Safe and seamless mobility at rail crossings

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PART I  2 Issues, 4 Challenges, A Solution
PART II  TRAINFO Technologies & Case Studies
PART III Connected & Automated Vehicles at Rail Crossings
Issue 1: Blocked & occupied crossings

Trends
• Growing economy & increasing rail activity
• Shrinking train crews & difficulty cutting trains
• Urban sprawl & new developments accessed by rail crossing
• Increasing traffic delays, safety concerns, emissions & complaints

Possible responses
• Cut trains
• Adjust train schedule
• FLBG, grade separation, rail relocation
• Regulations & enforcement
Issue 2: Train data requests

Trends

- Road authorities “need” real-time train data to manage traffic
- Navigation mapping companies “need” to show trains on maps
- Automated vehicles need train data to operate at rail crossings

Possible responses

- Cater to individual requests
- Travel to meet with road authorities
- Develop AV technologies
4 challenges / “How To’s”

Road authorities
1. **How to: address blocked crossings**... without cutting trains, re-scheduling trains, grade separation, or regulations?
2. **How to: address traffic issues at rail crossings**... without railroad involvement?

Railroads
1. **How to: support navigation mapping applications**... without showing train data on maps & managing multiple accounts?
2. **How to: support automated vehicles**... without increasing costs & liability and developing AV technology?
A solution

Trusted 3rd party traffic delay predictions at rail crossings
A solution

**Trusted 3rd party traffic delay predictions at rail crossings**

- Conceals train location information
- Account management & data protection for railroads
- Provision & maintenance of certified security standards
A solution

**Trusted 3rd party traffic delay predictions at rail crossings**

- Conceals train location information
- Account management & data protection for railroads
- Provision & maintenance of certified security standards
- Responsive to road authority requests
- Single point-of-contact between nav map & railroads
- Reduces railroad risk, liability & involvement with AVs at rail crossings
A solution

**Trusted 3rd party traffic delay predictions at rail crossings**

- Conceals train location information
- Account management & data protection for railroads
- Provision & maintenance of certified security standards
- Responsive to road authority requests
- Single point-of-contact between nav map & railroads
- Reduces railroad risk, liability & involvement with AVs at rail crossings
- Supports effective, low-cost options to address traffic issues
Predicts traffic delays at rail crossings

Provides re-route info to avoid trains

Provides APIs to integrate into:
- Roadside signs
- Traffic signals
- Navigation apps
- Dispatch systems

Evolving our technologies for automated vehicles (AVs)
How it works

**Step 1: Install hardware in the field**
- Install train detection sensor within 100 feet of rail crossing
- Install Bluetooth sensor along roadway within 100 feet of vehicles

**Step 2: Collect & analyze data**
- Sensors wirelessly transmit real-time data to our cloud server
- Our software measures & predicts traffic delays at rail crossing

**Step 3: Deliver traffic delay information to users**
- Drivers → roadside signs
- Road authorities → online dashboard, traffic signals, TMCs
- Navigation mapping companies → routing apps in phones & cars
- Emergency responders → dispatch software
TRAINFO Interactive Dashboard

Date
4/23/2018  2/5/2019

Avg. Delay per Vehicle by Crossing (min)

Avg. Delay per Vehicle by ODID (min)

Avg. Number of Vehicles Impacted per Day by Crossing

Avg. Number of Vehicles Impacted per Day by ODID

Avg. Vehicle-Delay per Day by Crossing (hr)

Avg. Vehicle-Delay per Day by ODID
Message 1
No train, normal traffic

Message 2
5-min before train arrives

Message 3
5 to 40 min after train clears
We have train sensor technology. WHAT IF permanent sign had been installed (~$1M) drivers go Kenaston or Pembina = saving $155M

Sign location gives drivers the chance to turn at McGillivray if they want to avoid train delay. Also, estimated drive time was bang on.

Actually <$100k

Janice Lukes
@JaniceLukes

Colin Fast
@policyfrog

Winnipeg Metro reporter

Winnipeg City Councillor
“I’m much more **relaxed and calm** as I approach the railway crossing now that I know when it will be blocked.”

“I use the [roadside] sign every day to decide if I should **re-route around the crossing**.”

“Now that I can re-route [around blocked railway crossings] I don’t think an underpass is needed anymore.”
Connected & automated vehicle research

Onboard Equipment
- Antenna
- Power
- Onboard unit
- HMI

Roadside Equipment
- Solar panel
- Roadside unit
- Train sensor
- Battery
Concluding remarks

2 issues
- Blocked & occupied crossings
- Train data requests

4 challenges
- Address blocked xings w/o cutting trains, re-scheduling, grade sep, regs
- Address traffic issues at rail crossings w/o railroad involvement
- Support navigation mapping applications w/o sharing train data
- Support automated vehicles w/o increasing risk, liability, costs

A solution
- Trusted 3rd party traffic delay predictions at rail crossings
Connected & automated vehicle research

The problem with CAVs at rail crossings

- Onboard sensors cannot detect trains
- Trains will not communicate with vehicles (no V2V)
- No V2I standards
Did the message arrive at the **right place** at the **right time**? No.

<table>
<thead>
<tr>
<th>V2V Target</th>
<th>100%</th>
<th>0%</th>
<th>2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>V2R Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Packet Reception Rate</td>
<td>67%</td>
<td>1.2%</td>
<td>1.4</td>
</tr>
<tr>
<td>Error Rate</td>
<td></td>
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<tr>
<td>Receptions per Second</td>
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</tbody>
</table>

% of messages received by OBU

% of time the HMI is in error state

# of messages received by OBU per second
Obstructed sightline was the main reason communication tests “failed.”

Rail crossing behind these trees.
Did the **right message** arrive in the **right way** for the driver? Yes.

**Message phase accuracy**

100%

Percent OBU messages received that match the RSU message delivered

**Driver feedback**

Highly useful, interested in expanded use