Background

The Movidity solution is a multimedia transcoding, transmission, and player system. Movidity leverages highly advanced algorithms, innovative video processing, and a new, unique transmission method to provide high quality Video and Audio-on-Demand along with two-way interactive capabilities to wireless mobile clients such as cell phones and PDA's.

Movidity's solution is so unique, that "lower-end" devices such as cell phones (that cannot normally run multimedia) are now able to render continuous video over a 2.5G network, with satisfying quality. This feat has earned Movidity numerous pending patents in various fields.

In this paper, we overview existing technologies along with their drawbacks and describe the unique, advanced capabilities of the Movidity solution.

TODAY'S LIMITATIONS

The current methods of distributing multimedia data over the wireless Internet to mobile clients are constrained by existing wireless bandwidth and quality of service issues, along with the real-time decoding, processing and displaying of multimedia content with limited client hardware capabilities.

These hardware limitations include slow CPUs, high memory latencies, slow drawing capabilities and the absence of YUV to RGB conversion capability in hardware.

INSIDE

STREAMING TECHNOLOGY ISSUES

Bit streaming is the current standard method of transmitting audio or video to cell phones over wireless networks. Either streamed bits are buffered and then decoded on-the-fly, or entire video files are downloaded or proportionately cached. Alternatively, as in progressive HTTP streaming, downloading occurs to a point where complete, continuous playback is deemed possible. In the case of wireless networks, bit streaming of audio/video content is usually is done over a non-reliable transport like UDP and requires a significant amount of error correction and duplication of content (extra stream correction data).

Streaming also adds other burdens, including the requirement for predictive motion correction in video decoding, adaptive encoding for varying channel bit rates and the need for the MMS (Multimedia Messaging Services) protocol (across the cellular network). Simply put, streaming technology is a poor choice for use over today's mobile wireless networks.

VIDEO & AUDIO CAPABILITIES

While video and audio playback capability exist on certain cell phone handsets today, the technology is typically embedded and takes advantage of low-level hardware processing to enable the performance required for media playback.

Through embedded media players, several cell phone handsets and handheld computers can play either streamed video or audio. Popular digital video encoding standards for some handsets are H.263 and MPEG4. The audio codecs, MP3, AMR and AAC, are also typically supported on some mobile handhelds. Newer video codecs, like H.264 could be used for video transmission to cell phones, but would require client devices with fast memory access to support their motion compensation methods.

EMBEDDED PLAYERS & PERFORMANCE

Embedded streaming media players rely on firmware integration to take advantage of the multitasking capabilities of cell phone handsets.

At the time of this writing, most cell phones cannot support multimedia playback because they are only capable of supporting one or a few concurrent processing threads.

""Simply put, streaming technology is a poor choice for today's mobile wireless networks"

Movidity breaks through the barriers that severely limit traditional streaming technology.

On handsets that have embedded media players, video is also limited to very low frame rates as the bandwidth available for streaming in North America is low, varying from 2-3kbytes/second to near ISDN speeds of 64Kbps.

Certain European countries along with Japan offer much higher connection speeds, varying from 64kbps to 300Kbps+, along with more technologically advanced cell phones with embedded media players that can achieve higher video frame rates.

Decoders for complex video codecs which support highly scalable video like MPEG4, and more complex audio codecs like AAC (for CD quality music), require multiple parallel processes and fast processing.

Mathematical algorithms designed for the large number of floating point samples for "higher end" MPEG4 and AAC, (requiring a sample rate of approximately 36,000 floating point calculations/second), are intended to run on specialized processors. Even at very low bit rates where MPEG4 is more efficient than its predecessors, MPEG4 software players depend on PC multitasking or hardware APIs for efficient processing to draw video frames.

JAVA CAPABILITIES

Currently, hardware independent Java (J2ME) offers two standard configurations on mobile clients: The Connected Limited Device Configuration (CLDC) is prevalent in the J2ME world, and powers cellular phones, pagers, PDAs, and other handheld devices. The Connected Device Configuration (CDC) targets more powerful devices, such as home appliances, set-top boxes, and Internet TVs. The Mobile Information Device Profile (MIDP) runs on top of the CLDC, and several profiles run on top of CDC.

Similarly, although Java decoders that play MP3 ringtones on cell phones exist today, there are no currently known Java players capable of playing AAC. In fact, many of the newer IDCT algorithms are targeted more towards customized logic chips that only perform IDCT (composed of many simple pipelined instructions as opposed to a few more complex ones).

Movidity Technology

Movidity is addressing an area which has enormous and far reaching potential. Until now, pushing "heavier", complex content such as color motion video and high quality audio to low functionality devices (including basic cell phones and other limited CPU / memory / bandwidth platforms) has been impossible.

"Movidity has created a new, significantly different technique...."

"Movidity's solution turns a simple web server into a powerful multimedia distribution platform."

Movidity has created a new, significantly different technique whose intent is to allow the delivery and presentation of rich content on limited capability platforms.

With highly advanced algorithms, a unique asynchronous object based transmission method along with an innovative visual rendering approach, Movidity has created an environment that allows the delivery and playback of rich video & audio content on standard Java enabled cell phones over low bandwidth wireless networks.

OBJECT TRANSMISSION

The Movidity transmission model does not involve bit streaming. Rather, it depends on the asynchronous transmission of "media objects."

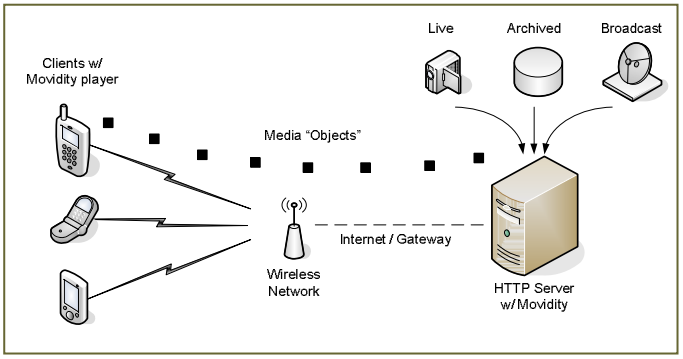
Video and audio are transmitted as discrete sets of objects; there is no channel model and no overhead for error correction as in bit-streaming. Video objects are encoded with an efficient video codec suitable for optimal picture quality on cell phone type displays – e.g. MPEG4, H.263 – along with audio, currently encoded in AAC.

The transmission model is, in fact, codec independent. It also dissociates encoding from available bandwidth or wireless transmission speeds. The transmission model does not require cellular MMS, as true video or audio-on-demand

can be provided by standard HTTP servers (although transmission is not through HTTP streaming), and is only limited by the sessional capabilities of HTTP servers in terms of concurrent client support. Movidity also supports TCP (via any port number), for transmission of objects (whereby object are sent as segments of TCP data payload). The transmission model supports both archived and live video / audio, along with ensuring consistent audio / visual quality for a given handset through the use of discrete video or audio objects. Additionally, the model also supports multiple media "streams" to a single client.

Media objects can be anywhere from 5KB to 60KB in size. Objects essentially appear as HTTP pages of data (or alternatively segments of TCP data) that are fetched from a web server or basic Linux server. Each object is re-assmebled as a complete, discrete unit, thereby allowing the player to render an object once it has been fetched and received into memory on the device. Objects are queued for playback according to both network and mobile device conditions.

The transmission model enables very large scale distribution without the need for dedicated content



Movidity media objects are passed from a standard HTTP server (with Movidity) to wireless clients using the Movidity player.

"The Java midlet plays true MPEG 4 video and AAC audio"

servers. Movidity's solution turns a simple web server into a powerful multimedia distribution system. Distributed servers need only to be known to a primary Movidity server that provides the content; otherwise they behave as common ISP web servers supporting large numbers of clients in different geographies through localized cellular network proxy servers. The Movidity transmission model is also independent of network protocols such as GPRS or CDMA.

Higher bandwidth wireless network infrastructures like CDMA EV-DO provide the opportunity to encode media at much higher rates through the Movidity transcoder. Because of the unique capabilities of object oriented transmission, the system is significantly more resilient to wireless (and wired) network anomalies than streaming technology.

JAVA MIDLET MEDIA PLAYER

The Movidity player is a Java midlet (J2ME). It is hardware independent and requires standard cell phone APIs - CLDC1.0 and MIDP2.0. (DoJa / J2ME is also supported for i-mode networks). The player has also been designed to run on specific MIDP1.0 phones, utilizing a 3rd party midlet. The Java midlet plays true MPEG4 video and AAC audio.

Playback performance is more dependent on the

Java processing capabilities of the handset rather than cellular network bandwidth. The player itself is quite small, typically under 25KB.

The Java player decodes MPEG4 in a highly efficient manner. To compensate for sluggish frame rate performance on handsets with slower Java implementations or processing capabilities, the player attempts to sustain an acceptable frame rate by utilizing 36 different optimizations in 3 different layers of decoding / processing.

The player can playback AAC encoded audio with or without a video component. In the case of purely audio applications, audio can be encoded at higher rates to provide excellent sound quality. With the transcoder, audio can be encoded from a live source, such as a radio broadcast.

In addition to AAC, the player also supports AMR and MP3 audio, with the ability to take advantage of AMR / MP3 embedded functions within a device.

The player can also run on PDA devices that support Java / J2ME, along with future support for PC based operating systems.

In cases where an embedded audio player application is present on a device (perhaps leveraging specialized hardware in a handset), then the Movidity midlet can sense the presence of this capability and use the embedded player to enhance audio playback.

As noted, it is also possible for the player function on devices that support only MIDP1.0 (which does not include audio capabilities), provided that the handset leverages a common 3rd party midlet (licensed / supported by a number of handset manufacturers).

"The Java player itself is very small, typically under 25KB"

"The exceptional innovations found in Movidity's technology disrupt the conventional TCO / ROI models of existing VoD providers"

Standard Web Servers

As Movidity's media system uses standard HTTP web servers to distribute on-demand content to wireless devices, the cost of VoD infrastructure is dramatically reduced – dedicated streaming servers are not required.

Existing, large scale ISP web server farms (and associated infrastructure) can now be leveraged to serve wireless clients with video & audio.

The exceptional innovations found in Movidity's technology disrupt the conventional TCO / ROI models of existing VoD providers; infrastructure costs to implement and operate both small and large scale (global) VoD services are so radically reduced that even the most cost sensitive organizations can now consider VoD.

Transcoder

The Movidity transcoder is a high performance server component that converts a variety of signals (MPEG1, MPEG2, MOV, high bit rate MPEG4 and

analog broadcasts) into MPEG4/AAC format, which is then further processed into discrete media (audio / video) objects.

The transcoder is Linux-based and required for any "live" video conversion. Due to its high performance nature, it can run at multiples of real-time to convert video archived in alternative formats to MPEG4.

The transcoder automatically recognizes the media input format; the user interface allows the specification of optimal encoding rates given the wireless bandwidth expectations of the particular cellular network provider. This “adaptive rate encoding” capability provides a superior experience to users when faced with varying network conditions.

The transcoder also facilitates the creation of media items and archives that can be accessed through the Internet based media site. Standard HTTP web servers (Apache, etc.) or any Linux based server with TCP/IP can then take the converted and formatted Movidity media objects for distribution to practically unlimited number of clients.

SECURITY

Since Movidity does not employ a "channel" based or streaming transmission model, there is no requirement for channel encryption.

Both the Movidity Java player and individual Movidity media objects are “keyed” to playback from a specific Movidity server. The player cannot be used to play video from an alternative server, unless it is a registered content server.

Movidity media objects appear as pages of HTTP data, which is unintelligible except to the Movidity player.

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