



MichNet News

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From the President's Desk

Time flies when you're having fun. It's been nearly a year since I arrived at Merit Network as the successor to networking legend **Eric Aupperle**. A lot has happened in the meantime, some of it planned, some of it unexpected, and all of it positive.

The big news of the past year was **Governor Engler's** high-speed Internet initiative. The legislation that Governor Engler signed in Lansing on March 14, 2002 was the most surprising and, from a long-term perspective, one of the most helpful parts of my first year as Merit's president.

Nothing like the Broadband Development Authority was in the cards when I drove to Ann Arbor from Baltimore. I arrived to take up my new job on a blazing hot afternoon in July, and settled into temporary lodgings at the Hawthorn Suites while I waited for my family to join me.

By the end of my first week, I had made my first of many trips to Lansing, where the Michigan Economic Development Corporation (MEDC) was spearheading LinkMichigan, the beginning of Governor Engler's initiative.

In July of last year, there was a lot of skepticism in Michigan at the prospect of new Internet policies from Lansing. Internet businesses, after five years of over-stimulation from venture capital and telecom investment, had hit a trough. Broadband was exciting, yes, but Excite@home was going bankrupt,



Merit President Hunt Williams speaks at Governor Engler's Broadband Breakfast, January 29, 2002, at Walsh College.

the cable companies were mired in service problems, and incumbent telephone companies seemed more focused on obtaining Tauzin-Dingell relief than on providing affordable DSL. Competitive local exchange carriers were struggling for market share. Marketplace choice was often limited to competing monopoly platforms. And earlier state initiatives like the "Michigan Information Network" were, depending on your point of view, either misguided or under-funded or a government intrusion into the affairs of the private sector.

This was the backdrop for Governor Engler's high-speed

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President's Desk

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Internet initiative. The situation was so convoluted that several Internet companies blamed the public for the slow pace of high-speed Internet in the state.

"It's not our fault," they seemed to say. "The Internet infrastructure is there, if only the customers would pay for our high-speed service." That position did not seem like a viable longterm strategy to me.

A Statewide Strategy

In the Spring of 2001, **Bob Filka** and **Doug Rothwell** of the MEDC had the job of developing a statewide plan for high-speed Internet. This resulted in a thoughtful and provocative LinkMichigan report from the MEDC that outlined the main themes of Governor Engler's subsequent legislative proposals.

- Aggregate and leverage the buying power of state government and private-sector groups like Merit.
- Streamline the permitting and right-of-way process and level the playing field for all providers.
- Develop a comprehensive inventory of Internet infrastructure in Michigan and identify where needs exist.
- Provide planning assistance grants for local communities to build new infrastructure in partnership with the private sector.

At the MEDC's invitation, Merit signed up to help manage the Regional Telecommunications Planning Assistance program. Aggregated buying was more difficult to implement. Although Merit serves many large consumers of bandwidth, it was obvious that our buying power, even combined with state government, would barely make a dent in the state's overall infrastructure needs.

On a rainy day in August, I drove to St. Ignace to visit the Mackinac

"Merit, the MEDC, and other interested organizations engaged in some frank discussions about how the state might bring financial leverage to the table . . ."

Bridge, and saw first-hand the graceful and massive structure that spans the two inland seas of Lake Michigan and Lake Huron, connecting the Upper and Lower Peninsulas.

In October, while en route to Michigan Tech and Northern Michigan University in the Upper Peninsula, I saw the physical and economic challenge of bringing high-speed Internet to the beautiful but sparsely populated northern part of the state.

And so Merit, the MEDC, and other interested organizations engaged in some frank discussions about how the state might bring financial leverage to the table to bridge the "capital gap" between the private sector and the public policy goals of LinkMichigan.

MiHi Speed Internet Legislation

When Governor Engler unveiled his "MiHi Speed Internet" legislation in December, the debate was joined. Senate Bill 881, one of several interlocking bills, offered a fresh and ingenious way to finance broadband infrastructure in the state. Governor Engler took a page from a successful method of funding low-income, affordable housing and proposed a new Broadband Development Authority modeled on the Michigan State Housing Development Authority (MSHDA). In existence since 1966, MSHDA has issued more than \$4 billion in state-backed bonds to provide financing to private developers of affordable housing. Governor Engler's idea was to make

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MichNet News

<http://www.merit.edu/michnet/mnn/>

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Glass is Freedom: High-Speed Internet Access with Fiber

Imagine taking the blazing speed of your Ethernet Local Area Networks (LANs) and using your own fiber optic network to provide the MichNet Internet connection to your organization. Dozens of Merit Affiliates are doing exactly that today. The fiber is privately owned, and results in tens of thousands of dollars in savings by replacing high-speed, expensive traditional telco circuits with Ethernet or ATM over fiber.

Any organization connecting to MichNet requires an access circuit from its network's "front-door" to the closest MichNet Point of Presence (POP). With a typical access circuit such as a single T1, the cost to the Affiliate can be \$3,000-7,000 annually. As an organization requires more

bandwidth, Merit adds a second and third T1, doubling and tripling the Affiliate's annual telco cost. Further growth requires a T3 (45M bps) circuit. This is a huge jump in capacity, as well as cost; T3s ring the cash register at \$25,000-40,000 annually. If an organization can connect to MichNet directly with its own private fiber, these telco circuits are removed from the service equation, resulting in significant direct cost savings.

Background

Let's define **customer-owned dark fiber**. This is optical fiber where the organization, the owner, has built a fiber optic network and is responsible for attaching the telecommunications equipment ("light-

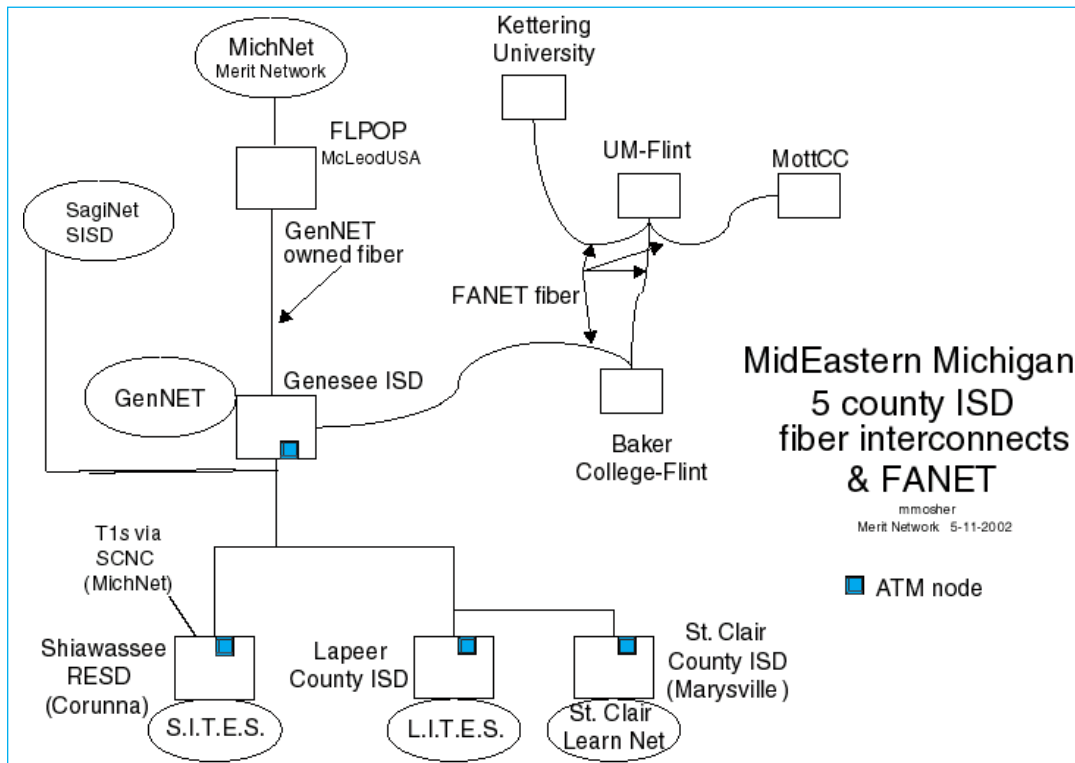
ing" the fiber). Traditionally, fiber networks are built by carriers who then sell a managed service. An example of this would be Ameritech and Verizon, who build fiber infrastructure for their own use, adding switches and connections using fiber and copper wiring to every customer building. They then offer voice and data services which use the fiber infrastructure.

With customer owned fiber, the customer chooses the provider(s) to connect to the fiber and the nature of the services offered. Most often today, this is for internal LAN traffic and Internet service. There is also lots of "local" 2-way interactive video traffic on these networks. The internal LAN and Internet traffic is most commonly Ethernet based or ATM. Ethernet can run

at 10M bps, FastEthernet at 100M bps, or Gigabit-Ethernet (GigE) at 1000M bps.

Who's building these fiber nets?

Intermediate School Districts (ISDs) are clearly leading the way in wide deployment of private fiber. This fits their mission of providing data and video services to the K-12 schools in their regions. There are at least sixteen ISDs in Michigan with countywide, or multi-countywide fiber networks in place today. Several other ISDs have new fiber networks in the works. In many cases the local college or university is a partner in the fiber build.



MidEastern Michigan 5 county ISD fiber interconnects & FANET

mmosher
Merit Network 5-11-2002

■ ATM node

In Flint, FANET connects the University of Michigan-Flint, Baker College, Kettering University, Mott Community College, and Genesee ISD.

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In the Grand Traverse Bay Area, Northwestern Michigan College (NMC) worked with the K-12 community in a five-county region to build one of the first educational private fiber networks in the state. Project Interconnect links school districts in Grand Traverse, Leelanau, Benzie, Kalkaska, and Antrim Counties for both two-way interactive video and Internet access. NMC hosts MichNet's backbone node in Traverse City and all agencies on the fiber get their Internet service via MichNet.

Health care organizations, colleges, and universities commonly have extensive fiber for their campus LANs, and many of these local networks extend to MichNet's backbone.

In Flint, FANET connects the University of Michigan-Flint, Baker College, Kettering University, Mott Community College, and Genesee ISD. FANET is an excellent example of a multi-type networking coalition. Through a connection at Genesee ISD, all these sites are connected to MichNet via fiber, with no "local-loop" telco expenses. For the FANET sites, Merit is contracted to manage the IP service on this fiber backbone.

In Mideastern Michigan, the ISDs have taken the next step of connecting their countywide fiber to each other. St. Clair County ISD, Lapeer County ISD, Genesee ISD, and Shiawassee RESD all have countywide fiber networks in place and have connected to their neighboring ISD. Saginaw ISD has committed to join this partnership, and their connection build should be completed this Spring. This interconnection allows the ISDs to run live video sessions between each of their videoconference rooms. More powerful yet, Lapeer and St. Clair ISDs are receiving their MichNet Internet service via this fiber. In the Fall of

2001, St. Clair was able to turn off a T3 access circuit they were funding to support Internet access.

Risks, Benefits, and Cost Analysis

A major concern with a privately owned network is reliability and management complexity. The advantage of purchasing telco circuits is the confidence that the telcos will ensure high reliability of their managed service. For the most part, T1s and T3s are very reliable, and there is a vendor to call if anything happens to the circuit. The circuits are also, for the most part, highly flexible in that they can be provisioned from any location, to any destination, as desired. The major downside of telco circuits is their high cost.

Many argue today that privately owned fiber networks are actually more reliable and easier to manage because the network architecture is simplified. It is important to note, however, that the management, maintenance, and oversight of private fiber becomes the owner's responsibility. Just as they own the fiber, they also need to own the tasks related to service reliability and managing the infrastructure. These are tasks that would have been delegated to a telco provider in the past.

Cost savings is the primary driver. High-speed telco circuits and Internet bandwidth is very expensive. If an organization can eliminate the annual cost of the access circuit this can justify the up-front investment in fiber. A typical payback on such a private fiber investment can

be 18-36 months. Equally important, the customer gets a 30-year network, with little increases in costs tied to bandwidth. These cost increases now involve equipment upgrades at the fiber ends, as well as upgraded tools and staff skills to manage the network and its services.

Another major advantage is realized through the aggregation of entities on a common local backbone. ISDs can represent the buying power of all the school districts in their region. When ISDs, libraries, hospitals, and colleges all connect on a common fiber network, their buying power increases, and a service provider like Merit can often drive costs down for everyone. St. Clair ISD benefits tremendously from its partnership with Lapeer ISD and Genesee ISD. It is a long haul from Flint to Port Huron. St. Clair's access circuit to MichNet-Flint costs a small fraction of a traditional T3.

For the MichNet backbone, Merit has engineered its own private fiber to enable the provision of very high-speed MichNet circuits in Ann Arbor, Kalamazoo, and very soon in Grand Rapids, Lansing, and Flint. Merit has reaped huge benefits from these same partnering efforts to engage in joint fiber builds to get from our backbone POPs to our long-haul carriers in these cities. An important measurement of Merit's success is the ability to increase network capacities while minimizing increase in costs, and these fiber acquisitions are true realizations of these objectives.

Merit encourages every organization to look at its situation to see if a fiber run directly to MichNet is feasible. The cost savings can be tremendous. Of course, Merit also realizes the strength of a private fiber configuration, allowing MichNet to be your Internet connection for a long, long time. Merit is interested to hear about opportunities in your region where we all can acquire faster service, at lower costs.

— Mike Mosher, Merit

Some definitions and comments on private dark fiber in this article have been borrowed with permission from the Waypoint Fiber - Dark Fiber FAQ (<http://www.waypointfiber.com/>)

PowerPoint presentation on Owning Dark Fiber, and Fiber networking in Flint and surrounding counties: <http://www.merit.edu/~mmosher/>



Ask the Experts: What is PKI?

If you have a question about a new network term or how a specific part of the Internet works, please e-mail it to editor@merit.edu.

Question: What is PKI (Public Key Infrastructure)? How does it work?

Answer: Provided by Sara Peth, Merit Member and Affiliate Services K-12 and Library Support Team

As commercial and non-profit organizations turn to the Internet and other electronic means to conduct business, protecting the confidentiality and integrity of sensitive data like financial transactions and medical records is critical. As a result, data encryption is becoming more common. There is an entire alphabet soup of encryption standards such as DES, 3DES, AES, PGP, SSL, IPSec, PKI, and more. PKI has been prominent in the networking press, but what is it?

PKI (Public Key Infrastructure) is an interoperating system of encryption keys, digital certificates, certificate authorities, and other authorities that identify, verify, and authenticate the people and devices involved in online transactions. PKI also provides the infrastructure of trust (e.g., where trust can be interpreted equally among all parties) based on policies, procedures, and risk management controls that are needed to support secure online transactions. In short, PKI provides a **secure infrastructure** for exchanging data over insecure networks like the Internet.

By using encryption, digital certificates, user certificates, and digital signatures to manage and authenticate users and transactions. PKI benefits include:

- Encrypting information to ensure confidentiality and data integrity,
- Verifying and authenticating a person's identity,

“...the security you put in place must be commensurate with the value of the data and systems you're protecting.”

— Sara Peth

- Enabling the centralized creation, distribution, tracking, and revocation of keys and digital certificates.
- Preventing users from denying that they have participated in a transaction (non-repudiation), and
- Providing digital signatures and timestamps that identify who was involved and indicate when the transaction occurred to prevent forged identities or messages.

All encryption systems rely on the concept of a “key.” Encryption is a systematic means of scrambling information so that it is unintelligible, but will be clear to the intended recipient who has the mechanism to unscramble the information. Mathematically related algorithms used to encrypt and decrypt the data generate the keys.

PKI's foundation is the public/private key pair generated by independent, but mathematically related algorithms (public key cryptography). If a public key is used to encrypt data, only the private key can decrypt it, and vice versa.

For example, if you send a private e-mail to a co-worker, you encrypt the e-mail with that person's public encryption key. That means no one can read it except the co-worker who has the private key to decrypt the message. Even if a third party intercepts the message, they could not decrypt it using the public key. Only the person with the private key can decrypt it. By the same token, if you encrypt a message using a private key, then any co-worker

who has the corresponding public key can try to decrypt it. If the co-worker can decrypt it, then he is assured that the message is from you.

One problem with this key-pair system is verifying the identity of the public key owner. A PKI system relies on digital certificates. Like a passport or driver's license, a digital certificate states that the user is who he or she claims to be. Digital certificates are issued by a Certificate Authority (CA) and contain information including the certificate's serial number, the certificate holder's name and public key, the CA issuing the certificate, and its expiration date.

The Certificate Authority is a trusted authority that issues a digital certificate associating an individual with their public key. The CA issues, manages, and revokes certificates. The CA may be the systems administrator who issues certificates to end users, or a large enterprise, a government agency, or a third-party consortium that acts as a trust agent for a specific industry. Verifying end-users may require in-person interviews or rely solely on information publicly provided and/or available, such as an e-mail address.

However, how can you be sure that the certificate holder's identity is valid? Identities can be stolen or spoofed. PKI goes a step further by relying on digital signatures to make sure that digital certificates aren't forged, stolen, or out-of-date.

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A digital signature verifies that a document hasn't been tampered with. Digital signatures are created by running a hashing function — an algorithm that creates a digital representation or “fingerprint” in the form of a “hash value” or “hash result.” This hashing algorithm condenses the document into a very small file, known as a “message digest,” uniquely associated with that document.

The sender encrypts the message digest using a private key and includes it with the document, creating a digital signature. The recipient decrypts the message digest with the sender's public key, and then runs the same hashing algorithm on the document. If this new message digest is identical to the first, the receiver can be assured that the document wasn't changed after the sender signed it.

Of course, PKI is more complicated than this brief explanation shows. Like all security measures in the world of electronic data exchange and the Internet, the security you put in place must be commensurate with the value of the data and systems you're protecting. With the increasing number of online financial transactions and online exchange of medical and other information, PKI offers one technological solution for convenient and secure online access to information while protecting privacy.



Network Security with Paul Amaranth

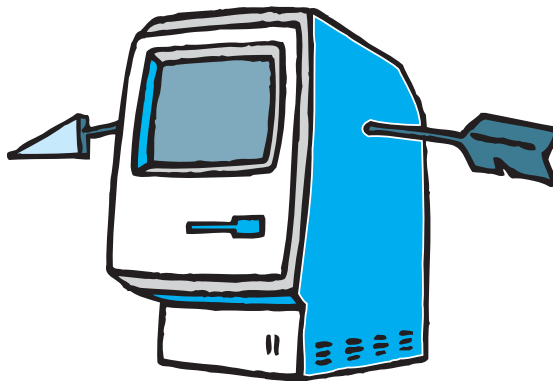
Port Scanning

Paul Amaranth has worked with computers for nearly 30 years. His experience encompasses many areas related to Information Technology including software development, system administration, and end-user support. Recently Amaranth has been involved with authentication software development, network and infrastructure design and deployment, and security. At Merit he will serve as a security resource for Members and Affiliates.

In the last column I described ways that someone could gather information about your organization that is publicly available. Using these techniques, someone could assemble a picture of your systems that are accessible via the Internet. The next thing a malicious person is likely to do is to perform a scan of your systems in order to identify potential weaknesses. In this column, I'll give an overview of the scanning process and point out a couple of tools that may be useful in your own environment.

You've Been Scanned!

If you've ever looked at your logs you may have noticed scanning activity. Generally the scans that show up in system logs are the most



Does your system have any open ports?

blatant type. It's worth noting that many casual attackers and script kiddies skip the reconnaissance phase and go directly to port scanning, often using a brute force method. A serious attacker who has specifically targeted your systems, however, will generally increase their odds of success by doing his (or her) homework first.

Scans run the gamut from very stealthy to obnoxiously loud and take several forms. The first type of scan is used to determine if the targeted host is up and connected to the net. The most obvious device for this is some variation of the “ping” command. A ping command takes its name from the sonar “pings” used by submarines. An Internet Control Message Protocol (ICMP) packet is sent out on the network to the target machine (or, more specifically, to the address of the target machine) and, if it is connected and responsive, a reply is sent back. Absence of a response generally indicates the address is not currently active. This is not always the case since firewalls may be configured to block ICMP traffic. If any device in the path to the target blocks ICMP traffic, the ping will be ineffective.

Just blocking ICMP traffic, however, does not hide your systems from a potential attacker. Any behavior that indicates a system is at the target address may be used to identify potential target hosts. Any open Transmission Control Protocol (TCP) port, for example, may be used to identify a connected host.

Open TCP Ports

TCP connections use a three-way handshake. The

originating host sends a Syn packet to the target host to initiate the connection. The target host responds with a Syn/Ack packet and the originating host is supposed to respond with an Ack packet, after which, the connection is opened. Obviously, if a Syn/Ack packet is received, the target is up and responding. If this is all that is desired, the Ack packet need not be sent and the connection abandoned before it is completely set up. Such a connection will generally not show up in the system logs. As an aside, this behavior is also used in a denial-of-service attack where the object is to pile up a large number of half opened connections and overwhelm the targeted system.

The problem with a TCP port scan is that properly configured systems will have a minimum number of open ports. However, a TCP scan may be used to identify web and mail servers as well as systems that have these services installed by default (e.g. Windows 2000 systems that run IIS as a default service).

Once specific systems have been identified as up and accessible, specific port scans are conducted. For TCP ports, this may range from a full connection attempt, to a Syn/Ack scan, or to even more stealthy behavior; there are many types of port scans available. This will identify the active services running on the target system.

OS Information

An interesting side benefit of the port scan is the ability to determine the type and specific release of the operating system on the target machine. Each vendor implements the network code slightly differently. Behavior is consistent from vendor to vendor on items that are spelled out in the official Request for Comment (RFC) documents, but may vary slightly when odd situations are encountered. By observing the behavior when sending malformed packets, the scanner may determine with great accuracy the operating system running at the other end.

This information is useful to an attacker since it may indicate what specific exploits might have a chance of cracking the system. If there is a known exploit available to attack one of the services listed in the port scan for the specific operating system version, your system is easy prey for the attacker.

Use Port Scanning to Your Advantage

Of course, you can use port scanning to your own advantage by scanning your systems for vulnerable ports and making sure the software on your system is running at the latest revision level. Your system administrators should run port scans on a consistent basis against your systems. You should know what every open port is doing on every system. Not only does this identify ports that are used by the normal system software, it will also identify ports that are used by malicious software running on a cracked system. Once a baseline is established, any changes that show up in a new scan will identify areas that need to be investigated.

When systems are cracked, the attacker will often leave a daemon or a backdoor that is listening on some port. These are often high numbered ports such as 16708, but will sometimes masquerade as a legitimate service such as a web-server using port 80. This is where it is important to know what services are running on what machines. An active webserver showing up on a machine that is not supposed to be running one is as much of a red flag as a daemon listening on port 16708. Cracked systems may not always have open ports, but as Distributed Denial of Service (DDoS) attacks have become common, the attacker perpetrating the attack typically sets up a remote control daemon on the cracked machine. By sending a simple command to the daemon, the attacker can instruct the cracked machine to flood some hapless victim with network packets without

“When systems are cracked, the attacker will often leave a daemon or a backdoor that is listening on some port.”

— Paul Amaranth

risk of the attack being traced back to the real source. The daemon has to listen on some port in order to be useful to the attacker and that port may be found using a port scanning tool.

Port Scanning Tools

A good port scanning tool is nmap (<http://www.insecure.org/nmap>). A free Windows tool that is pretty good is SuperScan (<http://www.foundstone.com/knowledge/scanning.html>). Either one of these tools may be used to do a port scan on your systems.

A full port scan should cover both TCP and User Data Protocol (UDP) ports.

A note of warning: Port scanning is somewhat in a gray area. It is an important system administration task, but it is also an activity actively used by hackers. Before doing any port scanning on your systems, be sure you have the appropriate authorization! Under no circumstances should you attempt a scan of systems for which you do not have authorization! Although many scans will not show up in system logs, they may be tracked with a network IDS (Intrusion Detection System). Unauthorized scanning is considered a hostile activity and may have serious consequences.

In the next column we'll start to look at how hackers use the information they've gathered to break into your system.

Send questions, comments, or feedback to amaranth@merit.edu

— Paul Amaranth, Merit



New Statistics Package is Easy to Use

In May Merit rolled out a new “production version” of the Cricket backbone router statistics, and finally discontinued the old SCION statistics. The “work in progress” version of the Cricket statistics had been available on Merit’s website since May 2000, but Merit’s support team members were not happy with the initial release.

“The graphs that this package created used average values,” said Internet Consultant **Dan Zegarac**. “This created numbers that were artificially low when you looked at statistics for longer time periods.”

For example, a value that peaked at 7M bps on a daily graph might show up as 6M bps on the weekly graph, and only 4M bps on the monthly graph.

MichNet Backbone Manager **Brian Cashman’s** first solution to this problem was to work with Merit staff to store the raw Cricket data in Merit’s new Oracle database so that he could have more control over the graph generation process.

“But this came with its own set of new problems,” said Brian. “I discovered we need to develop a reliable method for automatically processing the Cricket data so that it can be stored in our Oracle database system. Unfortunately, this is currently a manual process, but we’re working on resolving that.”

As a “temporary” solution, the Merit NOC modified Cricket to create a new set of Cricket graphs that show only peak values, without the averaging over time. These new graphs were released in early May, and Brian demonstrated how to use these new statistics to Merit’s Members and Affiliates via streaming media on May 8. (See <http://www.merit.edu/michnet/seminar/02specialstats/cricket.com> for an archive of the presentation).

How to Use the New Statistics

The new MichNet backbone statistics are available from Merit’s website at <http://www.merit.edu/michnet/statistics/affiliate/>. The first step to viewing your statistics is to select your organization’s name from the available drop-down list. Using Alma College as an example of a common Affiliate setup, here are the selections available (as of March 2002) when you select Alma College from the list of Merit Members and Affiliates.

1 Available Interfaces

Router	Interfaces	Description
ALMA-4	<input type="checkbox"/> fastethernet0_0	Alma College
ALMA-4	<input type="checkbox"/> fastethernet1_0	connection to CMU via MMNET

Select one of the following options. Please also specify a starting date if that option is selected. The resulting graph will cover the date range from the day selected to today. The format of the date is MMM DD, YYYY. The month can be in either upper or lower case.

Last 48 hours **4**
 Specify a Starting Date

Please enter a Starting Date

Each selection option is explained below.

1 — Available Interfaces

In the case of Merit’s Members and Affiliates, a router normally separates the Local Area Network (LAN) from its connection leading to MichNet and the wider Internet. An interface is an attachment point in a router.

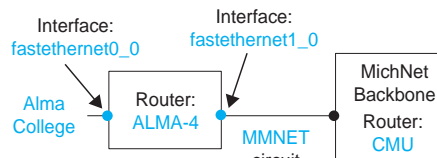
2 — Router

Routers are the most common equipment type connecting Merit’s Members and Affiliates to MichNet. In our example, the only router connecting Alma College to the MichNet Backbone is ALMA-4. If you clicked on ALMA-4 you would see a list of all the interfaces on ALMA-4.

3 — Interfaces/Description

Looking at the list of interfaces, along with their descriptions, can provide clues to which side of the router (LAN side or MichNet side) a specific interface is on. This becomes important when you are looking at the “in” and “out” parts of the graphs. In our example, “fastethernet0_0” must be the interface on the Alma College side of the router, and “fastethernet1_0” must be the interface on the circuit side of the router.

With the information provided above, you could visualize the following picture:



In this picture, the two blue dots represent the interfaces that you can select to generate a graph.

4 — “Last 48 Hours” or “Specify Starting Date”

You can choose to generate a 48-hour graph or a graph using a specific start date. Both versions will end with the current date and time.

Use the radio button to select which type of graph you want to generate. If you select “Specify Starting Date,” use the popup calendar to select a date. Or, you can type the date directly into the box, using the format “MMM DD, YYYY”. The earliest date which these graphs have data for is April 2000, or, for newer routers/circuits, the date the router/circuit was installed.

For More Information

If you have questions regarding the new backbone statistics, call your Member and Affiliate Services support team (<http://www.merit.edu/merit/m&a.services.html>) for help.



SNMP Vulnerabilities and Your MichNet Connection

MichNet routers have been re-configured in response to vulnerabilities in the Simple Network Management Protocol (SNMP) protocols reported by the CERT Coordination Center (CERT/CC) on February 12, 2002. (See <http://www.cert.org/advisories/CA-2002-03.html>) These vulnerabilities could have allowed an attacker to execute denial of service attacks, cause service interruptions, or gain access to non-public data on the routers.

While Merit has secured MichNet routers at MichNet-attached organizations, the steps taken do not address vulnerabilities that may exist behind the MichNet router on a MichNet-attached network. Network and systems administrators at MichNet-attached organizations should perform an assessment of SNMP vulnerabilities that may be present in operating systems or network devices on their networks. Where the SNMP vulnerabilities on the MichNet routers were limited to denial of service, service disruption, and unauthorized access to non-public data, SNMP vulnerabilities on other devices may be more serious, up to and including full compromise by an attacker.

SNMP is the most popular protocol in use to manage networked devices. Any device capable of running SNMP is potentially vulnerable. Common SNMP-enabled devices are routers, switches, hubs, bridges, wireless access points, and servers that run network management or monitoring software. However, SNMP is often available or enabled on other less obvious devices like printers, scanners, uninterruptible-power-supplies, and desktop computers.

SNMP runs as an agent or manager: manager software running on

one system makes requests of agent software running on network devices regarding their status. On MichNet routers, SNMP agents provide bandwidth utilization data to a server running SNMP as a manager that collects this data to produce the bandwidth utilization graphs available on our web pages.

Both managers and agents are vulnerable. Since the implementation of the protocols varies from vendor to vendor, the list of specific vulnerabilities and their fixes is quite large: the CERT/CC advisory that details this information takes up roughly 80 printed pages.

The general steps that should be taken, as outlined by CERT/CC are:

1. Apply a patch from your vendor;
2. Filter SNMP access to managed devices to ensure the traffic originates from known systems;
3. Change SNMP community strings from their defaults;
4. Disable all nonessential SNMP software;
5. Segregate network management traffic onto a separate network;
6. Filter SNMP services at your network perimeter.

Merit implemented steps one through three on MichNet routers. First, the IOS on the routers was brought up to best-available revision and patch level. Then, access to the "public" community SNMP data on MichNet routers, was closed. MichNet-attached organizations that wanted this data for their own monitoring purposes were asked to submit the IP addresses of the host or hosts that would poll MichNet routers. They were also asked to designate a new community string different from the defaults. These actions covered steps two and three.

Since SNMP is essential to the management and monitoring of MichNet routers, step four could not be implemented; SNMP continues to run on MichNet routers. Step five is implemented to protect the SNMP managers run by Merit, but the SNMP agents running on the MichNet routers obviously can not be segregated without taking them off the Internet.

Step six could be accomplished by closing down the known SNMP ports (predominantly 161 and 162) at MichNet's connections to the greater Internet, but because this would interfere with much legitimate activity, Merit did not do this.

Nor did Merit close down the known SNMP ports on MichNet routers at MichNet-attached organizations. This means that SNMP access from the Internet to MichNet-attached networks (ingress) is open, and it also means that SNMP access from MichNet-attached networks to the Internet (egress) is open.

To address the ingress issue, MichNet-attached organizations that have no need to allow SNMP access from networks external to their own should consider closing down the known SNMP ports on their firewall or router behind their MichNet router.

Closing down SNMP egress from a MichNet-attached organization could be accomplished using the same means. This would not protect the MichNet-attached organization from SNMP vulnerabilities, but it can be regarded as "good-citizen" behavior that would prevent their network from being used to originate SNMP-based attacks outbound to the Internet. Of course, it would be prudent to establish first if there are legitimate activities on the network that make use of outbound SNMP access.

— Jim Moran, Merit



"While Merit has secured MichNet routers at MichNet-attached organizations, the steps taken do not address vulnerabilities that may exist behind the MichNet router on a MichNet-attached network."

— Jim Moran

DIALING INTO MICHNET

All MichNet shared dial-in users must authenticate with an Access ID issued by their organization.

For information on how to obtain Access IDs, contact the network support staff at your site.

Dial-in users can connect to a network access server (NAS) by using Point-to-Point Protocol (PPP) or VT-100 terminal emulation programs. Terminal emulation users should set their **communication settings** to 8 data bits, no parity, 1 stop bit.

MichNet modems support the error correction protocols v.42 and MNP4, as well as the data compression protocols v.42bis and MNP5.

Local Access Numbers:

Before configuring your modem to automatically dial a MichNet access number, check Merit's Dialaccess searchbase to make sure it is a local number. Merit's Dialaccess searchbase is available on the web at:

<http://www.merit.edu/cgi-bin/db/dialaccess.pl>

Note: Merit Network, Inc. is not responsible for any telephone charges that might occur should you dial a non-local number.

Recommended Settings:

The following settings are recommended for use with PPP and MichNet dial-in access numbers.

Flow Control	CTS/RTS	On
	XON/XOFF	Off

CTS/RTS flow control must be enabled in your modem and your modem cable must be able to pass CTS and RTS signals. Since XON/XOFF flow control may interfere with binary file transfers, it is not recommended.

DCE/DTE Speeds	DCE (phone line) speed	DTE (computer port) speed
	34,667 to 52,000 bps (v.90)	230,400 or 115,200 bps
	33,600 bps (v.34)	115,200 or 57,600 bps
	28,800 bps (v.34)	115,200 or 57,600 bps

The DCE speed is negotiated to the highest reasonable speed by the modems and is not usually set by the user. The v.34 standard supports a range of speeds from 19,200 to 33,600 Kbps. Since many phone lines are of insufficient quality to support 33,600 Kbps, v.34 modems will often negotiate to a lower speed. Similarly, the v.90 standard supports a range of speeds from 34,667 to 52,000 bps, but typically users will see speeds in the 40,000 to 46,667 bps range.

The DTE speed (computer port) should be set higher than the DCE (phone line) speed to take advantage of compression when using terminal emulation or PPP.

About the Shared Dial-in Listing

Online listing

For the most current listing of dial-in numbers, check:

<http://www.merit.edu/michnet/dial-in/numbers/>

Terminal emulation users can find current numbers by entering **help** at the **host:** prompt and then selecting **MichNet Dial-in Numbers**.

Modem Speeds

All dial-in sites support carrier speeds of at least 33.6K bps. Most also support v.90, commonly called "56K." Dial-in numbers marked with a ✓ are v.90 locations.

Hunt Groups

There are currently seven aggregated dial-in locations (hunt groups) that serve multiple dial-in numbers at a single location. If a dial-in phone number includes a symbol instead of an amount for the number of lines, see the appropriate hunt group to determine how many lines are available, as follows:

Symbol	Hunt Group
Det	Greater Detroit
NW	NW Michigan
SE	SE Michigan
SC	Michigan, Lansing/ East Lansing Number
Sc	South Central Michigan
SW	SW Michigan
☝	Thumb Area
UP	Upper Peninsula

City	Phone No.	Lines
HUNT GROUP		
✓ Greater Detroit		805
✓ NW Michigan		483
✓ Sc Michigan		92
✓ SC Michigan		920
✓ SW Michigan		405
✓ SE Michigan		1610
✓ SW Michigan		405
✓ Thumb Area		115
✓ Upper Peninsula		403
MICHIGAN		
Addison	517 547-5621	16
✓ Adrian	517 265-6689	58
✓ Albion	517 629-7450	62
Allegan	616 686-0008	19

MichNet Shared Dial-in Numbers

City	Phone No.	Lines	City	Phone No.	Lines	City	Phone No.	Lines
✓ Alma	989 466-5322	96	✓ Flint	810 249-0300	SE	✓ New Boston	734 415-2200	SE
✓ Alpena	989 356-0704	184	✓ Fountain	231 785-4200	NW	✓ New Buffalo	616 469-5907	SW
✓ Ann Arbor	734 489-2200	437	✓ Frankfort	231 352-4134	NW	✓ Newberry	906 293-2982	UP
✓ Atlanta	989 785-4927	48	✓ Fremont	231 924-5662	NW	✓ Niles	616 537-4200	SW
✓ Au Gres	989 876-4180	8	✓ Fulton	616 255-4200	SW	✓ Northport	231 386-5029	NW
✓ Bad Axe	989 269-2693	☎	✓ Gaines	989 271-1308	SE	✓ Onaway	989 733-8968	31
✓ Baldwin	231 745-3182	NW	✓ Gaylord	989 732-1596	92	✓ Ontonagon	906 884-6495	18
✓ Barryton	989 382-8823	3	✓ Grand Haven	616 846-2617	SW	✓ Oscoda	989 215-2200	SE
✓ Battle Creek	616 963-9975	48	✓ Grand Marias	906 494-2536	2	✓ Owosso	989 729-7205	65
✓ Bay City	989 922-2200	SE	✓ Grand Rapids	616 224-7020	529	✓ Petersburg	734 279-1839	10
✓ Bear Lake	231 864-2210	2	✓ Grayling	989 348-9405	45	✓ Petoskey	231 347-1715	NW
✓ Belding	616 794-1046	SW	✓ Greenville	616 754-6816	SW	✓ Pinconning	989 879-6940	10
✓ Bergland	906 575-1035	UP	✓ Hale	989 728-2197	3	✓ Pontiac	248 232-7800	Det
✓ Big Bay	906 345-9496	UP	✓ Harrisville	989 724-5989	64	✓ Pontiac (OU)	248 370-4311	16
✓ Big Rapids	231 592-1040	NW	✓ Hart	231 873-7798	31	✓ Port Austin	989 738-7843	3
✓ Blanchard	989 561-5541	2	✓ Hastings	616 945-0348	SW	✓ Port Huron	810 455-2200	SE
✓ Blissfield	517 486-2072	9	✓ Hillsdale	517 439-9102	Sc	✓ Portland	517 647-5008	Sc
✓ Bloomingdale	616 521-4150	2	✓ Holland	616 355-0026	SW	✓ Powers	906 497-4081	UP
✓ Bois Blanc	231 634-7136	4	✓ Holly	248 531-2200	SE	✓ Remus	989 967-3022	4
✓ Boyne City	231 582-7492	NW	✓ Houghton	906 483-3120	90	✓ Rock	906 356-6691	UP
✓ Brevort	906 292-5522	UP	✓ Houghton Lake	989 366-4125	48	✓ Rogers City	989 734-3794	18
✓ Bridgman	616 465-3590	21	✓ Howard City	231 937-6069	11	✓ Romeo	586 894-7800	Det
✓ Brimley	906 248-2098	2	✓ Howell	517 586-2200	SE	✓ Roscommon	989 275-5134	65
✓ Brown City	810 346-4981	☎	✓ Hudson	517 448-2087	11	✓ Rose City	989 685-2109	32
✓ Buchanan	616 695-0168	SW	✓ Indian River	231 238-4962	43	✓ Rudyard	906 478-6330	4
✓ Byron	810 266-4404	SE	✓ Ionia	616 527-0685	SW	✓ Saginaw	989 921-2200	SE
✓ Cadillac	231 779-0683	NW	✓ Iron Mountain	906 776-1202	UP	✓ St. Clair	989 328-2200	SE
✓ Camden	517 368-5648	3	✓ Iron River	906 265-4810	UP	✓ St. Ignace	906 643-0077	UP
✓ Capac	810 395-8644	☎	✓ Ironwood	906 932-9914	UP	✓ St. Johns	989 224-0502	46
✓ Carney	906 639-3390	3	✓ Jackson	517 788-6300	144	✓ St. Joseph	616 983-1965	120
✓ Caro	989 673-1422	13	✓ Kalamazoo	616 387-2070	828	✓ Sand Creek	517 436-3266	24
✓ Carson City	989 584-6831	10	✓ Kaleva	231 362-3721	2	✓ Sandusky	810 682-2200	SE
✓ Caseville	989 856-9215	10	✓ Kalkaska	231 258-8479	NW	✓ Sault Ste. Marie	906 635-1533	UP
✓ Cassopolis	616 445-8618	22	✓ Kent City	616 678-4177	SW	✓ Sebewaing	989 883-5686	☎
✓ Cedar Springs	616 696-4941	SW	✓ Keweenaw	906 289-1045	UP	✓ Sidney	989 328-3300	27
✓ Cedarville	906 484-6400	4	✓ Kinde	989 874-4193	3	✓ South Haven	616 639-1909	43
✓ Central Lake	231 544-3056	27	✓ Lake City	231 839-6760	19	✓ Springport	517 857-4336	13
✓ Charlotte	517 543-1631	60	✓ Lakeview	989 352-7571	9	✓ Standish	989 846-1189	SE
✓ Chatham	906 439-5901	5	✓ L'Anse	906 524-5644	4	✓ Stephenson	906 753-2185	16
✓ Cheboygan	231 627-2220	NW	✓ Lansing	517 999-2678	SC	✓ Stockbridge	517 851-7382	48
✓ Chesaning	989 845-2917	16	✓ Lapeer	810 538-2200	SE	✓ Sturgis	616 659-0774	49
✓ Clare	989 421-2200	SE	✓ Lawrence	616 674-3296	26	✓ Tecumseh	517 424-4100	35
✓ Clarksville	616 739-4200	SW	✓ Levering	231 537-2497	2	✓ Tekonsha	517 767-4043	2
✓ Coldwater	517 279-7694	24	✓ Ludington	231 843-7167	98	✓ Temperance	734 847-6662	42
✓ Colon	616 432-3245	16	✓ Mackinac Island	906 847-0083	UP	✓ Three Rivers	616 279-5400	41
✓ Concord	517 524-9047	11	✓ Mancelona	231 587-0545	NW	✓ Traverse City	231 941-9826	NW
✓ Coral	231 896-4200	NW	✓ Manistee	231 398-0302	NW	✓ Trenton	734 559-2200	SE
✓ Crosswell	810 679-4013	☎	✓ Manistique	906 341-5977	19	✓ Trout Lake	906 569-0013	UP
✓ Crystal	989 235-3110	2	✓ Marcellus	616 646-2608	14	✓ Twining	989 867-4141	7
✓ Curtis	906 586-3257	UP	✓ Marquette	906 226-3891	UP	✓ Vassar	989 823-2157	☎
✓ Decatur	616 423-6023	20	✓ Mason	517 676-8600	Sc	✓ Warren	586 693-7800	Det
✓ Deckerville	810 376-1113	☎	✓ McBain	231 825-8232	10	✓ Watersmeet	906 358-9879	UP
✓ Detroit	313 586-7800	Det	✓ Memphis	810 392-3735	☎	✓ Watson	906 238-4352	2
✓ DeTour	906 297-3172	3	✓ Menominee	906 863-1002	UP	✓ Wayland	616 792-1211	SW
✓ Dowagiac	616 782-4568	57	✓ Mesick	231 885-2962	7	✓ West Branch	989 216-2200	SE
✓ Dryden	810 796-3333	SE	✓ Michigamme	906 323-1001	UP	✓ Westphalia	989 587-4451	8
✓ Dundee	734 529-5614	22	✓ Midland	989 923-2200	SE	✓ Williamston	517 655-1370	24
✓ East Lansing	517 999-2678	SC	✓ Millington	989 871-9774	3	✓ Yale	810 387-9368	☎
✓ Edmore	989 427-5957	14	✓ Mio	989 826-1229	61	NEW YORK CITY		
✓ Edwardsburg	616 663-5502	9	✓ Monroe	734 349-2200	SE		212 509-5270	10
✓ Elsie	989 862-4141	15	✓ Montrose	810 639-4895	17	WASHINGTON D.C.		
✓ Engadine	906 477-8096	UP	✓ Morenci	517 458-2206	10		202 484-4160	15
✓ Escanaba	906 789-2034	UP	✓ Morley	231 732-4200	NW	✓ WINDSOR		
✓ Ewart	231 734-6497	NW	✓ Mount Clemens	586 723-7800	Det		519 253-7486	23
✓ Fairgrove	989 693-6758	☎	✓ Mount Pleasant	989 772-6666	624	✓ MERIT FOR-FEE 800 NUMBER		
✓ Farmington	248 522-7800	Det	✓ Munising	906 387-3245	9		800 232-3379	24
✓ Fennville	616 561-7111	9	✓ Muskegon	231 728-4253	96			
✓ Fife Lake	231 827-4200	NW	✓ New Baltimore	586 684-2200	SE			

USENET News Available from Merit

There are many different ways to get people together to discuss something on the Internet. USENET News has been a part of the Internet for a very long time. Consisting of several millions of interested people all over the world, USENET is considered one of the world's largest online communities. USENET newsgroups are "distributed" among tens of thousands of "news servers" operated by Internet service providers, universities, companies, and other organizations. Each server receives copies of all messages in a newsgroup and stores them in a revolving database. News servers automatically exchange these messages among themselves, to keep each other's databases up-to-date. Each participant in a newsgroup reads messages from, and posts messages to, his/her "local" news server, using news-reading software such as the newsgroup module in Netscape Communicator or stand-alone software such as Forte Agent.

The Merit MichNet USENET news service offers over 38,500 newsgroups. Additional newsgroups can be provided upon request. Currently, articles are retained for 1 to 7 days. Merit has peering arrangements with the University of Michigan, Massachusetts Institute of Technology (MIT),

Consisting of several millions of interested people all over the world, USENET is considered one of the world's largest online communities.

and the University of Chicago (UIC). Merit continues to look for other peering arrangements.

Merit is currently serving 30+ MichNet organizations. The news servers are monitored 24x7, 365 days a year. The service is supported via two servers for redundancy. The servers run on PCs running FreeBSD operating system and INN News software.

Members and Affiliates that want to make USENET news available to their end users need to build an organizational news server. Next, they need to decide what method to use to supply the available articles, either a push or pull feed.

Smaller organizations with fewer users will likely need to conserve bandwidth. A "pull" feed using DNews software (see <http://netwinsite.com/>) retrieves items from the Merit server only when the organizations' users explicitly request specific newsgroups.

Large organizations with many users reading many newsgroups might prefer a "push" (send) feed. Every ten minutes this feed will automatically keep your servers up-to-date with a full set of available articles.

Regardless of the method chosen, Merit will supply news articles to an organization's server that will, in turn, provide those articles to the organization's end users.

Whether you already have a news server using other sources for USENET News, or you're thinking about providing the service to your users, give our Merit service a try. There is no additional cost to Merit Members and Affiliates, and it may help reduce your total bandwidth utilization. Contact your Member and Affiliate Services support team for more information.

— Sue Joiner, Merit



In order to organize the mass of USENET News articles (messages) and make it easier for people to find postings of their interest, they are broken down into hierarchies or newsgroups. Examples of the newsgroups are listed below:

The Big Eight international hierarchies:

- comp.* - computers
- humanities.* - humanities
- misc.* - miscellaneous stuff
- news.* - everything about news
- rec.* - recreation
- sci.* - science
- soc.* - society
- talk.* - serious talk

The Alternative news:

- alt.* - alternative, everything is allowed here

Country specific hierarchies:

These are organized by country codes, for example:

- at.* - Austria
- de.* - Germany
- it.* - Italy
- nl.* - Netherlands
- tw.* - Taiwan
- uk.* - UK

Additional and/or commercial hierarchies:

Examples here include:

- bionet.* - biology
- clari.* - Clarinet Network

Professional hierarchies:

These are set up by specific companies, for example:

- borland.*
- microsoft.*
- netscape.*

For further USENET News information, refer to:

Internet Software Consortium (INN Software): <http://www.isc.org/products/INN/>

USENET Organization site:

<http://www.usenet.org/>

Merit Affiliates Pioneer Internet2 Opportunities for Michigan K12 Students

"It helped me learn better, because I heard it from someone who actually experienced it."

— Student, Brandywine High School

Brandywine High School* students in Niles, Michigan culminated their Holocaust study with a live interview of a Holocaust survivor at the Museum of Tolerance in Los Angeles, California. No, Brandywine's field trip budget is not unusually large — Brandywine teachers are able to use interactive video facilities at their school to take their classes on virtual field trips.

Using interactive video, Michigan K12 students have met Vietnam War Veterans, Peace Corps Volunteers, Kosovo Refugees, and Hiroshima Survivors. They are visiting museums and zoos. They are spying on elephants living in a natural habitat.

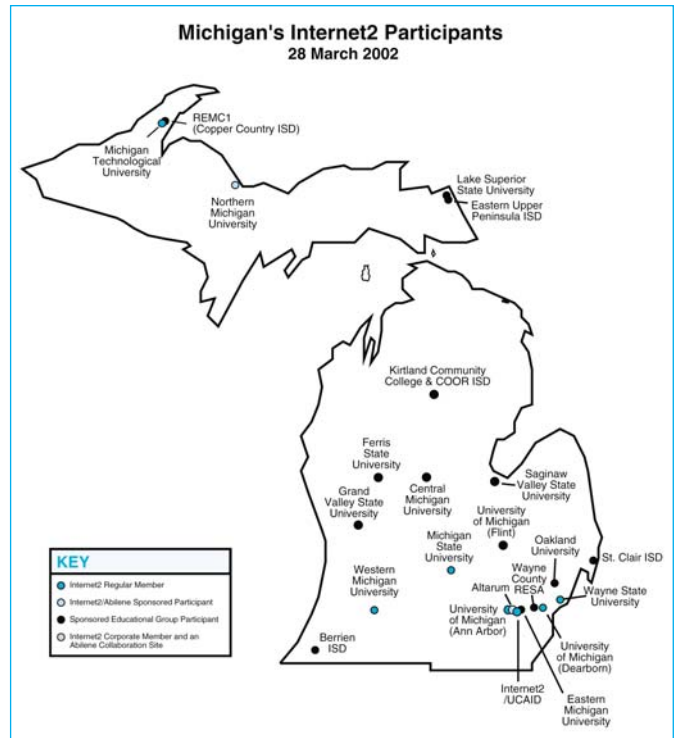
Going the Distance

There are two different technologies employed for these remote learning opportunities. One method is to lease an ISDN line from a phone company. For an hourly fee that might range from \$30 to \$100 depending on the location being called, schools can make an ISDN phone call between the student location and the destination. In this scenario schools have a special media room where they house the equipment and ISDN line necessary for this connection. Teachers sign up to use the room, and classes of 30 or more students experience interactive field trips together. Cameras and video equipment make it possible for the presenters at the destination to see and hear students' questions.

A second method is to use the Internet for the connection between the two sources. Unfortunately, using the regular Internet is not always a reliable method for high quality interactive video. If a class in

Michigan is meeting someone in Los Angeles, the path from Point A to Point B, after it leaves the MichNet Network, might encounter network congestion along the way. This congestion might cause a 2-second delay in the transmission, which would cause problems with both the audio and video quality. Internet2 provides a more reliable path to carry interactive video between two destinations. Internet2 is a consortium primarily of educational institutions that use a separate backbone network, called Abilene, for "Internet2 traffic." "Internet2 traffic" is simply any traffic traveling between two Internet2 participants across the Abilene backbone network. This network is extremely fast (OC48, or 2.5G bps today with upgrades to OC192 or 10G bps in the works). A quick look at the Abilene network traffic map (<http://loadrunner.uits.iu.edu/weathermaps/abilene/>) shows the highest utilization at 10-30%, with many routes at less than 2%. This relatively low utilization leaves lots of available "headroom" for short bursts of large amounts of traffic without causing network congestion or delays.

An impressive Internet2 demo features a teacher working with a music student at a remote location. The audio and video quality is so outstanding that both participants



agree the experience is just as good as being in the same room. This would not be true if there were any delays or jitter between the two sites.

K12 Internet2 Participants in Michigan

K12 organizations in Michigan gain access to Internet2 through a connection to Merit's MichNet Network. Six different educational organizations in Michigan currently have Internet2 access, including:

1. Wayne County RESA, since October 2001
2. Berrien County ISD, since January 2002
3. Eastern Upper Peninsula ISD, since January 2002
4. REMC 1 (located on the west side of the Upper Peninsula), since January 2002

See Internet2 on page 14

* The Brandywine School District is part of Berrien County Intermediate School District, which in turn is part of Regional Educational Media Center 11, a Merit Affiliate.

Internet2

from page 13

5. COOR ISD (Crawford, Oscoda, Ogemaw, and Roscommon Counties), since March 2002
6. St. Clair County ISD, since March 2002

These organizations serve 400,000 Michigan students.

Any K12 school, community college, private college or university, library, or healthcare organization engaged in education activities connected to MichNet can request Internet2 access at no additional charge due to MichNet's status as a Sponsored Educational Group Participant in Internet2/Abilene. While there is no fee for Internet2 access, an organization should have a fairly robust Internet connection to take advantage of the available opportunities.

The Internet2 Lifestyle

One advantage to using Internet2 for distance learning is it can be done from any computer on a school's network, utilizing a relatively inexpensive individual H.323 unit (a small video camera that sits on top of the computer monitor). This adds individual research possibilities to distance learning, in addition to today's "fieldtrip" scenario.

Imagine a student who is writing a paper on space travel. This student sends an e-mail to NASA, asking if there are any astronauts who would be willing to meet with her. NASA puts the student in touch (through e-mail) with an astronaut at the Internet2-connected NASA Goddard

Space Flight Center. The student and astronaut coordinate a time, and at the prearranged time the student goes to her school's media center where she uses a computer with an H.323 unit to meet the astronaut. Aside from the fact that the astronaut is on the computer screen, the student is able to interact with the astronaut as though they are in the same room. [Yes, I made this example up. But, it sounded reasonable to me.]

Internet2 is not just for video conferencing. Through Internet2, students can use resources that would not normally be available to them.

Through Internet2, St. Clair County ISD students are able to access a scanning electron microscope at the University of Michigan. "Our county's goal is to improve the math and science performance of our students," said **Scott Bryan**, St. Clair County ISD Information Technology Director. "Not having local access to research level facilities can be a barrier, and with Internet2 we can remove that barrier."

Each school is still able to use the video equipment it is now utilizing for ISDN videoconferences, but using Internet2 for the connectivity instead of paying for an ISDN line. Classroom "fieldtrips" no longer incur individual costs to the school.

The Internet2 Lifestyle Revisited

While Internet2 has tremendous potential, a drawback today the limited number of K-12 programs available over Internet2.

"Internet2 started as a higher education initiative," said **Jeff**

Ogden, Merit's Director for High Performance Networking. "K12 schools have only been able to gain Internet2 access since March 2001. It is not surprising that there are only a limited number of Internet2 opportunities available today."

"Our hope is that as the Internet2 community grows, more applications will become available," said **Jim Bembenek**, Berrien County ISD Director of Instructional Technology. "We plan to use Internet2 for video conferencing, but we have not found many providers who are able to take advantage of Internet2."

Larry Garter, Coordinator of Information Technology at COOR ISD concurs. "The need for Internet2 is a need for the future," said Garter. "But, the fact that we could get connected now without incurring additional cost made the move attractive."

Since there are no databases of K-12 speakers or programs available through Internet2, teachers and students must make individual contacts. At Eastern Upper Peninsula ISD the technology staff has brought in several speakers using H.323. "We have brought in speakers from several sites within Michigan, such as the Library of Michigan," said **Mike Porter**, EUPISD's Technology Coordinator. "Right now we are working to bring a guest speaker from Japan to our Japanese class."

For More Information

For more information on Internet2, visit Merit's website at <http://www.merit.edu/internet2>. The website includes a wide variety of information, including "How to Prepare Your Organization for Internet2," and "Potential Internet2 Applications for the K12 Environment."

To get connected to Internet2, contact your Member and Affiliate Services support team (<http://www.merit.edu/merit/m&a.service.html>).

— Candice Russell, Merit

Any K12 school, community college, private college or university, library, or healthcare organization engaged in education activities connected to MichNet can request Internet2 access at no additional charge due to MichNet's status as a Sponsored Educational Group Participant in Internet2/Abilene.



COATT: Preparing Teachers to Teach with Technology



The Consortium for Outstanding Achievement in Teaching with Technology (COATT) is a partnership of 18 Michigan colleges and universities and several K-12 educational organizations, including Merit Network and MACUL. Established in 1999, COATT was spearheaded by **Senator Carl Levin** to be a catalyst for improving the way technology is used in the state's educational system. Michigan already leads the nation in preparing new teachers and now is poised to be the best in training teachers to use educational technology to enhance student learning. A complete listing of current COATT higher education and K-12 members is available on the consortium web site, <http://www.coatt.org>.

COATT received a three-year, \$2.2 million dollar U. S. Department of Education *Preparing Tomorrow's Teachers to Use Technology* (PT3) catalyst grant. Developed to promote large-scale institutional change, PT3 funds innovative programs aimed at ensuring that the nation's teachers are "technology proficient and prepared to educate 21st century learners." The grant, *Developing an Ecology for Preparing Tomorrow's Teachers to Use Technology*, is administered by Spring Arbor University and supported by subcontracts at Merit Network, Michigan State University, and Eastern Michigan University.

High Standards for Technology Integration

COATT has developed a certificate program to recognize student and practicing teachers for their accomplishments in infusing technology into their classrooms. To receive the Michigan Certificate for

Outstanding Achievement in Teaching with Technology (MCOATT), preservice and inservice teachers submit an electronic portfolio that demonstrates the highest level of performance on the Michigan 7th Standard for entry-level teachers. The award is granted based on reviews by an expert panel of faculty and staff from COATT institutions. The MCOATT has become a respected and honored credential for all educators to attain. Portfolios of the 2001 MCOATT winners are available online at <http://www.coatt.org>.

PT3 Objectives

PT3 funding will be used to improve the technology experience of pre-service teachers during their student teaching practicum. Additionally, the PT3 initiative will address issues of digital equity by ensuring that a significant number of participants will complete their practice teaching in schools serving low-income students. By bringing together collaborative teams comprised of a student teacher, a cooperating teacher, faculty supervisor, and K-12 technologist, COATT is building a community and support system of exemplary technology-proficient K-12 educators. Resources from the grant will also be used to strengthen the portfolio development process. See <http://www.coatt.org/pt3/> for details about the grant. Project outcomes include:

- Enhanced student teaching experiences focused on teaching with technology.
- Training and resources for cooperating teachers that aid in mentoring student teachers.
- Workshops for collaborative teams to design technology-based teaching projects.
- Online resources that address effective mentoring, technology

curriculum integration, and digital portfolios.

- Increased understandings by COATT faculty of how to help students achieve recognition of excellence in the field with the MCOATT certificate.
- Strengthened professional relationships among K-12 and higher education faculty.
- Participation by faculty to initiate portfolio development in their own practice and that of their students.
- Increased participation by teacher candidates in COATT's pre-service recognition program.

Technology Training Workshops

The first major milestone of COATT's PT3 project will be piloting the 2002 Summer Institute scheduled for June 23rd-June 29th at Michigan State University. The goal of the Summer Institute will be to help teacher preparation institutions partner with school districts to improve the potential for successful use of technology during student teaching. Teams comprised of a student teacher, cooperating teacher, university supervisor or field instructor, and K-12 building technologist will form a "design community" to assist the student teacher in creating effective technology-infused lessons to be implemented during student teaching. Participants become a support system for the student throughout the design process and student teaching. The workshops will have both face-to-face and online components, extending over a yearlong training cycle.

— Nancy Copeland, Merit



From the World to Your Desktop — Streaming Media Delivers



Jason Russell engineers Merit and CREN's streaming media webcasts.

No time in your schedule to travel to that conference you wanted to attend? Grandparents can't make the long trip for graduation? Final exam coming up and you really wish to review that

dissection again? Many people are discovering that "seeing there" can be almost as good as "being there." Live and archived audiovisual presentations and events on any topic imaginable can be sent or "streamed" to any computer desktop with an Internet connection and freely available player software.

Merit has webcast the Merit Joint Technical Staff meetings since 1998 (<http://www.merit.edu/michnet/mjts/>) and the MichNet Seminars since 2000 (<http://www.merit.edu/michnet/seminar/>). A quick, informal survey of Merit's Members and Affiliates found that many folks rely on these webcasts as a valuable source for technical information.

When budget constraints forced Bay de Noc Community College to cancel staff travel, **Jim Lundberg** found the webcasts an important link to keeping current. He likes the fact that meeting archives are readily available. When he's seen a particularly useful session, he urges his colleagues to "attend." In Jim's opinion "It's the next best thing to being there. It's better than living in a vacuum."

Ingrid Halling, System Director of the Flint Area Library Cooperative Online Network concurs. She's virtually attended several meetings.

"It works very well, sound and audio. It's a great service for those who can't get away but want to stay informed."

Since 1997 Merit has webcast the Corporation for Research and Education Networking (CREN) TechTalks. Co-hosted by **Judith Boettcher**, Executive Director of CREN, and **Howard Strauss**, Manager of Advanced Applications at Princeton University, this bi-weekly audio series tackles everything from the current challenges, emerging trends, and breakthrough advances on IT topics of importance to the higher ed community. The TechTalk website (<http://www.cren.net/know/>) is a rich companion to the lively talk show, including plenty of links, background material and a text transcript of each broadcast. This engaging webcast starts off as a simple telephone conference call. Following the steps outlined below it is transformed into a webcast available throughout the world.

How Does it Work?

Streaming media offers the potential for anyone with a video camera, connection to the Internet, a multimedia computer and some specialized software to become the web's, if not Hollywood's, next Steven Spielberg.

Creating a webcast is a five step process; creating and capturing your audio/video, digitizing the captured signal, encoding the signal, streaming the signal from a server, and finally using a player to view/listen to the webcast.

1. **Audio/video is captured live or recorded to tape.** The data is stored in analog format.
2. **The pre-recorded or live signal is feed into a "digitizer" where it is converted from analog to digital format.** The digitizer may be a special card in a computer or a

small device that attaches to your analog source converting the signal to digital format. The device feeds the digital signal into your computer. Once the recording is in digital format it can be stored on CDs, DVDs or a hard disk. (Step 2 is unnecessary if you have a digital camcorder!)

3. **These multimedia files are now "encoded" or compressed.** Multimedia files are very large in size. A few minutes of video takes up hundreds of megabytes of storage. Left uncompressed the video would consume tremendous amounts of bandwidth as it's streamed. Encoding compresses the file, optimizing it for the best available quality that can be delivered over the selected bandwidth. As you might imagine, the algorithm used to encode a file to be streamed across a corporate LAN might preserve more color and audio fidelity than the compression scheme used on a file destined for viewers connected via a 56K modem. (RealMedia™ allows you to encode for several different bandwidth rates at once using its "SureStream" technology.)
4. **A computer with streaming server software is set up to send the digitized, encoded file over the Internet.** This is known as "webcasting." The server assigns the file a URL. The webcaster then adds a link to this URL on a web page which is the streaming server. For live webcasts when viewers click on the link they connect to the streaming server. It sends each viewer a "stream" or copy of the encoded file as it is generated in real time. A server can generate hundreds or thousands of live streams from a single source file. For archived or "on demand" webcasts this URL initiates a request to the server to stream the encoded file from the disk that it

is stored on. Just as with live webcasts multiple streams of the same file may be generated.

5. **Two things are required to receive a webcast: player software and Internet access.** The quality of the webcast depends on the encoding rate, the rate of the viewer's connection to the Internet, the size of the viewer's playback window, the fidelity of the speakers, and the quality of the original recording.

It may seem strange that the webcast doesn't immediately start when a viewer selects it. Initially a message will indicate data is being sent. The server is "buffering" the data. It's queuing up enough data, based on its understanding of the speed of the connection, so that the presentation will appear to run seamlessly on the viewer's desktop. Short delays in packet transmission are masked by the data in the queue waiting to be played.

What Platform Should I Use?

There are three major formats in the streaming arena; RealNetworks™, Windows Media™, and Apple QuickTime™. Each of these vendors supplies player software at no cost. The RealPlayer™ plays either Real or QuickTime format files. The other players will only play their native formats. Players are available for downloading from the web at:

- RealPlayer — http://www.realnetworks.com/products/media_players.html
- Windows Media Player — <http://www.microsoft.com/windows/windowsmedia/download/default.asp>
- Quicktime Player — <http://www.apple.com/quicktime/download/>

To produce a webcast you need the production and streaming server software available for each player.

For a real time comparison of the formats that you can judge yourself, visit the University of Wisconsin's streaming site at <http://www.doit.wisc.edu/services/streaming/compare.htm>. Merit provides

webcasting services through a RealServer from RealNetworks.

Things to Think About When Webcasting

Webcasting is primarily a broadcast medium. You must present material in compelling and engaging ways to hold your audience's attention. There are a number of things to consider before issuing the call for "Lights, camera, action!" Scout the location where you will be webcasting. Is there enough light available? What are the sound characteristics of the room? Whether webcasting a live or scripted presentation capturing the best quality audio is of the utmost importance. Make sure your presenters are well miked and monitor the audio throughout the webcast. If the situation permits, rehearse!

There is a lot that goes into creating quality audio/video productions. However, most Merit Members and Affiliates may actually have the talent and equipment they need within their own organization. K-12 schools often have multimedia equipment

and staff who have experience documenting school events. Many higher education institutions have audio-visual or technology units who can supply equipment and/or personnel to assist in your efforts. Students are a tremendous pool of creativity, excitement, and energy that can help make your curriculum come alive.

Merit Services

If you need a little help getting started, Merit provides a wide variety of services to support streaming media.

- Recording and producing live webcasts of events.
- Archiving and providing on-demand access to recorded events.
- Encoding recorded events for streaming.
- Custom workshops on getting started with streaming.

If you would like more information, please contact your Member and Affiliate Services support team.

— Stacey Donahue, Merit



A Streaming Sampler

Webcasting opens up enormous possibilities for education and information sharing. You can transcend time and space to demonstrate a skill, join a scientific expedition, capture the highlights of the last week's soccer game, or illustrate a dangerous situation.

Websites with streaming examples and supporting materials

- Techtalk on Firewalls: <http://www.cren.net/know/techtalk/events/firewalls.html>
- Women Exploring the Oceans: <http://www.womenoceanographers.org/>
- Surgical Education Videos: <http://www.streamor.com/opengyn/openindex.html>
- Veterinary Surgery: <http://pocahontus.doit.wisc.edu/VetMed/HTML/Lan/catframe56.htm>

RealMedia Streaming Samples

Once you launch the RealPlayer, select "Open URL" from the player's File menu.

- A sample lecture from a course on Environmentally Responsible Design at Michigan Technological University: http://streams.mtu.edu:8081/ramgen/MEEM5685_41.rm
- Cry of the Sirens — Manatees: <http://streaming.miami.edu:8080/ramgen/com/sirens.rm>
- East High Class of '72 reunion: <rtsp://www.easthigh72.com/EastHigh.rm>
- Jefferson Junior High's Production of in Guys and Dolls — Dubuque, Iowa: <http://www.dubuque.k12.ia.us/Jefferson/GuysandDolls/Largemovie.RAM>

President's Desk

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the same kind of low-cost financing available for broadband.

Senate Bill 880, the second prong in the Governor's approach, established a statewide standard for broadband use of public right-of-way and streamlined the permitting process for new infrastructure.

The attraction of Senate Bill 881 was obvious to Merit. Instead of leasing data communications facilities from traditional telecommunications providers on a short-term basis, Merit could move into the new world of direct use of dark or dim fiber that is purchased outright or obtained under a long-term leasehold. Instead of using operating funds for capital improvements to the MichNet backbone, Merit could work with the Broadband Development Authority to finance needed infrastructure. In Merit's view, Governor Engler's proposals were consistent with the changing face of high-speed telecommunication service and with market opportunities that were new, competitive, and technology-driven.

The President's Council of the State Universities of Michigan, represented by **Glenn Stevens**, came out strongly in favor of the broadband legislation. So did the Michigan Education Association, the Merit Advisory Council, and other leading research and education organizations.

But the reaction from other quarters at first was less positive. Ameritech and the cable industry opposed the legislation, and the Michigan Chamber of Commerce was initially adamant that it was a

bad idea. To them, there was no middle ground: State involvement in broadband meant state control.

Similarly, the Mackinac Center and editorial pages of the Detroit News said that Senate Bill 880 was a "new tax." They dismissed any proposal that did not conform to their free-market approach.

When the Republican-controlled Legislature did not take up the bills right away, the broadband legislation appeared to be dead on arrival. Because 2001 would be Governor Engler's last year in office, there was talk that the setback was an early sign of a lame-duck governor.

Boy, were they wrong.

A little-noticed third piece of legislation, Senate Bill 879, directed the Michigan Public Service Commission to investigate why it should not reduce the rates charged by certain large telecommunications providers in Michigan by \$200 million annually. This proposal would have an impact on the profit margins of incumbent telephone companies.

By January, Senate Bill 879 was effectively withdrawn. In its place was Senate Bill 999, which created tax incentives for large telecommunications providers in Michigan. Coincidentally, Ameritech and Comcast announced their support of the broadband package. Committee hearings were scheduled to begin.

If you've never witnessed a Senate or House hearing or spoken before a committee, I recommend it highly as an exercise in democracy. Legislatures are deliberative bodies at their core — which means taking testimony, defining the public interest, and forging a consensus around interests that are often conflicting. The result is encapsulated in

language that hopefully is precise and sometimes becomes law.

Broadband Hearings

The remarkable thing about the Michigan broadband hearings, which took three full weeks in the Senate and another three weeks in the House, was that the structural remedies proposed by Governor Engler remained intact. At the same time, the original legislation was improved in small but important ways that enabled the special interests to buy in and legislators on both sides of the aisle to claim credit for the outcome.

Senator Sikkema chaired the broadband hearings in the packed Senate Hearing Room. Lobbyists, corporate executives, and public officials all gathered to express their views. Merit was no exception. We were there to remind the Senators that the Michigan Legislature had played a central role in the development of data networking and the Internet; that in the late 1960s an appropriation of \$400,000 by the Legislature, matched by a National Science Foundation grant, had led to the formation of Merit; and that in the mid 1980s the Michigan Strategic Fund, in partnership with Merit, IBM and MCI, had helped develop the NSFNET, the first high speed national research and education network, which led directly to the growth of the commercial Internet.

In short, Merit was there as living proof that government could have a legitimate role to play in broadband development, and that public-private partnerships can be critical elements of a broader state economic development strategy.

As the Senate hearings proceeded, a series of articles appeared in the Wall Street Journal, the New York Times, and other national venues, drawing attention to the slow pace of broadband rollout across the country and suggesting that new federal policies were needed to stimulate the private sector. This changed the tenor of the debate in Lansing. Instead of a last-term proponent of a controversial public policy, Governor Engler

In short, Merit was there as living proof that government could have a legitimate role to play in broadband development, and that public-private partnerships can be critical elements of a broader state economic development strategy.

emerged as a leader who was helping to keep Michigan one step ahead of the rest of the nation.

Broadband Development Authority Created

Along with Doug Rothwell of the MEDC and **Laura Chappelle** of the Public Service Commission, a key advocate of the Governor's agenda was **Bill Rosenberg**, the first executive director of the Michigan State Housing Development Authority. Rosenberg and **Chris LaGrand**, a staff attorney in the Governor's office, were the architects of the MSHDA model for the new Broadband Development Authority.

In a quiet but persuasive way, Rosenberg made the case for the new state agency. As the telecommunications industry is deregulated, he argued, the predictable profit margin of regulated rates that enabled companies to make long-term capital investments begins to disappear. The Broadband Development Authority could tap the state's bonding capacity to help fill the gap.

This long-term view, combined with ample testimony that showed that large portions of Michigan were underserved by broadband, led the Senate and the House committees to adopt amendments that improved upon Governor Engler's legislation while retaining its essential structure.

The legislation ultimately passed by overwhelming margins in the committees and in the full House and Senate, and on March 14 Governor Engler stood on the dais in the State Capitol Building surrounded by a large group of legislators who had helped pass the "MiHiSpeed" Internet plan.

Governor Engler thanked "the two Kens," Ken Sikkema and **Ken Bradstreet**. As chairmen of the Senate and House committees, they had pushed the legislation forward while patiently listening to one interested party after another. Engler thanked a number of other individual legislators by name. And then, with a flourish of the pen, Senate Bills 880,

The most significant outcome for Merit is that we now have a potential source of low-cost, long-term capital as we upgrade our statewide network.

881, and 899 were signed into law, and the new Broadband Development Authority came into existence, with Bill Rosenberg as its first chairman, president and CEO. Six Board members were subsequently appointed on a bipartisan basis, including strong representation from the university and library communities, and from the Upper Peninsula.

What does all this mean for Merit and for our Members and Affiliates?

The most significant outcome for Merit is that we now have a potential source of low-cost, long-term capital as we upgrade our statewide network.

We now have greater capacity to partner with other organizations in the state in developing new broadband capabilities that can satisfy the ever-increasing bandwidth needs of our Members and Affiliates, without price increases that are tied directly to the speed of the circuit that is provided.

And Michigan has adopted a set of broadband policies that, if they are successful, are likely to be a model for similar initiatives in other states across the country.

None of this is guaranteed. The Broadband Development Authority is just getting started. The Authority is likely to establish rules of investment that involve substantial feasibility review, coordination with private partners, and proposals that are technically and financially sound. The availability of low-cost financing is just one of many ingredients in the management of Merit's world-class network.

But time sure flies when you're having fun!

I look forward to giving you a report on our progress next year.

— Hunt Williams, Merit



Merit's New Strategic Initiatives Director



When Merit hired Mary McLaughlin to take on its newly created position of Strategic Initiatives Director, Merit was busy preparing for the January and

February LinkMichigan regional planning meetings.

"I hit the ground running," said Mary. "My first task was to oversee Merit's regional planning activities."

Mary is the ideal person to work on the LinkMichigan project. She has extensive network planning experience, managing infrastructure development at service providers such as Bellcore, MidNet, and Verio. In addition, Mary was a member of the 1996 National Science Foundation (NSF) panel that provided network architecture review and funding recommendations to the NSF.

Mary's role at Merit's will be to look at the organization's strategic initiatives — both for the short and long term.

"The Internet service provider industry has changed," said Mary. "Assumptions that Merit made 7 or 8 years ago may no longer hold true."

Now that she has a handle on the LinkMichigan project, Mary is focusing on the MichNet Affiliate accounts. She is reviewing Merit's revenue, expenses, customers, and how Merit provides service.

"I am asking questions such as 'Do we talk with our Affiliates enough?' and 'What would help our Affiliates run their networks better?'" continued Mary. "I want to understand our Affiliates' evolving needs."





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Join the New H.323 Discussion Group!

Merit has set up a new majordomo e-mail list devoted to discussing H.323 (video over IP). It's now open for subscription. You can subscribe to the regular list or the digest version (sends all messages from the last 24 hours as one message).

To join the regular list just send email to "majordomo@merit.edu" and include "subscribe h323" in the body of the message. To join the digest form of the list send email to "majordomo@merit.edu" and include "subscribe h323-digest" in the body of the message.

Archives from the list are available at: <http://www.merit.edu/mail.archives/h323/>