Smarter Cities Series: Understanding the IBM Approach to Traffic Management

- Learn how traffic-related data analysis gives insight into traffic management
- Understand how products and technology can optimize and maintain transportation assets
- See how IBM has implemented solutions to real-world traffic management challenges
Introduction

Traffic is all about the movement of people and goods from one point to another. Traffic is a crucial element of the daily operations of any community or city. As commuters, we all travel by using private transportation, public transportation, or a combination of the two, such as vehicles, buses, boats, and rail systems.

Current city transportation systems and associated infrastructures are strained. In the future, these systems and infrastructures will become even more burdened due to a growing population and increased demands for mobility.

IBM® Smarter Traffic™ integrates technology and intelligence into the city transportation infrastructure. With this approach, transportation authorities can improve capacity, enhance travelers’ experiences, and make transportation systems and infrastructure more efficient, safer, and more secure. Smarter Traffic relies on these information technology (IT) concepts: gathering and visualizing data, managing assets, monitoring sensors, optimizing centralized analytics, and distributing control.

With Smarter Traffic, cities can gain an understanding of the current transportation infrastructure and traffic issues. This understanding is accomplished by capturing relevant data, analyzing that data, and providing insight. With real-time data and the use of appropriate tools and technology (such as automation, control systems, and analytics optimization), cities can improve their traffic flow and make smarter traffic a reality.

This IBM Redguide™ publication is for city officials and their IT architects who are looking for solutions to urban traffic-related challenges. This guide highlights the IBM Smarter Traffic vision that enhances the operation of urban traffic by predicting demand and optimizing capacity, assets, and infrastructure. The vision identifies ways to improve the end-to-end travel experience, by reducing the environmental impact of traffic and by ensuring the safety and security of travelers. It introduces the IBM Intelligent Transportation Version 1 Release 0 and Traffic Prediction Tool solutions and provides high-level architectures for these two solutions, including key components and capabilities.

This guide also provides information about the asset management software provided in the IBM Maximo® offerings through which a city’s transportation organizations can maintain and manage their assets. This guide provides a sampling of city case studies that show IBM solutions to various traffic-related challenges.
To understand the broader picture of IBM Smarter Cities™, see the following Redguide publications:

- *Smarter Cities Series: A Foundation for Understanding IBM Smarter Cities*, REDP-4733
- *Smarter Cities Series: Introducing the IBM City Operations and Management Solution*, REDP-4734

**Why Smarter Traffic**

In all societies, the transportation system is vital because it connects people, goods, and services. The smooth operation of this essential system directly impacts economic activity and the productivity in any city. It also influences the quality of life and general standard of living. Throughout history, significant advances have been made in transportation, such as new modes of travel and improvements in the transportation infrastructure (for example, paved roads, railways, and freeway systems). Each advance has led to a period of enhanced economic activity. Enhanced transportation systems create new economic opportunities; reduce the costs of moving people, goods, and services; and enable the continued growth of the city.

In recent decades, significant increases in urbanization have placed a burden on most traffic systems around the world. Clogged traffic systems deter economic activity. They also waste energy and release significant amounts of carbon dioxide (CO₂) into the atmosphere.

A traditional approach to solving traffic problems has been to make increases in the following ways:

- Increase the capacity of the underlying infrastructure by building more roads and bridges.
- Increase the number of vehicles providing transportation services, such as more public buses and trains.

These approaches have visibly reached their limits in existing cities. Cities need a new approach to these challenges that optimizes the use of existing infrastructure investments and provides safer, cleaner, and more efficient travel.

IBM Smarter Traffic solutions are key to resolving many traffic-related challenges. The next section highlights specific objectives and how Smarter Traffic intends to solve them.

**Objectives driving Smarter Traffic solutions**

Transportation providers today have four clear objectives (illustrated in Figure 1 on page 3) that can be helped by a Smarter Traffic solution:

- Predict demand and optimizing capacity, assets, and infrastructure.
- Improve the end-to-end experience for travelers.
- Increase operational efficiency while reducing environmental impact.
- Ensure safety and security.
Predict demand and optimizing capacity, assets, and infrastructure
A Smarter Traffic goal is to improve capacity utilization and make better use of existing investments in assets and infrastructure. This goal is accomplished by using the following methods:

- Collecting data on real-time network conditions
- Identifying mobility and usage patterns
- Predicting demand
- Encouraging a balanced use of available infrastructure and capacity

This goal is accomplished by using both near real-time analytics and historical data analysis on the data that is captured through roadside sensors and onboard equipment and that is obtained from other agencies. Analysis helps traffic management centers and transit service providers make well-informed decisions about the use and optimization of transportation resources.

The data collected can also be used to provide value-added services and new methods of funding road use and maintenance, such as through congestion charges. These methods can be used to shape traveler behavior to aid the environment.

Improve the end-to-end experience for travelers
Smarter Traffic seeks to improve the traveler's experience. For example, the solution can provide driving directions, inform travelers of route changes because of an incident or traffic congestion, and suggest various public transit options. The solution can also offer incentives to travelers to balance the use of public versus private transportation systems.

The data that is used makes determinations to aid the traffic flows directly from various transit operators and traffic management centers. Other data is based on value-added services that private operators provide. Making relevant data available to travelers is one of the most critical factors in making them satisfied with the city traffic system.

Increase operational efficiency while reducing environmental impact
Smarter Traffic seeks to enhance the operational efficiencies of individual transportation agencies, transit operators, and commercial fleet operators. Through tracking of assets, optimizing equipment availability, and ensuring maintenance effectiveness, Smarter Traffic
techniques reduce waste, improve reliability, and remove operational costs for transportation operators.

Smarter Traffic seeks to provide visibility of agency operations to other participants in the value chain. Included in this group are parts suppliers and maintenance crew contractors, enabling more effective collaboration. In addition, Smarter Traffic aids planning and decision making, resulting in significantly enhanced operational efficiencies throughout the system.

**Ensure safety and security**

To ensure the safety of citizens, information from onboard vehicle-equipment sensors is integrated with information from sensors onboard other vehicles and from infrastructure sensors on roads, curbs, and rail tracks. This technique improves the range of warnings that the vehicle driver receives, such as wrong lane entry, slippery road, and proximity alarms. Moreover, sensors that monitor conditions on infrastructure, such as roads or tracks, help to detect hazardous conditions so that maintenance crews can respond effectively. Through smart surveillance systems, rail lines, airports, and roadways can be constantly scanned to detect suspicious activities.

**Future of mobility**

An unprecedented stress is on the physical transportation infrastructure of cities. This stress arises because transportation resources are unable to keep up with demand. This trend is expected to continue, because urbanization is increasing around the world. Increases in physical capacity (such as roads, buses, and railways) provide small increases in supply. Technology and information-based solutions have the potential for quicker and more cost-effective solutions.

In Sam Palmisano’s speech “A Smart Transportation System: Improving Mobility for the 21st Century,” he stated, “We know what any transportation system is, on the most basic level. From ancient times to the present, any such system has been made up of three elements:

- **Vehicles:** Cars, ships, and planes, which move goods from one place to another
- **Pathways:** Roads, rail lines, shipping lanes, [which are] the infrastructure that allows movement to take place
- **Terminals:** Stations, car parks, airports, seaports, [which are] the endpoints where journeys begin and end, where passengers transfer from one mode of transportation to another, and where goods are tracked, organized, and assembled.\(^1\)

To this list we add *travelers*. Travelers are users of the transportation system. Smarter Traffic supports their ability to travel in a safe, cost-efficient, well-informed, and environmentally friendly manner.

**Smarter Traffic solution areas**

Our rapidly urbanizing planet depends on getting people and things from here to there. In the 20th century, that [means of transportation] meant freeways from state to state and nation to nation. In the 21st century, “smart” traffic systems can be the new milestone of progress.\(^2\)

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Through Smarter Traffic, IBM envisions and is creating solutions to deal with traffic challenges. The IBM Smarter Traffic solution includes the following areas:

- **Intelligent traffic solutions**

  Intelligent traffic solutions provide traffic information, data analysis, and reporting tools for Traffic Management Center (TMC) staff and traffic planners. With these capabilities, TMC staff and traffic planners can respond quickly to incidents and make well-informed decisions. They can analyze current and historic traffic data to enable transportation planning to evaluate, assess, and design transportation facilities such as streets, pedestrian lanes and crosswalks, and public transportation routes. They can also use this analysis to define roadway response plans.

  Traffic prediction (for a city or regional road network) uses historical and real-time data to anticipate future trends. The prediction is short term, for 10–60 minutes in advance, achieving extremely high accuracy. In addition to predicting car and truck traffic, the solution can be deployed for public transportation systems.

  Traffic prediction can help TMC staff achieve the following objectives:
  - Anticipate congestion and institute ways to better control it.
  - Make traffic and public transit systems flow more smoothly.
  - Deliver more capacity to meet growing demand.

- **Asset management and optimization**

  Asset management is about accurate, real-time monitoring of transportation assets, proactively optimizing their operational efficiency and maintenance costs. These actions can maximize the useful life of these assets. Solutions focus on maximizing the use and longevity of fixed and movable assets and maximizing the use of human resources, procurement, and service management. Also included in the solution area are transportation-specific capabilities, such as linear asset management, spatial, and mobile capabilities.

**IBM traffic solutions**

Cities are looking for ways to improve their traffic flows, better manage their public transportation, improve the traveler experience, and improve operational efficiencies. They have a strong need for city-wide visibility of transportation challenges, but existing solutions are limited in scope. In many cases, the existing solutions have limited capabilities and are not easily extended or scaled.

The following two key IBM solutions can improve traffic management:

- IBM Intelligent Transportation Version 1 Release 0 (V1.0)
- IBM Traffic Prediction Tool

**IBM Intelligent Transportation V1.0**

IBM Intelligent Transportation V1.0 provides new intelligence and insights, greater transparency, and increased visibility across an entire transportation network. It helps to analyze traffic behavior and events across diverse transportation network inputs. It also helps optimize throughput, efficiency, response time, and the traveling experience.
This solution provides the following tasks and advantages:

- Aggregates and normalizes multisource traffic data, producing consistent near real-time visibility and insight into traffic flow which can provide the following benefits:
  - Aid in the understanding and development of a better view of demand across an entire transportation network.
  - Provide a clear understanding into the effective use of transportation assets and infrastructure.
  - Help reduce the cost of transportation and roadway event monitoring.
  - Help reduce congestion by providing the insight needed to balance traffic across routes.

- Provides traffic analysis capabilities and access to historical and near real-time information about traffic performance, conditions, and incidents, resulting in the following potential:
  - Aid in improving operational efficiencies.
  - Extend the transportation network capacity by using current infrastructure and assets.
  - Save money and time by providing information about the location, status, and availability of transportation assets.

- Transforms multisource traffic data into a standard traffic information model, providing the basis for additional applications and solutions.

- Provide analysis and reporting to traffic operators and traffic planners, so that they can effectively achieve the following objectives:
  - Improve the management of traffic.
  - Improve the commuter or traveler experience.
  - Reduce pollution caused by traffic congestion.

IBM Intelligent Transportation gives insight into traffic flows, helps in the optimization of the flow of traffic, and includes the following functions:

- Access and visibility into near real-time and historic traffic data, including average speed, volume, and incident information

- Centralized management of traffic operations and traffic event information collected across geographic locations

- Traffic analysis and reporting capabilities, which aids traffic operators and traffic planners in the management of traffic

- Analysis of near real-time and historical data to provide insights to traffic operators and traffic planners

- Monitoring of traffic incidents and events in near real time to enhance security
Key components

Figure 2 shows the context diagram of the overall traffic management system with the IBM Intelligent Transportation solution.

Figure 2 includes the following high-level components:

- Roadway systems

  These systems consist of the following main categories:
  
  - Roadway control signal systems
    
    Traffic lights, variable message signs (VMSs), variable speed signs (VSSs), and lane signals are road control signal systems. They are used to manage traffic flow and inform travelers of changing road conditions or give direction so they can take appropriate actions.
  
  - Roadway reporting systems
    
    Roadway equipment including loop detectors, microwave sensors, video cameras, and telematics provide real-time traffic data. This data includes traffic volume, average speed, and roadway conditions. Along with data from fixed roadside sensors, vehicles on the road are also being tapped as a source of data, especially regarding traffic, queues, and related congestion data.
Traffic Management Center

A TMC supports road and highway systems. Real-time information is gathered from roadway reporting systems, public safety personnel, and other traffic reporters. With this information, TMC staff and traffic managers can make decisions and take appropriate actions. They allocate resources, such as road workers and maintenance personnel, and interact with public safety officials in the handling specific incidents. They can issue directives to the Roadway Control Signal Systems and provide information to Traveler Information Services.

Transportation planning

The transportation planning team uses current and historical traffic data to evaluate, assess, and design transportation systems (such as streets, highways, bike paths or lanes, and public transportation lines). Also, the transportation planning team analyzes incident data and generates incident response plans for use by the TMC.

Information Service Provider

The Information Service Provider is the mechanism that communicates traffic information between the various Traveler Information Services and the TMC.

Traveler Information Service

A Traveler Information Service informs travelers about concerns such as road incidents, road work, and driving conditions. This information is available through public websites or portals and devices (such as television, radio, mobile, and navigation devices) or is transmitted by using a Short Message Service (SMS).

Traffic Management Data Dictionary (TMDD) Gateway

Traffic data is generated by multiple roadside sources, such as loop detectors, video devices, and microwave sensors that can be supplied by multiple vendors. The traffic data (in various formats) is cleansed and standardized into the TMDD format by the gateway.

The IBM Intelligent Transportation solution includes the following key functions:

Traffic Operations Dashboard

The Traffic Operations Dashboard provides key traffic-related data and analysis results in the Intelligent Operations Center. This traffic management platform includes services, such as traffic information monitoring, traffic event handling, and traffic analysis for operators and the public. It addresses the following needs:

– Provides traffic management staff with a single view that consolidates information from various data sources
– Provides traffic management staff with dynamic, near real-time traffic information that is visualized on a geospatial map
  This map shows the level of services (LOS), indicating the traffic congestion and general traffic flow.
– Provides advanced traffic data analysis and graphical reporting capabilities that city planners can use to measure and manage traffic performance and to help them optimize their response to incidents

Geospatial information

Geospatial information supports the storage and presentation of geospatial information system (GIS) for dynamic graphical displays in the dashboard as in the following examples:

– GIS-based maps to visualize the road network, traffic volume, speed, density in near real time, or, alternatively, historical information
– Manual and automatic capturing of traffic events and incidents based on the data flows and logical architecture of Intelligent Transportation Systems (ITS) standards
– Device icons (for devices such as a VMS device or camera, traffic event, and traffic control devices) so that a user can select an icon to view detailed information

- Standards-based data exchange protocols
Data exchange takes data structured under one source schema and creates an instance in the target schema reflecting the source data as accurately as possible. It transforms multisource traffic data into a uniform traffic data model, standardizing various data collection units across separate data sources.

- Analysis
Analysis consists of business intelligence and analytic tools. These capabilities use traffic-specific and traffic-related data from various sources as input to the processing. The results of this analysis provide TMC staff and other city officials with insight and key information so that they can make well-informed decisions.

- Reporting
Reports for city officials, transportation planning, and TMC staff can be generated by using real-time and historical traffic data. Reports can be created dynamically and customized by using queries and filters against traffic data.

- Information Management
Standards-based Information Management collects, manages, and stores traffic data for use in reporting, sharing, and analysis. Because massive amounts of traffic data are generated, Information Management manages current data and archived historical data for use as needed.

- Administration
Administration enables the definition of users, user groups, visual user interface customization, and the assignment of roles and access to the various capabilities and data in the IBM Intelligent Transportation solution.

- Security
Security includes the following capabilities:
  – Authentication (establishing whether a client is who or what it claims to be in a particular context)
  – Authorization (determines whether a user or group has the necessary privileges to access resources)
  – Data- and information-level security for data and information at rest and in-flight
  – Application-, process-, and service-level security
  – Protection of traveler privacy and vehicle-specific information
Standards for traffic information management

This section identifies select industry standards that cover the flow of traffic information.

Standards for field equipment sensors to traffic centers
The following organizations define standards to aid in the transfer of data from field equipment sensors:

- The National Transportation Communication for ITS Protocol (NTCIP) has defined a set of communications protocols for traffic center-to-physical sensor communications, which is commonly used in the United States. This set of standards defines the device data dictionary for various roadside sensor objects, data encoding rules, and specific message sets that are associated with traffic center-to-traffic center communications. For more about these standards, go to the NTCIP website at:
  http://www.ntcip.org/

- The Open Communications Interface for Road Control Systems (OCIT-O) has defined the communications protocol and data structure from traffic centers to field equipment, which is used Europe. For more details about these standards, go to the OCIT-O website:
  http://www.ocit.org/indexE.htm

Standards for traffic center-to-traffic center communications
To make data from the field equipment available to interested parties, the following standards apply:

- The Traffic Management Data Dictionary (TMDD) Standards (produced by the Institute of Transportation Engineers) supports center-to-center communication. It helps centers to cooperate in the management of activities such as incident mitigation and event management. It provides the dialogs, message sets, data frames, and data elements to manage the shared use of these devices and the regional sharing of data and incident management responsibility. For more details about TMDD, go to the Institute of Transportation Engineers web page at:
  http://www.ite.org/standards/tmdd/

- The NTCIP DATEX-ASN specification offers a traffic center-to-traffic center communications and control standard, fulfilling the requirements of ISO 14817, covering part of the same functions as TMDD. DATEX II has since been developed to further the traffic center-to-traffic center communication and is now the dominant European standard. For more information about DATEX II, go to the DATEX website at:
  http://www.datex2.eu/

Traveler information standards
Table 1 shows useful information to travelers that have been developed by various organizations.

<table>
<thead>
<tr>
<th>Standards organization</th>
<th>Standards</th>
<th>Web address for more information</th>
</tr>
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<tbody>
<tr>
<td>European Committee for Standardization (CEN)</td>
<td>TTI for over Dedicated Short Range Communication (DSRC) frequency</td>
<td><a href="http://www.cen.eu/cen/pages/default.aspx">http://www.cen.eu/cen/pages/default.aspx</a></td>
</tr>
</tbody>
</table>
The following standards support the delivery of travel information for public transport services:

- European CEN ENV 13998 (geographic information source) provides dynamic passenger information to travelers at an access point, such as a bus stop.
- The American Public Transport Association (APTA) developed the Transit Communications Interface Profile (TCIP) standard, which provides the estimated times of arrival of a public vehicle at a particular access point.

### Location standards

It is increasingly important for traffic information management systems to capture, analyze, and communicate information about the locations of vehicles, sensors, and travelers. Several standards have emerged in this arena:

- ISO 19133/4 provides location-based services for tracking and navigation, including multimodal routing and navigation.
- The Society of Automotive Engineers (SAE) has developed standard SAE J2374, which is a location-referencing message specification.
- OpenGIS Location Service (OpenLS) from the Open Geospatial Consortium is another relevant standard in this space.

### Travel-related incident management standards

From a traffic perspective, the key standard in emergency incident management is the Institute for Electrical and Electronics Engineers (IEEE) 1512 family of standards. These standards cover incident management, including public safety and hazardous material incident management.

## IBM Traffic Prediction Tool

Today, large quantities of data are typically gathered from transport networks for purposes such as monitoring traffic flows and incidents, such as monitoring traffic flows and incidents and using video to collect tolls and to track vehicles. All of these systems produce data that can be aggregated to provide current snapshots of traffic levels and flows that are taking place across the network. This data is useful for the prediction of traffic volumes and flows in the short- and medium-term future.

The Traffic Prediction Tool provides traffic forecasts (including speed and volume) for the near future. In particular, it offers five future traffic values for both speed and volume, providing 10-, 15-, 30-, 45-, and 60-minute forecasts of present conditions. When data is available on faster
time scales, the Traffic Prediction Tool can be adapted to produce predictions on those time scales. It was developed to be effective on both expressways and urban road networks.

The Traffic Prediction Tool uses computing logic to make traffic prediction of real-time traffic over city road networks. It was originally developed by IBM Research and has achieved high accuracy and scalability.

Benefits of the Traffic Prediction Tool

The Traffic Prediction Tool helps analyze and optimize the traffic flow on the road network of a city. It forecasts the traffic characteristics for the short- and medium-term future. It provides a critical layer of intelligence by taking sensor data and applying sophisticated algorithms to it, creating relevant insights.

With accurate prediction of short-term and medium-term traffic patterns, the TMC staff can take corrective measures before congestion occurs. This preemptive action reduces and alleviates congestion. It also reduces pollution, which is a key environmental impact, and improves traveler satisfaction by providing a more predictable journey. Also, travelers can make well-informed decisions about routes based on information provided by the Traffic Prediction Tool. For example, with the generated information from the Traffic Prediction Tool, travelers can choose between the shortest route to their destination or the least likely congested route.

The Traffic Prediction Tool provides the following key benefits:

- Provides traffic operators with a view into the likely near-term traffic flow
- Facilitates decision-making for provisioning of variable-message traffic sign information
- Assists traffic operators in proactive signal setting and ramp metering, reducing traffic congestion
- Provides input for traveler information systems going beyond current data by using future predictive data in route planning
- Is highly efficient and can be run on a medium- to large-size network in real time
- Provides automated error correction algorithms to improve data quality

Architectural overview

The Traffic Prediction Tool provides short- and medium-term traffic predictions based on real-time and historical data. To operate properly, it must be integrated with existing traffic management solutions or a web portal.

Figure 3 on page 13 shows the traffic data flow between the Traffic Prediction Tool components and the user interface. Moving from left to right in Figure 3, the queue manager receives data from the traffic authority system or messaging client. The Extensive Markup Language (XML)-based data feeds (including accident and event data and speed and volume data) arrive in regular intervals. The Traffic Prediction Tool receives the data from the queue manager and then validates and aggregates the data. This cleansed data is loaded into the operational database.

On the right side in Figure 3, the Traffic Prediction Tool Scheduler manages the Traffic Prediction Tool Prediction Module, which makes predictions based on data from the operational database. Predictions are written to the database, which interacts with the output interface. The user can access this information through the GIS GUI Server and user
interface. As needed, security components authenticate authorized users and give them access to the results.

Also, travelers can obtain real-time alerts and advice on route selection, so that they can adjust their travel plans as necessary. These predictions apply both to the use of public and private transportation.

**Asset management and optimization**

Transportation-related organizations, such as road and traffic authorities and public transportation management, have a myriad of diverse assets that must be tracked, maintained, and used optimally. Many of the assets are high value and can be critical to protecting and improving human life. Typical assets include vehicles, such as cars, buses, and road maintenance equipment. They also include devices, such as traffic lights, road displays, roadway reporting devices, and IT equipment. These assets must be continuously monitored and maintained. The ability to perform predictive maintenance provides value because it enables components to be serviced before they fail, avoiding unscheduled or unplanned downtime.

Asset management deals with various aspects of the complete life cycle of assets. It includes the tracking and management of the asset and provides comprehensive maintenance work management. Its proactive maintenance work management includes preventive, reactive, and condition-based maintenance, schedule management, resource optimization, and key performance indicators (KPIs). KPIs can be used to monitor, track, and manage asset performance, utilization, and management activities.

Asset management extends to inventory planning, which supports maintenance by making the right parts available where they are needed in a timely manner. Asset management also covers the management of all types of vendor and supplier contracts. It provides the ability to define service offerings and establish service level agreements (SLAs) to help align service levels with organizational objectives.

Asset management should expedite maintenance activities to increase the productive life of each asset. It should improve the ability to meet safety, health, and environment requirements; reduce administrative time; and have a positive impact on maintenance costs.
Implementing a proactive maintenance approach provides many benefits, including the following examples:

- Reduces long-term maintenance costs by being proactive
- Reduces operations and inventory costs
- Improves asset performance, reliability, and availability
- Prolongs life of the asset
- Reduces fuel consumption and CO₂ emissions

**IBM asset management software**

IBM Maximo Asset Management, Maximo Linear Asset Manager, and Maximo for Transportation are key solutions for transportation organizations addressed by this IBM Redguide publication. They provide transportation organizations with the tools and best practices to help improve the productivity and life span of their critical assets.

**IBM Maximo for the transportation industry**: The IBM Maximo offering also applies to the broader transportation industry. However, this paper focuses on how the products apply to city and urban environments.

**Maximo Asset Management**

Maximo Asset Management is a comprehensive maintenance work management solution for planned and unplanned activities. It includes long- and short-term planning; preventive, reactive, and condition-based maintenance; schedule management; and resource optimization. It also provides KPIs.

The Maximo Asset Management solution provides insight into the condition of all assets and work processes to enable better planning and control. In addition, it offers the following benefits:

- Manages asset deployment, specifications, monitoring, calibration, costing, and tracking from a single system
-Provides enterprise asset management capabilities for long and short-term planning; preventive, reactive, and condition-based maintenance; scheduling; resource optimization; and KPIs
-Plans inventory to meet maintenance demand for spare parts, making the right parts available at the right location when needed
-Manages vendor contracts with comprehensive support for various contracts
-Aligns service levels with business objectives by defining service offerings and establishing SLAs
-Adapts to changing business requirements and connects with other enterprise systems through a flexible business-process configuration platform and scalable service-oriented architecture (SOA)

For more details about Maximo Asset Management, go to the Maximo Asset Management product page at:

Maximo Linear Asset Manager

Linear assets have specific requirements that demand a unique approach to asset management. IBM Maximo Linear Asset Manager, which extends IBM Maximo Asset Management capabilities, helps manage all linear asset types such as the following examples:

- Railway infrastructure, including tracks, switches, frogs, crossovers, and signals
- Road infrastructure, in particular road lanes, bridges, tunnels, variable message signs (VMS), and traffic signals
- Pipeline components, such as pipes, valves, pumps, and pipeline inspection gauges

Maximo Linear Asset Manager supports Smarter Traffic by helping in the management of roads for a city or an entire state, for a public road, or private tollway. Thousands of miles of roads, sidewalks, and guardrails demand periodic repair and ongoing maintenance. Crews are constantly at work to make repairs or perform construction projects to resolve problems and improve the infrastructure. By providing tools to send crews to the right location with the right material, linear asset management can help organizations increase productivity.

Maximo Linear Asset Manager can support an organization by helping it to comply with regulations, budget more accurately for repairs and projects, and improve an aging infrastructure.

For more details about Maximo Linear Asset Manager, go to the Maximo Linear Asset Manager product page at:


Maximo for Transportation

IBM Maximo for Transportation has capabilities beyond Maximo Asset Management. It provides transportation organizations with best practices to help to improve the productivity of their critical assets. This transportation industry-specific solution helps manage critical aspects of the life cycle of each asset.

Maximo for Transportation addresses stringent regulatory requirements with best practices to extend asset life, to optimize parts management, to reduce road calls, and to increase planned maintenance. It provides comprehensive capabilities in the following areas:

- Manages all transportation asset types, including fleets of cars, trucks, buses, locomotives and rail vehicles, aircraft, and vessels
- Furnishes enhanced work-management capabilities for campaigns, industry codes, labor certification, maintenance alerts, mechanic clip boards, and outside repair orders
- Provides extended inventory management features for cycle counting and fuel tank management

Maximo for Transportation gives fleet managers and maintenance officers data analysis capabilities and reporting to improve the management of their assets. It also rapidly delivers asset management information to technicians and inventory management personnel.

For more details about Maximo for Transportation, go to the Maximo for Transportation product page at:

Case studies

IBM has been working with various cities and organizations to solve traffic-related problems. This section provides brief descriptions of several of these solutions.

Congestion charging system in Stockholm

Stockholm, like many other cities, was suffering from traffic congestion problems. In 2006, the Swedish National Road Administration operated a trial of a congestion charging system. The goal was to introduce a toll that reduced the number of vehicles brought into the central district and provided additional revenue to pay for increased capacity in the public transportation system, improving service for people who use public transit.

The city of Stockholm, working with IBM and other partners, defined a cordon, or ring, around the central district with 18 points of entry and exit. These points were monitored by free-flow toll gates. Video cameras at the toll gates were triggered when a vehicle interrupted a laser beam. The cameras then captured images of the front and rear license plates and used local optical character recognition (OCR) to extract the vehicle license number. The vehicle license number was then transmitted to the data center.

To identify unclear license plate images, IBM Research developed a sophisticated recognition system that uses algorithms to reduce errors due to unclear or anomalous license plates. These algorithms use techniques, such as image enhancement and comparison of front and back license plates, to analyze the entire image and search for predefined patterns. After recognition, the system automatically records the license plate number, matches it with a vehicle registry database and processes billing.

After the trial completed, a majority of Stockholm residents voted in favor of the congestion charging system. Then, the Swedish parliament agreed to adopt the system permanently. Following the parliamentary process and with some enhancements, the system was put into operation in August 2007.

For more information about this solution, see the following resources on the web:

- “Driving change in Stockholm (podcast)”

- “IBM Brings 50% Reduction in Waiting Time to the Morning Commute in Sweden's Capital”

Public transportation improvements for Singapore Land Transport Authority

Singapore has created one of the most heavily used public transport networks in the world. The Singapore Land Transport Authority (LTA) needed the ability to allow more card issuers (providers) to issue cards for use in the Singapore public transit system. The ability to issue cards more freely gives commuters more choices and a unified payment system for transport.

The LTA worked with IBM to create a seamless national-transport-fare clearinghouse that was built on open standards. This solution gives customers a choice of cards to suit their needs, more accurate revenue apportionment for their transport operators, and a platform for a more flexible fare structure. With this solution, commuters can use a single card of their choice for fare transit payments, vehicle congestion charging, and parking charges.
For more information about this solution, see “Singapore Land Transport Authority maximizes ridership to minimize traffic congestion” at:


VMS Monitoring and Control Application for the New Zealand Transport Agency

The New Zealand Transport Agency (NZTA) works to help New Zealanders travel reliably and safely. It works to grow the country’s economy by investing in the movement of people and freight. More than 100 Variable Message Signs (VMS) are operating on New Zealand’s state highway network, providing road users with real-time traffic messages at strategic locations. VMS are built to NZTA-defined standards and are procured from different manufacturers around the world. The lack of a central controlling application for the VMS led to issues of cost, control, and compatibility. NZTA needed a single system to monitor and control the VMS nationwide.

IBM developed a Monitoring and Control Application (MACA) for NTZA. This application is used to post messages on the VMS and to monitor their status. MACA can control VMS from any manufacturer. It forms part of a system that uses video cameras and mobile devices to gather, analyze, and share information across transportation systems.

For more details about this solution, see “New Zealand Transport Agency ... Smarter traffic management through improved, centralized control and communications” at:


Free-flow tolling system for Queensland Motorways

Brisbane is the third largest city in Australia and the state capitol of Queensland. The city has grown rapidly, which has led to a rapid escalation of traffic congestion. To deal with this issue, the Government of Australia and Queensland Motorways, which runs Brisbane's major toll roads and bridges, introduced a free-flow tolling system. A partnership among IBM, Thales Australia, and Vitronic was established to construct an intelligent roadside and central tolling management solution to support the free-flow tolling system. The ultimate solution replaced manual toll collection booths, eliminating a principle bottleneck. The free-flow tolling system reduced commuting times for workers and enhanced their safety.

Vehicles are identified either by an in-vehicle tag or by analyzing footage of number (license) plates using two OCR engines, one at the roadside and a Dacolian engine at the central system.

A key part of the solution is the IBM Identification, Rating and Interoperability Services (IRIS) subsystem. IRIS is used to identify the vehicle owners, by using the roadside information, business logic, and vehicle and owner profile information. IRIS also calculates the required toll and forwards the consolidated information to the billing system.
For more details about this solution, see the following resources on the web:

- “Queensland Motorways heads off congestion in fast-growing Brisbane”
- “Queensland Motorways: Breaks up Traffic Congestion in Fast-Growing Brisbane ... Smarter Planet Leadership Series”

Integrated fare management solution in Dublin

Travelers and commuters rely on the Dublin public transportation system every day. The City of Dublin’s Railway Procurement Agency (RPA) created and implemented the infrastructure for an integrated ticketing system. The infrastructure was implemented throughout all public transportation in the greater Dublin area. With help from IBM, an integrated ticketing system was designed to process up to 2 million transactions a day. The solution can be extended to include other value-added services, such as requesting additional credits through the Internet.

This solution incorporated SmartCards to eliminate the need for commuters to carry cash to pay for tickets, ensuring fast, secure, and convenient transactions. By using the cards, travelers can transfer to different operators and modes of transport, and they can take advantage of flexible fares and ticket products.

These SmartCards are the de-facto standard for electronic ticketing in public transport. Customers hold their card over a reader at the gate or point of entry and speed through the ticketing process. The system provides a pay-as-you-go process by using reusable SmartCards. The process also supports weekly, monthly, and annual tickets that commuters can use on public and privately-operated transportation services.

For more details about this solution, see the following resources on the web:

- Integrated fare management
- “Integrated fare management for transportation”

Summary

This Redguide publication has shown how IBM Smarter Traffic solutions can help city officials and transportation service managers overcome the challenges of getting people and goods from point A to point B efficiently. These solutions apply advanced technology with new capabilities to help in traffic management. This paper has also shown how giving travelers traffic- and route-related information and relevant options improves their traveling experience.

This paper outlined various IBM Smarter Traffic solutions and explained the value they bring to traffic management. It introduced the IBM Intelligent Transportation and Traffic Prediction Tool solutions and explained the high-level architectures for these two solutions.
This paper provided information about IBM asset management software, which enables the transportation organizations of a city to better maintain and manage their assets. This paper also provided a sampling of case studies in various cities that has demonstrates IBM solutions in various traffic-related challenges.

**Other resources for more information**

For more IBM Redguide publications in the Smarter Cities Series, see the following papers:

- *Smarter Cities Series: A Foundation for Understanding IBM Smarter Cities*, REDP-4733
- *Smarter Cities Series: Introducing the IBM City Operations and Management Solution*, REDP-4734
- *Smarter Cities Series: Understanding the IBM Approach to Efficient Buildings*, REDP-4735

For insight into the IBM Passenger Rail Reservation solution, see *IBM Passenger Rail Reservation Service*, REDP-4714.

**The team who wrote this guide**

This guide was produced by a team of specialists from around the world working at the International Technical Support Organization (ITSO).

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