Advantages of the Sensys™ Wireless Vehicle Detection System

Accuracy. Reliability. Flexibility. Affordability.

WHITE PAPER

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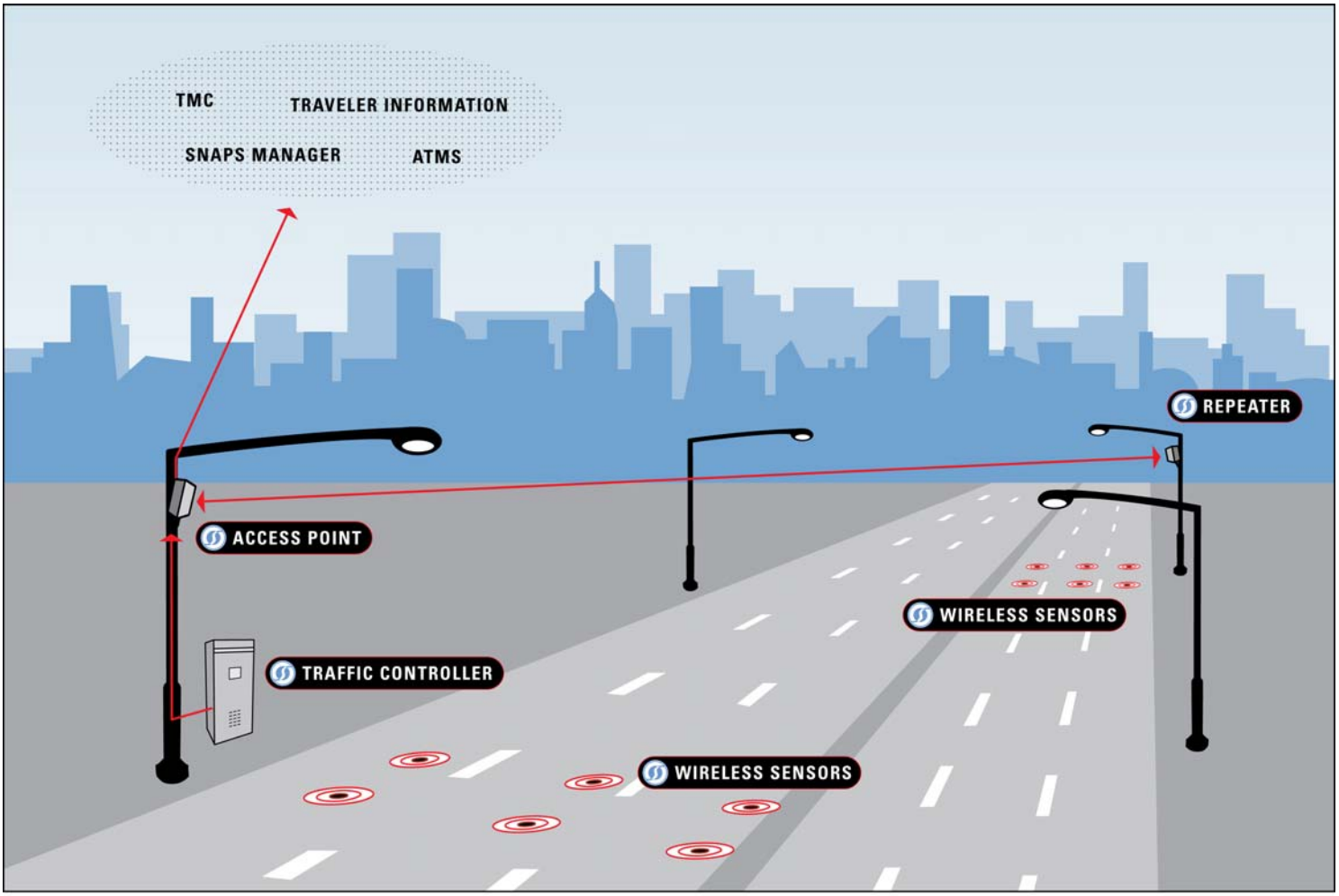
Vehicle detection is a fundamental element of traffic management, providing the raw data inputs for Advanced Traveler Information Systems and Advanced Transportation Management Systems as well as local traffic signal control at intersections and freeway ramps. Whether the goal is improved traffic flow and efficiency, enhanced safety, or planning for the development of future infrastructure, on-site real-time measurements of volume, speed, occupancy, vehicle length, presence, and headway are vital for both real-time traffic management and non-real-time statistical analysis.

Sensys Networks has combined state-of-the-art magnetic sensors with innovative low-power radio technology to create a reliable, accurate, and cost-effective vehicle detection system with the flexibility to address a wide range of traffic management applications. By utilizing sophisticated detection and wireless communications technologies to develop a new pavement-mounted vehicle sensing system, Sensys has created an essential component of traffic management systems for the 21st century – ***the Sensys™ Wireless Vehicle Detection System.***

A Wireless Alternative to Inductive Loops

The Sensys Wireless Vehicle Detection System can be used in traffic monitoring and management applications as a direct replacement for conventional inductive loops. Like inductive loops, Sensys wireless sensors can be located exactly where measurements are required, whether it is at a specific through lane, turn lane, or entrance or exit ramp.

The Sensys Wireless Vehicle Detection System employs ruggedized pavement-mounted magneto-resistive sensors to detect the presence and movement of vehicles. The Sensys vehicle sensors are wireless, transmitting their real-time detection data via radio to a nearby Sensys access point that then communicates the data to a local traffic controller, to a remote traffic management system, or to both at once. Thanks to patent-pending innovations by Sensys Networks in low-power circuitry and communications protocols, the average battery life of a sensor is 10 years.



The Sensys™ Wireless Vehicle Detection System

Installation of a Sensys wireless sensor simply requires boring a 4-inch / 10-cm diameter hole approximately 2 ¼ inches / 5.7 cm deep at the desired sensing location, placing the sensor into the hole so that it is properly aligned with the direction of traffic, and sealing the hole with fast-drying epoxy. No lead-in cabling or long saw cuts are required, and the circular pavement hole produces the least amount of damage and stress to the roadway.

Each small-sized Sensys wireless sensor is typically installed in the middle of a traffic lane where it will detect the presence and passage of vehicles in that lane. To measure vehicle speeds, two sensors are placed in the same lane with the distance between them measured and configured in software upon installation. Sophisticated signal processing algorithms in each sensor provide highly accurate vehicle detection as well as discrimination against interference from vehicles in adjacent lanes or vehicles that are traveling close to each other in the same lane. As vehicle detections are made, each wireless sensor employs low-power radio technology to send time-stamped detection event data to a nearby Sensys access point.

A Sensys access point can collect detection data from many Sensys wireless sensors, either directly from sensors within a range of approximately 150 feet / 46 meters (depending on the mounting height of the access point) or from sensors supported by one or more Sensys repeaters that are within a range of approximately 1000 feet / 305 meters of the access point or even greater as new radio designs are incorporated into the Sensys products. Detection data collected by the Sensys access point can then be provided via contact closure interface to a roadside traffic controller or via IP (Internet Protocol) communications over twisted pair, coaxial cable, fiber optic cable, or wireless services to central facilities or via both data paths simultaneously. As required by the particular traffic management application and the installation site, a Sensys access point can be configured with an integrated cellular data modem to support communications over either GSM cellular networks (using EDGE/GPRS data services) or CDMA cellular networks (using CDMA 1xRTT data services).

The Sensys vehicle detection system realizes considerable flexibility simply because a Sensys wireless sensor communicates via radio to its access point. In new deployments, a Sensys wireless sensor can be used wherever an inductive loop would otherwise be installed. In cases where inductive loops have already been deployed, a wireless sensor can replace each broken or malfunctioning loop. And, in many cases such as mid-block and advance detection, Sensys wireless sensors can be used where the installation of inductive loops would be too expensive or infeasible.

Ultimately, the Sensys Wireless Vehicle Detection System provides the accuracy of inductive loops but with much higher reliability, greater flexibility, and lower life-cycle costs.

Accuracy Equal To Inductive Loops

Inductive loops are generally considered to be the most accurate of all vehicle detection technologies, including advanced video and radar systems. Even so, the accuracy of a typical inductive loop can be degraded by incorrect sensitivity settings, cross-talk between adjacent loops, or changes to the local environment over time. In various independent studies, the Sensys Wireless Vehicle Detection System has repeatedly been shown to be just as accurate as well-maintained inductive loop detectors. Like inductive loops, the Sensys vehicle detection system's high level of accuracy is independent of weather or traffic conditions, and, thanks to the automatic self-calibration that each wireless sensor performs, this accuracy is maintained consistently and reliably. Sensys vehicle detection data can thus be trusted to be close to ground truth, regardless of the weather or the level of traffic at the time of measurement.

Test Results in Arizona. In a report dated May 2006, the Texas Transportation Institute (TTI) of Texas A&M University delivered to the Maricopa Association of Governments its assessment of the accuracy of freeway detector installations at 27 different locations in the Phoenix area maintained by the Transportation Technology Group of the Arizona Department of Transportation (ADOT). In particular, vehicle count accuracy was assessed by comparing data from each of the systems to at least 120 minutes of time-stamped video of the actual traffic.

According to the TTI report, the count accuracy of a Sensys Wireless Vehicle Detection System installation located in Scottsdale was better than that of the installed inductive loop detectors, with count errors of 1% or less over 15-minute intervals averaged over all lanes. The Sensys Wireless Vehicle Detection System had the best traffic count performance of any of the inductive loop or passive acoustic detector ADOT installations that were examined: over 15-minute intervals in any individual lane, the Sensys installation often had no count errors whatsoever.

Time Period	Location	Lanes	Start Time	Mean Absolute Error (%)	Percent Error in Traffic Counts by Lane Lane Code: A=outside (slow) ===> C, D, E, F = inside (fast or HOV)					
					A	B	C	D	E	F
In-Pavement Magneto-Resistive Detector (installed and maintained by the City of Scottsdale) [Percent error is for 15-minute traffic counts]										
Off-Peak	Loop 101 SB: S of Shea	3	12:40 PM	1%	1%	1%	0%			
Off-Peak	Loop 101 SB: S of Shea	3	12:55 PM	1%	1%	-3%	0%			
Off-Peak	Loop 101 SB: S of Shea	3	1:10 PM	1%	1%	2%	-2%			
Off-Peak	Loop 101 SB: S of Shea	3	1:25 PM	1%	1%	-2%	1%			
Peak	Loop 101 SB: S of Shea	3	2:36 PM	0%	0%	0%	0%			
Peak	Loop 101 SB: S of Shea	3	2:51 PM	0%	0%	0%	0%			
Peak	Loop 101 SB: S of Shea	3	3:06 PM	1%	0%	1%	0%			

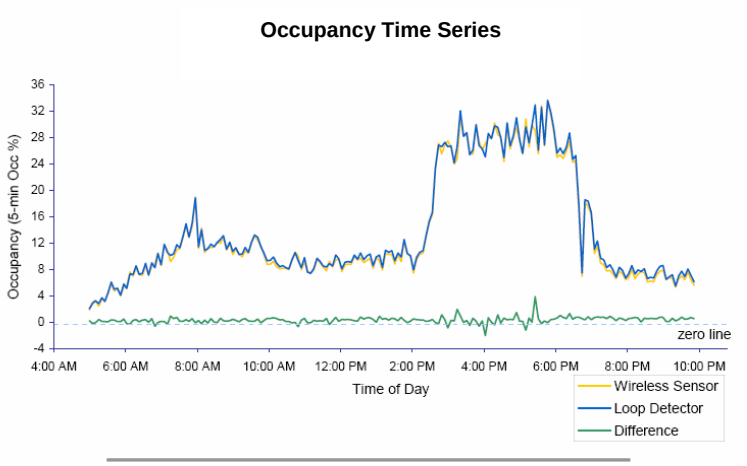
source: Texas Transportation Institute, "Final Report on Accuracy Evaluation of Arizona DOT Freeway Management System Detectors," May 2006

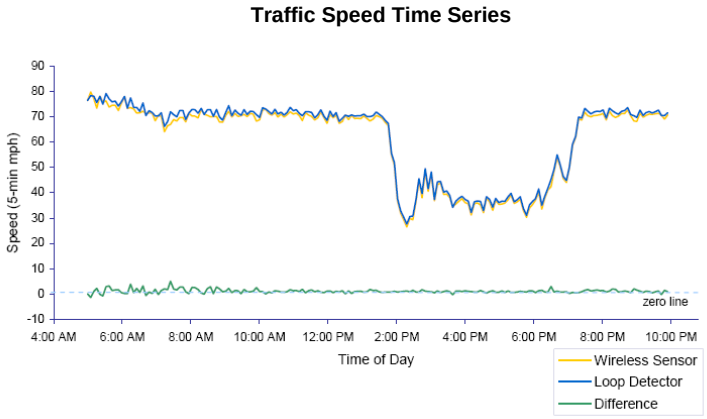
Sensys count errors over 15-minute intervals never exceeded 3% in any single lane, better performance than any of the other tested inductive loops and passive acoustic detectors

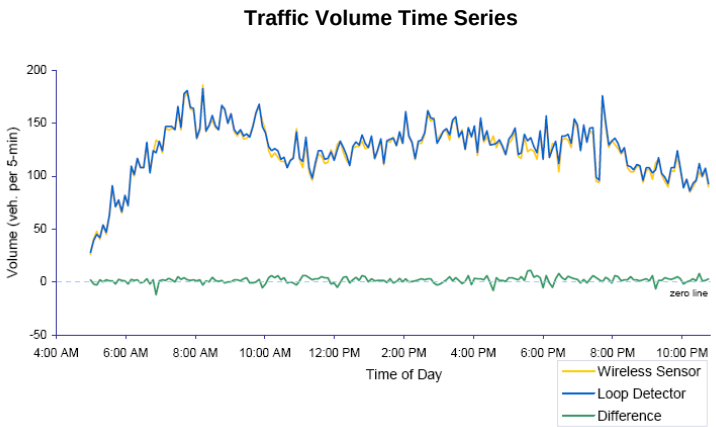
Test Results in California. In October of 2006, the California Center for Innovative Transportation (CCIT) of the University of California, Berkeley, with sponsorship from the California Department of Transportation (Caltrans), delivered its final report evaluating the performance and effectiveness of the Sensys Wireless Vehicle Detection System for measuring traffic. The report compared Sensys performance against data obtained from video cameras and inductive loops of the Berkeley Highway Laboratory, a 2.7-mile test bed for transportation research on Interstate 80 in Berkeley and Emeryville.

In general, the CCIT reported that "the essential ability of the [Sensys] wireless sensors to capture traffic patterns is at least close to, if not better, than that of loops." Measurements by both Sensys wireless sensors and inductive loops were compared to six video samples lasting five minutes each: two video samples were taken during periods of light congestion (0-5% occupancy); two were taken during periods of medium congestion (6-15% occupancy); and two were taken during periods of heavy congestion (greater than 15% occupancy).

When compared to ground truth as established by the traffic videos, the Sensys wireless sensors showed a count error of ~1%. The accuracy of the Sensys wireless sensors was directly comparable to that of the inductive loops: the difference between the number of vehicles counted in the videos and by the Sensys wireless sensors was 0.98-1.01%, while the difference between the number counted in the videos and by the inductive loops was 1.00-1.02%.







Sensys accuracy is virtually identical to that of well-maintained inductive loops

source: California Center for Innovative Transportation, "Evaluation of Wireless Traffic Sensors by Sensys Networks, Inc.," Final Report, October 2006

Consistent Accuracy In All Traffic Conditions. Unlike most radar-based detection systems, Sensys wireless sensors are not especially sensitive to variations in traffic flow. A Sensys installation can maintain practically the same high level of accuracy regardless of whether traffic is free-flowing or stop-and-go and bumper-to-bumper. This traffic-independent performance has been observed over and over – for example, the CCIT time series measurements shown previously indicate rush hour traffic between 3:00 pm and 6:30 pm, during which period the Sensys occupancy, speed, and volume measurements show only a slight increase in error relative to the inductive loop measurements.

Analogous Data To Inductive Loops. The CCIT study cited previously also highlighted how Sensys occupancy data directly correlates to occupancy data obtained from inductive loops. Although a Sensys wireless sensor has a smaller detection zone than that of most inductive loops and thus will produce a slightly different occupancy value for the same traffic conditions, Sensys occupancy values can be easily scaled by a constant so that they can be used in exactly the same way that occupancy values from inductive loops are used.

Relative Immunity To Environmental Conditions. Unlike most video vehicle detection systems, the Sensys vehicle detection system is not susceptible to environmental conditions. With video systems, fog or snow can completely prevent detection; glare, reflections, and incident sunlight (depending on the position of the camera and the time of year) can cause either missed detections or false detections; shadows can cause false detections or completely hide a vehicle from detection; and wind and vibrations can move the camera and generate either a false or dropped detection. With video systems, the camera mounting point is critical to performance – a stable platform for the camera is essential, and, if mounted too far away from the desired observation point, the camera may detect a single large vehicle rather than individual vehicles and may confuse traffic on multiple lanes, leading to over- or undercounts. By contrast, none of these weather or mounting conditions has any effect on Sensys performance.

High Reliability

Sensys wireless sensors provide the superior accuracy of inductive loops but with much greater reliability. The high reliability of the Sensys Wireless Vehicle Detection System and the long life and low cost of Sensys wireless sensors allow an "install and forget" policy – in the unlikely event a Sensys sensor should fail, installing a new sensor takes only a few minutes and is more cost-effective than repairing the failed sensor.

More Robust Than Inductive Loops. Although well-maintained inductive loops establish the benchmark for vehicle detection accuracy, they are notoriously unreliable. For example, the Caltrans PeMS (Freeway Performance Measurement System) showed that, on December 15th 2006, ~8,800 or 36.6% of the ~24,000 Caltrans-monitored inductive loops on freeways throughout California were inoperative, either permanently or intermittently.

In general, the reliability of freeway detectors, whether they are inductive loops or other technologies, could be much improved. In a recent survey of freeway detection technologies prepared for the United States Federal Highway Administration ("Metropolitan Intelligent Transportation System (ITS) 2004 Deployment Tracking Freeway Management Survey"), some agencies reported that as few as 10-20% of their deployed detectors were currently in service:

By contrast, Sensys wireless sensors and the overall Sensys Wireless Vehicle Detection System have been designed for maximum reliability. Like inductive loops, Sensys wireless sensors are pavement-mounted devices that are placed exactly where vehicle detection is required. Unlike inductive loops, however, Sensys wireless

sensors are not easily damaged by thermal expansion and contraction of the roadway, pavement shifting due to sandy soil conditions, pavement failure, or minor roadway construction. Because each Sensys wireless sensor in its hardened plastic case occupies only a small spot on the roadway, it does not experience the differential stress from the weight of passing vehicles that can lead to wire breaks in an inductive loop.

Furthermore, while some inductive loop deployments have suffered from cheap materials, incorrect gauge cabling, and improper or shoddy splicing, the installation of Sensys wireless sensors provides little or no opportunity for contractors to cut corners that may compromise performance and reliability.

Reliable Wireless Connectivity. Sensys wireless sensors communicate their detection data via two-way radio to a nearby Sensys access point which then uses wired or wireless connections to relay the data to a roadside traffic controller or centrally located traffic management system, as required by the application. The radio link between each Sensys wireless sensor and access point has been designed for reliable communications regardless of adverse weather conditions or the presence of nearby vehicles. Each time-stamped detection event is held in memory and transmitted repeatedly by the Sensys wireless sensor to the access point until the access point acknowledges successful receipt or the attempt times out, thereby virtually guaranteeing that the detection of a passing or stopped vehicle is reported.

The Sensys access point continually monitors the performance of the radio link to each Sensys wireless sensor, providing an RSSI (Receive Signal Strength Indicator) measurement of the received signal power and an LQI (Link Quality Index) figure of merit reflecting the quality of the link. At the time of installation, these values are inspected to ensure that the selected radio channel is not subject to local interference and that no sensors are beyond the range of the access point or its associated repeaters. Once a Sensys installation is operational, the RSSI and LQI levels of its sensors can be continually monitored so that, as needed, field maintenance can be alerted and any data collected over periods of inadequate RSSI/LQI can be flagged as questionable or invalid.

Reliable IP Communications. The Sensys Wireless Vehicle Detection System natively employs IP for its communication of detection data to traffic management systems. Data from any Sensys installation can thus be transmitted over any combination of wired and wireless packet data networks to any remote IP address. Either private or public data networks can be employed, and a virtual private network can be established to ensure data security if a publicly accessible IP network (such as a cellular data network) is used to relay the data to a private network.

Use of IP communications allows data from the Sensys Wireless Vehicle Detection System to be reliably and efficiently transmitted to facilities at virtually any distance from the installation site. By using TCP/IP (Transmission Control Protocol over IP), the reliable and in-sequence delivery of data is guaranteed whether the connection to the Sensys access point is wired or wireless.

Real-Time Performance Monitoring and Device Management. When provided with IP connectivity, a Sensys vehicle detection installation's operation can be monitored and managed remotely from a central facility. Any loss of connectivity to an individual Sensys wireless sensor or Sensys access point can be detected virtually immediately, where such loss of connectivity can be due to a unit failure or a temporary or permanent interruption of communications.

Each Sensys wireless sensor is individually addressable, and the performance of each sensor's radio link and its magnetometer can be continually monitored. For example, the instantaneous state of a sensor's radio link is revealed by monitoring its corresponding RSSI and LQI levels at the access point. This ability to monitor the

quality of vehicle detection and not just the availability of data represents a unique difference between the Sensys vehicle detection system and other technologies. For example, with an inductive loop, there is no way to determine remotely if it remains tuned and is delivering accurate results; with a radar system, misalignment can confuse data from different lanes with no way to detect the error; and, with a video system, shadows, glare, vibration, poor mounting, and other effects can disrupt accuracy at any time without any reliable means to discriminate good data from bad.

Intrinsic Reliability. Thanks to its fundamental design, the Sensys Wireless Vehicle Detection System provides mechanisms that ensure the availability and accuracy of its data. For example, installing two (or more) wireless sensors per lane is necessary to measure speed, but it also allows the data from each sensor to be checked for self-consistency and means that, in the event of sensor failure, at least one sensor can still provide vehicle count and occupancy data. Additionally, the failure of a single sensor is independent of the other installed sensors, so any lack of data in one traffic lane does not affect the data from the other lanes. Contrast this situation to that of a radar or video system, where equipment failure means that data for all lanes is lost. If a Sensys repeater or access point fails, all lanes may be affected, but remote monitoring via IP connectivity allows the failure to be quickly identified and corrected.

A Vehicle Detection Platform for Today's and Tomorrow's Applications

The Sensys Wireless Vehicle Detection System supports a greater variety of applications and deployment scenarios than any other alternative technology, whether it is an inductive loop, video, or radar system. More so than any other vehicle detection technology, the Sensys vehicle detection system provides a flexible platform for both today's and tomorrow's traffic management applications.

The Sensys Wireless Vehicle Detection System can thus play a significant role in improving traffic efficiency and mobility, enhancing traffic safety, improving the use of local, regional, and national infrastructure, and compiling detailed historical traffic data to assist in planning future infrastructure.

An All-Purpose Vehicle Detection System. Sensys wireless sensors can provide, either as direct or derived measurements, such data as vehicle volume, occupancy, speed, presence, length classification, headway, gap, direction of travel, and queue length with exceptional accuracy and reliability. This wide range of capabilities makes the Sensys Wireless Vehicle Detection System suitable for such varied traffic management applications as:

- ***freeway or arterial monitoring (count stations)***
- ***advance detection (traffic calming or dilemma zone protection)***
- ***stop bar detection***
- ***freeway ramp management***

The Sensys Wireless Vehicle Detection System can provide its detection data in formats directly analogous to that provided by inductive loops as well as in other formats. Detection data collected by the Sensys Wireless Vehicle Detection System can thus provide real-time traffic data to local roadside traffic signal controllers, to centralized Traffic Management Centers and Advanced Traveler Information Systems, to freeway and arterial traffic management systems such as MIST (Management Information System for Transportation), or to adaptive traffic signal control systems such as SCOOT (Split, Cycle, and Offset Optimization Technique), SCATS

(Sydney Coordinated Adaptive Traffic System), ACS Lite (Adaptive Control System Lite), RHODES (Real-Time Hierarchical Optimized Distributed Effective System), and OPAC (Optimization Policies for Adaptive Control). Moreover, the Sensys vehicle detection system can provide its real-time detection data to both local traffic controllers and central traffic management systems simultaneously, increasing its flexibility.

Deployment Versatility. The Sensys Wireless Vehicle Detection System can be configured as needed for virtually any site requiring vehicle detection. The Sensys wireless sensors are battery-powered, and, in order to simplify their installation, so, too, are the Sensys repeaters. Additionally, two repeaters can operate in tandem, significantly extending the range and coverage area of an access point. The Sensys access point is line-powered but can be configured to accept a nominal 12 VDC input so that it can be powered by solar panels with battery backup. A completely wireless deployment is thus possible using a solar-powered Sensys access point that is equipped with an integrated GSM or CDMA cellular data modem for wireless relay of the detection data.

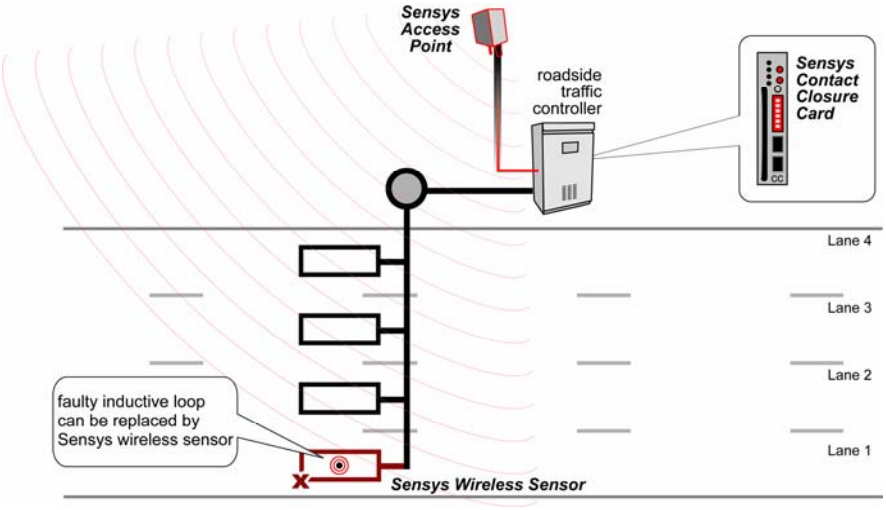
The basic architecture of the Sensys Wireless Vehicle Detection System – battery-powered pavement-mounted sensors that communicate wirelessly to a pole-mounted access point or repeater – means that the system can easily overcome deployment complications such as split roadways, flyovers, bridges, long distances from the traffic signal controller, high water tables, poor pavement quality, or other site-specific issues that would otherwise make the installation of inductive loops impractical or impossible. And where the deployment of a mid-block or advance detection system using inductive loops typically requires expensive trenching and conduit installation, these costs are completely avoided with the Sensys vehicle detection system. The versatility, ease of use, and low life-cycle cost of the Sensys Wireless Vehicle Detection System make it attractive in many situations where vehicle detection would otherwise not be practical.

Native IP Communications Facilitate System Integration. The Sensys Wireless Vehicle Detection System's native use of IP communications provides a wide range of immediate benefits, allowing traffic data collected by the Sensys vehicle detection system to be readily processed, archived, accessed, and distributed locally or regionally (or nationally or even internationally). IP connectivity permits real-time remote monitoring of all connected Sensys installations so that all Sensys components, including all installed sensors, can be monitored, configured, and updated remotely. Additionally, IP connectivity allows each Sensys wireless sensor's detection data to be time-stamped with an accuracy of 1 millisecond relative to an absolute time reference, where this synchronization permits data from many Sensys wireless sensors and from many geographically dispersed Sensys installations to be meaningfully compared.

Use of native IP communications further implies that Sensys data can be readily integrated into a wide variety of both existing and future software applications to support disparate Intelligent Transportation Systems, Advanced Transportation Management Systems, Advanced Traveler Information Systems, and other traffic management implementations. The Sensys Wireless Vehicle Detection System thus inherently provides the communications flexibility necessary so that its detection data can be used in many different and perhaps unanticipated ways.

System Integration with Roadside Traffic Controllers. While its native IP communications facilitate integration of the Sensys Wireless Vehicle Detection System with current and future traffic management systems, the system can also use contact closure signals to connect to existing roadside traffic controllers for the real-time control of traffic signals or for integration with existing freeway detection stations. As desired, both IP and contact closure connectivity can be supported simultaneously to allow a particular Sensys installation to fulfill varied objectives.

The Sensys Wireless Vehicle Detection System can be used with Type 170, NEMA TS1, NEMA TS2, or Type 2070 ATC traffic controllers by installing one or more Sensys contact closure cards into the detector shelf of the controller and connecting them to one or more Sensys access points. The real-time detection signals of the Sensys wireless sensors received by the Sensys access point are then converted into contact closure signals to the traffic controller that can be easily configured in the same way that inductive loops are configured to interface with a traffic controller. This capability means that Sensys wireless sensors can be readily used with existing traffic controllers to replace broken inductive loops, maximizing the value of existing infrastructure.



Sensys wireless sensors can extend the life of legacy infrastructure

Future-Proof Technology. The Sensys Wireless Vehicle Detection System truly represents the next generation of vehicle detection technology, providing data that can be used by tomorrow's traffic management applications as well as today's. The Sensys detection system intrinsically provides the flexibility to address future uses, offering a hardware platform that can host extended capabilities as well as allowing existing installations to be re-configured as detection requirements change or to be upgraded with new software.

While other technologies such as radar may only provide detection data that has been averaged or binned over a time interval, data from Sensys wireless sensors can be similarly averaged or can be provided on an individual vehicle basis for fine-grained detail. As a result, Sensys data can be used in legacy traffic management applications as well as in more sophisticated or future systems where high data granularity is demanded.

To ensure that the unanticipated needs of future applications can be met, the software and firmware used by the Sensys system can be upgraded as new features are made available and as they are required. New software and firmware can be distributed to each Sensys access point via its IP connectivity and can then be downloaded over-the-air via the radio links to the Sensys wireless sensors and repeaters.

The design of the Sensys access point as a Linux-based intelligent device allows it to function as a router, thereby taking advantage of the access point's IP connectivity to enhance the system's overall traffic management and monitoring capabilities with those of other peripheral devices. The Sensys access point can provide ports for such peripheral devices as still or video cameras, where future hardware implementations of the Sensys access point may integrate such devices. Using a Sensys access point as a router can also extend the area of coverage of a Sensys installation – for example, 3rd party point-to-point radios can be used as peripherals to connect remote Sensys access points and their supported sensors to a central Sensys access point with IP connectivity that acts as a router for the expanded network.

Affordable Advanced Technology

By keeping component and procurement costs low, by simplifying the deployment of vehicle detection sensors, by using sophisticated power management techniques to extend battery life, and by minimizing maintenance requirements, Sensys Networks has significantly reduced the life-cycle costs associated with vehicle detection. The Sensys Wireless Vehicle Detection System's low life-cycle cost allows capital, operations, and maintenance budgets to be more effectively utilized.

Low Procurement Costs. The Sensys detection system represents a unique integration of hardware, software, and mechanical packaging that is explicitly designed for vehicle detection applications. Wherever possible, Sensys has employed standards-based technology to control the costs of the Sensys components. By employing devices and integrated circuits designed, developed, and marketed for a wide range of applications beyond just vehicle detection, Sensys is able to take advantage of the economies of scale and keep product costs low, even with the unique packaging required for the harsh environment of roadside and pavement installation.

Fast and Simple Installation. The on-site installation process for the Sensys Wireless Vehicle Detection System does not require any special calibration or adjustment, allowing even minimally trained crews to quickly and safely deploy the Sensys components.

Installation of each Sensys wireless sensor takes approximately 10 minutes. Each Sensys wireless sensor can be placed at the exact location on the roadway where vehicle detection is desired, while the Sensys access point can be installed at the most convenient location that affords power, connectivity, and adequate range to the sensors. If all the sensors at a site are not within range of an access point, then one or more battery-powered Sensys repeaters can be used to relay data wirelessly from the most distant sensors back to the access point. For the Sensys access points and repeaters, the amount of setback from the roadway, the stability of the mounting point, the relative angle of the sun, and other considerations required by alternative systems are not critical, making installation all the more simple.

Minimal Roadway and Traffic Impacts. In the installation of all Sensys wireless sensors, no long pavement cuts are required, and, because of the sensors' wireless connectivity, no lead-in cabling is needed. The installation of Sensys wireless sensors is thus much less expensive and much less damaging to the roadway than that of any other in-pavement detection technologies.

The remaining Sensys components associated with an installation – the Sensys access point, optional Sensys repeaters, and optional connectivity to a roadside traffic controller using Sensys contact closure cards – are all non-intrusive and are easily and quickly installed without disrupting traffic.

As a result of the Sensys Wireless Vehicle Detection System's fast and easy physical installation, the costs associated with road closures are significantly reduced when compared to the installation of other in-pavement systems. Temporary or moving lane closures during off-peak hours are usually sufficient to allow a complete site to be installed safely.

Long Life. Thanks to its innovative ultra-low power consumption, battery life of a Sensys wireless sensor is exceptionally long, providing an average of 10 years for the flush-mounted sensor. The mechanical design of the Sensys Wireless Vehicle Detection System contributes to its long life. The hardened plastic case of each Sensys sensor and the small area occupied by each sensor on the roadway make it less susceptible to damage

from heavy traffic, pavement shifts, or minor roadwork than any other in-pavement detector technology. The Sensys access points, repeaters, and other components are all designed for reliability and survivability in extremes of both temperature and humidity.

Minimal Field Maintenance. Unlike radar systems which often must be routinely re-calibrated or video systems which must be periodically maintained to keep the camera lens clear of dirt and grime, very little field maintenance is required by any component of the Sensys Wireless Vehicle Detection System. In particular, the Sensys wireless sensors continuously self-calibrate their measurement of the earth's magnetic field and rarely, if ever, require field calibration, either upon installation or at any time thereafter.

The status of the Sensys wireless sensors, repeaters, and access point of a Sensys installation can all be monitored remotely through the access point's IP connectivity. Remote monitoring allows any failure of a Sensys wireless sensor, access point, or repeater to be quickly diagnosed. If a Sensys access point or repeater requires attention, any needed on-site maintenance to these above-ground, non-intrusive components can be done with minimal disruption to traffic; if a sensor has failed, its low cost and easy installation make field replacement the best form of maintenance. As necessary, configuration changes and firmware updates or upgrades can be delivered to the access point and then "over the air" via the wireless link to the sensors and repeaters.

A More Economical Choice Than Alternative Detection Technologies. Because of its low unit cost, easy installation, long life, and minimal maintenance requirements, the overall life-cycle cost of the Sensys Wireless Vehicle Detection System is a fraction of the costs associated with alternative inductive loop, radar, or video systems. The Sensys vehicle detection system can have both lower capital and lower operational costs than most other systems, making it a clear choice for municipalities and regions interested in the most effective use of their budgets.

Thanks to its low product cost and minimal cabling requirements, the total equipment costs for the Sensys Wireless Vehicle Detection System can be even less than for inductive loops. The main Sensys cost savings, however, are associated with installation and civil work – in-pavement installation of the Sensys wireless sensors is trivial compared to the installation of inductive loops, trenching and conduits are not needed, and almost any existing power source and pole or retaining wall can be used for the Sensys access point without any consideration of its setback from the road or its suitability as a vibration-free platform.

The Next Generation of Vehicle Detection Technology

The Sensys Wireless Vehicle Detection System represents a new way of creating sensor networks for the detection of vehicle traffic. Its exceptional accuracy, dependable reliability, flexibility to address a wide range of traffic management applications, and overall affordability make the Sensys Wireless Vehicle Detection System an ideal choice for both new and replacement deployments.

Because of its cost savings and overall flexibility, the Sensys vehicle detection system permits sensors to be deployed at a much higher density than has ever before been possible. The deployment of a pervasive network of vehicle sensors can facilitate an expanded use of Intelligent Transportation System technologies to improve traffic efficiency, enhance traffic safety, increase mobility, safeguard and enhance economic productivity, and reduce fuel consumption and emissions.

As industrialized economies confront the challenges of limited resources, heightened economic competition, and population and environmental pressures, the intelligent and rational management of the existing transportation infrastructure becomes increasingly important. In other words, how can regions pragmatically support the increased traffic associated with economic and population growth while maintaining both the efficient mobility of goods and people and the quality of life that likely enabled their success in the first place? The Sensys Wireless Vehicle Detection System offers a fundamental technology that can help enable enlightened, innovative, and cost-effective solutions to this complex problem.

For more information about advanced Sensys technology from Sensys Networks, please visit www.SensysNetworks.com or contact info@SensysNetworks.com