Δίκτυα Υπολογιστών στην Εκπαίδευση

Computer Networks for Education

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8/1/2010

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ΔΜΠΣ Πληροφοριακά Συστήματα	**Master Information Systems**
Δίκτυα Υπολογιστών	**Computer Networks**
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ΠΕΡΙΛΗΨΗ

Η παρούσα εργασία έχει σαν περιεχόμενο την πρόκληση που αντιμετωπίζουν όλο και περισσότερα εκπαιδευτικά ιδρύματα να εκσυγχρονιστούν και να περάσουν σε μια νέα εποχή διδασκαλίας με τη χρήση δικτύων Η/Υ. Παρουσιάζονται διάφορες περιπτώσεις εκπαιδευτικών ιδρυμάτων που έχουν εγκαταστήσει δίκτυα υπολογιστών και ή τα χρησιμοποιούν στη διδασκαλία τους ή παρέχονται σαν υποδομή και σαν εργαλεία στους μεγαλύτερους σε ηλικία μαθητές και φοιτητές. Τέλος υπάρχουν οι παρατηρήσεις σχετικά με αυτές τις περιπτώσεις και τα συμπεράσματα που βγαίνουν από αυτές.

ABSTRACT

This paper contains a view about the challenge of most educational institutes to pass from classical teaching methods to the 21st century education which includes wide use of computers and computer networks. There are several cases of institutes that have implemented networks to provide better services, teaching methods and tools. Of course there are some preconditions that must be seriously considered before the decision of installing a network and its implementation.

Computer Networks for Education

These are challenging times for education. Until a few years ago lessons in all schools were delivered in the traditional way. The last years more and more schools are facing the challenge to pass from the classical teaching methods to a new era of computer based education and eLearning methods. In higher education computers are a necessary and helpful tool and their use mainly involves Internet access, emails and applications for assignments. In the young ages computers can be a very useful learning tool but only after the teacher's guidance. Since the 802.11 IEEE standard and it's further extensions (mainly 802.11a, 802.11b, 802.11g) for wireless connection were ratified, high-speed, reliable and secure connections between computers have given the opportunity for network implementations in the service of huge organizations and in this case for educational institutions. Considering the wide expansion of mobile devices (netbooks, laptops, smartphones, multimedia devices) that support wireless fidelity (Wi-Fi) anyone could connect to an available network for instant communication, information and data sharing and Internet applications. This is an opportunity for the educational institutions to implement a network and provide:

-   To their students all the necessary tools for their research and their studies

-   To their teachers all the necessary tools to make their job easier, prepare their students and qualify them with the most essential and useful knowledge.

At the following pages there are case studies divided in two categories. Case studies for lower education (K12, high schools) and higher education (universities, colleges). In each category, for every educational institution there is a table with the necessary information about the characteristics of the institution, the challenge they had to face, the solution for it and the results   of   the   network   installation.

Lower education

School / characteristics:	**Giddings Independent School District** ● K-12 Education ● Giddings, Texas, USA ● 297 employees ● 1848 students
Challenge	● Deliver safe and secure 21st century learning environment that meets student and faculty needs ● Provide networked technology platform for new school that will continue to create options and opportunities for years to come ● Integrate disparate systems and centralize control and support to minimize costs and maximize performance, efficiency, and resources
Solution	● Web 2.0 infrastructure ● Converged applications ● Cisco Connected Real Estate (CRE) platform Routing And Switching: ● Cisco Catalyst® 6500 with VSS Switching and 10Gigabit Interfaces ● Cisco Catalyst 4500 Wireless: ● Cisco 4400 LAN Controller ● Cisco 1131 Access Points Voice and IP Communication: ● Cisco Unified 7941 IP Phones ● Cisco 2800 SRST Gateways ● Atlas IP PoE Speakers via Cisco Solution Plus Program ● Berbee Informacast via Cisco Solution Plus Program Digital Media: ● Cisco Digital Media System Video Signage and Digital Media Players ● Cisco Digital Media System Video Portal ● Cisco Digital Media Encoder 1100 ● Cisco Media Experience Engine (MXE) 3000 ● Cisco 40-inch LCD Displays Physical Security: ● Cisco Video Surveillance (VS) Operations Manager ● Cisco VS Encoding Server ● Cisco 2500 IP Cameras ● Cisco Physical Access Manager Appliance ● Cisco Physical Access Gateways ● Cisco PAM Badge Designer and Enroller SW Telepresence: ●Cisco TelePresence™ 500 Systems
Benefits / Results	● Increased connectivity and centralized communications and alerting capabilities ● Significant savings on power consumption and better control of energy use through centralized management of HVAC systems and lighting controls ● Integrated communications system and easy-to-use technology ● Physical security approach that is demanded by communities with video surveillance and door access controls and television monitoring systems ● Physical security approach that is demanded by communities with video surveillance and door access controls and television monitoring systems ● Ability to share and communicate critical information easily via video with Cisco's Digital Media Solution for Digital Signage and Desktop Video Integration

School / characteristics:	**Mooresville Graded School District** ● K-12 Education ● Mooresville, North Carolina USA ● 750 Employees
Challenge	● Provide over 4500 MacBook laptops to all students grades 4-12 including robust network to support the project ● Eliminate need for printed textbooks and merge traditional learning methodologies with interactive media ● Enable interactive learning environment
Solution	● Provide cutting edge 801.11n wireless network that supports the wealth of rich media available to today's educators ● Provide broadband wireless connectivity solution that creates access to a one-to-one environment consisting of over 4500 laptops at six sites Routing and Switching: ● Cisco Catalyst® 4500 Series Switches ● Cisco Catalyst 3750-E Series Switches ● Cisco Catalyst 3560 Series Switches Wireless: ● Cisco 4400 Series Wireless LAN Controllers ● Cisco Aironet® 1252 Series Access Points
Benefits / Results	● Ubiquitous access to vast array of online content and educational material ● Positive impact on student engagement and productivity, including an increased attendance rate to over 97% district wide and an 8% composite gain and academic achievement ● Solution for digital divide among all students in regard to socioeconomic, cultural and ethnic boundaries

School / characteristics:	**Park Hill School District** ● K-12 Education ● Kansas City, MO, USA ● 10,100 students ● 1500 administrators, faculty, and staff
Challenge	● Strained switching equipment and limited data storage, supporting over 20,000 users and 4,000 network devices ● Community desire for 24-hour access to network ● Separate network for storage platform making management difficult and complicated
Solution	● Installation of Cisco Catalyst 4500 Series Switches over IP network throughout 20 sites ● Implementation of Cisco Nexus 7000 platform to 21st century approach to data center concepts Routing and Switching: ● Cisco Catalyst 4500 Series Switches ● Cisco Catalyst 6500 Series Switches ● Cisco Nexus 7000 Series Switches
Benefits / Results	● Consolidated network, upgraded switches, and greater storage bandwidth ● Ability to take 100 percent virtual courses online through the Park Hill's Virtual Academy ● Secure, 24-hour access to approximately 200 online applications from anywhere in the world

School / characteristics:	**Boerne Independent School District** ● Education, K-12 ● Boerne, Texas USA ● 10 schools: 5 elementary schools, 2 middle schools, 2 high schools, 1 alternative school ● 948 faculty, staff and administrators ● 6,350 students
Challenge	● Increase IT department productivity and mobility for teachers, students, and administrators ● Improve ease of network use ● The ability to access the network 365 days a year, 24 hours a day
Solution	● Update network foundation to support newservices ● Create easily managed network that dynamically allocates bandwidth and access points when needed ● Integrate unified communications and wireless network for increased functionality Routing and Switching: ● Cisco Catalyst® 6509 Series Switches ● Cisco Catalyst 4500 Series Switches ● Cisco Catalyst 3560G/3750G Series Switches ● Cisco Cisco 2811 Integrated Services Router with Survivable Remote Site Telephony (SRST) Network Management: ● Solar Winds Security: ● Cisco Adaptive Security Appliance (ASA) Voice and IP Communications ● Cisco Unified Communications Manager ● Cisco Unity® Voicemail System ● Cisco 7900 Series IP telephones ● IPcelerate Wireless: ● Cisco Wireless Integrated Service Module ● Cisco 1131/1142 Lightweight Wireless Access Points
Benefits / Results	● Increased productivity of administrators, IT staff, and teachers ● Improved network scalability and ease of management ● The mobile tardy station: students who are late are accounted for via mobile technology ● The network implementation provides the ability to use helpful third-party applications such as IPcelerate

School / characteristics:	**Enlarged City School District Of Middletown** ● Pre thru K-12 Education ● Orange County, New York, USA ● 7208 Students
Challenge	● Aging voice and data networks, as well as low data storage bandwidth on outdated network infrastructure ● Difficult for students, teachers, and faculty to process and circulate data ● Need for major structural and educational improvements to better serve students, faculty, and staff
Solution	● Advanced infrastructure capable of handling any application, including voice, video, and data ● Advanced Unified Communications for increased productivity and lower costs Routing and Switching: ● Cisco Catalyst 3750 series Switches ● Cisco Catalyst 4500 Series Switches ● Cisco Catalyst 6500 Series Switches ● Cisco Catalyst 3560 series Switches Voice and IP Communications: ● Cisco Unified Messaging ● Cisco Call Manager 7.0
Benefits / Results	● Removed district buildings and schools from state "watch list" where they were identified as "needing improvement" ● Placed in the top one percent of public school districts in state ● Increased productivity, bandwidth, and availability on the network while decreasing costs for network maintenance

School / characteristics:	**Bayport-Blue Point Union Free School District** ● K-12 Education ● Bayport, New York, USA ● 2700 students ● 400 teachers and faculty
Challenge	● Deliver single-platform solution with an eye for future of education ● Increase student, teach, and faculty collaboration across district ● Improve safety, physical security, and Emergency communications, as well as network infrastructure districtwide
Solution	● Identify unified communications plan that supports unified messaging, wireless internet access, and wireless phones throughout district ● Deploy Cisco unified communication solution to improve contact between parents, teachers, students, and staff <u>Routing and Switching:</u> ● Cisco Catalyst®6500/3750/3560 Series Switching Infrastructure Security and VPN: ● Cisco IP Surveillance <u>Unified Communications:</u> ● Cisco Unified Communications Messenger Version 7.0 ● Cisco Unity® 5 ● 300 Cisco IP Phones ● Singlewire InformaCast ● PA System ● Cisco Digital Media System: DME 1100, 2200; DMM 5.0; DMP 4400 <u>Wireless:</u> ● Cisco Wireless Control System ● Cisco 4404 Wireless LAN Controller ● 300 Cisco 1142 Series Access Points Cisco WebEx®
Benefits / Results	● Increased network reliability and uptime by 20 percent ● Installation of 300 Cisco unified IP phones, enhancing student-teacher-parent collaboration and user productivity ● The new infrastructure enabled the district to save US$216,000 per year due to increased efficiency and a reduction in maintenance resources ● Improved safety and security of students

School / characteristics:	**Oaks Christian School** ● K-12 Education ● Westlake Village, California, USA ● 1200 students ● 90 teachers
Challenge	● Showcase grand opening of new middle school facility with digital signage ● Unify two campuses with robust, easy-to-use digital television mode ● Maintain and manage digital television with limited resources
Solution	● Implement Cisco Digital Signs solution running across both campuses ● Use Cisco Cast to broadcast four channels on both digital media panels and desktop video ● Deploy 20 Cisco LCD displays throughout campus <u>Cisco Digital Media Suite including:</u> ● Cisco Cast ● Cisco Digital Signs ● Cisco Show and Share
Benefits / Results	● Increased student school loyalty by promoting achievements throughout school ● Ability to deploy videos of school news and case studies in 21st century media environment

School / characteristics:	**Waipahu High School** ● Education K-12 ● Waipahu, Hawaii ● 261 employees including 183 instructors and 78 service staff
Challenge	● Deploy custom network solution that meets the needs of teachers and students ● Reduce operational costs ● Establish security and first responder communications
Solution	● Created a custom network solution, with added security benefits ● Provided cost-effective platform to install phone system throughout the school <u>Routing and Switching:</u> ● Cisco Catalyst 3560 Series Switches ● Cisco Catalyst 3750 Series Switches ● Cisco 2811 Integrated Services Router <u>Security and VPN:</u> ● Cisco Adaptive Security Appliances <u>Voice and IP Communications:</u> ● Cisco Unified 7900 Series IP Phones ● Cisco Unity® ● Cisco Unified Call Manager ● Cisco 180 Series Analog Telephone Adapters
Benefits / Results	● More efficient, reliable platform for running online educational programs and phone system at a lower cost (reduced by US$50 per foot) ● Increase in staff productivity, educational resources, and learning opportunities for students ● Significant increase in schoolwide and emergency preparedness communication efficiencies

School / characteristics:	**Paradise Valley Unified School District** ● K-12 Education ● Phoenix, Arizona, USA ● 34,000 Students ● 3,000 Staff
Challenge	● Advance pedagogy and success of remote learning and communication ● Deliver innate human expressions and experiences in remote communication
Solution	● Use multiple video cameras and high-definition screens for online learning and communication ● Share video and conduction of electronic dialogue ● Leverage Microwave Wireless Wide Area Network (WWAN) broadcast and districtwide telecommunications convergence on Voice Over Internet Protocol (VoIP) system <u>Video:</u> ● Cisco TelePresence System 500s (seven) and1300 (one) ● Cisco Unified Videoconferencing 3515 Multi Control Unit (MCU) ● Cisco Unified Communications Manager (two - CUCM) <u>Voice and IP Communications:</u> ● Cisco Unified Border Element (CUBE) ● Cisco Unified Communications Manager (seven - CUCM) ● Cisco Emergency Responder (E911) ● Cisco Unity Connections
Benefits / Results	● Delivered, individualized, and supported learning for all students, regardless of physical boundaries ● Connected with national and international post-secondary institutions for recruitment efforts, guest lectures, and more ● Created cost-effective, remote classrooms

Higher Education

School / characteristics:	**University of Iowa** ● Iowa City, USA ● 11 colleges ● 30,000 students
Challenge	● Plans to add 1,000 new access points throughout the campus by early September in order to close coverage gaps in the existing network and to extend wireless capabilities to all buildings where classes are held. Network Size: ●1,200 APs in 140 buildings across a 1,900-acre campus ●Growing to 2,200 APs during 2010
Solution	Infrastructure Mixture: ● Meru Networks AP208 and AP311 AirWave Products: ● AirWave Management Platform™ ● AirWave VisualRF^{TM} ● AirWave RAPIDS^{TM} ● 10 controllers ● 520 switches, routers, and other networking devices
Benefits / Results	● Time saving because the information they need to solve problems is accessible from one common location ● More Efficient Rogue Detection and Mitigation (with AirWave RAPIDS) ● Using a standard approach to the deployment and tools like AirWave they have the ability to increase the size of their network without increasing staff (*Steve Troester, Network Manager, University of Iowa,2009*) ● The network services team now has a clear picture of how the WLAN is used and what types of devices are accessing it ● Multi-Vendor Support Provides Flexibility: Although we have a non-Aruba WLAN, AirWave7 supports our infrastructure very well (*Steve Troester, Network Manager, University of Iowa, 2009*)

School / characteristics:	**Loyola Marymount University** ● Los Angeles, California, USA ● 8,000 full-time students ● 611 faculty members ● 17 residence halls ● 34 academic and administrative buildings ● outdoor areas
Challenge	● Wireless LAN big enough to cover the entire campus ● Management of both Cisco Aironet and Cisco Airespace product lines from one console ● Visibility and ease of use for user monitoring and efficient planning ● Enhanced Security through policy enforcement and rogue AP detection
Solution	● AirWave Wireless Management Suite ● RAPIDS Rogue Detection ● VisualRF™ Location and Mapping ● Cisco Aironet wireless access Points ● Cisco Airespace 4400 controllers
Benefits / Results	● The AirWave Management Platform™ (AMP) gives one common platform from which all these devices can be managed. ● AMP's reporting feature provides IT department with valuable trend reports that allow them to monitor network usage patterns and intelligently plan for growth. ● Strong Security ● Students love the wireless network for the flexibility and mobility it provides. AirWave software helps make it possible to deliver a robust, reliable service to our students without overwhelming our IT staff with additional support responsibilities (*Gary Landau, Director, Network Services Loyola Marymount University, 2008*)

School / characteristics:	**University Of Plymouth** ● Higher education ● Plymouth, United Kingdom ● 30,000 students, 3000 staff
Challenge	● Support high-bandwidth research need on demand ● Enable reliable collaboration and communications anywhere ● Keep pace with teaching innovations
Solution	● Cisco switches from the core to the edge ● Integrated support for unified messaging and wireless LAN ● Converged solution that supports high-bandwidth data, voice and video demands ● Cisco Catalyst 6500 Series switches ● Cisco Catalyst 3750-E and 3560-E Series switches ● 802.11n Cisco Aironet 1250 Series Access Points
Benefits / Results	● Provides unified messaging and access to voicemail from anywhere ● Enables easier communications and a more reliable and robust network ● Provides ease of management and cost efficiencies through a single platform ● Enables innovative teaching tools, such as multicast lecturing and video conferencing ● Provides better protection against security threats ● Offers a more reliable, flexible and larger-capacity data center

School / characteristics:	**Karunya University** ● Coimbatore, India ● 7,200 students ● 11 campus hostels ● 430 teaching faculty ● 220 support staff members
Challenge	●Replace legacy WLAN in order to improve performance, bandwidth and security in support of e-learning ● Handle high peak loads generated by online exams ●Improve manageability so that minimal staff can effectively support a large, extended network
Solution	● Aruba 6000 Mobility Controller ● Approximately 365 Aruba APs ●Aruba Policy Enforcement Firewall (PEF) for wired and wireless security ● Aruba's Adaptive Radio Management (ARM) technology
Benefits / Results	● High performance and scalability that meets demanding classroom needs ● Significantly improved efficiency in management tasks, allowing the IT staff to manage a large network ● Improved security

School / characteristics:	**James Cook University (JCU)** ● Townsville and Cairns, Queensland, Australia ● 17,500 students
Challenge	● Proliferation of wireless devices required network flexibility ● Existing wireless network could not support surge in online usage. ● Monitoring and managing existing network across the wide coverage area was time consuming
Solution	● 802.11n WLAN ● MC4100 Controllers ● 350 Meru AP320 Series Access Points ● E(z)RF Network Manager ● Meru's Virtual Cell™ architecture ● E(z)RF OnTheGo application
Benefits / Results	● Simplified installation and management by eliminating need for channel planning across the large coverage area ● Students and staff able to connect wirelessly with various devices and operating systems ●Management platform provides centralised management of the network at both campuses

School / characteristics:	**University Of Malaya** ● Kuala Lumpur, Malaysia ● 17 research centers ● 30,000 students, staff and faculty
Challenge	● Secure, scalable, centrally managed pervasive wireless LAN ● Needs-based quality of service policy for diverse academic community ● Support voice over Wi-Fi and data on a single campus SSID
Solution	● Aruba 6000 Multi-Service Mobility Controller ● Aruba AP 125 802.11n and AP-70 Access Points ● AirWave Management Suite ● Policy Enforcement Firewall
Benefits / Results	● Saved more than US $1.42 million in first year by eliminating ports, cables, switches, and labor costs associated with the campus-wide closet refresh and network expansion ● Eliminated 80% of ports in classrooms and staff areas. ● Provided high network availability and security. ● Reduced IT overhead by centralizing network management and providing remote diagnostics and updates ● Currently, voice, video and data are the most important applications, but we expect that the availability of pervasive connectivity will spawn the development of new collaborative, research, and learning applications (*Mr. Ng, Head of Networking University Malaya's campus-wide wireless project, 2008*)

School / characteristics:	**Texas A&M University** ● College Station, Texas, USA ● 47,000 students ● 16,500 daily wireless users ● 5.8 million square feet of wireless coverage
Challenge	● In order to decrease the costs of physical installations, many departments request wireless-only access for offices with transient occupants ● Reliable coverage ● Flexible platform with additional monitoring capabilities
Solution	<u>Infrastructure Mixture</u> ● Aruba 6000/M3 series controllers and Aruba 12x series access points ● Cisco 44xx/WiS M series controllers and 10xx series access points <u>Aruba Products</u> ● AirWave Wireless Management Suite ● AirWave RAPIDS Rogue Detection ● AirWave VisualRF Location and Mapping
Benefits / Results	● Easy to use an get the information needed ● Efficient Division of Labor ● Higher Productivity ● Proactive Management for Better Network Performance and Reliability ● Effective Management Reporting ● High security with AirWaveRAPIDS™

School / characteristics:	**Lund University** ● Lund, Scania, Sweden ● 65 buildings ● 40,000 students ● 6300 employees
Challenge	●Lund University needed to upgrade its network to better serve students and manage growth of new applications and services
Solution	●Avaya as the telephony vendor ● Extreme Networks over Cisco ● BlackDiamond® 10808 switch ● Extreme Networks' 4th generation chipset ● ExtremeXOS® modular software operating system ● For the access and distribution layer Lund has standardized on Summit®X450 and Summit 300 ● EPICenter® as their network management platform
Benefits / Results	● The new networks infra-structure supports the Lund University Network (LU-NET), which delivers services to four campuses, approximately 65 buildings, and approximately 40,000 students and 6300 employees at the university. ● Lund University has a much more scalable solution than it had in the past. ● Cost-effectiveness and ease of management of the new network solution lowers the overall total cost of network ownership

School / characteristics:	**Purdue University** ● West Lafayette, Indiana, USA ● 40,090 students ● 19,141 faculty and staff ● 20 million square foot campus
Challenge	● Provide the highest academic experience to the students. ● Provide mobile access everywhere on the campus.
Solution	● 6000 Cisco 802.11n access points ● Cisco Wireless Control System WCS)
Benefits / Results	● Delivered pervasive 802.11n wireless coverage ● Provided high-density and high-bandwidth capabilities to the wireless network ● Supported innovative mobile applications that improve student success rates ● Created a highly collaborative education environment ● Only three IT network managers can centrally monitor access points located throughout 255 buildings

School / characteristics:	**Nicolaus Copernicus University** ● Toruń, Poland ● 40,000 students
Challenge	● Need of a network that would give access to that number of students without breaks in service ● A network that would support new applications under consideration, such as voice over wireless IP
Solution	● After tests it chose Meru's virtualised wireless network to help it keep up with surging student demand for wireless Internet access ● Meru APs
Benefits / Results	● The problem of handover - the break in transmission when a client moves from one access point to another - is now solved. ● A network that provides secure Internet access and that is capable of serving a rapidly growing number of the university's students and faculty

School / characteristics:	**Brussels Regional Informatics Center (BRIC)** ● Brussels, Belgium ● 1.2 km^2
Challenge	● Outdoor and indoor coverage over 1.2 km^2 of hilly surroundings with bushes and trees ● High density transfers of data and capable of supporting VoIP ● Providing reliable connectivity and superior performance to each client. ● Students set up additional wireless networks – showing at least 40 other networks.
Solution	● Mixed 801.11abg environment ● 11b and 11g frequencies for normal coverage ● 11a for mesh network ● Meru's Air Traffic Control™ technology automatically distributes network data traffic ● APs close to the ground equipped with rechargeable batteries ● Used rogue APs from a previous network implementation as wide-ranging AP due to Meru's system that works like one virtual cell
Benefits / Results	● Meru Enterprise Mesh allowed difficult areas to obtain wireless coverage without sacrificing security. ● Mixed environment of 801.11abg – 78 AP's covering the campus maximizes client connectivity and performance. ●Virtual Cell was able to tolerate and manage interference caused by student networks. ● Scalability, low installation cost, and superior Quality of Service

School / characteristics:	**Capital Normal University** ● Beijing, China ● 27,000 students ● 2,500 teachers ● 3.5 square miles ● 17 college departments ● 61 labs ● 31 computer rooms
Challenge	● Required a scalable outdoor wireless mesh solution that could also provide seamless indoor coverage ● Needed a wireless mesh network that could overcome wireless interference in a large city environment. ● Capacity to support broadcast-quality video surveillance cameras in the future
Solution	● 289 Aruba wireless mesh routers, including the dual-radio MSR2000 wireless mesh routers ● Aruba's Adaptive Wireless Routing™ (AWR) technology
Benefits / Results	● Scalable Wi-Fi Access and Backhaul ● Solid security from end-to-end, beginning with the connection between clients and APs and extending across the backhaul from source to destination. ● Wireless mesh network security provisions are also top-to-bottom – from basic user access control at the application layer to traffic encryption during transmission at the physical layer

The most common feature of all the above case studies is that all the institutions want to provide to their students, teachers, professors and faculty the best possible service and the best possible learning tools, through the implementation of these projects. Of course there are differences between the goals of each institution and especially between the two big categories. In the category of lower education schools aim to use networks in the learning procedure an as learning tools. Most times under the guidance of the teachers. In the category of higher education student use the network for instant communication, info and data sharing and as a tool in their own study. A second difference is that in the first case networks are going to be built from zero, with no previous installations or legacy networks. While in the most cases of higher education the institutions planned to upgrade or rebuild a legacy network. In both cases networking and wireless networking in education has the following advantages:

- Gives students and faculty access to the academic network and the Internet in classrooms, laboratories, lecture halls, dormitories, common areas - even outdoors and between buildings.

- Networking has transformed the traditional approach for students facing assignment research, by providing a plethora of instantly accessible information.

- Grows the academic network cost-effectively, even in hard-to-wire spots.

- Provide greater flexibility - no need to move LAN connections when remodeling facilities or reallocating instructional and office space.

- Set up connections easily in remote locations such as distance-learning and adult education centers, temporary campus buildings, mobile classrooms, and research stations.

- Make it easy for students, faculty, and staff to share networked devices like printers, scanners, servers, and Internet gateways.

- Can establish a networked computer lab in any wireless-equipped classroom.

The implementation or the upgrade of a legacy network will benefit the educational institutions only under these preconditions:

- Perfect planning

- Management and network support

- Security and privacy

Planning

Network planning is the process of defining business requirements and growth plans to build a framework for connecting computers and other equipment in an organization. Thinking about these needs before jumping into the actual implementation eases the process, and increases the likelihood that the chosen network solution will match the requirements now and in the future. Each institution has its individual IT strategy. Therefore, planning must be done according to this strategy and the specific needs of each institution. There are four key questions that must be answered when planning a wireless network for a campus (according to *Simon Graham of Richmond American International University in London, 2001*):

- Who will use it (different approach when planning the implementation if it is for university students and if it is for K12 students)

- Where will they use it (network design, in which areas will it be used)

- What services to deliver (depends on the institution IT team strategy, for example teleconference, mail services etc.)

- How will they use it (computers and hardware capable to support the applications that will be used)

Every institution that wants to implement a network must assign this project to an expert and experienced IT team. The project must be straightly coordinated to the strategic goals of the institution. On that basis it must be planned the services that the network will provide, who and how will use it and the places that have to be covered. The network should have the appropriate capacity to support band-width-intensive activities such as large file transfers, computer-aided design and video. Just as important as wireless network performance is availability and mobility. Users must be able to roam from one area to another within a

building or outside and not lose their connection. During the planning stage, the IT team must consider the future plans for the network and the possible upgrades and expansion. This has to be done very carefully so that when this time comes the procedure will be accomplished without problems of latency and more than the estimated cost. Another thing that should be planned is who will manage the network and will support it.

Management and network support

When the network solution is defined, they decide whether they have the resources in-house to install and maintain it themselves or whether they require a consultant or external company to handle it. Networking products have become easier to use and administer over the years, so small organizations are finding that internal day-to-day management of the network is becoming increasingly cost effective. In this situation the network configuration and management has to be simple. Especially for schools that may not have the computing expertise to devote to establishing and constantly monitoring a network onsite. It should be easy for the LAN administrator to configure parameters, run diagnostics, and monitor performance from anywhere on the network using a web browser. External support will also likely be required, and it is worth considering using remote network administration tools to reduce the number of on-site visits necessary to keep the network running smoothly.

Security and privacy

The institutions are responsible for safe-guarding its data and network resources, as well as protecting their users' privacy. They must build security features into their network plan to protect their organizations most important asset - their information. Common network security precautions include passwords, virus protection, an external firewall and data encryption. There are also matters about the physical security of the cabins, data back up, uninterruptible power supply. Effective security measures are particularly important in academic settings where computer-literate young people may be tempted to test their skills against network defenses. Although it has been developed an array of security technologies designed to prevent unauthorized access to the wireless network and make transmissions indecipherable to eavesdroppers.

Conclusion

The decision to install a wireless network in a campus environment is a major strategic initiative for an organization. There are a multitude of technological and practical choices that must be made, and these choices are left up to the institutions' council and IT team. Since they decide to build a network they must be ready to accept great changes in the classical teaching methods, but only if the changes are aligned to the institution's strategy. The matters of planning, network management and support and security and privacy are of huge importance. Of something goes wrong the investment of the institutions will not have the estimated return in students' education and their money saving. Since they decide to install the network they must study all the characteristics of their case, they must study other similar cases and they must choose from a variety of solutions the one that best fits in their occasion.

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