Integration of Roadway Flood Information into an ITS Traffic Management System – An Example from Queensland, Australia

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The problem - why it floods in Queensland – 2010/2011 floods
Existing policy and the need for centralised monitoring and control
STREAMS ITS Traffic Management System
Case Study Roadway Flood Monitoring System
Benefits of STREAMS Integrated Environmental Monitoring Systems
TMR Statistics show that...

“More than half of flood-related deaths in Queensland are a result of driving through floodwater”

(Department of Transport and Main Roads)
When it Rains, it Pours!

- Parts of N.Qld average over 3,000 mm annually (12,400 mm record)
- La Niña events bring increased probability of wetter conditions over much of Australia

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Figure 1: Average annual rainfall, Australia. (Bureau of Meteorology, 2016b).

Figure 2: Average rainfall October to April, Queensland. (Bureau of Meteorology, 2016b).
Queensland Floods 2010/2011

- Highest SOI values ever recorded
- 33 flood-related deaths
- Many due to people driving through floodwaters
- Lack of information about road conditions ahead was a contributing factor
- Department of Transport & Main Roads (TMR) tasked with improving the accuracy and timeliness of road condition information given to the public
Existing Road Closure Process

- Rely on cameras, public notification or third party roadway flood monitoring services
- Road is assessed by transport department officers or local police
- Officer closes road only after consultation with police, TMR website operators and affected residents
- Road access information submitted to the transport department and published on website
A Change in Policy

Previously:

- Proprietary software and communications protocols
- No integration with STREAMS ITS Traffic Management System used by TMR
- TMCs have no visibility of these systems within STREAMS

Going Forward:

- TMC operators can centrally monitor and control Roadway Flood Monitoring Systems
What is STREAMS?

- Integration Platform for Traffic Management Operations

Figure 3: STREAMS distributed computing architecture.
What is STREAMS?

- Connect layer is key to the flexibility of STREAMS
- Supports multiple vendors for devices of a specific type through use of a device driver model
Benefits of Integrated Traffic Management Functions

- Synergy between existing systems and equipment – no vendor lock-in
- Secure, flexible data communications
- Reduced training and resourcing costs with a single ITS platform
- Single UI – optimised road network management
- Modular, scalable architecture allowing streamlined migrations and upgrades
- Efficient data management
Case Study – STREAMS Integrated Roadway Flood Monitoring System

Figure 5: Location of the Glendale Drive floodway in the suburb of Annandale, Townsville, North Queensland. (Google Maps, 2016).
Glendale Drive Floodway System

- Non-invasive CS475 radar sensor
- Solar powered with RF comms to nearby CR800 datalogger
- IP connection into TMR private network via Telstra UC-372SP3GE modem
- CR800 – Modbus to STREAMS Communications Processor (CP) located in TMC
- Data sent from CP to Application Server and presented as a Simple Device Value
- Allows any semantically similar device to be ingested and displayed

Figure 6: Radar Roadway Flood Monitoring System installed at the Glendale Drive floodway in Townsville.
Glendale Drive Floodway System

Figure 7: Communications schematic for the Glendale Drive Floodway in Townsville
Glendale Drive Floodway System

Figure 8: Example STREAMS user interface for a Roadway Flood Monitoring System.
Automated Responses

STREAMS Stimulus/Response Engine:

• TMC Operators select thresholds/conditions for alarming
• Once met, the software automatically sets a response on any actuator device (e.g. Road Condition Information Sign (RCIS)).

• 5 RCIS within Glendale Drive system
• Water Level automated response:

  Less than 0.03m  OPEN
  Between 0.03m and 0.09m  CAUTION
  Greater than 0.09m  CLOSED
Figure 9: Rainfall data (14/03/16 00:00 to 18/03/16 00:00) from a weather station located 5.6 km North West of the Glendale Drive Roadway Flood Monitoring System. Right axis indicates 24 Hour Accumulative Rainfall totals. (Campbell Scientific Australia, 2016).
Sample Flood Event – 16/03/16

Figure 10: Radar water level data (14/03/16 00:00 to 18/03/16 00:00) measured by the Glendale Drive Roadway Flood Monitoring System.
Sample Flood Event – 16/03/16

Figure 11: Glendale Drive floodway on 16th March 2016 under road closed conditions.
Main Benefits of a ITS Integrated RMFS

- Full visibility of flood conditions within a TMC with automated response engines
- Ensures timely distribution of road condition information to commuters (instantaneous)
- Allows for automated road closures during flood events
- Operational efficiency with re-opening of roads and bridges
- Reduced inconvenience to commuters whilst maintaining safety standards
- Optimised road network management and future cost savings through reduced training and resourcing costs and efficient data management
Other Road Weather Data

- Visibility
- Temp/RH
- Wind Speed/Direction
- Rainfall
- Ice Detection
- Surface Friction
- Surface Temp
References


An extended version of this paper is available at the following web address: