AITPM Victorian Branch Technical Forum
Freeway Management System for the M1

Wednesday 7th May 2008, 5:30pm – 7:00pm
VicRoads Theatrette, 60 Denmark Street, Kew

Our speakers tonight are...

Philip Walsh  
(Founder)  
Project Director, Freeway Management System, VicRoads

Tom Bueker  
Manager, Tolling and Traffic Systems, Transurban

John Gaffney  
Delivery Manager, Ramp Metering, VicRoads

Prof. Markos Papageorgiou  
Technical University of Crete

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AITPM Victorian Branch 2008 Technical Forum program

Wed 7 May  
Monash – City Link – Westgate Upgrade Project

Wed 11 June  
East West Link Needs Assessment  
(with Eng Aust/ITE) (DoT)

Wed 9 July  
Public Transport (DoT)

Tues 5 August  
Activity Centres – Transist Oriented Development

Wed 17 September  
Eastlink

Tues 7 October  
Congestion Management

Wed 12 November  
Sustainable Transport (DoT)

www.aitpm.com/main/n_activities_VIC.html

AITPM National Conference  
Perth:  
3 – 5 September 2008

www.aitpm.com
MCW Corridor

Statistics

- Traffic Numbers
  - Southern Link – up to 152,000 vehicles per day
  - Tunnels – up to 113,000 vehicles per day
- Mix of Vehicles
  - Car – 83.1%
  - Light Commercial Vehicle – 4.7%
  - Heavy Commercial Vehicles - 12.0% (40% am hours, 20% peak)
- Collision Statistics 2007 – Southern Link Only
  - Tunnels – 26
  - Open Road – 102
- Hazardous Events – total CityLink
  - Vehicle Breakdowns – 982
  - Debris - 359

What is Lane Usage Mgt?

- Situations Used
  - Tidal Flow
  - Tunnels
  - Part time use of shoulders / emergency lanes
  - Not feasible to construct shoulders / emergency lanes

Why?

- Improve Safety
  - Vehicle Breakdown
  - Secondary Incidents
  - Road Workers (incident response / maintenance)
- Provide Emergency Services Access
- Improve Capacity
  - Speed control – delay onset of flow breakdown
  - Turbulence – orderly merging of traffic upstream of incident / reduce lane changing
  - Clearing of incident
Traffic Management Task

- A Lane Usage Mgt System Supports:
  - Surveillance
  - Detection
  - Identification
  - Response
  - Management
  - Recovery

System Components

- CCTV
  - Pan Tilt Zoom
  - Fixed Cameras
- Traffic Data Stations
  - Volume, Occupancy, Speed
- Video Based Automatic Incident Detection
- Variable Message Signs
  - Main Line
  - Freeway / Tollway Entrances
- Advanced Lane Usage Signs
- Control and Monitoring System

Options Considered

- Traditional LUS
- Advanced LUS

ALUS Features

- Size – Type B in 80 kph zones
- Red & White LEDs
- High Reliability
- Optional Conspicuity Devices
- Flashing Annulus
- Weight < 20 kg
- Quick Removal and Installation
- Mounted on accessible or non accessible gantries

Test Gantry

Maintenance Concept

- sealed unit – no maintenance on site
- replace < 1 min
- return to vendor
- no configuration
- no moving parts
- hot swappable
- remote health monitoring
Key Points

- Where constraints preclude the construction of shoulders / emergency lanes – LUMS used to ensure road safety not degraded
- LUMS is more than just lane usage signs
- Effective implementation and usage will lead to a safer and more efficient road

Traffic Data

April Inbound Vehicle Mix

- Car
- HCV
- LCV
- Other
Presentation to AITPM

Coordinated Freeway Ramp Signals Project

Wednesday 7th May 2008

Presentation by John Gaffney
Delivery Manager Freeway Ramp Signals
Monash - CityLink – Westgate Upgrade Project
Major Projects Division
VicRoads

PROJECT OBJECTIVES

- Project Objectives:
  - Maximise performance across the entire 75km route
  - Maxmise utilisation of infrastructure
  - Improve efficiency by reducing travel times, travel time variability and congestion
  - Improve safety
  - Improve access to the freeway network

- A functional requirement is to reduce traffic weaving movements
- Current practice is to not meter freeway to freeway connections
- Alternatives are:
  - meter several upstream ramps on the feeder freeways eg. South Gippsland Freeway, Western Ring Road
  - single lane ramps entering freeway as a lane gain eg. Western Link

PROBLEMS ON MELBOURNE’S FREEWAYS

- Daily volumes on Melbourne’s freeways are growing around 5% pa
- Peak hour traffic throughput is in decline - some sections have declined as much as 25% in the past 5 years. WHY?

- Flow breakdown is occurring at locations where it would not be expected WHY?

Freeways rarely reach capacity

When Freeways reach capacity it is usually only for a short period and over a short section

2:59pm
Is capacity fixed or dynamic?

- When Freeways reach capacity it is usually only for a short period over a short section
  - Sections immediately upstream or downstream of a bottleneck usually do not reach capacity

Is capacity fixed or dynamic?

Markos Papageorgio – Euramp Project

“The traffic situation on today’s freeways resembles very much to the one in urban road networks prior to the introduction of traffic lights: blocked links, chaotic intersections, reduced safety.

It seems like road authorities and road users are still chasing the phantom of unlimited mobility that freeways were originally supposed to provide.
What is urgently needed is to restore and maintain the full utilisation of the freeways' capacity along with an orderly and balanced satisfaction of demand both during rush hours and in case of incidents.

Clearly, the passage from chaotic to optimal traffic conditions is only possible if today's "spontaneous" use of the freeway infrastructure is replaced by suitable control actions aiming at the benefit of all users.

Ramp metering is the most efficient means to this end, whereby short delays at on-ramps and freeway-to-freeway intersections is the (relatively low) price to pay for capacity flow on the freeway itself, leading to substantial savings for each individual road user.

- Still much to learn
- Further tuning and refinement of tools required
- Platform is robust and ready to be rolled out across Melbourne
RAMP METERING HIGHLIGHTS

Markos Papageorgiou
Technical University of Crete, Greece

INTRODUCTION

Originally: sufficient capacity for virtually unlimited mobility (without the need for control)

Ever increasing demand
→ Congestions
→ Degraded infrastructure use
at the time it is most urgently needed.

Goal: Operate freeway networks optimally (as a controllable system)

WHY RAMP METERING?

1st Answer

\[ q_{in} + d = 1.2 q_{cap} \]
\[ q_{con} = 0.95 q_{cap} \]

\[ \Delta T = \frac{q_{cap} - q_{con}}{q_{con}} = \frac{q_{in} + d - q_{con}}{q_{con}} \]

\[ e.g.: q_{con} = 0.95 q_{cap}; \quad q_{in} + d = 1.2 q_{cap} \]

\[ \Delta T = 20\% \]

2nd Answer

\[ q_{in} - q_{cap} - \gamma \]
\[ q_{out} \]

\[ \Delta T = \frac{q_{cap} - q_{con}}{q_{con}} = \gamma \]

\[ q_{in} + d - q_{con} \]

\[ \Delta T \]

Note: On-ramp queue should not interfere with surface street traffic.

LOCAL CONTROL ISSUES

Note: \( q_{in} \) less sensitive than \( q_{con} \)
(e.g. under adverse weather conditions)
WHY COORDINATED RAMP METERING?

No ramp queue constraints

- Little efficiency improvement via coordination
- Equity?
- Realistic?
- Diversion

Limited ramp storage capacity:
- Full ramp → Congestion “merely” retarded
- Equity: bad

⇒ significant improvement of both efficiency and equity via appropriate coordination

The rule-based coordinator HERO (reactive)

- Apply ALINEA to each ramp with $\delta = o_c$ and $w_{min}$ constraint.
- If ALINEA active at ramp i (master) and $w_i >$threshold, then set an analogous $w_{min}$ for the next upstream ramp i-1 (slave) (i.e. enlarge the available storage space).
- If $w_i + w_{i-1} >$threshold, then set an analogous $w_{min}$ for the next upstream ramp i-2 (slave)…
- … and so forth, up to ramp i-M or encounter of another ramp cluster.
- De-activation logic.

Developed within the European EURAMP project.

SIMULATION RESULTS

Amsterdam ringroad A10:
- 32 km (counter-clockwise)
- 21 on-ramps
- 20 off-ramps

No Control: TTS=14167 veh·h
**ALINEA without ramp storage constraints:** TTS = 7563 veh·h (-47%)

**ALINEA with ramp storage constraints:** TTS = 11515 veh·h (-19%)

\[ w_{\text{max}} \text{ is 30 veh for urban ramps and 200 veh for freeway ramps} \]

**HERO coordination:** TTS = 7466 veh·h (-47%)

\[ w_{\text{max}} \text{ is 30 veh for urban ramps and 200 veh for freeway ramps} \]

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**Impact of available storage space**

**ALINEA/HERO in Melbourne**

- Software specifications delivered
- Software development, implementation: accurate, fast, reliable
- Excellent co-operation, understanding, enthusiasm
- Emerging evaluation results: a success story!
- Future co-operation
- VicRoads at the international forefront in Ramp Metering