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Access Grid Node Minimum Requirements

by

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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 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 using 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 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 met or exceeded. In the past, AG nodes have had to conform to a specific hardware configuration. The objective was to build a system that could be deployed widely enough to investigate 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 in which the resources are provided via a spatial metaphor and virtual collaboration spaces are persistent. The architecture is open, extensible, and scalable and leverages established standards. The Access Grid comprises 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 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 enable groups to share data, computing resources, and applications among widely distributed participants.

The target use of the Access Grid involves six to eight nodes that have three to ten 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 used to bring participants (with reduced or full capabilities) into the collaboration include transcoding, subsampling, and mixing services.

AG Node Minimum Requirements

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

- Environment
  - 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 16 KHz audio streams via RTP [4]
  - Capture, process, encode, and transmit at least 1 16-bit 16 KHz audio stream via RTP [4]
  - Hands free, echo canceled, and full duplex [5]
  - Analog phone line
- Display
  - 3072x768 shared display space
  - Seating of users at a distance between 2 and 8 times the screen height
- Network
  - 100 Mbps local network connection
  - 10 Mbps wide area network connection
  - Multicast-capable (MSDP/PIM-SM/MBGP) network connection

Metrics for Success

In this section we establish acceptable ranges for each component of the Access Grid space.

Some aspects of performance are difficult to measure. For these, heuristics may be used to provide a measurement that is relative to the known best measurement. For example, multicast connectivity might be measured on the basis of the fraction of the time that bi-directional connectivity is available to a core set of working sites; display interactivity might be measured by a combination of processor load and window event frequency.

For measurable aspects of the Access Grid nodes, we provide an outline in Table 1 of the reasonable standards for latency, jitter, bandwidth, loss, and multicast.

The latency and jitter described here are end-to-end for one-way *local-network* measurements. Specifically, we indicate 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 affected by the choice of hardware, such as CPU, 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 an intercontinental scale can overwhelm the encode/decode latency.

Latency affects 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 workshops and the like.

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

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

Operational Best Practices

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

- Environmental Improvements
    - Create a comfortable environment for users to use for long periods of time
    - Minimize ambient noise
    - Provide full-spectrum, diffuse lighting, not directly above participants
    - Position node operators 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 forward, 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, depends on the degree to which AG nodes can capture the local environment and share it with other nodes. 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 node 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 AG 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.

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Appendixes

These appendixes provide examples of Access Grid node configurations that have met or exceeded the minimum requirements. 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 appendixes.

Appendix A: ANL Research Access Grid Node

See [10].

Qty.	*Description*
1	PC – Display: Dual 1.0 GHz PIII, 512 M Memory, 100 Mbit, 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 1 GHz, 256 M, 100 Mbit, with Redhat Linux
4	Hauppauge Win/TV Cards
1	PC - Audio: 1 GHz, 256 M, 100 Mbit, with Redhat Linux
1	Ensoniq AudioPCI
1	PC - Control: 1 GHz, 256 M, 100 Mbit, with Redhat Linux
1	Intel 460T - 16 Port Switch
1	Intel 460T – 1000 Base-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

See [11].

1	**Staged Rack**		**Including:**
		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	Hauppage 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	50 ft 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).