Next Generation Video Services Fundamentals
Experiences Consumers Want Now

Online Content on TV

Intuitive, Unified Navigation on All Devices

A portable multi-screen TV Experience

A TV experience that integrates with the rest of my online life

Support an increasing variety of services on an any device and deliver a common experience everywhere
Three Dimensions of the Problem
Content, Transport, and Devices

- Managed and Unmanaged Content
- Managed and Unmanaged Transport
- Managed and Unmanaged Devices
From Totally Best-Effort to Fully-Managed Offerings
Challenge is to Provide a Solution that Covers All

Design to the most general case
Optimize where appropriate
Today’s Over-the-Top Adaptive Streaming Delivery

- Service Providers have little control and visibility into OTT services
- Content Providers have little control of the delivery of their content
Video consumption is exploding around the world

• In 2015, Video traffic will be 3 times larger than it is today

• And mobile traffic will be 12 times what it is today
Two Worlds are Coming Together

Internet
- Simple access business model
- Built for scale
- Limited security/privacy
- No SLAs

Next Generation Internet
- Flexible business models
- Massive scale and performance
- Secure, privacy option, guaranteed
- Services anywhere on any device

Managed Services Network
- Varied business models
- Focused on services
- Built for performance
- Security, privacy, SLA guarantees
- Services anywhere on any device
Next-Gen Video Infrastructure

Key Tenets of IP Video Driving the Architecture

- **Built on Web Services Protocols**
  Cloud Service APIs - Accelerates universal reach and 3rd party innovation; Designed for virtualization

- **Exponential scale for large-scale unicast services**
  Leveraging caching technologies for efficient distribution
  Whilst addressing the challenges of large scale concurrency (i.e. Linear)

- **Video intelligence propagates deep into the network edge**
  Providing media, device, and network awareness

- **Open Client Architecture**
  Multi-device support – for PCs, gaming consoles, tablets, mobile devices, set-tops, etc. Leveraging the cloud to provide adaptation in concert with network intelligence

- **Services Across Managed and Unmanaged Networks**
  Common experience no matter where the user connects
  Design for unmanaged, optimized for managed
Videoscape Architecture

Cloud

Network

Client
Videoscape Architecture

CloudVerse (B2B)

Videoscape Enabled Services
- Live/Linear
- On-Demand
- Cloud DVR
- Cross Screen
- Companion
- SPI/Partner Enabled

Cloud

Network

Client

In the Home
- Legacy RF STB
- Cable STB with Videoscape Voyager Vantage
- Connected TV, PC & Tablet Soft Client

On the Go
- Notebook/PC/Mac Soft Client
- Smartphone/Tablet Soft Client

Provider Systems
- Subscriber Mgmt
- Billing

TRIBUNE
- TV Schedules

hulu
- Unmanaged VOD

Managed VOD
- OTA/Sat/Network Linear TV

Content Providers
- Unknown

Session Manager
- Connection Manager
- Device Manager

Alert Manager
- Client Frameworks
- Reporting & Analytics

End to End System Management
Acquisition Suite
Flexible Media Processing

- Digital Content Manager
- Cisco Transcode Manager
- Encapsulator/ABR Packager
- Virtual Origin Services
- AS Series Media Processors
- Mobile Content Adaptation Engine
Media Acquisition and Processing Portfolio

- MEP D9036 Modular Encoder
- D9800 Series Receivers
- Virtual Origin Services
- Cisco ROSA®
- Media Processor/Encapsulator
- Multi-Service Video Processing
- Live ABR Transcoding & Packaging
- Transcode Manager
- File Based Transcoding
- Receivers / Decoders
- Encoders
- VoD, Linear, nDVR Origin Server
- Control Systems
Media Processing – Primary, Secondary Distribution

- **D9036 Broadcast Quality Encoder**
  - Primary Distribution Encoder
  - Encoder in secondary distribution for very HQ channels (typ. 20% of line-up) or very low bitrates (IPTV)

- **DCM Digital Content Manager**
  - Processing of uncompressed, J2K and MPEG compressed streams
  - Secondary distribution content transcoding and preparation (+ DPI, encryption, logo, EAS, ..) : linear headend in a box
  - Future (CC): optimized solution for ABR, working together with Encapsulator

- **Media Processor/Encapsulator**
  - Transcoder and Encapsulation for ABR
  - Flexible transcoder for alternate codecs (VP8, WebM, ...)
  - Encapsulation offered as standalone capability
  - Plans to fully virtualize on UCS infrastructure

- **Transcode Manager**
  - File based transcoder
  - Automated QC, analysis and decision making
  - Plans to fully virtualize on UCS infrastructure
HTTP ABR – Format Comparison
No clear common ground apart from H.264/AAC

<table>
<thead>
<tr>
<th>HSS (Microsoft)</th>
<th>HLS (Apple)</th>
<th>HDS (Adobe)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transport Protocol</strong></td>
<td>HTTP</td>
<td>HTTP</td>
</tr>
<tr>
<td><strong>Fragment Size (typical)</strong></td>
<td>2 seconds</td>
<td>10 seconds</td>
</tr>
<tr>
<td><strong>#TCP connections</strong></td>
<td>1 or 2</td>
<td>1</td>
</tr>
<tr>
<td><strong># Content Files on Origin Server</strong></td>
<td>#profiles</td>
<td>#profiles x 720/Hr</td>
</tr>
<tr>
<td><strong>Codec Support</strong></td>
<td>VC-1, H.264,WMA</td>
<td>H.264</td>
</tr>
<tr>
<td><strong>Wire/Xport Format</strong></td>
<td>MP4 fragments</td>
<td>MP2TS fragments</td>
</tr>
<tr>
<td><strong>Content File Format on Origin Server</strong></td>
<td>.ismv Fragmented mp4</td>
<td>.ts Segmented TS</td>
</tr>
<tr>
<td><strong>Byte Range Mechanism</strong></td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td><strong>Std HTTP Origin Server</strong></td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Encryption/DRM</strong></td>
<td>Windows DRM PlayReady</td>
<td>AES-128</td>
</tr>
<tr>
<td><strong>Client</strong></td>
<td>Silverlight 2+ OSMF (OpenSource)</td>
<td>iPhone OS 3.0+ Quicktime X</td>
</tr>
<tr>
<td><strong>Manifest file</strong></td>
<td>.ismc (.ism/Mfest or .isml/Mfest)</td>
<td>.m3u8</td>
</tr>
<tr>
<td><strong>Origin server</strong></td>
<td>Helper integrated with IIS server</td>
<td>HTTP server</td>
</tr>
</tbody>
</table>
## Multi-Language Audio, Metadata Processing

**Still no convergence (actually worse)**

<table>
<thead>
<tr>
<th></th>
<th>HSS</th>
<th>HLS</th>
<th>HDS</th>
</tr>
</thead>
</table>
| **Multi-Language Audio** | • Single audio track per language  
• Track has language descriptor  
• URL fragment request contains descriptor | • HLS supports multiple audio tracks, but each segment contains all audio tracks (pre-iOS5)  
• iOS5 now allows for separable audio streams, TBD when non iOS devices will support (Roku, etc.)  
• Change result of Cisco working with Apple on requirements – Apple has tended to be very NA focused | • RTMP has no support for multiple audio tracks/IDs  
• HDS supports multiple audio tracks, but each segment contains video and all audio tracks  
• Cisco applying pressure on Adobe on both of these issues |
| **Metadata Processing** | Data Tracks (Name, Language, Sub-type)  
Sparse (has Parent Track)  
Non-Sparse (always present) | Timed metadata introduced earlier this year  
Private TS stream  
ES=ID3 tag payload | Cue points  
(Name, Multiple Parameters)  
Each parameter is (tag,value) pair |
| **Captions/Subtitles** | • Source converted to TTML – natively supported by client  
• Different approach highly desired to support bitmap-based subtitles (DVB) | • 608 user data on AVC ES for Closed Captioning  
• No subtitle support  
• Apple unlikely to add support soon | • No formal support  
• Client specific customer implementations (BBC) |
| **Ad Splicing** | SCTE-35 like metadata in sparse track  
Client based reaction to metadata  
Dual timelines to track parent and child (ad) streams | • Cloud based manifest manipulation  
• Client unaware of ad splice, additional metadata can be used to control trickmodes, etc.  
• Scale, cacheability implications of supporting highly targeted – manifest file management | • Client based reaction to some form of metadata  
• Little effort to standardize this data |

**Divergent views across providers on cloud-based only vs client-based only – based splicing, as well as combination of the two – implications on different ecosystems**
So how do we address the divergence?

Look at a generic ABR Content Flow

ABR Encoder Appliance

Source

Trans./Cond.

Encapsulate

Encrypt

Origin/Store

Helper (Frag.)

Distribution

Client

Single Stream
Highest Bitrate/Quality

Multiple Bitrates
Target Quality (N)

Multiple Bitrates
Target encapsulation formats (NxM)

Multiple Bitrates
Target encapsulation formats with DRM

Large video files or virtual files and manifests

Player-specific fragments/segments

CDN

Pre-segmented TS (HLS)

Contiguous Fragmented MP4 (Smooth)

IIS

Apache, IIS

CDN Root

CDN Edge
Encoding, Encapsulation, & Origin on a single UCS platform (multiple VMs)
Acquisition Suite Media Processor
Encode Once, Encapsulate Many

Video Source

Encoder
Fragmenter/Encapsulator
Adaptive Transport Streams

Stream 1
Stream 2
Stream 3
Stream 4
Stream 5
Stream 6
Stream 7
Stream 8

Stream 1
Stream 2
Stream 3
Stream 4
Stream 5
Stream 6
Stream 7
Stream 8

Stream 1
Stream 2
Stream 3
Stream 4
Stream 5
Stream 6
Stream 7
Stream 8

ATS is a common intermediate format that we can encapsulate to multiple output formats for different clients
Media Encapsulator

- External ABR Fragmenter/Encapsulation from Adaptive Transcoding Systems
  - X86 Linux-based Software
  - Extensible to new formats, manifest forms (DASH)
- ATS (Adaptive Transport Stream) Based
- Linear and soon VOD and JIT (Cloud DVR) Workflows
- Integration with DRM/Encryption and Advertising Subsystems
What is Just-in-Time Processing (JITP)?

- Single flavor in storage (Intermediary ABR-conditioned Format)
  - Result of VoD Transcode or Linear Recording
  - Assets Index to assist JIT
- On-demand, JITP produces Target-specific Manifest
  - Complete VoD Manifest if source asset complete
  - Linear Manifest starting at beginning of asset if still recording
- Client makes requests against provided manifest
  - Fragments: Random seeks against known fragments
  - Updated Manifest in case of manifest updates (HLS)
- JITP continues to update Manifest if required
- JITP only produces fragments on-demand that are requested
JIT Processing Flow

- Stored Indexed Intermediary Format
- Dynamic Manifest, Encapsulation and DRM based on requests
- Storage savings (only store common, ABR-independent format)
- Network savings (only deliver requested fragments, not full ABR set)
Virtual Origin Server

- Separates the Encapsulation, Encryption, Storage, and Helper functions into flexible processes that can be instantiated in different locations of the architecture.
- Provides a unified architecture for VOD, Linear, and Timeshifting (CloudDVR).
  Supports multiscreen deployments (Legacy STB & ABR clients).
- Proximity Routing, Load Balancing and Resiliency.
- Supports External Origins as well as direct ingest from Transcoders.
- Multi-vendor solution (Microsoft, Apple, Adobe).
  - For protocols with Helper functions (IIS & FMS), implements Helper functionality directly in VOS, eliminating the need for a layer of servers in the Data Center.
  - Removes a point of failure, increases ability to scale, deployment approaching the edge of the network.
- Adapts to evolving standards like DECE UV and DASH.
Distribution Suite

Content Distribution

- Service/Proximity Routing
- Edge Routing & Caching Tier
- CDN Tier (Data Center)
- CDN Tier (Core/Aggr Routing)
- CDN Content Acquirer
- CDS Cache
- CDS Streamer
- ASR9K (Video Service Module)
- Cable, xDSL, FTTH, 4G
- 3G/4G & WiFi

Multiscreen GW

#CiscoPlusCA
Service Router
• Low latency, caching (hierarchical & location based)
• Concurrent multi-protocol delivery
• VoD & Live streaming & download
• Stream Control HTTP, RTSP, RTMP
• High performance
• Detailed Reporting

Content Cache & Content Streamers
• Content Request Routing
• Global Load Balancing
• HTTP, RTMP, RTSP, DNS
• Content & Load Aware
• Subscriber & Network Aware
• BGP, OSPF Proximity

Content Acquirer
• Managed VoD Library Origin Server
• Scheduled & Dynamic Ingest to CDN
• Live Streams Ingest / Timeshifting
• VoD Prepositioning or Dynamic Cache-Fill
• Live Stream Splitting
• HTTP, FTP, CIFS, RTSP

Service Router
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VoD & Live Delivery Service Mgt
• System Monitoring
• Capacity Monitoring
• AAA Server Integration

Centralized EM
• WebGUI and HTTP API’s

IP Network (Core, Aggregation, Access, Wireline, WiFi, 3G, 4G)
Video Application Network (Origin, Encoders, Streaming Clients, EPG, Portal)
HTTP ABR – CDN Challenges

- ABR = Adaptive Bit Rate
  - Unicast HTTP-based delivery (and hence TCP congestion control)
  - Client-driven adaptation to available BW and CPU
- Large number of (relatively) small objects
  - File Storage vs. Wire Formats
- Transaction Load, File System Load
- Challenges to Reporting and Analytics
- No Inherent Server Side Session State
- Variability in client delivery implementations
- Lack of standard Content Access Protection methods
  - Prevent deep URL linking (including ABR fragments)
  - Prevent certain types of DoS attacks (e.g. Origin Server overload, cache poisoning)

### Diagram

#### Storage Format
- Progressive Download Session
  1 File
  
#### Wire Format
- 1 TCP Conn.
  1 transaction
- HTTP Live Streaming Session
  Files = N Profiles X Segments + M3U8 Manifests
  ~5-10 second/transaction
  1 trans. per 5-10 sec.
- Smooth Streaming Session
  Files = N Profiles + Manifests
  2 TCP Conn.
  2 second/transaction (separate A + V)
  2 trans. per 2 sec.
- Move Streaming Session
  Files = N Profiles X Segments + Manifest
  3-5 TCP Conn.
  2/3 sec. per transaction
  3 trans. per 2 sec.
The Challenges with Distributing ABR Objects

Old World
Progressive Download

New World
ABR Delivery

- Short fragment sizes translate to very high request TPS
- TCP connections can be short-lived (client and network conditions)
- Different standard fragment sizes (HLS v. Smooth) mean object sizes are different for each Delivery Service. CDS object handling can be configured on a per-DS basis

Transaction Rates

<table>
<thead>
<tr>
<th>Obj Length (sec)</th>
<th>Client Request TPS</th>
<th>TPS for 2000 Clients</th>
<th>Objects/Hour/Asset</th>
<th>Obj/Hour 200 Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth</td>
<td>2</td>
<td>0.500</td>
<td>1,000</td>
<td>1800</td>
</tr>
<tr>
<td>HLS</td>
<td>10</td>
<td>0.100</td>
<td>200</td>
<td>360</td>
</tr>
<tr>
<td>PDL</td>
<td>3600</td>
<td>0.000</td>
<td>0.56</td>
<td>1</td>
</tr>
</tbody>
</table>

Object Size (MB)

<table>
<thead>
<tr>
<th></th>
<th>3000 kbps</th>
<th>1500 kbps</th>
<th>500 kbps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth</td>
<td>0.75</td>
<td>0.38</td>
<td>0.13</td>
</tr>
<tr>
<td>HLS</td>
<td>3.8</td>
<td>1.9</td>
<td>0.6</td>
</tr>
<tr>
<td>PDL</td>
<td>1.350</td>
<td>675</td>
<td>225</td>
</tr>
</tbody>
</table>

3600 fragments x 7 profiles = 25,000 possible objects
CDS Optimizations for ABR

- Optimized TCP connection handling
  - Scaling to support the large # of connections for ABR
- Optimized HTTP transaction handling
  - Scaling to support the high transaction rate of ABR. CDNs designed for ordinary HTTP transaction loads will not meet the high transactional demands of ABR
- Request Bundling
  - For live streaming, aggregates multiple cache-fill requests for same content into a single request from next cache-tier or Origin Server
CDS Optimizations for ABR

• Small Object Cache Throughput Optimizations
  – Small objects written to memory, delayed write to disk
  – Large objects continue to be cached on disk
  – SSD support and optimizations
  – Customized object size caching behavior per Delivery Service

• Content Access Protection
  – URL signing
  – Access authentication through Conductor XMPP session persistence
CDS Optimizations for ABR

• Live ABR and Client Request Optimizations
  – Request Bundling – Multiple near-time requests result in single requests upstream
  – Range Request Caching (HLS clients, Progressive DL clients)
  – Client/Streamer Stickiness (Content Affinity)

• Service Visibility
  – Reporting and Analytics optimizations for ABR
    • Asset-level treatment of fragments, Session association across ABR profile shifts
  – Streamer performance metrics associated with delivery transactions for overall system behavior views
  – Exposure of service metrics and transaction logs for 3rd party monitoring/reporting systems.
Dashboards

- Dashboards link real-time data that has a common theme
  - Network Utilization
  - QoS
  - Client Access
  - Geo-location
  - Content Usage
Network Dashboard

- CDN Bandwidth Usage
- Requests Per Second
- Cache Hit Ratio
- Origin Offload
- Server Location
QoS Dashboard

- Average Fragment Bitrate
- Assets with 4xx Errors
- Response Codes
- 4xx Error Code Rates
- Average Time to Serve
Client Dashboard

- Client Density Map
- Number of Unique Clients
- Top 10 Clients by Request
- Top 10 Clients by Bytes Transferred
- Average Length of Stay
Media Suite
**Media Suite: Components**

**Content Management**
- Multiple content formats
- Sophisticated content bundling
- Customizable metadata model
- Metadata normalization
- Extensible workflow
- Transcoding and encryption
- Distribution to delivery network

**Entitlement**
- Product/Offer rules creation
- Subscription, rental, EST, ad-supported models supported
- Custom entitlement checks prior to authorization
- Accounts, devices, domains
- Multi-DRM framework
- Customer Care functionality

**Publishing**
- Feed aggregation & harmonization
- Multipoint catalog publishing
- Category management
- Playlist publishing
- Search and Rating
- Metering & reporting

**Linear**
- EPG ingest & normalization
- Channel maps/regionalization
- Uses VMS workflow, bundling & entitlement
- Unified search - linear & VOD
- Event framework for record controls
- XML-based output

**API's/Web Services**

**OSS/BSS**
Unified Metadata Representation
Traditional and non-traditional content sources

- YouTube
- Dailymotion
- Applications
- Linear/EPG
- VOD

Source-specific Pluggable modules

- Multiple, standardized query protocols
- Multiple, standardized metadata schema

Managed Client
Unmanaged Client
SCTE-130 CIS

Metadata Aggregation
Normalization
Combining Enhancement
Media Suite Functions

- **Content Management**
  - Ingestion of VOD metadata
  - Metadata editing & enhancement
  - Creation of products (assets and consumption policies)
  - Creation of linear channel lineup “bundles” and regions

- **Workflow Management**
  - Manages asset flow from ingestion through transcoding, encryption and distribution to origin system
  - Provide plug points for custom workflow steps

- **Catalog Publishing**
  - Retrieval via API’s or MRSS feeds
  - Direct to Videoscape client applications or to Portal for integration with HTML templates and other services
Media Suite Functions

- **Entitlement**
  - Determination of user entitlement to content
  - Interface with DRM License creation system to generate/deliver license based on product policies
  - Maintenance of “digital locker” per user account
  - Channel Products can be entitled to account
  - nDVR Policies - # of tuners, # of hours

- **EPG Manager**
  - Ingest and normalize EPG data from multiple providers/formats (Tribune, GLF, TV Anytime)
  - Daily updates of full EPG schedule and SOAP interface for single program updates
  - Create Regional Channel lineups & assign station numbers
  - Publish channel, station, program and schedule information
  - Support high volume, “cacheable” query responses
  - Integration with CMS to provide enhanced channel product information
Media Suite

Release VR5 Enhancements

• LSMS (Linear Services Management System)
  – Initial definition of a linear service parameters
  – Interface w/ transcoding systems to provide encoding requirements/profiles
  – Definition of “catch-up” window, nDVR recording policies (single/unique copy)
  – Enable dynamic changes to encoding parameters (reduce # of bit rates in “off” hours)

• Metadata Broker
  – High volume, high availability metadata query services for all Videoscape cloud components and end user devices
  – VOD assets & linear “program” data
  – Ad avails – published & non-published
  – SCTE-130 query support (CIS 2009/2011)
Media Suite
Release VR5 Enhancements

- CRS (Content Resolution Service)
  - Map request to device specific URL’s on CDN
  - Resolve VOD, nDVR, linear “live” and “catch-up” TV requests to asset URL’s

- Content Policy
  - Extension of current policies
  - Content consumption may be gated by location (in/outside home) or by connection type (WiFi vs. 3G/4G)
  - Ad insertion policy and behavior – e.g. can skip ads?
Customer Examples
TV Everywhere Content Management and Entitlement

AT&T U-verse Online
Paramount Media Store
Bell TV Online
Disney Movies Online
Onet TV Catch Up
Videoscape Clients
- Videoscape Cloud APIs enable consistent user experience
- Videoscape Cloud APIs leveraging best of XMPP and HTTP
- Client SDKs facilitate Cloud API use across diverse platforms
- Open access to 3rd Party Services
UI example screens
VOD Navigation

Iron Man 2
Movie, 2010 (124 min) | PG-13 | Science fiction, Adventure, Action

With the world now aware that he is Iron Man, billionaire inventor Tony Stark (Robert Downey Jr.) must forge new alliances and confront a powerful new enemy.

More Like This

Where the Wild Things Are
Movie, 2009 (101 min) | Adventure, Fantasy

War of the Worlds
Movie, 2005 (116 min) | Science fiction

Wanted
Movie, 2008 (110 min) | Action, Thriller

Up
Movie, 2009 (98 min) | Animated, Comedy, Adventure

Unstoppable
Movie, 2010 (98 min) | Action, Thriller

Tron: Legacy
Movie, 2010 (125 min) | Science fiction

Alice in Wonderland
Movie, 2010 (108 min) | PG | Fantasy, Adventure

Now a teenager, Alice (Mia Wasikowska) returns to Underland, where she must find her destiny and put an end to
UI example screens
EPG Navigation
Conductor
Service Issues to Solve

- Multi-device and multi-user support on multiple access networks
  - Resource management and session policies, e.g. max active users or devices in an account
  - Multiple playback format(s) for nDVR recordings
  - Companion Devices interaction
- Decoupling customers from hardware devices
  - Accounts, users, devices, personalized services, and parental control
  - Content Access Protection and Digital Rights Management (DRM)
- Service Visibility
  - Statistics, audience measurements, and troubleshooting in an ABR environment
- Asynchronous messaging
  - Program Guides, SW updates, Emergency Alerts, etc.
- Service Acceleration
  - Introduction of new services, rapid modification of existing services, and linking to external services (e.g. social networks)
Built to Scale for millions of Devices

**Adoption**

- XMPP currently being used in millions of devices for IM applications today.
- Open standards Approach allows for Extensibility to a number of Device types including STB’s
- Videoscape Conductor incorporates Jabber Technology and will address STB’s and soft clients running on Smartphones, PCs, and Tablets
- XMPP framework provides asynchronous real-time messaging and presence awareness to ‘Cloud’

**3.6B**
Mobile devices*

**300,000**
Daily Android Activations

**1.8B**
Mobile web access devices*

**Gartner research prediction; Gartner Forecast: Tablet PCs, Worldwide, November, 2010**
Conductor Services and Technology Toolkit

APIs/Web Services

Applications
- Videoscape Applications deliver targeted functionality for managing devices, endpoints
- Extensible through workflow, Simple (XML) data models

Services
- Session/service rules creation
- Service, Device, User, Context, Location based control
- Custom entitlement checks prior to authorization

Connectivity
- Standards-based with pluggable southbound interfaces for Service, BoSH, and WebSockets
- Widely proven real-time messaging plane scales to millions of concurrent sessions

APIs/Web Services

Companion Device Broker

Session Management

Audience Measurement

Video Service Management

Emergency Alert Manager

Time Shift TV

Resource Management

Linear Services

3rd Party Integration/API
Conductor Overall Architecture
Conductor - Physical Topology
Centralized or Distributed Architecture

- Message Router
- Node Controller
- Mgnt. Core
- Mgnt. Console
- Service
- TCP Sockets (w/ TLS)
- Connection Manager
- Mgmt. Core
- Mgmt. Console

Millions of Clients
PubSub

- Publish/Subscribe engine
  - Holds history
  - Items replaceable
- Distributed message replication
  - CMs help replicate messages
- Typical use in an SP-video system
  - Real-time feed update notifications
  - Emergency Alert Services
  - Client statistics/event reporting
  - Fault management
Example Cloud Service
ABR Session Management

- **Session State Manager** coordinates activity from client, acquisition components, delivery components, etc.
- **Resource Manager** can optionally count resources, reserve bandwidth, etc.
Example Client Service

Companion Device Browsing

- Search and Discover on Companion Devices
- Remote recording
- Shared viewing
- Share content

- Conductor facilitates discovery, capabilities exchange and communications
- Works whether devices are on same LAN/subnet or not (e.g., Tablet on 3G)

1. Tablet & TV sign on to Conductor. Authenticated, encrypted, persistent socket to TV and Tablet.

2. Tablet & TV receive presence messages showing current state of any household devices signed into Conductor.

3. Tablet and TV advertise capabilities in presence messages. Each device can discover that the other is “companion” capable (among other things).

4. Tablet initiates browsing session with TV. Browsing packets can be sent via Conductor (small XML packets) between TV and Tablet.
Q&A
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