AccessGrid Node at Faculty of Informatics

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Grid environment is traditionally understood as environment for large-scale distributed computing environment for demanding scientific applications. More recently the grid community has realized that this environment can be used for many other interesting applications namely for more general resource sharing (storage capacity, remote control of scientific instruments) and virtual collaboration. AccessGrid (AG) technology [1] created at Aragornne National Laboratory (ANL) defines set of standards both on hardware and software levels to create environment for virtual collaboration of distributed grid communities counting many participants. Virtual collaboration must not be limited to traditional means of communication like voice and video but it must allow for sharing workplace, presentation and application sharing, collaboration over shared documents etc. and it should feature easy extensibility.

Since Supercomputer Center at Masaryk University is leading group in grid computing in Czech Republic we had decided to create first AccessGrid node at Faculty of Informatics, Masaryk University to allow efficient communication with partners throughout the world. AG node became integral part of newly built Laboratory of Advanced Networking Technologies (ANTLab) [2] at the Faculty of Informatics, MU.

Suggested AccessGrid Architecture

AG architecture comprises of servers at ANL running server side software like Virtual Venues for virtual space segmentation and nodes distributed around the world (at the time of writing number of nodes totals to 172). One node is usually designed for 3 to 20 participants but there is also version for just one person called Personal Interface to Grid (PIG) [3]. AG architecture aims for communication by the most natural way possible. Schema of AG node is illustrated in Fig. 1.

AG node requires at least Fast Ethernet in LAN and 100 Mbps connectivity to global Internet. Network should support multicast but because of known issues with multicast deployment in LAN and especially in WAN as reliable service there are several tools to overcome these problems: vtc tool for bridging entirely based on unicast that uses UDP packet reflector running at ANL (this reflector is similar to the one described in [4]) and QuickBridge tool for bridging networks that support multicast locally but that don't feature global multicast connectivity. For multicast problem debugging Multicast Beacon tool is being used.

Conference hardware consists of following items:

- *display computer* – the computer should be dual-processor machine capable of being connected to several projectors and decode at least 18× QCIF (177×144 pixels) streams or 6× CIF (352×288 pixels) streams; computer should run MS Windows 2000, AG software suite for display computer and MS PowerPoint
- *projection equipment* – AG node should have at least three projection screens to have enough space for presentation and number of video windows by other participants
- *video capture computer* – again this computer should be dual processor one capable of capturing and encoding four concurrent video streams and it should run AG modified distribution of RedHat Linux

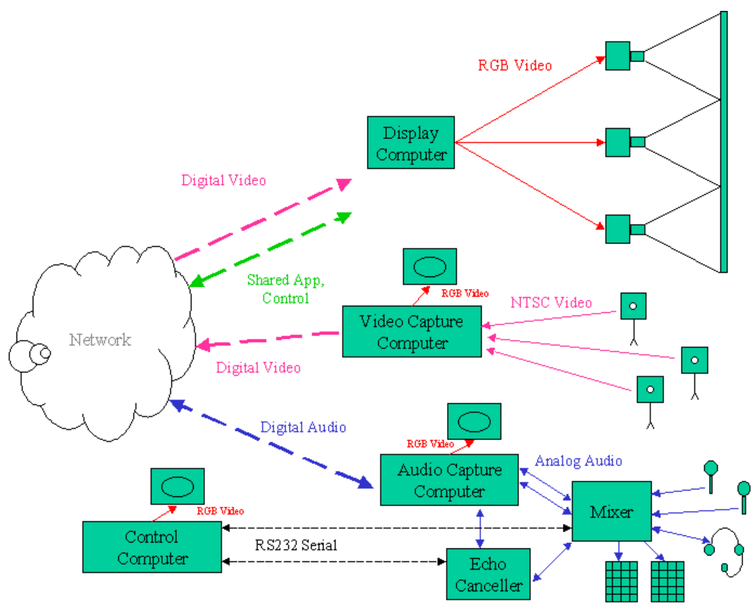

Fig. 1. Standard AG node architecture

- *cameras* – tracking cameras like SONY EVI D–30 are suggested as standard equipment
- *audio capture computer* – one processor machine is sufficient; it should be capable of capturing and encoding one 16-bit 16 kHz stream and decoding at least six 16-bit 16 kHz streams
- *audio equipment* – some *echo-cancellation device* like Gentner AP400 is strictly required; microphone types depend largely on acoustic characteristics of each room
- *control computer* – should be connected to Gentner echo-cancellation device via RS232 interface and it should run MS Windows 98 due to past Gentner AP-Ware compatibility problems

For software part AG node uses standard MBone Tools with some application slightly modified for better handling of large-scale videoconferencing. The most important of these are rat for audio transmission, vic for video transmission. It uses VNC for application sharing. There are several application developed for AG project: dppt (Distributed PowerPoint) is application running on top of MS PowerPoint allowing synchronized slide shows for all participants and MUD chatting software.

Local implementation

Because the AG node is integral part of the ANTLab from the very beginning AG considerations could be taken into account during room design phase (for schema of the node see Fig. 2). Acoustic requirements resulted in special acoustic panelling on the ceiling that eliminates most of echo and slow sound decay problems in the room and speaker system built into the ceiling. Even with current advanced echo-cancellation devices it is very important to create room with good acoustic properties to achieve high quality audio stream going out of that room. We are using both ceiling mounted and table-top flat microphones with omnidirectional characteristics. The room is equipped with powerful air-conditioning unit that makes possible conferences of larger groups for prolonged period of time. We have also built in some floor boxes that allow participants to connect their portable devices to power supply and wired network if needed. Moreover whole space is covered by 802.11b wireless network.

ANTLab features several projection screens for both production and experimental work so we decided to implement remote-controlled RGB and audio switching matrix that allows to switch among several videoconferencing modes including AG conference on software level without any touching any cabling. In addition to standard three screen 2D projection our AG node features two projector 3D projection based on using polarizing filters and glasses.

Computing power of state-of-art computers is a lot bigger compared to what was available when AG architecture was being defined so we were able to merge video capture computer and audio capture computer into single dual-processor machine. The machine is running FreeBSD 5.0-RELEASE because of more preemptive behavior of FreeBSD compared to Linux when machine is subjected to heavy load. We are also experimenting with OpenMASH version of vic software as a replacement for standard vic because of higher image quality that is achievable with this tool (OpenMASH vic is capable of producing streams up to 10 Mbps whereas standard vic is limited to 3 Mbps; but even standard vic is capable of decoding 10 Mbps stream so backward compatibility is retained). Since Gentner AP-Ware is now fully compatible with MS Windows 2000 there is no need for having control computer a separate machine and we are running Gentner software on display computer without any problem.

In addition to tracking camera as suggested by standard AG architecture we are using high-quality DV cameras CANON XM-2 to achieve high image quality. These cameras lack tracking capabilities therefore we are experimenting with PosiTrack tripod head that can be used with fixed camera to add tracking capabilities. Since we can connect DV cameras using IR control from software it is possible to use e.g. remote-controlled zooming, focusing, and white balancing as well.

Stable international multicast connectivity with reliable visibility of all groups needed is still a big issue so we use vtc unicast bridge from ANL to our site. AG node has 1 Gbps uplink and 100 Mbps local network that can be easily upgraded to 1 Gbps as all end nodes are already equipped with GigE NICs.

Personal version of AG node (PIG) is available in ANTLab too. It consists of one powerful computer equipped with triple-headed Matrox Parhelia card connected three LCD screens, small camera and head-set.

Future development

Currently AG evolves from version 1 to version 2 [5] which follows development in grid middle ware namely OGSA [6] architecture based on web services with soft-state mechanism that is being implemented in Globus

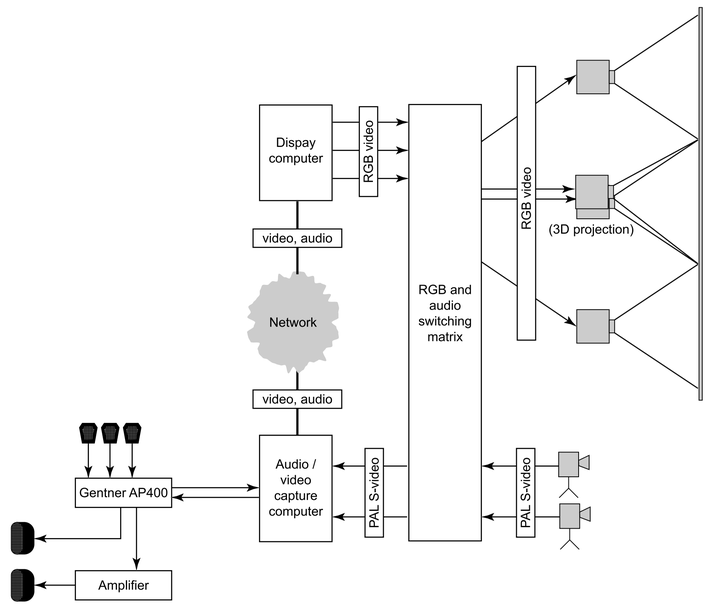

Fig. 2: Implemented AG node architecture

Toolkit 3.0 [7]. Furthermore it feature more tight integration with standard grid security based on public key infrastructure (PKI – X.509 certificates).

We want to follow this development and move to AG 2.0 as soon as it becomes stable enough to be usable in production mode. We would also like to contribute to AG by developing OGSA based web service for unified remote control of AG node (e.g. tracking cameras, Gentner).

Mobile AG Node

We are aware of the fact that it is either impossible or inefficient to build AG nodes on many places in Czech Republic because of high financial and space requirements so one ongoing project is to build rack mountable mobile version of AG node that can be transported to various sites as needed. Mobile node should be full-fledged version of AG node that follows the same architecture rules we used in fixed node in ANTLab.

Conclusions

AccessGrid technology enables grid environment to become complete platform for virtual collaboration of widely distributed big teams. That imposes serious challenges to videoconferencing environment and it is obvious that AG means big qualitative difference from current common videoconferences. Newly build AG node

Fig 3: Snapshot from running AG conference

at Masaryk University will enable grid community to participate in many international activities. Experiences from building and running AG node can be used for helping and improving several distance education projects that are being considered in Czech Republic.

References

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