MultiService SDN™

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SMPTE – Standard Agenda

- Describe the problem
- Propose an approach to addressing the problem
- Challenge the audience

(Honorable Mention & Thanks to John Mailhot)
Design systems to support the latest market & technology trends

While keeping costs down ... yet still provide scalability & elasticity
Cost & Bandwidth Improvements

- SDI/coax based Broadcast Routing & Dist. Equip. vs. COTS IP Switches
  - Traditional SDI/coax
    - From 2004 to 2014 = roughly ½ the price and 2-4 times the bandwidth
  - COTS IP Switches
    - From 2004 to 2014 = roughly ½ the price and 10 times the bandwidth

- Imagine same comparison w/ Broadcast Video Servers vs COTS IT Servers
  - Price, CPU, GPU, Memory, Storage, ...

- Now add in the higher density and lower power costs...
Economy of Scale

The “Information Technology” Economic Ecosystem

Standard Platforms
Virtual Machines
IP/Ethernet Networks
How does this play out in practice?

- **Dual 10 GBE NIC**
  - $434

- **PC HDSDI I/O**
  - ~$1000

- **HDSDI I/O For Audio Console**
  - $4399
Yeah – but who is really driving the growth!

The “Broadcast Media Bandwidth & Storage” Ecosystem

Requirements Ecosystem
So the Obvious Solution Is?

*Everything Just Moves to IP on IT HW!*

... *Problem Solved*

... *or is it?*
Now What is the Problem?

- If you don’t care what, how or when the network handles your data … no problem

- Many of our customers are used to managing video … not IP packets
  - I put my signal in the network … where did it go?
  - Where is the network sending my packets?
  - Why did the network do what it did?
  - What path is my data taking right now?
  - How do I make the network do what I want?

- As services are virtualized & run in Data Centers / Private Clouds … more complexity
  - If I (or my automatic fail-over) moves a VM from one server to another …
    - How do I get all the right network connections to follow it?
  - Can I write a script to turn up a VM and create all the network connections to/from it?
MultiService SDN™

- Seamless way to create, optimize, play and deliver media content
- **Software Defined Network (SDN)**
  - Decouple SW from HW
  - Move I/F’s from SDI/Coax to IP
- **Cloud-enabled, Virtualized Services**
  - Independent of processing
  - Use of standard IT platforms
- **Workflow Management**
  - Software defined workflows (SDW)
  - Orchestrate services into useful functions
- Scalability, Elasticity & Geo-diversity
- Lower cost of deployment & operation
Where did SDN come from?

- Researchers at UC Berkeley and Stanford
  - Wanted to do research on new network protocols and routing algorithms
  - But couldn’t make the switches they had do what they wanted
  - What they really wanted:
    - Turn off the intelligence “in” the switches
    - Have their own software program the forwarding tables
    - Have the switches act on the tables they made

- This grew into the “OpenFlow” whitepaper in March, 2008
  - Co-Authors from Stanford, MIT, UC Berkeley, Washington University, and Princeton

- This also marked the beginning of the OpenFlow Consortium
  - Created to develop & maintain the standards & coordinate interoperability tests
What did the OpenFlow paper propose?

- Separate the ports on the switch into
  - “Normal” ports
  - “Openflow” ports

- Connect ext. controller to switch using secure channel
  - Write (vendor independent) control schema
  - Program flow tables for the “Openflow” ports

- In Other Words:
Separate the Smart Management away from the high-volume packet processing through a common (secure) interface
They are, but they are quite powerful

Protocol processing that switches do ... can now be done through these
- Classical IP routing
- Utilizing VLANs – assembling private Ethernet networks easily & arbitrarily
- IGMP snooping or special multicast forwarding is supported

Fancy Routing Protocol Processing using these is a differentiator
- Some new switch vendors support nothing but OpenFlow
- DataCenter Industry uses these to provide
  - Virtual hosting services
  - Virtual machine redundancy & clustering
  - Virtual private clouds
- Large Data Enterprises (Google, Amazon, PayPal, etc) use it daily
Migration Path to IP

- Leverage COTS 10/40/100GE HW
  - SMPTE 2022 is widely accepted (base-band over IP)
  - On/off ramps to/from SDI support hybrid systems

- IP I/F’s enable virtualization & cloud integration
  - With familiar, consistent broadcast I/F’s
  - Consistent management interfaces

- Design for stair-step software upgrades

- Transition at customer’s pace
Signal Topologies of the Future Plant

- **SDI Router in the core, with a few IP things translated back to SDI**
  - Low-risk, add IP only as devices natively speak it
  - Requires translation where IP meets baseband
  - Difficult endgame

- **IP Switches in the middle, everything converged to IP**
  - Best-cost approach as more and more devices natively speak IP
  - Works well with top-of-rack architecture signal management
  - Requires translation for baseband devices to get to IP
  - Wire-level redundancy available for maintenance and uptime

- **Hybrid Core – Baseband plus IP**
  - Best of Both Worlds – baseband for baseband, IP for IP
  - Translators as tie-lines – automatically allocated and routed
  - Most cost-effective in the “Middle zone” of the crossover
  - Clear path to the all-IP endgame
In 2009, the Business Process Management (BPM) Center of Excellence (CoE) defined *Workflow* as:

*An orchestrated and repeatable pattern of business activity enabled by the systematic organization of resources into processes that transform materials, provide services, or process information.*
SDW- Software Defined Workflows

- Add new services/channels via easily configurable workflows
- Use orchestration to instantiate resources to execute workflow
- Replicate easily without re-engineering

![Diagram showing SDW Software Defined Workflows]

**Palette of SW services**

- Ingest
- Package
- Brand
- Play
- Schedule
- Encode
- Transcode

- DRM
- Bill
- Decode
- Ad insert
- Traffic
- QC
- Switch

**Workflow Creation**

- Master Control
- Branding & Graphics
- Editing
- Integrated Playout

**Orchestration**

- Channel Playout
- Transcode

**VMware Virtualization Layer**

- Operating System
  - CPU, Memory, NIC, Disk

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  - CPU, Memory, NIC, Disk

**X86 Architecture**
Open Ecosystem

- Software-Defined Networks and Workflows
- Use of open standards to enable vendor interoperability
- Allows media companies to pick best-of-breed vendors
- Imagine is building a Collaborative and Supportive Ecosystem
- Aligning with companies that share our vision, product direction and strategy
Resources

- McKeown et al. *OpenFlow: Enabling Innovation in Campus Networks* (March 14, 2008)
- [https://www.opennetworking.org/sdn-resources/sdn-library](https://www.opennetworking.org/sdn-resources/sdn-library)
- [http://www.techcentral.ie/software-defined-networking/](http://www.techcentral.ie/software-defined-networking/)
- [https://www.ftb.ca.gov/aboutFTB/Projects/ITSP/BPM_Glossary.pdf](https://www.ftb.ca.gov/aboutFTB/Projects/ITSP/BPM_Glossary.pdf)