Deploying an Intra and Inter-facility IP Media Production Network

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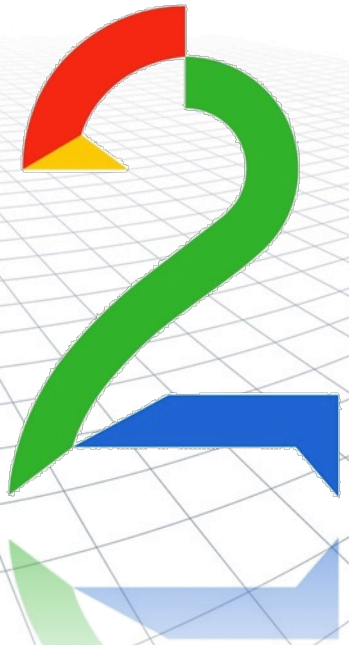
Robert Welch - Arista

TV 2 Norway

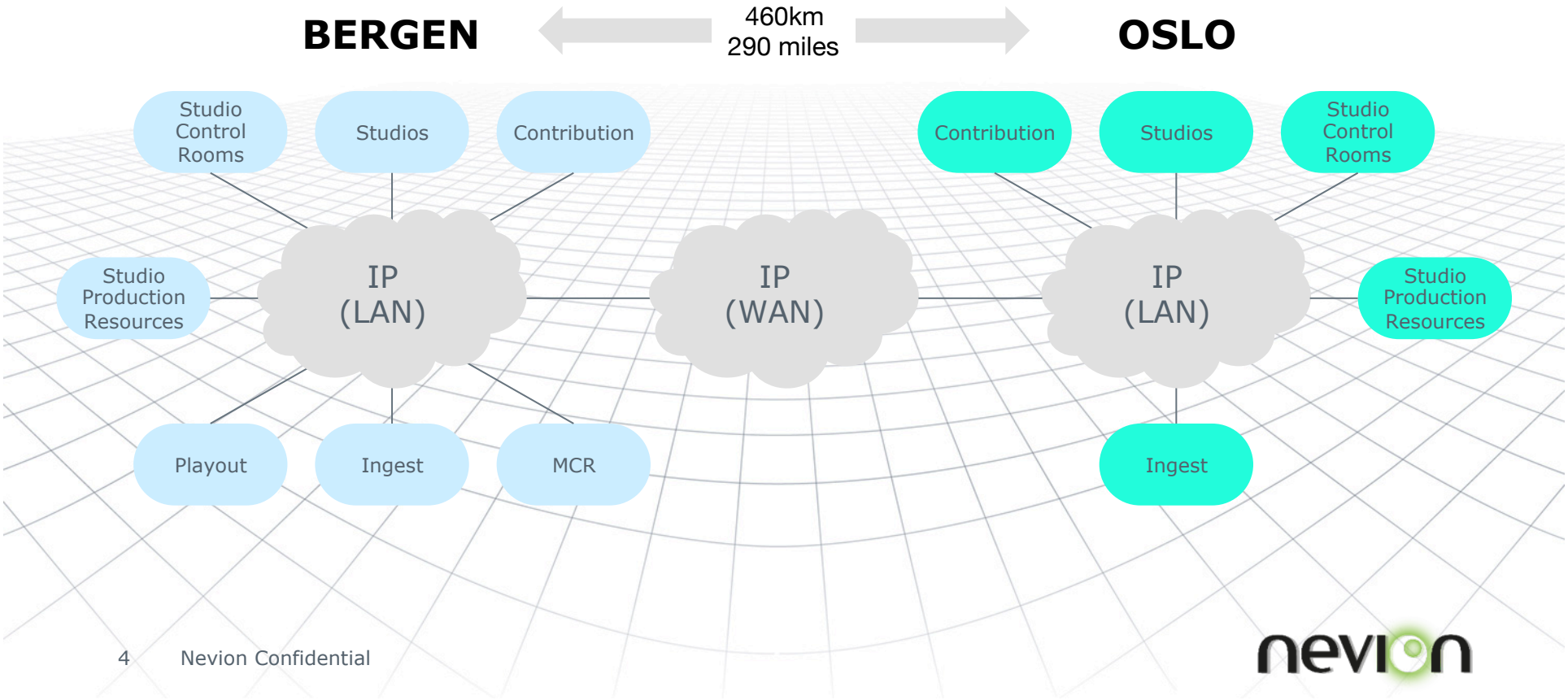
- Largest Commercial Broadcaster in Norway
- News and sports operation (7 studios)
- Large MCR operation
- 9 linear channels
- 31 OTT event channels
- VOD and web services



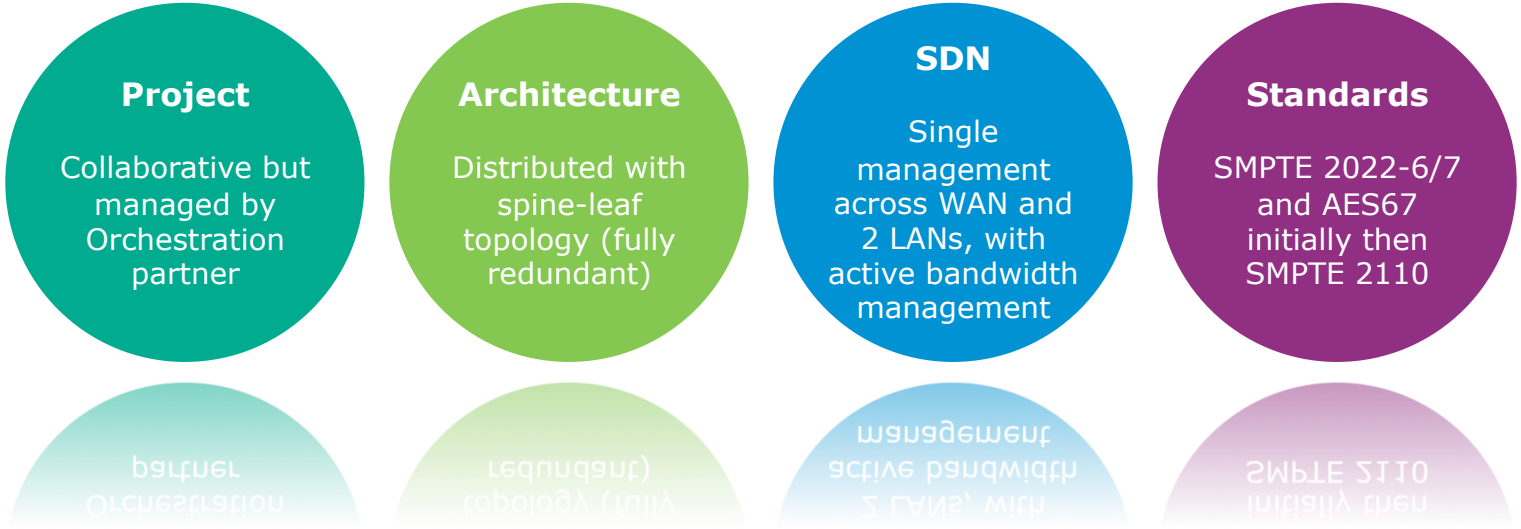
Objective: move to IP in facilities

- Driven by:
  - **Facilities relocation** to Bergen (08/2017) and Oslo (12/2017)
- Wanted to:
  - **Reduce OPEX**
  - **Avoid SDI Infrastructure**
  - **Platform Flexibility** (reduce impact of distance)
  - **Share resources** (on demand access

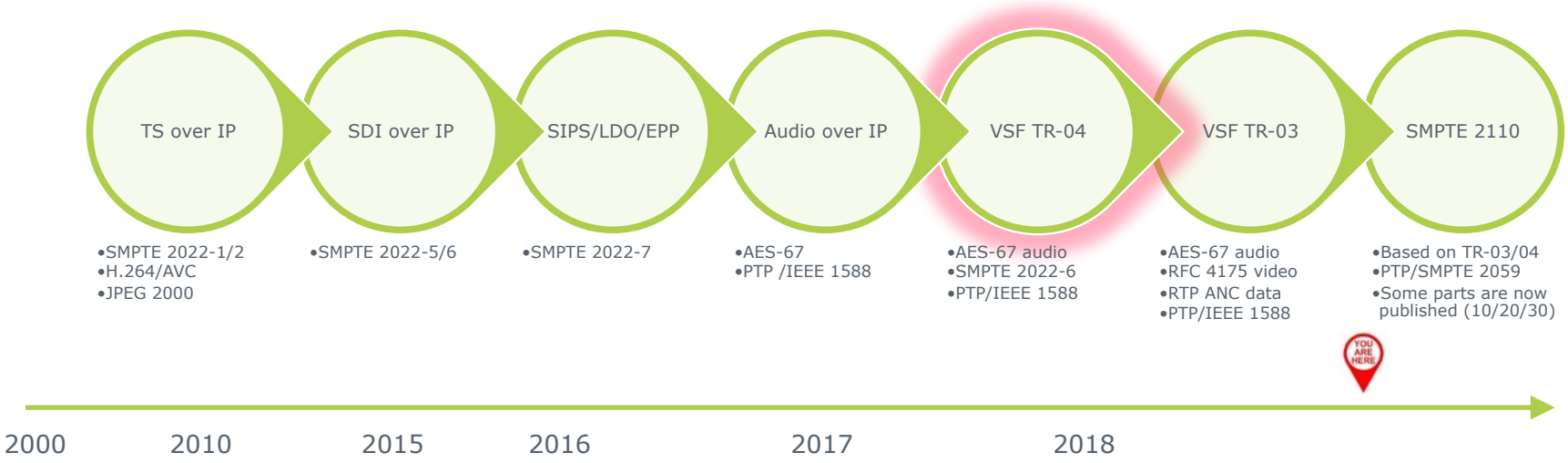
Basic **target set-up**



TV 2 **choices**


Project
Collaborative but managed by Orchestration partner
Architecture
Distributed with spine-leaf topology (fully redundant)
SDN
Single management across WAN and 2 LANs, with active bandwidth management
Standards
SMPTE 2022-6/7 and AES67 initially then SMPTE 2110

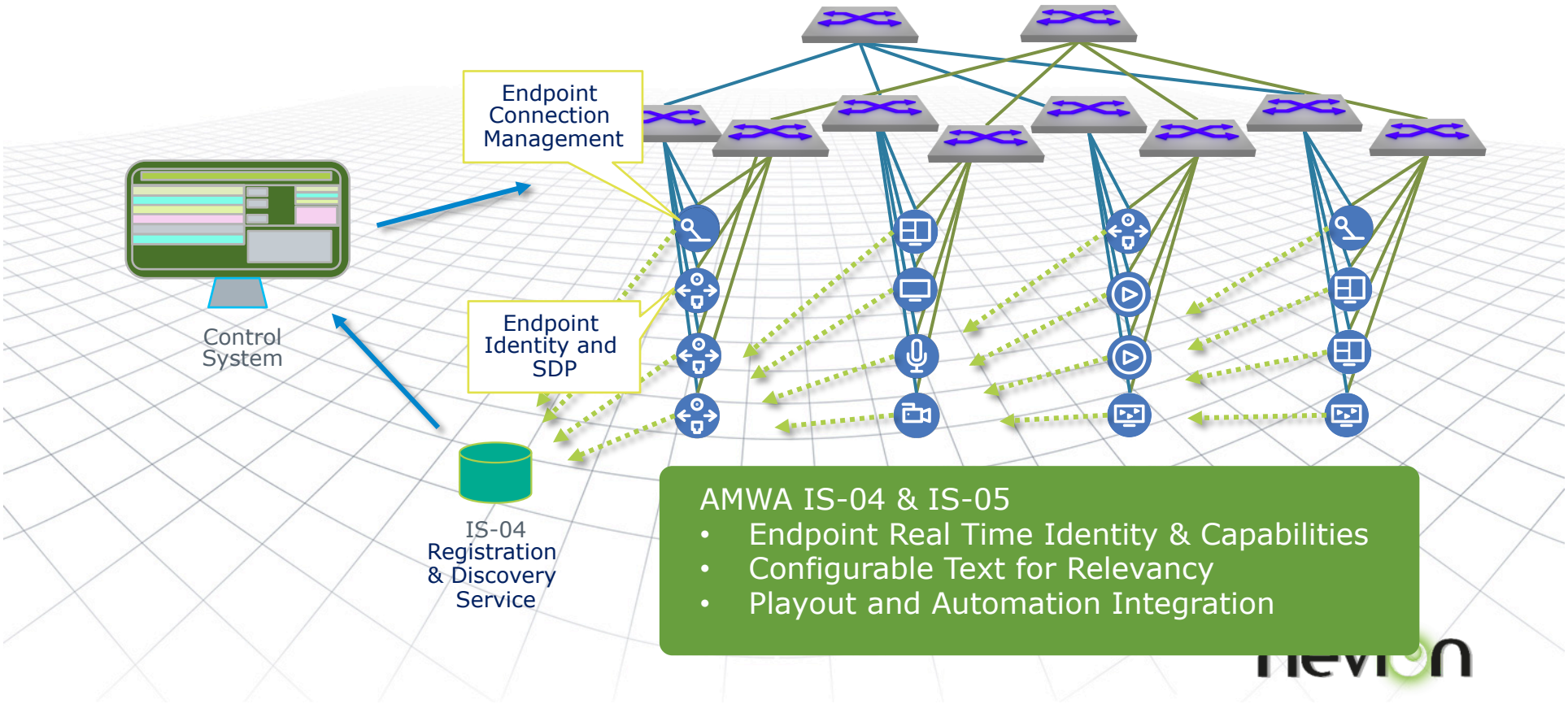
Standards evolution for IP production



Standards – Not ready in 2017

- ST 2110
  - 10: System Timing
  - 20: Uncompressed Video
  - 30: PCM Audio
  - 40: Ancillary Data
- NMOS
  - IS-04 Registration & Discovery
  - IS-05 Control
  - IS-06 Network API
  - IS-07 Event & Tally

AMWA IS-04 & IS-05
Connectivity Management



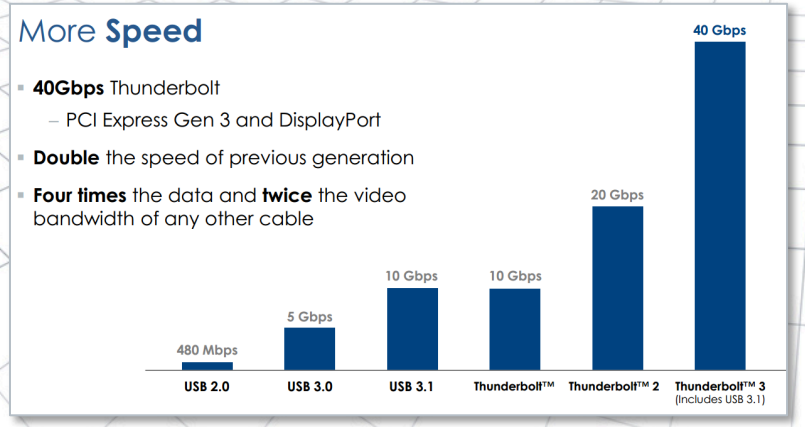
AMWA IS-04 & IS-05

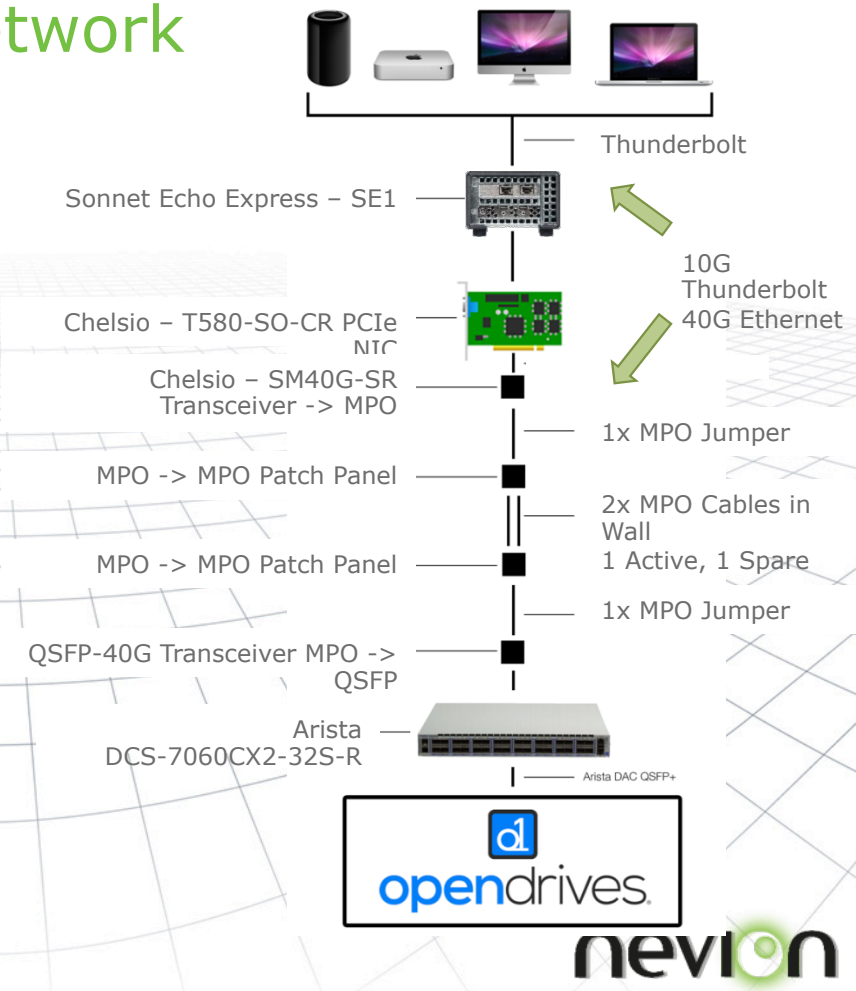
- Endpoint Real Time Identity & Capabilities
- Configurable Text for Relevancy
- Playout and Automation Integration

Thunderbolt 2 Edit Bay Network

Shared 40GbE Uplink Example

- USB 3.1 Exceeds the Speed of 10GbE
- Thunderbolt 1 Exceeds the Speed of 10GbE
- Throughput = Increased Productivity and Flexibility
- Adoption of 10G Edit Bays => 40G Edit Bays
- 10GbE Standard Interface Speed on New Systems
- **There is More Network Capacity at the Edge than in Your 10GbE Network.**





Thunderbolt 2 Edit Bay Network

Per Device Uplink Example

iMAC Pro:

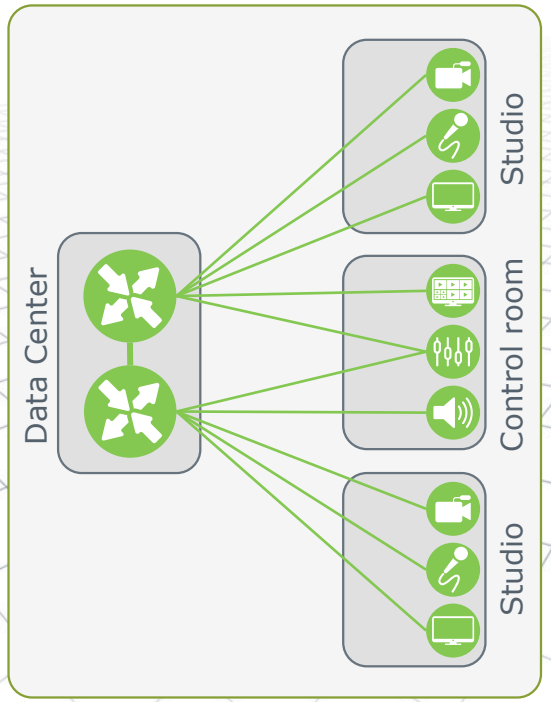
- 1x 10GbE, 4x Thunderbolt 3, 4x USB 3

Mac Pro (Trash Can Mac):

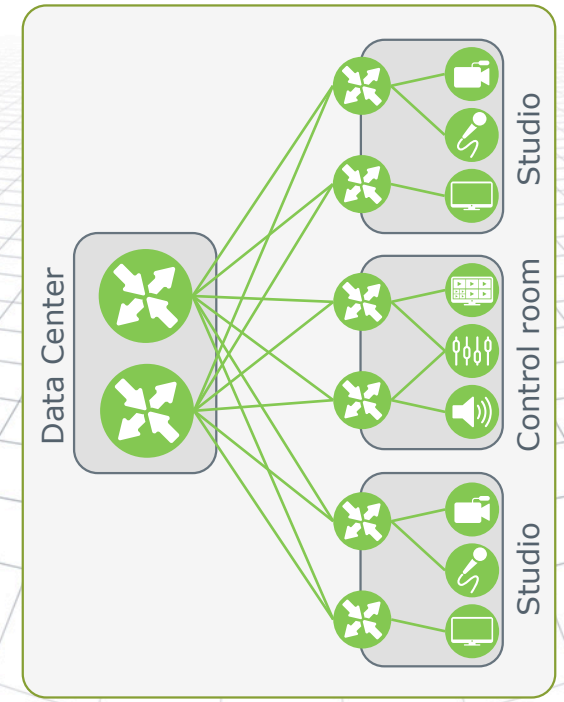
- 2x 1GbE, 6x Thunderbolt 2, 4x USB3

Typical **architecture options**

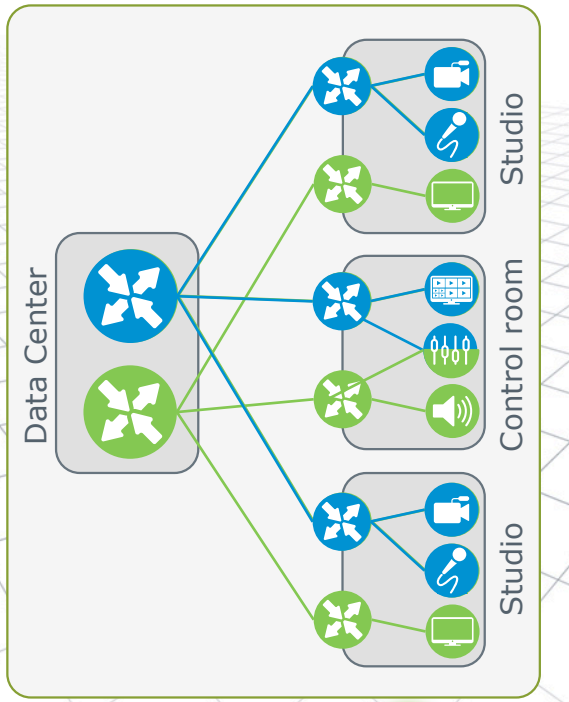
Centralized Star



True Leaf-Spine



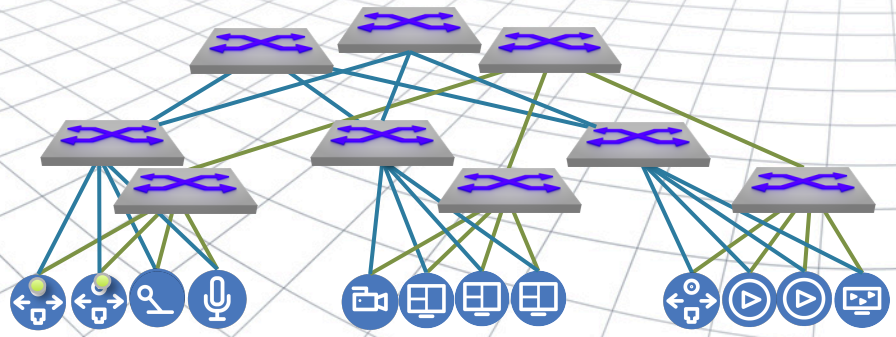
Pseudo Leaf-Spine
(Dual Star)

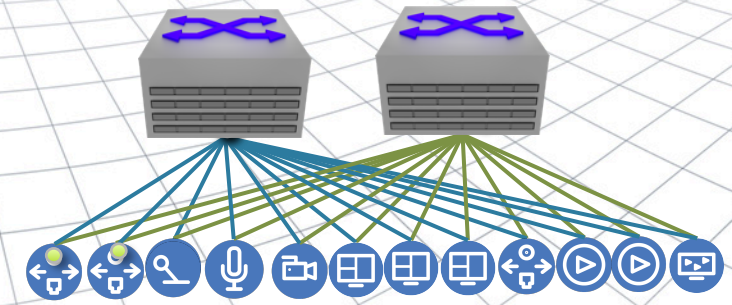


Network Topology Options

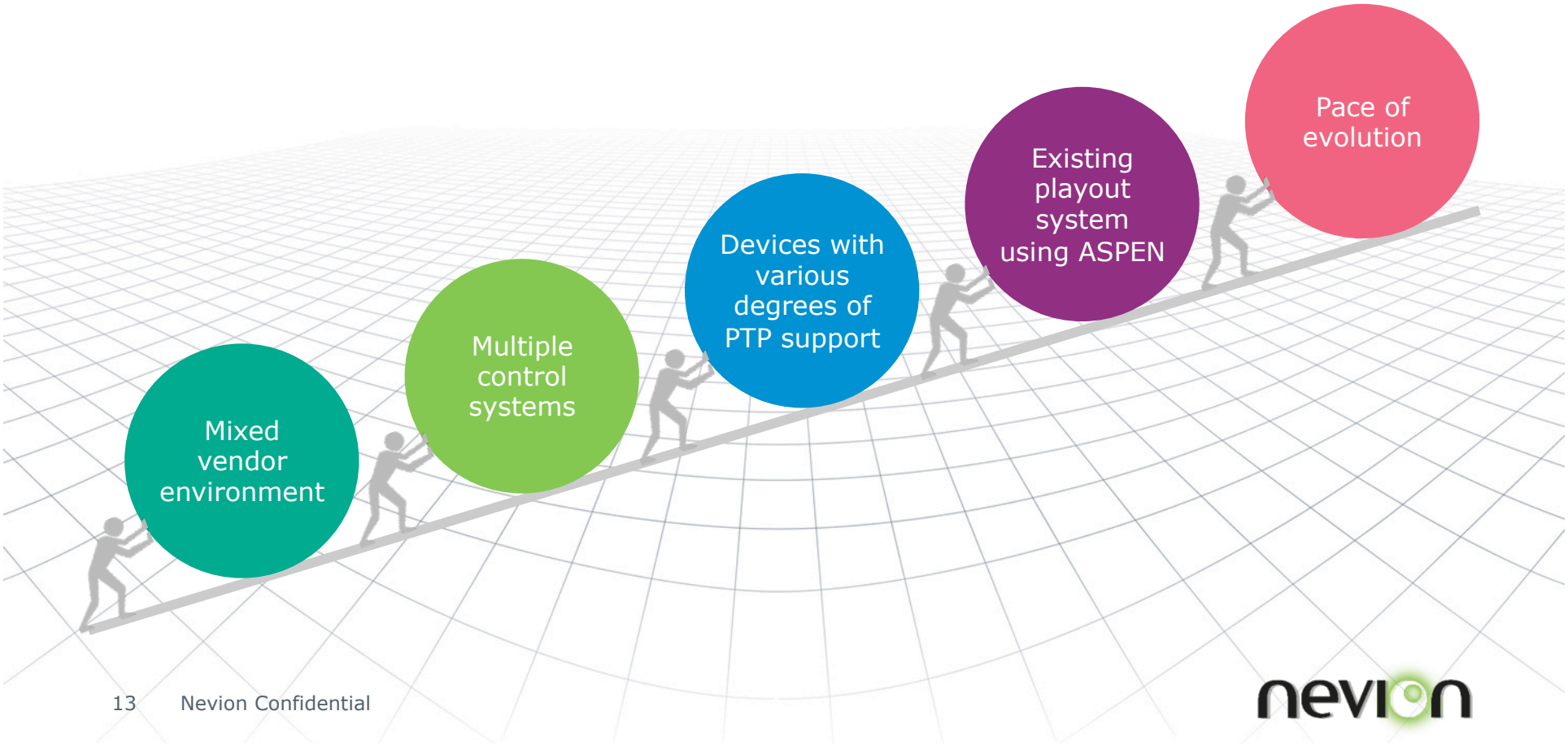
Spine / Leaf – Distributed
- Distributed Cabling
- Shared Uplink Bandwidth
- PTP Boundary Mode Considerations
- Mix and Match Spine and Leaf Options
- Inter-Switch Bandwidth Consideration
- Oversubscription Ratio

Monolithic Switch
- Non Blocking Architecture
- No SDN Requirement to Manage Inter-Switch Links
- PTP Boundary Mode Considerations
- Mix and Match Spine and Leaf Options
- Increase East / West Traffic Flow Bandwidth

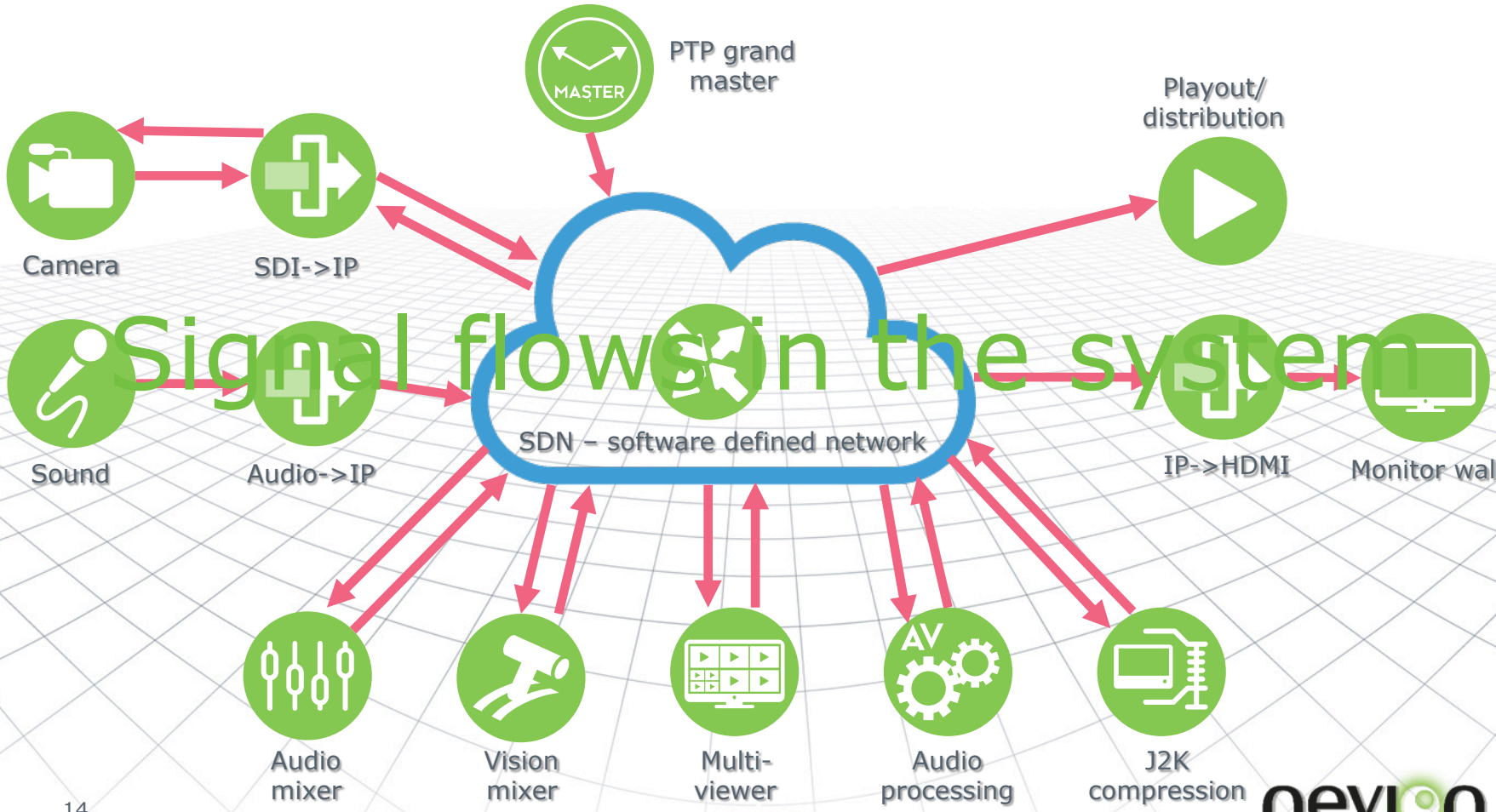




Some challenges to overcome

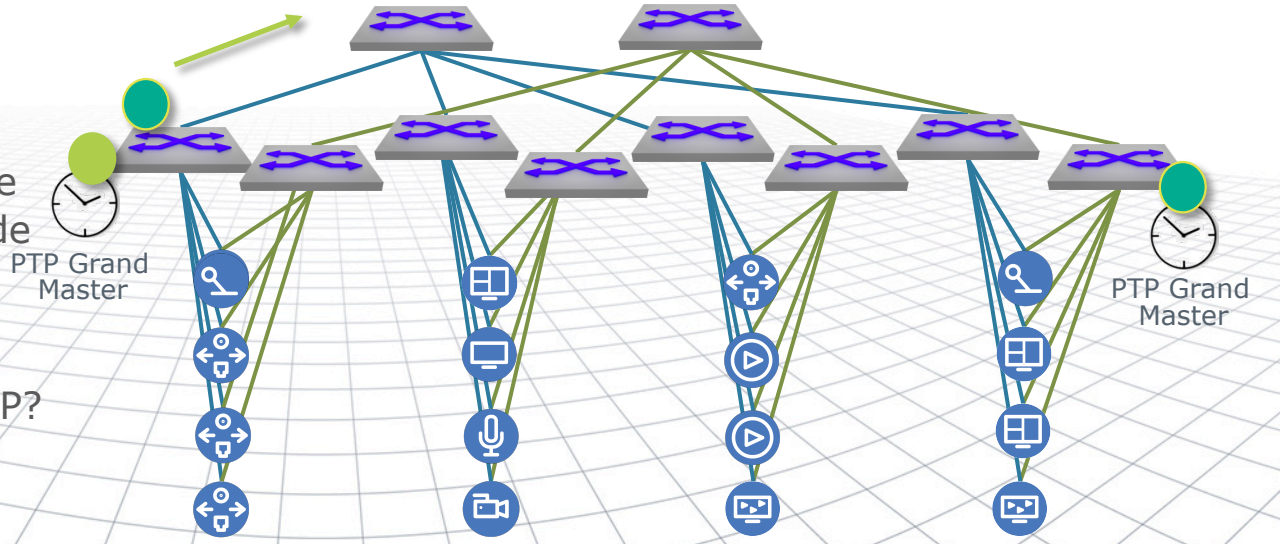


Signal flow in the system



Grand Master Placement and Redundancy

- **Switch Considerations**
  - Boundary Mode
  - Boundary Mode Scale
  - E2E Transparent Mode
  - ST 2059-2 Support
  - Routed Interface Requirement
  - In or Out of Band PTP?
  - 1 or 2 Step Support



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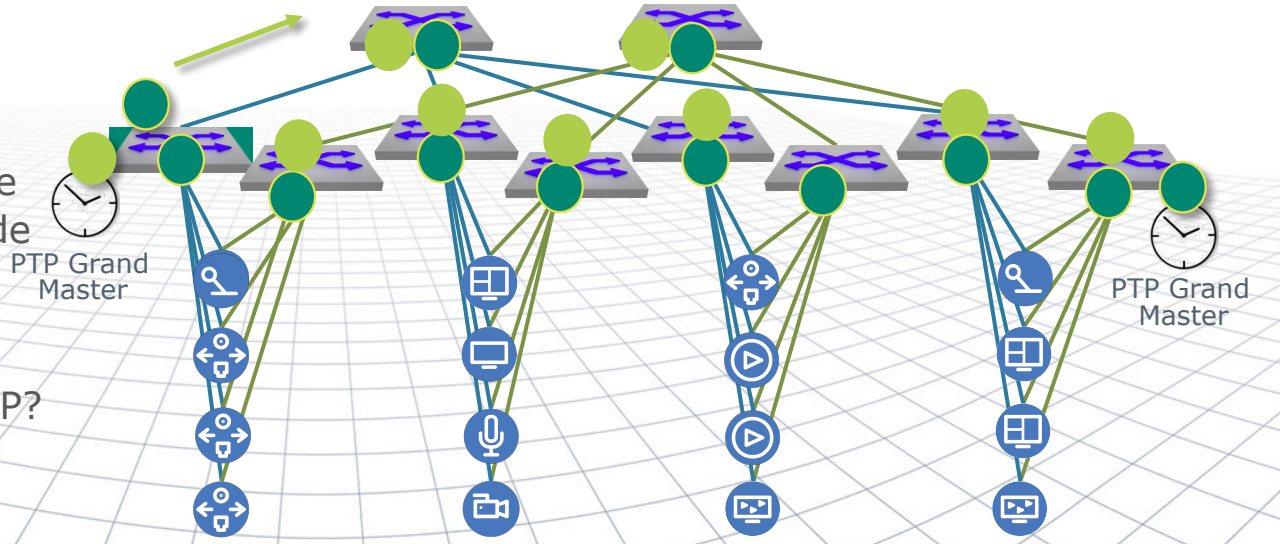

PTP Boundary Mode
- Increases PTP Grand Master Scale
- Is Master to Connected Nodes
- Improves System Wide Clock Synchronization

Grand Master Placement and Redundancy

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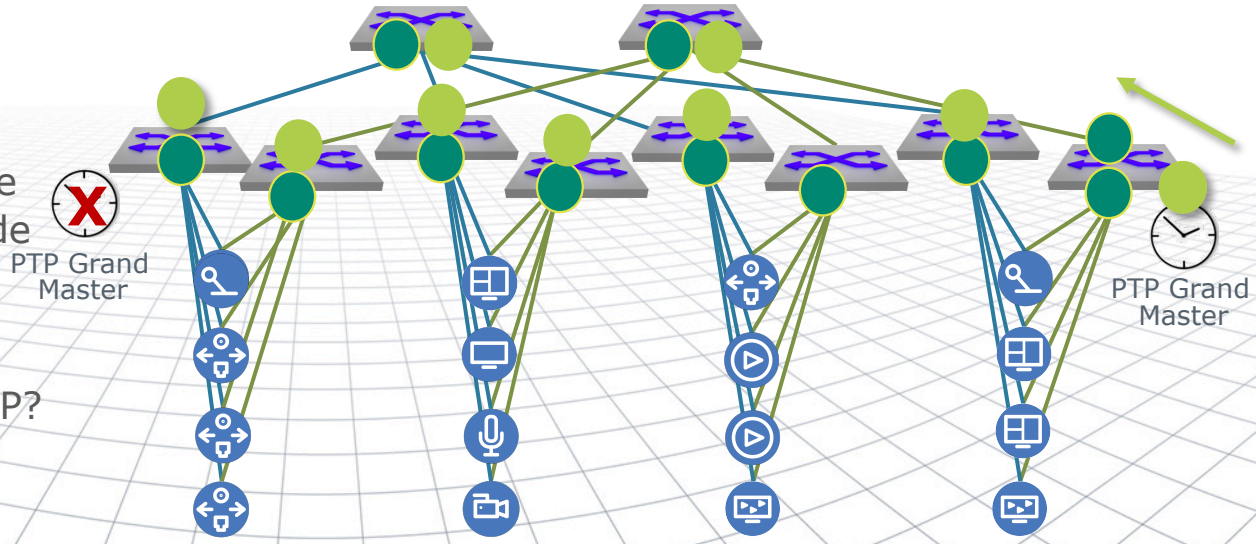
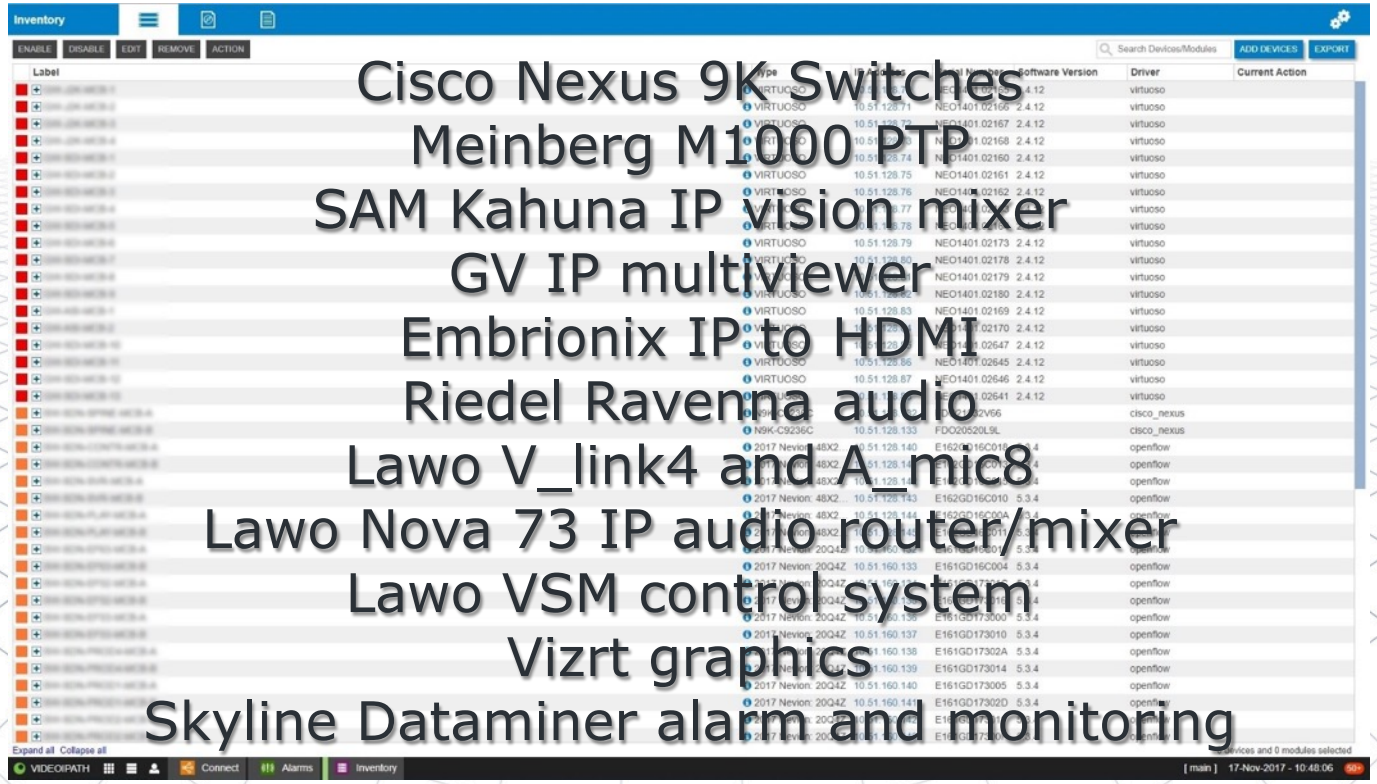


PTP Boundary Mode – Grand Master Change
- Reduces Effect on Connected Nodes
- Enables Geographic Redundancy
- Improves System Wide Clock Synchronization

Technology Partners



Cisco Nexus 9K Switches
Meinberg M1000 PTP
SAM Kahuna IP vision mixer
GV IP multiviewer
Embrionix IP to HDMI
Riedel Ravenna audio
Lawo V_link4 and A_mic8
Lawo Nova 73 IP audio router/mixer
Lawo VSM control system
Vizrt graphics
Skyline Dataminer alarm and monitoring

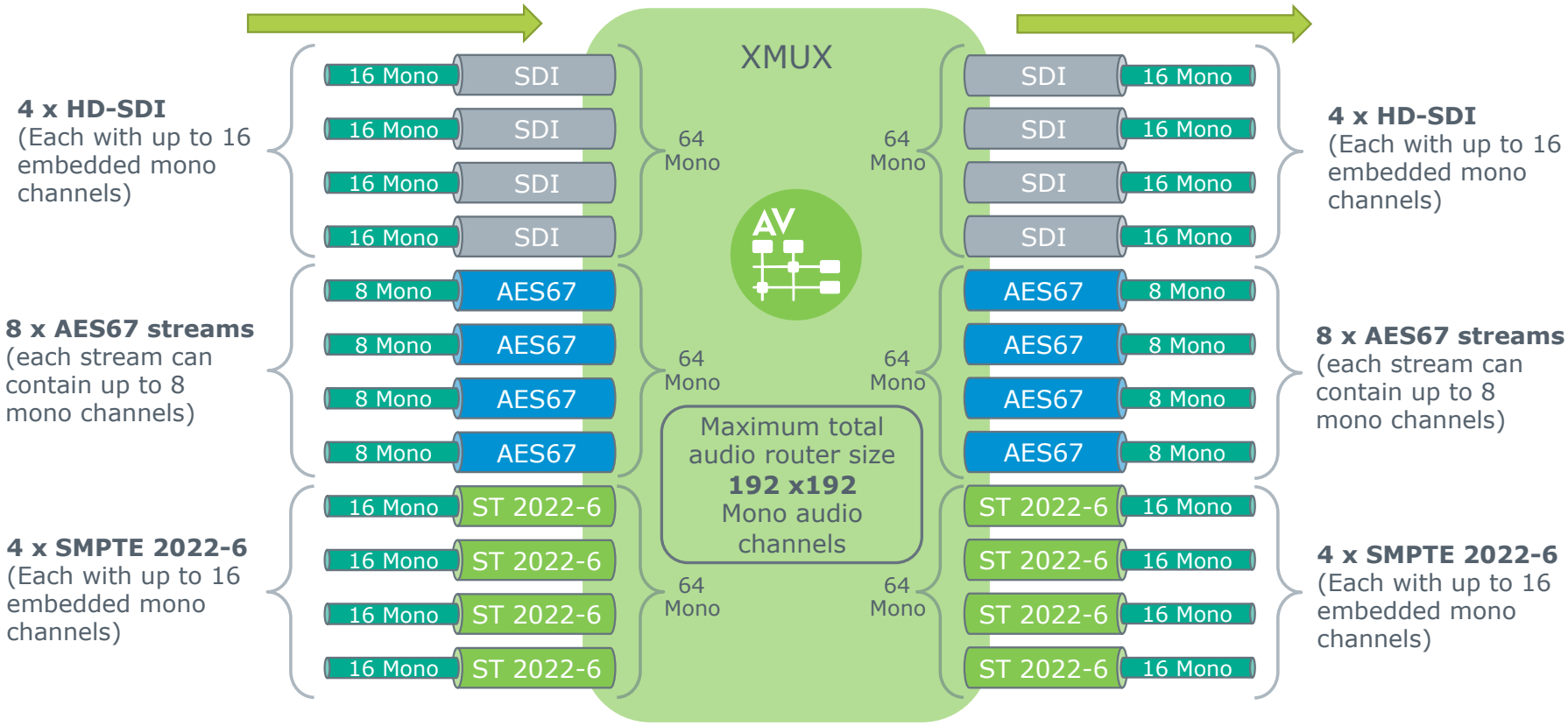
Nevion’s Contribution

Nevion VideoIPath
SDN control and
platform management

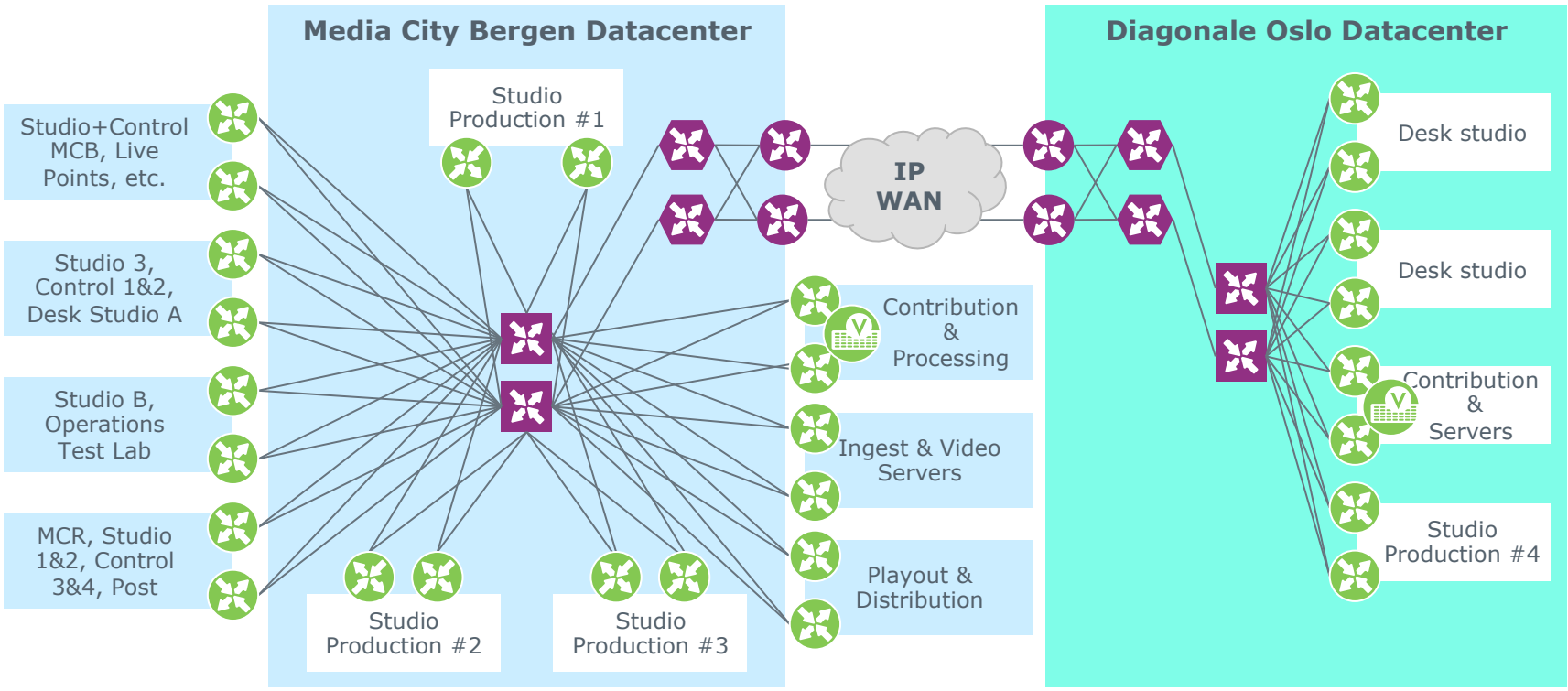
Nevion eMerge
10/40/100 Gb leaf switches
with Openflow

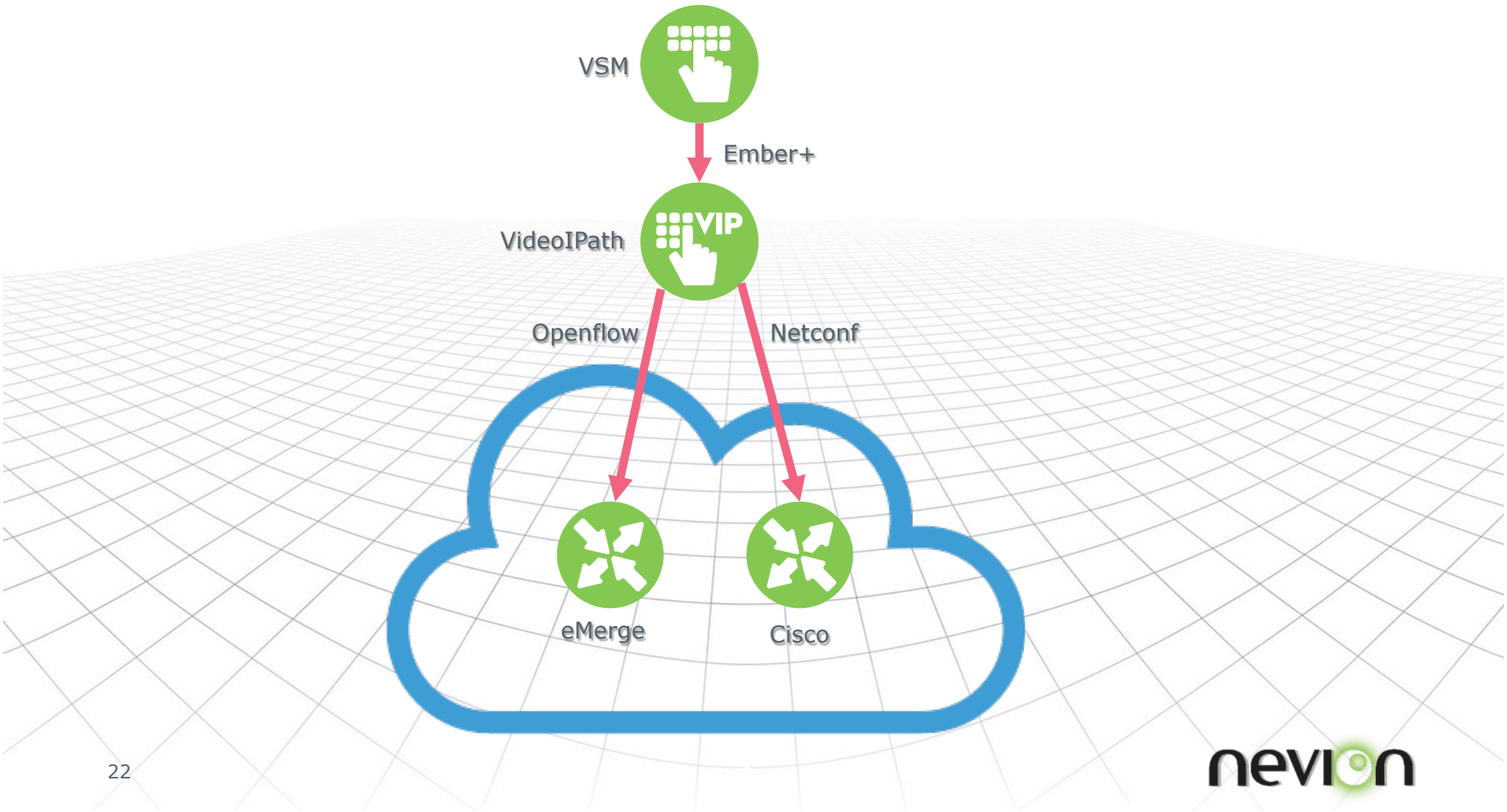
Nevion Virtuoso
Processing units

Gateway XMUX Video/Audio router



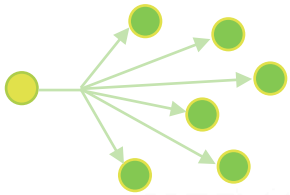
Orchestration and SDN Management



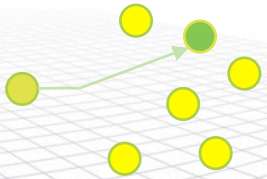

VSM
Ember+
VideoIPath
VIP
Openflow
Netconf
eMerge
Cisco

Multicast At A Glance

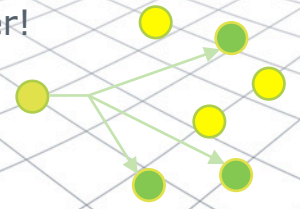
- Broadcast: One to all within the subnet



- Unicast: One to one, routable. Destination defined by sender.



- Multicast: One to none, one or many, routable. Destination defined by receiver!



- Multicast is a good fit for live uncompressed media
  - Typically there is a one to many fan out
  - The senders do not know who needs to consume their output
  - More efficient for sending endpoints, and network infrastructure – no traffic redundancy
  - Receiver redundancy is easy to achieve

Multicast At A Glance

- (S,G), Source Specific Multicast. The *subscriber* asks for traffic that was sent to a multicast group address (G), from a specific source (S).

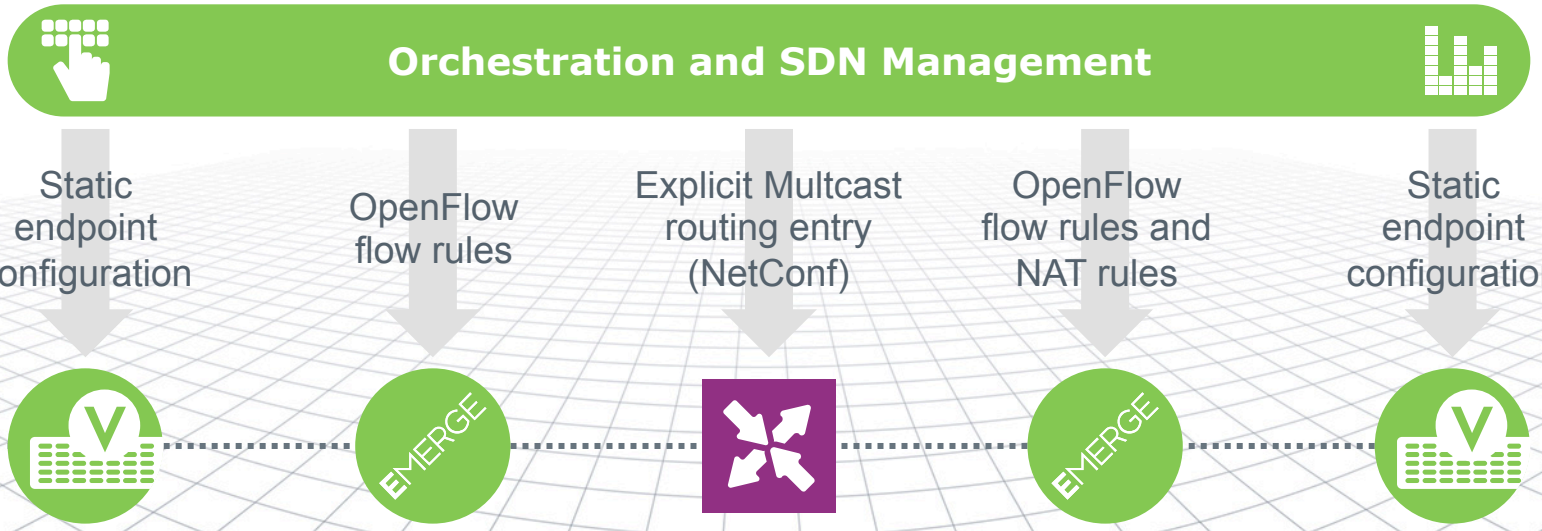
- An IGMPv3 infrastructure is required to support (S,G) requests. (*,G) requests are supported in all IGMP versions
- 2022-7 and destination based switching enabled by multicast. (Make before break)
- 2022-6 is a single essence stream. 2110-x defines individual essence streams for video (-20), audio (-30) and ancillary data (-40)

Multicast At A Glance

- (*,G), Any Source Multicast. The subscriber asks for ALL (*) traffic that was sent to the multicast group address requested (G).

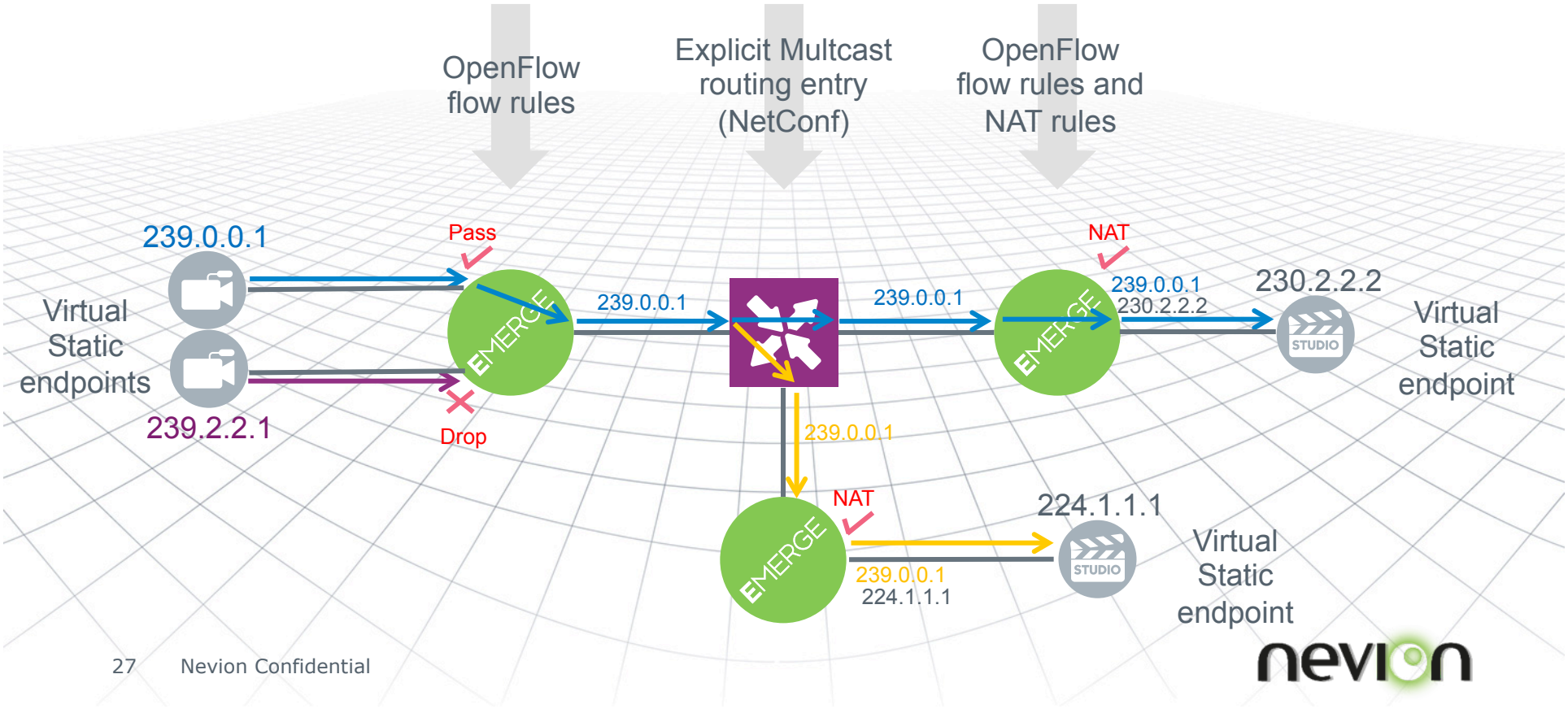
- (*,G) is very useful when you want all the traffic, from all participants – it's a good model for video/voice conferencing, or for services – you know the service you want, but not the source.

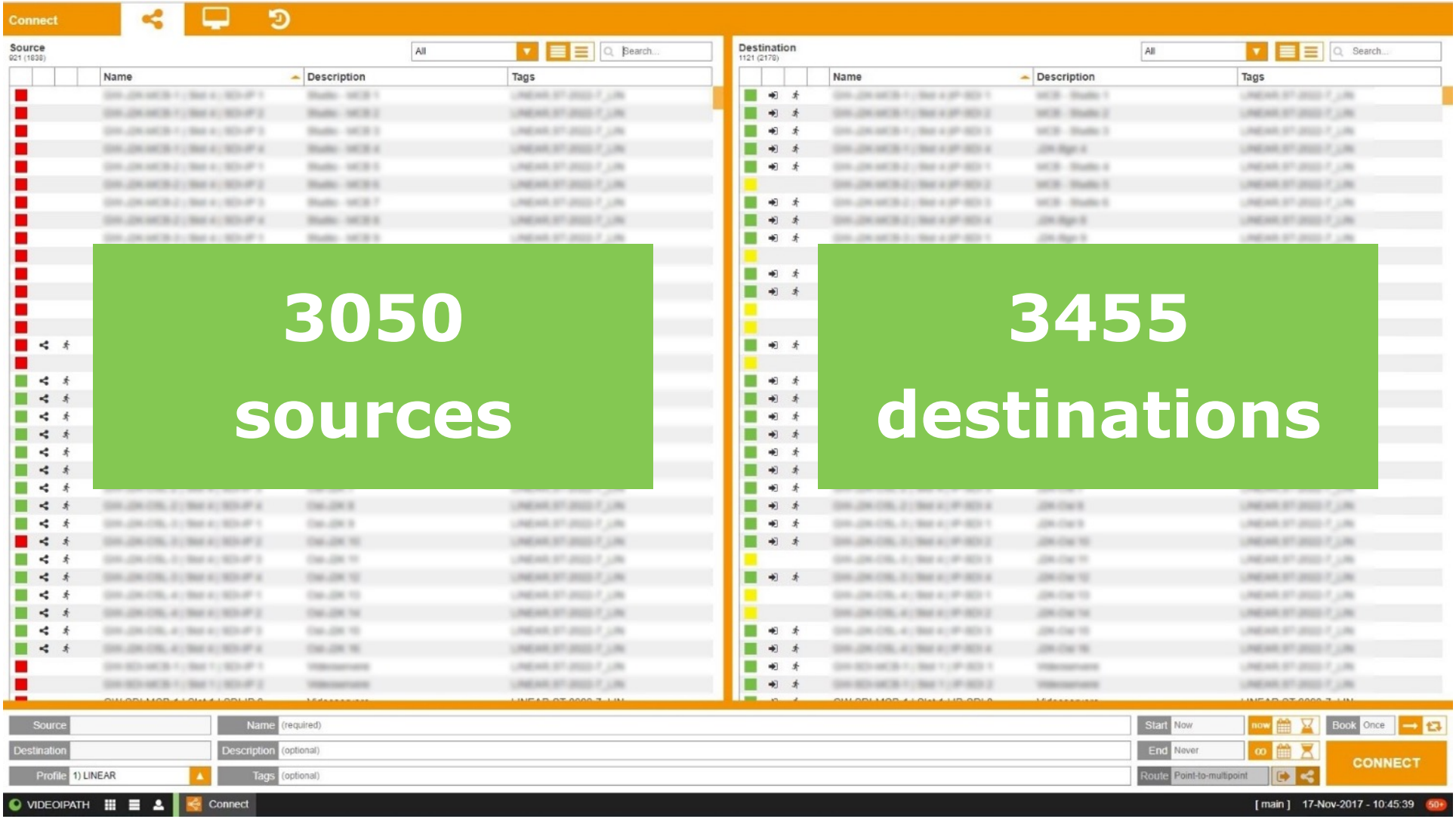
Hybrid SDN network control



Security	Stream resilience	Deterministic QoS	Media and data flows coexistence	Adapt to changing needs	Fast and clean switching

NAT – Driver-less deployment




Connect
Source
Destination
Name
Description
Tags
3050
sources
3455
destinations
CONNECT
VIDEOIPATH
Connect
[main] 17-Nov-2017 - 10:45:39

Fun Facts – Uncompressed 2110-20 Video Essence

Format	Sampling	Depth	Gen Pkt Mod	Per 10G	Per 40G	Per 100G
720p59.94	YCbCr-4:2:2	10	1,176 Mbps	7	30	80
1080i59.94	YCbCr-4:2:2	10	1,325 Mbps	6	26	65
1080p59.94	YCbCr-4:2:2	10	2,650 Mbps	3	13	35
2160p59.94	YCbCr-4:2:2	10	10,600 Mbps	~1	3	8
4320p59.94	YCbCr-4:2:2	10	42,397 Mbps			2

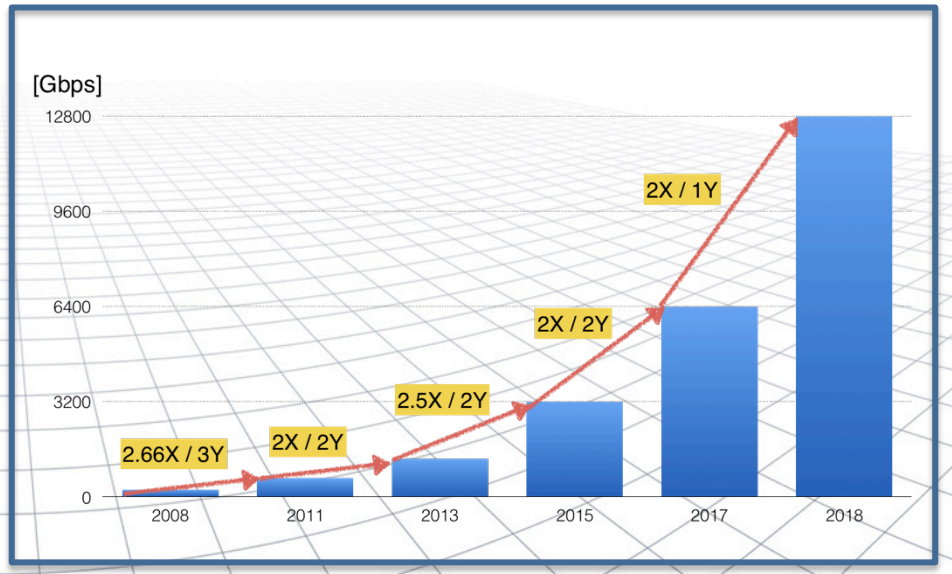
32x 100G Switch = 2,560 x 2560 SD
Note: Ethernet is Bi-Directional

Why Merchant Network Silicon is Winning

Merchant Silicon Firsts

- 2008: First ultra-low latency 24-port 10G single chip
- 2010: First Large Buffer 10G Chip with VOQ Fabric
- 2011: First 64-port 10G single chip switch
- 2012: First 32-port 40G single chip
- 2013: First Large Buffer 40G Chip with VOQ Fabric
- 2015: First 32-port 100G single chip
- 2016: First Router 100G Chip with VOQ Fabric
- 2017: First 64-port 100G single chip
- 2018: First 32-port 400G single chip (forecast)

Bandwidth Improvement



Merchant Silicon: Faster Time-to-Market, Better Execution and Faster Innovation

Live on-air August 12, 2017

What's **next for TV2**?

- ✓ Migration to **SMPTE 2110**
  - ✓ **Timing** already based on **2110-10** (2059-1/2)
  - ✓ **Audio** already based on **2110-30** (AES67)
  - ✓ **Video** using 2022-6, move to **2110-20**
  - ✓ **Metadata** using 2022-6, move to **2110-40**
- ✓ Adopt **NMOS** architecture
- ✓ Dynamic essence flows (**SDP**)
- ✓ **Orchestration** of workflows


THANK YOU!
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