SPIDER: A Wireless Solution for Mid-block detection

By Daniel Manor

About the author: Daniel Manor is a professional engineer (M.Sc., Computer Science, Princeton University, 1971; B.Sc., Electrical Engineering, Technion, 1969), with over 30 years experience in the design, manufacture, and installation of sophisticated and specialized radar, microwave and other sensor systems involving hardware and software, for both military and civilian applications. He is the holder of a two patents for an advanced radar warning receiver architecture. Mr. Manor is the founder of EIS Inc. (1989) and its president. He has held positions of senior responsibility at advanced technology companies both in Canada and abroad.

The combination of RTMS remote radar detectors with RF modems is not new. Such systems have been in use successfully since 1994, allowing quick, safe and flexible installation, without lane closures, while achieving high reliability and accuracy.

In recent years, the advent of new systems for urban traffic control has increased the demand for accurate traffic data from advance detectors, system detectors, spill-back queue detectors and dilemma zone detectors – all installed in midblock locations. Present Traffic-Responsive systems are evolving into Adaptive Traffic Control. To operate well, systems like SCOOT, SCATS, OPAC and ACS Light require increasingly accurate traffic measurements on all lanes at some distance from the intersection.

Clearly, future UTC systems will require significantly more and better detectors, capable of delivering a variety of measurements on traffic. A typical deployment may require advance detection stations at distances of 150-500 feet from the intersection. Detector locations are often dictated by system-related factors, such as the need to estimate speed, queue length and lane-traffic profiles.

Current UTC systems require second-by-second contact closure data feed into the intersection controllers, from which the required parameters are derived – volume, speed, queue length etc.

The ubiquitous loop detector has proven impractical for these applications, not only due to its high life-cycle-cost, but because of the high cost of installing such detectors at a significant distance from the intersection. Typical trenching and conduit costs in urban areas are in the range of $50-$100 per linear foot. The resulting high cost of installing advance detectors based on traditional loop detectors can reach 90% of the total system cost, a major deterrent to such deployments.

A simple solution from EIS Inc. is based upon the merging of two proven technologies. A solution that can save as much as 75% of that cost, facilitating easy and natural enhancement to existing systems, while making the emerging Adaptive Traffic Control systems affordable.

Advances in RF modem design have proven it effective in providing dependable all-weather wireless communication in the electromagnetically dense urban environment. Spread Spectrum RF modems are proving it every day, across links from several miles long to the shorter hops from detectors to the corner Controller cabinet.

Recently, EIS Electronic Integrated Systems Inc. of Toronto, Canada announced the launch of its third generation RTMS radar sensors, which include an internal RF modem. Sidefired RTMS sensors have been very attractive for UTC systems and thousands of these low-cost sensors have been deployed by Departments Of Transportation in many Advanced Traffic Management Systems, spanning both UTC and Freeway Traffic Management. Their high accuracy in all weather conditions, multi-zone capability, ease of installation on existing roadside poles while eliminating scheduled maintenance - has been quickly recognized by traffic professionals.

The combined ease of communicating with these wireless detectors using wireless modems and powering them by solar panels, made it possible to design and implement entirely wireless detection stations and new quick-deployment systems.

Such systems usually rely on Network-type RF modems, such as CDPD, GSM or other cellular modems. While these communication methods are efficient at providing real-time minute-by-minute information into a Traffic Operation Center, they do not fit UTC applications for the following main reasons:

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• Time-sharing of such networks by many users makes it impossible to ensure second-by-second data transmission, resulting in high and unpredictable network delays.
• They do not offer an easy and natural access of data into existing UTC systems, requiring special software integration effort.
• Reliance on cellular networks designed and operated by others
• The high subscription cost of each device on the network.

FHSS (Frequency Hopping Spread Spectrum) RF modems on the other hand, are ideal for urban traffic control applications due to their inherent strengths:
• Providing a secure dedicated link in a point-to-point or point-to-multipoint configuration, ensuring short transmission times virtually independent of network loading
• Their high immunity to interference, due to their distribution and ability to operate instantaneously over a wide band
• Full DOT ownership, eliminating additional operating costs.

The EIS SPIDER system (Simple Presence In-lane Detection Event Reporting), builds upon the advantages of the RTMS and FHSS RF modems. It integrates them into a seamless solution, delivering real-time contact closures from multiple RTMS detection stations directly into the Controller cabinet. At the cabinet, a SPIDER Controller Unit no bigger than a single loop-detector – delivers up to 32 dry-relay NEMA-compatible contact pairs into the Traffic Controller. The SPIDER Controller can be configured on site to control a network of up to 8 remote RTMS detectors, each delivering up to 8 contact pairs representing presence in User-defined detection zones.

Remote detection stations consist of a single RTMS radar sensor, powered by AC or DC with an integral FHSS RF modem and antenna, transmitting per-zone contact closure information in real time to the SPIDER Controller. These stations are built for the harsh environment and require no license to operate.

Figure: SPIDER System delivering multiple contact pair closures from 4 mid-block detectors.

The system is designed from the ground up, for sturdiness and dependability. It is based upon robust communications protocols, empha-