



# DataBus

“Supporting California's Educational Technology Community”

## TechSETS Promises to Provide Much-Needed Support for School Technologists

Todd Finnell, Imperial County Office of Education



Administered by the San Diego County Office of Education, under contract with the California Department of Education, TechSETS (Technical Support for Education Technology in Schools) is under development to support the escalating need for skilled technology support professionals in California schools. The explosive growth in school technology has emphasized the need for a common set of knowledge and competencies and appropriate professional development to ensure technology is adequately supported in schools.

Working with a wide range of vendors, field professionals, county offices of education, and school districts, TechSETS has set out to establish a statewide consensus on what technology support staff should know about and be able to do with technology and to document that consensus as a comprehensive matrix of skills.

TechSETS has the following initial objectives:

1. Identify technology skills needed, along with appropriate professional development, arrayed in a user-friendly matrix.
2. Collaborate with stakeholders to identify cost effective sources of training aligned to the matrix of skills.
3. Provide resources and support for California school technologists through an online inter-

*active helpdesk.*

4. Provide assistance for planning and installing technology infrastructures.

TechSETS plans to work in close collaboration with CEDPA and it’s members who comprise a majority of clients that TechSETS aims to support. A series of advisory, small focus group, and individual meetings are underway across the state to elicit feedback and focus TechSETS to best meet the needs of a wide range of support professionals. Involvement of CEDPA members is encouraged to ensure the needs of our diverse regions in California are appropriately and effectively met.

TechSETS will be launching its online helpdesk at

*(See “TechSETS” on Page 7)*

### Also In This Issue:

<b>Spotlight on Technology: Technology Literacy Challenge Grant – Project TEC.....</b>	<b>4</b>
<b>An Update on the Digital California Project.....</b>	<b>6</b>
<b>CEDPA Announces Membership Drive.....</b>	<b>7</b>
<b>CSIS Announces RFP for Phase Three Participation.....</b>	<b>8</b>
<b>Networked Storage.....</b>	<b>11</b>
<b>True-Life Experiences of CEDPA Directors.....</b>	<b>16</b>
<b>Breathing New Life Into Old Hardware.....</b>	<b>17</b>

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## 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:

**CEDPA**  
**P.O. Box 6552**  
**Huntington Beach, CA 92615-6552**

Electronic editions of the *DataBus* and information about CEDPA are available from CEDPA's website at

**<http://www.cedpa-k12.org>**

# It's Time To Identify Our Priorities

**Warren Williams, Grossmont Union High School District**

The public education IT business affords little time for contemplation. Schools present a series of deadlines that can not slip. They must be met. The State of California and the U.S. Government are reluctant to extend reporting deadlines. CBEDS and the J200 series must be filed on time or calls and letters indicating past due performance are sent to principals and superintendents. Miss a class size reduction report and thousands or hundreds of thousands of dollars are lost; and there is no way to consolidate requirements to mitigate these pressures.

Modern technology, computers, the WEB, and databases, have exacerbated the problem. The demand for information by parents, administrators, teachers, students and the community grows exponentially. The efficient IT professional who consistently stretches resources to meet increased demands, sows the seeds of tension, stress, work related injury, illness and poor performance for support personnel. Perhaps my memory is failing, but I seem to recall a time when we were only occasionally overworked. Things have changed. I cannot now identify a segment of the school community that is not consistently overworked. National statistics point to extended work-weeks for everyone. I find it common to talk to fellow managers who put in 50 and 60 hour work-weeks. Who has not had to work a Saturday every now and then just to catch up?

I present this discussion not to complain, but rather to suggest that we are all part of a collective problem that only together we can solve. The two recent tragedies in my district have caused me to think seriously about what we are doing to ourselves and to our children. To suggest that we shouldn't build a world class education in California would be ludicrous, but how we do it deserves consid-

erable attention. Can the subtle message of constant pressure to perform be inducing dysfunction in our students and our staffs. Can work overload be creating an environment that provokes symptoms of stress?

I cannot say, other than I suspect until we begin to find ways to work more intelligently, we will continue to see an increase in problems of adjustment. We need to begin to reflect on what is essential for attaining our goals and what is superfluous. We must pay attention to our kids and inquire about their struggles. We should meet with our staff frequently and check on job satisfaction and their ability to accomplish what is set before them. I think it is important that we attend to all of those working around us and find ways to make their work as pleasant and doable as possible, and to consistently keep it within a 40 hour timeframe.

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*Warren Williams is Assistant Superintendent, Information and Technology Services, for the Grossmont Union High School District. See related article, "True Life Experiences of CEDPA Directors," elsewhere in this issue.*

**2001 CEDPA Conference  
November 14-16, 2001  
DoubleTree Hotel  
Monterey-Fisherman's Wharf  
Monterey, California**

See <http://www.cedpa-k12.org/2001Conference/>

# Spotlight on Technology: Technology Literacy Challenge Grant – Project TEC

Joyce Hinkson, Ed.D., California Department of Education

According to David Bowling, Coordinator for the six districts that make up the technology consortium known as Project TEC (Arvin Union, Beardsley, Fairfax, McFarland Unified, Standard, and Vineland), technology use has... "grown exponentially" since the implementation of the Technology Literacy Challenge Grant. The consortium of small districts currently will have used TLC funds to place nearly 1000 computers online by the end of the 2001 school year. Additionally, with the help of E-rate, each district has provided state-of-the-art servers and infrastructure to accommodate six or more computers in every K-12 classroom across the consortium. Even with the considerable expense of hardware and network infrastructure, the primary goal of this program is not the acquisition of hardware. The main goal of the program is finding unique ways for six separate school districts with limited resources to work together to coordinate and implement a staff development program focused on effective integration of technology to promote learning in all curricular areas.

Project TEC (Technology Enhanced Curriculum) was first established in the fall of 1997 to attempt to narrow the region's digital divide. A Technology Literacy Challenge Grant award in 1998 gave the consortium the funds it needed to implement the vision and design of the project. A major percentage of the Kern county's socio-economically disadvantaged families are served by the consortium, in an area captured in print by John Steinbeck's, "The Grapes of Wrath". The consortium is the first of its kind in the Southern San Joaquin Valley.

At the close of the 2000 school year, the project had provided a technology center to all fourth and fifth grade classrooms as well as libraries across the districts. The centers consist of six multimedia computers, network printers, digital cameras, scanners and a suite of software for instructional use. There are approximately 90 such centers across the consortium. This, the final year of the program provides modern computers labs and peripherals at each district for use by middle school students.

A major focus of the TEC consortium continues to be staff development. The training model has evolved from productivity to technology/curriculum integration. Consortium-wide training begins each year with two day-long "boot camps" for targeted teachers in grades four through

six. In addition to the camps, two "re-boot" sessions are held prior to a week long "Summer Technology Institute" at Bakersfield College, which occurs just before each new school. Teachers receive a stipend for these five-hour sessions. To ensure that teachers receive training at their level of comfort, they may choose one of three classes based on their perceived technology proficiency; beginning, intermediate, and advanced. Training is conducted by Project TEC Coordinators representing each of the six districts that provide a new lesson plan integrating technology for each session. Three additional consortium-wide sessions, spaced throughout the year, are held on weekends. In addition, each district maintains support personnel to provide ongoing training and teacher assistance throughout the school year. A popular event that has grown out of the training sessions is the "Curriculum Swap Meet". During this workshop, teachers involved with Project TEC spend a Saturday presenting hands-on sessions demonstrating successful technology-integrated lessons with their peers.

David Bowling states that the success of this project has centered on a strong collaborative effort and the desire of the superintendents from each school district to ensure that funds spent on educational technology enhance instruction in meaningful ways. District leaders meet regularly to discuss the project, and plan future endeavors, and technology coordinators across the consortium work together to develop training modules and solve technical issues. Mr. Bowling, and Superintendents Michael McGuire (Arvin Union Elementary), Ken Chapman (Beardsley Elementary), Adolph Wirth (Fairfax Elementary), Dr. Roberto Cardenas (McFarland Unified), Dr. Erich Kwek (Standard Elementary) and Stephen Greenfield (Vineland Elementary), have pooled their personnel and resources to positively change education through this collaborative consortium. Opportunities not possible for these small, rural school districts just a few short years ago have been embraced and leveraged through successful implementation of the Technology Literacy Challenge Grant. If you have any questions about Project TEC, please contact Mr. David Bowling, (661) 903-1023 or by e-mail, dabowli@projecttec.k12.ca.us.

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*Dr. 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.*

# Exhibitors Wanted

**Oswaldo Galarza**  
**Orange Unified School District**

Four weeks after the last *DataBus* was distributed with the vendor registration forms for the 41<sup>st</sup> Annual CEDPA Conference, vendors subscribed 50% of the available booths. Some early paid-up participants include Accu-Scan, AMS.NET, Audio Graphic Systems, Data Impressions, Inc., Digitronics Software, Excelsior Software, Inc., Lexmark, MiLAN Technology, Network Catalyst Inc., Planware Systems LLC, SchoolMessenger, Spectrum Communications, and Tangent Computer, Inc. Additional information about these exhibitors appears at the CEDPA Conference Central website. The website will be updated as more vendors sign up, so check back often to see if your favorite vendor will be at the conference. If you know of a vendor who should be participating in our exhibit show, please have that vendor contact me or point them to CEDPA's website for registration forms.

The conference is scheduled to take place November 14<sup>th</sup>, 15<sup>th</sup>, and 16<sup>th</sup>, 2001 in beautiful Monterey California, at the DoubleTree Hotel Monterey-Fisherman's Wharf. The conference theme is "Education: The Digital Future". We have SOLD OUT the last three years with vendors scrambling to make special arrangements at the last minute. SIGN UP EARLY. Find the enclosed vendor registration form, complete and mail, fax, or email it to the vendor chair.

The CEDPA vendor show is one day only, November 15<sup>th</sup> and offers dedicated time for our vendors and attendees to meet with each other. No breakout sessions are scheduled during the Vendor Show. Visit CEDPA's Web site [www.cedpa-k12.org](http://www.cedpa-k12.org) to get more information or to download the vendor registration form. Feel free to contact the vendor chair at 714 628-4152 or by email at [galarza@orangeusd.k12.ca.us](mailto:galarza@orangeusd.k12.ca.us).

The floorspace available at the Monterey conference floor available has been expanded from the 1999 conference. This year, CEDPA is offering 68 10x10 booths and 5 Kiosks (20x20 Island booths) at the Monterey Conference Center.

CEDPA looks forward to your participation. Please mail your registration forms and fees to the Vendor chair:

Oswaldo Galarza / CEDPA  
Orange Unified School District  
1401 North Handy Street, Bldg. I  
Orange, CA 92867

# 2001 Call for Speakers

**Mike Caskey**  
**Stanislaus County Office of Education**

CEDPA is continuing to develop its 2001 Fall Conference program for breakout sessions. Your participation will contribute to a successful conference. If you have a topic you would like to present to our attendees, please sign up! This is your opportunity to share your experiences and lessons learned with your successful (or not so successful) hardware or software implementation. Please reserve your place early as we would like to have the conference program for breakout sessions developed and published with the Conference Announcement in July.

We are especially interested in your experiences with the following topics:

- Administrative systems migrations (student or financial systems)
- E-Rate experiences
- Network connectivity
- ATM or gigabit Ethernet implementation
- VPN Deployment
- Windows or Novell networking
- Emerging technologies
- Help desk support
- Data mining and warehousing
- Firewall design and implementation
- Intranet / Web development
- Instructional technology (with the exception of curriculum)
- Windows 2000
- Wireless technology

A breakout session typically lasts for 45-55 minutes and can seat up to 50 conference attendees. The majority of breakout sessions will be held on Wednesday, November 14, with a few session slots available on both Thursday, November 15, and Friday November 16.

A Call for Speakers form is included in this issue of the *DataBus*. The form is also posted at [www.cedpa-k12.org](http://www.cedpa-k12.org) in PDF format. You are encouraged to sign up as early as possible. Please complete and send your forms via postal mail, fax or e-mail to:

E-mail: [mcaskey@stan-co.k12.ca.us](mailto:mcaskey@stan-co.k12.ca.us)  
Fax: (209) 567-4365  
Voice: (209) 525-5095

# An Update on the Digital California Project

## A Summary of DCP News and Events

Dave Reese and Edwin W. Smith, 4CNet/California State University Office of the Chancellor

It is nearly the end of March 2001 as of this writing, and the activity level related to implementation of CENIC's Digital California Project is picking up steam very quickly. Here's where we stand at the moment.

The overall network architecture has been completed and the first round of 71 node sites located throughout all 58 county offices of education have been identified. During the month of February, onsite inspection visits were made to all candidate node sites. Installation of these sites will provide connectivity paths for the vast majority of K-12 schools throughout California.

Of course, a project of this size requiring the cooperation of numerous public and private organizations does not come without challenges. Several rural areas where broadband circuits are not readily available may require special technical solutions, which are being evaluated and worked on. The current timeline calls for the majority of the first round node sites to come online before the start of the new academic year beginning in September, and for the remaining node sites to be connected by the end of this calendar year. Thereafter, it is anticipated that an additional 60 node sites will be brought online beginning in early 2002, providing more robustness to the DCP network and increased access for all K-20 institutions throughout the state.

A comprehensive Request for Proposal (RFP) was issued in January for network hardware, equipment installation and circuits. A team of reviewers evaluated all proposals received. Pacific Bell, SBC DataComm, Verizon and Williams are expected to be the primary equipment and circuit vendors for implementation of the DCP network. The aggressive network implementation plan will require extraordinary cooperation and coordination activities among all the stakeholders, with liaisons from the eleven K-12 regions playing a major role in this project.

Two other important teams are now in place and ready to tackle their activities. John Vaille from the Stanislaus County Office of Education has agreed to serve as Director of the DCP Applications Coordination team, while Stephanie Halnan-Couch from the University of California Office of the President (UCOP) has agreed to lead the DCP Communications team. We will hopefully be able to provide more detailed information in our next CEDPA *DataBus* Newsletter update as to the types of

applications and content options under consideration for DCP, as well as the communications plans being developed for the various K-12 constituencies.

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*Dave Reese is Director of Network Administration and Planning for 4CNet, the telecommunications service and connectivity network for the California State Universities and the California Community Colleges. Edwin W. Smith is Project Manager for 4CNet. Dave and Edwin are members of the DCP Project Management Team.*

### 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 [listserv@cedpa-k12.org](mailto:listserv@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 [listserv@cedpa-k12.org](mailto:listserv@cedpa-k12.org) as above, except use the words **unsubscribe** and the name of the list you wish to leave.

# CEDPA Announces Membership Drive

**Greg Lindner**  
**Elk Grove Unified School District**

CEDPA has received many requests over the years for our advice and input on major statewide technology initiatives as well as our thoughts and opinions on current technology issues. In an effort to position our organization to be better prepared when we receive such requests, we surveyed our conference attendees regarding membership at our last conference.

Overwhelmingly, the conference attendees agreed having a formal membership would be a benefit to them, their organizations and for advocating on statewide technology issues. To facilitate our membership process we have developed an online membership form. To become an official member, the form must be filled out, printed, signed, and then faxed to our membership department. There is no annual fee at this time to gain membership but we are requiring the form to be signed and faxed back to us so that we have your authorization to include your responses on periodic surveys we may conduct on items of interest to our organization. Membership is open to individuals, organizations, retirees, and vendors.

Specifically, annual membership is granted to attendees of CEDPA's annual conference and is included in the main conference registration fee. Annual membership in CEDPA is also available to K-12 technology professionals and can be obtained by:

- Filling out the information requested on our membership page at <http://www.cedpa-k12.org/membership.shtml>
- Printing out the membership form that is returned to you,
- Signing the form; and
- Faxing the signed form to our membership department at 916.684.9447.

If you are not able to attend our annual conference, you must resubmit a signed membership form to renew your annual membership.

As a member, you are granted full membership benefits. You will receive our bi-monthly *Databus* newsletter, announcements for CEDPA-sponsored events and

*(See "Membership" on Page 30)*

## TechSETS

*(Continued from Page 1)*

the 2001 CEDPA Conference in Monterey. Working with a variety of stakeholders and major vendors, the helpdesk will provide resources and support for technology support professionals in California. A cadre of field experts will be recruited over the next several months to respond to a wide range of questions, initially related to the matrix and appropriate professional development. The scope of questions addressed by TechSETS will expand to cover other areas as the project develops. Responses to inquiries will be cataloged in an extensive knowledge base, searchable in an easy-to-use web interface. Over time, TechSETS will build its capacity to provide assistance by incorporating a variety of technology tools and resources in the online helpdesk. If interested in participating as a field expert, or if you know someone who would be important for us to contact, you should visit our website and complete the requested information under the Technical Expertise for California's Helpdesk (TECH) Program.

TechSETS is one of four Statewide Education Technology Services (SETS) to provide support and resources for California schools as authorized by AB1761. These services are those that "are more efficiently and effectively provided on a statewide basis."

As a result of a collaborative process including major professional organizations and education technology stakeholders, four approved services were identified to include:

Learning Resources (CLRN) - [www.clrn.org](http://www.clrn.org)

Professional Development and Resources for Administrators (TICAL) - [www.portical.org](http://www.portical.org)

Arranging Discount Pricing and Coordinating Statewide Licenses (C-SMART) - [www.c-smart.org](http://www.c-smart.org)

Professional Development and Resources for Technology Support Staff (TechSETS)  
[www.techsets.org](http://www.techsets.org)

For more information regarding TechSETS or to provide feedback, visit us online or contact Todd Finnell directly at [info@techsets.org](mailto:info@techsets.org) or (760) 312-6403. For information regarding other SETS projects, visit them at the web address listed above.

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*Todd Finnell is Director, Instructional Technology for the Imperial County Office of Education. He is on loan to the San Diego County Office of Education and is the TechSETS Project Manager. He may be reached by e-mail at [tfinnell@icoe.k12.ca.us](mailto:tfinnell@icoe.k12.ca.us).*

# CSIS Announces RFP for Phase Three Participation

Russ Brawn, California School Information Services

The California School Information Services (CSIS) Program has released a Request For Proposals (RFP) so that districts, county offices of education and other local education agencies can apply for funding to participate in Phase Three of CSIS. Nine consortia comprised of more than 150 districts and county offices of education are currently working with the CSIS Program to develop and implement solutions that will enable the accurate and timely exchange of student transcripts and assist local education agencies to electronically transmit reports to the California Department of Education. Five of these consortia received funding in July 1999 as part of CSIS Phase One, and four more consortia began Phase Two in July 2000. CSIS expects to receive between \$11 and \$20 million in FY 2001-02 funding to be allocated among successful applicants to form new Phase Three consortia and those districts joining any of the existing nine consortia. **The due date for submitting a Phase Three proposal is June 8, 2001.**

## CSIS Program Overview

CSIS was created to address a variety of challenges currently faced by LEAs trying to manage student information. CSIS is responsible for developing an electronic system of student information transfer for state reporting and exchange of individual student records that will serve the state's students, school districts, county offices of education, and school sites. Specific objectives of the CSIS program are to:

- Build LEAs local student information systems capacity and encourage LEAs to participate in statewide efforts to standardize data formats to facilitate information exchange.
- Promote timely transfer of student records between K12 schools as students move from one school to another.
- Promote faster and easier submission of transcripts by California high school students to California Colleges and Universities.
- Support educational policy decision-making at the local and state level by providing access to more comprehensive and timely information.
- Streamline reporting of education data between LEAs and the California Department of

Education.

The CSIS Program is headquartered in Sacramento, California.

Inherent in the CSIS Program is the need to establish a means to distinguish records for the approximately 6,000,000 California K12 students. A significant aspect of this work is *uniquely identifying students without compromising confidentiality*. Research and design work done by CSIS and participating consortia regarding the issues surrounding this need are unprecedented in the nation. Both records transfer and state reporting require multiple years of data, a problem compounded by the fact that students attend various institutions within those multiple school years. Each student's records are to be uniquely distinguishable from that of other students, and they are to be consistently identifiable over the entire academic career of each student from kindergarten through high school graduation. More than 570,000 students have already been assigned their unique CSIS Identifier.

## Local Funding Opportunity - Phase Three RFP

The purpose of the Request for Proposal (RFP) is to solicit proposals from qualified California school districts and county offices of education to develop and implement the capability to provide electronic student data for both state reporting and individual records transfer. It is through the RFP process that CSIS fulfills its goal to "Build capacity of Local Education Agencies to implement and maintain comparable, effective, and efficient student information systems that will support Local Education Agencies (LEA) daily program needs and promote the use of information for educational decision-making by school-site, district office and county staff."

## Project Scope

CSIS Phase Three will be conducted in three steps:

1. LEAs form a consortium, prepare, and submit a Phase Three proposal;
  - Based on the RFP requirements and additional information gained at the

(See "CSIS" on Page 9)



RFP Published	April 2, 2001
Bidders Conference in Sacramento	April 26, 2001
Letters of Intent Due	May 4, 2001
Proposals Due in Sacramento at 4:00 PM	June 8, 2001
Proposal Clarification Meetings (as needed) Held with Proposal Submitters	June 18-22, 2001
RFP Successful Bidders for Planning Grants Announced	June 29, 2001
Consortia Project Planning Begins	July 9, 2001
Detailed Implementation Plans Due	October 30 – December 28, 2001
Implementation Plans Reviewed and Approved	November 20, 2001 – January 25, 2002
Funded Implementation Projects Begin	December 1, 2001 – February 1, 2002

**Table 1. Overall Time Schedule**

scheduled bidders conference, submitters are to form a consortium of Local Education Agencies (LEAs) organized around a *single SIS software product* that offers a comprehensive district-wide solution, and has not been previously funded by CSIS.

- Submit a letter of intent identifying consortium members, including SIS vendor and product, List of total LEAs in the vendor's SIS user base that wish to participate in Phase Three, CDE Code, total number of sites and enrollment based on FY2000-01 CBEDS for each LEA.
  - Submit the proposal to CSIS that describes how the consortium will plan and implement Phase Three objectives.
2. For consortia awarded a Phase Three planning grant, the consortium members prepare a comprehensive project plan for developing and implementing CSIS-capable student information systems for each participating LEA. The planning grant will provide each consortium with funding to support a 4 to 6 month period in which the consortium will develop a comprehensive plan for implementing its Phase Three activities.
  3. LEAs implement their approved project plans. The approved implementation plan provides

the framework for a 20 to 22 month period to implement a CSIS-capable SIS district-wide. Data are populated, extracted, formatted, validated, and transmitted via secure Internet for state reporting and records transfer.

## Overall Time Schedule

See Table 1, above, for the overall time schedule.

Project proposals from consortia will be funded on a competitive basis, with funding intended to provide an incentive rather than to cover all possible costs. Consortia are expected to provide in-kind resources as well.

The complete RFP and supporting materials are downloadable from the CSIS web site at [http://www.csis.k12.ca.us/library/rfp\\_phase\\_three/](http://www.csis.k12.ca.us/library/rfp_phase_three/). General information about the CSIS Program and its activities are described on the web at <http://www.csis.k12.ca.us>. Any prospective applicant wishing clarification on the RFP should contact:

Bernadette McGinnis, Project Manager  
 California School Information Services  
 770 L Street, Suite 1180  
 Sacramento, CA 95816  
 Phone: 916-325-0887  
 Email: [bernadette@csis.k12.ca.us](mailto:bernadette@csis.k12.ca.us)

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*Russ Brawn is CSIS Information Systems Administrator for California School Information Services.*

# Networked Storage

Part I of a two-part series on  
deploying NAS or SANs in your  
school or district's environment

Darryl La Gace  
Lemon Grove School District

The Lemon Grove School District has developed a connected learning community model where it is commonplace for a student to be able to log on to a workstation at his or her desk and begin working on the day's activities. Teachers use Intranet sites to deliver instruction. Students can go home or to one of many access centers in the community to logon and do their homework. Parents can go online to check assignments or email a teacher to find out how their child is doing in school.

Schools and districts are faced with an ever-increasing expectation of access to information anytime anywhere. No problem, right? No problem, that is, unless you're in charge of the network and wondering how many days it will be before you have to add more disk space or bring up another server just to manage existing file storage.

In a two part series, we'll cover two storage technologies and what we have experienced in Lemon Grove deploying our new storage solution. Part I is a primer to get you familiar with the nuts and bolts of the network storage solutions available today and provide you with a better understanding of which might best suit your needs. In Part II, we'll cover the specifics of our design strategy and deployment steps. Finally, we'll cover some tips on things to consider when designing your own storage solution.

**S**o you want to build a Storage Area Network (SAN). There's nothing to it, right? Isn't everyone building a SAN? Why not **you**? After all, you want your facility to

be seen as a leading-edge data center and you're probably thinking that you can't do it without a SAN.

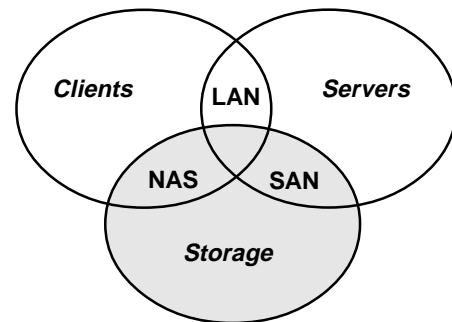
Before you step into the "SAN box," there are a few issues you'll need to consider. You'll need to know what a SAN really is and what it isn't. You'll also need to know the difference between SAN and NAS or Network Attached Storage. And finally, do you have a handle on where networked storage technology is headed in the future?

Part I should help you become familiar with networked storage and allow you to set appropriate expectations on the networked storage solutions available; NAS and SANs in particular. It should also help you set some realistic goals in terms of deploying storage in networked environments.

## Networked Storage 101

There are two popular forms of networked storage today: Network Attached Storage or NAS and Storage Area Networks or SAN. Both NAS and SAN provide the ability for multiple servers or clients to share storage resources, but they differ greatly in their implementation. The following diagram shows how NAS and SAN can be differentiated based on connectivity:

Storage Networking



*When multiple clients talk to servers, it's a LAN.  
When multiple clients talk directly to storage resources, it's NAS. And when multiple servers talk directly to storage resources, it's a SAN.*

In client-server computing, multiple clients (PCs or workstations) talk to a server over a local area network or LAN. A single server can service hundreds of clients depending on the configuration. Now, imagine those same clients seamlessly accessing storage resources without going through a traditional general-purpose file server. This is Network Attached Storage, or NAS. Next, picture the same principle, except that instead of multiple clients seamlessly accessing storage, you now have multiple servers accessing the storage resources. This is a

(See "Storage" on Page 11)

# Storage

(Continued from Page 10)

Storage Area Network, or SAN.

## NAS or SAN – What to Deploy and When

Analysts, editors, vendors, consultants, and customers throw around IT acronyms all the time, and NAS and SAN are no exceptions. NAS and SAN are in the news because end users are rapidly running out of disk space and looking to networked storage solutions to help solve the problems. IT administrators are spending too much time adding new disks to systems and too much time managing the increased storage resources. How do you cut through the hype and clearly position these two different ways of implementing networked storage in your environment?

First, identify what kind of system is talking to the storage device. In NAS, clients are talking to or sharing the storage resources. Client communications are usually centered on the transfer or access of **files**: copying, printing or sharing files between the client and the server or other clients on the network. In a SAN, however, multiple servers are sharing direct access to the storage resources. Communications between servers and storage is typically at a much lower level than communications to and from clients. Servers typically deal with information on a **block** level. Given this, one way to determine if it's NAS or SAN is to understand what is being communicated or shared within the storage device. If it's **file-based** communication, then NAS should be the first choice. If it's **block** level communications, such as data base manipulation or accessing a data warehouse, then SAN is most likely the proper choice.

Another way to look at the difference between NAS and SAN is to determine where the data needs to be accessed. If the data is to be accessed by a specialized workgroup over an existing LAN, then the best solution is to locate

the storage device within the workgroup (NAS). This will reduce the impact that the workgroup could have on the entire network if access is outside the workgroup environment. Likewise, if data needs to be accessed by many different users in multiple locations or via multiple different servers (i.e. email), then putting the storage near the servers or SAN, would be the best solution.

## NAS – Easy Does It

One of the key attributes of NAS devices is that they install within the existing LAN infrastructure. This makes them very easy to install and configure. Typically, all that is required is a device name and an IP address. And if the NAS device supports DHCP, then only the name is required because the host automatically assigns the NAS device an IP address.

To install and configure a NAS device, the user typically runs a web-based interface to set the device name and IP. Then, the NAS device is rebooted and is made available to all clients on the network. It usually takes between 10 and 15 minutes to install and configure a NAS device.

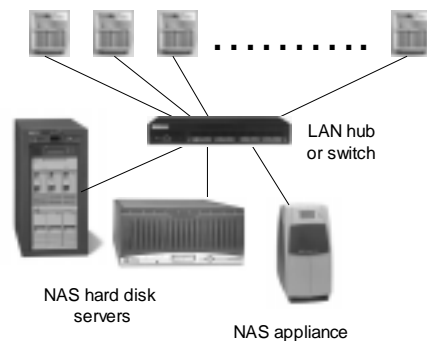
NAS devices use special “thin servers” to allow them to connect to the network and provide access to storage resources. These thin-servers, suited for specific tasks, are slimmed-down versions of regular file servers, with specialized software to handle minimal network and storage tasks. On the network, NAS devices allow clients to access storage.

The figure below shows how a NAS device would be connected in a typical workgroup configuration.

The downside in this simplistic approach is in managing NAS resources. Because they are specialized, they don't always integrate well with standard storage management

(See “Storage” on Page 12)

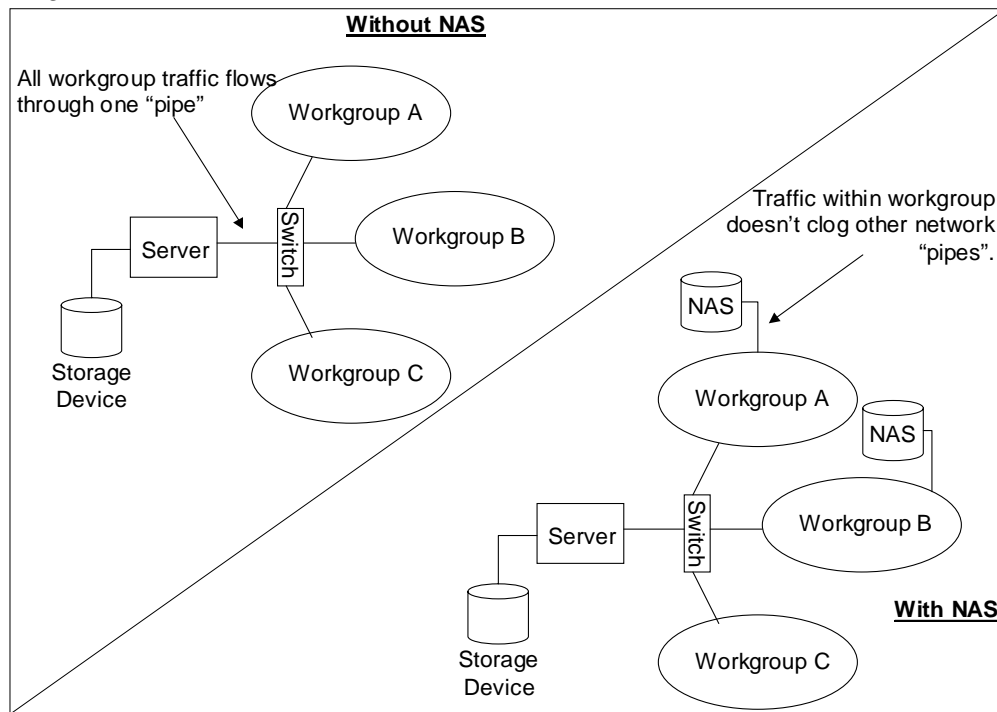
## NAS implementation



- easy to install/connect
- allows multiple hosts to share storage devices
- no host or O/S licensing required
- utilize existing LAN architecture
  - no new “plumbing” required
- support for multiple O/S
  - NT, Unix, Linux, etc

# Storage

(Continued from Page 11)



applications. For example, backup applications typically require agents to be installed on servers in order to allow them to be backed up. Since NAS devices don't have a full operating system, it may not be feasible to load the exact agent required. This means some NAS storage devices use proprietary backup methods or they must be backed up over the network, increasing network traffic and loading.

Also, because they have these special operating systems, NAS devices don't always integrate into the network management suite used by your customer. The best NAS devices will typically integrate into system management software like OpenView or Unicenter. Devices will be mapped in the system management view and the administrator can launch the NAS management tools directly from within these applications. Some NAS devices only send SNMP messages to these system management applications. These applications then decipher the message and display it to the administrator. Because of the wide variety of NAS solutions, not all messages can be deciphered simply, potentially complicating the network management task for the system administrator.

Data security is another issue to be addressed when considering the deployment of NAS devices. Today, most NAS solutions integrate within the O/S security system and access to a NAS device can be controlled via the O/S security and permissions settings. This occurs on the Primary Domain Controller. However, if O/S security is breached, then so is the access to the NAS device.

As noted, most NAS devices should be deployed in workgroup or departmental environments. Typically, most workgroups are set up based on the tasks that the clients perform and the client systems share files and applications that generate files in the workgroup. By using a NAS storage device such as a hard drive server, each client in the workgroup can store similar or shared information locally within the workgroup. The advantage here is that by limiting network traffic outside the workgroup, the bandwidth between workgroups can be freed up.

In the diagram above, all file transactions from workgroup A pass through the hub to the server and then to the disk drive. The same applies for workgroups B and C as well. In the lower right diagram, using NAS devices, file transactions that are specific to workgroup A never have to travel outside of the workgroup. The same applies to workgroup B. This means there is less traffic between workgroups than in the non-NAS configuration. Additionally, if the hub connecting the three workgroups to the server fails, workgroups A and B can still access data stored in the NAS device connected to their respective workgroup.

In summary, NAS devices are ideal for workgroup and departmental environments, where file sharing or file-based transactions occur within individual groups, such as sharing CAD drawings or email client archive files.

(See "Storage" on Page 13)

# Storage

(Continued from Page 12)

NAS devices can be used to isolate network transactions within a workgroup and can reduce the loading of the overall network bandwidth. Also, a NAS device can be placed throughout a network, enabling data storage to be done closer to client systems. Should a segment of the network fail, data within specific workgroups can still be processed, improving performance, reliability and availability.

## SAN – The Fix-All for Storage Consolidation

Those customers who need to share storage resources among many different servers would benefit from a SAN, using a high-speed network deployed exclusively for transmitting data to and from storage devices. Sharing storage resources in this manner improves manageability, reduces IT workload and improves access to and availability of data.

SANs are new and in their infancy. So are SAN standards, particularly in the area of connectivity. Today, SANs are designed and deployed using high-speed fibre channel (FC) connections between devices. These can be referred to as FC-SANs. FC-SANs can provide data at speeds of up to 100MB/sec and support multiple protocols. Protocols such as SCSI and TCP-IP can be transmitted via the same fibre channel network.

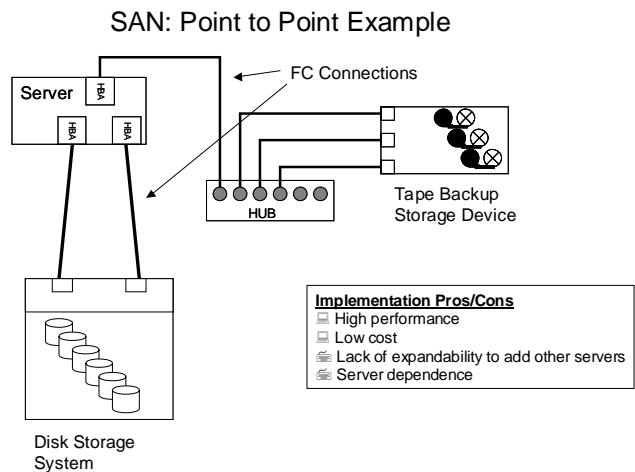
Most storage high-end devices in use today utilize the SCSI interface for communications. This makes fibre channel well suited for networking storage devices to servers. Since most individual SCSI devices transmit data between 2 and 20 MB/sec, several devices can communicate simultaneously, at full speed, in the same fibre channel network.

As with any network, it takes more than just wires to connect devices in a SAN. Host adapters, hubs and switches are required in FC SANs, just like in Ethernet LANs. It also takes software and other elements to build a fully functional SAN environment.

Fibre channel can be integrated between storage devices and servers in three major ways. The first and most straightforward is “**point to point.**” A fibre channel connection is made directly between the server and the storage device.

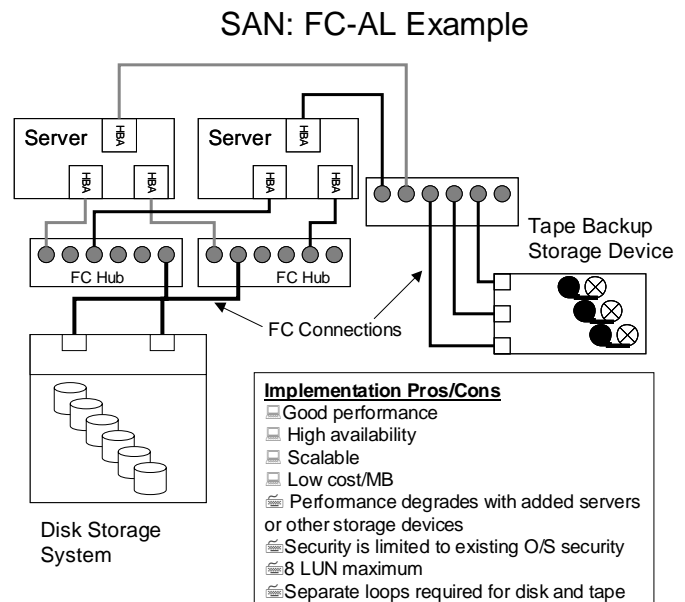
In the following illustration, the FC60 disk system and DLT library are each connected directly to the server. The FC60 is a dual channel device for redundancy and

thus requires two connections, each requiring a host adapter. Similarly, there is a direct connection to the DLT library requiring a separate host adapter. This kind of implementation provides for very high performance and high data availability via redundant data paths to the FC60. It is limited in terms of expandability since other servers cannot be added without disconnecting the various components and rebooting the server.



Another configuration for a FC-SAN is what is called **arbitrated loop** or FC-AL. In this configuration, hubs are used to allow a storage device to be shared with multiple servers.

In this configuration, three hubs are used to connect the



(See “Storage” on Page 14)

# Storage

(Continued from Page 13)

disk system and tape backup device to the server via a host bus adapter (HBA). Two hubs are used for the disk system connections for redundancy. Should one hub fail, the other will provide access to the data stored in the disk system. Each group of connections between a single hub and the storage devices and servers is referred to as a “loop.”

One limitation of the FC-AL implementation is that disk and tape subsystems cannot reside on the same loop. This is because in the FC-AL implementation, a loop initialization process (LIP) can be generated at any point in time by any device on the loop. If a tape drive and disk drive share the same loop and the tape drive fails, a LIP is generated and data being transmitted to the disk drive can be lost, without the system knowing it. Obviously, this is not acceptable, so in practice, all devices in a FC-AL implementation should be on separate loops.

Another issue that exists in the FC-AL environment is that the bandwidth to and from a hub is shared, just like in the Ethernet world. For example, if four ports in a hub are used, and all are active at once, the effective bandwidth per port is 33MB/sec. The port to the host provides 100MB/sec, but each of the 3 other ports shares this bandwidth. So the effective transfer rate is 100/3 or 33MB/sec. This means that the more devices that are connected to a FC-AL topology, the lower the net effective transfer rate.

The third and final way in which FC-SANs can be configured is called **FC switched fabric**. In the switched

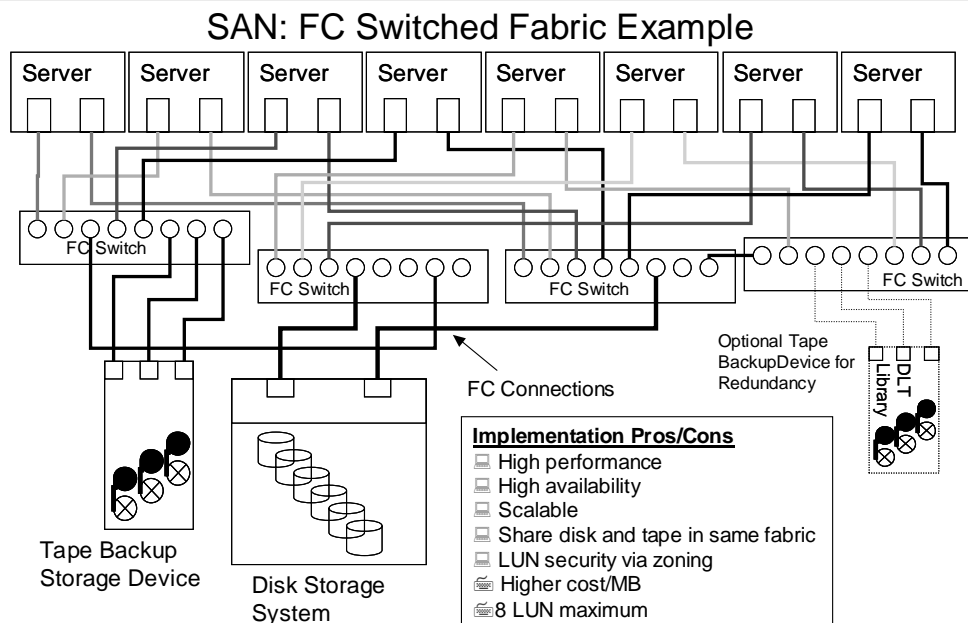
environment, hubs and switches are used to connect devices. The advantage of switches is that they can be configured to provide full bandwidth between any two ports. They don't suffer from the shared bandwidth limitations of hubs. The figure below shows a FC-Switched implementation.

In this configuration, eight servers share access to the FC60 and tape library. Again, multiple sets of switches are used to connect the servers to the disk array. Each server has two independent data paths to the FC60. The switches are cascaded in pairs. The tape library is directly connected to one switch, which gives access to each server through the switch pair. A second library can be added for redundancy to ensure data backup operations can be completed, even in the event of a switch failure.

In this switched environment, software is used to direct the connections between switch ports. Each port pair can operate at 100% bandwidth, independent of any other port pair on the switch. This type of configuration provides maximum performance and scalability, but is also the most expensive, due to the complexity and cost of the switch devices.

In addition to the hardware elements, software must be deployed that enables the customer to manage the SAN environment. This includes monitoring activity and events, as well as configuring the SAN components, to allow for streamlined communications between devices.

(See “Storage” on Page 15)



# Storage

(Continued from Page 14)

One critical role that the software can play in a SAN fabric is to dedicate a specific FC switch for use by certain server and storage combinations. This is referred to as **zoning**. By setting up specific zones in a switch, performance can be tailored, providing an added layer of security since it limits access to specific storage devices.

## SAN – The Challenge

As we've noted, SANs are in their infancy, and there are challenges that must be addressed before you can comfortably implement a true SAN solution.

**Interoperability.** Several of the major governing bodies are still developing standards for switch protocols, networking compatibility and other elements. Also, each major vendor has to test all the components that are required to build a SAN. This is not a trivial task, and as such, vendors are typically certifying only their own brand of storage products for use in the SAN. Vendor A products won't necessarily work with Vendor B products.

**Price of entry.** Because the various elements to building a SAN are new, they are expensive. Economies of scale have not been reached. Deploying a SAN can be an expensive, long-term investment that you must evaluate carefully.

## The Future – NAS and SAN

Access to information any time anywhere will be a key driver in the future as teachers, students and parents want more data at their fingertips, regardless of where they are. Both NAS and SAN can play a role in making this type of data access a reality. What might we encounter on the road to the future?

1. Advancements in traditional network protocols like Gigabit Ethernet provide a mainstream network with higher performance, allowing faster and more access to stored information in NAS applications. This gives rise to the development of pervasive networked appliances, which increase efficiency, and access to information.
2. Cost/GB of infrastructure required to deploy a FCSAN is greatly reduced, and interoperability between vendors and operating systems is achieved. This would lead to widespread deployment and make fibre channel easier to integrate and manage than it is today.
3. Both 1 and 2 may happen, which means both

Ethernet and FCSAN implementations will be used in various parts of an organization, depending your needs.

4. New technologies are developed to allow larger quantities of digital information to be more easily transported than today, perhaps providing the ability to carry 100's of Gigabytes of data on a credit card type device, and seamlessly integrating access to this information remotely.

Regardless of what the future holds, improving access to digital information is critical. As your demand for access increases, a SAN or NAS may likely be the solution to your storage needs.

Now you have the basic on two types of network storage. In part two we'll tell you the specifics of our network storage needs and what solution worked best for us. We'll also discuss deployment strategies and tips for a smooth transition to a new storage environment.

## Glossary of Terms

1. **LAN** – local area network; a network, typically Ethernet based, that allows servers, clients and storage devices to communicate with one another.
2. **SAN** – storage area network; a dedicated, high-speed network implementation allowing multiple servers to share access to storage devices.
3. **NAS** – network attached storage; refers to storage devices or appliances that can be shared among computers when attached to a LAN.
4. **FC** – fibre channel; a high-speed interface that is used to connect servers and storage devices together. This interface is capable of processing multiple communication protocols at one time.
5. **HBA** – host bus adapter; a device added to a server to allow communications to network components and storage devices.
6. **Hub** – networking device that allows multiple devices to communicate with one another by sharing available network bandwidth.
7. **Switch** – a networking device that allows multiple devices to communicate with one another by dedicating available bandwidth between devices.
8. **FC-Tape** – a communication standard that will allow for disk and tape devices to communicate directly with each other over a fibre channel SAN.

# True-Life Experiences of CEDPA Directors

**Addison Ching, California State University, Office of the Chancellor**

In addition to voluntarily serving on the CEDPA board, CEDPA directors have full-time professional commitments in various educational agencies throughout the state. Sometimes these commitments take CEDPA directors into uncharted territories, and sometimes with unpredictable results. During the past month, CEDPA Directors have had their hands full with true-life experiences. Here is a recap of those experiences.

## Rock and Roll Seattle

CEDPA Director and President-elect Scott Sexsmith and CEDPA Director and past-president Darryl LaGace were in Seattle, Washington, attending the Microsoft Connected Learning Community Technology Summit, a three-day gathering of school and education technology leaders from across the United States and Canada. More than 500 educators from over 250 school districts led and participated in sessions on teaching and learning, technology management and planning, and school leadership during the intensive, three-day conference in Seattle. The summit concluded with a keynote by Bill Gates sharing his belief that technology in the hands of great teachers is the single most powerful tool to improve student learning, create more agile and accountable schools, and increase parent and community involvement in education. However, Gates was upstaged by an untimely magnitude 6.8 earthquake that hit the Seattle area at 10:54 AM on February 28, 2001.

“After the quake hit (a long, long rumbling quake that seemed to never stop) we left the ballroom where Bill Gates and his associate were presenting Windows XP,” said Sexsmith. “It was interesting to see how different people handled the stress.”

Scott continued, “Some panicked and ran over others as they headed to the doors. People from all over the states (and Canada) were in attendance and some had never experienced one [earthquake] before. Some cried, some prayed, some panicked, some were calm. I was just surprised about how long it lasted. It was like the *Energizer bunny*. It kept going, and going, and going. I half expected the ceiling of the ballroom to come down on us. Most of us waited for the shaking to stop and then left the ballroom to try to figure out what had happened. I was worried about my wife Sherilyn who was up on the 45<sup>th</sup> floor when it hit, packing up our bags so we could check

out of the hotel that morning.”

“Sherilyn and I finally met up in the hotel lobby (after what seemed an eternity of trying to find each other with no phone service) and then decided that we’d best get our rental car and head for the airport since we had a flight in a few hours. We were also worried about the possibility of aftershocks. The hotel rode out the quake pretty well but we did see some slight damage outside. Sherilyn, with her bird’s-eye view from the 45<sup>th</sup> floor, saw some damage actually occurring during the quake. She said she was tossed around pretty well up there and lost her balance a couple of times,” said Sexsmith.

After arriving at the airport, the Sexsmiths found that any hopes to leave the Seattle area were dashed by the damage to the airport from the earthquake. “After getting to the SeaTac airport we found it to be closed since the air control tower had been damaged. The place was absolutely packed with people not knowing what to do. Tiles from the ceiling were down and there were quite a few water leaks,” said Scott. “We finally managed to get a hold of someone at Southwest Airlines on our cell phone (the phone system was overloaded and it was difficult to get a ‘live’ line). We re-booked our flight out of Portland, Oregon, and drove south in a rental. We arrived at Portland with plenty of time to spare, had a couple of drinks in the airport to calm our frayed nerves, and got to Sacramento around 11:00 PM. Home a little after midnight and sound asleep shortly thereafter!”

While Californians are accustomed to earthquakes, this was, nevertheless, a harrowing and anxious experience for Scott and his wife.

## Tragedy in San Diego

By now, the shooting on March 5, 2001, at Santana High School in Santee, California, by a 15-year old student of that school has been etched in the minds of everyone. Santana High School is one of the schools in the Grossmont Union High School District, a sprawling 9-12 district that covers much of east San Diego County. In addition to having an immediate impact on the educational process at Santana High School, the shooting also had a definite impact on the board’s normal conduct of business.

(See “Experiences” on Page 29)



# Breathing New Life Into Old Hardware

Tuan Nguyen, Microsoft Corporation

## Introduction

In a perfect world, all the hardware and software in schools would be state-of-the-art technology. But we don't live in a perfect world. In the real world, educators need to deliver quality education with the limited resources available to them.

Sometimes, that means schools must find a way to breathe new life into old computers. Can you imagine running the latest software, such as Microsoft® Office 97, on 386 PCs or older Macintoshes? That's exactly what many schools are doing today, through a new technology called Microsoft Windows NT® Server 4.0: Terminal Server Edition. For example:

- Baltimore's Walbrook High School runs its computerized student records and attendance system, as well as best-of-breed applications including Microsoft Office, on donated 386 computers that save about \$15,000 in networking expenses and \$45,000 (about 70 percent of its support budget) in support costs. Best of all, the new system eliminates the need for a daily, 20-minute attendance-taking period, so students get the equivalent of several extra days of instruction per year.
- Renton School District in Washington State lacks the money to replace its 4,000 PCs and Macintosh computers that are more than five years old and incapable of running today's software. But its limited budget is enough to take advantage of Windows NT Terminal Server and to keep those aging machines on the network and running state-of-the-art 32-bit applications.
- Administrators in Clark County, Nevada set up the evaluation for a new computer network with older PCs in a single Saturday-morning session—using two high-school students to install the software.

Windows NT Terminal Server is one of the newest members of the scalable family of Windows®-based platforms that also includes high-powered servers, workstations, NetPCs, desktop and multimedia computers, laptops, and handheld devices. Windows NT Terminal Server doesn't eliminate the need for PCs or any of these other devices. Instead, it's a new option that complements these other choices, giving technology managers more flexibility to stretch their technology dollars. With the combination of terminal servers and new PCs in a school,

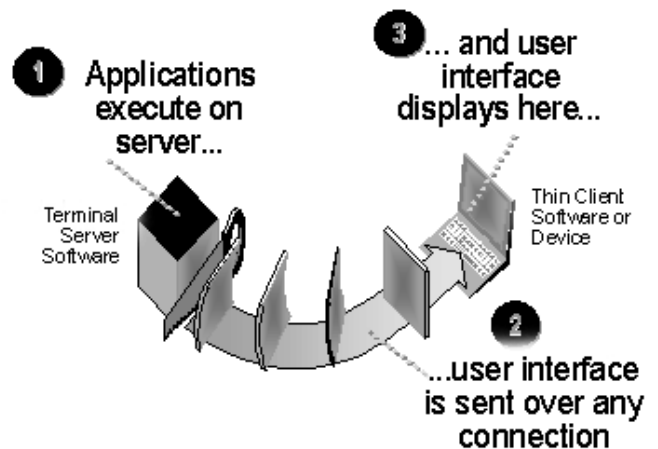
managers can provide computing and Internet access to more students, teachers, and administrators than they could with new PCs alone.

## Thin-Client Computing

Thin-client computing lets schools run the latest software by connecting lower-powered, older machines—as well as newer, low-cost devices—to powerful servers. A *thin client* is a computer, terminal, or other device with which the user works. Thin clients have a minimum of operating system software and no application software. The client has just enough software to start the device, connect to a server, and display the user interface.

A thin client can be an older Windows-based or MS-DOS®-based PC, Macintosh, UNIX computer, or a new Windows-based terminal. With thin clients, the applications run on the server. The client sends the user's keystrokes and mouse clicks to the server, where interaction with the application takes place. The server sends the graphical interface to the client, where it's displayed on the client screen for the benefit of the user.

## Windows NT Terminal Server



Windows NT Terminal Server is the software at the core of Microsoft's thin-client strategy. Windows NT Terminal Server gives new life to old equipment, especially on the desktop, and makes new, lower-cost devices useful components of school or campus networks. Windows NT Terminal Server gives schools 32-bit computing—the high-bandwidth computing associated with the

(See "New Life" on Page 18)

# New Life

(Continued from Page 17)

Microsoft Windows NT Workstation and Windows 98 operating systems—on machines that can't run those operating systems or that run other operating systems. It delivers the familiar Windows-based graphical environment and supports the latest Windows-based applications on new PCs, inexpensive Windows-based terminals, some Macintoshes, and older PCs.

## What Schools Are Seeking

Schools are seeking a technical solution to stretch their budget dollars and give students greater access to technology. Schools begin their search for the right solution by establishing criteria. Many decide that their solution must be:

- **Affordable** to acquire and maintain over the long term. They look not only at initial acquisition cost but also at the costs of installation, maintenance, technical support, training, and related hardware and software—costs that can easily exceed the initial purchase cost. Taken together, these various costs make up the total cost of ownership (TCO).
- **Easy** to install, use, maintain, and support. School districts may not want to invest in training and support for an entirely new operating system. They want a solution that leverages their existing expertise and infrastructure.
- **Compatible** with many applications such as Microsoft Office and Internet browsers. Some schools are evaluating third-party products such as Visio and education-specific applications such as Winnebago Spectrum's Library Management System and School Technology Management's Comprehensive Attendance, Administration, and Security System.
- **Able to support a variety of computer hardware**, leverage current investments, and accommodate growth based on the school's evolving needs.
- **Secure**, so schools can protect confidential student records and other data from unauthorized use and unauthorized users.

For a growing number of schools, the solution that meets these criteria is a thin-client strategy.

## Why Schools Made the Choice

Here's how a thin-client strategy with Windows NT Terminal Server meets the criteria that schools have identified for their technology solutions.

### Requirement #1: Affordable to Acquire and Maintain over the Long Term: Reduce the School's Total Cost of Ownership

Reducing the school's total cost of ownership—including the costs of acquiring maintenance, support, training, and upgrades—enables technology coordinators to stay within budget while meeting today's demands for student and teacher access and connectivity in less time. Windows NT Terminal Server provides a good interim networking solution that reduces TCO.

#### Real School Story: The Right Choice for Clark County, Nevada

"The school district needed a powerful, low-cost solution," says Jeff Ames, chairman of the Technology Advisory Committee for the Clark County (Nevada) Public Education Foundation, which evaluated and is implementing a solution based on Windows NT Terminal Server. "We looked at the other options, but not for long. We considered the Sun Javastation, then considered the price, and said no. We looked at the cost of UNIX administrators and that didn't make sense either. Some third-party solutions are available but from companies that may not continue to be around, or be in this business, when we need them down the road.

"We wanted something that gave us power, expandability, and flexibility to work with all of the up-to-date software and solutions we might choose later on," adds Ames. "We wanted something the kids could turn on and manage on their own. When we considered all of those factors, Windows NT Terminal Server was the only logical solution."

How does Windows NT Terminal Server help reduce the total cost of ownership?

- By eliminating the need to create, install, or update applications on the desktop.

#### Real School Story: Keeping Up with Technology in Cheltenham, United Kingdom

The Arthur Dye Primary School in Cheltenham, United Kingdom introduced Windows-based terminals connected to Windows NT Terminal Server. This solution has enabled the school to save 25 percent on the initial cost of the network (compared to a PC implementation) and achieve cost savings on software upgrades.

Because all hardware and software upgrades can be performed centrally on the server, expensive upgrade costs at each workstation are avoided.

(See "New Life" on Page 19)

# New Life

(Continued from Page 18)

“We anticipate that they will not only save time and money for the school, but will also help the children to meet the demands of the national curriculum,” says Jim Abraham, head teacher.

- By administering desktops centrally.

## **Real School Story: Fighting Obsolescence in Renton, Washington**

Renton School District in Washington State has 4,000 PCs and faces the prospect of seeing 20 percent of those machines become obsolete each year. Unfortunately, the district lacks the funds to replace those machines on a regular basis. Its solution: Windows NT Terminal Server.

“We’re extremely skinny on our technical resources,” says Renton School District Technology Project Manager Randall Turner, “so anything we can do to utilize their time and effort and reduce our costs is a great advantage. Terminal Server lets us administer desktops centrally, and that clearly allows us to keep costs low.”

- By reducing the cost of network deployment and technical support.
- By letting you use new Windows-based terminal devices that cost less than PCs.
- By extending the life of legacy desktop computers, like 386s and 486s with little random access memory (RAM) or hard-disk space.

## **Real School Story: Lowering TCO in Baltimore**

Baltimore’s Walbrook High School runs its custom education software primarily on 100 older-model 386 PCs, donated to the school by the Social Security Administration and others. Walbrook’s secret to running a high-powered network on low-end equipment was the Windows NT Server network operating system paired with Citrix’s WinFrame server, the predecessor product to Windows NT Terminal Server. WinFrame allowed the applications to run over low-cost, passive network hubs. The solution uses just 10 percent of the bandwidth of a typical computer network, while providing the equivalent of Pentium 120-MHz performance for 32-bit applications on those older PCs. And it saves the school about \$15,000 in networking expenses and \$45,000 (about 70 percent of its support budget) in support costs. Best of all, the new system eliminates the need for a daily, 20-minute attendance-taking period, so students get the equivalent of several extra days of instruction per year.

## **Requirement #2: Easy to Install, Use, Maintain, and Support Both the Server and Applications**

Windows NT Terminal Server is easy to install, reducing the up-front time and cost of establishing the Windows NT Terminal Server-based network and allowing schools to use existing expertise and infrastructure.

## **Real School Story: “Extremely Smooth” in Clark County**

At Clark County’s Chaparral High School, the Windows NT Terminal Server was installed in a computer lab during a single, Saturday-

morning session in June. Students Jeff Eφος and Aaron Gitlin, along with teacher Larry Wood and two outside technicians, completed the process in less than three hours.

“The Windows NT Terminal Server installation was automated and streamlined,” notes Eφος. “It went extremely smooth.”

To install the software, the students first ran the installation program from a CD, loading the server software onto a Pentium II, 233-MHz, 4-GB server built and donated by independent Microsoft Certified Solution Provider Michada Computers, a company in Clark County’s technology program. Other than responding to automated prompts, the students had only to set the server’s swap file, which they did with the technicians’ help.

Next, it was onto the first clients for the Windows NT Terminal Server evaluation: a set of 486 machines, the first of what will become a much larger network. A local corporation donated these PCs because they no longer could run current software—or so those owners thought! The students used the server’s automatic installation disk utility to create the floppy disks needed to load the client software onto the PCs. They also cut their own CAT5 cabling to connect each of the machines to the hub.

“From there, it was just a matter of feeding disks into the machines,” says Eφος.

Installing or upgrading applications—not just the network software—is also fast and easy, because technology managers can handle these chores just once, at the server, instead of touching each computer. Depending upon the network configuration, support can be less costly because support technicians don’t have to travel to the desktops nearly as often to fix problems—saving trips down the hall or miles across town. Network administrators can perform many management tasks remotely from any desktop, ensuring they can manage the system from almost anywhere. This saves time and expense.

## **Real School Story: Easy Maintenance in Baltimore**

The remote-access capability in Microsoft’s technology enabled School Technology Management (STM), an independent Microsoft Certified Solution Provider, to provide most of its technical support to Walbrook High School without having to come on site. STM’s involvement underscores the valuable role that Solution Providers play in helping schools to implement solutions based on Windows NT Terminal Server. STM conducted most software maintenance, such as virus definition updates, remotely by using Microsoft Systems Management Server, a Microsoft BackOffice<sup>®</sup> family server application. The centralized, remote support capabilities helped the school reduce support costs by 70 percent.

## **Requirement #3: Compatible with many applications such as Microsoft Office and Internet browsers**

It’s crucial that schools do not have to create all-new

(See “New Life” on Page 20)

# New Life

(Continued from Page 19)

software applications or use non-mainstream software because of system requirements. So schools considering Windows NT Terminal Server typically confirm its ability to run their current applications.

## Real School Story: Using Best-of-Breed and Custom Software in Baltimore

The Windows NT operating system and Citrix Winframe, the predecessor product to Terminal Server, brought Microsoft Office applications to every desktop on the Walbrook High School network—even donated 386s—allowing the school to standardize on best-of-breed applications for the broadest range of tasks, including electronic mail and Internet access. Yet the network also runs Baltimore's customized attendance-taking and student-records applications that expedite administration, cut administrative costs by 30 percent, and free teachers to spend more time teaching.

## Real School Example: Tracking Bus Maintenance and Student Records in Renton, Washington

At Washington State's Renton School District, Windows NT Terminal Server provides the perfect solution for quick access to maintenance information for buses—an application that couldn't run on the school's Novell network. Teachers also gain access to 12,000 student records, conducting sorts and running Microsoft Access from both Macintoshes and Windows-based PCs.

"Using Terminal Server we successfully query the Microsoft Access database and run Microsoft Office, thereby eliminating the problem of not being able to access our databases from our Macintosh computers," says Randall Turner, district technology manager. "The teachers are thrilled. We also increase the speed of classroom access to the Internet by running Microsoft Internet Explorer and Windows NT Terminal Server."

Renton also uses Windows NT Terminal Server to run Microsoft Office 97, Microsoft Project, and Visio from its older Macintosh Centris computers—machines that could not run the applications on their own.

Windows NT Terminal Server can access most 16-bit and 32-bit Windows-based applications that run on a Windows NT-based computer, including Microsoft Office, Microsoft Internet Explorer, Microsoft Exchange, the Microsoft Outlook™ messaging and collaboration client, Microsoft Project, Microsoft Access, and Microsoft Visual Basic®-based applications.

The Learning Company, Inc. (TLC) has tested its products—including MathKeys, CornerStone, and SkillsBank4—using Windows NT Terminal Server and has worked successfully with schools deploying them. Some schools are evaluating the use of Windows NT Terminal Server to run:

- Third-party products such as Visio
- Education-specific solutions such as Winnebago Spectrum's Library Management System and

School Technology Management's Comprehensive Attendance, Administration, and Security System

- Their school's own, internal applications

**A Warning about Compatibility:** Windows NT Terminal Server is *not* the choice for applications that make significant use of video, audio, animation, or other multimedia that must send significant amounts of information over the Windows NT Terminal Server network.

How appropriate is Windows NT Terminal Server for your important software? Your evaluation of Windows NT Terminal Server should include your test of the key applications you plan to run and how many users can access Windows NT Terminal Server simultaneously and make heavy use of applications over the network. Testing the number of Terminal Servers you plan to access is also recommended. Several companies offer testing services so you can determine compatibility of your new or existing custom software with Windows NT Terminal Server.

To check the compatibility of a specific application, consult with the application's vendor. To visit a Web-based showcase of tested applications that run well on Windows NT Terminal Server, go to <http://www.microsoft.com/ntserver/basics/terminalserver/partner/showcaseintro.asp>

## Requirement #4: Able to Support a Variety of Computer Hardware and Accommodate Growth Based on the School's Evolving Needs

Schools need to know that they'll be able to continue to use this technology as their schools grow and needs change. Windows NT Terminal Server meets this need.

### Real School Story: Enabling Future Growth in Baltimore

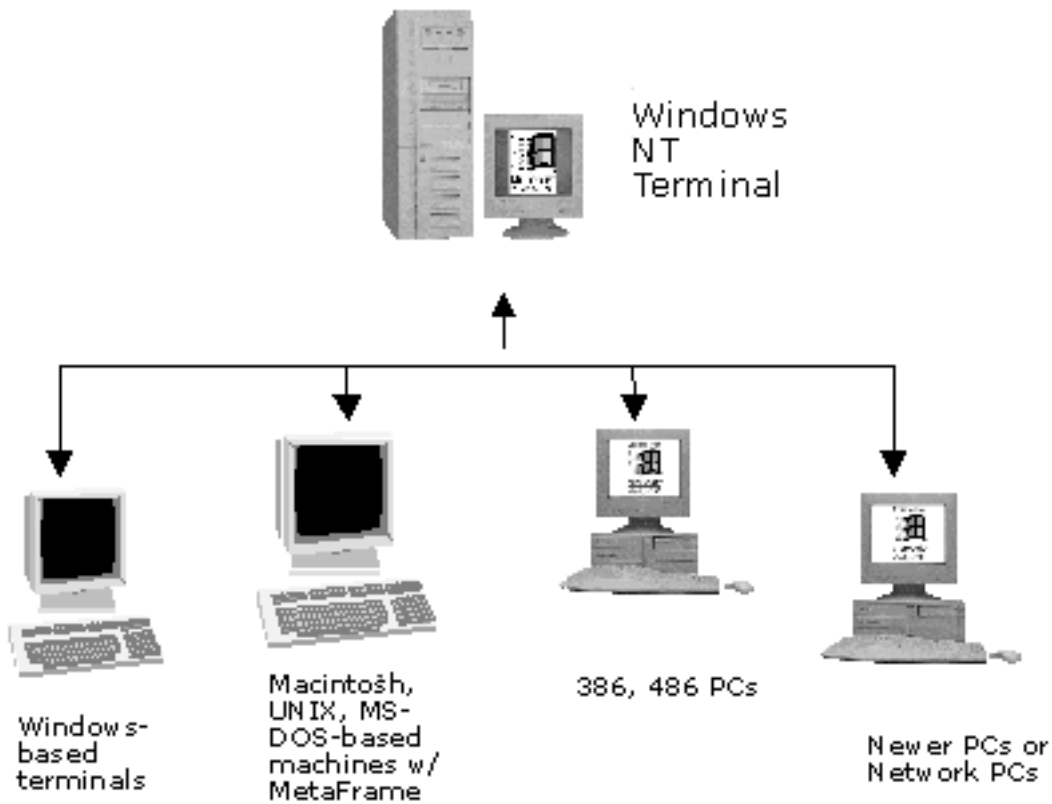
The Walbrook High School solution is scalable to grow with the needs of the school. The school is currently using a dual-Pentium server with 128 MB of RAM and a 4-GB hard disk that the school already had on site. The machine supports 30 simultaneous users and can be upgraded to support 60 users later.

In addition to more users, Walbrook administrators anticipate new uses for their solution. They expect to use a new student assessment module to create their own electronic assessment tests. In contrast to traditional assessment tests given once or twice a year, students at Walbrook will take computer-based electronic assessment tests on a regular basis so the school can track each child's progress in all subjects. The school is also considering expanding the system to support authorized Internet access by parents—giving those parents the ability to check on their children's schedules, grades, and attendance records.

(See "New Life" on Page 21)

# New Life

(Continued from Page 20)



Many times, growth means the ability to add new and different hardware. Typical clients in a Windows NT Terminal Server-based network can include the following:

- **Windows-based Terminals.** A Windows-based terminal typically costs less than \$500 and lowers the total cost of ownership. Look for them from Boundless, NCD, Neoware, Tektronix, and Wyse Technology Inc.
- **Non-Windows-based Computers.** With the addition of MetaFrame from Citrix Systems Inc., schools can deploy Terminal Server on Macintosh, UNIX, Windows version 3.1, and MS-DOS-based client computers.
- **386-based and 486-based Personal Computers.** Legacy PCs combine the benefits of centralized computing with the benefits of a low-cost, intelligent desktop. PCs can run applications locally or from a Terminal Server.
- **Newer Personal Computers or Network PCs (NetPCs) with Zero Administration Kit.** This option gives you the flexibility to run applications

locally or from the server, as you prefer. And it lowers the total cost of ownership. MetaFrame is thin-client/server software from Citrix Systems that extends the capabilities of Windows NT Terminal Server. MetaFrame lets you connect a broader range of clients to Windows NT Terminal Server, including MS-DOS, 16-bit Windows, Java-based devices, Macintosh, UNIX devices, and ICA Windows-based terminals.

Some education networks already use Citrix WinFrame, older software based on Microsoft Windows NT Server version 3.51 that delivers Windows-based applications to Windows-based terminals and some legacy desktops. Managers of these networks will want to upgrade to the combination of Microsoft Windows NT Terminal Server and Citrix MetaFrame to gain tighter integration, the graphical user interface in Windows 95 and Windows 98, improved reliability with Windows NT Server 4.0, and full access to technical support services and training for Windows NT Server.

#### Real School Story: New Life for Aging Macintoshes in Renton

Renton School District extended Windows NT Terminal Server with

(See "New Life" on Page 22)

# New Life

(Continued from Page 21)

Citrix MetaFrame to run Terminal Server on its 68040 and PowerPC Macintosh-based computers. On the server side, Windows NT Terminal Server is running on a dual Pentium Pro 200-MHz computer with 256 MB of memory. District officials say it's been impossible for them to distinguish the performance of Visio and Microsoft Project running across the network to a Macintosh Centris 610 from copies of the same software run locally.

Because the Windows family of operating systems provides a wide range of solutions, customers are not locked into a Terminal Server environment as their needs change or grow. If a user requires more power, administrators can swap out a Windows-based terminal client for a more powerful low-end PC or workstation. Also, Windows-based terminals from different manufacturers are compatible, so they can be mixed and matched.

## **Real School Story: Windows-based Terminals in Cheltenham, United Kingdom**

The Arthur Dye Primary School in the United Kingdom installed Winterm Windows-based terminals from Wyse Technology Inc. connected to Windows NT Terminal Server. The school implemented a network of Winterm thin clients that provide pupils with access to educational and business software, plus connectivity to the Internet.

The school describes the Winterm desktop environment as controllable and stable, yet easy to manage and responsive to student needs. Winterm thin clients significantly improve the speed at which students access the software. And because files reside on the server—not on floppy disks—viruses are a thing of the past. To monitor and assist each pupil, teachers and administrators can shadow or take control of any user session on the network.

“We found that the Winterm terminals offered considerable cost savings as well as performance that equaled that of the PCs,” says head teacher Jim Abraham.

## **Real School Story: Windows Terminal over the Internet**

The Menta Group has found yet another use for Windows Terminal Server: serving up courseware over the Internet. Several school districts around the country—including Phoenix and Park Forest, Ill.—are beta testing Menta's new solution to provide curriculum to physically challenged K–12 students at home.

Students use their home PCs or Macs to connect to the Windows NT Terminal Server with Citrix MetaFrame at their school district. They download the client software component quickly—just 20 seconds at 56K—and it resides on their machines for future sessions. Students can access course instruction and take tests. Scores can be posted to the Web and teachers can monitor student progress while the students are online if they wish. The new solution makes it very economical to acquire and use educational software, because it only needs to be maintained once, at the server.

Not all thin clients are created equal. How do these choices compare? See the table in the Resources section of this document.

## **Requirement #5: Secure So Schools Can Protect Confidential Student Records and Other Data from Unauthorized Use and Unauthorized Users**

Security is top of mind for every technology director. Schools are particularly vulnerable to both the curious and the malicious, so protecting networks is essential. Windows NT Terminal Server uses the robust security features of Windows NT Server, so technology managers can restrict access to desktops or servers. Administrators can define restrictions on logon attempts, connection time, and security for individuals or groups.

## **Real School Story: Security in Baltimore**

With their new solution, Walbrook High School users get all the standard benefits of Windows NT Server—from a highly reliable, highly stable system to outstanding security and effective remote access. The school used the hierarchical features of Windows NT to specify the folders and files to which staff had access.

“Windows NT is fantastic,” raves Walbrook principal Marilyn Rondeau. “It stays up and running even if the user exits improperly. And it gives us outstanding security and remote-access capabilities.”

For example, Walbrook uses features of Windows NT to lock down the 54 desktops that it installed in two student computer labs, so students can't sabotage the computers or get into inappropriate directories. Windows NT security provides this reliable, secure environment with minimal lab administration.

## **Advice from School Technology Directors: Implementation Strategy**

Once you've identified your solution criteria and completed the evaluation process, it's time to consider how best to implement a solution. In this section, you'll find information, options, and ideas for effective implementations of Microsoft Windows NT Terminal Server. For additional deployment information, see the Windows NT Terminal Server deployment guide at <http://www.microsoft.com/ntserver/basics/terminalserver/deployment/resources/>

## **When Planning a Windows NT Terminal Server Evaluation and Implementation**

Consider the following, which are described in more detail later in this section:

- **Plan for capacity and performance.** Project how many servers and terminals you'll need, and what performance you'll get from that combination. Test

(See “New Life” on Page 23)

# New Life

(Continued from Page 22)

the number of simultaneous users.

- **Test your software.** Not all education applications have been tested with Windows NT Terminal Server. Test your applications in a lab environment before deciding to implement.
- **Consider locking down desktops** using the Zero Administration Kit to minimize support needs.
- **Prepare your school for Year 2000 technical issues,** using Windows NT Terminal Server to help.
- **Understand possible installation issues.** Follow the tips and tactics listed below.
- **Project your training needs.** Even though Windows NT Terminal Server minimizes training needs, your support staff will require some training.
- **Anticipate and prepare for your support requirements.**

## Warning: Prepare for Limitations of Windows NT Terminal Server

Windows NT Terminal Server is a superb new complement for your technology mix. But it's not a panacea. Be aware that:

- Windows NT Terminal Server is not the solution for running many multimedia applications, such as those using streaming video, WAV files, and other audio, graphics, or animation.
- It is very important to plan and test your applications and the number of users and servers anticipated. See the "Planning for Capacity and Performance" section.
- Because Windows NT Terminal Server runs applications on a centralized server rather than on each user's desktop, users are dependent on the server and the network. Make sure you have ample network management resources, backup servers, and plans for getting the server up and running should it stop functioning.

## Consider Using a Certified Solution Provider

Independent Microsoft Certified Solution Providers specialize in the technology needs of schools like yours and can be invaluable in helping you with any or all phases of your implementation, from evaluation and planning

through maintenance, training, and support. Solution Providers are located throughout the United States and around the world. To find a Solution Provider, go to <http://www.microsoft.com/education/partner/resource/guide/partner.htm>

## Planning for Capacity and Performance

How many users will you be able to support on a Windows NT Terminal Server and what type of server hardware will you need? Scalability and performance of a terminal server depends on the applications, the server configuration, and usage intensity. Microsoft recommends the following:

- **Number of Users:** Windows NT Terminal Server on a single Pentium Pro server will support about 15–45 users, depending on user activity. A dual-processor server will support about 30–90 users. The number of people that you'll be able to support on a terminal server depends in part on how heavily they use the system.
- **Memory:** Use 32 MB of base memory plus 4–12 MB per user for the terminal server, depending on the application and the users' performance requirements.
- **Network Use:** Expect Windows NT Terminal Server to require 2–6 Kbps of network bandwidth per user, depending upon the extent of use.

## Consider Using the Zero Administration Kit with Windows NT Terminal Server to Lock Down the Desktop and Minimize Support

Because your Windows NT Terminal Server users are sharing the same environment, they have the potential to disrupt not only their own systems, but also the systems of other users. That's because a potential disruption takes place not on the local hard disk of a single server but on the server that all users must share. You can head off this problem and create a controlled environment by using the Microsoft Windows NT Workstation Zero Administration Kit (ZAK). ZAK allows automatic installation and configuration of restricted or "lock-down" Windows NT Workstation-based desktops. This minimizes user access—particularly by students—to the parts

of the operating system outside their authorized applications. ZAK also includes several policy templates for implementing Windows NT policies. For more infor-

(See "New Life" on Page 24)

# New Life

(Continued from Page 23)

mation on ZAK, go to <http://www.microsoft.com/ntserver/basics/terminalserver/deployment/resources/zak.asp>

## Prepare Your School: Facilitating Year 2000 Deployment Strategies

Worried about your Year 2000 (Y2K) compliance? Windows NT Terminal Server can help solve Y2K challenges in two key ways:

- **Replacing noncompliant BIOSs.** Older personal computers often have basic input/output systems (BIOSs) that are not Y2K compatible. Schools and campuses can deploy the Windows NT Terminal Server client on these computers, allowing them to be used as terminal server workstations until their BIOSs can be replaced. If the server running Windows NT Terminal Server is Y2K compliant, the clients connected to it will operate correctly.
- **Deploying compliant applications.** You can deploy Microsoft Y2K-compliant applications quickly by installing them on servers running Windows NT Terminal Server. Users then can discard their noncompliant applications and use the newer versions on Windows NT Terminal Server until compliant applications are deployed throughout the organization. For planning and deploying applications, see the Microsoft Year 2000 Resource Center. The Resource Center contains comprehensive information about Microsoft products and how they are affected by the Year 2000. The Resource Center is located at <http://www.microsoft.com/technet/topics/year2k/default.htm>

## Understanding Installation: Tips and Tactics for Installing Windows NT Terminal Server

Users already familiar with Windows NT Server will find that installing Windows NT Terminal Server is very similar. Here are some considerations to keep in mind:

- Windows NT Terminal Server code includes Windows NT Server 4.0 plus Service Pack 3. Technology managers should do a fresh installation of Terminal Server, which includes Windows NT Server 4.0, rather than attempting to upgrade an existing installation of Windows NT Server 4.0.

- Plan your memory requirements for use in a multiuser environment (number of users multiplied by 4–12 MB of RAM, depending on what the users are doing).
- The Transmission Control Protocol/Internet Protocol (TCP/IP) is required for Windows NT Terminal Server and is automatically installed when you run Setup.
- WinFrame users should note that Windows NT Terminal Server is an upgrade for WinFrame versions 1.6 and 1.7 only. For derivative releases of WinFrame, such as WinDD, see your supplier for details of upgrade opportunities.
- If you would like more information about the appropriate uses of thin-client computing, one book (written prior to the release of the newest Windows NT Server 4.0 and Windows NT Terminal Server) is “Understanding Thin-Client Computing.” You can find information about this book and a sample chapter at <http://mspress.microsoft.com/prod/books/1518.htm>  
An additional resource is the Thin-Client Strategy Market Bulletin, available at <http://www.microsoft.com/NTworkstation/community/mktbulletin/thinclient.asp>
- Install Windows NT Terminal Server as a stand-alone server, not as a primary domain controller or backup domain controller, so it can dedicate its resources to client applications.
- Install Windows NT Terminal Server on a Windows NT File System (NTFS) partition. NTFS provides greater security for users in a multiuser environment who access the same data structures.
- Do you want to deploy several Terminal Servers in your network? To configure and roll out multiple servers quickly and effectively, use the Microsoft Windows NT OS Image Preparation Tool utility, together with a disk duplication program, to “clone” or duplicate servers running Windows NT Terminal Server. A number of software and hardware solutions are available in the marketplace to duplicate hard-disk images.

(See “New Life” on Page 25)



# New Life

(Continued from Page 24)

## Anticipate Training and Support Requirements and Options

### Take an Instructor-led Course

A Microsoft Certified Technical Education Center (Microsoft CTEC) near you offers *Course 1198: Supporting Microsoft Windows NT Server 4.0, Terminal Server Edition*. This course provides a comprehensive look at the issues in deploying and supporting Windows NT Terminal Server in your school, district, or campus. To locate a Microsoft CTEC near you, visit [http://www.microsoft.com/train\\_cert/](http://www.microsoft.com/train_cert/)

### Participate in a Microsoft Seminar Online

Microsoft offers three online seminars about Windows NT Terminal Server: a 25-minute overview, a 10-minute presentation on scalability, and a 16-minute focus on application compatibility. Select the modules you want to view whenever you're ready—and interact with Microsoft engineers who will respond to your e-mail questions promptly. The free (connect charges may apply) seminars are available now at <http://www.microsoft.com/seminar/98/ve/terminal/portal.htm>

### Consult a Microsoft Certified Solution Provider in Your Local Area

If your institution needs support from a third party with expertise in deploying Windows NT Terminal Server, contact a Microsoft Certified Solution Provider near you. Solution Providers are consulting organizations trained in Microsoft technology and qualified to help institutions like yours get the most out of their technology investments. If you need help identifying a Solution Provider, go to <http://www.microsoft.com/education/partner/resource/guide/partner.htm>

### Support Options

The Support Online Web site from Microsoft Technical Support offers you a powerful range of options for getting assistance. You can search the Microsoft Knowledge Base and access information and downloadable files in the Search Support Online area at <http://support.microsoft.com/support/>

Phone support options for Windows NT Terminal Server include Pay-Per-Incident Support in the United States and Canada at U.S.\$195 per incident. You also may submit a paid incident via the Internet with the online Web Response tool. In addition, Microsoft offers phone sup-

port through a Priority Annual Account in the United States and Canada for U.S.\$1,695 per 10 incidents.

Microsoft also offers Priority Plus and Premier Support options. For more information on these options, visit <http://support.microsoft.com/support/contact/>

*Microsoft Sourcebook for the Help Desk* can serve as your complete guide to delivering high-quality help-desk solutions. It provides effective, economical ways to deliver high-quality technical support to your school or district computer users. It offers clear, complete information you need for evaluating, setting up, and managing help-desk solutions. The latest edition includes information on migration, help-desk strategies in multivendor environments, and more. The Sourcebook also includes a companion CD fully updated with expanded contents and tools.

Whether you're setting up a help desk for the first time, optimizing for efficiency, or balancing internal and external resources, you'll find valuable answers in this book and companion CD. *Microsoft Sourcebook for the Help Desk* is available for purchase from Microsoft Press at <http://mspress.microsoft.com/prod/books/1304.htm>

### Subscribe to Microsoft TechNet

Microsoft TechNet is a CD-ROM subscription product that delivers the most current evaluation, deployment, and support information on key Microsoft products. It is one of the smartest investments you can make, whether you're making high-level decisions on technology, deploying new systems, or supporting them on a daily basis.

Every month, TechNet delivers multiple CDs packed with the critical information you need to successfully run Microsoft systems at your organization. It's packed with 300,000 pages of technical information, enlightening case studies, all the Microsoft Resource Kits, and the entire Microsoft Knowledge Base, with answers to more than 60,000 questions. Plus, 3,000 new pages per month are devoted to updated articles, service packs, drivers, and patches. Instead of fighting fires, you'll have time to make strategic network decisions; help administrators, teachers, and students better help themselves; and offer insightful, well-informed recommendations to technology committees, administration, and management. Microsoft offers reduced academic pricing for TechNet. For more

(See "New Life" on Page 26)

# New Life

(Continued from Page 25)

information, go to <http://www.microsoft.com/technet/subscription/about.htm>

## Things You'll Need to Know

- Minimum system requirements
- Pricing and licensing
- Resources: Comparing thin clients and features at a glance
- Additional tools and resources: Contact information

## Minimum System Requirements for Windows NT Terminal Server

To put Windows NT Terminal Server to work, here's what you need:

### Server

- Intel-based processor (such as Intel Pentium or higher) or Alpha
- 32 MB of RAM, plus 4–12 MB for each typical user who is connecting
- 128 MB of available hard-disk space on the partition that will contain the Windows NT Terminal Server system files
- **For a computer with an Intel-based processor:** 3.5" high-density disk drive plus CD-ROM drive
- VGA or higher-resolution monitor
- TCP/IP compatibility
- High-performance bus, such as EISA, MCA, or PCI

### Clients

- 386 or higher processor
- 4 MB of RAM
- 4 MB of available hard-disk space
- 3.5" high-density disk drive
- TCP/IP network interface card

- VGA or higher-resolution monitor
- Microsoft Mouse or compatible pointing device
- Windows-based terminal specifications

## Pricing and Licensing

Microsoft has designed Windows NT Terminal Server to be affordable, especially for schools that will be using it on legacy PCs. The exact amount that it will cost your school depends on:

- How many clients you will support
- What type of clients you will support (e.g., Windows-based, non-Windows-based)
- Whether you need to purchase hardware or can use existing hardware

First, plan to acquire the Windows NT Terminal Server software and the server software license. Then, plan for acquiring licenses for the clients that will access the server.

As shown in Table 1, the type of client (Windows for Workgroups, Windows 95, Windows 98, Macintosh, MS-DOS, UNIX, Windows 3.1, or Windows NT Workstation) determines the type of client license required.

If you are adding Macintosh, Windows 3.1, MS-DOS, or UNIX computers to your Windows NT Terminal Server-based network, you will need to acquire the Citrix MetaFrame Server and Client License package. For more details including pricing for MetaFrame, go to <http://www.citrix.com/education/>

Understanding the Microsoft End-User License Agreement (EULA) and licensing programs is critical to using and managing Microsoft software. The Microsoft Licenses Web site explains the licensing rights for Microsoft products. Education customers can qualify for affordable academic pricing, and many education cus-

(See "New Life" on Page 27)

**Table 1. Client Licensing Requirements**

Client Licensing Requirements	Windows for Workgroups Windows 3.11, Windows 95, Windows 98	Macintosh, MS-DOS, UNIX	Windows 3.1	Windows NT Workstation
Windows NT ServerClient Access License (CAL)	√	√	√	√
Windows NT Workstation License	√	√	√	–
Metaframe Server and Client License Package	–	√	√	–

√ = client access license required

– = client access license not required or already included

# New Life

(Continued from Page 26)

**Table 2. Comparing Thin Clients**

Comparing Thin Clients	Windows-based Terminals	PC with Terminal Server	Network Computer	PC	Net PC
Processor	Many types	Intel-based operating system	Several types	Intel-based operating system	Intel-based operating system
RAM	4-16 MB	4-16 MB	16-64 MB	16-32 MB	16-32 MB
Peripherals	Local/Remote	Local/Remote	Remote	Local/Remote	Local/Remote
ISA Expansion	NA	Yes	NA	Yes	No
Hardware Detection	NA	Optional	NA	Optional	Yes
Sealed Case	Yes	No	Yes	No	Yes
Power Management	Yes	Optional	No	Optional	Yes
Windows Operating System Execution	Remote	Local	NA	Local	Local
Application Execution	Remote	Local/Remote	Remote	Local	Local
Java Execution	Remote	Local/Remote	Local	Local	Local
Browser	Remote	Local	Local	Local	Local
Data Storage	Remote	Remote	Remote	Both	Remote
Cache	RAM	Disk	RAM	Disk	Disk
Centralized Management	Yes	Yes	Yes	Yes	Yes
Remote Software Installation	NA	Optional	No	No	Yes
Remote Boot	NA	Optional	Yes	No	Yes

tomers qualify for even lower volume pricing through the Microsoft U.S. Open License or Select programs. The Microsoft U.S. Open License Program is designed to provide flexible volume-based pricing for academic institutions with five or more desktops. Microsoft Education Select 4.0 Academic Volume License is a volume software licensing program designed for eligible education and other qualifying customers with more than 1,000 desktops.

For more information regarding Microsoft Software Licenses, visit <http://www.microsoft.com/licenses/>

To acquire Windows NT Terminal Server, use your organizational purchasing process or go directly to a Microsoft Authorized Education Reseller (AER). There is a Microsoft AER near you who can assist with all your Microsoft product-licensing needs. A list of Microsoft

resellers can be found at <http://www.microsoft.com/education/partner/opps/aerinfo.htm>

Academic pricing information can be found at <http://www.microsoft.com/education/pricing/> Visit this site to determine the estimated academic prices for the Microsoft software you are considering acquiring.

## Resources

### Comparing Thin Clients

Which thin client—or combination of thin clients—is best for your school? Table 2 explains the differences among thin-client technologies in the marketplace today.

### Features at A Glance

The following table summarizes various features.

**Table 3. Features At A Glance**

Feature	Description
<b>EASE OF USE</b>	
<b>Multiple Client Support</b>	Delivers the familiar Windows (Windows 95, Windows 98, and Windows NT Workstation) graphical user interface to users of Windows-based terminals and legacy desktops, including Win16, Macintosh, UNIX, and Win32 <sup>®</sup> -based desktops. (Connectivity to Macintosh and UNIX-based machines requires third-party add-on.)
<b>Roaming Disconnect Support</b>	Supports the ability for users to disconnect from a session without logging off. This allows users to leave a session active, or running, while disconnected and then reconnect to the existing session from another machine or at another time. Supports multiple simultaneous logon sessions from different desktops.
<b>Multiple Logon Support</b>	This enables users to log on to numerous Terminal Servers or a single Terminal Server many times to do multiple tasks or to run multiple unique desktop sessions.
<b>Automatic Session Reconnection/Resume</b>	Keeps session active and automatically reconnects when clients are disconnected from the server for a period of time.

(See "New Life" on Page 28)

# New Life

(Continued from Page 27)

<b>MANAGEABILITY</b>	
<b>Windows-based Terminals Based on Windows CE Operating System</b>	Windows-based terminals for Windows NT Terminal Server, based on a custom implementation of the Windows CE operating system and the Remote Desktop Protocol, are or will be available from major terminal partners such as Wyse, NCD, Boundless, Tektronix, and Neoware.
<b>Client Connection Manager</b>	A new client connection tool to allow single-icon connections to sessions or applications will be developed through a simple wizard-based tool.
<b>Terminal Server License Manager</b>	A new License Manager tool has been added to allow administrators to track, from every Terminal Server, all the licenses for the Windows NT Terminal Server clients connecting to one or more servers.
<b>Distributed File System Support</b>	Terminal Server offers full support for the Microsoft Distributed File System (DFS). Support is for connecting to a DFS share and hosting DFS shares from a Terminal Server.
<b>New System Policy Components to Allow Further Lock-down of Terminal Server–Based Desktops</b>	New components have been added to the desktop and Start menu (Disconnect, Logoff, and Windows NT Security) for Terminal Server clients. System policy capabilities disable those additional components of the Terminal Server client interface with a mouse click.
<b>Centralized Application Installation and Update</b>	Allows administrators to install applications once at the Terminal Server and provide access to the latest applications immediately to all connected Terminal Server clients.
<b>Integration with Microsoft Zero Administration Kit</b>	Delivers the functionality and benefits of the Zero Administration Kit to Terminal Server clients, including non-Windows-based machines. (Connectivity to Macintosh and UNIX-based machines requires third-party add-on.) This includes the ability to create locked-down user profiles.
<b>Terminal Server Administration</b>	The Terminal Server Administration tool is used to query and manage Terminal Server sessions, users, and processes. Among its functions, the utility can: <ul style="list-style-type: none"> <li>§ Disconnect a Terminal Server session</li> <li>§ Send a message to a Terminal Server session or user</li> <li>§ Reset a Terminal Server session</li> <li>§ Display Terminal Server session connection status</li> <li>§ Display Terminal Server session client information</li> <li>§ Display user and system processes</li> <li>§ Terminate a process</li> <li>§ Display Terminal Server information</li> </ul>
<b>Terminal Server Connection Configuration</b>	Creates, modifies, and deletes sessions and session sets on your Terminal Server. Among its functions, Terminal Server Connection Configuration can: <ul style="list-style-type: none"> <li>§ Configure a new connection</li> <li>§ Manage permissions for a connection</li> <li>§ Add users and groups to permission lists</li> <li>§ Control timeout settings and disconnect settings</li> </ul>
<b>Integration with Windows NT Server User Manager for Domains</b>	Terminal Server user accounts are created the same way as they are for users of Windows NT Server. This allows existing computer users to access their accounts from terminal and terminal emulation desktops. It also adds new options specific to the Terminal Server environment.
<b>Integration with Windows NT Server Performance Monitor</b>	Allows system administrators to easily track Terminal Server system performance. Performance Monitor with Terminal Server can: <ul style="list-style-type: none"> <li>§ Track processor use per user session</li> <li>§ Track memory allocation per user session</li> <li>§ Track paged memory usage and swapping per user session</li> </ul>
<b>Messaging Support</b>	Administrators have the capability to alert users to system shutdowns and upgrades or new application postings.
<b>Remote Control Administration</b>	Any user of Terminal Server with administrative privileges and access to the administrative utilities on the Terminal Server can remotely manage the Terminal Server.
<b>Configurable Inactivity Timeout</b>	Administrators can configure when to time out sessions due to inactivity. This feature enables server load reduction.
<b>APPLICATION COMPATIBILITY</b>	
<b>Application Compatibility</b>	Extensive testing of more than 50 applications for compatibility and ease of installation in a Terminal Server environment.
<b>Support for Applications Based on the Visual Basic and Visual C++® development systems</b>	Support for any 16-bit or 32-bit application that runs on Windows NT 4.0 today, including 32-bit and 16-bit Visual Basic–created applications.
<b>Support for Microsoft Office 4.2, Office for Windows 95, and Office 97</b>	Support for the most recent releases of the most popular productivity applications.
<b>Support for Browser-based Applications Including ActiveX® Controls and Java Applets</b>	Microsoft Internet Explorer and Netscape Navigator were extensively tested, including tests of Microsoft ActiveX controls and Java applets to ensure complete browser and application compatibility.
<b>Microsoft BackOffice Family Server Support</b>	Support for the BackOffice family of server applications, including Microsoft Exchange Server, Microsoft SQL Server™, and Microsoft SNA Server.

(See “New Life” on Page 29)

# New Life

(Continued from Page 28)

<b>SCALABILITY, PERFORMANCE</b>	
<b>New Performance Enhancements</b>	Many improvements to the RDP protocol's caching, packet use, frame size, and so on have provided significant performance improvements over the development process.
<b>Support for Alpha Processor-based Clients and Servers</b>	Alpha processors are fully supported in Terminal Server. Those companies using Alpha-based versions of Windows NT Server and Windows NT Workstation now have a client to connect to any Terminal Server.
<b>Highly Scalable Server System</b>	Base guidelines for estimating number of active users per server are 18–20 users per processor for heavy users and 45–50 users per processor for light or task-based users. The number will vary depending upon users' processor speed, application load, and usage pattern.
<b>Support for Up to 32-processor SMP Machines</b>	Terminal Server supports up to four processors out of the box. In addition, a separate version is available from original equipment manufacturers (OEMs) to support systems with up to 32 processors.
<b>SECURITY</b>	
<b>Multiple Encryption Levels</b>	1. Administrators have the option to configure data transmission between the Terminal Server and Terminal Server clients to encrypt all or some of the data transmitted between the client and server at three different levels, depending on their security needs.
<b>Encrypted Logon</b>	Terminal Server logon process is encrypted (by default) on the wire, ensuring secure transfer of user name and password.
<b>Encrypted Password Every Time</b>	Includes change password, unlock desktop, and unlock screen saver.
<b>Ability to Limit Number of Logon Attempts</b>	Administrators can limit the number of user logon attempts to prevent hackers from attacking a server.
<b>Ability to Limit Connection Time</b>	Administrators can limit the connection time of any individual user or groups of users.
<b>Ability to Manage User Security by Groups of Users</b>	Administrators can set up security restrictions for individual users or groups of users. This includes limiting the ability to redirect to local devices.

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# Experiences

(Continued from Page 16)

In order to streamline the completion of CEDPA business, the board makes extensive use of electronic mail and teleconferencing to communicate conference matters and reach decisions concerning issues that require timely attention. Immediately after the shooting, the board noticed a significant absence of participation from CEDPA's president, Warren Williams. Later that week the board found out why. "I [have] been at Santana High School since Monday," reported Warren. Williams is Assistant Superintendent for Information and Technology Services for the Grossmont Union High School District and was undoubtedly involved with crisis management and counseling at Santana High School. A CEDPA board meeting previously scheduled for the end of the following week was hastily rearranged to accommodate Warren's availability. But it doesn't end here.

## Tragedy Repeats Itself

No sooner had the wounds of the Santana High School shooting begun to heal, that another tragic shooting took place. This time the shooting involved an 18-year old student at another San Diego County high school, Granite Hills High School in El Cajon, California. Granite Hills High School is also a school of the Grossmont

Union High School District. Reports credit Richard Agundez Jr., an El Cajon police officer assigned to the Granite Hills campus, with swift response and timely intervention that prevented further injuries or fatalities. "Agent Agundez is the hero of the day," said Granite Hills Principal Georgette Torres. "He certainly is our hero."

One of the first reports to the board of the shooting came from CEDPA Secretary Jane Kauble during the early afternoon of the day of the shooting. Jane messaged to the board, "Well...[it] looks like Warren is going to be tied up for awhile again! There was a shooting at Granite Hills High School in El Cajon. This is Georgette's school and in Warren's district."

The CEDPA board knows Georgette Torres as Georgette, wife of CEDPA President Warren Williams. As a true professional, Georgette later told me, "We can only become stronger because of this."

It's now back to business for the CEDPA board...as best as can be done under these difficult circumstances. However, the impressions of these true-life experiences will take a long time to dissipate, especially for those who were directly involved.

# Membership

(Continued from Page 7)

our Annual Conference, and access to membership-only web-based information repositories now under development. You will also have the right to vote on CEDPA business issues.

At CEDPA's discretion, the information you provide may be shared with other CEDPA members and professional affiliates to facilitate information exchange and networking.

Finally, you will also be asked to certify the following:

*"I accept membership in CEDPA K-12 Technologists, and support the objectives of CEDPA as stated in the organization by-laws (<http://www.cedpa-k12.org/>*

*bylaws.shtml* ). I recognize that I may periodically be asked to participate in surveys, the results of which will be used to present a statewide voice regarding K-12 technology issues, but that my participation in any survey is voluntary."

By having our members sign an annual membership form and participate in surveys we believe we will be able to more effectively represent statewide technology views from those that are doing the work on a daily basis. We feel this is a very powerful voice that is being underutilized at this time. We hope you take the time to fill out the membership form and fax it in and we look forward to working with you more closely on technology issues in the future.

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