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ABSTRACT

An analysis and evaluation by the State of North Carolina on its effective use of technology revealed that the state was highly fragmented in the use of and access to technology; the result of this evaluation was the vision of a state-wide network that would link 3,400 sites on a state-of-the-art telecommunications system. Southern Bell created a set of guidelines designed to assure broadcast quality audio and video production and to maintain high standards of construction for North Carolina Information Highway (NCIH) sites. On July 1, 1993, Guilford County Schools (GCS) merged three school systems; it was proposed that by rebuilding the budget inherited from three systems and capitalizing on savings made possible through the merger, GCS could allocate 1.7 million dollars to construct 17 of the 104 technology sites scheduled for the first year. Once constructed, GCS could address the following issues: equity, increased achievement, efficient use of financial resources, enhanced learning opportunities, expanded communication and evaluation. The classroom design for GCS makes the operation of the distance learning lab simple enough to encourage novice users. The use of new technologies in GCS's advanced information infrastructure fuels the creative development of new educational approaches and demonstrates the potential of electronic communication. (AEF)

Information Highway: Implementation Through Partnerships

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Background

The State of North Carolina, in an effort to analyze and evaluate its effective use of technology, formed two major commissions, the General Performance Audit Commission (GPAC) and NC 2000. Through the work of these groups, a major weakness was determined. Both groups reported in their findings that the state was highly fragmented in the use of and access to technology. The result of these recommendations was the vision of a state-wide network that would link 3,400 sites on a state-of-the-art telecommunications system.

A key component of the vision was that the network would be a publicly owned switched broad band system. In 1991 the three major and twenty-four independent telephone companies in North Carolina began meeting to form a partnership that crossed all traditional boundaries and made possible a true state-wide network. By 1992 Governor Jim Hunt was able to sign a

letter-of-intent establishing the State as the "anchor tenant" with a commitment to establish the first 400 sites by 2005.

Over a two-year period in excess of 300 citizens participated in committees that developed the technical standards, determined various user applications, training modules, scheduling procedures, etc. By January 1994, three companies had been selected as the approved room integrators on a convenience contract basis to facilitate easy and consistent acquisition and installation of the video and audio equipment. During this time the telephone companies completed their system designs and began the process of installing Asynchronous Transfer Mode (ATM) stitches and laying fiber. These companies invested over 160 million dollars in new construction.

Simultaneously, throughout the state five pilot projects were exploring different delivery technologies that included compressed video on T-1 lines, Integrated Services Digital Network (ISDN) technology, microwave and full band fiber optic construction. The findings of these projects were instrumental in the final design of the North Carolina Information Highway (NCIH).

Southern Bell created a set of guidelines designed to assure broadcast quality audio and video production and to maintain high standards of construction for NCIH sites. These guidelines became The Premise Users

Infrastructure Guide and were adopted as the official standard. Each site has a student camera, a teacher camera, and a document camera. Monitors are located at both ends of the rooms, one for the teacher, and one for the students. The room is operated by a small touch screen panel at the teacher's desk that controls all the equipment in a large rack at the back of the room.

Each distance learning lab was renovated with carpet, acoustical treatment, paint, and new HVAC and ceilings where needed. The average cost of renovation was $11,000 per room. Guilford County Schools successfully undertook the amazing task of completing room renovation and equipment installation for 15 sites in just seven weeks. The ability to meet this deadline was possible only because of the tremendous commitment of the telephone companies, room integrator vendors, and construction vendors. Everyone recognized the significance of initiating the highway with the opening of the school year and made the personal and professional sacrifices that were necessary to meet the challenge.

Structure of Network

"The definition of 'Distance Learning' ranges from correspondence courses taken through the mail, all the way up to live, interactive classrooms

with full motion video, full spectrum audio, and integrated connectivity. In between are an array of one–way and interactive voice and video techniques that vary in terms of their quality and objectives.

"For the interactive classroom to be successful, excellent picture quality and high fidelity audio must be present. The architecture for this phenomenon must encompass a digital fiber optic network built on standard transport and switching technology common in the industry. Using these defined standards, a video signal is converted into a digital bit stream, with data being transmitted over the network. The signal is then reconstructed back into the original analog signal, or at least close to the original. This process is done in a device called a CODEC, an acronym for coder/decoder. However, the lower the bit rate of transformation, the more difficult is the task of faithfully transmitting and reproducing the original signal. The technique for squeezing the video signal into small bandwidths for transmission is called compression. The more the compression, the more computer processing is required to accurately predict reconstruction of the original video image. Why digital fiber instead of analog? One of the advantages of digital fiber is the high picture quality. Even over long distances, digital fiber networks produce clear, crisp video images. Another advantage of digital fiber is that the piece of equipment that transmits the signal over the

fiber also acts as a multiplexor. This means that the digital video signal can be combined with other digital signals – video, data, fax, or voice – and transmitted over the same fiber. Analog fiber does not offer this capability. With analog fiber, you can only transmit analog signals. The NCIH uses SONET (Synchronous Optical Network) standards to get the greatest efficiency from the fiber. NCIH also depends on ATM switches that process all of the multiplexed information in the form of ATM 'cells'.

"Once the video and voice signals leave the control cabinet, the CODEC converts them to digital signals. The service multiplexor combines the signals, assembles them into ATM cells and converts them to optical signals. The ATM cells are then transmitted over fiber to where the broadband switch is located. Then the equipment at the switch location routes the signals back through the network to the appropriate site.

"At the destination site, service multiplexors pass the signals to the CODECs. After the conversion from digital signals to analog video and voice, they transmit the analog signals over coax cable to the control cabinet and the appropriate monitors and speakers. Sound time consuming? It is not. All of this happens in less time than it takes you to blink your eyes!" (used with permission of the NCIH staff)

Guilford County Schools (GCS)

On July 1, 1993, Guilford County Schools merged three school systems, two city and a county school system, to form the third largest school system in the state. Located in Central North Carolina, Guilford county encompasses 650 square miles and includes urban, suburban and rural populations. There are 93 schools supporting over 57,000 students. High school sizes range from 660 to nearly 1,500 students and prior to merger had highly disparate course offerings and curricular designs. As would be expected, there were other inequities based on funding issues, staffing, and local culture.

Superintendent Jerry D. Weast, Ed.D., determined in the fall of 1993 that the then proposed NCIH provided an opportunity to resolve many pressing issues to the new school system. Weast approached the State with a bold plan. By rebuilding the budget inherited from three systems and capitalizing on savings made possible through merger GCS could allocate 1.7 million dollars to construct 17 of the first 104 sites scheduled for year one. This included each of fourteen high schools, an education center, and through a cooperative agreement, two sites at the local community college. Guilford County would become the only large school system in NC to connect all of its high schools to the information highway. The proposal

received approval and was supported by unanimous votes from the school board and the county commissioners.

Once constructed GCS could address the following issues: equity, increased achievement, efficient use of financial resources and enhanced learning opportunities as well as teacher preparation.

Educational Equity: The distance learning labs allow GCS to provide course equity both locally and statewide. Students are given access to courses that they would have otherwise never been able to take either because of low enrollment at their school, or the lack of a qualified instructor. Curricular offerings are equalized, a more uniform quality of instruction is provided, and the school system's monetary resources are more evenly distributed. For example:

- Advanced placement and foreign language courses are being taught at schools where as few as two students require a particular course to meet their individual educational goals.
- The expertise of a teacher who has studied African American History in Africa is shared with several schools at once.
- Interested students receive instruction in a totally unique integrated curriculum, Science of the Mind, from the nationally acclaimed North Carolina School of Science and Math.

Increasing Student Achievement: GCS is impacting student achievement by offering additional challenging courses, utilizing expert consultations, and providing access to remote information resources available throughout the state. For example:

- 122 high school students and 18 math teachers have voluntarily enrolled in a night class taught by a noted university professor. The course is designed to stress practical applications of graphing calculators, a typically weak area of achievement on the AP Exam.
- Biology students participated in a three day electronic field trip to Kenya to study African wildlife.
- Over 1,200 fourth grade students learned how to improve their scores on the North Carolina Writing Test by receiving instruction and practice in interactive lessons via the information highway.

Cost Efficiencies: Through eliminating unnecessary travel, reducing busing and maximizing the utilization of staff, GCS will realize cost savings. For example:

- A teacher meeting the needs of five schools at one period represents the equivalent savings of an entire teacher's salary for one full time position.
- Recently a 30-minute meeting between just three people on the

network for a curricular planning session saved 72 miles travel reimbursement and over three man–hours of professional salaries and lost productivity time.

- Students taking French IV on the highway do not require the 28 miles of daily busing, creating savings in salary, fuel and maintenance costs.

An additional benefit is that students and teachers will experience increased safety because of reduced travel risks. And, it is impossible to place a dollar amount to that reward.

Educational Opportunities: Regardless of location, students in Guilford County have been given access to course work otherwise unavailable to them; have broken the boundaries of time and space through electronic field trips; and have worked directly with experts such as the Curator of a Smithsonian Institution's Museum, who would normally be inaccessible to them. These opportunities have significantly enhanced the quality of education for the students.

Staff development is enhanced as teachers cooperate and share with peers. They are learning by example as they participate in class sessions led by highly successful instructors. By being able to receive these experiences without leaving their school, teachers can better utilize their valuable time and are more inclined to take advantage of staff development

opportunities outside their normal environment. GCS has been selected to be the national testbed site for an exciting staff development program designed to promote quality in education because the producers seek to verify the effectiveness of training teachers through electronic interaction.

Expanded Communication: The virtual classroom provides unique opportunities for interaction in ways never experienced before and creates an environment that fosters the development of associations with other educational institutions and communities. GCS is forging new relationships with institutions throughout the state and nation. For example, GCS and the Indianapolis Public Schools are developing a "sister–system" association based on mutual interest in distance learning. GCS is working with the University of North Carolina – Chapel Hill and the local county government to make training readily available to area health professionals and government employees using the distance learning labs.

Evaluation: Increased student achievement through the use of the information highway is expected, though not yet measurable due to the newness of the network. At the end of the year, comparisons of standardized tests, Advanced Placement Exams, and other quantifiable measurements will be made. However, anecdotal evidence after six months of operation from teachers, students and parents clearly supports the knowledge that students

are highly motivated to learn in this environment.

Summary of NCIH Survey – February 1995: "Measurement of site coordinators, facilitators, teachers, and students attitudes toward the information highway was obtained in February 1995. The sample size included 7 site coordinators, 12 facilitators, 20 teachers, and 265 students at the high school level. There were seven open–ended items on the survey to determine each participant's reactions toward the distance learning experience. A content analysis of the responses to each question was summarized by the category of participants previously mentioned. For the purposes of this presentation, the results of the survey pertain to three questions: What was most successful about your experience with distance learning; What was least successful about your experience with distance learning; and What helps teachers and students create a successful learning environment.

"Nineteen of the 20 teachers indicated what was most successful about the distance learning experience was interaction between students from different schools, ease in sharing ideas with peers, and the fact that an instructor could teach several classes in different locations at the same time. Ten of the 12 facilitators and the 7 site coordinators had similar responses, but they included the idea of distance learning providing the ability to reach

more students with certain subjects where demand does not warrant a teacher at individual sites. Approximately 70 percent (185) of the 265 students responding thought communicating over long distances with other teachers and students within the school system, the state, and the country was the most successful part of the experience. Another 61 percent (163) of the students indicated that being able to see on the monitor what the teacher was trying to teach was the most successful part of the distance learning experience. All four groups pointed out that communication with others was the most successful part of the experience thus far.

"When asked what they found least successful about the distance learning experience, all four groups listed technical problems with the system and difficulty in scheduling: 17 teachers, 10 facilitators, 7 site coordinators, and 190 (72 percent) students. Also 64 percent (170) of the students indicated the least successful part about the experience was lack of one–on–one contact with teacher and no enough time to get into serious discussions.

"Responses to what helps create a successful learning environment varied somewhat among groups, but all groups were consistent in mentioning setting the tone of the classroom environment. All 20 of the teachers indicated that teachers and studetns need to be at ease and

comfortable with the new technology in their classroom environment. Eleven of the 12 facilitators thought teachers motivation coupled with student interest creates a successful learning environment. Five of the seven site coordinators felt discipline, good teaching and advanced planning helped teachers and students create a sucessful learning environment. The majority of the students (65 percent), felt that cooperation, communication, use of modern technology to benefit learning, and lessons that involve creativity and new ideas created a successful environment for them to learn."*

Partnerships: Every effort is made to educate students, faculty, parents, citizens, and business leaders about the real and potential benefits of electronic communication. Utilizing media coverage, special events, PTA meetings, open house demonstrations, and professional conference presentations, GCS is constantly reaching to every segment of Guilford County and beyond. For example:

- Local organizations for economic development and community business leaders have been able to use nearby schools to discuss

*This survey was undertaken and completed by Dr. Sharon Johnson, Grants and Special Projects, Guilford County Schools. Her assistance is greatly appreciated.

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with the North Carolina Secretary of Commerce (located 90 miles and 1 1/2 hours away), via interactive video, current economic trends and how the highway will impact business communication.

- The GCS distance learning labs have been demonstrated at PTA meetings giving parents an opportunity to meet parents from other sections of the community, to meet their children's distance learning teacher, and to experience the marvel of telecommunications first-hand.
- Chicago Public Schools and neighboring school systems have turned to GCS for assistance in designing and implementing networks of their own.

The classroom design for GCS utilizes advanced touch-screen control panels making the operation of the distance learning lab as simple as the single touch of a finger. This simplicity has encouraged even the most novice user, with five minutes of instruction, to become proficient in operating the room. Students actively participate in this role adding an additional level of interest to their classes.

Though in operation for just six months, GCS is already striving to expand its capabilities on the highway by exploring data connectivity. GCS is implementing a pilot project to add Internet access to a high school,

middle school, elementary school, education center and administrative office. When complete GCS will be the first school system on the NCIH to utilize data connectivity (at fiber speeds) and will lead to system wide connectivity of all schools to the information highway through a combination of technologies, new and old.

The learning labs are also future oriented as they are equipped to convert to other video technology standards as soon as they are adopted. Additionally, plans are being developed to link the distance learning labs as computer networks to facilitate instantaneous data transfer such as text files or tests to further enhance the maximum use of the technology available.

Guilford County Schools clearly stands out in North Carolina for vision, commitment, and leadership in technology. The use of leading edge technologies in GCS's advanced information infrastructure fuels the creative development of new educational approaches and demonstrates the potential of electronic communication. Thus, GCS is poised to attain the goal of being the model for the 21st Century School system.