Detection of Incident using Vehicle Detection Data
An Investigation

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  - Incident Detection and its benefits
  - What others are doing
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- Conclusions

What is an incident?
- Obstruction(s) to traffic flow on the carriageway
- Example – Flooding, accident, debris, etc.
- Result – non-recurrent congestion

What Incidents do we deal with?

NZ Police
- attend 15-18,000 "incidents" on the motorways each year
  (1,250-1,500 per month, 40 to 50 per day)
- 7.25% are crashes

AMA attend less
- 100-120 incidents per month
  - Active for 3,100 hours per year
  (or 9 hours per day)
How do we deal with incidents?

The action

Incident Response – Timeline and Traffic

Typical Example

Typical Incident

2730 vehicles affected
19,110 on-wake travel delay
28,754 on-road travel delay
$7,134 cost of on-road travel delay

91 on-road delay
30 minutes
1.4 Occupants per vehicle

TYPICAL LOCATION
- 3 Lanes
- 25 Veh/min per lane

TYPICAL USER
- 1.4 Occupants per vehicle

TYPICAL INCIDENT
- 30 minutes duration

7 on-road delay
1.4 time congestion
$16 per hour

4/4/2011
Other Benefits of Automatic Incident Detection

- Traffic Operation Center (TOC)
- Network Manager – Incident Response
- Customers
- Economic benefits

Where can we improve?

<table>
<thead>
<tr>
<th>Benefits</th>
<th>Economic benefits</th>
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<tbody>
<tr>
<td>Traffic Operation Center (TOC)</td>
<td></td>
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<tr>
<td>Network Manager – Incident Response</td>
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<td>Customers</td>
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<td>Economic benefits</td>
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Other Benefits of Automatic Incident Detection

- Traffic Operation Center (TOC)
- Network Manager – Incident Response
- Customers
- Economic benefits

What are others doing?

<table>
<thead>
<tr>
<th>Type</th>
<th>Algorithm</th>
<th>Occupancy</th>
<th>Volume</th>
<th>Speed</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comparative (Rule Based)</td>
<td>California Basic, 7 &amp; 8</td>
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<td>All Purpose Incident Detection (APID)</td>
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<td>Pattern Recognition (PATREC)</td>
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<td>Statistical</td>
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<td>Bayesian</td>
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<td>Time Series</td>
<td>Auto Regressive Integrated Moving Average (ARIMA)</td>
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<td>High Occupancy (HIOCC)</td>
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<td>Smoothing/Filtering</td>
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Game changers in Auckland

- Two important game changers were implemented recently:
  - Ramp Signals
  - Implementation of Standard Sensor Data Format (SSDF)

What are we doing?

- Defining Corridor/Area of Interest
- Using traffic data
  - Traffic Flow Characteristics, e.g. volume, occupancy, speed
  - Historic Flow Data profile
- Time-series of volume, occupancy, speed
- Development of a hybrid rule based / statistical model

Area of interest

- Greenlane Interchange
- Ellerslie Interchange
- South Eastern Highway

Section length: ≈ 6.0 km
Section Characters: 3 lanes generally
Direction: Southbound

Isolating Incidents from other activities

Known
- Recurring Congestion
- Bottlenecks
- Operation of Capacity Management Equipment, e.g. Moveable Lane Barriers

Planned
- Construction works
- Maintenance activities
- Special Events (Parade, game, concerts)

Incidents
- Major/Minor Crashes
- Stalled vehicles
- Bridge failures/Obstacles
- Surface, debris, animals, cattle
Traffic Flow Characteristics

30 seconds Volume vs Occupancy
(Ellerslie-Panmure Highway upstream of incident)

Importance of Historic Flow Data Profile
- Quick identification of outside the norm operating conditions
- Establishing flow, occupancy and speed characteristics at individual detector stations

Example of an Annual Speed Profile
Time-series and Rate of Change

- An incident **cannot** be identified from simple Flow/Occupancy, Speed/Flow curves
- Historic profiles allow us to identify recurring conditions
- An incident can be identified from speed, flow, volume time-series
  - Rate of Change is a good indicator to distinguish incidents from planned activities

Key Difference: Incident vs. Congestion

- Abrupt changes in both Volume and Occupancy upstream of an incident
- Abrupt changes in both Volume and Occupancy downstream of an incident

Speed and Volume during an incident

- Speed and volume characteristics under influence of incident
Two-Stage Detection Process

Reduction of detection time is one of the key measures to reduce the duration of incident and there are significant cumulative benefits to be attained.

Implementation of an effective AID system will benefit Road Users, Network Manager, Traffic Operation Center.

It’s important to differentiate the different characteristics of Incident and Recurrent Congestion using Historic Data.

Conclusions

Question(s)

Current Use Today

Reduction of detection time is one of the key measures to reduce the duration of incident and there are significant cumulative benefits to be attained.

Implementation of an effective AID system will benefit Road Users, Network Manager, Traffic Operation Center.

It’s important to differentiate the different characteristics of Incident and Recurrent Congestion using Historic Data.

Conclusions

Question(s)

Current Use Today
SSDF and EJT use of Enhanced Motorway Model

Differentiators:
- Location Enabled
- Road Network Motorway Model
- Enhanced Metadata Management

Profile:

Trip Component 1

Differentiators:
- Location Enabled
- Road Network Motorway Model
- Enhanced Metadata Management

Redoubt Rd
Destination 1

Start Node
End Node 1
End Node 2
End Node 3

Mt Wellington
Destination 2

Nelson St
Destination 3

Mainline
Master Journey

Trip Component 2

Trip Component 3

Traffic Velocity Console
Auckland Traffic Web Site
90% VO
+ Location + Association with Model
+ Estimated Speed
+ Time

Operators
The Radio Network
Public, Internal & Operators

SSDF Data Value Add & Data Enhancements

SSDF Data Value Add & Data Enhancements

Traffic Velocity Console
Public Traffic Data Repository
DYNAC

IC2 with Model
Estimated Speed + Time

Signs
Traffic Devices
Public
EJT Software
EJT Software

Public, Internal & Operators

Public, Internal & Operators

Open Web Services Data Access

Traffic Devices
Public

Public Traffic Data Repository
DYNAC

Traffic Devices
Public

Open Web Services Data Access