



Flash Memory Summit

SSD Telco/MSO Case Studies

SSDs Enable IP CDN & iVOD

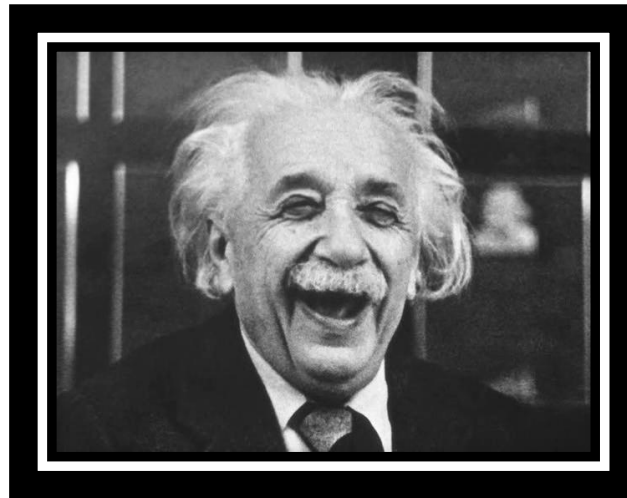
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Sanity Solutions: Focusing on Paradigm Shifts!



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



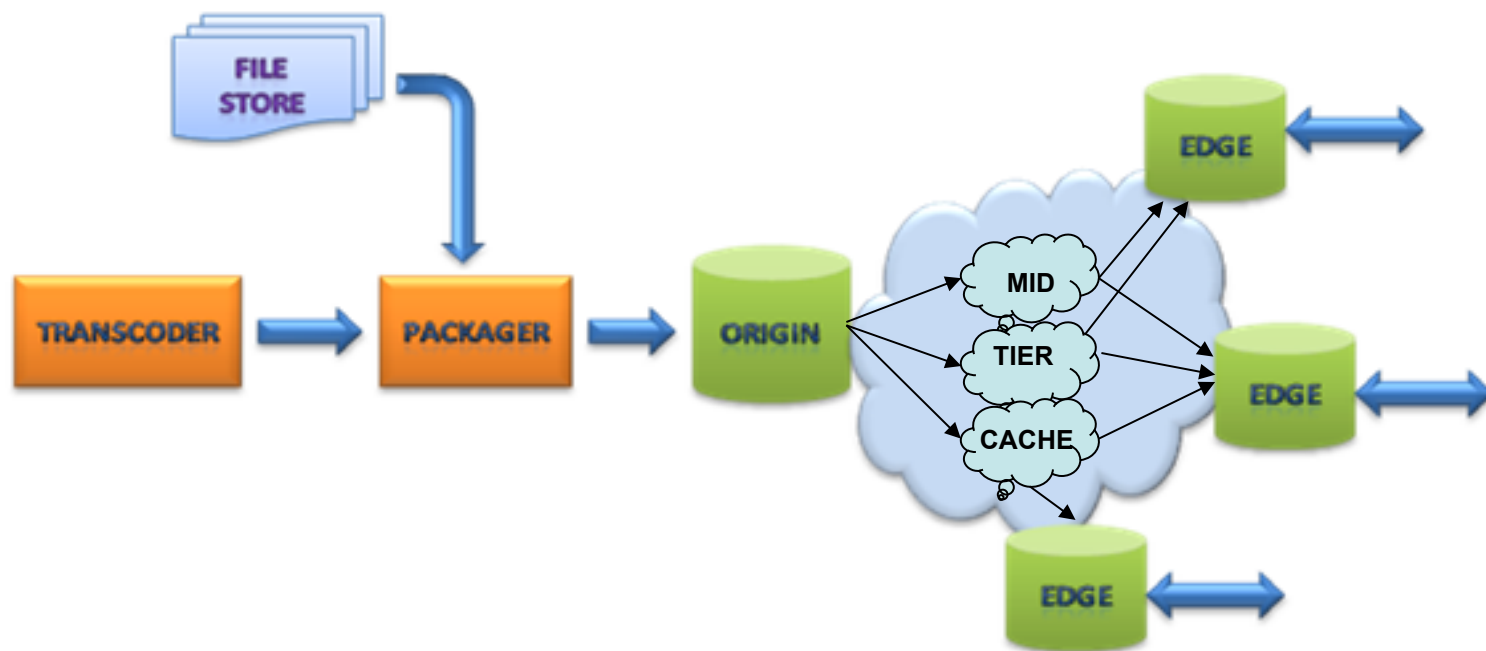
AGENDA

❖ **IP-CDN Case Study**

❖ **Interactive-VOD Case Study**

❖ **CDN Future Trends and Requirements**

Simplified CDN Architecture



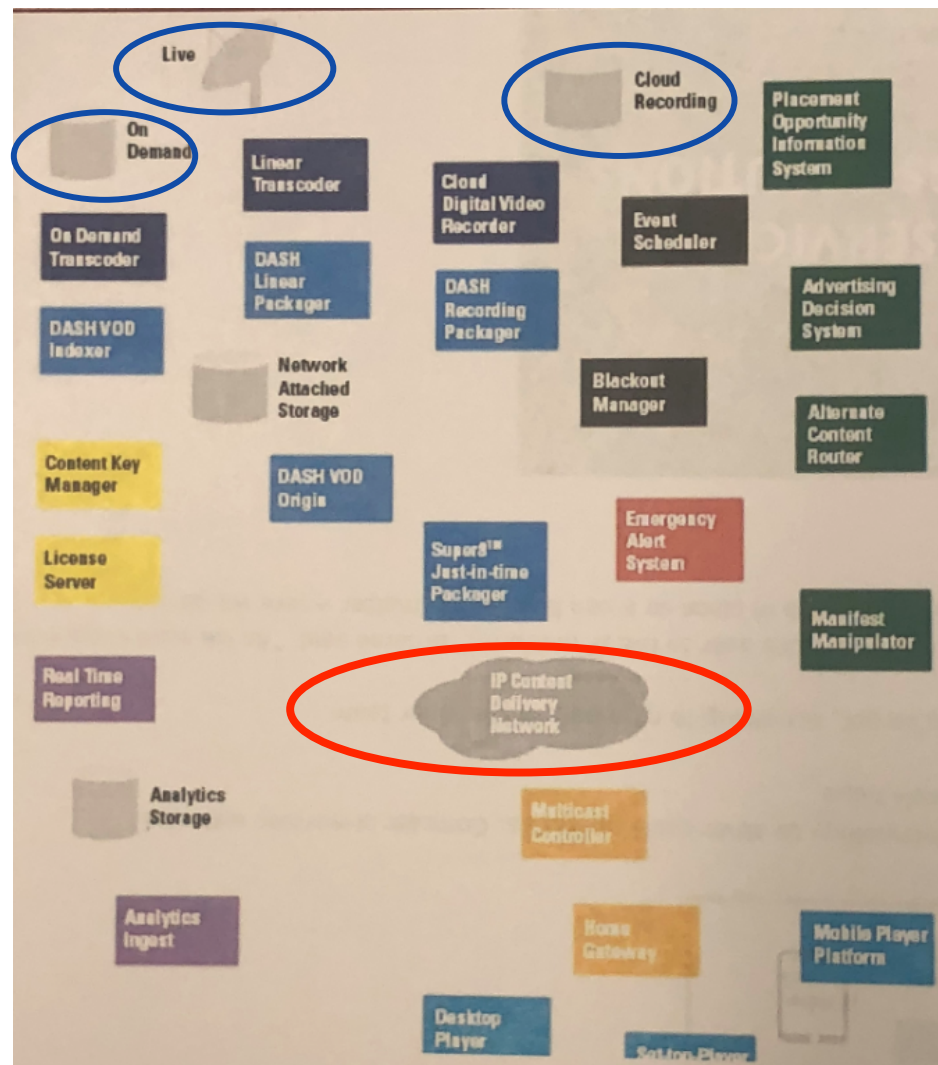


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Real Life CDN

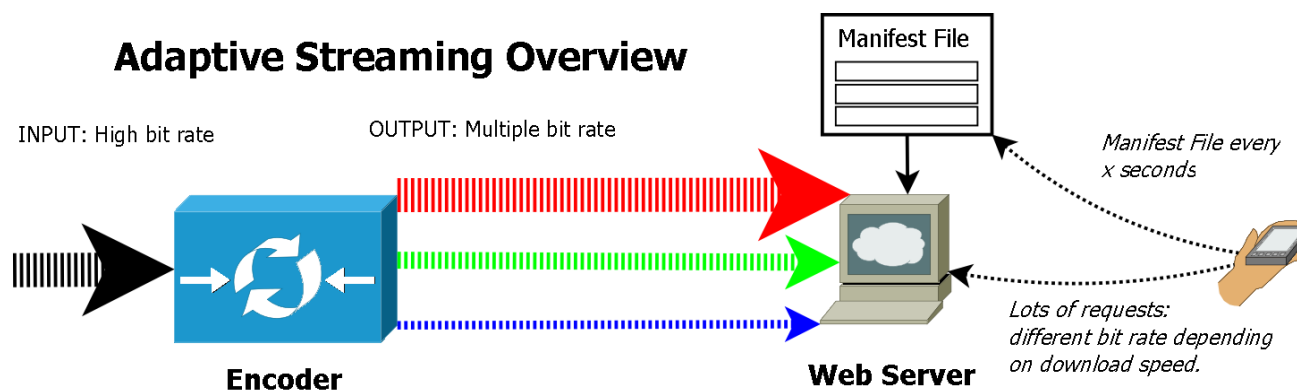


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Complex Ecosystem

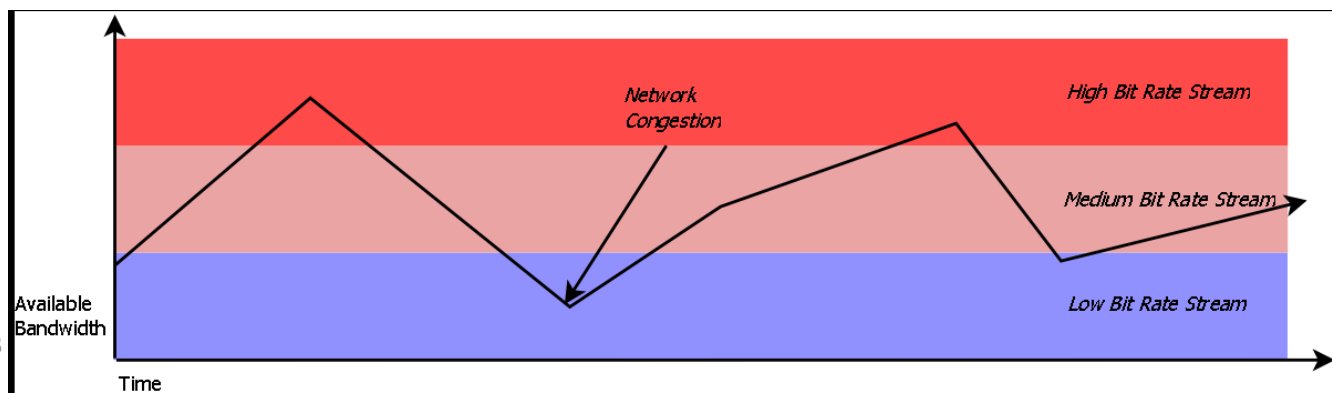
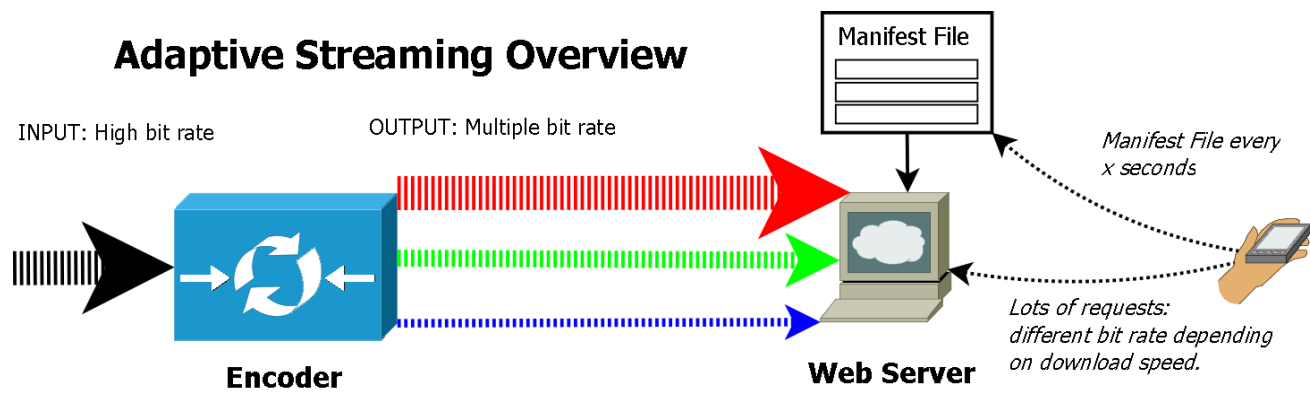
CDN Adaptive Bit Rate Streaming



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





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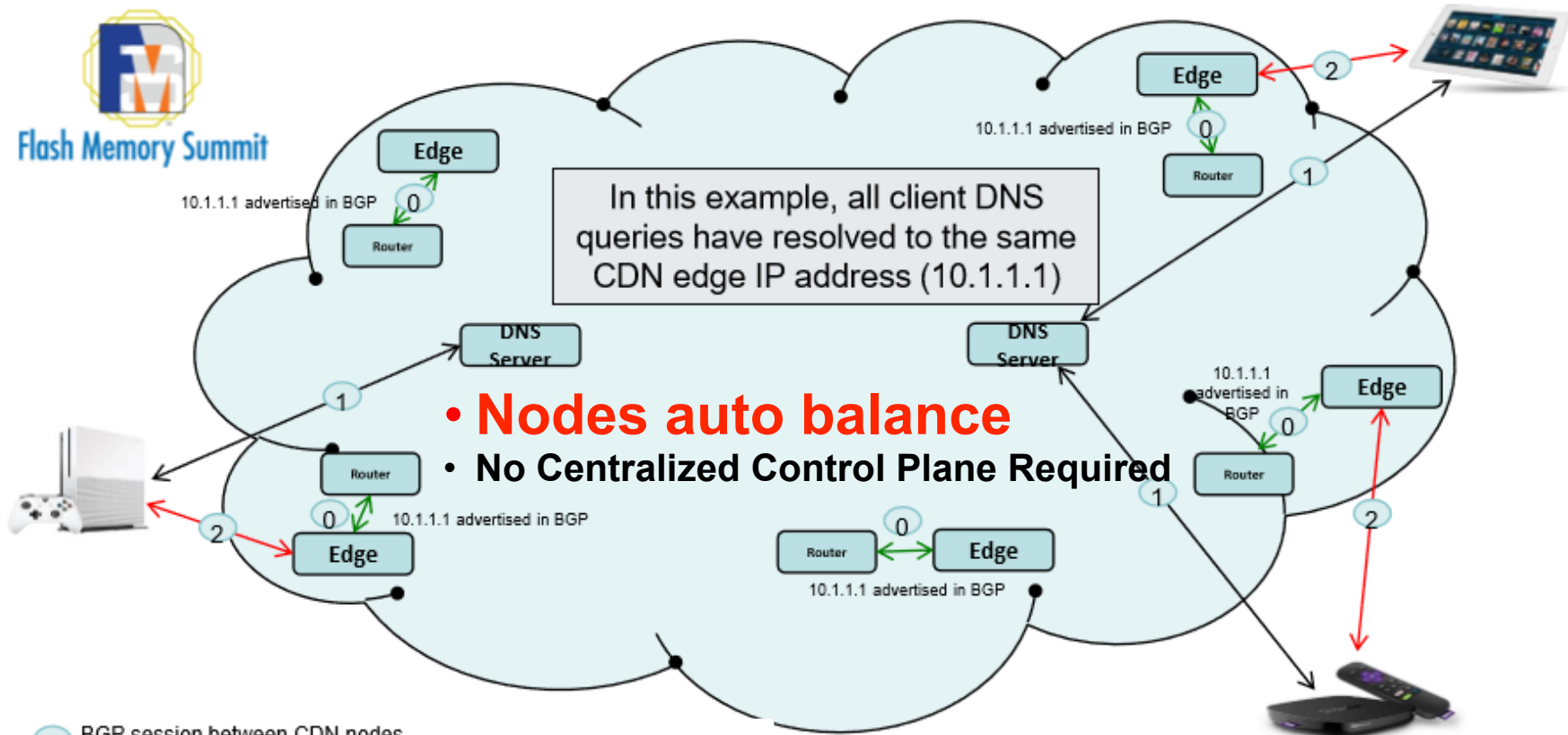
Technology Problem Set

- 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**



- 0 BGP session between CDN nodes
- 1-N (up to 32) of the IP(v6) addresses mentioned in the next step
- 1 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
- 2 Client begins requesting content from the resolved IP(v6) address, the network forces that request to the closest advertising node



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IP CDN Deployment Results

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



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INTERACTIVE VOD BUSINESS REQUIREMENTS:

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

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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



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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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