The Audio Muddle

Mono-Channel Audio Manipulation in a Multi-Channel World

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Why is Audio always the Problem?

- Audio is used in very different ways in different parts of the chain
  - Playout, Master Control, and Distribution (usually) organize the audio into finished mixes (5.1, 2.0) or at least a common lineup.
  - Production (sometimes) organizes the audio into groups of related sources – but it varies…
  - Both have exceptions and variations

- IP did not create this headache – Audio has always been hard

How The Audio Problem Manifests in IP

- In IP systems, audio is organized into streams
  - Streams usually contain multiple channels
  - Multi-channel streams help manage Systemic Complexity
- IS-04 lists the streams (senders)
- IS-05 switches the streams (to the receivers)

- But what if you want to manipulate it?
  - Shuffle, substitution, or even wild-mapping? How?

Mono-Channel Control of Audio (using Multi-channel Streams)

- Every Audio device has different capabilities [receivers especially]
  - # of senders/receivers, how many channels per
  - mapping & control of the internal audio channels matrix
- IS-05 describes “Stream-based” audio routing
  - Yes IS-08 manages the destination map between streams and internals
  - But IS-08 is not widely deployed yet – and only helps if there are lots of receivers
- System Efficiency is improved if there are multiple channels per audio stream
  - If the content has a pattern (5.1 mixes for example) its best for the streams to follow it
  - Ingress operations can align to a target format, but destinations might not eat it well
- *Operationally, Customers want mono-channel granularity of control over the audio*
  - As designers, our job is to give them fine-grained control, regardless of the above

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The Puzzle-Pieces of the Audio Puzzle

- Routing-System ***Sources*** bundle the Video, Audio, and ANCData
  - Stream-based routing for Video works well (typically there is one video)
  - There may be multiple audio streams
    - Inside each stream there are multiple channels
    - The same source channel might appear in more than one stream

- Routing-System ***Destinations*** include Video, Audio, and ANCdata
  - Video Stream Receivers for stream-based video routing
  - Ideally the destinations as the user sees them are *Audio Channels* (downstream of the stream receivers and streams-to-channels matrix)
  - VANC will have similar challenges as audio

I Thought IS-08 Solved this problem?

- IS-04 and IS-05 treat audio streams as monolithic essences – mixes or tracks to be kept together in the network, and switched together to the receiver

- Sometimes, operationally, there is a need to route the individual tracks more specifically – at the “mono” level

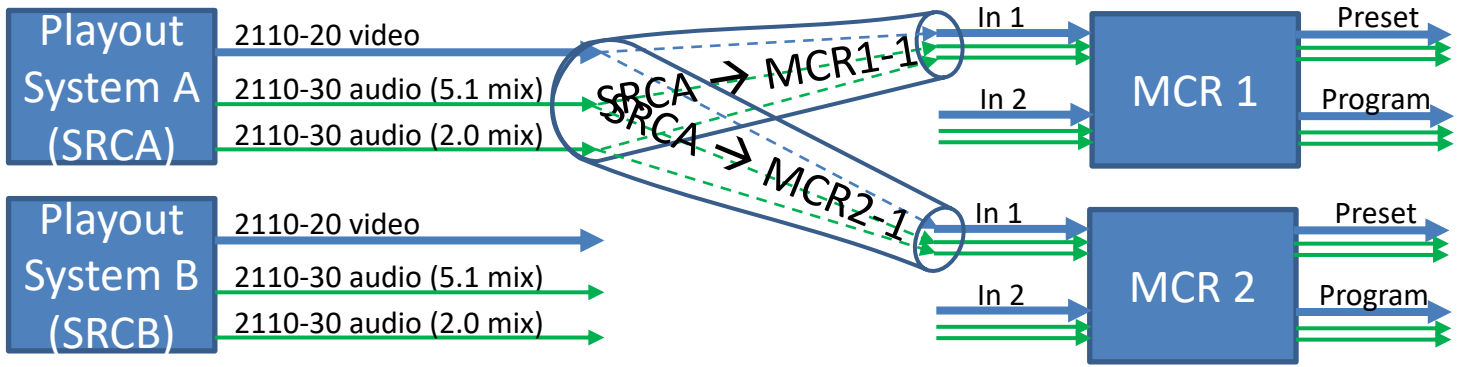
- IS-08 provides an open/public API for controllers to manipulate the individual tracks on receivers and senders, while retaining the general efficiency of keeping related tracks organized together into streams

Why not just make every mono channel into a separate multicast audio stream?

- Making each track its own stream is possible, except…
  - It creates a more complicated system overall because of the very large number of streams
  - Some receiving devices don't have a lot of separate audio stream receivers, so (you cant use them)
  - Overall signal switching time can suffer because of the number of separate stream "joins" in every operation

Audio Stream Routing

- What is Stream Routing? Its what 2110-30 + IS-05 does by default
  - Routes logical groupings of content easily



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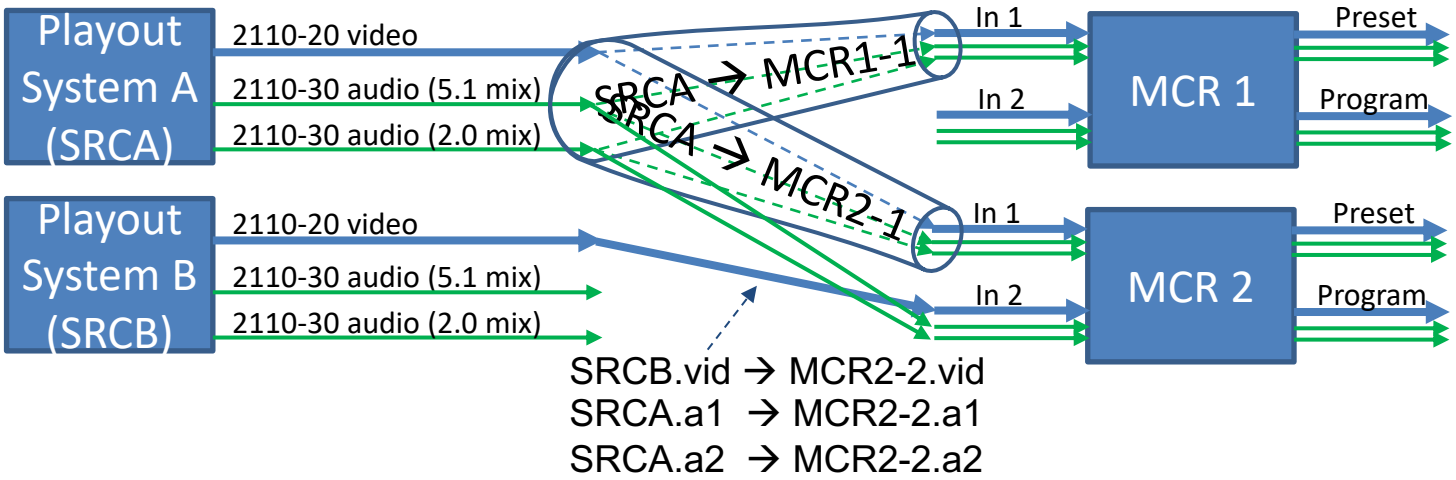

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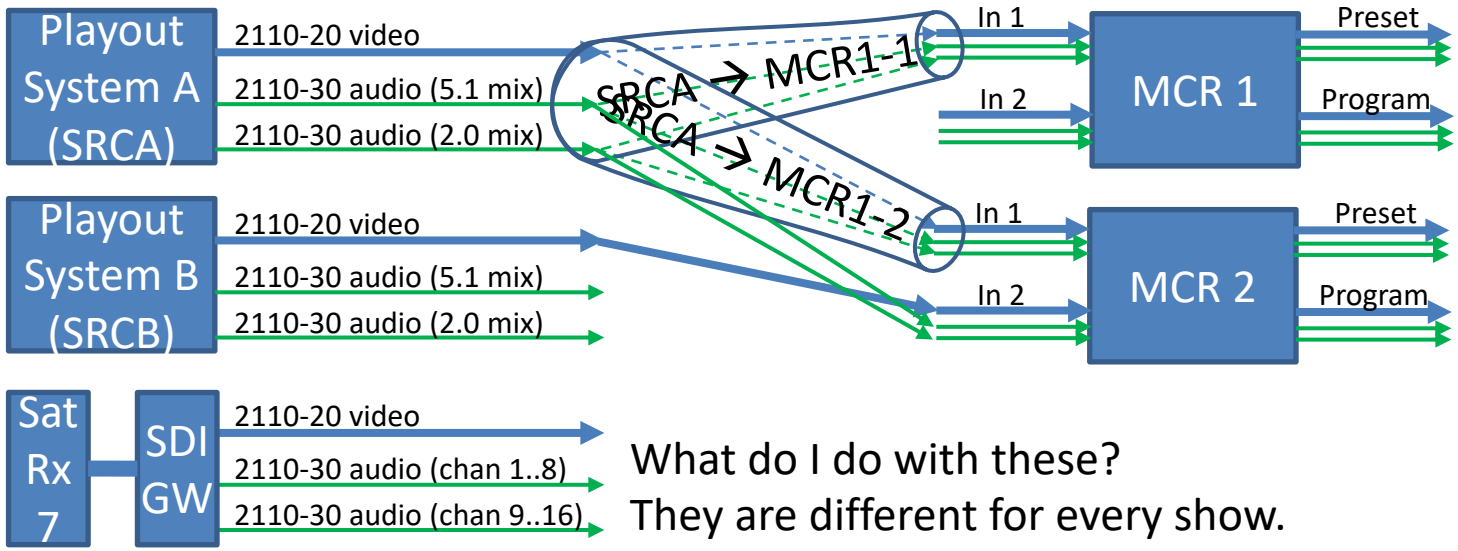
Audio Stream Routing

- What is Stream Routing? Its what 2110-30 + IS-05 does by default
  - Routes logical groupings of content easily
  - Break-away routing at the stream level
  - But how do you integrate signals that are not consistent?



What do I do with these?
They are different for every show.
And they are not organized like the others.

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What does the Operations User want?

- Route a whole source to a whole destination (REM5 → MCR3A)
  - Video connects to video
  - Source audio channels connect to destination audio channels
  - Control system does “whatever it has to do” to make it happen

- Route individual audio channels (break-away or discrete)
  - Connect a specific source audio channel (which might be part of a larger stream) to the destination audio channel (without disturbing the other channels)

- Manage PCM and Non-PCM properly when using Dolby-E

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Another Way to look at Audio Routing

- Control System represents audio sources to user as a set of “source channels”
  - The relationship of the channels to underlying streams is captured from the source devices or learned through other means
  - Stream Senders are also visible to support stream-based routing where needed

- Control System represents audio destinations as a set of “destination channels”
  - User sees a route from a source channel to a destination channel

- The Destination devices are either ***Capable*** or ***Need Help***
  - *Capable* destinations have enough stream receivers and controls for their mapping matrix
  - *Need Help* destinations may require an external helper matrix to assist in the routing

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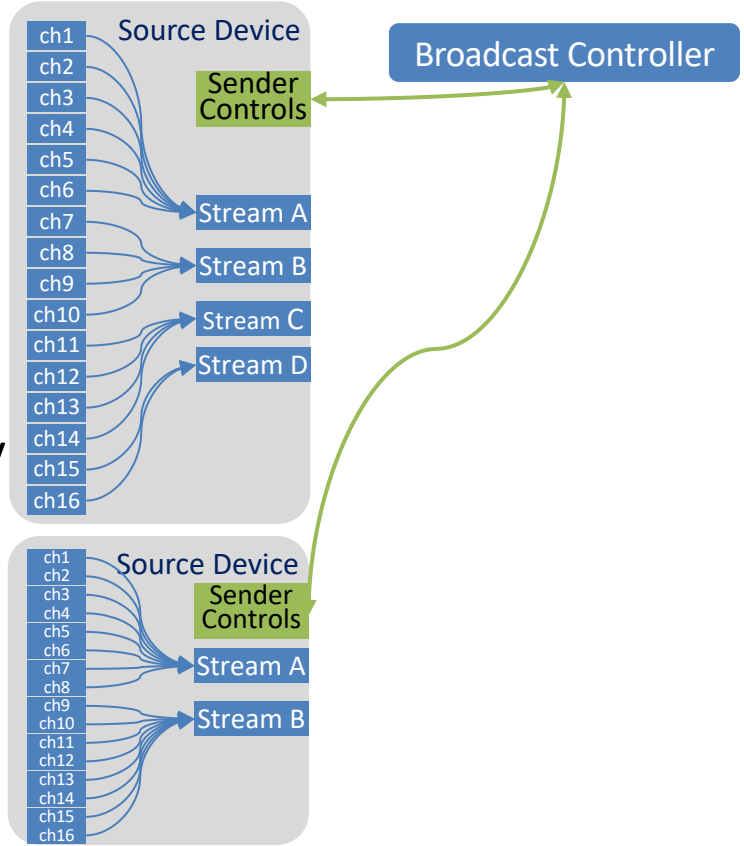
Mono-Track Audio Routing: Audio Sources

- Audio Source Channels exist inside the device
- They are mapped into network streams in some way
  - Hopefully an organized way
  - But sometimes not
- Ingress operators might modify the mapping on an event basis through the controls of the ingress device
- Controller follows the map dynamically at runtime



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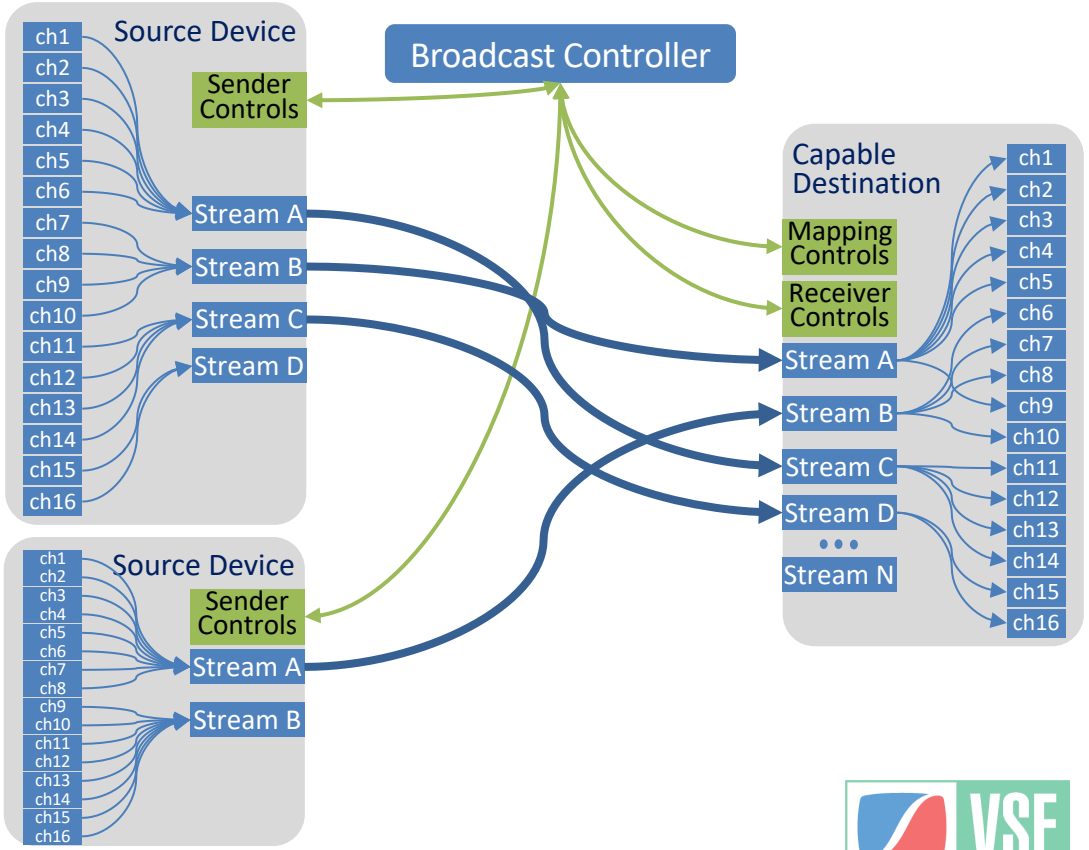
Mono Track Audio Routing: ***Capable*** Destinations

- Capable Destinations have
  - Enough Stream Receivers
  - Controllable internal mapping
- BC manages the receivers, and sends the necessary streams to the end device
- BC manages the channel mapping inside the end device
- Channel-level routing is supported including break-away cases between and across streams



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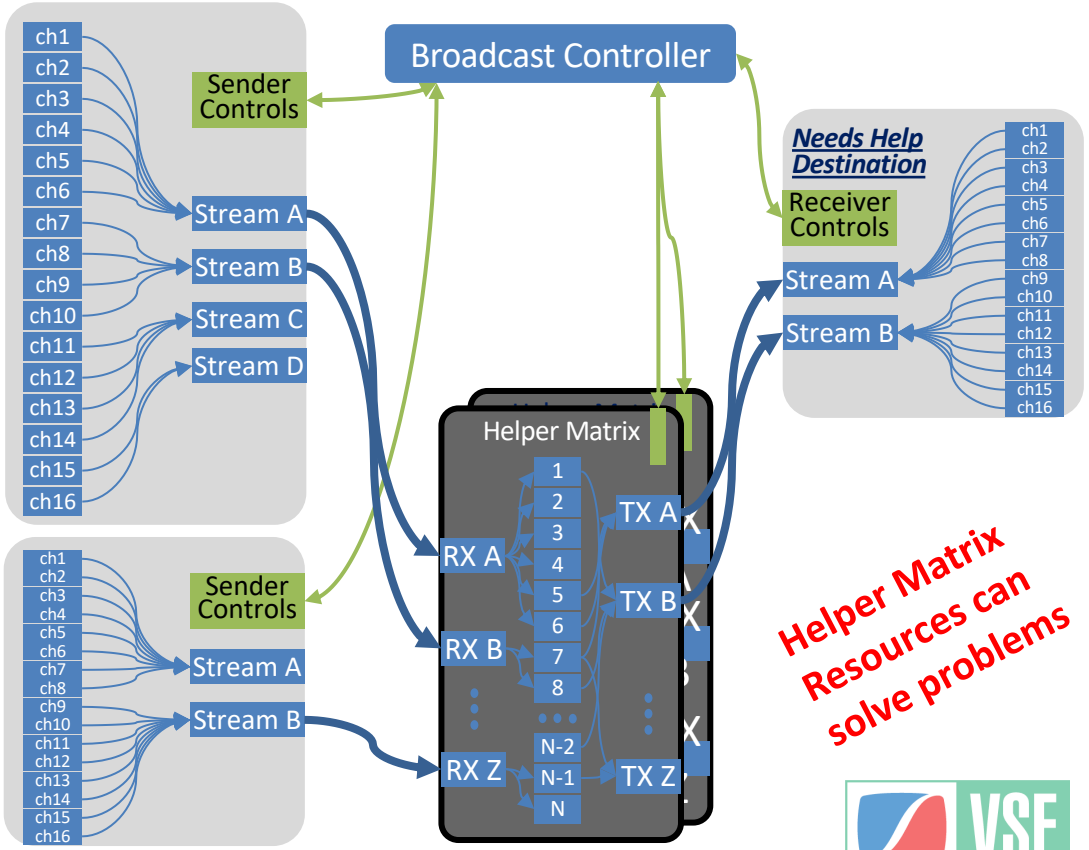
Mono Track Audio Routing: Dest that ***Need Help***

- Some Destinations need help
- BC Manages a pool of "Helper Matrices"
- The Helper Matrices do channel based routes for devices that can't do it themselves
  - BC allocates helper RX and TX on the fly as needed
  - If a helper-matrix fails, the affected streams are re-allocated to other helper matrices
- Channel-level routing is possible including break-away cases within and across streams



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Conclusion

- Users want what they want – despite what is convenient

- ST2110 + IS-04/05 can deliver the appearance of Mono-Track Routing even though the streams are multichannel
  - If there are enough stream receivers in the devices
  - If there is a path to control the matrix downstream (IS-08)
  - Or If there is a “helper matrix” paradigm in place

Thank You

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