SSD Telco/MSO Case Studies

SSDs Enable IP CDN & iVOD

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ENAP-201-1_Enterprise Applications
Sanity Solutions: Focusing on Paradigm Shifts!

**Insanity**: doing the same thing over and over again and expecting different results
AGENDA

- IP-CDN Case Study
- Interactive-VOD Case Study
- CDN Future Trends and Requirements
Simplified CDN Architecture
Real Life CDN

Complex Ecosystem
CDN Adaptive Bit Rate Streaming

Adaptive Streaming Overview

INPUT: High bit rate
OUTPUT: Multiple bit rate

Encoder
Web Server

Manifest File

Manifest File every x seconds

Lots of requests: different bit rate depending on download speed.

Adaptive Bit Rates:
• 5 to 7 Key Formats
• 100KB to 1.5MB payload
• ~1.7MB/sec
• 2 sec to 6 sec Chunks
CDN Adaptive Bit Rate Streaming

Adaptive Streaming Overview

INPUT: High bit rate
OUTPUT: Multiple bit rate

Encoder

Web Server

Manifest File

Lots of requests: different bit rate depending on download speed.

Manifest File every x seconds

Available Bandwidth

Time

Network Congestion
High Bit Rate Stream
Medium Bit Rate Stream
Low Bit Rate Stream
Technology Problem Set

- IP Video Delivery CDNs are...
  - **Network Intensive** (and as a result, PCI bus intensive)
  - **CPU intensive** (Linux Realtime vs. Soft IRQ threads)
  - **Disk intensive** (in the case of Video-on-Demand; e.g. IOPs)
  - **RAM intensive** (in the case of Live Video; e.g. streams/sec.)

- Different delivery profiles (VOD vs. Live, for example) do not co-exist well (think head-of-line blocking)

- Short-lived TCP sessions and time-sensitive delivery require significant OS and NIC tuning.
Video CDN Functional Requirements

- Here is what I want my CDN to do:
  - Serve clients from the “closest” available node
  - If unavailable, find the “next closest” available node
  - Immediately identify and bypass failed nodes
  - Support immediate removal from service
In this example, all client DNS queries have resolved to the same CDN edge IP address (10.1.1.1)

- Nodes auto balance
- No Centralized Control Plane Required

BGP session between CDN nodes
1:N (up to 32) of the IP(v6) addresses mentioned in the next step
Client performs DNS query to resolve CDN hostname, DNS servers return 1 of N (32) IPv4 and IPv6 addresses, 10.1.1.1 in this case
Client begins requesting content from the resolved IP(v6) address, the network forces that request to the closest advertising node
## IP CDN Deployment Results

<table>
<thead>
<tr>
<th>Metric</th>
<th>Measured Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version I (2015) Total Capacity</td>
<td>~1Tb/s</td>
</tr>
<tr>
<td>Version II (2018) Total Capacity</td>
<td>~3Tb/s (2x per-node capacity at same monetary &amp; RU price point)</td>
</tr>
<tr>
<td>ABR Bitrate Request Range</td>
<td>~80% to 90%</td>
</tr>
<tr>
<td>Highest ABR Bitrate Delivery Time</td>
<td>~.5s</td>
</tr>
<tr>
<td>Infrastructure-based service availability</td>
<td>100%</td>
</tr>
<tr>
<td>Centralized Control-plane per-bit price compression</td>
<td>100%</td>
</tr>
<tr>
<td>RU per-density improvement</td>
<td>8x</td>
</tr>
</tbody>
</table>
INTERACTIVE VOD

BUSINESS REQUIREMENTS:

- Instant Availability (~10 Min)
- Time-Shifted Delivery
- Popular shows
- Sports Events
- Digital Rights Management
- Any Device, Anywhere
Technical Requirements

• Accessible for 24 to 72 hours
• Starts streaming < 2 seconds after hitting play
• SSD storage for 2 - 6 seconds of ABR formats
• High capacity required (1 copy per subscriber)
• Performance vs. Cost vs. Power tradeoffs
• Low write latency key for prepositioning content
• Original requirement of 6TB/server (Cassandra)
Cablevision 2006 Court Case (Single Copy Legal Requirement)

- **Network DVR (NDVR)**, or **network personal video recorder (NPVR)**, stored at the provider's central location rather than at the consumer's private home.
- But must **for legal reasons be recorded and stored as separate copies**. Essentially implementing a traditional DVR with network based storage.
- If 100,000 people are watching a recorded version of the Voice or Survivor or Game of Thrones, then there are 100,000 copies!
- **The “fine” is $50,000 PER violation** (e.g. would be $50M!)
The Solution: TLC SSDs

• SSDs are priced by “Durability” (DWPD)
  • Requirement is .3 DPDW (1 write per 3 days)
• 4 x 1.6TB NVMe – blew away 6TB “limit”
• Changed to 8 x 1.6TB SATA in 1 RU server
• Reduced overall server count by 1/3
• 2 X capacity/server, saved space & power
WHAT’S NEXT? WHAT’S REQUIRED?

- **IP CDNs:**
  - Pushing the CDN closer to the Edge to minimize latencies.
  - Additional caching layers to avoid CDN and network hotspots

- **VOD Delivery:**
  - Intelligent long term caching is critical, since content is not as transient
  - Accommodating longer-tail content which constantly changes
  - High I/O solutions for heavy write access without impacting reads
  - Higher capacity NVMe flash and Storage Class Memories
NEXT CHALLENGES

CONVERGED CDN
NON-VIDEO CDN
CUSTOMIZATION

Next Gen ABR VOD
Next Gen ABR Live Video CDN
Thank You!

Questions?

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