Why SVIP?

Chuck Meyer, CTO – Production, Grass Valley
What is it about IP Technology

- Why is it Inevitable?
- How can we plan for it?
- Paradox of Commoditization
The Business of Technology

Figure 1. NoC Technology entering Plateau of Productivity in 2013
The Business of Technology

VISIBILITY

Peak of Inflated Expectations
Plateau of Productivity
Slope of Enlightenment
Trough of Disillusionment

Technology Trigger
TIME
# Wire Speed Latency Update

<table>
<thead>
<tr>
<th>Network Speed</th>
<th>Delay</th>
<th>Lines</th>
<th>2014</th>
<th>2017</th>
<th>2020</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Time</td>
<td>usec</td>
<td>14.8</td>
<td>7.4</td>
<td>3.7</td>
<td>1.9</td>
</tr>
<tr>
<td>1 GbE</td>
<td>37</td>
<td>2.5</td>
<td>5</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>10 GbE</td>
<td>3.7</td>
<td>0.25</td>
<td>0.5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>25 GbE</strong></td>
<td><strong>1.5</strong></td>
<td><strong>0.1</strong></td>
<td><strong>0.2</strong></td>
<td><strong>0.4</strong></td>
<td><strong>0.8</strong></td>
</tr>
<tr>
<td>50 GbE</td>
<td>0.75</td>
<td>0.05</td>
<td>0.1</td>
<td>0.2</td>
<td><strong>0.4</strong></td>
</tr>
</tbody>
</table>
Latency Validation Data

Figure 8. Latency per Switch Hop

Switch 6
Switch 5
Switch 4
Switch 3
Switch 2
Switch 1

Min. to Max. Latency per Switch Hop (µs)

0 0.5 1 1.5 2 2.5 3 3.5 4

Courtesy
Brian Keane
Aperi Corporation

Thomas Edwards
Fox Networks E&O
Faster than Real Time is Deterministic

- 25 GbE / 10 GbE will carry payloads faster than real time
  - 270, 1.5 G, 3 g

- Isochronous data transport provides useful “gaps”

- Exchange a modest bit of latency for larger gains in flexibility
What Problem are we Solving

- 4K
- Or is it UHD?
- Is it P-Q, HLG, S-Log3???
- Is it 4:2:0, 4:2:2 or 4:4:4???
- Is it 24, 60 or 120???

- Or, is it 8K?

- 9 Gbps to over 100 Gbps
Monetize Content

- Rapidly
- Across viewing devices
- Picture formats
- Consumption styles

- With one factory
Why IP?

Are we trying to replace SDI with IP?

No.

We need to leverage Internet Scale Technology for new business models which effectively compete in the modern connected world.
"I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail."

Fasteners as an analogy
Fasteners as an analogy
Fastener Explosion
One Tool for all
One Tool for all

INTEROPERABILITY
The Tool

……an abstract model of networking, called the Basic Reference Model or seven-layer model…… Wiki
The Tool and the principle

Encapsulation

OSI Reference Model

1. PHYSICAL
2. DATA LINK
3. NETWORK
4. TRANSPORT
5. SESSION
6. PRESENTATION
7. APPLICATION
The argument for OSI

- Audio, Video, metadata and time are all data

- Compliance to the OSI stack model ensures that ALL media can transit over ANY physical layer
  - WiFi
  - 802.XYZ (copper, fiber)
  - SONET, OTN
  - DVB – XYZ 2
  - ATSC 3.0
Content is Production’s end goal

❖ Neither the fastener nor its tool are as important as what is being built

❖ New Content Factories must exploit Internet Technology to simultaneously provide immediacy and choice
  - News
  - Episodic
  - Documentary
  - Long Segment
  - Sports
OSI Protocol Stack

- **L7** = SMPTE 274
- **L6** = 2022-6 Header
- **L5** = RTP (for example)
- **L4** = UDP (for example)
- **L3** = Internet Protocol
- **L2** = Ethernet
- **L1** = Copper, Fiber, etc.
Application of the OSI Layer Model to Media Streaming
Long-Haul Gateway Layers

- Ethernet with MPLS
Long-Haul Gateway Layers
- Ethernet with Sonet/SDH or OTN
Virtualization and Abstraction

- Layers 3 and 4 isolate layer 1 from layer 7
  - The application does not depend on the physical layer
  - The infrastructure is *abstracted*

- A property of the network is bandwidth
  - The application may run multiple instances provided there is sufficient bandwidth
  - The infrastructure enables *virtualization* of applications
Typical Packet “on the wire”

IPG = Inter-Packet Gap
Pre = Preamble
Hdr = Packet Header
Post = Frame Check Sequence and Post-amble (end character(s))
We already have one RTP method
Why is 2022-6 criticized?

- HD-SDI is widely used for production
  - It includes up to 16 channels of embedded audio
  - It includes meta-data
  - Rich ecosystem of equipment available today
- SMPTE 2022-6 is fundamentally no different than HDI-SDI
- Multi-Vendor Proof of Concept (POC) for production, which includes cameras, production switchers and servers, in addition to routers and multi-viewers have all been done with SMPTE 2022-6
HD-SDI with embedded audio, and other data, minimized cable count
- 1 wire for Video, Audio and metadata

Essence, loosely defined, is that audio, video and metadata required to create the content product
- The product which can be monetized

Data networks are very good at carrying multiple, independent streams simultaneously
Essence

- One physical network segment can carry many different essence types

- This is the advantage for production
  - Using essence enables the traditional production workflow where audio, video, metadata and control information all had their own physical layer in the plant

- 4 wires are now 1 physical wire, with 4 virtual tributaries inside. There are 4 virtual wires
Reduction in Physical Transport Types

Separate Interfaces
In Current Broadcast Facility

Virtual Channels/Lanes/Pipes in the Physical Transport
For a Media Streaming Model

N/A
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
SDI Coax or Fiber
10/100/1000Base-T
Serial RS422
Composite Video Coax
Serial RS422
10/100/1000Base-T
Serial RS232
Primary Requirements for the Value Proposition

- COTS router optimized
- Low latency, no dropped packets
- Compressed or uncompressed
- Time aware
- Manage bundles easily with session protocols
  - Everything is in-band
- Technical metadata

It is all just data
Common operating point

- Ethernet is the data link layer of choice
- Internet Protocol is the network layer of choice

- What are the differences for the transport layer?
Cloud Architecture

JT-NM RA 1.0 Published at IBC 2015

http://www.jt-nm.org/
Cloud Architecture

Client
SaaS
PaaS
IaaS

JT-NM RA 1.0 Published at IBC 2015
http://www.jt-nm.org/
The Common CORE

Configuration, Command and Monitoring

Video Processing
Multi-Viewers
Graphics
Playout & Presentation

OSI Reference Model

TRANSPORT
NETWORK
DATA LINK
PHYSICAL
Scalable Product Architecture

- **Dedicated**
  - Compact, low power

- **Open market**
  - Platforms

- **Virtualized**
  - Software
    - (cloud)

- **Cost optimized, real time, low power**

- **Authoring**
  - VIoT
  - MAM

- **Distributed**
  - Rich feature set

- **Minimum viable feature set**
What do 10GBE connections look like?

- **SFP+ Cages on the equipment**
- **SFP+ Optics LC duplex**
  - Multimode Fiber OM3 300M
  - Singlemode Fiber choices
    - SRS (2km), LR (10km), ER (40km)
- **SFP+ Direct-Attach Cables**
  - Active Optical good to 20+M
  - Beware Passive “twinax” – bad
  - Highly Reliable – no optical joints
  - Made by many competitive vendors in many lengths

<table>
<thead>
<tr>
<th>Speed</th>
<th>OM1</th>
<th>OM2</th>
<th>OM3</th>
<th>OM4</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 Gbps</td>
<td>33m</td>
<td>62m</td>
<td>Up to 300m</td>
<td>Up to 400m</td>
</tr>
</tbody>
</table>
What does 40GBE look like?

- 40GBE (QSFP+)
  - Four Lanes of 10G inside the SFP
  - MPT/MPO Connector to 8 fibers
    - Passive breakout to 10GBE
    - Available in MM or SM
  - CWDM to duplex LC fiber
    - Two fibers, each with 4 wavelengths
  - True 40Gbit laser/receiver
    - Very expensive single wavelength
  - Active Direct-Attach Cables
    - QSFP-to-QSFP (40G)
    - QSFP-to-four-SFP+ (4 10G ends)
What about 25G, 50G, and 100G?

- **25G looks just like 10G:** SFP+ → SFP28
  - Except the bits move faster

- **50G is a bonded pair of 25G**
  - No special connector, just 2xSFP28 or half of QSFP28

- **100G looks like 40G:** QSFP+ → QSFP28
  - 4 lanes at 25G

- **Link budgets on fibers are a little shorter**
Connector Lingo – How to Read the Spec

- **SFP+**  ==  10GBE Capable  
  (often 1G/10G configurable)

- **QSFP+**  ==  40GBE Capable  
  (often can do 4x10GBE)

- **SFP28**  ==  like SFP+ but can do up to 25GBE

- **QSFP28**  ==  4 lanes that can do 25GBE each
  - Often (be sure to check) can configure as
    4x10G  1x40G  4x25G  2x50G  or 1x100G

**QSFP100**  ==  another common name for QSFP28
Closing Comments

- If IP is seen as a business enabler for live production:
  - SaaS and Client applications have the most leverage
  - IaaS should be hidden, or transparent, yet easily scaled
    - Based on contemporary OSI stack
    - Ethernet, IP, RTP
- Providing Internet Scale and Abstraction for the business of Monetizing Content
Closing Comments

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