ITS SERVICE BOOK

ITS909 TRAFFIC INCIDENT MANAGEMENT – DETECTION AND TRAVELLER INFORMATION

Purpose

Incident Detection relies on technology to identify and respond to unplanned events affecting safety and mobility along a roadway.

The objectives of Incident Detection are to:

- Improve incident response and clearance times
- Improve safety
- Reduce secondary collisions
- Reduce congestion

The Federal Highway Administration (FHWA) has identified five (5) functional areas associated with Traffic Incident Management:

1. Detection and Verification
2. Traveller Information
3. Response
4. Scene Management and Traffic Control
5. Quick Clearance and Recovery

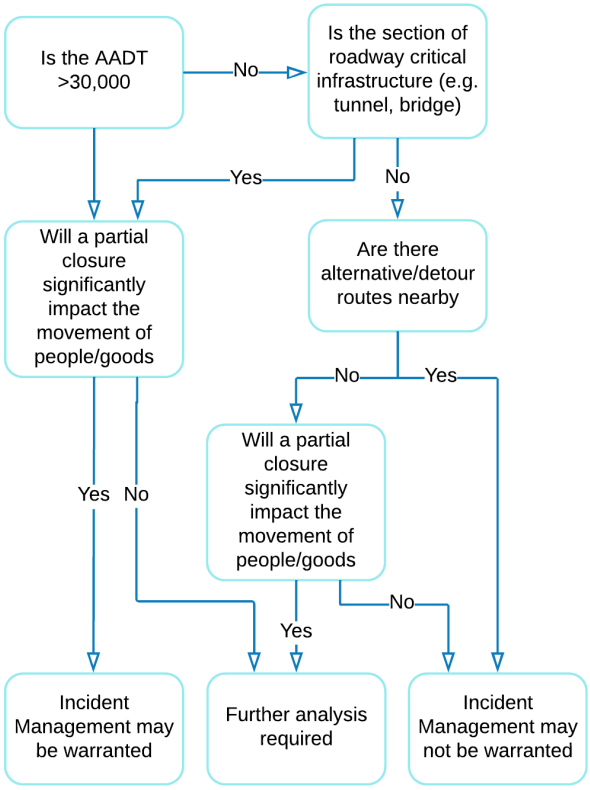
The ITS functionalities of Traffic Incident Management will be primarily focused on areas 1 and 2 related to incident detection, verification and traveller information.

Considerations for Use

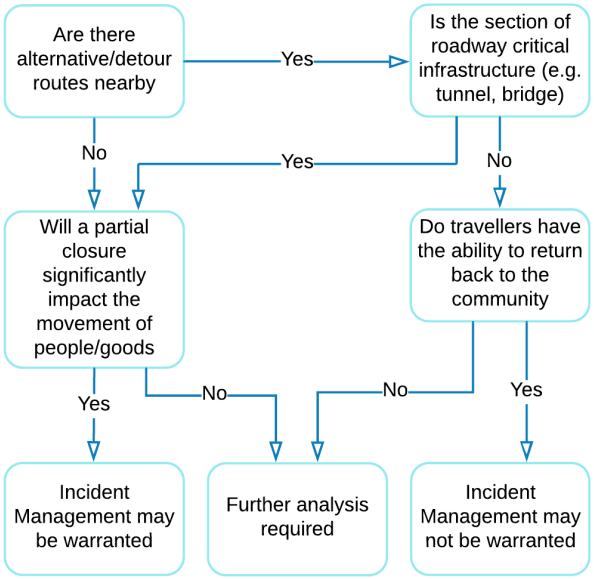
Incident Detection can be applied to all road types but should be given a higher priority to key commuter and commercial vehicle routes and where active incidents may cause significant delay.

The following decision tree provides a reference for considering Incident Detection in urban and/or rural applications.

Urban Application



Rural Application



ITS Service Applicability and Limitations of this Service Book

This Service Book may be used in conjunction with other related MTO ITS Services that may have Service Books associated with them.

- ITS201 – Planning Data
- ITS302 – Integrated Winter Maintenance Decision Support
- ITS304 – Work Zone Management
- ITS501 – Routing Support for Emergency Responders
- ITS503 – Automated Collision Notification
- ITS504 – Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
- ITS505 – Incident Scene Safety – Incident Ahead Warnings
- ITS506 – Incident Scene Safety – Motorists Guidance
- ITS908 – Regional Traffic Management
- ITS910 – Traffic Incident Management – Long/ Emergency Detour Routes Management

Limitations

This Service Book will aid in determining the need, components, purpose and general placement of devices needed for Incident Detection. Further analysis to identify the specific needs of Incident Detection is encouraged.

While technologies and data sources continue to evolve, this Service Book references technologies already approved by MTO.

System Components

The key ITS components for Incident Detection are based on:

- Detection – a means to detect when an incident has occurred
- Verification – a means to verify a detected incident actually occurred and the potential response needed to address it
- Traveller Information – a means to notify travellers of the location and/or conditions resulting from the incident.

  The means and protocol to notify the appropriate authorities (e.g. first responders), and subsequently be notified of the clearance of the incident shall also be possible but is not included within the scope of this ITS Service Book.

Detection

A variety of means have been utilized for incident detection. There are two folds: automation of the incident detection through the applications of technologies and manual reporting.

Automation of the incident detection uses a series of algorithms based on speed and coverage area parameters to determine the presence and location of an incident. Currently, this function is not in use because of high false alarm rates due to the following reason.

While in-pavement detectors (e.g. inductive loops) are a proven and reliable source for some level of incident detection. They are challenging to maintain due to periodic pavement rehabilitation.

As such, this Service Book focuses on non-intrusive detection technology services to detect and process the data.

Detection technologies may include:

Radar/Microwave Traffic Sensors

- Best-suited for non-intrusive deployments
- Applications include
  - road-side side-fire
  - road-side/median 360^{O}
  - road-side/gantry-mount up/downstream
- Incident granularity limited to distance between adjacent detectors
- Lane level information available

Bluetooth/Wi-Fi detectors

- Primarily used for travel time and can complement an incident detection sytem

Travellers/Response Personnel/Media

- Manual reporting (e.g. OPP, AMC) of incidents

Verification

Methods of incident verification may include:

CCTV Video Monitoring

- Visual verification of an incident using roadside CCTV cameras that provide continuous coverage

Operational Capabilities

- TMC/TOC with adequate resources and capabilities to verify and respond to detected incidents. Depending on the capabilities of the ATMS and Video Management System (VMS), the system can automatically prompt the operator of potential incidents. This can be further enhanced with pre-defined messages based on the location and type of incident further minimizing the period between detection and verification (and ultimately the clearance) of the incident.

Traveller Information

Motorists can be made aware of conditions through a variety of medium including:

Variable Message Signs

- Remotely accessible signage is upstream of the incident to provide driver awareness and traveller information related to the incident. (Refer to the Concept section for potential message types.)
- Leverage permanent messages signs where possible

Ontario 511

- Broadcast incident information to the Ontario 511 portal and other open-source data feeds (e.g. Waze Connected Citizens)

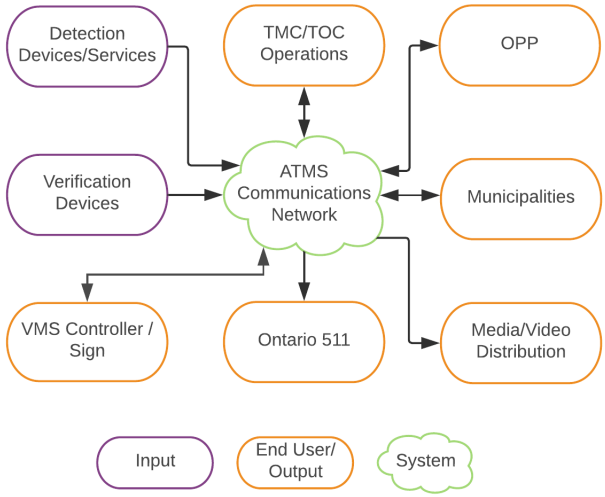
Media

- Communication with Municipal Partners

Architecture

The following architecture provides an overview of the system components and their interactions and information flows. Roadside detectors capture and transmit data to an in-house or hosted system. The system uses an algorithm to predict the occurrence of an incident. If detected, an alert is sent to the TMC/TOC operator and they subsequently verify the incident.

After verification, respective traveller information is disseminated through the appropriate channels (e.g. Ontario 511, VMS, TMC/TOC, Area Maintenance Contractor)

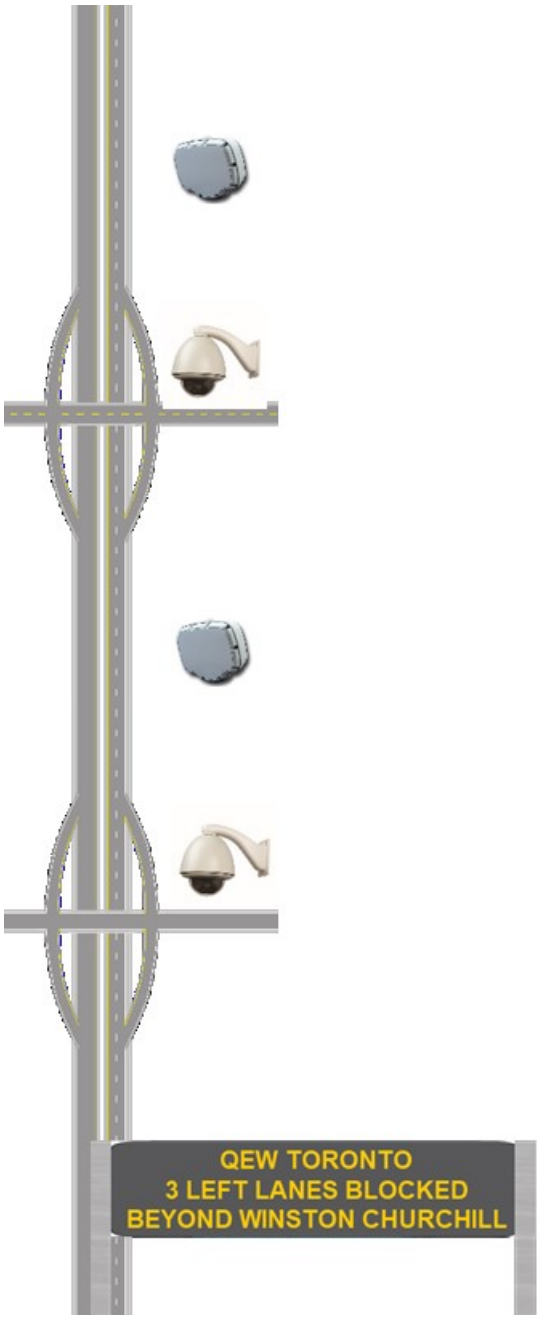


Traffic Management

While Incident Detection Systems can be configured for autonomous operation with pre-defined messages for verified incidents, TMC/TOC operators are generally involved at the verification stage to ensure traveller information is accurate and responses are adequate.

Concept

An example concept of a roadside Incident Detection System is shown. Actual deployments may vary based on specific site conditions, existing infrastructure, and overall requirements. Concepts are not to scale.



Deployment Considerations

The following are some considerations as part of the deployment of Incident Detection:

- In the event of an incident, it is anticipated the TMC/TOC operator will take all necessary steps to maximize safety first and foremost prior to initiating ITS-related work tasks
- CCTV cameras shall be spaced approximately 1,000 metres apart (or 2,000 metres when using higher poles) while taking into consideration sightlines
- Detectors may be spaced at 500 - 1200 meters apart to provide a reasonable level of granularity in urban areas. Please consult the ITS Section for any updates on the detector technology and the deployment guideline.
- Consider local terrain and clear zone requirements to assess the placement of VMS
- Consider geometric constraints, sightlines, and decision points when placing detection and verification devices
- Consider maintenance roles, responsibilities, and processes for each component
- Incident detection is based on a combination of detection devices (e.g. CCTV) and primely incident reports from OPP, AMC, media news, etc.
- Maintain communications with OPP Communications Centre and any other key parties to monitor incident and traffic management activities along with incident clearance
- Ensure Traveller Information is reset to pre-incident conditions once the incident has cleared
- VMS may be utilized for other sign applications when incidents are not present. Refer to MTO DMS Policy for message priority guidelines.

Messaging Examples

Emergency Full Closure (Bilingual)

Emergency Full Closure (Mainline)

ALL LANES BLOCKED
BEYOND WINSTON CHURCHILL

Emergency Full Closure (Connecting Roadway)

QEW TORONTO
ALL LANES BLOCKED
BEYOND WINSTON CHURCHILL

Emergency Full Closure (Expressway/Collectors)

COLLECTOR LANES BLOCKED
BEYOND KEELE
THRU. TRAFFIC USE EXPRESS

COLLECTOR LANES BLOCKED
BEYOND KEELE

HWY. 401 EAST
COLLECTOR LANES BLOCKED
BEYOND KEELE

Partial Closure (Stopped Traffic)

RIGHT LANE CLOSED AHEAD ↔ BE PREPARED TO STOP

Partial Closure (Traffic Not Stopped)

LEFT LANE CLOSED AHEAD ↔ EXPECT DELAYS

Partial Closure (Mainline)

2 LEFT LANES BLOCKED
BEYOND WINSTON CHURCHILL

Partial Closure (Connecting Roadway)

QEW TORONTO
3 LEFT LANES BLOCKED
BEYOND WINSTON CHURCHILL

Partial Closure (Expressway/Collector)

2 RIGHT LANES BLOCKED
IN EXPRESS
BEYOND KEELE

HWY 401 EAST EXPRESS
2 RIGHT LANES BLOCKED
BEYOND KEELE

Emergency Full Closure (West/Northwest Region)

401 CLOSED AHEAD ↔ BE PREPARED TO STOP

401 CLOSED AHEAD ↔ EXPECT DELAYS

Partial Closure (East Region)

LANE REDUCTION AHEAD

RÉDUCTION DES VOIES

Partial Closure (Northeast Region)

69 1 LANE/VOIE ESTAIRE -PARRY SOUND

16 1 LANE/VOIE AT/À N MONETVILLE

522 CLOSED/FERMÉE AT/À HWY/RTE 69

Costs and Procurement Strategy

Budgetary costs are provided below for system components. A combination of the components can help to provide an estimate for a specific application.

However, there may be additional costs to integrate the Incident Management to MTO's TMC/TOC Operations and associated systems.

Refer to HiCo for additional details and regional estimates.

Element	Cost (2019)
Purchase: Supply and Install	
Permanent	

Element	Cost (2019)
Non-Intrusive Radar Detectors	$10,000
Bluetooth Detector	$7,000
Dome Camera	$5,000
Camera Lowering Device System with Pole	$25,000
Digital Video Recorder	$1,500
Pole-Mounted VMS	$100,000
Overhead VMS Sign	$400,000 - $500,000
ATMS Controller Cabinet Site	$20,000
Civil Provisions (Ducts, F/O, Power)	$150,000 per km
9.0 m Concrete Pole	$2,800
Traffic Control (per lane closure)	$4,000
Semi-Permanent/Temporary	
Pole-Mounted Sensor on Trailer	$10,000
Pole-Mounted Sensor on Trolley	$8,500
Traffic Barrel Sensor	$5,000
Portable Variable Message Sign	$30,000
Pole-Mount Camera on Trailer	$30,000
Digital Video Recorder	$1,500
Fixed-Mounted VMS	$75,000
Solar Power Kit	$3,000
Cellular Modem	$1,000
9.0 m Wooden Pole	$1.800
Traffic Control (per closure)	$4,000
Operations and Maintenance	
Cellular Fees (if applicable)	$75 per month
Hosted Data Processing and Maintenance of Bluetooth Detectors and Modems	$125 - $175 per month per detector
Maintenance of signs, cabinets, solar power systems, etc.	~10% of capital/year
Rental	
Probe Data	$500 per km/year
Traffic Detection Kit (4 detectors, PVMS)	$8,500 per month

Sample Cost Deployment

An example of Incident Detection may consist of:

- Four (4) non-intrusive radar detectors mounted on a concrete pole at an existing ATMS site

  4 x $10,000 = $40,000

  4 x $2,800 = $11,200
- Four (4) CCTV cameras on camera lowering device systems with local recording at an existing ATMS site

  4 x $5,000 = $20,000

  4 x 25,000 = $100,000

  4 x $5,000 = $20,000
- Total Deployment = $140,000
- There may be additional costs to integrate the Bluetooth system to MTO's TMC/TOC Operations and associated systems.

System Life Cycle

The expected life cycle may range from 5 to 10 years depending on the configuration.

The mean time between failures (MTBF) of relevant equipment for planning, and rehabilitation purposes:

- ATMS Controller – 15 years+
- Bluetooth Detectors – 5 years
- CCTV Camera – 5 years
- Cellular Modem – 5 years
- Civil Provisions – 25+ years
- Controller Cabinet – 25+ years
- F/O Cable – 25+ years
- Network Switch – 15 years+

- Non-intrusive Traffic Sensor – 5 years
- Overhead VMS – 15 years
- Pole-Mounted VMS – 15 years
- Poles – 25 years+
- Portable-Mounted VMS – 5 years
- Portable VMS – 5 years

Case Studies/Previous Deployments

Description	Components
Highway 400-Series Corridors Ministry of Transportation Ontario	• Various corridors deploying a Freeway Traffic Management System (FTMS) • Includes various devices including cameras, traffic detectors, signage and associated communications, power, and cabinet infrastructure
KC Scout System Missouri DOT	• Began deploying a video analytics based incident detection system in 2012 for their 300+ cameras • Noticed more efficient results in automated detection immediately
Incident Detection/Verification System Minnesota DOT	• Utilizes video to manually detect and verify incidents. VMS signs are updated accordingly • All key corridors have full coverage

Performance Measures

- Roadway Clearance Time – the time period when an incident is first detected to all pre-incident lanes becoming available
- Secondary Incidents – the number of incidents occurring between while the primary incident is still active. This may include incidents within the incident scene, queue, and the opposite direction of the incident scene.
- Number of incidents detected through the Incident Detection system

Emerging/Alternative Technologies

This section details emerging technologies and/or alternative technologies not currently supported by the MTO.

CCTV Video Analytics

- Options for video analytics/image processing used to identify vehicle speeds (analytics not currently used by MTO)
- Detection systems should have an automated incident detection algorithm to automatically prompt TMC operators of potential incidents (not currently used by MTO)
- Maintenance program to ensure clean camera lens/housing

Probe Data

- Portability, scalability, infrastructure-free, comparable/better granularity than other detection technologies
- Probe data platform utilized with potential to expand to existing ATMS platforms through customized API integrations

Waze Connected Citizens

- Crowd-sourced data from Waze users to obtain notifications of detected incidents
- Reported incidents need to be vetted through a verification process

Aerial CCTV Video Monitoring (not currently used by MTO)

- Visual verification of an incident using a deployment of aerial vehicles such as drones

Automated Incident Detection

- Detection systems should have an automated incident detection algorithm to automatically prompt TMC operators of potential incidents (not currently used by MTO)