Title:
An Experience of Higher Quality Video Applications for the Access Grid

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Abstract:

Several factors are making high-definition (HD) videoconferencing more desirable and affordable:
- fast growing standards for HD video
- more available software HD video applications
- increases in the kind and number of HD cameras and display devices
- more affordable equipment costs
- improved computer system performance
- increases in network bandwidth and wider use of broadband

High-definition videoconferencing can provide higher resolution video and potentially more realistic collaboration that more closely approximates interaction that is face to face. Such realism can be especially important in telemedicine applications where physicians need to get a clear picture of the signs and symptoms patients present or consulting clinicians need to interpret a range of different images to make or confirm diagnoses. It is also important in distance learning applications where students need to understand visual information containing clinical content.

The National Library of Medicine is interested in HD videoconferencing tools for better real-time remote collaboration, improved distance learning for bioinformatics training, and telemedicine applications. The AccessGrid is one of the leading videoconferencing and collaboration tools for such research and it has been deployed by NLM and many universities and medical schools. Consequently, we are investigating varied higher definition videoconferencing options for use with AccessGrid.

In this presentation, we will discuss the HD alternatives that we have explored and some of the success and problems that we have encountered in our tests. We will also share observations about how these compare to other non-HD video alternatives, such as DVTS, standard TV level h.264 and mpeg4. Many of the alternatives are already fully incorporated within the AG environment, but some are not.

We have identified five possible high-definition videoconferencing solutions with AccessGrid. The first is the HDV extension for AG from the Korea Advanced Institute of Science and Technology. The second is the iHDTV technology from the Research Channel. The third is

the H264 extension for AG from the SUMOVER project with HD video input through HD capture car. The fourth is the H264 extension for AG from the SUMOVER project with HD video input directly through USB port. The fifth is the UltraGrid from ISI.

Test results:

Solution 1: HDV extension for AG from the Korea Advanced Institute of Science & Technology.

- Software: AccessGrid 3.1, HDV extension for AG
- Hardware: HDV camcorder through IEEE 1394 port

The HDV extension for AG works well, its 1080i HD video quality is very good and motion is smooth with little jitter. It can be implemented at low cost, since one only needs an inexpensive HDV camcorder, which can be found in consumer electronic stores, and a computer with an IEEE 1394 port for the camera's video input. The software is free and the only apparent drawback is that there is an approximate two second delay (at least with our current hardware). We believe a better HDV camcorder and higher performance computer will definitely decrease latency. Some notes from this testing are: 1) A good IEEE 1394 port is important and not all IEEE 1394 ports meet the standard. A bad one can add latency and jitter. 2) A good video card is required for all users, both near and far end, to display the HD video. Some video cards introduce image artifacts.

Solution 2: H264 extension for AG from the SUMOVER project with HD video input through HD capture card.

- Software: AccessGrid 3.1, H264 extension for AG from the SUMOVER project
- Hardware: HD video input through a HD capture card

The H264 extension for AG from the SUMOVER project only provides standard NTSC/PAL resolution. Although video source is from a HD camera and a HD video capture card is used, the AG video consumer program cannot detect or process the video input. We believe that after the SUMOVER project implements HD level support for this H264 extension, it will be a great HD video application with low deployment cost. Compared to the HDV application, this solution has higher cost since it requires a HD capture card in addition to a HD camcorder, but almost all HD videoconferencing solutions other than HDV will cost more. The current H264 extension can be used with standard resolution, but presents different issues that we discuss below.

Solution 3: H264 extension for AG from the SUMOVER project with HD video input directly through USB port.

- Software: AccessGrid 3.1, H264 extension for AG from SUMOVER project
- Hardware: Logitech HD camera (960x720) through USB port

As in the previous test, the AG video consumer cannot process the HD video, but it does process the video as standard resolution. We investigated this solution because, much like the HDV solution, it only needs a HD camera plugged into a computer port (in this case USB). When

the SUMOVER project provides HD support for this H264 extension and the computers available are robust enough to process h.264 with only software. This solution will be both cost efficient (the Logitech HD camera is only $100) and effort saving.

Solution 4: iHDTV from Research Channel.

- Software: iHDTV from the Research Channel
- Hardware: AJA HD Video I/O Cards, Sony HD camera,

Although iHDTV has not been incorporated into AG, it is one of the most advanced uncompressed HD video applications. We have successfully tested it inside NLM and between NLM and University of Michigan. The 1080i HD video quality is very good and there is almost no latency. Its drawbacks are relatively higher equipment and set up costs due to the need to acquire and install converter and embedder devices, configure the open source software, and maintain and upgrade it. The 1.5 gigabit streams generated require two NIC cards on each computer that are GbE with PCI-x or PCI-e interface. (Note that a GbE with PCI interface will not work). Different computers are needed to send and receive streams as well as a 10 Gbps network or a means to use dynamic switching and "multiplexing" to manage the streams. Modifying iHDTV software to enable adjustable resolution and bandwidth use would make its application more viable. We have not tested the technology for sending and receiving streams on a single fast machine.

Solution 5: UltraGrid from ISI

- Software: AccessGrid 3.1, Ultragrid from ISI.
- Hardware: AJA HD Video I/O Cards, Sony HD camera.

UltraGrid is another uncompressed HD video application like iHDTV. It is fully incorporated with AG and it has a version with compression added that reduces the streams to 250 mbps. Its uncompressed 1080i HD video quality supposed to be very good and there is almost no delay. The compressed video is not as good. We are in the process of testing UltraGrid and plan to complete these tests before the AG Retreat.

We Have investigated some high quality non-HD video applications for AccessGrid. Though they are not as good as HD level video applications, they did provide high enough video quality for certain applications without the need for HD devices.

Solution 6: DVTS extension from Korea Advanced Institute of Science and Technology.

- Software: AccessGrid 3.1, DVTS extension for AG
- Hardware: miniDV camcorder through IEEE 1394 port

Video quality from DVTS is good and there is little delay. If there is no need to show detail, this technology may suffice and the costs only involve a miniDV camcorder which can be less than half the price of a HD camera.

Solution 7: H264 extension for AG from the SUMOVER project with standard video input through standard capture card.

- Software: AccessGrid 3.1, H264 extension for AG from the SUMOVER project
- Hardware: Standard camera, standard capture card

This solution includes two configurations: the h.264 part and the mpeg4 part of the H264 extension. Both configurations produce good video quality, but the mpeg4 has much less jitter because it uses more compression. The resolution is about the same as DVTS and may suffice for videoconferencing when the need to see detail is not important and its costs are relatively higher for it requires an additional video capture card.

Each of these high-quality video alternatives may be suitable, depending on the application. HD level video is important when more realism is desired and when more resolution and the need to detect detail in the video is paramount. We have found that our test results have been affected by different I/O and other devices that may not meet standards. Our aim in sharing these tests results is to determine whether others in the community have encountered similar problems and have achieved similar results.