Innovations in Road Weather

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How Do We Warn Them About This!

We have tried this before!

- Limited Success
  - Visibility and wet pavement worked well
  - Snow/ice struggled
- Issues
  - Trigger mechanism/logic
  - Communications

What are we going to talk about?

- The technology – what has changed
- What is possible
- Customer Examples
  - Vtrans (Vermont)
  - CDOT (Colorado)
  - ODOT (Oregon)
  - Iowa DOT

Key to Success

- To properly solve a trouble spot location there are several critical steps to follow
  - Understand what weather condition(s) is causing the issue (temperature, wind, wet, etc.)
  - Select the correct, most reliable sensor(s) for the job
  - Consider placement carefully (early warning, placement for convenience in this case is not an option)

The Trigger.

- In most activation cases we are wanting to monitor and alert based on roadway surface condition.
- For much of the past 20+ years that we have been trying this we have relied on in-pavement sensors.
- In-pavement sensors are good for human decision makers, but not as good for automated activation.
- Why?

Estimations

- In-pavement sensors know:
  - pavement temperature
  - wet/dry
  - presence of chemical
  - depth of the substance above
- In-pavement sensors don’t know, so they estimate:
  - Presence of snow or ice

Non-intrusives are changing the game

- Sure the fact that they are not placed in the pavement is a huge safety and installation cost savings, but the key is in the information coming from them.
- Friction & “seeing” the condition
- What is friction?
  - Friction is a force that opposes the motion between two objects in contact with each other

Why Friction?

- Why are we interested in measuring friction ?
  - Friction is the only well defined quantity that uniquely describes how slippery the road surface is:
    - For a dry road friction varies around 0.80 ± 0.10 for typical tires and pavement surfaces
    - If there is hard ice on the surface, every car will experience a dramatic drop of friction despite the quality of the tires -> friction will drop down to about 0.10 – 0.20 with a thick layer of hard ice

Friction and ITS

- Friction gives us that quantitative number to be able to make automated decisions.
- 0.6 and above = Grip good
- 0.4 to 0.59 = Grip poor
- 0.39 and below = Very poor grip

- This value can greatly improve the algorithms needed to make decisions, and provide an easier decision process.

Vermont – VTrans
Statewide RWIS and ITS

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Background

- ConnectVermont™ started by Tourism Commissioner in 2000
- Traveler Information was focal point
- 2001 VermontVacation website
- 2002 Vermont joins CARS/511 consortium
- 2002 511 implemented
- 2003 Randolph LPFM station and Williston RWIS implemented

Courtesy of Vtrans – Robert White
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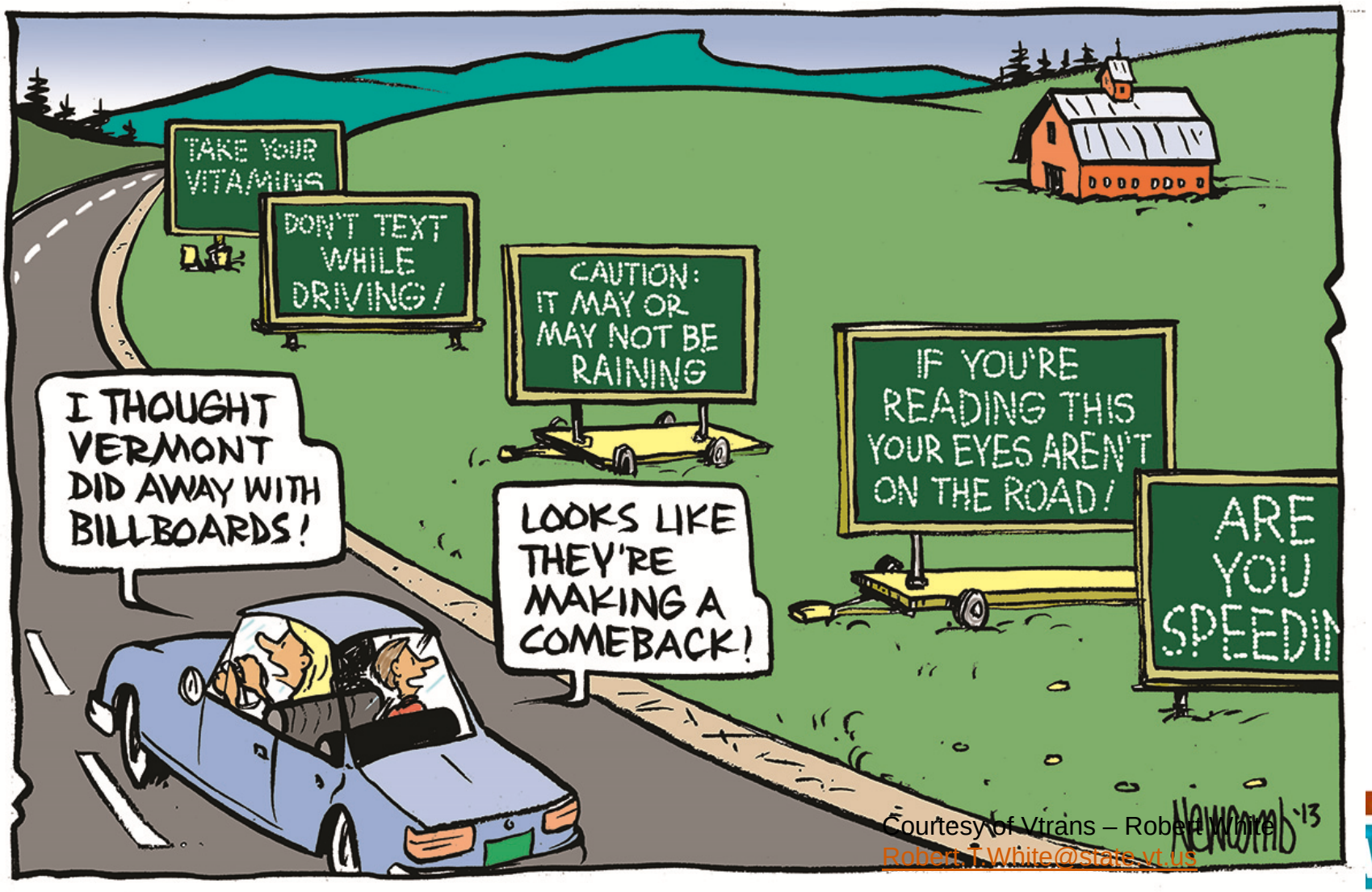
Background continued

- 2004/5 Derby LPFM Station and Brookfield RWIS implemented
- ***2005 – first VMS implemented!!!!***
- 2006 – present 24 more RWIS statewide implemented
- 2008 – Transportation Operations Center (TOC)
- 2009 RWIS automated control of VMS implemented (Best of ITS/A National Award)
- 2013 RWIS/VMS combo implemented

Courtesy of Vtrans – Robert White
Robert.T.White@state.vt.us

Vermont's Rural ITS Challenges



Courtesy of Vtrans – Robert White
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Vermont RWIS

- 28 RWIS implemented Statewide
- 3 are RWIS/VMS Combos
  - Low Roadside Profile

Courtesy of Vtrans – Robert White
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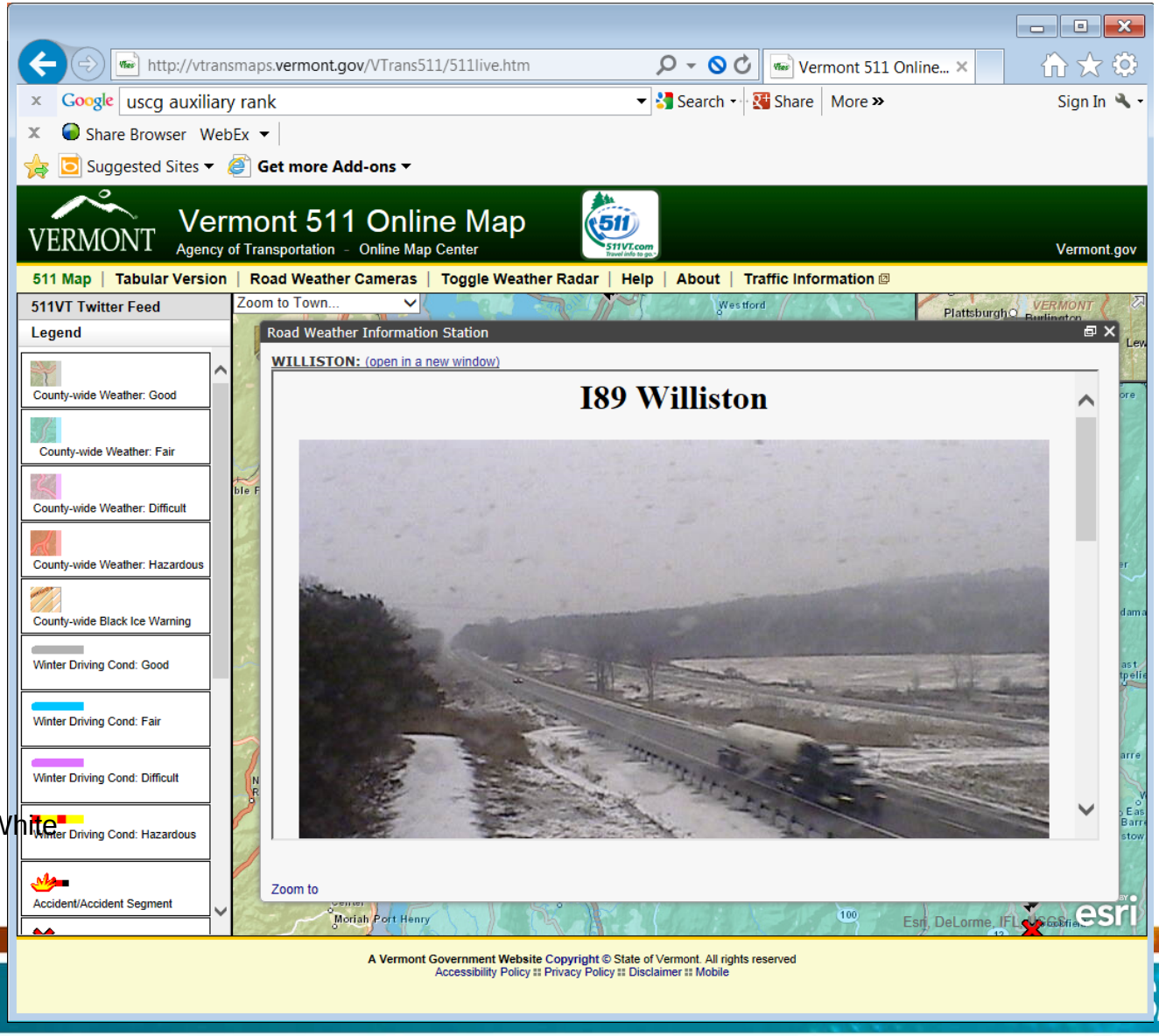
VTrans 511 RWIS Camera



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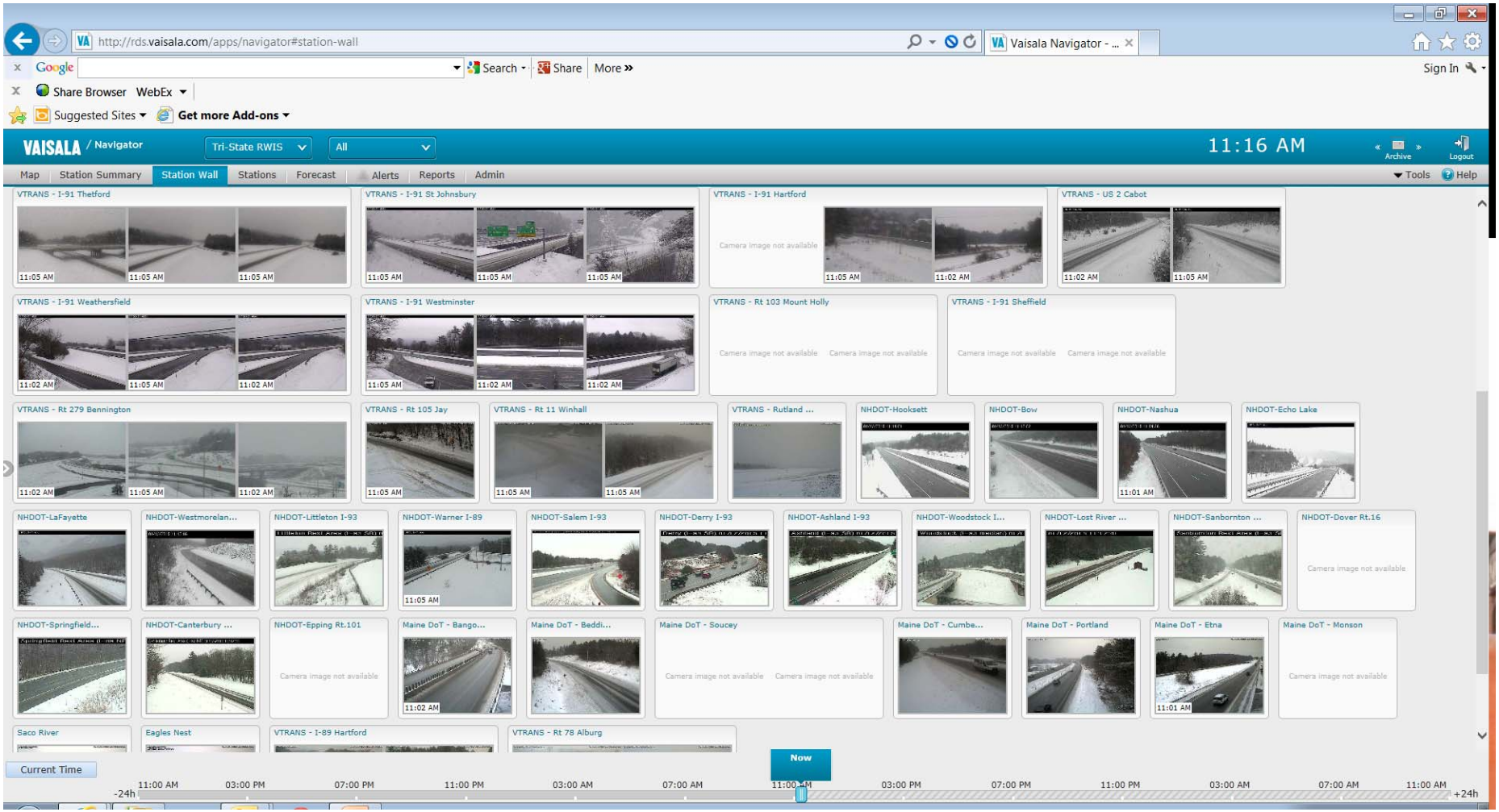
Tri-State RDS Navigator



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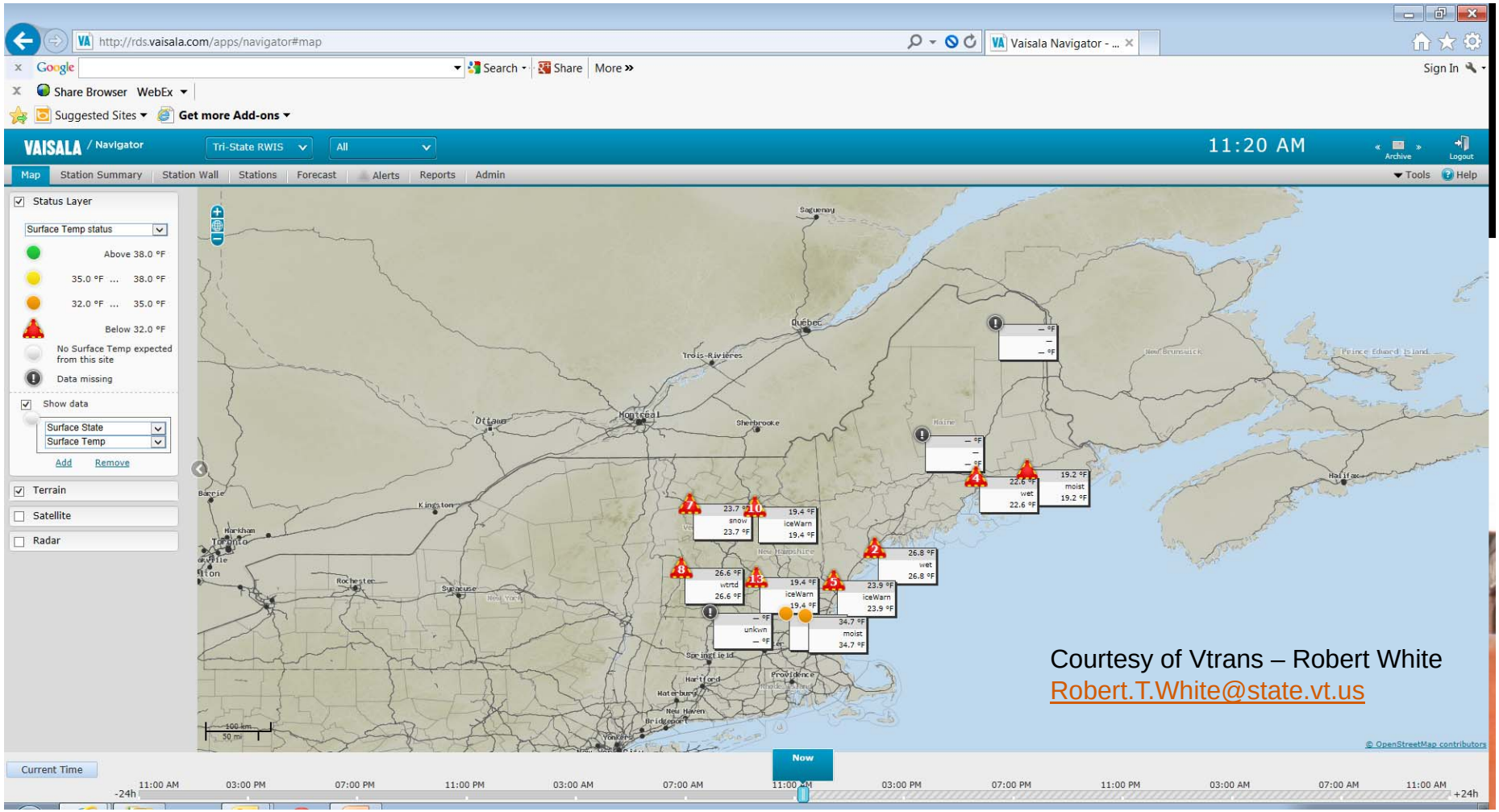

Concord Monitor - Streamlined info for DOT, drivers the aim of planned traffic management system

Courtesy of Vtrans – Robert White
Robert.T.White@state.vt.us

Future Goals

- Continue RWIS & VMS rollout statewide to reach goal of 60 RWIS/150 VMS with 30 RWIS/VMS/WIMS combo planned
- Replace current interim 511 system with new Tri-State/NE regional ATMS-511 system
- Install fiber optic infrastructure to support statewide ITS and integrate with neighboring states.

Courtesy of Vtrans – Robert White
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CDOT – Colorado – Local ITS Challenge

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State Highway 82 Snowmass Canyon Icing Detection System

- Project started in September 2000 and was completed in October 2004.
- $100 million project widened 3.5 mile section of SH 82 through Snowmass Canyon, a narrow valley created by the Roaring Fork River.
- Like Glenwood Canyon, the project involved building two roadways one virtually on top of the other along steep, geologically unstable slopes using a terraced system of retaining walls and bridges to minimize environmental impacts.

Courtesy of CDOT– Mike Curtis
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Terraced System

Courtesy of CDOT– Mike Curtis
michael.curtis@state.co.us

History of Problem during Winter

- Drivers on State Highway 82 are traveling down valley (towards Glenwood Springs) and enter Snowmass Canyon at Mile Marker 30.4. The roadway is dry.
- When conditions are dry many drivers who are unfamiliar with road fail to think ahead.
- On warm days, the snow that has accumulated during the winter against the concrete barrier melts. The three curves at the east entrance to Snowmass Canyon in the westbound lanes are super elevated, so the water from the melting snow drains across the roadway.
- In the dead of winter, the sun disappears from the roadway in the narrow canyon so by 2 pm the roadway is in full shadow and ice. To the motorists it appears just wet instead of black ice.

Courtesy of CDOT– Mike Curtis
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History Continued

- Motorists that are unaware and driving at too high a rate of speed (posted limit is 50 mph with curve advisory of 45 mph) spin out of control at approximately Mile Marker 30 .
- There were 11 accidents in 2005; 12 in 2006; 3 in 2007; 11 in 2008; 8 in 2009; and 5 in 2010.
- CDOT obtained funding from the Federal Highway Administration in 2010 to address this problem.

Courtesy of CDOT– Mike Curtis
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Icing Detection System Design Components

- Weather Station (RWIS) with Vaisala Non Invasive Infrared Sensors (Surface Condition & Surface Temperature) Mounted on Weather Station Tower at Mile Marker 29.79.
- Wireless Communication with RWIS via Cell Modem. Antenna for CDMA about foot down from top of tower.
- Wireless Spread Spectrum System (Freewave) to Communicate with Variable Message Sign at Mile Marker 30.45. Antenna for Wireless System on top of tower.

RWIS Phillips River View Looking West

Courtesy of CDOT– Mike Curtis
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RWIS Phillips River View Looking East

Courtesy of CDOT– Mike Curtis
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RWIS at Phillips River View

Courtesy of CDOT– Mike Curtis
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Variable Message Sign at East Entrance to Snowmass Canyon

Courtesy of CDOT– Mike Curtis
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Variable Message Sign at East Entrance to Snowmass Canyon

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Oregon DOT – Curve Warning

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Curve Warning System

- U.S. 26 and State Highway 217
- High incident exit ramp
- Crash statistics
  - 81% Wet
  - 14% Dry
  - 4% Unknown
  - 1% Ice

Courtesy of ODOT– Dennis Mitchell
FHWA Road Weather Management Meeting 2014

Solution

- Activates base on grip/friction
- Sensors
  - Pavement temperature
  - Pavement condition
  - Visibility
- Other Weather and ITS Projects
  - Additional curve warning
  - Variable speed project based on weather condition

Other Example - Iowa DOT

- http://www.kcci.com/news/dot-invents-new-way-to-keep-you-safe-on-icy-roads/30954760
- Or Google “Iowa DOT speed limit weather”

Summary

- Non-intrusive sensors have greatly improved capabilities for automation
- Consider many factors during planning stage
- Motorist reaction and actions might not respond to messaging without quality PR
- If motorist lose trust in system, project will struggle