US Department
of Transportation
Federal Highway
Administration

The Role of Access Policies in Wireline Shared Resource Projects

Prepared for:
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EXECUTIVE SUMMARY

In light of the pending declaratory proceeding in CC Docket No. 98-1, the Federal Highway Administration (FHWA) is interested in determining whether there is a relationship between

- Geographic extent of broadband telecommunications infrastructure available for general use, and
- Degree and type of control exercised by the public right-of-way (ROW) owner over infrastructure placement in limited access highway ROW.

This paper provides background information for evaluating a possible relationship. In addition to exploring telecommunications infrastructure with regard to universal service, that is, geographic coverage of the state, this paper also explores the extent and depth of telecommunications support for public sector activities, specifically, communications support for intelligent transportation systems (ITS) and other transportation agency activities.

Both public transportation agencies and private shared resource partners have an interest in maintaining control over telecommunications infrastructure installation on interstate and other limited access highways. Private partners generally prefer limited physical access to ROW by competitors for at least a minimum period in order to better market their capacity as well as to protect their installed infrastructure from accidental damage.

Because they are primarily responsible for maintaining safe roads for the traveling public, transportation agencies also support controls on infrastructure placement on limited access roadway ROW as a way of limiting construction along the ROW, thus minimizing impacts on highway safety. They do this in several ways: restricting physical access to a single telecommunications manager in any specific ROW stretch, limiting the time period during which they will consider proposals, and fostering coordination among vendors that respond within the defined time period. Controls in support of safety concerns may also help the public agencies maximize the scope and completeness of their shared resource programs.

Table 1 of the paper describes the essential features of nine agencies' resource sharing programs. Table 2 presents road and telecommunications infrastructure mileage for each state involved in resource sharing and assigns a "degree of control" rating according to presence or absence of physical and temporal controls as indicated by project characteristics summarized in Table 1. Table 3 includes data on National Highway System (NHS)[1] and shared resource project mileage, degree of control, and information on telecommunications support for intelligent transportation system (ITS) and other transportation agency needs.

[1] The NHS was established "to provide an interconnected system of principal arterial routes which will serve major population centers, international border crossings, ports, airports, public transportation facilities, and other intermodal transportation facilities and other major travel destinations; meet national defense requirements; and serve interstate and interregional travel" (title 23 U.S. Code, Section 103). The NHS includes all interstate highways and tollways and selected major and primary arterial roads.

Table ES-1 below presents an overview of the nine shared resource projects reviewed for this paper, based on Tables 2 and 3 of the full paper. Grouping states by degree of control ratings, those states exercising the greatest control over access also have the highest average and individual coverage ratios. That is, mileage of fiber optic backbone installed in shared resource projects is equal to a higher percentage of the state's NHS mileage. And, states with the least control over access also achieve the lowest individual and average geographic coverage; states with intermediate levels of control fall in the middle. The relationship between telecommunications support for transportation and degree of control is less clear. That is, although all states with maximum control do receive full equipment and operations and maintenance support for their telecommunications backbone, so does one open access state (Arkansas). States with limited control receive less than full support for ITS and transportation agency communication needs.

It should be noted that four of the nine projects are still in negotiation.[2] If these are eliminated from Table ES-1, it increases the average coverage of the two remaining projects with a rating of "3", reduces to one the observed projects with an degree of control rating of "2" (Colorado, which has a coverage ratio of 0.36 and will receive equipment but no operations and maintenance for ITS telecommunications), and leaves projects with an degree of control rating of "1" unchanged.

Table ES-1: Shared Resource Projects: Overview of Degree of control [3],Geographic Coverage and Telecommunications Support for ITS

Degree of Control Rating[4]	Average Coverage[5]	Telecom Support for Transportation Agency Needs	Number of States
3	0.45	Equipment, operations & maintenance for telecom backbone.	3
2	0.25	Ranges from empty conduits and dark fiber (with connections to POPs) to less-than-full equipment and operations & maintenance.	4
1	0.10	One state receiving only dark fiber and some empty conduit; other state receiving equipment, operations & maintenance plus empty conduit.	2

[2] Details of projects in negotiations are presented with the caveat that final terms may differ from those presented or negotiations may break down and prevent a final agreement.

[3] This table includes projects that are completed and projects that are in progress.

[4] Degree of control rating defined as follows: 3=no physical or temporal controls; 2=temporal control only; 1=temporal and physical controls (and physical controls are explicit and assured for a given time period, not by default). See text for more detailed explanation.

[5] Geographic coverage for each state is defined as the ratio:

[state ROW mileage in shared resource projects] / *[state NHS mileage]*

Data on shared resource project mileage are based on most recently available information from the agencies that are participating in these projects; NHS mileage is taken from *Highway Statistics 1997*, Table HM-30 "National Highway System Length - 1997, Miles Open and Not Open to Traffic"; U.S. Department of Transportation, Federal Highway Administration; p. V-32 (mileage data for Maryland is for 1996).

In addition to degree and type of control on ROW access, several other factors may determine the quality of a shared resource arrangement. This report does not address the impact of these other factors, which include (but are not limited to) the following:

- Current market demand,
- Availability of alternate ROW,
- Liability and environmental responsibilities,
- Agency responsiveness to time constraints,
- Flexibility of RFPs, and
- Negotiating skills.

The data and analysis presented in this report suggest that there is a correlation between controls on direct access to limited access highway ROW and level of statewide, geographic coverage. Although the sample is limited, there also seems to be some relationship between access control and provision of telecommunications capacity and support services to meet transportation management needs. That is, it seems likely that agencies are able to better leverage ROW assets to achieve public sector social and telecommunications objectives when ROW access is constrained.

PURPOSE

In light of the Federal Communications Commission's pending declaratory proceeding in CC Docket No. 98-1 on the Minnesota DOT's shared resource arrangement, the U.S. Department of Transportation and its FHWA are interested in determining whether there is a correlation between the degree to which access to limited access roadway ROW is controlled and the level of statewide, geographic coverage for broadband telecommunications (i.e., fiber optic infrastructure). The FHWA has chosen to research and present project characteristics of wireline shared resource programs instituted by state departments of transportation (state DOTs), excluding analysis of toll authorities and municipalities because they are categorically different. To this end, this document explores the essential characteristics of nine resource sharing arrangements. This is a small sample, due to the limited number of completed shared resource arrangements and time constraints on research, and thus cannot be the basis for precise predictions regarding future shared resource projects. Nonetheless, several relationships emerge that support existence of the postulated correlation.

SELECTION OF PROGRAMS FOR ANALYSIS

Analysis is based on nine major wireline shared resource programs executed by state departments of transportation throughout the United States; Table 1 describes the basic features of projects under these programs. The FHWA's March 1999 inventory, *Resource Sharing State by State Status Report*, serves as the basis for program selection. To compile this inventory, the FHWA requested state-level departments of transportation and toll authorities to report the status of shared resource arrangements on interstate rights-of-way (ROW). Forty-seven of 52 states and territories responded to the survey. Of these, 16 reported that they currently have or are pursuing shared resource arrangements that allow telecommunications firms to install fiber optic infrastructure on interstate ROW in exchange for some type of compensation. Separate interviews with officials from one non-responding state revealed that both the state DOT and toll authority had executed shared resource arrangements for fiber optic networks. One state DOT that had reported issuing a request for bids has now completed one agreement and is negotiating another. Thus, a total of 20 wireline shared resource projects in 18 states were considered for analysis and presentation. For the purpose of this analysis, the FHWA chose to investigate only shared resource arrangements pursued by state DOTs. Toll authorities were excluded because they constitute separate, revenue-generating institutions. Although they must maintain similar highway standards, their more independent fiscal status generally gives them greater autonomy and flexibility in negotiating contracts and receiving compensation. As a result, deals struck by toll authorities do not represent the same sorts of opportunities and constraints faced by state DOTs. Thus, four states were excluded from analysis because their shared resource programs involved only toll authorities (Indiana, Massachusetts, New York, and Pennsylvania). Two other states with tollway projects also had non-tollway projects; data on these projects were retained in the analysis (Kansas and Oklahoma).

Several other programs were excluded because of insufficient data, limited project scope, or cash-only relationships. For example, two projects were excluded because each involved access to one bridge only (South Carolina and Tennessee). While they technically constitute

shared resource arrangements, the FHWA did not think that the one-bridge projects rose to the level of full shared resource programs. Ultimately, nine state programs qualified for this analysis; several states have more than one project.

Project information for each of these transportation agencies draws upon a variety of sources including the *1999 State by State Status Report*, interviews with agency officials, press releases, RFPs, contracts, shared resources guidances and policy papers. Specific sources are footnoted in the tables and text.

BASIC FEATURES OF SHARED RESOURCE PROGRAMS REVIEWED

For each of the nine state programs included in this analysis, Table 1 presents two types of basic information: features of individual shared resource projects, and support to transportation agency communications. The "Project Features" column summarizes shared resource arrangement access conditions and other contract characteristics. For example, it notes the current number of vendors that are separately located in the ROW. This number may refer to vendors that have constructed telecommunications infrastructure along the same stretch of ROW or vendors that have constructed telecommunications infrastructure along different portions of highway ROW. That is, it may refer to the circumstance where multiple vendors have constructed separate, side-by-side trenches.

From the point of view of the public agency, features relating to control and the number of vendors allowed access are relevant to safety issues. Logically, because every instance of construction along ROW is a potential threat to the safety of the traveling public as well as those working near the active roadway, arrangements that allow a greater number of parallel trenches or greater physical intrusions risk greater degradation of highway safety as the level of construction activity is greater.

The Project Features column also notes whether or not future trenches or periods of construction are possible. Text explains the circumstances under which additional construction would be permitted. For instance, an agency with a very open access policy might only have one vendor currently located in its ROW. However, if its policy allows all telecommunications vendors offering acceptable compensation to access its ROW, increased demand for bandwidth through the state may lead to construction of multiple trenches in agency ROW, which could degrade safe highway operation.

In this column, a final measure notes whether the agency requires a lead firm to coordinate and collocate infrastructure for multiple firms. In such a case, an agency may grant ROW access to multiple firms, but also designate one lead firm to construct one trench and simultaneously lay conduits and fiber for all firms. In this way, multiple firms may be accommodated in one construction period. By limiting the number of necessary construction efforts, this method minimizes safety hazards. Such a requirement would be considered, for purposes of this analysis, to be a form of physically controlled access.

The Project Features column also describes the geographic range of the shared resource projects as the total mileage containing telecommunications infrastructure. In general, the majority of these miles lie along previously prohibited limited access ROW. However, some of the network miles lie along state highway ROW, which has traditionally accommodated utilities. Such mileage serves two groups: the general public, some of which might not otherwise have access to broad band telecommunications; and the public transportation agency seeking a telecommunications backbone for Intelligent Transportation Systems (ITS).

Table 1 also notes the term of restricted access during which the private partner is the only firm permitted to construct telecommunications infrastructure in the limited access ROW. During this period of temporal constraint, the private partner may be required to sell or sublease excess capacity to other firms.

In Table 1, the "Support to Transport Agency Communications" column identifies technical features of the telecommunications network provided to the transportation agency. The information provided is intended to provide a measure of how well the network obtained by the agency meets ITS and other transportation agency telecommunications needs with regard to supporting equipment and operations and maintenance. Achieving that objective depends on coverage but often also on equipment and operations and maintenance support that the public agency might not otherwise be able to afford. For instance, under some arrangements, the private partner provides excellent network mileage, but leaves procurement of significant portions of infrastructure up to the agency. The private partner may only provide empty conduit and require the agency to contract separately for fiber, equipment, operations and maintenance. Other partners provide dark fiber, but not equipment to "light" (or enable communication via) the fiber.[6] Still other partners provide lit fiber, operations, maintenance, and upgrades for the life of the contract. Clearly, a straight comparison of miles covered does not capture the full value of an arrangement to the agency. Thus, this column notes whether the arrangement provides equipment to "light" fiber optic cable and whether it provides operations and maintenance. It also notes specific ITS needs that the agency wants to support with its telecommunications network. Below the summary measures, text describes the specific equipment and services that the agency receives as part of the shared resource arrangement.

ANALYTICAL DATA FOR PROGRAMS REVIEWED

Tables 2 and 3 present the data used for analysis of the nine shared resource programs and the relationships between selected features. Table 2 uses information from Table 1 and additional sources to focus on geographic coverage and degree of control over limited access roadway ROW. Table 3 uses the same basic information to focus on telecommunications support for ITS and degree of control. Both tables list states in descending order of geographic coverage, where geographic coverage is defined as the ratio:

$$\frac{\text{[state ROW mileage in shared resource projects]}}{\text{[state National Highway System mileage]}}$$

Congress designated the National Highway System as the highest-level road network in the country; it is more inclusive than the interstate highway system.[7] For the purposes of this

[6] "Dark" fiber refers to fiber optic cable alone. "Lit" fiber refers to fiber optic cable and all necessary hardware and software to send communications along that fiber.

[7] The NHS was established "to provide an interconnected system of principal arterial routes which will serve major population centers, international border crossings, ports, airports, public transportation facilities, and other intermodal transportation facilities and other major travel destinations; meet national defense requirements; and serve interstate and interregional travel" (title 23 U.S. Code, Section 103). The NHS includes all interstate highways and tollways and selected major and primary arterial roads.

analysis, it is a better indication than the interstate system alone of the basic highway system that serves as the core roadway infrastructure in any given state.

Degree of control categories are: fully controlled, partially controlled, or open access according to physical control (numbers of partners having direct physical access to ROW) and temporal control (restricted time period during which project proposals will be considered and accepted). Fully controlled access, assigned an degree of control rating of "3", is defined as any arrangement that restricts the number of telecommunications firms installing separate telecommunications infrastructure during some defined time period. That is, these programs are characterized by both physical and temporal controls.

Partially controlled access, assigned a rating of "2", is defined as any arrangement that includes temporal but not physical controls. That is, partners may gain direct physical access to ROW for telecommunications infrastructure only during specific time "windows" when the state issues RFPs for shared resource partnerships. However, during the project proposal window, multiple partners may gain direct access to the same ROW. Both fully and partially controlled access arrangements may provide alternate means of access for vendors by requiring the selected shared resource partner(s) to install and sublease excess capacity or conduit space.

Fully open access, given a rating of "1", is defined as any arrangement that allows multiple firms to install separate infrastructure along the same segments of ROW at any time. That is, there are neither physical nor temporal controls on direct access.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
Arkansas (Arkansas DOT) 1996	Number of vendors separately located in ROW: 3 Future trenches possible: yes Lead firm: no Miles: 400-500 miles As of 1996, three companies had leases for access to 400-500 miles of Arkansas DOT ROW. Private partners each own conduits on their separate ROW segments and sublease conduit space to each other where their interests overlap. Therefore, at no point do the companies' trenches overlap. Private partners do not have exclusive access and no one firm will access statewide interstate ROW. Arkansas DOT expects eventual build-out for complete interstate backbone and will entertain all applicants in future. Leases are granted in perpetuity. Arkansas does not limit the number of partners allowed access to its ROW. However, the number of separate trenches is limited by the fact that the DOT has designated a 10-foot wide utility corridor for fiber, which will accommodate only two co-existing trenches.	Equipment to light fiber: yes Operations & Maintenance: yes Stated ITS uses: closed circuit television (CCTV) and radio capability to link up all 10 regional headquarters Arkansas DOT receives a total of 5 dark fibers, 1 empty conduit stretching from Little Rock to Memphis, splice points adjacent to the 10 regional headquarters and at interchanges, and maintenance from the three telecommunications companies.[9] Arkansas DOT issued its first and only RFP after being approached by a number of companies for ROW access. Arkansas DOT's intent was to cover its entire interstate system of which the original 5 dark fibers covered around 82% percent. No new RFP has been issued, although Arkansas DOT has gained equipment to light the fibers through subsequent negotiations with the original companies. In retrospect, Arkansas DOT officials think the original shared resource deal undervalued Arkansas DOT's ROW.[10]
Colorado (CDOT) 1999 Colorado (CDOT), cont.	Number of vendors separately located in ROW: 1 Future trenches possible: yes Lead firm: yes Miles: 1,200 miles (Term of Restricted Access: TBD, 1-2 years) CDOT has recently finalized an agreement with MFS Network Technologies, the firm selected through a competitive RFP process. MFSNT will build a digital fiber optic network on up to 1,200 miles of CDOT ROW. MFSNT will sublease capacity to other vendors including local exchange carriers, interexchange carriers, competitive-access providers, cable television operators, and paging and	Equipment to light fiber: yes Operations & Maintenance: no Stated ITS uses: communications between district offices and traveler information CDOT will receive 24 dark fibers and the equipment to light them along interstate ROW. In addition, CDOT will receive access points every 5,000 ft. and 140 miles of two 2" conduits. CDOT will receive connections to district offices off of interstate ROW in Durango, Craig, Greeley, and Alamosa via 4 lighted fibers per

[8] This table includes projects that are completed and projects that are in progress. Information presented in the table is based on most recently available information from the agencies that are participating in these projects.
[9] Jim Gaither, Arkansas DOT, interview, April 1999.
[10] Jim Gaither, Arkansas DOT, interview, April 1999.
[11] John Muscatell, Colorado DOT, interview, April 1999.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
	cellular/personal communications providers. MFSNT will have exclusive access to ROW segments only during construction (1-2 years depending on location). Once construction is complete, CDOT may grant ROW access to additional telecommunications providers until at least 5 years after this RFP was issued. The term of the current agreement is for 20 years with one 20-year renewal. MFS's planned network will not cover all of the interstate that CDOT desires, particularly one section of I-76. The original RFP will be kept open for at least 5 years or, at the state's initiative, until telecommunications firms have contracted to install infrastructure along all portions of Colorado's interstates. To date, there have been no new bidders.[11]	route. CDOT does not receive splicing, connections, maintenance, or operations.[12] John Muscatell of CDOT notes that, "This partnership will meet the Colorado Department of Transportation's communications needs, as well as help provide telecommunications infrastructure for the entire state."[13] In the future, the network may provide capacity for traveler information service providers as part of ITS development in the state.
Kansas (KDOT) 1999 Kansas (KDOT), cont.	Number of vendors separately located in ROW: 1* Future trenches possible: yes Lead firm: NA Miles: 150 miles KDOT issued a request for bids for a fiber optic telecommunications network in the Kansas City metropolitan area. KDOT specified minimum requirements for the telecommunications infrastructure and listed a number of additional items that proposers could choose to offer. Proposers were permitted to request compensation for the telecommunications infrastructure in terms of cash, access to ROW for commercial telecommunications development, or some combination of the two. The requested network was to cover 150 highway miles (mostly interstate) in the Kansas City metro area. KDOT signed a thirty-year contract that will provide empty conduit and access points over 150 highway miles and telecommunications service to link department offices. The contractor receives barter compensation in terms of access to ROW for commercial telecommunications development. KDOT prefers to minimize safety impacts on its highway ROW. Therefore, it intends to allow telecommunications access to ROW only when such access is	Equipment to light fiber: no Operations & Maintenance: no* Stated ITS uses: Support traffic management and other operations of a Traffic Operations Center (TOC) jointly owned by Missouri and Kansas KDOT will receive 3 empty conduits with access points at all interchanges. It will also receive telecommunications service equal to OC-12 bandwidth from any of the private partners points-of-presence (POPs) located at thirty-mile intervals. (After the first 17 years of the contract term, the private partner will upgrade KDOT's service to OC-48 bandwidth.) To provide telecommunications service to devices along the ROW, KDOT is responsible for backhaul from ROW access points to the private partner's points-of-presence (POPs). That is, KDOT is responsible for pulling fiber through the conduits and providing any equipment and splicing necessary to light the fiber and connect devices along the ROW. *KDOT would be responsible for operations and maintenance of any fiber and equipment it installs. The private partner implicitly provides operations and

[12] John Muscatell, Colorado DOT, interview, April 1999.
[13] ITS America, "ITS America Member Announces Plans for A High-Speed Network in Colorado," as reported by PRNewswire, Omaha, NE, December 14, 1998.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
	necessary to provide infrastructure required for KDOT's own telecommunications network. It is possible that KDOT will accommodate additional telecommunications providers in its ROW in the future, but only as compensation for infrastructure specifically solicited through a request for bid process. *KDOT split its wireline shared resource program into two initial ROW offerings. Therefore, there will be at least two separate contracts and areas of construction. It is possible for the same contractor to win both ROW offerings. (This table entry refers to the first, Kansas City metropolitan area offering. See "In Negotiations" section below for details on the statewide arrangement, which is still in negotiations.)	maintenance for the OC-12 and OC-48 service.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
Maryland (Maryland State Highway Authority, SHA)[14] 1995	Number of vendors separately located in ROW: 2 Future trenches possible: yes Lead firm: yes Miles: 80 miles In 1994, two telecommunications firms negotiated 40-year, non-exclusive contracts to develop telecommunications infrastructure along a 75 mile ROW corridor. MCI is the prime contractor responsible for laying all fiber. TCG is a subcontractor to MCI, but offers separate compensation to the state.[15] Contracts may be renewed for two additional ten-year terms.[16] SHA only offered 75 miles in the original RFP. A Second RFP, which was statewide, received no response bids. A third RFP (also statewide) was issued in 1996 and is open until January 2000. Under this last RFP there has been one resource sharing agreement on five miles of SHA ROW near a crossing point off of the Potomac river.	Equipment to light fiber: yes (for TCG agreement) Operations & Maintenance: yes (for TCG agreement) Stated ITS uses: Two different telecommunications vendors (MCI and TCG) are included under the original 75-mile agreement. MCI contributes 24 dark fibers plus a one time $1 million payment to offset costs of telecommunications equipment.[17] (MCI did not provide equipment directly to light the fiber or access points at which to attach local devices). TCG contributes 4 lit and 20 dark fibers plus maintenance and upgrades. At least some of SHA's fiber has access points every half mile. Telecommunications needs analysis determined that the Maryland State Highway Authority needs a network that will cover 546 miles of state highway and interstate and can support video transmission and connection of devices located along the roadway. MSHA intends to use the network to transmit data (60 percent video) among a statewide communications center, satellite operations centers and other SHA facilities.
Minnesota (MNDOT) 1997 Minnesota (MNDOT), cont.	Number of vendors separately located in ROW: 1 Future trenches possible: no* Lead firm: yes Miles: 2,000 miles MNDOT has partnered with ICS/UCN to develop a 2,000 mile fiber optic backbone network on freeways and other trunk highways. The contract establishes the private partner as the exclusive point of contact and control for fiber in MNDOT interstate ROW for a ten-year period. The partner will enter into agreements with other telecom firms to collocate, sell, or lease system capacity.	Equipment to light fiber: yes Operations & Maintenance: yes Stated ITS uses: transportation management, traffic management center, connection ofdistrict and maintenance offices, weather/roadway information systems MNDOT's fiber optic backbone will consist of 48 strands of fibers in most locations using SONET technology and a multi-ring self-healing architecture. Capacity will be provided through single terminating equipment at 13 hubs and 17 MNDOT

[14] RFPs for Maryland SHA ROW were issued by Maryland Department of General Services and Department of Management and Budget.
[15] U.S. Department of Transportation, "Longitudinal Utility Accommodation: Case Studies for Trading Access to Freeway ROW for Wireline Telecommunications, Draft," Federal Highway Administration Office of Program Quality Coordination, OPQ 96-06, October 1996, p.7.
[16] U.S. Department of Transportation, "Longitudinal Utility Accommodation: Case Studies for Trading Access to Freeway ROW for Wireline Telecommunications, Draft," Federal Highway Administration Office of Program Quality Coordination, OPQ 96-06, October 1996, p.11.
[17] ITS America, "Shared Resource Projects: An Action Guide," pp.20-21.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
	*During the term of restricted access, MNDOT will not allow another firm to construct a second trench. It is also unlikely that the original partner would need or be permitted to construct a second trench. Future trenches are possible at the end of the term of restricted access.	regional offices. MNDOT receives 10 dark fibers on each ring, 20 percent of initial lit capacity, 20 percent of future lit capacity, pull boxes and fiber cable at specified locations in the state and share of partner's hut and pedestal space. Depending on MNDOT's needs, the terminating equipment will support DS-1,DS-3, OC-3 or OC-12 interfaces. Additionally, MNDOT receives $5 million in value of additional installed fiber and related equipment designed to serve and integrate MNDOT's ITS system. The State has the right to procure additional lit capacity at 80% of the most favored customers' rates and charges. Minnesota's transportation management and ITS programs required increased telecommunications capacity to support traffic management center functions, connection of 17 district and maintenance offices, and data collection and reporting for weather/roadway information systems. Without the shared resource arrangement, these transportation needs as well as other state communications needs would have been funded through increased expenditures for the state communications network, MNet.[18]
Missouri (MHTC) 1994 Missouri (MHTC), cont.	Number of vendors separately located in ROW: 1 Future trenches possible: no* Lead firm: yes Miles: 2,000 miles Through a competitive RFP process, Missouri Highway and Transportation Commission (MHTC) completed a shared resource agreement with Digital Teleport Inc. (DTI). DTI was granted exclusive access for the 40 year contract term to install fiber along 2,000 miles of state ROW including 200 miles of ROW in and around St. Louis. DTI has the right to approve any other firm's request for longitudinal telecommunications access to MHTC ROW that is greater than 1,000 yards.[19] DTI will sublease capacity to other telecom vendors. MHTC leveraged	Equipment to light fiber: yes Operations & Maintenance: yes Stated ITS uses: traffic surveillance and management, incident detection and management, traveler information, roadway weather information, and internal communications. In return for ROW access, DTI operates and maintains a dedicated, lighted bundle of 6 fibers with access points at interchanges, rest areas, and weigh stations[21] for MHTC use. DTI bears the cost of all parts of the system including installation, splicing, connections, operations, multiplexers, lasers, drivers, maintenance, and upgrades.

[18] ITS America, "Shared Resource Projects: An Action Guide," pp.22 and 24.
[19] U.S. Department of Transportation, "Longitudinal Utility Accommodation: Case Studies for Trading Access to Freeway ROW for Wireline Telecommunications, Draft," Federal Highway Administration Office of Program Quality Coordination, OPQ 96-06, October 1996, p.11.
[20] Missouri DOT, interview, April 1999.
[21] U.S. Department of Transportation, "Longitudinal Utility Accommodation: Case Studies for Trading Access to Freeway ROW for Wireline Telecommunications, Draft," Federal Highway Administration Office of Program Quality Coordination, OPQ 96-06, October 1996, p.11.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
	interest in urban areas to obtain statewide backbone, but the partner is now finding the rural areas profitable as well. MHTC's initial impetus was an RFP seeking a statewide network. Although infrastructure use is statewide, different areas of the state have greater need for ITS and were designated as priorities in the RFP. The first of these areas was St. Louis, followed by Kansas City and then rural areas.[20] The contract between MHTC and DTI does not specifically address the circumstance in which DTI cannot meet demand for system capacity. It appears that MHTC has not reserved the right to select a second private partner if DTI's system cannot meet demand for capacity. A second extensive trench/construction period is less likely. *During the term of exclusive access, MHTC will not allow another firm to construct a second trench. It is unlikely that the original partner would construct a second trench. Future trenches are possible after the 40-year term.	In the most recent amendment to the contract, MHTC gained infrastructure to hook up their district offices. This infrastructure represents around 2% of the total and is the only portion of fiber optics that is not on interstate rights-of-way.[22]
Oklahoma (Oklahoma DOT) 1998 Oklahoma (Oklahoma DOT), cont.	Number of vendors separately located in ROW: 1 Future trenches possible: yes Lead firm: no Miles: 88 Oklahoma DOT (ODOT) participates in an agreement with Oklahoma Turnpike Authority (OTA) and Indian Nations Fiber Optics. Public agencies get barter compensation in exchange for access to 225 miles of combined OTA and ODOT ROW. ODOT ROW contribution is approximately 88 miles.	Equipment to light fiber: no Operations & Maintenance: no Stated ITS uses: variable message signs, monitoring cameras, and video-based detection systems Oklahoma DOT receives: 80 miles of 12 dark fibers, 8 miles of 24 dark fibers, 60 fiber splices in the Oklahoma City area, 77 ground level pull boxes use of 24 miles of two empty conduits, installation, splicing, and patch panel connection for a continuous 4 fiber loop connecting an ODOT survey office with the H.E. Bailey Turnpike, and communications to remote ODOT offices through the use of OTA infrastructure[23]

[22] Missouri DOT, interview, April 1999.
[23] Newsletter of the ITS Cooperative Deployment Network, "Oklahoma Transportation Agencies Gain Wide-Ranging Fiber Capacity in New Agreement," available on-line http://www.nawgits.com/okfiber.html (downloaded 12/3/98).

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
Projects In Negotiation		
Kansas (KDOT) 1999[24] Kansas (KDOT), cont.	Number of vendors separately located in ROW: 1* Future trenches possible: yes Lead firm: NA Miles: 550 miles KDOT issued a request for bids for a statewide fiber optic telecommunications network. KDOT specified minimum requirements for the telecommunications infrastructure and listed a number of additional items that bidders could choose to offer. Bidders were permitted to request compensation for the telecommunications infrastructure in terms of cash, access to ROW for commercial telecommunications development, or some combination of the two. The requested network was to cover all KDOT interstates except for 150 miles in the Kansas City metro area, which were addressed in an earlier request for bids. KDOT is currently negotiating a thirty-year contract that would provide infrastructure over 550 interstate miles and telecommunications service to link department offices. The contractor will receive barter compensation in terms of access to ROW for commercial telecommunications development. KDOT prefers to minimize safety impacts on its highway ROW. Therefore, it intends to allow telecommunications access to ROW only when such access is necessary to provide infrastructure required for KDOT's own telecommunications network. It is possible that KDOT will accommodate additional telecommunications providers in its ROW in the future, but only as compensation for infrastructure specifically solicited through a request for bid process. *KDOT split its wireline shared resource program into two initial ROW offerings. Therefore, there will be at least two separate contracts and areas of construction. It is possible for the same contractor to win both ROW offerings. (This table entry refers to the second, statewide offering, which is still in negotiations. See the earlier KDOT entry for the completed Kansas City area agreement.)	Equipment to light fiber: no Operations & Maintenance: no* Stated ITS uses: Support traffic management and other operations throughout Kansas; coordinate ITS with Missouri KDOT is still in negotiations with the winning bidder. As of April 16, 1999, KDOT expected to receive 2 empty conduits with access points at all interchanges and access to a ribbon of 12 dark fibers in the private partner's conduit. It will also receive telecommunications service equal to OC-12 bandwidth from any of the private partners points-of-presence (POPs). (After the first 10 years of the contract term, the private partner will upgrade KDOT's service to OC-24 bandwidth.) To provide telecommunications service to devices along the ROW, KDOT is responsible for backhaul from ROW access points to the private partner's POPs. That is, KDOT is responsible for providing any equipment, operations, and maintenance necessary to light the fiber and connect devices along the ROW. *KDOT would be responsible for operations and maintenance of any fiber and equipment it installs. The private partner implicitly provides operations and maintenance for the OC-12 and OC-24 service.
Maryland (Maryland	Number of vendors separately located in ROW: 3* Future trenches possible: yes	Equipment to light fiber: NA

[24] Matt Volz, Kansas Department of Transportation, interview, 4/16/99. All information for this table was obtained from the aforementioned interview.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
State Highway Authority, SHA)[25] 1995	Lead firm: NA Miles: 300 miles * Total of new and existing separately-located vendors. Maryland is currently negotiating a fiber optic agreement with a single firm for access to 300 miles of ROW.[26] SHA has indicated that proposers may locate on ROW that already contains a trench/telecommunications infrastructure.	Operations & Maintenance: NA Stated ITS uses: NA
Virginia (VDOT) 1999 Virginia (VDOT), cont.	Number of vendors separately located in ROW: 1 Future trenches possible: yes Lead firm: yes Miles: 1,300 miles Term of Restricted Access: 20 yrs. As a result of an RFP process, VDOT is in negotiations with one telecommunications firm for a 1,300-mile fiber optic build-out that would cover the majority of Virginia's highway system. This infrastructure would also extend outside of interstate rights-of-way in order to connect district offices. According to VDOT, the partner would be granted exclusive access to VDOT ROW for a 20 year term, but must make infrastructure and capacity available to others. The partner must also ensure that the system has enough capacity for other private entities.[27] If demand for access to the telecommunications infrastructure on VDOT ROW exceeds the private partner's installed capacity, VDOT will issue another RFP for a second shared resource arrangement to provide additional telecommunications infrastructure.	Equipment to light fiber: yes Operations & Maintenance: yes Stated ITS uses: extensive – infrastructure will be the backbone of VDOT's entire ITS plan VDOT's system would be independent from its partner's. According to VDOT, the agency would receive 48 dedicated lit fibers in urban areas; 18 lit fibers in rural areas for VDOT use and potential use by other state agencies. VDOT will also receive fiber access points, although the exact number and frequency will not be determined until after the agreement is finalized. The private partner would provide operations and maintenance for the 20-year contract term.[28] VDOT seeks this infrastructure as a key component to its overall state ITS plan. Therefore, when VDOT initially issued its RFP, the agency gave priority to the firm that offered the largest system possible.[29]
Washington (WSDOT)	Number of vendors separately located in ROW: 1 Future trenches possible: yes	Equipment to light fiber: yes (some) Operations & Maintenance: yes (some)

[25] RFPs for Maryland SHA ROW were issued by Maryland Department of General Services and Department of Management and Budget.
[26] Alisoun K. Moore, MSHA, interview, April 1999.
[27] Virginia DOT, interview, September 1998.
[28] Kevin Barron, Virginia DOT, interview, April 1999.
[29] Kevin Barron, Virginia DOT, interview, April 1999.

TABLE 1: CHARACTERISTICS OF SHARED RESOURCE PROJECTS[8]		
Agency & Contract Date	***Project Features***	***Support for Transport Agency Communications***
	Lead firm: no Miles: 690 (approximately) Washington DOT is currently negotiating a shared resource arrangement with a telecommunications firm selected as a result of a competitive RFP process. According to WSDOT, the contract is expected to grant non-exclusive access for a 25 year term.[30] The RFP stated a preference for a statewide network, but did not prohibit firms with more limited interests from bidding. The RFP allowed WSDOT to select one or multiple firms to achieve a statewide network. WSDOT prefers to allow only one trench in interstate ROW. However, under the agreement, WSDOT may issue additional RFPs and select additional shared resource partners if it so chooses. WSDOT received two bids in response to this original RFP. The agreement will not specifically require the private partner to install excess capacity or empty conduits. WSDOT expects the private partner to install excess capacity to meet federal and state laws and follow good business practices.	Stated ITS uses: traffic cameras, road weather information systems, weigh-in-motion, traffic management According to WSDOT, the agreement will provide some quantity of lit and dark fiber, equipment, and access points.[31] Because contract negotiations are not complete, more specific information on the type and quantity of bartered goods is not yet available The purpose of the shared resource project is to enhance telecommunications service and competition throughout the state and support ITS telecommunications needs. The state's high commitment to universal service was a significant motivating factor for requesting a statewide network. Although statewide coverage provides a benefit to ITS deployment, coverage of rural areas was not strictly necessary for ITS reasons alone.

[30] John Milton, Washington DOT, interview, 4/13/1999.
[31] John Milton, Washington DOT, interview, 4/13/1999.

TABLE 2: DEGREE OF CONTROL OF SHARED RESOURCE PROJECTS, RANKED BY GEOGRAPHIC COVERAGE[32, 33]

State	National Highway System (NHS), Linear Miles Open to Traffic[34]			Shared Resource (SR) Projects		Geographic Coverage, Ratio: SR Miles/NHS Miles	Degree of Control Rating[35]	Type and Extent of Control
	Rural	Urban	Total	Miles	Contract Status			
Minnesota	3,255	697	3,952	2,000	*COMP*	0.51	3	*Physical control; fixed-term temporal control.* Physical access/management limited to selected firm for 10 years; other firms accommodated as collocators contracted before construction completed, and through purchase or sublease of system capacity. No explicit arrangements for expanding public or private capacity if capacity runs out prior to 10 year term.
Missouri	3,379	980	4,359	2,000	*COMP*	0.46	3	*Physical control; fixed-term temporal control.* Physical access/management limited to selected firm for 40 years; other firms accommodated through purchase or sublease of system capacity. No explicit arrangements for expanding public or private capacity if capacity runs out prior to 40 year term.
Virginia Virginia, cont.	2,194	1,252	3,446	1,300	*INCOM*	0.38	3	*Physical control; capacity-dependent temporal control.* Physical access/management limited to selected firm for 20 years; selected manager must make infrastructure and capacity available to other firms and must ensure that system has sufficient capacity to do this. VDOT reserves the right to issue another RFP if demand for ROW access exceeds private manager's installed (excess) capacity.

[32] This table includes projects that are completed and projects that are in progress. Information on shared resource projects presented in the table is based on most recently available information from the agencies that are participating in these projects.

[33] Geographic coverage for each state is defined as: [miles of ROW containing telecommunications infrastructure from shared resource projects/miles of National Highway System]. See text for more detailed explanation.

[34] Source: *Highway Statistics 1997*, Table HM-30 "National Highway System Length - 1997, Miles Open and Not Open to Traffic"; U.S. Department of Transportation, Federal Highway Administration; p. V-32 (mileage data for Maryland is for 1996).

[35] Degree of control rating defined as follows: 3=no physical or temporal controls; 2=temporal control only; 1=temporal and physical controls (and physical controls are explicit and assured for a given time period, not by default). See text for more detailed explanation.

TABLE 2: DEGREE OF CONTROL OF SHARED RESOURCE PROJECTS, RANKED BY GEOGRAPHIC COVERAGE[32, 33]

State	National Highway System (NHS), Linear Miles Open to Traffic[34]			Shared Resource (SR) Projects		Geographic Coverage, Ratio: SR Miles/NHS Miles	Degree of Control Rating[35]	Type and Extent of Control
	Rural	Urban	Total	Miles	Contract Status			
Colorado	2,604	752	3,356	1,200	*COMP*	0.36	2	*Physical control for limited period; no other physical or explicit temporal controls.* Physical access limited to one firm during 1-2 year construction period; after this CDOT will consider requests from other vendors for projects requiring ROW access to same ROW for at least 5 years from date of initial RFP issue. After this window closes, CDOT may decide to extend the RFP period or issue another RFP if it still lacks a comprehensive system.
Maryland	789	649	1,438	380	*INCOM*	0.26	2	*No physical control; fixed-term temporal control for current statewide solicitation*. Original project has two participants. Neither original project nor current RFP places controls on physical access to ROW, i.e., no guarantees against additional firms in same ROW. Current project has limited window for bids; no policy against future solicitations.
Washington	2,577	820	3,397	690	*INCOM*	0.20	2	*No assurance of physical control; DOT-determined temporal control.* Uses competitive RFP process but no assurances to selected vendor that other vendors will be denied direct access. WSDOT may issues additional RFPs and select additional partners if/when it chooses to do so.
Kansas	3,307	418	3,725	700	*INCOM*	0.19	2	*No guaranteed physical control*; *DOT-determined temporal control*. Although there could be de facto control on physical access, KDOT offers no guarantees to telecom providers. Whether or not other private firms gain direct access to ROW depends on whether or not KDOT decides to issue new RFP to gain additional telecom capacity for its needs.
Arkansas	2,217	385	2,602	450	*COMP*	0.17	1	*No physical or temporal controls except for physical limit on space available in designated 10 foot-wide telecom infrastructure corridor on interstate highways.* Note however that initial three partners sublease from each other wherever they overlap (I.e., single manager on any specific ROW).
Oklahoma	2,831	480	3,311	88	*COMP*	0.03	1	*No physical or temporal controls.* Currently one private vendor but others could gain access as well.

TABLE 3: TELECOMMUNICATIONS INFRASTRUCTURE FROM SHARED RESOURCE PROJECTS, RANKED BY GEOGRAPHIC COVERAGE[36, 37]

State	National Highway System (NHS), Linear Miles Open to Traffic[38]			Shared Resource (SR) Projects		Geographic Coverage, Ratio: SR Miles/NHS Miles	Degree of control Rating[39]	Project Support for ITS Telecommunications (from Table 1 of paper)
	Rural	Urban	Total	Miles	Contract Status			
Minnesota	3,255	697	3,952	2,000	*COMP*	0.51	3	*Equipment, operations & maintenance for telecom backbone*
Missouri	3,379	980	4,359	2,000	*COMP*	0.46	3	*Equipment, operations & maintenance for telecom backbone*
Virginia	2,194	1,252	3,446	1,300	*INCOM*	0.38	3	*Equipment, operations & maintenance for telecom backbone*
Colorado	2,604	752	3,356	1,200	*COMP*	0.36	2	*Equipment but no operations & maintenance*
Maryland*	789	649	1,438	380	*INCOM*	0.26	2	*Equipment, operations & maintenance for a portion of capacity in telecom backbone in original I95 project; current RFP not resulted in contract yet.*
Washington	2,577	820	3,397	690	*INCOM*	0.20	2	*Some equipment, some operations & maintenance support; still in negotiation.*
Kansas	3,307	418	3,725	700	*INCOM*	0.19	2	*No equipment, no operations & maintenance support; receiving empty conduits and dark fiber plus OC-12 from POPs*
Arkansas	2,217	385	2,602	450	*COMP*	0.17	1	*Equipment, operations & maintenance plus empty conduit*
Oklahoma	2,831	480	3,311	88	*COMP*	0.03	1	*No equipment and no operations & maintenance; public agency receives dark fiber and some empty conduit space.*

[36] This table includes projects that are completed and projects that are in progress. Information on shared resource projects presented in the table is based on most recently available information from the agencies that are participating in these projects.

[37] Geographic coverage for each state is defined as: [miles of ROW containing telecommunications infrastructure from shared resource projects/miles of National Highway System]. See text for more detailed explanation.

[38] Source: *Highway Statistics 1997*, Table HM-30 "National Highway System Length - 1997, Miles Open and Not Open to Traffic"; U.S. Department of Transportation, Federal Highway Administration; p. V-32 (mileage data for Maryland is for 1996).

[39] Degree of control rating defined as follows: 3=no physical or temporal controls; 2=temporal control only; 1=temporal and physical controls (and physical controls are explicit and assured for a given time period, not by default). See text for more detailed explanation.

ANALYSIS

The data and analysis presented in this report indicate a correlation between controls on direct access to ROW for infrastructure on limited access roadways and the level of statewide, geographic coverage for broadband telecommunications. Table 2 clearly shows that the majority of programs (seven of nine) involve significant control by the state agencies. As discussed below, three of the nine impose physical controls as well as temporal. One program imposes a short period of physical control (construction period) but the window of opportunity for additional projects is guaranteed open only for 5 years from RFP issue. Three other programs have "open access" periods that, once closed, will only be reopened when the public agency sees fit. If the public agencies' needs are well met by the partners gained in the initial program period, the four agencies with state-determined temporal controls might never reopen the proposal window, thus imposing de facto strict controls on future direct access.

Although the sample is limited, data also indicate a relationship between access control and provision of telecommunications capacity and support services to meet transportation management needs. That is, it appears that state agencies are able to better leverage ROW assets to achieve public sector social and telecommunications objectives when ROW access is constrained.

Data in Table 2 support the proposition that there is a correlation between degree of control and geographic coverage. Ranking projects by geographic coverage, Table 2 indicates that the top three programs in terms of geographic coverage (Minnesota, Missouri, and Virginia with ratios of 0.51, 0.46, and 0.38 respectively) are all characterized by physical and temporal control. The fourth ranked project (Colorado, with coverage ratio of 0.36) has physical control only during the construction period, which provides the vendor with at least a head start on competitors seeking access to the ROW. Moreover, the "open access" period is only assured for five years from the date of RFP issue, although agency officials are currently committed to extending the open period if they do not meet their coverage objective within that five year period. The next three programs (Maryland, Washington, and Kansas with coverage ratios of 0.26, 0.20, and 0.19 respectively) all include temporal controls, although the opportunity period for open access varies. Of these three programs, the one with the greatest coverage has a fixed period of open access and then state DOT-determined temporal control (i.e., the time period of control depends on when the state DOT decides to issue a new RFP). The other two with somewhat lower coverage have state DOT-determined temporal controls. With agency-determined temporal control, a new RFP could be forthcoming very soon after the initial program but, since the period is based on DOT telecom needs for transportation, it is more likely to be farther into the future given the infrastructure being installed under the initial programs. The public agencies do not limit the number of partners allowed onto the ROW during the program window but, by imposing temporal limits, they do control the period during which such access will be sanctioned. This, of course, de facto limits the number of firms gaining entry.

The last two programs are categorized as fully open. Of these, Arkansas attains geographic coverage (ratio of 0.17) only slightly less than the two higher ranked programs, which have DOT-determined temporal controls.

Shared resource arrangements with broad geographic scope both enhance universal service and support transportation management needs. However, to meet transportation needs, arrangements must not only provide broad geographic scope, but also deliver sufficient telecommunications capacity and support services to enable intelligent transportation system (ITS) deployment. Therefore, it is not only necessary to compare the geographic scope of projects, but also the equipment and services provided to the public agency.

Data in Table 3 suggest that maximum control of ROW access (physical and temporal) may also promote greater technical support for public sector ITS and other transportation communications needs, although the relationship is less consistent for "partially controlled" and "open access" programs. The three fully controlled programs have not only the greatest coverage but also full equipment, operations and maintenance support for their systems. Of the partially controlled programs, one (Maryland) gains much but not all of the equipment and maintenance required for the backbone installed in its initial project along a heavily traveled interstate; support for telecommunications needs from the second project has not yet been determined. Similarly, projects in the other two partially controlled programs (Washington and Kansas) are still in negotiation and thus still uncertain, although it would appear that full equipment, operations and maintenance are not expected. For example, most recent information indicates that KDOT will receive a combination of empty conduit along the ROW and OC-12 bandwidth *starting at the private partner's points-of-presence (POPs).* This means that KDOT must either pull fiber or separately purchase service between its access points on the ROW and the private partner's POPs.

Of the open programs, Arkansas is an anomaly – the state will receive equipment, operations and maintenance, and empty conduit for the current project.

Taken together, data from both Tables 2 and 3 support a preliminary conclusion that temporal control coupled with control on direct physical access can generate more technically, operationally, and geographically complete networks in support of public sector programs. The advantage of partial control over open access is less clear. The greater coverage associated with more fully controlled program also, of course, supports the social objective of universal broad band service.

This report considered only the impact of access policy on the quality of shared resource arrangements obtained by transportation agencies. In addition to the degree of control exercised by the public agency, several other factors may determine the quality of shared resource arrangements. This report does not attempt to analyze the impact of these other factors, which include, but are not limited to, the following:

- Form of real property right (i.e., easement, lease, franchise, license),
- Access for maintenance,
- Details of compensation and payment mechanisms,

- Liability (relating to system repair, tort actions, and consequential damages)
- Environmental liability,
- Agency responsiveness to time constraints,
- Responsibility for relocation,
- Flexibility of RFPs, and
- Negotiating skills.

CONCLUSIONS

The data and analysis presented in this report indicate that there is a correlation between projects that control access and projects that achieve a high level of statewide geographic coverage and sufficient telecommunications capacity and support services to meet transportation needs. That is, agencies that restrict direct physical access to ROW and/or restrict the window of opportunity for project approval may be more successful in leveraging ROW assets to obtain statewide deployment of technologically advanced telecommunications infrastructure that will enhance universal service and support transportation management needs.