

# TRAFFIC MANAGEMENT SYSTEMS (TMS)

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## Introduction

**Introduction** Traffic Management Systems (TMS) use a variety of technologies to manage traffic flows and the effects of congestion on the road network. Traffic Management Systems do this by addressing the traffic management effects of accidents and slow moving or queuing vehicles, planned events and extreme weather.

TMS include, ramp signaling, dynamic lane management, variable speed limits, incident detection, vehicle activated signs and adaptive traffic signal control. Many of the systems are usually integrated to gain maximum benefit.

Managing the allocation of road space is an important concept that is becoming increasingly relevant as it is not feasible or cost-effective to continue to accommodate the growth of urban traffic by constructing additional roads. It is widely acknowledged that a large part of added road capacity is often quickly absorbed by 'induced' demand.

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## Objective

**Objective** This section focuses on the application of TMS and how it can be used to achieve Travel Demand Management (TDM) goals.

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## Benefits

### Application of TMS

TMS measures can be applied in urban, peri-urban, and rural areas, as appropriate. TMS systems are often used on the state highway network, and are likely to operate across different organisational boundaries.

Roading authorities wanting to introduce TMS should work closely with the New Zealand Transport Agency, regional authorities (including cross boundary) the police and wider emergency services, passenger transport operators and other stakeholders in order to consider wider network implications.

In addition to this, planned measures by the local road authority that may displace extra vehicles onto the state highway network, will need to be assessed in terms of their implications for TMS applications on the state highway system.

## Tools for Traffic Management Systems

### Automatic Incident Detection (AID)

Incident detection tools are designed to reduce the time taken in identifying and reacting to incidents on the network. If combined with other TMS and Traveler Information Services (TIS) it can improve network efficiency by minimising congestion. It can also contribute to reduced response times for emergency vehicles and also minimise the chances of secondary accidents occurring.

Automatic Incident Detection (AID) is usually implemented through the use of sensors or detectors and aims to detect traffic incidents along major roadways. Sensors are usually divided into two categories; intrusive (buried within the road) and non-intrusive (not buried within the road).

Intrusive sensors such as inductive loop detectors (ILD) are installed at regular intervals along the road and gather information on each vehicle in order to detect abnormal changes in traffic movements and therefore identify incidents.

Non-intrusive technologies such as video incident detection (VID) or closed circuit television (CCTV) are installed on poles or overhead gantries and detect incidents through observation of changes in the general traffic flow.

Other technologies such as microwave detectors have been used in place of ILD to detect speed of vehicles. The detectors are spaced every 100m and identify incidents by observing a sudden drop in speed, as opposed to a gradual decline in speed

over a longer time.

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### **Ramp signalling/ Metering**

Ramp signals are essentially traffic lights at motorway on-ramps that manage the flow of traffic onto the motorway during peak periods. When lights are red, vehicles stop and wait for the green signal. When lights turn green, two cars (one from each lane) are able to drive down the ramp to merge easily with motorway traffic. Ramp signals run on a quick cycle, only a few seconds between green lights. Ramp signals do not have to operate all the time and can be switched on when necessary, especially during morning and afternoon peaks and other busy times.

Ramp metering can be a cost effective tool in improving the throughput of a motorway and overall road network. It is most effective when applied system wide along a corridor that balances the needs of maximising motorway throughput in addition to effective queue management.

There are a number of equity issues that need to be taken into account when ramp metering is installed. Using traffic signals as a similar example, if a minor road meets a major road, and the major road is operating at capacity, it might be most efficient (in terms of minimal total delay) to give 100% of the green time to the major road and 0% to the minor road. However traffic signals alternate back and forth to ensure equity of road users so that travellers on minor roads do not have to have an excessive wait. A similar limit on individual delay, even at the expense of overall motorway efficiency, may be necessary for ramp meters to be equitable.

As well as benefits there are some disadvantages to ramp metering. Ramp metering can result in longer wait times to enter the motorway.

Another issue that relates to the on-ramps design is the length from the signals to the motorway. Some on-ramps have short gaps between the signals and the motorway that a suitable merging speed can not be reached. In situations like this ramp signals can result in more congestion.

While ramp flow meters can help at the margins, delaying the onset of motorway breakdowns and the recovery of freer flowing conditions, making the motorway flow smoother, it cannot eliminate congestion entirely. It has been found that ramp meters are particularly helpful for longer trips.

Ramp signaling is used worldwide, it has been successfully used for over 40 years in some cities including the United States, Germany, Canada, Belgium and England.

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**Variable message signs**

Variable message signs (VMS) can be used to alert drivers to traffic incidents ahead, congestion, events, parking availability and weather conditions.

There are three broad categories of information that can be displayed via VMSs:

- control (e.g. lane control, prescribing control)
- warning (e.g. weather conditions, incidents, congestion, road works, road closures)
- information (e.g. useful traffic/weather information, network messages, safety messages)

The benefits of providing real time travel information include:

- a reduction in driver frustration
  - allowing drivers to choose to use alternative routes
  - a reduction in congestion
  - improved safety
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**Variable Speed Limits**

Variable Speed Limits (VSL) and advisory speeds are designed to 'smooth traffic flow' by introducing a temporary speed limit based on traffic volumes and hence delay the start of congestion conditions. Other outcomes include enhanced safety and reduced vehicle emissions.

VSL systems primarily aim to reduce incidents by managing the posted speed limits for congested or hazardous situations.

The benefits of variable speed signs is that they:

- improve journey times
  - smooth traffic flow by minimising vehicles stopping and starting
  - reduce accidents
  - produce environmental benefits through fewer emissions
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**Lane control**

Lane control aims to enhance the efficiency of the highway through ensuring best use of existing road space. There are several types of lane control that can be implemented including:

- tidal flow operations for peak periods
- part time running lanes
- lane management for specific vehicle types e.g. bus priority lanes
- lane management systems e.g. overhead lane control matrix signs
- dynamic road markings



*Lane Control with movable barrier - Auckland Harbour Bridge*

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**Adaptive traffic signal control**

Adaptive traffic signals can improve network efficiency by optimising signal timings and balancing traffic flows. This is achieved through automatic updating of cycle times that highlight changes in traffic distribution and volumes.

Adaptive Traffic signal control enable traffic signal controlled junctions to interact with each other. Such tools include Sydney Coordinated Adaptive Traffic System (SCATS).

Adaptive traffic signal control systems seek to optimise traffic flow by considering traffic flow at multiple sites rather than a single junction's performance. This area wide approach can bring significant traffic management benefits including reduced congestion and faster more reliable journey times.

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## Where to apply these Tools

	Centre	Urban	Suburban	Rural
Automatic Incident Detection	★★★	★★★	★★	★
Ramp Signalling/ Measuring	★★★	★★★	★★	-
Variable Message Signs	★★★	★★★	★★★	★★
Variable Speed Limits	★★★	★★★	★★	★
Lane Control	★★★	★★★	★★	★
Adaptive Traffic Signal Control	★★★	★★★	★★	★

*This table is an indication only. Individual projects should consider the unique features of the local environment.*

## Case Study - Traffic Incident Monitoring: Auckland's Motorways

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### Traffic Incident Monitoring: Auckland's Motorways

The Advanced Traffic Management System which is a sophisticated traffic incident monitoring and management control centre was introduced in Auckland during 1999. The system operates on sections of the motorway network, Northern, North-western and Southern, and provides enhanced safety and traffic information to the travelling public and enables rapid co-ordination with emergency services to achieve faster clearance of accident sites and other incidents.

The 24 hour/seven days a week system uses the latest technology including:

- 7 Variable Message Signs to inform motorists of road conditions, breakdowns, traffic incidents or bad surfaces
- 35 pan/tilt/zoom cameras monitoring some 32 km of motorway
- 84 lane control signals on 20 gantries to guide traffic flow across the Harbour Bridge
- moveable lane barriers

The Sydney Coordinated Adaptive Traffic System (SCATS) software package is an area based traffic management intersection control system that responds to changes in traffic flow and conditions by adjusting the phasing at each traffic light cycle in real-time.

In July 2003 the regional integration of traffic management was enhanced through the linking of Auckland City's SCATS system, which co-ordinates traffic signals on local arterial roads. The linkage of the four SCATS systems to the Auckland Traffic Management Centre (ATTOMS) provides access to 61 Closed Circuit Television (CCTV) cameras. The integration of the two systems now provides a more coordinated approach to the management of traffic over a wide area of Auckland.

## Case Study - Wellington Automatic Traffic Management System

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The primary purpose of the Petone to Terrace Tunnel Advanced Traffic Management System (ATMS) is to improve safety and incident response times, and effectively manage traffic on this section of State highway.

Following the introduction of an ATMS on Ngauranga Gorge, significant benefits have been obtained from the state highway network, including a reduced crash and incident rate through the controlled sections, improved incident response times and ability of these facilities across a wider area of the network. Transit has embarked on a programme to extend the system to other parts of the Wellington State highway.

The key strategic goal of this project is to operate the Petone to Terrace Tunnel State Highway corridor in a way that contributes to an integrated, safe and responsive, and sustainable transport system.

The project will:

- Improve management of general traffic flow, in conjunction with the Ngauranga and Petone sections, and traffic signal controls within the Wellington urban network
  - Achieve improved rapid identification of problems on the highway
  - Improve targeted response to, and clearance of incidents
  - Provide early and accurate alerts to drivers of congested or hazardous traffic and road conditions
  - Assist in matching traffic speed to network conditions, to improve safety and optimize flow
  - Provide a sustainable asset and improve the network functionality.
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# Case Study - UK, M42 Motorway, Active Traffic Management

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## UK, M42 Motorway, Active Traffic Management

The Active Traffic Management (ATM) scheme is a new pilot motorway scheme that has been put in place on the M42, junction 3A to 7, to the South- East of Birmingham in the UK. The main purpose of an Active Traffic Management scheme is to manage congestion, but it can also be used to manage the traffic around an incident.

The M42 between junction 3A and 7 was chosen because of its strategic importance to the Midlands area in distributing local and national traffic and providing a link between the M40 and M6 motorways. This section of motorway is 17km long. The total observed Average Daily Traffic (ADT) in both directions on the M42-ATM section is approximately 1 30,000 vehicles.

Controlling the traffic across all lanes, with the right speed for the traffic conditions, enables the traffic to flow more smoothly. This reduces constant stopping and starting, which therefore helps to prevent the break down of traffic flow, thus reducing congestion.

The system sets the same speed across the carriageway, which reduces the need for drivers to change lanes. When necessary, the system also sets messages on the driver information signs to inform road users of the road conditions ahead of them. This helps to protect queuing traffic because drivers are aware of slow moving or stationary traffic ahead.

In the case of severe congestion or an incident in one of the normal running lanes the hard shoulder may be opened to traffic under controlled conditions. When this stretch of the M42 is not congested and there are no incidents, all normal motorway rules apply.

The key aspects of this ATM scheme are:

- the use of variable mandatory speed limits,
- the dynamic use of the hard shoulder during periods of congestion,
- the provision of dedicated Emergency Refuge Areas (ERAs) for use when vehicles break down,
- The installation of gantries with signals and Variable Message Signs (VMS).

The benefits of the scheme include:

- More reliable journey times
- Reduced congestion
- Enhanced information for drivers

- Quicker response times to incidents

Construction of the scheme started in March 2003. Following a phased introduction, the full operation of 4-Lane Variable Mandatory Speed Limits commenced in September 2006.

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## Case Study - Australia, M1 Upgrade Project, Intelligent Management System

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### Australia, M1 upgrade project, intelligent management system

The M1 project, officially known as the Monash-West Gate Freeway is a 75km corridor in Melbourne. Construction of the freeway commenced in 2007.

The Monash West Gateway carries traffic volumes in excess of 164,000 veh/day and traffic on this route has increased at a rate of 3-5% each year over the past four years (Vic Gov 2006, cited in Austroads 2007).

The project will include the introduction of an intelligent freeway management system to improve traffic flow and travel time reliability during peak times.

The system will include ramp signals to monitor and control traffic, and on-road signage to communicate to drivers. It is predicted that the introduction of ramp signals on freeway entrances will improve throughput on the freeway by up to 20 per cent during peak periods.

The new system will also include a lane use management system to better manage on-road communications. The system will use electronic signs to tell drivers which lanes are currently open, what speed to travel and manage the closure of lanes when an incident occurs. It is envisaged that the system, once in place will improve the management of incidents and return the freeway to normal operating conditions more quickly after an incident.

It is assumed that the benefits from integrated operations comprising of ramp metering, speed control, traveller information and contraflow operations will result in restoring capacity to 2000 veh/day.

## Complementary measures

- Road Pricing
- Accessibility
- Urban Design
- Priority Lanes
- Travel Planning
- Traffic Information Systems

## Other policies addressed

- Congestion
- Economic Efficiency
- Land use
- Safety

## Further Information

### Resources

Auckland Motorways – ramp signaling

<http://www.aucklandmotorways.co.nz/rampsignalling/rampsignalling.html>

UK, Highways Agency,

<http://www.highways.gov.uk/knowledge/1361.aspx>

The Auckland Traffic Management Unit

<http://www.oag.govt.nz/2004/working-together/case-study3.htm/>

US Department of Transportation

<http://www.fhwa.dot.gov/tfhrc/safety/tms.htm>

LTSA, Road Safety Management System

<http://www.ltsa.govt.nz/roads/sms/overview-of-sms.html>

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