Outline

- Introduction
- Protecting Media over IP
- Real-time Monitoring
- Centralized Management
- Nationwide Contribution Broadcast Network
Contribution Broadcast

- IP for contribution media is mostly used for long distance
- Gaining acceptance for transport of uncompressed media and for extension of production facilities
Contribution Broadcast

• Bandwidth cost is dropping
  – Compressed video over 1G is growing strong
  – Video over 10G is being deployed
• Infrastructure extension
  – Share and collaborate easily over WAN.
• Standardization is accelerating inter-operability
  – No need for proprietary systems.
• Requirements for IP media transport is better understood
  – System adaptation and infrastructure performance is no longer a black art.
Contribution Broadcast

- How do we increase and accelerate acceptance?
- Reliability (Protect/monitor in real-time)
  - Ensure content delivery and timely fault-resolution
- Increase Familiarity
  - Make Media over IP appear like typical Broadcast infrastructure
- Prevent disruption that can occur with rogue packets/elements
  - Need deterministic behavior
Three keys in easing the transition

• Resiliency
  – Leverage and extend protection mechanisms to provide protection of high value content

• Monitoring
  – Apply comprehensive monitoring to target fault finding and recovery to minimize disruption

• Centralized Management
  – Provide control over system connectivity to guarantee performance while simplifying the complexity of operation.
Media Protection
Leveraging IP for Resiliency
Protecting Media over IP

- Standardization is hugely important
  - Benefits of SMPTE ST2022-x specs cannot be understated.
- FEC (2022-1/5)
- A little bit of insurance against occasional packet loss
  - Doesn’t help when there is a long burst and is no help at all when there is a link flap or link loss
- RTP switching (2022-7)
  - Seamless switching when path diversity is available
  - Highest level of protection - beyond FEC
Protecting Media over IP – Extensions

• Extended FEC
  – Simplest method is to increase the FEC matrix size.
  – Extending number of columns increases robustness to burst losses
  – Of course increases latency

• RTP Switching
  – Enhanced design accepts packets from any stream for switching
  – Can take alternate packets from any stream for 100% FEC type behavior

• Hardware Redundancy with RTP switching protects for link/stream faults in the network and for hardware faults too
  – Inter-connect hardware systems at transmit and receive with intelligent processing
Dual path strategy with SIPS (RTP Switching)

- RTP Switching as defined by ST 2022-7
- Seamless switching in case of link failure in one path
- With buffering and packet by packet comparison
- Can protect for packet losses from any link as long as not simultaneous

No disruption to signal
Encoder Partner Protection (EPP)

- For a 1+1 hardware redundancy with RTP switching
- Media transmitted on Master-Primary and Slave-Secondary
- Slave can be free-running or RTP-synchronized with Master
EPP and network protection

- For Link failures or packet losses
  - Media travels down secondary path from master sender to receivers

No disruption to signal
EPP and sender protection

• For transmitter hardware failures
  • Media travels via the slave sender down secondary path to receivers

No disruption to signal
EPP and **receiver protection**

- For receiver failures
  - Media travels via master sender to independent receivers
Media Monitoring
Real-time Integrity Checks
Real-time Monitoring

- Monitoring is typically an after-thought
- Monitoring must be approached from a holistic perspective
- Can’t just monitor end-points and expect to diagnose fault
Real-time Monitoring

- Lots of guidance available
  - SMPTE for SDI, ITU Y.1541 for network performance, TR101-290 for TS.
  - Measurement of all points in the transmission chain provides the ability to quickly diagnose faults.
  - Leads to information overload

- Important to consider CORRELATION
  - Monitoring points/alarms associated to services
  - Provide fault determination not only alarming
Media Service Monitoring

- Media Service Requirement
  - Equipment Layer
  - Logical Layer
  - Service Layer

- Monitoring Services
  - QoS and QoE scores
  - SLA compliance
  - Usage Patterns

- Media Network
  - Equipment Layer
  - Logical Layer

- Monitoring connections

- Media Service Delivery

- HD-Video/Audio
  - Miami to New York
Real-time Monitoring

- Present salient data for user-friendly fault finding
- Multiple views for application specific requirements
- Distributed monitoring. Send data and views to anyone / anywhere
- No need for fixed monitoring location
Simplifying the Complex

Centralized Management – The SDN way
Baseband vs IP

- Baseband systems are typically locked down and not dynamic
  - Static environment that is inflexible but highly reassuring
- IP systems are dynamic with individual nodes making autonomous decisions
  - Highly flexible environment and high potential for confusion
  - Non-deterministic and in-secure
Traditional broadcast infrastructure

Traffic engineering = Tieline management
Centralized IP routing intelligence

Next generation IP media routing with Openflow
Baseband vs IP

• Traditional approach for configuring paths on network switches
  – CLI based (commit configs to each network switch in native OS)
  – Slow as it requires config checks/parsing. Multi-second operation.
  – Can provide deterministic switching through VLAN trunking and multi-point distribution

• Protocol based (configuration determined by the control plane in response to IGMP messaging)
  – Automated and relatively speedy
  – Non-deterministic may cause bandwidth loading issues
Software Defined Networks (SDN) - What is it?

• Essentially separates network control from forwarding plane
• Applications can control the network via API
• Open standards-based and vendor-neutral
• Possibilities for packet inspection and modification
OpenFlow - A key part of SDN

- Open-source communications interface between the control- and forwarding layers within an SDN architecture
- Enables the Controller to interact with the forwarding plane and make adjustments to the network
- Centralized management and control of flow-tables in networking devices from multiple vendors
- Direct access to switch forwarding means less time spent in configuration checks and commits = near instant on behavior
OpenFlow - A key part of SDN

- Auto-discovery of nodes and links
  - Leverage high density top-of-rack Ethernet Switches
  - Highly Scalable. Add switches as network grows.
- Any flow into network can be transported with little requirement for unique software drivers
- Packet inspection, matching, modification for highly flexible processing
- **Automatic access control**
  - All elements under central management and no unauthorized elements allowed to access network. Any unauthorized changes are automatically overridden
- Wealth of information for advanced monitoring and pre-emptive fault remedies
Case Study

BT and ITV – A National IP Broadcast Network
BT/ITV IP Contribution

• BT built a nation wide IP contribution network for ITV
  – 12 main and 28 remote facilities in a dual star
  – 10GigE for uncompressed SDI over IP (DWDM)
  – GigE for SDI over JPEG 2000 over IP (MetroE)
  – Two data centers for high resiliency
  – Centralized management for connection and alarm management
BT/ITV IP Contribution

- Critical Site
- Critical Site
- Critical Site
- Critical Site

- West Data Center
- East Data Center

- 10 Gigabit Ethernet Wavelengths
- Uncompressed
- Metro Gigabit Ethernet
- JPEG 2000 compression

- Selected Regional Site
- Selected Regional Site
- Selected Regional Site
- Selected Regional Site
ITV Premise

- SDI baseband monitoring as demark for signal integrity at hand-off
- Media adapters performing SMPTE ST2022-1/2 (JPEG 2000), 5/6 (uncompressed), 7 (RTP switching)
- 10Gigabit top of rack Ethernet aggregation switches
BT Core

- SDI baseband monitoring for signal integrity monitoring
- Media adapters performing SMPTE ST2022-1/2/5/6/7
- SDI baseband routing for video switching
- 10Gigabit modular Ethernet switches
Resiliency

- Highly resilient network architecture
- Dual star 1+1 hardware redundancy at the edge
- Dual RTP streams to two geographically separate data centers
- ST2022-5 for FEC and ST2022-7 for seamless RTP switching
User Friendly Provisioning

- Multi-tenanted environment
- Access control with user profiles limiting visibility to associated elements
- End-user (broadcaster) has access to manage their services
- Provisioning of services by at least 30 concurrent users with a minimum of 30 bookings a day
- Easy to use (familiarity) control panel type interface
Key Attributes

• Centralized connection management enables non-specialist to easily set up occasional-use connections without expertise
• Connections are provisioned virtually instantly relative to the minimum of 5 minutes or more previously.
• Media shared in real-time between any location
• Latency reduced from 600ms to just a few msec for uncompressed and <100 ms for J2K
• Highly resilient media transport for high value content
Thank You

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