How Connected Vehicles and Devices are Revolutionizing Incident Detection and Work Zone Management: Examples from Other Parts of the US

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Topics

• Evolution of Data: INRIX circa 2008, 2011 and today
• The Big Data Challenge
• INRIX XD Monitoring
• The Indiana Example
INRIX Fusion Engine
Fusing data from multiple sources

- GPS Probe Data processed through geo-spatial filtering engine
  - Use Location, Heading & exclusive contextual information from vehicle bus

- Inference Engine fuses map-matched GPS probe data & ‘healthy’ physical sensor data
  - Detects Outliers
  - Weights data points by source
  - Computes latency-weighted average flow condition data & estimates confidence-interval

- Adaptive Spatial Resolution
  - Adjusts spatial granularity of data to allow confidence-interval to be met

(From 2008 Presentation to NJDOT/NJTP)
2008 Coverage
How We Deliver

**Aggregate Content**

- Smart Driver Network
  - Aggregate traffic & related content from >500 sources

**Analyze & Process**

- Fusion Engine
  - Enhance data using advanced error detection algorithms

- Real-Time Processing
- Predictive Modeling
- SpeedWaves Secondary Road Analysis

**Deliver Solutions**

- Products & Services
  - Deliver traffic-powered data, apps and tools to customers via Connected & Broadcast Services

**Connected Services**

- Apps & Tools
- Directions & Driver Services
- Traffic Information

**Sources & Information**

- Largest GPS Probe Network in the World
- Road Sensors & Other Traffic Flow Sources
- Floating Cellular Vehicle Data
- Traffic Metadata to Enable Predictions
- Traffic Metadata
- User Generated Content

(From 2011 Presentation to NJDOT/NJTP)
INRIX Traffic Intelligence Network
North America, Spring 2011

Examples of 15-Minute Real-Time Snapshots
2011 Coverage and Info
The INRIX Business Today

Connected Car Services

Traffic Data & Platform
World’s Largest Traffic Probe Network

Near Future

Analytics & Applications

More than 250+ Customers To-date
INRIX Traffic Intelligence Network

North America, Spring 2014

Examples of 15-Minute Real-Time Snapshots
Today’s Coverage
Today’s Accuracy

<table>
<thead>
<tr>
<th>Ground Truth Speed Range, in MPH</th>
<th>2008 - 2009 (16 Tests, 5 States)</th>
<th>2010 - 2011 (19 Tests, 8 States)</th>
<th>2012 - 2013 (7 Tests, 7 States)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 30</td>
<td>5.9, 4.4, 2.5</td>
<td>5.0, 3.9</td>
<td>2.1, 1.9</td>
</tr>
<tr>
<td>30-45</td>
<td>7.5, 5.0</td>
<td>2.6, 2.1</td>
<td>2.6, 1.9</td>
</tr>
<tr>
<td>45 - 60</td>
<td>2.6, 1.9</td>
<td>1.9, 1.1</td>
<td>2.8, 2.3</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>1.9, 1.1</td>
<td>1.1, 1.5</td>
<td>2.3, 1.5</td>
</tr>
<tr>
<td>Overall</td>
<td>2.8, 2.3</td>
<td>1.5, 1.5</td>
<td></td>
</tr>
</tbody>
</table>

Error in MPH (<10 MPH Contract Requirement)
INRIX Vehicle Probe Trajectories
December 17, 2013
I-95 NB, Brunswick, GA

- Little circles are specific vehicle readings
- Lines connect data from the same vehicle
  - “Vehicle trajectory”
- Color of dot/line indicate specific vehicle speed/travel time
  - Dot is speed for single reading
  - Line is travel time between multiple readings
- This is the base data the powers INRIX processing

Outlier data that must be detected and discarded
Possible/likely opening; Candidates for INRIX operator review
Possible closures; Candidates for INRIX operator review
Data Profile – PA Turnpike July 30, 2014

- INRIX historic data shows original incident occurs around 20:10 UTC (16:10 local)
- Closure is enforced at Downingtown, PA
- Max queue back to Malvern, PA at 18:30
- Vehicles take up to 2 hours queuing to exit
- Maximum queue length about 7.5 miles
- Trapped traffic is released within the closed section after about 19:40 local time
- The road reopens to through traffic after 02:25 UTC (22:25 local time)
Data Profile – I-75, FL - Aug 04, 2014

- INRIX historic data shows original incident occurs around 18:20 UTC (14:20 local)
- Accident location is 3.5m upstream of Exit 368 (~ MM372)
- Closure enforced at exit 368 from 14:55 local
- Vehicles take up to 45 minutes queuing to exit, up to 7km/4.5 mile queue

- Trapped traffic is released within the closed section after about 15:30 local time
- Closure at Exit 368 lifts shortly afterwards, causing a secondary queue to develop
- Secondary queue is up to 12km/7.5 miles, up to 25 minute delay
- All clear after 16:50 local time
Big Data Challenge

• How to make sense of all this data...in real-time...to do something useful
• INRIX Approach
  • INRIX XD Traffic
  • Data Integration
  • Real-Time Analytics
INRIX XD Segments

• Purpose built for dynamic traffic reporting
• Function precisely like TMC segments
  • Fixed segments, fully populated data, updated every minute
• Key Benefits of XD Segments
  • ~40% More Coverage nationally – large increases in ramps and arterials
  • Better segment granularity – typical segment length ~1 mile (1.7 mile max)
  • Eliminate gaps and overlaps endemic in TMC segments
  • Not dependent upon TMC Consortium for codes
  • Sub-segment granularity optional – data and tiles
INRIXTraffic Mobile App shows XD Traffic Data
XD Monitoring
XD Monitoring Covers More Roads
(~30% more coverage and 2x segments in NJ)
Available Interchange Coverage

TMC Segments

INRIX XD Segments

~10X Coverage Increase in NJ Ramps
More Connected Vehicles – more roads, more granularity, more accurate speeds
Congestion Layer needs a “free flow” speed to normalize roads of all types
Cutting through the Clutter

Where is traffic slow?
...Or slowed compared to typical?
With multi-source data available too ....
Get a full picture across road types and agencies...in a single view
Queue Monitoring – TMC Segments
Queue Monitoring – XD Segments
XD in Action – NJTP October 9, 2014
INRIX data shows incident impacted traffic near Exit 5 about 1:15pm EDT (17:15 UTC)
Location of incident is pinpointed to near Rancocas Rd Overpass
Through traffic blocked on two separate occasions
Congestion backs up 7.4 miles at worst extent, but all clear by 3:45pm
XD in Action – NJTP October 9, 2014
Incident Detection Application

Explanation

**Delta Speed**: Difference in speed from an initial segment to the adjacent segment downstream.

This is where we as an industry need to focus our attention. High speed to low speed indicates the back of a queue.

Real Time Data
(every minute)

- XD Segments
  - Segment 1: 70 MPH
  - Segment 2: 68 MPH
  - Segment 3: 35 MPH

Delta Speed
-2 mph
-33 mph
XD Segments Supporting Queue Detection (Indiana DOT/Purdue) – “Game Changing Fidelity”

http://tinyurl.com/purdue-indot-queue-warning

http://youtu.be/5eFwSBGZkql
Incident Detection Application
Incident Detection
Performance Measures – Delta Speed

2012

2013

2014
Thank You!

• Rick Schuman (rick@inrix.com)