Chapter 10

Intelligent Transportation Systems
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INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent Transportation Systems (ITS) is the application of electronics, communications, or information processing, used singly or in combination, to improve the efficiency or safety of a surface transportation system. ITS can connect vehicles, travelers, and highways, helping to improve the travel experience by providing information such as roadway congestion locations, accidents, construction delays, optimum routing, weather conditions, and traveler information. The 2001 report, OKI Regional ITS Plan, guides OKI and its member agencies in planning, programming and implementing integrated multimodal ITS over the next ten years. The goals of the ITS plan include:

- Improving mobility of people and goods
- Protecting environmental quality
- Improving travel safety

The ITS plan identified projects in three program tracks: 1) optimize existing ITS, 2) integrate systems and agencies, and 3) expand geographic coverage and services.

NATIONAL ITS ARCHITECTURE

The United States Department of Transportation issued the ITS Architecture Consistency Rule in 2001. This rule requires regions to prepare ITS plans and architectures that are consistent with certain federal standards, if they wish to apply federal funds to their ITS programs. The OKI Regional ITS Plan is in conformance with the federal consistency rule and also incorporates a regional ITS architecture that describes how systems will be interconnected in the region.

ITS COMPONENTS

An ITS is comprised of one or more technology systems depending on a metropolitan area's needs. Initially, the ITS core components focused on the freeway system, but technology systems are also being applied to major arterials and intersections, transit systems, and intermodal connections. In an integrated ITS, multiple components support each other and optimize the transportation system's efficiency. Among the most common core components are those listed below:

- An Advanced Traffic Management System, usually focused on freeways, collects information on traffic conditions and transmits the data to a control center for use in monitoring traffic conditions and detecting congestion problems.
• A **Traveler Information System** provides information to help motorists avoid congestion. This information, which may be obtained prior to or during travel, can include real time traffic conditions, routing alternatives, transit schedules, assistance with rideshare registration, and other travel-related information.

• An **Incident Management Program** detects, verifies, and transmits information on the location and nature of vehicle accidents or breakdowns so that the appropriate emergency service can be quickly dispatched, thereby reducing incident response and removal times.

• An **Advanced Traffic Monitoring System** provides a repository for data used in transportation planning and transportation system management.

• An **Advanced Public Transit Management System** enables bus fleets to be operated so that travel time is reduced and customer service and security are enhanced.

• A **Traffic Signal Control System** synchronizes the timing of multiple traffic signals in a corridor in order to improve traffic flow and reduce stop-and-go travel.

• **Electronic Fare Payment Systems** facilitate payment for parking, bus and train fares as well as tolls.

In reducing travel time, an ITS’ effectiveness is the combined result of its core components. These technologies contribute individually and through interaction with each other to reduce congestion and delay, increase travel speeds and traffic throughput, reduce the frequency and severity of accidents, and optimize the existing transportation system. By moving more traffic more quickly, an ITS can eliminate the need for new transportation facilities. An ITS can also be significant for improving safety and lowering vehicle emissions and fuel consumption.

**EXISTING ITS PROGRAMS**
The most extensive system of advanced ITS technologies in the OKI region is ARTIMIS, the Advanced Regional Traffic Interactive Management and Information System. ARTIMIS evolved from OKI’s interest in reducing congestion from interstate reconstruction, which was scheduled to begin in 1987 and last for several years, and in ITS potential to optimize freeway system efficiency, improve safety, and benefit air quality. ARTIMIS was initiated by OKI’s completion of a feasibility study in 1988, followed by a preliminary engineering design in 1991. Through the teamwork of OKI, the Kentucky Transportation Cabinet (KYTC), the Ohio Department of Transportation (ODOT), and local governments, ARTIMIS was designed to provide consolidated traffic management without regard to state and local political boundaries.
Figure 10-1
ARTIMIS System Coverage

Legend
Managed Roadways
- Fiber Optic Cable
- Less Instrumentation
When it came fully online in early 1998, ARTIMIS became one of the first ITS in the country to provide seamless freeway traffic management across state borders. ARTIMIS covers the 98 miles of the region’s freeway system with the heaviest traffic:

- I-75, I-71 (including Fort Washington Way), and I-471 within the I-275 beltway
- The I-75/I-71 segment south of the beltway to US 42
- I-275 in northern Hamilton County between US 22 (Montgomery Road) and SR 4
- I-275 in northern Kentucky from Kellogg Avenue and the Ohio River Bridge to the Ohio River Bridge at the Indiana state line
- Ronald Reagan Highway between I-75 and I-71
- SR 562 (the Norwood Lateral)

ARTIMIS is operated by traffic controllers stationed at a control center. The control center, situated in downtown Cincinnati and centrally located on the ARTIMIS system, receives all of the information collected from the field. The control center is the point from which traveler information is disseminated and traffic is managed.

ARTIMIS’ components include:

The **Advanced Traffic Management System (ATMS)** collects information on traffic conditions per lane and transmits it to the control center. The information is collected by loop detectors installed in the pavement every one-third to one-half mile, wide beam radar detectors on I-71, and video cameras on Fort Washington Way. These technologies collect traffic speed, volume, and vehicle density data throughout the entire ARTIMIS system, in addition to providing visual surveillance on some segments for use in verifying congestion and determining the cause of incidents. When traffic speeds drop below a certain level, controllers are alerted to conditions that may warrant remedial action. On I-75 and parts of I-275 — which are the most heavily traveled freeways — closed circuit television (CCTV) cameras provide pan-tilt-zoom capabilities for full-motion video coverage that make these segments completely visible at the control center.

The **Advanced Traveler Information System (ATIS)** is one of the most sophisticated traveler information components in the country. It provides information on traffic problems and alternative routes through a combination of changeable message signs strategically located throughout the system, a highway advisory radio frequency, and a multi-faceted traveler advisory telephone service. Figure 10-1 shows the existing geographic coverage of the ARTIMIS system. The telephone service makes information available through either a landline or cellular phone and can be accessed anywhere in the region.
by dialing “511”. This has become the national standard for accessing traveler information in selected metropolitan areas. The OKI region was the first area in the United States to implement the 511 service. The service provides such travel-related information as:

- Up-to-the-minute and route-specific traffic conditions
- Bus routes and schedules of the region’s two largest transit operators (SORTA and TANK)
- Airport shuttle service and schedules
- Local weather information
- Traffic conditions throughout Indiana, Kentucky and Ohio

Since its inception in 1996, the 511 system has handled millions of calls, and its use has steadily increased. The service has recently been upgraded to provide express touch-tone keypad entry and voice recognition capabilities.

The website, [www.artimis.org](http://www.artimis.org), provides similar traffic information and real-time video from the ARTIMIS traffic cameras.

To supplement information on traffic conditions, almost 200 mobile “probes” — which include buses, OKI rideshare vans, and cell phone users — and spotter aircraft report information observed while traveling or from flights made during peak hours.

The **Incident Management Program** expedites the relay of information on incident occurrence, cause, and location to those involved in emergency response, such as 911 dispatchers, police and fire departments, paramedics, towing services, and emergency management services. To further expedite incident response and removal, this program includes the following special features:

- The **Freeway Emergency Service Patrol**, which operates three vans in Ohio and two in Kentucky on assigned freeway segments, provides gas, minor repairs, or other assistance to disabled vehicles to expedite their return to operation or move onto the shoulder or off the freeway.
- **Median markers** are located every tenth of a mile for use in accurately reporting and quickly locating incident locations. These specially designed markers, and also signs located on each ramp that identify direction and location, are being used for expediting incident response time.
- A **Regional Incident Management Task Force** continues to provide coordination among the many agencies involved in incident management. Task force members include representatives from fire and rescue; state and local law enforcement; emergency management and response organizations; communication centers; local, regional, and state
transportation agencies; and the American Red Cross. The Task Force mission is to set up regional policies and protocols for responding to incidents within a multi-state, “home-rule” setting, such as how to expedite the removal of abandoned vehicles.

- The **Traffic Monitoring System (TMS)** provides data for use in measuring the freeway system’s performance. Data on travel speed, volume, and vehicle density by lane mile is collected and stored from ARTIMIS’ 1,100 vehicle detection devices.

A benefit-cost evaluation of ARTIMIS was conducted in 2001. Benefits for five performance measures were calculated: user mobility, travel time reliability, fuel consumption, accidents, and emissions. Travel time reliability showed the greatest benefit to date, due to ARTIMIS’ incident management elements. The evaluation indicates that ARTIMIS has a benefit-cost ratio of 12:1. This was based on the ARTIMIS core infrastructure. With expansion of ARTIMIS, the benefit-cost ratio will become even more favorable. This is because expansion costs could be lower than original installation costs, since the core infrastructure at the ARTIMIS control center, and much of the communications infrastructure is already in place.

In addition to ARTIMIS, several other advanced ITS technologies are already in place in the region including:

- The **City of Cincinnati Advanced Traffic Signal System** is an advanced centralized traffic signal control system. The system enables city staff to operate traffic signals as an integrated whole from a control room. Without this system, traffic signal timing changes would have to be accomplished in the field at each signal controller. In addition, staff would not be able to clearly understand the relationships between the different intersection operations.

- SORTA’s **Automated Vehicle Location System & Computer Aided Dispatch** tracks a coach’s location using global positioning satellites. The tracking information is provided to the automated dispatch system and enables dispatchers to maintain on-time performance.

- TANK’s **Automated Vehicle Location System & Computer Aided Dispatch** was also recently implemented. TANK has installed the same system used by SORTA to ensure that transit schedule information can be shared across the Ohio River.

- The **Hamilton County Radio Communications System & Computer-Aided Dispatch** is an 800MHz trunked system that, among other features, enables multiple agencies in Ohio to communicate over common channels. In the past, emergency responders and public works officials could not communicate over radio, because each agency operated on
different channels. Enabling these communications improves the unified response to crashes on area roadways, increasing accident survivability and reducing delay to other travelers. The computer-aided dispatch system provides dispatchers with an automated tool to locate and track emergency crews and their activities.

- The Boone County Radio Communications System & Computer-Aided Dispatch is a recently upgraded radio system and recently installed computer-aided dispatch system. The Boone County System operates in the 425MHz range and enables communications with multiple emergency response agencies throughout Northern Kentucky.

RECOMMENDATIONS FOR ITS
As freeway traffic continues to increase, ITS infrastructure will become increasingly important for reducing congestion and delay and otherwise improving traffic flow. ITS project recommendations seek to optimize, integrate and expand the system. Optimization projects modify the current ITS in place, to ensure optimal and more efficient performance. Optimization projects include enhancing existing ARTIMIS field devices, installation of information kiosks and arterial signal operations upgrades. Integration projects connect agencies, systems and staff to create new, enhanced systems. These projects include upgrading ARTIMIS to support integrated architecture and integration of ARTIMIS with 911 dispatching. Other projects seek to expand the geographic system coverage and services of ITS with an emphasis on the freeways and key arterials. Recommended expansion projects include the installation of new ARTIMIS field devices and communications equipment, SORTA/TANK transit itinerary planning system and a truck-oriented traveler information system. The freeway segments that may be included in the ARTIMIS system expansion are:

- the remainder of I-275
- I-74 inside the beltway
- I-75 outside the beltway north to SR 73
- I-71 outside the beltway north to SR 48
- I-75/I-71 outside the beltway south to the junction where I-75 and I-71 separate
- Ronald Reagan Highway between I-75 and I-275

A complete list of potential ITS projects can be found in the OKI Regional ITS Plan.

STUDIES AND COSTS FOR IMPLEMENTING RECOMMENDATIONS
For many of the preceding recommendations for ITS, additional studies are needed to address such issues as specific infrastructure needs, phasing, deployment procedures, and cost estimates. The annual operating and
maintenance cost of ARTIMIS is estimated at $5.4 million. Table 10-1 provides cost estimates for optimization, integration and expansion. Total recommended cost is $52 million.

Table 10-1
Cost Estimates for ITS Projects

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<th>Project</th>
<th>Kentucky Needs</th>
<th>Ohio Needs</th>
<th>Kentucky Recommended</th>
<th>Ohio Recommended</th>
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<td>Optimizing existing system</td>
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