#AABAC

AVnu Alliance Broadcast Advisory Council

"How Big do my pipes need to be?" – Traffic Shaping & Infrastructure planning

May 16, 2013

Andre Fredette, Ph.D., Extreme Networks

Note: The Technical presentation portion of this session will be recorded and made available online to Broadcast Advisory Council members

Welcome
AVnu Alliance Broadcast Advisory Council

Andre Fredette, Ph.D.

AVnu Alliance, Member, Technical Working Group

Extreme Networks, Sr. Principal Engineer

Email: afredette@extremenetworks.com

Note: The Technical presentation portion of this session will be recorded and made available online to Broadcast Advisory Counsil members

Agenda

- Quick Review of Stream Reservation Protocol
- Shaping
  - How it works
  - Why we do it
- Bandwidth
  - Bandwidth Requirements
  - Infrastructure planning

What/Who is the AVnu Alliance?

- **The industry consortium to lead the adoption of certified open standards-based AV networking**
  - *AVB (Audio/Video Bridging) is the first set of AV networking standards approved by the IEEE.*
- **A non-profit organization defining AVB certification and promotion**
  - *Members include major automotive, professional AV, consumer and silicon/platform manufacturers.*
  - ***Member manufacturers** are given **access** to test tools and plugfests in advance of submission for official AVnu interoperability certification.*

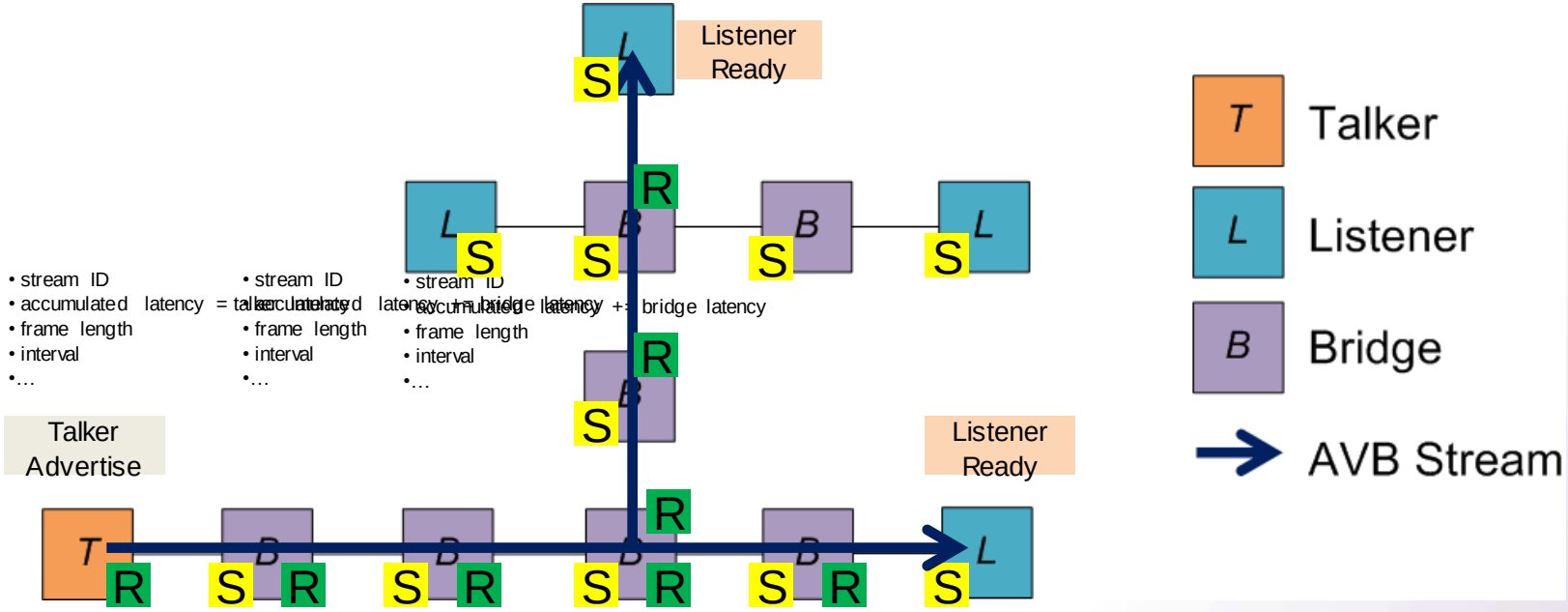
AVB Terminology

- **Stream** – A “pipe” that contains one or more channels of audio and/or video data in an AVB cloud
- **Talker** – An entity in the AVB cloud that can send a stream
- **Listener** – An entity in the AVB cloud that can receive a stream
- **Controller** – An entity on the network which configures and connects Talkers and Listeners in an AVB network

Stream Reservation Protocol

- Enables the cloud to self-manage its bandwidth allocations
- Talkers/Listeners request permission before streams are allowed to flow
- The cloud guarantees a portion of the bandwidth will be available for legacy traffic (per port)
- Priority-based reservations

Stream Reservation Example



(From IEEE 802.1 Tutorial on Deterministic Ethernet, November 2012)

QoS for AVB

- SRP used to reserve the bandwidth
  - Prevents links from becoming oversubscribed
  - Talkers are forbidden from transmitting without a reservation
  - AVB bridges block streams without reservations
- AVB Traffic is carried in the Highest priority Queues
  - Reduces latency
- Shaping has multiple benefits
  - Spaces frames out as much as possible to reduce bursting and bunching
    - Limits buffering requirements along the path
  - The spacing and rate limiting protects AVB streams from other AVB streams
    - Limits the maximum amount of interference/delay
  - Protects best effort traffic by limiting AVB traffic to a known maximum (75% by default)
    - Allows the convergence of AV and other traffic on the same network.

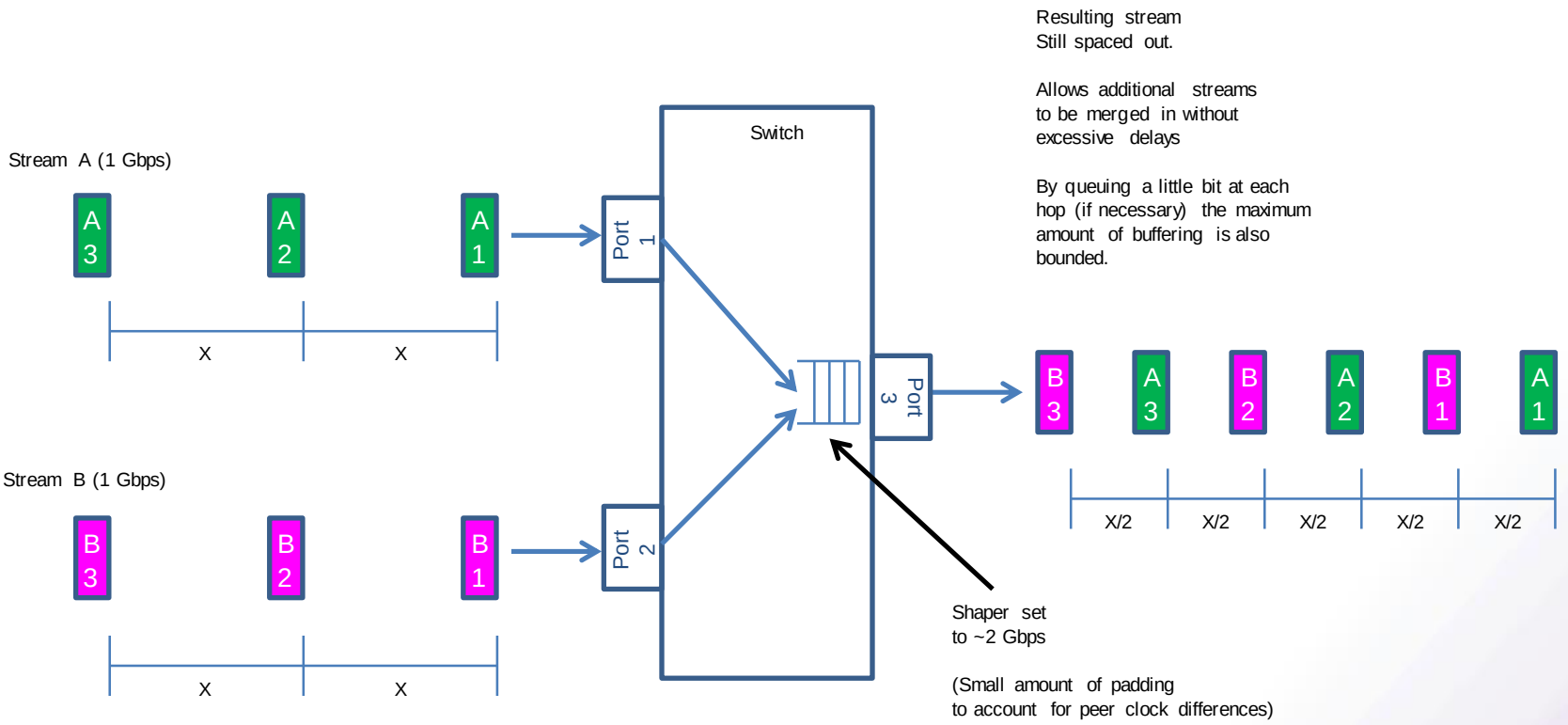
Forwarding and Queuing for Time Sensitive Systems (FQTSS)

- Originally defined in IEEE 802.1Qav (Now part of IEEE 802.1Q-2011)
- Defines
  - Credit-Based Shaper algorithm
  - SRP Boundary Detection
  - Bandwidth availability parameters used for reservations
  - Mapping from priorities to queues

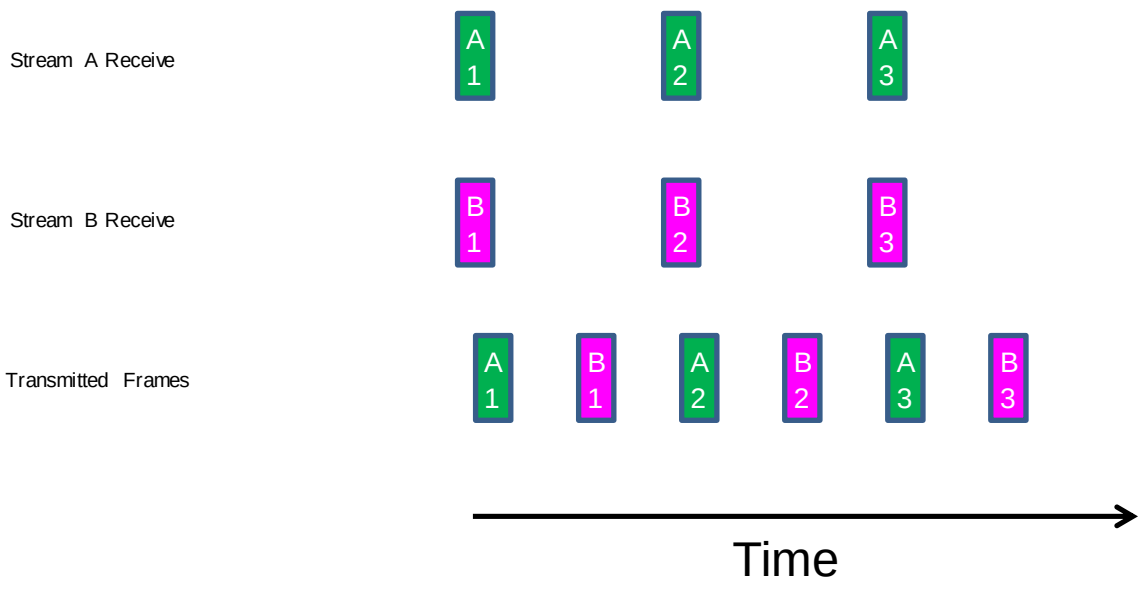
Making a Reservation in the Switch (SRP -> FQTSS)

- Verify bandwidth is available
- Reduce available bandwidth by stream bandwidth
- Set shaper allowed bandwidth on port
- Add port to forwarding for Stream Destination MAC address in forwarding table
- Send the Listener message upstream toward the Talker

Shaping Example

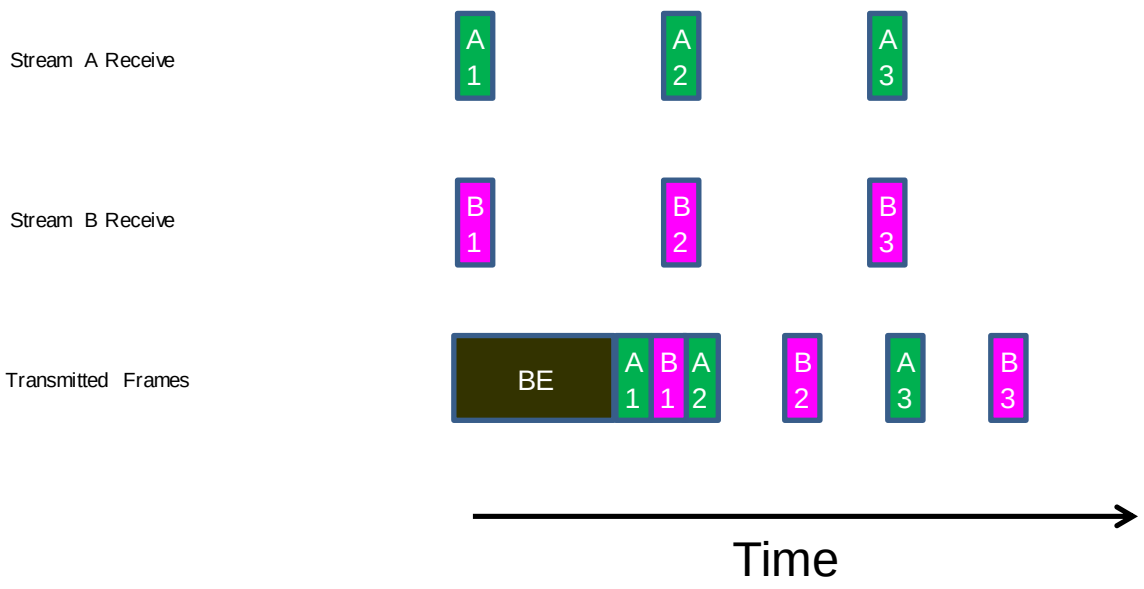


Shaping: Maintaining Spacing



- If frames from different streams arrive at switch at almost the same time from different ingress ports, some frames get delayed a small amount until credits are available
  - Preserves the spacing.

Shaping: Interfering Frames



- If a lower priority best effort frame interferes with AVB traffic, the AVB traffic will burst until it catches up.

Stream Bandwidth Requirements

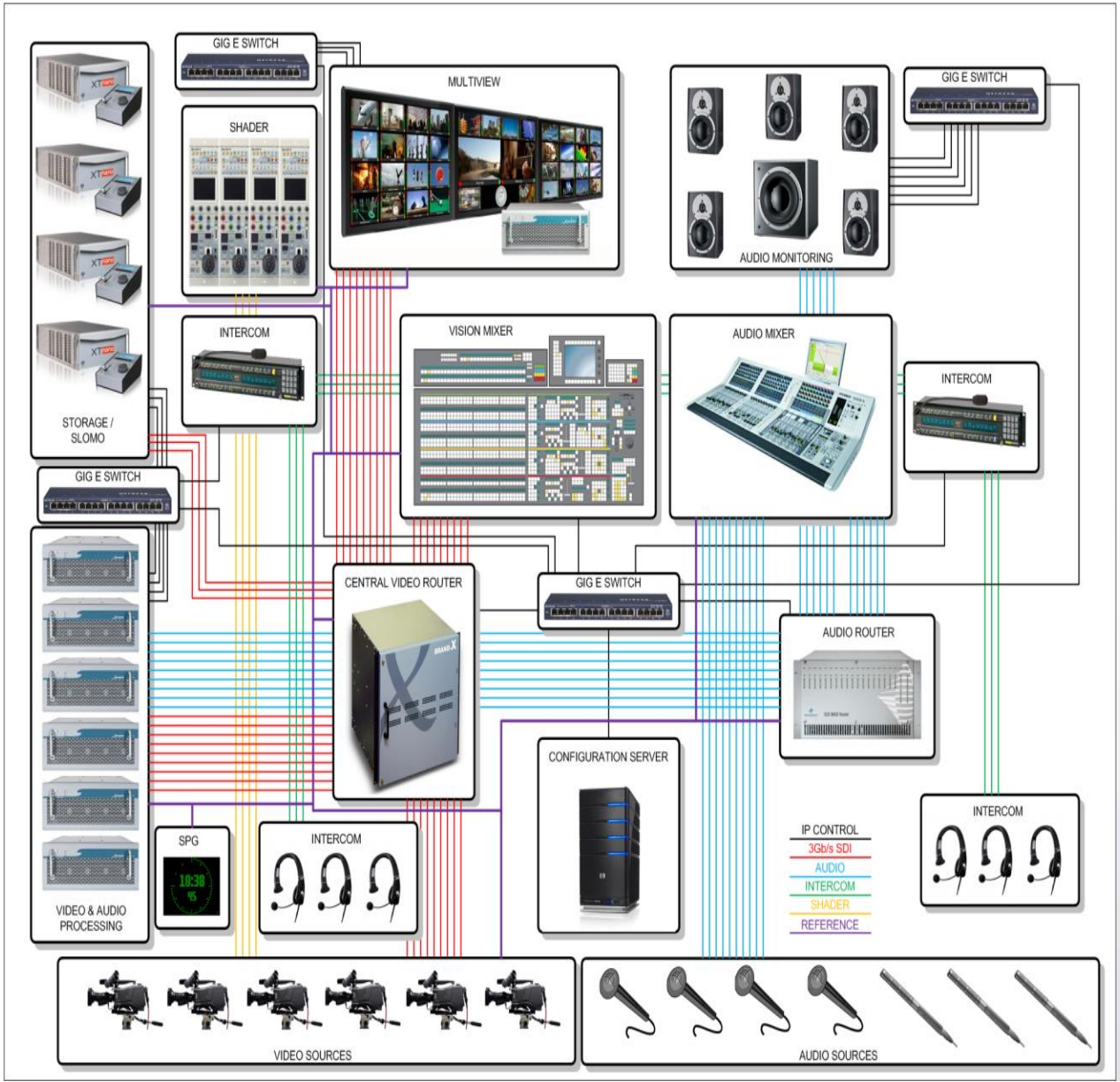
(Derived from IEEE 802.1Q-2011 Table 35-5)

Source	Raw Bit Rate	TSpec MaxFrameSize	TSpec MaxIntervalFrames	Ethernet Bandwidth	Streams/10 Gbps Link (75% Utilization)
48kHz stereo audio stream (32-bit samples) Class A [B11]	~3 Mbps	80	1 (8,000 frames/sec)	7.87 Mbps	952
96kHz stereo audio stream (32-bit samples) Class A [B11]	~6 Mbps	128	1 (8,000 frames/sec)	10.94 Mbps	685
MPEG2-TS video Class B [B11]	~24 Mbps	786	1 (4,000 frames/sec)	26.53 Mbps	282
SD SDI (Level C) uncompressed Class A [B46]	270 Mbps	1442	3 (24,000 frames/sec)	285.12 Mbps	26
SD SDI (Level D) uncompressed Class A [B46]	360 Mbps	1442	4 (32,000 frames/sec)	380.16 Mbps	19
HD SDI 1080i uncompressed Class A [B47]	1.485 Gbps	1486	16 (128,000 frames/sec)	1.56 Gbps	4
HD SDI 1080p uncompressed Class A [B48]	2.97 Gbps	1486	32 (256,000 frames/sec)	3.13 Gbps	2

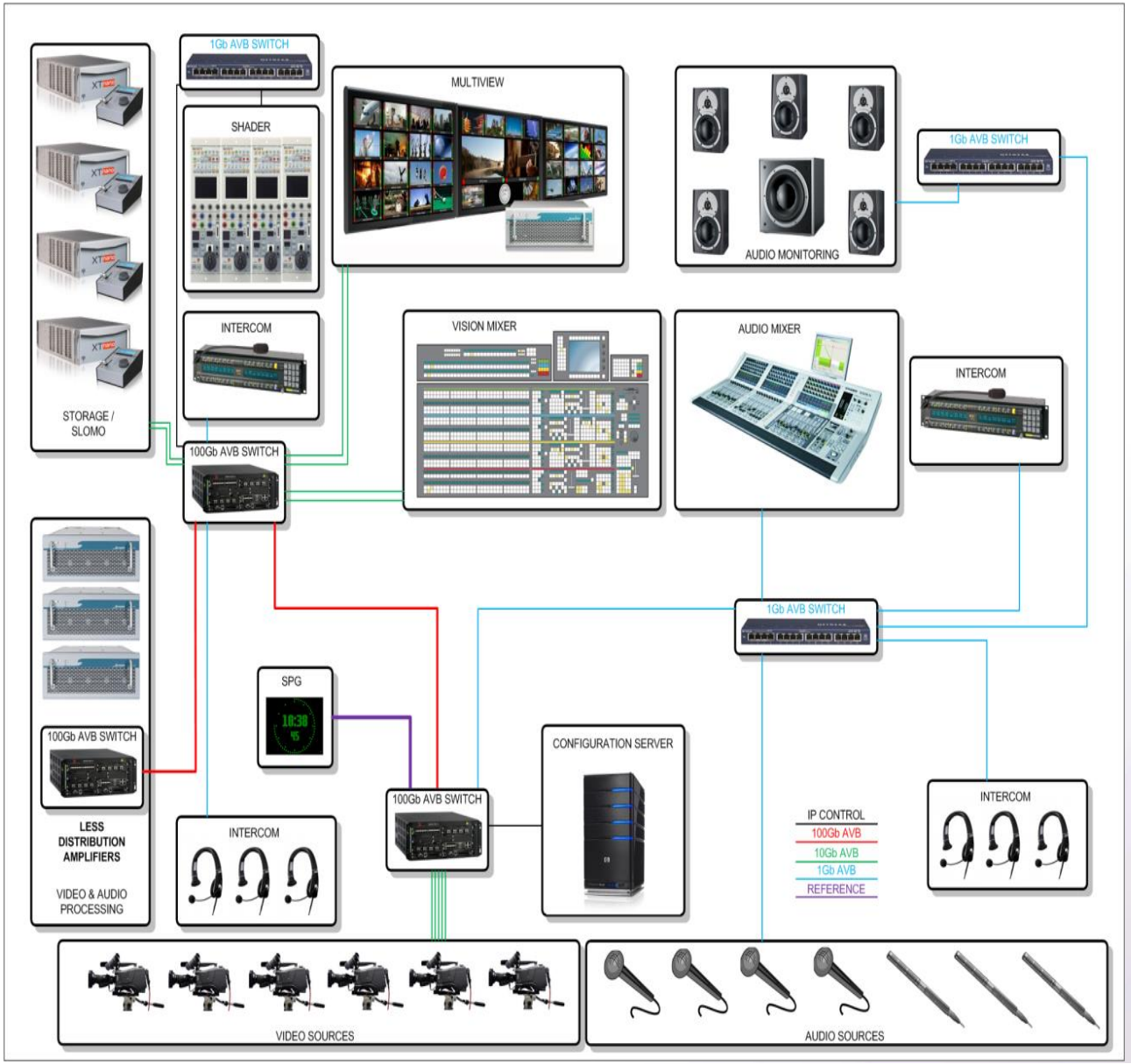
Infrastructure planning

- Important Factors
  - Total number of streams
  - Total stream bandwidth
- If Total stream bandwidth exceeds link bandwidth
  - SRP will tell you when and where there is a problem, but it's better to plan ahead of time
  - Evaluate locations of Talkers and Listeners
  - Ensure that there is enough bandwidth from each talker to each of the listeners.
- From a bandwidth perspective
  - It is better to co-locate Talkers and Listeners on the same switch
  - If not possible, organize network so that talkers and listeners are as close as possible.
- Less Important Factor
  - Total number of Listeners

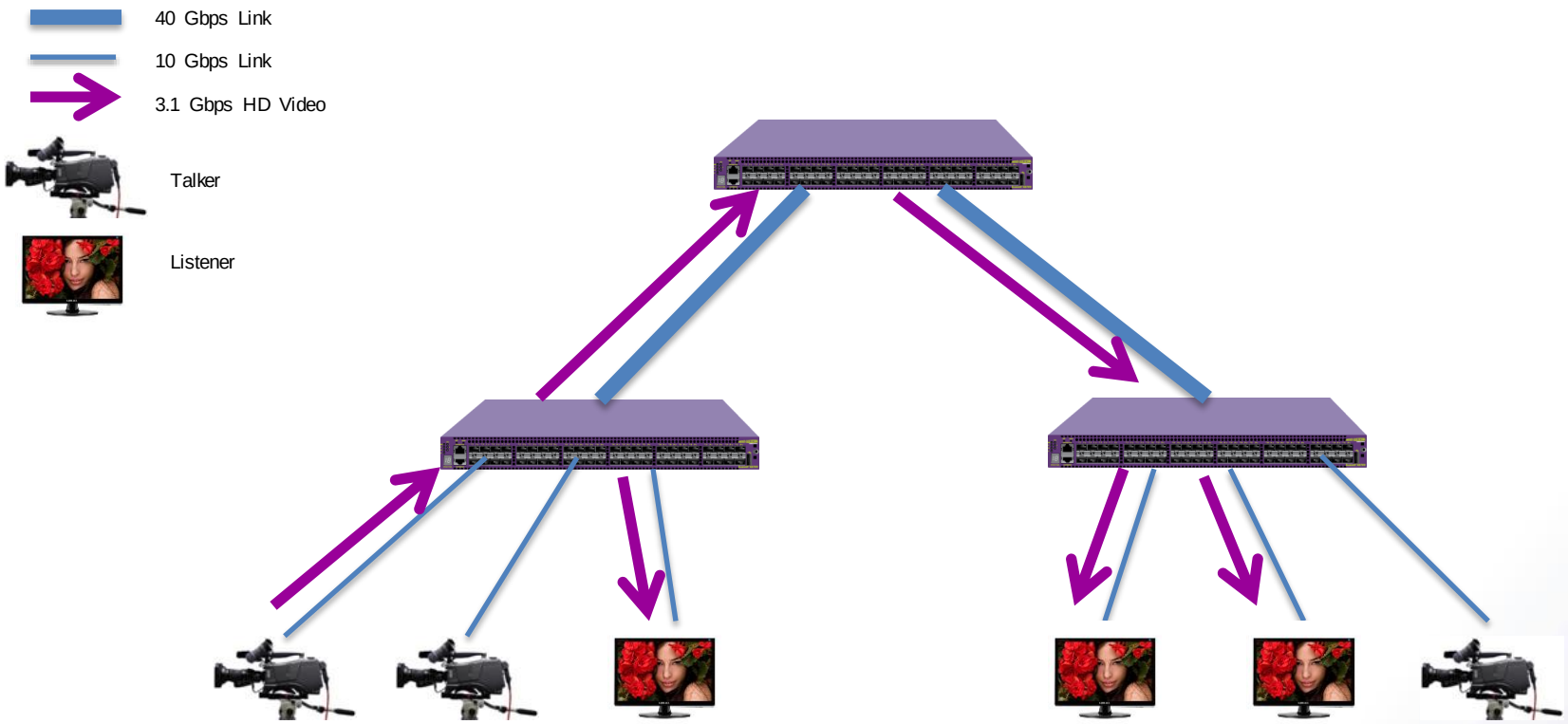
Todays (live) broadcast infrastructure



Native AVB Infrastructure (Tomorrow)

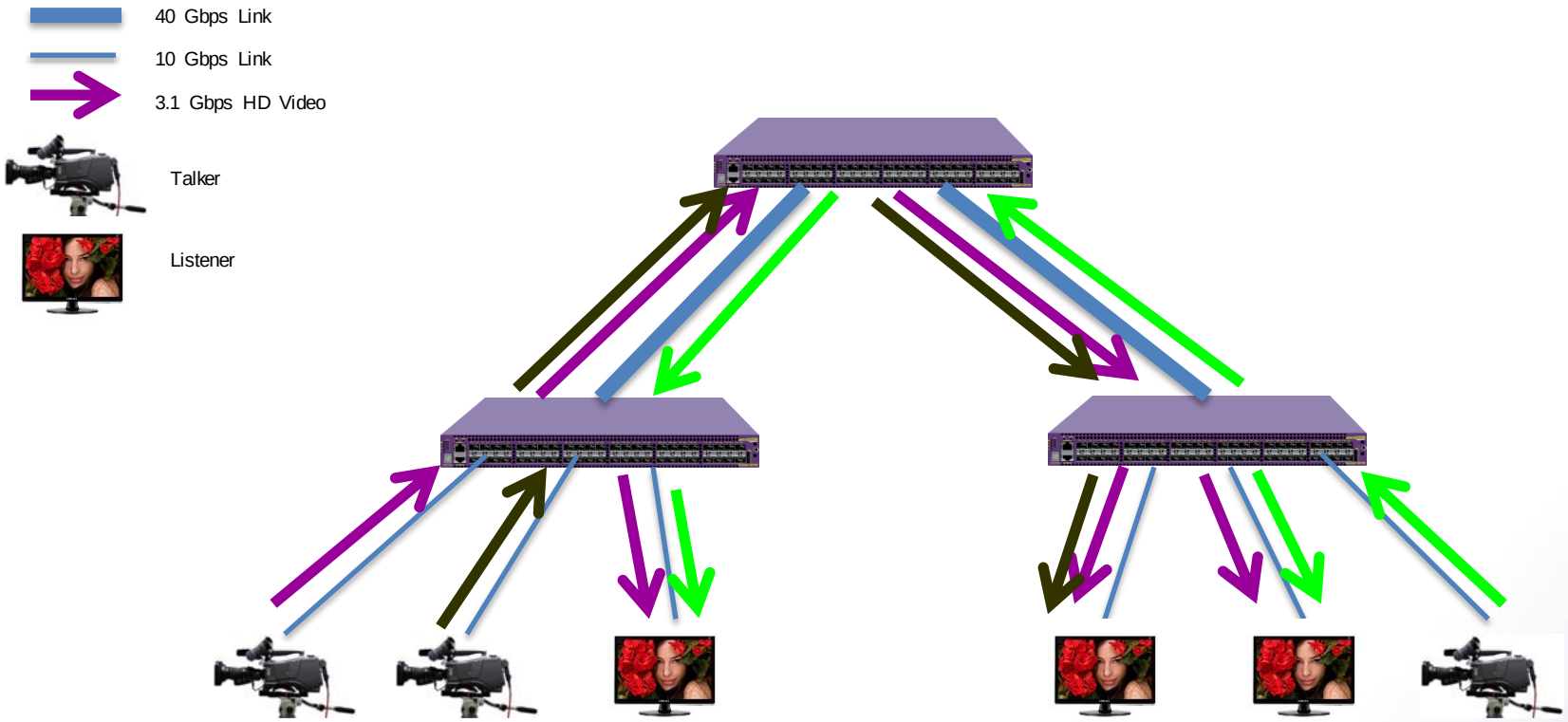


Video Network



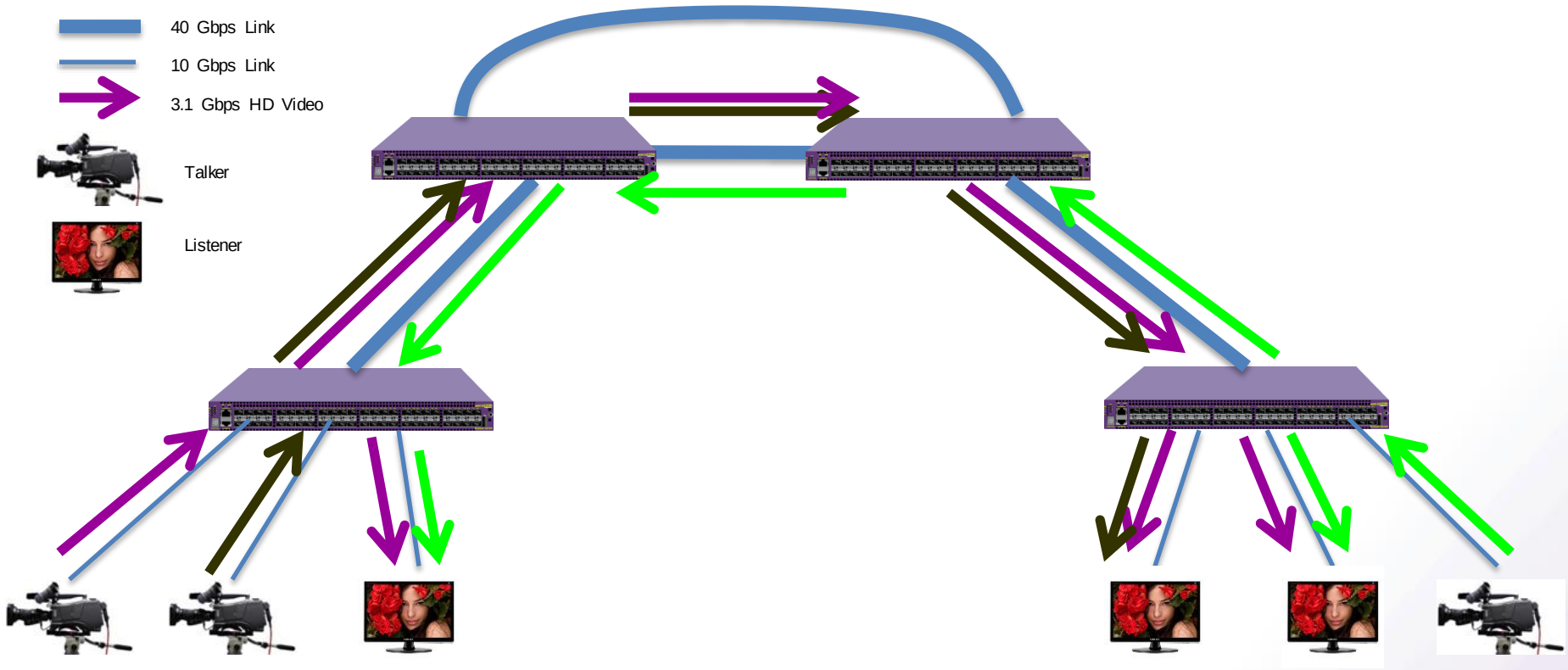
- For each 3.1 Gbps stream
  - Need 3.1Gbps bandwidth between each switch and to each listener
- Switches efficiently replicate data out to multiple listeners
  - No need to count each listener in bandwidth calculations

Video Network



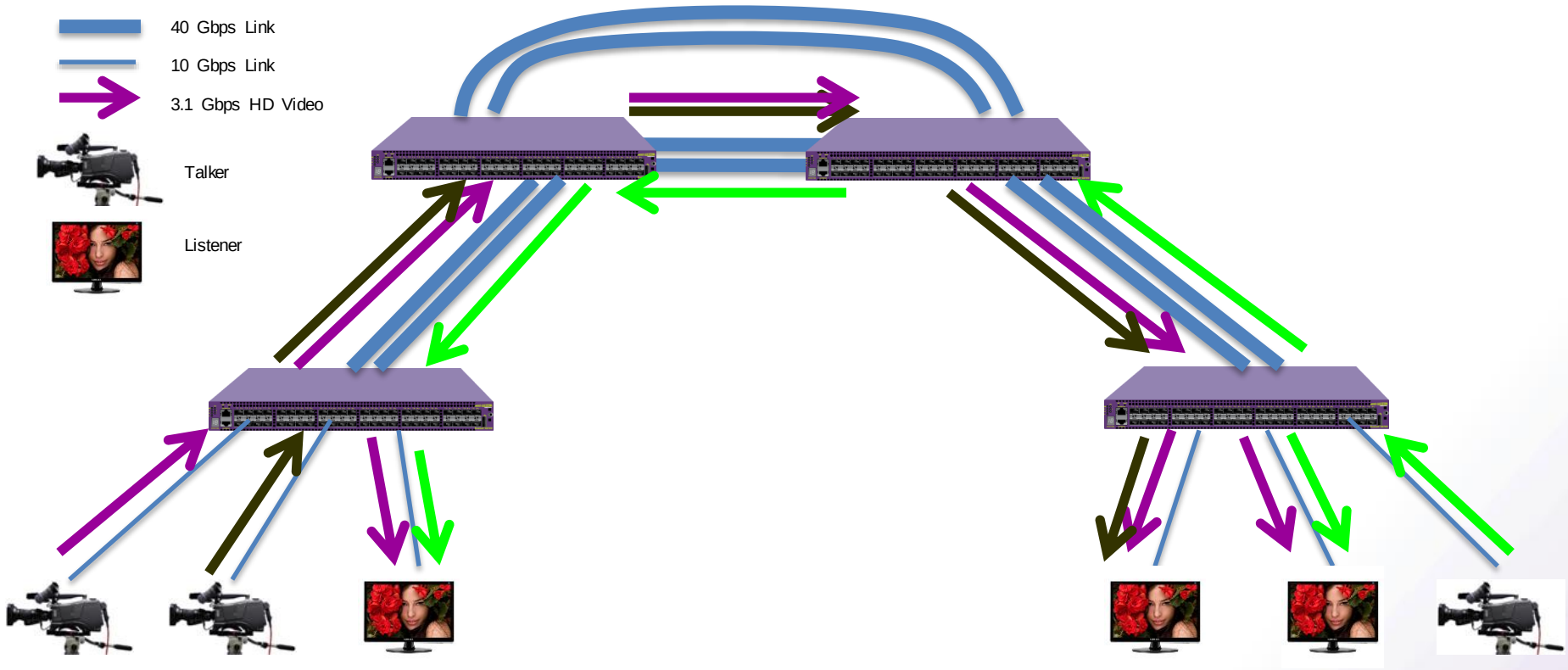
- Links are full duplex, and streams are uni-directional, so bandwidth is only required in the direction from Talker to Listener.

Distributed Network



- For a distributed network,
  - core swtiches can be “chained” together,
  - rings or meshes can be used for redundant paths

Link Aggregation



- Max 3.1 Gbps HD video streams per link @ 75% max utilization
  - 10 Gbps: 2 in each direction
  - 40 Gbps: 9 in each direction
  - 100 Gbps: 23 in each direction
- More bandwidth will be needed
- Solution: Link Aggregation (also provides link redundancy)

Open Discussion

- Next Session
  - Thursday, June 6, 2013
  - 8 AM PDT (GMT-7)
  - Topic
    - Timing and SMPTE 2022 compared to AVB

Feedback on this session

Thank You!

#AABAC