Live Broadcasting:
How-To Examples Using the Microsoft Media Platform

Chris Knowlton
Senior Product Manager
Microsoft
Objectives

• Understand common scenarios for live broadcasting with the Microsoft Media Platform

• Learn how-to steps for some common live broadcast scenarios

• Deliver to a wide range of end user conditions and clients
CONTEXT SETTING
2010 Vancouver Olympics
Live Broadcast Workflow

Capture → Encode → Deliver & Manage → Receive

Content Protection - Microsoft PlayReady

Microsoft Expression Encoder 4 Pro

Windows Server IIS Media Services

Microsoft Silverlight

Windows Media Services 2008

Windows Media Player
Live Streaming Workflows

From basic live streaming...
Live Streaming Workflows

...with straightforward workflows...

Acquire → Encode → Deliver → Consume
Live Streaming Workflows

...to highly enhanced experiences...

- HD quality Video
- Alternate Camera Angles
- Highlights, Stats, and Chat
- Instant Replay
- Slow Motion
- FFWD / REW
- Key Plays Menu & Markers
- "Go Live" Button
- Quality Meter
- Live Ad Insertions
Live Streaming Workflows

...that are a bit more complex.
Vancouver 2010 Winter Olympics
Other Major Sporting Events
Corporate Events
TECHNOLOGIES
Microsoft Expression Encoder 4 SP2

• Video encoder, editor, and SDK
• Replaces Windows Media Encoder
• Features in version 4 with Service Pack 2
  – OD, Live Smooth Streaming Presets (VC-1, H.264)
  – Publish directly to IIS & WMS origin servers
  – PlayReady DRM encryption for Smooth Streaming
  – High quality, unlimited screen capture encoding
  – High perf: NVIDIA / Intel GPU accel, multiple CPUs
  – SRS 5.1 audio encoding built in
Expression Encoder 4 SP2

DEMO
Encoding Partners

• Professional Encoder Partner Ecosystem
  – Live – Inlet, Envivio, Digital Rapids
  – VOD – Live partners, plus Elemental, Grab Networks, Rhozet, Telestream, TwoFour Digital, Viewcast

• Each is finding ways to add value, e.g.:
  – Carrier-class reliability
  – Enterprise-class pricing
  – Education-class ease of use

• See [http://www.iis.net/media/partners](http://www.iis.net/media/partners) for a longer list of partners
Windows Server

• Complete server operating system
• Available at different price points, starting at Free with Microsoft WebsiteSpark, BizSpark, DreamSpark
• Includes media server capabilities via Free downloads from Microsoft.com:
  – Windows Media Services
  – Internet Information Services (IIS) Media Services
Core Media Server Scenarios

• Enterprise
  – On-demand training
  – Live executive broadcast

• Internet
  – News & entertainment
  – Music & movie services
  – Internet-based Radio/TV stations
  – Radio & television rebroadcasts
  – Live event broadcasts
Delivering Media with Windows Server

- Unicast Streaming
  - WMS RTSP
  - WMS HTTP
- MBR Streaming
  - Intelligent Streaming
- Multicast Streaming
  - WMS Multicast

- Progressive Download
  - Bit Rate Throttling
  - Web Playlists
- Adaptive Streaming
  - Smooth Streaming
  - Apple HLS
- Multicast Streaming
  - Smooth Multicast
Key Media Server Features

• Live & on-demand streaming
• Access control via authentication / authorization
• Rich logging & advertising support
• Multiple-bit-rate streaming
• Fast Streaming & Advanced FF/RW
• Archiving & Play While Archiving
• Extensible platform
• Server Core installation...
• Caching & Proxying...
• Scalability...
Server Core Option

• Design
  – Minimal-footprint headless installation option
  – For running fixed-function server roles
  – Good option for Windows Embedded appliances
  – Supports all WMS plug-ins

• Benefits
  – Eliminates GUI and client features
  – Reduces hardware requirements
  – Reduces overall attack surface
  – Reduces servicing costs
Scalability

• WMS example on standard rack-mount server

- WMS 9.0 scalability
  - Optimizations: +400 connections
  - TCP Offload: +1,500 connections
  - x64 Support: +1,200 connections
  - 3,000 concurrent 300kbps connections
  - Total: 6,100 connections
  + 10-25% more on Server Core

• IIS is typically much more scalable than WMS
Caching & Proxying

• WMS and IIS provide caching & proxying
  – WMS Cache/Proxy plug-in – part of WMS
  – IIS Application Request Routing (ARR) – download

• Benefits
  – Improved end user experience
  – Reduced load on the origin server
  – Reduced load on the network
Caching & Proxying

• Usage Options
  – Proxy – allows broadcast stream splitting
  – Caching
    • Opportunistic caching
    • Pre-caching (e.g., using DFSR)
    • Adheres to Expiry Date on content
  – Reverse Proxy
    • Provides a gateway server to users
    • Redirects content requests to a specified origin server
Affordable Media Delivery Options

- **Costs for Windows Server 2008 R2:**

<table>
<thead>
<tr>
<th>Edition</th>
<th>Cost</th>
<th>Features</th>
<th>Notes</th>
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<tbody>
<tr>
<td>Web Server</td>
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<td>99%, Web-facing</td>
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<tr>
<td>Web Server</td>
<td>$ 469 / server</td>
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<td>Standard</td>
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<td>99% of features</td>
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<tr>
<td>Datacenter</td>
<td>$2,999 / proc.</td>
<td>All features</td>
<td>3</td>
</tr>
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</table>

**Notes:**
1. Spark programs provide free Web Server licenses for up to 3 years
2. WMS Multicast requires Enterprise or Datacenter edition
3. Standard, Datacenter, and Enterprise are available via Service Provider Licensing Agreement (SPLA), which charges for actual monthly usage
## Live Streaming – WMS vs. IIS

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<thead>
<tr>
<th>Live Streaming Features</th>
<th>WMS 2008</th>
<th>IISMS 4.x</th>
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<td>Unicast HTTP streaming from live encoders</td>
<td>✔</td>
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<td>Broadcast streaming from files</td>
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<td>Server- and client-side logging</td>
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<tr>
<td>High Availability content sourcing (encoder failover)</td>
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<td>Archiving of live streams</td>
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<tr>
<td>Multiple-bit-rate streaming (Intelligent vs. Smooth)</td>
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<td>HTTP Streaming</td>
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<tr>
<td>RTSP/TCP &amp; RTSP/UDP Streaming</td>
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<td>Multicast streaming</td>
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<tr>
<td>Play While Archiving (late joiner feature)</td>
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<tr>
<td>Windows Media Services proxying and caching</td>
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<tr>
<td>Advanced Server-Side Playlists</td>
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<tr>
<td>Standard HTTP proxying and caching</td>
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<tr>
<td>Full Network DVR</td>
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<td>✔</td>
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<tr>
<td>Low-Latency Streaming</td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

* Targeting availability in IIS Media Services 4.5
Web Platform Installer

DEMO
Live Traditional Streaming with Expression Encoder and Windows Media Services

DEMO
Time to stretch!

10-MINUTE BREAK
IIS SMOOTH STREAMING
Traditional Streaming Pros & Cons

• Benefits of Traditional Streaming
  – Responsive User Experience
    • Users can pause, seek, fast-forward, rewind with ease
  – Effective use of bandwidth
    • Send only the content your users watch
  – Rich Logging and Monitoring
    • Know what your users are watching at all times

• Challenge of Traditional Streaming: Higher TCO
  – Packets do not make use of HTTP caching networks
  – Must deploy streaming edge servers to scale out
Progressive Download Pros & Cons

• Benefits of traditional progressive download
  – Broad reach
    • No need for streaming code in the player
    • Gets through all firewalls
  – Optimized, cost-effective global delivery
    • Cacheable by existing HTTP caches
    • Distributed worldwide by CDN HTTP infrastructures

• Challenges
  – Limited user experience – no... live streaming, instant start, instant seeking, or interactivity
  – Wasted bandwidth (user downloads 100%, watches 20%)
  – No visibility into viewer behavior & experience
The "Last Mile" Challenge

The "Last Mile" from Server to Client

Low Bandwidth
Fast CPU

"Best quality I can download"

"Best quality I can render"

"Best quality, period"

Conditions change every second

High Bandwidth
Slow CPU

High Bandwidth
Fast CPU

The "Last Mile" from Server to Client
Smooth Streaming - A New Approach

• Makes use of globally available HTTP caches:
  – Stateless – no persistent connections required
  – No dedicated servers or overlay networks required
  – No provisioning required
• Adapts to constantly changing conditions
• Rich, interactive user experience
• Customizable, real-time client reporting
• Delivers only the bits needed for that moment
IIS Smooth Streaming

**Step 01:** Live or pre-recorded video is sent to encoder.

- **Live Broadcast** (Sports)
- **Pre-recorded video** (Movies, TV)

- Video Encoder
IIS Smooth Streaming

**STEP 02** Encoder generates video streams of varying quality and sends them to IIS server.

- 3Mbps High quality
- 2.4Mbps
- 1.5Mbps
- 600k
- 300k Low quality

IIS Servers
IIS Smooth Streaming

**STEP 03**
Server creates stream fragments and delivers to Edge servers.

Edge server

- 3Mbps High quality
- 2.4Mbps
- 1.5Mbps
- 600k
- 300k Low quality
**IIS Smooth Streaming**

**STEP 04**

Edge server delivers most appropriate stream to each client. Stream quality depends upon both the client and the network.

- **High-quality network**
  - Best (higher performance client): 3Mbps, 2.4Mbps, 3Mbps

- **Variable network**
  - Better (medium performance client): 2.4Mbps, 600k, 2.4Mbps

- **Low-quality network**
  - Good (lower performance client): 600k, 300k, 600k
Basic IIS Smooth Streaming

300K @ 00:00?
700K @ 00:02?
2.4M @ 00:04?
1.5M @ 00:06?
2.4M @ 00:08?

300K (start quickly)
700K (good network)
2.4M (great network)
1.5M (glitch)
2.4M (play on...)

Bit Rate Heuristics
Smooth Streaming Results

• Internet video is as good or better than TV
  – Users with only SD TVs can see Internet HD on their computers

• Users experience content in new ways
  – Contextual linking, Live DVR, multiple camera angles...

• Advertising can be very targeted
  – Ads that interest you, in HD
  – Could be embedded, interactive ads

• Longer engagement times
  – Users who watch HD content via the Internet stay engaged longer
www.IIS.net Graphing Player

DEMO
Live Smooth Streaming

• Builds on Smooth Streaming
  – Cacheable HTTP delivery for Live events
  – Trick Play: FF, Rewind, Slow Motion
  – Network Digital Video Recorder (DVR) functionality
    • Pause, Instant Replay, Go to Start, Go to Live…

• Synchronized in-stream text & metadata
  – Captioning and subtitling
  – Sparse data (e.g., chapter markers)
  – Control events (e.g., ad insertion points)
Live Smooth Streaming

• Multiple audio tracks (e.g., languages)

• Low-Latency Live Smooth Streaming
  – Less that 2 seconds from source to client screen
  – HTTP cacheable media delivery
  – Enables financial, gam(bl)ing, and surveillance verticals
Live Smooth Streaming with Expression Encoder and IIS Media Services to PC and iPad

DEMO
Encoding for Live Smooth Streaming

• IIS Smooth Streaming encoders create:
  – Fragmented MP4 files
    • Contiguous MP4 files on disk
      – Easier file management
      – Can have separate files per bit rate, or one large MBR file
    • IIS fragments MP4 files into smaller cacheable objects
      – Highly scalable stateless delivery via HTTP caching
      – Users only receive the fragments they need, saving bandwidth
  – Two manifests
    • Server (.ism) – lists available tracks and bit rates
    • Client (.ismc) – lists codecs, resolutions, fragment index
Other Smooth Encoding Options

• Smooth Streaming Format SDK
  – Enables encoder and workflow products

• IIS Transform Manager
  – On-Demand transcoding, transmuxing, encryption
  – User-specified Watch Folders for content ingest
    • Expression Encoder integration for transcoding
  – Work queue and job management framework
    • Local scheduler for simple scenarios
    • HPC integration for scale-out
  – Task API on MSDN for ISV-supplied tasks and jobs
Smooth Multicast

• Smooth Multicast (coming soon)
  – Combines best of multicast and Smooth Streaming
  – Reliable, scalable delivery on multicast networks
  – Rollover to standard Smooth Streaming
  – Full DVR support
MICROSOFT MEDIA PLATFORM (MMP)
Overview of Microsoft Media Platform

The Microsoft Media Platform provides a comprehensive set of functions to support encoding, delivering and playing rich media to virtually any type of network connected device.

At the highest level, the Media Platform provides out of the box capabilities for each step of a video workflow:

- **Encode**: Encode and transcode live and archived media assets using industry standard H.264 and VC-1 codecs.
- **Deliver**: Deliver media via traditional streaming, dynamic adaptive streaming over HTTP, and intelligent progressive download.
- **Watch**: Create immersive end-user media experiences on PC and Mac using Silverlight, HTML5 or native client technologies with advanced playback functions and support for closed captions.
MMP Components

Services
- Windows Server
  - IIS Media Services
- Windows Azure

Tools
- Microsoft Expression Encoder
- Microsoft PlayReady

Clients
- Microsoft Silverlight
- HTML5
- iOS 4
  - Smooth Streaming
  - PlayReady
  - Client Porting Kits

Frameworks
- Microsoft Media Platform
  - Video Editor
  - Content Manager
  - Player Framework
  - Audience Insight
MMP Video Editor

• Provides instant highlights during live events
• Faster time to market with highlights
  – Repurpose existing assets
  – No transcoding, so publish in seconds
• Reduction in costs
  – Free tool - no expensive video workstations
  – No additional storage costs
• Web based video editing
  – Location independent
  – Platform independent
• Fits in with encoders and other workflow tools
MMP Video Editor

- Used for Olympics
- Built on Silverlight
- Source code is provided
- Learn more at [http://videoeditor.codeplex.com](http://videoeditor.codeplex.com)
MMP Video Editor

DEMO
Smooth Streaming Clients

• iPhone, iPod, and iPad support
  – Server delivers in devices’ native formats or in Smooth Streaming format
  – Single set of Smooth files – easy to manage
• Running on Linux STBs today
• Coming to Android soon
IIS Advanced Logging

• Rich user engagement data
  – Perform deep analysis
  – Improve ROI

• Real-time integration for near-live monitoring

• Real-time filtering keeps client data separated

• Compatible with WMS and other W3C logging

• Centralized client logging for large networks
Content Protection/DRM

• Supported in Smooth Streaming via...
  – PIFF (Protected Interoperable File Format)
  – Smooth Streaming Format SDK
  – Smooth Streaming Player SDK
  – One-click PlayReady in IIS (coming soon!)

• Netflix and the Digital Entertainment Content Ecosystem (DECE – now branded as Ultraviolet) are using PIFF as the basis of their file format
Application Request Routing (ARR)

- Makes IIS a full-featured HTTP cache proxy
- Works better together with Smooth Streaming
- Provides control and extensibility for scaling
Scaling Out IIS Smooth Streaming

- Use a Content Delivery Network (CDN)
- Use an Online Video Platform (OVP)
- Purchase caching appliances
- Build out a set of IIS caching servers
- Ensure a high-availability architecture
Unicast Scale-out

- Streaming on HQ Network
  - eCDN IISMS Origin Server
  - eCDN IISMS Cache/Proxy Server
  - DMZ or CDN HTTP Caching Servers
  - Remote Users on Corpnet
  - Remote Users not on Corpnet
Hybrid Unicast/Multicast Scaleout

Origin Server

Streaming on Primary LAN

500-750-1100 kbps Multicast

500-750 kbps Unicast

500-750 kbps Multicast & Unicast

Edge Server

Streaming to Remote Site

DMZ or CDN Edge Servers

Remote Users on WAN

Remote Users not on WAN

500-750 kbps Unicast
High Availability Architecture

- Failover at each point in the critical path
  - Encoder – redundant or hot-spare model
  - Ingest – active/passive recommended
  - Origin – active/active recommended
Live DVR and Archive Settings

• For Live Smooth Streaming broadcasts, use these features:
  – Temporary DVR archive
    • Delete DVR archive after live broadcast is done
  – Sliding window DVR archive
    • Only archive the most recent NN minutes
    • Ideal for 24/7 live broadcasts
  – Archive segmentation
    • Create a new archive file for every NN minutes
Next Steps – Encoding

• Expression Encoder
  – Upgrade the free trial version on-line for just $199

• Third-party encoders
  – See the list at http://www.iis.net/media/partners
  – Visit encoder companies here on the show floor
Next Steps – Serving & Scaling

• Visit http://ww.iis.net/media to learn more about Windows Media Services, IIS Media Services, and edge caching

• See the list of CDN partners at http://www.iis.net/media/partners

• Follow up with OVPs and EVM ISVs
Next Steps – Consume

- Learn about the broader MMP Player Framework at http://smf.codeplex.com
- Learn more about the IIS Smooth Streaming Client, see http://www.iis.net/smoothplayer
- Get the details on the Microsoft Silverlight Analytics Framework at http://msaf.codeplex.com
Resources - Demos

www.IIS.net/media/demo
Resources – Partners

www.IIS.net/media/partners

Partners
While you can use Microsoft technologies to build a complete end-to-end solution on your own, sometimes working with one or more partners can help you achieve your goals more easily and quickly. Below, you will find a set of partners that have announced products or services that support IIS Media Services, including IIS Smooth Streaming. Click on a partner name to learn more. If you know of additional companies that should be on this list, please contact us.

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<th>Advertising &amp; Analytics</th>
<th>Client Development</th>
<th>Content Distribution</th>
<th>Content Protection</th>
<th>Encoding</th>
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FILL OUT YOUR EVALUATION FORM
Q & A
smooth@microsoft.com

SEND E-MAIL WITH ANY FOLLOW-UP QUESTIONS...