

2001 LTER Technology Task Committee - Working Group Report Archbold Biological Station, January 8-9 2001

(<http://www.lternet.edu/technology/2001techtask/>)



By working group members: [Brian Kloeppe](#) – CWT, [Paul Hanson](#) – NTL, [John Thomlinson](#) – LUQ, [Jay Ziemann](#) - VCR, [Mike Rugge](#) – FCE, [Bill Michener](#) – NET, and [John Vande Castle](#) - NET (editor)

The committee would like to thank Hilary Swain and the staff of the Archbold Biological Station for their help and assistance during the meeting.

Background:

The full [LTER Technology committee](#), consists of one representative per LTER site. The committee met in 1999 to review in general, current technology needs across the Network. The 1999 [LTER committee report](#) contained a number of recommendations and provided the background for this meeting. In January of 2001, John Vande Castle, the committee chair, organized a subset of the committee as a working “task” group to revisit LTER technology issues. This report is a summary of discussions from the meeting of this group was held at Archbold Biological Station, January 7-9, 2001.

Initial PowerPoint presentations also provided background for the meeting and documented past and current efforts. These reports and links to the presentations:

John Vande Castle - [Meeting agenda, goals and background information](#)

Paul Hanson – [Wireless Technologies](#) and LTER 2000 All Scientists Meeting [Wireless Workshop Presentation](#)

John Thomlinson – [Wireless and LTER Remote Sensing Issues](#)

The “Technology Task Committee” focused on the following issues:

- Follow up on items from the last full LTER Technology Committee meeting
- Follow up and document items from the All Scientists meeting
- Document potential technological needs for "LTER" type sites ranging from field station to proposed NEON sites.
- Prioritize technologies and related training activities that could be implemented across the LTER Network.

The committee reviewed past recommendations for important technologies and discussed which efforts could be accomplished within a reasonable framework of time and money. The committee discussed the items and documented the timeframe within which they could be implemented and estimates of the costs for each.

The following technologies were identified as important for implementation within the LTER and associated Networks. Discussion of these technologies was used as a basis for the prioritized list of action items.

- Automation of site measurements - Existing, Emerging and Needed technologies
- Portable computer technology for field notes, Existing technologies

- Real-time data communications - Existing, Emerging and Needed technologies
- Datalogging systems - Existing, Emerging technologies
 - Automated data transmission - Existing, Emerging and Needed technologies
 - Short range Ethernet - Spread-Spectrum wireless - Existing technologies
 - Long range digital serial data transmission – Existing technologies
 - Cellular digital packet data (CDPD) Existing technologies
 - Satellite data technologies for transmission of data – Existing (emerging)
 - Robotic observation packages - Emerging and Needed technologies
 - Optical Sensor Measurements Existing, Emerging and Needed technologies
 - Night observation video - Existing - Emerging and specialized technologies
 - Micro-sensor systems – Emerging and Needed technologies
 - "laboratories on a chip" for field and laboratory measurements - Emerging technologies
 - Small-package GPS systems (animal observation/tracking) - Emerging technologies
 - Automated camera systems – Existing technologies
 - Standardized genetic mapping tools for species identification – Emerging, Needed technologies
 - Long-term sample preservations and storage – Existing – Funding needed and implemented across the LTER Network

Terms for technologies:

Existing	Exists and is useful today, may or may not be evolving
Evolving	Just coming on line, beginning to be useful but not fully developed, shows promise
Needed	Highly needed but not yet available due to technology (or exceedingly high current cost)

Summary:

These primary items the committee identified are summarized as:

1. The Technology Committee will develop a Web portal providing access and documentation to significant information on new technologies for LTER research. The effort was initiated by Brian Kloeppe and the Technology Task Committee and will be maintained by John Vande Castle at the LTER Network Office.
(<http://www.lternet.edu/technology/portal>)
2. A series of training workshops is needed to educate users and potential users of new and emerging technologies within LTER. These include the following areas:
 - a. Wireless data transmission at LTER sites
 - b. Advanced sensor technologies for field and laboratory sensors. This will include medical, engineering and nanotechnologies.
 - c. Applications and capabilities of hyperspectral remote sensing data
3. Acquire Landsat data for LTER research: Costs for 2 scenes per year of all 24 LTER sites will be approximately \$32,000
4. Obtain and archive High Resolution Aerial Photography for use in site-level field research (including declassified, historic reconnaissance data).
5. Digital Video – Real-time observations, monitoring and use for site documentation and virtual tour: Digital video, digital still and webcam technology. Recommendations for a workshop and an on-line technology guidebook.
6. Coordinated remote sensing activities within the LTER program – Initiate a small committee to focus on coordinated remote sensing issues across the LTER Network.
7. Make TERRA and related products easily accessible for the LTER Network (especially from MODIS)
8. High performance computing Continue to coordinate and expand massive data storage, modeling and visualization through NPACI efforts with SDSC and other interactions. A summary is presented in this report.
9. Use of High Performance GRID Networking technologies.

1. A Technology Web portal

The Technology Committee will develop a Web portal providing access and documentation to significant information on new technologies for LTER research. The effort was initiated by Brian Kloeppe and the Technology Task Committee and will be maintained by John Vande Castle at the LTER Network Office. (<http://www.lternet.edu/technology/portal>). Suggestions, and additions to the information can be submitted to [John Vande Castle](#).

2. *In situ* environmental sensors

LTER scientists continually have needed to make numerous types of field and laboratory measurements. In the field, there is a special need to have compact and robust instrumentation that requires a minimum of servicing. Today many of our programs deploy sensor arrays or sondes to measure such parameters as temperature, salinity/conductivity, oxygen, pH, redox, several forms of solar radiation, and other measurements. While some of these sensors are capable of accurate measurements, they require varying degrees of maintenance in order to maintain accuracy and proper response times. As an example, pH and oxygen probes are notorious for drift and are highly subject to bio-fouling, as well as poisoning by normal environmental constituents such as sulfide. New technologies are emerging that promise to greatly reduce these interferences and problems, reducing maintenance and increasing data flow and veracity.

The purpose of this section is to introduce new and promising technologies and it is not meant to be an exhaustive review of the commonly used current methods. Given below will be several examples of these technologies that exist today. These examples describe on the products of two companies. This is not meant to be an endorsement of these products to the exclusion of other equally modern products. These are simply ones with which we are familiar, and we welcome other examples.

Solar Radiation Today many LTER and similar scientists use instruments to measure Photosynthetically Active Radiation (PAR) and other forms of solar radiation. Many scientists rely on the highly reliable and robust systems, such as those made by Li-Cor. These measure PAR either in a terrestrial environment, or submerged. Sensors are available in either 2 or 4p configurations. For many applications these are fully sufficient, however for studying the effects of algal blooms or turbidity plumes of differing color and albedo on submerged plants such as sea grasses, more information is desired. Until recently the available submersible spectroradiometers have been large, expensive, and cumbersome to use.



For more detailed light field information, Ocean Optics recently introduced a miniature spectrometer that is barely bigger than a deck of cards. The USB2000 is powered by and communicates with a portable computer through a USB port. Radiation is brought in by a fiber optics cable that can vary from a few cm to 10's of meters. The active end of the cable can be raised into a canopy, directed at specific objects, or submerged 20 m in seawater. The unit measures from 2-1100 nm, and is customizable. Full scans are as rapid as 13 ms. This device gives the investigator greatly enhanced information about the environment, and the data can also be integrated to make it compatible with other more traditional sensors. The unit itself is about \$ 2,000, and fiber optic waveguides and other accessories range from several hundred to several thousand dollars, based on requirements. With this type of device as a base, it is possible to measure ambient and reflected light as well as transmitted light, as in a spectrophotometer for conventional nutrient analysis, or for fluorescence

applications in conjunction with an excitation source.

Oxygen and pH These are two measurements routinely needed by ecologists that are not difficult to perform for single measurements (except in high sulfide areas), but are commonly subject to fouling and drift for longer-term continuous measurement. The Ocean Optics submersible pH unit measures pH by optically tracking the color change of a pH-sensitive disk, similar to the more highly sensitive litmus-type dyes, but embedded in a solid-state matrix.



The FOXY (for Fiber Optic oXYgen sensor) unit operates by using a 470 nm light in

pulsed or continuous transmission as a stimulation pulse. The USB2000 then measures the partial pressure of gaseous and dissolved oxygen by color change in a thin-film coating on the probe tip. The system has a faster response time than conventional sensors, is highly stable, and is insensitive to sulfide.



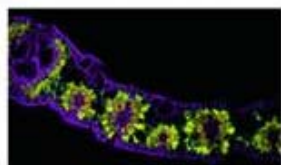
From these real world examples, it would seem that optical methods show much promise for further development, and that compounds that change color, as the pH dyes as the parameter of interest changes, or show changes in intensity of induced fluorescence with change in saturation state, could be developed for many other parameters of environmental interest.

Photosynthesis Determination of plant photosynthesis, and of the effects of changes in environmental conditions (eg. temperature, salinity), or exposure to toxicants on rates of photosynthesis is of fundamental importance to ecologists at numerous spatial and temporal scales. Numerous methodologies have been used to measure (or estimate) plant photosynthesis. These methods vary from determining changes in CO₂ or O₂, with methods ranging from Warburg manometers to gas sensors, to measuring leaf growth or collecting leaf litterfall. These vary greatly in the equipment required, the subsequent cost, and the degree of alteration or destruction of the plants being studied.

A new method to recently emerge uses Pulse Amplitude Modulated (PAM) Fluorimetry which applies a pulse-modulated light for selective detection of chlorophyll fluorescence yield. With the addition of PAR measurement, the apparent electron transport of Photosystem II can be calculated.

MICROFIBER-PAM Chlorophyll Fluorometer

based on PAM-CONTROL Universal Control Unit for small spot measurements down to the single cell level in different layers of photosynthesizing tissues.



The Walz Company markets a variety of units to determine productivity of plants in terrestrial settings and submerged to 50 m. The field versions of this equipment are extremely light and compact. The methodology is completely non-invasive, and readily lends itself to repetitive measurements on the same plant or leaf over time.

Proposed Workshop:

Workshop organizers:

- Jay Zieman, Bill Michener, Paul Hanson

Objectives:

- Transfer of information about existing technologies in industries other than ecology into ecology
- Review state-of-the-art sensor technologies
- Design optimal sensor arrays
- Identify existing, emerging and needed technologies

Participants:

- Engineers, ecologists, biomedical technologists, industry reps/developers (e.g., Campbell Scientific, Hydrolab, LANL, Ocean-Optics, WALZ, YSI, LiCor, Onsite, GE Medical Systems, LTER/NEON reps, NSF observers, NASA

Logistics:

- 3-4 day long workshop

Products:

- Web materials
- White paper (technical report)
- BioScience article

3. Wireless Data Transmission at LTER Sites:

Background:

The Luquillo (LUQ), North Temperate Lakes (NTL) LTER sites and the LTER Network Office (NET) have implemented wireless spread spectrum communication technologies – both for both serial (figure 1.) and Ethernet data transmission. Both Luquillo and North Temperate Lakes have been the focus of wireless field tests by and NSF funded grant to Old Colorado City communications (<http://wireless.oldcolo.com>). Discussions for the implementation of wireless technologies at the Bonanza Creek (BNS) and Toolik Lake (ARC) LTER sites has also taken place. Documentation of the experiences and discussions can be found at: <http://wireless.oldcolo.com/biology/LoquilloMenu.htm>. NET is currently investigating the implementation of several point-to-point and general wireless technologies for Webcam and data transmission to be used at LTER sites within the Schoolyard LTER program.



Figure 1. An example of serial spread spectrum communication between a laptop computer and a Campbell data logger located on a buoy.

As used here, “wireless” refers to spread spectrum communication in the 900+ MHz and 2.4+ GHz bands of the

electromagnetic spectrum. In this case, spread spectrum has been used to facilitate serial and Ethernet computer communication. Spread spectrum requires no FCC licensing; permits high band-width data throughput; and is implemented by more than two dozen commercial vendors who build ready-to-use computer peripherals. Serial communication has been applied to uploading and debriefing dataloggers, and Ethernet has been applied to both datalogger communication and general LAN communication. For longer distances (i.e., more than a few hundred feet), line of sight is required for Ethernet links and near line of sight is required for serial. This limitation imposes restraints on both field applications and within-lab network communication.

For computer networking, wireless communication is a bit more expensive than traditional land lines, but can provide data throughput rates equivalent to standard 10 Mbit LAN rates (note that 100 Mb throughput on recent standard category 5 wiring is 10 times faster than the best wireless LAN rates). Examples of Ethernet bridges and PC cards include respectively the Aironet 340 Series 11Mbps DSSS Access Point (\$1,200) and the CISCO Aironet 340 11MBPS DSSS (\$189).

Although wireless provides solutions for communication within a site, its line of site limitation makes it a difficult installation for Internet connectivity over long distances. A better solution for connecting field stations to the Internet might be satellite hookups from one of several satellite vendors/ISPs – most notably Tachyon. As an example, Tachyon provides bi-directional IP services anywhere in the U.S. (and many other locations) at throughputs ranging from 64 Kb to 2 Mb in asynchronous mode. Their premium service allows 264 Kb out of the station and 2Mb into the station, at a cost of about \$1,800 per month, with a \$5,000 installation fee. They also sell less expensive services, starting at \$250 per month with lower data rates. Considering that other consortia are developing satellite networks, this currently expensive service might become economically viable at a larger scale sometime in the next decade.

Proposed Wireless Workshop:

The LTER Technology committee proposes a workshop with two main objectives: 1) to inform the scientific community about wireless communication, and 2) to demonstrate the installation and configuration of wireless systems. Specific applications of wireless communication could include:

- Providing Ethernet communication between buildings that currently are not wired.
- Using wireless Ethernet to allow “anywhere LAN access” at a field station.
- Using wireless Ethernet to communicate with smart sampling systems.
- Installing and configuring wireless serial radios to facilitate datalogger programming and debriefing.

The workshop would be held at an LTER site where wireless communication has been installed. Workshop leaders would cover the following information:

- The history and theory of wireless communication.
- How to install and configure wireless devices and their antennae.
- How to conduct a wireless site survey to determine site coverage.
- Using wireless communication with dataloggers.
- Software solutions for live sensor communication and publication to the Internet.

Workshop organizers:

Paul Hanson, Brian Kloeppe and John Vande Castle

Workshop participants:

Participants would include representatives from LTER sites who are interested in implementing wireless solutions. The maximum number of organizers and participants would be 24.

Cost:

An approximate cost at \$750 per person would be \$18,000.

Logistics:

A 3-4 day workshop would be hosted at an LTER site, such as NTL.

Products:

- Web materials
- White paper (technical report)
- BiScience article

4. Landsat data for LTER research:

Science need for Landsat TM imagery:

Almost all the processes and states measured at LTER sites, to be understood fully, must be understood in a spatial context. Land-cover changes around a site, as well as within the site itself, can have major effects on the structure and function of the ecosystems we study. Landsat Thematic Mapper (TM) data give a unique perspective on the land-cover dynamics at a site. For many of the sites, there is a history of up to 15 years of TM data. Furthermore, in conjunction with onsite validation data, TM imagery can be used to scale-up process measurements across a site or a region. Therefore, it is imperative that the sites continue to obtain TM imagery each year. Because of the variability of spectral characteristics throughout the year each site should have two images, based on the prevailing seasonality at the site, per year. The cost of this (approx \$32,000) could be borne by the Network Office or some separate funding source to assure that there is a legacy of consistent, standardized, high-quality imagery for every site.

5. High Resolution Aerial Photography (including declassified, historic reconnaissance data)

High Resolution aerial photography:

There are several emerging, low-cost, high-resolution aerial photography systems. Typically, these use a digital still camera coupled to a GPS and attitude sensors, and they include software to perform precision geocoding. They do not require a customized aircraft, which reduces the cost of an overflight considerably. The current systems are limited to approximately the same wavelengths as film cameras, but it is possible that this will change if sufficient market is seen by camera manufacturers for extended wavelength capabilities. It is not inconceivable that a light-weight, relatively low-cost, TM-like multispectral camera could be available in the next few years if the market were present.

The technology committee will collate information on what is currently available and post it to the technology portal website. Individual sites are strongly encouraged to share their experiences with these types of imagery through the portal. Information to be posted will include vendor names and contact information, special airplane requirements, spatial and spectral resolution, approximate cost, and where applicable, assessments of locational error and general image quality and usability.

6. Digital Video

The Technology Task committee recommended that LTER sites seriously consider investments of equipment and software to acquire and archive digital imagery. The digital data removes the extra step to digitize analog photography, which become increasingly difficult as one moves from more simple still to motion picture video. The digital video recommendation ranges from simple digital camera pictures that can include time, latitude and longitude to processed scenes of [digital panoramic](#) imagery. Digital motion picture can provide valuable information and document experimental procedures.

7. WebCams:

The LTER Technology task group recommended the installation of Internet-based Webcams for real-time monitoring. A number of examples exist, ranging from the more expensive pan/tilt/zoom versions such as at the [Niwott Ridge LTER](#) site, to more simple fixed cameras such as one installed at the [Sevilleta LTER](#) site. The Webcams can be used to remotely monitor current site conditions, as well as climate and landscape changes. The cameras are very useful for observation and documentation of weather conditions during satellite remote sensing data acquisition. Various Webcam configurations exist, but the simplest configurations access the Webcam data through a web page and configured IP address of the camera itself. Installation costs can range from less than \$1k to more than \$7k.

8. Coordinated remote sensing activities within the LTER program

Coordinated remote sensing effort:

The Technology Committee stresses the need for better coordination of remote sensing activities among LTER sites. In the last two years the availability of remotely sensed data has increased dramatically, and this trend appears set to continue for the foreseeable future. Much of these data are novel, for example the hyperspectral imagery from Hyperion, and this will present (technological) challenges for many of the sites.

For maximum leverage of NSF funds, the LTER network must make the most efficient use possible of these remotely sensed products. This can be most easily achieved by good coordination among the sites and the Network Office. A remote sensing committee should be formed, along the lines of the data management committee. The mission of this committee would be to coordinate remote sensing efforts among the LTER sites, to help sites remain current on the new remote sensing technologies and data products as they become available, to share information and technologies, such as algorithms and to position the LTER network and/or individual sites or groups of sites for new funding possibilities related to remote sensing technologies.

The remote sensing committee should meet annually and, for highest efficiency, the meetings should be held at LTER or other sites with (important) remote sensing activities. Examples might include NASA labs, EDC, etc. The committee should have an executive committee of three or four members and the full committee should comprise one member from each site (including the exec committee) for a total of 24 members. The network office should provide travel funds for the annual meeting of the committee.

The Technology Task Committee proposed that the first meeting be held at ESA in 2001. This is being held at Madison, and U.W. satisfies the host institution requirements, being an LTER institution with major remote sensing capabilities. Another advantage is that for this first meeting, travel funds would not be requested from the network office for all participants, since it is likely that many of the members will be going to ESA with other funds. A recommended product from this activity would be a *Bioscience* article.

9. TERRA and related products (MODUS):

MODIS and other TERRA-related products:

The Technology Committee recommends that the LTER Network Office work with the MODIS team, or with the EOS Data Gateway group to improve ease of access to these novel types of imagery by LTER sites. More accessible documentation of the individual products is needed. There is no question that the TERRA products provide an unprecedented opportunity to the sites for monitoring and analyzing land cover and ecological processes, but there is a danger that the sheer volume of data will overwhelm site remote-sensing capabilities. The nascent remote sensing committee would be the ideal body to provide guidance and support to the network in the use of both the products themselves and the data gateway.

10. High performance computing: massive data storage, modeling and visualization

The LTER Network Office has focused on high performance computation components consisting of massive data storage, modeling, and visualization of ecological data. These efforts have focused on NPACI work with the San Diego Super Computing Center (SDSC). The goal of the interactions is to see how LTER ecologists can use the high performance resources. The collaborations are summarized at: <http://www.sdsc.edu/sdsc-lter/>.

NPACI Modeling :

The modeling collaboration efforts have included porting code for MAIZE and a coupled RAMS/GEMTM Models to the multi-node SP system at SDSC. Integrations have permitted resolution by a factor of 25. This increased resolution also allows us to integrate long periods and still resolve mesoscale circulations, and their subsequent feedbacks to biota. The modeling efforts have also been ported to the "Blue Horizon" at SDSC for hurricane simulations. The modeling results can be found at <http://www.sdsc.edu/sdsc-lter/demo0001.avi> and <http://www.lternet.edu/technology/2001techtask/cloud0001.avi> - **WARNING** - THESE ARE LARGE FILES !

NPACI Ecological Data visualization:

Ecological data visualization projects for terrain analysis and vegetation time series change have been investigated. This includes visualization of the RAMS/GEMTM coupled models. A digital "fly-trough" of the Sevilleta and Kellogg LTER sites was generated. SDSC visualization facilities were also used for animation of vegetation changes over the region of the Sevilleta LTER site from 1989 through 1999.

ESS hyperspectral data archive:

Implementation of high performance computing components have been part of a collaborative effort between the San Diego Super Computer Center (SDSC) and the LTER Network Office. The effort, as part of an NPACI Earth System Science (ESS) collaboration, has focused on high performance computation components consisting of massive data storage, modeling, and visualization of ecological data. A mass data access and processing system has been prototyped using the High Performance Storage System (HPSS) at SDSC. The system has been designated the LTER spatial data workbench.

The system provides World Wide Web access via extensible markup language to hyperspectral data and related data products. A prototype web page for data access has been developed (<http://srb.npaci.edu/hyperlterfd.html>). The system permits access to hyperspectral data products, which can exceed 50gb, by associated researchers within LTER and NASA. To date, overflights of 1997, 1998 and 1999 for the Sevilleta LTER site have been placed online. Similar datasets are now prepared for the Jornada LTER site. A user interface is currently under development for improved access to documentation, raw and processed data and links to other computational systems such as data analysis and mining tools.

There are 3 tasks associated with the spatial data workbench:

- Assembling and creating value-added data products from remote sensing data.
- Integration, analysis, and application of these products.
- Ground truth validation of these products.

The spatial data workbench resulted as a collaborative effort to use expertise and resources of the Long-Term Ecological Research Network (LTER), and the San Diego Super Computer Center (SDSC) for a data and computationally intensive analysis and mining of ecologically significant data sets. The collaboration plans to incorporate data sets ranging from localized hyperspectral imagery to global data products of ecological variables. The data workbench will include access to conventional data mining and remote sensing tools in the data analysis.

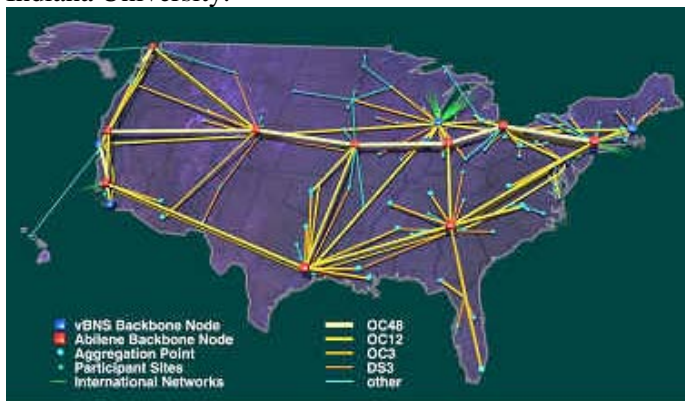
The following data are planned for incorporate into the system during 2001:

- Local hyperspectral AVIRIS (and future space-borne Hyperion) data sets . This would represent analysis of data rich in spectral content – more than 200 data layers, each representing measurements of the earth’s surface in 10 nm wavelength increments. The data are currently collected at a ground resolution of 30 meters, over an extent of approximately 15 by 50km. Some low elevation data is also available at a ground resolution of 4m These data are already available from a pilot collaborative project between the LTER program and SDSC.

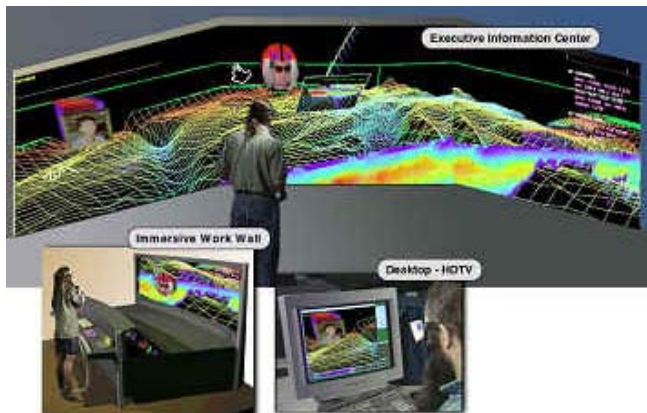
11.Grid interactive resource: High Performance Networking and the GRID

Our ability to collect massive amounts of environmental and other types of data has necessitated the development of the communications and networking infrastructure that is necessary to transmit those data. For instance, broad-spectrum wireless communication now supports automated environmental monitoring in remote areas (see Item 2).

Extensive high performance networks, such as the Internet 2 and STAR TAP are available and useful for facilitating scientific data exchange, model simulation, communication, and teaching. The following figure provides an illustration of the (currently) two Internet2 backbone networks, the vBNS developed by MCI Worldcom and the National Science Foundation and Abilene, developed by the University Corporation for Advanced Internet Development, Qwest, Cisco and Indiana University.



Advances in communication and networking also support advanced scientific applications. Tele-cubicles and CAVEs are different interfaces used for some advanced applications. Immersion in a virtual world, or interaction among people using these interfaces allows people to interact with applications in new ways (see below). The requirements of network applications using these kinds of displays generally require advanced networking. For example, web-based telemicroscopy allows users at remote locations to access advanced electron microscopes for sample analysis.



Another example of the applications supported by high performance networking is the Access Grid which is defined as:

The infrastructure and software technologies enabling linking together distributed Active (Work)Spaces to support highly distributed collaborations in science, engineering and education, integrated with and providing seamless access to the resources of the National Technology Grid.



It consists of multimedia display, presentation and interactions environments, interfaces to grid middleware, interfaces to visualization environments. The Access Grid will support large-scale distributed meetings, collaborative work sessions, seminars, lectures, tutorials and training. The figure illustrates the general format of display from the Access Grid. The Access Grid design point is group-to-group communication (thus differentiating it from desktop-to-desktop based tools that are focused on individual communication). The Access Grid environment must enable both formal and informal group interactions. Large-format displays integrated with intelligent or active meeting rooms are a central feature of the Access Grid nodes. Access Grid nodes are "designed spaces" that explicitly contain the high-end audio and visual technology needed to provide a high-quality compelling user experience.

The Access Grid complements the computational grid, indeed the Access Grid node concept is specifically targeted to provide "group" access to the Grid. This access may be for remote visualization or interactive applications, or for utilizing the high-bandwidth environment for virtual meetings and events. The Alliance Access Grid project is aimed at prototyping a number of Access Grid Nodes and using this prototype to conduct remote meetings, site visits, training sessions and educational events. These Access Grid Nodes will also provide a research environment for the development of distributed data and visualization corridors and for studying issues relating to collaborative work in distributed environments.

The Technology Committee, in collaboration with the Information Management Committee, proposes to assess current LTER networking capabilities and identify future opportunities for enhancing network communications. In addition, current and future applications that can be supported by high performance networking will be examined in light of their relevance to LTER and ILTER activities.

12. Pictures:

2001 Technology Task Committee Meeting [Photos](#) from the Archbold Biological Station.