

STATE OF COLORADO



DEPARTMENT OF TRANSPORTATION

ITS Branch

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During 2000-2001, the Intelligent Transportation Systems (ITS) Branch formed a Steering Committee representing stakeholders throughout CDOT; to update CDOT's ITS Strategic Plan. Other CDOT stakeholders, including Regional Transportation Directors (RTDs), Traffic Engineers and Maintenance Superintendents, also actively participated in the process. In addition, the plan development was coordinated with TREX and other similar major activities in the DRCOG, Colorado Springs and Pueblo areas.

Throughout 2001, the strategic plan was presented to CDOT Executive Director, Deputy Director, Director of Staff Branches, the CTMC Subcommittee of the Transportation Commission and the EMT. As a result, it has been modified and components have been added to reflect upper management guidance. A main component that was added based on the EMT and the Chief Engineer's comments is the Integrated ITS Plan. This plan details current funds allocated and additional funds needed to maintain, operate and replace the existing ITS infrastructure, as well as a recommended investment strategy to implement the statewide strategic priorities identified in the strategic plan.

The spreadsheet on the next page shows estimated funding requirements to maintain and operate the existing infrastructure, as well as funding needs to implement strategic statewide investment recommendations identified by the strategic plan. At the direction of the EMT, the ITS Branch is conducting statewide planning activities, using in-house and consultant resources, to develop a CDOT ITS Maintenance Management Program and detailed corridor master plans. The outcome of these efforts will accurately and in further detail determine the funding requirements, priorities, and deployment strategies. It is envisioned that, once the level of funding has been determined, a more detailed multi-year deployment plan will be developed. This plan will be updated on an annual basis, to reflect any changes in annual funding levels. The planning documents that are being developed will facilitate that need.

It must be emphasized again that the proposed funding plan relates to statewide strategic funding and investment needs, as identified by all of the stakeholders, throughout the process. The planning effort that is currently underway, will determine responsibilities and allocation of any funds among different CDOT stakeholders (Regions, ITS Branch and DTD).

Attached to this transmittal are the following documents:

- A one-page summary of estimated funding requirements.
- The executive summary to the ITS Strategic Plan.
- The Integrated ITS Plan charts, attached as an Addendum to the Executive Summary, describing maintenance and investment strategies.

**Statewide ITS Strategic Plan (Including TREX, Regions, DTD, and ITS Branch)
 Strategic Funding Needs Summary**

Future M&O Strategy Based on 15 Year Average Replacement Cycle; Existing Infrastructure Plus TREX													
M&O and Replacement Requirements	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Total M&O and Replacement Requirements for 15 Year Cycle	14,509,255	15,628,633	16,199,692	17,012,782	17,608,266	18,849,514	18,502,123	14,211,195	14,637,531	15,076,657	15,628,957	16,097,826	19,478,884
Less: Funded M&O (No Replacement Funds) Needs	5,745,472	6,601,936	6,902,194	7,436,360	7,644,551	8,586,887	5,033,494	5,184,499	5,340,034	5,500,235	5,665,242	5,835,199	6,010,255
Unfunded M&O (Including Replacement) Needs	8,763,783	9,026,696	9,297,497	9,576,422	9,963,715	10,262,626	13,468,629	9,026,696	9,297,497	9,576,422	9,963,715	10,262,626	13,468,629
Projected Functionality	Project underway to baseline current functionality, statewide. The proposed funding estimated to provide 90% functionality. This estimate is based on the current level of funding and functionality for those devices the CTMC controls.												

Implementation of the Statewide Strategic Capital Investment Priorities as Identified in the ITS Strategic Plan													
Investment Strategy	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Recommended Total Investment Strategy (Includes Resulting M&O Impacts)	10,880,054	17,894,885	32,242,601	28,654,155	20,324,411	21,972,935	20,674,018	14,665,402	10,905,660	11,980,376	13,054,526	14,160,901	15,300,467
Less: Funded Investment (Including TREX) Needs	10,880,054	10,939,663	9,585,212	6,740,000	2,553,160	1,300,000	-	-	-	-	-	-	-
Unfunded Investment Strategy	-	6,955,222	22,657,389	21,914,155	17,771,251	20,672,935	20,674,018	14,665,402	10,905,660	11,980,376	13,054,526	14,160,901	15,300,467

Summation of Future M&O and Capital Investment Strategy													
Total Program	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Statewide ITS Program	25,389,309	33,523,517	48,442,293	45,666,937	37,932,677	40,822,449	39,176,141	28,876,598	25,543,191	27,057,033	28,683,483	30,258,727	34,779,351
Less: Current Funding	16,625,526	17,541,599	16,487,406	14,176,360	10,197,711	9,886,887	5,033,494	5,184,499	5,340,034	5,500,235	5,665,242	5,835,199	6,010,255
Unfunded Program Requirements	8,763,783	15,981,918	31,954,887	31,490,577	27,734,966	30,935,561	34,142,647	23,692,099	20,203,157	21,556,798	23,018,241	24,423,528	28,769,096

Colorado Department of Transportation

Intelligent Transportation Systems Strategic Plan



EXECUTIVE SUMMARY

January 2002

Executive Summary



The Intelligent Transportation Systems (ITS) Strategic Plan was developed by a cross-functional ITS Steering Committee, with input from staff at both Colorado Department of Transportation (CDOT) headquarters and the six CDOT Regions. The Steering Committee helped to develop a department-wide vision and strategic direction for ITS.

The Plan discusses the vision for and benefits of ITS and several performance measure metrics associated with ITS. It identifies how ITS Core Services and business related objectives align with the CDOT Investment Categories, and identifies recommended strategies within each Core Service area. It outlines the highest level ITS strategies and identifies the resources and implementing actions required to achieve them. The plan priorities have received broad-based support across CDOT Regions and headquarters. This ITS Strategic Plan will be used to provide guidance and direction for current and future ITS investment and implementation.

An Addendum to the Plan beginning on Page E-13 includes Charts with explanations that provide greater detail and clarity regarding resource requirements and investment strategies that are discussed and recommended in the Plan. The Charts provide a visual format to help in understanding the individual as well as combined components that are recommended in the Plan.

A. Plan Role

The ITS Strategic Plan establishes the following:

- CDOT's overall vision and strategic direction for ITS investments.
- CDOT consensus on ITS investment priorities and how to institutionalize ITS into CDOT's business areas and functions.
- Strategies that address the major issues that CDOT's Regions and Headquarters are facing in implementing ITS.
- A framework for evaluating the benefits and costs of ITS that considers capital investments, operating, and maintenance costs, and the contribution of ITS to CDOT's department-wide investment objectives.
- Overall organizational roles and responsibilities for moving towards the vision for ITS.
- Development of ITS core services and tools and services and a performance-based methodology to measure their contribution to CDOT Investment Categories.

The Plan also provides a framework for working with Metropolitan Planning Organizations and other local jurisdictions to assist with development of ITS Regional Architectures, and refine the existing Statewide ITS Architecture. The Plan enables CDOT to integrate ITS planning into the statewide planning process and comply with the applicable federal rules and regulations.

B. The Vision for ITS

The Colorado Department of Transportation's vision for ITS is one in which current and contemporary technologies are used to:

Provide reliable, accurate, and timely traveler information, and real-time traffic management and operation of the highway system through fully integrated, coordinated, and maintained Intelligent Transportation Systems, so that users are able to make decisions that enhance and improve their choice of travel, mode, route, and time, thereby resulting in a more productive, efficient, and safe transportation system.

The goal is an overall traveler information and traffic management system that allows for integration and interfacing of existing legacy as well as future systems, and one in which information is managed as an asset of value to transportation system users and transportation providers of all types. CDOT's role is to provide statewide leadership by deploying the enabling infrastructure, developing partnerships, establishing policies and procedures with stakeholders to ensure integration and seamless access to data, and by providing advocacy for those ITS investments that have a strong business case.

1. Benefits of ITS

Traffic volumes and subsequent related congestion continue to increase on Colorado's highways, while at the same time, travelers demand information concerning road conditions. ITS has the ability to detect, collect, analyze, and disseminate timely and accurate information through a wide range of integrated systems.

The ITS Strategic Plan targets investments to enable CDOT and its customers to realize measurable benefits from ITS:

- **ITS has the potential to provide a highly cost-effective component of CDOT's approach to improving the mobility and safety of Colorado's traveling public.**
- **ITS provides economic and quality-of-life benefits to Colorado highway users.**

Using traveler information, highway users can determine which mode will meet their travel demands more effectively, shorten trip times, avoid congested areas, and postpone travel until conditions improve. Traveler information provides value to the

traveling public by allowing pre-trip and en-route trip planning. Using the ITS system, CDOT can manage traffic operations to increase the productivity and efficiency of the system.

The vision is one in which ITS is a significant element of CDOT's portfolio of investments providing highly cost-effective strategies for meeting Colorado's current and future transportation needs by:

- **Improving mobility through maximizing the productivity of the transportation system** by using ITS to increase the throughput of passengers and vehicles on the transportation system. This will effectively increase the capacity of the existing transportation system. CDOT would use ITS to continuously manage and fine tune the operation of the transportation system in response to travel demand and in the event of incidents that interrupt their normal operations.
- **Improving mobility through providing travel choices and increasing travel efficiency** through access to comprehensive, reliable, accurate, and timely traveler information, travelers will be able to make informed decisions concerning their travel prior to and during travel. ITS will enable travelers and businesses to choose travel time, mode, and route more efficiently based on real time information regarding travel conditions. This will help to spread the volume of travelers among modes and over time, reduce the costs of doing business, and enhance the quality of life in Colorado.
- **Increasing safety for the traveling public** by enabling faster response to incidents and reducing incidents through active traffic and incident management. A secondary mobility benefit is realized from broadcasting of alternative routings for avoiding incidents and resulting congestion in incident areas. These alternate routings and traffic patterns will be developed as part of Incident Management Plans. CDOT will use a combination of ITS technologies to enhance the safety of the traveling public, by monitoring system operations, planning and managing transportation affected by special events, and providing travel related weather advisory information.
- **Enhancing intermodal connectivity and inter-jurisdictional coordination** by promoting and supporting seamless intermodal transportation connectivity and Colorado's ITS systems. CDOT ITS envisions managing information as a resource that will enhance intermodal connectivity between services provided by public and private transportation providers.

2. Using ITS Performance Measures

The vision is for business-based investments that will yield real transportation benefits. Performance measurement is a key element to the ITS vision. The ITS Branch has developed several performance measures for tracking and identifying the

mobility and safety benefits of ITS. Performance measures that will demonstrate the return from ITS investments are shown in Exhibit E-1.

Exhibit E-1: Measuring the Benefits of ITS

Principal Benefits	Selected Performance Measures*
Maximizing productivity of current transportation system	<ul style="list-style-type: none"> • Increase in vehicle and passenger throughput. • Reduction in total lost productivity due to incidents and congestion.
Increasing travel efficiency	<ul style="list-style-type: none"> • Use of travel information to select travel mode and reduce travel time and costs (through use of pre-trip and en-route travel information).
Increasing safety	<ul style="list-style-type: none"> • Shorten incident response times. • Reduction of secondary accidents due to incidents.

Note (): See ITS Branch Performance Measurement documents for details.*

C. Plan Elements

The plan includes 14 strategies and 33 implementing actions that address the issues identified by the ITS Steering Committee. These fall into three categories: policy and procedural change, investment, and technical assistance. The strategies and their relationship to CDOT ITS Core Services are shown and summarized in Exhibit E-2.

1. Policy and Procedures – Institutionalizing ITS

- **Develop and implement policy and procedures for ITS activities, including: statewide traveler information, asset management and maintenance, and replacement planning and budgeting.**

At the regional and statewide level, there are many examples where improved policies and procedures are necessary to ensure that ITS core services are provided as effectively as possible. These range from operational consistency issues to the need to develop statewide ITS standards and procurement specifications, as well as transmitting of timely information (such as dispatch of CDOT Maintenance Forces by the Colorado State Patrol (CSP); reporting of road conditions from CSP to traffic operations centers for update of CDOT Web site). This also involves accounting for preventative maintenance, repair, and lifecycle costs in investment decisions, specifying maintenance responsibilities, and developing ITS maintenance finance mechanisms.

- **Institutionalize ITS into CDOT's business practices through policy and procedural change.**

This involves incorporating ITS into: planning and project prioritization, the project development process, and maintenance management.

The ITS Branch has been working in this area, incorporating important ITS policy tenants into the following documents: Training Modules for Integrating Modal Projects into the Planning Process, Policy Guidance Considerations for Project Priority Programming Process (4P) and the Corridor Optimization Guidelines.

- **Ensure that CDOT's project programming and financing mechanisms enable ITS to be funded as part of projects or as stand alone investments where cost-effective.**

Most of the currently committed projects do not address ITS in most CDOT Regions. The regions do not believe that ITS will be incorporated in planned projects due to extremely tight financial constraints. Project budgets currently make minimal allowance for ITS components. The ITS Branch will work to explore various funding scenarios to ensure that ITS devices are incorporated into project costs, and funded where warranted, by their contribution to system performance.

2. Statewide Strategic Investments

- **As a strategic statewide priority, continue to invest in the deployment of the ITS enabling infrastructure.**

This includes completion of the traffic management centers and implementation of the communications infrastructure that ITS devices will use, resulting in more reliable communication links and a substantial reduction in cost over time. This effort is recognized as fundamental to the operational success, as well as to fully utilize and efficiently manage a statewide traveler information and traffic management system. Currently, funding is in place to construct a Traffic Management Center, which includes deployment of the Advanced Traffic Management System/Advanced Traveler Information System software.

- **Continue to plan and invest in the statewide traveler information systems to support CDOT mobility and safety objectives.**

The traveler information system is a strategic statewide system involving the deployment and integration of ITS devices and communication infrastructure to disseminate information. The system includes: the CDOT Web site, the statewide use of dynamic message signs, close-circuit television cameras, highway advisory radios, road-weather information systems, and other systems, equipment, and tools. Device and communication infrastructure deployment will

consider the diverse needs of both urban and rural areas. The ITS Branch will establish a statewide/corridor “blueprint” for the optimum device and location for collection and dissemination of traveler information.

3. Technical Assistance

- **Provide support for ITS planning and project delivery.**

This involves the ITS Branch continuing to provide technical support for ITS as it is institutionalized into CDOT’s business areas and functions. This ranges from establishing standards and providing systems planning, to supporting benefit/cost analysis and performance measurement.

Exhibit E-2: CDOT ITS Strategies

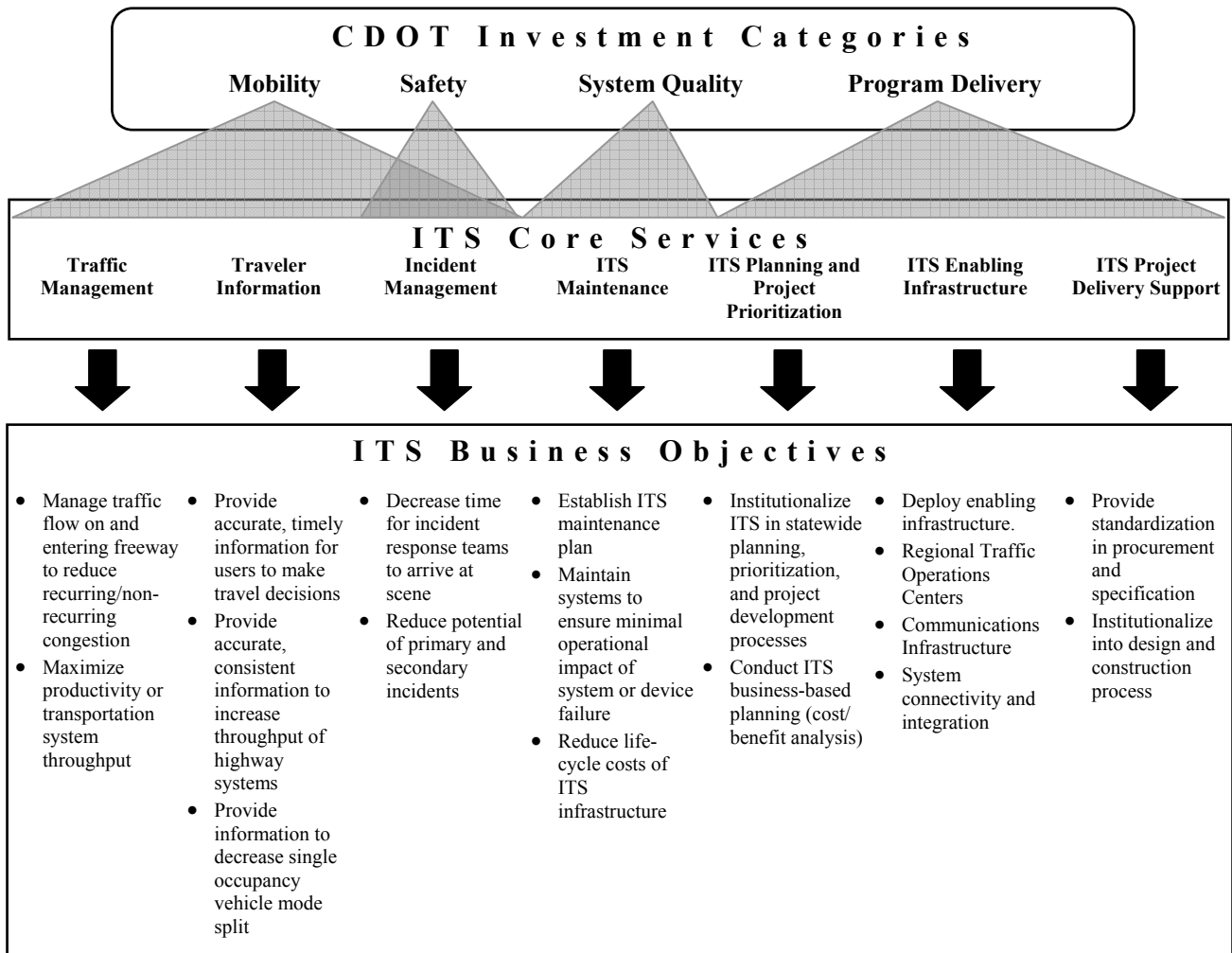
Core Services	Strategies
Traffic Management	<ul style="list-style-type: none"> • Establish active traffic management in priority corridors.
Traveler Information	<ul style="list-style-type: none"> • Continue statewide deployment of ITS devices used for collecting pre-trip and en-route travel planning information. • Develop the Advanced Traveler Information System – disseminate statewide traveler information.
Incident Management	<ul style="list-style-type: none"> • Use real-time road condition information to deploy and assist with incident response. • Use active traffic management capabilities to reduce congestion arising from recurring/non-recurring incidents and provide traveler information about incidents.
ITS Maintenance	<ul style="list-style-type: none"> • Establish a statewide ITS maintenance planning, replacement, and budgeting process.
ITS Planning and Project Prioritization	<ul style="list-style-type: none"> • Conduct statewide ITS deployment planning and provide leadership for implementing the statewide ITS enabling infrastructure. • Use performance measures to evaluate ITS contributions to CDOT investment categories. • Institutionalize ITS into the statewide and regional planning processes. • Institutionalize ITS into CDOT's project scoping processes.
ITS Enabling Infrastructure	<ul style="list-style-type: none"> • Deploy ITS enabling infrastructure on a statewide basis.
ITS Project Delivery Support	<ul style="list-style-type: none"> • Establish statewide ITS device procurement specifications and guidelines. • Establish policies, procedures, and provide guidelines for inspection and acceptance of ITS components. • Develop and establish statewide design standards for ITS systems and devices.

D. ITS Core Services and Business Objectives

The ITS Strategic Plan establishes CDOT-wide ITS business objectives, presented in Exhibit E-3. The objectives identify what ITS aims to accomplish through the delivery of

each core service area. The core services identify the major ITS program areas and functions that support CDOT objectives and CDOT Investment Strategies.

Exhibit E-3: ITS Core Services and Business Objectives



E. Implementation

Implementation involves statewide strategic investments, policy and procedural change, and technical assistance. The Plan identifies 33 actions for implementation. The Plan includes details of each action item includes: a description, scope of work, prioritization, identification of responsibilities, and expected durations. Many of these actions are being implemented through on-going work, but there is a considerable volume of new work to be performed. There is broad agreement from CDOT Regions that statewide leadership is

required to implement this plan. The following principles guide the implementation of the ITS Strategic Plan.

1. Responsibilities

- The ITS Branch will take the lead role, be responsible for and facilitate coordination, planning, development and implementation of statewide strategic investments of ITS systems and devices that pertain to the enabling infrastructure, policies and procedures, standards and specifications, and performance measures.
- The ITS Branch will provide progress reports on action implementation status to the CTMC subcommittee and the EMT to ensure accountability and strategy implementation.
- The Regions will actively participate with implementation of statewide strategic investments, be responsible for implementation of Regional strategies and action items, and initiate and facilitate ITS implementation through the regional transportation planning process.

2. Resource Requirements

The ITS Strategic Plan includes recommendations and outlines resource requirements for implementing the Plan actions. There are two major categories that are addressed in the context of resource requirements: 1) Preventative Maintenance and Replacement of Existing ITS Infrastructure; and 2) ITS Statewide Enabling Infrastructure and Statewide Traveler Information Strategic Investments. Exhibit E-4 presents a summary of the resource requirements necessary to implement this Plan. In addition, an Addendum to the Plan is attached that discusses each of the areas in greater detail, and provides Charts that illustrate the recommendation. Implementation will require the continued funding of ITS as a statewide strategic investment.

a. Preventative Maintenance and Replacement of Existing ITS Infrastructure

In the development of the Plan, the stakeholders unanimously agreed that preventative maintenance and replacement of existing ITS infrastructure should be the highest priority. As this Plan was being developed, a Quality Assurance Review Team was assembled to perform an analysis regarding statewide maintenance and replacement of ITS devices. Historic maintenance records and data available through the TMC, national data and FHWA figures were analyzed to estimate unit maintenance costs for different devices, in terms of a percentage of asset value. The results of the analysis are shown on Charts 1 and 2 expressed in terms of a 10 year and 15 year replacement cycle.

b. ITS Statewide Enabling Infrastructure and Statewide Traveler Information Strategic Investments

CDOT will invest in the statewide enabling infrastructure and statewide traveler information as a statewide strategic investment. Following is a description regarding each of these activities. The statewide enabling infrastructure consists of integrating the Traffic Operation Centers (TOCs) and the Traffic Management Center (TMC), deployment of fiber optic backbone and high-speed add/drop multiplexers and connection of numerous existing devices for collecting and disseminating traffic information:

- **Completion and full functionality of the TOCs in Colorado Springs, Eisenhower Tunnel, Hanging Lakes Tunnel, and the TMC in Denver.**

The goal is to provide for center-to-center (C2C) connectivity and redundant fail over communication links among the centers. The Denver center currently operates out of an interim facility. Funds have been approved to acquire the Advanced Traveler Information System/Advanced Traffic Management System operating system and improve the TMC's functionality and expand its capacity. Improving the TMC is anticipated to begin in 2003. Electronic communications equipment has been installed in the Eisenhower and Hanging Lakes Tunnels facilities that will allow for C2C once the communications infrastructure is in place. A workstation exchange between Colorado Springs and Denver has resulted in an "interim C2C" connection. A complete C2C connection will be possible once the communications infrastructure is in place.

- **Deployment and installation of a long haul high-speed fiber optic backbone and all SONET high-speed equipment necessary for its operation (Tier 1 in Exhibit E-4).**

Fiber has been installed on I-70 from the Kansas/Colorado state line to Denver, various segments of inerduct/conduit have been installed on I-70 from Denver to Glenwood Springs and fiber has been installed on I-25 in the Denver metro area as part of the State's Shared Resources Project. Recently, however, the Project was suspended due to the contractor filing bankruptcy. At the same time as the long haul high-speed fiber backbone is being deployed, CDOT will deploy high-speed add/drop multiplexers at strategic node/concentration points in order to maximize the fiber optic backbone. (Referred to as Tier 2 in Exhibit E-4.)

- For those areas of the state where fiber will not be available, CDOT will conduct communication needs assessments, and pursue other modes of reliable communication.

- **Connectivity of approximately 500 existing devices to the high-speed backbone is estimated to cost \$20 million dollars (Tier 3).**

This includes all construction, installation, and connection of fiber and conduit, and installation of fiber optic transceivers, to connect devices to the fiber backbone.

CDOT will plan for and finance the statewide traveler information as a statewide strategic investment that meets regional and statewide needs. In meetings with the Regions, there was agreement that providing traveler information should be a priority and a statewide function. Within the next year, in order to determine level of deployment and associated costs, the ITS Branch, in working with other stakeholders, will perform cost/benefit analysis on selected corridors and produce a plan that addresses device, location, a thorough assessment of communication needs and integration issues, cost and options concerning incremental deployment.

- A preliminary, rough estimate of the cost for statewide traveler information has been developed (see Exhibit E-4). This estimate is based on Incident Management Plans and Regional ITS and DMS deployment plans as they pertain to State Significant Corridors, and the Denver Regional ITS Strategic Plan for the Denver regional area.
- This cost estimate only includes deployment of DMS, HAR, Video Cameras, and Website dissemination, collectively considered as devices used to interface with end users to provide traveler information. The estimate does not include cost of additional data collection devices. Such devices could be installed either as part of construction projects or as stand alone projects.

c. Policies and Procedures

Initial development of new policies, procedures, and then institutionalization activities will be assessed to determine if the work can be performed using existing staff, reallocating staff assignments or acquiring temporary assistance. The ITS Branch is in the process of performing detailed staffing analysis regarding each of the action items to determine the most effective use of resources.

A key part of the Plan includes actions that will establish procedures and recommend funding mechanisms for replacement and maintenance for ITS devices and systems. Currently, and as part of the Quality Assurance Review recommendations, the ITS Branch is working to develop a program (ITS Maintenance Plan) for maintenance and capital replacement of ITS devices.

More information regarding the ITS Maintenance Plan is provided in the Addendum.

d. Technical Assistance

The ITS Branch will continue to provide technical assistance. The Strategic Plan defines the scope of the assistance. The expectation is that this work will mostly be absorbed as new policies and procedures are institutionalized in the workload and responsibilities of existing staff. Assistance will be provided using existing staff, reallocating staff assignments or through contracting with consultants.

Exhibit E-4: ITS Resource Requirements

Preventative Maintenance and Replacement of Existing ITS Infrastructure	
<ul style="list-style-type: none"> • Statewide (15 year replacement cycle) 	<ul style="list-style-type: none"> • \$3.7 million for preventative maintenance and an additional \$5 million for device replacement on a 15-year cycle beginning in 2002. TREX will require an additional \$1.8 million for preventative maintenance and an additional \$1.1 to replace devices beginning in 2008.
ITS Statewide Enabling Infrastructure Strategic Investments	
Traffic Operation and Management Centers	
<ul style="list-style-type: none"> • Denver 	<ul style="list-style-type: none"> • \$6.7 million ITS earmark (50/50 federal and state split for integration and full functionality of Denver TMC). • \$6.7 million approved by Transportation Commission for construction of Denver TMC. • The ITS earmark is programmed to design, engineer, acquire the Advanced Traveler Information System/Advanced Traffic Management System operating system, software, firmware, and hardware, and perform integration activities within the Center.
<ul style="list-style-type: none"> • Colorado Springs 	<ul style="list-style-type: none"> • \$3 - \$4 million
<ul style="list-style-type: none"> • Eisenhower Tunnel 	<ul style="list-style-type: none"> • \$4 - \$5 million
<ul style="list-style-type: none"> • Hanging Lakes Tunnel 	<ul style="list-style-type: none"> • \$4 - \$6 million
Fiber Optic Network	
<ul style="list-style-type: none"> • Tier 1 	<ul style="list-style-type: none"> • \$34.5 million
<ul style="list-style-type: none"> • Tier 2 	<ul style="list-style-type: none"> • \$3 – \$4 million
<ul style="list-style-type: none"> • Tier 3 	<ul style="list-style-type: none"> • \$20 million
Statewide Traveler Information	
<ul style="list-style-type: none"> • State Corridors 	<ul style="list-style-type: none"> • \$ 36.5 million based on deployment of: <ul style="list-style-type: none"> – 44 dynamic message signs, 54 CCTVs, and 7 highway advisory radio systems at strategic locations on state significant corridors interstate highways. – 49 dynamic message signs, 34 CCTVs, and 7 highway advisory radio systems on state significant corridors non-interstate highways. • Includes cost to connect device to fiber backbone. • The cost associated to maintain and replace equipment on a 15-year cycle is shown on Chart 5.
<ul style="list-style-type: none"> • Denver Metro Area 	<ul style="list-style-type: none"> • \$ 41 million. <ul style="list-style-type: none"> – Based on Denver Regional ITS Strategic Plan developed by DRCOG, with participation from CDOT ITS Branch. That plan recommended limited device deployment in the Mountains and Plains area of the DRCOG Region. Those device deployments are included in the CDOT ITS Strategic Plan for Statewide Traveler Information and State Corridors. – In the area of traveler information, as it pertains to freeways that CDOT operates within the Region, the Plan recommends deployment of 53 DMSs and 172 CCTVs. – Estimate includes DRCOG Plan recommendation for \$1 million for improvements to traveler information services and \$4 million for deployment of interactive traveler information services. • Includes cost to connect device to fiber backbone. • The cost associated to maintain and replace equipment on a 15-year cycle is shown on Chart 5.

Addendum to the ITS Strategic Plan Executive Summary

Preventative Maintenance and Capital Replacement of Existing ITS Infrastructure

Throughout the development of this Plan, the stakeholders identified preventative maintenance and replacement of existing devices as the highest priority.

Currently, and as part of the QAR recommendations, the ITS Branch is working to develop a program for maintenance and capital replacement of ITS devices (ITS Maintenance Plan), which will be modeled on, and consistent with, CDOT's Highway Maintenance Levels of Service (LOS). This will provide a tool to effectively manage the maintenance/life-cycle replacement of ITS devices in conjunction with appropriate ITS device levels of service, and to allocate resources in accordance with desired device/system LOS. We anticipate that the ITS Maintenance Plan will be completed by December 2002.

In the interim, however, to provide a level of magnitude, work performed in the QAR was utilized to develop two maintenance/replacement scenarios. The /scenarios display the QAR recommendations in terms of a 10 and 15-year maintenance/replacement cycle.

A third scenario (20-year replacement cycle with no increase in maintenance) was developed for scenario evaluation purposes.

The ITS Branch, the Regions, TREX, DTD, Eisenhower Tunnel and Hanging Lakes Tunnel provided information regarding current funding and what each spends to operate, maintain and replace ITS devices. The information was aggregated to show current funding and expenditures associated with ITS statewide. This information is uniform in each of the three scenarios.

Chart 1

**Statewide ITS Operations and Maintenance & Capital Replacement,
 Including TREX (Preventative Maintenance Plus a 10 Year Replacement Cycle)**
 in inflated dollars

May 22, 2002

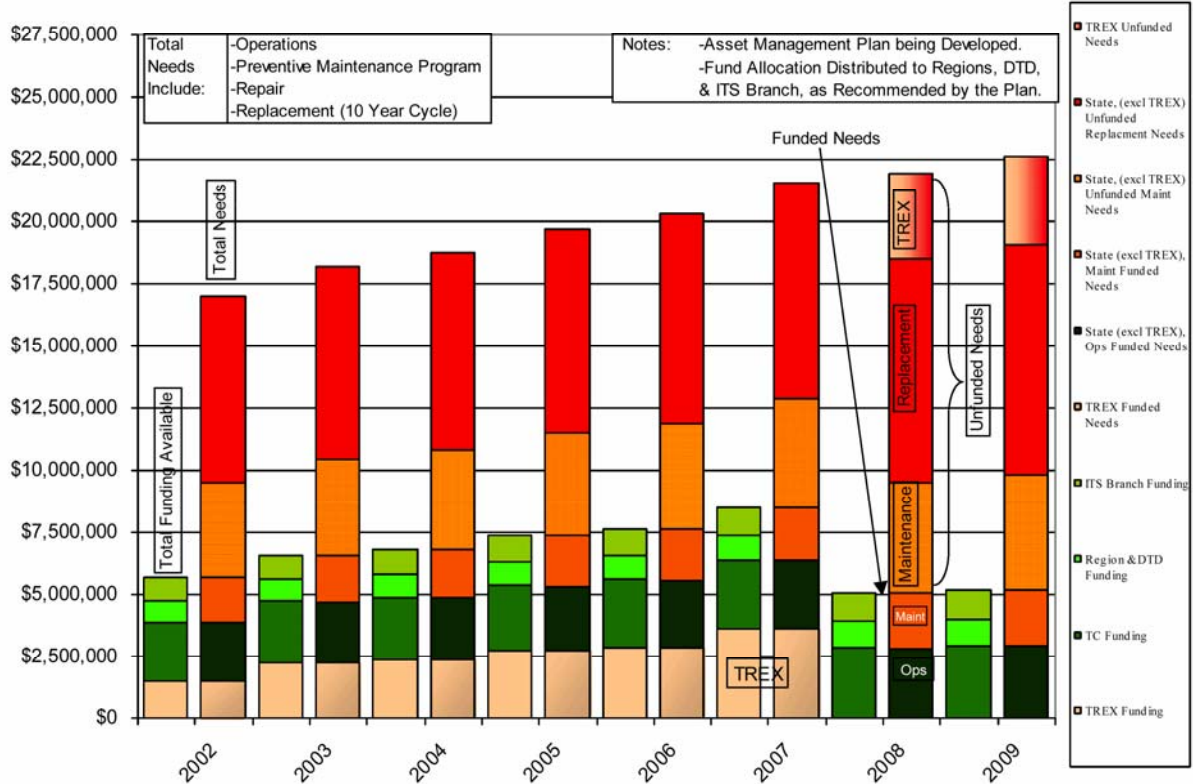


Chart 1 shows the additional funding that would be necessary to maintain and replace devices, at the highest level, as recommended by the QAR. This scenario requires an additional \$3.7 million for preventative maintenance and an additional \$7.5 million for device replacement on a 10-year cycle beginning in 2002. Also, TREX is only funded through 2007. In 2008 the ITS infrastructure deployed by TREX will become the responsibility of the state, and will require an additional \$1.8 million for preventative maintenance and an additional \$1.7 to replace /devices.

Chart 2

**Statewide ITS Operations and Maintenance & Capital Replacement,
 Including TREX (Preventative Maintenance Plus a 15 Year Replacement Cycle)**
 in inflated dollars

May 22, 2002

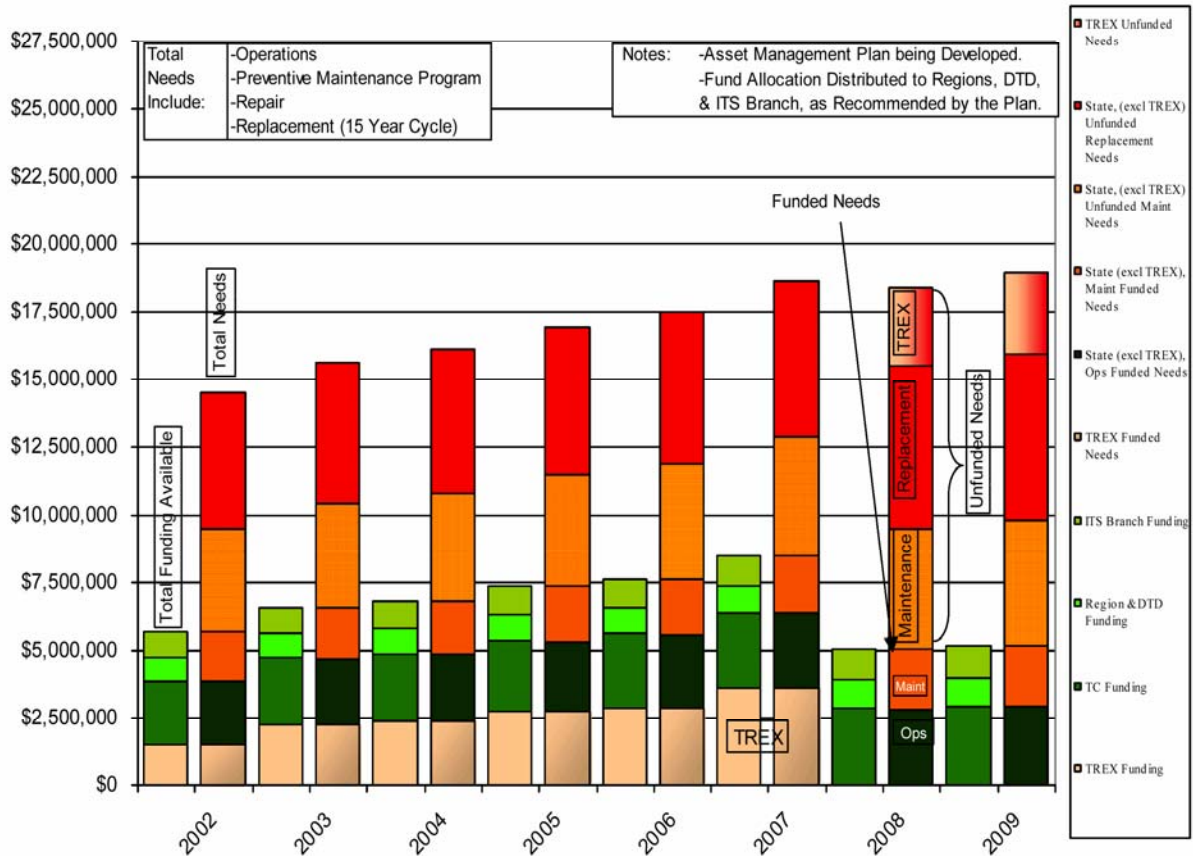


Chart 2 shows the additional funding that would be necessary to maintain and replace devices, at a very adequate level, as recommended by the QAR. This scenario requires an additional \$3.7 million for preventative maintenance and an additional \$5 million for device replacement on a 15-year cycle beginning in 2002. In this scenario TREX will require an additional \$1.8 million for preventative maintenance and an additional \$1.1 million to replace devices beginning in 2008.

Chart 3

**Statewide ITS Operations and Maintenance & Capital Replacement,
 Including TREX (Current Maintenance Level Plus a 20 Year Replacement Cycle)**
 in inflated dollars

May 22, 2002

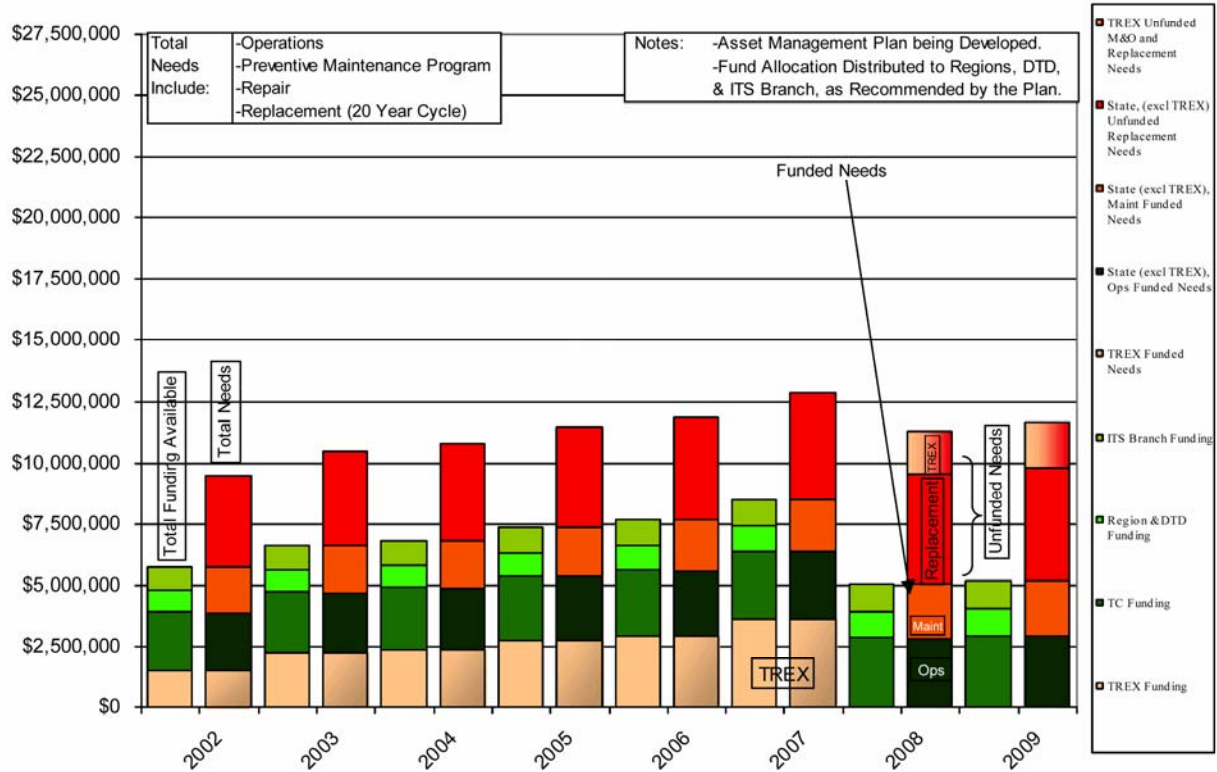


Chart 3 shows the additional funding that would be necessary to replace devices over a 20-year cycle. This scenario continues with current funding levels for maintenance activities, which includes very little if any preventative maintenance. It requires an additional \$3.75 million for device replacement beginning in 2002. In this scenario TREX will still require an additional \$940 thousand to maintain (although at a reduced level) and an additional \$850 thousand to replace devices beginning in 2008.

Chart 4

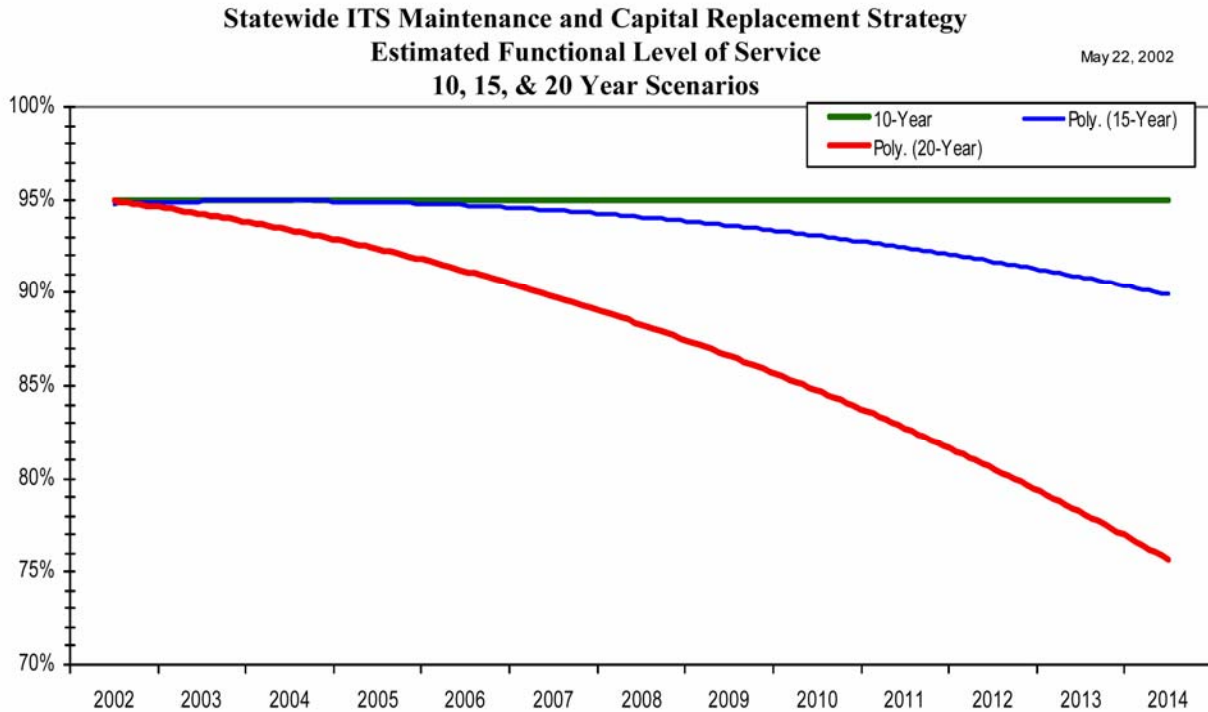


Chart 4 shows the relationship between each of the maintenance/replacement scenarios and its expected functional level of service. Functional level of service is defined as the level at which devices and systems are operationally functioning. Slide 4 clearly shows that there is a direct correlation between device maintenance/replacement and its functional level of service. There is only 5% difference in terms of functional level of service between the 10-year and 15-year scenarios. However, there is a 29% difference in terms of cost between the 10-year and 15-year scenarios. For these reasons, the 15-year scenario is preferred and recommended because it provides an acceptable functional level of service while saving more than \$32 million over the time period shown.

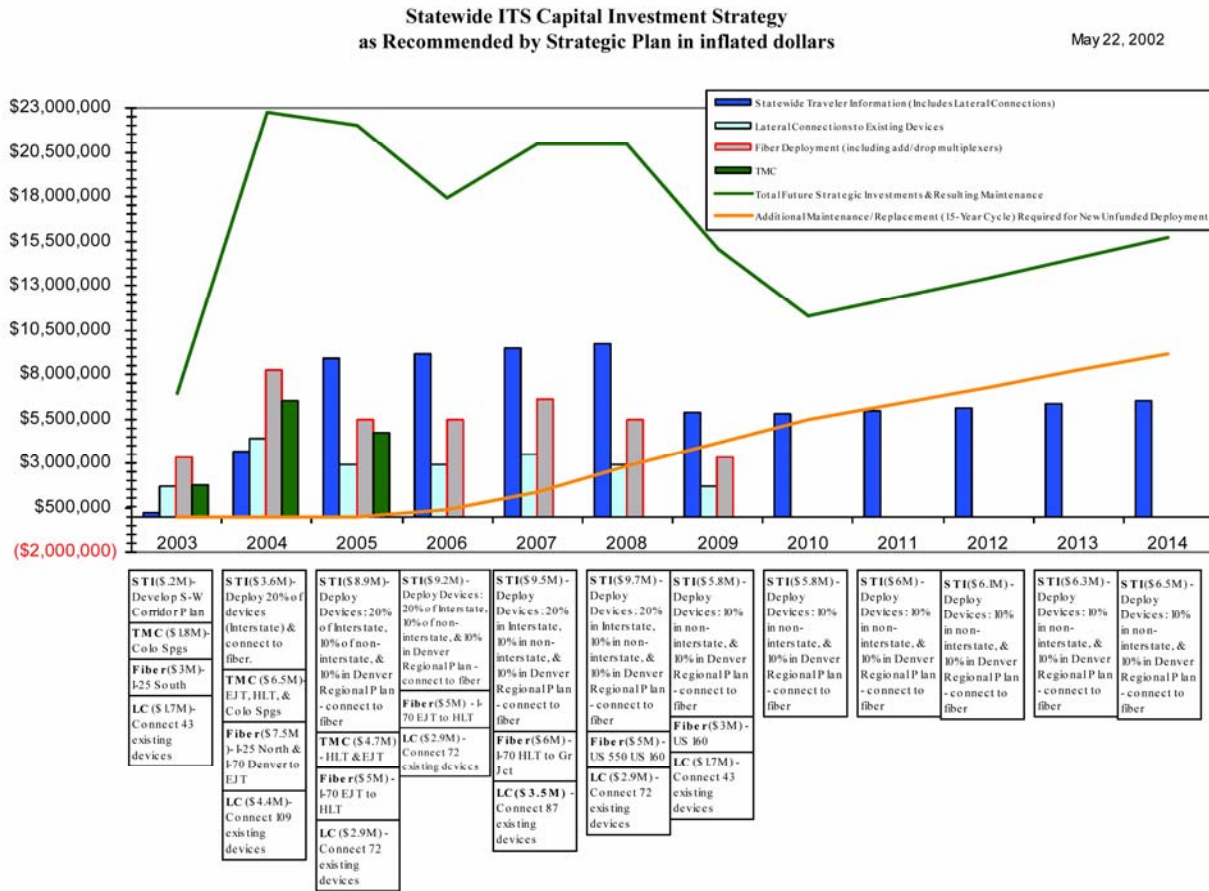
ITS Statewide Enabling Infrastructure and Statewide Traveler Information Strategic Investments

CDOT will invest in the statewide enabling infrastructure and statewide traveler information as a statewide strategic investment. Chart 5 shows the proposed deployment strategy regarding the enabling infrastructure and the statewide traveler information components.

The statewide enabling infrastructure consists of integrating the Traffic Operation Centers (TOCs) and the Traffic Management Center (TMC), deployment of fiber optic backbone and high-speed add/drop multiplexers and connection of numerous existing devices for collecting and disseminating traffic information. These three areas are discussed in more detail below.

The statewide traveler information component consists of deploying devices on Interstate highways and on state significant non-interstate highways in order to improve the level of, and enhance the coverage of, information provided to travelers. The strategy represents a systematic implementation approach based on coordinating enabling infrastructure and statewide traveler information activities, and deployment based on corridor prioritization.

Chart 5



Traffic Management Centers

Chart 5 shows the strategy to perform integration activities at the TOCs and TMC to make them fully functional so that device modules are interfaced into their operating systems, and that their operating systems, although different, will be able to communicate among each other, and when necessary remotely operate each other. These integration activities are proposed to be performed between 2003 and 2005 with a small piece carrying over to 2006. Currently, several integration activities are being done at each center to certain levels; however the Denver TMC is the only piece that is fully funded. The total cost to integrate the centers is estimated at \$26.5 million of which \$13.5 million is committed to these activities.

Fiber Deployment and Connection to Existing Devices

Chart 5 shows the strategy to continue with the deployment of fiber as originally envisioned in the Shared Resources Project. A dedicated communications backbone is essential in terms of reliability, functionality and operational effectiveness and efficiency. The strategy proposes to deploy fiber on the identified Interstate segments between 2003 and 2007 and on the identified non-interstate segments in 2008 and 2009. Currently, the ITS Branch in partnership with Colorado Springs and Douglas County is working to deploy fiber on I-25 south from Lincoln Avenue to Monument Hill to connect with existing fiber on both ends. This will provide C2C connection between Denver and Colorado Springs, and allow for devices to be connected to the fiber along the corridor. The Tier 2 high-speed add/drop multiplexers will be deployed in conjunction with the fiber, and are incorporated in the fiber estimate. The total cost to deploy fiber is estimated at \$38 million. The I-25 South fiber deployment is estimated at \$3.3 million, which the ITS Branch, Colorado Springs and Douglas County are collectively working to fund.

Statewide Traveler Information

Chart 5 shows the strategy regarding recommended deployment of additional devices to improve and enhance delivery of statewide traveler information and traffic and incident management services. The strategy proposes deployment on the Interstate highways over a five-year period from 2004 through 2008. The Interstate highways is the priority due to its functional level of service, the number of vehicles that operate on it (the Interstate is about 10% of the state highway system centerline miles yet it handles greater than 30% of the average daily traffic) and to take advantage of and get the maximum benefit from the fiber that is and will be deployed. The total cost to deploy the Interstate and connect the devices is estimated at \$19.2 million. The strategy also proposes deployment on non-interstate highways that are part of the state significant corridors. These highways provide significant inter-regional connectivity within the state. The strategy proposes deployment over a ten-year period from 2005 through 2014. The total cost to deploy the non-interstate and connect devices where applicable is estimated at \$17.3 million. In addition, the strategy proposes deployment on the state highways (Interstates and freeways) that are identified as Mobility Corridors in the Denver Regional ITS Strategic Plan. The strategy proposes deployment over a ten-year period from 2005 through 2015. The total cost to deploy in accordance with the Denver Regional ITS Strategic Plan and connect devices is estimated at \$41 million.

Chart 5 also shows an additional maintenance obligation associated with the deployment of the Statewide Traveler Information infrastructure. The estimate is for maintenance and replacement of devices based on a 15-year replacement cycle. The estimate shows that about \$393 thousand will be needed beginning in 2006, and will increase to about \$9.2 million in 2014 when deployment of the statewide capital investment strategy is complete.

Chart 6

**Statewide ITS Investment Strategy
 Fiber & Lateral Connection Deployment Strategy**
 in inflated dollars

May 22, 2002

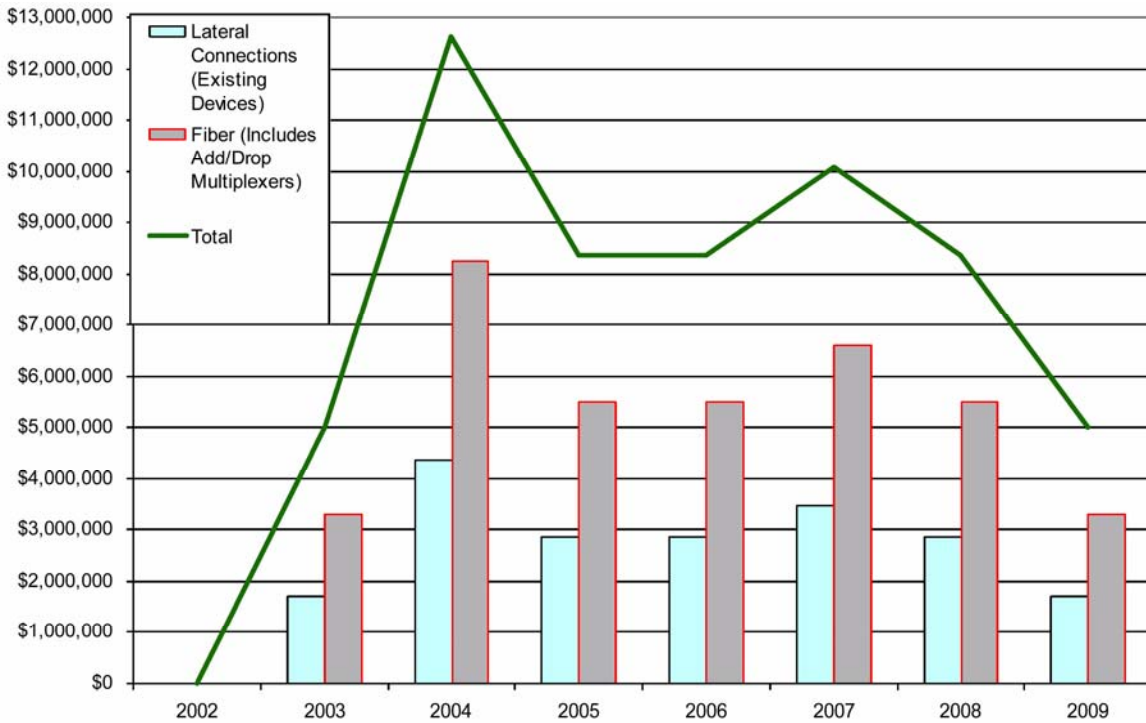
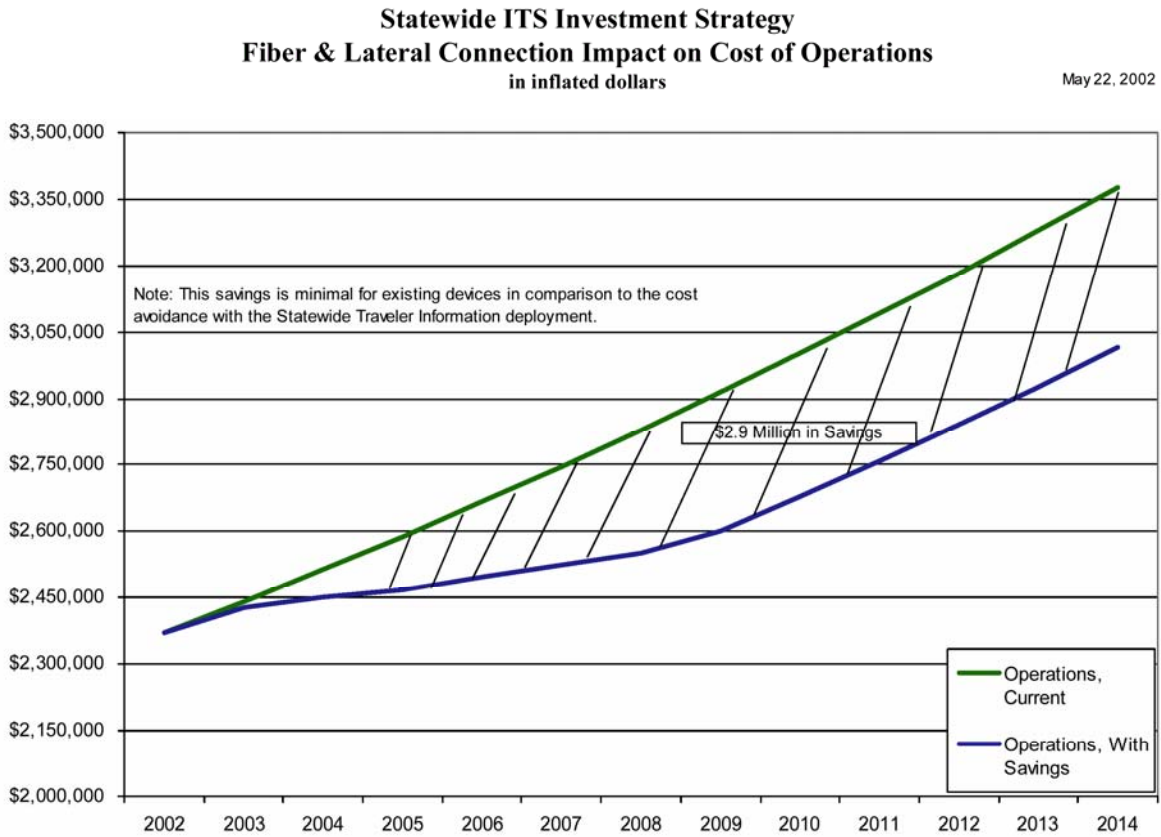


Chart 6 shows a breakdown regarding fiber and lateral connection deployment. Approximately 500 existing devices are proposed to be connected in conjunction with the fiber deployment between 2003 and 2009. The total cost to connect existing devices is estimated at \$20 million.

Chart 7



As devices are connected, there is a reduction in communications cost associated with operating the devices. Chart 7 shows estimated cost savings of approximately \$3 million between 2003 and 2014.

Chart 8

**Statewide Combined ITS Capital Investment Strategy
 Total Strategy, Funded Projects, and Investment Gap
 in inflated dollars**

May 22, 2002

Year	Investment Strategy Gap
2002	-
2003	6,970,000
2004	22,725,000
2005	22,045,950
2006	17,563,429
2007	19,538,931
2008	18,122,699
2009	10,864,204
2010	5,787,676
2011	5,961,306
2012	6,140,145
2013	6,324,350
2014	6,514,080

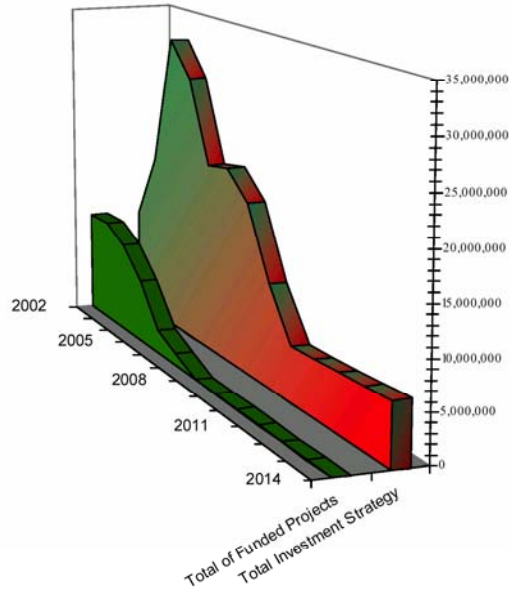


Chart 8 shows the total recommended capital investment strategy that was detailed in Chart 5, in relationship to the currently funded projects, and the investment gap that exists between them.

Chart 9

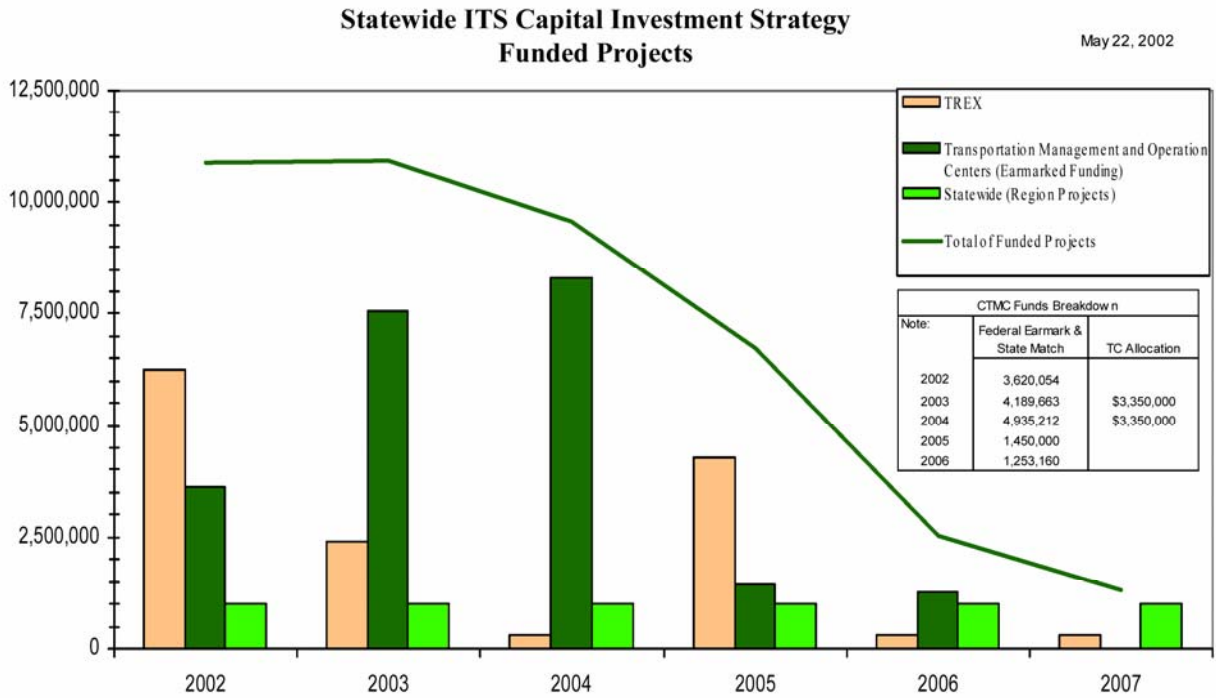


Chart 9 provides a breakdown concerning the funded projects identified in Chart 8.

Chart 10

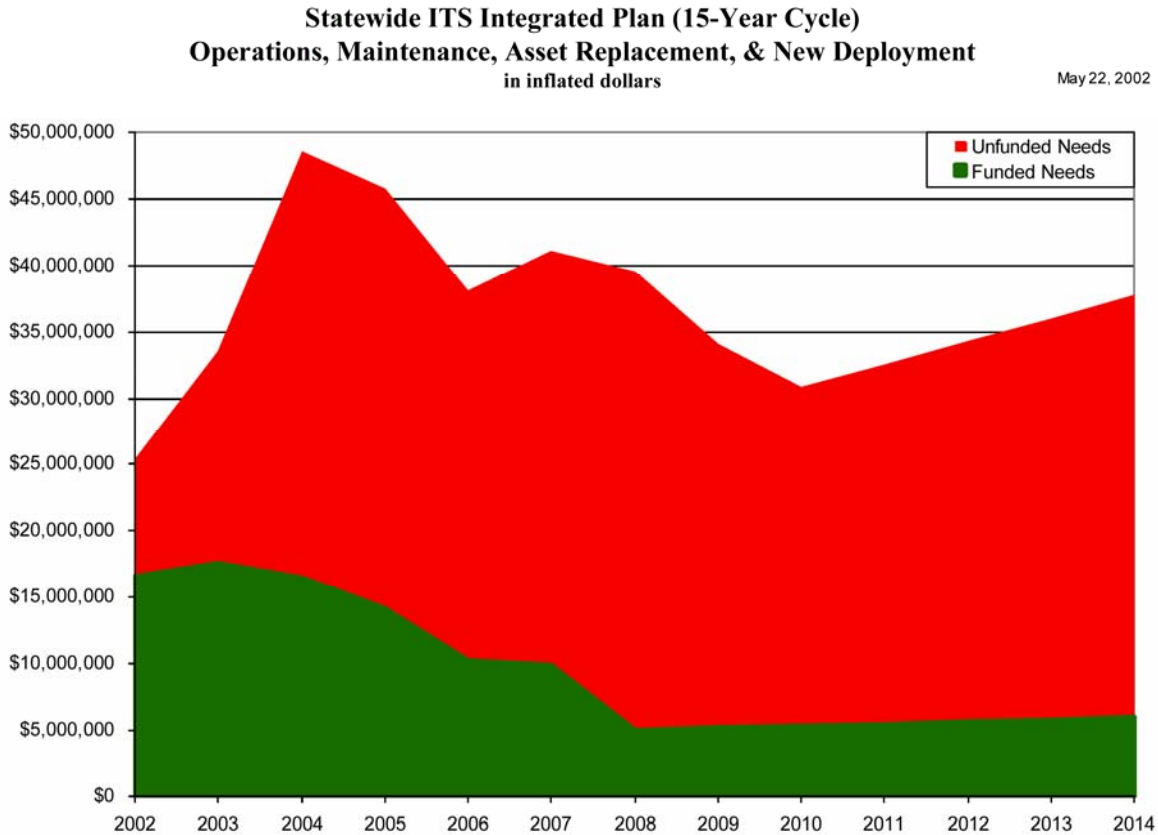


Chart 10 is a summary of the entire ITS statewide program. The Funded Needs portion includes projects that are currently funded, as well as current operations and maintenance funding levels indexed to 2014. The Unfunded Needs portion includes, in addition to what is included in the Funded Needs portion, additional funding required:

- To perform preventative maintenance and capital replacement of existing ITS devices on a 15-year cycle,
- To deploy the enabling infrastructure and statewide traveler information components, and
- To perform preventative maintenance and capital replacement on enabling infrastructure and statewide traveler information components on a 15-year cycle.