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The following article highlighting the value of TrafficCast's BlueTOAD in monitoring travel times and speeds on arterial roadways appeared in the May, 2011 edition of the Newsletter of the ITS-Midwest chapter of ITS-America

Bluetooth Detection: How About Arterials?

Nick Kiernan
Vice President, Business Development
TrafficCast

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Success has been demonstrated using Bluetooth signals in determining travel times and road speeds on expressways. But is it an answer to the elusive quest for arterial travel times?

The emergence of Bluetooth detection technology has been an important trend in Intelligent Transportation Systems (ITS) over the last three years. The technology has evolved from academic research projects in University engineering departments, to roadside tests of accuracy, to commercial deployments, to providing route travel times and road speeds in real time.

Arterial deployment is the next, and perhaps, most exciting step for applying Bluetooth detection technology. Due to expense, as well as environmental factors such as road contours, jurisdictions, and installed infrastructure, traditional sensors such as loop detectors and side-fire radar are often not practical on arterial corridors. Bluetooth detection has become a viable option for non-intrusive sensor technology on arterials.

Using compact roadside receivers, Bluetooth sensors detect anonymous mobile device identifications used to connect Bluetooth technologies (such as "hands-free" headsets and in-dash sync services) and calculate travel time by analysis of timestamps on subsequent detections. The technology can also monitor vehicle movements through intersections, interchanges and alternate routes, providing a depth of data unmatched by traditional planning procedures.

Bluetooth is an open technology protocol developed in 1994 to enable electronic devices to wirelessly connect over relatively short distances. The functionality is built into a wide range of products, from cars and mobile phones to medical devices and computers. It enables sharing of voice, music, photos, videos, data and other information between two paired devices. Unique identifications called Media Access Control (MAC) addresses are at the core of Bluetooth-enabled devices. The international Bluetooth Special Interest

Group (SIG) manages the protocols of assigning these addresses, so that the anonymity of the user is maintained, while the devices themselves emit signals to find each other to connect.

In traffic applications, roadside receivers detect these "here I am" broadcasts. While no connection with the device is made, the detections are time stamped. Since each MAC address is unique to its device, the devices become effective vehicle probes as subsequent sensors detect them again.

It is estimated that more than 20% of all vehicles contain a discoverable Bluetooth device. Increasingly the vehicles themselves are Bluetooth devices as Ford Sync and GM OnStar deploy wireless features in the cabin. Of course, for use as probes, more important than Bluetooth penetration is matching rates, the percentage of vehicle flow that can be matched by detections of pairs of sensors. This percentage ranges from two to over ten percent in most deployments, more than sufficient for accurate travel time information.

Interstate Applications

Initial commercial applications on expressways demonstrated that Bluetooth detection provided travel time accuracy equivalent to toll tag readers and license plate recognition systems at significantly reduced cost of installation and operations.

In the Midwest, the Illinois Department of Transportation (IDOT) installed BlueTOAD™ (the Bluetooth detection technology developed by TrafficCast, based in Madison WI), on the Eisenhower Expressway to maintain provision of travel times during the roadway's resurfacing last summer. "The Eisenhower resurfacing project was a high priority, and we needed to help drivers deal with the expected congestion," commented Jeff Galas, Manager of the IDOT Traffic Systems Center (TSC). "This BlueTOAD technology plan came together quickly, and it works. I've driven the route often, and the travel times are correct."

Arterial Applications

But what about arterials? The dynamics of traffic flow are quite different than limited access roadways. Does the stop & go traffic at signals diminish the ability of Bluetooth detection to quantify accurate speeds and travel times? Are sufficient Bluetooth signals available for detection on an arterial? Can Bluetooth signals from pedestrians and bicyclists that share arterial routes be filtered effectively? And ultimately, can Bluetooth detection deliver meaningful driver information to support utilization of arterial corridors in urban and suburban settings as route alternatives to interstates and expressways?

Recent studies, including evaluations in Florida and Minnesota, confirm that Bluetooth detection, when deployed thoughtfully, is an effective and accurate method to determine arterial travel times and road speeds.

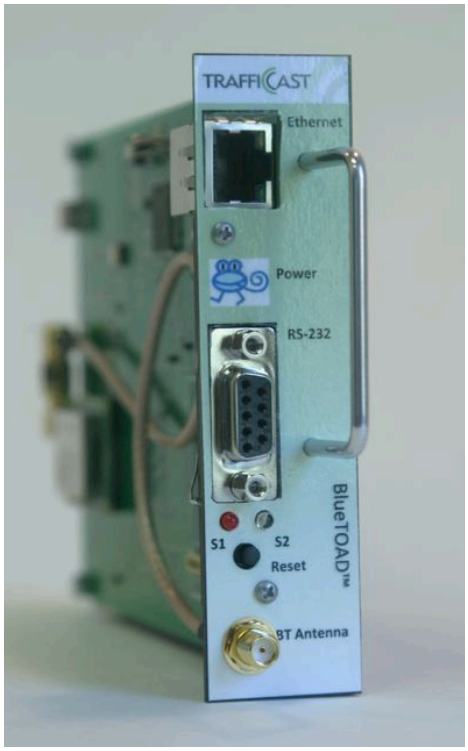
Working on behalf of the Transportation Management Center of Sarasota County, Florida, PBS&J installed BlueTOAD units on FL State Highway 780 (Fruitville Road). The study compared BlueTOAD travel times and road speeds against similar data from vehicle magnetic imaging technology installed for the evaluation, as well as traditional drive tests collecting floating car data.

The PBS&J report following this evaluation showed that the distribution of Bluetooth detections, and more importantly, matches of unique MAC addresses, were evenly spread through both peak and off-peak hours. Peak hour match rates were between 3.7% and 5.7% of total vehicle flow. Match rates during off-peak hours were relatively lower, although the data did represent actual conditions. The report determined, "…that the distribution of matches is even enough to provide accurate-real time data."

Bluetooth detection data were shown to have less than 2 mph variability from what was alternatively shown by magnetic imaging, or less than seven seconds per mile. The floating car data resulted in somewhat higher variability, though PBS&J noted that this result was expected due to the limited number of drive runs that took place.

Anticipating the ability of an Advanced Traffic Management System (ATMS) to improve signal timing and mitigate increasing congestion with this data, the Sarasota evaluation report also notes that in comparison to toll pass readers and License Plate Recognition systems, BlueTOAD installation and long-term operations costs are significantly lower. At the same time, peak and off-peak data sampling was more than sufficient to deliver current road speeds with high statistical confidence.

Regarding pedestrian movements, the BlueTOAD platform processes data through relevant percentile filters and factors deployment considerations such as road segment length between units. Combined with other algorithmic



BlueTOAD Ethernet Card

features, the system effectively isolates non-vehicle detections and other outliers. In other words, pedestrian movements are detected, but filtering removes their impact from travel time calculations.

The PBS&J report concluded that use of Bluetooth devices "…was an acceptable means of travel time and data collection. BlueTOAD can assist in the development and performance measures of (Sarasota) County's ATMS, provide real travel time data for incident detection, and generate traffic planning while maintaining traveler privacy."

Iteris, Inc. implemented a similar trial of Bluetooth detection technology in Hennepin County, Minnesota as part of MN/DOT's 2009/2010 ITS Innovative Idea Program. With hardware and software for the project provided by Savari Networks' Streetwave System, Iteris installed a series of Bluetooth detectors at six signalized intersections on Bottineau Boulevard, County State Aid Highway (CSAH) 81, near Crystal, MN northwest of Minneapolis.

Similar to the PBS&J findings in Florida, Iteris reported that Bluetooth detection in Minnesota was a viable technology for arterial road speed detection. Match rates were in the comparable 4% range. Using floating car data as the baseline, travel times based on Bluetooth detections were within equivalent scales.

Steve Garbe, Associate Vice President of Iteris led the Hennepin evaluation and noted that collection of baseline floating car data for an arterial is helpful in planning installations. As an example, Steve mentioned that"…the baseline data helped us discover that installing readers somewhat apart from intersections could diminish the impact of detections from vehicles delayed by a left turn." This impact could also be addressed by increasing the percentile for filtering the detection matches.

In general, Iteris concluded that Bluetooth readers could provide accurate travel times for arterial corridors, especially those with an Average Daily Traffic (ADT) of at least 15,000 vehicles per day.

Installation of Solar Self Contained BlueTOAD Unit

In the ITS Midwest region, the Lake County Illinois Department of Transportation is about to evaluate Bluetooth detection along the busy Washington Street corridor, from IL-83 to US-41. Lake County's ultimate goal is to supplement travel times on IDOT and Illinois Tollway interstate routes with accurate information on alternate, parallel and intersecting arterial corridors.

Taking advantage of existing fiber, available at most major intersections, Lake County plans to install Bluetooth detection equipment inside signal cabinets, with direct connectivity to the County's Traffic Management Center. In addition to real-time speed and travel time data, the County anticipates gathering an archive of data to support planning functions and optimized signal timing.

While projecting technology trends can be difficult, Bluetooth utilization in vehicles will only increase for the foreseeable future. Hands-free calling laws are one reason, but more and more Bluetooth devices are integrated into the vehicle itself.

Moreover, Bluetooth protocols are firmly established as the technical standard for wireless connectivity. While these will evolve, it is difficult to foresee them disappearing, much less being replaced, as they enable technology products of disparate purposes, brands and generations to conveniently link-up. The open standards maintained by the Bluetooth SIG determine how these devices discover each other. Within this discoverable mode of operation, Bluetooth will provide transportation agencies, operators and planners an exceptionally robust and cost-effective vehicle probe, for both expressways and arterials.