IP Fabric Architectures for SMPTE 2110

Bits By The Bay 2018 Conference

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Cisco Systems
Industry Challenges and Requirements

- COTS Switches
- Deterministic Network
- End Point Synchronization
- High Availability
- Network Security
- Scalability
- Unchanged Operator Workflow
- **Internal Non-Blocking**: Line Rate Forwarding for Unicast and Multicast
- **Hose Model**: Host Ports BW = Uplink BW
- **Port speed**: 10G/25G/40G/100G >>> 400G
- **Port form factor**: Copper vs Fiber
- **Redundancy**: Single or Dual supervisors
Switch Internal Architecture

Main Board
- ASIC
- 36 x QSFP28
- To front panel ports

CPU Board
- FPGA
- 2 DIMM
- CPU

Internal Daughter Board (Console/IO Card)
- 10/100/1000 Mgmt ports
- RJ45 Console
- USB

PSU
- 3000W
SMPTE 2110 End Points

- Native IP Support
  - Cameras
  - Playout Systems
- Connect directly to the fabric
- SDI endpoints
- Legacy
- Requires IPGs
- IPGs can become SDI aggregation point

Connectivity
Per flow 1.5, 3 or 12Gbps
Per Port 10, 25, 40, 50 or 100Gbps
Single Chassis

Benefits
• Small Form factor
• Simple to manage

Considerations
• Large Failure Domain
• Cabling consideration
• Forklift upgrade
Scalable Spine and Leaf Fabric

Benefits
- Scalable
- Flexible placement of Leafs
- Distributed = Small failure domains
- Modern IT Data Centers

Considerations
- Bandwidth Management
- Network Visibility
- Automation
- Security
Deployment Use Cases

**Studio (multiple rooms)**

**Sporting Venue**

**OB Van/Truck**

- **Spine-Leaf**
- **Spine-Leaf**
- **Single Modular Switch**
IGMP = Gateway to IP world

- SDI router sets up path

- End Point requests path setup using IGMP
  - Fabric sets up path
**IP Addressing**

### Unicast IP

**End Host addressing**

- **Address**: 10.10.10.1
- **Mask**: 255.255.255.0

### Multicast IP

**Group addressing**

- **Multicast Group Address Range**: 224.0.0.0 - 239.255.255.255

- **Multicast address = flow address**: 239.1.1.1
Multicast Conceptual Model
IP Routing Protocols

A unique packet addressed to each destination.

src addr: 10.1.1.1

Unicast Routing
- OSPF
- ISIS
- BGP
**IP Routing Protocols**

**Unicast Routing**
- OSPF
- ISIS
- BGP

**Multicast Routing**
- PIM
- IGMP

A unique packet addressed to each destination.

Replicated at each node along the tree.
IGMPv2 – Joining a Group

**Note:** The IGMP message does not include the identity of the multicast source

IGMP Membership Report
Requested Group: 234.1.1.1
Source IP: 10.1.1.1
Dest IP: 234.1.1.1

Receiver 1
Eth0:10.1.1.1

Receiver 2
Eth0:10.1.1.2

First-hop router
Eth0:10.1.1.254

Receiver 1
I want to receive group 234.1.1.1
Eth0:10.1.1.1

Receiver 2
Eth0:10.1.1.2

Non-receiver

Non-receiver

Multicast Stream
IGMPv3 – Joining a Group

I want 234.1.1.1 from source IP 192.168.1.1

IGMP Membership Report
Requested Group: 234.1.1.1
Group Source: 192.168.1.1
Source IP: 10.1.1.1
Destination IP: 224.0.0.22

Non-receiver

I also want 234.1.1.1 from source IP 192.168.1.1

Receiver 1
Eth0:10.1.1.1

Receiver 2
Eth0:10.1.1.2

Source
192.168.1.1

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PIM - Multipathing
Scalable Spine and Leaf Fabric

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Considerations
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- Network Visibility
- Automation
- Security
Multicast Scale

SMPTE 2022-6

- Ancillary
- Audio
- Video

SMPTE 2110

- Video
- Audio
- Audio
- Audio
- Audio
- Audio
- Audio
- Audio
- Audio
- Ancillary

4x - 16x Multicast Route Scale
IP Fabric with Redundant Networks

- Two Independent Fabric
- Two Independent Network Controller
- Single Broadcast Controller
- End point connected to both fabrics
PTP Considerations

Transparent Clock

GM

Spine

Leaf

Leaf

Sync
DelayRequest
DelayResponse
PTP Considerations

Transparent Clock

GM

Spine

Leaf

Better Scale
Lower Load on the GM

Boundary Clock

GM

Spine

Leaf

Sync
Delay Request
Delay Response
Lets put it together
AIMS Reference Design

NON-BLOCKING BANDWIDTH MODEL

FIGURE 4 – LARGER SYSTEMS TEMPLATE
In the context of AMWA IS0x
Overall Workflow
Registration and Discovery of Endpoints

Automated registration for ease of use
Overall Workflow

Discovery of Network Topology and Registration of Endpoints

Common API for Network integration
Overall Workflow

Connections for transporting media between sender and receiver(s)

Multi-vendor Connection Management

AMWA NMOS IS-04: Node/Register API
AMWA NMOS IS-05: Connection Mgmt API
AMWA NMOS IS-05: Node/Register API
AMWA NMOS IS-05: Connection Mgmt API

Network Controller

IP Network

SMPTE ST 2110 (RFC 4175, AES67 Ancillary Data)

Sources

Broadcast Controller

IS-04: Query API
Broadcast Infrastructure Control Service
Control Management Service

Sources

Receivers
Summary

• Identify End Points: ports, speeds, number of flows,
  • Compressed / Uncompressed / 2022-6 vs 2110
• Sizing for immediate project and for growth
  • Single Chassis vs Fabric Architecture
• COTS switches
  • Routing Protocols support, Multicast PIM / IGMP / SSM
  • Internally non-blocking
  • PTP support
• Fabric Architecture
  • Bandwidth Aware Fabric
  • Network Controller
• PTP and advantage of boundary clock
• High Availability