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Cognitive Techniques Encouraging Productive Use of Access Grid Synchronous Multi-Media Communication Technology at Worcester Polytechnic Institute

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By

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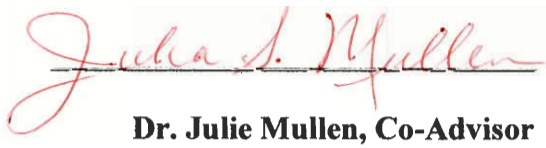

Dr. Julie Mullen, Co-Advisor

1. Access Grid
2. Human Factors

Abstract

Worcester Polytechnic Institute is commencing the use of Access Grid (AG) synchronous, multi-media communication technology. New technology predicates celerity of acceptance and adaptation as quintessential to maximizing benefits. Through on campus interviews with WPI faculty, administration and students, this project identified AG uses and meeting structures that will be employed by the WPI community. Research has be conducted pertaining to the human factors affecting each meeting type (i.e. negotiation, research collaboration) with respect to previous communication technology (i.e. videoconferencing.) This has provided a set of possible human factors for each meeting structure. Interviews with experienced AG users were used to provide the basis for a set of AG specific human factors as well as potential methods of bypassing the factors. From this information, a manual was developed that includes the human factors relevant for each meeting structure. In order to help new users become effective communicators, a list of recommendations have be developed and included. While the manual is most relevant to WPI, a version will be submitted to the AG Documentation Project.

Table of Contents

INTRODUCTION

The current volume of technological change predicates that every possible measure be taken when choosing and implementing a new technology in order to insure its success. The Access Grid (AG)is a state of the art telecommunications system that allows users at multiple locations to communicate with eachother using high bandwidth audio and video. The AG was developed at Argonne National Laboratory in order to provide a global research environment as well as to study the requirements needed to perform collaborative work in a geographically distributed environment. Inherent in AG communication technology are cognitive, behavioral and social factors that can have a significant impact on the novice user. In general, ease of initial use is critical to user satisfaction and directly correlated to repeat use of the technology. This project identifies the factors that affect ease of use, and develops a manual for the WPI community to encourage the productive use of Access Grid technology. For the purpose of this report, productivity is based on knowledge of relevant cognitive factors and the choice of the AG user to enhance the quality of the meeting by recognizing and alleviating these factors whenever possible.

As is the natural progression with any new technology, a novice user, over time, will begin to recognize cognitive factors inherent in the technology and alter their actions to alleviate the effects of the cognitive factor. Through the generation of a manual, this report seeks to shorten the length of this learning curve. This is especially important for the WPI community since its student body has recently been ranked by The Princeton Review as the sixth hardest-working student body of all colleges in the nation. This also directly applies to the administration, faculty and staff. With this in mind, any project that can enhance the productive the use of a new technology, which in and of

itself broadens the communications capability of WPI, contributes to the continued success of the WPI community.

The ultimate goal is to have the manual available on WPI's AG web site. A secondary version will be submitted to the AG documentation project. This would not only achieve the aforementioned goal of enhancing productivity of use by the WPI community, but could be used to market the Access Grid communication capability within the community.

BACKGROUND

If, as it is said to be not unlikely in the near future, the principle of sight is applied to the telephone, as well as that of sound, Earth will be in truth a paradise, and distance will lose its enchantment by being abolished altogether.

Arthur Strand, 1898 [18].

From the time of Socrates and Democritus the distinction between cognitive and behavioral knowledge and psychology has been discussed. Based on the work of Overskeid, *it seems fair to say that no fundamental difference, only different terminology, and prejudice, no doubt, stands between the unity of radical behaviourism and cognitive psychology.* [24] Therefore for the purposes of this paper, little distinction will be made in the use of these two terms. In actuality, the meaning will be the combined mechanisms by which a person acquires knowledge and information germane to the use of the Access Grid.

There are not many studies that specifically address the cognitive, behavioral, and social aspects of the Access Grid. Therefore, studies of previously considered "new" technologies will be used as bases for extrapolation of factors that may be apropos. Three categories need to be considered, namely, the type of communication media, the purpose of the communication, and the social, cognitive, behavioral, and psychological factors themselves.

Types of Communication

Although conversations and communications are either between people or for their benefit, the necessity of communication has spawned an industry. In its simplest terms, the communication or telecommunication industry is the business of conveying information. In earliest human history, conveying information was accomplished by grunts, gestures or symbols. Today, communications generally refers to systems and technologies that make communication available to large numbers of people. With current technology, that essentially means to any person on the Earth. [3]

Table 1 below lists some of the main types of communication media germane to the discussion of the Access Grid. Obviously, there are many more types of communication media such as telegraph, drum beats, etc. The list is not intended to be all-inclusive. It should also be noted that the list also contains some advances that are both appropriate to mention and imminent. Likewise, it should be noted that various combinations of these types of communication media, coupled with advances in technology, give rise to new types of communication. Table 1 essentially can also be viewed as a nutshell of the history of the communication industry.

*Face-to Face	Verbal	* Wireless Telephone	Messages
	Sign Language		Wireless internet
* Written	Letters, memos		One to one, conferences
	Postal mail		Text
	Postal packages		Pictures
*Television	Satellite	* Internet	Text
	Cable, non-cable		Images, graphics, video
	broadband		Sound, voice
	Video, DVD		Interactive television
	HDTV	* Video-conferencing	
	Interactive communication	* PACAA	(Personal, All-inclusive
* Access Grid			Communications, Any time, Any where)

Table 1 Types of Communication Media

This industry is evolving at an amazing rate. Consider that the industry had its origins in the 15th century, with the invention of the printing press, which allowed the inexpensive dissemination of information to large numbers of people, even at great distances. The latter part of the 19th century saw an explosion of new inventions: photographs (1830), the first telegraph system (1844), the telephone (1876), phonographs (1877), motion pictures (1890s), Marconi's first wireless message(1895), television (1920s), and the internet (1960s). [3] Instantaneous transmission of information was not only possible, but accepted as part of every day life.

Face-to-face Communications

Face-to-face communication deserves special attention, and should be in a category of its own. It is considered to be the most efficacious means of communication. It provides the most audio, visual, and emotional stimuli of any other form of communication. It is not only the quintessential benchmark against which all other forms of communications have been measured, but also the goal of the telecommunications industry to imitate. [14] In considering the complexity of human interactions, face-to-face communications creates and maintains the optimum environment for these numerous interactions to be assimilated and assessed. [8] One of the human factors highly correlated with face-to-face conversations is proximity. Although proximity will be discussed in more detail, it is necessary to mention it in context with face-to-face conversations because it holds the same benchmark status as face-to-face communications. Studies have shown that there is a predictable decline in collaborative efforts that corresponds directly with increasing distances between people. This remains true even when organizational goals and objectives or similar research interests are considered. [19] Since face-to-face communications seems to imply close

proximity, it is the experience of informal interactions that seems to make face-to-face communications successful where other forms of communications are not as effective. This, however, does not preclude that other forms or types of communications will not be successful if used in the right circumstances. [10]

Table 2 shows the most common human factors that are considered in telecommunication research studies. As previously mentioned, most telecommunications studies compare some combination of these human factors in one particular type of communication media to face-to-face communications. The assumption that is generally accepted as self evident is that face-to-face communications is not only most efficacious but most natural. In most studies, this postulate is taken as intuitively true, without question or discussion.

* Proximity and perception of proximity
* Degree of eye to eye contact
* Quality of communication content and delivery
* Quality of feedback to communicator
* Visibility of non-verbal cues
* Number of participants
* Gender of participants
* Social or organizational status of participants
* Amount of interactively
* Degree of anonymity
* Time constraints
* Assessment of truthfulness and honesty
* Expectations of communications
* Reward system for cooperation in collaborative efforts
* Time delay between communications
* Familiarity of participants
* Commonality of language, meaning, and background
* Meeting dynamics in general
* Familarity with use of new communication technology

Table 2. Human Factors Related to Communications

The factors listed in Table 2 are a synopsis of recurring topics in published literature.

If the Access Grid is to be judged as previously new telecommunications technology have been, future researchers will conduct numerous studies using some combination of the human factors listed in Table 2. The ultimate measure of goodness will be, as in the past, how close the Access Grid approximates face-to-face communications. This seems to beg the question as to whether telecommunication technology can ever fully imitate face-to-face conversations. Dr. Edward M. Hallowell, of Harvard University Medical School, would seem to say no.

For over twenty years, Dr. Hallowell has been a psychiatrist, conducted research, and collected anecdotal evidence to suggest that there is something more to face-to-face communications than the human factors usually considered in Table 2. His research will be discussed here, rather than with the human factors in Table 2, because of its unique significance. His studies have found that people *need to experience what I call the human moment: an authentic psychological encounter that can happen only when two people share the same physical space.* Concurrent and corequisite with actual physical proximity are emotional and intellectual attention. This is significant because any deficit of the human moment can damage a person's emotional health. *I have given the human moment a name because I believe that it has started to disappear from modern life -- and I sense that we all maybe about to discover the destructive power of its absence.* [13]

Dr. Hallowell's research suggests that brain function, which is governed by brain chemistry, is altered either positively or negatively by the amount of person-to-person contact an individual maintains. The brain controls the release of the stress hormones epinephrine, norepinephrine, and cortisol. The greater the positive face-to-face contact a person has, the lower the levels of these hormones in the blood stream. Other hormones that promote trust and bonding, namely, oxytocin

and vasopressin, also increase with face-to-face meetings where a person has a greater chance of feeling empathy for another person. Dr. Hallowell hypothesizes that personal contact also stimulates critical neurotransmitters, namely, dopamine, which enhances attention and pleasure, and serotonin, which reduces fear and worry. Dr. Hallowell cautions that *the human moment is neglected at the brain's peril.* [13]

Dr. Hallowell's caution is not frivolous. His work shows that as the human moment diminishes, the psychology of the mind replaces it with what he calls *toxic worry.* Manifestations of toxic worry can run the gamut of distrusting organizations and people, questioning personal beliefs, motives, performance, and self-worth, to paranoia and aggression. At the very least, it can allow little misunderstandings to fester into major confrontations. In the electronic communications environment, the non-verbal cues that mitigate worry, such as body language, tone of voice, intonation, and facial expressions, to name a few, are sometimes masked or missing all together. This can have a devastating affect on intelligent and sophisticated people who are accustomed to incorporating subtle language, irony, and wit into their communication style. Toxic worry becomes a debilitating and immobilizing anxiety that can lead to indecision and have destructive consequences. [13]

Dr. Hallowell's work unequivocally corroborates the studies of Rocco (1998), which conclude that some face-to-face contact is essential to restoring the trust that predictably breaks down in electronic communication environments. [26] Consider the amplifying affect that ordinary daily life situations present in diminishing the human moment. ATMs, electronic banking, automated menu driven telephone answering systems, automated reservation systems, distance learning, and

many other technological systems continually deplete individualistic needs for authentic human contact.

Significant attention has been given to face-to-face communication, the relevance of proximity, and a unique study identifying a critical human need in an electronic communications environment. Taken together, they represent the quintessential conundrum for modern society. Barring some cataclysmic event like the polarity of the Earth's electromagnetic poles changing, rapid technological evolution guarantees that society will, of necessity, adapt accordingly. This conundrum represents the most critical factor in implementing any new electronic communication technology.

Linear to Dynamic Communications - the Quantum Leap

Once the first giant step was made away from face-to-face communications, there was no turning back. Telecommunications growth has truly been exponential. Although Table 1 shows many types of communications media, it also shows a rise in the degree of technological complexity required. Prior to further discussion of Table 1, two points should be made.

The first is that as one proceeds downward from face-to-face communication, which itself is a sophisticated multimodal system, one can see an evolution from single use modes of communication to almost unbounded multi-media possibilities. There is also a corresponding transition from a more simple to a more complex level of technical sophistication required. The objective of the telecommunications industry, however, is to make the mode of communication

technically transparent. [25] This transition has transformed electronic communications from a linear to a dynamic environment.

The second point is that sometimes this new dynamic environment can seem out of control or even chaotic. By definition, however, a chaotic system is one in which the behavior of its components cannot be predicted. At times its components may seem orderly, however, they are really out of control. Chaos is typified by pure randomness. A complex system, on the other hand, is one whose components are not easily controllable and in a constant state of transition. For short periods of time, the components may show a degree of order or adaptation, but subsequently transition to a new level. Although complex systems may contain some semblance of randomness and order, they are more closely associated with pure order. [12] This distinction is necessary when discussing the current state of the telecommunications industry. The natural human perception of the industry is one of chaos. The seemingly inability to keep pace with changing technology is at the root of this perception. The industry itself, however, is fairly predictable and therefore, a highly complex system. A typical example is the predictability of AOL's future movement into the cutting-edge interactive television market as a natural extension of its current communications technology. [4] Another example is the inevitable movement toward PACAA (Personal, All-inclusive Communications, Any time, Any where).

Video Conferencing

Videoconferences are designed to provide both audio and video communication capability to a society that is becoming increasingly mobile, and in which the necessity of collaborative efforts at a distance continues to grow. The most common usage of the term "video conferencing" is in conjunction with single-purpose meeting rooms specially equipped with cameras, monitors, and computer software and middle ware that make the videoconferencing possible. Essentially, these sites provide the capability for a group of people at one location to hold a meeting with a group of people at a distant location with similar communications technology. With advances in digital cameras connected to PCs, the term can also be applied to people who hold video meetings over the internet. In its simplest configuration, videoconference attendees will only see the faces of attendees at a remote location, in addition to a feedback view of what the attendees at the remote location are seeing. Documents, drawings, pictures, etc. can also be viewed simultaneously. [19]

Studies indicate that video degradation, which is dependent on bandwidth availability, is a significant problem. Perceptible lag times in reception, echoing, and single-direction audio systems are noticeably different from face-to-face communications. These impediments cause distractions, which detract from the quality of the meeting. [21] Another study indicated that some video conferencing systems created artificial functional restrictions on conversational patterns that were usually associated with audio only communications. There was rigid turn-taking in the conversations with very little conversational overlap. Conversational abnormalities were normalized when the camera showed the face and shoulders of the participants since this provided a slightly better perception of non-verbal cues. Additionally, in some systems, eye-to-eye contact was precluded by the camera showing the participants line of sight either above or below the line of sight of other participants. [19, 23] Disassociation from the meeting becomes a critical issue

because of the lecture style of interaction. This is exacerbated by seemingly artificial turn-taking in the conversations by use of directed questions. [22]

Some systems use a monitor, which is divided into multiple quadrants. Several of the quadrants show participants at remote locations, while the fourth is the feedback image of oneself. This type of system makes it difficult to assess when a remote participant shifts their focus. Sellen tried an experiment in which he used multiple monitors and cameras to provide separate images. The only improvement observed was more overlapping conversations. The participants in his study preferred face-to-face communications. [19, 27]

The Access Grid

A little over one hundred years ago, Strand [18] foresaw the direction that the telecommunications industry would take, and its implicit mission to abolish the perception of distance. Unfortunately for some people, the paradise he foresaw has been perceived as a technological nightmare fraught with cognitive and social dysfunction. In 1998 Rick Stevens called a meeting to discuss the combination of advanced technologies that would be required to allow people at remote locations to communicate their thoughts, ideas, music, literature, designs, and the gamut of academic and business activities through an "invisible" medium that resolved the distractions of older technologies.

From that meeting, the Access Grid was conceived and developed by researchers in the Math and Computer Science Division of Argonne National Laboratory with assistance from the Department of Energy and the National Science Foundation. Rick Stevens, Director of the Math and Computer Science Division at ANL, and leader of the original research team that developed Access Grid technology, once said, *the goal of the Access Grid is to create a network of persistent "active spaces" that will enhance scientific creativity and productivity. As it evolves, it will enable the creation of truly compelling collaborative environments.*[25]

"Active spaces" enable large-scale scientific and technical collaboration among several groups simultaneously. With microphones, speakers, and several computers for audio, video, control and display, Access Grid technology is a generation ahead of video conferencing. The Access Grid uses multicast technology on an Internet2 backbone. This increases the available bandwidth, and subsequently the quality of the audio and visual display. The technology can be compared to a visual chat room that enables a large number of people to interact and exchange ideas with each other through video, voice, text and graphics. [1]

Within this technology, a node is defined to be the hardware and software required for a remote site to connect to the grid. Each node has a large-format multimedia display, presentation and interaction software, interfaces to the grid middleware, and interfaces to remote visualization environments. [1]

The audience area of a node is designed to allow up to twenty people per site to interact with those at other sites. Most sites are maintained by node operators. They serve as technicians that make

behind the scenes adjustments to the audio, visual and displays. The operators correct any preventable technical glitches in order that the audience members can use the technology without focusing on the technology.

The Access Grid offers many advantages in comparison to other types of multimodal communication technology such as video conferencing, Poly Cam H323 and Net Meeting. Poly Cam and Net Meeting are similar in concept to the Access Grid. All forms seek to provide enhanced internet based video communications technology. They differ in that they are desktop-based unicast systems set to accommodate two to four people. They do not provide data encryption or access control. Access Grid is much larger in scale and aims to provide a media for group to group collaboration. With this in mind, data encryption, access control and common data updateability are key features.

Poly Cam and Net Meeting are significantly less expensive to implement than the Access Grid. While videoconferencing is also less expensive to implement than the Access Grid, its operation cost at this point is much higher. At most a videoconference can accommodate 10 people at $350 per hour. [2]

Although the cost may be high in comparison to other telecommunication software, AG can substantially reduce travel. The high bandwidth available allows research collaborators to share complex data and images without having to meet. The information can be in a format that both parties can simultaneously manipulate the data. This allows for remote group interaction, or collaboration of groups permanently separated by distance. Access Grid also offers support for

node users pertaining to how to organize and run an Access Grid event. A tutorial is in place that details the roles and responsibilities of the event organizational committee. [2]

Currently, Access Grid technology has been implemented in over 11 countries, 75 universities, 18 government laboratories and 7 different companies. Its main use to date has been for informal meetings and workshops. It is expanding into the academic and social sector. Classes are offered and social events are held on the Access Grid. Students on college campuses hold access grid events that range from distributed rap sessions to thesis defense. Social scientists see the grid as a means to study issues related to collaborative work. One can glean that the potential uses of this burgeoning technology are boundless.[25]

Access Grid technology is essentially in its infancy. New nodes are being created, as existing nodes put their efforts into expanding the areas of use. Grid operators are continually researching the ever increasing technological advances that may be commensurate with improving the grid. There are currently few studies that specifically address the cognitive, behavioral and social ramifications of the Access Grid.

Purpose of Communication

A discussion of the human factors associated with the implementation of a new communication technology would be remiss if it did not consider the purposes for which the communication was needed. Table 3 is a partial, but broad spectrum list for which communications technology is used. This list was developed from a review of studies of previous technologies. The items were mentioned in references [6, 8, 10, 11, 14, 22, 26, 29]. These references were identified in the

literature search. Many other purposes could be added to the list, however, in terms of their nature, they would likely be either redundant, similar in characteristic, or an amalgam of items already on the list. For example, a meeting to discuss an employee's performance review would likely be a combination of social, friendly, information exchange, discussion, feedback, decision making, consensus, collaborative work, and negotiation. [15]

* Non-task oriented
  - Social, friendly
  - Information exchange

* Task oriented
  - Artistic
  - Performance - Music, dance, theater
  - Exhibitions
  - Collaborative work

* Academic
  - Meetings
  - Instructional, tutorial
  - Collaborative work

* General and Business Meetings
  - Information exchange and dissemination
  - Discussion
  - Feedback
  - Decision making
  - Consensus
  - Innovation and creative brainstorming
  - Strategic and operational planning
  - Problem solving
  - Trouble shooting
  - Crisis management
  - Collaborative work
  - Negotiation

Table 3. Use of Communication Technology

Some initial comments about Table 3 would be apropos. It is important to note that almost all forms of task-oriented communications involve some degree of collaborative work. This is

significant because the communication technology must be able to provide an environment that enables the human factors of communication to be conducive to that type of effort. As was previously mentioned, there is a predictable decline in collaborative efforts that corresponds directly with increasing distances between people. This remains true even when organizational goals and objectives or similar research interests are considered. [19]

As one scans Table 3 from top to bottom, irrespective of technology, there is a general trend toward increasing interpersonal skills required for successful communication in the respective areas. This suggests that there is a similar general trend regarding the increased importance of the role that human factors play in the success of the communication that the technology must accommodate.

As an example, consider a contentious interactive negotiation via electronic mediated communications. This scenario is probably the most difficult test of a communication technology's capability. An interactive negotiation can begin with either extreme cordiality or a "game face" attitude. This is normally followed by either subtle or overt posturing, sometimes running the gamut of disarming friendliness, implying false initial conditions, to direct intimidation. Although posturing usually continues throughout the negotiation, there comes a point where gambits are used to obtain information about the opponent's demands and especially about the strength of their conviction about the demands, and any hidden agendas or potential bargaining traps. In some negotiations both parties present initial positions or demands to facilitate initial discussions. Nevertheless, the aforementioned probing and testing phase is continuously used. How far apart the parties are from an agreement, and the criticalness of the outcome, will

determine the mood and direction of subsequent discussions. Throughout the negotiation process, in a guarded and calculated manner, written, verbal and non-verbal information is exchanged and assessed. Carefully crafted discussions include all the dynamics of problem solving, trouble shooting, crisis management, brainstorming, decision making and hopefully achieving consensus. This takes place in a sometimes highly-charged environment where there is a high level of uncertainty and stress.

From a negotiator's point of view, the communication technology must be absolutely transparent and provide the same level of direct and indirect information about an opponent as real time face-to-face communication does. Sometimes an instantaneous flinch or an almost imperceptible widening or closing of an opponent's pupil can provide valuable non-verbal information. Sometimes the chief negotiator may be very stoic and in control of his or her emotions, but another member of the opposing negotiating team may inadvertently give away a deviating non-verbal signal. The communication technology must be able to convey this information.

One might contend that this measure of the communication technology's ability is too rigid since both negotiating teams are using the same technology and are therefore at the same advantage or disadvantage. This is not true because essentially a successful negotiation depends on the skill of the negotiator and not the technology employed. The communication technology's playing field is only level when it permits each negotiator to optimize the use of all their negotiating skills.

In an extreme case, one may also contend that the time delay between communications and the lack of video communication actually prevented a catastrophic result, as in the case of the Cuban

missile crisis. One may argue that the lack of video information increased the level of uncertainty on both sides and therefore increased the probability that each decision would be truly a zero-sum decision. Further one may argue that the time delay between communications, on one hand, increased uncertainty, but on the other, gave time to strategize and think more rationally than one may think in a real time interactive situation. To this, one might postulate that the choice of appropriate communication technology, depending on intended use, could be critical.

Communication is the act of the recipient.

Peter Drucker [9]

Human Factors in Communication Technology

In previous sections, the types of communication technology available, along with their potential combinations and extensions, as well as the intended uses of communications technology were presented. Within these presentations were discussions of relevant human factors. These factors can be classified as social, emotional, behavioral, cognitive and psychological. Peter Drucker's statement that *Communication is the act of the recipient,* has a second part, *Downward communications cannot work and do not work. They come after upward communications have been successfully established.* [9] The American Management Association would agree with his

position. According to the AMA, for effective communication to take place, several factors must be present. There must be a sender, who transmits a clear message. There must be a receiver, who can receive the message, and is capable of understanding the message. There must also be feedback to the sender, so that the sender knows that the message was correctly interpreted. Within the communication exchange there are many human factors that affect the quality of the communication. Table 2 lists some common human factors that can affect the quality of individual or group communications.

Considering all the items in Tables 1, 2, and 3, there are a large number of combinations of studies that could be conducted in order to thoroughly and exhaustively determine the exact relationships and correlations between all these items. (The actual number of combinations is 3.35 followed by 72 zeros.) That is why the approach that was used for determining which factors are germane to effectuating novice use of the Access Grid will consist of looking at existing studies of human factors of older technologies and combining them with the experiences of existing Access Grid users. Below, a sample of studies is provided in order to give an appreciation of how some human factors are related to the use of older technologies for various purposes of communication.

The value of proximity for communications, especially in task-oriented collaborative work has already been mentioned. However, Hollan suggests that trying to achieve the perception of proximity through imitation will always put participants at a disadvantage. He feels that imitation, regardless of how close technology can imitate proximity, will never be the same as being there. Dr. Hallowell's work would seem to corroborate this. [13, 14, 29]

Eye contact is a critical human factor with respect to any form of communication. It provides non-verbal information about attention, agreement, disagreement, concern, understanding, questioning, and even emotional state. The current speaker can move his or her eyes in the direction of another participant in order to handoff the conversation without the use of a more formal mechanism. Eye contact and movement essentially provide a perceptive feedback system. [22] The quality of the content of a communication is largely dependent on the efforts of all participants. The more the participants are aware of how the communication technology works, the more they can tailor their communication style to the medium in use. Consequently, the more effective their delivery will be. [19, 26]

Feedback can be direct, indirect, visible, verbal, non-verbal, written, or perceived. It can be immediate, or have a time delay. In any case, it is a critical component of insuring that the intended message was received, understood, and the impact it had on the receiver. [14, 15, 22, 23, 26]

Nolen discusses at least thirty non-verbal cues in his article. A few examples include nodding, posture, hand gestures and body position. He discusses them primarily with regard to face-to-face communications. With the importance he places on recognizing them and using them effectively, the implication for communication technology is that it must enable participants to see and sense as many non-verbal cues as in face-to-face conversations. [20, 22]

Number of participants poses an interesting problem because the answer is totally dependent on the purpose for which the communication was initiated. Most people feel the urge to have to say

something at a meeting, whether the meeting is in their field of expertise or not. Therefore, the general rule is that fewer qualified participants will be more productive than a greater number of less qualified participants. A possible exception to this rule is a brainstorming meeting intended to increase innovation and creativity. Here, anyone might make a significant contribution.

Young states that her study confirms that women are silenced in bureaucratic structures. The structures inhibit their communications, overtly, by not being consulted, and covertly, by not being offered the opportunity to respond. Out of necessity, they have to resort to informal communications networks. Gender, may therefore be a factor to consider. [30]

In socially and organizationally heterogeneous meetings, participants of lower status generally voluntarily participate less than if they were in homogeneous groups. The exception to this is when participants can maintain their anonymity. In these cases voluntary participation increases to virtually the same level for all participants. In this situation, all participants are more truthful and forthcoming with opinions and suggestions. Participants with higher social or organizational status, in general, do not value or have the same level of satisfaction as they have for meetings in which participants can be identified because the higher ranking individuals lose a sense of power and control. [22, 26]

With regard to communications intended for collaboration, there are several factors which are important to consider. Productivity increases if the participants either already have a high level of familiarity with eachother or can achieve a common level of familiarity very quickly. A group's common social identity also aids in the establishment of collaborators familiarity with one another.

Also in such collaborative ventures, some individuals may decide to withdraw from participating in achieving the group task. This is commonly referred to as the social dilemma. In such circumstances, the reward system has to be clearly defined so that individuals who contribute to the task know that they will be recognized for their efforts beyond the recognition given to the entire group. Similarly, productivity increases if the expectations for the task or communication are clearly defined. Placing time constraints on the group only marginally increases productivity if the group perceives that the task is do-able within the time allocated. The exception to this is a group's reaction to a crisis situation. [7, 9, 11, 26, 29]

Eye Behavior

Research has shown that eye movement can influence a person's perception of conversational timing and tone. Shifts in eye placement can suggest a hand-off in the conversation. [34] When a person is finished speaking, their gaze shifts to meet the gaze of the person with whom they are conversing. This 'hand-off' is important to the overall tone and structure of the conversation. If individuals are not aware of the conversational hand-offs it can inhibit cognitive fluency. For example, if an individual takes a pause for a conversational handoff in the absence of visual information, they will interrupt not only the verbal fluency but also the cognitive formation of thoughts of the person with whom they are conversing. In videoconferencing, the perception of eye movement is heavily rooted in the position of the camera. Some camera orientations only allow for a view from a high elevation in the room; this does not allow for the interpretation of eye movements. Based on my conversations with AG node operators, Don Morton and Jennifer Teig VonHoffman, [Appendix 2.2, 2.3] the same is true of Access Grid technology. In casual meetings,

eye contact may not be as important as it is for negotiations, research collaboration or distance learning where active, thoughtful, and timely responses are expected.

Often times, the most important benefit of a face-to-face meeting is the increased perception of trust. Trust can be instilled through eye contact. At defined distances, the variation in pupil size during an individual's response correlates to the truthfulness of the response. In order to shirk his reputation as "Tricky Dickey" former U.S. President Richard M. Nixon tried to eliminate shifty-eye behaviors and nonfluencies that helped reinforced the notion.[17] In my conversation with Jennifer Teig Von Hoffman,[Appendix 2.3] the perception of eye contact cannot be established over the Access Grid because of camera placement. In contrast to eye behavior, eye contact is especially important for general meetings and negotiations but not as important for distance learning.

Facial Expressions

In addition to eye contact, facial expressions are also very important aspects of face-to-face discussions. Facial expressions allude to the emotion underlying the verbal portion of the discussion. Smiling, raised eyebrows and blushing are each visual cues of emotion. Developmental psychologists can attest to the fact that very young children who have not yet learned to speak can gather and assess meanings from their mother's facial expressions and eye contact. Emotional cues afford conversationalists the information needed to know when their partner is uncomfortable and it is necessary to change the subject. In addition to personal comfort, facial expressions also allude to sincerity. Research has shown that meetings conducted face-to-face have a more inherent sense of closure than meetings conducted over a telecommunications media. [26]

In videoconferencing, the transmission of facial expressions is dependent upon the position of the camera. Some camera orientations only allow for a top view; this subsequently distorts facial expressions. Based on my conversations with Don Morton and Jennifer Teig VonHoffman [Appendix 2.2, 2.3], the same is true of Access Grid Technology. According to Prof. Sullivan [Appendix 2.4], this factor, though often lacking from AG meetings, is very important for negotiations and distance learning but not as important for research collaborations where the ground work for trust and a common goal is apparent.

Proximity

At face value, proximity is the sense of sharing a common space. Physically sharing a common space generates a sense of community. Common phrases like "we're all in the same boat" allude to the cognitive importance of proximity. In terms of a face-to-face meeting, the informality of a proximate community facilitates the exchange of questions, ideas, information and expounding on particular subject matter. If members do not have the sense of proximity gained from sharing a common space, the individual is more apt to be distracted and less apt to contribute to the discussion. [11]

On a higher level, one chooses a degree of proximity with which to orient themselves. This can serve as an indicator of interpersonal relationships. There are four classifications of degrees of proximity: up to 1.5 feet is intimate; 1.5 to 4 feet is personal; 4 to 12 feet is social; and more than 12 feet is public. [35] Within this framework one also chooses an orientation. For competitive tasks, people usually sit opposite each other. For cooperative tasks, people sit side-by-side.

Videoconferencing, though containing a visual input, does not allow for the manipulation of proximity. The orientation is always set in opposition to each other and subsequently always has competitive overtones. According to Morton [Appendix 2.2], each remote location is a community unto itself. Any attempt to initiate casual communication across remote locations did not succeed. It is his perspective that casual communication among remote locations does not come naturally. Generating a sense of community is especially important for distance learning and workshops and inherent in research collaboration.

Gestures

The way a person presents themselves, their style of dress and the proximity to another person that they chose during a conversation subconsciously determines personal credibility. Body placement and posture also allude to a person's social attractiveness. The more socially attractive a person is the more apt they are to persuade and lead others. Head nodding, relaxed body positions, open body positions, and forward leaning, all place the body in a socially attractive position and are among the strongest non-verbal cues. [17] For example, a change from a relaxed to a more formal posture may indicate a change in the relationship. Hand gestures used to illustrate an object or action place emphasis and informational redundancy that improve the clarity of the message. [37] A major complaint of video-mediated communication is the inability to convey the aforementioned personal characteristics, that is, a true sense of the appearance of participants.

Summary

Implementing a new communications technology is like having to sit on a stool with three legs. If any one of the legs is weak or breaks, there is a good chance you will fall. In the case of implementing a new communications technology, the first leg is the technology itself. It has to work, be almost transparent to the participants, and replicate face-to-face communications as closely as possible. The second leg is the fit between the technology and its intended use. Table 2 shows some potential uses for the Access Grid. The Access Grid has to be able to accommodate these uses or evolve to be able to do so. The third leg is totally dependent on the participant's acceptance and adaptation of the new technology. Here consideration of all the relevant human factors (social, intellectual, emotional, behavioral, cognitive, and psychological) is critical. Since all three legs are so closely inter-related, all three must be strong in order to guarantee not only a successful implementation, but also continually growing usage.

O'Conaill mentioned that the reason that video conferencing has never really been accepted and successful is not solely due to the limitations of the technology. It suggests that equally culpable is the fact that it was never properly marketed, and that people were never properly educated in its use.[22] With the implementation of any new technology, if the users are not aware of the technology, or how to use it, the use of the technology will become very limited.

The objective of this project, therefore, is to take the first small step in helping to educate the novice user of the Access Grid at WPI. This can be accomplished by developing a manual that encourages productivity on the part of the AG user. Through knowledge of the human factors that

should be considered when planning for and participating in an AG session, the user begins the technology further on the learning curve. This will save time and ensures productivity.

METHODOLOGY

The express objective of this project is to develop a manual that facilitates the use of the Access Grid for novice users by making them aware of how the human factors listed in Table 2 can affect an AG meeting. Therefore, the most pragmatic approach is to take a subset of the aforementioned human factors and heuristically determine their transferability from published studies of older technologies to the Access Grid for incorporation into the manual. It cannot be overstated that the manual is intended to help first-time and novice users ascend the learning curve of Access Grid use.

The primary criterion considered the types of possible meetings that will be held over the Access Grid within the WPI community by first-time or novice users. Then, using typical meeting dynamics and scenarios associated with each type of meeting, show how germane human factors may influence the efficacy of a meeting.

Also, it is important to note that the WPI community is extremely diverse with respect to interests, knowledge, comfort levels with new technology, personal preferences and styles when participating interactively at meetings. This added dimension makes the applicable combination of meeting dynamics and human factors totally dependent on the individuals participating in any given meeting. Therefore, the human factors and meeting dynamic guidelines developed for the manual are geared to the typical first-time user.

It should be noted that stating the methodology that will be used to accomplish the objective of this project may seem overly simplistic. In actuality, it is somewhat complex because of the combinations of items and factors previously mentioned.

As a primary step, it was essential to determine the most common meeting structures that will be employed by the WPI community. In order to accomplish this, interviews were held with 15 members of the WPI community. The community included faculty, students and administration. The distribution of persons interviewed were five faculty, five administration and five students. Faculty members were chosen based on their title, their known distant research collaborators, or their departmental influence. Examples of each type of selection are the following. Dr. Miller is the director of WPI's Center for Educational Development, Technology and Assessment. Dr Sullivan conducts research with faculty from the University of Puerto Rico and the University of Wisconsin. He was chosen as a result of these distant connections and the data-intensive nature of his research. Dr. Walker is the head of the mathematical sciences department. He was chosen in order to gather information related to departmental use of the technology.

As previously mentioned, interview questions focused on determining potential WPI applications for the technology. Other issues such as the context in which the interviewee learned of AG technology serve to provide a frame of reference. An assessment can not be made if the potential uses of the Access Grid were a result of the interviewees original thought or merely repeating a potential use that had been mentioned to them. While this is not quantitative by any means, it does provide a reference. Questions such as 'if you were to use the technology, on what would you base this decision?' provides some indication as to what the individual views as positive aspects of

the technology over previous forms of communication technology. Conversely, questions related to advantages and disadvantages of AG enable the individual to comment on any foreseeable negative aspects in addition to reiterating the positive aspects. This provides information related to issues viewed as potential roadblocks to the WPI community. As this project aims to enhance usability of the AG, it is important to understand what may hinder potential use. Lastly, if the individual has used the technology, it is beneficial to know their initial interpretations. This provides insight into the potential anxieties of the first time user. From these questions, a list of meeting types were determined as well as background information related to hurdles to AG use.

Background research was conducted on challenges faced by previous technologies with respect to each meeting type. From this research a list of potential cognitive factors were developed.

A second set of interviews were conducted with members from the Access Grid community of users. These members are considered well experienced AG users and consequently provided information related to overcoming the foreseeable roadblocks viewed by the WPI community as well as potential cognitive issues present in the research. Some of these cognitive factors are not factors with AG. Some cognitive factors were introduced by AG technology. The main objective behind the second set of interviews was to evaluate the impact of the cognitive factors determined through research, and determine the cognitive factors unique to AG. A secondary objective was to determine if the experienced user has developed a methods for compensating for negative cognitive factors. For example, if eye contact is a cognitive factor, cameras can be positioned such that it appears that the party is making eye contact with the party with whom they are meeting.

The aforementioned information was compiled into a manual [Appendix 3]. The manual contains guidelines, cognitive factors associated with various meeting structures and recommendations for successful use by the new user. While this manual is most relevant to the WPI community, a version will be submitted for addition to the Access Grid Documentation Project.

Within the framework of this methodology, there are some postulates that were assumed to be true. The first is that almost all studies of older technologies use face-to-face meetings as the standard against which the particular technology should be measured. This paper postulates that under certain circumstances, the use of a particular technology may be more efficacious than a face-to-face meeting. For example in a telephone conversation, people tend to pay more attention to the context of the conversation because they are not encumbered by the social stresses of a face-to-face conversation.

The second is that the Access Grid technology is in its infancy and will continue to evolve. Concurrently, other telecommunications components that have, albeit remotely, similar capabilities to those of the AG may become more widely available to the public. As this occurs, people will acclimate to technological advances. For example, as people acclimate to wireless-video-telephones with conference call capability, the novel impact of the Access Grid technology may be lessened. Therefore, the relative importance of various factors may change over time for the first-time user.

The third postulate is somewhat axiomatic to the second. As the technology evolves, users will adapt to the Access Grid. That is, they will initially fit the Access Grid to their tasks, and

subsequently learn to fit their tasks to the Access Grid. For example, in the past, if a senior wanted to discuss graduate programs at a remote college with a professor, the first contact would have been made by a formal letter. As the Internet became more widely used, the same formal type letter may have been transmitted over the Internet. Currently, the same first contact with a graduate school professor could be made using a less formal email, since less formal emails are now considered an acceptable method of communication.

The next two postulates are that the more quickly the user ascends the learning curve, the more likely the user will continue to use and develop new uses for the Access Grid. Similarly, the ease of initial use correlates directly with user comfort, satisfaction, and probable future use. The final postulate is that with continued, persistent and creative use of the Access Grid, the technology itself will become increasingly transparent.

The methodology used in this paper is oriented toward laying the groundwork for the WPI community to optimize and evolve the use of the Access Grid as individual needs and ingenuity demands. The development of an initial user's manual is a pragmatic approach aimed at facilitating first-time or novice use of the Access Grid.

Results and Discussion

Results

Results of Interviews with the WPI Community

Interviews with the WPI community were held primarily to determine some of the potential uses of the Access Grid at WPI. The responses listed by percentage were generalized into the following categories: Collaboration, Social Events, Data Intensive Research Collaboration and Distance Learning. Table 4 shows the generalized list.

Collaboration	73.3%
Social Events	40.0%
Data Intensive Research Collaboration	26.7%
Distance Learning	13.3%

Table 4. Percentage of interviewees designating a specific use category.

The same interviewees were asked what other telecommunication equipment they were familiar with to achieve the meeting types listed in Table 4. Although everyone uses the internet, the other technologies employed are shown in Table 5 with their respective user percentages.

Video Conferencing	53.3%
NetMeeting	20.0%
Instant Messaging	20.0%
PictureTel	13.3%
Conference Calls	13.3%

Table 5. Percentage of interviewees designating specific telecommunications experiences.

Based on the same interview pool, Table 6, below lists the perceived problems associated with the technologies listed in Table 5.

Video Conferencing
Disjointed Audio and Visual (excessive delay time)
Flickering Images
Difficulty focusing on camera and users at the same time
Use of common artifacts difficult
Net Meeting
Technological problems interfere with use (e.g. excessive connection time and need for telephone backup)
Instant Messaging
Impersonal
Sometimes difficult to follow the context
Messages are received on a first come first serve basis leading to disjointed conversation.
PictureTel
Disjointed Video

Table 6 Perceived problems with aforementioned technologies.

Results of Research

Based on background research, the following list represents the major cognitive problems encountered with previous multimodal technologies.

Video Conferencing

In ability to see gestures/mannerisms of users

Increased distraction from audio delays and flickering video

Rigid conversational turn taking (pauses more than overlaps)

Difficult eye-to-eye contact

Unable to maintain gaze awareness

Perception of psychological distance

Increased cognitive burden

Cannot choose orientation

Results of Interviews with the Access Grid Community

The following results are attained from interviews with the access grid community.

Cognitive factors associated with Entertainment on AG

Psychological distancing

Noise distractions

Interruptions from audience

Difficulty with two-sided audience

Cognitive factors associated with Distance Learning on AG

Psychological distancing

Lack of community

Lack of visual cues

Cognitive factors associated with meetings on AG

May not be able to recognize the individual head-on

Do not gather non-verbal cues

Can not gather physical characteristics (e.g. how tall/short, how they walk or choose to orient themselves for the meeting)

Lack of visual emblems

Disruption due to technical difficulty

Rigid turn taking

Cognitive factors associated with Data Intensive Research Collaboration on AG

Presenter is looking at monitor instead of camera

Smearing of visual data

Compensating for negative cognitive factors

The following are methods suggested by the Access Grid Community and the formal research for how to compensate for negative cognitive factors associated with each meeting type.

How to get around Entertainment issues

Be aware of the pick-up of the microphones

Place performers at the head of a horseshoe so the entire audience is in front of them

Try to engage the remote audience early on to get them into the event

How to get around Distance Learning Issues

Create a learner-centered environment

Encourage multi-remote-site discussion groups

Generate syllabus based upon combined calendars

Focus on one or two students from each remote site to gather non-verbal cues

How to get around meeting cognitive factors

Ensure a "good" camera angle

Reorganize the meeting to account for people having technical difficulty

Ask specific people for input

Make sure microphone batteries are fully charged before beginning the meeting

How to get around data intensive research cognitive factors

Changed the resolution settings and bandwidth to prevent visual data smearing

Discussion

Commentary on Interviews With Members Of The WPI Community

Interviews were conducted with members of the faculty, students and staff of WPI in order to ascertain baseline information regarding knowledge of the Access Grid, appropriate applications, factors that the members of the community felt were important for them to consider using the Access Grid and any other perceptions they had about the new technology being implemented at WPI. Their perspectives also served as a partial guide for information that would be necessary to include in the user's manual developed as part of this project. Interviews were conducted by Lorin Jakubek with the following members of the WPI community:

Administration:

John Heyl – Vice President of Development and University Relations

Tom Lynch – Vice President of Information Technology

Sia Najafi – Manager Academic Computing

Stephanie Blaisdell – Director of Diversity and Women's Programs

Kevin Kelly – Vice President of Enrollment Management

Faculty:

Professor John Sullivan – Professor of Mechanical Engineering

Professor Homer Walker – Department Head/ Professor of Mathematics

Professor Paul Davis – Dean of Interdisciplinary and Global studies Division/ Professor of Mathematics

Professor Judith Miller – Director of the Center for Educational Development, Technology and Assessment / Prof. of Biology

Professor Jonathan Barnett – Professor of Fire Protection Engineering

Students:

Kara Hartling WPI Senior, ROTC Company Commander

Cindy Chung - WPI senior, Member of the Chinese Student Association

Boris Masis - WPI Sophomore, Dance Team Vice President, Computer Scientist

Sandeep Goel - WPI Senior, Poet

Jen Gray - Soccom President

The first area of interest was the context in which the interviewees first learned about the Access Grid. Of the 15 members interviewed, 47% first learned of the Access Grid from Dr. Mullen. This group was primarily composed of the faculty members. Dr. Mullen is Academic Computing Application Scientist responsible for aiding the WPI community in the use of Super Computing for scholarship and research. She has been instrumental in the implementation of the WPI Access Grid Site and will be the primary node operator on campus. A third of the participants learned of the Access Grid from Lorin Jakubek; two initially learned of the Access Grid from participation in the Information Technology Department CabiNet Meetings, and one participant learned of the Access Grid from WPI's Technews.

Collaborative Meetings

Eleven of the fifteen participants responded that their most likely use of the Access Grid would involve some form of collaborative meetings. One respondent stated that this would be an ideal mechanism for collaborative research between WPI and the University of Puerto Rico and the University of Wisconsin. Usually faculty from UPR visit WPI for one week. However, this does

not allow direct training of undergraduates, graduates and postdoctoral students from UPR. AG will allow direct training and collaboration. AG technology will allow members of the University of Wisconsin's Primate Center to observe the monkeys owned by WPI and UMASS Medical Center. The information from the monkeys will be streamed through WPI's AG system the same way any room on campus can be used as an overflow room for an event. (Professor Sullivan)

In addition to mentioning collaborative meetings and research in general, other aspects were mentioned, for example, the use of the AG to have groups observe archived meetings. WPI could use the AG for collaboration purposes between professors at different universities, or students away from campus working on their IQPs. Use for the faculty as a research collaboration tool for attending professional conferences was also mentioned. Collaboration between team members working on MQPs and IQPs was considered a valuable potential application

Distance Learning

Two interviewees responded that they thought that the AG would be a good means of engaging in distance learning. Professional conferences were previously mentioned. One intended to use it with the University of Melbourne for a Doctoral Dissertation Defense. Access to classes, conferences, and research activities was also mentioned in the context of distance learning.

Communication Between Similar Groups at Multiple Locations: Communities

Twenty percent responded that the Access grid would be an excellent way of communicating with groups that have similar interests at other locations. There would be interest from ROTC, dependent on cost, to communicate with ROTC units at other schools. This would not only include items of general interest, but the potential for specialized technical learning and training.

The Chinese Student Association thought the AG would be an innovative way of sharing cultural information with groups at other universities. The possibility of planning joint events germane to their interests was welcomed.

Other similar associative activities might include activities related to the Alumni Association, including conferences, speeches, and even the inauguration of a new president.

Social Events

Six respondents mentioned that the Access Grid would present a great opportunity to hold social events. Groups who have similar interest could hold sessions related, for example, to poetry. A campus TV-like show, small art events, concerts, rap sessions, and even an Access Grid Coffee House were mentioned. It was felt that the Access Grid presented an almost unlimited opportunity for groups with similar interests to communicate in a unique medium. It was interesting to note that when a potential event was mentioned how the students quickly thought of other events on their own.

Other Potential Applications

Several other applications were mentioned as potentially being advantageous. They are listed below in no particular order:

Admissions may use the Access Grid to demonstrate the caliber of WPI students. They might be interested in having a set time every week, for example every Tuesday, in which visitors can attend an AG session in which students are presenting or discussing their IQPs or MQPs from remote locations. Project teams with similar project interests may even be able to use the AG to share information from their respective locations.

In one instance, the Access Grid was viewed as a great learning tool for participating in multi-site or even international meetings. The respondent felt that the experience would provide a definite advantage in the business world after graduation.

Two respondents stated that they did not see any applications in which they would be interested or any reason why they would use the Access Grid at this point. The conclusion that should be made from their statements is that there is an opportunity for marketing the Access Grid within the WPI community, and that the user's manual developed as part of this project may alleviate apprehension for using this new technology.

Although the sample size was not large enough for a rigorous statistical analysis, there seems to be a correlation in how the aforementioned groups viewed potential uses of the Access Grid. For

example administration would focus on the use of the Access Grid for marketing the excellent attributes of WPI. The faculty seemed to be concerned about extending knowledge through either research or distant learning. Finally, the students most easily associated with the use of the access grid for social activities.

Reasons for Choosing the Access Grid

The following reasons were given for choosing the Access Grid over other existing technologies: The primary reason, stated by 33%, for choosing the Access Grid was the availability of a high bandwidth not available in other technologies. In one case the respondent stated that only the AG provided the bandwidth necessary for discussing neuroimaging and even allowing for direct numerical analysis of the same data from multiple locations. Coincident with bandwidth is the ability to provide higher resolution, and higher quality video.

Other reasons mentioned were availability, reduction in travel time and expense, previous experience, flexibility of venues, and "everyone likes to be on TV." The AG totally eliminates the confusion in conference calls that results when people participating in these calls have similar sounding voices. It was also mentioned that the AG is a good medium for disseminating ideas and "getting your name out there."

While many positive reasons were mentioned, there were also some cautions presented. One was that although in the United States a high bandwidth is available, there may be some problems interfacing with some countries like Australia where the network capabilities are not truly

compatible. Another caution was that using the Access Grid may not be efficacious because of the potential "aggravation in terms of time and grief necessary to arrange a meeting."

Expectations of the Interviewees Regarding the Access Grid

The following expectations are compatible with the perceived potential applications presented above. About half of the interviewees, in one form or another, expressed the benefits of a high bandwidth at being the primary expectation. This included high quality audio and video. Although only one reference was made to expecting the Access Grid to be as good as a face-to-face meeting, two-thirds also made reference to the expectation that the Access Grid should be "better" than video conferencing. This included being more synchronous than video conferencing, with better sound and video, with no time delays, with multiple person interaction without confusion on larger screens. A quarter of the interviewees expected that the Access Grid should be better than video conferencing in that conference aids, whiteboards, and data be available to all nodes simultaneously, with data being passed in real time. The most important expectation was that the Access Grid should be a significant improvement over video conferencing.

Other expectations were that the AG would easily provide remote training capability, the ability to conduct and participate in experiments from remote sites, that it would eventually remove language barriers, and be able to interface with other telecommunication media such as video conferencing sites. Another expectation was that with the ability to "broadcast" outside the WPI network in real time, the use of the Access Grid would be a major vehicle in highlighting the technological capabilities of WPI. One respondent cautioned that the appropriate technology

should be used for the appropriate circumstance. That is, that in some cases a simple cost-effective telephone call may suffice.

Experience of the Interviewees with Other Telecommunication Technology

All people interviewed had experience with Instant Messaging, live chat, or email. One comment was that these forms seem too impersonal. Approximately half had experience with conference calls. One comment was that hand-offs of the conversation, and knowing who was talking could be a problem.

Sixty percent had experience with video conferencing. One comment was that the audio-video was disjointed and could be distracting. Another comment was that the interviewee didn't expect the use of video conferencing to replicate a face-to-face meeting so there was a lower expectation which resulted in use of the technology as it is. Similarly, a comment was made that new software and interfaces are currently being developed at Cal Tech that will attempt to eliminate some of the "annoyances." Three interviewees had experience with Picturetel. The comment was that the picture was disjointed and refreshed every few seconds. It took too long to secure the connection. Four interviewees had experience with Netmeeting. In this case, the video was very disjointed and the audio was so poor that a telephone had to be used to replace the audio portion.

Only two of the people interviewed at WPI had used the Access Grid to date. Now that the WPI node is in operation, it is expected that this number will rise dramatically.

Initial Impressions of the Access Grid

Although only two interviewees had actually used the Access Grid, the people interviewed had some very definite opinions of the advantages, or disadvantages regarding the Access Grid. Among the perceived advantages are the following. The Access Grid will allow for real time numerical analysis of data at multiple locations. The high bandwidth will provide superior audio and video capability. Location of the nodes will minimize concerns over traveling to meetings, that is concerns about time, costs, weather or terrorism. It will also provide better access to meetings for persons with disabilities. With minimal travel time, more frequent, global meetings will be possible. International participation will provide an added dimension to discussions. It will provide the opportunity to speak to experts in any given field. It will revolutionize collaborative efforts and information exchange. It gives more of a feeling of proximity, puts a face to collaborators, provides the ability to have more intense meetings than video conferencing, and provides the opportunity to observe some non-verbal cues and gestures.

Regarding the perceived disadvantages, there is some concern that the location of other nodes may preclude the possibility of getting all the people needed to attend a meeting. There was also concern that traveling 45 minutes to attend a 15-minute meeting is not practical. There was also concern that using the appropriate and most efficacious telecommunication technology may be overlooked in favor of using a "new" technology. Concern was also expressed over setting up a large multiple node meeting and then having the technology not work. Another concern was over the scheduling of meetings and competition for meeting times. Regarding the scheduling, there is a perception that it may be more difficult to schedule all the factors related to a multiple node

meeting than it is worth. Meeting participants would rather concentrate on the content of a meeting rather than arrangements and concerns over the technology working. They essentially want all aspects of technology and scheduling to be transparent to them. It is felt that an Access Grid meeting cannot take the place of a fact-to-face meeting. At a multiple node meeting, "participants can't shake hands." As a result, AG meetings may still seem too impersonal. It is disconcerting to see yourself. Overcoming user difficulties with initial ease of use was a major concern.

Observations Regarding the WPI Community Interviews

It is obvious that the WPI community is poised and ready to utilize a newer and better telecommunications technology. They have experienced the pitfalls of previous technologies and are anticipating that the Access Grid will eliminate them. They appreciate that an Access Grid meeting will not take the place of a face-to-face meeting, however desirable a face-to-face meeting may be. Being technologically oriented, it seems that the WPI community will adapt to the Access Grid parameters if the scheduling and technology are made transparent to the users. With only two of those interviewed having direct Access Grid experience, it is important that the benefits and capabilities of the Access Grid be actively marketed to the rest of the community. It is also critical that all the aspects of scheduling an AG event and all the concerns about the technology "working" be made transparent to the users. In order for the WPI community to ascend the learning curve as quickly and easily as possible, it is also critical that the user's manual developed for this IQP project address the concerns of initial Access Grid users. There is a team leadership opportunity for everyone working on the Access Grid to contribute to the WPI community by making the

technology, scheduling, and ease of use transparent to the users, thereby benefiting the reputation of WPI as a technological leader.

Distance Learning

The main difficulty with distance learning, experienced in both on-line and video based courses, is the actual perception of distance by the participants. Repman and Logan state "interactions lie at the heart of any learning situation and remain critical to active learning." Interactions between participants are restrictive in distance learning. In order to actively learn, there must be an application and a constant reinforcement of lecture material. This is primarily accomplished through student-to-student interaction or through student-teacher interaction. Nevertheless, in today's highly mobile society, there is a definite need for distance learning and education. In addition to formal college-like classes, there is a need in industry to train technicians without having to incur the cost of travel to a central location. Wolcott states that "It is time we shift our attention from how to work around the distance in its physical sense, to how to keep from further distancing learners in a psychological and social sense." The current challenge is to maximize the use of the technology while minimizing the adverse cognitive impact on participants.

The Access Grid certainly raises the technological bar when it comes to distance learning. Currently, it seems that learning over the Access Grid is dominated by technological and computing type courses. According to Leslie Southern of the Ohio Super Computing Center, classes are currently held for over 100 people at 16 different nodes. In one case the nodes were physically located from Alaska to England. In cases such as these, the scheduling of the classes has to accommodate the different time zones. Therefore, what may be covered in a two-day

seminar at one location may have to be scheduled over a four-day period on the Access Grid. In another interview, with Don Morton he found it beneficial for classes to be held twice a week for one and a half hours each. One class was held over the Access Grid while the other was held at each of the respective participating universities. The goal was to have a synergistic learning experience for the students by having the faculty of three different universities participate in the teaching. It was felt that this increased the caliber of the information disseminated to the students.

In a classroom setting, a student is natural member of a community because of its inherent nature or mutual proximity. Since this mutual proximity is absent from on-line courses, it is conceivable that participants might feel disconnected, to some extent, from the learning process. The informality of a proximate community facilitates the exchange of questions, ideas, information and expounding on particular subject matter. Educational media which precludes this informal interaction and exchange significantly inhibits both initial and retentive learning. Wolcott feels that "Combining both physical and psychological distance makes for a potentially troublesome mix" and does not provide an environment conducive to active learning.

The Access Grid cannot totally replicate a true classroom setting at this time. Even participants at the same node do not seem to interact in the same manner as in a normal classroom. There appears to be less pre-session interaction by attendees at a given Access Grid node since they are not as familiar with one another as they are in a classroom setting. In some cases the instructors would like more participation from remote locations. In other cases there may be participants at other locations that know more than the instructor. In the latter case, the learning experience can be significantly increased. One method currently being used to encourage more participant

interaction is to have a participant web site or chat room where profiles are listed and the participants have a mechanism for exchanging ideas, asking for help with the work, or just finding out more about the other participants. Although the same technique can be used in other learning environments, it is especially helpful with the use of the Access Grid to the instructors since it provides informal feedback which they can use to modify the teaching sessions.

Circumventing psychological distance

Instructor-Centered Learning Environments

In a traditional classroom setting, psychological distance is minimized since participants overtly maintain the simple sense of sharing the same space. In a regular classroom situation students are usually more familiar with one another and interact accordingly. When students are at different locations the probability is low that they would have this same sense of familiarity. Correspondingly interactions are fewer unless the instructor actively initiates interaction. The sense of psychological distance may be increased when the instruction is one-directional. This is commonly known as an "instructor-centered" learning environment. In this environment, the instructor transfers information, examples, and answers to anticipated questions, but does not build a rapport with the students. This lack of rapport which makes the process totally impersonal can cause psychological distance. It minimizes or totally eliminates the quality of direct, related association from the minds of the participants. Although this can also happen in a conventional classroom it is more prone to happen when participants already have a sense of separation by distance. In Access Grid events, it is critical for the presenter, the floor manager, and the node

operators to preplan and work together to increase the feeling of proximity and connectiveness to the event.

Shift to Learner-Centered Environments

Repman and Logan state that "in a learner-centered environment, the instructor is not the 'star' or the 'sage on the stage.' In the learner-centered environment the instructor becomes the 'guide on the side,' with sometimes unexpected opportunities to reflect on his or her instructional style and philosophy." This can be accomplished by asking questions that evoke thought and result in multiple student comments. When asked a question, the instructor may guide the students with step-by-step questions to help them develop the answer on their own. This is akin to the Socratic method of teaching from which the word educate is derived, i.e., e - ducare, L., to lead from. To some extent application of the Socratic method over the Access Grid is dependent on the material being presented. For example, if the event is geared to dissemination of the empirical information one does not need to shift to a learner centered environment. However, if the material being disseminated is geared to soliciting creativity, understanding or problem solving skills, one method of accomplishing this, as outlined above is to teach a process for accomplishing this by asking directed questions.

Lack of Rapport

Wolcott states that "Both teacher-to-student rapport and student-to-student rapport are crucial in creating a sense of community among learners." Frequently in a distance-learning environment, the student does not feel part of a community of learners. Repman and Logan state that "students

interacting with other students increase their participation and enhance their motivation and learning." This problem manifests itself in text-based learning environments where the technology does not allow for student-student interaction. In a video-based learning environment, time is expensive and becomes a limiting, critical factor. If a class is one hour long, the participant pays for one hour of information or instruction. Therefore, a student is less likely or unable to spend any part of that hour building a sense of community with their peers. Lack of rapport precludes the exchange of shared experiences or values thereby diminishing the learning potential. For example, it is a commonly held educational paradigm that there is a correlation between increased sensory stimulus and the ease of learning.

Just a rapport is important between students; it also appears that Access Grid learning events need ancillary mechanisms at the current time to increase the rapport between presenters and participants. Web sites and chat rooms, as mentioned earlier, seem to be one mechanism. Since this is essentially a passive mechanism in that participants chose their level of participation, it is critical that presenters design presentations which encourage or even force participation.

Encourage a Community of Learners

On-line text-based environments can be augmented to encourage community through the use of message boards. Students participating in a class can be asked to post information to the message board and submit a biography. With this information, the instructor can create lessons that highlight the shared experiences of the students. This also allows the instructor to welcome students in a more personal manner. Text-based distance learning can allow for student-student

interaction through private chat-rooms. The use of message boards and chat rooms enhances a sense of community between the instructor and the students.

Additionally, two-way audio/video-based environments can add much more functionality and flexibility. Although a lesson must last a given amount of time, it is possible to establish connections with remote locations, for example, fifteen minutes before and after the official lesson. This allows the instructor to communicate with the students, and the students to interact with each other.

Untimely Responses

Another major problem with distance learning is untimely responses. Lack of proximity also makes the teaching experience impersonal for the instructor. This in turn puts less pressure on instructors to return assignments, answer questions or provide feedback on a timely basis. This puts the students at a disadvantage since they are unable to gauge their actual understanding of the subject material or receive additional information they may require. As a result, students may feel helpless, forgotten, or unimportant resulting in a sense of psychological isolation. The Access Grid provides a mechanism for questions to be answered in real time just as they are in a conventional classroom or meeting. Similarly, as in a classroom or meeting setting, the decision to answer, defer, or leave for future research by the participants is at the discretion of the presenter. According to Don Morton, in some cases, Access Grid presenters that have also set up list serves, have found it beneficial to have certain questions not answered in real time but discussed by the participants over the list serve. As with conventional educational methods, it is important for the

presenter to monitor the direction of the discussion so that erroneous information is not permitted to infiltrate the discussion and to insure that answers are received in a timely manner relative to their importance to continuing instructional progress. This is especially true of the Access Grid since you can essentially have ongoing discussions 24 hours a day between events.

Timely Responses

Repman and Logan state "Feedback should be prompt, focused, and constructive". This is especially true for the Access Grid to prevent students from feeling dissociated from the event or instructor.

Instructional Feedback

In both video and text based environments, instructors are at another disadvantage since they lack the capability to read non-verbal cues. In a traditional classroom, instructors can sense when a students understand a topic, when they are bored with a topic or completely confused. Clamor for example can either mean there is confusion or boredom with a lesson. When sharing the same room with the students, an instructor receives direct feedback and can adjust the teaching style, rate of information dissemination or even ask direct questions to gauge participant understanding. However, with the loss of proximity and the resultant direct feedback, the instructor has to gear the lesson to the "average" participant and anticipate the "average" level of participant interest. The instructor has no mechanism for judging feedback on a timely basis in order to adjust the teaching approach. Although the perception of nonverbal cues is better over the Access Grid than videoconferencing due to the increased bandwidth which allows enhanced audio and visual

information. The instructor must be cognizant to elicit verbal cues in order to assess feedback. Some presenters obtain instructional feedback through the response to the problem sets they assign. Others rely on surveys at the end of the session. In one case, Don Morton held a panel discussion after the session to obtain feedback. These practices are considered good teaching evaluation techniques in a conventional educational setting. They are especially important for presenters over the Access Grid since the access Grid is a new technology in which the instructor must calibrate the accuracy of their feedback.

Request Student Feedback

This can be accomplished formally or informally. For a text-based environment, submission of progress reports is a likely option. Audio/video based environments allow for more casual requests for feedback in the form of questions. An instructor may simply ask, "Is this clear?" Depending on the quality of the audio/video based technology it may even be possible to detect non-verbal cues from students. However, if there is a significant time delay, the instructor may subconsciously ignore these feedback cues because they become dissociative and are out of phase with the lesson.

Data Intensive Research Collaboration

With respect to collaborative research over the Access Grid, there are some positive and negative aspects. First, a regular home TV uses about 30 frames per second whereas the Access Grid uses about 5 fps. Therefore resolution and bandwidth for animation can present a problem to a researcher. Security of information for a researcher should also be considered. Although access is somewhat limited, the node operator and other people may be present. Also UNIX based systems

are susceptible to hackers. Therefore regarding research, the Access Grid is useful for updates and coordination type activities but not for working on highly sensitive research. Fortunately, according to Dr. Mullen, these issues are being addressed in the new version of AG software.

With respect to collaborative research the critical cognitive factor is the mutual establishment of honesty and trust. This is especially true if the collaborators have not formed a collaborative relation prior to the specific research. The visual portions of Access Grid technology can alleviate some of the initial skepticism. Additionally, scheduling some events prior to the actual collaborative effort in which they can establish mutual understanding and sense of values might be helpful. Another consideration is the level of security required for the research. Since the technical staff at each node will be monitoring the sessions it is essential for the researchers to discuss the security needs and the ability of the Access Grid to provide such security.

General Meetings

Many companies are turning to videoconferencing and Web conferencing to replace air travel. This is especially true after the Gulf War and the events of September 11th. Since meetings are deeply dependent on auditory and visual inputs, a successful medium must have the capability to accommodate high quality audio and visual channels. To date, the most advanced video-conferencing packages cannot accommodate all the criteria to hold meetings in which the technology does not in some way detract from a meeting. For example, the following areas are areas in which video-conferencing technology is not transparent to the participants.

Audio Delays

Audio delays can be expected with most types of video-mediated communication technology. In simple cases the audio delays are just an annoyance, however in extreme cases, audio delays can change the intended content since the audio channel is out of phase with the video channel. For the Access Grid, audio delays are "considered normal." Knowing this ahead of time participants should be prepared to pause and wait for a response without distraction. The worst-case scenario would be to have to use telephone backup.

Poor Audio Quality

While audio delays can change the content, poor audio quality can change the latent meaning. Inherent speech ambiguities and minor slip-ups are often times overlooked due to the static and fuzz associated with poor audio quality. Participants find themselves concentrating more on trying to decipher the audio rather that concentrating on the content of the meeting. As previously discussed, bandwidth and resolution can be a problem for some applications. There is one consideration that should be noted regarding audio content. That is, all of the background noise from all the nodes is transmitted equally through the two speakers in the room. Therefore, paper shuffling, moving things on a desk etc. can be a major distraction. Even if one participant whispers to another, everyone can sometimes hear it. This may not only be distracting but even embarrassing. Presenters should also be aware that if they, for example, put a book down too hard on the table, it can make a very loud noise at the remote sites. Although this is a technical issue that to some extent can be compensated for by the audio computer, when the compensation is not great enough at entertainment events this can cause distractions.

Visual Inputs

Lack of Appearance

The way a person presents themselves, choice of dress and the proximity to another person that they chose during a conversation subconsciously determines personal credibility. For a meeting to be successful, a sense of credibility must be established. According to Leathers, U.S. General George Patton "practiced his 'war face' in front of a mirror so that he would be perceived as unusually determined, powerful, and brave." A major complaint of video-mediated communication is the inability to convey the aforementioned personal characteristics, that is, a true sense of the appearance of participants. Videoconferences can have a "talking-head" feel that negates any impression of credibility. With the Access Grid, one loses the ability to judge some characteristics. For example, one may have difficulty judging a person's height, how they walk, their mannerisms, or even their demonstration of "presence" in a room.

Additionally, facial expressions, and eye contact are also important aspects of face-to-face meetings. Facial visual inputs convey a sense of what the speaker and listener are feeling. Viller states that without this information participants "can only treat messages on 'face value' being without access to any signals that may indicate deliberate misinformation." Video-conferencing significantly limits participants' ability to have access to this non-verbal information. For the Access Grid, eye-to-eye contact can sometimes be a problem depending on camera angle and the view the node operator chooses to transmit. According to Jennifer Teig VonHoffman, "There's no trick for establishing eye contact." By this she is implying that it is almost impossible to

accomplish. Additionally for the Access Grid, it is sometimes difficult to recognize people at other nodes even if one has already met them in person because of bad camera angle or choice of image to feed by the node operator. Similarly, if the presenter moves out of the camera view, this can be distracting to the participants. Some presenters use the monitor as a self-guide to staying in front of the camera. Regarding the video quality, the node operator plays a critical part in selection of views to transmit. Visual inputs and cues may be dependent on the configuration of the room itself. For example, it might be easier to gain visual cues from an arrangement of one center viewing area surrounded by many smaller windows of equal size. It is advisable to speak to the node operator regarding any concerns you might have over establishing good video contact.

Body placement and posture also allude to a person's social attractiveness. The more socially attractive a person is the more apt they are to persuade and lead others. Leathers believes that head nodding, relaxed body positions, open body positions, and forward leaning, all place the body in a socially attractive position and are among the strongest non-verbal cues. For example, a change from a relaxed to a more formal posture may indicate a change in the relationship. Popelka and Berger found that hand gestures are used to illustrate an object or action, place emphasis and informational redundancy that improves the clarity of the message. From the presenter's point of view, if the presenter uses the monitor to stay "in camera" then the sites should not have any difficulty with unnecessary distractions. The presenter however is somewhat limited in what they can see of the participants. They can see some arm movement, crossed arms, yawning, and moving things around the table by the participants. This is also somewhat dependent on the views that the node operator chooses to transmit.

Lack of Visual Emblems

Visual emblems are gestures used instead of words, for example, the use of a headshake may signify either "no" or approval, the meaning of which can only be ascertained from the total context of the interpersonal interaction. The same is true for greeting with a handshake. The manner in which a person shakes another person's hand can immediately convey that the person is happy to see the other person, impassive to them, or even angry with them, all without saying one word. Collective learned experience has enabled people to assess the significance of a handshake. They can quickly judge if it conveys friendship or peer-like respect. The positive benefits or negative aspects of a handshake cannot be experienced in video conferencing. Although the absence of a handshake does not have any negative implications, participants are forced to look for and rely on other non-verbal cues. Since the node operator selects the views to be transmitted, which may vary from panoramic to a tight zoom shot; with the exception of people at each individual site, visual emblems can sometimes be lost to the Access Grid participants at other locations. Access Grid users can alternatively turn to trying to use verbal cues to gain the same information that could be gained in a face-to-face meeting.

Proximity

During face-to-face interactions, proximity and orientation are indicators of personal attitude and demeanor. Hall defined four classifications of degrees of proximity: up to 1.5 feet is intimate; 1.5 to 4 feet is personal; 4 to 12 feet is social; and more than 12 feet is public. Hess states that "Different nonverbal cues are thought to be relevant at different ranges." For example, at the intimate range, pupil size is a factor; however, at the public distance mutual gaze is no longer

relevant. In general, either direct proximity or the sense of proximity is considered beneficial. However, Short's research on video-conferencing indicates that there is a "possibility that proximity, although unreal as a cue in any physical sense, may distort the interaction by imposing a constant distance level of apparent proximity on the interaction." This implies that question of proximity should be carefully considered since its added value is not really known for video-conferencing. Obviously users of the Access Grid are spatially separated. For example if there is a single presenter, the onus is then on the presenter for making all participants feel as they are actually present physically at the meeting.

Just as participants choose proximity, they also choose an orientation. According to Sommer, for competitive tasks, people sit opposite one another, while for cooperative tasks, people sit side-by-side. For video-mediated communication, there is no choice of orientation. The camera is usually placed on top of the monitor and as a result you are forced into competitive position. One Access Grid user suggested that at the site of the presenter, all participants sit at a horseshoe shaped table, with the presenter at the apex of the curve so that all participants are in view of the presenter. They felt that this would also aid the participants viewing the presentation from other nodes, as it would make the presenter appear more natural in that type of setting.

Turn Taking

Shifting the conversation from one person to another is accomplished very naturally in face-to-face conversations. In video systems, this task is sometimes not as easily accomplished. The common jargon is to refer to this as turn taking. It is not only the method by which continuity is maintained but also it is psychologically perceived as an act of mutual attention and responsiveness. It is

governed by audio and visual cues in the form of head nods, slight utterances like 'yes' and 'um' and eye contact. Most video systems do not restore eye contact efficiently to act as a timely cue. However, with the Access Grid this problem maybe minimized by the responsiveness of the node operator to selecting views which most represent the reality of the event.

In most cases, the camera cannot be placed directly in alignment with the picture of the eyes. So if a person believes they are looking a person in the eye, their gaze may be elsewhere based on where the camera is. In extreme cases the regulatory function of eye contact can be reversed. For example, Champness found that if a person looks away, but inadvertently looks at the camera, the person with whom they are conversing will sense eye contact and assume it is their turn to speak. This results in disturbances and interrupted conversation. It is possible to achieve some semblance of eye contact if the presenter looks directly into the camera instead of the remote location to which they are speaking. In a one on one meeting, if the camera is place just above the main remote window the participant can look at the remote site while talking and still mimic eye contact.

Entertainment

With respect to audio entertainment events, it is crucial for the organizers and the floor managers and the node operators to plan the event carefully beforehand. In "community" type events, there has to be a definite strategy in place to manage the background noise. If the people at the different nodes become noisy, this noise will be transmitted along with the audio presentation through the same two speakers. This could be very disruptive. A floor manager at each node may be required to control the participant's noise level, or to even ask them to leave if they become too noisy.

Conclusion

After conducting research, and interviewing members of the WPI and the Access Grid communities, one can conclude that the Access Grid is a very advanced telecommunications system. Inherent with the implementation of advanced new technology, are human behavioral factors that must be addressed in order to improve the ability of the new user to gain access to this technology; to acclimate to new technology and then use it frequently. Concurrent are the prerequisites to reduce the initial learning time, increase the initial ease of use and comfort level, and increase the initial satisfaction with the technology. This paper and the accompanying manual *A New User's Guide to the WPI Access Grid* identifies and offers recommendations to accomplish the aforementioned prerequisites.

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Appendices

Appendix 1 : Interviews with WPI Community

Appendix 2: Interviews with Access Grid Community

Appendix 1 : Interviews with WPI Community

Lorin Jakubek - Interview Notes

Professor Sullivan – Nov 18th 2002

1. In what context did you first learn of AG technology? Dr. Mullen

2. Do you see yourself making use of AG technology? How?

   Research collaboration with University of Puerto Rico and the University of Wisconsin. Usually faculty from UPR visit WPI for one week. However, this does not allow direct training of undergraduates, graduates and postdoctoral students from UPR. AG will allow direct training and collaboration. AG technology will allow members of the University of Wisconsin primate center to observe the monkeys owned by WPI and UMASS med. I think information from the monkeys will be streamed through WPI's AG system the same way any room on campus can be used as an overflow room for an event.

3. On what have you based this decision?

   A high bandwidth is required to discuss neuroimaging findings at a distance. High bandwidth is a critical component of the AG package. This makes AG the more likely technology over videoconferencing in this case. AG will also allow for direct numerical analysis of the same data from multiple remote locations.

4. What do you expect of the technology?

   High Bandwidth, remote training capability, the ability to conduct experiments from remote sites via Internet 2. Data to be passed down in real time.

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   N/A

6. In your opinion, what are the pros and cons of AG technology?

   No cons mentioned.

7. Have you already used it?

   No.

8. If you already have… what were your initial impressions and experiences?

   Used BU's power wall not AG. The power wall will allow the visual area needed to enable a group to perform numerical analysises on MRI data.

Professor Walker – Nov. 18th 2002

1. In what context did you first learn of AG technology?

   Dr. Mullen

2. Do you see yourself making use of AG technology? How?

   Research collaboration. Group observation of archived meetings (no remote location)

3. On what have you based this decision?

   Availability of bandwidth. Save on travel time.

4. What do you expect of the technology?

   More synchronous than video conferencing.

5. What is your experience with similar technology (e.g. video conferencing and Net Meeting)

   Disjointed audio and visual input when using other technologies such as videoconferencing.

6. In your opinion, what are the pros and cons of AG technology?

   Disadvantage - Availability of nodes.

7. Have you already used it?

   No but he looks forward to using it.

8. If you already have… what were your initial impressions and experiences?

   N/a

Prof. Davis – Dec. 3rd 2002

1. In what context did you first learn of AG technology?

Dr. Mullen

2. Do you see yourself making use of AG technology? How?

   Meetings… in place of conference calls.
   Admissions – something along the lines of : every Tuesday visitors can watch a live presentation from students who are conducting their IQP or MQP abroad.
   Project teams can be arranged from different project centers.
   Project teams can give little presentations to each other if topics are similar.
   Interviews for faculty and grad students… not a good idea because we can't sell WPI to them… and if we want them… so does everyone else.

3. On what have you based this decision?

   Conference calls… voices often sound similar resulting in confusion.

4. What do you expect of the technology?

   Multiple person interactions similar to meetings held around a conference table.
   With people from remote locations chiming in.
   No more confusion resulting from unintelligible voices

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   Interview over picturetel. Conference Calls

6. In your opinion, what are the pros and cons of AG technology?

   Pros – multicast synchronous… high bandwidth
   Cons – feasibility of connectivity either due to node location or system down time
   Logistically email may be easier 45-minute drive for a 15-minute meeting etc.

7. Have you already used it?

   No

8. If you already have… what were your initial impressions and experiences?

   N/A

Prof. Judy Miller – Dec. 3rd 2002

1. In what context did you first learn of AG technology?

   Dr. Mullen

2. Do you see yourself making use of AG technology? How?

   Distance Learning tool – training events for faculty
   Research collaboration
   Professional conferences

3. On what have you based this decision?

   Availability… and rather not travel

4. What do you expect of the technology?

   More versatile than video conferencing… seminar aids available to all remote locations… audience participation and addition of data (whiteboard)

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   Picturetel… "Clunky" picture every few seconds so it was very disjointed.
   Family uses Net Meeting… spend about half the time securing the connection and talking about the technology…

6. In your opinion, what are the pros and cons of AG technology?

   Cost
   Competing with others for space
   Overcoming user difficulties… easy of use…
   Availability of other nodes to arrange meetings.

7. Have you already used it?

   No

8. If you already have… what were your initial impressions and experiences?

Prof. Jonathan Barnett

1. In what context did you first learn of AG technology? Dr. Mullen

2. Do you see yourself making use of AG technology? How?

   Use it with the University of Melbourne for a Doctoral Dissertation Defense. Perhaps to advise an MQP… however Australian computer network is very slow.

3. On what have you based this decision?

   Broadband… is good but there may be difficulty with Australian Networks. It might not be advantageous given the cost in terms of time and grief to arrange a meeting.

4. What do you expect of the technology?

   It will be fancier… but do I need fancy? 'Telephone call costs minimal amount of grief… is it as good… no… does it get the job done… yes.'

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   Netmeeting to Australia was impossible. Couldn't get audio and visual to work… needed to use a telephone for audio.

6. In your opinion, what are the pros and cons of AG technology?

   Who arranges everything? There may be schedulers… but who arranges everything else? The travel directions… the food… the invitations at all locations. The technology would be fantastic if these issues were taken care of with comparitively little effort on the part of the organizer. Otherwise it is more effort to arrange the meetings for multiple locations than it would be if using other technologies, or no technology at all.

7. Have you already used it?

   No

8. If you already have… what were your initial impressions and experiences?

Kara Hartling WPI Senior, ROTC Company Commander

1. In what context did you first learn of AG technology?

   Lorin Jakubek

2. Do you see yourself making use of AG technology? How?

Perhaps… Navy is a bit slow with technology updates. There would be interest from ROTC if it didn't cost anything. May use it to communicate with ROTC units from other schools.

3. On what have you based this decision?

   Previous experience with ROTC.

4. What do you expect of the technology?

   Good… for the cost it better do things other technology can't do.

5. What is your experience with similar technology (e.g. video conferencing and Net Meeting)

   Instant Messaging

6. In your opinion, what are the pros and cons of AG technology?

   Can work and attend meetings regardless of weather with minimal travel. Meetings accessible to handicap audience.
   Takes away from the humanity of face-to-face communication… can't shake hands.

7. Have you already used it?

   No.

8. If you already have… what were your initial impressions and experiences?

Cindy Chung – WPI senior, Member of the Chinese Student Association

1. In what context did you first learn of AG technology?

   Lorin Jakubek

2. Do you see yourself making use of AG technology? How?

Not personally… perhaps as an audience member for a class or conference. CSA might be interested in speaking to CSA organizations from other schools for activities like "Night of the Dragon"

3. On what have you based this decision?

   Availability.

4. What do you expect of the technology?

   Great Audio/Visual.

5. What is your experience with similar technology (eg video conferencing and Net Meeting)

   Online Instant Messaging… Live Chat.

6. In your opinion, what are the pros and cons of AG technology?

   Cuts down on travel time.

7. Have you already used it?

   No.

8. If you already have… what were your initial impressions and experiences?

Boris Masis – WPI Sophomore, Dance Club Vice President, Future Computer Scientist

1. In what context did you first learn of AG technology?

   I learned about the AccessGrid in WPI's Technews newspaper, though the first time I used VRVS(Virtual Rooms Videoconferencing System) was about a year ago

2. Do you see yourself making use of AG technology? How?

   I haven't used AG per se, so I'll answer the question in terms of VRVS (which I understand to be synonymous with AG for my purposes). I have used it in the past and could see myself using it again to communicate with my parents in New Hampshire as well as other users on the internet (maybe at other colleges) if the technology becomes broadly used. WPI could use it for collaboration purposes between professors at different universities, or students away from campus on IQPs etc. I can also see it having potential as a tool for distance learning.

3. On what have you based this decision?

   VRVS utilized much more bandwidth than any competing product I've tried (namely netmeeting and some other smalled "video chat" packages) and as a result allowed for higher resolution, higher quality video with more frames per second.

4. What do you expect of the technology?

   Explained previously.

5. What is your experience with similar technology (eg video conferencing and Net Meeting)

   Explained previously.

6. In your opinion, what are the pros and cons of AG technology?

   Again answering in terms of VRVS; the technology allows for useful video conferencing (ie. it is not a toy like netmeeting). However, utilizing the VIC client, it is clear that the project is in "testing phase." That is, the application has a tendency to crash and use 100% of the cpu, making it more of a technology demo as opposed to something I would use daily at this point.

7. Have you already used it?

   VRVS... not ag

8. If you already have... what were your initial impressions and experiences?

   I don't feel the need to make eye contact when using the system, in fact doing so is nearly impossible because I am looking at the video of the user at the other end, and cannot simultaneously be looking at the camera. As I said this does not particularly bother me, though I have an inclination that it may take away from the feel of having a "face-to-face" conversation. In my personal perception I think that VRVS/AG and video conferencing/collaboration tools in general hold a lot of potential for becoming a "killer app" for high bandwidth connections and fast computer hardware. At the same time I think that video conferencing/collaboration can be useful and has a relatively high "cool" factor, which should help, drive adaptation once the technology has matured. The VIC client utilized by VRVS for transmitting/receiving video is written in java, and while the language has some powerful features (like cross platform compilation) by default it presents its own, non-standard user interface for all operating systems. In particular I am referring to the look of the buttons and windows of the VIC client. I believe that before the program can hope for a wide target audience, they will have to modify the interface to match the operating system it is running on. There are other HCI problems I've noticed while using VRVS, such as unclear labeling of program functions. While it will not take long to modify these, the current situation adds to the "testing phase" feel. oh also on a different note you might want to try http://dhcp-126-205.caltech.edu I just got that link

from the CalTech VRVS developer I was talking to, its version 3 of the VRVS package. I haven't tried it myself yet, but it's a beta that is yet available on the public. It might give you a sneak peek at what's to come

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Sandeep Goel – WPI Senior, Poet

1. In what context did you first learn of AG technology?

   Lorin Jakubek

2. Do you see yourself making use of AG technology? How?

   Yes – when I work for a company perhaps for conferences overseas or other parts of the country. It could work for Slam Poetry.

3. On what have you based this decision?

   Good medium to distribute ideas and get your name out there.

4. What do you expect of the technology?

   Good sound quality. Text box for mumbles. Understanding everyone despite language.

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   AOL Instant Messenger – impersonal.

6. In your opinion, what are the pros and cons of AG technology?

   No delay… Communicate with many people without traveling. No translation. Not as personal as face-to-face… but more personal than IM or email.

7. Have you already used it?

   No.

John Heyl

1. In what context did you first learn of AG technology?

CabiNet Meeting with Tom Lynch

2. Do you see yourself making use of AG technology? How?

   Alumni relations conferences… speeches… inauguration of new president

3. On what have you based this decision?

   Availability

4. What do you expect of the technology?

   No delay. Larger screen. More Collaboration – white board.

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   Video conferencing.

6. In your opinion, what are the pros and cons of AG technology?

   People from all over the world will attend forums. Opportunity to speak to field experts through the AG when the opportunity might not have been present. Will get the attention of voting institutions and NSF. Location is good for tours.

7. Have you already used it?

   No

8. If you already have… what were your initial impressions and experiences?

   Outside questions to look into :
   What will be on the screen when there aren't active events for tours and things like that?
   Ideas for a different name for the WPI community.

Tom Lynch and Sia Najafi

1. In what context did you first learn of AG technology?

   Dr. Mullen

2. Do you see yourself making use of AG technology? How?

Students making communities over the AG – Distributed rap sessions
Group to group collaboration
Conferencing – bioinformatics
Admissions – global projects – marketing
Global classroom – distance learning
Performing arts
Alumni project center communities

3. On what have you based this decision?

   Application for Internet 2… uses 1/3 of available bandwidth.

4. What do you expect of the technology?

   Can be used with many different protocols… multifunction as videoconferencing equipment and access grid node.

5. What is your experience with similar technology (e.g. video conferencing and Net

   Meeting)

   Not the same impact as a phone call.

6. In your opinion, what are the pros and cons of AG technology?

   See subtle forms of communication.
   No need to travel.
   Overlap between various videoconferences.
   Awkward… might not be medium of choice.
   For distance learning – must be produced in order to keep the interest of the audience. AG will enable more elaborate productions.
   Emerging technology lab- any room on campus can be an over flow room for an event.
   Risk – are people going to use it?
   No increase in staff – need operators
   Keep up with high demand.
   Jump start on professional future for students.
   New way of expressing conceptual info through graphical interactive environment.
   WPI could become a technological leader not only in Worcester but nationally.

7. Have you already used it?

   Yes.

8. If you already have… what were your initial impressions and experiences?

   Felt like you were there.

Put a face to collaborators
Relationship different than phone conversation.
More intense than usual videoconferencing.
Gestures obvious.

Stephanie Blaisdell

1. In what context did you first learn of AG technology?

   Lorin Jakubek

2. Do you see yourself making use of AG technology? How?

   Doubtful.

3. On what have you based this decision?

   Availability at other universities/companies.

4. What do you expect of the technology?

   A step up from video-conferencing.

5. What is your experience with similar technology (eg video conferencing and Net Meeting)

   Videoconferencing.

6. In your opinion, what are the pros and cons of AG technology?

   More personal than the telephone; less personal than face-to-face. People with whom she will be meeting must have the technology and know how to use it.

7. Have you already used it?

   No.

8. If you already have… what were your initial impressions and experiences?

Jen Gray – Soccom President

1. In what context did you first learn of AG technology?

   Lorin Jakubek

2. Do you see yourself making use of AG technology? How?

   Campus TV show; small art events, perhaps coffee houses

3. On what have you based this decision?

   Size of Audience.
   Flexibility of venues.
   Everyone likes to be on TV.

4. What do you expect of the technology?

   Broadcast outside WPI network in realtime.

5. What is your experience with similar technology (eg video conferencing and Net Meeting)

   Teleconferencing.

6. In your opinion, what are the pros and cons of AG technology?

   Movability of tables and chairs… a lot of equipment which will make it difficult for social events.

7. Have you already used it?

   No.

8. If you already have… what were your initial impressions and experiences?

Kevin Kelly

1. In what context did you first learn of AG technology?

   Information Technology Department's to the cabinet.

2. Do you see yourself making use of AG technology? How?

   Having difficulty envisioning that.

3. On what have you based this decision?

   Admissions works with highschools where this type of technology is not available.

4. What do you expect of the technology?

   To highlight technological nature of what WPI has to offer. Glorified videoconferencing with maximum head room.

5. What is your experience with similar technology (eg video conferencing and Net Meeting)

   Videoconferencing. Not an especially great experience; flickering images, disjointed audio and visual.

6. In your opinion, what are the pros and cons of AG technology?

   Pros: Tool for faculty research; gaudy high-tech technology to point to during tours; expose the resourses of WPI to other places and enable the WPI community to take advantage of outside resources available over the AG.

   Cons: It's new. Consequently, it's not well understood. It might take awhile for people to get used to using the technology. It is also not widely available.

7. Have you already used it?

   Seen it in use yes.

8. If you already have... what were your initial impressions and experiences?

   Disconcerting to see yourself and hear yourself. Audio and visual is of very good quality. Shared powerpoint will be beneficial. The ability to resize screens to ensure no one is falling out of the frame is much better than zoom and pan.

Appendix 2: Interviews with Access Grid Community

2.1 Leslie Southern – Ohio Super Computing Center.

Ms. Southern was chosen for this interview since she is a node operator at the Ohio Super Computing Center. She is also responsible for conducting numerous workshops over the Access Grid.

Context of workshop?

1. How long was the event? We've done different formats. Typical workshops are two full days. To accommodate the number of participants and the number of time zones, we have separated the two full day format into 4 half days. For example, the Intermediate MPI is being offered on Thursday afternoons in February 2003.

2. What was the subject matter? The subjects cover high performance computing areas of interest. The most recent workshops using the AG have been on MPI (October 2002) and Intermediate MPI (February 2003). These workshops are sponsored by the National Computational Science Alliance's Partners for Advanced Computational Services.

3. How many attended? Average over 100 people from 12-16 sites.

4. Were all attendees visible to each other and to you? Yes. Guests were asked to send only two visual inputs; the host node operator chose one of the two. All guests were visible, using the smallest screen possible.

5. How did you monitor questions from attendee screens? If host site, there would be a producer and floor manager to monitor the MUD. Attendees from the host site did not have individual microphones; only one microphone on the presenter. When host attendees would ask questions it was 'Phil Donohue' Style.

6. How were workshop materials distributed (i.e. website, designed not to need materials?)? There were two webpages; one for the attendees, one for the organizers. Attendees would obtain course materials from the attendee website. Some sites also offered attendees hardcopies of the materials or hands on capability to follow along. The organizational site would allow the technical coordinator, training coordinator and node operator to all be on the same page as far as reservations.

Participants

7. Were all participants in the same time zone? No. Participants come from Alaska to Manchester, England. Switching to a 4-day conference makes it a little easier to handle time-zone differences and allows information to absorb.

Instructor style

8. When asked questions, how did the instructor respond? Answer the question promptly.

9. When the instructor asked questions, did you notice any difference in the activity of those present versus those at remote locations? More activity from those at remote locations. The host site attendees feel 'on the spot.'

10. How would you define the instructor's relationship with the attendees at remote locations? Very good he knows them pretty well. People will come up to him at conferences and mention that they had attended one of his workshops.

11. How did it develop if at all? Through problem set exercises and email. If he finds a unique programming style, he'll point it out and recognize participants.

Participants During Session

12. Did you notice any nonverbal cues of the attendees at the remote locations? Hasn't happen. He gets all his active feedback from verbal cues.

13. In your opinion, did the attendees at remote locations feel part of the workshop? How were you able to tell? Yes. The instructor is very interactive. He stares into the camera and involves different sites.

14. Were there any breaks? What did the typical attendee do during these breaks? Yes. I don't know, I typically didn't stay myself.

Feedback

15. Did you seek feedback from the students related to teaching style/interactions with media? Yes.

16. How often? Once at the end of the 2-day workshop.

17. In what form was this feedback given? Problem sets serve as feedback and closing questionnaire.

Conclusion

18. Was anything distracting to you; i.e. Technological glitches, cognitive issues with perception of distance? No.

19. In retrospect, is there anything that you would change? 2-day to 4-day workshop.

20. What do you see as the success of this workshop? They learn everything. Interaction with the audience and attendees from remote locations part of the audience like everyone else. Occasionally there will be someone attending who will know more than the instructor; the

openness and sharing of information creates an environment where everyone including the instructor can learn something.

2.2 Interview with Don Morton.

Don Morton organized the Beer Symposium and was an instructor of a class held over the Access Grid.

Entertainment

General

1. What was your role in the event? For the Beer Symposium, I helped organize it. I sent emails advertising the event. During the event I served as the moderator.

2. Was there a target audience in mind if so who? The goal of the symposium was to go beyond the science seminars usually held on the AG to create more of a Global Village. Ideally we wanted people who had a sense of humor and liked beer. We wanted to attract 'real people' not the technical people who usually use the grid.

3. What was the nature of the event? (i.e. music based, dance based, poetry etc.) Beer based.

Operational

4. How many attended? Ten to twelve different sites attended with five to seven people at each site.

5. Were each of the participant windows viewed on the screen? All the participants were visible, however it was up to the operator to decide which of the views were used. Usually only one or two of the five or so views sent would be used.

6. If not, what was the maximum number allowed on the screen? Occasionally it is necessary to leave some participants in the lurking region however it is very rare and was not necessary for this event. If it is necessary, only video connections from active sites are on the screen.

7. How did you monitor participation/views of the non-viewed audience? N/A

8. Is there a traditional window orientation you would suggest for entertainment-based events? There are three projectors, so the most active window should be in the center and be larger than all the other windows.

9. Does it vary with the nature of the event (type of performance?)? No. Active windows are usually almost always in the center.

Organizational

10. How did you advertise? Posts on Agtech. There was also a web page dedicated to the event.

11. How long did it take you to plan the event? It was a lot of work. It took about 20 hours to plan and organize. There were time zone issues that needed to be straightened out and PowerPoint presentations to be uploaded

12. How often did you seek for feedback? At the very end of the symposium.

13. How did you collect feedback from the audience? We met with a few attendees at the very end in a panel session. We tried to highlight strong and weak areas.

14. Was the feedback you received from the audience homogenous? Yes, for the most part people complained about the noise. There are all these people making their individual noises, but it all comes through one pair of speakers. Since we were dealing with alcohol; it got pretty noisy.

15. If not, how did you establish preference? N/A

16. Did you observe any audio/visual delays/glitches? Yeah, that's pretty normal for someone to have difficulty connecting.

17. Were there any interruptions from the audience? Again, it was a beer symposium. Of course there were interruptions from the audience. Some people got loud and obnoxious.

18. How would you handle them? They would be asked politely over the MUD to correct their behavior.

Conclusions

19. If you had users attend an entertainment event for the first time, is there any advice you would give them? The microphones carry conversation more than you would think. If you are whispering to someone, don't be surprised if people at other sites hear you. Be warned because it can get embarrassing. With this in mind, don't throw things on the table. It is very noisy at the remote locations.

20. What advise would you give your musical performers? I would not give the performers any advice, because they should do what they usually do. However, I would advise the individual sites if I expected the audio levels to be tricky.

21. What advise would you give your visual performers? It might be easier for visual performers to be at the head of a horseshoe so the entire audience is in front of them.

22. What advice would you give other node operators? I would tell them exactly what I plan to do, and what they need to do it. I would give any necessary warnings and help them adjust.

23. If you had it to do over again, what would you change? I would organize the conversation a little better. During the first few minutes, it's like a first class where you set the stage and tone for the rest of the classes. I would therefore engage the remote audiences a little more at the beginning.

Distance Learning

Context of class

1. How many times per week did the class meet and for how long? The class met twice a week for 1.5 hours. One of the sessions was held over the AG. The other session was with their individual classes and instructors.

2. What was the subject matter? Introduction to HPC (High Performance Computing); parallel computing.

3. How were course materials distributed (i.e. course website, designed not to need materials?)? There was a course website, however, not all the students had the same materials. There might have been a few slight differences. There was a weekly teleconference held to discuss the curriculum.

4. Were all participants in the same time zone? No.

Human Factors and AG Class

5. When students asked questions, how did you respond? I would answer the questions. We really wanted more questions.

6. When you asked questions, did you notice any difference in the activity of the present students versus those at remote locations? No; they would both do what most students do in that they would sit there and not want to answer.

7. Did you notice the nonverbal cues of the students at the remote locations? I'd notice nods and yawning. It's very dependent on how node operators set cameras. I'd recommend they focus on one or two people clearly rather than an entire room blury.

8. How would you define your relationship with the students at remote locations? How did it develop if at all? I didn't know them as well as the students here. I knew their names. It's easier to engage a few students than to try to engage all of them at once; communications bottleneck.

9. In your opinion, did the students at remote locations feel part of the learning process? How were you able to tell? Yes, based on the questionnaire at the end.

10. Did students from remote locations interact with each other? Students would communicate with other locations very little. They stayed pretty much to their own groups. It's something we'd like to work on in the future. We'd start a discussion, but it's not quite as natural.

11. Was there time before and after class to allow students to interact with each other? Yes, but they only communicated with their own groups. It doesn't come naturally; I think it needs to be forced.

12. At any point in time did you catch yourself ignoring one section of the class? If so what section? No. There were only two other sections, so you can't really ignore 1/3rd the class.

13. Over what media did students ask extra-help questions? Extra help questions would usually be asked during the local sessions. There were a few questions to the list-serve.

14. How would you rate the timeliness of your responses? In class questions were answered immediately. However, questions to the list serve were allowed to bounce among the students. The list serve was primarily for students to help each other.

15. Did you seek feedback from the students related to teaching style/interactions with media? Yes prepared a survey at the end of the semester. Not so much the teaching style.

16. How often? Once at the end.

17. In what form was this feedback given? Survey.

18. Was anything distracting to you as the instructor; i.e. Technological glitches, cognitive issues with perception of distance? The students' semesters ended at different times, so one section would be in a partying mood while the other section was a little more stressed.

19. In retrospect, is there anything that you would change? I would encourage conversation among remote locations a little more strongly than we did.

20. What do you see as the success of this course?

We are in the frontier regions. It is unlikely that any one of our institutions will have more breadth of expertise than the three institutions combined. Therefore by combining some of our classes we are increasing the quality of education. Also, our students experience diversity in the classroom.

2.3 Interview with JenniferTeig VonHoffman

Meetings over Access Grid

Context

1. What was the nature of this meeting? (i.e. marketing, interview, or casual) I've participated in all kinds of meeting types.

2. Did you meet the person beforehand in person? In some cases yes, in other cases no.

3. How close were you geographically? As close as Dartmouth or WPI to as distant as China.

4. How many were present at the meeting?
   Job Interview : 1 candidate, 3 sites, 5 or 6 at each site.
   Grad school application: Group interview. 10 students present for interview. Three sites, main site had a handful of faculty, two remote sites had a handful of interviewees. Faculty would rotate who was interviewing at any given point in time.
   Work Planning: informal; 1 on 1.
   Formal; 10-15 people some on telephone connections only.

Human Factors

5. If have not met some participants beforehand, would you contrast you initial impressions versus those gathered during a face-to-face meeting?

   PIG nodes often have a bad camera angle so you may not be able to recognize the individual head-on. You also do not gather nonverbal information such as: physical characteristics (Tall short etc.), how they walk, how they chose to orient themselves around the table or the insinuation of the handshake.

6. If you have met some of the participants prior to the meeting in person, how do you feel the AG captured the person's appearance/persona? That is very dependent on the camera angle. Sometimes a person's persona can be altered based upon their comfort level with the technology and the cameras.

7. Did you experience any audio delays, glitches or static? Yes. That's normal.

8. If yes, to your knowledge, did this interfere with the intended content of the meeting in anyway? I have seen that happen. If I were running the meeting I would restructure the meeting to allow the person with the technological difficulty to present later in order to

give them time to fix the problem. It can interfere with the natural flow. Technological difficulty can be similar to interruptions from a loud speaker.

9. Were there any conversational interruptions? All the time.

10. If so, what caused them?

    Same as real life behavior. You have to ask specific people for input. You can't merely look over like in face-to-face communications.

11. Were the other participants able to establish 'eye contact' or create a sense of eye contact with you and vice versa?

    There is no trick for establishing eye contact.

12. Did you observe head nodding? Yes.

13. Did you observe any non-verbal cues that alluded to you when it was your turn to speak? (I.e. shift in eye contact; body movement) No unless it's a one on one meeting it's fairly ambiguous.

14. Did you observe any changes in posture during the meeting? Yes.

15. Were you able to get a feel for the other participants' feelings for certain subjects through non-verbal communication (i.e. facial expressions, eye movement, posture)?

    Yes. Depends on size and camera angle. You hear things, like laughter, shuffling of papers on a desk; or you see them rubbing their forehead or crossing their arms.

16. Do you use the personal image that appears on the screen? Yes.

17. If so for what purpose?

    To ensure you don't wander out of camera angle. I use it as a mirror to monitor the delivery of important talks or lectures. I find it reassures me that they can see me.

18. If not; why not? N/A

19. What do you feel is the best room set-up for formal meetings?

    There is not one best setup. Ideally all participants should be in a conference style node for this type of meeting. However, depending on what your particular room style is, that may not be possible.

20. What do you feel is the best room orientation for collaboration?

    There really isn't a lot of experience with research collaboration.

21. Do you feel there is a maximum number of participant windows above which you cannot focus on everyone equally?

    It really depends on the layout. One big window with 30 tiny windows might be easier than eight windows poorly arranged.

22. If yes, in your opinion, what is this maximum number? N/A

23. Over the course of the meeting did you feel distracted at any time and by what?

    Yes, outside life just like a normal meeting. Minor annoyances might be microphones that need to be fixed, or people who changes batteries in the middle of a meeting, if you move out of camera, network loss in the form of video or audio quality. It's more distracting as a node operator. People are content to work around the problems.

2.4 Interview with Professor Sullivan and Ziji Wu

1. What was your role in the collaboration?

   We are both researchers. Our research is mathematically based however a good portion is visual. Prior to the AG we would collaborate face-to-face.

2. How did you find presentation of data?

   The presentation was encouraging but not sufficient. We are limited by bandwidth. For example a TV is 24-30 frames per second, the AG is 4-5 frames per second. Therefore the animation needs some improvement. Also, the display would need higher resolution.

3. How would this type of collaboration compare to face-to-face?

   The exchange of data in face-to-face discussions is far better than audio-visual mediums. For our purposes, the data is far more intensive than the limited bandwidth of AG can accommodate.

4. Did anything strike you as awkward?

   The position of the cameras was a little funny. The presentor is looking at the monitor, not the camera. Has a mirror magic feel.

5. Did you feel your research was safe?

Yes. The data access is protected by security measures.

6. If not what safe guards would you recommend?(nondisclosure agreements)

   N/A

7. Does the presents of the node operator affect you ability to speak simplistically about the research?

   No, not at all. Since we primarily use the AG to discuss progress, security is not that important.

8. It is possible for people to sit in on meetings without being visible on the main screen; how do you safeguard against that?

   Who is allowed to lurk is at the disgression of the node operator. At the Dartmouth lounge and the WPI lounge the entrance password is protected. However, in the course of the development of the AG, like any other leaky security unix system, any hacker can gain access.

9. What percentage of your meeting is brianstorming/resolution of problems/different approaches/extensions of research?

   As I mentioned before, we primarily use the AG to discuss progress, not necessarily scientific strategy or brainstorming.

10. Were there any glitches in the program during your use?

    Undoubtedly. There was some audio clicking and smearing of the visual images. In order to fix the situation, Dartmouth changed their resolution settings and WPI increased bandwidth.

11. If the data is mutually updateable... has there been an occasion where you update it in different ways resulting in confusion?

    This is an unresolved issue. The CPU is mutual, with simultaneous access to only one desktop. As far as I know this is not an issue yet. It is handled the same way as Unix system – when the file is open any other member with the right permissions has the document in "read only" mode.

12. Where is the new data saved?

A script is sent to read the file from the main source. Everyone uses the same file. The entire file is not sent over. In general, the use of AG for research collaboration is still experimental and needs improvement. It would not be a good idea for 1 on 1 research collaboration since most people do not need the visual component.

Appendix 3: A New User's Guide to the WPI Access Grid

A New User's Guide To The WPI Access Grid

Prepared by
Lorin M. Jakubek

Under the Direction of:
Dr. Holly Ault
and
Dr. Julia Mullen

A New User's Guide
To The
WPI Access Grid

has been prepared as an Interactive Qualifying Project and
submitted to the Faculty of the WORCESTER POLYTECHNIC INSTITUTE
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by

Lorin M. Jakubek

April 15, 2003

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PREFACE

I enthusiastically undertook the research for and preparation of "*A new User's* Guide to the WPI Access Grid" as an opportunity to give something beneficial and tangible back to the WPI community before I graduated. An IQP in a state-of-the-art technological field became a perfect vehicle for accomplishing this goal.

We are all aware that change is the only constant in life. In our lifetimes, technological changes could become overwhelming. One reason for preparing "*A New User's Guide to the WPI Access Grid*" was to make it a little easier for the WPI community to acclimate to one of these changes. Hopefully, the technology itself will improve your ability to communicate with colleagues and friends for both work and entertainment. Similarly, I hope that this guide will help to reduce learning time and improve your initial satisfaction with using the Access Grid at WPI. Studies which are cited in my IQP Research Report state that the three critical factors in getting people to acclimate to new technology and then use it, frequently are: the need to reduce the initial learning time, increase the initial ease of use and comfort level, and increase the initial satisfaction with the technology. Sometimes when people have repeated bad experiences with a new technology, they either begin to feel that they are not capable of using it, or they feel that using the technology is simply not worth the effort. Recognizing that everyone has a different affinity for new technology, the goal of this guide is to help you in your initial use of the Access Grid.

"*A New User's Guide to the WPI Access Grid*" is not meant to be a definitive work on the behavioral aspects of using the Access Grid, nor is it meant to be a technical presentation. It is meant to provide information that will be useful at this point in time for the WPI community to use the Access Grid. I would strongly recommend that as the community gains experience, this guide be updated to reflect future requirements. Interim to a formal update, I would further recommend that a Web site be created so that Access Grid users can record their experiences in using the Access Grid by relevant categories, in order to help other users in the WPI community.

Lorin M. Jakubek

Worcester, Massachusetts
April 15, 2003

Table of Contents

If, as it is said to be not unlikely in the near future, the principle of sight is applied to the telephone, as well as that of sound, Earth will be in truth a paradise, and distance will lose its enchantment by being abolished altogether.

Arthur Strand, **1898**

1. INTRODUCTION

The Access Grid is essentially the advanced telecommunications technology that allows groups of people who are geographically separated to exchange both aural and visual information at a high bandwidth in real time. The Access Grid was developed at Argonne National Laboratory, Chicago, IL, in order to provide a global research environment, as well as to study the requirements needed to perform collaborative work in a geographically distributed environment. Today, the uses of the Access Grid have expanded greatly. The important thing to remember is that you now have the opportunity to use this state-of-the-art telecommunications technology to your advantage.

Techno phobia is commonly understood to mean the fear of using either new or existing technology. When people have recurring bad experiences using technology, they tend to blame themselves. They feel incapable of mastering the technology, which results in fear of the technology. In many cases, however, it is really the poor design of the technology that is to blame. Virtually everyone knows how to use the telephone. Think, however, how you feel when you use the phone and get an automated, menu-driven answering system that puts you into a circular menu with no escape except to hang up. You certainly know how to use the phone. The phone obviously works. You know that there are people at the number you called, but a poorly designed system is so frustrating that you never call that number again. The same is true for poorly designed web sites. Think of how much business a company loses because of poorly designed answering systems or web sites. Well there is good news when it comes to the Access Grid. The ultimate goal of the Access Grid is to make the technology totally transparent to the user. There may be some glitches because the technology is still evolving. However there are people where you use the Access Grid technology whose job it is to solve these technical problems so that you can focus on using it. You do not have to be concerned about techno phobia.

To whet your imagination for how you might use the Access Grid, some broad categories might be useful at this point. Any activity in which there is the need for collaboration between two individuals or ten groups of individuals is a candidate for the Access Grid. This might include two scientists working on the same research from two different universities, to the Mayors and their staffs located in the major cities in the United States working on Homeland Security issues. Distance learning is another interesting category. In this case, a course or seminar could be offered at one location and attended by participants at, for example, fifty locations. Alternatively, three professors can teach a course from three different university locations, respectively. Their students would receive the synergistic benefit of their expertise and

perspectives. In the corporate and technological environment there is the continual need to keep current. Seminars and remote technical training are also a significant part of distance learning. Entertainment is another possibility. From art to music, there can be interactive participation by people at different locations to major events being viewed by people at remote locations. Essentially, the same reasons why people meet or gather currently, can be the same reasons why people have Access Grid sessions, excluding of course, those cases where actual physical proximity is required.

Although a new discovery can rapidly change any technology, there seems to be the possibility that the Access Grid could be the telecommunications infrastructure of the 21st Century. As it gains wider acceptance and critical mass, the previous statement may prove true. There are two significant advantages to using the Access Grid. The first is the substantial reduction in travel time, with the coincident savings in money and increases in productivity. The second is the opportunity to gain access to unique communities and events in a real-time interactive way, including both audio and video.

2. TERMINOLOGY and TIPS

As with every technology, there is jargon germane to that specific technology. In using the Access Grid, there are some specific words that you will need to know. Some of these words and phrases are presented solely to increase your comfort level and represent areas for other people who will be directly responsible, while others will directly be beneficial to your using the Access Grid.

2.1 The Grid

The **grid** itself is the totality of all the heterogeneous equipment and software located around the world that allows the communications of high quality audio and video information between locations. This includes the entire complex networks, computers, storage systems, and any special instruments or equipment. It also includes all the systems for managing the resources, security, tracking, accounting, and background communications between Node Operators to diagnose and fix technical problems in real time so that the technology is as transparent to the user as possible.

2.2 Node

The **Access Grid Node**, or simply **Node**, is all the equipment and software that is operated by the technical staff at your location that makes it possible for you to have access to the grid. This also includes the display wall, projectors, cameras and microphones that are strategically placed around the room. It is your individual doorway or point of entry to the Access Grid that makes the real-time sharing of audio and video data possible. It allows you to be seen and heard by other Nodes while simultaneously seeing and hearing participants at other Nodes.

It is important to note that although there are minimum equipment and software requirements for a Node, not every Node has the same equipment and software. Therefore, if you are planning to use the Access Grid, you should contact the Node Operator as soon as possible to describe how you want to use the Access Grid. It is the responsibility of the Node Operator to make sure that the other Nodes will be able to accommodate the technical requirements of your intended use or make alternative recommendations for you to have a successful session.

2.3 Access Grid Site

The **Access Grid Site** is the physical room or rooms in which the Node equipment and software is located, along with all the other items that will be needed for your Access Grid session.

Just as Nodes may have different technical configurations, individual sites may have different physical configurations. This is also important to be aware of since, for example, if you are giving a presentation, you may look at the display screen and see that other sites may look entirely different from each other. Some may have a conference room look, while some may have more of a classroom look. Some rooms may have a wider arrangement and some may have a narrower but longer arrangement. Some tables may have separate monitors or instruments from the others. You should be aware of these differences and be prepared to accommodate these differences when you are trying to obtain and assess non-verbal feedback from the other Nodes.

People have become very accustomed to subconsciously obtaining non-verbal feedback in face-to-face meetings. Eye contact, gestures, and body language give an indication of interest or boredom, agreement or disagreement, and the emotional strength of the response. The new user of the Access Grid should be aware that, although this may still be possible over the Access Grid, the non-verbal feedback should be judged cautiously. The new user should be aware that the staff technician at each Node is monitoring the different cameras in the room and selecting the video output being sent back to the new user's Node. A simple choice of camera angle may unintentionally bias the feedback being received. It is therefore important that if feedback is important to the presenter, the presenter should use other means, like direct questions, to gauge the feedback.

2.4 Access Grid Sessions and Events

An **Access Grid Session** is the formal name for the actual amount of time a person or group spends or plans to spend on the Access Grid An **Access Grid Event** represents the collective sessions being attended for a common purpose.

2.5 Back Channel Communications

As was previously mentioned, the Node technical staff operates behind the scenes and concurrently with an Access Grid Event to insure that there are no technical problems. During this **Back Channel Communications,** all the technical staff at all the Nodes participating in a particular Access Grid Event communicate with each other in order to insure that the event runs smoothly and without interruption. This activity is transparent to the users. This activity is usually done over the Access Grid in parallel to the Event. In some instances, a telephone is used as a backup for any audio failure during the Event or the Background Channel Communication. The presenter may receive a cue-card type message stating that, for example, the audio is out at the Node in California.

While all this background communication insures an uninterrupted Event, the new user should be cognizant that this activity is being performed and that the respective technical staff is monitoring the Event. The new user should carefully consider this fact when assessing the security needs of the information being communicated.

2.6 Bandwidth

Bandwidth is a measure of the capacity of any telecommunication medium for carrying information. It is the difference between the highest and lowest frequency capable of being transmitted. The Access Grid has a wider bandwidth than video-conferencing systems, and for most applications, the Access Grid bandwidth is sufficient. The new user should be aware that for some unique situations, the bandwidth of the Access Grid might not be sufficient. If there is any concern over this, the user should check with the Node Operator prior to the Event. Usually prior to an AG Event there is a technical rehearsal. For a major Event, this is followed by another rehearsal involving the producers and the presenters. Any bandwidth concerns should be discovered and addressed during these rehearsals.

2.7 Display Screen

At the Access Grid Site, there is a **Display Screen**. It is usually located in the front of the room and enables the participants at that site to view multiple windows. The larger center projection is

usually a projection of the local site. The windows around the center window are usually projections from other sites. The Node Operator controls the display screen.

New users should be aware that they will see themselves in the center window just as they appear to the other sites. This may be distracting for some new users. It is like seeing yourself on television in real time as you are giving your presentation. Knowing this ahead of time, new users can use this to their advantage. They can use this to adjust their presentation style. One method for acclimating to this is to practice the presentation in front of a mirror until you feel comfortable seeing yourself giving the presentation. Then, during the actual presentation, you can watch the windows from the other Nodes to gauge feedback.

2.8 Event Control

For certain types of sessions, the new user may want to consider the use of a **Floor Manager.** The Floor Manager can function in many different capacities. The Floor Manager is responsible for the flow of the session and adherence to schedules. The responsibilities can encompass adjustments to the session due to the length of individual presentations, to hand-offs between questions and answers. Additionally, a **Master of Ceremony** may be used to introduce speakers, presentations, or demonstrations.

2.9 Virtual Venue and Reservations

A **Virtual Venue** is a non-physical room that exists on the web in which groups meet for an Access Grid Event. In order to avoid conflicts, a **Reservation** is required to be assigned to a virtual venue. Once you are in a virtual venue room, you will be able to see and hear all of the groups that are operating in that particular venue. If you move to another venue, you will only be able to see, hear and participate in the current venue. In order for you or your group to communicate with other groups, all groups must meet in the same venue at the same time. A member of your local Access Grid technical team is responsible for making the reservation. However, you will need to provide the date, beginning time, ending time, the event topic, a description of the event, a list of other Nodes requested to attend, and sometimes a link where other information can be obtained about the event. The Node technical staff can advise you on how to view the schedule of future events or the archive of events that were scheduled over the past year.

2.10 Time Zones

The new user should be aware that different Sites could be located in different **Time Zones.** The local Site technical staff can be helpful in obtaining information about time zones from the Access Grid Schedule Site. The consideration here is that if an Event will include a wide range of time zones, the time schedule should be carefully planned. If the event will be relatively short, it may be easy to schedule the time at a mutually convenient time. If an event is relatively long, say eight hours, it may be necessary to schedule the Event as two four hour sessions over two days.

2.11 Synchronous and Asynchronous

The Access Grid is a **Synchronous** multimedia tool. It allows simultaneous interactions between people in real-time. Sometimes it is beneficial to supplement Access Grid Events with **Asynchronous,** non-simultaneous, tools like a web site in which participants can post questions,

assignments, profiles, answers to other people's questions or comments at their leisure. This is a good practice in collaborative efforts or distance learning situations in order to update information, answer questions and obtain feedback before the next scheduled Access Grid Event.

2.12 Formal and Informal Events

The new user should be aware that there are **formal** Access Grid Events in which a greater level of planning and technical support is needed, and **informal** Access Grid Events in which, for example, a few people at a few Nodes, can hold regular meetings without much planning or technical support. The new user has to assess the tradeoffs between using asynchronous tools and informal Access Grid meetings between scheduled formal Access Grid Events.

Although there are thousands of terms that can be presented in a section about the terminology associated with the Access Grid, this section was intended to provide an initial overview of some of the terms that the new user might encounter. Some tips were also provided which were intended to assist the new user in identifying certain characteristics of the Access Grid. These may be helpful to the new user prior to using the Access Grid. Some characteristics were presented to illustrate to the new user the flexibility of the Access Grid in accommodating their needs. The key point to remember about this section is that there are technical support people at the WPI Site whose job it is not only to take care of all the technical issues for using the Access Grid, but also to answer questions from users about how the Access Grid might be beneficial to their planned use. It is important for you to get to know the technical support staff and feel free to ask them questions. You should also be aware that the WPI Access Grid Site is relatively new and the technical staff is also on a learning curve. If they cannot answer your questions immediately, please be patient as they are very interested in providing the best assistance possible.

3. HUMAN BEHAVIOR AND THE ACCESS GRID

3.1 Face to Face

From birth, people's minds have been trained to value **face-to-face** interactions as the epitome of all interactions. Face-to-face interactions are the interactions where people communicate in the same location and in very close proximity to one another. The reason that this type of interaction is valued so highly is that it gives the most direct verbal and non-verbal feedback. From eye contact to gestures, body language, visual appearance, and even the way a handshake is extended, provides a wealth of information that is subconsciously conveyed and interpreted.

3.2 Cognitive Burden

Over the years, the telecommunications industry has attempted to mimic and imitate face-to-face interactions and held these interactions as the standard against which the effectiveness of a communications medium was measured. To the contrary, however, some might argue that any interaction in which there is a high **cognitive burden**, that is, a high mental expenditure of effort required to process thinking, reasoning, memory, language and perception, may actually impede the thought process. For example, in a telephone conversation, some people actually pay more attention to the content of the conversation than they would in face-to-face conversation because they are not burdened with some of the social requirements of face-to-face conversation.

The Access Grid is a communications technology that comes closest to imitating face-to-face communications. On one hand, the new user should be aware that feedback will not be the same as a face-to-face meeting, and that a conscious alternative means will have to be developed in order to obtain the level of feedback required. More direct questions may need to be asked. Questionnaires may need to be periodically used, or chat rooms may be set up to supplement an Access Grid Event in order to monitor feedback. On the other hand, knowing ahead of time that there is a difference in feedback, the new user has the opportunity to modify the presentation style to be more interactive than tutorial. Animated enthusiasm can sometimes help. In some cases, a moderator or discussion-facilitator style may work to the new user's advantage.

It is important for the new user to realize that even though the Access Grid cannot mirror face-to-face meetings exactly, it is still a powerful state-of-the-art method of communications. It will continue to evolve and become more powerful as its technological components advance. The Internet went from introduction to a commonplace necessity in less than ten years. It would behoove the new user to become familiar with the Access Grid and gain experience in using it.

3.3 Proximity

In meetings or social events where people are physically present in the same location, there is a sense of **proximity.** There are often similar shared values. One can get an immediate impression of someone in the same location by, for example, how they enter the room or even by their general appearance.

In an Access Grid Event, people generally do not have the same sense of proximity. In many cases because of camera angle or the view that the Node Operator chooses to transmit, it may even be impossible to judge a person's height. Moreover, the brief social interactions that occur

before a meeting begins, is lost to participants at other Sites. If increasing the sense of presence among an Event's participants is critical to the event, the new user may want to try increasing the amount of interaction and the quality of interactions among the participants, in order to make them feel that they are an active part of the Event. Additionally, you may ask the Node Operator to request that all the Node Operators select video transmissions that show a greater field of view.

3.4 Individual Differences

Individual differences, the fact that everyone is uniquely different because of their genetic make-up and life experiences, guarantees that each participant in an Access Grid Event will have different perceptions and associations with the contents of the Event. Also, since the Access Grid facilitates international Events, there could be significant cultural differences that give rise to different interpretations or implications of the Event's content. The new user must be aware of those factors that will effect how an Event is perceived. For example, in the Western World, using the hand gesture to signify "OK" is considered a positive gesture. In the Middle East, the same gesture is considered an insult because it is wishing that the "eye of evil should look down" on the person. For global Events, the new user should make an effort to insure that there is nothing culturally offensive in the content of the Event. For global Events, the use of idioms, colloquialisms and jargon, should be replaced with straightforward language. International units of measure are also preferred. It has also been common practice to give a presentation aimed at the "average-target audience." Considering the impact of individual differences and increasing global audiences, it would be advantageous for the new user to take the time to understand some of these unique differences in order to appeal to a broader audience.

3.5 Gaze Awareness and Eye Contact

Gaze awareness and **eye contact** play an important role in assessing what a person is looking at, their level of interest or boredom, agreement or disagreement with respect to a conversation or presentation. The new user should be aware that during an Access Grid Event, the perception of gaze awareness or eye contact may be very accurate or sometimes biased by the camera angle selected by the Node Operator. Sometimes increasing the interactivity or use of direct questions will clarify the feedback. Repetitive use of these techniques during an Event will help insure continual accurate feedback.

3.6 Turn Taking

In normal conversations, a gesture, glance, or pause in speech may be the signal for someone else to speak. During an Access Grid Event, which is an open discussion or a highly interactive meeting, **turn taking** may become a problem. The new user should be aware that this may occur and that there is a definite need to take an active role in controlling the speech hand-offs. In order to maintain control and increase meeting productivity, the cardinal rule is that only one person may speak at a time. In some cases the new user may choose to have a moderator or facilitator present to control the turn taking.

3.7 Distractions

Since the Access Grid Site has several microphones placed strategically around the room, the new user and all participants should be aware of noise **distractions.** Sometimes the rustling of

papers, moving objects on the table, and moving chairs while changing your seating position can cause a distraction since all Sites will hear the noise from all other Sites. Even whispering to the person next to you may be picked up by the audio system and broadcast to all other Sites. This may prove to be embarrassing. As a presenter, you should also be aware that indelicately placing a book on your table may have a "crashing" effect at other Sites.

Distractions may also occur when there is too much visual stimulus during a presentation. Too many slides or PowerPoint projections, which are changed very quickly, may cause a visual distraction. The same is true if the size of projections varies too much. It should be noted that on a visual aid, unless the presenter directs attention to a specific area, the normal perceptive response is to focus more attention toward the center and less toward the peripheral areas.

These represent the most common behavioral adjustments that a new Access Grid user may encounter. As you discuss the plans of you specific Access Grid Event with the Node Operator, the Node Operator may point out other behavioral adjustments that may be necessitated by your individual Event.

4. HOW TO ARRANGE FOR AN ACCESS GRID SESSION

As you already know, the Access Grid can be used for numerous formal and informal Events including learning, research, work, social, and entertainment. Perhaps the easiest way to get started using the Access Grid is to begin with an informal event with a friend or colleague at another Site. This will provide a friendly environment for your first exposure to the Access Grid. It will also introduce you to the technical staff at the WPI Site and give you first-hand experience in a rudimentary session. Another way to get a feel for an Access Grid Session is to ask the Node Operator if there are any scheduled sessions that you could attend just for the experience.

When you are ready to hold your own Event, there are certain things you should do. As you review the following guidelines, keep in mind that the things you need to do for an informal Event are far less than for a major formal Event.

4.1 First Things

The first thing to do is think through and plan what you want to accomplish via an Access Grid Event. This would include the content of the session, the date, time, how long you think you will need, and if you want the session open to sites you select or to the entire Access Grid. You should also have some idea of whether you will need any special equipment for demonstrations, PowerPoint presentations, interface for laptops, or if you think you will use your guitar at the session. You should also have some idea of the security requirements you may need.

4.2 Working Plan

Once you have a working plan, you should contact the Node Operator as soon as possible to discuss your plan and to determine the scheduling logistics for your Event. The Node Operator will give you some helpful feedback and check the schedule. This will also make the Node Operator aware of any special technical requirements for which the technical staff will have to be prepared. The Node Operator will also inform you of any format requirements that may be necessary for your presentation material.

4.3 Required Information

Once you think that your event is ready to be scheduled, you will have to provide the Node Operator with some information for scheduling the Event. This includes:

a) the day and date (Tuesday, 04-15-2003)
b) the beginning and ending times (1:00 PM - 3:00 PM EDT)
c) the title of the Event
d) a brief description of the topic
e) a list of sites you wish to connect to, or
f) a statement that "all sites are welcome to attend"
g) if possible, a link where more information about the Event can be obtained

4.4 Node Operator

It is typically the Node Operator's responsibility to inform any presenters about what to expect and how to act during a session. If you are planning to have guest presenters, you could prepare them or suggest that they speak with the Node Operator.

4.5 Lead Time

If any material needs to be uploaded, such as a PowerPoint presentation, you should ask the Node Operator what lead-time is required for uploading the material before your Event. Please give any such material to the Node Operator in plenty of time.

4.6 Complexity

Depending on the complexity of the Event, the technical staff might have a technical rehearsal. This would include the technical staff from all the invited sites to ensure that the Event will run without interruption. In some instances, another rehearsal might be held with all the presenters to make sure everyone knows what to do, to make sure PowerPoint presentations run smoothly, and that there is coordination between the presentations and the technical aspects of the Event. As a new user, you can ask the Node Operator if it is possible to schedule a rehearsal before the actual Event to "get the feel of the room."

4.7 Contingencies

You should also have a discussion with the Node Operator to plan for contingencies and emergencies. The Node Operator should prepare you for how the Node Operator will communicate with you and what you should do if there are some problems that cannot be resolved on the back channel in real time. Although most Events run without any interruption, you should still be aware of what to do just in case there is a problem.

For major formal Events or presentations that are critical, it may be a good idea to ask the Node Operator to schedule a formal dress rehearsal. The dress rehearsal can be recorded. If there is a major technical failure at your Node, the prerecorded presentation can be played. This will not have the same real-time interactive benefits that the Access Grid offers, but it may avoid a disaster.

4.8 Getting to Know You

In certain circumstances it may be beneficial to contact people at the other sites before the scheduled Access Grid Event. Sometimes extending a personal invitation, briefly discussing the Event, obtaining initial feedback, soliciting suggestions and, in general, getting to know the other participants, can provide valuable insight that would make your Access Grid Event more successful.

Now that you have done everything you need to do for your presentation, relax and enjoy the new technology at your disposal.

DETAILS OF SPECIFIC USES OF THE ACCESS GRID

5. Distance Learning

The Access Grid certainly raises the technological bar when it comes to distance learning. In a classroom setting, a student is a natural member of a community because of a community's inherent nature or mutual proximity. Since this mutual proximity is absent from on-line courses, it is conceivable that participants might feel disconnected, to some extent, from the learning process. The informality of a proximate community facilitates the exchange of questions, ideas, information, and expounding on particular subject matter.

The new user should be aware that the Access Grid cannot totally replicate a true classroom setting at this time. Even participants at the same Node do not seem to interact in the same manner as in a normal classroom. There appears to be less pre-session interaction by attendees at a given Access Grid Node since they are not as familiar with one another as they are in a classroom setting. The new user should also be aware that there are some methods they can use to increase participation and the feeling of belonging to the class. One method currently being used to encourage more participant interaction is to have a participant web site or chat room where profiles are listed and the participants have a mechanism for exchanging ideas, asking for help with the work, or just finding out more about the other participants. Although the same technique can be used in other learning environments, they are especially helpful to presenters using the Access Grid as it provides informal feedback that they can use to modify the teaching session.

Circumventing psychological distance

Instructor-Centered Learning Environments

In a traditional classroom setting, psychological distance is minimized since participants overtly maintain the simple sense of sharing the same space. In a regular classroom situation, students are usually more familiar with one another and interact accordingly. When students are at different locations, the probability is low that they would have this same sense of familiarity. Correspondingly, interactions are fewer unless the instructor actively initiates interaction. The sense of psychological distance may be increased when the instruction is one-directional. In this environment, the instructor transfers information, examples, and answers to anticipated questions, but does not build a rapport with the students. This lack of rapport, which makes the process totally impersonal, can cause psychological distance. Although this can also happen in a conventional classroom, it is more prone to happen when participants already have a sense of separation by distance. The new user should be aware that in Access Grid Events, it is critical for the Presenter, the Floor Manager, and the Node Operators to preplan and work together to increase the feeling of proximity and connectiveness to the event.

Shift to Learner-Centered Environments

Another method that can be employed by the new user to increase participation is for the Instructor to act as a guide rather than an Instructor. This can be accomplished by asking questions that evoke thought and result in multiple student comments. When asked a question, the Instructor may guide the students with step-by-step questions to help them develop the answers on their own. However, if the material being disseminated is geared to soliciting creativity, understanding, or problem solving skills, one method of accomplishing this, as outlined above, is by asking directed questions in order to teach this process.

Lack of Rapport

Frequently, in a distance-learning environment, the student does not feel part of a community of learners. For example, if a class is one-hour long, a student is less likely or unable to spend any part of that hour building a sense of community with other participants. Lack of rapport precludes the exchange of shared experiences or values, thereby diminishing the learning potential. It is a commonly held educational paradigm that there is a correlation between increased sensory stimulus and the ease of learning. Similarly, just as rapport is important between students; it is also important between the presenter and the students.

For the situations mentioned above, the new user should be aware that the problem could be alleviated if the Access Grid Learning Event is supplemented by ancillary mechanisms that increase the rapport between presenters and participants. The new user may want to try using Web sites and chat rooms. However, since this is essentially a passive mechanism in that participants choose their level of participation, it is critical that the user design presentations, which encourage or even force participation in the Web site or chat room.

Encourage a Community of Learners

The new user may want to try augmenting the Access Grid Event through the use of message boards to increase the sense of community. Students participating in a class can be asked to post information to the message board and submit a biography. With this information, the new user can create lessons that highlight the shared experiences of the students. This also allows the new user to welcome students in a more personal manner. Where several students may want to discuss a topic in greater detail, the new presenter of an Access Grid Event may additionally suggest student-student private chat-rooms. The use of message boards and chat rooms will enhance a sense of community between the new user and the participants.

Another technique that the new user might employ to increase the sense of community and participation, is to establish connections with remote locations; for example, fifteen minutes before and after the official lesson. This allows the new user additional time to communicate with the students, and the students to interact with each other. The new user is encouraged to try these methods.

Untimely Responses

The new user should be aware that another major problem with distance learning is untimely responses. Lack of proximity can make the teaching experience impersonal for the new user. This in turn puts less pressure on the new user to return assignments, answer questions, or provide feedback on a timely basis. The new user should be aware that untimely responses may

put the participants at a disadvantage since they are unable to gauge their actual understanding of the subject material or receive additional information they may require. As a result, participants may feel helpless, forgotten, or unimportant, resulting in a sense of psychological isolation.

The new user will find that the Access Grid provides a mechanism for questions to be answered in real time just as they are in a conventional classroom or meeting. Similarly, as in a classroom or meeting setting, the decision to answer, defer, or leave for future research by the participants, is at the discretion of the new user. Again, augmenting the Access Grid Event with, for example, chat rooms, the new user may find it beneficial to have certain questions not answered in real time, but discussed by the participants in the chat room.

As with conventional educational methods, it is important for the new user to monitor the direction of the discussion so that erroneous information is not permitted to infiltrate the discussion and to insure that answers are received in a timely manner relative to their importance to continuing instructional progress. This is especially true of the Access Grid since chat rooms can essentially be active 24 hours a day between events.

Timely Responses

The new user should be very cognizant that a timely response to any type of open question is critical. It would be very helpful to the participants if the response were also concise and constructive. This will help the new user avoid any problems with the participants feeling disassociated from the event or the new user.

Instructional Feedback

The new user may feel at a disadvantage when first using the Access Grid when it comes to perceiving or reading non-verbal cues. In a traditional classroom, instructors can sense when students understand a topic, when they are bored with a topic, or completely confused. When sharing the same room with the students, an instructor receives direct feedback and can adjust the teaching style, rate of information dissemination, or even ask direct questions to gauge participant understanding.

However, with the loss of proximity, the new user may not be able to assess the direct feedback that they are accustomed to receiving. The new user may feel that they have no mechanism for judging feedback on a timely basis in order to adjust the approach they are using for the material they are presenting.

The new user must be cognizant to elicit verbal cues in order to assess feedback. The new user can try to obtain instructional feedback through the response to the problem sets they assign. Additionally, they may try using either periodic surveys or surveys at the end of the session. The new user may also choose to schedule a panel discussion dedicated to obtaining feedback. These practices are considered good teaching evaluation techniques in a conventional educational setting. They are especially important for new users to try over the Access Grid, since the Access Grid is a new technology in which the new user must calibrate the accuracy of the feedback they are receiving.

Request Student Feedback

The new user should be aware that there is no substitute for directly requesting participant feedback. This can be accomplished formally through periodic assignments or informally by simply asking, "Is this clear?" The new user should get into the habit of frequently asking questions of the participants. This is probably one of the easiest ways that a new user can obtain feedback.

Data Intensive Research Collaboration

With respect to collaborative research over the Access Grid, the new user should be aware that there are some positive and negative aspects. Resolution and bandwidth for animation may present a problem to a researcher in certain circumstances. Security of information for a researcher may also be another problem since technical staff at each Node will essentially be monitoring the Event. The new user should make it a practice to discuss any of these types of issues with the Node Operator.

The new user should be aware that with respect to collaborative research, a critical cognitive factor is the establishment of mutual trust. This is especially true if the collaborators have not formed a collaborative relation prior to using the Access Grid for specific research. The video portions of Access Grid technology can alleviate some of the initial skepticism. The new user may want to schedule an Access Grid Event with the prospective collaborator in order to gain a better sense of trust. In this Event, they might also discuss shared values as a means of establishing mutual trust and understanding. In an extreme case, the new user may need to initially schedule a face-to-face meeting with the prospective collaborator before meaningful work may commence on the Access Grid.

General Meetings

The new user should feel confident that one of the main benefits to using the Access Grid is the reduction in travel time. This is also a critical concern especially after the events of September 11th and continuing threats of terrorism. Meetings are dependent upon high quality audio and video capabilities. The new user of the Access Grid may already have some experience with a video conferencing system. In general, the Access Grid technology is more transparent to the user than that of video conferencing. The following categories are provided for the new user to see how the Access Grid has solved some of the cognitive problems inherent with video conferencing.

Audio Delays

With video conferencing, audio delays can be expected. In simple cases, the audio delays are just an annoyance. However, in extreme cases, audio delays can change the intended content since the audio channel is out of phase with the video channel. For the Access Grid, audio delays are the same as in normal conversation. In the rare case, if there is a significant problem with the audio channel, telephone backup can be used to a remote Node.

Poor Audio Quality

Sometimes in video conferencing, audio delays can change the contextual meaning. Inherent speech ambiguities and minor slip-ups are oftentimes overlooked due to static, fuzz and poor audio quality. Participants find themselves concentrating more on trying to decipher the audio rather that concentrating on the content of the meeting.

This is not generally a problem with the Access Grid. There is one consideration that should be noted regarding audio content on the Access Grid however. That is, all of the background noise from all the Nodes is transmitted equally through the speakers in the room. Therefore, paper shuffling, moving things on a desk, etc., may be a distraction. Even if one participant whispers to another, everyone may hear it. This may not only be distracting but even embarrassing. Presenters should also be aware that if they, for example, put a book down too hard on the table, it can make a very loud noise at the remote sites. This is a technical issue that, to some extent, can be compensated for by the audio computer. When the compensation is not great enough at entertainment events, this can cause distractions. This is another area where, if the new user is concerned, they should speak to the Node Operator.

Visual Inputs

Lack of Appearance

The way people present themselves, their choice of dress, and their proximity to another person during a conversation, subconsciously determines personal credibility. For a meeting to be successful, the new user should be aware that a sense of credibility must be established. A major complaint of video-conferencing is the inability to accurately convey personal characteristics. Facial expressions and eye contact are also important aspects of meetings. Facial visual inputs convey a sense of what the speaker and listener are feeling. Video-conferencing significantly limits a participant's ability to access this non-verbal information.

For the Access Grid, eye-to-eye contact is less of a problem. When it is a problem, it may be caused by the camera angle and the view the Node Operator chooses to transmit. Since the Node Operator chooses the video images being transmitted on the Access Grid, the new user should have a discussion with the Node Operator, who then communicates with other Node Operators over the back channel, if certain video choices are preferable.

There are some things that are not a problem in Access Grid use, but are things that the new user should know. For example, if the presenter moves out of the camera view, this can be distracting to the participants. Some presenters use the monitor as a self-guide to staying in front of the camera.

Visual input and cues may be dependent on the configuration of the room itself. For example, it might be easier to gain visual cues from an arrangement of one central viewing area surrounded by many smaller windows of equal size. The Node Operator plays a critical part in the selection of views to transmit. It is advisable to speak to the Node Operator regarding any concerns you might have over establishing good video contact.

Lack of Visual Emblems

Visual emblems are gestures used instead of words. For example, the use of a headshake may signify either "no" or approval, the meaning of which can only be ascertained from the total context of the interpersonal interaction. Collective learned experience has enabled people to assess the significance of visual emblems. They can quickly judge if this conveys friendship or peer-like respect.

There is less of a loss of visual emblems with the Access Grid than video-conferencing. New users, however, may need to look for and rely on other non-verbal cues. The Node Operator selects the views to be transmitted, which may vary from panoramic to tight zoom shots. With the exception of people at each individual site, the loss of visual emblems can sometimes be minimized to the Access Grid participants. The new Access Grid users can alternatively try using verbal cues to gain the same information that could be gained in a face-to-face meeting.

Proximity

During face-to-face interactions, proximity and orientation are indicators of personal attitude and demeanor. In general, either direct proximity or the sense of proximity is considered beneficial. Obviously, users of the Access Grid are spatially separated. The new user should make a conscious effort, if they are a sole presenter, to make all participants feel as if they are actually present physically at the meeting.

Just as participants choose proximity, they also choose an orientation. In general, for competitive tasks, people sit opposite one another, while for cooperative tasks, people sit side-by-side. For video-conferencing, there is no choice of orientation. The camera is usually placed on top of the monitor and as a result participants are forced into competitive positions. For the Access Grid, there is more flexibility in choice of room arrangement, thereby giving a better sense of establishing a more natural orientation and setting.

Turn Taking

Shifting the conversation from one person to another is accomplished very naturally in face-to-face conversations. In video-conferencing systems, this task is sometimes not as easily accomplished. The common jargon is to refer to this as turn taking. It is not only the method by which continuity is maintained but also it is psychologically perceived as an act of mutual attention and responsiveness. It is governed by audio and visual cues in the form of head nods, slight utterances like 'yes' and 'um' and eye contact. Most video-conferencing systems do not restore eye contact efficiently to act as a timely cue. However, with the Access Grid, this problem maybe minimized by the responsiveness of the Node Operator in selecting views which most represent the reality of the event.

The new user should be aware that in some cases, the camera cannot be placed in direct alignment with the picture of the eyes. So if a person believes they are looking a person in the eyes, their gaze may be elsewhere, based on where the camera is actually located. In an extreme case, if a person gazes in a certain direction and inadvertently looks in the direction of a camera, it can mistakenly be taken as a signal for someone else to speak. This may result in disturbances and interrupted conversation. It is possible to achieve some semblance of eye contact if the

presenter looks directly into the camera instead of the remote location to which they are speaking. In a one-on-one meeting, if the camera is place just above the main remote window the participant can look at the remote site while talking and still mimic eye contact.

Entertainment

With respect to audio entertainment events, it is crucial for the Organizers, Floor Managers and the Node Operators to plan the event carefully and well in advance of the Event. In "community" type events, there has to be a definite strategy in place to manage the background noise. If the people at the different Nodes become noisy, this noise may be transmitted along with the audio presentation to other Sites. This could be very disruptive. A Floor Manager at each Node may be required to control the participant's noise level, or to even ask them to leave if they become too noisy.

9. CONCLUSION

The WPI Access Grid Site is relatively new. As with the implementation of any new technology, everyone learns about the technology by using it. Fortunately, the goal of Access Grid technology is to make the technology itself as transparent to the user as possible so that the new user's only real responsibility is to try using it. The technical staff will help as much as possible. Hopefully this guide gives you some insight as to what the Access Grid's potential is, as well as some information that will make your initial use easier.

As was previously suggested, initially try using the Access Grid with a friend or colleague at a different Site. This will give you some experience and exposure in a non-threatening environment. It will also give you the opportunity to meet the technical staff who will be able to help you with future Events. At firs, you will find that you will try to fit the Access Grid technology to the way you are currently accustomed to communicating. As you continue to use the Access Grid, you will find that it will be easier to plan your activities around maximizing the capabilities of the Access Grid. This is a natural progression in the evolution and use of new technology.

The most important thing for the new user to do is continue to try to use the Access Grid technology in order to increase comfort level. Also, try attending Events that are scheduled and open to all Sites. You can also gain experience in this manner as a passive participant, while seeing how more experienced users run and manage Events.

The Access Grid is a very powerful telecommunications tool that can be used for learning, work, social, and entertainment activities. As its use expands, the Access Grid community will have unparalleled opportunities for innovative communication of knowledge and information. WPI is fortunate to have access to this technology. I would encourage everyone in the WPI community to become familiar with its use.