Media World Communications
Adams Platform 1.0

High-Quality Streaming Video over Narrowband Networks

Test Summary

Premise: High-quality digitized video can generate in excess of 1.6 GB per minute of raw data. Conventional schemes like MPEG-4 sacrifice quality when encoding for narrowband playback. Adams Platform's radically new approach enables high-quality streaming video over narrowband networks.

Media World Communications Ltd. commissioned The Tolly Group to validate the capabilities of Adams Platform (AP) technology in streaming high-quality, full-screen video across narrowband networks.

Adams Platform (AP) technology introduces a radically different solution to video streaming that combines multi-stage, proprietary compression algorithms with an optimizing server transport protocol. The dramatic reduction in bandwidth needed to deliver Video-on-Demand (VoD) and similar offerings will open up a new era in rich-content delivery.

Engineers conducted both quantitative and qualitative tests of the technology across simulated networks at speeds of 56 Kbps and compared AP quality to MPEG-4 files encoded at equivalent bit rates. Engineers also conducted tests of AP technology delivering full-screen video across 14.4 Kbps links. Testing was conducted in Melbourne, Australia in September 2003 with additional testing in October 2003.

Tests reveal that AP technology can deliver high-quality, full-screen video streamed over 56 Kbps network connections. Furthermore, engineers observed good-quality, full-screen video streamed over 14.4 Kbps network connections.

Because of the nature of the product claims, extraordinary measures were used to guarantee the integrity of the test environment. See the Test Configuration and Methodology Section for details.

Test Highlights

❍ Delivers high-quality, full-screen streaming video over 56 Kbps WAN links

❍ Allows Video-on-Demand (VoD) over existing narrowband networks

❍ Delivers dramatically higher quality than MPEG-4 solutions over equivalent link speeds

❍ Delivers good quality, full-screen streaming video over 14.4 Kbps WAN links

Video Streaming: Quality Comparison
Adams Platform vs. MPEG-4
(4= Excellent, 3 = Good, 2 = Marginal, 1 = Poor)[1]
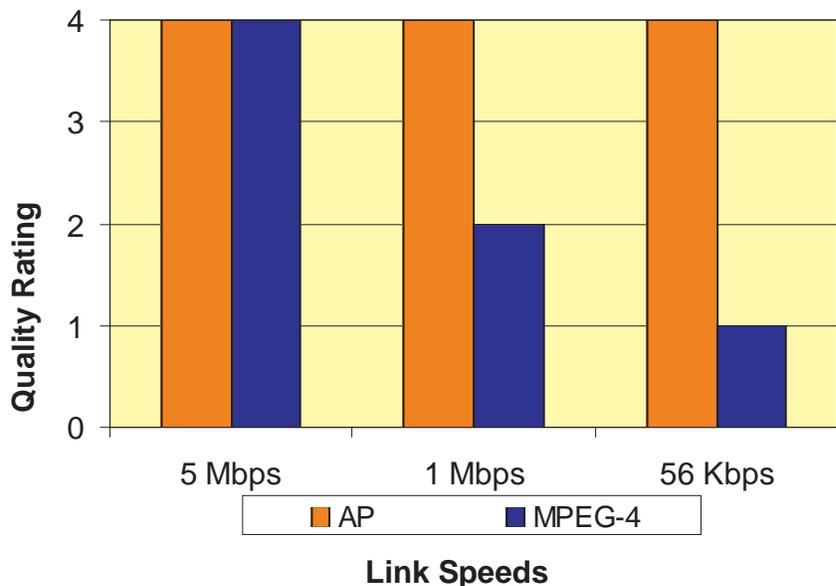
Link Speeds
Note: For MPEG, x-axis represents encoding rates

[1]Refer to Figure 2, "Quality Level/Definition"

Source: The Tolly Group, October 2003   *Figure 1*

RESULTS

STREAMING OVER 56 KBPS - FEATURE FILM CLIP 1

While multiple tests were run with various film clips as the source, testers selected a high-action clip with varying contrast, considerable subject and camera movement, varying length dissolves, dramatic visual effects and extreme lighting highlights to provide a direct comparison between the AP offering and commercially available MPEG-4. (See Figure 1.)

The AP version of the clip provided high-quality, full-screen, real-time video across all link speeds tested down to and including 56 Kbps. No artifacts or jagged motion was observed.

At 56 Kbps, network traffic was observed beginning approximately 10 to 15 seconds prior to the commencement of the clip playing back. Once begun, the clip played through to the end without pausing. The clip was played back on a commercial quality TV monitor. Network traffic ceased shortly before the end of the playback.

Engineers monitored the network traffic produced by the AP video stream. Only a little more than 700,000 bytes - including network-layer headers and acknowledgement packets - flowed across the client side of the network during the playback. Playback began approximately 10 seconds after the start of network activity.

At higher speeds, the AP file streamed from the server to the client as fast as the link speed would allow and network activity ceased shortly after the playback started.

MPEG-4: DEGRADED QUALITY

Using the latest encoders from Apple Computer, Inc. and Microsoft Corp., the same clip was encoded as MPEG-4 at rates to match the chosen link speeds.

To provide a visual comparison to the AP output, these clips were played back. Since they were already encoded for a specific transport speed, they were played back locally to maximize the quality.

At 5 Mbps, the sample exhibited minor artifacts but overall quality was high. At 1 Mbps artifacts were present and motion was often jagged. At 56 Kbps artifacts were severe and motion was so jagged as to make the clip unwatchable.

STREAMING OVER 14.4 KBPS - FEATURE FILM CLIP 2

Quality Level	Definition
Excellent	Broadcast or DVD-like viewing experience
Good	Minor artifacts
Marginal	Severe artifacts and/or jagged motion
Poor	Unwatchable. Severely degraded image with jagged or frozen motion

Source: The Tolly Group, October 2003   *Figure 2*

Feature Film Clip 1 Details				
	AP	**MPEG-4**		
	All Tests	**5 Mbps**	**1 Mbps**	**56 Kbps**
Duration (mm:ss/frames)	1:35/03			
Original Raw Size (bytes)	2,656,030,123			
Streamed Data Size (bytes) (MPEG values are encoded file sizes – local playback)	731,172 (total network traffic)	60,075,469	12,425,721	7,251,087

Source: The Tolly Group, October 2003   *Figure 3*

Following the same procedure as the previous test, a 20-minute clip from a feature length movie was streamed across a network transport configured for 14.4 Kbps.

The overall quality was still good even with such a low transport speed.

The network monitor reported a total of only 2,454,281 bytes present on the network for the entire 20-minute playback period. This total included network overhead.

Proof of Transport

A key facet of the validation procedure was to prove that the video playback being observed was being built from the data streaming across the network (and not somehow generated or cached locally).

While a re-run of the 20-minute playback test, previously referenced, was in progress testers deliberately introduced severe network impairments, specifically 25% packet loss, into the emulated WAN. This was done at a random interval several minutes into the test.

Testers observed that shortly after the impairments were introduced, after the client buffer was depleted, the client video playback ceased as the severe network impairments prevented the client from retrieving additional video data.

This test, repeated multiple times using different clips and different network impairments, proved that the source of the data for the client playback was the data being streamed across the network by the server.

Analysis

The video compression algorithms at the heart of AP technology provide high-quality, full-screen video delivery at network link speeds previously unthinkable and offers a radical improvement over existing commercial solutions.

Such technology can provide the basis for products that will enable video transmission over existing wireline and wireless communication infrastructures.

Test Configuration and Methodology

As noted earlier, the radical advancements claimed by the Adams Platform technology bring with them a heavy burden of proof. Thus, for this test, extremely strict measures were implemented to guarantee the integrity of the test environment and the testing process.

Film clips used for this test were selected by The Tolly Group who oversaw the conversion process from DigiBetacam to digital video format (720x576) and retained possession of both the tape and digital data until the Adams Platform software that was to be used for the test was physically secured.

The CDs containing the software used for the test were placed in a bank vault before the digitized video was provided to the Adams Platform team for pre-processing.

Two Apple Power Mac G4 (400Mhz PowerPC) machines were used. The streaming server was implemented on one and the client machine on the other. The machines ran OS9.1. Both machines were outfitted with MIRO DC20 boards. (This was required component only for the machine playing back the AP content and was not used by the server during streaming.) Each machine was connected to a Netgear hub on opposite sides of the WAN emulation device.

New, unformatted hard-drives were provided by the test team for this test. Test engineers physically inspected these machines prior to installation to verify that no additional hardware components were present in the machines.

Engineers verified that the machines were loaded only with commercial OS and utility programs and that the CDs used for the AP code came from the bank vault. Furthermore, at the end of each test session, the hard-drives were uninstalled and stored in portable safe to which only the test engineer had the access code and override keys.

An Agilent Wireless LAN Analyzer

was used to make certain that no

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802.11b or 80211a wireless transmission was present in the test lab.

WAN Emulation

Spirent's IP Wave 2.0 (beta) was installed on a Windows 2000 machine outfitted with dual Fast Ethernet NICs to provide the emulated WAN environment. This instrument was used to set adjust the bandwidth between streaming server and client as well as to introduce impairments for the "proof of transport" tests.

The Agilent Software Advisor, installed on a separate Windows 2000 machine, was connected to the client-side hub. It was used both to verify the bandwidth settings of the WAN emulator as well as to provide data traffic statistics.
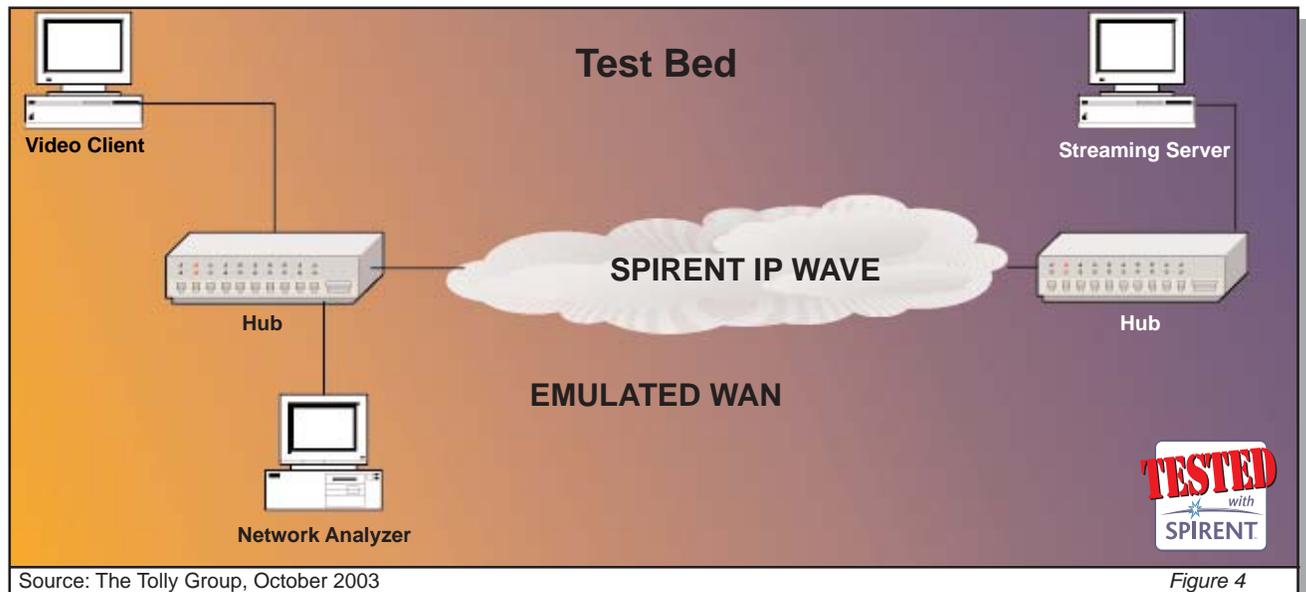
MPEG Local Playback

Comparison clips were created using the same digital video input and encoded using the latest available encoders. Apple QuickTime was used for 56kbit/s and 1Mbit/s. Since Apple does not offer 5Mbit/s encoding, Microsoft's encoder was used to product that file.
The files were played back on a high-end Windows 2000 machine outfitted with a Leadtek WinFast A310 TDH video card.

Test Bed

Video Client

Streaming Server

Hub

SPIRENT IP WAVE

Hub

EMULATED WAN

Network Analyzer

TESTED
with
SPIRENT

Source: The Tolly Group, October 2003   *Figure 4*

The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web address
Agilent Technologies, Inc.	Software Advisor V15.0	http://www.agilent.com
Agilent Technologies, Inc.	Wireless LAN Analyzer V2.5.1	http://www.agilent.com
Spirent Communications	IP Wave 2.0	http://www.spirent.com

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Project Profile

Sponsor: Media World Communications
Document number: 203125
Product Class: Video Compression and Streaming

Products under test:
❍ Adams Platform Batch Video Encoder V1.0

❍ Adams Platform Real-time Video Transport Server V1.0

❍ Adams Platform Real-time Video Decoder V1.0

Testing window: September and October 2003

Software Status: Prototype

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