Auckland Motorways

Detection of Incident using Vehicle Detection Data

An Investigation

Hanford Cheung & Ngan Truong

New Zealand Government

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What is an incident?

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

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What Incidents do we deal with?

NZ Police

– attend 15-18,000 "incidents" on the motorways each year *(1250-1500 per month, 40 to 50 per day)*

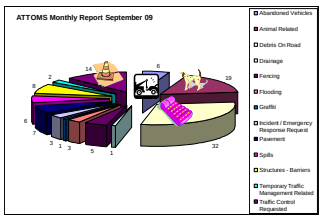
–7.25% are crashes

AMA attend less

– 100-120 incidents per month

–Active for 3,100 hours per year

(or 9 hours per day)



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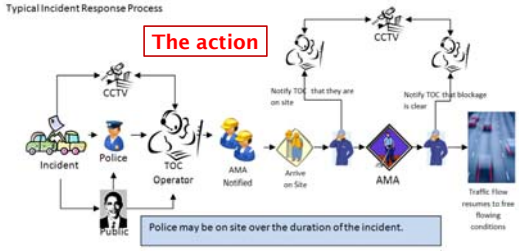
How do we deal with incidents?



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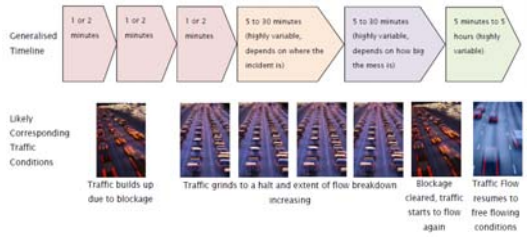
Incident Response – Timeline and Traffic



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Typical Example

TYPICAL LOCATION
- 3 Lanes
- 91 Vehicles per minute

TYPICAL USER
- 1.4 Occupants per vehicle

TYPICAL INCIDENT
- 30 minutes duration

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One Incident

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Benefit of responding to an incident one minute quicker

	Per Incident (30 min Duration)	Per Day (8 Incidents)	Per Year (245 Days)
Vehicle Travel Delay	637 min	5,096 min	1,248,520 min
Occupant Travel Delay	892 min	7,134 min	1,747,928 min
Cost of Delay	$237	$1,902	$466,114

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Where can we improve?

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Other Benefits of Automatic Incident Detection

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

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What are others doing?

Type	Algorithm	Occupancy	Volume	Speed	Others
Comparative (Rule Base)	• California Basic, 7 & 8 • All Purpose Incident Detection (APID) • Pattern Recognition PATREG	√ √ √	√	√	
Statistical	• Standard Normal Deviation (SND) • Bayesian	√ √	√	√	Energy
Time Series	• Auto Regressive Integrated Moving Average (ARIMA) • High Occupancy (HIOCC)	√ √	√		
Smoothing/ Filtering	• Double Exponential Smoothing (DES)	√	√		
Traffic Modelling	• Mc Master	√	√	√	

Game changers in Auckland

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

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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

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Area of interest

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

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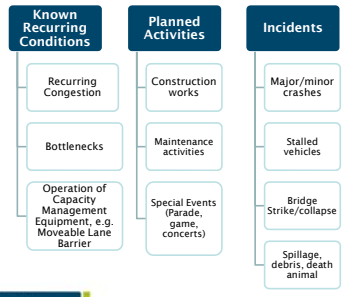
Isolating Incidents from other activities



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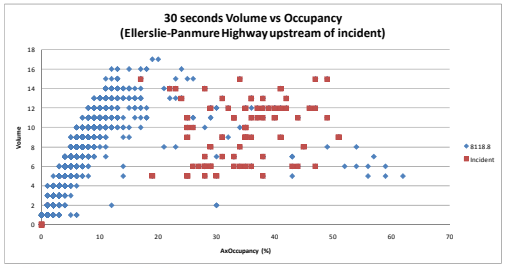
Traffic Flow Characteristics



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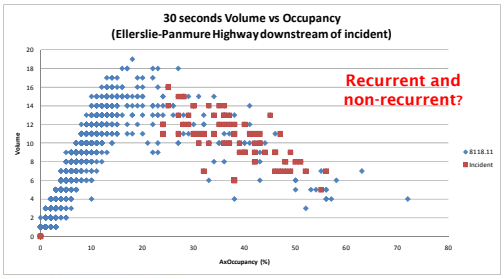
Traffic Flow Characteristics



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Importance of Historic Flow Data Profile

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

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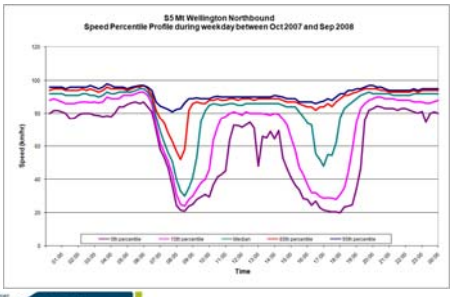
Example of an Annual Speed Profile



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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

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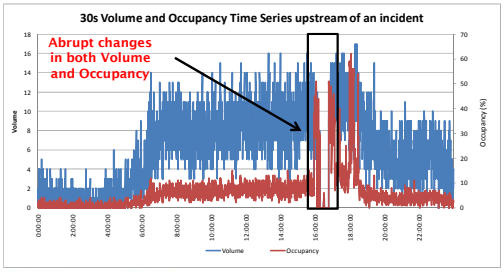
Key Difference: Incident vs. Congestion



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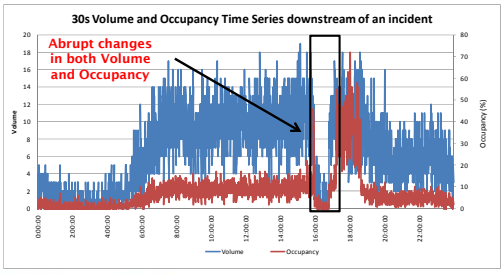

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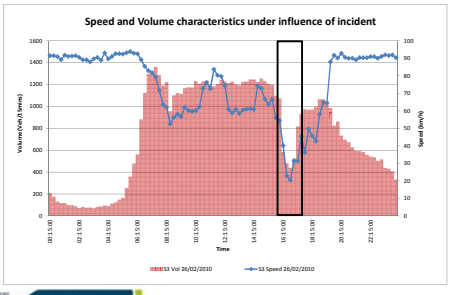
Speed and Volume during an incident



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Two-Stage Detection Process

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Conclusions

- 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

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Question(s)

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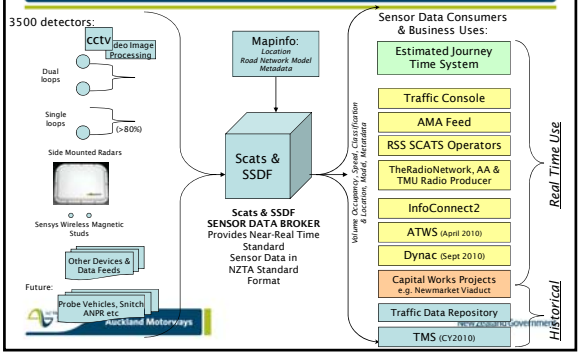
Current Use Today

there are 9+ downstream consumers



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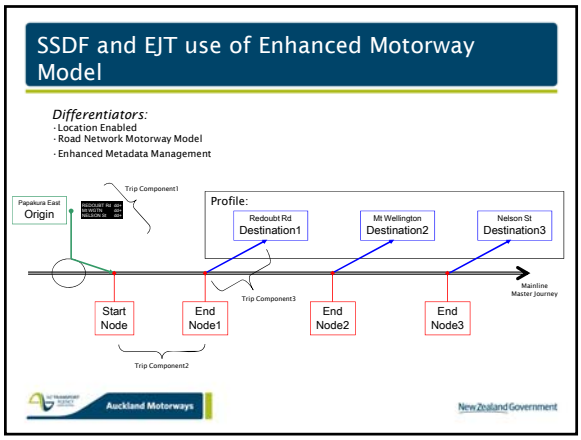
SSDF and EJT use of Enhanced Motorway Model
Differentiators:
· Location Enabled
· Road Network Motorway Model
· Enhanced Metadata Management
Papakura East
Origin
Trip Component1
Profile:
Redoubt Rd
Destination1
Mt Wellington
Destination2
Nelson St
Destination3
Start Node
End Node1
End Node2
End Node3
Trip Component2
Trip Component3
Mainline Master Journey
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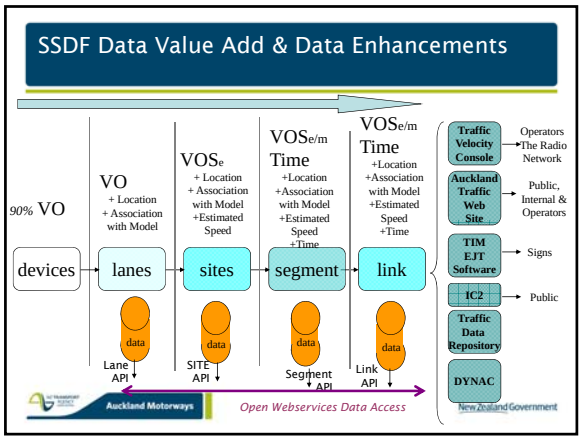
SSDF Data Value Add & Data Enhancements
90% VO
devices
VO
+ Location
+ Association with Model
lanes
VOSe
+ Location
+ Association with Model
+Estimated Speed
sites
VOSe/m Time
+Location
+Association with Model
+Estimated Speed
+Time
segment
VOSe/m Time
+Location
+Association with Model
+Estimated Speed
+Time
link
data
Lane API
SITE API
Segment API
Link API
Open Webservices Data Access
Traffic Velocity Console
Operators The Radio Network
Auckland Traffic Web Site
Public, Internal & Operators
TIM EJT Software
Signs
IC2
Public
Traffic Data Repository
DYNAC
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