

ARGONNE NATIONAL LABORATORY
9700 South Cass Avenue
Argonne, IL 60439

Futures Laboratory
Mathematics and Computer Science Division
(fl-info@mcs.anl.gov)

Access Grid Node Minimum Requirements

by

Ivan R. Judson

Mathematics and Computer Science Division

Technical Memorandum No. 257

April 2002

This work was supported by the Mathematical, Information, and Computational Sciences Division subprogram of the Office of Advanced Scientific Computing Research, U.S. Department of Energy, under Contract W-31-109-ENG-38.

Argonne National Laboratory, with facilities in the states of Illinois and Idaho, is owned by the United States Government and operated by The University of Chicago under the provisions of a contract with the Department of Energy.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor The University of Chicago, nor any of their employees or officers, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of document authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, Argonne National Laboratory, or The University of Chicago.

Available electronically at <http://www.doe.gov/bridge>

Available for a processing fee to U.S. Department of
Energy and its contractors, in paper, from:

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
phone: (865) 576-8401
fax: (865) 576-5728
email: reports@adonis.osti.gov

Contents

Abstract	1
Overview	1
AG Node Minimum Requirements	2
Metrics for Success	3
Operational Best Practices	3
Conclusion	4
References	4
Appendices	6
Appendix A: ANL Research Access Grid Node[10]	6
Appendix B: InSORS 2 Box Node Configuration[11]	7

Access Grid Node Minimum Requirements

by

Ivan R. Judson

Futures Laboratory
Mathematics and Computer Science Division
Argonne National Laboratory
9700 S. Cass Ave.
Argonne, IL 60439
(fl-info@mcs.anl.gov)

Abstract

The Access Grid is a group-to-group collaborative system developed at Argonne National Laboratory. The system is designed to support high-fidelity, high-bandwidth interactions. This document specifies the minimum requirements that need to be fulfilled for a space to be considered an Access Grid Node.

Overview

The Access Grid (AG)[1] infrastructure creates a collaborative environment designed to provide seamless, interactive group-to-group collaborations among groups that are not co-located. This enables a rich set of interactions to occur by utilizing streaming media, providing a semi-immersive environment in which the technology fades into the background. Designed to be always on, instantaneous interactions occur across widely distributed sites. In order to effectively interact across the Access Grid, users are best served by Access Grid Nodes (AGNs) conforming to a minimum set of standards to provide the seamless semi-immersive environment. Similar to other semi-immersive and fully immersive systems, the success of the Access Grid is contingent upon the degree to which these standards are achieved or exceeded. In the past AG Nodes have had to conform to a specific hardware configuration. This was to build a system that can be deployed widely enough to investigate the open research questions in group-to-group collaboration. Now that the AG is established, it is important to enable the investigation of alternative AG Node configurations. This document specifies the minimum functionality required for a space to be considered an Access Grid Node.

The Access Grid provides a group-to-group collaboration environment with unique features including resources provided via a spatial metaphor and the virtual collaboration spaces are persistent. The architecture is open, extensible, scalable, and leverages established standards. The Access Grid is made up into three major parts, Virtual Venues Services, Access Grid Nodes, and Access Grid Network Services. The Venues Services provide navigation, discovery and security for resources. Access Grid Nodes are spaces that are designed to provide comfortable, high fidelity, natural interactions with Access Grid resources. Access Grid Network Services provide capabilities such as venue recording, stream processing, and bridging between the

Access Grid and other collaboration systems. Applications can use this infrastructure to provide groups with the ability to share data, computing resources, and applications among widely distributed participants.

The target use of the Access Grid involves 6-8 nodes that have 3-10 participants per node. The intent of the Access Grid is to enable groups of collaborators to increase productivity by reducing the work involved in finding expert resources, people, publications, source code, data and computing resources. The Access Grid is also used for classroom lectures, training, invited talks, and collaborative activities such as strategy and management meetings.

Inevitably, collaborations involve participants that are not co-located with other participants. These users need to be able to interact with the Access Grid as fully as their technology permits them. Users that do not have a space that meets the minimum requirements, but need to participate in AG based collaborations can do so at a reduced level of functionality. Participants without nodes connect to the AG venues through AG network services. AG network services resolve the mismatch in capabilities between the participants' environment and the rest of the AG. AG network services that might be utilized to bring participants into the collaboration include transcoding, subsampling and mixing services. The same AG network services that allow users with reduced capabilities, also provide the same services for users with extra capabilities.

AG Node Minimum Requirements

Major characteristics of the AGN include the size and layout of the space, software environment, video capabilities, audio capabilities, display capabilities, and network capabilities. Each of these components contributes to the collective success of the AGN at providing the seamless experience groups expect when using the Access Grid.

- Environment
 - Have space for a minimum of 3 people to participate
- Software
 - Virtual Venues Client Software 1.0 or later
 - Venues Text Chat Client Software: TkMOO 0.3.32
 - NLANR Multicast Beacon Software[2]
- Video
 - Receive, Decode, and Present at least 18 QCIF (177x144) and 6, CIF (352x288) H.261[3] Video Streams via RTP[4]
 - Capture, Encode, and Transmit at least 4 CIF (352x288) H.261[3] Video Streams via RTP[4]
- Audio
 - Receive, Decode, Process and Present at least 6 16 bit 16KHz Audio Streams via RTP[4]
 - Capture, Process, Encode and Transmit at least 1 16 bit 16 KHz Audio Stream via RTP[4]
 - Audio should be Hands Free, Echo Cancelled, and Full Duplex[5]
 - Analog Phone line
- Display
 - 3072x768 shared display space
 - The design and layout of the seating should allow users to sit at a distance between 2 and 8 times the screen height
- Network
 - 100Mbps Local Network Connection
 - 10Mbps Wide Area Network Connection
 - Multicast Capable (MSDP/PIM-SM/MBGP) Network Connection

Metrics for Success

In order to determine if a space is an AGN, it has to be determined if the space adequately fulfills the minimum requirements. In order to do that performance standards for each component must be established, such that measurements can be taken and compared over time, among different sites. Each of the parts of the AGN have different standards by which to measure, this section tries to establish acceptable ranges for each measurement for each component of the space.

Some aspects of AGNs performance are difficult to measure. For these characteristics heuristics may be used to provide a measurement that is relative to the known possible best measurements. For example, multicast connectivity might be measured on the basis of the fraction of the time bi-directional connectivity is available to a core set of known-working sites; display interactivity might be measured by a combination of processor load and window event frequency. For some measurable aspects of the AGN we provide the table below outlining the reasonable standards to be considered an AGN.

The latency and jitter described here are end-to-end for one-way *local-network* measurements. That means it indicates an acceptable level of performance for capture, encoding, network transmission and reception, decoding and presentation between devices directly connected on a local network, in one direction. These are all impacted by the choice of hardware, such as CPUs, memory, capture and display hardware. The impact of WAN latency is not included, since that is a function of the underlying network paths involved, and on inter-continental scale can overwhelm the encode/decode latency.

Latency impacts the interaction between sites. Longer latencies introduce greater formality in conversations, as each site has to wait to avoid talking over another. While larger latencies are acceptable for broadcast or lecture models, it becomes uncomfortable for, e.g. workshops.

Stream Type	Maximum Latency	Maximum Jitter	Minimum Bandwidth	Maximum Loss	Multicast
Text	100 ms	N/A	64Kb/s	0%	No
Audio[6, 7]	400 ms	60ms	64Kb/s	5%	Yes
Video[8]	400 ms	30ms	256Kb/s x 4 = 1Mb/s	25%	Yes

Table 1: Acceptable performance requirements for media streams on the Access Grid.

Operational Best Practices

In addition to the minimum requirements for a space to be considered an AGN, the following practices are encouraged. Adherence to these practices is not required, but strongly encouraged as it significantly improves the quality of AG interactions.

- Environmental Improvements
 - Create a comfortable environment for users to use for long periods of time
 - Reduce ambient noise to a minimum
 - Full spectrum, diffuse lighting, not directly above participants
 - Position node operator's where they can easily see the display

- Place the node operator's microphone in a way that reduces the transmission of key strokes and whispering
- Video
 - Position Cameras so that they provide
 - A view of the shared display
 - A view of audience space
 - Two views for close-ups
 - Place cameras to simulate eye contact[9]
 - Use a neutral color of medium brightness on backgrounds[9]
- Audio
 - Place microphones so that participants can be heard without leaving their chair, bending fwd, or raising their voice
- Display
 - Merge multiple display panes into a single seamless display, abut the edges and align the tops and bottoms of adjacent projectors
 - Create the largest possible display, possibly using creative projector mounting and short-throw lenses for the projectors[9]

Conclusion

The goal of the Access Grid, to provide seamless, interactive group collaborations among groups that are not co-located is dependent upon the degree to which AGN's can capture the local environment and share it with other AGN's. Good networks, multiple views, solid, clear, hands-free, full-duplex audio, large shared displays, and standards compliant software are required to achieve this goal. During construction of the initial AG prototype it was important to have a single AGN configuration; so that AG researchers could help new users adopt the technology. Now that the Access Grid is widely adopted and research into AG technology is being pursued by many institutions, it is important that standards be established to enable many groups to investigate AGN configurations specific to different situations, communities, and environments. This document specifies the requirements, metrics,, and minimum performance that enable a space to become an Access Grid Node.

References

1. Childers, L., et al. *Access Grid: Immersive Group-to-Group Collaborative Visualization*. in *Immersive Projection Technology*. 2000. Ames, Iowa.
2. *Multicast Beacon*. 2000, National Laboratory for Applied Network Research.
3. *Video codec for audiovisual services at px64kb/s ITU-T (International Telecommunications Union - Telecommunication Standardisation Sector) Recommendation H.261*. 1993.
4. Schuzrinne, H., et al., *RFC 1889: RTP: A Transport Protocol for Real-Time Applications*. 1996.

5. Dourish, P., et al., *Your Place or Mine? Learning from Long-Term Use of Audio-Video Communications*. Journal of Computer Supported Cooperative Work, 1996. 5(1): p. 33-62.
6. Frey, A., *How We Tested H.323-Based Video Conferencing*, in *Network Computing*. 1997, TechWeb, Business Technology Network.
7. Ferrari, D., *Client Requirements for Real-Time Communications Services; RFC-1193*. 1990, Network Information Center, SRI International.
8. Lee, S. and L. Wu. *Variable Rate Video Transport in Broadband Transport Networks*. in *SPIE Conference on Visual Communications and Image Processing*. 1988: SPIE.
9. Patrick, E., *Re: AG Node Room*, ag-tech@mcs.anl.gov. 2001.
10. Olson, R., *Access Grid Hardware Specification*. 2001: Access Grid Documentation Project (<http://www.accessgrid.org/agdp>).
11. *InSORS Access Grid Hardware Specification*. 2001.

Appendices

These appendices provide examples Access Grid Node configurations that have met or exceeded the minimum requirements for a space to be considered an AGN. Once a proposed configuration has been verified to meet the minimum requirements, please send the configuration to ag-mcs@mcs.anl.gov and it will be incorporated into these Appendices.

Appendix A: ANL Research Access Grid Node[10]

Qty.	Description
1	PC – Display: Dual 1.0GHz PIII, 512M Memory, 100Mbit, with Windows 2000/Office 2000
2	Dual Headed Matrox Graphics Cards
1	17" SXGA Flat Panel Monitor
1	Keyboard
1	Mouse
1	PC - Video: Dual 1GHz, 256M, 100Mbit, with Redhat Linux
4	Hauppauge Win/TV Cards
1	PC - Audio: 1GHz, 256M, 100Mbit, with Redhat Linux
1	Ensoniq AudioPCI
1	PC - Control: 1GHz, 256M, 100Mbit, with Redhat Linux
1	Intel 460T - 16 Port Switch
1	Intel 460T - 1000Base-T Gigabit
3	XGA Native Projectors
3	Canon VC-C4
1	Canon VC-C4R
4	Radio Labs S-VHS Video Amplifier + Power (Model FP-SVDA4 & PS-24A)
2	Genelec 1029A Speakers
1	Gentner XAP-800
1	Gentner XAP-TH2
4	Shure Condenser Boundary Microphone
4	Shure Ceiling Mounted Microphones (w/ Omnidirectional Elements)
1	Radio Labs Bi-directional IHF Interface (Model RU-LA2D)
1	Furman Power Conditioner (PL-PLUS)
1	4x1 KVM Switch
4	KVM to Host Cables
4	100B-T Cat 5 UTP 2'
3	VGA Cables
4	S-VHS Cables
4	XLR Mic Extension
4	XLR Mic Extension
1	Serial Cable for Gentner Control
1	Gentner to MM100 Audio Cable
1	MM100 to PC Audio Cable
1	PC to MM100 Audio Cable
1	MM100 to Gentner Audio Cable
8	Mic to Gentner Audio Cables
2	Gentner to Speaker Audio Cables

Appendix B: InSORS 2 Box Node Configuration[11]

1	Staged Rack	Which includes:
	1	Rack – Net Shelter or Armoire to better fit with room décor
	1	Rack mounted power panel with surge protection
	1	Belkin KVM switch and associated cables
	1	Impedance Matcher
	1	Impedance Rack Mount Kit
	1	Ensoniq PCI Sound Card
	1	Video XLR Plate and associated
	1	Microphone XLR Plate and associated cables
	1	Dell PowerEdge 1400 with RedHat Linux
	1	QuadHead Matrox Graphic Cards
	1	Dell Precision 530 with Windows2000
	4	Hauppauge Video Capture Cards
	1	Keyboard
	1	Mouse
	1	Gentner XAP800 and associated cables
	1	Gentner XAP800-TH1 and associated cables
4	Tabletop Microphones Crown PCC-160	
1	Wireless Microphone	
1	Stalk Microphone	
6	Extended microphone cables	
2	Genelec Speakers	
2	Extended speaker cables	
3	Canon VC-C4 S-Video PTZ cameras	
1	Canon VC-C4R S-Video PTZ camera	
4	50ft S-Video Cables	
3	Toshiba TLP-X10 Projectors	
3	Extended projector cables	
3	Projector ceiling mounts	

Note: This configuration requires the use of inSORS client software on both computers as well as use of the inSORS venue using either Netscape or Internet Explorer.

Optional Equipment:

Gentner AP400 can be substituted for the XAP800/TH1 with a reduction in microphones to a maximum of 4 total.

A 15" (or higher) monitor can be added for separate operator console (otherwise entire desktop projected to wall).