Innovative Finance to Accelerate Adoption of Intelligent Transportation Systems

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Cell Phones to Enable Intelligent Transportation Systems

Richard Mudge

My firm specializes in identifying the location of cellular phones. Our approach was developed in response to a Federal Communications Commission (FCC) mandate to locate 911 emergency calls placed from cell phones by October 2001. This ability, in turn, can provide speed and travel time estimates. Such knowledge of system performance has important implications for how we use and manage our transportation systems.

Now I will provide some background on how our technology works. Very simply, our ability to locate cell phones in real time means we can also estimate speeds and travel times. The system is passive, so that data are collected as pure statistics. It is scalable, meaning that it covers everything: expressways, arterials, and all major roads. It is granular, meaning that we collect data at a micro level and then can combine them in a way that best suits each application. It is digital, so we can communicate with the rest of the world. The potential markets for these data have only begun to develop. As a result, we need to figure out how to amass funding today to build a system for which we believe a market will exist in the future.

We have begun to deploy this system in a dozen cities. In most cases the city or state is supporting the effort (often with federal funds); in others, we are moving ahead on our own. Of the public-private partnerships, the largest ones are taking place in San Francisco; San Diego; Hampton Roads, Virginia; and Washington, D.C.

Let me now talk more generally about ITS and some of the funding requirements. The track record of ITS is limited. Right now, a growing number of people in the business believe that ITS will grow rapidly. Granted, there is a history of overpromising, but I believe we are on the verge of much more rapid deployment.

A second key point is that we have witnessed a strong base of public spending—which may not continue. FHWA had a lot to do with getting ITS started, but the actual level of guaranteed funding is pretty low today. Most research and development, or R&D, spending now comes from the private sector. Although profits are not yet overwhelming—indeed, they are mostly nonexistent—I firmly believe that the private market in ITS will ultimately be huge. I think that when the system matures, the applications and the profits will exceed most forecasts.

Why is there a need for cash? First, for R&D. I know that our company has spent $20 million to $30 million to bring us to our current stage. Most funding has come in the form of venture capital, which I view as quite proper. Second, funding is needed for deployment and operations. This, more than R&D, is the place for public-private partnerships and innovative financing.

Let me get a bit philosophical. ITS America and ITS in general are set up as a giant public-private partnership. Ultimately, if the public sector is not actively involved in financing ITS, the applications will still move forward on a wholly private basis. In our business, for example, U.S. Wireless will sell data to the public sector as opposed to being a partner with it. I happen to have a personal bias in favor of public-private partnerships, but without greater success, ITS will become mainly a private-sector business.

I will now discuss several models by which the exchange of data for funding can take place. Using U.S. Wireless as an example, the easiest model is for a public agency simply to pay us cash. In the Bay Area, for instance, we will provide basic speed data for all major roads for a 5- to 6-year period. We will be paid $5 million over that period, and in return we will build and operate a network. Although $5 million may sound like a lot, believe me, our costs will be higher. Once we have our network built up, we will try to sell data and location information on the commercial market. It is a nice partnership: we build our system faster while the public sector gets the data it wants sooner and for less.

Hampton Roads offers another spin on the same cash model. There, the available funding is insufficient to provide full reachable coverage. So for Hampton Roads we will provide only spot information in selected places. In short, we have to scale the service to the amount of money the public sector contributes. But for us that is a very clean and simple model.

The second model is similar but is based on a loan rather than cash contribution. The loan might derive from a SIB or TIFIA. In this situation, we build and operate the network with loan proceeds and then repay the loan. These types of loans are attractive because of their potentially deferred schedule. A 5-year repayment schedule allows the private market time to develop in order to have money to pay it back. Also, the interest rate is not bad, often less than what a start-up company would have to pay. Still, you need revenues to pay back the loan; potential sources include private-sector revenues as well as public-sector payments for location information.

In the loan scenario, I happen to be biased toward SIB loans because it is easier to deal with state departments of transportation than federal agencies. Moreover, the SIB can cover a higher percentage of the costs, since TIFIA will cover only 33 percent of project costs. Also, the cash requirements for these ITS applications are fairly small; these are the kinds of projects for which $10 million or $20 million goes a long way. TIFIA is geared toward more costly projects. To the extent that a state requires us to match our SIB loan, we can do so with our own private equity or public funds. It is also possible that the public sector could help us out with contributed assets such as existing data or land to house a tower. For TIFIA, it is a little different. As I mentioned, TIFIA financing pays only one-third of costs, so you have to find two-thirds of the funding from somewhere else. Furthermore, it takes a long time to go through the TIFIA process.

Let me talk about a third model that looks a lot like pure private financing. Like any firm, we can borrow money from the capital markets. When dealing with a toll road, for example, one borrows against toll revenues. This is a relatively well-defined market—perhaps your projections will be off a bit, but you still have a decent trend line. With ITS, however, we face a brand-new market. In this case, in borrowing money from the financial markets, good customers may be more valuable than a promising forecast. The public sector can help significantly in this regard. For example, obtaining contracts from five state DOTs to buy our data for the next 5 years has the power of a guarantee from a Fortune 500 company. In this example there is no direct public commitment in the form of upfront cash or a loan. Rather, the public sector provides a long-term revenue base.

As another real-world example, I will describe our deal in San Diego. We are part of a coalition that believes it will take $11 million to get the project up and running. The public sector, through federal highway money mainly, will contribute less than $4 million. Our forecast indicates that we should make a lot more than that $11 million gap. Still, it is necessary to come up with that funding in the meantime. As discussed, there are many ways in which the public sector can help provide both moral and tangible support to get that done.

In closing, let me turn things around a little bit. I have talked a lot about how my firm wants to interact with the public sector and use innovative financing tools. But I also think the whole ITS community can provide a different way of thinking about transportation and methods to generate revenue for more traditional uses. For example, the ITS community can provide accurate, real-time data on how extensively specific facilities are being used, what travel times are being realized, and whether people are getting to work on time or not. For airports, we can tell, for example, how long rental cars and buses are on the property. In theory, if you can measure the true use of your system, it is possible to develop a more rational set of user fees. For once you measure the true use of the system you have a way of charging for it—in our case we would use cell phones as a kind of universal transponder. And thus you can charge for parking, for special facilities at airports, and other transportation-related services. This also provides real-time market feedback.

Public-Private Partnerships: TrafficStation Case Study

Robert Schulenburg

I would like to talk about several projects that we at TrafficStation are working on. These include a New York effort called Trips 123 and the AZTech project here in Phoenix. In essence, our niche lies in disseminating interactive traffic and traveler information services via the Internet.

Trips 123, which is a federally sponsored metropolitan model deployment initiative (MDI) for ITS, is a rather large project. It involves 17 agencies and serves about 22 million people. Under a 5-year contract we serve as the exclusive broker for all regional transportation information, including transit. We capture information on all the buses, ferries, trains, subways, and freeways, all combined. You can imagine the complexities of dealing with all 17 agencies and 60 transit organizations, which in turn operate more than 1,000 bus lines and 10,000 bus stops.

The Trips 123 project started for us more than a year and a half ago. Since then, the mobile arena has exploded. As little as 18 months ago, there was no Internet access on your cell phone, of course. This is still a brand-new thing, but there are projections of more than 1 billion users of cell phones around the world and more Internet access via cell phones than home personal computers within 1 or 2 years.

We anticipate launching the Trips 123 project around January 2001. It is a cooperative venture between the New York State Department of Transpor-tation, all the member transit agencies, and of course the private-sector participants. The project covers 29 counties, 25 900 km^2 (10,000 mi^2), and 20 million people, 60 percent of whom use some form of transit. The website will have information concerning not only all the forms of transit within that area, but also incidents or activities related to construction, flooding, fires, and schedule changes. The website will include a free section that will be fairly generic. Alternatively, users can subscribe to this service, in which case we will actually call you to warn you of any accidents or changes affecting your commuting plans. For example, if you come to the website and input travel plans from A to B and from 8:00 to 9:00 a.m., you can request to receive an automated message on your cell phone or e-mail, a fax, a page, or a message to your personal digital assistant. Once you make that request we will watch your route for you and notify you if anything whatsoever happens with your route.

The mission of Trips 123 is to disseminate this information to regional travelers in a manner that creates value and generates revenues for both the public and the private partners on this project. The project's ultimate goal is to be self-sustaining. One nice thing is that when you have the subways, trains, ferries, buses, and freeways as partners, you tend to have access to quite a bit of surplus advertising space.

The market segments for this kind of information are widespread, including broadcast (such as radio and television), newspapers, other media, Internet portals (such as Yahoo! and AltaVista), and brand-new enterprise portals, which I will discuss in a moment. Many people out there are looking for content, and traffic fits right in with the basic pillars of content: news, sports, weather, and stocks. One nice thing about traffic is that it creates itself—there is no need to hire writers to create the story. Another nice thing about traffic information is that it gets stale real fast, so you have to check it out once or twice a day at a minimum. And cellular phone companies love this kind of thing. Once you have invested the time and effort to enter your commuting patterns, storing them for applications that use geographic positioning, you are less likely to switch your cellular carrier.

The next big thing on the horizon is the use of the automotive portals. We have not seen them yet, but we know they are coming. Under this technology you will see the cell phone combined with car navigation, news, stocks, sports, weather, and traffic, all personalized and all coming to your car while you are driving. In the back seat you will have an LCD screen showing DVD movies, games, and other things to keep your kids happy.

The other big thing out there is enterprise portals to support things like fleet management for major companies. Consider, for example, a company with thousands of employees. How do you track all of these people and how do you get them to their appointments on time? How do you integrate their schedules? This is especially important for Internet-based delivery firms like Kozmo and Webvan, many of which promise a half-hour delivery window.

These are some of the models and services we are considering for Trips 123. We are very much looking to be profitable and self-sustaining. AZTech provides another excellent example of this new world, and fortunately you get to hear about that from our next speaker.

Public-Private Partnerships: AZTech Experiences

Timothy Wolfe

I'm going to talk to you about the AZTech project, which, as Robert Schulenburg indicated, is one of several MDIs. The feds picked four metropolitan areas to be involved in a model deployment for urban areas: Seattle, New York, San Antonio, and Phoenix. The official launch of the AZTech project was September 28, 1998, roughly 2 years ago.

The goal of the MDI is actually to deploy ITS: this is not a research project or a field test, but rather a live deployment to see what you can do with it. The feds brought forward some funding, but unfortunately not enough money to cover all costs. We had to find other sources of funding, as I will discuss later.

Let me speak specifically about the MDI in Maricopa County, which encompasses Phoenix. It covers a pretty good-sized area, including 22 jurisdictions and 3 million people. The MDI proposal was submitted jointly by the Arizona Department of Transportation (ADOT), Maricopa County, the Maricopa Association of Governments, and all the local jurisdictions. Some noteworthy features of the area include the very high influx of winter visitors and tourists; the fact that it is a major business area including Motorola, Intel, and Allied Signal; and rapid growth that places heavy demands on freeways and traffic.

Quite a bit of the necessary ITS infrastructure was in place already. ADOT had a freeway management system. The cities and counties had traffic signal systems. But none of it was tied together, so one of the main objectives was to bring it all together. We are also looking at how to share that information between jurisdictions and get it out to the public.

In essence the system works by taking data from the city traffic operations centers, the ADOT freeway management system, airports, transit, and emergency management systems and pulling all that data together into one format. Then we find creative ways to get the data out to the public through partners such as TrafficStation.

We use some very basic tried and proven technologies, like the telephone. We have a toll-free phone number, which the public can call to get road condition information. Soon the number will change to 511, which FCC has selected as a standard number for all road information. Our freeway speed maps are available through the Internet, with information again free to the public. We also have a number of variable message signs for major highways and local streets.

We provide video feeds to all of the local television channels locally and to cable television with more detailed and regular information. During the peak hours the station provides information on speed, road condition, and any incidents or accidents.

As for slightly newer, more sophisticated technologies, we have deployed about 35 electronic kiosks at government buildings, shopping malls, and the like. The information covers all modes, including transit, airports, freeways, and city streets. The kiosks also feature weather information from the National Weather Service.

There are also personal messaging applications. You can input your route and the time you will be going to a specific location and then receive a page if there are any accidents or closures on the route. You can also get personalized e-mail, and we have found this to be very popular in the afternoon, with people checking their e-mail before they leave work.

With regard to even more sophisticated technologies, we are now developing a wireless application prototype, which will become the standard once we all learn to talk to the Internet through cellular telephones. We are deploying about 30 of these smart phones in Phoenix as a test, but I expect to be able to broadcast information to anyone with a cell phone. And certainly, portable digital assistants or handheld PCs offer us another way to furnish information.

So what does all this technology mean? If you are a tourist, of whom we have many in Phoenix, you can obtain helpful mapping and road condition information. However, for that to work, we must have standards in place so that any cell phone will work all over the country. Those standards are being developed right now and represent one of the key goals of ITS America and FHWA. And if you are a commuter, this technology provides reliable day-to-day traffic information, all in a comfortable format.

How was all of this funded? Part of it came from roughly $7 million in federal ITS funds. That served as a catalyst to get this started: not enough to do everything, but a way to bring the right parties together and get them started. The region also contributed some of our own CMAQ program. The state contributed state highway funds. In addition, the counties and cities pooled to amass some additional funding. Private funding was critical as well. The typical private partner might get anywhere from $200,000 to $500,000 to participate in this but had to expend millions of dollars to get up and running.

Here is the rough estimate: about $7 million in federal funds; $4 million in public funds from states, cities, and counties; and well over $3.5 million in private funds. In addition, about $35 million worth of infrastructure was being put into place anyway, including cameras, loop detectors, ramp meters, and variable message signs—all paid from public funding.

There is still a long way to go before we can meet the overall goal of providing traveler information to the public and connecting the traffic centers together throughout the Maricopa County region. Eight of the cities are up and running, with roughly 15 more to go. AZTech is an ongoing project and closely coordinated with each of the jurisdictions involved, and we look forward to further progress.

Opportunities for 5.9 GHz

Dick Schnacke

What does 5.9 GHz mean? It is a new band available for dedicated short-range communications (DSRC), and today I would like to talk about what DSRC is and how its capabilities will be expanded in the coming years. DSRC refers to the typical link used for vehicle-to-roadside communications, characterized by high reliability, high accuracy, and high speed. Vehicle-to-vehicle data communications are also within the province of DSRC.

DSRC is one of the four main types of communication links, or enabling communication technologies, that are defined in the ITS national architecture. Of the 30-odd applications now defined in the architecture, roughly two-thirds depend on DSRC in one form or another. DSRC is probably known to most of you through electronic toll collection. A lot of folks think that tags and readers, which are DSRC products, are exclusive to toll applications. They are not: today these tags are used primarily for toll and traffic management, but they present other opportunities as well.

There are 20 to 25 applications that depend on DSRC, as found in the ITS national architecture, and all will be addressed in the new 5.9-GHz band. In the near term you will continue to see electronic toll collection, of course, as well as parking payments and all kinds of drive-through payment opportunities. Traffic management presents another near-term opportunity, for when tags are circulating for toll collection, they can also be used as probes to monitor how well traffic is moving. Near-term applications include truck tracking, weigh-station bypasses, access control, inventory control, fleet management, and fleet data transfer. Everybody seems to want to move data wirelessly to vehicles in motion.

Medium-term opportunities, I think, include more extensive drive-through payments, including cash-free fuel payments, fast food payments, and the like. Signal priority control and signal preemption opportunities are on the horizon. Many believe that intersections will eventually be wired, especially very complex intersections where the traffic flows are difficult to manage or where accident rates are very high. Emergency and transit vehicles will be equipped in such a manner that they can communicate with the intersection and control the signalization, at least to some degree.

There are certainly many opportunities to move data into the vehicle and display information to the driver. A lot of this is related to safety, with warnings about potential collisions, oncoming emergency vehicles, icy bridges, and so forth. There are many kinds of warnings that would be useful to a driver. Many commercial vehicle activities are also about to crank up that go far beyond the weigh-station and border-crossing opportunities that are already being serviced today. And in the longer term, we are looking at collision avoidance systems; highway-rail intersection warnings, especially at noncontrolled crossings; and truck rollover warnings.

What is new in DSRC? As I said before, the biggest thing is that FCC has allocated this new 5.9-GHz band for us—75 MHz of clear channel that runs from 5.85 to 5.925 GHz. This is a big deal, since 75 MHz is a big allocation—about twice the bandwidth that was granted to the cellular companies, for example. I think this demonstrates that FCC sees the future of ITS, believes that a lot of data will be generated, and has provided a big pipe for us to push the data through.

Another important thing is that unlike the 915-MHz band where we are operating DSRC systems today, there are no "legacy" systems in this new band. This means we do not have to be compatible with any preexisting equipment. We have a clean slate, and we can design the new generation of equipment to be as effective as possible.

Another development in the DSRC area is the creation of standards for this new band. We have been given a valuable resource, and FCC now requires that we indicate in a fair amount of detail how we are going to use this new band, how are we going to channelize it, and what kind of rules are we going to impose on users. Partly as a result of this FCC action, the DSRC industry has created a consortium of all the major manufacturers in North America to work on standards and decide how best to build a business around this new band.

What does this mean to people? Having a very wide band to move data through will help to overcome interference problems. And it will help to improve range. Today we are servicing applications out to 15 or 30 m (50 or 100 ft) of range, which really is a very small communication zone. The new systems for the 5.9-GHz band will offer services out to at least 300 m (1,000 ft) and possibly up to 900 m (3,000 ft) of range. And third, the rate of data transmission will dramatically increase. Today, we are moving data at between 300 and 500 kilobits per second; we are now looking at speeds of at least 4 megabits per second and perhaps as high as 50 or more megabits per second.

Interference-free conditions and a clear channel mean we can do things that involve safety—things like intersection collision avoidance, signal preemption, and signal priority systems—without having to worry about whether the channel will be available. Longer ranges allow you to provide driver information, such as a congestion alert or safety warnings, in time for it to be useful. Drivers cannot really make decisions about alternate routes if they receive the information only 30 m (100 ft) before they arrive at the area of concern. And high-speed operations will permit transmission of much more complex data, which will be valuable for almost all applications, including toll collection. We know, for example, that the level of data encryption will increase in the future, and this will require all applications to move more data to handle the overhead of that encryption.

One of the things that everyone is very concerned about is balancing the way data flow at the roadside and within the vehicle. Currently there is a disconnect in the speeds, so we face the problem of connecting the roadside and the vehicle with a system that is capable of supporting high data rates. Today's systems will not do it, but we believe that the new 5.9-GHz band will provide something that allows data to move very quickly across the wireless link.

Earlier I mentioned a few near-, medium-, and long-term applications, but there are so many more. Everywhere I turn I see potential applications for DSRC. Here are some of my recent thoughts: how about adding a network of beacons along metropolitan area freeway systems, with a congestion-alert beacon just ahead of every exit point from the freeway? I live in Dallas, Texas, and I cannot tell you the number of times I will pop over a rise and find a big traffic jam just ahead of me. I have missed the exit, and I am stuck. In those cases I would have given a lot for a warning before passing the last escape route from the freeway.

Or how about enhancements to a cellular-based parking reservation system, which are already available in Europe? You make a reservation on the phone, and then, on arrival, eventually find your reserved space. Instead of driving aimlessly, a network of beacons in the parking garage could communicate with the transponder on your vehicle, recognize your vehicle as it passes strategic points, and give you directions to your space.

Automobile diagnostics provide another excellent possibility. Consider an automobile equipped with a transponder and the ITS data bus, which will be introduced in about 2 years and could tie into the vehicle diagnostics system. You take your car in for service. With beacons at the entry door to the maintenance shop, you need not stand there describing your car's problems; rather, the problem is downloaded from your vehicle to the shop's computer system in a matter of milliseconds over a wireless link. Now the shop can tell you what is wrong, and maybe even what it will cost.

Have you seen the new cars that automatically adjust the seat and mirrors for Driver 1 and Driver 2? Well, these drivers might be different in a lot of other ways as well. If the automobile were equipped with a transponder and the ITS data bus, a garage-mounted beacon could tie the car to your home computer system. Through DSRC, the system could update onboard systems as you initiate a trip, including information on weather, traffic, maps, and music—potentially customized to the driver as well as the trip. Imagine the benefits of replacing those MP3 music files your kids listen to with something you actually want to hear before you even get in the car!

What about a system that would not only temporarily mute your own audio system when an emergency vehicle is in the area, but also provide an emergency warning through your radio speakers? A beacon atop emergency vehicles will broadcast ahead. This will tie into your vehicle through the DSRC system, preempt the radio or CD player, and bring the warning right to you.

All this brings me to the important chicken-and-egg question. It is hard for consumers to justify the expense of installing highly enabled transponders on their vehicles without a mature infrastructure to provide services. But at the same time, it is difficult for potential service providers to justify the costs of roadside infrastructure without a critical mass of transponders in circulation. We in the industry believe that the most probable solution to this dilemma is that eventually new vehicles will be mandated to include a highly enabled transponder to support the safety applications. It is fortunate that the safety applications are probably the most demanding ones, so if a system can support those, it probably can handle all of these other applications as well.

In the future, I think that the level of vehicle connectivity will be one of the ways you judge a vehicle. You currently look at things like horsepower, mileage, and such; in just a few short years you will be comparison shopping on the basis of data capacity and bragging to your friends about your 42 megabits of data capability.