CEDPA K-12 TECHNOLOGISTS
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DataBus

"Supporting California's Educational Technology Community"

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The Challenges and Rewards of the Virtual Educational Community

Warren Williams, Grossmont Union High School District

The days of the traditional classroom are numbered. A multitude of forces are converging to alter the long held view that education takes place inside a self contained classroom with a teacher who engineers a curriculum and holds students responsible for meeting goals not necessarily connected to a larger learning community. The three factors most responsible for the educational redesign in California are Internet connectivity, standards based education and increased parental involvement. This convergence is what underlies the theme for this year's CEDPA conference. As the capacity to take education outside the four walls of the classroom becomes a reality, the challenges meeting today's educational technologist increase exponentially. In Santa Barbara this November, CEDPA's intent is to bring together speakers, sessions and vendors who will articulate the components for the development of a successful virtual learning community.

The virtual learning community is characterized by a learn anywhere, anytime capacity. It consists of students with personal computers or other connected devices. It is monitored by a staff trained in technology and collaborative across disciplines and grade levels. It is communicative in a multidirectional manner with parents, business persons, administrators and other concerned individuals all contributing to a student's educational growth. It relies on strong and versatile databases, capable of handling any type of student data including performance based demonstrations. It has measurable standards and the expectation of students is that they master certain essential skills before proceeding to the next set of tasks. It includes many opportunities for remediation and review. It informs parents and departments of education how well individual students are doing, measures the competence of teachers and details the effectiveness of schools.

California has launched its version of the virtual learning community with programs like Digital High School, soon Digital Middle School, the California Student Information System and a new round of technology initiatives that push educational strategies into a virtual mode. Vendors have risen to the challenge and wireless technologies will render hardwired infrastructures as tokens of their former selves. Laptops, ebooks, palm devices and digital Internet phones will need sophisti-

(See "Community" on Page 13)

Also In This Issue:

The CEDPA Board of Directors

CEDPA Information

CEDPA is an association of K-12 Technologists. Founded in 1960, the major emphasis of the association's activities are directed towards improving K-12 Technology in public education within the State of California and to prepare its membership to better meet and support the technological needs of Administrative and Instructional Programs.

CEDPA is a California non-profit corporation, as recognized by the Internal Revenue Service.

As cited in CEDPA's bylaws, the purpose of this organization shall be:

(a) To provide information to the California public educational community concerning educational information systems and technologies via dissemination at an annual conference, through quarterly periodicals and special seminars.

(b) To foster the exchange of knowledge of educational information systems and technologies concepts, systems and experiences between local education agencies and other associations both at the state and national level.

(c) To inform the association membership of important information concerning educational information systems and technologies.

(d) To provide recommendations to the State Department of Education, State Legislature, school districts, county offices of education and other public educational organizations concerning educational information systems and technologies.

(e) To develop professional standards for the educational information systems and technologies community within the State of California.

Yearly membership in CEDPA is granted to attendees of the Association's annual conference. Individuals interested in the Association's mailings may request to be added to CEDPA's mailing list by writing to the address below or filling out the interest form at CEDPA's website.

The *DataBus* is published bimonthly by the California Educational Data Processing Association and is distributed without charge to all members of the association and other selected technologists within the State of California who are interested in information systems processing and technology in K-12 education. Submissions, correspondence, and address changes should be sent to the editor at:

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Electronic editions of the *DataBus* and information about CEDPA are available from CEDPA's website at
http://www.cedpa-k12.org

President's Corner

Darryl La Gace, Lemon Grove School District

While summer is fast approaching, your board is working harder than ever. At our last regular board meeting in March the board went through a strategic planning process to refine their ideas on goals and objectives for the year 2000. A conference theme was also announced: "**Supporting a Virtual Learning Community**."

With the rapid growth of technology in our schools, CEDPA continues to be a key resource for K-12 technologists throughout the state. Our organizational objectives are designed to provide leadership and support to information technology and form the basis for strategic planning activities. Key areas of focus for CEDPA over the next year include:

1. Continue to deliver a great conference;
2. Host regional SIG meetings;
3. Improve the content of the CEDPA web site;
4. Increase the ways the ***Databus*** is distributed to increase readership; and
5. Continue to focus on the needs of our members.

As we work on these objectives, we need you–our membership– to keep us informed as to what you want out of the organization.

In the upcoming weeks, the board will be forming a membership sub-committee to assist us in our goals. If you have ideas or thoughts for the committee to consider, please email them to directors@cedpa-k12 .org.

Thanks to the excellent work of the conference subcommittee (Warren Williams, Russ Brawn, Greg Lindner, Jane Kauble, Mike Caskey, and Scott Sexsmith.) You can expect this year's conference to be full of innovative ideas and resources. With this year's theme, "Supporting a Virtual Learning Community," you are bound to hear lots about existing and emerging technologies that support both systems within our schools and those in and around our communities. You will see examples and visions of how the two can interconnect to extend learning beyond the traditional classroom. Our vendors continue to boost the value of the conference, providing not only the best ways to see and purchase new products but often provide engineers to help answer technical questions or give us insight on how we can improve our networks. As with past conferences, this year's conference is one you won't want to miss, so mark you calendars early for November 15-17, 2000, at the Fess Parker's DoubleTree Resort in Santa Barbara.

Microwave Radio

Al Pfeltz, Taylor Communications

Microwave radio has proven its viability, capability and benefit for voice communications since the 1950's. Data and audio/video transmissions, however, have experienced user acceptance only since the mid-1980's. This delay can be directly attributed to the radio manufacturers having focused traditionally on the common carriers, the broadcast industry and the Government. To these entities the vendors have offered customary T1, multiple T1's, T3 and OC3. These approaches have offered a means for "bypassing" the traditional leased lines but have done little to address the bandwidth necessities of the expanding metropolitan area networks ("MAN's) and/or Wide Area Networks (WAN's).

In the mid-1980's, the first modern microwave systems designed to provide full bandwidth Ethernet were introduced, delivered and implemented. Later, added capacity was needed and the Full Duplex Ethernet solutions were furnished. However, the need for greater capacity has continued to expand. Several new answers have emerged.

Microwave Matures

If capacity beyond a T1, several T1's, Ethernet or Full Duplex Ethernet were needed in a wireless environment, the next step would be to implement a T3 microwave link. This did not appear to be an expensive solution — on the surface. The radios were about twice the cost of a traditional Ethernet link but provided about four times the bandwidth. The hidden expenses came from connecting the system to the network. The only accepted procedures were to utilize DS3/DSU's and to interface into a High Speed Serial Interface ("HSSI") port on the routers or to employ a direct connection to an ATM/DS3 port on the routers. These interface alternatives almost quadrupled the cost for a microwave upgrade.

(See "Microwave" on Page 14)

2000 CEDPA Conference
November 15-17, 2000
Fess Parker DoubleTree Resort
Santa Barbara, California

Technology Spotlight On: Oakland Unified School District

An Update on the Technology Literacy Challenge Grant Program

Joyce Hinkson, California Department of Education

If staff development can be likened to a "moving target", then Oakland Unified seems to have made a direct hit, as well as a direct impact.

Oakland Unified successfully competed and was awarded two Technology Literacy Challenge grants, the first in 1997, and the second in 1998. The 1997 (or Round 1) grant focused on grades 6-8, and the 1998 (Round 2 grant focused on grade 5. The Core Values and Foundations projects for history and language arts currently serves over 200 grade 5-8 teachers and over 9,000 students in this large, urban district. Staff development is an integral component of their program, ably run by Peter Hutcher, Project Director and Pam Bovyer, Project Manager.

Oakland's staff development program promotes the integration of technology tools into the training, provides materials, encourages and motivates through collaborative efforts such as coaching, e-mail access and community partnerships. Teachers also participate in threaded discussions and receive resources through an Internet forum hosted by Blackboard.Com. Lesson plans and activities are available on-line, supported in part by a partnership between Oakland Unified and U.C. Berkeley Interactive University Project with the Bay Area Writing Project as the primary partner. Pam noted that, for her, one of the most exciting things about being a part of the grant is "…the chance to see a complete staff development program, from inception to fruition."

Students and teachers have access to primary source documents as well as a variety of other materials from the Internet Library. Each classroom has been equipped with a networked Research Center that includes two new multi-media computers, three refurbished computers (486s with Internet connection), and a Laser printer. Classrooms also have access to a digital camera, a variety of videos and student materials, and a large screen monitor. Fifth grade classrooms also have Alpha-Smart keyboards. The Core Values program melds critical thinking skills with the implementation of academic standards.

Although a project of this size and scope took longer than anticipated to implement, the project is now moving along quickly. Besides staff development, two areas of the project with which Pam is especially pleased are the availability of technical and curricular support and the Virtual Museum, which showcases student work. Much of the credit for the Virtual Museum goes to the talent of the webmaster, Linda Swanson. You can view the Core Values project on the California Department of Education's web site: http://www.cde.ca.gov/tlc. Click on the TLC Project Web Sites link.

More good news has followed Core Values: In addition to having the staff development model adopted for other curricular areas by the district, Oakland Unified recently received an Urban Institute grant to do an in-depth evaluation of their project. Congratulations!

For more information on this Project, you may contact: Peter Hutcher or Pam Bovyer, Oakland Unified School District, (510) 879-8579 or (510) 879-2681.

Joyce Hinkson is a consultant for the California Department of Education's Education Technology Office. She may be reached at (916) 323-2241 or by e-mail at jhinkson@cde.ca.gov.

Microsoft Proxy Server

Tuan Nguyen, Microsoft Corporation

The Connected Learning Community

New technologies have created exciting new opportunities for education. It is now possible for every student to have extensive access to the world's knowledge. Every student can be ensured learning methods best suited to his or her unique needs. These technologies enable students, teachers, and communities to create a new learning environment of connected PCs, which we at Microsoft call The Connected Learning Community. In the Connected Learning Community, all students have access to a computer that is connected online; each student is empowered to pursue their own individual path of learning; and students, parents, educators, and the extended community are all connected.

The technology to make this possible is now available through the Microsoft® Windows NT® operating system platform and Microsoft's BackOffice® Suite of products. Microsoft recognizes, though, that the power of these new learning tools must be controlled. Schools need to manage and customize the access which students, teachers, and administrators are given to Internet resources. They also need sensitive information on the internal network to be protected from unauthorized access.

The best solution for these needs is the Microsoft Proxy Server, included in the BackOffice Suite of products. Microsoft Proxy Server allows you to provide Internet access to an entire school system through a single, secure link. You can set up just one IP address for your network, and have a set of private Internet addresses for all other computers. Powerful administrative capabilities allow you to monitor which sites are being visited and block access to inappropriate sites, while also restricting the access that the outside world has to internal documents.

Microsoft Proxy Is a Secure, Easily Managed Internet Solution

Microsoft Proxy Server's single, secure gateway eliminates the need to share one dedicated machine for the Internet among multiple students. This eliminates the need to run multiple Internet lines into the school to provide different computers with separate connections, and delivers maximum accessibility, while helping to simplify administration.

Microsoft Proxy Server Web Site: Intuitive Interface

The Windows® interface is consistent throughout the current Microsoft operating systems: Windows 95, Windows NT Server 4.0, and Windows NT Workstation 4.0. The most widely used interface in the world gives schools the advantage of familiarizing their students to an operating system they are likely to be using in the business world. Additionally, the familiar and intuitive interface is consistent throughout Microsoft Proxy Server and other Microsoft products, making Proxy Server an easily managed and powerful tool for teachers and school administrators.

Auto Online Connect and Disconnect

To save even more time, and provide better access control, the Auto Dial tool in Microsoft Proxy Server automatically connects to your Internet Service Provider (ISP) whenever a user needs information not already stored in the local cache. When the desired information is retrieved from the ISP and stored, Auto Dial disconnects from your ISP, saving online costs. For example, if a teacher accesses the Web before school from a computer in a classroom, the Proxy Server-based system would dial your ISP, cache the information he or she accesses, and then disconnect, saving time in the classroom. How? When the students and teacher go to that same information later on, the computer will recognize the cached information as if it were on the Web, and not even dial your ISP.

High-Performance Access

Microsoft Proxy Server also delivers high-performance access to the Internet and your intranet. Proxy Server improves response times and minimizes network traffic by caching a local copy of frequently requested Internet or intranet data on a local computer. Proxy Server does this by dynamically analyzing Internet and intranet use and automatically identifying the most frequently used data. Proxy Server then caches this information, thus ensuring that users can access the most popular information quickly. Proxy Server also enables administrators to define a Time-to-Live for all objects in the cache, helping to keep the information fresh and ensure maximum effi-

(See "Proxy" on Page 6)

Proxy

(Continued from Page 5)

ciency. For example, with these tools you could provide a quick way to access an up-to-date MSNBC web page several times a day, without having to go out and retrieve this information over the Internet every time.

Compatible and Flexible

Proxy Server runs on Windows NT Server, and allows a range clients to access the Internet. In fact, if your computers can run a Web browser, they can take advantage of your server, regardless of their platform. Microsoft Proxy Server is easily integrated with the following platforms:

Windows NT Server
Windows NT Workstation
Windows 95
Windows for Workgroups/Windows 3.1
UNIX
Macintosh

Microsoft Proxy Server integrates easily with Windows NT Directory Services allowing an easy plug-in and single log on for the network's users. In other words, if you already have a Windows NT network running, any user on that network can be given privileges to access the Internet through Proxy Server from any computer on the network, without having to enter their username and password multiple times.

Additionally, Microsoft Proxy Server is easily integrated with existing network protocols. It integrates tightly with the Windows NT Server networking, security, and administrative interface, so you can centrally administer Proxy Server using the same tools. Popular network protocols are supported, so it works easily with your existing network. Proxy Server works on both IPX/SPX and TCP/IP-based platforms. It also works with existing Web browsers, and most desktop operating systems and hardware platforms.

Microsoft Proxy Server supports open standards for broad compatibility. It complies fully with the CERN-proxy standard, which supports the HTTP, FTP, and gopher protocols, providing access to the widest possible range of browsers and Internet applications. Proxy Server supports the Secure Sockets Layer (SSL) for secure data communication through data encryption and decryption. WinSock Proxy, which is included with Proxy Server, supports Windows Sockets version 1.1-compatible applications running on a private network-including LDAP, IRC, SMTP, Microsoft SQL Server(tm), RealAudio, and VDOLive¾without any modification.

Powerful and Easily Managed

Microsoft Proxy Server helps ensure that your users can access the rich content of the growing number of applications on the Internet. Proxy Server does this by providing support for a wide range of applications and protocols¾including those with live, streaming audio and video such as RealAudio and VDOLive, LDAP, IRC, SMTP, and Microsoft SQL Server¾and provide transparent access from any desktop. Active, Intelligent Caching stores frequently accessed Internet data on the server where users can bring it up without going on the Internet. This enables the school district to serve a greater number of Internet users, thereby providing higher capacity without adding bandwidth to its existing Internet connection.

Microsoft Proxy Server is integrated tightly with Windows NT Server user authentication, preventing unauthorized Internet users from connecting to your private network, thus keeping your sensitive data secure. This feature enables network administrators to restrict access by user name or group affiliation, and block access to restricted sites by IP address or domain so you can ensure that your users are using their Internet privileges appropriately. A school district can easily restrict access to certain protocols or from certain schools, and in an extreme situation school administrators could easily turn off student access to the Internet altogether and make it available to the teachers only.

From One Educator to Another

The Lee County School district needed to connect its schools to the Internet. The district, with more than 4,100 students in 13 schools (K-12), is the poorest school district in Virginia. "Lee County Public School System needed an inexpensive source of teaching materials to deal with rising costs and declining state funding," says Dr. Bishop, superintendent Lee County Public School System. The different sizes of schools in the district made having all of the schools connected a necessity. "Setting up a LAN, by the time you buy the software and everything, is about $30,000 to $32,000 per school. So it's not very cost-effective to put that LAN in small schools that don't have many books to start with." explains Paul Elswick, parent advocate and technical consultant, Educational Technology, LLC. Lee County installed a WAN

(See "Proxy" on Page 7)

Proxy

(Continued from Page 6)

to link all its school libraries together and set up Microsoft Proxy Server to connect all schools to the Internet through one economical link.

The Lee County School district found Microsoft Proxy Server to be the best solution. "For a great deal less money than the cost of setting up 10 dial-up lines and maintaining them, you could easily put a server into a school, and put in an ISDN line and Proxy Server," Alan Hughes, Microsoft Certified Product Specialist, observes. Because all the school libraries in the district were to be linked by a WAN, the district needed to find a client/server library tracking system. The district contacted Alan Hughes, a Microsoft Certified Product Specialist, to develop a client/server library management software system from scratch. "Any computer that can run a browser can have access to all 13 of our libraries from anywhere in the school system," notes Hughes. With Proxy Server, Lee County was able to set up just one IP address along with private Internet addresses for each of its 324 client computers. This configuration simplifies administration of the WAN and enables administrators to move computers from school to school without having to reconfigure them each time. Hughes began to develop a list of IP addresses and domain names to which they could deny access. The system uses Hughes's own automated program, which collects inappropriate site addresses to be filtered out and automatically loads them into the Proxy Server Registry every night.

Ultimately Lee County expects to have at least one computer in every classroom to provide a ratio of four students to one computer. The district is also actively trying to create the first virtual Governor's School in the state, which would provide enhanced learning experiences for gifted students. The goal, according to Elswick, is to be able to pull in curricula from the best curriculum developers in the country. "We feel like the Internet is the equalizer and Microsoft Proxy Server makes it possible to do just about anything here that you can do in a big city."

Why Use Microsoft Proxy Server in Your School?

Using Microsoft Proxy Server, your school can take advantage of the many ways the Internet can facilitate learning and enrich what is taught in the classroom, without leaving your network vulnerable to attacks from the outside or to inappropriate use from within your own network. Proxy Server will make Web use from within your school quicker and more easily managed, giving your users access to a rich diversity of Internet multimedia and interactive content, while saving you money by making efficient use of Internet dial-ups. Proxy Server is truly a powerful tool, integrated with the popular Windows NT Server, and included as part of the Microsoft BackOffice family of products.

System Requirements Hardware

Intel and compatible systems: *

- 486/33-MHz or higher Pentium or Pentium Pro processor
- Support for IPX/SPX is available on Windows 95 and Windows NT
- 15 MB of available hard-disk space**

RISC-based systems: *

- System with an Alpha processor
- 20 MB of available hard-disk space**

Microsoft Windows NT Server Operating system version 4.0 or later and

Microsoft Windows NT Server version 4.0 Service Pack 3 or later.

16 MB of memory (RAM)

CD-ROM drive

VGA, Super VGA, or video graphics adapter compatible with Windows NT Server 4.0

* See your reseller for a list of compatible systems and peripherals.

**Actual Requirements will vary based on your system configuration and on the features you choose to install. System requirements of Windows NT-based programs may exceed system requirements for Proxy Server. Does not include user-defined Web cache space. (Web cache requires NTFS partition.)

Software:

Microsoft Windows NT Server version 4.0

Microsoft Internet Information Server version 2.0 (included with Windows NT Server 4.0)

Windows NT Server 4.0 Service Pack (provided on the Microsoft Proxy Server CD-ROM)

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California Takes the E-Rate

A Summary of the Current State of E-Rate from the California Department of Education

Van Wilkinson, California Department of Education

The first-ever statewide E-rate meeting, hosted by the California Department of Education (CDE), was held March 1, drawing over 70 tech leaders to Sacramento to assist in giving California a clearer direction with E-rate implementation. Several CEDPA members were present, contributing to lively group work resulting in recommendations to the CDE. A special presenter who sits on the board of the Universal Service Administrative Company (USAC), Kathleen Ouye, spoke to the group about E-rate's past and future, giving reassuring indicators that there will be a Year 4 and Year 5 under current Congressional funding.

California was among ten states represented at a national E-rate meeting in Washington, D.C. on March 6-7, sponsored by the Council of Chief State School Officers (CCSSO) at which representatives of the SLD and FCC worked with the CCSSO representatives on current and future E-rate issues. Attendees were reminded by CCSSO officials that E-rate is the single largest existing federal education project. Although final policies will be released by the Federal Communications Commission (FCC) and the Schools and Libraries Division (SLD), there are some general trends emerging. One is the obvious over-subscribing of the program, in which $2.25 billion cannot cover the $4.72 billion requested for program Year 3. Based on prior years' experience, it is estimated that a relatively large number of the $4.72 billion in requests will not result in fully funded discounts.

Another issue is the potential for some applicants in the 80-90 percent discount range to "gold plate" their internal connections applications, requesting infrastructure systems far more complex than their recipient schools are prepared to utilize. Client Service Bureau (CSB), Program Integrity Assurance (PIA), and audit processes at the SLD compare an applicant's request with their planned access to (non E-rate) resources necessary to make use of what they are requesting. Nationally, there are some vendors who are using the E-rate program to coax high-discount applicants into agreements that are not consistent with the intent of E-rate, primarily in the areas of (a) supplying ineligible items by charging unreasonable costs for eligible items and (b) preparing the applications in such a way that conflicts of interest are apparent.

In the area of technology planning, no applicant has yet been denied solely on the basis of a weak or defective technology plan. However, in the PIA or audit stages, the technology plan is scrutinized with regard to the questioned item(s), and weak or defective technology plans have then become a part of the larger overall denial of application process. There may be a renewed effort, possibly in the fall, by the SLD to strengthen or adjust the technology planning aspects of the program.

Lastly, there is the issue of how the discount savings are being handled in various applicants' local budgets. If E-rate participants disperse the savings from discounts (principally recurring costs) into budget areas other than education technology, two dangers arise. One, the applicant may grow accustomed to "living at a discount level" with no budgetary mechanism to revert to non-discounted costs in the event discounts end. Two, if the CSB, PIA, or audit process reveals that there is not access to locally-funded resources needed to utilize the discounted goods and services, discounts may be denied.

Watch the CDE's web site (http://www.cde.ca.gov/erate/) for useful E-rate postings.

At the April 5, 2000, SLD meeting, Year 3 funding levels were approved, pending FCC's agreement to keep the total national cap at $2.25 billion.

(1) Issue Funding Commitment Letters (FCLs) to all applicants who filed inside the window for "priority 1" services, which are telecommunications and Internet access. Generally, this means that all who applied correctly in the window for discounts on phone service, data circuits, and Internet service provider (ISP) costs should be approved.

(2) Issue Funding Commitment Letters (FCLs) to those applicants who filed inside the window for "priority 2" services (internal connections) and who are at the 90 percent (or higher) discount level. Internal connections are generally the network wiring and hardware components.

(3) Not issue Funding Commitment Letters (FCLs) to those applicants who filed inside the window for "priority 2" services (internal connections) who are below the 90 percent discount level.

(4) Recognize that those applicants who filed inside the window for "priority 2" services (internal connections) and are in the 81 to 89 percent discount range MAY

(See "E-Rate" on Page 9)

E-Rate

(Continued from Page 8)

be funded, to some extent, based on the final rollout of all other discount commitments.

(5) Set aside $272 million for contingencies.

The release date for Wave 1 of FCLs has not been announced, nor have any such letters been issued. (The unofficial target start date is later in April.)

Follow-up after March 1 statewide meeting

1. California's larger E-rate questions have been brought to Council of Chief State School Officers (CCSSO) E-rate leadership forum, with SLD and FCC representatives. Discussions are regular and ongoing, keeping California in a contributing and knowledgeable position nationally.

2. Work is underway today to release a CDE Call For Presenters application, soliciting volunteer vendors to team with CDE and COE E-rate leaders to assemble and deliver trainings, both in preparation for Year 4 applications and for specific/complex topics such as telco accounting, contract language, and procurement options. Goal: a training calendar by mid-summer.

3. The California Public Utilities Commission (CPUC) has before it a resolution (T-16381) dealing with the California Teleconnect Fund (CTF), E-rate, and stacking. Oakland USD has been a regular participant (and the only education entity) in the CPUC work groups leading to this resolution. It will be heard May 18 in San Francisco, and it appears to have no harmful effects for current and future CTF participants and may offer relief to others who used "reverse stacking" in the earlier days of the E-rate program.

Current E-rate News

1. Year 3 funding is underway, with the first two waves of funding commitment letters already out and more on the way. Funding will cover all properly filed applications in the priority categories of telecommunications and Internet access.

2. Year 3 funding will cover all properly filed applications in the non-priority category of "internal connections" (mostly cable plant and hardware) who are at the at the 90 percent discount level and SOME properly filed applications who are at the 81-89 percent discount levels, starting with 89 percent and working down. Some California applicants have already received funding commitment letters at the 88 percent level. There are few who believe the funding will reach to 81 percent.

3. Single-entity (e.g., single-school district, single-school) applicants who are at the 80 percent discount level may be at a built-in disadvantage and may have to appeal to the FCC to seek relief within 30 days of being denied. Because ALL single-entity applications who have 50-74 percent of their students eligible for the national meals programs are set specifically and exactly at the 80 percent level, there is no differentiation between those schools, even though some may be at the 86 or 88 percent level, which would have otherwise been funded.

4. The PIA (Program Integrity Assurance) staff is aggressively checking Year 3 applications. This occurs when the applicant has not provided enough detail in their Form 471 Item 21 attachment to allow the PIA staff to determine the extent of ineligible uses as a percentage of eligible uses — then, the PIA asks for additional detail. An example of this occurs in cell phone use. Instructionally-related personnel (superintendent, principal, teachers, counselors, curriculum coordinators, etc.) are eligible; non-instructional personnel (maintenance, bussing, cafeteria, security, etc.) are ineligible. When the ineligible use exceeds 30 percent of the dollars for the FRN, the whole FRN is denied. The same process applies to long-distance calling cards, and if the PIA requests the applicant to provide sample phone bills as backup details, they may just count the number of calls and determine a percentage. The key issue is that the applicant must appeal its denial to the FCC within the 30-day period if the denial appears to be based on inaccurate percentages of ineligible uses.

5. If an applicant is denied a Cisco 2500 series router on the grounds that it is an ineligible remote access server, the applicant may appeal its denial to the FCC within the 30-day period if the router's remote access port is not used or if its use is instructionally-related. That's what a Montana applicant did successfully, but that FCC decision is not necessarily precedent-setting.

6. Un-spent funds from prior E-rate program years are being used to reduce (offset) the current carriers' collection rate instead of being funneled back into the program to cover more applicants. Although the FCC has not ruled conclusively on how to dispose of these un-used funds, the current practice gives us diminishing hope of "carrying it over" into subsequent funding years.

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Wireless Local-Area Networking

Sue Mangiapane, Cisco Systems

What Is Wireless Local-Area Networking?

In the simplest of terms, a wireless local-area network (WLAN) does exactly what the name implies: it provides all the features and benefits of traditional LAN technologies such as Ethernet and Token Ring without the limitations of wires or cables. But to view a WLAN just in terms of the cables it does not have is to miss the point: WLANs redefine the way we view LANs. Connectivity no longer implies attachment. Local areas are measured not in feet or meters, but miles or kilometers. An infrastructure need not be buried in the ground or hidden behind the walls—an "infrastructure" can move and change at the speed of the organization. This technology has several immediate applications, including:

- IT professionals or business executives who want mobility within the enterprise, perhaps in addition to a traditional wired network
- Business owners or IT directors who need flexibility for frequent LAN wiring changes, either throughout the site or in selected areas
- Any school whose site is not conducive to LAN wiring because of building or budget limitations, such as older buildings, leased space, or temporary sites
- Any school that needs the flexibility and cost savings offered by a line-of-sight, building-to-building bridge to avoid expensive trenches, leased lines, or right-of-way issues

WLANs use a transmission medium, just like wired LANs. Instead of using twisted-pair or fiber-optic cable, WLANs use either infrared light (IR) or radio frequencies (RF). Of the two, RF is far more popular for its longer-range, higher- bandwidth, and wider coverage. Most wireless LANs today use the 2.4-gigahertz (GHz) frequency band, the only portion of the RF spectrum reserved around the world for unlicensed devices. The freedom and flexibility of wireless networking can be applied both within buildings and between buildings.

In-Building WLANs

WLAN technology can take the place of a traditional wired network or extend its reach and capabilities. Much like their wired counterparts, in-building WLAN equipment consists of PC Card, Personal Computer Interface (PCI), and Industry-Standard Architecture (ISA) client adapters, as well as access points[1], which perform functions similar to wired networking hubs. Similar to wired LANs for small or temporary installations, a WLAN can be arranged in a peer-to-peer or ad hoc topology[2] using only client adapters. For added functionality and range, access points can be incorporated to act as the center of a star topology and function as a bridge to an Ethernet network as well.

Within a building, wireless enables computing that is both mobile and connected. With a PC Card client adapter installed in a notebook or hand-held PC, users can move freely within a facility while maintaining access to the network.

Applying wireless LAN technology to desktop systems provides an organization with flexibility impossible with a traditional LAN. Desktop client systems can be located in places where running cable is impractical or impossible. Desktop PCs can be redeployed anywhere within a facility as frequently as needed, making wireless ideal for temporary workgroups and fast-growing organizations.

Building-to-Building WLANs

In much the same way that a commercial radio signal can be picked up in all sorts of weather miles from its transmitter, WLAN technology applies the power of radio waves to truly redefine the "local" in LAN. With a wireless bridge, networks located in buildings miles from each other can be integrated into a single local-area network. When bridging between buildings with traditional copper or fiber-optic cable, freeways, lakes, and even local governments can be impassible obstacles. A wireless bridge makes them irrelevant, transmitting data through the air and requiring no license or right of way.

Without a wireless alternative, organizations frequently resort to wide area networking (WAN) technologies to link together separate LANs. Contracting with a local telephone provider for a leased line presents a variety of drawbacks. Installation is typically expensive and rarely immediate. Monthly fees are often quite high for bandwidth that by LAN standards is very low. A wireless bridge can be purchased and then installed in an afternoon for a cost that is often comparable to a T1

(See "Wireless" on Page 11)

Wireless

(Continued from Page 10)

installation charge alone. Once the investment is made, there are no recurring charges. And today's wireless bridges provide the band- width one would expect from a technology rooted in data, rather than voice, communications.

The Wireless LAN Standard

In the wired world, Ethernet has grown to become the predominant LAN technology. Its evolution parallels, and indeed foreshadows, the development of the wireless LAN standard. Defined by the Institute of Electrical and Electronics Engineers (IEEE) with the 802.3 standard, Ethernet provides an evolving, high-speed, widely available and interoperable networking standard. It has continued to evolve to keep pace with the data rate and throughput requirements of contemporary LANs. Originally providing for 10 megabit per second (Mbps) transfer rates, the Ethernet standard evolved to include the 100 Mbps transfer rates required for network backbones and bandwidth-intensive applications. The IEEE 802.3 standard is open, decreasing barriers to market entry and resulting in a wide range of suppliers, products, and price points from which Ethernet users can choose. Perhaps most importantly, conformance to the Ethernet standard allows for interoperability, enabling users to select individual products from multiple vendors while secure in the knowledge that they will all work together.

The first wireless LAN technologies were low-speed (1-2 Mbps) proprietary offerings. Despite these shortcomings, the freedom and flexibility of wireless allowed these early products to find a place in vertical markets such as retail and warehousing where mobile workers use hand-held devices for inventory management and data collection. Later, hospitals applied wireless technology to deliver patient information right to the bedside. And as computers made their way into the classrooms, schools and universities began installing wireless networks to avoid cabling costs and share Internet access. The pioneering wireless vendors soon realized that for the technology to gain broad market acceptance, an Ethernet-like standard was needed. The vendors joined together in 1991, first proposing, and then building, a standard based on contributed technologies. In June 1997, the IEEE released the 802.11 standard for wireless local-area networking.

Just as the 802.3 Ethernet standard allows for data transmission over twisted-pair and coaxial cable, the 802.11 WLAN standard allows for transmission over different media. Compliant media include infrared light and two types of radio transmission within the unlicensed 2.4-GHz frequency band: frequency hopping spread spectrum (FHSS) and direct sequence spread spectrum (DSSS). Spread spectrum is a modulation technique developed in the 1940s that spreads a transmission signal over a broad band of radio frequencies. This technique is ideal for data communications because it is less susceptible to radio noise and creates little interference. FHSS is limited to a 2-Mbps data transfer rate and is recommended for only very specific applications such as certain types of watercraft. For all other wireless LAN applications, DSSS is the better choice. The recently released evolution of the IEEE standard, 802.11b, provides for a full Ethernet-like data rate of 11 Mbps over DSSS. FHSS does not support data rates greater than 2 Mbps.

The Future of Wireless Local-Area Networking

The history of technology improvement in the wired LANs can be summed up with the mantra "Faster, Better, and Cheaper." Wireless LAN technology has already started down that road: data rates have increased from 1 to 11 Mbps, interoperability became reality with the introduction of the IEEE 802.11 standard, and prices have dramatically decreased. The improvements seen so far are just a beginning.

Performance

IEEE 802.11b standard 11 Mbps WLANs operate in the 2.4-GHz frequency band where there is room for increased bandwidth. Using an optional modulation technique within the 802.11b specification, it is possible to double the current data rate. Cisco already has 22 Mbps on the road map for the future. Wireless LAN manufacturers migrated from the 900-MHz band to the 2.4-GHz band to improve data rate. This pattern promises to continue, with a broader frequency band capable of supporting higher bandwidth available at 5-GHz. The IEEE has already issued a specification (802.11a) for equipment operating at 5-GHz that supports up to a 54-Mbps data rate. This generation of technology will likely carry a significant price premium when it is introduced sometime in 2001. As is typical, this premium will decrease over time while data rates increase: the 5.7-GHz band promises to allow for the next breakthrough data rate—100 Mbps. While performance will unquestionably continue to improve,

(See "Wireless" on Page 12)

Wireless

(Continued from Page 11)

customers will continue to require a reliable partner to integrate these dynamic technologies seamlessly into the existing network. Cisco provides the stability and network expertise to make such integration a reality.

Security

The wired equivalent privacy (WEP) option to the 802.11 standard is only the first step in addressing customer security concerns. Cisco provides the greatest level of security available today for wireless networking, offering up to 128-bit encryption and supporting both the encryption and authentication options of the 802.11 standard. As specified in the standard, Cisco uses the RC4 algorithm with a 40- or 128-bit key. When WEP is enabled, each station (clients and access points) has up to four keys. The keys are used to encrypt the data before it is transmitted through the airwaves. If a station receives a packet that is not encrypted with the appropriate key, the packet will be discarded and never delivered to the host.

Although the 802.11 standard provides strong encryption services to secure the WLAN, the means by which the secure keys are granted, revoked, and refreshed is undefined. Fortunately, several key administration architectures are available for use in the enterprise. The best approach for large networks is centralized key management, which uses centralized encryption key servers. The ongoing Cisco strategy includes the addition of encryption key servers, to ensure that valuable data is protected. Encryption key servers provide for centralized creation of keys, distribution of keys, and ongoing key rotation. Key servers enable the network administrator to command the creation of RSA public/private key pairs at the client level that are required for client authentication. The Cisco key server will also provide for the generation and distribution to clients and access points of the RC4 keys needed for packet encryption. This implementation eases administration and helps avoid compromising confidential keys. Cisco will continue to enhance security measures to ensure best-of-class security throughout the enterprise network.

Mobility Services

A primary advantage of WLANs is mobility, but no industry standard currently addresses the tracking or management of mobile devices in its Management Information Base (MIB). This omission would prohibit users from roaming between wireless access points that cover a common area, such as a complete floor of a building. Cisco has addressed this issue, providing its own versions of mobility algorithms that facilitate roaming within an IP domain (such as a floor) with an eye towards optimizing roaming across IP domains (such as an enterprise campus).

Management

Wireless access points share the functions of both hubs and switches. Wireless clients associating with access points share the wireless LAN, similar to the way a hub functions, but the access point can additionally track movement of clients across its domain and permit or deny specific traffic or clients from communicating through it. For network managers to use these services to advantage, it is necessary to instrument the access point like a hub and a switch.

The Cisco WLAN devices are manageable through common Telnet or SNMP (I or II) services and a Web browser interface to facilitate its monitoring and control. In addition to bridge statistics and counters, the access point also offers additional features that make it powerful and manageable, including mapping of wireless access points and their associated clients as well as monitoring and reporting of client statistics. Access points can also control access and the flow of traffic through the wireless LAN via Media Access Control (MAC) and protocol-level access lists. Configuration parameters, as well as code images for access points, can be centrally configured and managed to facilitate consistency of WLAN network policy.

Price

Declining wireless LAN equipment prices have opened up whole new markets. As volumes continue to increase, manufacturing efficiencies and cost-reduction engineering will allow for even further price reductions. Although it is unlikely that the price of a wireless client adapter will ever match that of a wired one when cabling cost and labor are accounted for, the difference will become increasingly insignificant.

Conclusion

Today, the WLAN has redefined what it means to be connected. It has stretched the boundaries of the local-area network. It makes an infrastructure as dynamic as it

(See "Wireless" on Page 13)

Wireless

(Continued from Page 12)

needs to be. And it's only just starting: the standard is less than three years old, with the high-speed 802.11b yet to reach its first birthday. With standard and interoperable wireless products, LANs can reach scales unimaginable with a wired infrastructure. They can make high-speed interconnections for a fraction of the cost of traditional wide-area technologies. In a wireless world, users can roam not just within a campus but within a city, while maintaining a high-speed link to extranets, intranets, and the Internet itself. The future of wireless local-area networking is now—and it's at Cisco.

[1]A wireless LAN transceiver that acts as a hub, and bridges between wireless and wired networks.
[2]A wireless network composed only of stations without access points.

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CEDPA Listservs

As a service to K-12 Technologists, CEDPA hosts several e-mail discussion distribution forums (listservs) on various technology topics. These lists are open to anyone with an interest in the topic area.

Edtech - A discussion forum for educational technology issues.

Erate - A discussion forum for E-Rate, the FCC ruling on Universal Service that provides schools and libraries significant discounts on telecommunications services.

To join a distribution list, send an e-mail message to listserver@cedpa-k12.org. Leave the message subject blank. The message body should contain only two words: the word **subscribe** and the name of the discussion list you wish to join. The rest of the message should remain blank. Do not append your signature line or any other text to the message.

To leave a list, send a message to listserver@cedpa-k12.org as above, except use the words **unsubscribe** and the name of the list you wish to leave.

Community

(Continued from Page 1)

cated design, security and monitoring capability to retain their robust capacity in a wireless environment. The State has recognized the power of technology to deliver a world class education to its students and it is counting on the educational technologist to grasp the significance of these educational programs to create a better learning community.

This virtual learning community will need technologists to attend to educational as well as technological innovation. They must be aware that parents want access to student information - grades, attendance, schedules, performances, sports - at any time of the day. They want their students to research from home or a friend's house as well as at school. Online resources can't be restricted to labs or LANs. Licensing and security issues take on new meaning. Parents also want access to schools and the resources there. Why should tax money investments be restricted to a six hour day? Many schools are now opening up in the evening for parents to learn the stuff of the WEB. Who will teach them? They want data to support a school's contention of good performance. They demand explanations for certain scores on measurement rubrics and insist on adequate electronic resources to insure their student's success. They expect the educational technologist to provide sufficient material online for student projects but not information that could harm. The dilemma for managers of networks is where to draw the line - too little information and teachers complain, too much and parents can become irate.

Student information systems are confronted with managing data beyond the transcript. Data marts are proving to be an effective strategy for keeping disparate systems and databases connected. Portals are designed to allow enduser organization of data elements. Divergent trends lead to terminal based application sets and to faster and more powerful workstations. Support staff must constantly reinvent and redefine its skills set and capability. There is a need for perpetual training in the educational technology profession. The convergence of voice, video in this milieu adds a complexity that provokes anxiety for managers charged with capital equipment acquisition.

While the challenges are many, so are the rewards. The educational technologist is at the forefront of reform and redesign. CEDPA is uniquely positioned to afford the educational technology community a forum for the exploration of ideas. It can afford the attendee many opportunities for sharing and learning proven strategies. We hope you can join us in Santa Barbara as we explore these issues.

Microwave

(Continued from Page3)

The entrepreneurial spirit emerged with the introduction of the Fast Ethernet radios. These units, although more expensive than the DS3 radios, provided a less costly turnkey solution since there was an ability to interface the system directly into Fast Ethernet ports on either routers or a switches. Again the price/performance curve has been followed; the Fast Ethernet turnkey implementation cost about seventy-five per cent (75%) of a DS3 connection but provides over twice the bandwidth.

An alternative solution has now appeared in the market. This incorporates the bandwidth of the traditional DS3 radio with the interface ease of the Fast Ethernet system. Rather than the customary HSSI and DS3/DSU or ATM/DS3, this unit contains a 100baseT connection. This enhancement now brings this offering into line of the price/performance curve with the widely accepted 10/20 Mbps Ethernet and Fast Ethernet products.

Conclusions

In creating a MAN and/or WAN, a network manager has three connectivity options; these are leased lines, fiber optics cabling and microwave radios. These are the most robust and reliable alternatives/options although connections with limited distance can also be made with infrared or spread spectrum equipment. Each transmission medium has its own benefits and drawbacks in terms of price, bandwidth, availability and reliability. With constant changes with all of these approaches, a network manager must frequently evaluate these approaches and ascertain the best solution for each leg in a MAN or WAN.

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