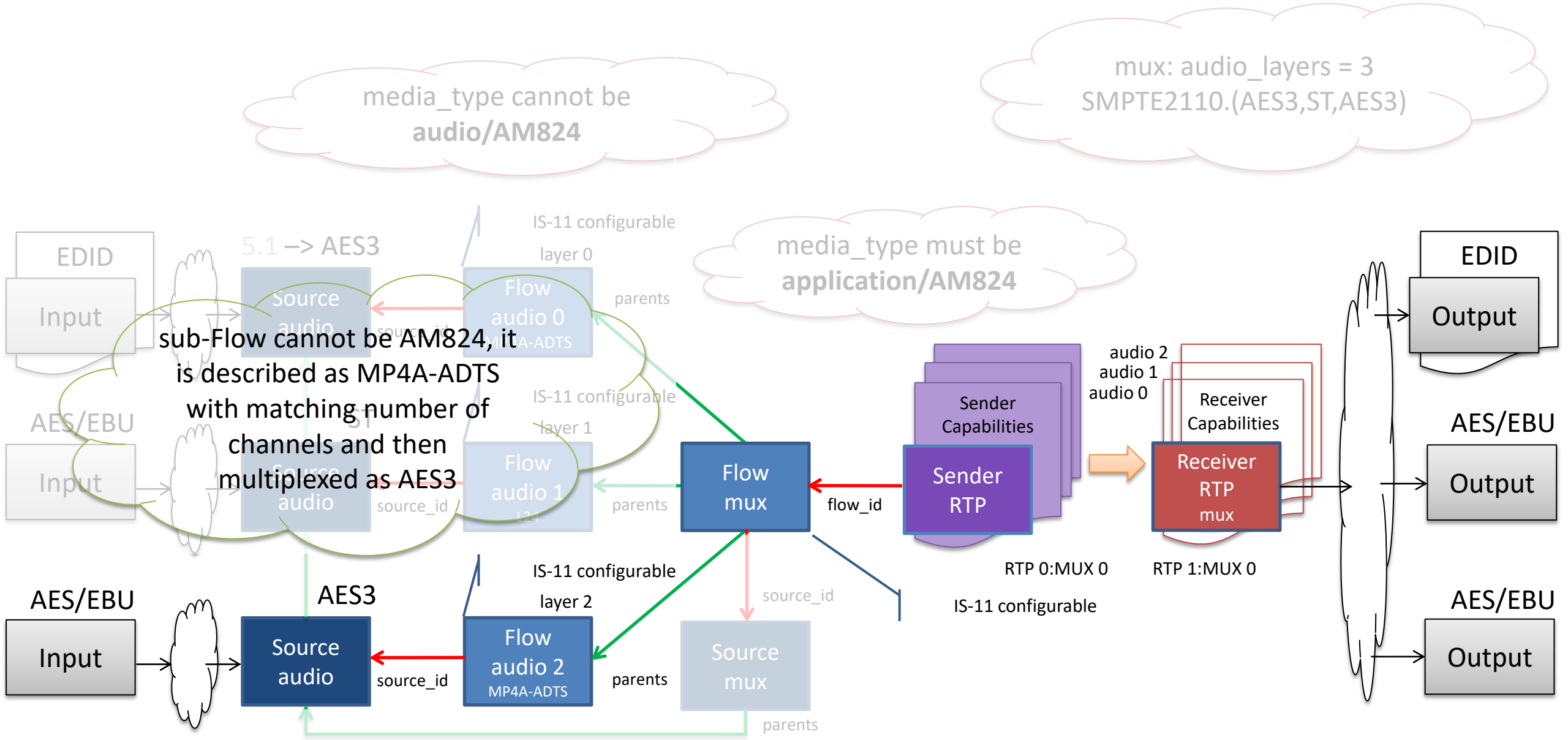
channel-order concept



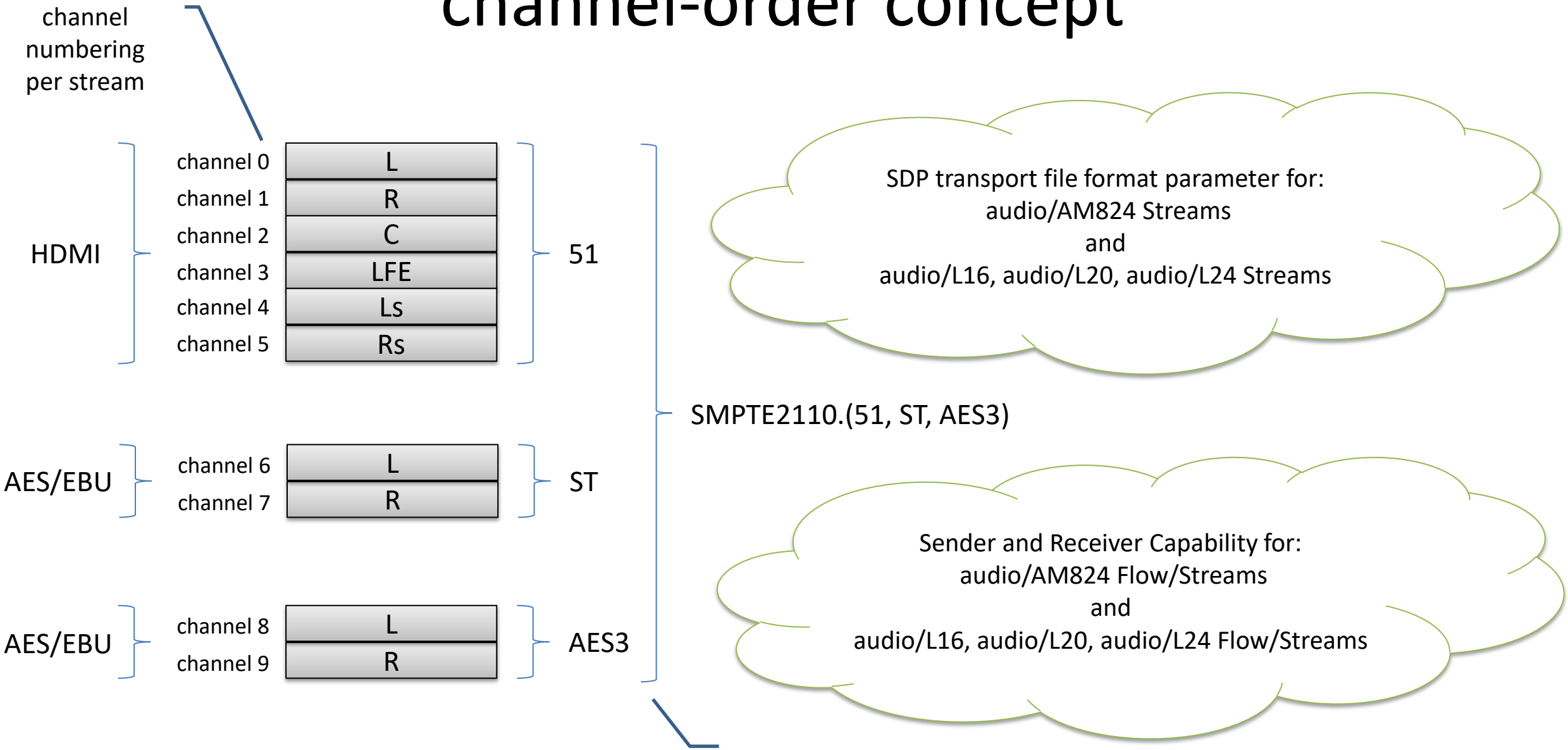
Fully-described AM824 Multiplexed Audio sub-Streams



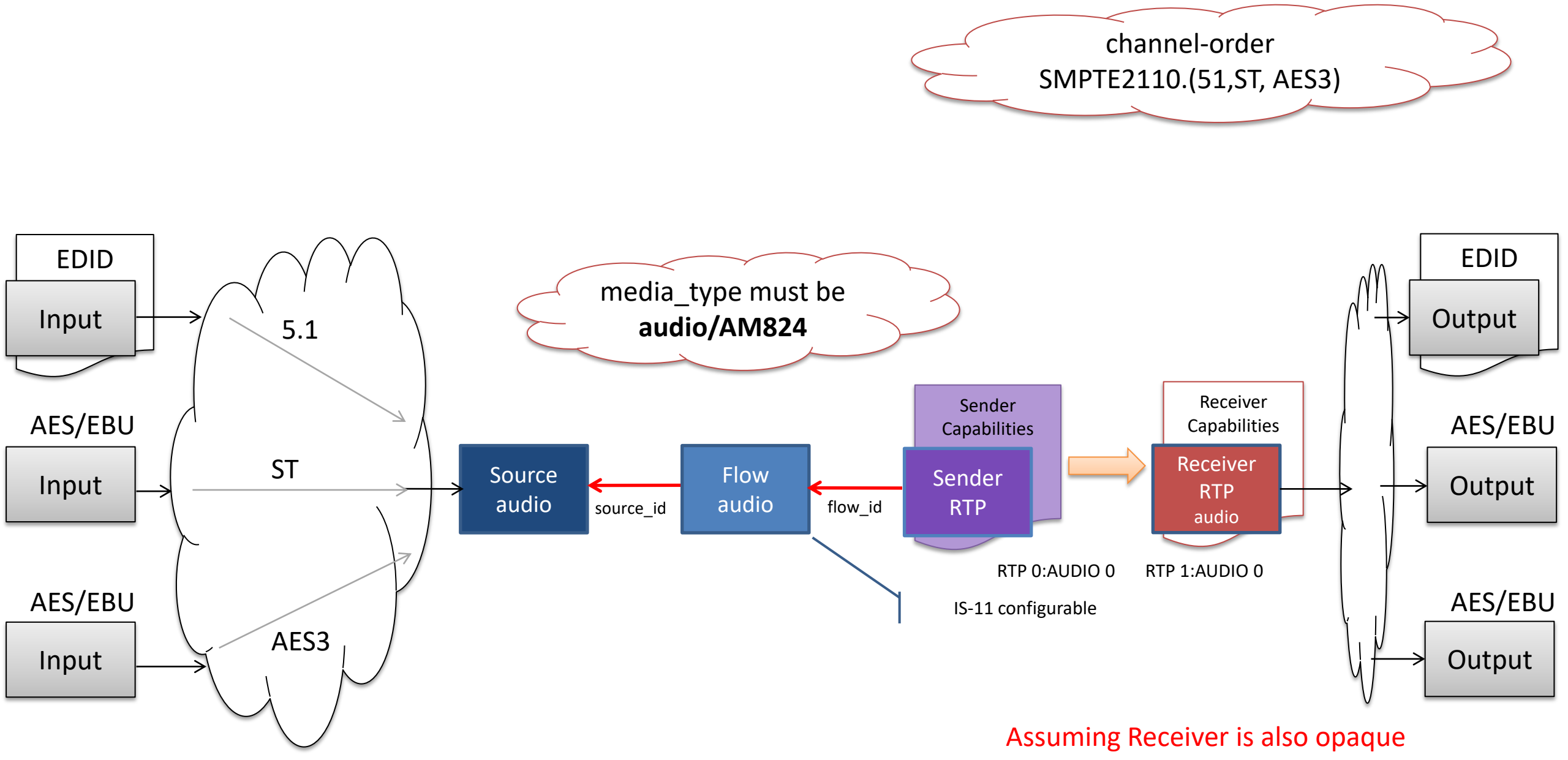
Fully-described AM824 Multiplexed Audio sub-Streams



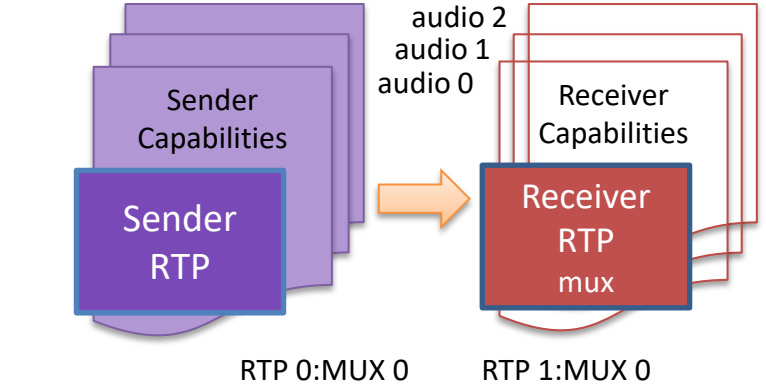
channel-order concept

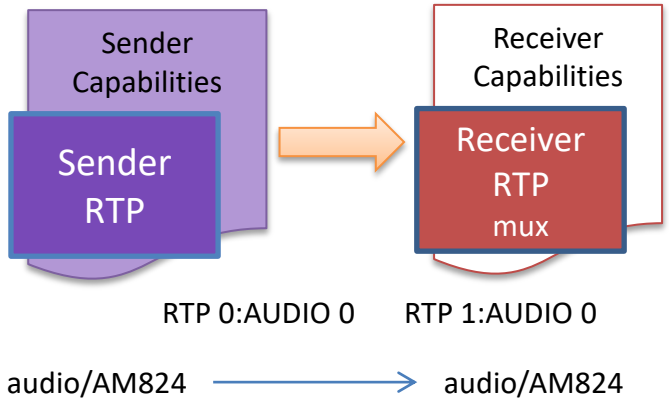


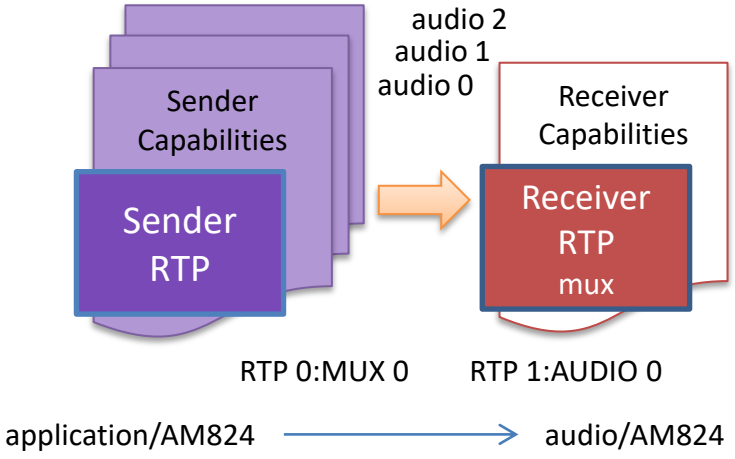
Opaque AM824 Multiplexed Audio sub-Streams

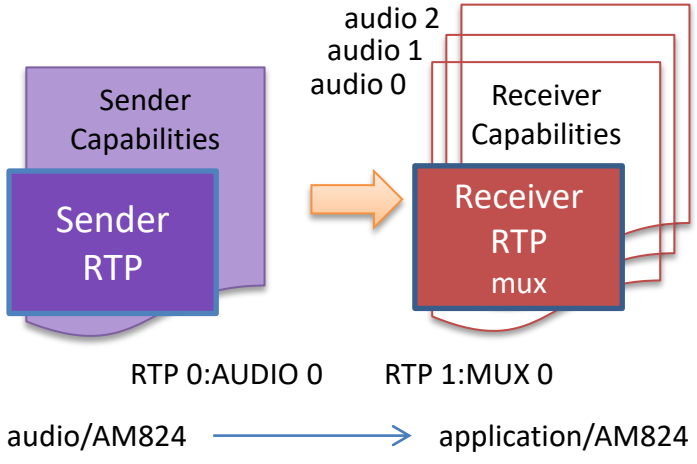


Opaque / Fully Described mix and match

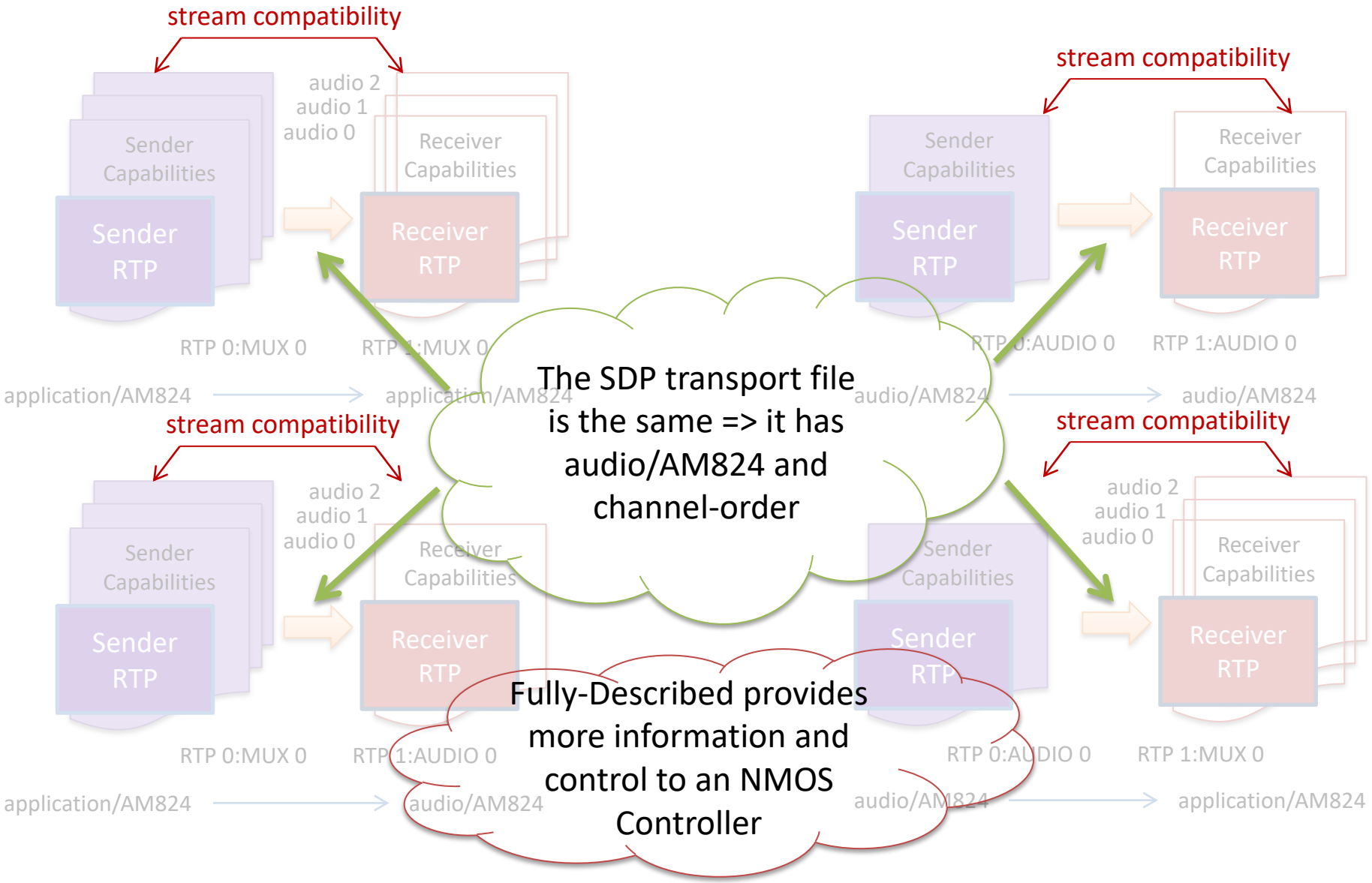








Opaque / Fully Described mix and match



- This concludes our overview of NMOS AES3 and AM824 audio, a key feature of Matrox NMOS Advanced Streaming Architecture.

- If you have any questions, feel free to reach out at abouchar@matrox.com.

- Thank you for attending.