Public Safety Operations and Traffic Management - A Force for the Future

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There are a number of converging forces that will allow an improved and even more efficient interconnect between public safety operations and those management systems used by the traffic management community to address incident management and congestion mitigation. In the rural environment, increasing the efficiency of this interconnect will also materially assist in the deployment of Automatic Crash Notification (ACN) and in the provision of more timely traveler information. Overall, fleet efficiencies and economy of operation, incident zone safety and improvements in the time required to restore traffic, are all areas that benefit from this close interconnect. From more rapid detection, verification and response to incidents, to minimization of the time required to transport the injured to a medical facility, interconnection promises great benefits with minimal incremental expense required to link the systems. While, to date, there has been resistance to this interconnection of public safety operations and traffic management, proliferation of the cell phone has done much to bring the systems together. From the traffic engineer's perspective, the cell phone has become one of the fastest incident notification devices available. From the Public Safety perspective, emergency call takers are facing a daily increase in the number of emergency notification calls transmitted by cell phone. Over 90% of these are traffic related; the cell phone has become the enabling technology for ACN. Coupled with this is the imminent emergence of a number of technologies that will provide the ability to accurately, rapidly, and easily locate these wireless devices. Thus, the cell phone is rapidly becoming the driving force to bring the two functions together. This paper highlights some of the methods and levels of interconnect; discusses the pluses and minuses against a backdrop of real-world examples and lays out a potential path forward. Key words: Automatic Crash Notification, cell phone, interconnect, public safety, wireless geolocation.

TRAFFIC MANAGEMENT TODAY

There is a movement afoot - one that is going to benefit traveler, traffic engineer, and first responder alike. The traditional walls that have separated the traffic management and public safety communities are starting to crumble, and we will all be the beneficiaries.

To this point in time, development of the operating systems supporting these functions has been conducted in almost a totally independent mode. The same can be said for their mode of operation; exchange of real-time information was at best scanty. A major causative factor is that the various Departments of Transportation (DOT) have historically focused on managing the pavement infrastructure, not operating it. There has been almost a total focus given on "managing" the paving, widening and resurfacing projects; "operating" was not in the lexicon. These have been the "vote-getters" that have competed so successfully over the years for tight budgetary dollars. When it came to addressing the flow of traffic most of the action took the place of passive design measures. This has been particularly true with respect to the freeway and major arterials. With the advent of the Intelligent Transportation System (ITS) movement, this has begun to change. Now the DOTs are beginning to actively control the flow of traffic and are implementing region-wide incident management and congestion mitigation plans. The Advanced Transportation Management Systems (ATMS) currently being deployed in most major metropolitan areas are generally based on a solid ability to rapidly and accurately detect incidents and congestion. That this information could be of value to other governmental agencies has not been, nor is it being contested now. Unfortunately the cost of deploying a detection network with its supporting communication system has caused most ATMS deployments to be done in an incremental or phased approach. Thus even in some of the larger ATMS deployments such as Atlanta, Houston, or Seattle, a significant part of the freeway or interstate system is not yet included; coverage of the major arterials is even more patchy and coverage on the rural system essentially does not exist. This means that the ability to provide information about traffic conditions is still sketchy or non-existent for significant portions of the infrastructure.

TECHNOLOGY SHIFT

While no one in public safety contests the potential value of real-time traffic conditions and road report information to their dispatch and operations systems, the current maturity or lack of coverage of the deployed ATMS does not force the issue; that is about to change. Since the introduction of the Enhanced 911 system or E911, all wireline 911 calls received at the Public Safety Answering Point (PSAP) are accompanied by Automatic Number Identification/Automatic Location Identification (ANI/ALI) data. The same is not currently true with wireless or cellular phones (only number identification is available). To correct this, the Federal Communication Commission (FCC) has mandated that by October 2001 the cellular industry must be able to determine and transmit cellular phone location with a minimum of 125m accuracy when a cellular phone makes an E911 call. The wireless industry has jumped on the bandwagon and soon will be able to not only meet, but also far exceed this mandate. Current projections are that the location accuracy will be in the 20m range **plus the direction of travel and speed may also be available.** For some technical solutions to this FCC mandate, the estimates concerning the accuracy for direction of travel are plus or minus 5 degrees and for speed, plus or minus 3 MPH. Given that there are almost 80 million wireless phones in operation in the United

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States it can be readily extrapolated that there are essentially 80 million new traffic detectors available to the traffic management community for incident management and congestion mitigation purposes. This is not to say that there will be an overnight quantum leap in capabilities. Additional algorithm work will be required to adapt the location, velocity, and direction input from wireless phones, but the potential is boundless. This potential for using the location data is the first major impact of the cellular phone on the current way of doing business for both the traffic engineering and public safety communities.

Another major impact is the sheer volume of emergency calls now being received from cellular phones by the 911 system. In 1998, the Cellular Telephone Industry Association estimated that there were approximately 98,000 calls made on wireless phones to a 911 system every day. Other statistics indicate that 90% of these are traffic related and estimates indicate that from 25% to 50% of the number of callers do not know their location. Prior to the cellular phone's explosion, most traffic related incidents were reported by traffic enforcement officers or by callers using wireline devices. There were a few calls with more accurate information about the details of the incident. Now there are instances of as many as 75-100 calls being received about the same traffic-related incident. This has placed a tremendous burden on the public safety call-takers. There is no thought that establishment of an interconnect between traffic management and public safety systems will mean that a call will not be answered. But by tying the two systems together, corroborating information from the traffic detection network can be made available to the call-takers, thus allowing an informed dispatch decision to be made much more quickly and efficiently. Where this has happened there has been a marked increase in the effectiveness of the First Responders and a corresponding decrease in the overall system-wide 911-response time.

The third area of impact has been the availability of the phone to initiate emergency calls. This availability is now taking a major leap forward because of the cell-phone's ability to support Automatic Crash Notification (ACN). Current estimates are that Telematic/ Mayday Devices will be deployed in up to 4 million vehicles in the next three years; General Motors alone estimates that they will have one million subscribers for their OnStar™ system by 2001. Given this type of growth projection, it is easy to forecast the cost of implementation going down. This cost decrease will cause the number of deployed devices to go up and thus, will produce faster incremental growth in the number of geo-located wireless devices available for the information stream. While there are no apparent links to the traffic management system, every new wireless device mounted in or transported by a vehicle becomes another potential source of information to the traffic management community.

DO WE HAVE A WAY AHEAD?

This is not to say that everything is rosy. There are fundamental philosophical design issues that may impact the viability of cellular location as a detection methodology. Remembering that the FCC ruling is focused on providing information to the public safety function, the ability to use a wireless device as a detection device in an ATMS has not been a consideration.

There are two basic technical solutions available to meet the FCC requirement - handset-based or network-based. The handset-based solution relies on Differential Global Positioning System (DGPS) technology, and while it will provide very accurate location data (potentially down to a car-length when the Federal Railroad Administration completes the deployment of the National Differential GPS network in 2003, location data is probably only going to be available when an emergency call is made.

On the other hand, network-based solutions will be of benefit as they are going to produce location information on a fairly regular (generally 15-minute) basis as a function of tracking the device to facilitate call routing. This polling feature is what allows cellular roaming; the cellular system needs to know which cell a phone is in at any point in time. Given the projected density of the cellular phone population, particularly in the urban and near-urban areas, there should be a sufficient number of devices providing location based reports to formulate a fairly accurate depiction of traffic conditions being experienced by vehicle mounted or transported cellular phones.

Using the network solution, there is not a requirement to track a phone over the 15-minute period to generate direction and speed information. Rather, all three of the attributes - position, direction and speed - are gathered each time that the device is polled. This is the area where algorithms must be prepared, for example, to sort out pedestrian traffic from vehicle traffic in the downtown areas and, most important, eliminate all privacy information from the process.

What is not yet in the works is the ability to track a phone to generate Origin/Destination (OD) information. This is not a requirement to satisfy the FCC mandate and would entail considerably more software development.

There are additional problems. There are currently 5,500 Public Safety Answering Points (PSAP) that service 911 calls. There is going to have to be a fairly serious effort made to accommodate the information coming directly from the wireless systems and coming from the traffic management system.

There are a number of joint public safety/traffic management operation centers where the two functions have no more connectivity than being located in the same facility. Interconnection can achieve "virtual" co-location despite geographic separation.

Some people feel that placing both functions in the same location will achieve the majority of the potential benefits. I would argue that this is not the case, for in these instances most of the coordination is manual as well as spasmodic and ad hoc. This does not produce the same level of benefit, as does the basic level of interconnection. Interconnection can achieve "virtual" co-location despite geographic separation.

A COMMON LEXICON

For purposes of this discussion we will categorize the three transfer products in ascending order of technical complexity, as voice, video and data while the interconnect will generally be defined as falling into one of four levels. Remember that the issue is interconnection, not co-location.

Level One is the bare minimum level of interconnect and may be no more complex than an off-hook or ring-down circuit connecting the traffic management center with the PSAP. This is the "voice-only" level and is quickly and easily established with no impact on the current computer system at either end since it is totally "man-in-loop". There are no other requirements beyond adjusting Standard Operating Procedures within the two systems to ensure

that calls are made in a timely fashion. Implementation of Level One will begin to develop the close working relationship that can and should be fostered between these two Public Service systems. It will provide more rapid corroborating information to the public safety call-taker and will allow the traffic managers to respond to incidents far more rapidly.

But using the axiom that "a picture is worth a thousand words," Level Two involves the ability to pass control of Closed Circuit TV (CCTV) camera views between the two systems. Almost every ATMS has a large number of cameras installed as part of the deployment. These are used by traffic managers to verify indications generated by the installed detection system. Similarly, more and more of the larger metropolitan public safety agencies are installing security cameras in the Central Business Districts and high population density areas such as shopping centers, stadiums and airports. By being able to pass control of these cameras to the other partner in an interconnected system, the area of visual coverage and accuracy of response is markedly improved. One major concern is who has access to these tools and who controls them during an incident. Public Safety operations personnel may want to have the ability to zoom in on an accident scene to assist the on-scene incident commander while the traffic managers may want to zoom out and pan the camera in an effort to implement the proper traffic management response. Both requirements are valid and will take some close cooperation to work the issue. Beyond the control issues are the cost of procurement and maintenance. With an integrated management plan focusing on a team approach, these issues can be worked out to the betterment of all.

Level Three is the exchange of data from screen to screen. If you placed the typical public safety call-taker's screen next to a traffic incident manager's screen, you would observe a significant commonality of data elements for all traffic-related incidents. Being able to simultaneously fill in data fields on both systems with a "single keystroke" will produce significant savings in the time necessary to arrive at implementation decisions for both systems. For the most part this is not a technically challenging problem. The only area of concern is to be sure that the requisite "firewalls" are in place to protect the privacy of information that is an integral part of the public safety operation but not required by the traffic management community. In actuality, the hard part will be to get the appropriate intergovernmental agreements in place to allow this exchange of data. There is an understandable reluctance on the part of public safety to have any information contained within their system exposed to other agencies without the same safeguards.

The fourth and most comprehensive level is the automatic cross population of the two system's databases. There are a number of technical concerns to address, but none are insurmountable given today's technologies. The biggest concern stems from the geo-location system. As can be readily understood, the public safety community relies on street addresses for geo-location. This reliance is caused by the fact that the majority of the initiating action for their operations originate based on a call from an individual citizen who currently has no way of determining his location in terms of Latitude and Longitude. The current exceptions to this rule are the calls originating out of the ACN systems since they are based on DGPS. When the geo-location mandate is fully implemented, the public safety Computer Aided Dispatch (CAD) systems are going to have to be able to do the geo-location cross-reference from the Latitude/Longitude system to street addresses since the incoming calls will carry a mixture of geo-referencing methodologies. This is not a trivial task.

It is envisioned that the majority of these systems will be GIS based, which raises the additional concern about the spatial errors that are induced when transferring location data from one GIS application to another. Errors of as much as 300 meters are not uncommon when transferring from one GIS application program to another. Generally this is not as much of a problem in the rural environment, but can raise significant hurdles to interconnection of urban systems. Currently, the only way to overcome this issue, if it exists for a particular locale, is for all of the agencies contemplating joining an interconnected system to agree to a common GIS platform. Although this is not the most satisfactory solution, it is one that may be required given the current level of variation between platforms.

This variation is probably the single most significant technical stumbling block when trying to interface with existing public safety CAD systems, which tend to be very proprietary in nature. This problem may diminish in the future as new or replacement CAD systems are installed.

The other major problem, which is more emotional than technical, is the issue of jurisdictional autonomy. When information is to be shared or exchanged between two or more governmental agencies, there is the understandable worry about increasing exposure to increased liability. Since many of the larger ATMS's are run by a state-level agency and the public safety CAD by a local agency, there is an understandable reluctance to interconnect.

Suffice to say that this can be eliminated technically with a high degree of assurance that information can be protected using a combination of procedures and software privileging. The hardest institutions to convince will be law enforcement ,but if everyone has a clear understanding of the design, protections and, most importantly, the benefits of establishing an interconnect, it can be done.

SUMMARY

Where is this whole movement going? There are more and more examples of successful interconnects. The Cellular Telecommunications Industry Association, the Association of Public Safety Communications Officials (APCO), and National Emergency Number Association (NENA) have been fairly active in support of the development of the wireless location program, but have backed off a bit in the face of the industry's lethargic response, and more importantly, because of the FCC's sluggish push toward implementation. This could have been a major stumbling block to the quick implementation of the wireless implementation technology. The whole movement may have seen a revitalization because on 15 September, 1999 the FCC adopted revisions, which require 100 percent compliance NLT 31 December 2004, to its wireless E911 rules affecting the hand-set based solutions.

These revisions have the potential of rapidly accelerating the geo-location of wireless phones but it may well be in a direction that may not produce the majority of the benefits to the ITS community. Given the cost of network solutions as opposed to the steadily reducing cost of the hand-set based solutions, the wireless industry does not see the value of the business case in a public safety only application. The revenue stream is legislated and not subject to providing additional returns on their investment.

Therefore, if the ITS community is to benefit from this emerging technology, we must make our needs known to the wireless industry now before the commitment to the hand-set technology is too far advanced. We may be facing the VHS-BETA marketing decision all over again. At the time BETA was the far better solution but it was relatively expensive so the industry settled on VHS and the rest is history.

When you consider the cost of installing and maintaining a detection network throughout a region as compared to the probable cost of acquiring the data from the wireless industry, or if you consider the fact that the deployment will be almost overnight, the value of being able to avail ourselves of this new technology should be readily apparent. ITS America is watching this program very closely and is sponsoring several efforts to try to forge the bond with public safety as quickly as possible by working with the national public safety associations. This top-down push will go a long way toward accelerating the process but just as much value can be achieved at the local level. That is our job.