DOCUMENT RESUME

ED 386 141 IR 017 099

TITLE	North Carolina Instructional Technology Plan and Guide: Technological Recommendations and Standards.
INSTITUTION	North Carolina School Technology Commission.
PUB DATE	Feb 95
NOTE	97p.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	Academic Achievement; Curriculum Development; Educational Finance; *Educational Planning; Educational Research; *Educational Technology; Elementary Secondary Education; *Instructional Development; Mission Statements; School Districts; Staff Development; Standards
IDENTIFIERS	Information Infrastructure; *North Carolina; *Technology Plans

ABSTRACT

This long-range state technology plan for North Carolina is the culmination of a series of research and planning efforts on improving student performance and enhancing the teaching/learning process through the effective use of technology. The plan includes the following components: a mission statement and vision; instructional technology initiatives in terms of elementary and secondary school programs and state/classroom curriculum development and instructional management systems; technical infrastructure; personnel; staff development and training; procurement; financial analysis; and monitoring and evaluation. The research and planning process of the plan is also discussed. A list of School Technology Commission members, a statewide technology study process and findings, and appendices are provided. Appendices include the following: alignment of the technology plan with G.S. 115C-102.6A, the relationship of initiatives and model configurations, a staffing/personnel prototype, a sample technology planning guide, and program requirements and statement of assurance of the long-range school district technology plan. In a second section, this document provides technological recommendations and standards; highlights include collaboration, connectivity, hardware and software configurations, and a table of supporting documents. (Author/AEF)

North Carolina

Instructional Technology Plan

North Carolina
School Technology Commission
February, 1995

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FOREWORD

State policy makers have come to recognize technology's potential for improving the quality of education in North Carolina. As a result, they are taking measures to maximize returns on the investment of state technology funds that will be allocated to public schools. In 1993, G.S. 115C-102.5 established the School Technology Commission and charged it with developing a state technology plan aimed at improving and enhancing classroom instruction. As specified in the legislation, the School Technology Commission has conducted a statewide requirements analysis and outlined a foundation for using learning and instructional management technologies to improve student performance.

An extensive needs analysis was completed by the Center for Educational Leadership and Technology (CELT), a non-profit educational research and planning firm based in Marlborough, Massachusetts. These services were secured by the School Technology Commission in accordance with the required legislation. The research and planning activities conducted by CELT in conjunction with the North Carolina Department of Public Instruction (DPI) involved educators at all levels, as well as other key stakeholders. Additional endeavors of the School Technology Commission were accomplished with the assistance of numerous outside consultants brought in for advice and collaboration. Several Commission sub-committees were appointed to study and make recommendations in areas critical to the quality of local school technology plans.

The School Technology Commission's quest to improve student performance and to address the needs identified by the study findings produced clear courses of action in nine areas: mission statement and vision, instructional technology initiatives, technical infrastructure, personnel, staff development and training, procurement, financial analysis, monitoring/evaluation, and local school district technology planning process. These courses of action are evident in the recommendations outlined in the Executive Summary.

Also evident in the recommendations are the local technology plan components required by the legislation. Some of the components are woven through all facets of the plan. Other components, such as those which require individual attention, including the need to establish links to the North Carolina Information Highway, are contained in individual sections of the plan.

The School Technology Commission wishes to express appreciation for the opportunity to assist in planning and laying the groundwork for the process that will guide schools in the use of technology for improved instruction.

LIST OF COMMISSION MEMBERS

The School Technology Commission was created by the Legislature and charged with the responsibility for developing a state school technology plan for improving student performance in the public schools through the use of learning and instructional management technologies. The following is a list of School Technology Commission members:

School Technology Commission Members

Speaker's Appointments

Ms. Nelda G. Caddell
Media and Technology Executive Director, Durham Public Schools

The Honorable David H. Diamont
Representative, North Carolina House

Mr. Bob Hunt
Data Processing Director, Moore County Schools

Ms. Gail Morse, Co-Chair
Business/Industry/Technology Liaison
North Carolina Public School Forum

Dr. J. Frank Yeager
Superintendent, Buncombe County Schools

President Pro Tempore's Appointments

Mr. Noble Dillard
Classroom Teacher, Science Department Chair
Charlotte-Mecklenburg Schools

Mr. Terry Mitchell
Computer Coordinator
Camden County Schools

Mr. Gary Steppe, Co-Chair
Assistant Superintendent
Cherokee County Schools

Dr. Brenda S. Tinkham
Principal, Riverview Elementary School
Hertford County Schools

The Honorable Leslie J. Winner
Senator, North Carolina Senate

Governor's Appointments

Mr. Alan Blatecky
Vice President, MCNC

Dr. Roland W. Doepner
Professor, Mars Hill College

School Technology Commission Members (continued)

Governor's Appointments (continued)

Ms. Jane Smith Patterson
Office of the Governor

Dr. Johnny E. Presson
Retired School Superintendent

University of North Carolina System

Dr. John H. Harrison IV
Associate Vice President
for Academic Affairs, University of North Carolina

North Carolina Community College System

Dr. Parker Chesson
Executive Vice President
Department of Community Colleges

North Carolina Department of Public Instruction

Mr. Bob Etheridge
State Superintendent
North Carolina Department of Public Instruction

Office of the State Controller

Mr. Tom Runkle
Chief Planning and Education Officer

Department of Public Instruction and Legislative Staff to Commission

Mr. Bill Alexander
Director, Government Relations
North Carolina Department of Public Instruction

Ms. Elsie L. Brumback
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North Carolina Department of Public Instruction

Mr. Jim Johnson
Senior Fiscal Analyst
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Dr. Jim Watts
Education Specialist
Research Division/Legislative Services

EXECUTIVE SUMMARY

Introduction

The primary purpose of the *North Carolina Instructional Technology Plan* is to improve student performance and enhance the teaching/learning process through the effective use of technology. Students today must be empowered through the use of technology to think more critically, communicate more creatively, and solve problems more analytically. According to the U.S. Department of Labor's *SCANS* report, the demand for technologically literate workers in North Carolina will increase threefold by the year 2000. In order to facilitate school/curricula improvements and provide students with the needed skills and competencies, a comprehensive, information technology infrastructure is essential.

The School Technology Commission created by the Legislature (G.S. 115C-102.5) first met in January of 1994 to: (1) assess current status and projected use of learning and instructional management technologies, and (2) develop an instructional technology plan that will improve student achievement. The plan was designed as a flexible, cost-effective framework to guide and assist all public school and state agency personnel involved. Appendix A in the *North Carolina Instructional Technology Plan* provides a matrix that compares and contrasts the requirements of G.S. 115C-102.6A with corresponding sections of this plan.

The School Technology Commission believes that the following components of the *North Carolina Instructional Technology Plan* will enable all North Carolina students to access and use technology to improve their productivity and gain the skills necessary to become contributing members of their community and life-long learners:

- mission statement and vision
- instructional technology initiatives
- technical infrastructure
- personnel
- staff development and training
- financial analysis
- monitoring/evaluation
- local school district technology planning process

Requirements Analysis

In developing the *North Carolina Instructional Technology Plan*, the School Technology Commission secured the Center for Educational Leadership and Technology (CELT) to conduct a statewide technology study. Tasks of the study were directly related to the requirements analysis outlined in G.S. 115C-102.6 and include the following: testing assumptions related to the current presence and use of technology in North Carolina schools, studying technology's potential to meet identified instructional goals, and projecting the steps necessary to establish and use effectively all available resources to improve instruction and allow linkage to the global environment.

Two characteristics of the research study established strong credibility to the data that assisted the School Technology Commission's work. First, the research approaches used were diverse and comprehensive -- 975 on-site interviews, 110 focus groups, 1,891 school-level surveys, document reviews, and comparative research. Second, there were high levels of involvement and responses by classroom teachers, school administrators, and community members to the study research and follow-up planning activities.

Recommendations

Based upon the extensive research and planning efforts coordinated by the School Technology Commission, the following key findings, recommendations, and legislative requirements form the foundation for the *North Carolina Instructional Technology Plan* (NCITP).

Findings	Recommendations
1. The use of technology in the schools is fragmented and inequitable.	School systems should adhere to the following schedule for initial integration and implementation unless they can demonstrate to the State Board of Education that an alternative targeting of resources is necessary for the LEA to meet an important instructional need: • *elementary school* -- language arts/ mathematics • *middle school* -- integrated technology and remedial support • *high school* -- information skills/ mathematics/science/vocational and technical education • *state/classroom* -- curriculum development and instructional management systems *(refer to NCITP pages 15 to 28)*
2. Most teachers have very little access to technology and have not been trained to tap the potential of existing technology.	The School Technology Commission and the Department of Public Instruction should develop new models and networks for delivery of staff development activities. These activities should enable teachers to integrate the use of technology into their classrooms to improve learning. *(refer to NCITP pages 37 to 39)*
3. Teacher preparation programs are neither adequately equipped nor prepared to provide staff development and training for aspiring or practicing teachers to use technologies to improve student performance.	Within one year of the General Assembly's acceptance of the Commission's report, the State Board of Education should review policies that relate to the exit competencies of preservice teachers. They should then work with Institutions of Higher Education (IHEs) to develop an implementation schedule that ensures that their graduates demonstrate desired technology competencies prior to their obtaining initial teacher certification. *(refer to NCITP pages 38 to 39)*

4. Few schools have a technology infrastructure to support an effective range of technology tools and applications.	Schools should use the North Carolina instructional technology plan guide entitled *Technological Recommendations and Standards* which includes collaborative procurement strategies to assist in planning and implementing instructional technology initiatives. *(refer to NCITP pages 28 to 34)*
5. Only about 20% of the schools reported having a comprehensive information technology plan to support teaching, learning, and management that includes a voice, video, and data network infrastructure.	All local school districts using the outlined guidelines and criteria must develop a long-range, districtwide information technology plan to be reviewed every two years. The General Assembly, as soon as possible, should allocate to each school district up to 10% of their state appropriated funds to develop a local technology plan based on state-provided criteria, guidelines for approval, and a specified amount of funds expected to be allocated. In addition, the General Assembly should appropriate $450,000 for the development and implementation of a series of planning support services as well as electronic planning tools and templates. *(refer to NCITP pages 49 to 54)*
6. The most frequently identified barriers/problems were lack of funds and ongoing maintenance and support.	Establish a school technology trust fund with a continual revenue stream. A total appropriation of $381 million should be committed to the support of the *North Carolina Instructional Technology Plan* over the initial five years. *(refer to NCITP pages 44 to 47)*
7. Staff support for enhanced curriculum integration and technical assistance/ operation is inadequate and must be increased at all education levels.	The General Assembly should fund or provide an allocation for the approved, but unfunded, Basic Education Program media and technology positions. *(refer to NCITP pages 35 to 36)*
8. More than 50% of the North Carolina classroom teachers using technology indicated having firsthand knowledge of convincing evidence that technology improved student learning.	An ongoing series of formative and summative evaluation procedures must be developed to monitor the implementation of the *North Carolina Instructional Technology Plan* and evaluate its impact on student achievement. *(refer to NCITP pages 47 to 48)*

Summary

The *North Carolina Instructional Technology Plan* is the culmination of a series of research and planning efforts that have been conducted by the School Technology Commission with ongoing support by the Department of Public Instruction. Technology initiatives that differ from those outlined in this plan will require approval by the State Board of Education and notification to the School Technology Commission. The Plan's underlying premise is that by providing a technologically enriched learning/teaching environment in all schools, every student will become more proficient as he/she progresses through the stages articulated in the *North Carolina Standard Course of Study*. Knowing how to apply technology in schools is only the beginning. Developing focused technology initiatives and creating an appropriate "critical mass" of resources at the local and state levels is the next major challenge for North Carolina schools.

STATEWIDE TECHNOLOGY STUDY PROCESS AND FINDINGS

The School Technology Commission, with the assistance of the Center for Educational Leadership and Technology (CELT) conducted a statewide technology study focused on the collection and examination of data in the following areas:

- current use of technology in schools
- instructional goals that technology can meet
- technologies available to meet instructional goals
- determination of a basic level of technology for every school
- required staffing for the technology-supported school system and school
- essential staff development for maximizing benefits of learning and instructional technologies
- projected costs for implementing plans

The multifaceted process employed for data collection, combined with high levels of participation in interviews and surveys, provided the School Technology Commission with a broad sample of exceptionally credible information. An overview of the study process and some preliminary findings follow.

Study Process

CELT implemented various methods of data collection in the study process, including surveys of North Carolina schools, and teacher preparation institutions, interviews with school personnel throughout the state, and focus group sessions conducted in local school districts.

- *Surveys* — Surveys designed to analyze local technology status and requirements were developed and mailed to *all public schools* and *all teacher preparation programs*. Both surveys received a high rate of return, with the majority of the teacher preparation institutions responding and *1,891 (95%) of the 2,000 surveyed schools responding*.
- *Interviews* — Approximately *975 structured interviews were conducted with teachers* and other school system staff in *18 school districts*, including three districts selected from each state technical assistance center (TAC) area. Districts were selected to obtain representation from a variety of geographic regions -- rural and urban, large and small, wealthy and poor. Interviewed staff represented a cross-section of the district's educational community and included teachers, education technology specialists, counselors, administrators, students, and community members.
- *Focus groups* — Three focus groups were conducted in each of the six TACs during a two-week period. Within each school system, participants were selected from both the most technologically enabled and technologically deprived schools. *The 110 teachers who participated were grouped by level (elementary, middle, secondary).*

- *Complementary activities* — As complementary activities to field-based interviews and survey results analyses, CELT staff conducted interviews with state agency personnel, studied technology-related data already collected by North Carolina agencies, examined education technology systems in other states, and reviewed various national sources of literature related to education technology.

Study Findings

Following are major conclusions that were drawn, collectively, from the entire scope of research activities. They are presented in detail, along with related findings, in the study report entitled, *North Carolina Learning and Instructional Management Technologies: Preliminary Findings and Analysis.*

Infrastructure	Few schools have a technology infrastructure sufficient to support an effective range of current technologies tools and applications. Only 6% of surveyed school personnel stated that their schools are currently networked. Approximately 28% of the existing classroom computers are capable of being cost-effectively integrated into the environment.
Access	Most teachers have very limited access to technologies tools and applications. Only 33% of the surveyed respondents reported availability of computers either in the classroom, media center, or computer lab. The reported use of devices such as videodiscs, CD-ROMs, and telecomputing as well as applications such as spreadsheets, graphics, desktop publishing, and hypermedia were dramatically low.
Training	Most teachers place as high a value on training as they do on the amount and quality of technology available in their classrooms. Few have been trained to tap effectively the potential of technologies available to them.
Student Performance	A majority of those reporting any technology use indicated firsthand knowledge of convincing evidence that the use of technology improved student learning.
Leadership	The study found a high correlation between the school principal's level of knowledge and commitment to integration of education technology and the success of a given school's program.
Institutions of Higher Education	At this time, teacher preparation institutions are not adequately equipped or prepared to provide proper staff development and training in technology. School staff rated locally delivered technology-related programs much higher than those provided by institutions of higher education. Teachers who have graduated from North Carolina schools within the last three years are not well-prepared to use and integrate technology into the teaching and learning process.

Barriers

Most frequently identified barriers were access to technology and time to learn and practice applications. Some of the most frequently cited problems were inadequate and inconsistent levels of funding, as well as lack of technical and curriculum integration support.

In summary, these findings highlight several issues/concerns about the status of technology in North Carolina schools that will prevent educators from meeting many of the state's current goals. These issues/concerns include, but are not limited to:

- helping students achieve required computer proficiency skills as mandated by the state board of education prior to high school graduation
- providing students technology-supported environments for developing higher-level thinking and communication skills outlined in the *North Carolina Standard Course of Study*
- producing graduates who are equipped to succeed in post-secondary studies and in fields of employment -- most of which present daily challenges requiring students/employees to demonstrate their ability to access, analyze, and communicate information created by an information- and technology-driven culture and age
- providing equitable opportunities and resources for all students to learn and succeed

LONG-RANGE STATE TECHNOLOGY PLAN

1. Mission Statement and Vision

Because the classroom is the focal point for teaching and learning, the standard for creating a technology-supported school should be set within this context. In so doing, two fundamental characteristics will differentiate the daily surroundings and activities of a technology-supported classroom in North Carolina from most classrooms today. Technology-supported classrooms will be:

- equipped with diverse options for teaching and learning that only technology can offer or make possible
- managed by a knowledgeable, skilled, and motivated teacher who is both comfortable and creative with technology

In support of the first characteristic, students will be provided a technology-rich environment conducive to improving academic achievement in all areas. They will, on a daily basis, be developing and using higher-level thinking and communication skills and engaging in problem-solving activities that model real-life situations.

With the presence of technology such as videodiscs, CD-ROMs, telecommunications, information networks, and desktop publishing, students will work individually or in groups at an appropriate level of challenge or interest. This will allow them to grasp simple and complex knowledge and skills more quickly, accessing and benefiting from resources beyond the school walls, and experiencing the satisfaction of tracking their own progress.

With the local and far-reaching communication that technology makes possible, students will be learning the value and skills of cooperative and collaborative learning, information-age research, and communication in a variety of contexts -- contexts most of them will encounter later in the workplace.

In support of the second characteristic, teachers must be equipped with learning and instructional management technology and be well-trained to use it. They must depart from the traditional lecturing plus seat work model of teaching and become facilitators of learning for each student in the classroom.

With technology providing both a record of a student's academic history and the capacity to manage learning progress and activities, teachers must have the *data and information* they need to individualize instruction/assessment and make other important instructional management decisions. By providing online reference material related to objectives in the standard course of study and accountability requirements, teachers will know the *standard academic expectations* students must meet across the state and guide them toward these achievements without question or confusion.

Further, technology will be used to connect teachers to materials and services within the school, school district, and community. Technology will also link them to many other avenues for instruction via the state information highway. Teachers will have the ability to access a wealth of

media and resources tailored to individual proficiency levels, learning styles, and interests. Technology will unite classroom teachers with other educators, school counselors, community service agencies, professional development information and opportunities, and various learning networks. Teachers will have many sources of *support* to inspire, motivate, and help them become knowledgeable and skilled professionals.

Thus the vision that the School Technology Commission believes will prepare North Carolina students for the twenty-first century is that *all students will be enabled by technology to solve problems, improve their productivity, and gain the skills necessary to become contributing members of their community and life-long learners.* To realize this vision, North Carolina educators must be able to:

- ensure equity of access regardless of geographic location or local economic support
- establish interoperability between and among users in all public school settings
- ensure that appropriate technologies and their applications are integrated into the curriculum as defined by the *North Carolina Standard Course of Study*
- identify professional and technical personnel requirements and competencies
- create staff development programs that maximize the effective use of technology

Lastly, technology will assist teachers in taking attendance, grading, producing report cards, and performing other routine record-keeping tasks. This will enable them to have more time to facilitate the progress of each individual child, group interaction, and learning; to receive support from other educators; and to increase the range and strength of their professional competencies.

The 1990s is an exciting time for North Carolina's schools -- a time of great change and challenge. As educators strive to address the needs of students who will work in the twenty-first century, they must also reassess the role and purpose of the current educational system. In order to provide students with the needed skills and competencies and remove traditional educational barriers, a series of comprehensive and systemic technology initiatives is essential.

Note: At the end of the following sections the state organizations with primary and support responsibility are noted in the sections entitled "Implementation Guidelines" using the abbreviations listed below:

DPI:	Department of Public Instruction
GA:	General Assembly
IHE:	Institutions of Higher Education
IRMC:	Information Resource Management Commission
LEA:	Local Education Agencies
NCIH:	North Carolina Information Highway
P&C:	Division of State Purchase and Contract
SBE:	State Board of Education
STC:	School Technology Commission

2. Instructional Technology Initiatives

In keeping with the content and philosophies of the *North Carolina Standard Course of Study*, the identified instructional technology initiatives will nurture the development of students to become:

- self-directed learners
- complex thinkers
- quality producers
- collaborative workers
- community contributors

The CELT study showed that the following school levels and their accompanying areas of emphasis are most ready for infusion of technology, based on proven effectiveness and the readiness of North Carolina's teachers to integrate technology into these areas of the curriculum:

- *elementary school* -- language arts/mathematics
- *middle school* -- integrated technology and remedial support
- *high school* -- information skills/mathematics/science/vocational and technical education
- *state/classroom* -- curriculum development and instructional management systems

The following four sections will address implementation and integration issues for the identified areas of emphasis at the elementary, middle, high school, and state/classroom levels. For each level, the discussion will include an introduction and identification of need, suggestions for appropriate technology applications, anticipated benefits to students, and guidelines for implementation.

2.1 Elementary School (K-5) -- Language Arts/Mathematics

2.1.1 Introduction/Need

The advent of the information media age has heralded a significant paradigm shift from *product*-oriented to *process*-oriented curriculum in North Carolina's schools. In order to prepare young learners adequately for successful navigation through an increasingly complex information-based society, a set of elementary objectives has been identified and prioritized for the infusion of learning and instructional management technologies. Language arts and mathematics, two curricular areas that have been targeted by the State Board of Education as having primary importance in elementary education, have been cited as areas in which technology can improve student performance and greatly enhance teaching and learning in the elementary school.

Fundamental language arts, mathematics, and social skills constitute the focus of student attention at this stage. In conjunction with developing needs, early elementary learners are grounded in concrete, hands-on experiences. Review and practice of core concepts are facilitated by using a variety of

instructional models in both technology-rich and non-technology-enhanced environments. Basic reading, mathematics, and technology literacy skills emerge as students transition into the upper elementary level where opportunities to access a variety of information resources should prevail. Skill development with respect to listening, speaking, reading, writing, viewing, and presenting becomes an integral component of learning and investigating. Upper elementary learners engage in purposeful, directed learning activities that draw upon both semi-concrete and semi-abstract reasoning.

The teacher plays a critical role in terms of modeling consistent integration of technology to elementary students. By using technology as a tool, educators can seize upon and accentuate "teachable moments," such as sharing student-generated word processed stories utilizing a classroom projection system.

2.1.2 Appropriate Technology Applications

Language Arts

Learners who are building language arts skills can use technology to become self-directed investigators and explorers. They can benefit from the use of computer-assisted instruction technologies such as tutorial, simulation, and content-driven interactive software. In addition, CD-ROM titles offer tremendous potential with respect to interactive storybooks. Writing opportunities abound with the advent of word processing software targeted specifically for young authors. Telecommunications facilitate text-based interactions with others outside the classroom while providing opportunities to engage in purposeful writing. Visual presentation of information is made possible for even the youngest learner through the use of graphics-based software such as drawing, painting, graphing, and charting applications.

Mathematics

In addition to traditional computational skills, elementary students who are investigating the world using mathematical concepts must develop sequential higher-order thinking skills in problem solving, communication, reasoning, and mathematical connections. Technology provides a vehicle to establish and build upon existing competencies, and it allows the math classroom to be connected to the world. Calculators have become as widely accepted a tool in the student's book bag as pencils. Drill and practice software titles and content-specific software assist the young learner in mastering discrete numeration, measurement, and computational skills. Simple database and spreadsheet creation can lead to improved problem solving and visual expression of statistical information. Young learners can explore patterns and sequences by using the appropriate drawing/painting or pattern-based software. Today's students must be able to articulate math problems and solutions in a narrative format. Explaining problems via word processing and graphical software can be an important means of fulfilling that objective.

2.1.3 Student Benefits

Across all disciplines, but particularly important in the areas of language arts and mathematics, instructional technologies offer elementary students a broad spectrum of learning activities geared to the many levels seen at this rapidly changing developmental stage. Educators within elementary schools embracing heterogeneous grouping require a multitude of resources to provide a classroom which is diverse enough to address the needs of each learner in an engaging and appropriate fashion. Technology, as a motivator to learning, has also shown to be very successful with at-risk students by providing positive reinforcers, building self-esteem, and initiating remediation in the elementary years.

Language Arts

Although national standards in the area of language arts have not yet been clearly articulated, they are currently under development. The *North Carolina Standard Course of Study* has delineated competency goals and objectives that address the areas of reading, writing, speaking, listening, viewing, and presenting. At the elementary level, these expectations translate into measurable student performances such as:

- competence to learn in real-life situations
- increased reasoning, decision making, and complex problem solving
- evidence of self-directed learning
- effective use of communication

Technology is of particular value when applied to the writing process. Word processing software intrinsically lends itself to the drafting, revision, editing, and publishing phases of student writing. Elementary learners are naturally attracted to technology as a means by which to harness their boundless desire to process and interpret the world around them.

Mathematics

The National Council of Teachers of Mathematics (NCTM) supports the use of technology as an inquiry tool in the movement toward symbolic understanding of mathematical concepts. In addition, the *North Carolina Standard Course of Study* identifies student performances relating to the following process skills:

- observing
- classifying (concrete)
- using space/time relations
- using numbers
- communicating
- inferring

- predicting
- interpreting data (at the rudimentary level)
- formulating hypotheses (simple)

At the elementary level, development of higher-order thinking skills, such as recognizing, describing, problem solving, analyzing data, and estimating are also performances that can be strengthened through the incorporation of technology into the mathematics program.

2.1.4 Implementation Guidelines

The School Technology Commission recommends the following:

2.1.4.1 Structure a technology-oriented environment which supports and perpetuates the innate sense of curiosity and wonder that children bring with them as they enter school, while simultaneously allowing them to learn to use technology effectively as a tool. [LEA]

2.1.4.2 Incorporate some degree of hands-on instruction surrounding the use of discrete applications such as educational games and graphics-enhanced rudimentary word processing software. [LEA]

2.1.4.3 Continue to integrate technology into school library media centers to strengthen language arts/information skills and math simulations. [LEA, DPI]

2.1.4.4 Create in elementary students a sense of delight in "reaching out to learn" through the use of introductory telecommunication experiences which are often accompanied by interdisciplinary curriculum materials, especially in math and language arts. [LEA]

2.2 Middle School (6-8) -- Integrated Technology and Remedial Support

2.2.1 Introduction/Need

With the inclusion of technology competency testing at the middle school level proposed to begin between 1995 and 1996, educators and the State Board of Education have identified mastery of the technology competencies described in the *North Carolina Standard Course of Study* as a high priority. Current educational pedagogy does not encourage the attainment of technology competencies in isolation at any instructional level. As a result, curriculum must be defined as the integration and infusion of instructional technologies with existing and emerging curriculum. North Carolina middle school educators must seek to achieve the delicate balance of teaching and learning *"about technology"* with the task of teaching and learning *"with technology."*

Based upon the statewide technology study, computer skills, communication skills, mathematics, and science were identified as priority areas at the middle school level. It is recommended that the first initiatives to align the middle school computer skills articulated in the *North Carolina Standard Course of Study* should involve the disciplines of communication skills (oral, written, visual), mathematics, and science.

The nature of these alignment and integration activities will take into consideration the unique developmental needs of the middle school learner and provide opportunities which:

- nurture emerging higher-order thinking skills
- formalize team membership and cooperative learning skills
- establish self-confidence and self-esteem

Within middle school classrooms across the state, North Carolina educators must provide students with role models for using technology to become effective and efficient users of twenty-first-century tools and resources. The *North Carolina Standard Course of Study* emphasizes word processing, database, spreadsheet, and telecommunication mastery at the middle school grades. These productivity tools are ideally suited to curriculum integration activities.

In addition, technology at the middle school level will be used to assist students who demonstrate a need for improving basic skills. Computer-assisted instruction technologies (e.g., tutorial, simulation, and content-driven interactive software) that are age-appropriate will be incorporated into instructional programs for these middle school students.

2.2.2 Appropriate Technology Applications

Integrated Technology

Schools within North Carolina have the ability to address developing computer skills at grades six, seven, and eight with a conservative investment in software due to the emphasis on productivity tools at this level. Upgrades and enhancements to familiar integrated applications continue to appear on the educational software market annually. Attractively priced site licenses and network versions make access to comprehensive productivity packages (including word processing, spreadsheet, database, graphics, and presentation) and telecommunication capacity affordable to all schools.

The statewide technology study recommends the emphasis be placed on:

- design, presentation, productivity, and research technologies to address the middle school computer and communication skills goals and objectives
- data manipulation technologies in the form of graphing calculators and spreadsheets in the discipline of mathematics
- research (electronic encyclopedias and databases, visual archives, online access and data collection projects), presentation (laser video, presentations, multimedia), and data manipulation (computer-linked probes and meters) technologies for inclusion in the middle school science curriculum

The middle/junior high population is a highly mobile group. Those schools that have embraced the true middle school concept of cluster/team teaching also enjoy flexibility of scheduling and regrouping on a regular basis. The instructional technology solutions selected for this level will address this movement and flexibility. Most middle school educators find the need for a computer lab as well as ready access to computers within their classrooms. Peripheral devices such as laserdisc players, scanners, video cameras, probes, and projection equipment need to be readily available within the teaching cluster. The middle school concept is conducive to sharing these resources among teachers within the same teaching team/cluster. Middle schools within North Carolina would be wise to purchase a number of mobile (desktop models on mobile carts) and/or portable (laptops or notebooks) computer systems to maximize usage and support flexibility.

Remedial Support

Although educators may be inclined to aim a host of computer-assisted instruction (CAI) applications at the student who has not mastered core competencies by the middle school grades, it is the responsibility of school staff to identify the means by which each individual student requiring remediation learns best. As articulated in the statewide technology study, "If children can't learn the way we teach, we must teach the way they learn." Instructional technology applications provide teachers with many ways to tailor learning experiences to each student's learning style and strengths. The learner must not be considered at fault, but rather lacking the approach and resources to address his/her learning style. To attempt remediation in the manner that has failed the student to date will not lead to the desired results. Educators will continue to need professional development in the process of identifying individual learning styles and aligning appropriate instructional technology solutions to allow the student with remedial needs to achieve mastery of core competencies.

2.2.3 Student Benefits

Integrated Technology

Students graduating in the year 2000 and beyond will be masters of basic technology productivity tools, seekers of knowledge, and quality decision makers. The initiatives prescribed for the middle school student will allow required skills to be mastered while simultaneously allowing for students to investigate personal areas of preference within the disciplines.

The computer skills listed in the introduction of the *North Carolina Standard Course of Study* will be interwoven across the disciplines of communication skills, mathematics, and science. The learning and instructional management technologies will facilitate the attainment of proficiency of the math, writing, science, and research process skills articulated in the *North Carolina Standard Course of Study.*

North Carolina students will engage in technology- and non-technology-based activities focused upon exercising their higher-order thinking skills. The middle school years will be critical for providing a host of opportunities to sharpen this population's higher-order thinking and problem-solving skills.

The infusion and integration of core technology competencies to attain proficiency in the areas of math and science are clearly in parallel with emerging and existing national standards, specifically the math (National Council of Teachers of Mathematics) and science (National Science Teachers Association) standards.

Remedial Support

Technology applications used for remedial support provide "at risk" populations at the middle school level remediation in a motivating, rewarding, individualized, and confidential arena. Although concepts addressed may be well below the assigned grade level, material can be presented in a developmentally appropriate and engaging fashion, thus preserving and enhancing the student's self-esteem.

2.2.4 Implementation Guidelines

The School Technology Commission recommends the following:

2.2.4.1 Embrace an integrated approach for linking core technology competencies with content objectives and process skills. [LEA, DPI]

2.2.4.2 Provide teacher workstations with large group presentation capacity so that teachers can role model the use of technology to present information and direct and manage collaborative activities. [LEA]

2.2.4.3 Establish sufficient computer labs to provide adequate access in order to facilitate the mastery of computer skills identified at the middle school level. [LEA]

2.2.4.4 Equip all classrooms with student workstations for the continuation of instructional activities begun in the computer lab including, but not limited to, the use of word processing in communication skills activities, spreadsheets, databases, and simulations in both math and science activities. [LEA]

2.2.4.5 Provide students and teachers access to powerful and engaging electronic databases and encyclopedias (CD-ROMs, laserdiscs, floppy disks) and online access to global information sources (commercial services, Internet, university systems, experts) for research awareness activities through the library media centers in North Carolina middle schools. [LEA]

2.2.4.6 Centralize remedial curricular resources through a school and districtwide network infrastructure, allowing teachers access to these resources for students "at risk" of not mastering basic skills on an as-needed and appropriate basis. [LEA]

2.3 High School (9-12) -- Information Skills/Mathematics/ Science/Vocational and Technical Education

2.3.1 Introduction/Need

By the time a student reaches high school, he/she has been exposed to and has used many different technologies. During the next four years of schooling, a student needs opportunities to practice with different technologies in a variety of real-time situations in order to achieve mastery. Areas stressed by the School Technology Commission for initial infusion of technology are information skills, mathematics and science, and business education and tech prep. Technology initiatives should be undertaken that continue to introduce state-of-the-art technologies to strengthen information skills, enhance and align the disciplines of mathematics and science, and address vocational education with the emphasis on business education, tech prep, and school-to-work programs.

During the study that aligned technologies with curriculum, the 11 disciplines covered in the *North Carolina Standard Course of Study* were ranked for effectiveness based on study findings. At the high school level, information skills, mathematics, science, and vocational education appeared respectively in that order of priority for infusion of technologies.

The *North Carolina Instructional Technology Plan* describes the vision that will prepare high school students for twenty-first century living. It addresses the developmental needs of high school students and the learning and teaching activities that use technology as a tool. The developmental needs of high

school learners are to:

- formalize higher-order thinking skills
- experience real-world environments
- develop a sense of community membership

The learning activities should be relevant to the world in which they live. With technology providing access to powerful databases, electronic mail, and multimedia tools, the teacher should assume the role of mentor, coach, mediator, and partner in investigation while guiding the students in their learning.

2.3.2 Appropriate Technology Applications

The statewide technology study identifies the specific technologies that align to the curriculum areas at the high school. All technologies are appropriate for high school students ranging from the low-cost word processors used by all students to the high-cost technology systems such as CAD and micro-based science laboratory systems.

Information Skills

Specifically to address information skills, the appropriate technologies include:

- distance communication services
- presentation and graphics software
- productivity software tools
- research archives and telecommunication services

Mathematics

The National Council of Teachers of Mathematics (NCTM) acknowledges instructional technologies as a natural complement to their emerging standards. For example, the use of graphing calculators and computers for conceptual understanding, symbol sense, and mathematical modeling closely aligns with algebra content and concepts. The study identified the following learning technologies as appropriate for the secondary student in the attainment of mathematical concepts:

- data manipulation (graphing, charting, statistical analysis, spreadsheet software, and data collection devices)
- productivity and research technologies
- presentation applications to communicate research data and theory development
- distance communication resources to gather data globally and participate in a full range of advanced mathematics courses

Science

According to the National Science Teachers Association (NSTA), the umbrella of science should consist of multiple integrated modules (life science, physical science, earth science, scientific reasoning, and technology) that should be taught concurrently. Given this approach, science, like math, focuses largely on real-world problems and situations to which the learner must find solutions. Possible technology applications centering on the field of science include, but are not limited to:

- videodisc/CD-ROM collections for use as a highly visual aid, motivating students based upon exploration of real world experiences and interactive simulations/ models
- graphing calculators or microcomputer-based laboratories that include sensors and probes for conducting scientific experiments and for collecting, organizing, comparing and sharing data
- telecommunication applications which are often used in scientific discovery to share scientific data, gather results that are posted to national bulletin boards, conduct significant research, and compare results
- decision-making groupware that allows large group participation in current environmental issues while facilitating open-ended exploration of significant problems

Vocational and Technical Education

For vocational and technical education (business education and technology preparation programs such as tech prep), the appropriate technologies identified are the same as those for information skills, but with less emphasis on presentation and more on management applications (outlining, calendaring, and scheduling; and project, portfolio and financial management). In addition, technology for vocational education suggests the following technologies:

- data manipulation (graphing, statistical analysis, and data collection)
- creation (patterns, drawing, digital photography, broadcast production, thought generators)
- design (robotics, CAD/CAM, and choreography)

In addition to the above disciplines, all curriculum areas at the high school level can use computer-assisted instruction technologies appropriately for tutorials, theme-based courseware for content-specific instruction, and simulations for cooperative learning.

2.3.3 Student Benefits

Within the *North Carolina Standard Course of Study*, process skills are outlined for research, writing/communication skills, mathematics, and science. In addition, based upon contempo-

rary education technology research, these process skills should be integrated with higher-order thinking skills. The higher-order skills that should be addressed in high school and supported by technology are analysis, synthesis, and evaluation of information.

Information Skills

Through the application of research technologies networked throughout the school via the school library media center (telecommunications, electronic encyclopedias and databases, visual archives, and remote libraries), students will develop the capacity to access, analyze, and interpret vast information resources. By increasing access and diversifying research projects using technology, high school students will develop their capacities as life-long learners.

Mathematics

The infusion of learning technologies in the area of mathematics as articulated in study documents embracing the National Council of Teachers of Mathematics standards will pave the way for North Carolina students to excel in math and science achievement. Students will engage in problem-solving, communication, reasoning, and mathematical concepts at high levels in real-world settings. Basic numeration and computation skills attained in prior grades will becomes the tools of the secondary school mathematician in algebra, trigonometry, calculus, and geometry.

Science

The collection, manipulation, and interpretation of data to create new knowledge and hypotheses are fundamental skills of the high school student. Data management technologies (hardware and software) increase the level of mastery for higher-order thinking and processing skills which the student will possess throughout life.

Vocational and Technical Education

Technology preparation and school-to-work programs also fall under the jurisdiction of vocational education in the high school. Business education is a part of the vocational education curriculum as well. Competency-based programs in these areas will involve technologies in order to prepare the students:

- for employment in emerging occupations
- for participation in advanced or highly-skilled post-secondary education
- with lab experiences that assist them in making informed decisions and in the application of practical life skills

2.3.4 Implementation Guidelines

North Carolina's overall funding cycle for technology assumes that high schools will receive an infusion of state funds upon attainment of goals at lower levels. Assuming all students arrive at high school with mastery of computer skills, they are ready to apply technology to their independent learning activities. Thus, the School Technology Commission recommends the following implementation strategies:

2.3.4.1 Continue to integrate technology into the library/media centers in order to strengthen information skills and align these technologies with access to global information resources. [LEA, DPI]

2.3.4.2 Continue to embrace and incorporate the NCTM and NSTA standards at the secondary level through the ongoing revision of curricular objectives and activities. [LEA, DPI]

2.3.4.3 Infuse vocational and technical education programs with technology in order to prepare students to enter the world of work from a business education curriculum or a school-to-work program that has provided them with the technical skills needed to proceed to a technical college. [LEA, DPI]

2.3.4.4 Ensure the availability of technology for scientific experiments and simulations of real-life problems in order to strengthen the student's mastery of higher-order thinking skills. [LEA]

2.3.4.5 Establish evaluation processes to ensure the quality of technology's impact on teaching and learning in all subject areas. [LEA, DPI]

2.3.4.6 Evaluate remaining high school curriculum areas for technology needs and prioritize for technology integration as funding becomes available. [STC, DPI]

2.4 State/Classroom -- Curriculum Development and Instructional Management Systems

2.4.1 Introduction/Need

Technology that can assist educators in developing curriculum and managing instruction can be found in relational database software systems. These systems align curriculum, instructional resources, assessment, and student information. Such systems allow for the orderly and integrated flow of large quantities of information that impacts teaching, learning, educational management, and decision making at all levels. With this type of technology tool, educators are able to articulate and record learning goals and expected student performances as they relate to the selected curriculum and state initiatives. Once performances are created, these software tools allow for the detailing

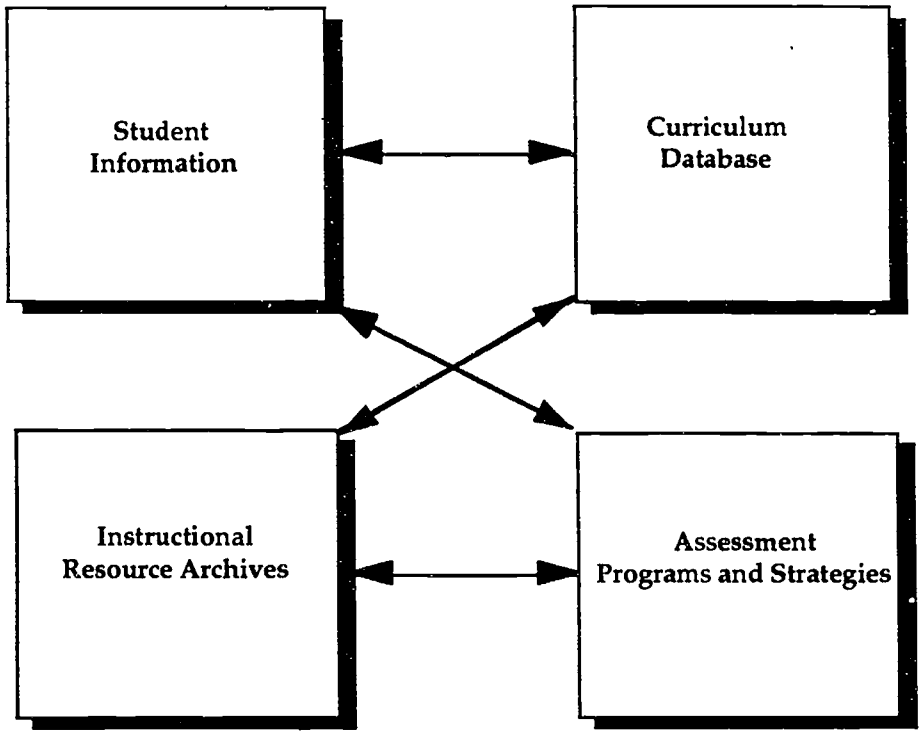
of instructional resources (software, video, manipulatives, text, etc.) as they support the teaching processes/strategies that will lead to student mastery. Student assessment can also be correlated to performances. By electronically linking curriculum, learning, and assessment, curriculum development/instructional support software provides the integrated information necessary to improve the educational process.

2.4.2 Appropriate Technology Applications

North Carolina has the opportunity to use powerful relational database solutions to link the *North Carolina Standard Course of Study* with technology resources and all other instructional resources. Relational database software designed for curriculum development and instructional management must link curriculum, instructional, and networked resources; assessment; and student information databases.

Figure 1 demonstrates the recommended curriculum alignment process available through the application of technology using curriculum development/instructional management software.

Figure 1: Recommended Curriculum Alignment Process



2.4.3 Student Benefits

When technology is used to facilitate the curriculum development process at *both the state and local levels*, students will be provided a clearer understanding of the educational goals they must achieve. From an instructional management perspective, students will be provided a more accurate assessment of their performance and can immediately identify support resources.

2.4.4 Implementation Guidelines

The School Technology Commission recommends the following:

2.4.4.1 Conduct an analysis of curriculum development and instructional management needs at the classroom, school, district, and state level. [DPI]

2.4.4.2 Evaluate existing curriculum development and instructional management software applications. [DPI]

2.4.4.3 Establish guidelines for a co-development relationship with appropriate software vendors in order to retrofit their software applications to meet North Carolina's curriculum development and instructional management needs. [DPI]

2.4.4.4 Distribute customized curriculum development and instructional management system software and related databases to schools. [DPI]

3. Technical Infrastructure

3.1 Introduction/Need

The primary purpose of this section is to present the essential technical considerations for implementing the *North Carolina Instructional Technology Plan* (NCITP). It addresses the following three main objectives that are fundamental to the development and execution of long-range technology plans:

- establishing uniform practices and procedures based on collaboration and connectivity
- establishing technical standards and recommendations for model configurations
- retrofitting present equipment, addressing the issues of older buildings, and wiring and cabling instructions

The technical standards provide a foundation for the consideration of and planning for collaborative efforts among local, regional, and state-level groups. They also serve as examples, aids, and references for assisting local schools in developing plans and building individual technical facilities.

Technical infrastructuring support is one key issue of the *North Carolina Instructional Technology Plan*. Support areas are of particular importance to the usefulness of the state plan, the worthiness of the individual school technology plans, and the ultimate success of the technical infrastructure at the local school buildings. Areas of primary interest include personnel (e.g., numbers, types, and organization of staff), training, purchasing (e.g., potential use of statewide, high-volume discounts and minimization of administrative efforts), and management (e.g., use of common staffing resources and facilities for managing software, providing technical assistance, and performing research and development tasks).

The proper implementation and employment of current, available technology (including hardware, software, and communications) have been considered in creating recommendations and standards. Much more emphasis, however, has been placed on the ability to (1) accomplish an orderly and cost-effective scalability and growth of technical resources (i.e., the transition from standalone workstations to local-area networks or LANs, from networked labs to schoolwide networks, and school networks to a wide-area network or WAN); (2) achieve widespread and effective communications with the outside world, as economically practical; and (3) address the connectivity issues of security, instructional resource availability, and adequate human resources.

The technical standards have been developed through a logical and iterative process, beginning with the instructional requirements for achieving expected student performances identified in the state's *Standard Course of Study*. Representative applications software packages that target important categories of education technologies were identified and alternative hardware and network configurations were formulated based on software requirements and emerging trends.

Through the use of support resources, the *North Carolina Instructional Technology Plan* offers a unique and far-reaching opportunity for the state to address technology implementation. The form and focus of the supporting resources must link directly to the methods and practices of implementing the technical standards. Without adequate, well-managed, and appropriately organized supporting resources, the technical standards will fail to contribute significantly to the achievement of instructional goals.

3.2 Uniform Practices and Procedures

The *North Carolina Instructional Technology Plan* recommends a series of uniform practices and procedures (associated with the technical infrastructure) that provides opportunities for statewide economies of scale in procurements, training, support, planning, and operations. The recommendations also strive to ensure successful implementation as well as cost-effective, ongoing support and operation of the technical components and are organized based upon the need for collaboration and connectivity among the schools.

3.2.1 Collaboration

It is imperative that schools work together at local, regional, and state levels in order to achieve a critical mass that will empower them to drive the technology market and procure equipment and services at dramatically reduced rates. Funding strategies and acquisition activities must be well-planned, organized, and coordinated. This unified effort may have many partners, including local education agencies, the Department of Public Instruction, universities, community colleges, private colleges, regional consortia, local governments, businesses, or other appropriate organizations. It is recommended

that collaborative undertakings be considered for the following areas:

Purchasing	By joining efforts, educators can purchase hardware, software, supplies, maintenance, and support at greatly reduced rates.
Evaluation	Hardware test sites and software assessment centers would enable school personnel to become more competent technology decision makers. Results would be used for statewide contracts.
Support	Sharing support personnel (technicians, resource personnel, and North Carolina Information Highway facilitators) is a viable alternative for smaller schools and LEAs who otherwise could not afford such resources.
Maintenance	School districts must explore the possibility of forming partnerships with each other or with other local entities to address maintenance and repair service needs.
Training	Consolidation of training efforts for professional, technical, and support personnel must be investigated.
License management	Centralized management of software licenses and upgrades will be beneficial for many schools.

The importance of this coordination of efforts must not be underestimated. If this approach is undertaken seriously and energetically by the educators in North Carolina, not only will scarce resources be used more effectively, but eventually collaborative decision making will emerge.

3.2.2 Connectivity

School districts need to devise a comprehensive technology plan that can be implemented in phases. This plan should embrace the concept of connectivity, which is simply the linking of technology by wires, communication devices, and compatible software to facilitate rapid communication throughout the school. The initial phase of the plan will include implementation of the core infrastructure that will provide a basis for future procurement decisions and reduce the need for additional retrofitting.

Among the issues that impact connectivity decisions are the following:

Security	A hierarchy of rights for network users (students, teachers, administrators, etc.) will be used to control access to the server and other resources.
Support	Technical and instructional support are critical components. It is recommended that school districts investigate the possibility of sharing human resources.
Resource availability	Schools must plan for outside connections in order to access resources otherwise unavailable at the school, district, or regional levels.
Wiring	All new buildings need to be wired for data, voice, and video transmissions in accordance with IRMC guidelines. Older facilities should include retrofit plans that are feasible and attainable.
Electronics	Plans will include the installation of wiring closets. Then, as design phases are implemented, appropriate electronic components can be installed within the closets.
LAN	Local-area networks -- the linking of computers over a relatively small geographic area -- will be part of an integrated model of networked schools. This design will connect most or all parts of the school, so that technologies and databases are accessible and useful wherever they are needed.
WAN	Wide-area networks enable users to connect to sites outside the school, expanding student, teacher, and administrator outreach to external resources, databases, library resources, video retrieval, and to other individuals. The plan for a wide-area network will include a router and network connections.

3.3 Technical Standards

3.3.1 Determining Requirements

One of the most important concepts in technology planning is that curriculum and instruction decisions must be the driving force behind the selection and purchase of software and hardware solutions. The *North Carolina Standard Course of Study* provides a framework for the basic curriculum. It states that developing critical thinking skills and integrating technology into the curriculum are essential. In addition to this basic framework, the *North Carolina Standard Course of Study* dictates that each school must assume the responsibility for identifying the special needs in that particular learning environment.

When selecting learning and instructional management technology resources, educators need to consider the following:

- developmental needs of the K-12 instructional levels
- diverse learning styles and multiple intelligences
- exceptional abilities and aptitudes

There are many excellent software packages that target these important considerations. These software programs can be referenced by disciplines.

3.3.2 Model Hardware/Software and Network Configurations

Model hardware/software and network configurations have been developed to assist in the purchase, training, support, planning, and operation of the four instructional technology initiatives described in the *North Carolina Instructional Technology Plan*. These model configurations are listed below:

- network-ready workstations
- self-contained networked lab
- distributed schoolwide network
- library/media center
- instructional management systems

A mixture of configurations -- full labs, mini-labs/clusters, (even standalones) -- is the ideal solution for most schools. These can all be connected by school/districtwide networks. This blend of configurations allows for curricular needs to drive the selection of hardware based upon software availability.

Schools may eventually have more than one server and move toward a networked model designed to connect most or all parts of the school. Careful, ongoing planning is an integral part of creating a viable technology infrastructure. It is unlikely that two schools will develop the same technology plans or implement the model configurations in exactly the same way.

3.3.3 Other Considerations

There are other areas which must be addressed when planning for technology. These considerations fall within the realm of facility retrofit. It is important to determine what is required to bring a given school facility up to signal distribution (data, voice, and video) and electrical supply standards necessary to install the schoolwide basic technology program. North Carolina has established a set of standards for networking, cabling, and telecommunications. Schools may decide to use these standards when developing their plans. Heating, ventilation, air conditioning, environmental issues (noise, radiation, lighting), furniture, and space requirements also need to be addressed.

3.4 Supporting Documents

The Department of Public Instruction (DPI), the Information Resource Management Commission (IRMC), and the North Carolina Information Highway (NCIH) project have developed a series of technical standards, recommendations, statements of direction, and other aids to assist schools and districts in implementing a wide range of instructional technology. Appendix B references all of the documents available to support the technological infrastructure needed to implement the four instructional initiatives.

3.5 North Carolina Information Highway

The North Carolina Information Highway (NCIH) is a bold and far-reaching initiative that offers the potential for providing enormous benefits to the state. Applications that can be put to use for the public schools include: (1) distance learning that enables students in rural areas to receive the same quality and breadth of courses as their peers in metropolitan districts and allows urban districts to offer a more substantial range of courses economically; (2) ongoing (in-service) training of teachers that is conducted without requiring teachers to travel to training sites; (3) global connectivity to enrich the learning environment by allowing teachers and students to access leading libraries, access remote information sources (databases), and converse with other students and colleagues; and (4) improvement of the exchange of data and streamlining the distribution and management of software in the classroom.

To obtain the full range of benefits presented by the NCIH, the following objectives must be met.

- The NCIH must be able to offer more cost-effective services.
- Applications utilizing the transmission of data must be further developed.

- The schools must install the technical infrastructure (e.g., multimedia workstations, servers, LANs, and audio/video facilities) and the support staff necessary to take advantage of the high-speed communications capabilities of the NCIH.
- The model school site staff must develop new instructional programs that are appropriate for meeting the changing needs of students.

Initially, the NCIH is focusing on audio/video-based applications, such as distance learning.

The NCIH management, located in the State Controller's office, should: (1) develop a migration path that permits a school to participate initially in the NCIH by connecting in a cost-effective manner to information networks; and (2) develop a series of incremental technology capabilities and benefits on the way to full deployment. Until further instructional applications of the NCIH are developed, LEAs should use state technology funds for the NCIH only if that expenditure is clearly appropriate to meet an important instructional need.

3.6 Implementation Guidelines

The School Technology Commission recommends the following:

3.6.1 Establish a requirement that devises a comprehensive, long-range plan to include a core technical infrastructure, providing a basis for future procurement decisions and thus reducing the need for additional retrofitting. [LEA, DPI, IRMC]

3.6.2 Develop guidelines that will encourage schools and other government agencies to work together at local, regional, and state levels in order to achieve both a critical mass and economies of scale that will empower them to drive the technology market and procure hardware, software, and services at dramatically reduced rates from volume discounts. [LEA, DPI, IRMC]

3.6.3 Use the North Carolina Instructional Technology Plan Guide: *Technological Recommendations and Standards* to assist in planning and implementing instructional initiatives. [LEA]

3.6.4 Use state-established guidelines for purchasing new resources and creating the standards by which current school technology programs may be assessed. [LEA]

3.6.5 Develop a migration path that permits a school to participate in NCIH initially by connecting to information networks in a cost-effective manner. [NCIH]

3.6.6 Develop a series of incremental technology capabilities and benefits that schools can use on their way to full deployment of the information highway. [NCIH]

4. Personnel

4.1 Introduction/Need

The effective implementation of the *North Carolina Instructional Technology Plan* will be impossible without the availability of trained professional staff. These individuals should represent a variety of career paths: school-level media coordinators, system-level media supervisors, instructional technology specialists, school-based instructional technology teachers, and technicians. These school- and system-level personnel will require a strong support system from both the Technical Assistant Centers and the Raleigh-based staff of the Department of Public Instruction.

4.2 Professional and Technical Requirements

The need for technology expertise and assistance at the state level has already been addressed by the Legislature in G.S. 1125C-102.7 (f). In this section, the Legislature appropriated funding for six technology specialists to be housed in the TACs. These specialists will work collaboratively with media and technology personnel on a diverse array of technologies and their integration into the instructional process.

In North Carolina, colleges and universities are accredited by the State Board of Education to offer graduate degree programs for the following positions and areas of expertise:

- school library media coordinators (076)
- system-level media supervisors (078)
- instructional technology specialist -- computer (077)
- instructional technology specialist -- telecommunications (074)
- Special Endorsement in Computer Education (079)

Professionals certified in these areas will focus upon helping local school systems plan for technology and its integration into the instructional program within individual schools. Additional individuals or contracted service providers will be needed to maintain and repair all types of equipment, including the network.

4.3 Funding Options for Personnel

Since current legislative funding for technology is limited to non-recurring funds, the School Technology Commission recommends that the Legislature consider using some of the remaining Basic Education Program (BEP) positions to acquire the personnel needed to provide leadership and expertise in building and maintaining technologically rich education environments. Thus, the School Technology Commission recommends that the 1,000 BEP positions allocated originally for school media coordinators be broadened to include any of the personnel certified in the five media and technology categories. Further, the School Technology Commission recommends that the instructional assistant positions, targeted for computer and media labs, be converted to a dollar amount that would be

distributed to schools on a "floor plus ADM" allocation. Since schools and school systems already have a variety of media and technology programs in place with various configurations of staffing, these recommendations would allow enough flexibility for LEAs to build upon previous personnel decisions by either adding additional staff where needed or securing cost-effective contracted services.

The suggested personnel prototype in Appendix C is based on Commission members' own experiences and expertise in this area, as well as on recommendations from outside consultants and professional organizations.

4.4 Evaluation

Evaluation of the effectiveness of staffing options within individual school systems should be tied to program evaluation. Sample evaluations should include, but not be limited to:

- End-of-Grade/End-of-Course (EOG/EOC) test scores
- questions regarding the effectiveness of staff development activities both within the school and throughout the school system
- user-satisfaction surveys regarding maintenance/repair visits
- evaluation of resource support (i.e., circulation/use statistics, collection maps, collection development plans)

4.5 Implementation Guidelines

The School Technology Commission recommends the following:

4.5.1 Fund personnel to support local technology plans, guided by the prototype presented in Appendix C, with emphasis on addressing both professional and technical requirements at the building level. [LEA]

4.5.2 Fund certified media and technology positions, originally approved under the Basic Education Program, and allocate to schools on the basis of 1-to-60 teachers, with every school system receiving at least one position. The phase-in schedule should be:

- 40% of positions -- Year 1 [GA]
- 20% of positions -- Year 2 [GA]
- 20% of positions -- Year 3 [GA]
- 20% of positions -- Year 4 [GA]

4.5.3 Ensure staffing requirements, if necessary, be met using a phased-in approach, with provisions for waivers as necessary. [LEA]

4.5.4 Convert instructional assistant positions originally approved under the Basic Education Program for staff media and computer labs, to a dollar amount and

allocate to school systems on a phased-in "floor plus ADM" basis. This will provide technical support and assistance at the building level. These funds may be used for either technical personnel or service contracts. [GA, LEA]

4.5.5 Review certification competencies required of all media and technology graduate programs to ensure currency and relevance, within one year of the State Board of Education's acceptance of the *North Carolina Instructional Technology Plan*. This should be done by the State Board of Education. [SBE, DPI]

5. Staff Development and Training

5.1 Introduction/Need

The School Technology Commission believes that appropriate and adequate staff training will be the "key to success" regarding the utilization of technology to improve student learning in North Carolina schools. Further, the School Technology Commission recommends that all future endeavors relative to education technology have an ongoing staff development and training component that recognizes technology as being in a state of continuous change. The potential benefit that students can derive from the integration of technology in the classroom requires that North Carolina teachers become trained and updated in technology use on a regular, timely basis.

Twenty years of research assert that the future learner must be an *active* learner, that is, one who plays an active role in the acquisition, analysis, and organization of knowledge and skills. To develop such learners, the classroom teacher must be the one who *facilitates* learning, rather than inculcates "instruction." Such learning must be situational, enabling students to draw meaning from their learning experiences in a context.

G.S. 115C-102.6 recognizes the validity of this interrelationship between classroom use of instructional technology and the need for staff development of North Carolina teachers in this area. The findings of the external consultant (CELT) re-emphasized the significance of this relationship with data from North Carolina teachers and other educators suggesting that staff development and training were as important to them as the technological tools themselves. Such staff development requires small group collaboration in classroom settings. Here, teachers build upon existing knowledge about curriculum and practice and have opportunities to experiment and reflect upon new experiences. Providing ongoing support for change and implementation of technology ensures that this training will have a continuing effect in the classroom.

5.2 Implementation Guidelines

The following implementation guidelines will ensure that staff development and training plans are in compliance with G.S. 115C-102.6.

The implementation guidelines for staff development and training are clustered according to the following areas -- curriculum and technology integration, preservice teacher education, leadership training, and state/regional support.

The School Technology Commission recommends the following:

5.2.1 Curriculum and Technology Integration

5.2.1.1 Provide timely staff development opportunities in order to create instructional units that integrate content objectives and process skills with appropriate technology competencies for enhanced student learning. [DPI, IHE, LEA]

5.2.1.2 Involve teachers working collaboratively in teams using technology as a learning medium for staff development models such as "train-the-trainers." [DPI, IHE, LEA]

5.2.1.3 Include a staff development budget allocation based on 20% to 30% of the total technology program cost. One half of the staff development cost (up to 12.5%) may be paid from state-appropriated school technology funds and the remaining half from other sources, including community partnerships and/or local, state, and federal staff development budgets. [LEA]

5.2.2 Preservice Teacher Education

5.2.2.1 Review policies that relate to the exit competencies of preservice teachers, revise certification and recertification requirements accordingly, and work with IHEs to develop an implementation schedule that ensures that their graduates demonstrate desired technology competencies. This should be done by the State Board of Education within one year of the State Board of Education's acceptance of the School Technology Commission's report. [SBE, DPI, IHE]

5.2.2.2 Require all accredited teacher education programs to incorporate technology application modules within every methods course. Encourage higher education staff, through their own staff development, to model the use of a variety of technologies appropriate to individual courses and subject matter. [SBE]

5.2.2.3 Prepare and disseminate a series of distance learning telecourses for regular and preservice teachers. DPI should utilize the Federal Star Schools grant and ensure these programs be designed to incorporate real-time examples of the teaching and learning process as it relates to technology use and the understanding of educational theory. [DPI]

5.2.3 Leadership Training

5.2.3.1 Implement training programs designed to instruct North Carolina school administrators (e.g., Principal's Executive Program, IHE graduate programs, etc.) about the skills and resources needed for integrating technology into the instructional process. [DPI, IHE]

5.2.3.2 Explore, evaluate, and implement a variety of models for school-level technology leadership training to include:

- a "train-the-trainers" approach using the delivery resources of an interactive broadcasting technology [DPI]
- access to online resources, mentoring, and "just-in-time" training [DPI, IHE, LEA]

5.2.3.3 Raise the awareness of school administrators (at all levels) through a series of summer institutes concerning the instructional aspects of technology. This will empower them to plan learning environments effectively. [DPI]

5.2.4 State/Regional Support

5.2.4.1 Develop new models and networks for delivery of staff development. [STC, DPI]

5.2.4.2 Establish an Advisory Council on Staff Development Technology Training to assist the Department of Public Instruction in monitoring the implementation of system staff development plans, to evaluate their progress, and to provide advice and consultation as needed. [STC, DPI]

5.2.4.3 Fund the research and development of staff training models around the state through the implementation of a $100,000 incentive planning grant process that would be awarded by the School Technology Commission. This approach would include the collaborative efforts of LEAs, IHEs, and other appropriate entities. Contract awards will be limited to a maximum of $10,000 per grant. [GA, STC]

6. Procurement

The *North Carolina Instructional Technology Plan* is a supplement to current Purchasing guidelines and regulations as found in the State Purchasing Manual. Nothing is intended to circumvent any previously established procedures.

6.1 Introduction/Need

The School Technology Commission (STC) recognizes the need for a process of statewide standardized procurement. Three important

elements that are essential in this process are:

- Technologies procured by the local school systems must be compatible so classrooms and offices can be interconnected by a schoolwide information and resource sharing system; schools can be interconnected by a districtwide network; and districts can be interconnected by a statewide network.
- Hardware and software technical standards must be continuously updated to keep technology current and must include procurement agreements containing clauses for future upgrades.
- For each dollar spent in technology procurement -- whether for hardware, software, building wiring services, technical support services, or training/staff development services -- the greatest value must be received.

Stakeholders must play an active role in both the standards-setting and procurement processes in order to realize the significance of these three essential elements. The following stakeholder roles are recommended:

- Standards-setting
  - *Hardware and network* — For each component within the *North Carolina Instructional Technology Plan* (servers, workstations, printers, scanners, telephones, building wiring, communications software, network management software, system software, video systems, etc.), the Department of Public Instruction (DPI) and Information Resource Management Commission (IRMC) have formed a standard-setting committee to work collaboratively on the establishment of initial standards and their revision over time.
  - *Learning and instructional management software* — The Department of Public Instruction should establish a knowledge database for local school systems that is available in either paper form or online. Such a database would contain the *North Carolina Standard Course of Study*, a comprehensive library of learning and instructional management software; correlations between such software; model lesson plans for the use of the software; and informal and formal evaluations on the results of its use; and other instructional resources.
- Procurement

  Whenever components are identified that are widely applicable across local school systems, the Division of State Purchase and Contract and the Department of Public Instruction should implement large-scale contracts with suppliers. Such contracts would then be available for procurement by local school systems implementing the *North Carolina Instructional Technology Plan*. This should result in savings of 20-to-30% for hardware and 40-to-60% for software and related materials to those school systems choosing to use these contracts. In order to maintain the ability to attain the most competitive price, such procurement agreements should contain price protection clauses that guarantee the option of securing the lowest price over the life of the procurement agreement.

6.2 Inventory Control

Maintenance of education technology inventory records is imperative for:

- financial record keeping and insurance purposes
- maintaining and upgrading the education technology system
- monitoring and updating the NCITP

These three requirements differ in the nature and level of detail of the information that must be maintained for each unit of hardware, system software, application software, licensed databases, etc.

For financial record keeping and insurance purposes, only a summary record needs to be maintained. This requirement can be met through utilization of the financial asset management system currently employed by school systems throughout North Carolina.

For system maintenance and upgrading purposes, a detailed record must be kept on each hardware and software component of the system as follows:

- hardware (workstations, file servers, printers, communication routers, etc.) -- record each attribute of the unit's configuration to include processor type, memory, storage system, etc.
- software (operating systems, applications software packages, databases, etc.) -- record authorized licensee, licensing conditions, limitations/restrictions, and version number

Within a school system that has achieved a wide-area network that interconnects every system component, use of an automated system management package represents an efficient means for inventory management and maintenance. Automated system management packages use the network resources to track each component of the system, detect maintenance requirements, and update software libraries.

This inventory requirement must be addressed within each local school system's education technology plan, so that once each year an updated inventory record that includes a bar code and fixed asset number is submitted to the Department of Public Instruction for inclusion into a statewide database.

6.3 Software/Hardware Evaluation

6.3.1 Selection Criteria

Local Education Agencies (LEAs) should refer to the following criteria when selecting software/hardware:

- demonstrated effectiveness in improving learning
- ease of use (user-friendly)
- total cost of ownership (defined as acquisition, annual maintenance and upgrade fees, etc.)

- features/performance
- adherence to curriculum and technical standards
- compatibility with existing resources

Considerable competition exists among the various application vendors. Popular features introduced within one vendor's product are usually incorporated into other vendors' products in a short period of time. Practically every high-end application has, or will soon have, all of the features that North Carolina is likely to require.

Compatibility with existing resources implies that North Carolina school personnel are already familiar with the application, which minimizes training and support costs, as well as purchase costs, since many may already have the software.

Many of these objectives are often in conflict. For example, a low-cost product may also have low functionality. Software that offers many powerful features is often harder to use. Adherence to curriculum and technical standards may mean incompatibility with existing resources.

Assuming that more than one product meets the functional requirements, product selection should be based upon consistency of the user interface and file format between the PC and Macintosh versions of the software.

These selection criteria will lower training and support costs as well as improve individual and organizational productivity.

6.3.2 Licensing

The approach to licensing and software placement must be examined thoroughly when moving to a network environment. A district no longer needs to license a piece of software to individual machines, since licenses can be based on the number of simultaneous users. In general, this means that a district needs far fewer licenses for each software package. To take maximum advantage of network licensing, all applications should be placed on and executed from the network, so that the number of simultaneous users can be tracked.

Portable computers that will be taken home are a major exception. They must have licensed copies of all the software that will be used when they are not attached to the network. Although it is technically feasible to dial into the district network from a laptop, the low dialup line speeds make loading applications in this way impractical.

6.3.3 Purchasing Options

The price of a software package can vary depending upon whether it was purchased individually, in volume, as a site license (school or district), or as a statewide license. Some

vendors separate the cost of the license from its media and/or documentation which can be expensive.

Individual purchases are generally the most expensive. Some vendors offer significant discounts for volume purchases which are often referred to as LAN or lab packs. By purchasing in volume, the unit price drops as the number of units purchased increases. For extremely large volumes, vendors often use site licenses. These vary considerably from vendor-to-vendor and sometimes are negotiated on a case-by-case basis. Typically, site licenses allow unlimited use of the application by employees and students and may allow use of the software on home computers.

In a network environment, a school needs to purchase only the number of licenses that will be used simultaneously. As a result, some applications will require hundreds of licenses, while others may require relatively few. Most software vendors today do not require a separate license for every workstation.

If the applications are placed on a network and are thus available to everyone, there is no need for extensive media for every license. Most of today's software packages have extensive online help that can drastically reduce the need for multiple manuals. To address these issues and keep product costs competitive, many vendors separate the costs of media and/or documentation from the right-to-use the software (license).

Most vendors offer educational discount licenses. Such discounts may apply to individual purchases, volume purchases, and site licenses. Some vendors use special distributors for their educational versions.

The cost of upgrades of application software is typically lower than the cost of the initial purchase. However, many companies also offer "competitive upgrades" that allow users of a competitor's product to switch software at a very low cost. Typically the same price is charged for upgrades and competitive upgrades.

6.4 Implementation Guidelines

The School Technology Commission recommends the following:

6.4.1 Secure affordable access to telecommunication services and equipment through aggregated purchasing and support for education/community/business partnerships that prototype leveraging of resources. [LEA, DPI, P&C]

6.4.2 Establish a state education advisory committee on technology standards to advise the Department of Public Instruction, Division of State Purchase and Contract, Information Resource Management Commission, and Legislature on quality, technical, functional, security, service, and other standards by consulting with developers and educators in North Carolina and other states and by other means. [DPI]

6.4.3 Review the current state textbook adoption rules, processes, and procedures of the State Textbook Commission and recommend to the State Board of Education any modifications that are needed to account for the differences between print and electronic instructional materials. [DPI, SBE]

6.4.4 Investigate software purchasing strategies -- including statewide licensing, site licensing, volume pricing, individual pricing, collaborative and/or consortia purchasing -- while simultaneously focusing on pricing structures that include educational discounts, options for separating right-to-use from media documentation and upgrades for previously purchased software. [DPI, IRMC, P&C]

7. Financial Analysis

Past experience has shown that the most effective implementation of learning and instructional management technologies occurs when the funding program is continuous over a multi-year period. Continuous funding facilitates for the development of high-quality, long-range local plans and allows for the deployment of resources to be coordinated with staff development and infrastructure improvements.

7.1 Funding Priorities and Options

The funding priorities have been based upon the instructional technology initiatives outlined in Section B of this plan. Both the funding priorities and the technology initiatives are based upon the extensive research and planning of the School Technology Commission. Specific allocations for each level (elementary, middle, high school) were established based on the cost of a typical technology initiative as outlined in Figure 2. These costs were established based on the program requirements and on "critical mass." It is important to note that unless a critical mass of technology resources and training is provided, there will be no measurable gains in student performances. *Therefore, it is essential that the school technology funds be targeted and focused on improving*:

- language arts and mathematics at the elementary school level
- technology integration and remedial support in the middle grades
- information skills, mathematics, science, and vocational-technology education at the secondary school level
- curriculum development and instructional management system development at the state/classroom level

Figure 2: Prototype Cost of a Typical Technology Initiative

Category of Expense	Elementary	Middle	High
(1) Software	22,500	33,750	48,750
(2) Hardware	45,000	67,500	97,500
(3) Network	48,750	73,125	105,625
(4) Staff Support	TBD	TBD	TBD
(5) Training	18,750	28,125	40,625
(6) Supplies	4,500	6,750	9,750
(7) Maintenance	7,500	11,250	16,250
(8) Planning/management	3,000	4,500	6,500
TOTAL	$150,000	$225,000	$325,000

NOTES:

The cost for each of the initiatives is based on (average) 482 students at the elementary level, 657 students at the middle school level, and 863 students at the high school level.

(1) Software: Includes instructional and productivity software applications.

(2) Hardware: Includes approximately 30, 45, and 65 student/teacher workstations (desktops and laptops respectively) for an average school (15-to-25 classrooms) and a corresponding number of printers, projection systems, and multimedia equipment.

(3) Network: Includes the wiring, file servers, and communication equipment/software to connect workstations, peripherals, and provide external telecommunications.

(4) Staff support: Identifies, as a minimum, one instructional technology specialist and one technical support specialist at each school. Positions are to be funded through the BEP process.

(5) Training: Is based on a minimum of 20-to-30% of the total technology initiative cost, of which 12.5% may come from school technology funds. Funds from other staff development and training sources must be used to satisfy this minimum.

Technology initiatives that differ from those outlined in this plan will require approval by the State Board of Education and notification to the School Technology Commission. These initiatives or deviations: (1) must document instructional need, (2) show that the initiative will produce results in the targeted area, and (3) include a statement of program assurance that recommended technology initiatives contained in the *North Carolina Instructional Technology Plan* have been met.

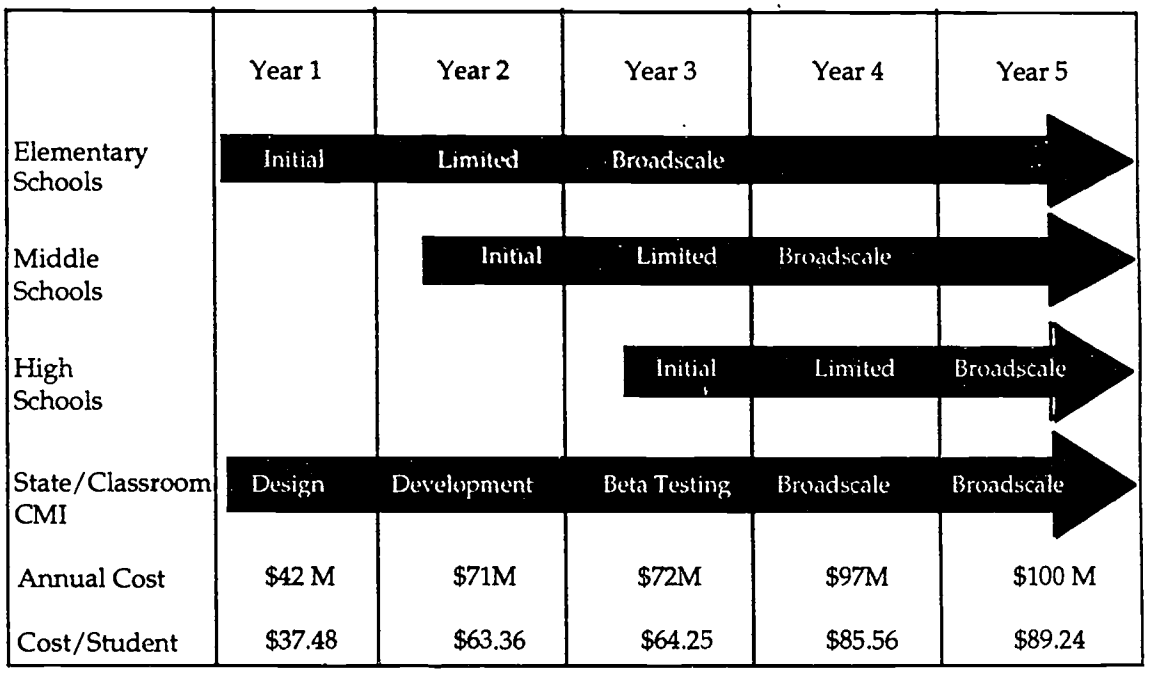
Based upon these targeted areas of student improvement and the proposed technology initiatives, the total cost by school level over the five-year implementation schedule follows:

Elementary Schools — 1,241 schools @ $150,000	$186,150,000
Middle Schools — 337 schools @ $225,000	76,000,000
High Schools — 350 schools @ $325,000	114,000,000
State/Classroom – Curriculum Development/ Instructional Management	5,000,000
TOTAL NCITP PROGRAM COSTS	**$381,150,000**

7.2 Implementation Schedule/Considerations

The overall schedule for the *North Carolina Instructional Technology Plan* program covers a five-year period. Figure 3 illustrates the overall sum and sequence implementation schedule.

Figure 3: Overall Implementation and Budget Schedule



Note: The projected ongoing costs for support, maintenance, replacement, and upgrades to the *North Carolina Instructional Technology Plan*, after the five-year implementation schedule, are estimated at 15% of the total cost or approximately $55 million annually (adjusted for inflation).

7.3 Implementation Guidelines

The effective use of state-supplied technology funds and the prospects of a continuous funding program from the state Legislature will be enhanced to the extent that the following recommendations are reflected in the program administration. The School Technology Commission recommends the following:

7.3.1 Develop annual program implementation milestones that are reportable and accountable each October in the report to the Legislature. [STC, DPI, LEA]

7.3.2 Provide visible support and participation by major employers, possibly through the establishment of an advisory panel to the Local Technology Planning Commission. [LEA]

7.3.3 Create a local public relations program focused on students, parents, and the general public. [LEA]

7.3.4 Use the Technology Trust Fund established in SB1505 to allocate not only the *North Carolina Instructional Technology Plan* specific funding, but also other state/federal funds allocated to support the implementation of local technology plans. [GA, STC, DPI]

7.3.5 Integrate the various Department of Public Instruction technology initiatives through development of a comprehensive education technology plan within the Department. [DPI]

8. Monitoring/Evaluation

The purpose of monitoring and evaluating technology plan performance is to provide assurance that the resources being invested in technology are improving student learning and to identify issues that arise when integrating powerful technology tools into the *North Carolina Standard Course of Study*.

Monitoring and evaluation efforts must be designed to keep the implementation on course and aligned with the need to demonstrate improved student performance based on the targeted technology initiatives and the mandated school reforms. A careful monitoring and evaluation plan will help to ensure an effective and efficient investment of public funds. Appropriate strategies include both formative (process) and summative (result) evaluation.

8.1 Formative Monitoring and Evaluation

Formative monitoring and evaluation of the *North Carolina Instructional Technology Plan* should focus on all strategies for designing, developing, and implementing the overall program. Everyone who authorizes, manages, and uses the proposed technology initiatives will share responsibility for shaping the embedded technology resources to best support education reform. The process of implementing the plan must provide feedback that can be used in adjusting operational procedures to achieve maximum results.

8.2 Summative Monitoring and Evaluation

Summative monitoring and evaluation should include components that work in conjunction with the existing statewide assessment program. After benchmark data from the statewide assessment program is collected for comparison, a sampling designed to select schools implementing particular technology initiatives (e.g., elementary language arts and mathematics) should assess this year's data, measuring improvement that may be attributable to the technology initiative. As implementation proceeds to other instructional levels, similar benchmark data from the statewide assessment program should be collected for later comparisons.

As students become more comfortable with the various technology initiatives, evaluators will begin to focus on sophisticated levels of use and examine how the applications impact student learning.

A critical consideration in designing monitoring and evaluation systems for technology initiatives is the identification of all program components and associated performance variables to be studied. Implementation of technology initiatives is necessarily complex and will involve thousands of educators statewide. The program components must be monitored since there are many interdependencies among different parts of the plan. For example, the quality and timeliness of professional development efforts are critical to the effective use of technology initiative applications, whether they be instructional, teacher utilities, classroom management, or school management. Careful evaluation designs will be developed in order to attribute improvements directly to the technology initiative interventions.

8.3 Implementation Guidelines

The School Technology Commission recommends the following:

8.3.1 Involve each level within the North Carolina education hierarchy with the process of collecting, aggregating, analyzing, and reporting evaluation information. [DPI, LEA]

8.3.2 Support evaluation research aimed at determining critical factors in the successful implementation of large-scale change efforts. [DPI]

8.3.3 Apply lessons learned from other states that are in different stages of technology plan implementation by using assessments of those states' programs to assist in focusing the evaluation for the North Carolina's Instructional Technology Plan. [STC, DPI]

8.3.4 Improve program evaluation by using the power of the technology applications to capture and report automatically relevant information concerning the use of the innovations. [DPI, LEA]

LONG-RANGE LOCAL SCHOOL DISTRICT TECHNOLOGY PLAN

1. Introduction/Need

A comprehensive technology plan is critical as districts, schools, teachers, students, and the community attempt to articulate a set of goals that will maximize the learning capabilities of students and prepare them for the twenty-first century. The purpose of a local school district technology plan should be to:

- Establish a process that develops the effective use of technology to promote student learning in the school system.
- Develop strategies for creating critical mass and equitable use of technology in each school within the system.
- Enable the school system to obtain state funds via approval of a comprehensive and systemic technology plan.
- Identify a core technical infrastructure that provides a basis for future procurement decisions.
- Form collaboratives to achieve critical mass and economies of scale to influence technology markets and procurement options.
- Implement staff development activities designed to integrate the use of technology into the curriculum to improve learning.

The plan itself is fluid, constantly in need of evaluation and modification as the curriculum, educational initiatives, and technology grow and change.

2. Planning Process

The technology planning process must be an extensive, collaborative, and ongoing effort that is likely to supersede other district-level projects in magnitude and scope. It requires a systemic change that accepts the incorporation of technology into the curriculum as a standard practice in the classroom environment.

The local technology planning approaches are designed to lead local educators systematically through a comprehensive planning process by providing a set of integrated technical support services at the statewide, regional, district, and school levels.

2.1 Key Stakeholders

The overall purpose of local school district technology planning is not only to produce a written plan, but also to build constituent support for the use of technology to improve student learning. As a result, it is essential that this planning involves "key stakeholders" from the onset. The following list of key stakeholders should be

considered for membership in local school district technology planning committees:

- superintendent(s)
- school principal(s)
- library, media, and technology leadership
- vocational and technical education specialists
- special education personnel
- Chapter 1 personnel
- classroom teachers
- students/alumni
- higher education personnel
- legislative representation
- local government leaders and staff
- business/industry representative(s)
- parents
- local school board members
- school business manager(s)
- maintenance personnel

2.2 Planning Steps

The planning process guidelines provided in Appendix D have been designed to facilitate an effective local school district technology planning process. In general, the steps in the planning process are as follows:

- getting started
- orientation and public information awareness
- assessment of current technology program status and learner needs
- identification of curriculum initiatives
- design of a technology-supported learning environment
- development of implementation plan and budget
- monitoring, evaluation, and revisions of the plan

2.3 Local Plan Approval

Before a district technology plan is submitted to the school superintendent and local school board, it is important to perform an internal audit and review. Individuals with primary responsibility for plan implementation (e.g., staff development coordinator, curriculum director, media and technology personnel, maintenance supervisor, finance officer) should conduct the review.

After sign-off by these key individuals, the next step involves presenting the technology plan to the district superintendent so that the top educational leader in the district can address any issues or questions before submitting the completed plan for the local school board's review and approval. An essential issue to consider is quality assurance to determine how well the completed technology plan addresses school and curriculum improvement objectives and complies with requirements in the *North Carolina Instructional Technology Plan*. All local school districts are required to sign and attach the "Long-Range School District Technology Plan: Program Requirements and Statement of Assurance" (see Appendix E).

Upon approval by the local school board, two copies of the plan will be submitted to the Department of Public Instruction. The department will conduct an overall plan review, focusing on the curriculum, staff development, and personnel sections and will forward one copy to the Information Resource Management Commission for a technical review. The plan will next be forwarded to the State Board of Education for approval. If the plan requires modifications, technical assistance will be available from the Department of Public Instruction's Technical Assistance Centers.

2.4 The Plan Components

To achieve maximum effectiveness, a local technology plan must be a collaborative educational and community effort. *The minimum components of a comprehensive, long-range, district technology plan must include the following:*

- vision statement
- goals
- objectives
- strategies/timeline
- expected results
- monitoring and evaluation
- financial considerations

A description of the possible content of each of the required components follows:

Vision Statement
The vision statement of the local technology plan should be consistent with the *North Carolina Instructional Technology Plan.* It must be broad in scope and a dynamic document that reflects the continuous growth of the school system supported by the effective use of technology to improve student learning.

Goals
Goals form the framework for the planning process and for the implementation of the technology plan. They must align with other educational goals within the system and be realistic for the near future by acknowledging the constraints of local priorities, costs, and other barriers. The goals of the school system technology plan must set a direction and reflect the school system's:

- curriculum, instruction, and student performance needs
- equitable access to appropriate technology applications
- ongoing staff development programs
- community and parental interactions
- collaboration with business/industry, social service agencies, higher education, etc.

Objectives
Each objective should be observable, measurable, and define the necessary action steps for achieving each goal. The objectives should set priorities, focus on specific instructional programs, and include all functions necessary to implement and support the program.

Strategies/Timeline
Strategies and related timelines comprise the action steps for each objective. Curriculum and instruction should be the major focus of the local technology plan. Strategies should address the following areas:

- curriculum/instruction
- technology acquisition/upgrading/reallocation (i.e., infrastructure, hardware, software and materials, and equipment)
- staff training
- personnel requirement
- funding implications
- data management coordination
- inventory/maintenance/repair
- facility renovation
- extent to which access to the North Carolina Information Highway, via direct connections either at the school or district level, helps to achieve instructional goals that cannot be met otherwise

Expected Results
In accordance with the legislative mandate (G.S. 115C-102.7), the school system's technology plan should address the effects of technology on:

- student learning/achievement
- student workforce readiness
- teacher productivity
- cost-effectiveness

Monitoring and Evaluation
Evaluation should include not just a statement of the implementation plan results, but also a means of accomplishing needed changes. The evaluation process for the school system technology plan should address the expected results and should be comprised of a(n):

- description of the beginning state for each goal
- identification of the realistic expectation for each goal
- indication of the progress made using a checklist, chart, or matrix
- inclusion of evidences of the progress made on each goal

- description of the evaluation procedure to include, but not be limited to, the annual review, the modifications for the next phase, and the mechanism for change
- articulation with appropriate components of the annual statewide student assessment program

Financial Considerations
Funding for education technology must consider a variety of sources as well as the reallocation of existing funds. In addition, strategies must be developed that identify "return on investments" and establish techniques for improving economies of scale. The technology budgets should be developed based upon a stage/phase approach to implementation.

2.5 Implementation Guidelines

The Standard Technology Commission recommends the following:

2.5.1 Allocate, as soon as possible, to each school district up to 10% of its state-appropriated technology dollars to develop a local technology plan, based on state-provided criteria, guidelines for approval, and a specified amount of money expected to be allocated. [GA]

2.5.2 Develop long-range, districtwide, school technology plans using the guidelines and criteria described in the *North Carolina Instructional Technology Plan*. [LEA]

2.5.3 Each local school district shall ensure that assistive technology devices or assistive technology services, or both, are made available to students with a disability if required as part of the student's special education, related services, or supplementary aids and services. (34 Code of Federal Regulations 300.320, Individuals with Disabilities Education Act) [DPI, STC]

2.5.4 Develop a systematic procedure for each local school system to evaluate its progress annually toward meeting its specified technology goals. [LEA]

2.5.5 Provide support services to assist local school systems in developing high-quality technology plans in compliance with the *North Carolina Instructional Technology Plan*. [DPI]

2.5.6 Establish bidding procedures to obtain customized electronic planning tools/templates designed to:

- assist local school personnel in the development of school and districtwide technology plans [DPI, STC]
- standardize local technology plan format [DPI, STC]
- provide "just in time" access to local and statewide data [DPI, STC]
- assist in identifying support services needed on a regional or statewide basis [DPI, STC]
- identify areas of critical mass in order to achieve economies of scale [DPI, STC]

2.5.7 Use the customized electronic planning tools/templates provided by the state to develop, submit, monitor, and update a local technology plan. School systems that submit and obtain plan approval prior to the availability of the electronic planning tools/templates, have sixty days to convert their plan to this electronic format once it becomes available. [LEA]

CONCLUSION

Technology is, and will continue to be, a moving target. If technology is to be integrated into schools successfully, then teachers must understand that instructional technology is not just hardware or software, but rather a process or approach to teaching and learning. This process and/or approach must be taught to prospective and practicing teachers alike.

In the past, far too little emphasis has been placed on making technology directly available to the classroom teacher. Although major expenditures have been designated for technology, the majority of purchases have been made for student use or for administrative computers. Schools must begin to look beyond the "students-to-computer ratio" model and place technology into the hands of classroom teachers who have been trained to use it effectively.

As long as the university remains the primary means of preparing new teachers, the content of teacher preparation programs will be determined, for better or worse, by professors who teach teachers. State boards of education and other accrediting bodies must take a leadership role in requiring teacher education programs to move away from the teacher-directed lecture format and toward a problem-solving/analytical mode of instruction that teaches and models technology use.

If technology is going to be used successfully in the future, we must learn from the mistakes of the past. First, we must educate teachers to use technology effectively. Second, we must put powerful technology directly into the hands of students and classroom teachers. Third, we must support teachers as the technology applications change and new ones emerge. Fourth, research must be conducted with respect to understanding the relationship between human learning and technology. The result of this research must be improved instruction. There is little doubt that the future of education technology is only as good as the instruction that is provided to students, regardless of the sophistication of the technology infrastructure. However, the effective use of technology in North Carolina schools is essential in order to implement broadscale education reforms and specific curriculum improvement strategies for improved student learning.

APPENDIX A

ALIGNMENT OF *NORTH CAROLINA INSTRUCTIONAL TECHNOLOGY PLAN* WITH G.S. 115C-102.6A

G.S. 115.C-102.6A Elements of the State School Technology Plan -- SB1505

Section	Requirements	State Plan Reference
a1.	Integration of North Carolina Information Highway (NCIH) into state plan • impact on implementation priorities • impact on school technologies	Page 33
b1.	Common technical standards/uniform procurement practices • technology purchases • training technical support • local planning • operations	Pages 28 - 31
b2.	Conceptual technical architecture • principles • standards for interoperability • installation guidelines	Pages 32 - 33
b3.	Quality assurance policies • school technology projects • training programs • systems documentation • maintenance plan	Pages 29 - 30
b4.	Policies and procedures resulting in vendor-neutral operating environment • school technology hardware • software (systems level and applications) • networks/communications equipment	Page 32
b5.	Inventory control program	Page 41
b6.	Continuous ongoing training program • integration of technology and instruction • use of instructional applications	Pages 37 - 39
b7.	Recommendations to SBE on teacher pre-service	Page 38
b8.	Proposals for leadership training • use of school technology to improve instruction • use of school technology as a management tool	Page 39
b9.	Development of expertise on school technology • state level • regional level	Pages 35 - 36

b10.	Flexible local planning system	Pages 49 - 54
b11.	Comprehensive school technology design • meet the needs of all students • ensure access to challenging curricula and instruction for children at risk of school failure	Pages 15 - 28
b12.	School technologies related to NCSCOS	Pages 26 - 27
b13.	Effective integration of technologies • standard course of study • state assessment program • student data management	Pages 15 - 28
b14.	School technologies uses • communications tool • instructional tool • management tool • problem solving, exploration, and advanced skills	Pages 15 - 28
b15.	Proposals for equipment needs (Voc Ed) • vocational education • technical preparation (tech prep) • science instruction	Pages 22 - 26
b16.	Specifications for local school system • components • review and approval	Pages 49 - 54

APPENDIX B

RELATIONSHIP OF INITIATIVES AND MODEL CONFIGURATIONS

NORTH CAROLINA TECHNICAL STANDARDS AND GUIDELINES

Area of Consideration	Preliminary Standard	Recommendation or Statement of Direction	Implementation Aids and Supporting References
1. Internal LAN of only Motorola (Apple/Mac) machines on a single server	Macintosh Operating system (System 7), AppleTalk/Ethernet networking, AppleShare file and print services	IRMC standard review to be forthcoming	The guide to the NCITP entitled Technological Recommendations and Standards
2. Internal LAN of only Intel machines on a singe server	DOS/WINDOWS operating system, Novell networking, file, and print services	IRMC approved standards	Page 4 of Technology Standards and Supporting Products for Local Area Networks The guide to the NCITP entitled Technological Recommendations and Standards
3. Internal LAN of mixed Motorola and Intel machines on a single server	Workstation operating systems as specified above. Networking protocols same as above for native environments; however NetWare for Macintosh supports file and print services on common server with Novell "Intel" file and print services to enable the sharing of files and print services between both environments.	IRMC approved standards	Page 4 of Technology Standards and Supporting Products for Local Area Networks The guide to the NCITP entitled Technological Recommendations and Standards
4. Inter-network Transport	TCP/IP	IRMC approved standard is TCP/IP	Page 5 of Technology Standards and Supporting Products for Local Area Networks
5. LAN Technology for the School	Ethernet wired to state telecommunications standards.	Ethernet is recommended for all new installations. Token Ring is acceptable if it already exists in the school. Multiple bridged/routed LANs of Apple and Intel servers are acceptable.	Page 4 of Technology Standards and Supporting Products for Local Area Networks STS-1000 Telecommunications Wiring Guidelines

NORTH CAROLINA TECHNICAL STANDARDS AND GUIDELINES (continued)

Area of Consideration	Preliminary Standard	Recommendation or Statement of Direction	Implementation Aids and Supporting References
6. Electronic Mail (e-mail) external to the school	SMTP/MIME products Current Connectivity: Commercial service providers such as NandoNet or Interpath provide Internet based E-mail services Future Connectivity: Internet access via E.A.S.I. SIPS dial connection to Internet is in the RFP stage. E-mail through AS/400 gateway from Office Vision is in the final testing stage.	IRMC Standard	IRMC Approved, January 4, 1994 and March 1, 1994; Electronic Messaging/Mail
7. Electronic Mail (E-mail) within the school	SMTP/MIME products	IRMC Standard	IRMC Approved January 4, 1994 and March 1, 1994, Electronic Messaging/Mail
8. LAN Physical Infrastructure	State Wiring Standards: Backbone: UTP Level 5 (EIA/TIA TSB36) or Fiber Optic Multimode Horizontal Distribution: UTP Level 5 (EIA/TIA TSB36) Intelligent Hubs: SNMP compliant hubs which scale to support a variety of medias (i.e., 10baseT, thinnet, fiber).	IRMC Standard IRMC Standard	DPI Guidelines to Provide Uniform Wiring Service for Telecommunications in N. C. Public Schools DPI Primer on Cabling Design and Implementation
9. Video	State Published Specifications		DPI Guidelines to Provide Uniform Wiring Service for Telecommunications in N. C. Public Schools DPI Primer on Cabling Design and Implementation NCIH Documents
10. Telephony and Voice Messaging	Under study		

APPENDIX C

STAFFING/PERSONNEL PROTOTYPE

Staffing/Personnel Prototype

The number and location of building- and system-level positions should be adjusted to reflect collaboration and sharing of personnel between small schools and school districts as deemed appropriate.

Professional

Professional Positions Needed	Role	Number and Location*	Funding Source
Building-level Instructional Media and Technology Coordinator	To work within an individual school, coordinating development, and implementation of the school's media and technology plan; coordinating training for teachers; and coordinating media and technology purchases.	One for every 60 teachers, with each LEA getting at least one position.	Use BEP positions approved but not yet funded.
System-level Instructional Technology Specialists	To work with all schools in the district, coordinating development and implementation of local technology plan; coordinating training for teachers; and coordinating instructional technology purchases by the schools and district	TBD	New funding would be required.
Regional Instructional Technology Specialist	To assist local school systems in developing long-range technology plans consistent with G.S.115C-102.6A.	Six (one housed in each Technical Assist. Center)	Already funded by G.S.115C-102.7.

Technical

Technical Positions Needed	Role	Number and Location*	Funding Source
Building-level Technology Support Technicians	To set up, maintain, repair (or recommended replacement of) software, hardware, and other infrastructure components and to provide technical services and user support within an individual school.	One in each school (more than one for large schools)	Recommend turning BEP support positions into dollars and allocate based on "floor plus ADM."
System-level Technology Support Technicians	To set up, maintain, repair (or recommended replacement of) software, hardware, and other infrastructure components and to provide technical services and user support across schools within the system.	TBD	New funding would be required.

APPENDIX D

SAMPLE TECHNOLOGY PLANNING GUIDE

SAMPLE TECHNOLOGY PLANNING GUIDE

Step 0 Get Started	Step 1 Initiate Technology Planning Activities	Step 2 Assess Current Education Technology Program Status	Step 3 Identify Curriculum Initiatives	Step 4 Analyze and Design Technology Support System	Step 5 Stage and Phase Implementation	Step 6 Monitor, Evaluate and Revise the Plan
• Secure support/ commitment of key leadership.	• Communicate education technology vision with stakeholders.	• Investigate community resources and partnerships.	• Assess local curriculum strengths and weaknesses.	• Identify instructional, administrative and communication software solutions.	• Prioritize instructional and administrative initiatives.	• Select technology plan and program evaluation model.
• Identify community of stakeholders.	• Research, describe, and demonstrate emerging technologies.	• Assess students, teachers and administrators (skills/knowledge/ attitudes).	• Determine information management needs.	• Develop technology hardware, facilities, and network (voice, video, data) standards and requirements.	• Reallocate and upgrade current resources.	• Determine appropriate evaluation tools, activities, and milestones.
• Review /evaluate curriculum improvement efforts.	• Identify tasks, timelines, levels of responsibility, and milestones for planning process.	• Query parents, community groups, and local businesses regarding perceived needs.	• Identify and prioritize curriculum improvement approaches supported by technology.	• Develop operations, maintenance, and revise policies and procedures.	• Assign leadership roles and responsibilities for technology activities.	• Establish linkages and timelines for evaluation activities.
• Investigate effective technology practices in support of curriculum improvement	• Formulate a public information and awareness plan.	• Inventory hardware, software, facilities, and network capacity.	• Design strategies to align technologies with curriculum improvement approaches.	• Design professional development plan.	• Establish time frame to secure new resources (human and technology).	• Develop a process to incorporate evaluation information for future planning.
• Review technology vision and draft a related mission statement.	• Research/identify potential funding strategies and sources.	• Review existing education technology initiatives and expenditures.	• Create technology plan goal and objective statements.	• Establish human resource organizational structure to implement plan.	• Create timeline to acquire, install, and test hardware and software.	• Communicate technology planning results with stakeholders.

Step 0 Get Started	Step 1 Initiate Technology Planning Activities	Step 2 Assess Current Education Technology Program Status	Step 3 Identify Curriculum Initiatives	Step 4 Analyze and Design Technology Support System	Step 5 Stage and Phase Implementation	Step 6 Monitor, Evaluate and Revise the Plan
• Assign leadership roles for technology planning. • Design organizational team structures.	• Conduct introductory orientation to leadership team.	• Assess existing professional development activities. • Assess existing technology related staffing, policies and procedures.	• Determine curriculum instructional technology integration approaches.	• Construct cost matrices and line item budget including funding sources. • Develop 3 - 5 year implementation schedule.	• Specify professional development needs and develop calendar of activities. • Establish implementation timeline for instructional and administrative initiatives.	

APPENDIX E

LONG-RANGE SCHOOL DISTRICT TECHNOLOGY PLAN:

PROGRAM REQUIREMENTS AND STATEMENT OF ASSURANCE

REQUIRED SUBSTANTIVE COMPONENTS OF THE LOCAL SCHOOL DISTRICT TECHNOLOGY PLAN

The local school board has actively involved key stakeholders in the development of a district wide technology plan that includes the following key components:

- A vision statement consistent with the North Carolina Instructional Technology Plan.
- Instructional initiatives that follow the School Technology Commission's recommended implementation framework (Elementary, Middle, High School) unless the local board of education provides documentation that the implementation schedule has already been met or that an alternative targeting of resources is necessary in order to meet local instructional priorities.
- A systematic procedure of evaluating annually the progress toward meeting the goals of the local technology plan, including the effects of technology on student learning and achievement, student workforce readiness, teacher productivity, and cost effectiveness.
- Core technical infrastructure designed to meet Information Resource Management Commission standards to assure compatibility, connectivity, and cost-effectiveness.
- A staff development and training component that includes all instructional and appropriate administrative personnel and is based on an expenditure of 20 to 30% of the total cost of the technology program. Of this total, 12.5% may be paid from state appropriated technology funds, with the balance from other state, local, private or federal sources.
- An inventory control system that meets the requirements specified in the NCITP and utilizes the North Carolina financial asset management system.
- A financial management plan that identifies both the sources of funds for the short and long term implementation of the local plan and the expected return on investment of the local school technology plan.

LEA NAME _____ Number _____

Signed: _____ _____

Superintendent Local Board Chair

North Carolina Instructional Technology Plan

Guide:

Technological Recommendations and Standards

February, 1995

TABLE OF CONTENTS

1. INTRODUCTION

The primary purpose of this section is to present the essential technical considerations for implementing the North Carolina Instructional Technology Plan (NCITP). It addresses the following three main areas fundamental to the development and execution of long-range technology plans:

- collaboration
- connectivity
- hardware configurations

These technical standards provide a foundation for the collaborative planning and support efforts among local, regional, and state-level groups. Support areas are of particular importance to the usefulness of the NCITP, the worthiness of the individual school technology plans, and the ultimate success of the technical infrastructure at the local school buildings. Areas of primary interest include personnel training (i.e., numbers, types, and organization of staff), purchasing (e.g., potential use of statewide, high-volume discounts and minimization of administrative efforts), and management (e.g., use of common staffing resources and facilities for managing software, providing technical assistance, and performing research and development tasks).

The proper implementation and employment of current available technology (including hardware, software, and communications) has been a consideration in creating the recommendations and standards. More emphasis, however, has been placed on the ability to:

- accomplish an orderly and cost-effective scalability and growth of technical resources (e.g., the transition from standalone workstations to local-area networks -- LANs, from networked labs to schoolwide networks, from school networks to a wide-area network -- WAN)
- achieve economically practical widespread and effective communications with the outside world
- address the connectivity issues of security, instructional resource availability, and adequate human resources

The technical standards have been developed through a logical and iterative process, beginning with the instructional requirements for achieving outcomes identified in the state's Standard Course of Study. Representative applications software packages that target important categories[1] of educational technologies were identified, and alternative hardware and network configurations were formulated based on software requirements and emerging trends.

The technical recommendations and standards consist of (a) statewide specifications for items common to all installations; (b) model hardware/software and network configurations; and, (c) other considerations, such as retrofitting present equipment and addressing building, wiring, and cabling issues. The standards and recommendations outlined in this guide will serve as examples, aids, and references for assisting local schools in developing plans and building technical facilities.

Traditional uses of instructional computers have addressed the areas of drill and practice, supplemental instruction, and computer programming. The implementation of the architecture

[1] North Carolina Plan for Learning and Instructional Management Technologies, February, 1995.

described in this document will contribute materially to providing capabilities beyond these basic functions. Students and teachers will be able to explore, discover, research and communicate with worldwide resources in order to fulfill both structured educational requirements and to pursue the personal enrichment of each individual. It is intended that access to necessary resources will be available, regardless of time of day or geographic location.

Through the wise and judicious use of support resources, the NCITP offers a unique and far-reaching opportunity for the state to address comprehensively the planning for and implementation of technology for instructional purposes in its public schools. The form and focus of the supporting resources must link directly to the methods and practices of implementing the technical standards. Without adequate, well-managed and appropriately organized supporting resources, the technical standards will fail to contribute significantly to the achievement of instructional goals.

2. COLLABORATION

It is imperative that schools work together at local, regional, and state levels in order to achieve a critical mass that will empower them to drive the technology market and procure equipment and services at dramatically reduced rates. Funding strategies and acquisition activities must be well-planned, organized, and coordinated. This unity of effort may have many partners, including local education agencies, Department of Public Instruction, universities, community colleges, private colleges, regional consortia, and city/county businesses and organizations. It is recommended that collaborative undertakings be considered for the following areas:

Purchasing	By joining efforts, educators can purchase hardware, software, supplies, maintenance, and support at greatly reduced rates.
Evaluation	Regional hardware test sites and software assessment centers would enable school personnel to become more competent technology decision makers.
Support	Sharing support personnel (technicians, resource personnel, and North Carolina Information Highway facilitators) may be a viable alternative for smaller schools and LEA's who otherwise could not afford such resources.
Maintenance	School districts should explore the possibility of forming partnerships to address maintenance and repair service needs.
Training	Consolidation of training efforts for professional, technical, and support personnel should be investigated.
License management	Centralized management of software licenses and upgrades would be beneficial for many schools.

The power of this coordination of efforts must not be underestimated. If this approach is undertaken seriously and energetically by the educators in North Carolina, eventually collaborative decision making as it relates to technology specifications, as well as other areas, will emerge.

3. CONNECTIVITY

School districts need to devise a comprehensive technology plan that can be implemented in phases. This plan should embrace the concept of connectivity, which is simply the linking of technology by wires and communication devices to facilitate rapid communication throughout the school, as well as through the North Carolina Information Highway and beyond. Phase I of the plan should include the core infrastructure which will provide a basis for future procurement decisions, thus eliminating the need for additional retrofitting. School districts need to become adept at monitoring the technology industry to be sure they will be purchasing equipment that will last six to ten years and whose life expectancy can be expanded through equipment upgrades. Among the issues that impact connectivity decisions are the following:

Security	There needs to be a hierarchy of rights for network users (students, teachers, administrators, etc.) to control access to the server and other resources.
Support	Technical and instructional support is a critical component of any plan and it is suggested that school districts investigate the possibility of sharing human resources.
Resource availability	Schools must plan for outside connections to access resources otherwise unavailable at the school, district, or regional level.
Wiring	All new buildings need to be wired for data, voice, and video transmissions. Guidelines for wiring standards have been established by the North Carolina Department of Public Instruction.[2] Older facilities should include retrofit plans that are feasible and attainable.
Electronics	Plans should include the installation of wiring closets. Then as design phases are implemented, appropriate electronic components can be installed within the closets.
LAN	Local-area networks link computers over a relatively small geographic area and should be part of an *integrated* model. As indicated in the diagram on the following page, integrated models of networked schools are those designed to connect most or all parts of the school, so that technologies and databases are accessible and useful wherever they are needed.
WAN	Wide-area networks enable users to connect to sites outside the school, expanding student, teacher, and administrator outreach to external resources, databases, library resources, video retrieval, and other individuals. The plan for a wide-area network must include a router and a CSU/DSU (digital modem). This will make possible connection to the North Carolina Information Highway, facilitating communication among schools, LEAs, and the environment beyond.

[2] Guidelines to Provide Uniform Wiring Service for Telecommunications in North Carolina Public Schools, Version 1.10, July 2, 1991 and A Primer on Cabling Design and Implementation, May, 1992.

4. HARDWARE/SOFTWARE CONFIGURATIONS

4.1. Determining Requirements

One of the most important concepts in technology planning is that curriculum and instruction decisions must be the driving force behind the selection and purchase of software and hardware solutions. The North Carolina Standard Course of Study provides a framework for the basic curriculum. It states that critical thinking skills and curriculum integration are important issues. In addition to this basic framework, each school must assume the responsibility for identifying the special needs in that particular learning environment. No two schools will develop the same technology plans for some of the following reasons:

- schools have different goals and priorities
- many types of resources, tools, and connections can effectively achieve the same goals
- choices schools make in developing their plans will vary significantly, depending upon what they already have to work with and their options for funding and assistance

When selecting learning and instructional management technology resources, educators need to consider the following:

- developmental needs of the K-12 instructional levels, elementary, middle, and high
- diverse learning styles and multiple intelligences
- exceptional abilities and aptitudes

There are many excellent software packages that target the important *categories* of educational technologies. These software programs can also be referenced by *disciplines*. Either way, certain conclusions can be drawn about hardware requirements by examining the software specifications. What is immediately evident is the wide range of RAM requirements for these programs (128K to 16MB). The trend has been toward increased memory capacity; therefore, workstations need to be equipped with at least 8MB of RAM (with expansion capabilities). This does not mean that every machine should have this amount, as some programs (multimedia, CAD, VoCATS) may require more memory. Most elementary applications and multimedia CDs require sound which necessitate the use of headsets. Many programs require a hard disk drive, are available only on a compact disc, or work only on a network. Nearly all the newer educational programs require a color display (SVGA) and more powerful processors. The following pages contain configurations that are recommendations or guidelines for minimum hardware standards as of November, 1994.

4.2. Model Hardware/Software and Network Configurations

Model hardware/software and network configurations have been developed to assist in the purchase, training, support, planning, and operation of the four Instructional Technology initiatives described in the NCITP. These model configurations are:

- network-ready workstations
- networked lab

- distributed network
- library/media center
- instructional management systems

Schools may eventually have more than one server and move toward a networked model designed to connect most or all parts of the school. Careful, ongoing planning is an integral part of creating a viable technology infrastructure.

A mixture of these strategies, full labs, mini-labs/clusters, (even standalones) all connected by school/districtwide networks, is the ideal solution for most schools. This allows for curricular needs to drive the selection of hardware based upon software availability.

The pages immediately following the figure show the detailed configuration components and associated recommendations and considerations for each model. Please note that information in the "Recommendations & Considerations" columns are not mandatory. For example, when an Intel 486/Pentium is listed, it should be understood that processors from other vendors making compatible processors are acceptable. For server administrative software, vendor software other than the ones mentioned are acceptable if they meet the school's instructional and network administrative needs better.

MINIMUM GUIDELINES
FEBRUARY, 1995
NETWORK-READY WORKSTATIONS

ITEM	RECOMMENDATIONS & CONSIDERATIONS
Standalone Workstations:	
Processor	Intel: 486; Motorola: 68040; PowerPC
RAM	8 MB
Floppy Drive[3]	Internal, 3.5 high density
Hard Disk Drive	400 MB
Display	Color, SVGA
Mouse	Standard
Keyboard	Standard
Sound[4]	Sound capabilities
Video port/adapter[5]	
Bus Controller	IDE or SCSI; PCI or VLB
CD-ROM[6]	Dual speed
Networking port[7]	
System Software	Intel: DOS/Windows; Motorola: MacOS
Headsets[8]	
Printers	As appropriate
Modem with communication software[9]	
Projection System	
Overhead projector	4,000 lumen
LCD	Color, active matrix
Video Presentation	
TV	
VCR	
Laserdisc	
Software	
Installation fees	Software and Hardware
Supplies	
Maintenance	
Surge Protector	

[3] May need at least one machine with two floppy drives.
[4] Sound needed at elementary; not every machine middle/high schools.
[5] Video port/adapter on computers used for projection and presentation.
[6] Not necessary for every machine.
[7] Must be reserved for network card.
[8] Required for all workstations using software with sound.
[9] Needed on one machine. May be placed on server

MINIMUM GUIDELINES
FEBRUARY, 1995
NETWORKED LAB

ITEM	RECOMMENDATIONS & CONSIDERATIONS
Server:	
Processor	Intel: 486/Pentium; Motorola: 68040; PowerPC
RAM (expandable)	16 MB
Hard Disk Drive	1 GB
Display	12" monochrome VGA
Network Card	Ethernet
System Software	Intel: DOS; Motorola: System 7
Network Software	Intel: NetWare 3.12; Motorola: AppleShare
Admin. Software[10]	
Workstations:	
Processor	Intel: 486; Motorola: 68040; PowerPC
RAM	8 MB
Floppy Drive[11]	Internal, 3.5 high density
Hard Disk Drive	300 MB
Display	Color, SVGA
Mouse	Standard
Keyboard	Standard
Sound[12]	Sound capabilities
Video port/adapter[13]	
Bus Controller	IDE or SCSI; PCI or VLB
CD-ROM[14]	Dual speed
Network Card	Ethernet
System Software	Intel: DOS/Windows; Motorola: Ma
Headsets[15]	
Printers	As appropriate
Modem with communication software[16]	
Projection System	
Overhead projector	4,000 lumen
LCD	Color, active matrix
Video Presentation	
TV	
VCR	
Laserdisc	
Software	
Installation fees	Software and Hardware
Supplies	
Maintenance	
Uninterrupted Power Supply	for server
Surge Protectors	for all devices
Cabling and Concentrators	
Patch Cables	

[10] This is a good feature for labs, but not a requirement.
[11] May need at least one machine with two floppy drives.
[12] Sound needed at elementary; not every machine middle/high schools.
[13] Video port/adapter on computers used for projection and presentation.
[14] Not necessary for every machine.
[15] Required for all workstations using software with sound.
[16] Needed on one machine. May be placed on the server.

MINIMUM GUIDELINES
FEBRUARY, 1995
DISTRIBUTED NETWORK[17]

The hardware specifications for a distributed network are the same as a networked lab with the possible exception of the amount of storage on the server hard disk drive and the number of printers. The number of workstations and the software requirements will determine the size of the hard drive.

[17] Four or five networked computers in each classroom

MINIMUM GUIDELINES
FEBRUARY, 1995

LIBRARY/MEDIA CENTER

ITEM	RECOMMENDATIONS & CONSIDERATIONS
Server:	
Processor	Intel: 486/Pentium; Motorola: 68040; PowerPC
RAM (expandable)	16 MB
Hard Disk Drive	1 GB
Display	12" monochrome VGA
Network Card	Ethernet
System Software	Intel: DOS; Motorola: MacOS
Network Software	Intel: NetWare 3.12; Motorola: MacOS
Admin. Software[18]	
Catalog & Circulation Stations:	
Processor	Intel: 486; Motorola: 68040; PowerPC
RAM	8 MB
Floppy Drive	Internal, 3.5 high density
Hard Disk Drive	400 MB
Display	Color, SVGA
Mouse	Standard
Keyboard	Standard
Bar code scanner	
Sound[19]	Sound capabilities
Bus Controller	IDE or SCSI; PCI or VLB
CD-ROM[20]	Dual speed
Network Card	Ethernet
System Software	Intel: DOS/Windows; Motorola: System 7
Headsets[21]	
Printers	Ink jet, at least one laser
Modem with communication software[22]	
Projection System	
Overhead projector	4,000 lumen
LCD	Color, active matrix
Video Distribution	Head-in Distribution System Integrated Communication System
TV	
VCR	
Laserdisc	
Video production equipment	Camcorder with tripod, lights and wireless mike
Software	Circulation, research, reference
Installation fees	Software and Hardware
Supplies	
Maintenance[23]	
Uninterrupted Power Supply	for server
Surge Protectors	for all devices
Cabling and Concentrators	Including Patch Cables

[18] This is a good feature for media centers, but not a requirement.
[19] Needed at workstations with CD-ROM drives.
[20] Not necessary for every machine.
[21] Required for all workstations using software with sound.
[22] Needed on one machine. May be placed on the server.
[23] Must include an annual software maintenance fee.

MINIMUM GUIDELINES
FEBRUARY, 1995
INSTRUCTIONAL MANAGEMENT SYSTEMS[24] (VoCATS)

ITEM	RECOMMENDATIONS & CONSIDERATIONS
Server:	
Processor	Intel: 486/Pentium; Motorola: 68040; PowerPC
RAM (expandable)	Intel: 16 MB; Motorola: 20MB
Hard Disk Drive	1 GB
Display	12" monochrome VGA
Network Card	Ethernet
System Software	Intel: DOS; Motorola: MacOS
Network Software	Intel: NetWare 3.12; Motorola: AppleShare
Workstations:	
Processor	Intel: 486; Motorola: 68040; PowerPC
RAM	8 MB (16MB)[25]
Floppy Drive[26]	Internal, 3.5 high density
Hard Disk Drive	400MB[27]
Bernoulli Drive[28]	
Display	Color, SVGA
Mouse	Standard
Keyboard	Standard
Network Card	Ethernet
System Software	Intel: DOS/Windows; Motorola: MacOS
Printers	One laser[29] or as appropriate
Modem with communication software[30]	
Software	CTB or Abacus; PageMaker 5.0[31]
Installation fees	Software and Hardware
Supplies	
Maintenance[32]	
Uninterrupted Power Supply	for server
Surge Protectors	for all devices
Cabling and Concentrators	
Patch Cables	

[24] Up to 2,000 student ADM.
[25] Need 16 MB RAM for VoCATS.
[26] May need at least one machine with two floppy drives.
[27] Need 400MB hard drive for VoCATS.
[28] Needed for VoCATS.
[29] Laser printer needs 2MB RAM for VoCATS; need postscript printer to print NCSCOS.
[30] Needed on one machine. May be placed on the server.
[31] Required to print NCSCOS and VoCATS tests.
[32] Must include an annual software maintenance fee.

4.3. Comparison of Model Configurations

The different model configurations can be generalized into three conceptual approaches for implementing instructional technology into the schools:

- network-ready workstations
- networked lab -- a large number of networked computers placed in a single room
- distributed network -- similar to a networked lab, but the actual computers are placed in small groups in individual classrooms.

The following table shows the advantages and disadvantages of each approach.

ADVANTAGES AND DISADVANTAGES OF THE CONFIGURATIONS

The general consensus around the issue of labs versus computers in the classrooms is that a mix including multiple organizational strategies, full-labs, mini-labs/clusters (even standalones) all connected by school/districtwide networks, is the ideal solution for most schools. This allows for curricular needs to drive the selection of hardware based upon software availability.

CONFIGURATION	ADVANTAGES	DISADVANTAGES
Network-Ready Workstations	Available for use prior to having a network	Must purchase more software, unless use site license
		Must shuffle diskettes
		Lack of software management
		Difficult to share files, peripherals
		One computer per classroom is insufficient for student access
		Need printer sharing devices or one printer per computer
Networked Lab	May share files/peripheral devices (printers)	Higher price tag (need server, cabling, retrofit)
	Software more economical	May need assistance in managing lab
	Whole class engagement in lab environment	Need an extra room to house lab
	Software management centrally handled	One lab generally is not enough for large school
	Wider range of software available	
Distributed Network--4-5 Workstations in Classroom	Different groups of students may use computers all day	Higher price tag (need server, extensive cabling, retrofit)
	Easy teacher access -- teaching/planning	Need more printers (one per classroom)
	File sharing possible among classrooms	Need network expertise (onsite assistance)
	Students become more active in learning process	
	Wider range of software available	
	Total connectivity throughout school opens door for greater communication (e-mail), future options	

As stated earlier, no two schools will adopt the same configurations. The reasons for this are 1) schools will have different goals and priorities to guide the decisions they make; 2) many types of resources, tools, and connections can effectively achieve the same goals; and 3) the choices schools make in developing their plans will vary significantly, depending upon what they already have to work with and their options for funding and assistance. It is important for schools to be given the opportunity to implement the configurations that best meet their needs.

4.4. Other Considerations

The preceding tables depict the minimum hardware recommendations that may be used as benchmark configurations in a basic technology plan. These guidelines may be used for purchasing new resources. They also establish the standards by which in-place school technology programs may be assessed. This in turn, determines the additional resources necessary to ensure the desired result in every school. However, there are other areas which must be addressed when planning for technology. These considerations fall within the realm of facility retrofit. It is important to determine what is required to bring a given school facility up to signal distribution (data, voice, and video) and electrical supply standards necessary to install the schoolwide basic technology program. North Carolina has established a set of standards for networking[33], cabling[34], and telecommunication[35] which schools may use when developing their plans. Heating, ventilation, air conditioning, environmental issues (noise, radiation, lighting), furniture, and space requirements also need to be addressed.

[33]North Carolina document--Requirements and Procedures for Installing Local Area Networks, March 1994.

[34]North Carolina document--A Primer on Cabling Design and Implementation: Considerations for Decision-Makers, May 1992.

[35] North Carolina document--Guidelines to Provide Uniform Wiring Service for Telecommunications in North Carolina Public Schools, July 1991.

5. SUPPORTING DOCUMENTS

The Department of Public Instruction, the Information Resource Management Council (IRMC), and the North Carolina Information Highway project have developed a series of technical standards, recommendations, statements of direction, and other aids to assist schools and districts in implementing a wide range of instructional technology. The following table references all of the documents available to support the technological infrastructure needed for the four instructional initiatives.

NORTH CAROLINA TECHNICAL STANDARDS AND GUIDELINES

Area of Consideration	Preliminary Standard	Recommendation or Statement of Direction	Implementation Aids and Supporting References
1. Internal LAN of only Motorola (Apple/Mac) machines on a single server	Macintosh Operating system (System 7), AppleTalk/Ethernet networking, AppleShare file and print services	No Current Standard but approved for implementation	The guide to the NCITP entitled Technological Recommendations and Standards
2. Internal LAN of only Intel machines on a singe server	DOS/WINDOWS operating system, Novell networking, file, and print services	IRMC approved standards	Page 4 of Technology Standards and Supporting Products for Local Area Networks The guide to the NCITP entitled Technological Recommendations and Standards
3. Internal LAN of mixed Motorola and Intel machines on a single server	Workstation operating systems as specified above. Networking protocols same as above for native environments; however NetWare for Macintosh supports file and print services on common server with Novell "Intel" file and print services to enable the sharing of files and print services between both environments.	IRMC approved standards	Page 4 of Technology Standards and Supporting Products for Local Area Networks The guide to the NCITP entitled Technological Recommendations and Standards
4. Inter-network Transport	TCP/IP	IRMC approved standard is TCP/IP.	Page 5 of Technology Standards and Supporting Products for Local Area Networks
5. LAN Topology for the School	Ethernet wired to state telecommunications standards	Ethernet is recommended for all new installations. Token Ring is acceptable if it already exists in the school. Multiple bridged/routed LANs of Apple and Intel servers are acceptable.	Page 4 of Technology Standards and Supporting Products for Local Area Networks STS-1000 Telecommunications Wiring Guidelines

NORTH CAROLINA TECHNICAL STANDARDS AND GUIDELINES (continued)

Area of Consideration	Preliminary Standard	Recommendation or Statement of Direction	Implementation Aids and Supporting References
6. Electronic Mail (e-mail) external to the school	SMTP/MIME/POP3 products Current Connectivity : Commercial service providers such as NandoNet or Interpath provide Internet based E-mail services Future Connectivity : Internet access via E.A.S.I. SIPS dial connection to Internet is in the RFP stage. E-mail through AS/400 gateway from Office Vision is in the final testing stage.	IRMC Standard	IRMC Approved, January 4, 1994 and March 1, 1994; Electronic Messaging/Mail
7. Electronic Mail (e-mail) within the school	SMTP/MIME/POP3 products	IRMC Standard	IRMC Approved January 4, 1994 and March 1, 1994, Electronic Messaging/Mail
8. LAN Physical Infrastructure	State Wiring Standards: Backbone : UTP Level 5 (EIA/TIA TSB36) or Fiber Optic Multimode Horizontal Distribution : UTP Level 5 (EIA/TIA TSB36) Intelligent Hubs : SNMP compliant hubs. State contract for Synoptic hubs.	IRMC Standard IRMC Standard	DPI Guidelines to Provide Uniform Wiring Service for Telecommunications in N. C. Public Schools DPI Primer on Cabling Design and Implementation
9. Video	State Published Specifications		DPI Guidelines to Provide Uniform Wiring Service for Telecommunications in N. C. Public Schools DPI Primer on Cabling Design and Implementation NCIH Documents
10. Telephony and Voice Messaging			IRMC Approved September 7, 1993, Voice Processing Standards