The AT&T Developer Program: Webcast Series

Guidelines for Delivering Streaming Services on AT&T’s Wireless Network

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Rysavy Research
Introduction - The AT&T Developer Program

Commitment to Data Developers – support for each step of the wireless application development process

> Access to the latest information on building solutions for the AT&T wireless network
  - Detailed Device & Modem Specifications
  - APIs, Toolkits, and Sample Code
  - Developer Gateways

> Technical support and educational opportunities
  - Webcasts
  - Developer Forums
  - Documentation and FAQs

> Subsidized wireless devices & discounted data service plans*
  - For additional video streaming support, using Content Delivery Networks (CDN) allows large scalability without the need of extensive build out.
    - In addition to better QoS delivery you also get reduced latency that can be key, especially in live event scenarios.
    - AT&T ICDS is optimized for delivery of HTTP Adaptive Streaming

http://developer.att.com

Follow us on Twitter: attdeveloper

*For Deluxe members
To view all AT&T’s Newly Released Devices

- Filter tool to search for device features easily

Answer the question at the end of the webcast and win an AT&T Phone!

Samsung Jack  HP iPAQ Glisten  Motorola Backflip  LG Arena  BlackBerry® Bold 9700  Samsung Strive

Win an AT&T Phone!

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Wireless Streaming Services

- AT&T encourages video streaming when done efficiently and appropriately.
- AT&T does not guarantee available bandwidth for sustained streaming sessions or persistent video or audio quality.
- AT&T reserves the right to address bandwidth utilization, congestion, or quality. AT&T also reserves the right to specify performance characteristics.
- AT&T wireless-data services may not be used in connection with high-bandwidth applications that disproportionately contribute to network congestion and function in a manner that is inconsistent with AT&T wireless data services optimization requirements.
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Rysavy Research

Wireless Streaming: Technology and Guidelines
Streaming Guidelines Agenda

- Key Considerations
- Media Delivery Background
- AT&T Key Recommendations for Media Delivery
- Additional AT&T Guidelines
- Streaming in the Future
- Conclusion
- Q&A
Introduction

- Content of this Webcast is presented in more detail in accompanying white paper.

- Audio/video streaming can work well over wireless networks but needs special considerations and optimization.

- AT&T network and devices offered by AT&T have extensive streaming support.

- Wireless connections can include 2G, 3G, and Wi-Fi.
Key Considerations – Content Type

- Content is either audio or video.
- Varies by type of content and complexity.
- Varying level of detail, activity, and fidelity needs.

- Video content has to be shaped based on:
  - Content type
  - Device screen size
  - Resolution
  - Network throughput
Key Considerations – Content Delivery

- Communications method for delivering media information.
- Includes rate adaptation, protocols, and delivery options such as real-time streaming versus progressive downloads.
- Devices offered by AT&T support 3GPP Packet Streaming Service (PSS) as well as HTTP delivery.
- Most handheld devices support mobile-specific protocols (e.g. PSS).
- Higher-end devices (e.g., smartphones, netbooks) may use same protocols as other computing systems.
Key Considerations – Containers, Encoding

Containers:

> File formats and other means of storing media information.
> Feature phones use mobile-specific containers (e.g., 3GP).
> Higher-end devices may use same containers as other computing systems (e.g. WMV).

Encoding:

> Algorithms for compressing and decompressing content.
> Many available codecs are available for audio and video (software- and hardware-based).
> Mobile devices use same codecs as other computing systems.
> Advanced codecs such as H.264 are well suited for wireless.
Key Considerations – Device, Network

Device:

> Various devices: lower-end handsets, smartphones, netbooks, notebooks.
> Capabilities vary across device types.
> Processing speed, resolution, and supported codecs.

Network:

> 2G, 3G, Wi-Fi
> Wireless networks have different characteristics than wireline.
> Varying speeds and transmission quality.
> Mobility characteristics such as handover and roaming.
Content Delivery and Protocols

Downloads:
- Simplest approach (e.g., podcast, full-track song).
- Often accomplished via HTTP.
- Play cannot begin until download completes.
- Digital Rights Management (DRM) considerations.

Progressive Downloads:
- Extension of download approach, though the experience is similar to streaming.
- Content begins to play shortly after download begins.

Streaming:
- Continuous audio/video.
- Player presents content almost immediately.
- Can adapt bit rates in response to network conditions.
Streaming Approaches

3GPP Based Packet-Switched Streaming Service

- Content is delivered primarily using Real Time Streaming Protocol (RTSP) and Real Time Transfer Protocol (RTP).
- Built-in mechanism to adjust to network conditions.
- Audio and video encoded at various bit rates.

Streaming over HTTP – Non Adaptive

- Similar to progressive download without caching of content.
- Can use an ordinary Web server.
- Content exists as single file on server.

Streaming over HTTP – Adaptive

- Accommodates real-time changes in throughput rates in response to network conditions. E.g. Apple’s Live Streaming protocol. Other vendor solutions are available as well.
HTTP Rate Adaptation

Good conditions

Media split into series of file chunks.
1 to 4 seconds typical amount.

Different bit rates used under different network conditions.

Poor conditions
## Containers and Codecs

<table>
<thead>
<tr>
<th>Container</th>
<th>Video Codecs</th>
</tr>
</thead>
<tbody>
<tr>
<td>3GP</td>
<td>H.263, H.264, MPEG4 Part 2</td>
</tr>
<tr>
<td>FLV (Flash)</td>
<td>H.264, On2 VP6, Sorenson Spark</td>
</tr>
<tr>
<td>F4V (Flash)</td>
<td>H.264</td>
</tr>
<tr>
<td>Ogg (Open Format)</td>
<td>Theora</td>
</tr>
<tr>
<td>MP4</td>
<td>H.263, H.264, Dirac, VC-1, MPEG4 Part 2 ASP</td>
</tr>
<tr>
<td>MKV</td>
<td>Sorenson, Cinepak, Real Video, Theora, H.263, H.264, Dirac</td>
</tr>
<tr>
<td>WMV</td>
<td>VC-1</td>
</tr>
</tbody>
</table>
## Device Categories and Capabilities

<table>
<thead>
<tr>
<th>Type of Device</th>
<th>Media Capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower-end handsets (e.g., closed-OS feature phones)</td>
<td>Common audio and video codecs (e.g., H.264) but restricted selection.</td>
</tr>
<tr>
<td></td>
<td>Mobile-specific containers (e.g. 3GP).</td>
</tr>
<tr>
<td></td>
<td>Mobile-specific delivery protocols (e.g., 3GPP PSS).</td>
</tr>
<tr>
<td>Higher-end handsets (e.g., most feature-rich phones and most open-OS smart phones)</td>
<td>Common audio and video codecs. Wider choice.</td>
</tr>
<tr>
<td></td>
<td>Mobile-specific and common containers. Varies by platform.</td>
</tr>
<tr>
<td></td>
<td>Mobile-specific and common delivery protocols. Wider choice than lower-end handsets.</td>
</tr>
<tr>
<td>Netbooks/notebooks</td>
<td>Greatest choice of built-in and installable players and support of codecs, containers, and delivery protocols.</td>
</tr>
</tbody>
</table>
## Network Type and Mobility

<table>
<thead>
<tr>
<th>Technology</th>
<th>Typical Download Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>2G (EDGE)</td>
<td>Range from 70 to 135 kbps</td>
</tr>
<tr>
<td>3G (UMTS/HSPA)</td>
<td>Range from 200 kbps to 3 Mbps</td>
</tr>
<tr>
<td></td>
<td>Note: (AT&amp;T’s low-end typical 3G speed is significantly faster)</td>
</tr>
</tbody>
</table>

Throughputs depend on multiple factors such as radio-signal quality, network loading, and devices.

Hotspot speeds can vary by backhaul bandwidth and congestion.

Seamless handover from network perspective for intra-system handover and handover between 2G and 3G.

Today, there is no handover to Wi-Fi. Device either maintains two connections or must establish a new connection.
Key Recommendation – Wi-Fi

Where feasible, use Wi-Fi for multimedia streaming.

- Wi-Fi hotspots are part of AT&T’s wireless offering.
- More and more devices support Wi-Fi.
- Many devices will automatically connect to AT&T Wi-Fi hotspots.
- Application should use Wi-Fi as a default option.
- Wi-Fi network selection can be done either under application control or user control.
- Wi-Fi traffic is not routed through the AT&T WAP Gateway; developers will not be able to rely on WAP headers on WiFi.
# APIs for Network Connection Control

<table>
<thead>
<tr>
<th>Platform</th>
<th>API</th>
</tr>
</thead>
<tbody>
<tr>
<td>Android</td>
<td>Use android.net. ConnectivityManager class to query and control the active connection.</td>
</tr>
<tr>
<td>BlackBerry</td>
<td>Use standard javax packages such as javax.microedition.io. Connector and URL option of 'interface.'</td>
</tr>
<tr>
<td>iPhone</td>
<td>Use Objective C, the Reachability API, and the Sockets API to check for connection types and open connections.</td>
</tr>
<tr>
<td>Symbian</td>
<td>With C++, use the Connection Manager API, such as instance RConnectionManager. With Java ME, use interfaces in javax.microedition.io.</td>
</tr>
<tr>
<td>Windows</td>
<td>With .NET Development, use the OpenNETCF.net package in the Smart Device Framework. With C++, use the Connection Manager API in connmgr.h.</td>
</tr>
<tr>
<td>Windows Mobile 7</td>
<td>Use the new Mobile Broadband API. COM based API declared in mbnapi.h. Old APIs from Windows Mobile 5/6 are still available.</td>
</tr>
</tbody>
</table>
Key Recommendation – Codecs

➢ Where possible, content should be encoded in H.264 “Baseline Profile.”
   - AT&T is working to ensure that more and more wireless devices support H.264 for video.
   - Most devices offered by AT&T support H.264 “Baseline Profile” up to Level 1.2.
   - A small number of low-end 3G devices only support level 1.0 and 1.1.
   - Some of high-end devices support levels 2.2 and 3.0.
   - Some devices support additional video codecs.
   - For details on codec support per device, please refer to http://developer.att.com/developer/device_home.jsp
Developer Site Example: HTC Pure

Video Player Details:

> Screen Height: 800 pixels
> Screen Width: 480 pixels
> Video Delivery: Streaming and Download
> Video Format: MP4, H.263+AMR, MPEG4, WMV, H.264, 3GP
> Video Protocols: UDP, RTSP, RTP, TCP
> Total Video Storage Capacity: Up to available memory
> Max Number Of Videos: Up to available memory

Comparable information available for every AT&T device.
Key Recommendation – Bit Rates

- Higher rate is not always better; can adversely affect user experience based on network conditions and device.
  - All content should be encoded at multiple rates to allow optimum starting experience depending on the network type, as well as capabilities and resolution of the device.
  - As a general guideline, the following rate ranges are recommended:
    - 2G: 44 to 64 kbps helps prevent excessive buffering.
    - 3G: 85 to 200 kbps can provide a good user experience.
- WiFi can support higher rates.
- Content delivery should support adaptive delivery mechanisms wherever possible.
Key Recommendation – Delivery Method

- Use the 3GPP Packet-Switched Streaming Service Protocol for delivering the content in a continuous form of streaming.
  - Most of the AT&T handheld device portfolio supports 3GPP Rel 6 PSS protocol.
  - 3GPP Rel 6 Rate adaptation recommended to dynamically adjust the content bit rate.
  - Other HTTP adaptive streaming protocols can be used if supported by the device and the application.
  - For Simple HTTP Delivery (as for Progressive Downloads), use efficient mechanisms to minimize needed bandwidth. E.g. Limit play-ahead time and maintain 10-20 seconds of content before playback.
Guidelines – Audio Encoding

- Codec of choice is HE-AACv2, if supported by the range of targeted handsets.
- Also known as aacPlus v2.
- Format is backward compatible with AAC-LC, universally supported by 3GPP video-capable handsets.
- Following general guidance applies for various content types using HE-AACv2 encoding:
  - Low-quality mono (e.g., news, weather) – sampling rate 22 kHz, bit rate 24 kbps. (Note: lower sampling rates may be acceptable for this type of content.)
  - Medium-quality stereo (e.g., for sporting events and movies) – sampling rate 32 kHz, bit rate 32 kbps.
  - High-quality stereo (e.g., music, movies) – sampling rate 44.1 kHz, bit rate 64 kbps.
Guidelines – Video Frame Rate

- Consider resolution of target devices.
- Encode separately for each desired resolution and aspect ratio.
- Maintain aspect ratio of source content.
- Majority devices support 15 frames per second. Newer devices support 30 fps.
- Consider 15 fps for 2G/3G, 24-30 fps for Wi-Fi.
- Higher encoding rates do not necessarily translate to better customer experience.
Guidelines – User Feedback

- Some users may be on usage-based plans.

- Where appropriate, consider providing users information about amount of data content may consume.
Future – Radio-Technology Advances

HSPA:

> Faster radio links as technology matures.
> Expanding backhaul capability.
> AT&T has deployed HSPA 7.2 technology across its 3G cell sites.
> As the standards for HSPA continue to develop, AT&T continues to evaluate and consider the technology and performance enhancements.

LTE:

> Beginning in 2011, AT&T is planning to deploy Long Term Evolution (LTE) technology.
> A scalable IP network with “always-on” capabilities to support a wide range of IP-based multimedia services and applications.
Future – QoS-Enabled Networks

- GERAN
- UTRAN
- SGSN
- MME

Rel’7 Legacy GSM/UMTS

One-Tunnel Option

Evolved RAN, e.g., LTE

PCRF: Policy and Charging Rules Function

Allows dynamic policy for QoS Management.

Control

User Plane

Serving Gateway

PDN Gateway

EPC/SAE Access Gateway

Non 3GPP IP Access

IP Services, IMS

Future – QoS-Enabled Networks

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Future – HTML 5

- Implements audio and video using `<audio>` and `<video>` tags.
- Separate media player (usually plugin) not required.
- Only mobile browser supporting HTML 5 is iPhone Safari.
- HTML 5 object model will allow full control via JavaScript; potentially enables advanced features such as adaptive streaming.
- Hold great promise, but not yet final, implementations are immature.
Conclusion and Call to Action

- The AT&T wireless networks and devices support streaming.

- Special considerations at multiple levels:
  - Content creation
  - Delivery protocols (adaptive best)
  - Efficient codecs
  - Device capabilities
  - Network capabilities

- Download our white paper at:
  http://developer.att.com/videostreaming
CONTEST

Question: Most devices offered by AT&T support H.264 Baseline Profile up to what level?

A: Level 1.0  
B: Level 1.1  
C: Level 1.2  
D: Level 2.2  
E: Level 3.0

Send answers to: developer.program@att.com
Winners will be selected randomly from correct responses
Streaming over Wireless Networks

QUESTION & ANSWERS

Webcast slides will be posted shortly on

http://developer.att.com/webcasts