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16. Abstract In 1996, the U.S. and Mexico passed legislation to deregulate their telecommunications industries. In both countries, telecommunications deregulation dramatically changed the nature of the competitive relationships between telecommunications service and equipment providers, as well as the changing nature of the market in general. These changes will affect the development and use of individual telecommunications technologies, and will also affect the nature of public-private partnerships for the research, development, and deployment of intelligent transportation systems (ITS), particularly at the U.S.-Mexico border. Regulatory changes in the telecommunications sector will affect many of the technologies that form the foundation of ITS, and will also change the nature of the market for telecommunications services and equipment. This study explores in a nontechnical fashion the major provisions of each Telecommunications Act and how deregulation may affect the research and eventual deployment of ITS at the national and state level. This study also specifically addresses how deployment of ITS in the U.S.-Mexico border region may be affected by the interaction of two simultaneously changing telecommunications markets.					
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**EFFECT OF TELECOMMUNICATIONS DEREGULATION
ON THE DEPLOYMENT OF INTELLIGENT TRANSPORTATION
SYSTEMS IN TEXAS AND AT THE U.S.-MEXICO BORDER —
SUMMARY REPORT**

by

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Research Report 97/03
Research Project IB-01: Improve Transportation Efficiency in the U.S.-Mexico
Border Area Through the Use of ITS

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EXECUTIVE SUMMARY

In 1996, the U.S. and Mexico passed legislation to deregulate their telecommunications industries. In both countries, telecommunications deregulation dramatically changed the nature of the competitive relationships between telecommunications service and equipment providers, as well as changing the nature of the market in general. These changes will affect the development and use of individual telecommunications technologies, and will also affect the nature of public-private partnerships for the research, development, and deployment of Intelligent Transportation Systems (ITS), particularly at the U.S.-Mexico border.

Regulatory changes in the telecommunications sector will affect many of the technologies that form the foundation of ITS, and will also change the nature of the market for telecommunications services and equipment. This study explores in a non-technical fashion the major provisions of both Telecommunications Acts and how each may affect the research and eventual deployment of ITS at the national and state level. This study also specifically addresses how deployment of ITS in the U.S.-Mexico border region may be affected by the interaction of two simultaneously changing telecommunications markets.

As a result of the 1996 Act, long-distance and local telephone service providers can, in theory if not in practice, compete in each others' markets. Service providers are now competing to capture the biggest market area and market share. This has resulted in, among other things, service "bundling," huge mergers, and many important questions regarding the use and valuation of right-of-way.

Right-of-way along state highways has become an extremely valuable resource. Many state Departments of Transportation (DOTs), by entering into "shared resource" projects with private sector telecommunications providers, are trying to leverage this resource in an attempt to gain additional capacity for state-owned networks. Crucial issues for states when considering such partnerships are whether to lease or own this network, who to choose for a partner, and how to structure the partnership. Answers to these questions often depend on how much of the state network is (or will be) devoted to ITS. Complex, high-bandwidth ITS applications are expensive to design, build, and maintain, particularly over the long-term.

The push toward industrial privatization in Mexico has now reached the telecommunications sector. Mexico's 1995 telecommunications legislation concentrated on privatizing Telmex and introducing competition to the long-distance market. Currently, there are three major long-distance service competitors to Telmex (which is partnered with SBC). Each of these competitive entities includes a major U.S.-based service provider — AT&T/GTE, MCI, and Bell Atlantic. The involvement of these firms may open the door for the eventual deployment of advanced telecommunications-based transportation technologies in Mexico, and could conceivably make it easier to install ITS systems at the border and in Mexico's interior to reduce congestion and facilitate trade.

It is clear that the U.S. in general, and each of its states in particular, will be affected by the new telecommunications legislation passed in the U.S.. U.S. states along the border with Mexico will also have to address the affect of the Mexican telecommunications reorganization and assess how it will impact their trade and communications with Mexico. It is abundantly clear that many of these effects are not yet known.

The Acts' effects on the development and deployment of ITS will also be hazy for the time being, partly because the impact of ITS in general has yet to be assessed, and partly because ITS systems have yet to be deployed and used on a widespread basis — especially at the border. However, it is reasonable to assume that the increasingly interdependent relationship between telecommunications and transportation, combined with the changing competitive atmosphere of the telecommunications industries in both the U.S. and Mexico, will have a marked effect on the development, deployment, and use of ITS in the U.S. and at the U.S.-Mexico border.

Wireline and wireless telecommunications systems are the keys to building a national ITS infrastructure. Although the 1996 Act opened the telecommunications industry to competition nationwide, and the FCC has issued benchmarks, guidelines, and rules for regulatory change, each state is free to issue its own rules and guidelines for interconnection. Some state public utility commissions (PUC's) have been more aggressive than others in setting these rates and rules. State officials should consider it their responsibility to respond proactively to the changes the new telecommunications legislation will bring. They should develop strategies to take advantage of new opportunities and to ensure that they are not adversely affected by the mergers and alliances that are the apparent by-product of the legislation. They should ensure that their state's telecommunications sector is developed to support long-term economic plans.

State Utility Commissions and state DOTs are pivotal in this respect. State Utility Commissions will set the tone for how each state will address telecommunications competition by regulating how it will occur, and how much it will cost. DOTs must assess from a cost/benefit (or other) standpoint whether to lease or own the state network (or pieces of it), and attempt to decide on the nature of use and development of right-of-way. The speed at which these decisions are made is crucial to their success and usefulness.

DOTs in states located at the U.S. border with Mexico should also take into account the state's function as a major crossing point for U.S.-Mexico trade. Expediting and managing this trade, and its related transportation movements, is a telecommunications technology-intensive task heavily dependent on the commitment (both political and financial) of state DOTs to deploy ITS at border crossings. Long-range planning with Mexico is also particularly important when developing transportation-related infrastructure, of which telecommunications is an integral part.

In creating these strategies and policies for telecommunications, state agencies should seek the counsel, advice, and involvement of major service and technology providers, as well as transportation and telecommunications research organizations. By doing so, state agencies will find it easier to make the necessary changes to their operations and will be on their way toward creating

a comprehensive and integrated telecommunications infrastructure conducive to meeting requirements for economic development in the future.

Certain issues will be important for federal, state and local governments, as well as the private sector, to track. When reading this study, there are a series of questions and issues to keep in mind. These issues include:

- The extent to which public-private partnerships have formed or not formed for the purpose of research and/or deployment of telecommunications based systems, such as ITS.
- The position and attitude each state takes with respect to telecommunications deregulation — which states are taking a pro-competition stance, which ones are not, and how each state is managing its responsibility to set the ground rules and interconnection fees for competition in the local market.
- The manner in which states are or are not attempting to pursue “shared resource” projects for right-of-way and for ITS with private telecommunications providers and whether or not each state’s strategy (partnering or not partnering, and, if partnering, the structure of the partnership) has been successful. A related issue to watch is whether or not the window of opportunity for these projects is closing.
- The extent to which U.S. telecommunications providers’ involvement in the Mexican long-distance market will or will not affect the deployment of ITS systems at the border and in the interior of Mexico.

THE TELECOMMUNICATIONS ACT OF 1996

The rapid convergence and integration of new voice, video, sound, and data technologies has set off a wave of legislation designed to facilitate competition in the telecommunications industry. The U.S. and Mexico have both recently overhauled their telecommunications regulations—the U.S. in February 1996 and Mexico in May 1995. These acts have far-reaching implications for the future of a variety of technologies that form the foundation of ITS.

News of deals, partnerships, and alliances between telecommunications firms can be found every week, if not daily, in the business section of almost any major newspaper. Structural shifts in the industry are being caused by the combined effects of the 1996 Act and the rapid evolution and convergence of telecommunications technologies with advanced transportation management systems. Because of the increased capacity of fiber-optic cables to carry high-speed, multimedia digital information, the fiber-optic network (particularly well-suited to ITS) has steadily become more important to the world of commerce. The ability to make data transfers and multimedia transmissions from fixed, mobile, or remote sites has revolutionized transportation. As the importance of telecommunications to economic activity increases, the relationship of transportation to telecommunications will become stronger.

Stakeholders in the telecommunications and transportation industries realize that legislation affecting the development and marketing of telecommunications technologies, or the competitive environment in which these technologies and systems exist, will significantly impact ITS.

PROVISIONS OF THE TELECOMMUNICATIONS ACT OF 1996

Signed on February 8, 1996, the Telecommunications Act of 1996 (the “Act”) dramatically changes the ground rules for competition and regulation in virtually all sectors of the communications industry, from local and long-distance telephone services, to cable television, broadcasting, computer services, and equipment manufacturing. The 1996 Act’s provisions fall into five major areas:

- telephone service,
- telecommunications equipment manufacturing,
- cable television,
- radio and television broadcasting, and
- the Internet and on-line computer services.

In each of these major areas, a variety of cross-market entry barriers have been eliminated, market/geographical concentration and merger rules relaxed, and new obligations placed on the FCC and state regulators, particularly in the area of monitoring “appropriate content.” Briefly, long-distance and local telephone companies are now able to compete in each other’s markets, and they can also offer video services over phone lines, competing directly with cable providers. Cable operators can now enter the telephone market, and the federal regulations governing cable rates will gradually be lifted. The Act relaxes limits on the number of television and radio stations a single

company can own, and also requires television sets to be equipped with a “V-chip” to block violent programming. The bill also imposes criminal penalties for knowingly transmitting “indecent” material on the Internet (however, this provision is currently being debated in the United States court systems).

Some sections of the 1996 Act are self-executing, but in many cases the FCC must first issue regulations that indicate the specifics by which many of the provisions should be carried out and the procedures and rules by which cable operators, state public utility commissions (PUCs), and others must operate in order to implement the regulatory changes the law demands. The Act imposes deadlines on the FCC for issuing these regulations.

SERVICE BUNDLING

Long-distance providers, regional Bell companies, cable television operators, satellite operators, Internet providers, digital wireless service providers, state utility commissions, and perhaps even local power companies all want to move into each other’s markets. These companies are taking advantage of the provisions in the 1996 Act that allow single communications companies to offer bundled services outside of their “core” activities. Bundles can include combinations of local, long-distance, wireless service, cable television service, Internet service, and perhaps even electricity and home monitoring services.

It is generally assumed that bundling, combined with firms’ ability to cross over into a variety of telecommunications markets, will work to keep prices low and competitive for individual users. Service providers anticipate that bundled services will help attract “lifetime” customers by providing all the competitively priced, technologically advanced services a customer could want in a “one-stop-shopping” format. They also hope that bundling will maximize revenues as customers use more of their services; the profits will go to the carriers that have the maximum number of services in their bundle and market this bundle to the users with the most money to spend.

Competition through “bundling” has already pushed a variety of telecommunications service and equipment providers to forge alliances to remain viable; the success of the bundling concept in many respects depends on the number of consumers in each provider’s market and how big geographically the provider’s market is. It is *unclear* who will be the winners and losers in an environment filled with new partnerships for expanded services and expanded coverage areas.

PARTNERING AND ALLIANCES

Partnering between telecommunications service providers is the flip side of the telecommunications competition coin. If competition theoretically allows smaller companies to get into the markets that have historically been the domain of the giant telecom corporations, competition also paradoxically encourages the development of huge telecommunications mergers, and we have already begun to see these occur.

Bell Atlantic and NYNEX announced their \$23 billion merger (the second-largest merger deal in U.S. history) in April 1996, as did SBC Communications (the parent company of Southwestern Bell) and Pacific Telesis Group. The logic of these mergers is partly based on the need to add value to already existing networks and partly based on the necessity of making the transition to bundling and long-distance services more profitable by avoiding some of the costs associated with interconnection through linked and adjacent geographical areas. The only way to make the bundling concept work is by taking advantage of economies of scale—in the telecommunications business, this most often means geographical interconnectedness.

The 1996 Act left responsibility for the regulation of many of these activities to the FCC, and the FCC in turn has given the states wide latitude to modify FCC regulations. The FCC has indicated certain minimum points of interconnection necessary to permit competing carriers to operate efficiently, and has also set guidelines on a minimum list of unbundled services that incumbent local telcos must make available to new entrants upon request. The FCC also has decided on other contentious issues, such as interconnection fees. The FCC finalized its decisions on many of these issues in August 1996, and there are already court challenges to these rules by the long-distance operators and the Bells.

CHALLENGES TO THE FCC “RULES OF ENGAGEMENT”

Regulations were issued in August 1996 by the FCC to establish minimum benchmarks for how and at what prices competitors may plug into the Bells’ local telephone network. The FCC has ordered the Bells to sell their local services at a 17 to 25 percent discount off retail rates; the Bells argue that 5 to 10 percent would be more reasonable and are hoping that they can persuade state utility regulators to go lower than the FCC’s recommended discount. States may approve smaller discounts provided they conduct extensive cost analyses to show that the lower rates are warranted.

The Bells are also challenging the FCC’s directive to provide network components on an “a la carte” basis—they have historically resisted unbundling these components to make them available to competitors, citing that they are unique assets and expensive to maintain. In addition, they are challenging the provision requiring them to allow long-distance and cellular competitors to avoid paying access charges to have their calls completed; these charges add up to almost \$25 billion a year and, for many states, help subsidize universal service goals. The Bells fear that if they do charge these fees, competitors could simply install their own switches and then lease local loops by themselves.

TECHNOLOGICAL ADVANCEMENT

Another effect of the Act may be a dramatic increase in the use of wireless telephony and related services, as well as the Internet—which can now be accessed over wireline or wireless systems, and via satellite and cable through your television. Advanced telecommunications-based technologies

comprise an increasingly large part of many business operations because their costs are much lower than they used to be and because they are much more important to business operations than before.

The ability of telecommunications service and equipment providers to move into markets previously off limits may also encourage these firms to invest in research and development in new technologies and in new fields, such as ITS. What is almost certain is that technology and service delivery will advance as each type of provider attempts to win over customers in new markets. These customers will include the lucrative public sector, in particular state DOTs—that usually not only own the right-of-way but also operate extensive and complex private telecommunications networks that, among other things, support ITS. The explosive growth of wireless, combined with the big push to install fiber-optic cable, has led to a land rush for public right-of-way.

POSSIBLE IMPACTS OF THE 1996 ACT ON ITS

A fundamental and potentially costly component of the ITS architecture is telecommunications technology. The 1996 Act, by changing the competitive and regulatory atmosphere in which telecommunications technologies and systems exist, will not only affect the development of standards for equipment and service provision, but also influence the choice of technology and service provider. These choices, combined with the effect of "bundling" and partnering, will mean that the costs of this critical component of ITS will vary more than in the past and become a more complex facet of transportation systems planning. Informed decision making is imperative.

Because there are so many ways that telecommunications technologies in support of ITS can be grouped and used together, standards for their use individually and as part of networks are important. These standards, which form the basic requirements for interaction between components of the ITS architecture, can encourage wider and more efficient use of ITS.

ITS National Architecture (NA) documentation, developed by the U.S. DOT's Joint Program Office (JPO), has developed several guidelines for state and local agencies venturing into ITS research and deployment. The NA program has a number of recommendations on how DOTs can tie together users and services on a single advanced telecommunications network. Although the NA does not recommend specific technologies for a particular ITS activity or component, it does recommend appropriate interfaces between the various elements of ITS and outlines the options available for the three basic ITS communications media: wireline, wireless, and vehicle-to-roadside. The NA guidelines also provide a list of standards, some in telecommunications applications, that are considered vital to ITS deployment. These standards may indeed help to guide the creation of public-private partnerships for the deployment of ITS.

THE ROLE OF THE STATES

The divestiture of AT&T in the mid-1980s opened new options for states in the regulation of telecommunications by encouraging them to examine their telecommunications networks and to reconsider (or consider for the first time) how telecommunications would impact economic development within the state. States were forced to think more closely about the nature of their telecommunications use, the costs associated with use (local rates and long-distance rates), and the costs/benefits of modernization. States began to understand that telecommunications was an investment that could promote (or hinder) economic development. The growing importance of telecommunications in government, defense, and most importantly, the global marketplace made states (and their public utility commissions) key players in the telecom market. States vary widely, however, in their approach to telecommunications regulation.

The decisions made by the states in the next few years regarding telecommunications infrastructure and choice of service providers are extremely important. For example, increased trade with Mexico, combined with population growth, places border states squarely in the center of a variety of telecommunications and transportation issues. Texas cities with transportation management centers

(TMCs), such as Houston and San Antonio, have a big stake in the outcome of decisions that the Texas Department of Transportation (TxDOT) will make with regard to ITS telecommunications standards and equipment, right-of-way, choice of provider for shared resource projects or interconnections, and levels of technological advancement (which come at a cost).

Border cities such as Laredo, El Paso, Nogales, and San Diego are prime targets for the deployment of a variety of ITS technologies, not just state- and city-supported initiatives, but federally funded programs such as the North American Trade Automation Prototype (NATAP). Border states must be ready to meet these and other telecommunications challenges, and do so in a way that not only encourages economic development but facilitates cooperation with other states.

PARTNERING, COMPETITION, AND RIGHT-OF-WAY

Many state DOTs operate their own telecommunications network to support various transportation-related activities, particularly ITS. Many have traditionally believed that, for the purposes of statewide operations, it is better for the agency to build and maintain its own network along state right-of-ways as long as such a responsibility is practical. As telecommunications technologies and services become more expensive and complex, many DOTs are rapidly reaching a point where the state-run network is becoming too expensive to construct and maintain without a private-sector partner. In addition, now that long-distance and local telecommunications providers can compete in each other's markets and offer bundled services, DOTs must decide which firm to work with and what kind of services they want should they choose to enter into a partnership with a private sector service provider.

Should a state DOT seek private-sector telecommunications service providers as partners to boost state-network capacity and assist in network maintenance? Will different communications routes and stretches of right-of-way be served by different service providers? If so, what are the implications for this kind of arrangement politically and financially? Will state DOTs impose some regulations on rates and fees for all operators wishing to do business with the state, or choose providers on the basis of competitive bidding (assuming all providers have access to all local wireline infrastructure, which may or may not be the case)? These and other questions presage a difficult road ahead for many state DOTs in defining the role they must begin to play in the future development of state telecommunications infrastructure.

These difficulties are compounded by the historic lack of involvement on the part of many private telecommunications service providers in ITS activities. The ITS NA, for example, was developed almost exclusively by a combination of transportation and defense industry participants. This is slowly beginning to change as telecommunications firms begin to see opportunities for their involvement as a consequence of the 1996 Act.

The Bells seem to vary greatly regarding their desired role in the future research, development, and deployment of ITS. Two Bells, Southwestern Bell and Bell Atlantic, are generally perceived as aggressive in their pursuit of new business opportunities in the field of ITS. Reactions of the other

Bells seem lukewarm. Many industry analysts believe, however, that as the Bells become accustomed to working with transportation applications in general, they will begin to see opportunities for partnerships for ITS and other state-network services. The interest, cooperation, and support of private-sector providers may make many states' decision-making processes easier.

RIGHT-OF-WAY ISSUES

Clearly, total control over a network allows a state to operate ITS technologies free from interference. A DOT could design a custom network emphasizing major thoroughfares and designed specifically to meet the needs of the agency and its personnel; it could retain control over its own technology and depreciate costs over the life of a system. In addition, the DOT already owns the right-of-way. Despite the advantages of a state-run network, however, there are some disadvantages, and in light of the changes caused by the 1996 Act, some of these disadvantages are significant.

It is reasonable to ask why state-run telecommunications networks have become so complex and costly. For many states, the answer lies in the addition of ITS to the telecommunications equation. Networks that must support ITS applications are complex, high-bandwidth creatures. What makes the networks that support ITS so complex and costly is, first, the video component; second, the extent of data linking and distribution requirements; and third, the reliability requirements stipulated for the network. Then there is the other factor—upgrading. With technology turnover occurring so frequently, a state DOT would have the added responsibility and expense of overhauling the entire network on a fairly frequent basis and hiring personnel with advanced training in telecommunications engineering to maintain it. Many states also have not yet conducted adequate analyses that would help them to make a realistic assessment of whether to lease capacity or build it.

The use of highway right-of-way for telecommunications and other public utilities is common. Many states have started partnering with private firms for exclusive use of certain areas of the right-of-way. This “exclusive use” is a valuable commodity because states usually do not allow firms to have exclusivity in the traditional utility corridor. Sharing the public resource of right-of-way with private telecommunications providers in exchange for telecommunications capacity and related network services, also known as “shared resource” projects, is considered a special form of public-private partnering. It can further the interests of both the state and the private sector because each shares in the resource of right-of-way and the resource of telecommunications capacity. These shared resource projects are especially relevant to the development, deployment, and operation of ITS technologies. Despite different system architectures in many ITS projects, almost all anticipate or require the use of infrastructure in or on longitudinal right-of-way to link system components.

Although ITS systems can be installed, owned, and operated exclusively by the public sector, shared resource projects offer cash-strapped public-sector agencies a way to achieve implementation of ITS with a lower financial burden, and also allow the public-sector agencies in charge of ITS implementation to obtain state-of-the-art equipment and technologies. Because the 1996 Act changes the nature of competition in the telecommunications industry, states must be aware of how these “partnerships” with telecommunications providers, existing and anticipated, will be affected.

MEXICO'S TELECOMMUNICATIONS INDUSTRY

Building a more modern infrastructure capable of moving goods and individuals rapidly and efficiently is one of the most important goals of every nation; the existence of infrastructure designed to support commerce is also of great importance and includes both transportation and telecommunications networks. Large-scale infrastructure development projects are often expensive and difficult to finance solely through tax revenues or other kinds of internal resources. In many cases, governments faced with this problem have decided to privatize what had previously been government-owned and -operated enterprises. Efforts at privatization in Mexico's telecommunications sector over the past few years have dramatically improved the operation of this important sector of the economy and made it a tool for economic development and progress.

Mexico began to restructure its telecommunications industry in the late 1980s as part of a general program of economic reform. In 1989, the government announced its intention to privatize Telmex, and in 1990, 51 percent of Telmex was purchased for \$1.758 billion by a consortium comprised of Southwestern Bell, France Telecom, and Grupo Carso, a Mexican conglomerate.

At that time, the Mexican government also opened up local telecommunications services and mobile communications to competition and decided that the long-distance sector, one of the most profitable segments of the telecom market, would be reserved for Telmex until 1997. The continuation of Telmex's long-distance monopoly involved a tradeoff, however. Telmex was required to expand its number of subscribers by at least 12 percent per year (which it has achieved), as well as to provide telephone service to all towns of more than 500 inhabitants by 1994, a task that is almost complete.

Telmex and its partners have employed a variety of telecommunications technologies, including standard copper wires, fiber-optic lines, and cellular, satellite, and microwave technologies to improve service in Mexico. Mexico's long-distance infrastructure, for example, is comprised of a microwave and fiber-optic "backbone" network linking 54 major cities throughout Mexico. AT&T constructed 60 percent of this network in partnership with Telmex. In 1991, AT&T began the construction of five cross-border fiber-optic cables designed to not only handle international residential calls between the U.S. and Mexico, but also to provide businesses with data transmission and facsimile services. Sprint operates several cross-border fiber-optic cables as well.

MEXICO'S 1995 TELECOMMUNICATIONS LAW

In mid-January 1995, the Mexican Congress agreed to amend the Mexican Constitution and remove satellite communications from the list of strategic areas in which the Mexican government is legally required to hold a monopoly, and to further privatize Telmex, the national satellite carrier. Following extensive modification, Mexico's Senate passed the legislation in April 1995, with the Chamber of Deputies passing it in May 1995. The legislation introduces a wide range of opportunities for competition and new entry (both domestic and foreign) into Mexico's telecommunications market, and includes a full reorganization of the SCT. Some of the provisions of Mexico's 1995 Act include:

- amendment of Article 28 of the Mexican Constitution to permit privatization of, and encourage competition in, the Mexican satellite industry;
- increase in foreign ownership limits to 49 percent for most telecommunications services;
- establishment of new spectrum use categories and specification of corresponding spectrum authorization requirements (e.g., the “concessions” required for public telecommunications networks and spectrum use, the “permits” required for resale services and transmitting earth stations, and the “registration” required for provision of value-added services);
- elimination of restrictions on services provided by competitive public telecommunications networks, including long-distance services, after August 10, 1996;
- authority for use of auctions to grant concessions for nongovernmental frequency use;
- deregulation of receive-only earth stations;
- adoption of open architecture principles for network interconnection;
- establishment of nondiscriminatory tariffing principles; and
- the creation of a new regulatory authority, independent of the SCT, by August 10, 1996.

MEXICO’S LONG-DISTANCE SECTOR

Now that the long-distance sector in Mexico is opening to competition, many of the world’s largest telecommunications service providers are forming alliances with Mexican firms. SBC, the parent company of Southwestern Bell, has partnered up with Sprint to form an alliance with Telmex. AT&T has formed an alliance named “Alestra” with the Mexican industrial conglomerate Grupo Alfa and another conglomerate, “Unicom,” comprised of partners GTE, Bancomer, Grupo Visa, and Telefonica de España. MCI partnered up with Grupo Financiero Banamex and Accival, S.A. (or Banacci, Mexico’s largest financial institution and holder of Mexico’s largest private network) to create “Avantel.” Iusacell is joining up with Bell Atlantic, its partial owner, to provide roaming service in the U.S. and Canada.

Although Telmex will lose market share when the long-distance market opens, its strategy is to take advantage of its position as the “owner” of the majority of telephone lines in Mexico. Regardless of the choice of long-distance provider, odds are that the call will have to be routed over Telmex lines, allowing Telmex to obtain revenue from interconnection agreements. Yet, because the interconnect fees were set in pesos, it is unclear how fluctuations in the exchange rate will affect the rate structure.

In June 1996 the SCT released the rules that regulate how customers will be allowed to choose their long-distance provider. Under the plan, which also sets a timetable for opening the market and a new

numbering system for area codes, a phone user will be allowed to choose a carrier in one of three ways. The schedule for competition to begin is complicated and staggered, with some cities not opening until 2000. In addition, if a customer does not choose a long-distance carrier by the time the city opens up to competition, the default carrier will be the company that had previously offered long-distance services. In most cases, this would be Telmex.

MEXICO'S CELLULAR INDUSTRY

Perhaps the most dramatic development in Mexico's telecommunications industry is the rapid growth of cellular telephony. Cellular services are growing at unprecedented rates throughout the world; however, they are growing even more rapidly in Latin America because of a variety of pre-existing functional limitations on wire transmission infrastructure and antiquated billing systems. These problems are being remedied, but in the meantime it can still take over a year to get a telephone installed in many Latin American countries.

By contrast, at least in Mexico, it is possible to purchase a cellular telephone and get service the same day. This was a consequence of the opening of the mobile communications services market in 1989-90 as part of Telmex's privatization. To an extent, growth in the mobile communications industry in Mexico may reflect significant unmet demand on Telmex's fixed wireline network, but the higher prices for mobile services make it a relatively expensive substitute. Telcel, however, is aggressive in its distribution and marketing strategies, targeting the business user and reinforcing the concept of a cellular telephone as a necessity for both business and nonbusiness uses. All customers are offered free emergency calls, and most Telcel customers also have "roaming" capability in all major U.S. and Canadian cities, and, through an agreement with SBC, Telcel can offer customers automatic call delivery in areas served by SBC.

COMPUTER TECHNOLOGIES AND THE DEVELOPMENT OF THE INTERNET IN MEXICO

In the U.S., thanks to advanced technology, market competition, and the absence of tight regulation, access to and development of the Internet, as well as its use as a business tool, is relatively inexpensive and widespread. Beyond the initial cost of a computer, appropriate software, and a modem, the individual user in the U.S. needs only a telephone line and access to an on-line service. The relative costs of on-line services are also quite low.

In Mexico, things are much different, although the recent privatization and involvement of U.S. telecom companies in the long-distance service market may change all that—and the market is enormous, with the number of individuals connected to the Internet by the year 2000 expected to be over 750,000. The number of commercial Internet providers in Mexico is also growing quickly.

The actual statistics for on-line use in Latin America are somewhat hazy; the Internet and its related services are expanding rapidly in this region. Brazil is the largest Internet market, followed by Mexico. Although Mexico has been connected to the Internet for only seven years, it has recently

seen tremendous growth in this technology, with access dominated by educational institutions. While there is no independent Internet backbone in Mexico, the recent digitalization of the Mexican telephone network has facilitated the transmission of Internet traffic—especially over long-distance networks.

Telmex has been the principal carrier of Internet traffic in Mexico, but Avantel has recently debuted its service, *InternetMCI de Avantel*, to provide dedicated Internet access. The Avantel service links up to *Internet MCI*, which is the world's largest Internet backbone network. As the long-distance sector in Mexico continues to open up city by city, new points of Internet access are expected to dramatically expand the availability of commercial Internet services.

This will have many interesting implications for the development of the Internet-based ITS systems and technologies (in-vehicle and outside of the vehicle), and their more widespread acceptance and use in Mexico and at the U.S.-Mexico border.

THE EFFECTS OF CHANGES IN THE TELECOMMUNICATIONS INDUSTRY ON ITS IN THE U.S.-MEXICO BORDER AREA

Telecommunications and transportation infrastructure and services are crucial to the economic development and growth of a nation, as well as its separate regions and individual cities. The U.S.-Mexico border region is a special illustration of this point. The region stands out in that it straddles an international border between two nations of different levels of economic development, with individual cities on either side highly interdependent on one another, as if there were no border. These cities struggle with the difficulties the border presents. Border telecommunications infrastructure projects have, as many infrastructure projects have, fallen victim to the peso devaluation and ensuing economic crisis. The situation is changing, but it is still not yet at a point where these projects are moving forward at a rapid pace.

Since the advent of mechanized, mass-production techniques, telecommunications applications have become an integral part of production at the border and are extremely important in today's high-tech production and distribution strategies. Information creation, transmittal, manipulation, and storage has become an industry of its own. Advanced telecommunications infrastructure is a necessary component of the flexible production processes and logistics management techniques so important to cross-border commerce. Border transportation, telecommunications, and economic development are therefore closely linked.

Some businesses and activities are more prone to enhancement via telecommunications applications than others. One such business is the maquiladora plant. Another is a business that employs "just-in-time" manufacturing strategies. In addition, information-intensive activities, such as operations supporting Customs Service and Immigration and Naturalization Service (INS) inspections, are telecommunications-intensive due to information needs.

MAQUILADORAS, TELECOMMUNICATIONS, AND ITS

Many large U.S. firms do business in Mexico by conducting a part of their manufacturing with maquiladoras, firms in Mexico that assemble or finish goods that have been shipped in pieces or parts from the U.S. and then sent back to the U.S. for sale and distribution. Many maquiladoras are jointly owned by Mexican and U.S. partners, although the percentage of ownership tends to vary. Most are located only a short distance from the border to save transportation costs.

Many of the maquiladora activities are automated and employ just-in-time manufacturing and distribution techniques that are telecommunications- and transportation-intensive. These factors require the maquiladora plant to use advanced and highly efficient telecommunications technologies within the plant and with its parent, typically located in the United States. The trans-border nature of this communication has been a significant issue, not only because of outdated trans-border regulatory agreements, but also because securing quick and reliable hookups and service from Telmex has, until recently, been a big problem.

The level of sophistication of trans-border communications has consistently raised questions on both sides of the border on how to best develop intelligent telecommunications networks in support of the maquiladoras and the traffic they generate, and how to have efficient communication between the maquiladora, the parent company, and the transportation providers moving materials back and forth.

Maquiladoras have historically operated their own bypass telecommunications networks in an effort to avoid the Mexican system. For the communities of El Paso and Ciudad Juárez, efforts at using telecommunications technology to facilitate and attract economic development were hampered because of the significant differences between the telecommunications systems on both sides of the border and because, until recently, Southwestern Bell (the local exchange carrier for the area) was prohibited from the trans-border telecommunications business—working with AT&T/Telmex was the only way to get adequate cross-border telecommunications services unless you wanted to construct a bypass network. Since the privatization of Telmex there are now many different options for cross-border telecommunications, including fiber-optic networks, a variety of cellular and satellite options, and the existence of competitors to Telmex.

As Telmex undergoes privatization and competition comes to Mexico's long-distance network, the pressure for large companies to bypass the network is expected to decrease. This will hopefully lead, over time, to the more aggressive use of information and telecommunications technologies by firms doing business in Mexico, and may be a key factor in Mexico's use of ITS. Mexican firms, city governments, and city planning organizations may be more likely to invest in and encourage the use of ITS once these kinds of technologies become more feasible and less expensive to operate. U.S. firms and research institutions, in partnership with their Mexican counterparts, may play a big part in making this happen. Lastly, the use of information technologies and ITS products may also become more important as trade-oriented traffic moves further away from the immediate commercial zones of the border region. Even now, maquiladora plants have begun to move away from the commercial zones and into the interior of Mexico.

CROSS-BORDER COMMERCIAL ACTIVITY AND ITS

Although much U.S.-Mexico trade revolves around the operation of the maquiladoras, usually close to the border, a large percentage of activity involves moving goods between interior points in each nation. Telecommunications technologies and ITS systems used in connection with U.S.-Mexico trade must therefore be able to function beyond the immediate border area, and this poses a challenge.

Both maquiladora and nonmaquiladora operations use a variety of technologies to facilitate the production, distribution, storage, and transport of goods across the border and often far from the border. To accomplish the coordination of these activities (which usually fall under the category of "logistics management"), firms employ a wide variety of advanced technologies and network them within the firm and with other networks outside the firm. These networked commercial technologies complement public-sector ITS technologies and, in so doing, help to decrease (or manage) traffic congestion arising from commercial transportation movements. In the case of the border, they also help facilitate the data exchange that is necessary for a variety of Customs procedures.

In adopting these techniques and technologies, a firm can reduce its order cycle time and inventory levels to such an extent that transportation and its associated costs become focal points, along with related technologies. Routing technologies, weigh-in-motion, two-way satellite communications networks, advanced vehicle and shipment tracking techniques, electronic toll and fee collection, transponder applications, and electronic document filing and information exchange are all aspects of ITS that can influence a firm's bottom line. At the border, these are a necessity because of the requirements of customs and immigration inspection.

What is important to note is that these kinds of systems are virtually nonexistent in the interior of Mexico, making transportation to or from the interior difficult to track and otherwise manage. Some larger American transportation firms have entered into strategic alliances with their Mexican transportation partners, and/or opened up offices in Mexico, to, among other things, facilitate shipment tracking and delivery. Often, these kinds of alliances involve technology transfer. In many cases, the U.S. firm can provide its Mexican partner with in-vehicle ITS equipment and/or access to its communications network. Most Mexican trucking firms, however, do not now consistently employ such technologies on their own due to their expense and the fact that little infrastructure exists in the interior to make the expense worthwhile.

Such technology transfers and partnerships are important in the age of just-in-time manufacturing, where a delay of days, even hours, can confuse an entire production schedule. They are also extremely important for trucking firms that move less-than-truckload (LTL) or intermodal cross-border shipments. The ability to track a shipment, or adjust/customize routing, is of paramount importance to these firms. ITS technologies allow these movements to occur smoothly. Yet, in the Mexican interior, these systems and technologies are only beginning to be employed by transportation providers. This may be changing dramatically in the next few years, though, as a consequence of the increasing involvement of U.S. telecom giants in partnership with Mexican firms to provide telecommunications services.

Cities along both sides of the border must begin thinking about how these dramatic changes in the nature of telecommunications will begin to affect them. How will increased competition in the U.S. and Mexico affect initiatives such as NATAP, or the operation of TMCs in border states? How will DOTs manage issues of right-of-way, especially those stretches of right-of-way that abut border infrastructure that is not state- but city-owned? There are not yet answers to these questions, but it pays to examine some of the alternatives in order to formulate appropriate solutions.

It seems likely that the market for ITS research and deployment at the U.S.-Mexico will soon be increasing dramatically; as Mexico's border cities and interior cities begin to feel the effects of competition, they will also have access to more advanced technology at (hopefully) less expensive rates. These cities will have easier access to better hardware and software, and the benefit of timing, in the sense that each of the consortia for long distance is scrambling for market share (on both sides of the border). Many of the U.S. firms that are part of these consortia are actively trying to position themselves to be the firm chosen to provide certain services. These firms are eager to break into new markets and be the first to establish a presence.

CONCLUSIONS AND RECOMMENDATIONS

It is clear that the U.S. in general, and each of its states in particular, will be affected by the new telecommunications legislation passed in the U.S. The U.S. states along the border will also have to address the affect of the Mexican telecommunications reorganization and assess how it will impact their trade and communications with Mexico. It is also clear that many of these effects are not yet known.

The Acts' effects on the development and deployment of ITS will also be hazy for the time being, partly because the impact of ITS in general has yet to be assessed, and partly because ITS systems have yet to be deployed and used on a widespread basis—particularly at the border. However, it is reasonable to assume that the increasingly interdependent relationship between telecommunications and transportation combined with the changing competitive atmosphere of the telecommunications industries in both the U.S. and Mexico will have a marked effect on the development, deployment, and use of ITS in the U.S. and at the U.S.-Mexico border.

Wireline and wireless telecommunications systems are the keys to building a national ITS infrastructure. Although the 1996 Act opened the telecommunications industry to competition nationwide, and the FCC has issued benchmarks, guidelines, and rules for regulatory change, each state is also free to issue its own rules and guidelines for interconnection arrangements. Some state public utility commissions are more aggressive than others in setting these rates and rules. State officials should consider it their responsibility to respond proactively to the changes the new telecommunications legislation will bring. They should develop strategies to take advantage of new opportunities and to ensure that they are not adversely affected by the mergers and alliances that are the apparent by-product of the legislation. They should ensure that the telecommunications sector in the state is developed to support long-term economic plans.

State public utility commissions and state DOTs are pivotal in this respect. State public utility commissions will set the tone for how each state will address telecommunications competition by regulating how it will occur and how much it will cost. DOTs must assess from a cost/benefit standpoint whether to lease or own the state network (or pieces of it), and attempt to decide on the appropriate use, valuation, and level of development of right-of-way. The speed at which these decisions are made is crucial to their success and usefulness.

DOTs in states that share a border with Mexico should also take into account the state's function as a major crossing point for U.S.-Mexico trade. Expediting and managing this trade and its related traffic is a telecommunications-intensive task heavily dependent on the commitment of state DOTs to deploy ITS at border crossings. Long-range planning with Mexico is also particularly important when planning for transportation-related infrastructure, of which telecommunications is an integral part.

In creating these strategies and policies for telecommunications, state agencies should seek the counsel, advice, and involvement of major service and technology providers. By doing so, state

agencies will find it easier to make the necessary changes in their operations and will be on their way toward creating a comprehensive and integrated telecommunications infrastructure conducive to meeting requirements for economic development into the future.

SUMMARY OF RECOMMENDATIONS IN FINAL REPORT

General Recommendations

The final report indicated that, in general, certain issues will be important for federal, state, and local governments, as well as the private sector, to continue to track in the coming year. These issues include:

- The extent to which public-private partnerships have formed or not formed for the purpose of research and/or deployment of telecommunications-based systems, such as ITS.
- The position and attitude each state takes with respect to telecommunications deregulation—which states are taking a pro-competition stance, which ones are not, and how each state is managing its responsibility to set the ground rules and interconnection fees for competition in the local market.
- The manner in which states are or are not attempting to pursue “shared resource” projects for right-of-way and for ITS with private telecommunications providers and whether or not each state’s strategy (partnering or not partnering and, if partnering, the structure of the partnership) has been successful. A related issue to watch is whether or not the window of opportunity for these projects is closing.
- The extent to which U.S. telecommunications providers’ involvement in the Mexican long-distance market will or will not affect the deployment of ITS systems at the border and in the interior of Mexico.

The Federal Government

Recommendation 1: Ensure that states set interconnection rates fairly.

Recommendation 2: Ensure that states do not hinder competition and, in so doing, adversely affect other states.

Recommendation 3: Support the creation of public-private partnerships in telecommunications at the state level.

Recommendation 4: Support partnerships designed to facilitate the research and deployment of ITS.

The States

- Recommendations 1 and 2: Creation of “master plans” for telecommunications services at the state and agency level.
- Recommendation 3: Encourage strategic investment and planning for ITS.
- Recommendation 4: Encourage research into telecommunications and ITS.
- Recommendation 5: Stress education about the relationship between technology, transportation, and economic development.

The State of Texas and the Texas Department of Transportation

- Recommendation 1: Creation of a “master plan” for telecommunications services and partnering in the state of Texas.
- Recommendation 2: Creation of agency-level “master plans” for telecommunications services.
- Recommendation 3: Development of strategies for the use of right-of-way.
- Recommendation 4: Development of strategies for effective and efficient Deployment of and investment in telecommunications-based Technologies at the U.S.-Mexico border.
- Recommendation 5: Create partnerships for cross-border transportation, technology exchange, and research.
- Recommendation 6: Development of a prototype for public-private partnerships for telecommunications services in Texas.
- Recommendation 7: Develop a direction for strategic investment in ITS in Texas.
- Recommendation 8: Encourage research and education.

REFERENCES

Ken Auletta and Richard McDonald. "Breakdown in Communications," interview by Elizabeth Farnsworth, *OnLine Newshour, Background Transcripts*, February 2, 1996 (MacNeil/Lehrer Productions & PBS: 1996). Available from <http://web-cr01.pbs.org/newshour/bb/cyberspace/cyberspace.html>.

Blumenfeld and Cohen—Technology Law Group. *Overview of the Telecommunications Act of 1996*. 1996. Available from http://www.clark.net/techlaw/act_summary.html as of September, 1996.

Deloitte & Touche Consulting Group. *The Telecommunications Act of 1996: Frequently Asked Questions*, Deloitte Touche Tohmatsu International, 1996. Available from <http://dtus.com/>.

Deloitte & Touche Consulting Group. *Telecommunications Industry 1996 Outlook: New Services, New Infrastructure, New Competition and New Regulations*. Telecommunications Consulting Group, 1996 (cited March 1996). Available from <http://www.dttus.com/>.

Scott Blake Harris and Aileen A. Piscotta. *Special Report: Mexico, 1995 Federal Telecommunications Law and Reorganization of the Secretaria de Comunicaciones y Transportes (SCT)*. Federal Communications Commission International Bureau, Planning and Negotiations Division, October 1995. Found on the FCC web pages: <http://www.fcc.gov/ib/pnd/neg/mexico.html>.

International Technology Consultants. "Mexico's New Telecommunications Law: The Long Distance Sector." *ITC Latin American Telecom Report*, Vol. 4, No. 7, July 15, 1995.

International Technology Consultants. "Latin America Tangles With the Web." *Latin America Telecom Report*, Volume 5, No. 11, November 15, 1996.

Susan Jakubiak and Donna Brady. *Shared Resources Projects: Trading Public Highway Right-of-Way for Telecommunication*. Preprint, Paper No. 46, Intelligent Transportation Systems (ITS) America 1996 Annual Meeting (Houston, 1996), p. 1.

Justine Newsome. "Mexico Sets Rules for New Long-Distance Telephone Carriers." *Bloomberg Business News*, 1996. Found at the LatinoLink web site: <http://latinolink.com/biz/0623bemx.html>.

Ian Nuttall. "Getting to the Bottom Line on Telecommunication Costs." *COMtrans*, August/September 1996, pp. 10-11.

"On the Right Track . . ." *Inperspective*, LDDS WorldCom, 1994. Found at: <http://www.wiltel.com/perspect/94su10.html>.

Brian Reale. *The State of the Internet in Latin America*. From on-line information provider: NAFTA Net (<http://www.nafta.net/comuniq7.htm>) in May 1996, and originally published in *El Mensajero* on March 6, 1996.

Luis Rey. "Competition Comes to Mexican Telecoms." *OECD Observer*, (194):26-29, 1995, Jun/Jul, from ABI/Inform service, accession number 01064015.

Frederick Williams. *The New Telecommunications: Infrastructure for the Information Age*. The Free Press, A Division of Macmillan, Inc: New York, 1991, pp 140-141.