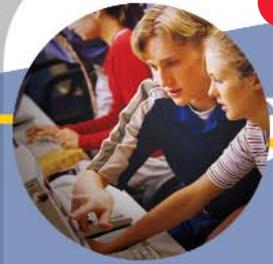


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## Developing Regional Education Networks

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1 2 3



a b c  
1 2



## Educational Technology Access —

### Where North Carolina Needs to Be:

*“Global competitors are investing in information communication technologies (ICT) for education, both to prepare their children for the global, knowledge-based workplace and to increase the effectiveness of teaching and learning.”*

*“Link investments in education, economic development and ICT... Creating a catalyst that can unleash the creativity of educators, students, and communities working to implement these new visions.”*

— Transforming Learning for the 21st Century:  
An Economic Imperative, C. Dede, Harvard, Sept. 2005

*“Broadband access does enhance economic growth and performance, and...the assumed (and oft-touted) economic impacts of broadband are real and measurable.”*

*“...broadband access does matter to the economy, just as common sense would say it should...”*

— “Measuring Broadband’s Economic Impact” Dec. 2005,  
by Lehr, Osorio, Gillett, and Sirbu of MIT and CMU

*“If North Carolina is going to develop globally-competitive workers in a time when technology gives us access to ‘anytime, anyplace knowledge,’ then we need to do three things: provide broadband connectivity to every citizen, make it affordable and teach our students 21st Century Skills.”*

— Lt. Governor Bev Perdue, Chairman, BETA

*“The promise of North Carolina’s future lies in people’s ability to use, manage, and understand technology... North Carolina pledges that graduates from its K-12 schools, community colleges, and universities will possess attributes... use information and technology tools to enhance learning, increase productivity, and promote creativity.”*

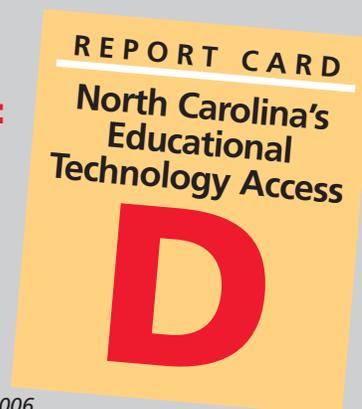
— Business Education Technology Alliance 2006 Report  
to the State Board of Education and Joint Education Oversight Committee

*“...if reform were to take place, students would be the first to adapt... it is natural to them...”*

— a North Carolina eighth grader’s response  
to use of technology in the classroom

## Educational Technology Access —

### Where North Carolina Is Today:



Source:  
Education Week  
May 2006  
*Technology Counts 2006*  
[www.edweek.org/ew/tc/2006multilp\\_state\\_data.html](http://www.edweek.org/ew/tc/2006multilp_state_data.html)

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# Executive Summary

## Feasibility Study for Developing Regional Education Networks

(in fulfillment of Session Law 2005-276, Senate Bill 622, Section 7.42)

*For current and emerging applications ... schools need significantly more than T1 access; only 7.8 percent of North Carolina K-12 public schools have such capacity.*

**Legislative Directive:** The 2005 General Assembly directed e-NC to work with stakeholders<sup>1</sup> to (i) evaluate the statewide status and adequacy of existing broadband connectivity and Internet-enabled access to educational technology and service applications and (ii) recommend ways to maximize the use of existing public and private network resources to support growth in broadband service access to K-20 schools across the State, including under-served regions.

**High-Speed Broadband - strengthening education's role in economic development:** Broadband refers to the ability of the user to view content across the Internet that includes large files, such as video, audio and 3D. High-speed connectivity confers an increased ability to take advantage of enhanced resources that are practical only via broadband formats. 21st Century learning environments absolutely require a broadband network to deliver the tools and information needed to prepare students for full participation in the increasingly competitive global economy.

### FINDINGS

- **Connectivity for education is an Economic Development Issue**, leveling the playing field for all learners and enabling life-long learning anytime, anywhere.
- **21st Century Schooling requires a balance of elements:** leadership, instructional and technical plans, staff development, facilities, and equipment. Broadband requirements follow instructional program development and administrative needs.
- BETA reports and recommendations are on target — Infrastructure for higher education is largely adequate: access for universities is sufficient and community colleges are approaching adequacy; **K-12 schools do not consistently meet administrative/instructional requirements.**
- Best practice education networks are • state funded • separate technology and content management • start with Higher Education with extension to K-12 • **leverage E-Rate through state support** (ranging from training to filing for E-Rate).
- Existing capacity varies, evidencing the **need for local customization and control of implementation plans.** Challenges arise from differences in the extent to which schools have developed their technology vision, and from small technology and staff budgets, E-Rate limitations and restrictions, and leadership resources.

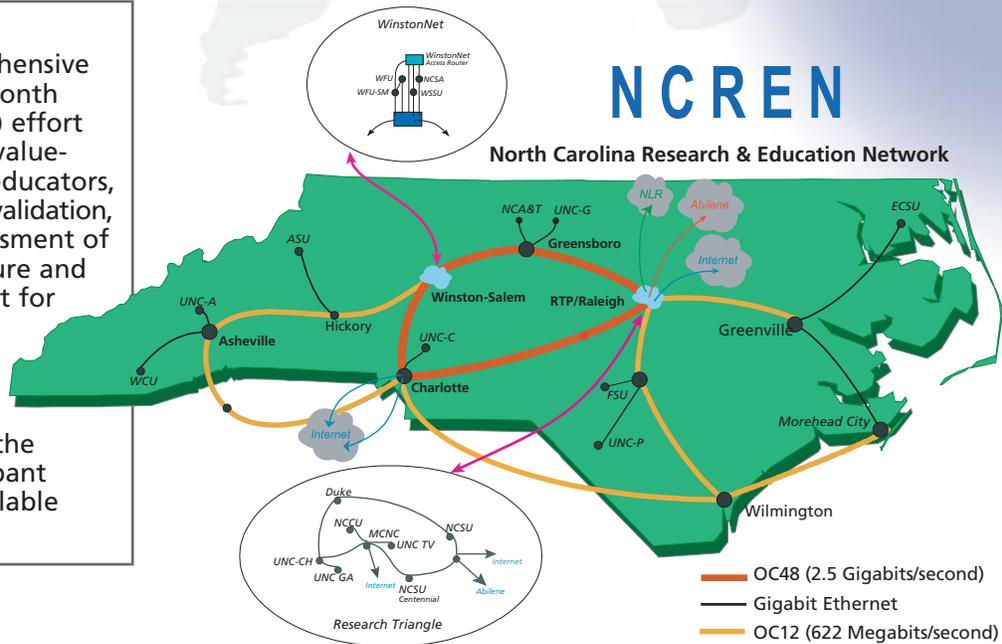
### TOP LEVEL RECOMMENDATIONS

1. **Extend the statewide backbone to all schools**, building on the existing NCREN backbone (with cooperative extension through existing and/or new North Carolina regional networks).
2. **Leverage statewide resources** to finish the job — NCREN/MCNC, state government, UNC, NCCCS, NCICU, K-12, e-NC, business, providers.
3. **Implement a coordinated, inclusive program** that builds support to enable schools while maintaining local independence through the e-NC grass-roots empowerment model.
4. **Leverage best practices to optimize E-Rate**, building local capability to optimize E-Rate application results.
5. **Provide funding** for infrastructure backbone, connectivity, and related support services.

<sup>1</sup> Input from the following organizations framed this report's findings and recommendations: K-12 administrators and educators, MCNC/NC Research Education Network (NCREN), NC Community College System, NC Department of Public Instruction, NC Information Technology Services (ITS) and the University of North Carolina System.

### Process:

A rigorous, comprehensive and interactive 5-month (started in Jan. '06.) effort comprised of high-value-added input from educators, data collection and validation, and thorough assessment of existing infrastructure and design development for critical upgrades is the foundation for this report and its recommendations. Documentation of the process and participant stakeholders is available upon request.



## RESULTS AND ANTICIPATED BENEFITS

Full implementation of the Feasibility Study recommendations will create a common statewide educational network backbone that will deliver and sustain

- Statewide licensing of content and software resources
- Internet2 access for all schools delivering broadband connectivity to every student
- Consistent standards for service providers and client schools
- Common infrastructure and services management
- Demand aggregation and improved quality of service
- Last mile competition
- Increased local control - keeping local network traffic local
- Connectivity that is customized and scalable to the capabilities and needs of local schools

## IMPLEMENTATION PLAN

- Establish a virtual alliance of state government, the NC Research & Education Network (NCREN), and all elements of the K-20 education community under a private non-profit 501 (c) 3 umbrella that collaborates with businesses, industry, and service providers to deliver critical and relevant connectivity to all schools. Transition to the 501 (c) 3 will be managed by e-NC.
- Expand the NCREN.
- Selectively expand through Cooperative Regionalism (e.g., WinstonNet and WNC EdNET) by catalyzing economic development including education reform.
- Install a transitional program through e-NC to prepare for project deployment. This will include detailing backbone expansion; addressing the legal requirements to establish a 501(c)3 entity; and prioritizing Local Education Agency (LEA) implementation.

# I Project Summary

## LEGISLATIVE DIRECTIVE

The 2005 General Assembly directed e-NC to undertake a feasibility study on developing an education network, serving all regions of the state that “provide and sustain broadband service access to individual students and teachers in schools, community colleges, and universities.” (Session Law 2005-276, Senate Bill 622, Section 7.42.) The legislation specifically requested: “(i) an evaluation of existing technology and service applications such as the statewide infrastructure, those operated by the private sector, the North Carolina Research and Education Network, and networks such as Winston-Net and (ii) an evaluation of newer technology such as wireless broadband access. It shall recommend ways to maximize the use of these existing resources to support growth in broadband service access to the State, including underserved regions.”

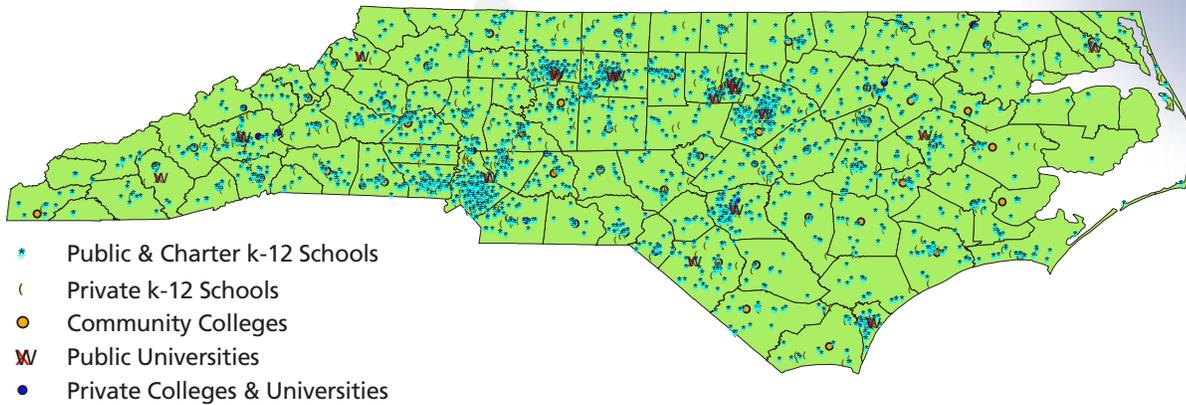
## PROCESS

Meetings were held with representatives from all levels of the education community to ascertain their vision, their descriptions of need, and to gather their input on a recommended systemic solution. The study team undertook data collection and validation; a review of current infrastructure; and design development for infrastructure upgrading. Continual briefings and collaboration with stakeholders were held at locations across the state. Contributing to the education network study were representatives from the University of North Carolina (UNC) system, the North Carolina Community College System (NCCCS), the K-12 sector, the North Carolina Department of Public Instruction (DPI), MCNC, State ITS, network service providers, telecommunications companies, and network equipment companies.

The need for infrastructure improvement in K-12 emerged as a special problem. Multiple site visits to Local Education Agencies (LEAs) were made across the state and presentations were made at five group meetings attended by LEA Technology Directors. Using this information and working in conjunction with network designers from MCNC/NCREN; State Government, including ITS and DPI; LEAs; regional networks; and the private sector, a network infrastructure has been conceptualized, with projected costs, to address the requirements of the legislation.

## ENVIRONMENT

The Business and Education Technology Alliance (BETA) reported in its *Revised Recommendations for Preparing North Carolina for Competitive Advantage in the Knowledge Age*: “In the 21st century, an age requiring information and technology literacy, it shall be the mission of North Carolina to provide to all of its citizens the tools, resources, processes and systems to access information to solve problems, communicate clearly, make informed decisions, and construct new knowledge, products and systems.” These comments echoed those of Governor Easley, as reflected in his 21st Century initiatives. In the audience most directly impacted, the role of technology holds a paramount role. Sandra Farmer, Principal of Williford Elementary School in Nash County, stated: “Technology has offered hope for some of my children where there is no hope.” (Williford’s student population includes 33% homeless



Based on information provided by the NC Dept of Public Instruction, the University of North Carolina, the Association of Independent Colleges & Universities, and the NC Community College System.

This map shows all NC schools.

children, as recognized by the U.S. Department of Education.) Students reinforce this view. As one Wake County eighth grader noted: "If reform [with enhanced technology in schools] were to take place, students would be among the first to adapt."

A critical tool for the 21st Century learning environment is a broadband network to serve the K-20 community. The need for broadband service is a North Carolina economic development issue because of the need for lifelong learning to compete in the 21st century. Beginning at the pre-K level, 21st century schooling requires a balance of leadership, instructional and technical personnel, staff development, facilities and equipment. Connectivity requirements follow instructional program development and administrative needs. These connectivity requirements can be met with a coordinated, not centralized, program, which can level the playing field for all learners. The education network effort will provide a broadband network that enables a new class of tools.

## FINDINGS

1. The BETA report and recommendations accurately portray the current education and economic environment and along with the vision of the Governor, the Lt. Governor, educators, teachers and students-evidence a compelling need for broadband to all students.
2. Infrastructure needs for the K-20 community vary; the University system's immediate needs are met and the Community College system is approaching a satisfactory level of connectivity; K-12 still does not have a satisfactory infrastructure to meet the instructional and administrative requirements of all school systems. For current and emerging applications schools need significantly more than T1 access, yet only 7.8 percent of North Carolina schools have such capacity.

3. There is a need to leverage all statewide resources to:

- Extend and expand the existing North Carolina infrastructure model and incorporate the best practices of other states in the process. Best practices include funding provided by the state; separation of the technology responsibility from the content responsibility; expansion of the higher education network model to K-12; and leveraging the E-Rate program through state support with training and filing.
- Ensure that Instructional and administrative plans drive connectivity levels, since each system is unique and no single plan fits all.
- Give school systems an opportunity to expand their technology vision. Comments to the study team indicated that schools have been limited to date by small budgets for technology and technology staff, E-Rate limitations and restrictions, and leadership.
- Leverage the innovation, resourcefulness, and creativity that schools have already exhibited within current constraints, and apply regional concepts where practical.

## RECOMMENDATIONS

To address the directive of the North Carolina General Assembly and to address the mission of the Governor, the Business Education Technology Alliance, school leaders, teachers and students to meet 21st century educational and economic development needs, it is recommended to:

1. Extend broadband to all schools.
2. Leverage statewide resources-NCREN, state government, UNC, Community Colleges, North Carolina Independent Colleges and Universities (NCICU), K-12, and e-NC.
3. Coordinate an inclusive virtual program to enable schools, exercising local independence, and to promote cooperative regionalism, following the e-NC model
4. Leverage best practices to optimize E-Rate.
5. Provide state funding to:
  - Extend the statewide backbone structure.
  - Cover connectivity costs.
  - Provide support services.

The following table summarizes the Total Cost of Ownership projection for implementing these recommendations in terms of non-recurring and recurring elements.

NC Education Network (Projections)	2006-07 Initial Request Expansion Budget		2007-08 Continuation Expansion Budget		2008-09 Continuation Expansion Budget		2009-10 Continuation Expansion Budget	
	NRC	ARC	NRC	ARC	NRC	ARC	NRC	ARC
Expansion Request	\$5,300,000	\$18,701,878	\$0	\$5,345,727	\$0	\$4,245,727	\$4,900,000	\$0
Total Dollars Allocated (NRC + ARC)	\$24,001,878		\$24,047,605		\$28,293,332		\$33,193,332	
NC Education Network (Projections)	2010-11 Continuation Expansion Budget		2011-12 Continuation Expansion Budget		2012-13 Continuation Expansion Budget		2013-14 and ongoing Continuation Expansion Budget	
	NRC	ARC	NRC	ARC	NRC	ARC	NRC	ARC
Expansion Request	\$0	\$0	\$0	\$0	\$3,000,000	\$1,000,000	\$0	\$0
Total Dollars Allocated (NRC + ARC)	\$28,293,332		\$28,293,332		\$32,293,332		\$29,293,332	

## IMPLEMENTATION

Implementing the recommendations will require four essential steps.

1. Provide a common educational network backbone that will:
  - Leverage each provider's unique attributes and provide for local choices
  - Provide broadband connectivity, enabling specific and appropriate connectivity levels consistent with needs of individual schools.
  - Establish standards to ensure that every K-12 institution has the appropriate quality of access to support all educational and administrative requirements.
  - Aggregate demand
  - Increase last mile competition
  - Ensure quality-of-service to the level of higher education
  - Be scalable in order to increase connectivity as needs require
  - Integrate technology across the entire K-20 spectrum for benefits and services, including instructional collaboration and administrative efficiency.
2. Establish the North Carolina Education Network that will:
  - Be a virtual alliance of State Government, NCREN, and all of the K-20. Education Community
  - Be under a private non-profit 501 (c) 3 umbrella
  - Maintain relationships and collaborate with businesses, industry, partners, providers
  - Selectively encourage and catalyze cooperative regionalism concepts such as WinstonNet and WNC EdNET, ultimately creating a route to local/regional development and a route to lifelong learning.
  - Be an ongoing service/support organization dedicated to enabling schools with network design assistance and other collaborative and regional services, all of which would be available to LEAs on an opt-in basis.
  - Be an ongoing service/support organization to schools districts on E-Rate optimization.
3. Plan a three-year network implementation timeline. The funding recommendation plan reflects a practical time line implementation over three years. LEA-specific circumstances are unique and, realistically, all could not evolve more quickly when considering existing contracts with providers, network reviews, and longer-term upgrades. The backbone upgrade can begin immediately, with other actions to follow.
4. Install a transitional program through e-NC to prepare for project deployment. This will include developing a complete project plan, detailing the backbone expansion; addressing the legal requirements to establish a 501(c)3 entity; and prioritizing Local Education Agency (LEA) implementation and support services. Handoff to the virtual Education Network Organization will occur as expeditiously as possible.

When the report's broadband connectivity recommendations are implemented, it is anticipated that the North Carolina learning environment will fully and equitably support a 21st century teaching and learning environment for all of North Carolina's students and be another step towards enabling lifelong learners. The hope for Williford Elementary's children and the challenge of the Wake County 8th grader will be realized.

## II. Needs and Responsibilities

### VISION

*" We have worked hard to make this state a global competitor, and I am committed to continuing the critical investments in education, workforce development and infrastructure that are essential in building the best, most educated workforce in America," said Easley. "That is why it is so important that business leaders in North Carolina partner with us as we reform our education system to better provide the skilled workforce businesses need in this global economy."*

Governor Michael Easley  
from speech to the state's  
business leaders

### MISSION

*" If NC is going to develop globally-competitive workers, in a time when technology gives us access to 'anytime, anywhere knowledge,' then we will need to do three things: provide broadband connectivity to every citizen, make it affordable, and teach our students technology literacy skills."*

Lieutenant Governor Perdue  
Chairman, BETA

### RATIONALE

*" A child in the far reaches of our state who does not have access to rigorous coursework is at a significant disadvantage; a virtual school can help rectify this."*

Howard Lee, Chair  
State Board of Education

### BENEFIT

*" Technology has offered hope for some of my children where there is no hope."*

Sandra Farmer, Principal  
Williford Elementary School, Nash County  
[School Population includes 33% homeless children, as recognized by the U.S. Department of Education.]

These statements put into human terms the vision that frames the education network effort. They make clear the need and responsibility to create a 21st Century learning environment for all North Carolina schoolchildren, college students, and lifelong learners. Learners at all levels need an environment that opens the door to the world and prepares them to join it.

## THE ENVIRONMENT: INSTRUCTION DRIVING CONNECTIVITY

Frances Bradburn, Director of Instructional Technology, North Carolina Department of Public Instruction, envisions 21st Century learning environments where children will be engaged and empowered in resource-rich environments that are aligned with developmental needs at all levels. She describes these environments as follows

### 21st Century schools will be exciting, resource-rich places for teaching and learning!

- More small-group activities
- Inquiry-based, constructivist approach
- Lower student-teacher ratios
- Teams of media & technology specialists collaborating with classroom teachers
- Extended learning opportunities 24/7 for students and the community

*“ Twenty-first Century schools are exciting places in which to teach and learn. In general, there are more small group learning activities and less whole-class, teacher-centered instruction. Since the goal of education is to teach children how to learn, not necessarily what to learn, most teachers use an inquiry-based, constructivist approach in which students solve problems. Learning is based on prior knowledge and focused around guided research and systematically cultivated higher order thinking skills. All schools are supported by a team of school library media and technology specialists who collaborate with classroom teachers to provide a resource-rich, technology-rich teaching and learning environment while simultaneously lowering student/teacher ratio.*

*“ Each school has facilities and personnel that are necessary for a 21st Century education. Besides individual classroom spaces-many with movable walls and flexible desk/table/cubicle configurations-each school has a media center, computer lab(s), and a TV studio. These facilities are open beyond the traditional school day. Students and the community have extended learning opportunities early in the morning, late into the evening, and on weekends.”*

- Resources are ubiquitous
- Technology is ubiquitous
- Technology is transparent

*“ A variety of school library media and technology personnel, both instructional and technical, support all these spaces, working collaboratively with teachers, administrators, and community members to provide technology and resources within a 24/7 learning environment for every citizen.*

*“ The resources are ubiquitous!. High-speed Internet access allows students and teachers to use a wide variety of resources like NC WiseOwl, videostreaming, online courses, video conferencing, and project-based collaborative environments. The Web and Internet2 are all options, as teachers help students discern which resources, experts, or platforms are the most appropriate for their particular project or course of study.*

*“ The technology itself is ubiquitous as well. Every student has access to a computing device at school and at home, with a variety of peripherals to supplement its use including assistive/adaptive devices for special needs. Teachers and administrators are provided a variety of tools-handheld devices for easy, walk-around assessment and classroom/building management chores; a tablet computer for field trips, work at home, meetings, and note taking; and a desktop for data analysis, multimedia production, and creating documents and reports.*

*“ Each classroom is outfitted with an interactive digital white board and data projector, a classroom set of individual student response devices, digital and video cameras, a telephone, one or more multimedia work stations that include printers, science probeware for experiments, digital microscopes, and graphing scientific calculators for the upper grades. Technology is transparent, with students and teachers naturally using appropriate technology resources as needs arise, treating them as problem-solving, enabling tools. The technology is used developmentally, with applications and tools chosen based on the educational- and age-appropriateness for the students involved....*

**21st Century schools will align with developmental needs at all levels.**

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For the most challenged students, technology provides:

The focus, extra help, tools, and confidence to overcome diverse challenges to development and learning.

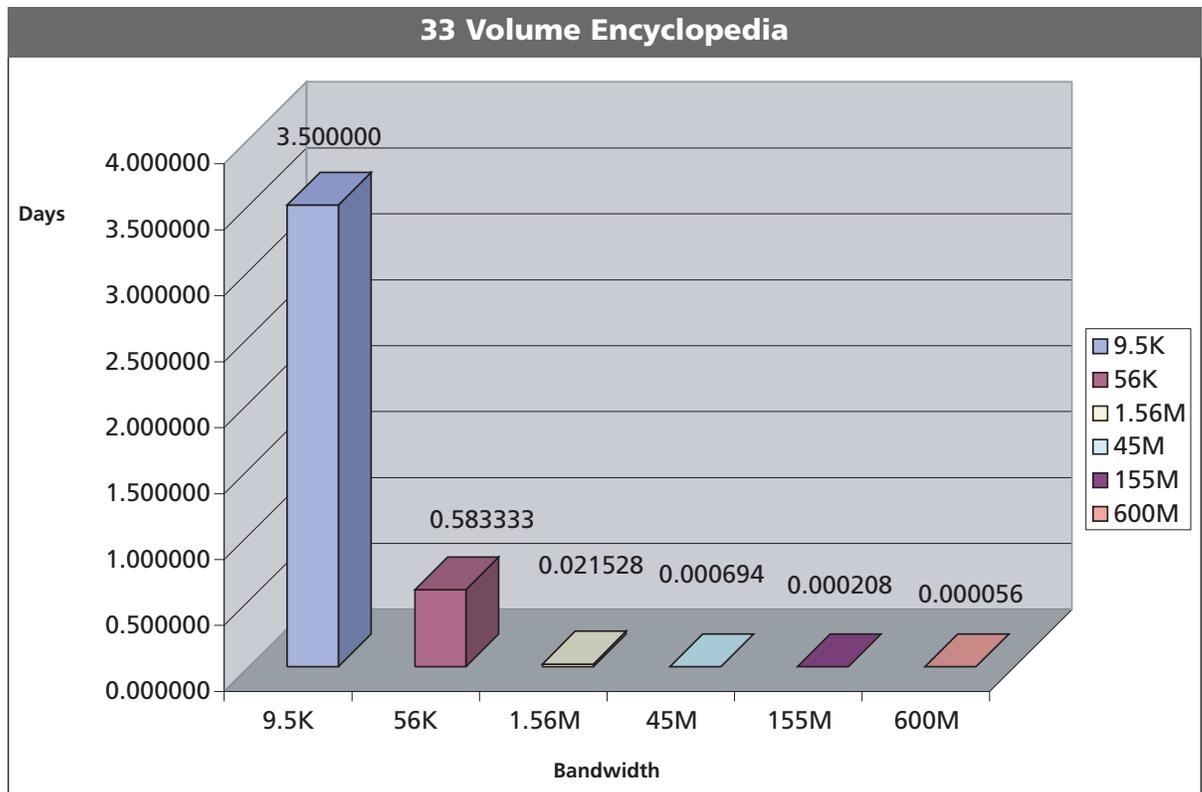
*“ Technology in schools is an amazing accelerator and motivator, yet it is meaningless without the careful guidance and nurturing of classroom teachers and media and technology personnel. These are the individuals who bring the rigor, relevance, and relationships so important to 21st Century learning; technology is only the tool they use to help them work their magic.”*



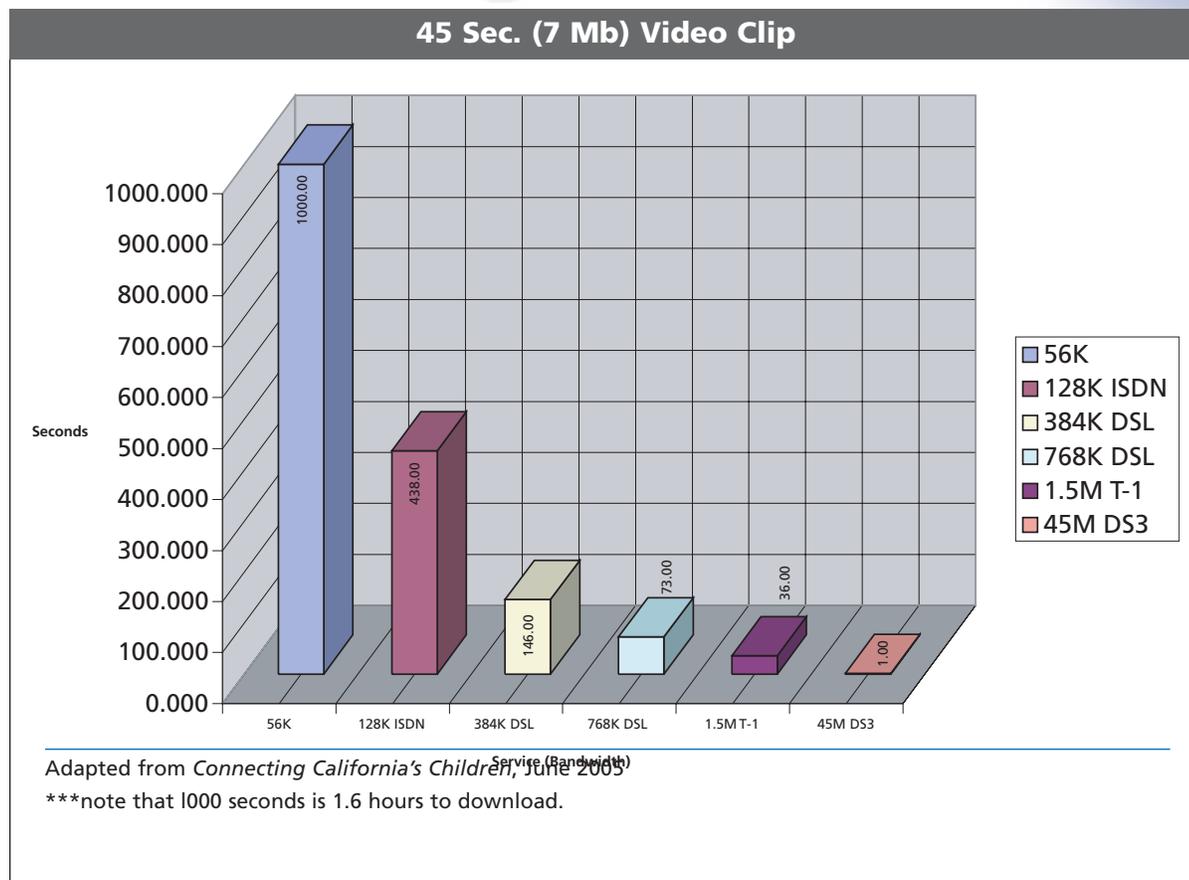
## THE CONNECTIVITY: BROADBAND ACCESS, QUALITY, AND SPEED

What is broadband and what is its role in this vision of 21st century learning and the digital world of students in our schools? A technical definition — and there are many — refers to “the ability of the user to view content across the Internet that includes large files, such as video, audio, and 3D. The term narrowband can refer to the inability to do so. A user’s broadband capability is typically governed by the last mile issue, the connection between the ISP and the user.” (Source: Learnthat.com)

Connectivity is evaluated along three factors: access, quality and speed. Inherent in broadband networks is continuous access: 24/7 refers to the fact that a broadband system is available 24 hours a day, seven days a week. Besides the obvious advantage of being always on, broadband also has the advantage of being a single system that performs the functions previously requiring multiple stand-alone systems. In the best of these systems, Quality of Service (QoS) is a given, i.e., even the most dynamic data, such as a video signal, can be seen without any jerkiness or latency. The chart that follows shows the time required to transmit 33 volumes of the Encyclopedia Britannica at various transmission speeds. As the number of texts and reference resources available in on-line format continues to grow the need for broadband can only escalate.



In a 21st century learning environment, a wide array of instructional video resources is not only available but required. The chart that follows shows the difference that a broadband network can make when downloading a 45-second video clip.



## III. Findings

### OUR CHILDREN'S DIGITAL WORLD

The phrase “digital world” is used so pervasively that one might forget that it describes a relatively recent phenomenon. The everyday digital world only surfaced in the 1980s, meaning that only the youngest of adults have grown up totally in a world where digital signaling has impacted the most common activities, from starting a car to telephoning a friend without a wire. Marc Prensky, an educational consultant and writer, has called the children born during and since the digital emergence digital natives. Digital immigrants are those born before the digital age. (M. Prensky, “Listen to the Digital Natives,” *Educational Leadership*.) As we look at our schools today, we realize that both teachers and school leadership are predominately digital immigrants, struggling to assist the digital natives in a school environment still embedded in the pre-digital world. And the natives know the difference! Mr. Prensky quotes one student: “School didn’t teach me to read — I learned from my games.”

### PRELIMINARY RESULTS FROM RECENT STUDIES

#### **IMPACT schools are making a difference.**

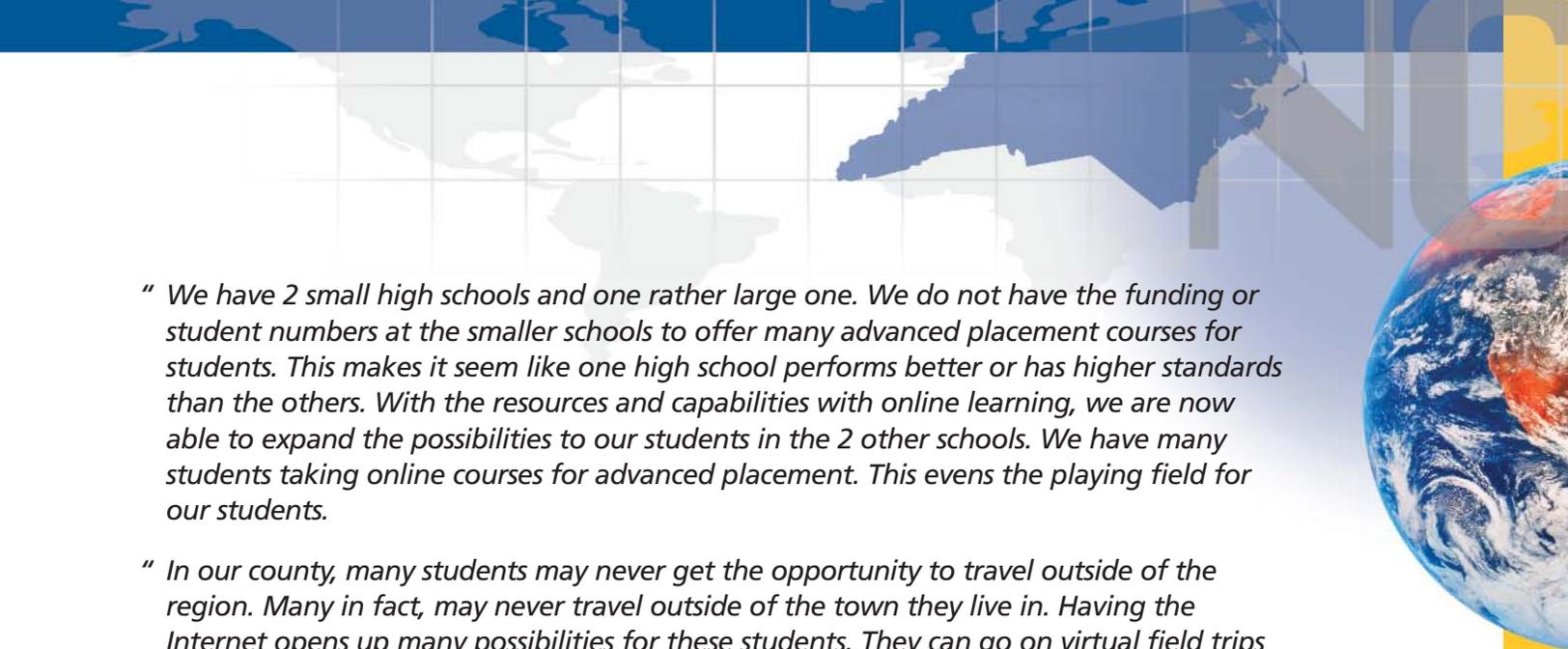
To seek scientific-based evidence regarding the role of technology in student achievement in a school environment, the North Carolina Department of Public Instruction (DPI) has embarked upon a three year study of 11 schools, each implementing DPI’s IMPACT model of technology integration into instruction, with the use of federal Enhancing Education through Technology (EETT) funds. Results, although preliminary, are already very positive.

After a first year studying in schools infused with technology, technology assistance, targeted professional development for teachers, and additional digital instructional resources, the most challenged students showed reading gains exceeding those of students in schools lacking these resources. These were students who were on free/reduced lunch programs, whose parents had less than a high school education, or who had either learning or physical exceptionalities. Similar achievement gains were found in math.

Moreover, in a world struggling to find teachers for the typically lower-achieving populations, “more teachers transferred into IMPACT schools in 2004-05 than in 2003-04, and fewer transferred out.” (Frances Bradburn. *LANCET Study: Looking at North Carolina’s Educational Technology*) According to Dr. Larry Price, superintendent of Wilson County Schools, home of the IMPACT Model School Wells Elementary, “This is the model we should be using across the state-for all our schools.”

#### **Other schools are struggling.**

While the “Impact” schools have benefited from an infusion of \$450,000 per-year per- school , over the course of 3 years, other school systems struggle, as evidenced by this response from one school system regarding the status of connectivity in its district and its impact on student learning:

- 
- “ We have 2 small high schools and one rather large one. We do not have the funding or student numbers at the smaller schools to offer many advanced placement courses for students. This makes it seem like one high school performs better or has higher standards than the others. With the resources and capabilities with online learning, we are now able to expand the possibilities to our students in the 2 other schools. We have many students taking online courses for advanced placement. This evens the playing field for our students.*
- “ In our county, many students may never get the opportunity to travel outside of the region. Many in fact, may never travel outside of the town they live in. Having the Internet opens up many possibilities for these students. They can go on virtual field trips to places that they might not ever get to explore.*
- “ Funding is always tight in a small school system. Many schools are tight on funding for books, graphing calculators, and science hands-on materials. We have been able to find teacher resources on the Internet that enable them to have the resources that we can not afford. For example, kids can dissect a frog or pig without having to purchase expensive lab equipment. They can complete physics activities on the Internet utilizing videoconferencing capabilities. They can have their own personal graphing calculator by simply clicking on a website.*
- “ In my district, we did not have adequate bandwidth last year. An entire class could not go on the Internet at the same time. We had to pair up students, which created a disastrous learning environment. We could not offer online testing all at once, we had to arrange each school at a specific time. We could not offer some distance learning courses that required videoconferencing. We also had the opportunity to receive free videoconferencing equipment through Western Carolina University and we had to turn it down because our network structure did not have the capacity to handle its load. Many of our teachers have wanted to stream video content and audio content for curriculum integrations, but we have had to turn these things off due to the lack of bandwidth. We have also had problems with remotely managing our equipment before we had adequate bandwidth. Our technicians might have to drive almost 30 miles to check on something that could have been done remotely.*
- “ ...it can be very frustrating as a teacher when you want to use technology and it does not work. Without proper bandwidth, we could not do videoconferencing, audio streaming, online courses, online staff development, enrichment courses, online digital assessment programs like study island, remote management of equipment, management of HVAC equipment, online purchasing, online grades, web page management, NC WISE, etc.”*

Amanda Crisp, Technology Coordinator  
Cherokee County Schools

The need to address the discrepancies in resources, including technology access, among North Carolina school systems has been made clear by judicial decisions made in the Leandro case. While the instructional leaders continue reviewing and refining best practices in technology integration in the classroom, it behooves the technology leaders in the state to determine the most cost-effective/efficient way to support the instructional efforts by providing consistent access to digital resources and learning experiences in all North Carolina classrooms, to benefit all North Carolina students. This access can only be provided by a 21st century broadband network that readily and efficiently transforms the local schoolhouse — to a world schoolhouse.

## NATIONAL USE OF BROADBAND IN EDUCATION

In a world that is constantly shrinking, one where information and knowledge is the new gold standard, high-speed networks offer significant possibilities for enhancing and extending teaching and learning. Although the commercial Internet continues to grow and expand — three quarters of Americans go online an average of 12.5 hours per week, and nearly 61% percent of residential users have broadband access, many educators complain the commercial Internet does not offer reliable end-to-end performance critical for education needs. Internet2<sup>®</sup> came into existence not to replace the commercial Internet, but to offer a separate and much more efficient pathway to send information. (Source: John Fleischman, “The Need for Speed,” *Converge Magazine*.) The goal of this study is to reach into the classroom, placing such a capability into the hands of all educators and learners. For instructional purposes, a teacher with a broadband connection can readily open a video clip of an alligator maneuvering in its natural habitat, rather than just showing a static, text only web site or holding up a picture. In this way, Johnny, in the last row, is much more likely to stay engaged in the lesson, rather than text messaging or passing a note to his friend.

The technology and configuration of broadband networks serving K-12 and post-secondary institutions vary from state to state. Indeed, in some states, there are multiple networks serving the post-secondary and K-12 communities, e.i., Kentucky and Georgia. Today, 34 states offer K-12/K-20 networks through sponsorship by university Internet2 members.<sup>2</sup> Funding mechanisms also vary, albeit K-12 systems in all states receive support from the federal E-Rate program, which provides discounts to schools for telecommunication services. In spite of the great range of circumstances, there are lessons that can be learned from the best practices of selected states, including the upgrading and integration of their educational networks onto one high-capacity system. These systems provide ready interoperability between their educational institutions — from universities conducting high-end research to K-12 schools using bandwidth intensive multimedia resources for instruction.

### A Look at Selected States

The following are states that have developed broadband networks with characteristics similar to North Carolina. These state networks vary according to coverage area and bandwidth speed, in the technology used and in the applications delivered. The states also vary in the mechanisms to fund their networks.

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<sup>2</sup> Fleischman, John. “The Need for Speed,” *Converge Magazine*, Volume 1, Issue 1. Accessed at <http://www.convergemag.com/story.php?catid=231&storyid=99165>, 4/25/ 2006



<b>WASHINGTON</b>	In Washington the current K-20 network serves sites with connections ranging from 10 Mbps to 155 Mbps over both copper and fiber. The network is transitioning to fast Ethernet and serves all K-12 district offices, 475 school sites, public universities and colleges, community and technical colleges and 15 private colleges. The University of Washington has been a leader in guiding and supporting Internet2 projects from the K-12 sector.
<b>CALIFORNIA</b>	The K-12HighSpeedNetwork/California Research and Education Network (K-12HSN/CalREN) is nearing completion of its own high-speed, high-bandwidth network that will connect over 900 school districts, encompassing more than 8,000 schools. Currently 86% of its K-12 schools are connected to Internet2. It is a consortium of LEAs managing access to CalREN. It is closely tied to the statewide network (CENIC), but rotates LEA management.
<b>FLORIDA</b>	Florida has also recently transitioned its FIRN backbone to the state's SunCom ATM network with OC 3 and T3 circuits. FIRN remains as an organizational entity, serving all 67 school districts, with 90% of the 3,600 public schools connected (and 70% classrooms); also all 28 community colleges; all 11 state universities; and other affiliated educational entities. The state files E-Rate form 471 (description of telecommunication services ordered) on behalf of those school systems submitting a letter of agency to the state.
<b>MISSOURI</b>	Missouri's MoreNet employs a high-speed Shared Network Backbone that provides more than one Gigabit of shared access to the commercial Internet for all customers as well as Internet2 connectivity for higher education and K-12 constituencies. Its number of users is impressive: 26 public and 38 private higher education institutions; 515 of 524 school districts, 131 of 142 public libraries; and other state agencies and educational outreach organizations. The state files as a statewide consortium for E-Rate discounts on Internet service only. Missouri is also particularly impressive, not only for its \$1:\$15 leveraged cost for online resources that it licenses for MoreNet, but also for the range of resources it has developed within the state for offering over Internet2, including remote video conferencing celebrating the Lewis and Clark expedition and its "Virtually Missouri" database.

<p><b>OHIO</b></p>	<p>Ohio's OARnet is the Ohio-based provider of Internet services to higher education, public schools, and other government agencies. Created in 1987, it has grown to manage services for Ohio's Education and Research Community through the Ohio GigaPoP. In 2004, OARnet funded over 1600 miles of fiber lines to universities, colleges, K-12 schools and communities desiring broadband access.</p>
<p><b>OKLAHOMA</b></p>	<p>Since 1992 Oklahoma has been developing and expanding a fiber optic/wireless network, OneNet, which serves all levels of education and state agencies. Currently it has 1,600 customers, including all of the state's colleges and university, all career-technology centers; approximately 80% of all K-12 schools, who are provided with Internet2 access through the network, albeit at varying speeds; and 95% of public libraries. The network uses a combination of a state-owned backbone with OC-12 and OC-48 circuits and leased circuits for the end sites to 42 hubs.</p>
<p><b>UTAH</b></p>	<p>Utah also has had a long history in developing its Utah Education Network (UEN) to serve all levels of education. Currently the network serves more than 500,000 schoolchildren in more than 820 public schools as well as the state's post-secondary institutions. The Utah network is notable for its resource sharing among the various educational levels, including data sharing and video conferencing. The Electronic High School, supported by UEN, shares more than 160 teachers for the instruction of over 20,000 students dispersed statewide. Utah has consolidated its E-Rate application process.</p>

## Optimizing the E-Rate Process

Implied in the above discussion of broadband achievements in selected states is a possibility that many of the states' accomplishments have been, at least in part, the result of optimizing the E-Rate process. This optimization falls into three categories. Following are descriptions of the categories, along with examples of other states' E-Rate efforts.

**Consolidated applications.** For the supporting network infrastructure to access the digital resources, Maine has consolidated its E-Rate application process through a joint consortium application by the Maine State Library and the Maine Department of Education. In Mississippi, the State ITS files a consortium application for Internet service and is the billed entity. One hundred percent of schools and 98 percent of public libraries receive service.

**Centralized application assistance.** Other states, while not filing consortia requests on behalf of their school systems, do provide substantial centralized assistance in the application process, through web sites and regional training. Washington and Pennsylvania are notable in this regard, including, in the case of Washington, centralized submission of all districts' applications.

In contrast, North Carolina currently lacks centralized application assistance or consolidated applications. Many North Carolina LEAs utilize independent consultants to develop the E-Rate application, with the result that consultant fees siphon-off 4-12% of E-Rate dollars coming to the local school system.

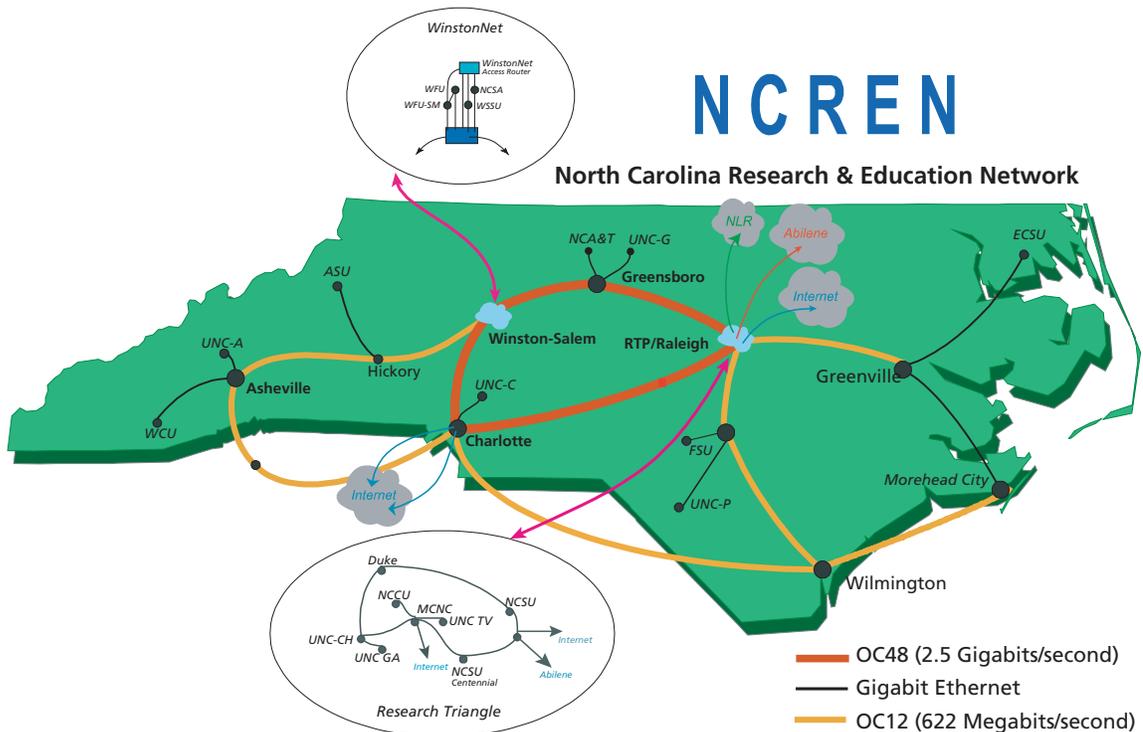
**Supplemental state support.** Perhaps most beneficial to school systems is the supplemental state level "E-Rate" funding provided in Maine and Pennsylvania. Maine has created the Maine Telecommunications Education Access Fund "for Internet access (56 KBps frame relay, T1s, or DSL) and Internet services. The portion of the cost not paid by federal E-Rate has been paid using the MTEAF." (State of Maine. Public Utilities Commission. Docket No. 2001-223. August 30, 2005.) Pennsylvania passed Act 183 in 2004 to create the state's own Education Technology Fund (E-fund). With this act \$10 million dollars annually, for six years, is to be provided, on a competitive grant basis, to assist schools with acquisition of telecommunications services, support, and resources. Federal E-Rate funds can be used to meet the "matching" requirements of the state's competitive grant program.



## BROADBAND IN NORTH CAROLINA

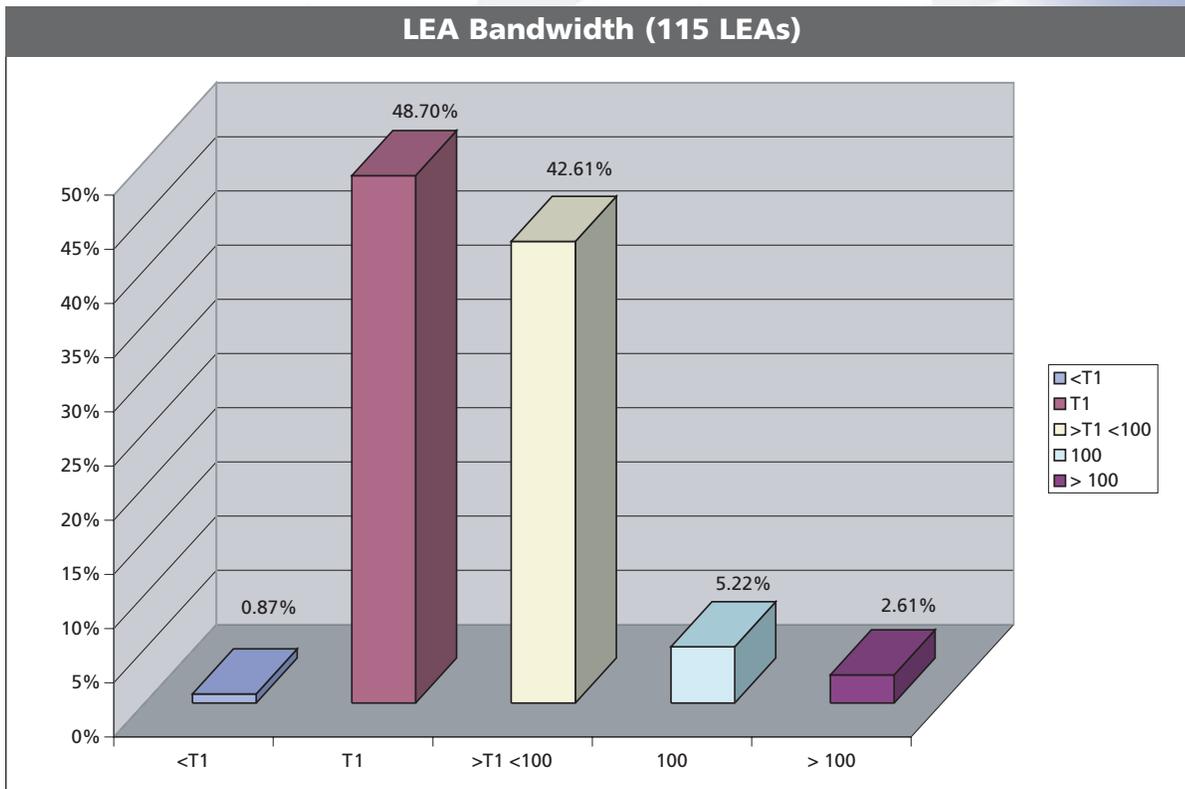
### Infrastructure Status and Needs

With its high-speed connections not only to the commodity Internet but also to Internet2 and the National Lambda Rail (NLR), the university system already has in place an infrastructure sufficient for its immediate needs. The university system has benefited from earlier state vision for a coordinated network and the expertise to implement it. In conjunction with MCNC/NCREN, an interconnection of regional networks has also been established around the state, which further strengthens North Carolina's existing infrastructure. (See Appendix E.)



The existing network, as depicted in the above graphic can be expanded to better serve the entire education community, across all levels K-20. Redesigned and up-graded, a system of networks will be able to serve K-12, the Community College System, and still accommodate future university system needs. (See Appendix D for a more detailed description of the current University and Community College network infrastructure).

Similar trends requiring additional bandwidth prevail in North Carolina's K-12 schools, comparable to those nationally. In 2006, the percentage of North Carolina schools with T1 or higher Internet access had jumped to 99.2 percent from 49 percent in 2001. However, a T1 line is fast becoming the equivalent of the prior 56k modem for modern transport needs. For current and emerging applications, particularly when simultaneous use occurs, schools need significantly more than T1 access, and, as the following chart reflects, only 7.8 percent of North Carolina K-12 public schools have that capacity. In considering the development of the North Carolina Virtual, it will require an underlying delivery and distribution mechanism that guarantees that all citizens across the state will enjoy consistent access to online educational resources.



Further demand on this capacity, per 2005 figures, is the 98.81 percent individual classrooms with Internet access and the 3.533 students per Internet-connected computer, definitely an improvement over 1997's 103 students-per-computer but certainly a strain on any network with limited bandwidth. This strain will only be exacerbated as the use of Internet-based instructional and administrative tools are adopted by additional schools and LEAs.

## K-12 Issues

North Carolina has been moving forward to improve both school and classroom connectivity and bringing the appropriate equipment into the classrooms for students to use. However, as the comment from Cherokee County exemplifies, as well as broad-based LEA feedback, **major issues remain for K-12 in North Carolina:**

1. Connectivity/bandwidth allocation
2. Staffing
3. E-Rate leveraging

### 1. Connectivity/bandwidth allocation

K-12 instructional needs will drive the ever-increasing need for connectivity and bandwidth. As states and their school systems have risen to the connectivity challenge, a greater sophistication of analysis has transpired. Initially it was commonly held that every school should have T1 (1.5 Mbps) access as a minimum. This standard is no longer sufficient for optimal access to use of the various learning and administrative applications of a school. This formula also does not take into consideration

differences in grade levels or size of schools. To address these differences California is developing a matrix of school bandwidth needs based upon number of students in a school and the characteristics of the school (including grade level and existing level of technology use for instruction and administration). This process will enable them to develop what California terms a bit-per-student ratio.

### Bandwidth (Connectivity) Allocation in California

(Future results from California formula based on K-12 instructional needs)

School type	Basic	Emerging	Advanced
Elementary	X bps/student	Y bps/student	Z bps/student
Middle/junior high	XX bps/student	YY bps/student	ZZ bps/student
High school	XXX bps/student	YYY bps/student	ZZZ bps/student

*Connecting California's Children, June 2005*

North Carolina's Business and Education Technology Alliance (BETA) Subcommittee on Hardware and Software Infrastructure similarly noted that bandwidth for Pre-Kindergarten-12th grade should vary, depending upon need and usage, ranging between 100 Megabit-1 Gigabit, depending upon grade level and school size. BETA also noted that all community colleges should provide 1 Gb to 2 Gb for their instructional and administrative needs. Based upon further review, this guideline appears to be solid.

**Using Internet2, a research and education-based network (education only sites) offers a safer environment for students in addition to greater bandwidth.**

Unfortunately, few of the 600 schools with access to Internet2 through the ITS network (MCNC/NCREN) have taken advantage of this resource. Limited bandwidth to individual schools, the last mile, has meant that there is often a network bottleneck and therefore low incentives to participate in e-field trip events (e.g., on the trail of Lewis and Clark) and interschool collaborations that take place on Internet2. Today's guidelines suggest that 100 Mbps is needed to fully benefit from Internet2. Moreover, because of networking issues in North Carolina, there are still approximately 1800 schools with no access at all to Internet2. Recommendations put forth in this study will emphasize standards and scalable bandwidth, with a core plan that will handoff Gigabit Ethernet interface to everyone, making Internet2 more readily available to the entire schools, classrooms and administrators.

The following tables give an analysis of the benefits a typical school would realize from expanded connectivity and Internet service, looking at services and applications currently available and those anticipated in the future.



Today's Services/and Applications	Benefit
<p>Internet access for students and teacher to on-line research and instructional resources, e.g., NC WiseOwl; and full courses for students and professional development for teachers</p>	<ul style="list-style-type: none"> <li>■ Provides high-speed, reliable service for just in time classroom instruction, avoiding connection and downloading delays</li> <li>■ Improves security and filtering</li> <li>■ Provides adequate bandwidth and quality of service for web-based video resources</li> </ul>

Emerging Services/Applications	Benefit
<p>Internet2 access for students and teachers</p>	<ul style="list-style-type: none"> <li>■ Dedicated educational network, eliminating security issues and providing access to the most innovative of digital resources and experiences</li> </ul>
<p>Transmission of NC WISE data from approximately 2,400 K-12 schools</p>	<ul style="list-style-type: none"> <li>■ Provides adequate bandwidth to transfer data at peak times without interruption of simultaneous instruction using digital resources</li> </ul>
<p>Connectivity for administrative applications, including a standardized course management system for NC Virtual, internal institutional applications, electronic purchasing, student transcript transfers</p>	<ul style="list-style-type: none"> <li>■ Provides adequate bandwidth for simultaneous users of local and statewide applications</li> <li>■ Provides standard level of security</li> <li>■ Provides greater productivity in staff time, particularly handling routine operations</li> </ul>
<p>Virtual environments (e-field trips, 3-D simulations)</p>	<ul style="list-style-type: none"> <li>■ Enriches learning by taking students outside of their local environment</li> </ul>
<p>Collaboration and resource sharing with universities, community colleges, and other public schools nationally and internationally</p>	<ul style="list-style-type: none"> <li>■ Provides adequate bandwidth for real-time, interactive sessions, including use of video conferencing</li> <li>■ Provides enhanced opportunities for database sharing, e.g., of learning objects</li> <li>■ Maximizes and shares skills of master teachers</li> <li>■ Gives students skills in both team building and interactive project development, skills highly valued in many 21st century workplaces</li> </ul>
<p>Electronic assessment</p>	<ul style="list-style-type: none"> <li>■ Enables more efficient, standardized testing</li> <li>■ Provides more rapid feedback to students</li> <li>■ Enables more rapid remediation intervention, if require</li> </ul>

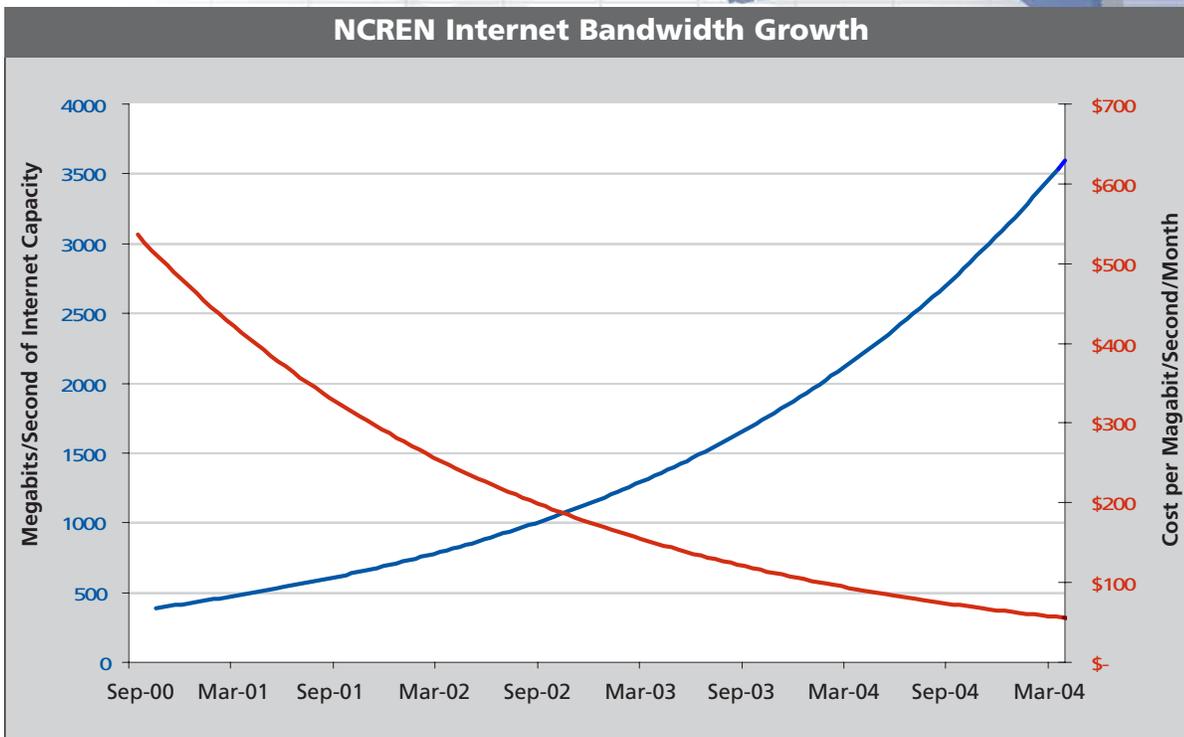
Emerging Services/Applications	Benefit
Centralized web-based application software (for both instructional and administrative needs)	<ul style="list-style-type: none"> <li>■ Results in cost-savings due to aggregation of services/licenses</li> </ul>
Enhanced communication tools with the larger community	<ul style="list-style-type: none"> <li>■ Improves school security by more complete, rapid communication with local law enforcement</li> <li>■ Improves parental access to school information</li> <li>■ Improves virtual school programs</li> </ul>

Tomorrow's Services/Applications	Benefit
Teacher controlled tools for on-line tutoring and monitoring of student progress	<ul style="list-style-type: none"> <li>■ Customizes/individualizes student instruction, which, in turn, maximizes and makes more efficient a teacher's time with an individual student</li> </ul>
Technical support at the regional level and remotely	<ul style="list-style-type: none"> <li>■ Provides standard infrastructure for efficient, timely trouble-shooting</li> <li>■ Alleviates local staff shortages</li> </ul>

Estimates of bandwidth usage per application may not appear significant, but it is commonly agreed that if even a portion of North Carolina schools participated in the same live video event-transported over the existing infrastructure-a massive bottleneck and/or shutdown of the system would occur. This likelihood places connectivity and bandwidth allocation first in the list of issues for North Carolina schools seeking access to digital resources fundamental to a 21st century learning environment for their students.

A concern in the findings was an undetermined projection in K-12 connectivity needs to enable instructional and administrative plans and programs. This information is required to construct a comprehensive infrastructure. This study presumes that the BETA study projections of 1000 Mbps to the LEA and 100 Mbps in the schools are appropriate. In addition, during the Study, LEAs confirmed this projection as accurate.

A comparison that indicates a predictable need is the following higher education bandwidth demand curve. It shows the exponential growth in bandwidth demand over 5 years, starting in September 2000. With K-12 at, or below, the lower left point on this curve, it is likely to experience a similar growth in connectivity needs to support 21st century teaching and learning tools. This curve agrees with the connectivity vision put forth by North Carolina's leadership.



## 2. Staffing

During the period of this Connectivity Feasibility Study, many discussions included connectivity, content (instructional and administrative) and technology staffing as necessary and complementary elements of a successful and sustainable strategy for 21st Century education. It is the sole task of the Connectivity Feasibility study panel to address issues related to bringing Internet access up to the standard needed to support instructional goals statewide. Important content and staffing issues are being addressed elsewhere.

Technology staffing is the particular focus of the School Technology Commission. According to DPI staff, "Today's technology staffing levels generally fall short of recommendations and will be more significantly understaffed if broadband access, more equipment and systems are provided to all schools". Per the IMPACT Guidelines for North Carolina Media and Technology Programs, August 2005, one technology facilitator and one technology assistant are recommended per 1000 students.

## 3. E-Rate optimization

The E-Rate (Education Rate) program is a federal program created in 1996, through the Universal Service Fund, for the purpose of making telecommunications services and Internet access more affordable, and, hence, more available in K-12 schools and public libraries throughout the nation. For a more complete description of the program, see Appendix C.

What is the status of E-Rate in North Carolina? In one four-year study (1998-2001) of E-Rate commitments to states, North Carolina ranked 25th, with an average of \$101.15 received per child over the course of four years.

States with comparable school-age populations, in terms of size, that ranked ahead of North Carolina were: Arizona-8th, with an average \$168.60 per child; Tennessee-13th, with \$153.04 per child; Missouri-16th, \$128.29 per child; and Massachusetts-19th, with \$120.07 per child. (Source: "Following the Money: E-Rate vs. Title I," <http://fundsforlearning.com/data/faq.html>.) As shown in the first table that follows, by 2004, the most recent year for which complete cumulative data are available, North Carolina still lagged behind these other states in terms of total funding, with the exception of Massachusetts. The second table shows another perspective, comparing North Carolina's E-Rate funding in relation to neighboring states, irrespective of school age population.

### E-Rate Funding in Selected States

State	School Population	1998-2004 Total Funding*	1998-2004* Av./yr. Funding	2004 Funding**
Arizona	1 million	\$ 357,898,233	\$ 51.1 M	\$ 57,469,107
Tennessee	.936 million	341,857,424	48.8 M	44,721,070
Missouri	.906 million	305,635,135	43.7 M	36,755,899
<b>North Carolina</b>	<b>1.4 million</b>	<b>266,145,475</b>	<b>38.0 M</b>	<b>43,172,746</b>
Massachusetts	1 million	247,406,737	35.3 M	25,475,676

\* Totals compiled from annual state data at E-Rate Central <http://www.E-Ratecentral.com/us/default.asp>. Accessed 3/16/2006.

\*\* E-Rate Central. <http://www.E-Ratecentral.com/us/default.asp>. Accessed 3/16/2006.

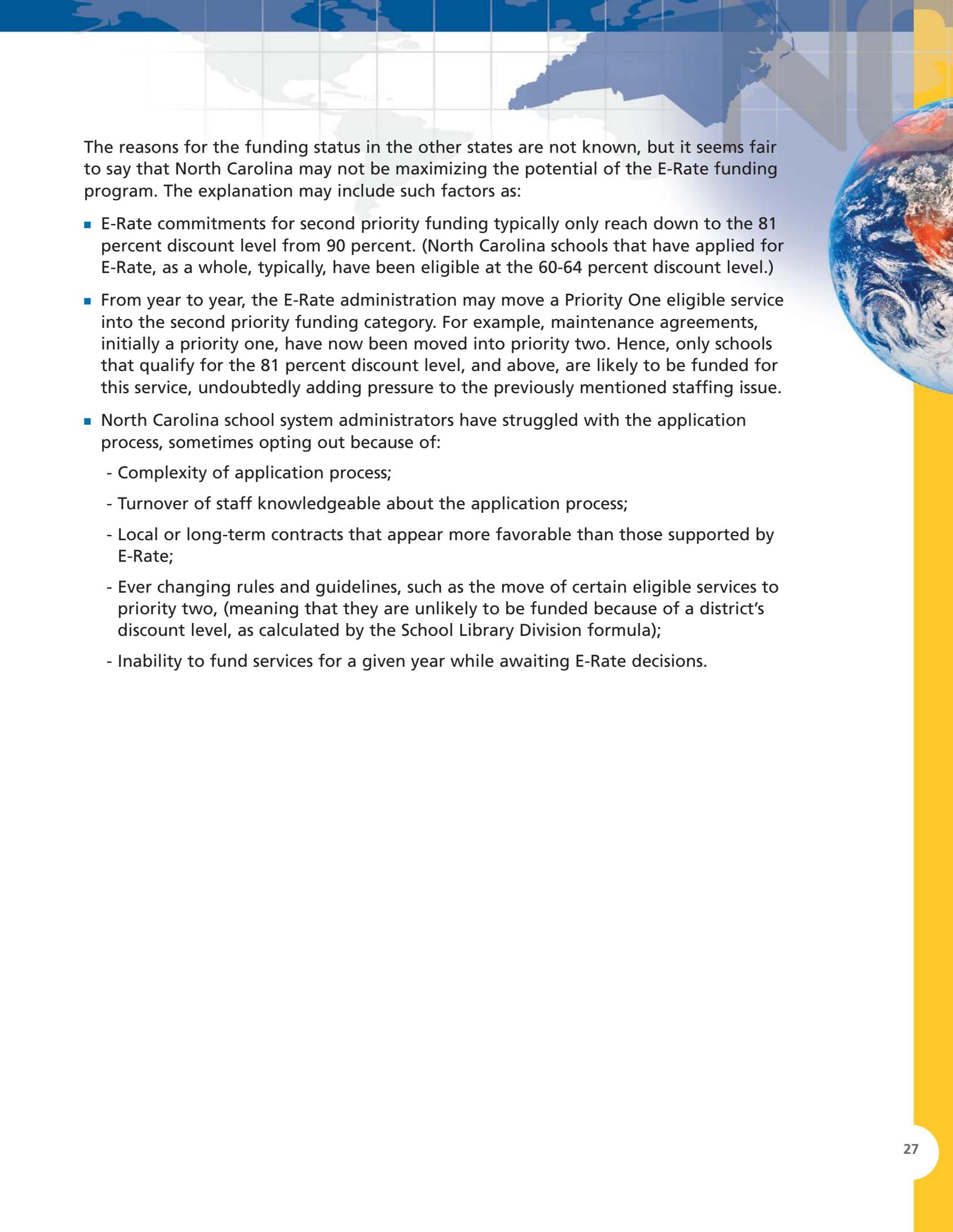
### E-Rate Funding in Selected Southeastern States

State/K-12 Population*	1998-2004 Total Funding**	1998-2004** Av./yr. Funding	2004 Funding***
Florida/2.6M	\$ 449,074,419	\$ 64.2	\$ 77,261,296
Georgia/1.5M	471,870,596	67.4	67,843,946
South Carolina/.7M	330,001,414	47.1	40,153,227
<b>North Carolina/1.4M</b>	<b>266,145,475</b>	<b>38.0</b>	<b>43,172,746</b>
Virginia/1.2M	179,944,191	25.7	27,172,568
West Virginia/.28M	60,020,580	8.6	8,947,009

\* National Center for Education Statistics, <http://www.nces.ed.gov>. Accessed April 17, 2006.

\*\* Totals compiled from annual state data at E-Rate Central. <http://www.E-Ratecentral.com/us/default.asp>. Accessed 4/12/2006.

\*\*\* E-Rate Central. <http://www.E-Ratecentral.com/us/default.asp>. Accessed 4/12/2006.



The reasons for the funding status in the other states are not known, but it seems fair to say that North Carolina may not be maximizing the potential of the E-Rate funding program. The explanation may include such factors as:

- E-Rate commitments for second priority funding typically only reach down to the 81 percent discount level from 90 percent. (North Carolina schools that have applied for E-Rate, as a whole, typically, have been eligible at the 60-64 percent discount level.)
- From year to year, the E-Rate administration may move a Priority One eligible service into the second priority funding category. For example, maintenance agreements, initially a priority one, have now been moved into priority two. Hence, only schools that qualify for the 81 percent discount level, and above, are likely to be funded for this service, undoubtedly adding pressure to the previously mentioned staffing issue.
- North Carolina school system administrators have struggled with the application process, sometimes opting out because of:
  - Complexity of application process;
  - Turnover of staff knowledgeable about the application process;
  - Local or long-term contracts that appear more favorable than those supported by E-Rate;
  - Ever changing rules and guidelines, such as the move of certain eligible services to priority two, (meaning that they are unlikely to be funded because of a district's discount level, as calculated by the School Library Division formula);
  - Inability to fund services for a given year while awaiting E-Rate decisions.

## IV. Recommendations

To address the directive of the North Carolina General Assembly and to address the vision of the Governor, the Business Education Technology Alliance, school leaders, educators and students to meet 21st century educational and statewide economic development needs, it is recommended that North Carolina:

1. **Extend broadband to all schools.**
2. **Leverage existing statewide resources:**  
NCREN, state government, UNC, Community Colleges, NCICU, K-12, and e-NC.
3. **Coordinate an inclusive virtual program to enable schools and promote cooperative regionalism.**
4. **Leverage best practices to optimize E-Rate**
5. **Provide state funding to:**
  - a. Extend the statewide backbone structure. One-time and periodic refresh costs (non-recurring) will be required to build out the statewide NCREN backbone. This task can be realized in one year and will require minimal future upgrade expenditures every 3-4 years. While higher education may require additional upgrades, it will not be restricted by the inclusion of K-12 in the network.
  - b. Reimburse connectivity costs (net of E-Rate for K-12). For example, if School System A receives 80 percent telecommunication service discounts through the federal E-Rate program, the state would pay the remaining 20 percent. This state reimbursement will allow school systems to focus additional dollars on their localized technology needs.
  - c. Provide support services to enable each school system to develop and maintain an optimum network design. This on-going engineering and technical support cost will be integrated into a managed service agreement rate, where possible. These recurring costs will cover:
    - Network operations center, 24x7 day to day operations
    - Engineering and design (backbone/transport, connection, school WAN and LAN) and staffing can be sourced from both the Education Network and regional networks.
    - Other optional services, to include consulting for application and network technology services, network and application knowledge, liaison between Education Network engineering and school technicians, assistance to school network design (PoP to classroom, available and required when connecting to backbone), E-Rate consulting and service eligibility (partial and turnkey), hosting and other potential coordinated services.
    - Administration, to include procurement (contracting and negotiating), financial services, E-Rate consolidation, leadership (operations, strategic, outreach).

## North Carolina K-12 Education Network

Costs Items	Implementation period			Total Implementation	Sustainment Phase		Total Projected Cost of NCEN
	July 2006 - June 2007	July 2007 - June 2008	July 2008 - June 2009		July 2009 - June 2010	July 2010 - June 2011	
Statewide Education Backbone Upgrade - one time	\$5,300,000	\$0	\$0	\$5,300,000	\$4,900,000	\$0	\$10,200,000
Statewide Education Backbone - recurring	\$1,000,000	\$1,500,000	\$2,000,000	\$4,500,000	\$2,000,000	\$2,000,000	\$8,500,000
Existing LEA Connectivity	\$16,155,997	\$8,077,999		\$24,233,996	\$0	\$0	\$24,233,996
New Education Network Connectivity	\$16,026,080	\$32,052,160	\$48,078,240	\$96,156,480	\$48,078,240	\$48,078,240	\$192,312,960
Network Operations and Security	\$1,100,000	\$2,200,000	\$2,200,000	\$5,500,000	\$2,200,000	\$2,200,000	\$9,900,000
Education Network Transition Team	\$1,674,481	\$0	\$0	\$1,674,481	\$0	\$0	\$1,674,481
Education Network Sustainment Team	\$0	\$1,865,129	\$2,055,777	\$3,920,906	\$2,055,777	\$2,055,777	\$8,032,460
Contingency ( 8% )	\$2,654,566	\$3,330,413	\$4,006,259	\$9,991,238	\$4,006,259	\$4,006,259	\$18,003,756
<b>Total Costs</b>	<b>\$43,911,125</b>	<b>\$49,025,700</b>	<b>\$58,340,276</b>	<b>\$151,277,101</b>	<b>\$63,240,276</b>	<b>\$58,340,276</b>	<b>\$272,857,653</b>
<b>Income Source</b>							
State Appropriation Request	\$24,001,878	\$24,047,605	\$28,293,332	\$76,342,815	\$33,193,332	\$28,293,332	\$137,829,479
Carryover	\$0	\$0	\$0	\$0	\$0	\$0	\$0
eRate Reimbursement (60%)	\$19,909,246	\$24,978,095	\$30,046,944	\$74,934,286	\$30,046,944	\$30,046,944	\$135,028,174
<b>Total Income</b>	<b>\$43,911,124</b>	<b>\$49,025,700</b>	<b>\$58,340,276</b>	<b>\$151,277,101</b>	<b>\$63,240,276</b>	<b>\$58,340,276</b>	<b>\$272,857,653</b>
Funding Over (under) projection	(\$0)	(\$0)	(\$0)	(\$0)	(\$0)	(\$0)	

This detailed projection of Total Costs to implement the recommendations reflects a three-year LEA transition from existing connectivity programs to the proposed broadband program. The fourth year shows the impact of a periodic refresh of the backbone. Including a recommended contingency and carryover provision, this projection requires average annual recurring expenditure of \$25 million and a non-recurring expenditure of \$5 million in the first and fourth year.

## V. Action Items

### **ACTION ITEM 1: PROVIDE A COMMON NETWORK BACKBONE.**

Provide a common educational network backbone that will enable maximum leveraging of content, capability, and resources across all levels of the educational spectrum. Characteristics of the network backbone will include:

1. Existing PoPs will be upgraded in a number of locations around the state to facilitate least-cost access to the maximum number of end user sites
2. PoP locations will be 'telco-grade', i.e., redundant power, HVAC, physical security
3. Network 'backbone' will have diverse paths and connect to at least two other locations.
4. It will ensure evergreen network architecture.
5. It will realize cost economies and quality of service.

This backbone will:

- a. Leverage each provider's unique attributes and provide for local choices.
  - Leverage the backbone and Internet services of MCNC/NCREN.
  - Leverage the call center and help desk of State ITS and NCREN.
  - The network will be engineered to ensure competition among commercial providers, leveraging the unique strength of each.
    - PoP locations will be provider-neutral, i.e., all potential providers will be allowed to present service at the location (including private fiber) at no premium.
    - Access technology choice is the provider's. There is no preference provided the requirements for presentation to the endpoints and defined service levels are met.
    - Common point of inter-exchange of local Internet traffic.
- b. Provide minimum connectivity, enabling specific and appropriate connectivity levels consistent with needs of individual schools.
  - Ensure a minimum standard of connectivity for all schools and ensure upgrading as needed.
  - Initial bandwidth available from each school location to the PoP will be 100 Mbps Ethernet interface and will be capable of upward adjustment in arbitrary increments up to the max of 1 Gbps
  - Provide high-speed Internet and Internet2 access.
- c. Establish standards to ensure that every K-12 institution has the appropriate quality of access to support all educational and administrative requirements.
  - Gigabit Ethernet presentation at Local Education Agency (LEA) locations
  - Gigabit Ethernet with 802.1q vLAN capability at PoP



d. Enable LEAs to build on basic capability.

- A base level of capability will be provided, designed to meet all minimum statewide academic and administrative requirements. A flexible design will enable each LEA to build additional capability based on its unique needs, and give it choices on how to build this capability.
- End-user locations will have the option of choosing a redundant path to the network backbone.
- Each LEA will be offered collocation space in the PoP.
- Each LEA will be given full management visibility into the network.
- LEAs and other educational entities will retain responsibility for policy decisions related to information technology, including their own routing, content filtering and security policy. That responsibility remains with the individual entity. Implementation of those policies may be a service offered by the network operator.

**SUMMARY OF INFRASTRUCTURE BENEFITS**

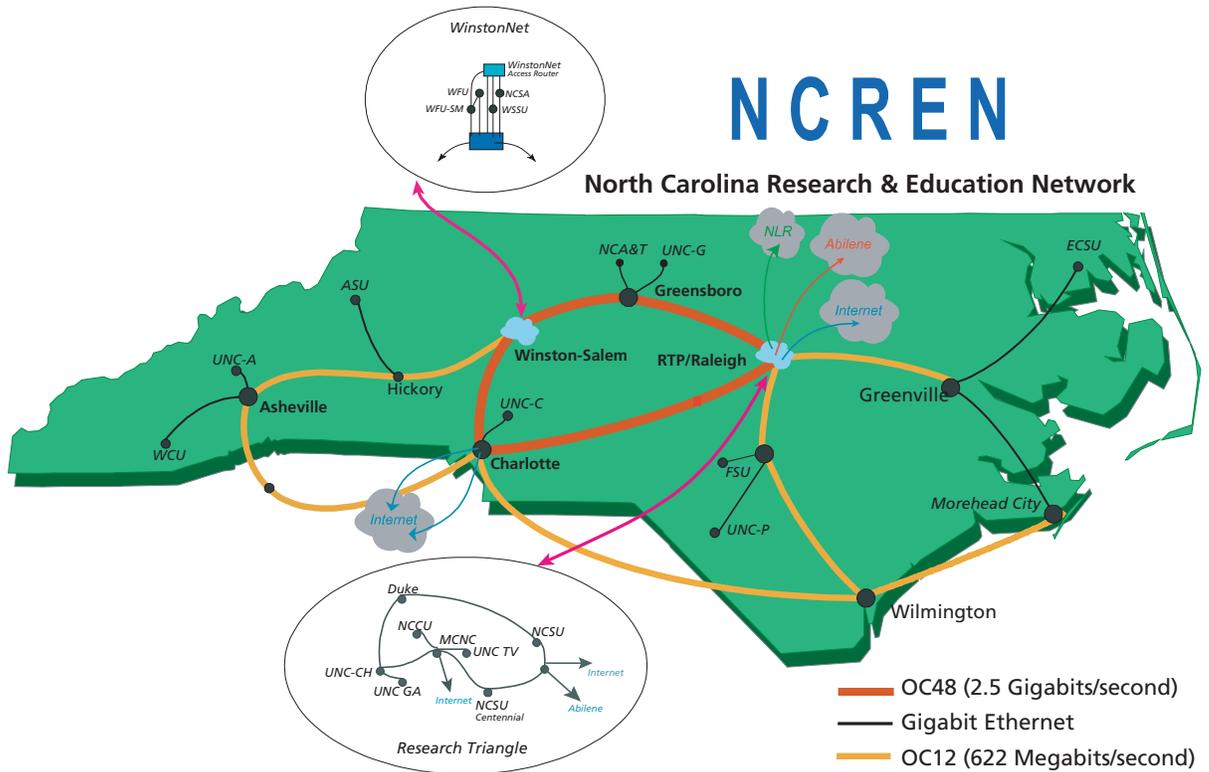
- |   |   |  |
|---|---|--|
| ■ Local choices   | ■ Ensured quality of service                          | ■ Internet2 accessible for all schools   |
| ■ Established standards                                 | ■ Common infrastructure and services management       | ■ Integrated technology across K-20 , including instructional collaboration and administrative efficiency. |
| ■ Aggregated demand                                     | ■ Local network traffic kept local                    |  |
| ■ Last mile competition                                 | ■ Scalable, to increase connectivity as needs require |  |
| ■ Statewide licensing of content and software resources |   |  |

With this proposal, an infrastructure has been designed that creates a state backbone, allying and building upon the existing State ITS, NCREN/MCNC, and regional network facilities for all in-state applications, services and Internet2 access. This 10 Gbps backbone will connect directly to K-12 schools and district central offices, with a minimum of 100 Mbps to an individual site.

As determined by local circumstances (cost, contract, bandwidth requirements, QoS, etc.), the network will use any or all of existing infrastructure, fiber, microwave/other wireless and fast Ethernet technologies to connect to individual sites. Further, while the Education Network will offer Internet service to those LEAs wishing to receive it through the Network, LEAs, at their discretion, may contract with or continue contracts with other Internet Service Providers (ISPs).

## Existing Backbone

The current MCNC/NCREN network into which the State ITS network connects is shown on the following map. Also illustrated are two regional networks, with WinstonNET at the top and RTP at the bottom. When expanded, this backbone will enable all schools, statewide.

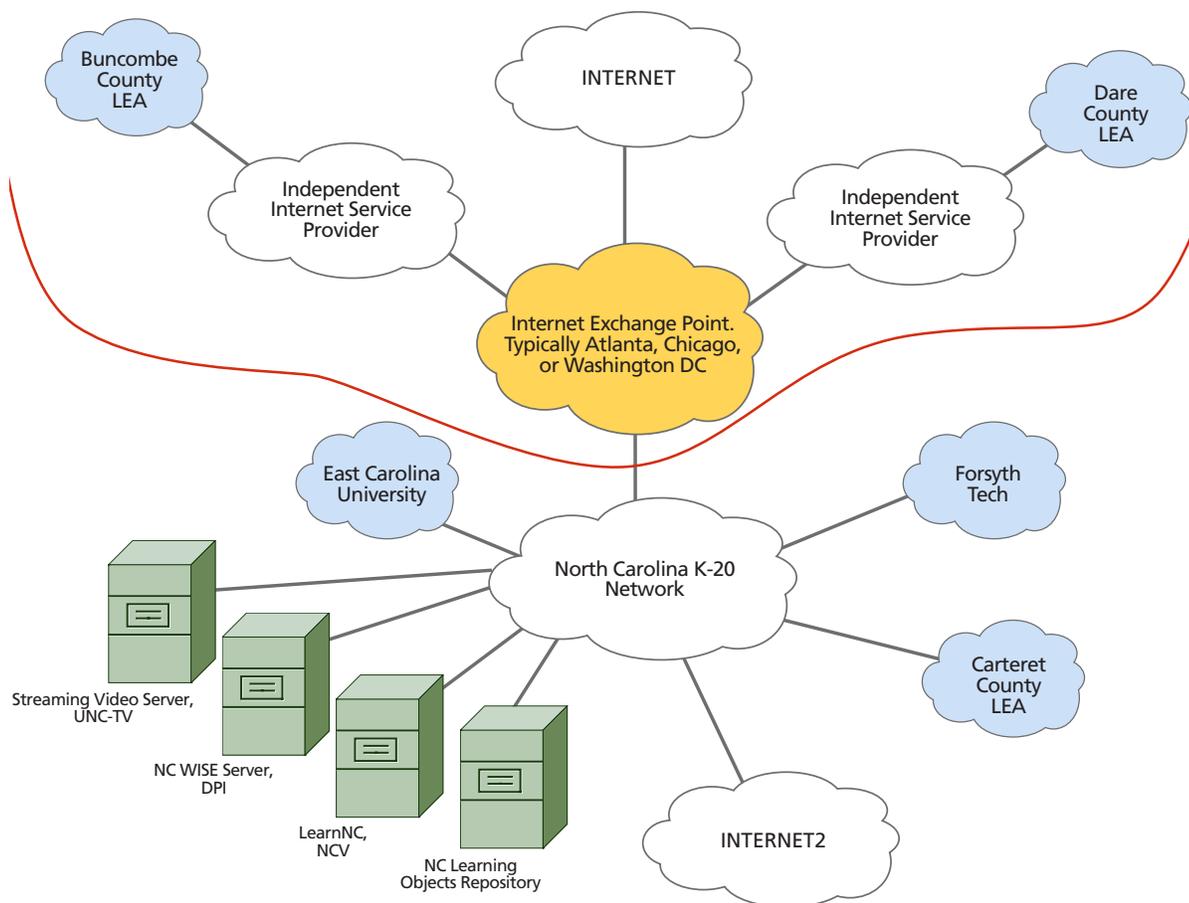


The following graphics show the proposed network at various levels of service. The intent of the drawings is to depict what the impact of a true K-20 networked environment within North Carolina would facilitate. The concept of keeping local traffic local is a hallmark of Research and Education networks nationwide. Within North Carolina, because of existing work between NCREN and ITS, this is largely possible for the higher education community. However, where K-12 schools are involved, this is not the case. Because K-12 network users represent the future of NC, it's imperative that their technological needs be met today.

The top portion of the following drawing identifies existing constituency within North Carolina and how, today, they largely connect to each other and to resources within North Carolina via facilities and equipment located outside of the state. All institutions have Internet connectivity in some shape or fashion, but in general these sites communicate through each other via an Internet exchange point where independent Internet Service Providers exchange data. This usually occurs in some place outside of North Carolina, in general Washington, DC, Atlanta, Georgia, or Chicago, Illinois. In this environment, the nexus of connectivity and Internet resources for many North Carolina

educational institutions is located somewhere else and outside the control of its stakeholders, namely its students, faculty, and citizens. The distance between these systems and the North Carolina Education Network contributes to poorer performance from these schools to the resources accessed directly through this network, leading inefficiencies and a loss of benefits for users. Because of NCREN's unique positioning as a connector to the Abilene network (Internet2), which is a nationwide research and education network, those sites not directly connected to the Education Network are denied access to the many education-only services that are available through Internet2.

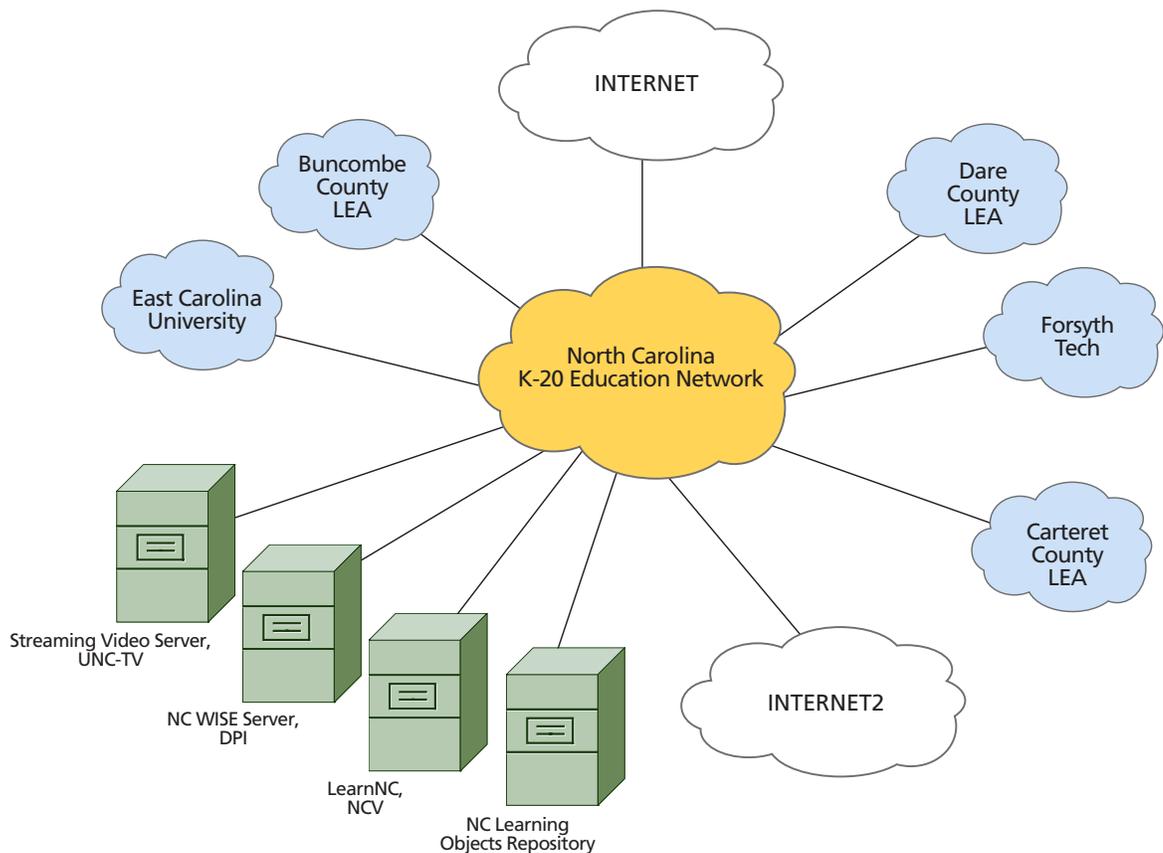
### Current K-12 Network Configuration



The bottom half of the above drawing illustrates those elements that are already directly connected to the North Carolina Education Network. These institutions are able to access important educational applications located within North Carolina, including the Learn-NC server at UNC-CH, the NC WISE Server at DPI, the NC Learning Objects Repository, and the newly established NC Virtual High School.

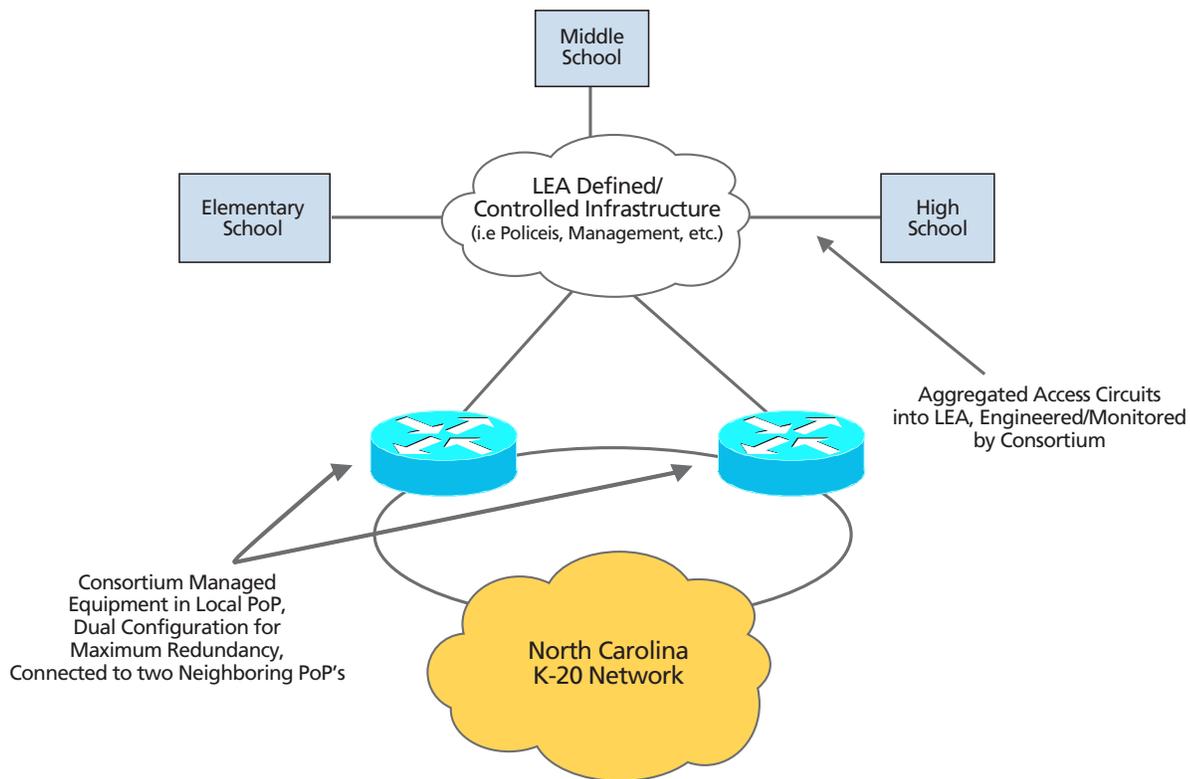
The following diagram depicts the recommended North Carolina Education Network. It would shift the center of the universe, at least in terms of traffic between its stakeholders, back to the network residing within North Carolina. This would achieve the concept of keeping local traffic local, and increase the performance of applications by teachers, students, and faculty amongst all layers of education within North Carolina and create a seamless networking experience for all K-20 institutions. At this point, users of the network within the state of North Carolina have no dependency on other areas of the Internet to achieve their needs.

### Recommended Education Network



The following drawing depicts how a LEA would be connected to the network. It reflects a key network operating principle, namely that a network must provide the greatest possible amount of resiliency in the network.

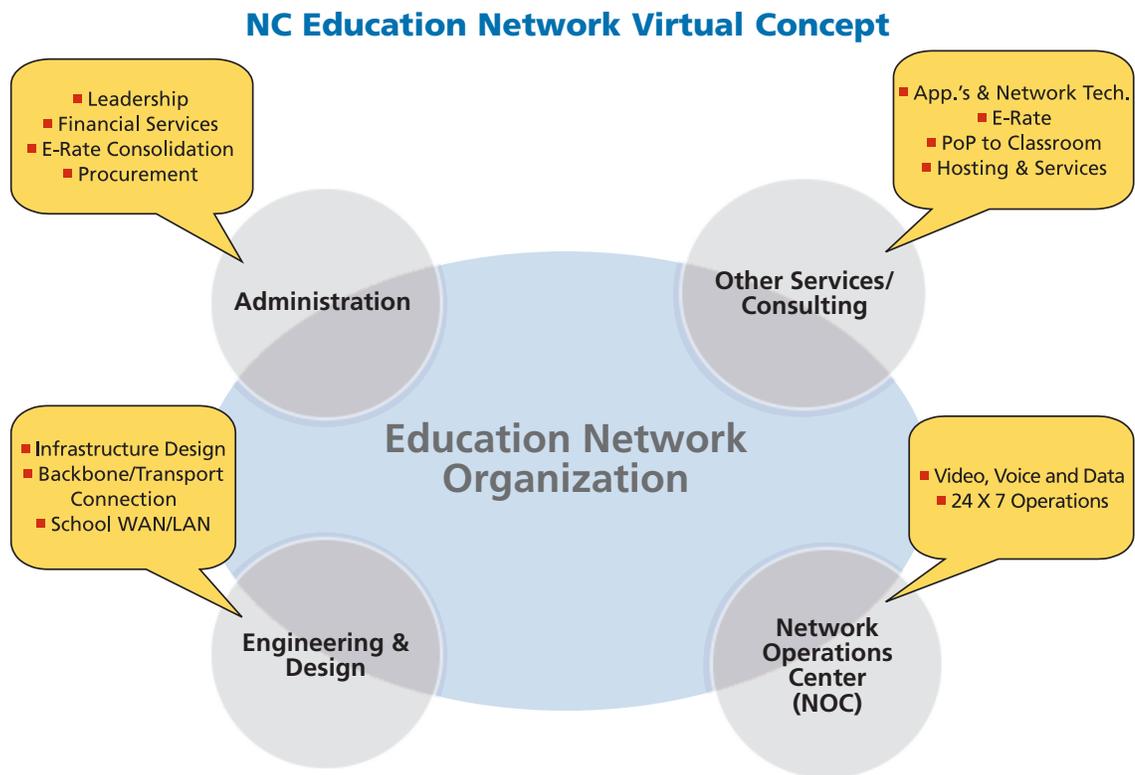
### Service Delivery to LEA



## ACTION ITEM 2: ESTABLISH THE NORTH CAROLINA EDUCATION NETWORK

Establish the North Carolina Education Network that will:

- a. Be a virtual alliance of NCREN, State Government, and all of the K-20 Education Community, thereby leveraging all state resources, building upon the existing North Carolina infrastructure and taking into consideration best practices of other states. This alliance is directed towards the vision of lifelong learning outlined by BETA and state leadership. Responding to this vision requires all resources collaborate beyond traditional organization structures, while refraining from costly, duplicative new organizational structures.



- b. Continually reinforce in all infrastructure planning that technology/connectivity follows instructional goals, plans, and requirements.
- c. Operate under a private non-profit 501 (c) 3 umbrella to execute and exercise standard business activities (e.g., agreements, contracts and procurement). The Board of Directors will be established so as to fairly represent all stakeholders.
- d. Minimize costs for the state as a whole by optimizing efficiencies and aggregating costs for services where appropriate.
- e. Maintain relationships and collaborate with businesses, industry, partners, and providers. The State has been well-served with services provided by the private business and industry community. In the design of the proposed network, a key principle is to keep the infrastructure provider neutral so that all doors remain open to providers, both public and private.

f. Selectively expand through cooperative regionalism current and future networks, such as WinstonNet and WNC EdNET. This route to lifelong community learning is strategic to supporting the broader BETA vision. The State has been well-served with services provided by the private business and industry community, as enabled, in part, by e-NC In the design of the proposed network, a key principle is to keep the infrastructure provider neutral so that doors remain open to all providers, both public and private.

*“ A Statewide approach to infrastructure is essential, but it will be through cooperation at a regional and local level that 21st century networking will be attained.... Cooperative regionalism is based on two simple observations. First, even though the Internet has made the entire world accessible, it is still the last mile of connectivity that counts. Second, people still want to have face-to-face contact with others over issues that affect the area in which they live. Local issues are best solved locally... In concrete terms, the Cooperative Regional model brings local educational organizations together, from K-12 to Higher Ed to form purchasing cooperatives.... The [Cooperative Regional] model depends on the financial participation of the members. A service which is free has no value. The recommended model includes a combination of membership fees and central support.... The most effective model, however, is not to purchase on a state-negotiated contract, but for the Regional Cooperative to negotiate for a [sic] local resources directly, with the appropriate support from the State and its representatives such as MCNC....A principal driving factor in the local participation with a local resource is that a shared regional networking architecture - where each organization is most highly connected to its neighbors - provides continual motivation for local cooperation.”*

Dr. Jay L. Dominick of WinstonNet  
and CIO of Wake Forest University

(See Appendix C for the whole of Dr. Dominick's statement.)

g. Be an ongoing service/support organization dedicated to enabling schools with network design, other collaborative and regional services, available to LEAs, with the opportunity to level the playing field, on an opt-in basis.

- h. Be an ongoing service/support organization to school districts on E-Rate. The following areas may require state-level assistance and might be beneficial to individual districts' efforts with the federal E-Rate program:
- Provide appropriate levels of professional development and training for E-Rate applicants, including school superintendents and their staffs
  - Provide “networking opportunities” for E-Rate applicants, including at regional meetings
  - Provide updated information and timeline reminders, e.g., if the Schools and Library Division of Universal Service Administrative Company (SLD) changes a date on the waiting period for contract finalizations, alert school systems
  - Provide a centralized, up-to-date, web-based repository for E-Rate information and resources, e.g., informational PowerPoint presentations, etc.
  - Provide regular and just-in-time orientations to update those with E-Rate experience, and especially for those new to the responsibility
  - Educate architects and school planners regarding E-Rate eligible services when planning schools
  - Conduct forums for vendors to ensure full understanding of E-Rate regulations, e.g., the meaning of contractual language that states “pending E-Rate funding” and to relay the infrastructure needs of the K-12 audience
  - Educate and clarify for all audiences any misconceptions about the current state of school infrastructure and misconceptions regarding funding for priority one and two services. In this latter instance, misconceptions exist regarding “unexpended” dollars. Funding commitments sometimes appear unexpended due to federal delays in funding commitments. Hence, when the SLD finally commits to discounts, a school system has no way of spending those dollars.)
  - Offer E-Rate filing assistance.
  - Consider the organizational recommendation that follows for organizing an E-Rate support service that could both assist LEAs with those E-Rate functions that must stay at the local level and those functions which could possibly be moved to a more centralized organization, thus freeing up valuable administrative and instructional time locally:

#### **RECOMMENDATION FOR ORGANIZING AN E-RATE SUPPORT SERVICE**

Create an E-Rate function to file all Priority 1 requests for schools. This department would also provide regional training for schools to assist with their Priority 2 applications. They would keep schools informed of rule changes and provide awareness sessions for superintendents and school boards. This department should be composed of the following:

- State E-Rate Coordinator who will oversee this function and supervise the staff that supports it.
- At least 6 individuals trained to handle E-Rate applications. This would be one person for each of the states technology regions.
- At least 2 clerical support staff members to assist in the enormous amount of paperwork and filings for all participants.



**ACTION ITEM 3:**

**PLAN A THREE-YEAR NETWORK IMPLEMENTATION TIMELINE.**

A realistic timetable for statewide implementation of the education network is three years. LEA specific circumstances are unique and, realistically, all could not evolve more quickly when considering existing contracts with providers, longer-term upgrade requirement/assessment, and determination of a complete high quality network plan.

**ACTION ITEM 4:**

**INSTALL A TRANSITIONAL PROGRAM THROUGH E-NC.**

Upon funding, install a transitional management program through e-NC to prepare for project deployment. This will include detailing backbone expansion; addressing the legal and logistical requirements to establish a 501(c)3 entity and organization; identify and recruit key staff, and set a prioritized Local Education Agency (LEA) implementation schedule.

## VI. Conclusion

**A digital native has issued an invitation.**

**It is up to us to respond.**

Recently an 8th grade North Carolina student took the time to send her thoughts on education to state officials. The following is an excerpt:

*“ The public school system is designed like a conveyor belt: everything progresses at the same rate, is treated the same, and comes out the other end with generally the same experiences. It’s an Industrial Revolution creation and worked in the Industrial Revolution’s society. As you are well aware, we are no longer in that era, but have moved on to the Technology age. The world is leaving our public school systems in the dust.*

*“ Today’s teenagers were the first to grow up completely engrossed in the Technology Age. However, they are being sent to an Industrial Revolution-style school. If reform were to take place, students would be among the first to adapt. They would be conforming to a way of life that was natural to them, as opposed to the school system’s outdated structure.*

*“ I propose a reformation in the structure of today’s schools: where teacher/student contact is minimized and student-independence is emphasized..... The remainder of the education would take place online, using forum for classroom discussions, e-mail to turn in assignments, etc....*

This young student, a “digital native” has issued an invitation. It is up to us to respond.

# Appendix A: Glossary

**Bandwidth** • Speed or capacity of a network connection. The more bandwidth a particular medium has, the faster data can be transmitted across it.

(Source: NCIH Assessment and Evaluation Report, Office of the State Controller, 1996)

**Broadband** • A service or system for transmitting large amounts of data, voice and video (i.e., greater than 1.5 Mb/s) rapidly over long distances.

(Source: NCIH Assessment)

**Dial-up** • Dial-up is the process of establishing a temporary connection via a switched network.

(Source: NCIH Assessment)

**Digital** • Representing data as discrete bits.

(Source: NCIH Assessment)

**DNS** • Short for Domain Name System (or Service or Server), an Internet service that translates domain names into IP addresses.

(Source: ISP Webopedia)

**DS3** • A long distance, point-to-point communications circuit that transmits 44.7 megabits per second and can provide up to 28T-1 channels. It usually runs over fiber-optic cable.

(Source: NCIH Assessment)

**Fast Ethernet** • A networking standard that supports data transfer rates up to 100 Mbps (100 megabits per second).

(Source: ISP Webopedia)

**Gigabit Ethernet** • Abbreviated GbE or GigE, a version of Ethernet, which supports data transfer rates of 1 Gigabit (1,000 megabits) per second.

(Source: ISP Webopedia)

**GigaPoP** • Short for gigabit Point of Presence, a network access point that supports data transfer rates of at least 1 Gbps. Currently, only a few gigaPoPs exist, and they are used primarily for accessing the Internet2 network.

(Source: ISP Webopedia)

**Internet2** • Testing-ground networking environment where universities, companies, and government laboratories work together and develop advanced Internet technologies such as telemedicine, digital libraries and virtual laboratories.

(Source: ISP Webopedia) It is available to North Carolina K-12 schools for educational activities and events as a Sponsored Educational Group by the University of North Carolina System)

**K-12, K-20** • When these terms are used in this study, it is understood that **pre-K-12**, and **pre-K-20** are intended.

**Latency** • In networking, the amount of time it takes a packet to travel from source to destination. Together, latency and bandwidth define the speed and capacity of a network.

(Source: ISP Webopedia)

**Mbps** • Megabits per second, the number of *bits* transmitted every second as measured in multiples of about one million (1,048,576 bits per second).

(Source: NCIH Assessment)

**National Lambda Rail (NLR)** • A consortium of leading U.S. research universities and private sector technology companies using an advanced optical, Ethernet and IP networking infrastructure on more than 10,000 miles of fiber optic cable across the United States.

(Source: National Lambda Rail)

**PoP** • Short for *point of presence*, an access point to the Internet. Internet Service Providers have typically multiple PoPs. A point of presence is a physical location, either part of the facilities of a telecommunications provider that the ISP rents or a separate location from the telecommunications provider, that houses servers, routers, ATM switches and digital/analog call aggregators.

(Source: ISP Webopedia)

**QoS** • Short for *Quality of Service*, a networking term that specifies a guaranteed throughput level.

(Source: ISP Webopedia)

**T1** • A long distance, point-to-point communications channel that transmits 1.5 megabits per second.

(Source: NCIH Assessment)



# Appendix B: Methodology for Feasibility Study

## 1. SESSION LAW 2005-276, SENATE BILL 6XX

General Assembly of North Carolina

Session 2005

Session Law 2005-276

Senate Bill 622

Part VII. Public Schools

### **Feasibility Study for Developing Regional Education Networks**

The North Carolina Rural Economic Development Center and the e-NC Authority, in collaboration with interested providers of broadband services, representatives from local school administrative units, the University of North Carolina, private colleges the State Board of Education, the State Chief Information Officer, and the Community College System shall perform a feasibility study on developing regional education networks that provide and sustain broadband service access to individual students and teachers in schools, community colleges, and universities.

The study shall include (i) an evaluation of existing technology and service applications such as the statewide infrastructure, those operated by the private sector, the North Carolina Research and Education Network, and networks such as Winston-Net and (ii) an evaluation of newer technology such as wireless broadband access. It shall recommend ways to maximize the use of these existing resources to support growth in broadband service access to the State, including underserved regions.

The North Carolina Rural Economic Development Center and the e-NC Authority shall report the results of the study to the 2006 Regular Session of the 2005 General Assembly.

## 2. PROJECT TEAM

### THE DATA COLLECTION, VALIDATION AND NETWORK DESIGN TEAM:

Team Member	Representing	Team Member	Representing
Angie Bailey	e-NC	Mark Cooke	ITS
Larry Creglow	e-NC	Richard Kelly	ITS/NCIH
Tom Merrihew	e-NC	Billy Willis	ITS
Jane Smith Patterson	e-NC	Benny Hendrix	DPI
Charlie Pittman	e-NC	Bill Randall	NCCCS
Donna Sullivan	e-NC	Derrick Murray	UNC-GA
Deborah Watts	e-NC	Jay Dominick	WFU
Joanna Wright	e-NC	Phil Emer	NCSU/FI
Tommy Jacobson	MCNC	Cindy Johnson	Lee County Schools
Mark Johnson	MCNC	Butch Rooney	Davie County Schools
John Killebrew	MCNC		

### LEA Focus Group:

Team Member	Representing	Team Member	Representing
Barry Pace	McDowell	Butch Rooney	Davie
David Edwards	Lenior	Andy Gibson	Clay
Jim Tagliareni	Moore	Steve Alexander	Cabarrus
Joe Poletti	Carteret	Glen Buck	Martin
Cindy Johnson	Lee	Rhonda Moses	Northampton
Scott Smith	Burke	Joe Dietzel	DPI

### THE REPORT PRODUCTION TEAM:

e-NC Authority staff • Contractors: Linda DeGrand, Pat Hill, Elena Skrinak

### SPECIAL APPRECIATION:

DPI Instructional Technology Division: • Frances Bradburn, Director • Wynn Smith, Section Chief

Regional Technology Consultants: • Mary Lou Daily • Acacia Dixon • Melanie Honeycutt • Kerry Mebane • Camp Price • Annemarie Timmerman

Legislation that directed this study was developed as a result of the work of the Business Education Technology Alliance (BETA), chaired by Lt. Governor Perdue.

## Appendix C: E-Rate Program

1998 was the first year of funding. The program is administered by the Universal Service Administrative Company (USAC), Schools and Libraries Division (SLD), and overseen by the Federal Communications Commission. The program is funded by fees from telecommunications carriers, paid into the Universal Service fund, with an annual cap currently of approximately \$2.25 billion.

Applicants to the fund can receive discounts for eligible services ranging from 20-90 percent, the percentage being based upon a formula factoring in the number of students participating in the free and reduced lunch program, and rural/urban location of individual schools. To apply, a school or school district must have a state approved technology plan that includes specified elements, including guarantee of an Internet filtering system for schools.

Only USAC/SLD specified services are eligible. The eligible services list and prioritization for funding varies some from year to year. Second priority services receive funding only after all applications have been processed for first priority services, e.g., Internet access is priority one, internal wiring is priority two. All services must be competitively bid according to a USAC/SLD established timeline. An application must be made annually for E-Rate funding for new services and services contracted on a year to year basis. Commitment letters from USAC to fund requested services may come after the close of the fiscal year for which the services were requested. As a result, many school systems were unable to move forward with contracts that were written 'dependent upon E-Rate funding'.

# Appendix D. Current Post-secondary Networking Status

## OVERVIEW

### Universities and Colleges

All 51 of North Carolina's 4 year colleges and universities are connected to Internet2. Of these, 11% are connected at 1.5 Mbps, 11% are connected at 1.5-10 Mbps, and 78% are connected at >10 Mbps. All have video conferencing capability

### Community College System

All 58 community colleges are now connected to Internet2-40% at 1.5 Mbps; 55% at 1.5-10Mbps; and 5% at >10Mbps. All have video conferencing capability. There are also approximately 82 satellite campuses and affiliated centers that have varying levels of connectivity.

The Infrastructure Sub-Committee for the Virtual High School (VHS) forecast the following broadband needs for the post-secondary community in North Carolina:

Institution	FY 05-06	FY 08-09	FY 11-12	FY 14-15
Community College	45Mbps	100Mbps	.5 Gb	1Gb
Universities	1Gb	2Gb	3Gb	5Gb

## FROM PAPPAS REPORT, "4.E.2INFRASTRUCTURE:

UNC and NCCCS." NC General Assembly. HB 1264:

*" Distance learning plays a prominent and increasing role at both UNC and NCCCS. It represents a cost effective and potentially high quality method for providing instruction to the existing student base, as well as dramatically extending the reach of the UNC and NCCCS student base. If growth at UNC and NCCCS continues at the current pace, the need for adequate technical infrastructure (bandwidth, related communications technologies, and support) is critical.*

*" A baseline review was undertaken of the University of North Carolina (UNC) and Community College (NCCCS) distance learning infrastructure in relation to their capacity, future utilization, and preparedness for anticipated growth.*

*" UNC TV, an affiliate of UNC, which serves both the community colleges and the university, has converted to digital and will have a data channel that can move massive amounts of data. Work is just beginning to determine the use of this resource in distance and online learning."*

## **“Bandwidth Capacity**

### **“UNC System**

*“ UNC’s bandwidth comes from the North Carolina Research and Education Network (NCREN). NCREN is a charter member of Quilt, the national association of GigaPoPs. This membership enables NCREN to procure, on behalf of all connected institutions, the very lowest possible Internet and Internet2 rates. NCREN’s charter allows the connection of all of Higher Education: UNC Universities; Community Colleges; K-12 Public and private schools; state, local, and county government offices; research organizations; other non-profit organizations; and a small number of related commercial organizations.*

*“ While UNC has considerable bandwidth, the demands are likely to continue to grow because of the anticipated increase in older students (partly as a result of demographics), the increase in part-time students, and the increase in courses with greater bandwidth requirements (such as health related courses and graduate programs).*

### **“NCCCS**

*“ T-1 data connectivity is provided to all Community Colleges, and is directly funded by the System Office through its ITS department. Colleges can elect to augment ITS bandwidth with local funding, or Colleges can contract with local Internet Service Providers. Some Community Colleges (for example, Guilford Technical Community College, Fayetteville Technical Community College, Pitt Community College) are buying more affordable bandwidth, which is a short-term solution.*

*“ There is clearly a constraint on bandwidth, and informal reports state that NCCCS is at 95% of capacity during peak usage periods. NCCCS (Ref. NCCCS Requests for Distance Learning IT Funding Proposal Project Justification) reports that ITS data service has not been uniformly increased in 4 years, but that typical data utilization of an organization increases 20 to 25% annually-even without introducing new bandwidth-intensive applications.*

*“ As student enrollment levels increase, peak periods will become even more of a concern, and cause more systems to drop under stress. Efforts such as the CCLINC Consortium requests for server upgrade and data base maintenance funding (Ref. NCCCS Requests for Distance Learning IT Funding Proposal Project Justification) are steps in the right direction.*



*“ For several years, the NCCCS and UNC have pursued an emerging wireless broadband technology called Educational Broadband Service (EBS), formerly ITFS. About half the community colleges and some of the universities hold licenses for bandwidths regulated by the Federal Communications Commission. This is still an emerging technology, but it has significant potential for the institutions serving rural North Carolina. The future will put even greater demands on bandwidth. These include, for example:*

- Implementing programs like the BioNetwork initiative will overstretch the 3MB service now in place in many of the Community Colleges (Ref. 2005-7 Expansion Budget Request Justification, page 1, para 4).
- Adding bandwidth intensive applications, such as Campus Cruiser, Video Streaming, e-procurement, H.323 video services, voice over IP, Allied health applications and other similar technology (Ref. 2005-7 Expansion Budget Request Justification, page 1, para 2.)
- Contemplating other technology initiatives such as:
  - The North Carolina Virtual High School that will provide a progression path from high school to Community College to university.
  - A learning content management system for system-wide management of all course materials. This initiative, when funded, could also help with consolidating programs and achieving system-wide cost efficiencies.

*“ The following issues could also impact the need for increased bandwidth by UNC and NCCCS:*

- Increasing the scope, depth and “media richness” of courses.
- Developing WiMax (wide area wireless).

**“ Reliability and Flexibility of Present Systems (UNC System/NCCCS)**

- Both systems are currently using Video Streaming, H.323 video services and voice over IP. These are accepted current technical standards that are designed to ensure both reliability and flexibility of systems. For example, H.323 allows video over IP, the Internet standard protocol.
- UNC utilizes video networking that includes automatic conversion gateways, 6 ISDN-B channels and various downlinks. All of these systems add reliability and flexibility of both capacity movement and course content.
- For NCCCS, the Data and NCIH Consolidation Project will upgrade the videoconferencing network to the current H.323 industry standard, allow expansion of video services to all main campuses, facilitate the expansion of data infrastructure at each College, and move all budget management to the System Office.

### **“ Preliminary Findings**

- The number of programs and courses offered through distance learning is growing rapidly for the NCCCS and UNC.
- Student enrollment in distance learning programs and courses are growing rapidly for both UNC and the NCCCS.
- Both UNC and the NCCCS appear to offer a greater percentage of courses through distance learning than the national averages.
- The level of involvement in distance learning activities varies widely with each University or Community College.
- The scope of support, and the facilities and personnel provided for content development vary considerably with each institution.
- The demands on UNC and the NCCCS networking infrastructure continue to grow, due to increased numbers of course offerings and student enrollments, as well as the offering of more technologically demanding content presentations.
- The present NCCCS network is near capacity for the distance learning offerings currently supported, creating a growing hurdle for expanding the scope or quantity of distance learning courses as well as planning future joint initiatives with the UNC.”

## Appendix E: Regional Service Collaboration and Economic Development in North Carolina

A key, yet limited, development in North Carolina's networking infrastructure has been the emergence of regional networks. Regional networks enable communities to establish their own network services for colleges, K-12 schools, local government organizations, businesses, and citizens, becoming catalysts for regional economic development. The significance of these organizations is reflected in Dr. Jay Dominick's following vision of cooperative regionalism for networking infrastructure and resulting economic development:

### COOPERATIVE REGIONALISM AN ORGANIC MODEL FOR STATEWIDE NETWORKING

*High-Speed Networking is the basis for educational and economic prosperity in the 21st century. The notion that access to this resource will be uniformly available and affordable across the State has not, however, proven correct. The leading metropolitan areas with the most aggressive Universities have not even been able to acquire world class connectivity except when they have cooperated. The key to being connected to the network of the future will be in forming purchasing collaboratives focused in relatively small geographies. A Statewide approach to infrastructure is essential, but it will be through cooperation at a regional and local level that 21st century networking will be attained.*

*Cooperative Regionalism is based on two simple observations. First, even though the Internet has made the entire world accessible, it is still the last mile of connectivity that counts. Second, people still want to have face-to-face contact with others over issues that affect the area in which they live. Local issues are best solved locally.*

*In concrete terms, the Cooperative Regional model brings local educational organizations together, from K-12 to Higher Ed to form purchasing cooperatives. These cooperatives aggregate demand, share costs and plan regional approaches to technology. Because they are locally based rather than centrally mandated, they form a natural organization for collaborative activities and for sharing costs. Most importantly, regionally based cooperatives allow for the development of mutual support models, wherein expertise and experience can be shared.*

*The model depends on the financial participation of the members. A service which is free has no value. The recommended model includes a combination of membership fees and central support. Membership fees are essential in order to sustain interest in the effective management of the cooperative. Most organizations, however, can not afford the full cost of a regional GigaBit Ethernet or wavelength-based network without support from the State. The most effective model however, is not to purchase on a state-negotiated contract, but for the Regional Cooperative to negotiate for a local*

*resources directly, with the appropriate support from the State and its representatives such as MCNC. In cases where there are not currently sufficient fiber resources, the Cooperative should take the lead in driving the implementation of the fiber network up to and including the deployment of the fiber resources directly. Preferably, this will be done in cooperation with local communications firms that possess the expertise to manage and maintain the resources on a long term basis.*

*A principal driving factor in the local participation with a local resource is that a shared regional networking architecture - where each organization is most highly connected to its neighbors - provides continual motivation for local cooperation. A shared Point of Presence on the Statewide Network allows for the sharing of costly resources such as routers, content filters, virus scanners, network monitors, video distribution resources and even computation resources. Local network traffic should stay local rather than traversing from one end of the state to the other.*

*Regional Cooperatives should stay relatively small, perhaps keeping their membership limited to no more than six counties. They should be encouraged to form super-cooperatives with nearby regions to form an interconnected and highly redundant statewide network in an organic manner. Interaction between the super-regional cooperatives should be encouraged and provided incentive at the State level. These large scale multi-member groups, when formed, should be represented on the board of NCREN.*

*This organic development model (local-regional-state) is most likely to be successful because it mimics the original development of the Internet. Had the Internet been a centrally mandated plan it would have failed. It succeeded because it facilitated a distributed membership model based on cooperative interest and local economics. The statewide network for the 21st century should follow the tide rather than fight it.*

Jay L. Dominick, Ph.D.

Following are brief descriptions of several of North Carolina's regional networks.

<p><b>The Western North Carolina Educational Network (WNC EdNET)</b></p> <p>Serving Jackson, Macon, Clay, Cherokee, Graham and Swain Counties)</p>	<p>WNC EdNET is a project designed to enhance learning through broadband technologies to educational institutions in six southwestern North Carolina counties. Collaborative assistance exists between: the six school districts, one tribal school district, Southwestern and Tri-County Community Colleges, Western Carolina University, and the Alliance for Southern Appalachian Prosperity. Grants have come from GoldenLeaf and Cherokee Preservation Foundation. With WRESA as the lead institution, Roger Metcalf and many others have developed a "bottoms up" movement to establish this showcase project of cooperative regionalism. With a planned budget of \$4.5 million, nearly \$3 million has been contributed and the work is now underway. With much collaboration, a planned lite-up date is about one year off.</p>
<p><b>WinstonNET Winston-Salem</b></p>	<p>WinstonNET, in Winston-Salem, was the first regional community network established in North Carolina. Founded in 2001, this non-profit community technology initiative has 26 miles of fiber and one gigaPoP peering point. The 10 members have collaborated with all sectors to leverage community development. Recent projects include the establishment of 40 computer labs throughout Forsyth County, 18 Winston-Salem City Parks and Recreation computer labs, 10 public library labs, and 12 labs established by Winston-Salem State University in area churches and other underserved areas. WinstonNet supports more than 350 computers and plans to expand this operation to another 50 labs over the next two years.</p>
<p><b>WNC-ERC</b></p>	<p>WNC-ERC, a large regional development effort funded mostly by Federal (infrastructure/Library of Congress) funds, has undertaken a broadband initiative as well as other infrastructure projects. A vision of \$100 million dollars has received nearly \$25 million to date.</p>
<p><b>Others</b></p>	<p>Stanley Net          Davie Net          Advantage West          Catawba County</p>



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e-NC Authority

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