DPA

MNT

The Colorado "Multi-Use Network"

Project Completion Report

"While our budget will shape many of our conversations, it will not stop us from taking steps that are needed to keep Colorado moving forward." Governor Bill Owens, State of the State address, January 16, 2003

Prepared by: The MNT Task Force
Presented to: Governor Bill Owens, October 2003

Table of Contents

Notice to readers:

This report is organized so that those interested in the most summarized form of MNT achievements and future opportunities may read just the Executive Summary. Those interested in more detail on achievements and future opportunities should refer to the chapter beginning on page 7. Those who wish to read about all phases of MNT may refer to the various other chapters in the report organized by subject as outlined in the Table of Contents below:

Applications in the Public Sector - Putting the MNT to Work . . . 77

Executive Summary

MNT Program Overview

The Multi-Use Network (MNT) concept was formulated in the February 1998 "Strategic Plan for a Statewide Telecommunications Infrastructure." It was authorized as a state program by SB 96-102. Its goal was to connect urban and rural communities across the state, bridging the digital divide. Its method was to use the public sector as an anchor tenant for telecommunications investment.

The Department of Personnel & Administration launched the MNT Program in June 2000 by formally entering into a public-private partnership with Qwest Communications. As anchor tenant, the State of Colorado agreed to aggregate its data telecommunications circuits onto the MNT. Qwest agreed to build a fiber-optic network spanning every county seat in the state. A sister program to the MNT, the Beanpole Program, authorized by HB 99-110, addressed the "last-mile" issue. The Beanpole Program was managed by the Department of Local Affairs until July 1, 2002 at which time the Department of Personnel & Administration (DPA) took responsibility.

The 3-year project build-out is virtually complete. Qwest and its strategic partners (Century Tel, Phillips Telephone and Eastern Slope) have established a total of 65 points of service (termed ANAPs or Aggregated Network Access Points) throughout Colorado. Qwest and its strategic partners have invested approximately $60 million in the infrastructure for the MNT and the State has agreed to pay approximately $9.5 million over ten years to reserve 20 Megabits per second of bandwidth at each of these ANAPs for public sector use. This income stream allows Qwest and its partners to establish fiber-optic points of presence in rural parts of Colorado where an adequate business case did not exist prior to the MNT. In addition to the 65 ANAPs operated by Qwest and its partners, the State has installed 5 Super ANAP sites to route internal state traffic utilizing MGX 8850 carrier grade switch equipment. The State installed 39 Edge sites at circuit aggregation points among the larger state agency operations throughout Colorado. (An "Edge" site is an end-user access point to the MNT designed to be shared among high bandwidth public sector users.) The State also installed an additional 39 county points of presence (CPOPs) to aggregate circuits at the county level that are not sufficient to justify a full Edge site. The State invested $13,250,000 in capital funds to purchase and install the equipment and services necessary to operate the State’s portion of the network bringing the total State contribution to just under $23 million.

As a result, in Colorado we have bridged the digital divide with a network that is capable of delivering voice, video and data services to every county in the state. This network provides a pipeline to the state's rural areas capable of supporting growth in existing and new industries while also providing access for public sector services in healthcare, education and government.

Summary of MNT Achievements

Below are listed the ten main achievements of the MNT program, followed by a cross-reference table showing the links between achievements and the specific statutory, programmatic, strategic and executive requirements of the program.

1. A statewide fiber backbone has been deployed throughout Colorado. Every node is served by two or more links. This makes the network "self healing" and highly reliable.

2. Access has been provided in every county, usually in the main central telephone office. Local access is then available to most circuits supported by the central office.

3. Expensive backhaul charges for rural customers have been reduced or eliminated. The new network tariffs are based on entering and exiting the network, not on distance traveled.

4. Equity in pricing has been established. - The same Qwest tariff rate applies to all areas of the state served by Qwest.

5. Affordable Internet access has been made available through the MNT to all local public entities, including schools, libraries, hospitals and local governments.

6. A seamless statewide intranet or enterprise network has been formed which is capable of tying together all state and local public entities.

7. The stage has been set for redundant or duplicate circuit connections at major public facilities to be reduced or eliminated through a strategy of circuit aggregation.

8. The $4.6 million Beanpole Program has helped 15 counties implement new last-mile broadband infrastructure within their communities and has helped another 18

counties in planning. All Beanpole communities that received planning and implementation funding are connected to the MNT.

9. The majority of all state agency circuits have been transferred to the MNT. All of the higher education networks interconnect with the MNT at the Front Range GigaPop. Approximately one-fourth of all local public entities now get their telecommunications and Internet service from the MNT.

10. Sound program management is in place for ongoing management of the MNT Program.

MNT Program Achievements vs. Authorizing Authority

	RELEVANT STATUTES						MNT PROGRAM GOALS					STATEWIDE STRATEGIC TELECOMMUNICATIONS PLAN						MNT EXECUTIVE ORDER		
ACHIEVEMENTS	23-11.5-104 – MNT Definition	24-30-903(1) – DPA Telecom Admin. Duty	24-30-903(3) – DPA Contract Powers	24-30-903(7) – Provide Access	24-32-3001 – Beanpole	24.37.5-203(1) – IMC Network Duty	1) Bridge Digital Divide	2) Enhance Econ. Development	3) E-Government	4) Aggregate Traffic	5) Change Pricing Model	1) All Agencies Participate	2) $13.5 Million Capital Funds	3) $7 Million Spending Authority	4) Additional FTE (not appropriated)	5) Community Incentive Fund	6) Examine Investment Opp'ty	1) Migrate all Networks to MNT	2) Convert all Traffic to MNT	3) Aggregate Purchasing
1) Statewide fiber backbone	✓					✓	✓	✓					✓							
2) Access in every county							✓	✓					✓							
3) Backhaul charges reduced or eliminated							✓	✓			✓									
4) Equity in pricing							✓	✓			✓									
5) Affordable Internet				✓							✓									
6) Seamless statewide intranet	✓		✓	✓					✓			✓						✓		
7) Circuit aggregation	✓		✓						✓	✓			✓	✓				✓		✓
8) Last mile infrastructure					✓		✓									✓				✓
9) Participation by state and local entities		✓		✓	✓					✓		✓				✓		✓	✓	
10) Program management		✓				✓							✓				✓		✓	

Summary of Future Opportunities for MNT

In the course of successfully completing the MNT project, we identified a number of future opportunities, documented here, which support the ongoing growth and maturation of the MNT network and its impact. In the table that follows, each future opportunity is linked to existing program authority.

1. Complete the last-mile build-out to all rural communities of reasonable size (e.g., over 1,000).

2. Implement enterprise-wide video conferencing and voice services on the MNT. "Enterprise-wide" means all state agencies and political subdivisions of the state.

3. Expand and develop specific applications of the MNT for economic development, e-government, healthcare, K-12 education and higher education.

4. Establish working relationships with non-MNT local independent telephone companies in order that the MNT's backbone and ATM services are available to customers of any Colorado local telephone carrier.

5. Obtain full participation from the public sector at the state and local levels of government including a pro-active E-rate education program for schools and libraries. All remaining separate, single-purpose circuits and networks will be consolidated with the MNT except where special circumstances or statutory provisions allow.

6. Stay abreast with technology and user needs by exploring Next Generation Networking (NGN). NGN is the research activity underway now nationally to explore and develop the successor to the Internet. NGN will be all fiber-optic based (end-to-end) and run at extremely fast speeds (billions of bits per second vs. today's Internet which runs at millions of bits per second).

7. Extend Internet2 services to our schools and colleges. Internet2 is a complementary program to NGN where the technology and applications for tomorrow's Gigabit speed networks is being developed and demonstrated. K-12 applications are a key Internet2 program area.

8. Protect our network with redundant Internet access. Provide back-up connections to the Internet beyond the main service the State uses to connect (the Front Range GigaPoP). Secure direct backup connections from the main MNT switches to an alternative, major Internet provider.

9. Measure the impact of the MNT in the areas of economic development, distance education and e-government. Work collaboratively with the mission agencies in these fields to leverage their current and ongoing assessment efforts.

10. Continue statewide networking governance beyond the MNT Task Force.

Future Opportunities vs. Existing Authorization

FUTURE OPPORTUNITIES	RELEVANT MNT STATUTES						MNT PROGRAM GOALS					STATEWIDE STRATEGIC TELECOMMUNICATIONS PLAN						MNT EXECUTIVE ORDER		
	23-11.5-104 – MNT Definition	24-30-903(1) – DPA Telecom Admin. Duty	24-30-903(3) – DPA Contract Powers	24-30-903(7) – Provide Access	24-32-3001 – Beampole	24.37.5-203(1) – IMC Network Duty	1) Bridge Digital Divide	2) Enhance Econ. Development	3) E-Government	4) Aggregate Traffic	5) Change Pricing Model	1) All Agencies Participate	2) $13.5 Million Capital Funds	3) $7 Million Spending Authority	4) Additional FTE (not appropriated)	5) Community Incentive Fund	6) Examine Investment Opp'ty	1) Migrate all Networks to MNT	2) Convert all Traffic to MNT	3) Aggregate Purchasing
1) Complete last-mile				✓	✓		✓									✓				
2) Implement enterprise video and voice IP	✓								✓	✓									✓	
3) Expand applications								✓	✓											
4) Work with non-MNT telephone companies			✓	✓	✓		✓				✓									✓
5) Obtain full participation of public sector	✓	✓	✓						✓	✓	✓	✓		✓				✓		
6) Explore Next Generation Networking																	✓			
7) Extend Internet2				✓					✓	✓										
8) Protect network with back-ups				✓																
9) Measure impact of MNT								✓	✓											
10) Continue statewide governance		✓				✓											✓			

Project Background

Strategic Plan for a Statewide Telecommunications Infrastructure

The concept for the Multi-use Network was developed in response to legislation passed by the General Assembly of the State of Colorado in 1996. The intent of SB 96-102 was to connect urban and rural communities across the state. This would bridge the digital divide that existed between the rural areas of the state (that had little to no access to affordable, high-speed telecommunications services) and the urban areas of the state (mostly along the Front Range) that did have affordable, high-speed access.

In October 1997, a task force was assembled to evaluate the State of Colorado's current and future use of telecommunications and to make strategic recommendations based upon its findings. This interdepartmental task force was comprised of representatives from the Departments of Personnel & Administration, Higher Education, Education, the Commission on Information Management (IMC) and State Libraries. The task force published the "Strategic Plan for a Statewide Telecommunications Infrastructure" in February 1998. (The task force was known as the Multi-Use Network Task Force and nicknamed the MNT; hence the program's acronym.)

The Strategic Plan's intent was to have the private sector build, own and operate at least the majority of this network with state government serving as anchor tenant. The Strategic Plan outlined six key objectives:

1. Legislation mandating the participation of all state agencies, including higher education, in the aggregation of telecommunications circuits to optimize the economies of scale;

2. One-time capital funding of $13.5 million to acquire Customer Premise Equipment to aggregate State circuits over a telecommunications infrastructure;

3. Spending Authority increase of $7 million annually to fund ongoing private sector operation and management of the telecommunications infrastructure;

4. Three additional full-time equivalent positions to augment the Central Coordination Authority for the oversight and planning of the telecommunications infrastructure. This requires an additional $161,000 of spending authority;

5. Establishment of a Community Incentive Funding program to enable communities to aggregate local demand and assist them in connecting to the statewide telecommunications infrastructure; and

6. Continued examination of alternative and innovative investment strategies to facilitate infrastructure development.

The Strategic Plan was put into effect in June 2000 by the Department of Personnel & Administration, which entered into a public-private partnership with Qwest Communications. As the anchor tenant, the State of Colorado aggregated its telecommunications requirements of state government agencies as the leverage investment for extension of telecommunications capabilities and advanced services throughout the state. Qwest had the role of configuration, implementation and ongoing management of the MNT fiber-optic network.

In bridging this digital divide and building a network backbone that was capable of delivering IP (Internet Protocol) data services and time-sensitive services such as video and voice to all counties of the state, the state supplied a lifeline to the rural areas of the state. By piping in telecommunications access to each county seat, the MNT promotes quality education, healthcare, entertainment and economic viability. Building this network infrastructure will serve as an economic stimulus for new and growing industries in rural Colorado because having access to high-speed telecommunications services will allow industries to flourish in rural parts of the state which was not possible prior to MNT.

As the state extended the backbone network to every county in the state, additional funding was set aside for addressing the "last-mile" access - or the telecommunications environment within a city or town. To provide for last-mile access, the State of Colorado implemented Beanpole funding for communities to access the MNT within a county or town, creating a community level of aggregated, network traffic.

MNT Program Goals

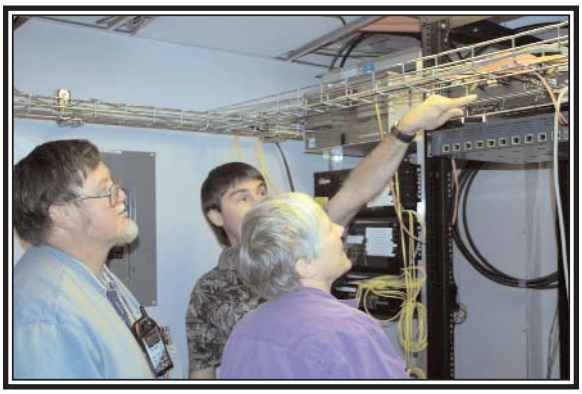
The MNT Program had five principal goals:

1. **Bridge the digital divide, bringing high-speed access to every county in the state.** The MNT will enable the same digital applications and services in rural counties as the metropolitan Front Range cities. MNT will be capable of delivering high-speed telecommunications services that accommodate emerging technologies for all counties of Colorado. Network bandwidth will expand to meet the customer requirements of more reliability and flexibility.

2. **Enhance economic development in the state.** MNT will promote rural economic development by extending telecommunications infrastructure to all corners of the state to encourage private investment with the state acting as the anchor tenant. This "upgrade" of the state's telecommunications infrastructure, through the aggregation of existing and impending demand, will provide many benefits to state agencies, schools, libraries and institutions of higher education and provide a stimulus to the state's economic development.

   Broadband services are becoming more important to the success of small and large businesses. For many, broadband is no longer an optional service; it is a standard for doing business. The network will provide businesses, especially those located in rural areas of the state, with the communication link they require to remain competitive with Front Range communities.

3. **Create a backbone for e-government.** MNT will provide a strong backbone for e-government. In addition, the MNT telecommunications infrastructure will aggregate traffic and reduce cost. The ability for an increased number of users to access state services online will be greatly enhanced, saving both time and money for the taxpayers of Colorado. In addition to the economic benefits, use of the MNT will transform government service. The MNT will provide the high-speed Internet connections that make "e-government" possible. This process will allow citizens to fill out forms and obtain licenses and permits over the Internet instead of the traditional, time-consuming



methods such as standing in line. Online applications will be accessible to the vast majority of Colorado citizens, making state government more user-friendly.

The state's MNT project will allow for uniform delivery of government, education and healthcare services and the ability to take networking to the next level among Colorado public entities.

For example, high-speed access can:

- Improve access to digitally-based educational materials and online courses for students and teachers from organizations within Colorado as well as from around the world. Note, Colorado's public institutions of higher education provided online courses to 41,316 students in 2002.
- Provide access to advanced placement classes for high school students who are not physically close to a higher education institution.
- Improve teachers' access to professional education programs that are offered by Colorado education institutions.
- Encourage collaboration among teachers from different schools and school districts.
- Promote collaboration among schools and school districts and state and local government.
- Encourage and provide access to online information resources to all users through their local public libraries.
- Encourage new outreach programs made possible by high-speed networks and improved Internet access.
- Create an organizational structure that will facilitate pre-K-12 access to the Internet.

- Facilitate the handling of jail and prison inmates for arraignment, health care examination and continuing education.
- Replace long travel time for municipal and county regional and statewide meetings through video conferencing.
- Provide faster data links between local and state government.
- Support continuing medical education.
- Support telehealth applications such as public awareness and disease control.
- Support telemedicine applications such as remote diagnoses, X-ray evaluation and treatment options.

4. **Aggregate traffic to reduce cost.** An aggregated network approach streamlines government by avoiding additional expenditures for duplicate state networks and provides the base infrastructure for electronic transactions. MNT reduces the costs of telecommunications services to state agencies. Telecommunications access costs have been significantly reduced by implementing local Aggregated Network Access Points (ANAPs) in each county seat throughout the state. The MNT significantly reduces the need to backhaul data services which reduces access costs.

   MNT will implement supplementary aggregation points to further reduce telecommunications costs throughout the state. The MNT will focus on aggregation within higher density communities. Additional savings will be realized with aggregation of services from state agencies and local public entities occupying the same building or campus.

5. **Change the model of telecommunications pricing for all users public and private.** By virtually eliminating backhaul access costs, MNT will change the model of telecommunications pricing for all customers within Colorado. Although state agencies will realize significant reductions in access costs, access charges will decrease for every customer in the state, not just state agencies.

Colorado Statutes Controlling Statewide Networking

The MNT Program is authorized and directed by several statutes. These are listed in Appendix 1.

MNT Executive Order

The MNT Program was established through the state planning effort that led to the February 1998 "Strategic Plan for a Statewide Telecommunications Infrastructure." After the MNT Program was authorized by SB 96-102, Governor Owens established the MNT Task Force to oversee the program's progress through Executive Order B 02 01. The executive order is found in Appendix 2. The Task Force members are listed in Appendix 3.

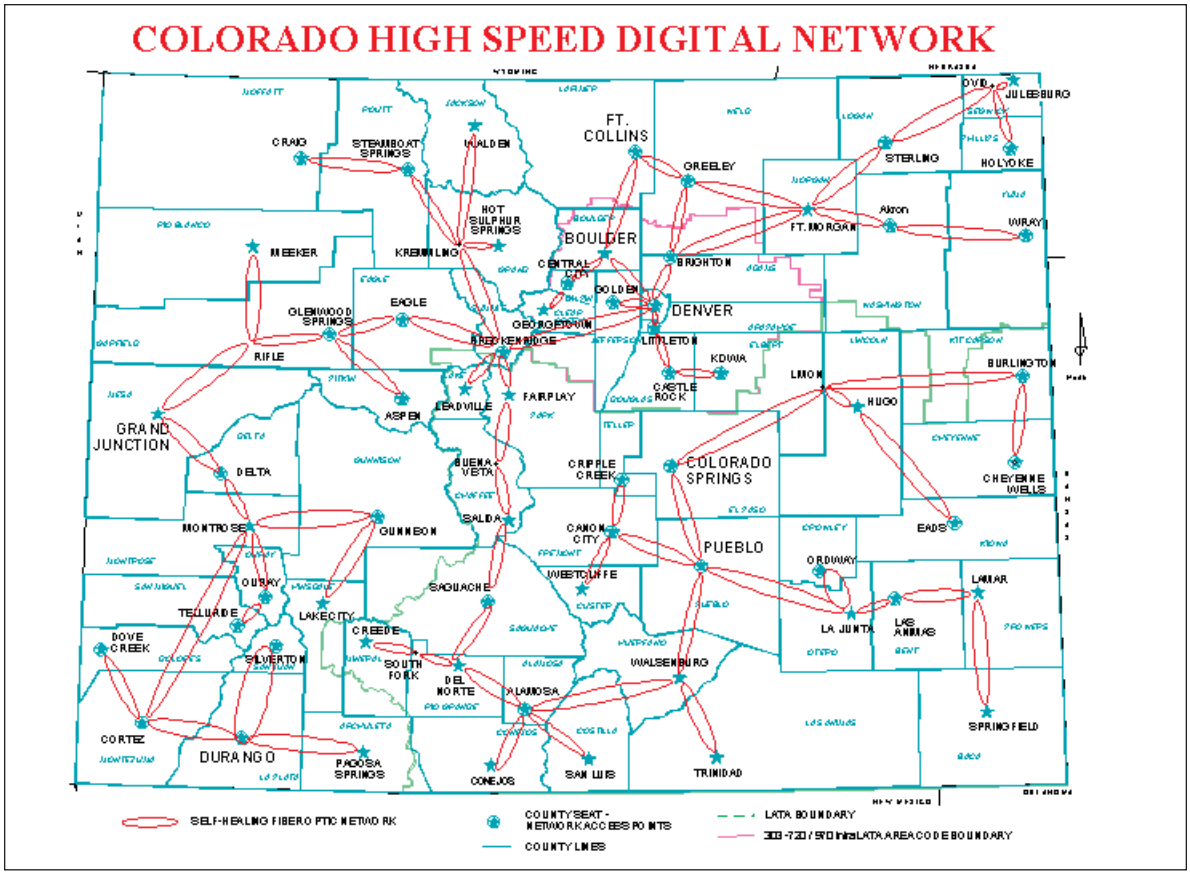
Achievements and Future Opportunities

Achievements

The MNT has helped bridge the digital divide in Colorado. The "digital divide" is a term used to describe inequality in access to digital telecommunications. Certain barriers, among them, geographic distance and population density, led to a situation where modern fiber-based telecommunications infrastructure was being deployed in metropolitan regions but not in rural regions of the state. This was the result of simple economics - the strength of the business case for telecommunications companies to make the investments needed to deploy fiber infrastructure. The MNT's core strategy to address this situation was for the State to serve as an "anchor tenant" to stimulate the investment needed to deploy fiber throughout the state. This strategy succeeded.

Statewide Fiber Backbone

Simply put, the main physical achievement of the MNT was the deployment of a fiber optic backbone throughout the state, reaching every county. Prior to MNT, fiber optic telecom-



munications infrastructure was largely limited to the Front Range corridor. After MNT, fiber optic trunks span the state.

Some key attributes of this statewide fiber backbone are:

- It reaches every county in the state.
- It provides increased telecommunications bandwidth to certain localities of the state where the prior network was pushed to the limits of its capacity and new data circuits were not available.
- The MNT backbone is generally redundant. It is built in loops so that if any of the loops lose functionality, loss of service is minimized. If a path is cut in one place, data flows along alternative routes to reach all points behind it.
- It is an integrated network. The MNT partners have forged a seamless network under uniform technical, pricing and administrative control. Thus, MNT is not a patchwork of different vendors and technologies. It is a single, seamless, coherent system.

A Point of Presence (ANAP) in Every County

The primary responsibility of Qwest in the MNT project was the implementation of Aggregated Network Access Points (ANAPs) throughout the state. An "ANAP" is a physical network point of presence on the MNT backbone. The ANAPs are owned, operated and managed by Qwest (or their strategic partners) and are physically located in phone company central offices. Network traffic in the form of frame relay or ATM (Asynchronous Transfer Mode) circuits from state agencies, local governments, schools, libraries and non-profit health providers are aggregated at the ANAP in each county and routed onto the MNT. Private sector business traffic is also aggregated at the ANAP and routed onto the private sector side of the network, Qwest's Colorado High Speed Digital Network (CHSDN). Properly, the MNT is a collection of circuits leased from Qwest, running on the CHSDN.

The State’s portion of the project was completed within the allocated capital budget and was generally implemented on time and on functionality. The MNT ANAP implementation was deployed in three phases over a three-year period. Qwest and its partners implemented 38 counties in the first year of the program, 11 counties in the second year, and 16 counties in the third year.

MNT Phase One: Completed September 15, 2001

County	ANAP	County	ANAP
Adams	Brighton	Huerfano	Walsenburg
Alamosa	Alamosa	Jefferson	Golden
Arapahoe	Littleton	LaPlata	Durango
Baca	Springfield	Larimer	Fort Collins
Bent	Las Animas	Las Animas	Trinidad
Boulder	Boulder	Lincoln	Limon
Broomfield	Broomfield	Logan	Sterling
Clear Creek	Georgetown	Mesa	Grand Junction
Crowley	Ordway	Montezuma	Cortez
Delta	Delta	Montrose	Montrose
Douglas	Castle Rock	Morgan	Fort Morgan
Eagle	Eagle	Otero	La Junta
El Paso	Colorado Springs	Pitkin	Aspen
Elbert	Kiowa	Prowers	Lamar
Fremont	Canon City	Sedgwick	Julesburg
Garfield	Glenwood Springs	Summit	Breckenridge
Garfield	Rifle	Washington	Akron
Gilpin	Central City	Weld	Greeley
Gunnison	Gunnison	Yuma	Wray

MNT Phase Two: Completed June 30, 2002

Country	ANAP	County	ANAP
Chaffee	Salida	Grand	Hot Sulphur Spgs.
Chaffee	Buena Vista	Moffat	Craig
Conejos	Conejos	Phillips	Holyoke
Costilla	San Luis	Routt	Steamboat Springs
Custer	Westcliffe	Saguache	Saguache
Dolores	Dove Creek		

MNT Phase Three: Completed October 30, 2003

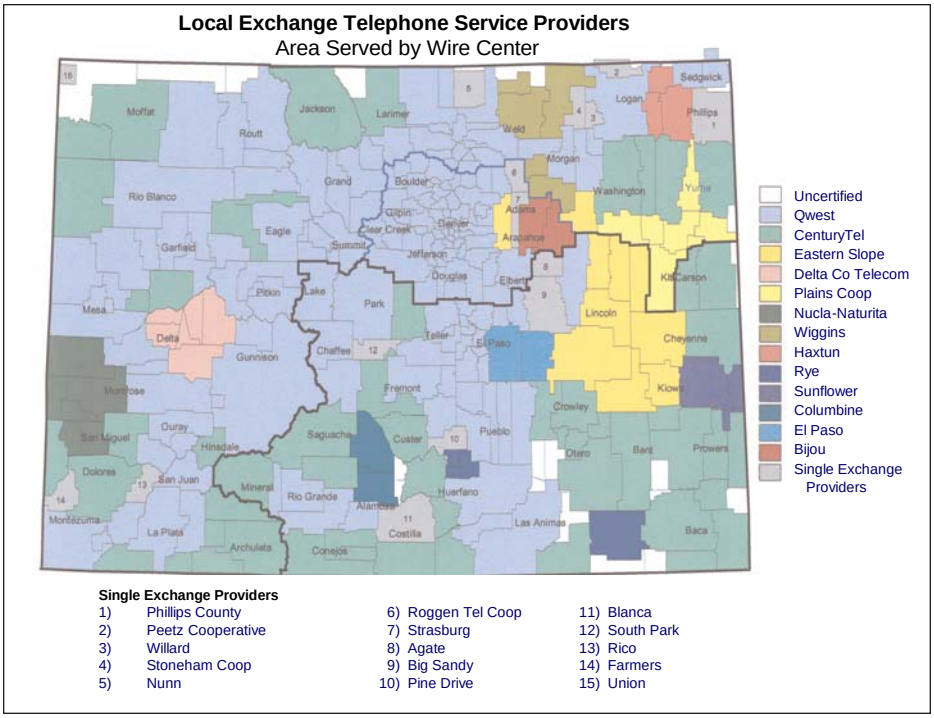
Country	ANAP	County	ANAP
Archuleta	Pagosa Springs	Mineral	Creede
Cheyenne	Cheyenne Wells	Ouray	Ouray
Hinsdale	Lake City	Park	Fairplay
Jackson	Walden	Rio Blanco	Meeker
Kiowa	Eads	Rio Grande	Del Norte
Kit Carson	Burlington	San Juan	Silverton*
Lake	Leadville	San Miguel	Telluride
Lincoln	Hugo	Teller	Cripple Creek

*Silverton has a 16 mile fiber build remaining from the La Plata County line which is await-

ing clearance of title issues with the power line right-of-way. As an interim solution, the microwave capacity into Silverton is being increased from 45 Megabits to 200 Megabits until the fiber run can be completed. There are no specific ANAPs in Denver, Aurora or Pueblo because Qwest has multiple central offices in each area. Garfield and Chaffee counties have two ANAPs each.

Reduced or Eliminated Backhaul

Prior to MNT, many communities had to pay for backhaul circuits to reach their ISPs or to access metropolitan telecommunications services. Because the MNT provides a type of service that is distance insensitive, communities within the ANAP zones no longer need to pay for backhaul.



The map to the left shows wire centers in the state. A "wire center" is the area served by a telephone central office. Usually all phone lines in a wire center have the same "prefix," e.g., the first 3 digits of the 7 digit phone number. Access to the MNT is possible throughout the wire centers associated with every central office where a MNT point of presence is located (i.e. an ANAP). Some counties have more than one wire center. The MNT is available without backhaul charges in the wire center associated with the ANAP and often with any adjacent wire centers. Backhaul charges may apply to customers within the non-ANAP wire centers. These backhaul charges are greatly reduced from the pre-MNT situation because the distance to reach the nearest ANAP (e.g., one within the county) is much less than reaching all the way back to a metropolitan area such as Denver.

The rules governing large telephone companies such as Qwest differ somewhat from the rules for small, local telephone carriers. The Qwest tariff applies in the areas of the map shaded light blue in the map above.

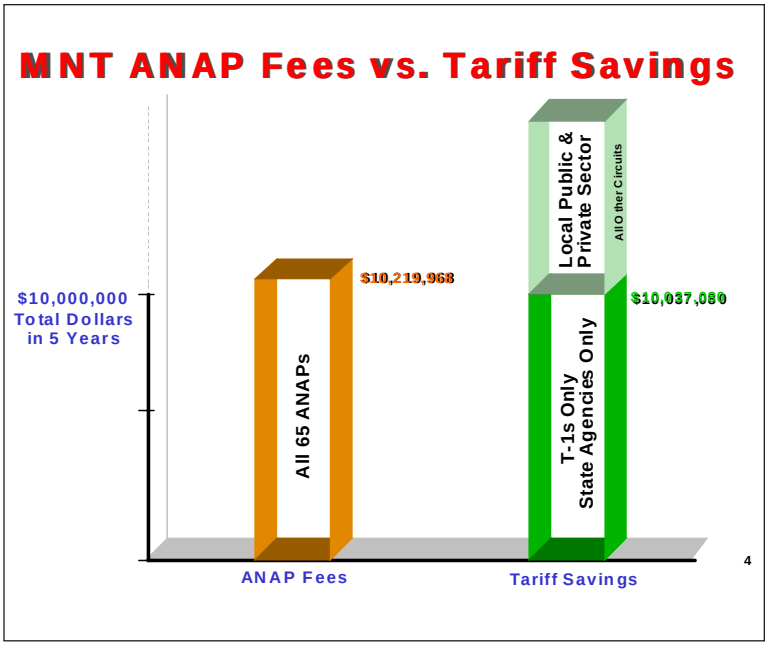
By virtually eliminating distance-sensitive backhaul charges, the MNT pricing model has decreased costs for every telecommunications customer, not just state agencies. For, example, the cost for a Qwest T-1 circuit before and after MNT:

Cost Savings Due to Elimination of Distance-Sensitive Backhaul Charges

City	Prior to MNT	Qwest Tariff Rate under MNT
Limon	$852.50	$329.85
Trinidad	$1,324.81	$329.85
Julesburg	$2,023.13	$329.85
Cortez	$615.17	$329.85
Leadville	$1,264.61	$329.85
Fairplay	$1,684.01	$329.85
Alamosa	$1,348.89	$329.85
Steamboat Springs	$1,180.33	$329.85
Gunnison	$1,059.96	$329.85

Equity in Pricing

MNT Qwest circuit tariffs are the same throughout the network. For example, the present tariff price for a Qwest T-1 circuit is $329.85. As long as a customer is located in the wire center of an ANAP, the price to access the MNT is the same, regardless of the distance of that region back to Denver. In this sense, the MNT has overcome the digital divide - there is no division among MNT customers in the prices they pay within ANAP wire centers.



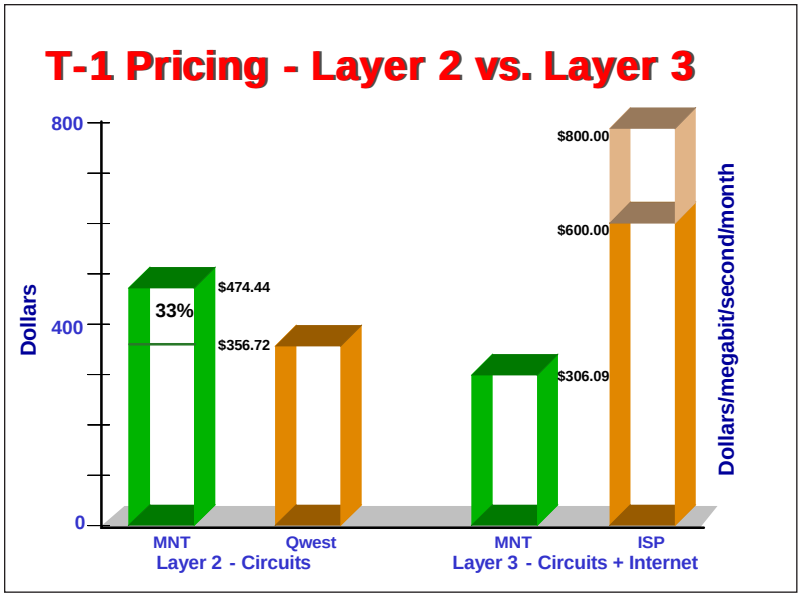
In addition, under the MNT contract, Qwest reduced its tariff rates on many telecommunications products. The overall cost reduction for Qwest T-1 circuits, for example, for just state agencies, over the initial 5 year MNT contract period totals $10,037,080 which more than pays for all ANAP fees for the entire MNT contract! This does not count T-1 savings to the private sector or local public entities nor does it count tariff savings on many other telecommunications products that were reduced under the MNT contract.

Internet Access to Local Public Entities

A major achievement of the MNT Program has been to provide Internet access to local public entities. This was not a provision of the original MNT plan but the MNT Program recognized this need and has bundled (included) Internet access with all MNT circuits. This Internet access is affordable to local public entities and provides a great incentive for local public entities to subscribe to the MNT. In the State's role as anchor tenant, it reserved 20 Mbps bandwidth at each ANAP. In some cases, this bandwidth exceeds what State agencies could consume alone. Therefore, it was desirable for local public entities to also participate in the MNT. Local public entities are projected to become the largest single MNT customer group.

Formation of Statewide Intranet

The way the MNT chose to provide Internet access to its users formed a seamless statewide intranet - an enterprise Wide Area Network for Internet data for the entire public sector - both state and local. This was done by joining an entity called the Front Range GigaPoP (FRGP), an Internet access buying cooperative managed by a large national research laboratory (the National Center for Atmospheric Research) with participation by many of the state's colleges and universities and the University of Wyoming. State agency and local public customers of the MNT plus the other coop members all connect to the FRGP. This means that traf-

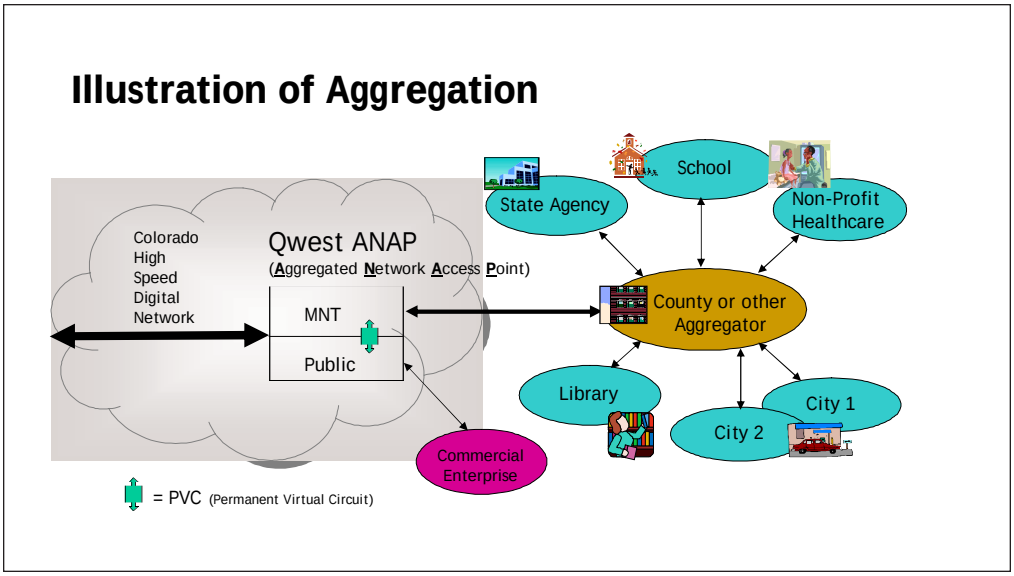


fic among these public entities within Colorado stays within our enterprise network, resulting in increased performance and reduced cost. The Front Range GigaPop currently spreads its Internet traffic across three providers: AT & T, Cable and Wireless and Level 3. These three providers are in fact the MNT's ISPs.

Illustrated in the figure to the left is the differential in cost to local public entities for Internet access via the MNT vs. a typical commodity ISP. The Qwest T-1 circuit cost of $329.85 plus the Universal Service Charge totals approximately $356.72. MNT adds 33% to this circuit cost for Internet access for a total of $474.44 per month or $306 per megabit per second per month. It is not unusual for rural ISPs to charge $800 to $1200 per month or $600 to $800 per megabit per second per month. MNT cannot replace an ISP because MNT does not offer email or web site hosting services but local public entities can benefit from the reduced cost of the State's participation in the Front Range GigaPop which shares its costs using a cooperative model.

Establishment of Strategies for Circuit Aggregation

MNT also implemented major aggregation points throughout the state to further reduce telecommunications costs. Categories of aggregation sites are defined by the size and type of equipment and class of service implemented at each aggregation site. The three types of aggregation sites directly on MNT (as opposed to ANAPs) are: Super ANAPs, Edge Sites and C-Pops.



Super ANAP implementation. Five Super ANAPs were deployed using an MGX 8850 core switch in each location. Each of the five Super ANAPs is located in an area where there is a high concentration of state government agencies. The Super ANAP site equipment is owned by the state and operated and managed by Qwest. Super ANAP sites are physically located in state-owned facilities as opposed to ANAPs which are in telephone company facilities. Network traffic from state agencies, local government, schools, libraries and non-profit health providers are aggregated at Super ANAP sites and routed onto the MNT. Super ANAP sites have at least an OC-3 (155 Mbps) connection to the MNT and some are already being upgraded to OC-12s (622 Mbps). The five Super ANAPs are located in Lakewood, Pueblo, and Denver (3 locations).

Edge Site implementation. 39 Edge sites were implemented, located in areas where state government agencies are highly concentrated and demand for integration of services exists. The Edge site equipment, typically a Cisco 6509 router, is owned and operated by the state and managed by Qwest. Edge sites are physically located in state-owned facilities. Network traffic in the form of frame relay or ATM circuits from state agencies, local government, schools, libraries and non-profit health providers can be aggregated at an Edge site and routed onto the Multi-Use Network. Edge sites typically have a DS-3 (45 Mbps) connection to the MNT.

C-Pop implementation. 39 C-Pops will also be implemented throughout the state. C-Pops are smaller “Edge” sites that are usually located within a non-state agency location such as a county courthouse. The equipment within a C-Pop is typically a Cisco 7206 or 3745 router depending on the aggregation potential in any one place. Smaller C-Pops have a T-1 connection (1.55 Mbps) and larger ones, a DS-3 (capable of 45 Mbps) to the MNT.

Aggregation reduces the number of direct customers entering the MNT network and therefore improves the quality of service possible given existing support resources. Aggregation also provides a cost incentive for local participating entities including state agencies such as Judicial, Human Services, Labor and Employment, Revenue and other agencies with locations in virtually every county throughout the state.

As an example, cost data for a specific aggregation instance for 222 S. 6th Street, Grand Junction, show savings of $22,910.28 per year.

Aggregation Example: 222 S. 6th Street, Grand Junction, Colorado

Before aggregation:

Agency	Circuit Type	Circuit Cost per month
State Agency 1	T-1	$474.44
State Agency 1	T-1	$474.44
State Agency 2	T-1	$474.44
State Agency 2	T-1	$729.60
State Agency 2	56k	$111.69
State Agency 3	T-1	$729.60
State Agency 3	T-1	$729.60
Total per month		$3,723.81

After aggregation:

Agency	Circuit Type	Circuit Cost per month
All	DS-3, 4 meg	$1,814.62
Total per month		$1,814.62

Savings is $22,910.28 per year. The aggregation concept is illustrated in the figure below.

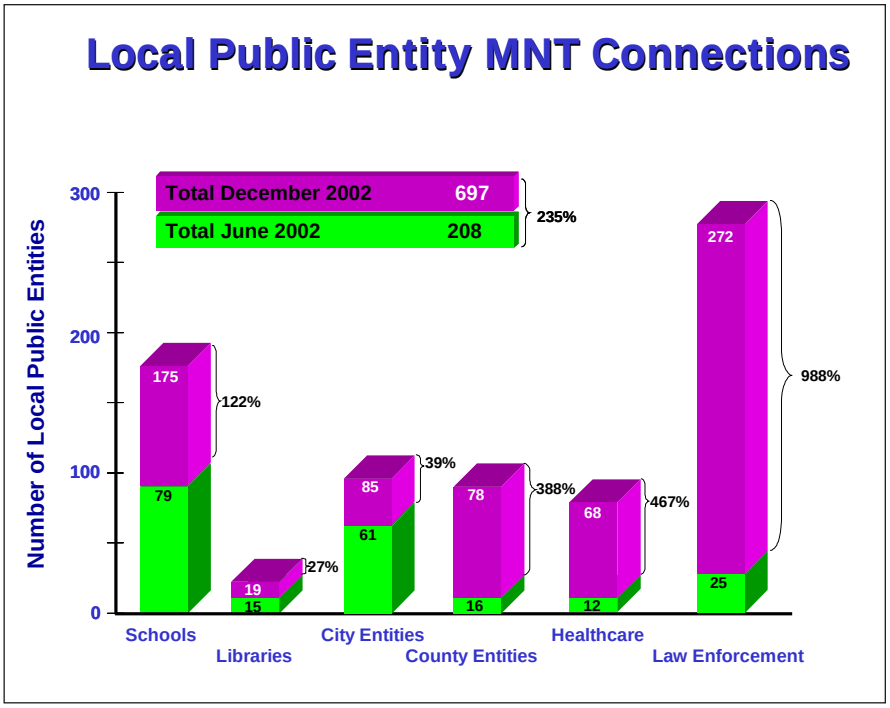
Last-Mile Fiber Infrastructure - The Beanpole Program

The MNT strategic plan recognized that the new statewide backbone needed to fan out to individual homes and offices within each county and community. This is sometimes termed the "last-mile" (or more aptly, the "first-mile"). The State authorized and funded the Beanpole Program to help certain communities build fiber infrastructure for this last mile access. As described in the chapter on the Beanpole Program, this plan was successfully implemented in 15 counties.

MNT Participation to Date

Participation from local public entities during the first year of operation (697) exceeded projections of 500. The chart on the next page compares local public entity participation in June 2002 versus December 2002.

Local public entity participation in MNT grew from 208 to 697 during this short time period with significant percentage growth from schools, cities, counties, hospitals and local law enforcement agencies. Since libraries often participate in large consortiums, the conversion of libraries will require more time.



Schools and libraries are eligible for a telecommunications subsidy from the federal government known as the E-rate program. The MNT program office has been proactive in working with schools and libraries to maximize participation in this federal program.

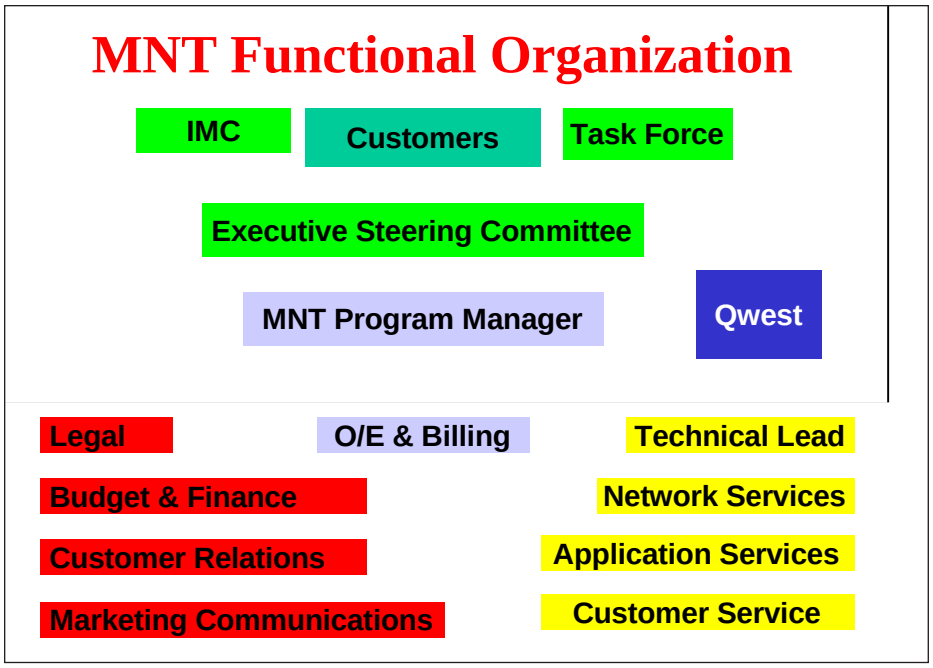
Most of higher education elected not to join MNT per se. Since higher education institutions already participate with MNT as members of the FRGP, their Internet access would not have changed anyway. Since all the higher education networks "touch" MNT at the FRGP, traffic that flows between higher education networks and MNT still remains within the state. So from a technical standpoint, all of the benefits of participating on the same network are achieved. The only issue has been higher education's decision not to participate in paying any portion of the ANAP fees. Under DoIT's Truth in Rates initiative, the ANAP fees are being separated from the hard network costs in the MNT pricing to state agencies and local public entities thus eliminating this "fairness" issue.

All Executive Branch state agencies joined MNT as the conversion of their networks allowed. The Secretary of State's office joined MNT and rolled out a highly successful web-based customer self-serve portfolio of applications. MNT may be used as the backbone for the implementation of the Help America Vote Act (HAVA) project. The Judicial Branch signed a Memorandum of Understanding to conduct a pilot program to convert a number of its circuits to MNT during FY04. Projections show that Judicial can increase all of their 56k and 64k circuits to T-1s (currently about 65% of their circuit portfolio is at these relatively slow speeds) on MNT for the same total cost. The key to these savings is the aggregation of data circuits at common physical points of presence.

MNT Project Management Achievements.

Establishment of a Functional Organization. In order to properly coordinate the build-out of the statewide network, the MNT project management office established a functional organization to support the MNT's efforts. The purpose of this functional organization was to ensure that all areas of a major business endeavor were included in the project management plan.

MNT's strong partnership with Qwest was a valuable asset in the MNT build-out. Qwest assigned a dedicated 20-member account and project team to provide project management and implementation support for the ANAP facilities construction throughout the state. The Qwest account team met weekly with the DoIT project team to provide status reports on the project.



DoIT's project staff included 54 employees, as well as 20 private sector contractors. DoIT was able to accomplish a great amount of work through outsourcing to private firms and individual contractors. Engineering design and consulting, audits, customer surveys, site surveys, marketing and communications programs, research assignments and pricing analyses among others were outsourced to individuals and small firms. DoIT was able to get work done quickly and inexpensively by outsourcing to individuals who had vast ranges of core competencies in all the functional business areas.

Additionally, DoIT established a Change Control Board to facilitate project changes and keep

the project focused on its original purpose. An Executive Steering Committee was also created to act as the "Board of Directors" for the project.

Midway through the project at the direction of the DPA Executive Director, a Program Manager, or "Chief Operating Officer" was appointed to act as the primary coordinator for all activities within the organization. This person also served as a focal point for communications and direction of the project.

Establishment of Procedures and Policies Another major accomplishment was the establishment and documentation of procedures, governances and policies for the project. A Participation Policy for non-profit organizations was created. Under this policy, DoIT management reviews eligibility for non-profit organizations wanting connectivity to the MNT. When a request to connect to the MNT is received from an organization that is not covered directly in the MNT statute, such as a non-profit, MNT connection eligibility is evaluated on a case-by-case basis to ensure a fair and consistent decision that is in compliance with state statutes and the MNT Participation Policy.

Order Entry Policies and Guidelines were created to help potential customers understand the process for connecting to MNT. Technical standards and guidelines were created to assist customers from a technical and equipment standpoint. The MNT created and published on the MNT Web site a Step-by-Step Process Guide for Gaining Internet Access through the MNT that depicted business processes for every business and technical step necessary for a successful connection to MNT. A robust order entry process was created to provision services to local public entities in a repeatable, predictable manner.

Creation of Marketing and Communications Tools. The MNT project would be most successful if it were run as a business entity. Marketing and communication with the public was an important element in the MNT's success. DoIT created tools to market and communicate with the public. The DoIT project team created a functional and informative Web site presentation that addresses all facets of working with and understanding MNT. Presentations, press releases and marketing information were created to facilitate communication.

The MNT project team created an Inquiries Database to document incoming calls and track notes on conversations with potential customers. Follow-up items were documented in the database to facilitate next step actions with prospective patrons.

Development of Measurements of Success

E-government Cost Savings. Additionally, DoIT researched and defined a baseline of the state agencies' telecommunications costs prior to implementation of the MNT. As no inventory of circuits existed for state agencies, the MNT project team created an inventory of existing circuits and current spending on telecommunications services. As the inventory was gathered, a baseline was created to identify actual telecommunications savings with implementation of the MNT.

Distance Learning. Since one of the MNT goals was to increase distance learning, particularly in rural Colorado, DPA will work with the Colorado Commission on Higher Education to establish metrics collection processes.

Project Management Conclusions

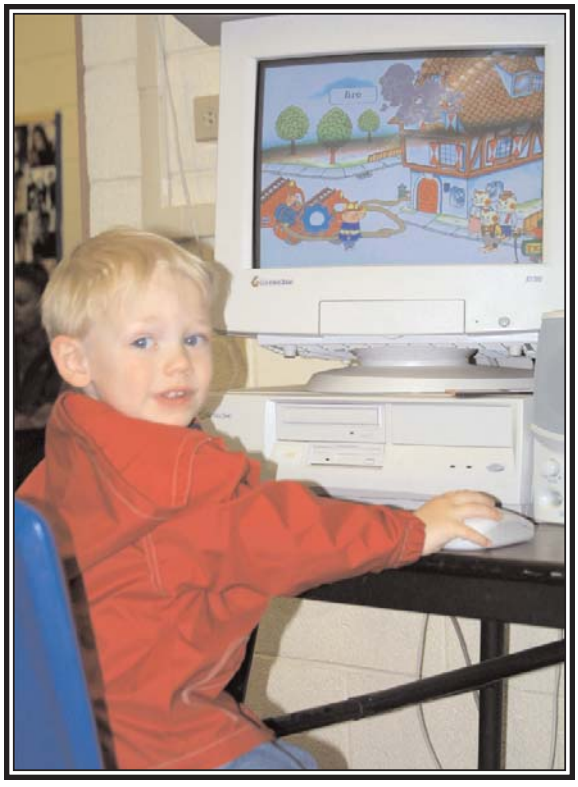
In general, the technical build out of the MNT physical infrastructure was well-managed by Qwest. The functional areas of project operations that needed improvement were those normally given a high priority in private sector business operations such as customer communication, marketing, public exposure and information dissemination but which are not always the core competency of state government telecommunications operations. Therefore, the use of outsourced resources that did possess these required skills was the key to the overall success of the project.

Future Opportunities

Even though the implementation portion of the MNT project has been successfully completed and a significant number of new users are joining the network from many rural locations in the state where cost effective connectivity was not available prior to MNT, there are still many remaining challenges and opportunities remaining to maximize the postivie impact of MNT on the state's economy and quality of life.

Last Mile

Improvement in backbone telecommunications delivery must be extended to the last-mile feeder systems. As backbone improvements have been made, we begin to see fiber build-outs at the neighborhood level. True broadband services will require a clear broadband path from source to the user, including the last-mile. This fact drives the need for material improvement in the local infrastructure. The Beanpole Program recognized, addressed and succeeded in causing material improvement in local infrastructure in the 15 counties that received Beanpole implementation grants but additional work and funding are needed to complete broadband diffusion throughout all reasonably sized communities. There are a variety of strategies to do this, ranging from reactivation of the Beanpole Program, to individual local governments making telecommunications a priority funding needs in their use of State or local fiscal resources.



Voice & Video

The MNT is the implementation of Colorado's Strategic Plan for Statewide Telecommunications Infrastructure.[1] It was intended to be capable of carrying voice, video, as well as data. Doing this remains a challenge facing the MNT Program. A first step in meeting this challenge is to conduct engineering studies for voice and video. These studies would determine enterprise-wide solutions to voice and video services that incorporate aggregation and provide universal access to every county.

[1] Adopted February 1998; available at http://www.oit.state.co.us/commissions/imc_documents.asp

Voice Services. As all public offices have access to a unified statewide IP infrastructure, certain advanced applications enabled by this infrastructure may be developed based on need and feasibility. Voice over IP services (VoIP), wherein MNT users can avoid intrastate long-distance charges when calls are placed to members of the MNT, are one example of such advanced applications. One result of the voice engineering study should be a discussion about when, how and to what degree VoIP technology should be rolled out.

The return on investment from a migration to VoIP has the potential to pay for the transition through cost-savings in long distance and local circuits. A further ROI will stem from such VoIP "plusses" such as unified messaging and directory services.

Video. Two-way interactive video is mission-critical in a number of current applications areas including: distance education, telehealth and remote arraignment. While current usage of two-way interactive video pales in comparison to voice, in the future, video services will become increasingly important and prevalent. In fact, video is seen by some to be the future "killer app" for the Internet. Because of the IP convergence of voice, data and video, the age-old promise of the videophone is becoming a reality.

Video technology is transitioning from pre-IP to post-IP solutions. The pre-IP solution is based on the H.320 standard and is characterized by a star configuration of point-to-point circuits converging at a central bridge (MCU) or cascade of bridges. The post-IP solution is based on the H.323 standard where the point-to-point circuits are replaced by the packet routing on the Internet or enterprise Intranet. With IP video, an era of desktop-to-desktop video-conferencing is ushered in, greatly expanding the scope of use covered by the more typical conference room applications of today.

In terms of return on investment, the case may be made that replacing just one monthly out-of-town trip to Denver for a rural municipality can pay the cost of video conferencing equipment. Similar arguments apply in the healthcare and education sectors.

Putting the MNT to Work

With the completion of the MNT Program, fiber-based telecommunications infrastructure has now been deployed throughout the state. It is appropriate to now shift our focus from "having" broadband to "using" it. The key objectives of the MNT Program were to improve economic development, education, and e-government. For this impact to happen, we need to put

the MNT to work in these applications areas. The applications chapter of this report presents some ideas for applications in economic development, e-government, K-12 education and healthcare.

Establishing Working Relationships with Non-MNT Local Independent Telephone Companies

The MNT partnership involves a coalition of private telephone companies, led by Qwest, enabling the MNT to have a presence in every county. However, a number of independent telephone companies were not party to the MNT contract. A challenge facing the MNT Program is to find ways to include these companies in the MNT's ATM network architecture in order to bring the same level and quality of service to their customers as is now available to the customers in MNT partner wire centers.

Obtaining Full Participation from the Public Sector

Full participation from state agencies and local public entities is essential to achieving the goals of the MNT Program. First, the state's effectiveness as an anchor tenant depends on how big a tenant it is. The more public traffic carried by the MNT, the more effective the public sector can be in continuing to lead the way to improved telecommunications in Colorado. Second, effective e-government services depend on a seamless, enterprise-wide IP infrastructure. To achieve this, it is essential that all data networks in the state migrate to the MNT. Substantial success has been made in this area. The state can no longer afford to maintain separate networks dedicated to single functions, except in those cases where a specific justification can be made. The efficiency of an enterprise system is only enhanced when state agencies are joined to other public entities such as local government, schools, libraries and hospitals in the same enterprise network. Finally, the cost-effectiveness of the MNT improves as the amount of traffic increases. With more paying public sector customers, the state's fixed annual fee to reserve bandwidth for the MNT (and other fixed costs) is amortized across a broader base.

Next Generation Networking

The MNT contract was awarded in the late 1990s, at a time before the term "broadband" entered the popular lexicon. As we move into this first decade of a new century, 1990's technology and systems will be replaced by new systems. Thus, a challenge facing the MNT Program is to prepare for the migration of today's MNT system to meet tomorrow's needs and use tomorrow's technology. We call this challenge Next Generation Networking (NGN).

The "target" for the MNT was 20 million bits per second (Mbps) of capacity, ensuring that optic fiber was used for transport to all counties in the state. Some users in the state are now moving far beyond this, to gigabit networking. Today's research networks become tomorrow's commodity networks. To prepare for tomorrow's networking reality, it is timely to begin exploring NGN technology today. NGN provides much higher speeds at much lower unit costs (per unit of capacity or speed). NGN uses optic fiber that is leased or owned to provide transport, with equipment that can be owned and operated by the customer or the telecommunications vendor. Indeed, NGN is being deployed in a variety of other states and nationally to support growth of the high tech economy. Some states now deploying NGN include: California, Indiana, Illinois, Iowa, Massachusetts, New York, North Carolina, Ohio, Utah, and Virginia. Two higher education consortia, one in the west and another in the southeast, are engaged in a national optical fiber deployment effort that would put the United states on a par with Canada, Japan and various other leading countries. This effort is being supported by Internet2, the next generation network for higher education, libraries and K-12.

NGN should be deployed opportunistically, by those who need and value it sufficiently that they will fund it. In the best interests of the state, departments and institutions should work across boundaries to maximize interconnectivity and promote shared use of Next Generation Network infrastructure.

Internet2

A related challenge to NGN is participation in Internet2. Internet2 is a collaboration among more than 100 U.S. universities to develop networking and advanced applications for learning and research. Since much teaching, learning, and collaborative research may require real-time multimedia and high-bandwidth interconnection, a major aspect of Internet2 is adding sufficient network infrastructure to support such applications. But Internet2 also intends to investigate and develop new ways to use the Internet and the Internet2 infrastructure for its

educational purposes. Although Internet2 is not envisioned as a future replacement for the Internet, its organizers hope to share their developments with other networks, including the Internet. Internet2 will include and further develop the National Science Foundation's very high-speed Backbone Network Service (vBNS) that currently interconnects research supercomputer centers in the U.S. The involved institutions plan to continue using the existing Internet for "ordinary" services such as e-mail, personal Web access, and news groups. The goal should be to include all of our colleges and schools in the Internet2 program who desire to participate. At present, Internet2 participation in Colorado is limited to a few of our largest research universities. Our schools and colleges can participate and contribute to this national learning exercise, and in so doing, become practiced and literate in new Internet capabilities as they are developed. All of the K-12 schools can join in the Internet2 program, but must do so as a group under the Sponsored Educational Group Participant (SEGP) program of Internet2. The MNT Program could facilitate this membership but at this time, the current demand for Internet2 does not justify the expense. As broadband capability is enjoyed by more and more people across the state, the demand for Internet2 could grow.

Redundant Internet Access

As indicated above, a key achievement of the MNT Program was the interconnection of all MNT Internet traffic at the Front Range GigaPoP. The FRGP is also our portal to the commodity Internet. If a serious outage should occur at the FRPG facility, the state's public sector would lose some or all ability to connect to one another as well as the outside world. Such connectivity is a critical asset. It is key to homeland security and to emergency response to man-made or natural disasters. Thus, the MNT Program is in the process of obtaining redundant access to the Internet, separate from the FRGP. It should be noted that the MNT core network is capable of high reliability, with four carrier quality MGX switches backing one another up and with all fiber optic circuits having Self-Healing Alternate Route Protection (SHARP). With the original funds available for MNT, the network was built to a high state of "reliability" but is not yet fully "redundant," meaning totally separate (both location and vendor) circuit paths and equipment.

Measuring the impact of the MNT

As the MNT backbone construction draws to completion, the program's infrastructure and access goals have been met: every county has access to fiber optic telecommunications connectivity; public sector access is being aggregated where possible to reduce duplication of circuits and the basic pricing paradigm for telecommunications service has been changed from

one of distance-sensitive charges to one uniform tariff for the majority of customers statewide regardless of location.

However, the MNT Program includes certain goals concerned with the impact of the MNT. Impact cannot yet be measured - we are just now completing the deployment phase of the project. Some passage of time is needed for the projected impacts to develop, coupled with ongoing efforts to promote adoption and use of the MNT. The final chapter of this report outlines how and who might conduct future impact assessments.

Continuing Statewide Networking Governance Beyond the MNT Task Force

As the MNT Program now comes to the conclusion of its construction phase, it is important that responsibility for both the strategic planning and operational oversight functions carried out by the MNT Task Force be explicitly assigned to the appropriate policy venues within the state's information technology governance community.

Venues with shared responsibility for statewide IT and telecommunications planning include: a continued MNT operation, the new strategic planning activity within the Department of Personnel & Administration (DPA), Division of Information Technologies (DoIT), the Office of Innovation and Technology (OIT) and the Information Management Commission (IMC). Telecommunications activity needs to be coordinated among these groups and DPA needs to continue its lead responsibility for continued strategic planning with regard to statewide networking.

This strategic planning and operational oversight activity at the state level must be connected to the local level of government and the ultimate MNT user and customer. The MNT and Beanpole Programs have engaged local public entities throughout the state, including local governments (municipal and county), economic development groups, schools and school districts, libraries, hospitals and healthcare facilities and college campuses. The needs, observations, perceptions and energy of these groups must be included in the planning activity for Colorado's public statewide networks. Annual user group meetings, meetings of special interest groups (e.g., K-12 or healthcare or local government), "road shows," and informal visits are all useful strategies in the inclusion of local public entities in future planning activity.

Products and Services

MNT was designed and built to support the delivery of voice and video services in addition to data services. MNT's customers are empowered to take advantage of this convergence (e.g., of voice, data, video) and to realize the full vision and original objective of the MNT, that is, to be a "multipurpose" network. The following sections discuss MNT's current and future products and services.

Frame Relay and ATM Transport Services

MNT has completed the statewide deployment of a fiber-optic based ATM and frame relay network. Using internetworking technologies, frame relay can be connected to ATM.

DSL (Digital Subscriber Link)

MNT has become what is known as a DSL (Digital Subscriber Link) "Mega Central" or aggregator through state contract with Qwest. This means that MNT customers who desire to use the DSL product may, where it is available, connect using Qwest DSL. DSL fills the gap between 64kbps and 1.5 Mbps (or T-1 speed). DSL (Digital Subscriber Line) is a technology for bringing high-bandwidth information to homes and small businesses over ordinary copper telephone lines. DSL is expected to replace ISDN in many areas and to compete with the cable modem in bringing multimedia and 3-D to homes and small businesses.

Since not all users need the full capacity of ATM, offering DSL was a way for MNT to serve customers who want better functionality than dial-up but where T-1 capacity is not required. This approach may also work well for employees who have a need to connect from home to work.

Internet Access

Layered on top of the frame relay and ATM network, MNT has deployed a seamless statewide Internet Protocol (IP) infrastructure available to all public entities in the state. High-speed Internet access enables and enhances applications of importance to each public sector customer.

Migration from Layer 2 to a Layer 3 Network Platform

The MNT network was originally designed to provide telecommunications transport on a switched basis to support data links. MNT planners contemplated converting MNT to a routable network to support Internet Protocol (IP) during a subsequent phase. Prior to MNT, state Internet access was provided by direct state contracts to Internet Service Providers (ISP). Circuit services on MNT originally consisted of frame relay and asynchronous transfer mode (ATM).

As the demand for Internet access grew, it became apparent that MNT would need to provide not only circuit connectivity at the data link level (known as layer 2) but also Internet Protocol services to state and local public entities. This meant that the network design needed to be converted to a routed network (known as Layer 3).

Enabling Legislation for Layer 3 Deployment

There are several key statues that authorized the state to provide Internet and Layer-3 routing services to public sector offices. The reasoning was that when specifying "digital networks," the General Assembly meant that to include access to the Internet.

- **24-37.5-203(1) C.R.S.:** IMC shall "(a) To develop and implement requirements for the statewide communications and information infrastructure based on present and future user applications; (b) To review existing portions of the statewide communications and information infrastructure to determine the areas of the state in which they exist and whether the existing portions are adequate and usable for present and future user applications; (c) To define and initiate a partnership between the public and private sector for funding and building the statewide communications and information infrastructure, with the understanding that the private sector will build the necessary portions of the statewide communications and information infrastructure; (d) To initiate a system to manage and use the statewide communications and information network in the most economical and

effective manner; (e) To oversee ongoing use of the statewide communications and information infrastructure; (f) To recommend, if necessary, further legislation and budget appropriations for ongoing implementation of the statewide communications and information infrastructure.

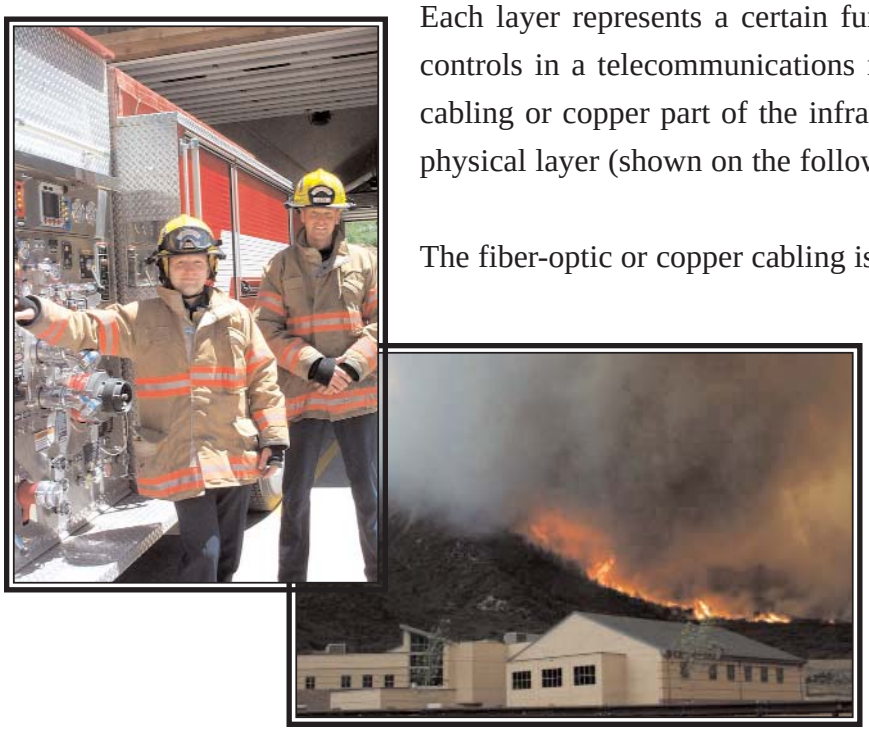
- **HB 99-1102, Section 20 (7):** The Department of Personnel & Administration shall maximize "access to digital networks of the state by all public offices of all levels, branches, and political subdivisions of the state within every community of the state."

- **SB 96-197, Section 104:** The MNT is defined as "a digital network capable of carrying integrated voice and video as well as text, graphics, and other electronic data between and among schools, public libraries, institutions of higher education, and state agencies."

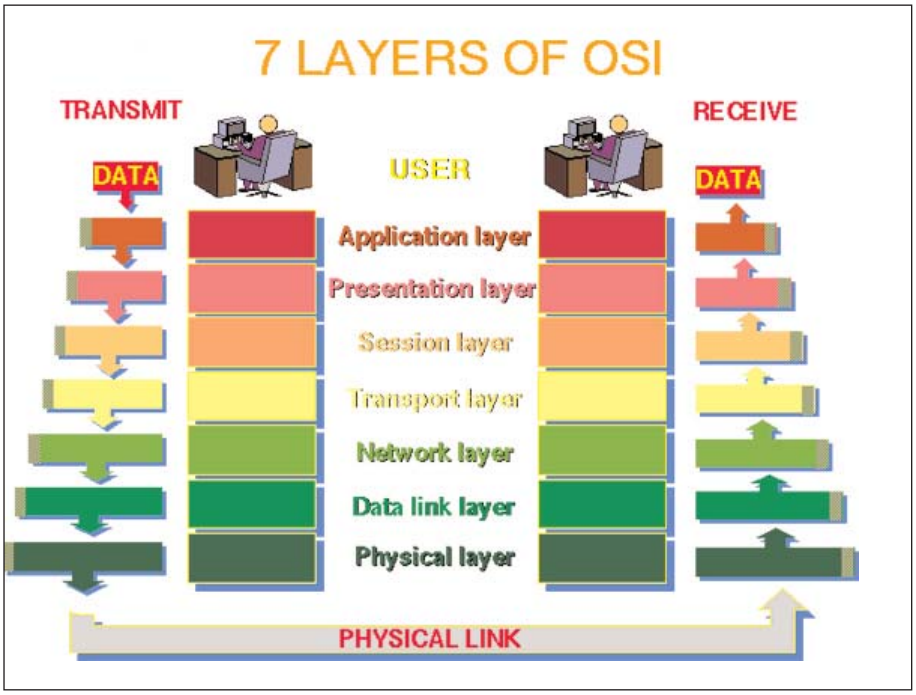
- **SB 99-1102, Section 30 (2):** Beanpole funds are for "communities seeking to aggregate the telecommunications services required by the public offices within the community to connect to the digital network operated by" the Department of Personnel & Administration."

What is Meant by "Layer 3"?

A telecommunications network may be thought of as a stack of various "layers" of service. Each layer represents a certain function or a certain set of controls in a telecommunications network. The fiber- optic cabling or copper part of the infrastructure is known as the physical layer (shown on the following page) or "Layer 1".



The fiber-optic or copper cabling is made useful by switches that establish circuit connections or establish a connection link (data link) from one point to another. This is termed the Data Link layer, or "Layer 2."



The next layer, "Layer 3," is known as the Network Layer. This layer provides switching and routing technologies (more control) creating logical paths known as virtual circuits for transmitting data from one location to another location or from one location to many locations. Layer 3 accommodates the capabilities of the Internet.

Benefits of Layer 3 Aggregation

As MNT moved from a layer 2 network to layer 3, MNT was able to offer more flexibility, better network management and control and more products and services to the local public sector. There are many benefits of aggregating the public sector's statewide traffic to a layer 3 platform. The following purposes and benefits have been provided by statewide layer 3 aggregation:

1. **Latency is reduced.** "Latency" is the time it takes for information to flow from the source to the destination. Latency is largely a function of the number of "hops" the information must take as it moves from router to router across the network from source to destination. When there are fewer hops; latency is reduced. Latency is very important in newer applications of the Internet such as Internet video conferencing or Internet telephony. When traffic between public entities is kept internal, there are fewer hops. If traffic has to be routed to the commodity Internet, there are more hops. The worst case is when he receiving and transmitting offices have different ISPs. To complete the routing of packets, the ISPs need to exchange traffic (or "peer") somewhere. Typically, these peering points are limited and are located at major national metropolitan areas, like Los Angeles or

Chicago. Therefore, as an example, information going from the local college to the local high school (if they each had different ISPs), may take a detour to L.A., and this detour takes time. If you try to use interactive video, it may not work.

2. **To provide more efficient intra-networking.** Public entities connecting to the MNT become part of the state's "enterprise" network. Information sent from one public office to another on this network does not go out onto the commodity Internet, but instead stays within the state, on the MNT, which reduces latency and costs and increases network performance. This enables the state to control network congestion and protocols, enabling advanced applications such as distance education, telemedicine, video conferencing, and voice over IP.

   Additionally, there is no need to pay an Internet Service Provider (ISP) charges for the traffic that is kept internal. Examples of internal traffic are: county to state agency; school-to-school, school to college; courthouse to corrections institution, clinic to hospital, etc. The cost savings as a whole are prorated to all MNT users.

3. **To provide multi-homed access to commodity Internet services, providing cost benefits to state agencies.** This provides the redundancy necessary for high quality of service needs of a statewide network. This also provides economy-of-scale through the purchase of ISP services in bulk. Members of the aggregated consortium pool their demand to buy Internet access at "wholesale" - instead of "retail" rates. The state now obtains its Internet service through its membership in a research and higher education Internet consortium called the Front Range GigaPop or FRGP. The FRGP is served by three ISPs: AT&T, Cable and Wireless and Level 3.

4. **To provide access for K-12 to Internet2.** Internet2 provides access to advanced, next-generation Internet resources with high-speed connectivity to the resources of 190 of America's top research universities, and high-speed access to federal and international networks. Internet2 has its own backbone independent and separate from the commodity Internet (sometimes called Internet-1). This backbone oper-

ates at phenomenal speeds, of the order of 10 billion bits per second (gigabits), which is 10,000 times faster than a typical connection. Internet2 access places the classroom in intimate contact with Internet experiments going on around the world. These include: content repositories, K-12 clearinghouses, digital libraries, and virtual museums. Approximately thirty states now participate in Internet2. Internet-2 promises a much richer learning environment through high-speed access to multi-media materials from around the country.

Internet2 access is only available for colleges, schools and libraries that are aggregated into a statewide network for the purposes of passing off traffic to Internet2. I2 rules require all K-12 I2 traffic to be aggregated. MNT does not provide Internet2 access at this time because there has not been a customer demand. The IP Address assignment scheme for MNT will accommodate I2 if needed.

5. **To peer all three major state network aggregation points:** state agencies, higher education and future research networks such as I2 can form a seamless, statewide single network enabling exchange of traffic among all state entities and between higher education and K-12.

6. **Additional services can be implemented earlier.** As the Internet evolves, new services can be added. The smaller the network, the easier to add the new upgrades. Compared to the global Internet, a public sector enterprise network for Colorado is very small indeed - and easier to keep up to date. For a new service to be universally available on the commodity Internet it needs to be universally implemented by all ISPs worldwide.

   Two new services of great importance within Colorado will be multi-casting (e.g., broadcasting messages on the Internet to many users simultaneously without having to send duplicate messages simultaneously to all users), and Voice over IP (e.g., using the Internet in place of the telephone network). This latter has many possibilities including the avoidance of long distance charges.

7. **"Permanent" IP addresses.** The state has a block of IP addresses for state agencies. Higher education institutions have their own blocks of IP addresses. The state has obtained a new block of IP addresses to allocate to local entities that use the MNT for Internet access. When a public sector entity obtains Internet access through MNT, it will be assigned a permanent block of addresses to use, which it may keep as long as it continues to participate in MNT. These IP addresses are "permanent" in the sense that, since MNT owns permanent IP addresses, should the state change its ISP, it will not need to get new IP address from the new ISP. This saves time and money as well as eases the ability to make changes "transparent" to MNT users.

Customer Profile

Description of Customers

The MNT is a subset network that is dedicated for use by the State of the Colorado High Speed Digital Network (CHSDN). The MNT portion of this network can only be used by federal, state, county, municipal and local public entities, and by all non-profit hospitals. However, any customer - public or private - may use the non-dedicated portion of the CHSDN; its tariffed service is open to all.

There are three types of customers for MNT:

1. **State Agencies.** To achieve the desired benefits in efficiency, economies of scale, and economic development, all state departments, agencies and institutions, including higher education are required to migrate their telecommunications networks to the MNT and cease operation of any new development of disparate telecommunications networks.

2. **Local Public Entities.** These include schools, libraries, cities and counties, non-profit organizations and hospitals. These entities are not required to connect to MNT; however, these organizations are eligible for MNT pricing and services. Requests by any other organizations, such as non-profits, to connect to the MNT will be evaluated on a case-by-case basis according to the following criteria:

    a. Network Availability and customer telecommunications compatibility.

    b. Types and purposes (public nature) of customer network traffic.

    c. Agreement to state and local provider terms and conditions, including participation in aggregating traffic with others.

3. **Private Organizations.** This would include all other private businesses and organizations. Although private organizations do not qualify for MNT, private organizations are a beneficiary of the network, as high-speed communications are now available to private organizations, through the CHSDN at the same tariff rates as MNT.

Market Analysis

There are approximately 3,000 to 4,000 local public locations that may eventually be enrolled in the service. Potential customers include:

Current and Potential Market Size by Customer Type

Type of Customer	Customers	Market Size
State Agency Data Circuits	2,000	3,000
School Districts	178	1700 sites
Public Library Jurisdictions	115	430
Boards of Coop Services (K-12)	20	20
Hospitals	86	86
Rural Primary Care Clinics	39	39
Counties	64	64
Municipalities	270	270
Totals	2,772	5,609

- 178 school districts (with approximately 1,700 classroom buildings);
- 115 public library jurisdictions (243 public service sites; 28% of the 115 jurisdictions have main and branch sites. Fifteen libraries have four or more service outlets - a total of 121, almost half of all Colorado library outlets);
- 20 BOCES (Boards of Cooperative Services) serving K-12 schools;
- 86 hospitals and 39 rural primary care clinics;
- 64 Counties (overlap: 2 city/counties);
- 270 Municipalities (overlap: 2 city/counties);
- Unknown number of potential non-profit organization participants.

Regional Internet Networks

There are in place a number of regional Internet networks which may connect intact to the MNT. These include:

- the WestCEL network of schools, colleges and libraries in the northwest
- AVNA, the Arkansas Valley Network Alliance, formerly the Connect Colorado Project of southwestern Colorado
- the Beanpole implementation communities, including;
  - southwestern Colorado, organized by Region 9 Economic Development District in Durango

  - southeastern Colorado, organized by Otero Junior College (and closely linked with AVNA)
  - northwestern Colorado, organized by the City of Steamboat Springs and the Yampa Valley Economic Development Corporation
  - Morgan County community, organized by Morgan County Commission
  - other Beanpole projects in various stages of development

- Boards of Cooperative Services (BOCES), K12 coordination districts that could serve certain geographical areas in lieu of the regional colleges
- Library consortia such as Marmot and Tripath

Customer Survey

In order to gather facts and data about the current needs and expectations of local public sector customers regarding connection to the MNT, DoIT conducted a survey together with the Business Research Division of the University of Colorado Boulder Leeds School of Business. The Colorado Counties, Inc., the Colorado Municipal League, the Colorado Association of School Executives, the Colorado State Library, and the Colorado Health & Hospital Association helped to sponsor and distribute the surveys across the state via mail and email.

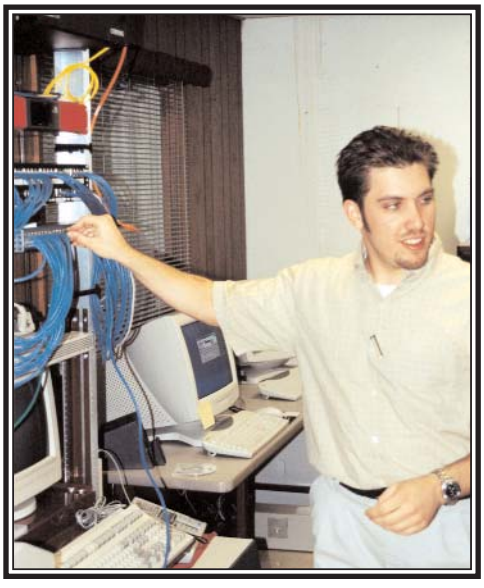
213 responses were received, with those responding representing 1,565 sites. The surveys received were representative of the counties throughout the state, as 59 out of 64 counties responded, as well as the various sectors, including counties, cities, schools, libraries, and non-profit hospitals.

This study brought interesting and useful information to light, including the following:

- 50% of sites lie across the "digital divide" and are using slow connections, including dial-up and other connections less than T-1.
- About two-thirds are satisfied with their current ISPs, although one-third is not.
- The average dedicated connection price is about $361/month.
- Many sites still pay low prices for slow-speed connections (e.g., $19.95 for a dial-up connection).
- 2 in 3 believe future applications are important to them (voice, video, on-line access to library content).
- 87% are interested in a community-based co-op that allows them to connect to the MNT and obtain Internet services.
- 1,000 sites will evaluate whether to switch ISPs over the next 18 months.
- The organizations made it clear about what they are looking for in an offering - cost is an overwhelmingly important deciding factor for these organizations, but performance, service and security are also important to them.

Current Internet Services Provided to Customers

The organizations were asked about their current Internet services and how these services are being provided. These services include Internet access, Web hosting, mail server, and local circuits. The majority of the organizations have Internet access provided by a vendor (87.8%). While some organizations did not utilize Web hosting, the ones that did were evenly split between providing their own and having a vendor provide it for them. 44.6 percent of organizations provided their own mail server, while 37.1 percent used a vendor. The majority of organizations used local circuits provided by a vendor, although a fair amount did not have local circuits at all.



The survey also asked about the services that were

bundled with their complete Internet offering. 43.7 % of the respondents stated that e-mail accounts were provided by their Internet service. 39.4 % were receiving local circuits as part of their service, and only 19.2 % were receiving some form of Web hosting.

Current Customer Monthly Costs for Internet Services

Organizations were asked to estimate their total monthly costs for their current Internet services. Costs ranged from zero to $9,800 per month per site. About half of the users paid less than $100. The average cost for all Internet services (Internet access, Local circuits, web hosting, and mail server) was $555.00 per month. Average cost for just Internet access was $285.28 per month. Costs varied according to the speed of the connection.

Current Customer Connection Speed

Internet access was divided into five categories by the speed of connection. About half of the organizations used a connection speed less than T-1, with 23.4 percent still using 56k or less. The relationship between cost and speed of connection was analyzed. Based on the median cost, dial-up represented the lowest median monthly cost at $20 and dedicated lines represented the highest at $156. Average costs were significantly higher. Most organizations (43.6%) maintained a dedicated line at their primary site, though a dial-up connection was still fairly prominent (28.6%). At their secondary sites, 21% used dial-up connections, while 19.7% maintained dedicated lines.

Among the two seemingly opposite ends of the technology spectrum, wireless and dial-up, one might expect higher concentrations of either technology in certain regions of the state. However, the location and number of wireless and dial-up users is spread throughout the state. There are not any concentrations of either wireless or dial-up users in any region of the state.

Customer Satisfaction with Current Services

Organizations were asked about their overall satisfaction with their current services. The majority of organizations were satisfied or very satisfied with their current service. Organizations appear to be least satisfied with the training they are receiving. Of the 135 respondents that were either satisfied or very satisfied with connection speed, 30 percent were using connections less than T-1. There were organizations in each sector that were satisfied with their current connection speed.

The respondents were also asked to comment on their own ability to meet both current and future needs. About 40 percent of organizations are able to meet current needs. Almost 30 percent are not adequately able to provide technical training for staff in LANs, routers, firewalls, etc. and approximately 25 percent cannot counter inappropriate uses. Only 20 percent or so are positioned to meet future needs. A good example is Security. While 54 percent of organizations indicate that the level of security meets its current needs, only 19.2 percent believe it will continue to do so in the future.

Provision of Technical and Network Support

The majority of organizations (70.9 percent) provide their own, in-house, technical support. 46.5 percent contract technical support out to other companies. 20.2 percent gain access to technical support through their ISP services.

Importance of Future Applications to Customers

There are many applications that will require high-speed Internet access in the future. Organizations indicate that the most important future applications to them are Video over the Internet, and access to a core body of online library resources. Twenty-three percent said that Video over the Internet would be very important or critical to their operations, and 42.7 percent said that access to a core body of online library resources would be very important or critical.

Customer Interest in MNT Cooperative

Organizations were asked about their initial interest in the MNT project, specifically, “To what degree would your organization be interested in joining a community-based cooperative effort to gain access to high-speed Internet services.” Out of the 213 respondents, 50.2 percent (107 organizations) expressed "definite interest" in the project, while 37.1 percent were “somewhat interested,” and only 8 percent were not interested. There were 55 different counties in the state of Colorado that had one or more organizations interested in the project.

Of the 135 respondents that were satisfied or very satisfied with connection speed, 9.6 per-

cent were not interested in MNT, 43 percent were somewhat interested, and 45.9 percent were definitely interested.

Customer Timeline for Changing to a New ISP

The organizations were asked to provide a timeline during which they would be able to consider an alternative ISP. 26.3% stated that sometime in the first half of calendar year 2003, they could consider another ISP, while 19.2% stated the second half of 2003 as a good time. 13.6% said they could begin considering a different ISP before the end of December 2002.

Customer Conditions for Participation in MNT

The respondents listed many factors that would contribute to their decision to participate in the MNT. Cost, performance, service, and security were the four most important factors. 67 percent of the organizations expressed cost as the most important factor, 54 percent believed performance would be a deciding factor, while 26 percent noted service (tech support, training, etc.), and 13 percent noted security.

Conclusion and Summary of Customer Survey

The following conclusions can be drawn from the Customer Survey:

- Survey was representative of counties and sectors.
- 50% sites lie across the "digital divide" - slow connections (less than T-1).
- ISP satisfaction - about two-thirds of the customers surveyed were satisfied with their existing ISP, one-third were not.
- Average dedicated connection price is in the ballpark ($361/month)

- Many sites still pay low prices for slow-speed connections (e.g., $19.95)
- 2 in 3 believe future applications that require high-speed Internet access are important to them (voice, video, core body of on-line library resources)
- 87% are interested in a community-based co-op
- 1,000 sites may switch ISPs over next 18 months; now is time to act

Timing is great for MNT to migrate additional customers onto the network. MNT must provide competitive pricing to the local public entities in order to entice them to change.

Market Plan

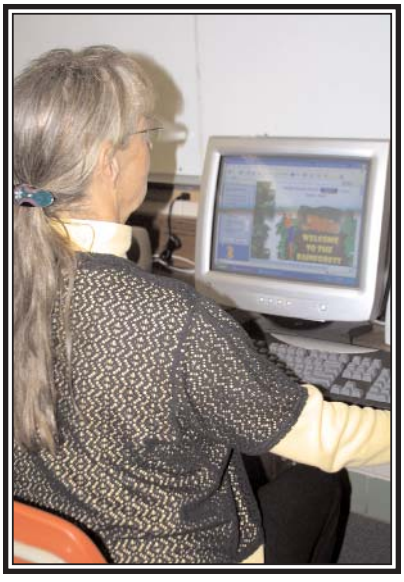
Eligibility for MNT Service

The statutes that created MNT, CRS 23-11.5-104, and that cover other telecommunications-related activities, such as Beanpole, prescribe that public entities may participate directly on the MNT network.

In determining whether or not an entity meets the general participation guidelines in the statutes, the Executive Director of the Department of Personnel & Administration is given the responsibility to carry out all duties in a manner that is consistent with the objective of maximizing access to digital networks of the state by all public offices of all levels, branches and political subdivisions of the state within every community of the state, CRS 24-30-903(7). The Executive Director therefore established a "Participation Policy" to ensure fair and consistent MNT eligibility determination. The Participation Policy in part states,

"…The eligible participants for the use of MNT include all state and federal departments, agencies, and institutions or political subdivisions of the state, federal, or of any local government. In addition, all non-profit hospitals are eligible to use the MNT. Any other organizations, including non-profits, will be evaluated on a case-by-case basis according to the following criteria:

1. Availability and customer telecommunications compatibility
2. Types and purposes (public nature) of customer network traffic
3. Agreement to state and local provider terms and conditions, including "participation in Network aggregating traffic with others."



Given MNT availability, the key to MNT eligibility is whose "traffic" is flowing through the circuits. For example, a non-profit hospital's circuit to a private sector physician would normally qualify for MNT because it is the hospital medical data that is being transmitted across the circuit. A private sector physician would not normally qualify for the

MNT side of the network although the physician could order the same service at the same price directly from Qwest.

Advertising and Promotion, Marketing Strategies

A number of information channels are available to facilitate communication regarding the MNT. The MNT Web Site provides extensive information on the program, its pricing, its policies and the processes for connecting to the MNT. The MNT Guide, also found on the MNT Web Site, provides useful contact information and processes regarding getting connected to the MNT network.

Additionally, DoIT staff has held city and town meetings to promote MNT's efforts and capabilities. The town meetings are referred to as "road shows". DoIT staff also conducts various face-to-face presentations and meetings. DoIT has established a hotline for potential MNT customers to obtain additional information as needed, and an inquiries database has been established to manage incoming calls and follow-up items.

As the State of Colorado is varied in terrain and geographically dispersed, much time is spent traveling from place to place for face-to-face meetings, engineering and site surveys, and “road shows”. As MNT continues to expand its customer base, DoIT may need to consider utilizing additional geographic representatives for promoting MNT services.

Pricing Considerations

Prior to July 1, 2003, the pricing arrangement for MNT services included tariff rates plus a surcharge of 23% of the MNT circuit costs. This surcharge covers a portion of the State of Colorado's MNT contractual fees, and has been termed the **C**olorado **D**igital-divide **E**limination **F**ee (CDEF). At the time MNT was offering services, the actual costs for ANAP fees, maintenance fees, LATA Crossing, Super ANAP circuits and overall management costs were not yet known. DoIT was charging 22.58% of tariff for frame relay circuits to state

agencies. 23% was chosen as the surcharge given the information available at that time.

Beginning with fiscal year 2003-2004, the MNT cost increased from 23% to 33% surcharge on layer 2 circuit costs. This increase reflects truth in rates - recovering actual costs for management of MNT. CDEF covers a portion of the MNT contractual fees, including Qwest project management fees, Aggregated Network Access Point (ANAP) fees, state core switch (MGX) maintenance fees, LATA Crossing, Super ANAP circuits and ISP-Layer 3 development. The cost of MNT participation using a 33% surcharge to cover network expenses appears to be between 50 and 75% of a typical ISP charge. So MNT continues to be a very price attractive option.

The MNT fee has made it possible to consider offering bandwidth-intensive e-government services in Sedgwick County and Costilla County, for example, in a manner that is consistent with what is commonly available in Mesa or Denver counties. The CDEF reflects the geographic disparity of service availability throughout the state of Colorado. By bridging the Digital-Divide the MNT will enable the same digital applications and services in the rural counties as the metropolitan Front Range cities.

As MNT offers other services, such as Voice over IP, ISP Layer 3 services, Internet2 services, and multicasting, various pricing levels may be offered based upon the level of service and the type of management of maintenance of services. Consideration for pricing may be in a "Bronze, Silver or Gold" level, depending upon the package of services and maintenance levels contracted.

Competitive Analysis of Pricing

The Customer Survey clearly indicated that MNT pricing must be competitive. One of the main reasons for public sector entities to switch to the MNT will be cost.

Standard ISP rates therefore establish a ceiling for MNT prices. On the average, MNT pricing, including the 33% surcharge, will equate to approximately a 25% discount over current ISP rates.

The following pricing is offered by competing Internet Service Providers as of March 2003. What about AOL and MSN – the two largest providers?

Comparison of Outsourced Internet Service Pricing

Company	Speed	Monthly Rate	Monthly Access Pricing	Total MonthlyCost
TransEdge	1.1M	$250	$330	$580
	1.5M	$360	$330	**$690**
Megapath	1M	$330	$330	$660
	1.5M	$400	$330	**$730**
Earthlink	1.1M	$349	$330	$679
	1.5M	$400	$330	**$730**
	Upload/Download			
Qwest	1024/1024	$203	$330	$533
	4096/1024	$300	$330	$630
	7168/1024	$430	$330	$760

MNT's total price for 1.5 Megabits per second per month is $475 – this includes Internet access pricing, MNT network costs and an approximation for the Federal Universal Service Fee. Therefore, MNT's pricing compares very favorably to $690, $730 and $730 per month shown in the table above.

Sales Plan

Past Accomplishments

All of the state agencies for Colorado are connected to MNT. There has been tremendous growth and demand from the local public entities to be connected to MNT in the last few months of 2002. In June of 2002, there were 208 local public entities that were connected to MNT. By December 2002, the number of customers including orders in process grew to 697.

Customer demand grew as a result of the following:

Services became available. MNT's implementation of ANAPs occurred from June 2001 through September 2003. Once all the ANAPs became operational, new customers could join MNT all over the state subject only to the availability of last mile facilities.

More services, flexibility and control. In moving from a Layer 2 platform to a Layer 3 network platform, MNT is able to offer more services, flexibility and more effective network management.

More effective marketing. Information is now readily available on MNT's pricing and procedures on the MNT Web Site and through the face-to-face meetings conducted through the road shows.

Timing. At the end of February 2002, MNT's capital budget was frozen for four months, from March 1 to the end of June. This meant that the physical conversion from Layer 2 to Layer 3 was delayed. As schools opened in September, MNT saw a dramatic increase in orders for circuits. With the budget freeze and the school cycle, pent-up demand for circuits resulted in a significant influx of orders at the end of 2002.

Reinforcement of Need. The high demand for services is reinforcement that the program is meeting the needs of the local public entities.

E-rate and the Universal Service Fund. Prior to the Telecommunications Act of 1996, the Universal Service Fund (USF) operated as a mechanism by which interstate long distance carriers were assessed fees to subsidize telephone service to low-income households and high-cost areas. The Communications Act of 1934 stated that all people in the United States should have access to "rapid, efficient, nationwide … communications service with adequate facilities at reasonable charges."

The Telecommunications Act of 1996 expanded the traditional definition of universal service – affordable, nationwide telephone service - to include among other things rural health care providers and eligible schools and libraries. Today, the FCC provides universal service support through four mechanisms:

1. High cost support mechanism provides support to telephone companies that serve high cost areas, thereby making phone service affordable for the residents of these regions.

2. Low income support mechanism assists low-income customers by helping to pay for monthly telephone charges as well as connection charges to initiate service.

3. Rural health care support mechanism allows rural health care providers to pay rates for telecommunications services similar to those of their urban counterparts, making telehealth services affordable.

4. Schools and libraries support mechanism popularly know as the "E-Rate," provides telecommunications services (e.g., local and long-distance calling, high-speed lines), Internet access, and internal connections (the equipment to deliver these services).

MNT hired an independent firm to educate schools and libraries regarding the E-rate process. The firm also facilitated the application process for applying for E-rate funding. The independent firm directly helped 17 school districts with education on the E-rate process. An additional 45 school and

library representatives were made aware of the E-rate program at a state-wide library teleconference. The results of the first year (Contract period - July 1, 2003 to June 30, 2004) E-rate marketing program are as follows:

- Tangible MNT savings for schools converting $516,000
- Increased federal funding to the state $195,000
- Number of school districts assisted 17
- Statewide library teleconference attendance 45

As MNT offers other services, such as Voice over IP, ISP Layer 3 services, Internet2 services, and multicasting, various pricing levels may be offered based upon the level of service and the type of management of maintenance of services. Consideration for pricing may be in a "Bronze, Silver or Gold" level, depending upon the package of services and maintenance levels contracted.

Schools and Libraries - Background

Generally, any school that meets the Elementary and Secondary Education Act of 1965's definition of a school is eligible to participate in the E-rate program, as are libraries that can receive assistance from a state's library administrative agency under the Library Services and Technology Act.

Specifically, schools and libraries do not receive direct funding from the program. Instead, they receive discounts on the costs of services provided by telecommunications vendors. The amount of discount each school or library can receive under the program ranges from 20% to 90 %, depending upon income and how rural the school's location is.

Each school or library that wishes to receive assistance for telecommunications services must complete an E-rate Form 471, which is typically due in mid-January each year. Once the application is approved, schools and libraries generally then order services from MNT. As this process takes a few months for approval, demand for MNT services is evident the following school year - again, producing orders toward the end of each calendar year.

DoIT anticipates continuing demand for services in the local public entity arena. DoIT also

anticipates peaks in demand to correlate with the school and budget cycle, creating a high demand for circuits at the end of each calendar year.

Sales and Order Process Cycle

There are seven major phases to the process for gaining connection to the MNT, each described in detail in the MNT Guide:

1. General Discovery Phase
2. Eligibility Determination Phase
3. Technical Discovery Phase
4. Customer Planning Phase, including Development of the Implementation Plan (Resources, Timeline, and Budget)
5. Implementation of Local Procurement Procedures Phase
6. Selection of Vendor(s) Phase
7. Installation, Management, and Maintenance of MNT Connection Phase.

Sales Forecast

As the MNT network nears completion, marketing efforts continue to be underway; procedures and policies are in place and demand for services will continue throughout the next several years of the project.

Local Public Entity Current – Current and Goal

	# of New Local Public Entity Customers	Total # of Customers
Through June 2003	700	700
July 2003 through June 2004	100	800
July 2004 through June 2005	100	900

Each customer may have one to six locations.

Financial Plan

Understanding the State of Colorado's Budget Cycle

In order to understand the financial model of the MNT Program, it is necessary to understand the State of Colorado's budget cycle.

The Role of the Joint Budget Committee

In most states, the executive branch initiates the main appropriation bill for the ongoing operations of state government. Colorado, however, has a strong legislative budget process. The General Assembly's permanent fiscal and budget review agency, the Joint Budget Committee (JBC), writes the annual appropriations bill – called the Long Bill – for the operations of state government. The JBC has six members: the Chairman and one majority and one minority member of the House Appropriations Committee, and the Chairman and one majority and one minority member of the Senate Appropriations Committee. Members serve two-year terms and are selected following the general election. Traditionally, the Senate elects its JBC members. In the House, the Speaker appoints the majority party members, and the minority party elects its member. The chairmanship alternates between the Chairmen of the Senate and House Appropriations Committees. The House and Senate calendars reflect the Joint Budget Committee's schedule during the legislative session.

Statutes charge the Joint Budget Committee with analyzing the management, operations, programs and fiscal needs of the departments of state government. The state Constitution requires a balanced budget. The Committee holds hearings and reviews the executive budget requests for each state agency and institution.

JBC Staff

The Committee has a non-partisan staff of fourteen analysts and two support staff. The departments and programs of state government are divided among the JBC staff analysts. Analysts review budget requests, prior year staff write-ups, statutes, appropriations reports, audit reports, interim committee reports, other pertinent information, and meet with agency personnel and other individuals to learn about programs, departments and their operations.

Budget Review and Analysis

Colorado has an annual budget cycle; the fiscal year begins July 1 and ends June 30. During late summer and early fall, departments submit their budget proposals to the Governor's

Office of State Planning and Budgeting as part of the executive budget process. The Governor and his staff review the budget proposals and limit each department's budget request based on the Governor's priorities, and they determine which new funding initiatives may be included in the request. Departments submit budgets to the Joint Budget Committee by November 1. As soon as practical after November 1, the JBC schedules hearings with the departments. The staff analysts brief the Committee on each budget request a few days prior to the hearing with the department. Briefings and hearings for most departments are scheduled in November and December before the General Assembly convenes in early January.

JBC staff briefings consist of written and oral presentations of budget issues and a review of expenditures and requests. Briefings are aimed at stimulating discussion among the Committee members about each department's budget request, its operations, issues of efficiency and effectiveness, and plans for the future. After the briefing, Committee members decide which issues they wish to discuss with the department. These may be topics presented by the staff or others Committee members wish to pursue. Staff analysts prepare a detailed agenda of these topics for the hearing, which also allows time for the department to discuss its priorities with the Committee. All briefings and hearings are open to the public and are also taped. The Joint Budget Committee does not accept public testimony on departmental budget requests at the hearings. The JBC meets Tuesdays and Thursdays with individuals and groups who wish to express concerns to the Committee.

In January, the Committee considers requests from departments for funding changes, called supplementals, for the current fiscal year. JBC analysts review these requests for funding changes and make recommendations to the Committee for its approval. In order for the state to have a balanced budget, the JBC may also need to find areas in the budget where funds can be taken back. When revenue shortfalls occur, the Governor must ask departments to restrict spending in order for the state to stay within projected revenues. The JBC staff analysts review these restrictions and make recommendations to the Committee, which then decides where funds can be taken back. Often this differs from the Governor's recommendations. Decisions are prepared and introduced as supplemental appropriation bills, which are acted on by the General Assembly.

By February 1, the General Assembly is required to certify, by joint resolution, the amount from the state's General Fund available for appropriation for the next fiscal year. This revenue resolution is very important to the deliberations of the JBC. During February and March, the

JBC makes decisions on the level of funding for state government for the next fiscal year. The Committee is responsible for funding the operations of the state as well as a required reserve (4% for FY 1993-94 and each year thereafter) out of the available General Fund revenues.

During February and March, when the JBC makes funding decisions for the upcoming fiscal year, analysts make and explain recommendations to the Committee on the number of employees, funding, and footnotes for each department. Long Bill footnotes are added to some line items to explain the purpose of the appropriation, or to request the department to submit specific information to the Committee. The Committee votes on each line item recommendation. Analysts recalculate where applicable and draft the Long Bill. At the end of the figure setting process, Committee members make changes to bring total funding in line with the revenue resolution and the statutory spending limit. Staff analysts prepare the Long Bill and write a narrative to explain the decisions made and to provide comparative information to the rest of the General Assembly.

The Long Bill is introduced for consideration by both houses, as a House Bill when the JBC Chairman is a House member, and as a Senate Bill when the JBC Chairman is a Senator. Legislative consideration begins in the party caucuses, where JBC members explain their decisions and answer questions from their colleagues, with help from the staff. The staff drafts all changes adopted by a caucus or requested by a legislator as amendments for action during floor debate. After both houses pass the Long Bill, the JBC members act as the conference committee to resolve differences between them. After both houses adopt the conference committee report, the bill is sent to the Governor. The Governor has line item veto power in acting on the bill.

Cash Fund Exempt Funding Used for State Agencies

The revenues received from MNT for state agencies are considered **Cash Fund Exempt.** Cash Fund Exempt means that revenues are exempt from the Taxpayers' Bill of Rights (TABOR) limitation, such as donations, collections from a previous year or revenues transferred from another agency. The Taxpayers' Bill of Rights (TABOR) limit (Article X, Section 20 of the Colorado Constitution) restricts the state's total revenue growth to the sum of inflation and population growth.

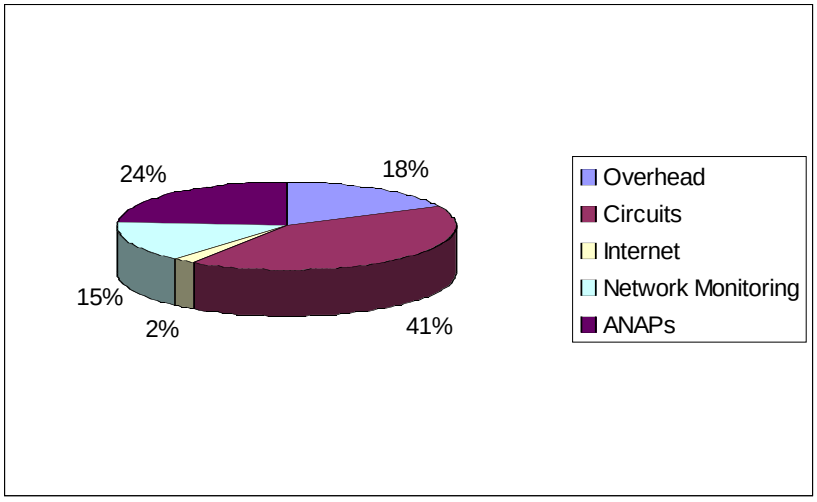
Current Program Costs

The following chart reflects MNT's annual budget and allocated costs for overhead, circuits, Internet access, network monitoring and the costs of the ANAPs.

Annual MNT Program Budget By Cost Category

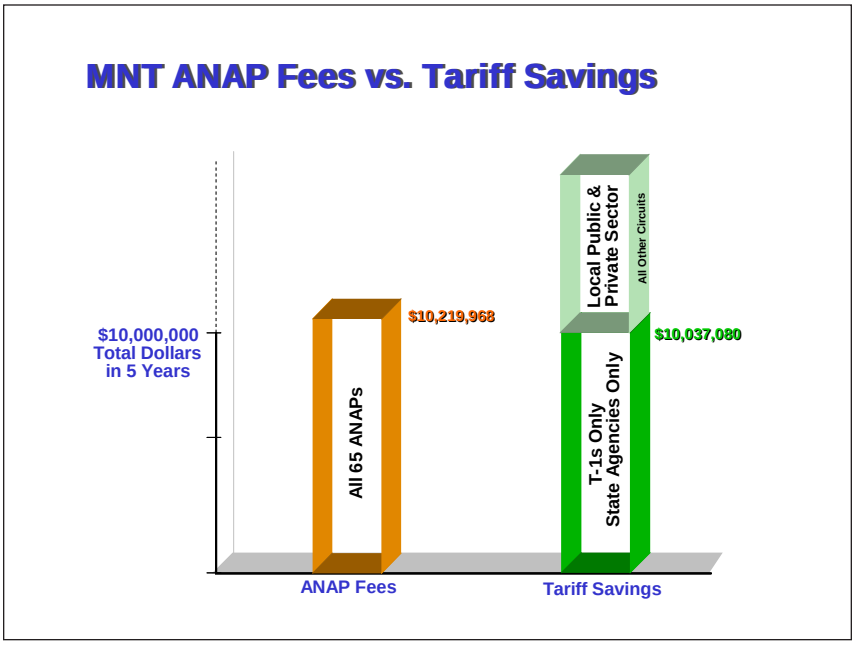
Cost Category	Annual Amount
Overhead	$2,114,000
Circuits	$4,930,000
Internet	$240,000
Network Monitoring	$1,800,000
ANAPs	$2,800,000
Total w/ ANAPs	$11,884,000
Subtotal w/o ANAPs	$7,044,000

The percentage breakdown that each category represents of the total program costs is as follows:



Cost Categories by Percent

The following figure illustrates that the MNT Program has (or will) recover the cost for ANAPs. The cost savings associated with moving from distance-sensitive T-1 service to the new MNT ATM T-1 service more than compensate for the cost of the ANAPs. The figure does not include other cost saving to MNT users, for example, savings on Internet access charges for local public entities.



Current Revenues

Prior to July 1, 2003, the pricing arrangement for MNT services included tariff rates plus a surcharge of 23% of the MNT circuit costs. This surcharge covers a portion of the State of Colorado's MNT contractual fees, and has been termed the Colorado Digital-divide Elimination Fee (CDEF). At the time MNT was offering services, the actual costs for ANAP fees, maintenance fees, LATA Crossing, Super ANAP circuits and overall management costs were not yet known. DoIT was charging 22.58% of tariff for frame relay circuits to state agencies. 23% was chosen as the surcharge given the information available at that time.

Beginning with fiscal year 2003-2004, the MNT cost increased from 23% to 33% surcharge on layer 2 circuit costs. This increase reflects truth in rates – recovering actual costs for management of MNT. CDEF covers a portion of the MNT contractual fees, including Qwest project management fees, state core switch (MGX) maintenance fees, LATA Crossing, Super ANAP circuits and ISP-Layer 3 development. Aggregated Network Access Point (ANAP) fees are no longer included in the CDEF but are paid directly from the DoIT budget. Current annualized revenues are expected to be approximately $4,200,000 this fiscal year.

Current Customer Revenue by Department or Market Segment

Currently, the local public entities are MNT's third largest customer segment, as of January

2003, representing almost 15% of the total annualized revenue. It is anticipated that the local public entities will very soon be MNT's largest customer segment, as this segment represents the largest potential market. As noted earlier in the Sales Plan, there are approximately 3,000 to 4,000 local public entity locations in the state. The top 10 customers (out of 24) account for almost 95% of revenue.

MNT Program Revenue by Customer

Customer	Annualized Billing	% of Total	Cumulative Total
Human Services	$ 892,317	20.98%	20.98%
Revenue	$ 701,115	16.49%	37.47%
Non-state (public)	$ 628,446	14.78%	52.25%
Public Safety	$ 505,999	11.90%	64.15%
Personnel & Admin.	$ 393,660	9.26%	73.41%
Corrections Admin.	$ 323,515	7.61%	81.02%
Transportation	$ 251,891	5.92%	86.94%
Natural Resources	$ 191,869	4.51%	91.45%
Public Defender	$ 101,457	2.39%	93.84%
Secretary of State	$ 37,385	0.88%	94.72%

Operations Plan

In order to support the continuing efforts of MNT, DoIT must continue to staff a functional organization. Additional staffing may be needed in order to meet the continuing demand for services and address customer service issues going forward. Below is a description of the existing DoIT organization, as well as the responsibilities and functional areas that need to continue to be addressed within the organization.

DoIT's Organization

Currently, the Network Services Group under the Division of Information Technologies (DoIT) in the Department of Personnel & Administration has traditionally assisted general state government agencies to design and complete their network and telecommunications projects. They also serve as consultants to the network staff from the various state agencies for many network projects.

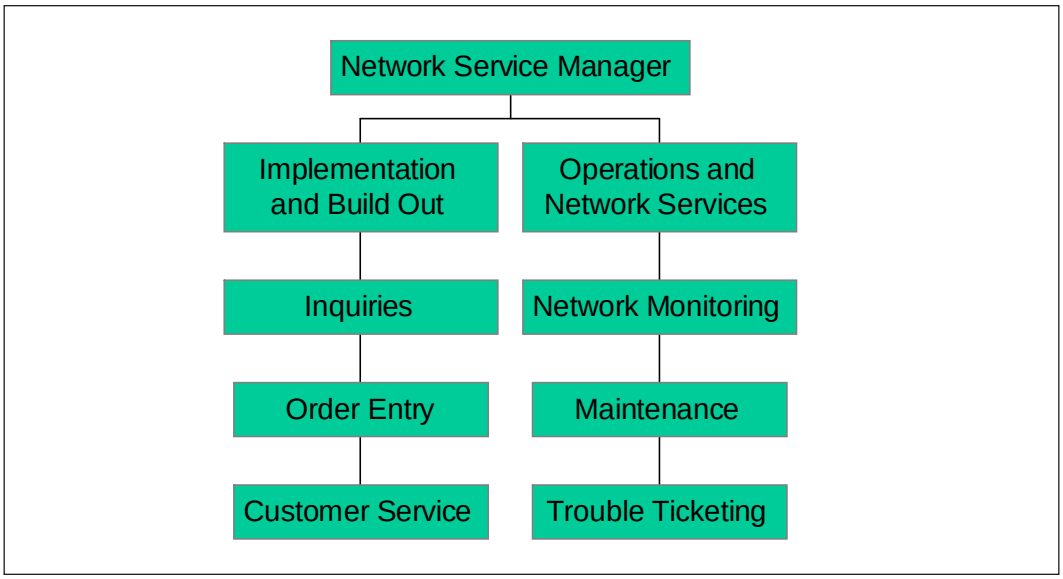
The Network Services Group operates the state Digital Data Network (DDN), the Colorado Information Network backbone (CIN and OCIN) and the Data Center Systems Network Architecture (SNA) network.

The MNT Implementation Team supervises the construction of the fiber-optic cable statewide build-out to the Aggregated Network Access Point (ANAP) in every county in the state. They are responsible for overseeing the building of the backbone - the information intrastate highway, but they are not responsible for completing all the "last-mile" work in the state. This is left up to the local community.

The MNT management and consulting team conducts road shows about the MNT project, performs preliminary assessments and can help point out potential MNT technical considerations. The MNT Implementation Team also answers customer questions during the discovery, planning, procurement and vendor selection process and then supervises the implementation phases. The MNT Team does not provide detailed engineering consulting services to local public entities.

Staffing for MNT has been established to address pre-sale and implementation of services, and operations. Conceptually, the organizational chart for DoIT network services is set up as follows:

MNT Organizational Structure



Change Control Board

Additionally, MNT established the Change Control Board to keep staff focused on the primary objectives of MNT and to facilitate positive change within the organization when needed.

Executive Steering Committee

The Executive Steering Committee was established to act as a Board of Directors for the project. The Executive Steering Committee reviews eligibility for non-profit organizations wanting connectivity to MNT. When a request to connect to the MNT is received from an organization that is not covered directly in the MNT statute, such as a non-profit, MNT connection eligibility will be evaluated on a case-by-case basis. Each case will be referred to the MNT Executive Steering Committee for a fair decision that is in compliance with the state statutes and with the MNT Participation Policy.

Outsourced Resources

Several private organizations and individuals have been hired by MNT for various functions supporting the MNT staff. Functional responsibilities have included E-rate assistance and training, marketing and communications, engineering and site survey support, road show and face-to-face meetings. MNT has been able to achieve an enormous amount of work through outsourcing various functions and responsibilities to individuals and outside firms.

Service Center Operations, Maintenance and Trouble Ticketing

DoIT operates and maintains a Customer Service Center staffed 24x7. For connected sites, the Service Center facilitates communications including network monitoring, network traffic measurement and recording and network problem identification, isolation and resolution as connectivity and performance issues arise and including tracking using a trouble ticketing system. Most of the problem resolution work is outsourced to third parties.

Management of IP Addresses

DoIT will manage allocation and transition support for two sets of IP addresses, one for standard Internet access and a separate subset for aggregate Internet2 access by K-12 schools and libraries. The I2 allocation may require a separate router and network connection/FRGP membership. Preliminary Internet2 block allocations have been made to five higher education sites (Colorado State University, Fort Collins; Mesa State College, Grand Junction; Western State College, Gunnison; Fort Lewis College, Durango; and Adams State College, Alamosa). The new Class "B" address block for standard Internet access and the Internet2 address block will be "owned" by the State of Colorado and administered by DoIT. Participating sites will be required to use NAT and possibly DHCP for address conservation.

Providing Technical and Engineering Assistance to Customer Sites

Participants range from sites with high technical knowledge and experienced full-time IT/Networking staff to sites with limited knowledge and part-time or consultative staffing, down to organizations with no knowledge, staff, or prior experience with IP network connectivity. There are locations that may not have local area networks (LANs) and are currently using dial-up for Internet access. These sites will need to be supported as they purchase and use their first dedicated connection. Each site is responsible for its own costs of equipment and MNT fees.

Basic Accounting, Billing, and Collection Services

DoIT operates and maintains a basic accounting, billing, and collection function for connected sites. Cost of the services are charged back to each of the sites. The MNT connection/bandwidth from Qwest or one of the Qwest partners will be billed from the phone company directly to the site or entity. The billing function accommodates E-rate subsidy payments and credits.

Network Operations

DoIT provides network operations for sites that are connected to MNT. Services provided include Layer-3 problem identification, isolation and resolution. Both connectivity and performance problems are addressed. All such services are provided at DoIT, i.e. no on-site support is anticipated.

- DoIT works with the customer to distribute and deploy the IP addresses.
- DoIT provides DNS (Domain Name System) services. The domain name system (DNS) is the way that Internet domain names are located and translated into Internet Protocol addresses. A domain name is a meaningful and easy-to-remember "handle" for an Internet address. Because maintaining a central list of domain name/IP address correspondences would be impractical, the lists of domain names and IP addresses are distributed throughout the Internet in a hierarchy of authority. Primary and secondary DNS servers are already in operation for DoIT. DoIT will either provide such services directly or "point to" DNS provided locally, at the choice of each site.
- DoIT and the customer work together to establish routes, monitor the network and maintain equipment.
- DoIT routes traffic appropriately, either in-state or out of state, and performs all routing functions necessary.

Network Monitoring and Maintenance

- DoIT is responsible for network monitoring and maintenance. Qwest is currently contracted to perform 24 X 7 network monitoring services.

Network Engineering

- DoIT provides network engineering in a consultative fashion, in support of sites that are contemplating connecting to the MNT.

- A key support tool is a set of technical and business standards. These standards are designed to create a uniform network environment for ease of engineering and support.

Customer Support and Training

- End-user sites will contact the DoIT Customer Service Center for technical support.
- Training on various technical topics may from time to time be delivered DoIT technical staff.
- DoIT will provide, as appropriate and from time to time, training classes in advanced network operations that will allow sites to take advantage of the advanced features of MNT InfoHub. Such training may include classes in multi-casting, Quality of Service, end-to-end performance, video-conferencing and Voice over IP.
- DoIT will periodically conduct surveys to identify how its technical support may be improved.

E-Rate Support

DoIT assists customers in obtaining E-rate subsidies for Internet services. The State of Colorado has an E-rate SPIN number, which means it is recognized by the federal government as an entity qualified to provide E-rate services.

- DoIT services are eligible for discount under the Internet Access category of service (the other two categories are: Telecommunications and Internal Connections). Note: circuits or the data transport is eligible under the Telecommunications category when it is provided by a Common Carrier such as Qwest.
- The telecommunications link for Internet2 is eligible for discount under the Telecommunications category. Membership dues and other non-related fees are not eligible for discounts.
- The internal connections components that include functionality for real-time or near real-time VoIP are eligible for discount under the Internal Connections category. The costs for services that provide VoIP capability over the Internet are not eligible for E-rate discounts.

- For a complete listing of eligible services refer to the Eligible Services List at: http://www.sl.universalservice.org/reference/eligible.asp

- For information on applying for E-rate, contact the Schools and Library Division (SLD) of the Universal Service Administrative Company (USAC) at 1-888-203-8100. For local assistance for schools, contact the Colorado Department of Education (CDE) at (303)-866-6850 and for local assistance to libraries contact the Colorado State Library (CSL) at (303)-866-6946.

Importance of Technical Standards

A key to the success of the two-tier approach, e.g, the MNT and numerous regional Edge sites and C-Pops, is a set of technical standards for how nodes are configured. This has two benefits:

1. It lessens the burden on nodes in engineering their networks because the engineering standards and guidelines will already be established. It should be noted that nodes would participate actively in developing these standards.

2. It lessens the burden on DoIT staff because all of its customers will be operating standardized network configurations.

Security

This section presents some recommendations for providing security across MNT connections. There are many aspects to security in a networked computer environment. Among them are: user security policies, host (computer) security policies and physical security and network security. Security designs should follow from a thorough assessment of security needs and always consider multiple conflicting factors such as protection provided, installation and operational costs and ease of use (i.e. a security design should appropriately weight productivity of personnel).

The material presented in this section addresses only some general aspects of computer and network security. Readers are referred to other material that presents a more comprehensive approach (e.g. see the Security Practices link at http://www.cert.org/, also http://www.sans.org/newlook/resources/).

Basis for a Security Design

Best practices for computer and network security should be implemented to the degree that a

site deems in its best interests. Among these are implementing strong passwords on hosts and network devices, applying security patches in a timely manner, implementing anti-virus protection, filtering inbound and outbound packets where IP addresses are obviously spoofed, using private IP addresses (for example, using Network Address Translation or NAT) on all internal computers that do not need to be directly accessible from the global Internet, etc. Although these measures are prudent, levels of security significantly exceeding these simple and standard measures are often required. The remainder of this section addresses enhanced security, specifically in the context on the MNT.

The MNT advocates a security design that provides: 1) multiple levels of security, 2) differing levels of security for individual sites behind a node and 3) low implementation and operational costs. Sites connecting to an individual node should engage in shared governance that addresses security. A flexible model at each node is advocated that will allow individual sites to implement security at the level that, in their best judgment, balances multiple conflicting factors, in accord with their needs for security and available resources.

Security via Virtual Private Networks (VPNs)

A security mechanism that is consistent with the precepts presented above is that of implementing Virtual Private Networks (VPNs). VPNs utilize digital encryption to protect data. When implemented, “strong” 128-bit encryption is recommended.

VPNs can be implemented between networks, between hosts (computers) and between an individual host and a network. For example, at the network level, VPNs can be implemented at a site's point of presence, e.g. a site firewall, a router or at a VPN concentrator that may be installed anywhere in a site's local area network. Indeed, numerous sites have implemented VPN concentrators to provide security for shared connections such as those deriving from internal wireless networks (implemented according to the 802.11b standard), external cable modems (such as provided by AT&T Broadband), or to provide encryption to and from external sites that require such enhanced security. Because of the flexibility and robust security that they provide, VPNs are highly recommended.

Two categories of research and analysis took place to provide ideas on how to meet MNT's challenge of continuing operations. First, research was done about initiatives in other states and second, a Request for Information (RFI) was issued to evaluate the abilities and costs of private sector outsourcing in providing the necessary services.

Overview of Initiatives In Other States

Most states have implemented statewide public sector Internet networks, often focusing on K-12 and other local public entities.

A 1999 survey conducted by Educause documents 35 state public sector/education networks. More states have added networks since 1999. Colorado is one of the 15 states as of 1999 that did not have a statewide public sector Internet network.

Graduate students at the Colorado School of Mines completed a white paper entitled "A Benchmarking Study of State Telecommunications Networks" in December 2002. Their paper, undertaken and sponsored by the MNT project team, can be found on the MNT web site at:
http://www.state.co.us/mnt/customerservice/StateNetworksBenchmarkStudy1-img.pdf
Short summaries of four such networks (Utah, Washington, Oregon and Missouri) are provided below.

Missouri

http://www.more.net/internet2/news/news03.html
As one of the first state education networks admitted to Internet2, MOREnet can now provide access to a new realm of digital experiences for Missouri's K-20 students and educators and offer a forum for knowledge sharing, idea and information exchange. MOREnet has also been asked to take a leadership role in the development of an Internet2 K20 Initiative that will take advantage of this expanded access. The mission of the I2 K20 Initiative is to enable the development and use of Internet applications, tools and content to enhance teaching and learning and in other ways further the mission of elementary, secondary and post secondary education in the United States.

Oregon

http://www.ode.state.or.us/orAccessNet/
The network is used to connect educators throughout Oregon, creating a statewide virtual education community. Administrators meet across the miles, saving dollars, time away from work and hours behind the steering wheel. Many school leaders are now able to attend meetings that they would not have been able to otherwise. Teachers access workshops and other professional development opportunities, including certification and licensure programs through higher education and community college institutions. Many Oregon students are

already accessing critical content, like foreign language and advanced placement science courses, that they wouldn't otherwise have had within their reach. Partnerships are being formed with content providers like the Oregon Museum of Science and Industry to bring world-class opportunities to all Oregon high school students and teachers.

Washington

http://www.wa.gov/dis/k20/

Across the state of Washington, students and educators from kindergarten through graduate school are using technology to speak to one another, learn from one another and explore the world and universe in new ways. A second-grade class in Burlington recently visited NASA via live videoconference. Steilacoom-area high school students conducted a real-time, two-way video conversation with high school students in South Africa, sharing opinions about politics, violence, lifestyles, technology and music. A disabled adult college student working and living in rural Grays Harbor County pursued a long-distance college degree to get the skills to land a better job in her own community. These examples provide just a glimpse of the many extraordinary stories detailed in this publication - dozens of vignettes about how educators are taking advantage of the K-20 Educational Telecommunications Network to help young and adult students flourish academically and professionally. And these stories are only the beginning. The use of technology is growing exponentially across the state as educators and students bring creative ideas and practices to life and as schools identify the means to fully tap the vast potential of the K-20 Network.

Utah

http://www.uen.org/

It is the mission of the Utah Education Network to: Provide the citizens of Utah access to the highest quality, most effective instructional experiences, educational administrative support services and teacher/faculty resources which will assist in achieving improved student learning; more effective communications among learners, teachers, faculty and parents; and greater efficiency in achieving statewide educational objectives. These services will be delivered, regardless of location or time, through seamless, technology rich, communications networks linking schools, libraries and homes to world-wide information networks, as well as businesses and industries.

EDNET is a two-way, fully interactive video network that allows students to take classes that might not be available to them in their local community. This network of fiber-optic cable, microwave radios and telephone lines connects schools throughout Utah. When enabled, each

site in the network has the ability to interact with other sites using full-motion video and high-quality audio. Currently 180 sites are connected to this network. A new addition to EDNET is the Utah Education Network Satellite System (UENSS). This satellite network provides one-way video, two-way audio delivery of courses to over 50 sites throughout the state.

Internet2 Initiatives

Approximately 30 states have joined Internet2 as Sponsored Education Group Participants to provide the ultra-high speed access to all K-12, library and community and state colleges.

Request for Information (RFI)

The MNT Program office issued a Request for Information through state Purchasing to vendors interested in providing Intranet services for the public sector. The RFI was published with a due date of August 26, 2002.

The RFI requested methods and cost data for certain services associated with providing a statewide intranet (shown below), but did not ask for information on Internet access per se (bandwidth charges) or for circuit transport charges. On this point, current state awards for Internet access quote prices of approximately $1,000 per month for T-1 access on a month-to-month basis ($1,009.80 for AT&T, $910.00 for Cable and Wireless, $1,000 for Qwest).

Fourteen responses were received. Six included complete requested budget information. Three provided less complete cost estimates, leaving out elements which they could not provide or which may be supplied by identified or yet-to-be determined partners. Several provided cost information only for elements of the state requirements that fit the vendor's marketed services. Five supplied no cost information or attached cost lists of services that were not directly related to the RFI requirements. Due to the complex requirements of the RFI, eight either named a partner or partners or indicated that an appropriate partner would be sought to accomplish the RFI requirements.

RFI Cost Information Results

The range of estimated costs presented in the RFI responses indicates the wide variety and depth of services that are proposed to fulfill the requirements. For example: the City of Glenwood Springs and Qwest both presented NOC operation cost estimates which appeared similar, though Qwest's was lower ($408 thousand vs. $485 thousand for year 1) and the highest cost estimate for NOC operations was over two million dollars a year (Volt). It also may be that some of the responses projected costs for these services for the entire MNT.

Total annual costs (based on totaled averages of RFI submissions), if distributed across 1,000 participating sites (an arbitrary index figure) would be $2,100 for Year 1 ($175 per month/site), $2,260 for Year 2 ($188 per month/site) and $2,300 for Year 3 ($192 per month/site). Basing similar cost projections on the median cost of submissions would suggest annual costs of $1,500 for Year 1 ($125 per month/site), $1,600 for Year 2 ($133 per month/site) and $1,650 for year 3 ($137.50 per month/site). A table of cost averages and medians is presented below:

Summary of RFI Responses

Averages	**Yr 1 500 sites**	**Yr 2 600 sites**	**Yr 3 700 sites**
Devise routing/network plan ($/yr)	$ 283,373	$ 290,038	$ 310,685
Eng. support/potential sites ($/yr)	$ 550,124	$ 610,708	$ 641,808
NOC services ($/yr)	$ 587,570	$ 677,083	$ 697,791
Billing services ($/yr)	$ 223,265	$ 218,553	$ 216,110
Admin. services, OH/profit ($/yr)	$ 280,989	$ 285,897	$ 276,647
Other services (desc. briefly) ($/yr)	$ 176,050	$ 174,932	$ 169,443
On-site support services ($/hr.)	$ 100	$ 93	$ 97
Total Engineering, NOC, Admin	$ 1,878,205	$ 2,038,751	$ 2,096,471
Total Annual Cost	**$ 2,101,470**	**$ 2,257,304**	**$ 2,312,581**

Summary of RFI Responses

Averages	Yr 1 500 sites	Yr 2 600 sites	Yr 3 700 sites
Medians			
Devise routing/network plan ($/yr)	$ 167,965	$ 202,750	$ 248,050
Eng. support/potential sites ($/yr)	$ 400,000	$ 400,000	$ 400,000
NOC services ($/yr)	$ 404,000	$ 400,000	$ 400,000
Billing services ($/yr)	$ 144,379	$ 138,759	$ 150,000
Admin. services, OH/profit ($/yr)	$ 220,000	$ 261,500	$ 243,500
Other services (desc. briefly) ($/yr)	$ 150,000	$ 180,000	$ 210,000
On-site support services ($/hr.)	$ 95	$ 80	$ 80
Total Engineering, NOC, Admin	$ 1,342,060	$ 1,444,330	$ 1,501,630
Total Annual Cost	**$ 1,486,440**	**$ 1,583,089**	**$ 1,651,630**

Recommended Solution - Reality of Costs

Since each of the RFI responses were cost prohibitive, the only recommended solution that could be implemented was to have DPA/DoIT provide all operational services and functions for MNT out of existing resources.

Beanpole – Addressing Last Mile Access

Background

In the original legislation, the Beanpole project was to be implemented by the Colorado Advanced Technology Institute. The Institute however was abolished by the legislature and responsibilities for implementation were transferred to the Colorado Department of Local Affairs (DoLA).

The legislation provided $4,676,000 to be used to promote last mile connectivity to the high-speed digital telecommunications system, which was being deployed by Qwest and its partners to serve the Multi Use Network. MNT was being developed by the Colorado Department of Personnel & Administration.

The initial program was to fund the start up of what was planned as a multi-year effort to connect Colorado's rural counties to the MNT. The Beanpole project was designed to demonstrate the feasibility of aggregating local public office telecommunications traffic and related revenue streams to determine whether the aggregated revenue streams, along with state support provided through the MNT and BP grant programs, would be sufficient to induce private telecommunications companies to invest in last mile connectivity for both public offices and private customers. It was long contended that a business case could not be made to justify such expenditures.

Public offices included state and local government locations, including school and special districts and certain non-profit facilities such as hospitals. Priority for funding was given to rural counties that were underserved as demonstrated by the lack of existing, affordable high-speed digital telecommunications services.

Planning, System Design and Implementation Grants

The bill allowed for two forms of investment. The first funding gave grants to communities for planning and system design. The second form of investment included giving grants for actual implementation of the plan, through the purchase of privately provided telecommunications services and necessary equipment to connect such services to local public offices.

The bill, as passed, included a requirement that Local Affairs contract for the administration of the project with a contractor. It was felt, at the time the legislation was being considered,

that providing for department administrative staff would create on going obligations for staffing and that DoLA did not possess the appropriately skilled staff to manage a telecommunications project.

Decisions were made by DoLA to contract for services with the Colorado Rural Development Council and with the Department of Higher Education for outreach, project administration and technical telecommunications background sorts of services.

Planning Grant Recipients

Over the course of several years, planning grants were made to the following entities:

1. Sedgwick County,
2. Northwestern Colorado (Routt, Rio Blanco and Moffat counties),
3. Southwestern Colorado (Montezuma, La Plata, Archuleta, San Juan and Dolores counties),
4. Southeastern Colorado (Otero, Prowers, Bent, Crowley and Kiowa counties),
5. Morgan County,
6. The San Luis Valley,
7. East Central Colorado (Kit Carson, Cheyenne, Lincoln and rural parts of Arapahoe, Elbert and Adams counties),
8. Summit County,
9. Eagle County,
10. Garfield County,
11. Pitkin County,
12. Yuma County,
13. Fremont County,
14. San Miguel County,
15. Custer County,
16. Logan County,
17. Phillips County and
18. Washington County

Implementation Grant Recipients

The following counties received funding for implementation activities:

Implementation Grant Recipients and Award Amounts

County	Award Amount
Routt, Rio Blanco and Moffat	$ 1,375,000
Montezuma and La Plata	$ 1,375,000
Otero, Prowers, Bent, Crowley and Kiowa	$ 750,000
Morgan	$ 258,000
Cheyenne and Kit Carson	$ 167,200
Sedgwick	$ 204,000
Summit	$ 472,688
Total	$ 4,601,888

Process Delays

During the early Beanpole days, it became apparent that most MNT technical staff resources would be needed to successfully connect state agencies to the new digital system. Vendor selection and contractual negotiations with the successful MNT vendor were delayed by appeals of rival vendors and by the complexities involved with the transfer of ownership of US West to Qwest which was concurrent with Beanpole/MNT start-ups. Nevertheless, all grant projects moved forward.

Status of Projects

When making decisions about where initial implementation projects should be completed, beanpole managers decided to test both regional approaches and single county programs. A regional telecommunications system had already been put in place in Southeastern Colorado connecting K-12 schools and local community colleges. An alternative telecommunications company, an affiliate of the local REA, was providing services. It was decided that local communities, through a request for proposal process, would augment the existing system by also connecting public offices associated with general-purpose governments and non-profit health care facilities. This system has been fully deployed and has been connected to the MNT since 2001.

In Southwestern Colorado, public offices in Montezuma County have been connected to the MNT since late in 2002. Public offices in La Plata County are connected for aggregation of their traffic, but the existing connection between the point of aggregation and the Qwest con-

nection to the MNT is deemed inadequate. A connection providing higher capacity (DS3) was scheduled. With the activation of public offices in these two counties, state and local officials will review whether any funds are remaining in the contract and determine whether additional communities can be connected.

In Northwestern Colorado, the local loops serving public offices in Routt, Rio Blanco and Moffat counties have been installed. With the arrival and final connection of equipment , public offices in these counties have been linked to the MNT. It is in the northwestern region of Colorado that the full potential of leveraged investment is expected to occur. The last mile vendor selected by the communities is NC Telecomm, an alternative provider that will establish a competitive situation for Qwest, the historical provider of service in this area. These will likely result in holding connectivity cost down for both public and private customers while providing a choice for consumers. This may be somewhat unique to the area since its economic opportunities are enhanced by winter and summer tourism and natural resource industries.

In Sedgwick County a small number of public offices have been connected. This sparsely populated, rural county in the far northeastern corner of the state had difficulty in attracting interest of traditional telecommunications providers. A regional wireless company did not pursue the Request for Proposal process for various reasons. Qwest's bid exceeded available funding. A local start up company was eventually selected to develop a wireless based system that will connect a small number of public offices in Julesburg and Ovid to the MNT. Whether a small customer-based system can be sustainable over the long term is questionable. Beanpole experiences in Sedgwick appear to, at least initially, indicate it may be difficult to induce private investment in rural counties that have a minimal commercial base unless the state is willing to provide disproportionate long-term subsidies to establish such connectivity.

Summit County is under contract with a vendor and is expected to establish service to its public offices late in the fall of 2003. Morgan, Cheyenne and Kit Carson counties are in the early stages of implementation activity.

For a variety of reasons, including timing, budget restrictions and delays in finding satisfactory last mile providers , no implementation funding was provided after the first year of the program. DoLA did, by using some of its other grant sources, continue to provide planning support through the fall of 2002.

The MNT will be deployed and available to all counties in Colorado by the end of September 2003. It is hoped that many communities, if not all, will be able to tie in either to the MNT system or to the private (Qwest and other telecommunications providers) side of the high-speed digital telecommunications network which has been successfully deployed to all Colorado counties.

It should be noted that there are numerous last mile connections, independent of the Beanpole project that are being made to the MNT and to the privately operated systems now available to the state. The City of Glenwood Springs, in Garfield County, has deployed fiber connections along its utility corridors, that will allow for both public and private connectivity to the statewide digital system. Individual school districts and other public offices are also connecting.

Plans have been completed in additional counties detailing where public offices are and what their bandwidth requirements would be to establish the types of services desired by local officials. It is hoped that the connectivity snowball has started rolling down the hill and will continue to roll with or without additional state inducement and support.

Lessons Learned

There were several lessons that were learned over the Beanpole implementation and program:

1. For purposes of telecommunications planning and implementation, existing political boundaries such as counties, planning regions, etc. are of little value. Future efforts should identify telecommunications service areas and work within them.

2. In sparsely populated areas with few businesses, aggregation of local public office traffic likely will not provide sufficient inducement for private investments. If a level playing field for all communities is expected, significantly higher subsidies

for remote areas will be necessary and will be on going in nature. A business case cannot be sustained without such subsidies.

3. The statutory requirement for connectivity to the state-operated MNT has both positive and negative aspects. The MNT can offer specialized services at very reasonable rates. The limitations on staff resources for the state-operated system while expanding the customer base significantly will be challenging.

4. It may have been far simpler to have provided the funding for Beanpole community connectivity to DPA and made it a part of the overall MNT contract. This would have allowed for the technical expertise that was available to DPA to be more readily available to local communities desiring to connect to the MNT. Setting up collaboratively but separately administered projects in DPA and DoLA proved to be a detriment to efficiency and timeliness.

5. Initially, DoLA believed its role and responsibilities were to administer a grant program wherein local communities would hire technical expertise for planning purposes. It likely would have been easier, less costly and more efficient to contract with a single technically skilled technical services provider who would have the time and benefit of becoming familiar with the complexities of tying local communities into the MNT all over the state. Preserving the local option, which is a significant part of DoLA's organizational culture, didn't work particularly well with the technical planning parts of the program. Neither DoLA, nor many of the local recipients, were well informed about technical partner selection, pricing of consultants or services.

6. Aggregation of services/revenue streams can be an effective tool for securing services and benefits for local telecomm users, particularly in more populated and commercially viable rural communities. A business case can be made to induce private investment where it might otherwise not happen through state support and guarantee of a specific revenue stream to provide local providers. Competition can be induced. Alternative providers can come to the table.

7. Health care, educational and personal access to telecommunications benefits will result from deployment and connectivity provided by the MNT/Beanpole projects. These will occur in almost all communities where connectivity is achieved. Economic development benefits are starting to accrue in the larger market center rural communities. It is unlikely that substantial economic development benefits will occur in the most rural and least populated towns and counties due to factors

that connectivity cannot change, e.g. availability of work force, access to market, transport costs, life style preferences of companies.

8. The design of the Beanpole legislation and requirements for connectivity only to the MNT were overly restrictive and failed to take into account preexisting systems which had been deployed, including some which were owned and operated by local governments. If an attempt is made to reestablish a rural connectivity assistance program, consideration should be given to allowing for local option to link to either the MNT or to privately provided systems.

9. Initially there was inadequate recognition of the demands that extending MNT service to a new large customer base would entail. Successes did not emerge until additional contractor resources could be hired and directed to focus on non-state customers, including Beanpole communities.

10. The Beanpole process worked the best in communities where a local/regional technology competent public office was located. This could involve a larger general-purpose government with an information technology program, a community college with a sophisticated information technology director of some other key actor.

A substantial portion of rural Colorado will be connected to the world via high-speed fiber by the fall of 2003. Rural Colorado will be receiving telecomm services at substantial savings from their previous costs while having access to higher speed and more effective opportunities to benefit general governmental services, K-12, higher education and rural health care. The seed has been planted and will grow.

We anticipate that, at the least, in those rural counties which did not receive beanpole implementation support, connectivity via local initiative will be achieved in the county seat communities where MNT connectivity and private commodity connectivity is currently available. This option was not available to these communities prior to MNT. Beanpole planning provides the information and direction and local communities will likely step forward with the will and resources needed to take the next step.

Local communities can combine the resources of local public offices, municipalities, county government, school districts, special districts, non-profits, for profit businesses and private citizens to help make a business case for last mile telecommunications providers to connect them to the state fiber backbone. The opportunity exists and all options need to be considered.

Applications in the Public Sector – Putting the MNT to Work

This chapter outlines MNT's vision for the next decade and the applications that will be supported by MNT for the following market sectors: E-Government, Economic Development, Healthcare, Higher Education and K-12 Education.

E-Government Applications for the General Public

Technology is a way to allow citizens access to their government and allow them to understand government programs and services. *"Citizens are often unaware of the multitude of services provided by governments and how tax dollars are allocated to enhance the quality of life in America. Once citizens can easily access online information and services, the traditional walls of government bureaucracies will become increasing transparent."*[2]

The governmental sector includes federal, state and local government. E-government applications will grow at all three levels, better integrating these three levels of government and linking each to the citizens they serve.

A good benchmark of e-government at the state level for the coming decade is a snapshot of current services now made available by various state governments throughout the nation:

- 91% allow citizens to pay taxes online.
- 87% transfer tax refunds to citizens electronically.
- 84% operate Web portals organized around life events.
- 48% have equipped most state police officers with digital mobile technologies.
- 47% have implemented a statewide IT architecture.
- 45% offer most of their social services application forms online.
- 41% accept at least one type of court filing online.[3]

By 2010, these benchmarks will all likely be 100%.

Governor's Office of Innovation and Technology is finalizing the 2003 Strategic Communications and Data Processing Plan to be submitted to the Information Management

[2]Trends and Their Effect on Municipal Government In Colorado, March 29, 2001
[3]2002 Digital State Survey, Government Technology magazine.

Commission as a statutory requirement. This plan identifies a framework for Colorado e-governance that includes 5 components:

1. **E-Government Solutions –** customer relationship management, change management and enterprise solutions development
2. **Enterprise Architecture –** information technology policy and standards, technology model, process and governance
3. **Portfolio Management** – planning and budgeting, information technology investment management and information technology asset management
4. **Public Policy –** legislative liaison, policy development, federal policy awareness
5. **Risk Management –** security policy and compliance, privacy policy and compliance, project oversight (independent verification and validation)

E-Government Applications Today

Below are some examples of how e-government services are being provided today in Colorado. These are examples only and are not intended to be comprehensive. Healthcare and education applications are treated in separate sections of this chapter. The examples below were drawn from Colorado's response to the 2002 Digital State Survey conducted by the Center for Digital Government and The Progress & Freedom Foundation and published in conjunction with Government Technology magazine. The full survey response for Colorado is available from the Governor's Office of Innovation and Technology.

Judicial

Colorado ranked in first place for two consecutive years in the survey. Key to this success was the Colorado Integrated Criminal Justice Information System (CICJIS), cited as a model for information sharing of the type now much in demand for homeland security. CICJIS manages some 60 different types of information transferred among the five participating agencies: adult corrections, juvenile corrections, the court system, the DA's office and all local law enforcement offices.

Citizens can follow the decision-making of Colorado trial, Appellate and Supreme courts with the ability to both track as well as acquire decisions and opinions via links on the state's website. The Court of Appeals and the Supreme Court each publish both case announcements

and oral argument schedules on their websites. Additionally, all published opinions are available online (from a link to the Colorado Bar Association's website) to the general public, free of charge. All trial court activity and decisions that can be made public according to the rules of public access and privacy (e.g., excluding juvenile cases) are also available online – through the court vendor's statewide system (http://www.cocourts.com/) – at a nominal charge. This "Colorado Courts" database contains millions of up-to-the-minute court records in four major case categories: Criminal, Civil, Traffic and Domestic Relations. This database is the publicly available portion of the Integrated Colorado On-Line Network (ICON), which is the official electronic courts repository of the Colorado Judicial Branch.

Corrections

The Colorado Department of Corrections (DOC) has implemented video conferencing capabilities at 13 of its 21 correctional facilities as well as Parole Headquarters and one regional Parole Center. The video network was originally established in 1997 for the purpose of conducting judicial proceedings and has since expanded to include telemedicine and Parole Board hearings.

The Federal courts have implemented video capabilities and request, at an ever-increasing rate, that arraignments and hearings be conducted via video. Average use to date is three Federal hearings per month using video. As the State District Courts increase their implementation of video conferencing, it is expected that the number of video arraignments and hearings will increase accordingly.

The Immigration and Naturalization Services have also utilized video teleconferencing for inmates in the DOC. In addition, many local trial courts have video arraignment capabilities with their local jails (e.g., Jefferson County, Adams County, Pueblo County Juvenile Correctional Facility, etc).

Social Services

In Colorado, many social services forms can be accessed online, either directly by a participant or by an authorized professional agent acting on the client's behalf. With regard to human services delivery, Colorado is a state supervised, county administered social service system. This means that while service programs may be developed at the state level, most client interactions take place at the local level. To facilitate this approach, at the state level the social services-related departments have constructed centralized information systems to

facilitate the uniform collection and analysis, dissemination and processing of basic human assistance services, human service provider expenditure and reimbursement requests, the many public and private resources for families and children and employment, training and workers compensation services. Highlights in the social services arena include:

Colorado has two significant social services projects underway to integrate client services across departments. The Colorado Benefits Management System (CBMS) is intended to streamline, simplify and make uniform eligibility decisions and services, simplify access to public assistance and medical benefits, improve customer service and provide increased stakeholder access to information. CBMS will replace six legacy systems.

- The Department of Labor and Employment's "genesis" initiative will result in a customer-focused model for providing unemployment insurance benefits and unemployment insurance tax services to the public.
- Several human services program in Colorado utilize electronic benefit transfers (EBT) for benefit distribution, including: Child Care, Child Support Enforcement, Child Welfare (including foster and adoption subsidy payments), Development Disabilities Services, Low-income Energy Assistance Program, Refugee Services, Vocational Rehabilitation and Workers Compensation. Over $500 million in payments are made annually through the Colorado Electronic Benefits Transfer Service (COEBTS).
- Online features in support of: disability determination, child welfare, employment services, mental health, supportive housing and homeless, unemployment benefits and workers compensation.

Revenue

At present, the Department of Revenue images coupon-sized documents during remittance processing and makes these available online to those individuals or tax filing services that pay for a viewer. A feasibility study has been completed to support the imaging of tax documents of all sizes.

The state has implemented direct deposit for the last filing year and received requests for direct deposit for over 445,000 filings representing 26% of total individual income tax returns. Taxpayers can view online the status of their tax filings.

The department is planning to develop an online business tax registration system which will utilize the Geographical Information Systems (GIS) location data to automatically determine the proper sales tax jurisdictions for the business taxpayer, resulting in better accuracy in recording jurisdiction information and monthly sales tax distributions to counties and cities.

Geographical Information Systems Data

Colorado's current strategy is to allow each state department to provide access, via direct data downloads, to their portion of the state's GIS data in lieu of centralizing this function to one server. Future integration is under review. The Colorado Department of Transportation provides multiple GIS layers in shape file format as well as county and incorporated city maps in PDF file format available for downloading to the general public through the CDOT website. CDOT staff and consultants use GIS data sets in project management, long range and corridor planning, project scoping and environmental assessments.

Transportation

The traveling public has access via the Web (http://www.cotrip.org), on a real-time basis to a host of travel related information including: road and weather conditions, alerts and restrictions, winter driving, construction, statewide weather station information and Denver metro area speed map for the interstate system. This information has been formatted for small screen viewing and is now accessible on mobile devices (cell phone, PDA, etc.), permitting access to information and traffic cameras while the traveler is in transit.

Colorado is a pilot state for the national Commercial Vehicle Information Systems and Networks program (CVISN). Since entering into the CVISN grant agreement, Colorado has implemented a statewide, networked roadside computer business system that assists in the identification and credential status verification of vehicles and serves as the method to enter event data, sell permits, issue receipts and perform administrative functions.

MNT Technology Goals for 2010 E-Government Support

The technology goals to support growth in e-government services parallel the goals for healthcare and education. Some key areas are:

- **Network Participation of Local Government.** Governmental services are implemented in tight coordination among state and local governments. As the systems described above mature in providing service to the citizen, it will become

ever more important that state agencies and their local government partners in counties and municipalities share in a seamless intranet infrastructure. Colorado statute provides that the Department of Personnel & Administration may provide network services to local governments and this service is offered through the Division of Information Technologies as a part of MNT service. By 2010, all county and municipal governments should participate in the state's public intranet.

- **Redundancy for the FRGP.** All state agencies currently obtain commodity Internet access from the FRGP. While state government has its own secure intranet, agencies cannot communicate with their customers and partners without commodity Internet access. Because of the centrality of the FRGP, a critical technology goal for 2010 is to implement a mirrored, fully redundant back-up facility to the FRGP, perhaps located at the Division of Information Technologies in Lakewood.

- **Video.** By 2010 the state should have conducted a feasibility study of the appropriate architecture to support interactive video teleconferencing needs of departments and local government and more importantly, video conferencing applications that span different departments and levels of government (including education and healthcare). This study should consider what policies, standards and architecture will best achieve this result. The video-over IP standard (H.323) is the most appropriate candidate standard today. The accompanying policy may be that all new video investment be H.323 compatible. Architectural alternatives to be examined include centralized, decentralized and hierarchical approaches to video bridging. Additional concerns involve bandwidth allocations or other quality of service strategies to ensure compatibility of video with other network applications (e.g., voice and data). As video becomes more prevalent, network bandwidth must scale to meet the demand.

Key Organizations to Support E-Government

The underlying precept of e-government (seamless service to the customer) requires the reciprocal involvement at all three levels of government in service delivery: federal, state and local participation is a requirement. Key organizations include:

1. **Division of Information Technologies (DoIT).** DoIT plays a central role as the public sector's network administrator. It also has a key role in the development of state-wide applications.

2. **Governor's Office of Innovation and Technology (OIT).** The OIT has the statu-

tory responsibility to provide information technology leadership to the state. OIT houses the office of the state's Chief Information Officer and sponsors the CIO forum, a critical clearinghouse and platform for action in coordinating IT development. The Secretary of Technology chairs and OIT supports, the Information Management Commission, the state's IT development oversight body.

3. **Colorado Municipal League.** CML is the key organization for interfacing with Colorado's cities and towns.

4. **Colorado Counties, Inc.** CCI represents the collective interests of Colorado's counties.

Economic Development Applications

The Multi-use Network project was a public-private partnership between the State of Colorado and Qwest Communications, Inc. In this partnership, the state acted as an "anchor tenant" in providing an incentive for Qwest to build a fiber optic telecommunications network spanning every county seat in the state. The network deployed by Qwest, termed the Colorado High-speed Digital Network (CHDN) is available to all customers (i.e., homes, businesses). That part of the network the state reserved to fulfill its role as anchor tenant is termed the Multi-use Network (or MNT) and is available only to public and certain non-profit entities.

The key intent of the MNT Program was to stimulate economic development in rural Colorado by providing high-speed telecommunications access for business. Therefore, the main driver of economic development is the CHDN, not the smaller MNT sub-network dedicated to use by the state.

By 2010, the following visions will support economic development:

- Existing businesses will be strengthened through access and use of the Internet.
- Rural Colorado will experience rapid growth in information technology-related jobs.
- Colorado's rural economy will become more diversified.
- Quality of life enhancements enabled by applications of MNT in government, education and healthcare will help in attracting new workers and jobs to rural

Colorado and increasing Colorado's rural standard of living.

The world is in transition from an industrial economy of yesterday to the knowledge-based economy of tomorrow. Skills and knowledge are replacing raw materials as the source of wealth. Access to broadband telecommunications systems will join access to transportation as one of the key routes to economic success.

The world economy is increasingly global and democratic. Low value-added services are migrating offshore to low-wage countries.

The winning strategy for advanced economies is to move to the earlier, more creative and knowledge-intensive phases of the value producing chain. This applies to Colorado in general and to rural Colorado in particular. This strategy is possible in rural areas because the new economy's basic resources (skills, knowledge and communications) are place-independent – they can move.

But place still matters. Those who possess scarce resources (skill, knowledge) now have greater flexibility in choosing where to live. Important to this choice is quality of life. People are now free to live where it is pleasant to live, not only where there is access to raw materials (the rust belt) or transportation (coastal ports, Chicago).

Colorado boasts one of the most majestic and beautiful natural settings in the world. However, quality of life is not just scenery. It also includes access to quality education (for oneself and one's family) and quality healthcare.

Today's Economic State of Affairs

Colorado ranks high nationally on a number of high tech and new economy indices:

#1 nationwide in concentration of high-tech workers (98 of every 1,000)[4]

#1 nationwide in percent of households with Internet access (51.8%)

#2 nationwide in percent of households with computers (62.6%)[5]

#1 in concentration of residents with a college education.

[4]AEA Cyberstates 2000
[5]NTIA Falling Through the Net, October 2000

#3 in the new economy positioning[6]

#4 with regard to state performance in the new economy7

However, most of our high tech prowess is located along the Front Range corridor. High-tech job concentrations in the rural regions of the state are much lower than the statewide rankings suggest.

By June 2003, all but three of Colorado's 64 county seats will have access to the CHSDN. In 19 counties, high-speed digital access is being extended to other municipalities than the county seat through the Beanpole Program. However, some 30 counties do not have programs in place to extend high-speed digital connectivity to non-county seat municipalities.

Elsewhere this report documents a number of anecdotes about business use of - and frustration with - Internet access. By and large, the advent of the CHDN has ushered in an era where Internet access is becoming less and less of a barrier and more and more a spur to business growth and development. For example, recently a financial services firm of approximately 80 employees had to leave Glenwood Springs for Denver due to lack of adequate high-speed telecommunications. Today, Glenwood Springs has completed a fiber ring interconnected to the CHDN specifically to support such economic development opportunities.

Today's – and Tomorrow's – Cost

The CHDN has helped overcome the "digital divide" in many localities of rural Colorado. The digital divide stemmed from two sources: lack of services and unaffordable cost of service. The CHDN has helped address both of these.

Lack of service. Many regions of Colorado, prior to the CHDN, had "run out" of telecommunications capacity. Orders for fast data circuits (T-1s) were backlogged and unavailable. One anecdote is of a Durango ISP that had to stop taking new dial-up customers because they could not get adequate bandwidth out of Durango to their main Internet backbone in Denver. This situation is now reversed -Durango has ample CHDN bandwidth to support all uses and users.

Unaffordable cost of service. Prior the CHDN, certain types of data circuits cost more depending on the distance/length of the circuit. Or a service would not be available in a given

[6]The Milken Institute's "New Economy Index", released in November 2001
[7]The Progressive Policy Institute (PPI) issued a "State New Economy Index" in June 2002

region and the customer had to lease a circuit back to a metropolitan area (via a so-called "backhaul" or FX circuit). Today, with the CHDN, ATM service (Asynchronous Transfer Mode, a type of packet-switched telecommunications service) is available to anyone within the wire centers associated with the CHDN with no distance-sensitive charges at all. The cost of ATM connectivity – point-to-point – is independent of the locations of the two endpoints.

2010 Technology Goals for Economic Development

Statewide Fiber Backbone. This goal has been reached today, in 2003. We mention it here to emphasize the fact that this perennial goal of the past has been achieved – it is now a reality. However, as indicated next, there is still some more work to be done.

Universal Broadband Access. As mentioned above, many communities (those that are not county seats) do not have access to the statewide ATM backbone. The 2010 goal for Colorado is to completely extend ATM access via the CHDN (or similar networks) to all municipalities with populations in excess of 500. There are several approaches to this goal:

- Telecommunications authorities. As contemplated in a bill introduced to the legislature in the 2003 general session, communities, if authorized to do so, might form telecommunications authorities to finance broadband build-out.

- Use of public funding available to local governments. Where connectivity is a local priority, local governments acting alone or collaboratively with other local governments can approach non-traditional state or federal discretionary grant programs where telecommunications projects may be eligible for funding. Such programs may include Community Development Block Grants, USDA Rural Development, US Department of Commerce, EDA, state energy and mineral or gaming impact assistance programs." Such programs often respond to communities' priorities in deciding how to use their discretionary funding. An additional resource is the Rural Telecommunications Enterprise Zone program established by the Colorado Public Utilities Commission.

- Community initiative. Several communities have implemented fiber loop broadband infrastructure completely on their own and with their own resources. Examples are; Glenwood Springs, Cortez, Durango and Gunnison. Local governments need not wait for state or federal funding availability to improve their competitiveness.

Technology Diffusion – Public/Private Collaboration. Effective adoption and use of networked technologies to do business in new ways is a difficult undertaking. Difficulty undertakings are often easier to manage when working in partnership with others. Therefore, communities should explore potential joint public/private collaborations. For example, video conferencing capabilities in the city hall building might be made available to small to medium sized businesses. By developing innovative uses of networked technology, the public sector can serve as an "anchor tenant of applications," sharing with the private sector these new potential uses. Finally, at the community level, both public and private sector IT professionals might form a community-based technology group that meets regularly to share information and exchange stories.

Rural Job Growth – The Opportunity in IT-Related Industries

The Internet is a revolutionary tool. Understanding this is the key to economic competitiveness. The Internet as a tool can be used in increasingly sophisticated ways. According to Howard Charney, Executive Vice President of Cisco Systems, effective use of the Internet has four phases: information, interaction, collaboration and transformation. Each phase requires greater bandwidth and connectivity than the proceeding one, yet offers more productivity and economic potential. The economic potential of the Internet to rural Colorado will depend to the degree and extent to which rural firms maximize transformative uses of the Internet.

Existing Business Base. The Internet (which, increasingly, requires broadband access to use adequately) is becoming the common denominator of modern society - everybody uses it all the time, at work, at home, in school. The Internet can be used to increase productivity of existing businesses when applied to almost any section of the value creation chain. One of the more obvious benefits of the 'net to rural Colorado is in the area of travel and tourism, especially lodging, restaurants and attractions. Another key application area is in agriculture, where our Cooperative Extension offices play a key support role.

New "Internet-Enabled" Non-IT Businesses. The Internet enables many new non-IT businesses. One example is a tumbleweed company, which markets their product internationally over the Internet (people in Japan are said to be especially fond of tumbleweeds). They can reach the world with their product cost-effectively by simply putting up their Web site and waiting for hits from search engines. But they could never survive as a business if the world had to come to their rural setting to find them and buy their product. A whole class of homecraft businesses falls into this area.

New IT-Related Businesses. Promising areas for job creation and growth in rural Colorado are the IT-producing and IT-consuming industries. By some estimates growth in the IT-producing industry accounted for half of all new jobs during the 1990s. As rural Colorado moves to capture more job growth, it makes sense to "go where the jobs are" and target these jobs in the IT industries.

For example, in the U.S. Bureau of Labor Statistics' projection of the fastest growing occupations for 2000-2010, five of the top six categories are IT-producing jobs:

- 100% growth, Computer Software Engineering Applications
- 97% growth, Computer Support Specialists
- 90% growth, Computer Software Engineering Systems Software
- 82% growth, Network and Computer Systems Engineers
- 60% growth, Computer Systems Analysts

It is worth noting that each of these job categories (except Computer Support Specialists) is also categorized in the highest quartile for median annual earnings. These jobs pay well!

Colorado hosts perhaps the world's greatest concentration, per capita, of this type of worker in our Front Range telecommunications, software, aerospace, high tech manufacturing, storage and advanced technologies (bio-tech, bio-medical, medical device) companies. Our goal as a state should be to spread out the concentration of these workers more broadly geographically throughout the state.

In addition to these IT-producing jobs, there are a host of related IT-consuming activities, ranging from financial services, to publishing, to insurance. All of these IT-consuming industry sectors share the key "new economy" characteristics of relying more on knowledge, skill and communications than on raw materials and transportation.

The Elusive Lone Eagle. Because of the place-independence of new economy knowledge workers, many set up small offices or home offices in remote locations. Because they typically do not incorporate, they are hard to track with government statistics. In fact, increasingly, the job market is characterized by more and more part-time and contract employment.

There is a whole spectrum of situations for these so-called “Lone Eagles,” ranging from telecommuting to consulting to freelancing to research and development. These “Lone Eagles” bring dollars into their region and spend dollars locally. They hire local part-time and full-time help. They often relocate from large urban centers and tend to become long-term residents of their new rural settings.

Call Centers. Call centers provide yet another opportunity for rural employment using digital communications. There are a whole variety of services supported via remote call centers, key among these are hotel reservations and software support. The “character” of rural people is attractive to call center operators, as rural residents tend to be well-educated, hard-working and stable employees. One distinction between this opportunity and the others, however, is income potential. Call centers tend to pay at or near minimum wage, which is great for an economically depressed rural area, but falls far short of the rural economic potential of the new economy.

Technology Innovation. University/Industry Collaboration. A key to technology job growth is the close synergy between research universities and advanced technology firms. This synergy is legendary from such places as Silicon Valley (in proximity to Stanford University) and Boston (in proximity to MIT). Ultimately, for metro and rural Colorado to play a role in global technology leadership, a tight technology transfer linkage must exist between our state's universities and college campuses and our high technology industry. This linkage should not only exist at the technology licensing stage of innovation, but throughout the entire innovation continuum from idea generation to commercialization.

Organizations Positioned to Impact Economic Development

A number of organizations are well positioned to mobilize to reach these outcomes. Working with organizations that are a part of the higher education community is critical. Some key organizations are:

1. The Governor's Office of Innovation and Technology (OIT). OIT has been responsible for inward economic investment - attracting high technology investment to the state. OIT organizes two annual events that would be useful in promoting high technology rural development, the annual High Technology Summit and the annual winter meeting of the Science and Technology Commission. OIT will play a key role in leading the public sector's use of computing and network

technologies and hence the public sector's viability as an anchor tenant for rural telecommunications infrastructure investment.

2. The Governor's Office of Economic Development (OED). OED has been responsible for promoting the growth and location of existing and traditional industries in the state. They operate a number of programs relevant to promoting IT-related growth in Colorado, including the network of Small Business Development Centers located throughout the state.

3. The Department of Local Affairs (DoLA). DoLA has provided administrative leadership to the Beanpole Program resulting in some demonstrable successes. If the Beanpole Program were renewed, DoLA could continue in this role as program administrator and DoIT could continue providing technical support. DoLA operates a number of funding programs that county and municipal governments may apply to for telecommunications support, including the Mineral Impact Assistance and the Community Development Block Grant programs.

4. Regional Economic Development Corporations (EDCs). Community spirit and pride are first and foremost in importance in driving economic development. Most communities have EDCs. Many have been instrumental over the past decade in helping bring the MNT and the Beanpole Programs to fruition. Community leadership and civic pride are "ground zero" for the development and execution of any plan of action for community improvement.

5. Front Range high technology industry trade associations (such as the Colorado Software and Internet Association and the American Electronics Association). These organizations have much to offer the rural regions of the state. Their corporate leaders, as successful entrepreneurs (some of them many times over), could help impart the spirit of entrepreneurship to their rural counterparts, or even take the step of starting their next ventures in a rural setting.

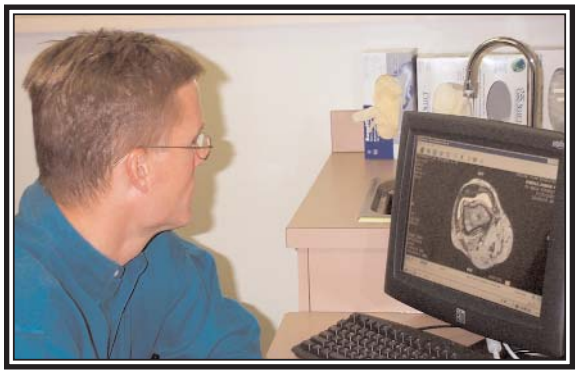
Healthcare Applications

“New Healthcare System for the 21st Century” will improve the quality, safety and cost-effectiveness of care through the use of collaborative care teams and information technology. This would include use of the Internet, Web-enabled call centers and broadband video communication systems within hospitals, provider offices, patient homes and community-based and long-term care settings for monitoring, treatment and decision support. Telehealth would contribute toward this vision by connecting patients and their caregivers for real time, scheduled and on-demand services that may not require face-to-face visits.[8]

[8] Institute of Medicine

The following vision statement is intended to help Colorado meet this challenge by 2010:

- (IP) network capable of supporting clinical, educational, care management and administrative telehealth applications.
- Each patient entry point (private practice, hospital or clinic) will be able to connect, point-to-point, on demand to any other hospital, clinic or designated data repository in the state to support clinical diagnosis and treatment.
- Self-paced Web-based and interactive real-time video courses will be routinely used by all levels of the healthcare work force in fulfilling their requirements for continuing education and to meet their life-long learning goals.
- Patients in need of home-based preventive health services, counseling, education, monitoring and self-management support for chronic health conditions will have access to low-cost, technology enabled systems linking them to their care managers.



- Statewide systems for high-risk communications involving medical errors, biological, chemical and other homeland defense threats will be integrated into the telehealth network.
- State and federal insurance and licensure regulations will permit and support telehealth services, including reciprocal state licensing for nurses, physicians and other healthcare professionals.

Today's State of Healthcare

The health services sector employed 144,600 persons in 2002.[9] This comprises fully 21 percent of the entire services sector and 6 percent of the total Colorado labor force. Clearly, this is a critical sector to Colorado, not only to our quality of life and well being, but to our standard of living and employment.

[9]Colorado Department of Labor and Employment

There are 120 licensed hospitals in Colorado.[10] Of these 92 are either public or non-profit. The bulk of licensed hospitals are in rural and suburban areas. These are supported by a half-dozen or so tertiary healthcare facilities located in metropolitan areas.

The four principal telehealth networks operating in Colorado:

- High Plains Rural Health Network serving the Banner system hospitals in the northeast and Poudre Valley Hospital,
- The Centura network in the southeast,
- The University of Colorado Health Sciences Center network (based in Denver and including the Fitzsimons Campus, Children's Hospital, hospitals in Craig, Montrose, Cortez and Grand Junction and Area Health Education Centers in Pueblo, Alamosa, Clifton, Greeley) and
- The Denver Health network (covering the hospital in Steamboat Springs and serving Department of Corrections facilities).

There is no comprehensive healthcare network established for southwestern Colorado. Multi-user conferences (as well as point-to-point connections) are set up through and using the bridges of these networks.

Patient care is often more costly and difficult to access than would be possible through the use of home-based telehealth support systems. The current telehealth networks are now mostly used by telehealth professionals for distance consultation, diagnosis, education, training and administration.

Today's Technology in Use by Healthcare Providers

Thirty-five percent of Colorado's licensed hospitals have video conferencing capability. (43 hospitals of 120). The terminal equipment deployed for video conferencing is largely H.320, which is not IP-ready. Video conferencing bridges used throughout the state are mostly H.320 technology, with some H.323 (IP-ready) capability coming on line.

Colorado's telehealth networks are virtually all comprised of point-to-point circuits (either T-1's or dial-up ISDN). Point-to-point connection capability is severely limited. For example, while the Yampa Valley Medical Center is connected to a bridge at Denver Health, it is not

[10] According to Colorado Department of Public Health and Environment Web site

possible for them to connect to other regional hospitals in Craig, Meeker, etc. The largest limitation, of course, is that the 65 percent of hospitals without video conferencing capability cannot be connected to at all. Those hospitals with dedicated circuits must, of necessity, use bridges to get to the other 35 percent of hospitals with video conferencing capability. This often requires spanning several networks and the involvement of several network administrators.

The use of desktop video conferencing is precluded entirely due to the relative lack of IP-compliant connections.

Healthcare Applications Used Today

Continuing medical education (CME), for credit and degree related courses and administrative video conferencing uses dominate over clinical applications today.

Realization of the full potential of clinical benefits is hampered by medical, business and professional concerns:

- Medically, referring providers may prefer to transfer the patient or recommend travel to a consulting provider rather than risk compromised care through remote diagnosis and/or treatment.
- Financially, institutions may prefer to treat referred patients on an in-patient basis or simplify billing complexities by using traditional procedures.
- Third-party payer systems (especially Medicaid) are not well established for telehealth procedures and multiple provider arrangements.
- Licensure issues preclude treatment, in-state, via telehealth by out-of-state providers.

Today's Costs

Hospitals are paying a premium for telecommunications and Internet services. Most hospitals are paying tariffed rates for T-1 and ISDN circuits. The T-1 rates are distance-sensitive. Some hospitals that have had telehealth services in the past have disconnected due to high cost and low usage.

The current high cost of video conferencing surely contributes to the low participation rate.

Justifying the ROI is especially difficult for rural hospitals with small patient loads and only occasional opportunities for telehealth sessions.

Use of ATM circuits on the MNT are limited for two reasons: 1) the MNT network is new and 2) the MNT ATM network is not interoperable with T-1 circuit end equipment.

Access to the federal Rural Healthcare Universal Service Fund is limited. Over the entire 4-year course of that program, only 19 Colorado hospitals have participated and received support. Total support received to date is $273,713. More aggressive participation in this program would result in additional resources for Colorado telehealth activities.

Cost-savings made possible by H.B. 99-1102 (which allows public and non-profit healthcare facilities to obtain network services from the state at rates offered to other state agencies) is largely unrealized, principally for the reasons cited above.

MNT Technology Goals for Healthcare for 2010

IP Connectivity

All public and non-profit hospitals, clinics and other strategic healthcare institutions (such as long-term care facilities, training programs, pharmacies, etc.) and networks will be linked in a seamless IP network infrastructure. IP traffic will be routed from facility to facility without exiting the state's intranet. This infrastructure will be reliable and secure. The network will be directly interconnected (i.e., “peered”) with private for-profit healthcare networks. The network will be peered with private ISPs serving homes thus enabling direct patient care in the home setting. IP bandwidth will be affordable and at sufficient capacity to support simultaneous voice, data and video traffic. Video will have priority through either excess bandwidth or Quality of Service (QoS) protocols. Privacy will be ensured through end-to-end encryption.

Video

All end equipment will support IP connectivity (e.g., the H.323 standard). Equipment will be completely mobile within the facility with respect to network resources; it will all utilize and share the same local area network (LAN). The LAN will also carry traffic for computers and possibly voice. Video will therefore be available at the desktop (utilizing desktop cameras), in mobile telehealth carts (which may include the necessary interfaces to standard diagnostic

equipment), at fixed telehealth locations and in videoconference rooms (featuring larger monitors, remotely controlled cameras and high-quality sound systems).

Voice

Hospital or clinic PBXs will support Voice over IP. All voice traffic with other public entities in the state will be routed through the state's IP network with no long distance toll charges.

Data

Hospital and clinic data systems will continue evolving naturally under the direction and control of each entity. To the extent that a participating institution utilizes the services of Applications Service Providers (ASPs), the necessary bandwidth to support these services will be available. All those reporting to the state will be online and disintermediated (streamlined, simplified and automated).

Realizing the Vision - Issues and Approaches

H.323 Migration. There are two components to this migration: end terminal equipment and bridges. As indicated above, the bulk of end equipment today is H.320. All of this end equipment will need to be converted to H.323 to realize the technology vision. Secondly, the H.320 bridges also will need to be converted to H.323. A sufficient number of ports will need to be acquired to support anticipated group video conferencing uses. No ports, however, will be needed to support point-to-point video conferencing. Bridging may be a utility-like service offered by the Division of Information Technologies for use by all sectors (healthcare, education, government). If so, the special needs of healthcare (privacy, reliability) will need to be recognized.

Circuit Migration. As mentioned above, in order to fully utilize the power of the MNT, the end equipment must be IP-compliant. Once this is done, however, healthcare facilities may obtain significant savings as indicated in the following point. State statute (C.R.S. 24-30-903 (3)) provides that the State Department of Personnel & Administration may provide digital network services to public and non-profit hospitals and clinics. The current state pricing for a T-1 circuit and IP services (IP numbers, IP routing, connection to the commodity Internet), is approximately $400/month. Contrast this to the current cost of a typical rural T-1 circuit on the order of $1,000/month and T-1 ISP services of a like amount for a total monthly cost

of $2,000. The state pricing represents an 80% cost savings. Contracts and timing are key concerns. Multi-year contracts may commit a facility to a given provider well into the future. If at all possible, it would be helpful if the state could negotiate terms with Qwest for rolling over contracts from dedicated or ISDN to ATM services without contract abridgement penalties.

Third-Party Payer and Licensure Issues. State and/or federal legislation and rule-making will be necessary to establish both professional licensure and insurance system support for telehealth.

Human Resource Issues

The changes outlined above are substantial, both in the areas of practice and technology. These changes will need appropriate training and support group formation at two levels.

Doctors and administrators will need to be trained and supported if they are to use the new telehealth technologies. They also will need to articulate and address concerns with these technologies, such as patient benefit, financial issues, privacy and reliability.

Hospital information technology professionals will need similar training and support, in this case, regarding the details of migration of end equipment, circuits and bridges. They will need support regarding the assurance of privacy, security and reliability. They will need to address issues of data convergence and learn how to manage a single IP network carrying multi-mode traffic (voice, data and video) and the protocols (QoS, multi-cast, etc.) that support this.

Funding Issues

Converting end-user video equipment. We may estimate the overall funding requirement given 120 hospitals as follows: allocate 2 units per hospital on average, at approximately $7,000 per video conferencing station and $5,000 for diagnostic telehealth equipment per station, plus $3,000 per site for routers to interface to the IP units. This represents a capital investment of $3.24 million. This may be more than the individual hospitals can bear; however, using a leasing option should reduce overall costs, especially on the front-end, and would facilitate “keeping up with technology” that is difficult with a purchase option.

Telehealth equipment. In addition to the telecommunications equipment is the cost of the medical equipment and/or interfaces of medical equipment with a digital network.

Concerning bridges. A similar calculation to that made for end-user video equipment may be made for conversion of bridges. The need for bridges to support point-to-point connections will be displaced by IP technology. Thus, bridges will only be necessary for multi-party videoconferences. It may be possible that the telehealth need for bridge ports can be consolidated with other sector's uses (education, corrections, etc.) through use of a bridging utility operated centrally, possibly by the Division of Information Technologies.

Regarding the Rural Healthcare Universal Service Fund. This fund bases support on the differential between rural and urban costs. No differential, no subsidy. Since the MNT eliminates this differential for all sites within the service area of county access point (known as an ANAP or Aggregated Network Access Point), once circuits are converted to the MNT, the RHC subsidy will likely not apply.

Cost savings. The net cost to facilities is likely to be reduced below what it is today even with the subsidy. For example, a T-1 circuit in Haxtun costs about $1,400 per month, versus the nearest "metropolitan" rate (in Greeley) of $500. Therefore, Haxtun enjoys a $900 subsidy bringing net cost to parity with Greeley's $500. This is just for the circuit and does not include Internet service. Currently, were Haxtun to meet its needs through a T-1 speed ATM circuit from the MNT, their overall cost would be approximately $400 including Internet. This represents a substantial cost savings over the current situation, even when the subsidy is included.

Last mile. Facilities lying outside of the ANAP service area (e.g., not in the county seat), would still be eligible to receive RHC support for the point-to-point circuits needed to reach the ATM cloud. A task to be carried out would model the costs, cost savings and break-even point for total conversion to the MNT and H.323. Costs include end equipment conversion and bridge conversion. Cost savings include circuit and IP connectivity savings. The former (costs) are largely capital items, while the latter are largely operational budget items. Therefore, there is the challenge of financing current (capital) costs with future (operational) savings. To address this challenge might be the establishment of a fund such as the one established in the late 1990s. The Learning Technology Grant and Revolving Loan Fund which

provided $20 million for technology for our schools and colleges. A similar strategy could help address H.323 migration.

Organizations Positioned to Impact Healthcare Initiatives

Numerous organizations are well positioned to mobilize to reach these outcomes. Working with organizations within the sector is the only effective way to proceed. Some key organizations are listed here:

1. Colorado Coalition for the Advancement of Telehealth (CCAT). This coalition is comprised of key players in the public healthcare and hospital community currently involved with telehealth. They are a representative grouping of those individuals who would be involved in achieving the 2010 goal. They are the leaders in this field.

2. The Colorado Council on Telehealth, formed under the auspices of the Governor's Office of Innovation and Technology, ensures close coordination between state government and the healthcare community.

3. State government is a stakeholder in achieving this vision. Key departments and agencies include: the Governor's Office of Science and Technology, the Information Management Commission, the Division of Information Technologies and the Colorado Department of Public Health and Environment. The Department of Healthcare Policy and Finance has initiated a series of disease management and care coordination demonstration projects supporting Medicaid patients within home, hospital, community and long term care settings using a range of telehealth applications.

4. Colorado Health and Hospital Association is the principal membership organization in Colorado to represent the interests of hospitals in the state. The association and its members play key roles in achieving the 2010 goal for telehealth.

5. Colorado Rural Health Center, a nonprofit advocacy agency, serves as the federal Office of Rural Health for Colorado.

6. University of Colorado Health Sciences Center, one of four campuses of the University of Colorado system. The mission of the University of Colorado Health Sciences Center is education, research, patient care and community service. UCHSC's telehealth network is described above.

7. Denver Health, Colorado's primary "safety net" healthcare institution, operates a

nationally renowned trauma center. It also operates the state's emergency medical technician training program and conducts public health services including response to terrorism and a 911 medical response system. In addition, Denver Health houses the Rocky Mountain Poison Center and offers telemedicine and on-site care to those incarcerated by the State of Colorado, the City and County of Denver and other jurisdictions.

8. High Plains Rural Health Network serves numerous rural healthcare facilities in Colorado, Nebraska, Kansas and Wyoming.

9. Centura serves its proprietary network of hospitals.

MNT and the Health Insurance Portability and Accountability Act (HIPAA) – Overview

The State of Colorado's Multi-Use Network (MNT) provides statewide network transport services to a number of state and local entities that require HIPAA compliant security solutions.

HIPAA does not require nor does it provide standards for certification of compliance by network transport providers. It also does not endorse or specify a single method of compliance for network users. Therefore, neither the MNT nor the Qwest Colorado High Speed Digital Network, or any other vendor network for that matter, requires certification as HIPAA compliant. The source and destination systems linked over a network, however, must be HIPAA compliant.

The State of Colorado's Multi-Use Network (MNT), like any basic data transport infrastructure, provides certain network-level security but not necessarily data-level security and, therefore, by itself, is not capable of completely satisfying customer needs for HIPAA compliance. HIPAA compliant customer needs must be established and met within the customer system, that is before the network connection boundary at the customer system firewall. The State of Colorado network architecture is designed to provide basic infrastructure security, for example, access control, intrusion detection, perimeter defense, response capability and testing/auditing. However, data security for HIPAA compliance is the responsibility of each HIPAA "covered entity" as defined in the HIPAA Administrative Simplification regulations. This means that data security might require encryption and decryption efforts in order to maintain confidentiality and data integrity between sender and recipient during the transport of information required to be HIPAA compliant.

Technical Issues

Network security focuses on keeping the network's components (circuits, routers, etc.) operational and undisrupted in order to ensure the transport mechanism's availability to all customers. Data security focuses on protecting confidentiality and integrity of the actual traffic flowing across a network. Unless changed, by April 14, 2003 anyone who conducts medical, financial, or administrative transactions using patient-identifiable data must comply with the new HIPAA Standards/Final Rules. Specifically, the Patient Privacy Rules require such entities to guard the integrity, confidentiality and availability of patient data during both storage and transport.

A review of current remote-access security practices within the MNT and in the health care field generally shows that “Virtual Private Network” (VPN) technology is emerging as a dominant methodology. VPNs use complex encryption and “tunneling” technology to provide a cost-effective alternative to costly point-to-point dedicated network linkages. Because of these cost efficiencies, many healthcare organizations are turning to VPNs as a way to conduct secure electronic transactions. VPNs have also become the standard method for remote access for all of Colorado's higher education campuses. The MNT supports the deployment of VPN technology for secure networking.

The first step in determining if the MNT can provide network services to a health care organization is to call **1-866-MNT-COLO** to determine eligibility. If the organization is an eligible participant, the next step is to request a price quotation for service, stating both the requirements for HIPAA compliance and the sites (or variety of sites) to which the organization needs HIPAA compliant connectivity. If the site's “upstream” connection has technical requirements (use of a specific device, encryption methodology or software application), these should be stated also.

If necessary, the MNT will refer the contact to one or more MNT partner vendors who will contact the health care organization to assess the organization's needs and suggest HIPAA compliant solutions that may be available and appropriate for their use. Qwest, for example, offers pre-sales assessment services for both technology and HIPAA-specific requirements for privacy and security. An MNT referral does not constitute an endorsement.

Please note that access to the MNT may be denied due to an organization's ineligibility under statute (HB-99-1102), the technology requested or incompatible business relationships of the health care organization. In those cases, the health care organization may want to contact Qwest or another network provider for transport services.

Additional HIPAA Information and Resources

Health Insurance Reform: Standards for Electronic Transactions
http://aspe.hhs.gov/admnsimp/final/txfin00.htm
HIPAA Security Standards Final Rule. The final Rule adopting HIPAA standards for the security of electronic health information was published in the Federal Register on February 20, 2003. This final rule specifies a series of administrative, technical and physical security procedures for covered entities to use to assure the confidentiality of electronic protected health information. The standards are delineated into either required or addressable implementation specifications.

Network Security Solutions for Healthcare - Making HIPAA SAFE
http://www.cisco.com/warp/public/345/hipaa/docs/hipaa_wp.pdf
Cisco, Inc. Web site. HIPAA (Health Insurance Portability & Accountability Act) requires that the Healthcare industry protect the privacy of patient records and promotes a national, uniform security standard for the secure electronic transmission of patient-identifiable information.

HIPAA is specific in its intent, but does not identify devices or architectures that would be viewed by the government as sufficient to secure patient data.

Qwest Communications and American Hospital Association Sign Agreement To Advance The Use Of Technology In Hospitals
http://www.qwest.com/about/media/pressroom/1,1720,807_current,00.html?storyId=807
The American Hospital Association selected Qwest, the lead vendor in the MNT partnership, as the preferred provider of network services to the healthcare field.

Higher Education – Background

Higher education actively pursued its own series of regional networks prior to MNT. Largely as a result of these private networks having been already developed, the majority of higher education institutions do not participate in MNT:

1. Higher education took a lead role in the formation of the Colorado Supernet in 1985.

2. In 1998 higher education implemented a statewide networking architecture around the Front Range GigaPoP (FRGP), a high-speed network meeting point in Denver. The FRGP provides cost-effective networking in the state at high levels of quality, performance and robustness. MNT joined the FRGP in 2001.

3. MNT and representatives of higher education formed a project team to conduct the purchasing process for a state award for Internet Service Provider services for the FRGP and other public users.

4. Representatives of higher education provided support to the MNT in various capacities, including: technical review of the responses to the MNT RFP, obtaining IP addresses, implementing Domain Name services and serving as the interim layer-3 provider while MNT was being built.

5. The scale of networking for higher education and for state agencies is different. In mid-2003 for example, higher education subscribed to 324.5 Mbps of Internet access at the FRGP while MNT subscribed to 60 Mbps. Thus, the current model where higher education obtains Internet bandwidth directly from the FRGP is the most beneficial to higher education.

6. Academic and institutional goals drive priority setting and investments for information technology decisions for higher education.[11]

Technology Goals for the Future

Redundancy for the FRGP. Because of the centrality of the FRGP, a critical technology goal is to implement a mirrored, fully redundant back-up facility to the FRGP.

Network Backbone. Research and test a gigabit network backbone interoperable with national network research testbeds (e.g., wave division multiplexing).

[11] Policy Manual, Commission on Higher Education

Video. All video end equipment will support IP connectivity (e.g., the H.323 standard). Interactive video should grow as a medium of distance education.

Voice. As existing telephone PBXs become obsolete and as Voice over IP technology matures, considerable migration to Voice over IP technology is expected.

Realizing the Vision – Issues, Approaches and Funding

Redundant FRGP. The expanded role of the FRGP, from primarily serving higher education, to serving state and local government, requires a higher level of service reliability. In point of fact, the FRGP has become an important asset to state government because Internet access will play a key role in any emergency response. MNT will develop a fully-redundant Internet connection from the FRGP and Qwest.

Gigabit Network Backbone. Two state departments have extraordinary requirements for network bandwidth – higher education and transportation – that go well beyond the typical needs of other state departments. Higher education is exploring with the Colorado Department of Transportation joint use of fiber optic assets in addition to the base capability provided by the MNT.

H.323 Migration. All video end equipment will be converted to the H.323 standard. This enables any MNT location to video conference with any other public entity on the MNT network.

Voice. State capital construction funding is the customary source of funding for upgrading voice networks. When the state fiscal resources return to normal, a priority should be to use the MNT as the network backbone for statewide VoIP deployment.

K-12 Education Applications

Your zip code should not dictate the quality of your education. By 2010, all elementary and secondary schools (K-12) in Colorado, through sharing in the high-speed Internet Protocol network, will:

- Share teachers among schools via interactive video distance learning and graphics and text based courses and programs
- Offer students college-level courses from professors via video distance learning and graphics and text based courses and programs provide access to online e-library resources to every school student, whether at home or in school
- Support media-rich online learning courses offered by individual schools or consortia of schools
- Provide customized online access to instructional and management applications and school and student data to parents, students, teachers and administrators via a statewide K-12 portal.
- Provide a core body of online library resources to all Colorado residents for access from homes, schools, or businesses

Today's State of Affairs for K-12 Education

In the fall of 2000, Colorado had 724,508 students enrolled in the 1,656 public schools of the state's 176 school districts employing 42,563 teachers. Colorado ranks 27th of all states in students per Internet computer, with 6.7 students sharing one Internet enabled computer in 2001, compared to 15 students per Internet computer in 1998.

In the fall of 2002, Colorado had 1925 students (approximately .26 percent of the 2002 total student enrollment) enrolled in one of the 23 Colorado cyber schools. At that time, nearly 1000 "brick and mortar" students in Colorado were taking at least one course online to supplement their school's curricula offerings.

Approximately three-quarters of schools reported Internet connection speeds of T-1 (1.54 Mbps) or greater; therefore, about one-quarter are operating at slower speeds. Ninety-nine of Colorado's school districts have Web sites.

Today's Technology

As indicated above, most schools have adequate access to the Internet and student access to computers although there are still several areas of poor access in the central mountains and the eastern plains. While most schools have Web sites, few support portals, e.g., personalized interfaces to school information based on the identification of the user.

Most of approximately 21 interactive two-way video networks are "islands of technology," accessible and useable only by the schools or districts participating in a given network. There is no capability for statewide K-12 video networking. Interconnection between the K-12 sector and higher education is extremely limited. Much of the video technology in use is not interoperable and includes analog fiber, digital fiber, H.320 circuit-based conferencing and H.323 video over Internet. There is neither a formal nor a de facto standard.

K-12 Applications Today

There are three main areas of information technology usage in K-12: instructional use in the classroom (including online library databases); administrative use; and distance education. All three of these applications depend on school access to the Internet. Some depend on home access to the Internet - an area of even greater disparity.

1. **Instructional use in classroom technology:** the Internet and computers are used for: gathering, organizing and storing information or data, manipulating, analyzing or interpreting the data, communicating conclusions and results, performing calculations and working in teams.

2. **Administrative uses:** include the typical business process applications of any enterprise. Most schools have some form of Student Information System to keep track of courses, students and test scores. Additionally, many online applications support the “business of school.”

3. **Distance education:** E-learning is supported in several ways:

    a. One-way broadcast delivery of self-paced instruction (often via PBS)

    b. Interactive video is used primarily to share teachers across several schools for courses of limited enrollment (i.e., foreign language, physics). Video is also used for administrative meetings.

    c. Online learning provides students an alternative to going to school for their instruction. Schools providing these full-time opportunities are often called “cyber schools.” Twenty-three school districts offer online learning, with total enrollment in the 2002-03 school year estimated to be 1,925 students. Larger programs include the Adams 12 Colorado Virtual Academy (925 students), Branson School Online (635 students) and the Vilas VILAS online (400 students). A major CDE grant has just been awarded to Colorado Online

Learning, a consortium of school districts, to aggregate and share online courses statewide.

d. The Colorado Online Education Programs Study Committee is investigating the viability and efficacy of online learning (cyber schools and supplemental programs) and will make recommendations to the General Assembly and State Board of Education in the areas of quality, access/equity, accountability and funding. Members represent the State Senate and House of Representatives, Colorado's 23 cyber schools, Colorado Online Learning and the State Board of Education and Department of Education.

e. In January 2003, the Colorado State Board of Education adopted rules requiring that publicly funded K-12 cyber schools commit to academic, communications and assessment requirements.

The Colorado Department of Education has a formal plan to increase the use of information technology in schools. The plan focuses on three areas: online schools, professional development and information-based decision-making.

Today's Cost

Colorado schools received $23.5 million in federal support for telecommunications and Internet services from the federal E-Rate program in 2002.

In 1996, the Colorado legislature established a $20 million Technology Learning Grant and Revolving Loan Fund to help schools acquire computer technology. This program was very successful in helping the K-12 community establish connections to the Internet just as the Internet was becoming universally important. The West-CEL and Arkansas Valley educational telecommunications networks established through this fund are still active today. All funds were expended and there has been no follow-on appropriation made to this program.

Schools are beginning to save money on circuit and Internet costs by connecting to the MNT. A typical rural T-1 circuit may cost $1,400 a month, plus an additional $800 per month for Internet access. The MNT has tariffed the same service at approximately $500 per month for schools within the service region of the MNT network.

MNT Technology Goals for K-12 Education for 2010

IP Connectivity

All schools will have high-speed Internet access through a shared statewide intranet. This intranet will provide access from one school to another, from K-12 schools to colleges and universities, to the commodity Internet and to the research Internet called Internet2. This intranet will have “quality of service” (QoS) ensuring the availability of bandwidth for video conferencing. In order to support rich communications between home (for students and parents) and school, the statewide intranet will be interconnected ("peered") with most major ISPs serving the private sector (homes and businesses).

Video

All video end equipment will support IP connectivity (e.g., the H.323 standard). Schools will each have one or more video classrooms that support teleconferencing with other schools and colleges. IP video will enable students to participate in classes from individual desktop PCs equipped with video cameras.

Voice

As existing telephone PBXs become obsolete, school districts may migrate to Voice over IP technology, saving thousands over the switched public network.

Data

Parents, teachers and administrators will be able to access data and other information (e.g., CSAP scores) about their students, teachers, schools and districts through a statewide K-12 portal. They will also be able to access online library resources and other materials.

Realizing the Vision - Issues and Approaches

Circuit Migration

The MNT will work closely with all school districts to see that those that wish to migrate telecommunications connectivity to the MNT system are able to do so seamlessly. This will

enable the schools and districts to avoid distance-sensitive circuit charges and share aggregate bandwidth needs with other public entities in their communities and regions.

ISP Migration

Schools will participate in a common statewide intranet for Internet access. The Division of Information Technologies will operate this intranet. School-to-school and school to college/university Internet traffic will stay inside the state intranet thus avoiding the performance drains of multiple “hops” and long latencies sometimes encountered when interconnecting (or "peering") traffic from users (schools, colleges and/or universities) on different ISPs.

H.323 Migration

All video end equipment will be converted to the H.323 standard. This enables any given school to videoconference with any other video school or indeed, any other public entity on MNT such as higher education institutions, libraries or state or local government offices.

K-12 Portal

The state will provide portal services to the K-12 community, either on a K-12 portal or as a subset of a Colorado Portal. Each school district will be able to customize and tailor the portal (e.g., the portal may look different to teachers and/or parents at different districts). K-12 data resources maintained by the Colorado Department of Education and by each district will be available through the K-12 portal for authenticated and authorized users (e.g., students, parents, teachers and administrators will all have different access rights, as established by the participating districts).

e-Library Portal

The K-12 portal may be expanded to support authentication and authorization for Colorado residents to a core body of online library resources. It is estimated that databases with full text aimed at children (K-12) could be licensed for the entire state, plus adequate support for training and management, for around $479,000. Databases that include general research materials for the general public, upper division high school and undergraduates, with around 5,200 full text scholarly journals could be licensed for every citizen in the state for around $750,000 to $1 million.

Internet2

The MNT network provides an opportunity to connect our K-12 system to the next generation research network, the Internet2. The Internet2 organization offers cost-effective connection on a statewide basis through its Sponsored Education Group Participants Program. Since participation in this program is statewide, it is appropriate for the MNT to consider joining and bundling Internet2 services with MNT connectivity. Many states are working with their school districts and others on high quality curriculum projects requiring high-speed bandwidth.

College Planning and Applications

The Colorado Mentor Web site, already in operation, will continue to help students explore, select, apply and finance their college educations.

Professional Development

For a tool to be useful, it must be used and used appropriately. The state's intranet will be used to provide professional development opportunities on how to use the intranet and will be used to provide professional development to Colorado's K-12 educators on how a variety of instructional and management issues.

Funding Issues

The MNT represents a great opportunity for K-12 to reduce connectivity and Internet costs, both at the circuit and ISP level. As indicated above, typical costs may be reduced by a factor of five or so for schools within the MNT service region. The federal E-rate program provides additional cost-savings to school districts serving low-income populations.

Schools will face funding challenges in migrating or acquiring H.323 video equipment. This and other technology needs might be addressed through a second round of funding of the Technology Learning Grant and Revolving Loan Fund. Schools will be challenged to provide staff and staff training for professional development in using educational technology.

On the bright side, enrollments of high school students in college-level courses are already funded through the Post secondary Educational Opportunities Act (PSEO). Under this act, both the school district and college receive state support. The student pays the college tuition, but is reimbursed by the school district upon successful completion of the course. The dis-

trict's state support under this program is significantly higher than the cost of this reimbursed tuition. This program is not applicable to 5th-year students (postgraduates). 4,053 students participated in this program in the fall of 2001; most of these enrollments were on-site. There is substantial opportunity to increase PSEO enrollments using educational technology. An audit of the PSEO program in June 2001 specified that the use of the MNT would improve high school student access to college and university courses.

Impacting Organizations

Numerous organizations are well positioned to mobilize to reach these outcomes. Working with organizations that are a part of the K-12 community is critical. Some key organizations are:

1. **Colorado Department of Education.** Key units within CDE are the Educational Technology unit and the Gifted and Talented unit. The Gifted and Talented unit is responsible for oversight of Advanced Placement (AP) and school-to-college (PSEO) courses.

2. **K-12 non-governmental organizations, including:** the Colorado Association of School Executives, the Colorado Association of School Boards and the Colorado Education Association.

3. **Division of Information Technologies (DoIT).** DoIT should work to see that all schools are informed about the state's intranet and that all those interested are connected.

4. **Colorado Online Learning,** the consortium of schools providing high-quality, standards-based, media-rich, interactive, instructor-led online courses to school districts throughout the state.

5. **Colorado's higher education institutions.** Our colleges and universities should expand access and participation in higher education by including online and interactive video access to PSEO courses. Using Internet and video technology, it is not necessary that the students in such a class all come from the same school, district, or region; the class may be drawn from students statewide and delivered through the state's intranet to the students at school in video classrooms or at their desktops.

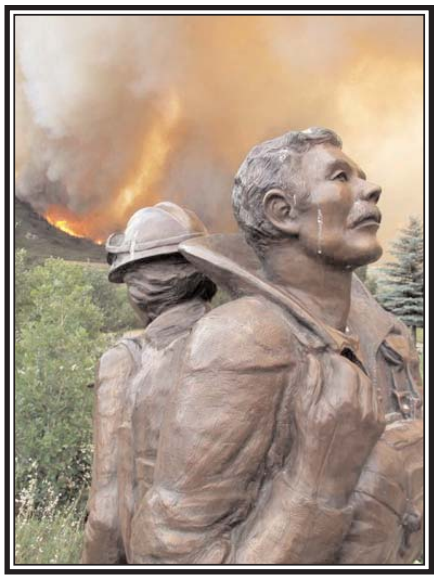
Measuring the Impact of the MNT

"Simple access is not really at the heart of digital divide challenge. Access is a necessary but far from sufficient condition for the successful utilization of the new technologies to sustain or improve economic performance. More important is how information technology is used, how organizations are structured and managed, the quality of training, as well as the attitudes of people who use information technology."

Infrastructure vs. Impact

As the MNT capital construction project draws to completion, the program's infrastructure and access goals have been met: every county will soon have access to fiber optic telecommunications connectivity, public sector access is being aggregated where possible to reduce duplication of circuits and the basic pricing paradigm for telecommunications service has been changed from one of distance-sensitive charges to one uniform tariff for all customers statewide regardless of location. These achievements have been thoroughly documented above.

However, certain MNT program goals are concerned with the impact of the MNT. Impact cannot yet be assessed. We are just now completing the deployment phase of the project and some passage time is needed for the projected impacts to develop. Additionally, ongoing effort is needed to promote adoption and use of the MNT as illustrated in the lead-in quote to this chapter.



The impact goals of the MNT were:

1. to enhance economic development in the state and
2. to create a backbone for e-government.

Objectives of Impact Assessment

The objectives of the impact assessment are as follows:

- To provide the metrics and data in a concise format that will serve as an ongoing self-evaluation tool, enabling key state and local agencies to work together in a synchronized approach to accelerate broadband deployment and usage on a county-by-county basis.

- To engage the private sector in a collaborative, grassroots effort, respecting the needs, values and relationships that exist within specific communities to achieve local connectivity, access and adoption.

- To publicize and celebrate our successes. To create national awareness of Colorado's statewide technical capabilities within the business community, with a multi-tiered objective:

  - Create opportunities for existing rural business.

  - Enable urban-based businesses to consider relocation or expansion into rural areas.

  - Attract new businesses to rural Colorado.

Methodology

To effectively measure the economic development and other benefits derived from broadband access as it becomes available to rural communities, we have developed a two-part measuring system consisting of statistical and anecdotal information. This measurement system addresses both the quantitative aspect of impacts as well as the qualitative, human, aspect. Because they are inseparable in real-life, it would be misleading and ineffective to focus on only one.

Development of Measurements of Success

Seventeen measures of success have been developed, organized under the four key goals of the MNT Program. Some measures will be collected in collaboration with the appropriate mission agencies, including the Colorado Department of Labor and Employment, the Colorado Department of Education, the Governor's Office of Economic Development, the

Colorado Department of Local Affairs and the Colorado Commission on Higher Education.

1) **Reduce costs to state and local government for telecommunications services. The MNT was designed to reduce telecommunications cost for government through the replacement of point-to-point circuits with a distance-insensitive packet-switched network.** This has enabled government entities to convert existing T-1 and similar data circuits from the old point-to-point tariff to the new lower-cost ATM rates. Further, by situating routers at locations where a number of state government circuits originate (e.g., county courthouses, state office buildings, etc.), those multiple circuits may be aggregated through use of routers into one single feeder circuit with resultant savings in overall bandwidth needed. Cost savings will be tracked for:

   1a. Total contract rate savings for T-1 circuits

   1b. Total reduced circuit costs through aggregation and consolidation based on the use of the CPOP routers (County Point of Presence)

2) **Serve as public sector anchor tenant for MNT.** The MNT public-private partnership was predicated on demand generated through the public sector acting as anchor tenant. State statutes clearly indicate that the MNT is to serve the following types of public entities: state agencies, county and municipal government, schools, libraries, hospitals and higher education. In order to determine the degree to which the MNT program is fulfilling this role, the following running statistics will be collected annually:

   2a. Total number of connections across all entities

   2b. Total bandwidth served

   2c. Total bandwidth to Internet

3) **Enhance telecommunications access for the private sector.** The purpose of approaching the MNT as a public-private partnership was to use public sector demand to justify the deployment of new infrastructure that the private sector could use. The private sector (e.g., homes and businesses) cannot usefully access broadband infrastructure at the ANAP unless it is possible to reach the ANAP via affordable connections. The standard of affordable broadband connections for metropolitan areas is now DSL or cable modem. In order to determine the degree to which the MNT program is fulfilling its role to stimulate private sector access, the following statistics will be collected annually:

3a. Number/percent of municipalities with ANAPs where DSL or cable modem access is available to the public.

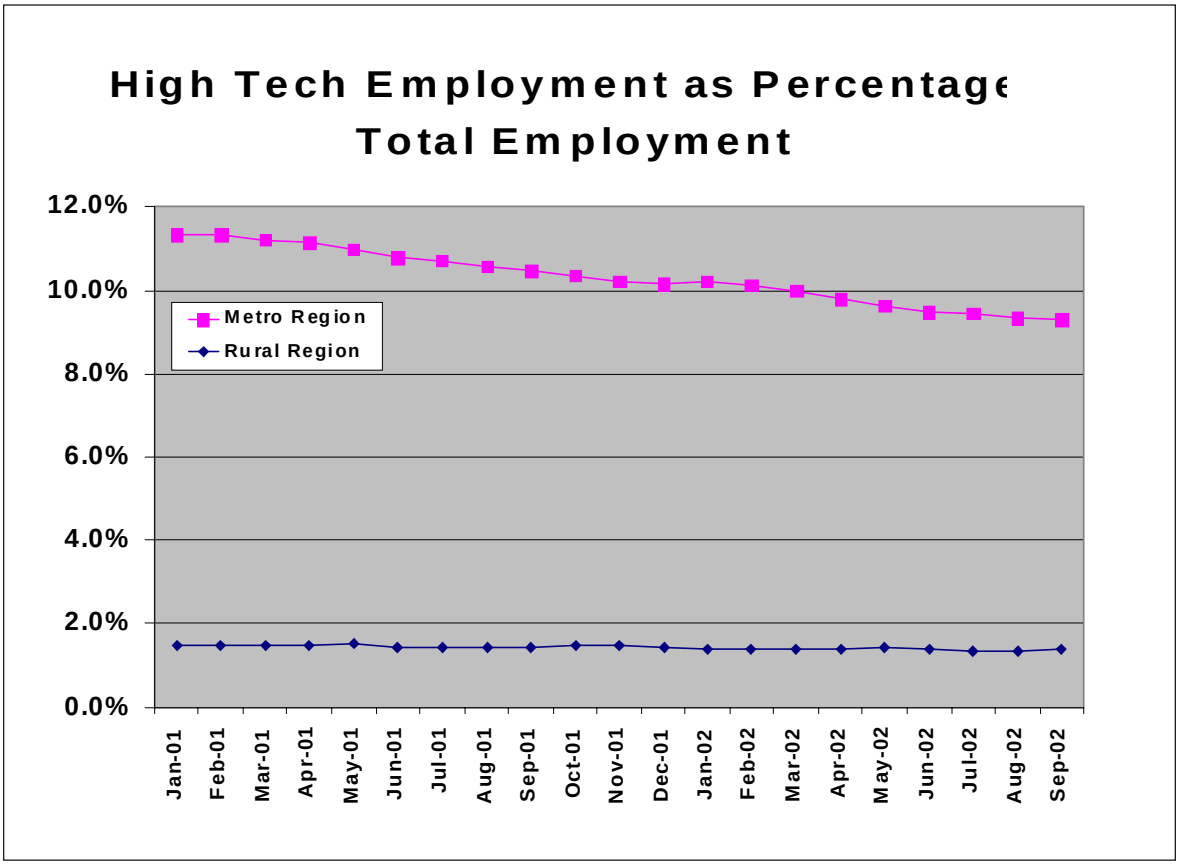
3b. Number of municipalities with ANAPs where last-mile fiber has been deployed subsequent to the deployment of the ANAP.

3c. Number non-ANAP municipalities that have been connected to the overall MNT by fiber.

4) **Promote rural economic development in Colorado.** The fundamental motivation for the MNT program is to provide the telecommunications infrastructure necessary for economic development. Simply put, the program was designed to remove the "digital divide" that had separated metropolitan regions of the state from rural regions in terms of telecommunications access. Many factors contribute to economic development besides broadband infrastructure, including access to capital, workforce availability and workforce development programs, healthcare access, K-12 school performance higher education access (especially via distance education) and access to transportation. Therefore, there is no simple causal link between the deployment of the MNT and economic development. However, the MNT program, in partnership with the Department of Labor and Employment Division of Labor Market Information and the Governor's Office of

Economic Development Small Business Development Centers will conduct the following quantitative analysis:

4a. Percentage of overall county employment housed in the "high tech" sector (employees, firms and average wage) and a comparison of this average for Front Range metropolitan counties vs. rural counties. The definition for "high tech" will be that used by the American Electronics Association in their annual city and state surveys.



The following table shows the current gap between high tech employment in metro and rural regions of Colorado. The goal is to raise the rural percentage from below 2% to 10%.

Several qualitative indicators will also be collected and the results will be incorporated into the annual report on MNT progress

4b. Attitudes and insights of community leaders from the small business sector concerning the availability of broadband access and the how this interacts with the other key determinants of rural economic development. This information will be collected via annual meetings with a small focus group of regional business leaders assembled under the auspices of the region's Small Business Development Center.

4c. Case studies illustrating both the success and challenges of building a business in rural Colorado taking advantage of broadband connectivity. These case studies will be continuously solicited from SBDC directors, using local newspaper accounts as a major source of information and collated on the MNT Web page.

4d. Survey of businesses likely to take advantage of broadband connectivity. An annual survey will be conducted. The survey will include all firms in the "high tech" industry sector.

5) **Improve educational opportunity particularly in rural Colorado.** In collaboration with the Colorado Department of Education, annual data will be obtained concerning K-12 school technology. The Department of Education has entered into a contract with a leading market information firm in the K-12 sector which will provide data, by school district for the items below:

5a. School district Internet bandwidth (normalized per student)

5b. Students per computer

5c. Percentage classrooms with Internet access

5d. Percentage computers with Internet access

In collaboration with the Colorado Commission on Higher Education, annual data will be obtained concerning the bandwidth of colleges' and universities' wide area networks, both for metropolitan and rural schools. This will help assess and track

the parity of access, on a student per capita basis, between rural and metropolitan institutions:

5e. Rural college Internet bandwidth (normalized per student) compared to metro bandwidth

These proposed quantitative metrics will be reported as per the table below:

Measure		Description	As of FY03
1	**Reduce government telecommunications costs**		
	1a	Total contract rate savings T-1s	$10,037,080
	1b	Total reduced circuit costs through aggregation and consolidation	
2	**Serve as anchor tenant**		
	2a	Total connections across all entities	
	2b	Total bandwidth served	
	2c	Total bandwidth to Internet	
3	**Enhance access for private sector**		
	3a	ANAPs with DSL or cable modem	
	3b	ANAP municipalities with last-mile fiber	
	3c	Non-ANAP municipalities connected to MNT by fiber	
4	**Promote rural economic development**		
	4a	Percentage total employment in "high tech", rural vs. metro	1.4% vs. 10.2%(FY02)
5	**Improve educational opportunity**		
	5a	School district Internet bandwidth	
	5b	Students per computer	
	5c	Classrooms with Internet	
	5d	Computers with Internet	
	5e	Rural college Internet bandwidth	

Qualitative Interviews

One-on-one interviews will provide qualitative, subjective, anecdotal information about the state of telecommunications adoption in rural Colorado. There is no substitute for talking to the people about their experiences and perceptions. A formal program of gathering this information will need to be established. Suggestions are provided below in the section on implementation. The results of collecting anecdotal information will provide:

- A contemporary picture of the factors that both facilitate and hinder broadband deployment and access.
- A profile of economic/business profitability practices directly resulting from broadband access.
- A communication forum for the private sector - a chance to actively participate in and drive economic development in their communities, continuing the public-private partnership that has been the basis of MNT.
- State agency connection to businesses creating a comprehensive approach to economic development.

Implementation

The MNT infrastructure is provided by one state entity, namely, DoIT. However, it is used by all state and local public entities, including state agencies, local governments, schools, hospitals and libraries. Each of these entities has its own organizational and governance structure charged with collecting and monitoring data about perform-

ance of their mission. To implement the MNT Impact Assessment Program, the MNT Program Office will work directly with mission agencies to assist them in incorporating into their own periodic constituent surveys appropriate measures that can be used to document the impact of the MNT and the new ear of broadband availability to the state.

For example, working in conjunction with both the Governor's Office of Economic Development (OED) and the Department of Local Affairs (DoLA), we would develop a cadre of interested and involved economic development professionals including, but not limited to Small Business Development Center directors and Revolving Loan Fund officers to conduct the one-on-one interviews. The advantages of selecting individuals from different groups are:

- Eliminate the bias of any particular organization.
- Utilize the full spectrum of economic development resources throughout the state respecting the unique character of each of the rural communities.
- Engage the private sector business population in order to identify common practices that will enhance utilization and confirm current connectivity status.

Because many of these resources are already positioned within the rural business communities, they are the best choice to engage the private sector, getting the true story and providing invaluable feedback. We also recommend that training should be provided and interview questions and format be prepared for them in order to standardize the process.

The MNT Program office will be approach additional organizations for assistance in documenting the impact of the MNT. We will propose they track indicators of the sorts of applications listed in the applications chapter. Key entities to work closely with include:

- Colorado Department of Education to track impact in the K-12 system
- Colorado Commission on Higher Education to track impacts in higher education
- Colorado Labor and Market Information Division to collect employment statistics

- Governor's Office of Economic Development to track job formation due to the MNT
- Colorado Coalition for the Advancement of Telehealth to monitor increased use of telecommunications services by healthcare facilities
- Other agencies as appropriate

Putting the Impact Assessment to Use

The Impact Assessment will be useful in several important ways:

1. First, it will help evaluate the success of the MNT program beyond the current success in infrastructure deployment. It will help answer the question, "If you build it, will they come?" It may help identify key areas where focused training or technical assistance programs could help users take fuller advantage of the MNT opportunity.

2. Second, it will help identify areas of the state that are not prospering because they still lack access to broadband. While the last-mile issue used to be urban vs. rural, in post-MNT Colorado, it is ANAP community vs. non-ANAP community, or Beanpole community vs. non-Beanpole community. The assessment will help us understand the job that remains in addressing the last-mile needs of reasonably sized population centers.

3. Third it will help us understand how the MNT is actually used and the impact that use has on quality of life (K-12, college, healthcare, government services) and standard of living (employment, wages, jobs, new firms). This is the primary purpose of the assessment, just as it is a primary goal of the MNT Program.

Timeline

In order to gain a clear and accurate picture of the impact of broadband over time, the study should be repeated annually for five years. We suggest the first report be prepared for release in June 2004, one year after the date of the completion of the MNT program deployment.

Funding

By working with state agencies with missions relating to the key MNT impact areas (economic development, e-government, education and healthcare), we can minimize the cost of MNT impact assessment. Involvement of the mission agencies in assessment is important as these agencies are also central to promoting the use and adoption of the MNT.

Conclusion

As we complete the construction phase of the MNT, we have documented our success in deployment of this new resource. However, some additional time will be needed for the MNT to impact the community.

We recommend that the assessments made include both statistical measures as well as anecdotal accounts of the impact of the MNT. We recommend an annual cycle of impact assessment of the MNT Program, with a series of reports beginning with one in June 2004.

We further recommend that these reports be prepared in partnership with the mission agencies responsible for programs in the four impact areas. As such, the Division of Information Technologies will work with candidate agencies in the months ahead to identify existing - or put in place new appropriate - measurement programs to document how the MNT is or is not affecting economic development, e-government, education and healthcare.

Appendix 1 – MNT Enabling Legislation

- **23-11.5-104 C.R.S. (SB 96-197):** The MNT is defined as "a digital network capable of carrying integrated voice and video as well as text, graphics and other electronic data between and among schools, public libraries, institutions of higher education and state agencies."

- **24-30-903(1):** The executive director of the department of personnel shall perform the following functions: (a) In consultation with local, state and federal departments, institutions and agencies, formulate recommendations for a current and long-range telecommunications plan, involving telephone, radio, microwave, facsimile closed circuit and cable television, teleconferencing, public broadcast, data communications transmission circuits, fiber optics, satellites, cellular radio and public safety radio communications systems required by the FCC public safety national plan and their integration into applicable telecommunications networks for approval of the governor; (b) Administer the approved current and long-range plan for telecommunications and exercise general supervision over all telecommunications networks, systems and microwave facilities, subject to the exception stated in subsection (2) of this section; (c) Review all existing and future telecommunications applications, planning, networks, systems, programs, equipment and facilities and establish priorities for those that are necessary and desirable to accomplish the purposes of this part 9; (d) Approve or disapprove the acquisition of telecommunications equipment and necessary licenses by any state department, institution, or agency;

- **24-30-903(3):** The executive director of the department of personnel may enter into contracts with any county, city and county, state agency, private schools, school district, board of cooperative educational services, or library and may act as a telecommunications network provider between or among two or more counties or state agencies for the purpose of providing teleconferencing facilities and services between or among such entities, including the judicial system of any county, the department of corrections and the department of human services and

any of their facilities. To assure the availability of such network throughout the various state agencies, private schools, school districts, boards of cooperative educational services, libraries and counties, the executive director of the department of personnel shall develop a uniform set of standards for facilities to be utilized by the contracting entities.

- **24-30-903(7) (HB 99-1102, Section 20):** The Department of Personnel & Administration shall maximize "access to digital networks of the state by all pubic offices of all levels, branches and political subdivisions of the state within every community of the state."

- **24-32-3001 (SB 99-1102, Section 30):** Beanpole funds are for "communities seeking to aggregate the telecommunications services required by the public offices within the community to connect to the digital network operated by" the Department of Personnel & Administration."

- **24-37.5-203 (1) C.R.S.:** IMC shall "(a) To develop and implement requirements for the statewide communications and information infrastructure based on present and future user applications; (b) To review existing portions of the statewide communications and information infrastructure to determine the areas of the state in which they exist and whether the existing portions are adequate and usable for present and future user applications; (c) To define and initiate a partnership between the public and private sector for funding and building the statewide communications and information infrastructure, with the understanding that the private sector will build the necessary portions of the statewide communications and information infrastructure; (d) To initiate a system to manage and use the statewide communications and information network in the most economical and effective manner; (e) To oversee ongoing use of the statewide communications and information infrastructure; (f) To recommend, if necessary, further legislation and budget appropriations for ongoing implementation of the statewide communications and information infrastructure.

Appendix 2 – MNT Task Force Executive Order

Executive Order B 02 01

Recreating the Colorado Statewide Information Infrastructure Task Force as the Multi-use Network Task Force

Pursuant to the authority vested in the Office of the Governor of the State of Colorado, I, Bill Owens, Governor of the State of Colorado, hereby issue this Executive Order recreating and renaming the Colorado Statewide Information Infrastructure Task Force to the Multi-Use Network Task Force.

1. Background and Purpose

A significant disparity between rural and urban communities in technology investment led to a "telecommunications gap" that left rural communities further behind and greatly impaired their ability to compete economically. An integrated statewide telecommunications infrastructure is essential to ensuring the citizens of Colorado access to government services, educational opportunities and the information resources they need to keep Colorado's economy competitive, locally and abroad. The Colorado Statewide Information Infrastructure Task Force was created on August 21, 1998, by Executive Order B 004 98, to address the "telecommunications gap" and its negative impact on the economy. It called for integration of the telecommunications infrastructure, thereby reducing the telecommunications gap between rural and urban communities. However, the continued practice of purchasing technology on a department-by-department basis has slowed the state's realization of its goal. A change in strategy is necessary to put the state on a path that will ensure the realization of its integration goals.

The effectiveness of the task force may be enhanced in two ways. First, by including representatives from departments not yet represented, the task force will gain greater expertise in its work towards integration of the telecommunications infrastructure. Second, a description of the task force mission with greater specificity will eliminate any ambiguities that may currently exist.

Integration of Colorado's telecommunications infrastructure will provide Colorado's state and local governments, educators, businesses and citizens with connections between and among institutions of higher education, school districts, public libraries, public hospitals, courts and government offices. This integration can be achieved through planned and coordinated pur-

chases of telecommunications technology by all state departments, agencies and institutions, including higher education. These coordinated purchases allow the state to take advantage of technologies of scale and assume the role of an "anchor tenant" in encouraging private sector investment in the infrastructure adequate to provide state-of-the-art telecommunications throughout the state. The resulting investment will lead to increased efficiency and greater economic development.

In addition to the economic benefits, use of the Multi-Use Network will transform government service. The Multi-Use Network provides the high-speed Internet connections that make "e-government" possible. This process allows citizens to fill out forms and obtain licenses and permits over the Internet instead of the traditional, timeconsuming methods such as standing in line. Once the Multi-Use network is complete, n-line applications will be accessible to the vast majority of Colorado citizens, making our state government more user friendly.

2. Task Force Recreated

The Colorado Statewide Information Infrastructure Task Force is hereby recreated as the Multi-Use Network (the "Task Force"). The Task Force shall perform only those duties and functions specifically designated in this Executive Order.

3. Scope

A. To achieve the desired benefits in efficiency, economies of scale and economic development, all state departments, agencies and institutions, including higher education shall:

i. Migrate their telecommunications networks to the Multi-Use Network and cease operation of and any new development of disparate telecommunications networks.

ii. Convert their network traffic to the Multi-Use Network in a timely manner according to Private Partner(s) and Department of Personnel/General Support Services, Colorado Government Technology Services project deployment schedules.

iii. Provide timely information requested by the Department of Personnel/ General Support Services to aggregate statewide telecommunications technology purchasing.

B. The Department of Personnel/General Support Services shall:

Implement and operate the statewide Multi-Use Network in partnership with its public/private partner(s), with oversight provided by the Task Force.

i. Maintain a central database and clearinghouse for current telecommunications standards that may be established and for other information that may be helpful to the managers of all state departments, institutions and agencies, including higher education, in the use and purchase of telecommunications technologies.

ii. Manage, administer and support the functions of the Task Force.

4. Membership of the Task Force

A. The Executive Director of the Department of Personnel/General Support Services or the Executive Director's designee shall chair the Task Force. The Executive Director or his/her designee shall be responsible for communication between the Task Force and the Governor.

B. At least one representative from the following departments shall be appointed by the Governor based on recommendations from the Executive Directors: the Department of Corrections; the Department of Education; the Department of Human Services; the Department of Labor & Employment; the Department of Natural Resources; the Department of Public Safety; the Department of Revenue; the Department of State; the Department of Transportation; and the Governor's Office of Innovation and Technology.

C. Up to three representatives shall be appointed by the Governor from the Department of Higher Education.

D. The membership of the Task Force may be modified by the Executive Director of the Department of Personnel/General Support Services.

5. Duties and Powers of the Task Force

The Task Force shall have the following duties and powers.

A. Ensure the aggregation of the state's purchases for telecommunications services.

B. Promote standards for the compatibility of equipment and software among state departments, agencies and institutions, including higher education, to facilitate the sharing of information.

C. Monitor the activities and progress of the state's private partner(s) to ensure that the contractual terms of the public/private partnership are fulfilled.

D. Report periodically to the Governor on progress toward the goals outlined above.

E. Engage other departments, agencies and institutions in supportive roles in the process, as appropriate.

F. Coordinate with other public entities to achieve the overall goals of this Executive Order.

6. Duration.

The Task Force shall continue in existence until December 31, 2005, unless review terminated or extended beyond that date by executive order of the Governor.

7. Past Executive Orders Superseded and Replaced

This Executive Order shall repeal and replace all previous executive orders pertaining to the Colorado Statewide Information Infrastructure Task Force and specifically Executive Order B 004 98, Colorado Statewide Information Infrastructure.

Given under my hand and the Executive Seal of the State of Colorado this 12th day of January, 2001.

(Signed) Bill Owens, Governor

Appendix 3 – MNT Task Force Members

Brian Balay
Nils Carlson
Peggy Catlin
Rina Delmonico
David Deluhery
Frank Edlin
Eric Feder
Anne Forsey
MaryLou LaCouture
Jim Lynn
Senator Ron May
Steve McDermott
Jennifer Okes
Jeff Richardson
Jim Rizzuto
Steve Swanson

Appendix 4 - Multi-Use Network Glossary of Terms

Aggregated Network Access Point – also called an "ANAP" – a physical network point of presence on the Multi-Use Network backbone. There are 65 ANAPs statewide, with at least one in each of Colorado's counties. The ANAPs are owned, operated and managed by Qwest and are physically located in Qwest facilities. Network traffic in the form of frame relay or ATM circuits from state agencies, local government, schools, libraries and non-profit health providers are aggregated at the ANAP in each county and routed onto the Multi-Use Network. Private sector business traffic is also aggregated at the ANAP and routed onto the private sector side of the Multi-Use Network called the Colorado High Speed Digital Network.

Aggregation Point – a physical site on a wide area network where routers, switches and other kinds of communication equipment make it possible to aggregate local area network traffic and connect this aggregated traffic to a wide area network, such as the Multi-Use Network.

ANAP – an acronym for Aggregated Network Access Point.

Anchor Tenant – a major client or business that can provide leadership and motivate additional participation for local investment in infrastructure and service development.

Asynchronous Transfer Mode – a high speed cell switching technology capable of transmitting multimedia services such as data, video and voice on a single network. Because of this capability, ATM was selected as the desired technology for the high-speed Multi-Use Network. Use of ATM technology allows the State of Colorado to aggregate its communication usage from its current diverse and multiple networks onto a single, high-speed fiber optic network.

ATM – an acronym for Asynchronous Transfer Mode technology.

Backbone – the high-speed lines and equipment that form the primary pathways within a network. Backbone networks provide interconnection between other networks. The backbone connects the ANAP locations.

Backhaul – the practice of bringing demand to a service rather than bringing service to the location where it is required. A term used to describe the charges resulting from a circuit required to connect a location without requested service to a site where the service is offered. Backhauling adds considerable expense to network connections because it commonly uses circuits that are priced by distance.

Bandwidth – a measure of capacity for a specific circuit, usually expressed as bits per second.

Beanpole Funds – funding for community level aggregation of network traffic, also known as community incentive funding. The Department of Local Affairs and the Colorado Rural Development Council managed the $4.6 million program with funding appropriated under House Bill 99-1102, a bill concerning encouragement of private sector telecommunications investment by providing incentives for the public sector to serve as “anchor tenant”. The Department of Local Affairs supports a Beanpole Project Advisory Committee to review grant guidelines, establish evaluative criteria, and review grant applications from Colorado’s regions and communities.

Circuit – a switched or dedicated communications path with a specified bandwidth (transmission speed / capacity).

Community Incentive Funding – grant funds used to aggregate local traffic and develop telecommunications technology of various kinds (K-12, library, non-profit health care, etc.) in Colorado communities.

DNS (Domain Name System) – the domain name system (DNS) is the way that Internet domain names are located and translated into Internet Protocol addresses. A domain name is a meaningful and easy-to-remember "handle" for an Internet address. Because maintaining a central list of domain name/IP address correspondences would be impractical, the lists of domain names and IP addresses are distributed throughout the Internet in a hierarchy of authority. There is probably a DNS server within close geographic proximity to your access provider that maps the domain names in your Internet requests or forwards them to other servers in the Internet.

DSL (Digital Subscriber Link) – DSL (Digital Subscriber Line) is a technology for bringing high-bandwidth information to homes and small businesses over ordinary copper telephone lines. Assuming your home or small business is close enough to a telephone company central office that offers DSL service, you may be able to receive data at rates up to 6.1 megabits (millions of bits) per second (of a theoretical 8.448 megabits per second), enabling continuous transmission of motion video, audio, and even 3-D effects. More typically, individual connections will provide from 1.544 Mbps to 512 Kbps downstream and about 128 Kbps upstream. A DSL line can carry both data and voice signals and the data part of the line is continuously connected. DSL installations began in 1998 and will continue at a greatly increased pace through the next decade in a number of communities in the U.S. and elsewhere. Compaq, Intel, and Microsoft working with telephone companies have

developed a standard and easier-to-install form of ADSL called G.lite that is accelerating deployment. DSL is expected to replace ISDN in many areas and to compete with the cable modem in bringing multimedia and 3-D to homes and small businesses.

Edge Sites – a physical network point of presence on the Multi-Use Network backbone. There are 39 Edge Sites, each located in areas where state government agencies are highly concentrated and demand for integration of services exists. The Edge Site equipment is owned by the state and operated and managed by the state. Edge Sites are physically located in state owned facilities. Network traffic in the form of frame relay or ATM circuits from state agencies, local government, schools, libraries and non-profit health providers may be aggregated at an Edge Site and routed onto the Multi-Use Network. Edge Sites typically have a minimum of a DS-3 (45 Mbps) connection to the Multi-Use Network.

End Sites – a physical network point of presence at the source location where state agencies and other public entities originate connections to the Multi-Use Network. There are approximately 2800 state owned End Sites located across the state serving state government agencies. The End Site equipment is owned by the state and operated and managed by the state. Network traffic from the agency End Site, in the form of frame relay or ATM circuits, is routed directly to an Edge Site or directly to an ANAP if not served by an Edge Site.

Fiber Optic – a technology using high purity, hair-thin fibers of glass to transmit information (data, video, voice). The bandwidth or capacity of the fiber optic cable is much greater than conventional cable or copper wire.

Frame Relay – a form of switching protocol used for wide area network connectivity.

Internet2 (I2)- Internet2 is a collaboration among more than 100 U.S. universities to develop networking and advanced applications for learning and research. Since much teaching, learning, and collaborative research may require real-time multimedia and high-bandwidth interconnection, a major aspect of Internet2 is adding sufficient network infrastructure to support such applications. But Internet2 also intends to investigate and develop new ways to use the Internet and the Internet2 infrastructure for its educational purposes. Although Internet2 is not envisioned as a future replacement for the Internet, its organizers hope to share their developments with other networks, including the Internet. Internet2 will include and further develop the National Science Foundation's very high-speed Backbone Network Service (vBNS) that currently interconnects research supercomputer centers in the U.S.

The involved institutions plan to continue using the existing Internet for "ordinary" services such as e-mail, personal Web access, and newsgroups.

ISP – (Internet Service Provider) – a commercial organization that provides access to the Internet via dial-up and dedicated connections.

LATA – (Local Access and Transport Area) – a regulatory and geographical area that determines carriers that can provide service within the LATA area and the carriers who can cross the LATA boundary and provide service between LATA's.

Local Loop – a general term describing the telephone lines comprising the infrastructure between a user location or building and the carriers' local central office. It is sometimes referred to as a subscriber local loop.

Mbps – an abbreviation of megabit per second.

Megabit – a measure of data transmission speed – 1,000,000 bits per second or approximately 125,000 characters per second.

Multi-Use Network Project – a public/private partnership to build a high speed digital network connecting all of Colorado's 64 counties and delivering advanced data, video and voice telecommunications services to state and local government agencies, schools, libraries and non-profit health providers. This innovative program is the centerpiece of Governor Bill Owens' plan to bridge the digital divide that has separated urban and rural areas of the state by providing services that enable distance learning, video conferencing, telemedicine, electronic commerce, and Internet access.

Public / Private Partnership – a business strategy in which a public entity and a vendor or provider of services pursue mutual advantages in the ethical provision of services.

Routers – physical devices deployed primarily at edge and end sites that route network traffic from source to destination. The routers connect local area networks to the MNT, which is a wide area network. Routers operate on network layer information and participate in running one or more network layer routing protocols.

Super ANAP (SANAP) – a physical network point of presence on the Multi-Use Network backbone. There are 5 Super ANAPs, each located in areas where there are extremely high concentrations of state government agencies. SANAP equipment is owned by the state and is physically located in state-owned facilities. Network traffic in the form of frame relay or ATM circuits from state agencies, local

government, schools, libraries and non-profit health providers may be aggregated at a SANAP and routed on the Multi-Use Network. Super ANAPs will utilize one or more OC-12 connections by the fall of 2003.

Switches – physical devices deployed at the ANAPs and Super ANAPs that turn data, video or voice traffic into packets for transmission across the network. Switches operate on network layer information and participate in running one or more network layer protocols.