Agenda

1. THE SDI ROUTER ANALOGY
2. THE LAYERED TECHNOLOGY STACK
3. PHYSICAL LAYER
4. NETWORK LAYER
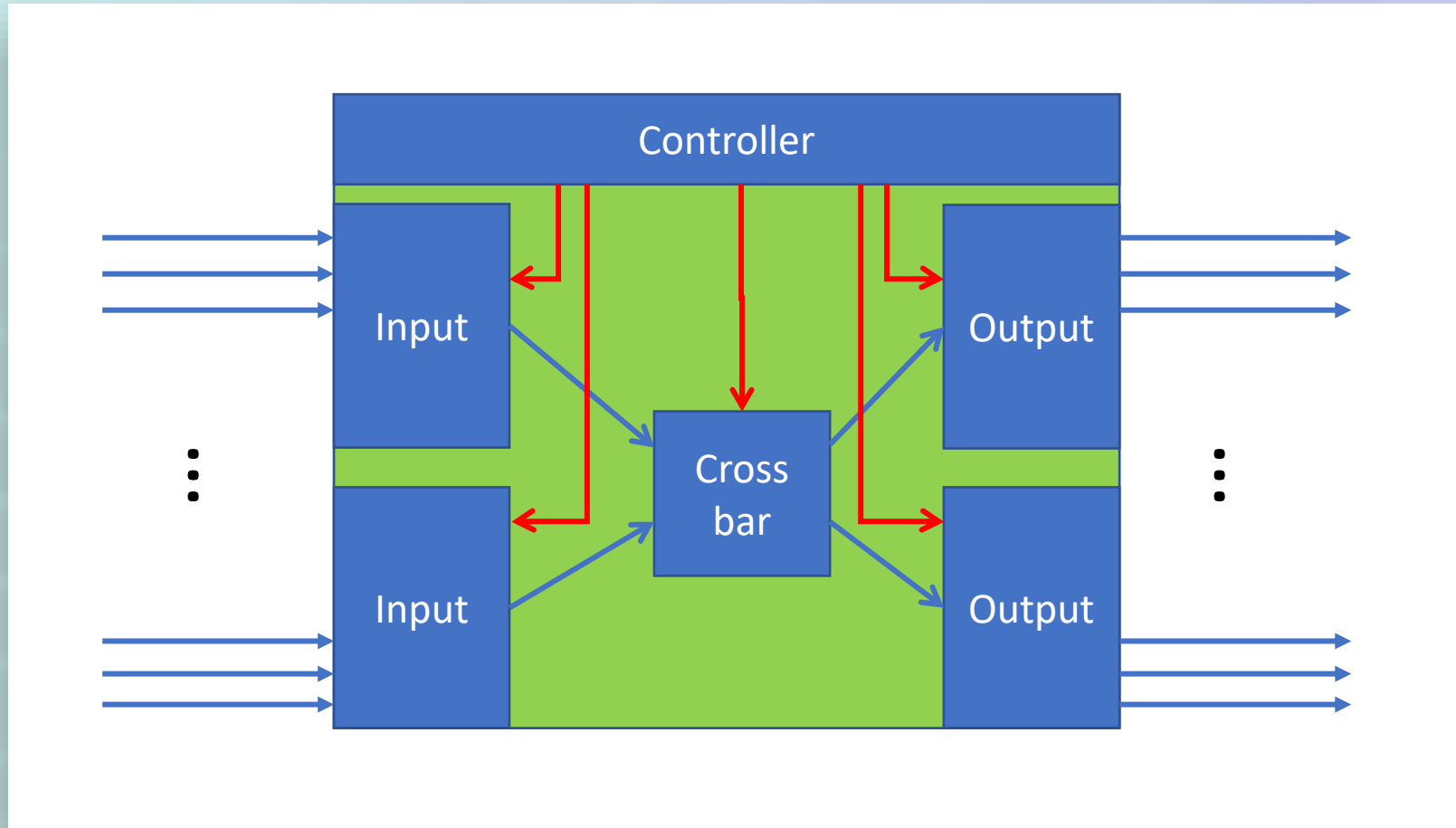5. NETWORK CONTROL LAYER
6. STREAM CONTROL LAYER
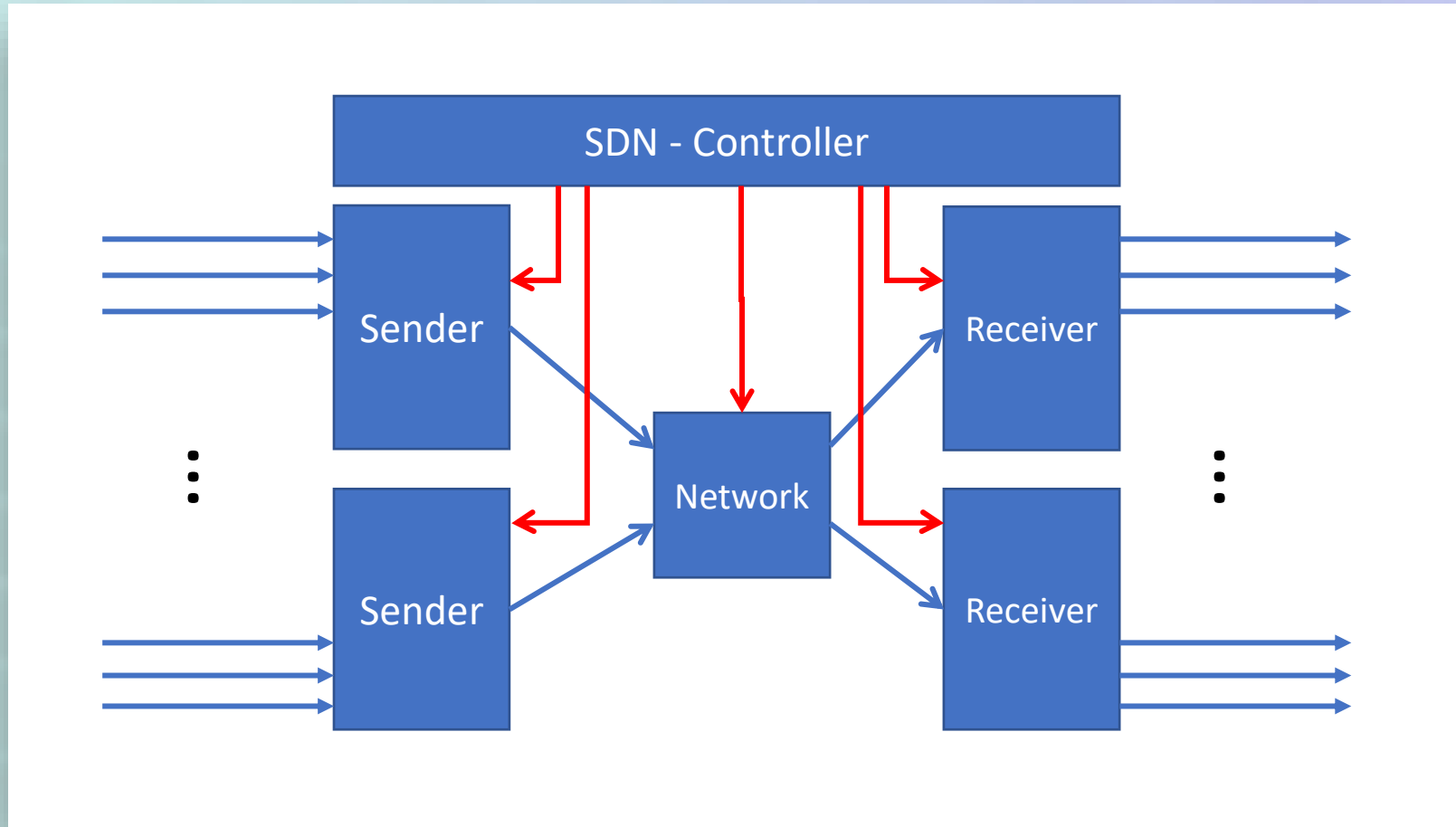7. BROADCAST CONTROL LAYER

SDI Router
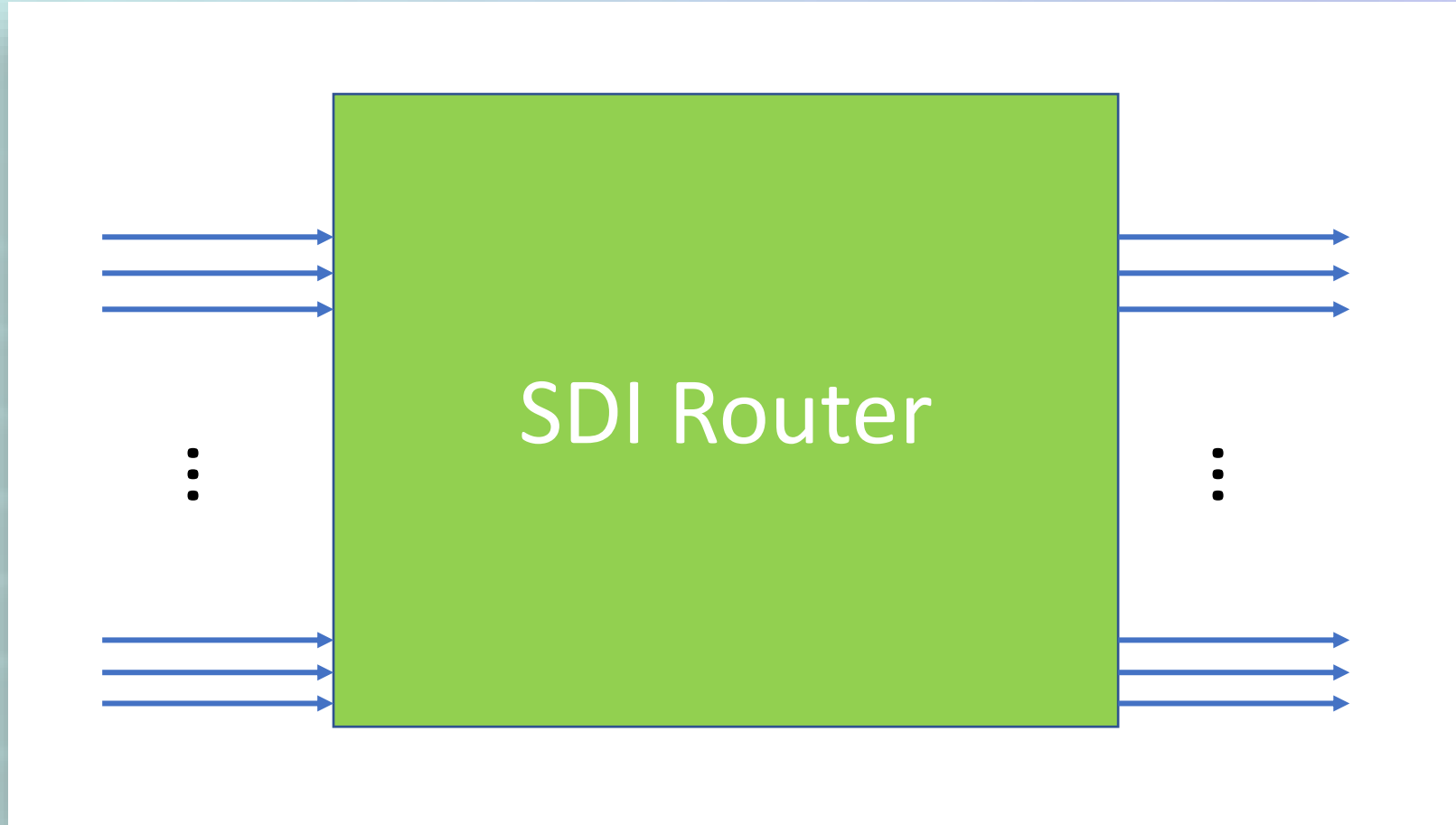
The Layered Stack – Compared to SDI

Left stack:
- Broadcast Control
- SDI
- Physical

Right stack:
- Broadcast Control
- Stream Control
- Network Control
- Network / PTP
- Physical
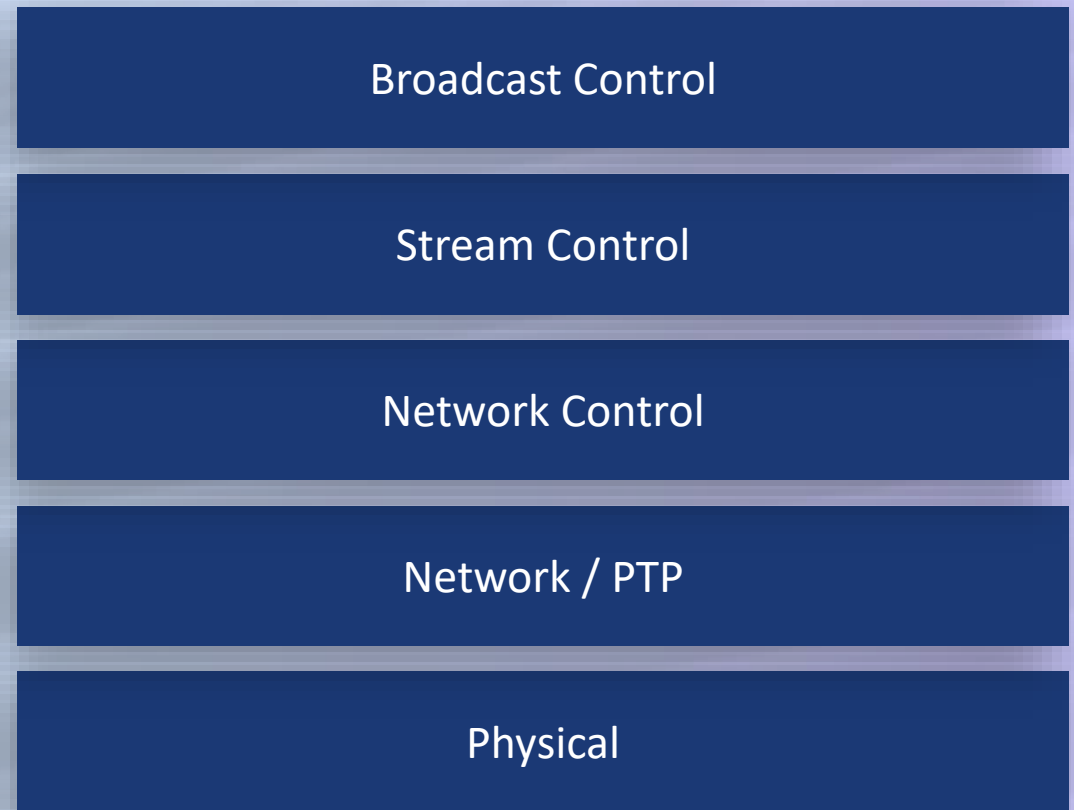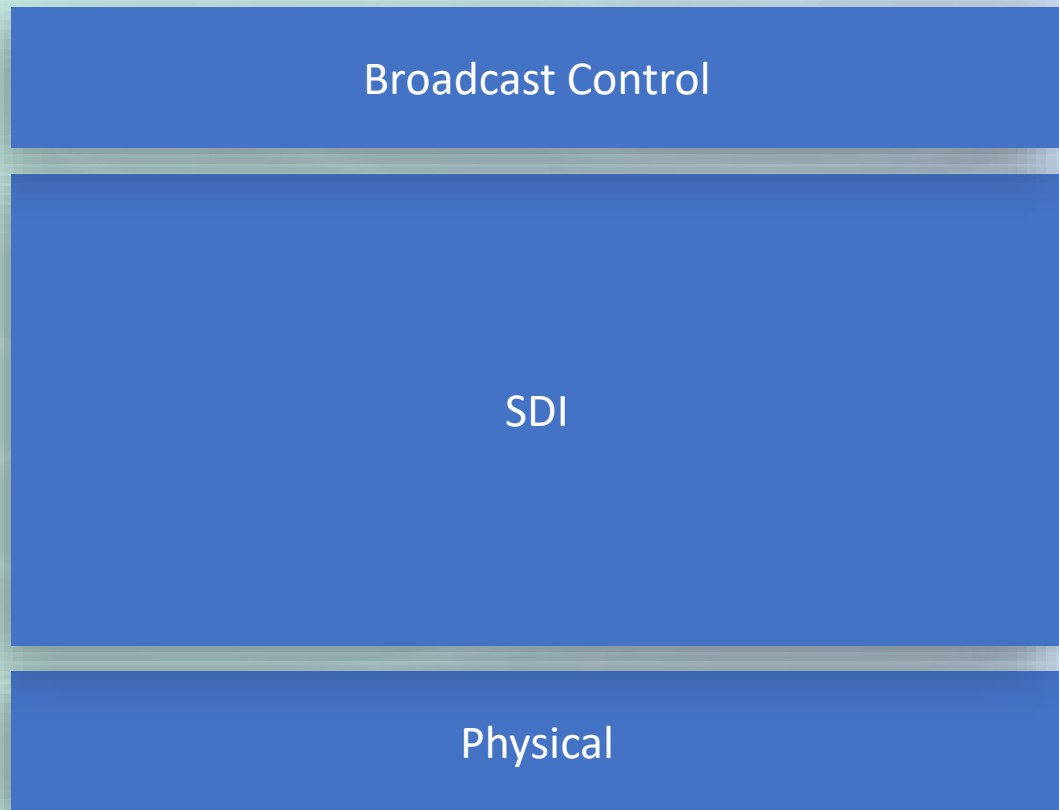
The Layered Stack

Broadcast Control

Stream Control

Network Control

Network / PTP

Physical

- Each layer provides a specific function and relies on the layer below.

- Not all layers are needed in every system.

- More than one layer might be combined in a single subsystem.

- Installation and Troubleshooting is most effective when done by layers.

Physical Layer

What is it about:

- Cables
- SFPs

What to look out for

- Is the cable correctly connected ?
- Fiber polarity and plug type (MPO connectors)
- Correct FEC type

Tools

- Switch User Interface
- DOM (Digital Optical Monitoring) statistics

MPO Connectors

- **Up to 12 Fibres** in one connector
(typically, 8 are used)
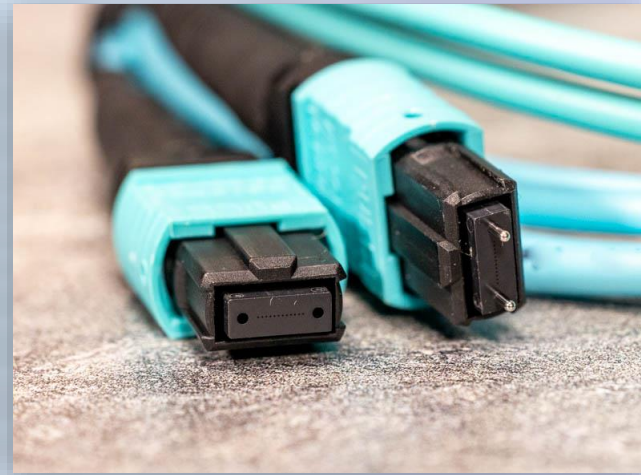
- **Breakout cables** are very useful for high density (100G to 4 x 25G or 40G to 4 x 10G)

- **Watch out:** Female can physically be connected to female – but connection will not work.

DOM Statistics and FEC Types

```
Ethernet1/1
    transceiver is present
    type is 1000base-LH
    name is CISCO-OPLINK
    part number is 1837023160
    revision is 01
    serial number is OPM25150E30
    nominal bitrate is 1300 MBit/sec
    Link length supported for 9/125um fiber is 10 km
    cisco id is 3
    cisco extended id number is 4
    cisco part number is 10-2625-02
    cisco product id is GLC-LH-SMD
    cisco version id is V02


        SFP Detail Diagnostics Information (internal calibration)
    -----------------------------------------------------------------
                Current           Alarms              Warnings
              Measurement    High        Low        High        Low
    -----------------------------------------------------------------
Temperature   35.00 C       89.00 C     -9.00 C     85.00 C     -5.00 C
Voltage        3.28 V        3.60 V      3.00 V      3.50 V      3.10 V
Current       24.12 mA      69.90 mA     4.50 mA    64.95 mA     5.50 mA
Tx Power      -6.19 dBm      0.99 dBm  -13.56 dBm   -3.00 dBm    -9.50 dBm
Rx Power      -7.07 dBm      0.99 dBm  -23.01 dBm   -3.00 dBm   -19.20 dBm
Transmit Fault Count = 0
    -----------------------------------------------------------------
Note: ++  high-alarm; +  high-warning; --  low-alarm; -  low-warning
```

```
auto         FEC auto
fc-fec       CL74(25/50G)
off          Turn FEC off
rs-cons16    RS FEC Consortium 1.6 (25G)
rs-fec       CL91(100G) or Consortium 1.5 (25/50G)
rs-ieee      RS FEC IEEE (25G)
```

Network Layer

What is it about
- Switch configuration

What to look out for
- IGMP Snooping Querier (If you are using a layer 2 network)
- Addressing issues
- PTP configuration errors:
  - Domain, timer and priority values
  - Control plane policing
- Problems with PTP Grandmaster failover scenarios

Tools
- Switch user interface
- Network Management System

IGMP Snooping Querier

- Only applicable in a Layer-2 network

- If your receivers loose their flow after 30 seconds, your network has no IGMP querier

- Recommendation to not build layer-2 media networks larger than one switch.

Look at the ptp counters of the interface.

Do the sync packets increase?

- If not, there is probably something wrong with the switch configuration.

Do the delay request packets increase?

- If not, the end device configuration is not matching (most probably the domain)

```
PTP Packet Counters of Interface Eth1/33:
----------------------------------------------------------------
Packet Type                    TX                        RX
----------------------------------------------------------------
Announce                       33                    5825643
Sync                           40                   11651217
FollowUp                       40                          0
Delay Request            11586191                          0
Delay Response                  0                   11586191
PDelay Request                  0                          0
PDelay Response                 0                          0
PDelay Followup                 0                          0
Management                     23                    1456154
Signaling                       0                          0
----------------------------------------------------------------
```

Network Control

What is it about

- Establishing the paths through a network that consists of multiple switches and links between them

What to look out for

- Are all switches reachable by the network controller?
- Is the controller showing the flow routed correctly?
- Is multicast routing the same between the network controller and the actual hardware?

Tools

- Switch UI
- Network Management System
- Network controller UI
- Flow monitoring (RTP flow monitoring, sflow)

End Device / Stream Control

What is it about:

- Connecting senders with receivers by copying SDPs from senders to receivers

What to look out for:

- Are the end devices reachable by the controller?
- Are the end devices configured with the required senders and receivers?
- Is the configuration correctly represented in NMOS?
- Is the SDP file on the sender matching the configuration?

Tools

- End Device UI
- Web browser for looking at the /x-nmos tree
- NMOS utilities

Broadcast Control

What is it about:

- Providing the User with a control interface
- Linking component flows (Association, Bouquet)

What to look out for:

- Audio channel configuration (Design Topic)
- Keep things as simple as possible

Tools

- Broadcast controller user interface
- Broadcast controller management interface
- Logs

Audio Channel Configuration

How many (mono) channels per stream?

- 1: is resource intensive (senders, receivers, flows)
- 4: compromise between 1 and 4
- 8: most compatible, but somewhat inflexible
- 16: matches SDI, but some devices don't support it
- Flexible: most complicated

General Design Thoughts

- **ST2110 systems are very flexible and powerful** but a significant change from exiting technologies and workflows.

- **Use design decisions** to adapt the many possibilities to your intended workflow.

- **Don't get carried away by the possibilities.** Keep things as simple as possible

- **Do not completely mimic your current workflows** that were based on traditional technology.

- **Be prepared to learn** more as you go.

- **Start small**, but relevant.

Qvestions?

IP SHOWCASE™

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