Weather and the Connected Vehicle





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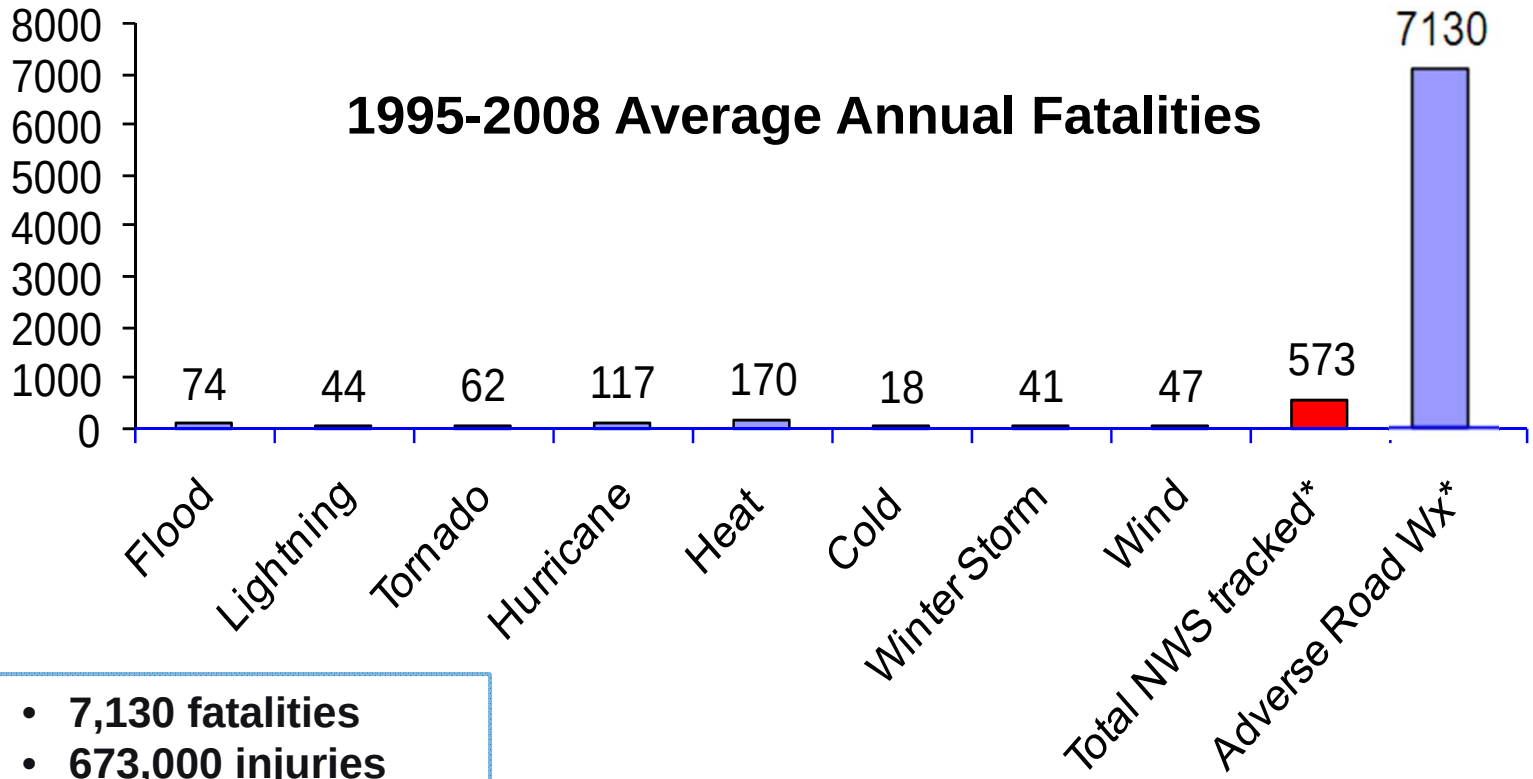
Presentation Overview

- Context
- *Clarus*
- Weather & the Connected Vehicle

Weather & Roads – Safety

Bottom Line: 24% of all crashes occur under adverse weather



- **7,130 fatalities**
- **673,000 injuries**
- **1.5 million crashes**

Weather & Roads – Economy & Environment

Trucking delays due to weather = $3.1billion/yr
for the 50 largest cities

Lost commerce due to snow
closures = $10billion/day

More than $2billion/yr is spent on
snow and ice control by State DOTs

Weather accounts for 25% of
non-recurring congestion

Chemicals affect watersheds, air quality and infrastructure

Road Weather Management

Goal – Improve mobility and safety by alleviating the impacts of weather on the surface transportation system

"Anytime, Anywhere Road Weather Information" is the program's mission

This includes current and predicted information about weather's affect on roads…

… and the decision support tools to aid road users and operators to make effective decisions, e.g.,

- When to pre-treat roads for snow & ice control
- When to post traveler advisories (fog, floods, rain, snow, etc.)

The *Clarus* Initiative

- *Clarus* is an R&D initiative to demonstrate and evaluate the value of “Anytime, Anywhere Road Weather Information” that is provided by both **public agencies and the private weather enterprise** to transportation users and operators.
- To do so, FHWA created a robust
  - ✓ data assimilation,
  - ✓ quality checking, and
  - ✓ data dissemination system

  that can provide near real-time atmospheric and pavement observations from the collective states’ investments in environmental sensor stations (ESS).

The *Clarus* System

www.clarus-system.com

- ✓ A database management system for all surface transportation weather observations in North America
- ✓ One database removes borders
- ✓ Provides advanced quality checking for both atmospheric & pavement data
- ✓ Includes extensive metadata
- ✓ Easy access via web portal & subscription

Clarus

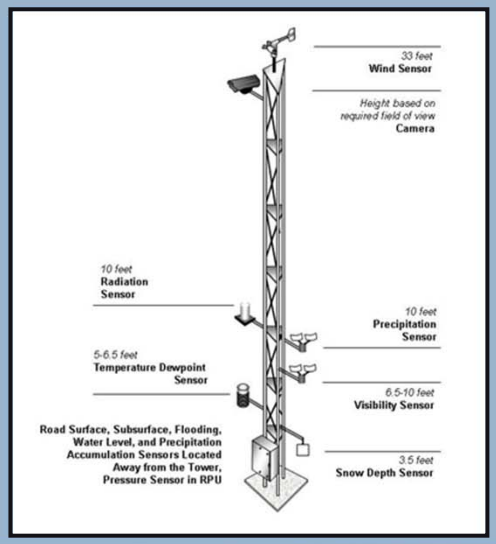
A Clear Solution For Road Weather Information

Over 75% of State DOTs Participate in *Clarus*

Sensor & Station Count

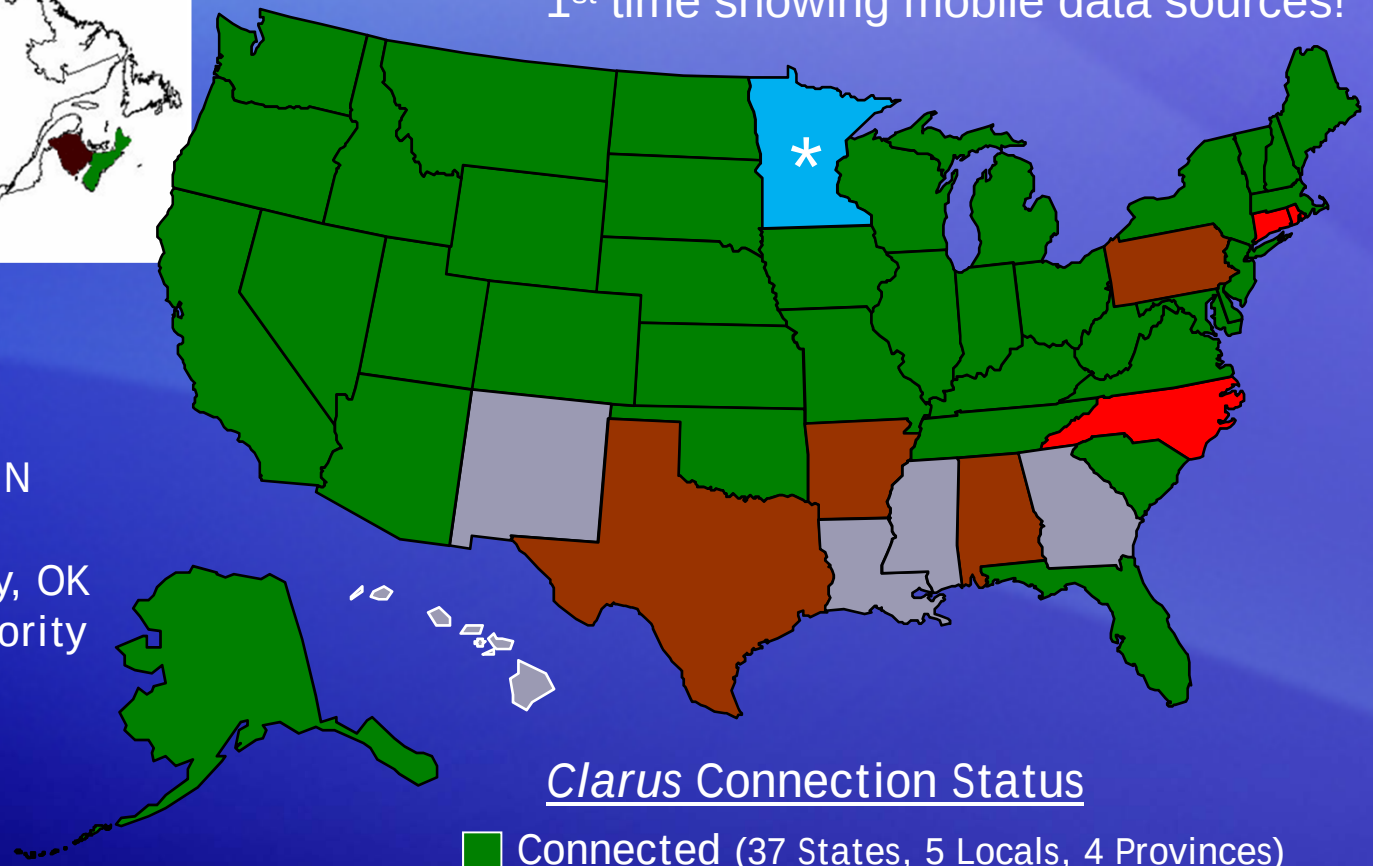
2,253 Sensor Stations (ESS)

52,471 Individual Sensors



Participation Status for *Clarus* as of August 24, 2011

*1st time showing mobile data sources!

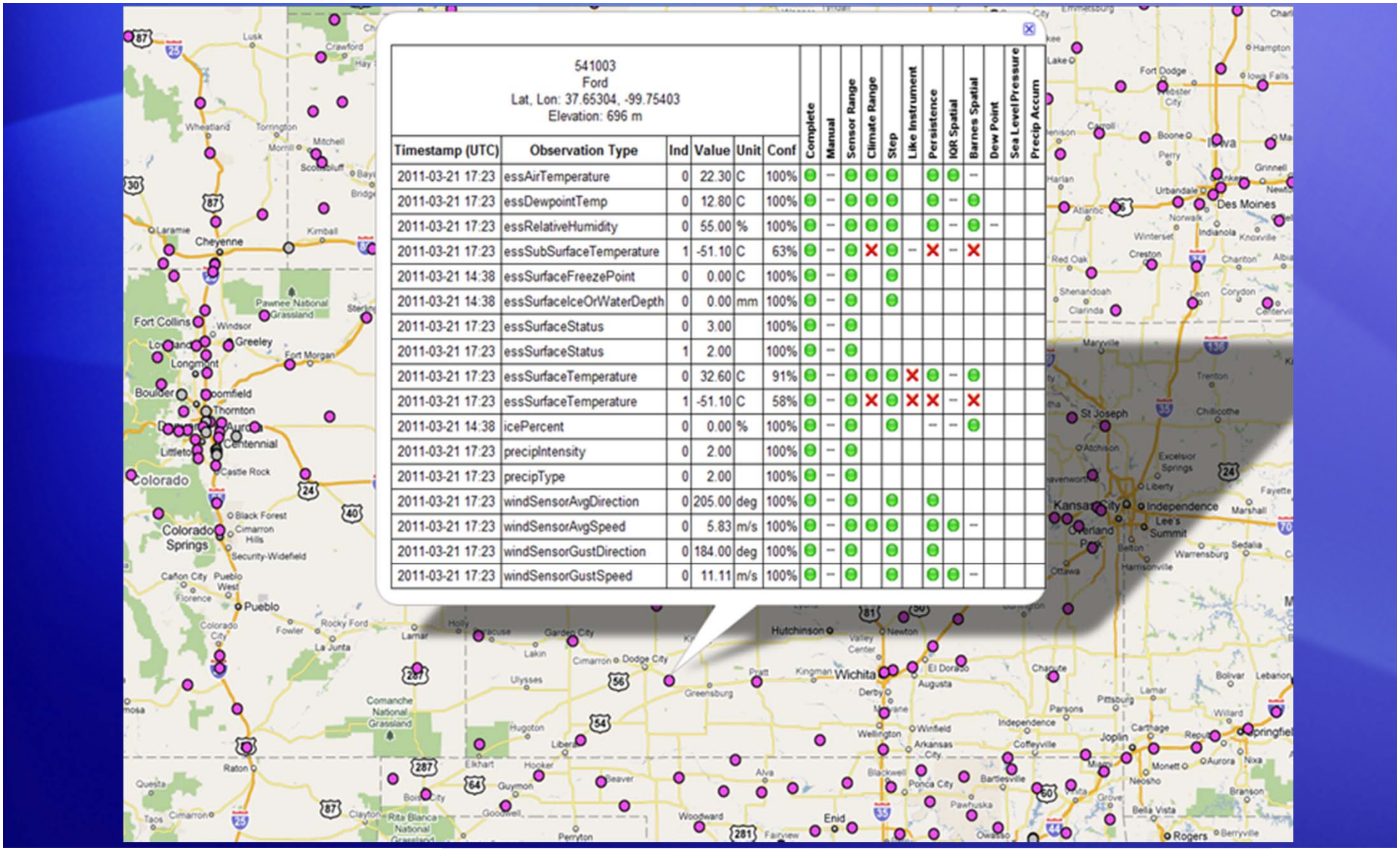


Local Participation
- City of Indianapolis, IN
- McHenry County, IL
- City of Oklahoma City, OK
- Kansas Turnpike Authority
- Parks Canada

Sensor & Station Count
2,253 Sensor Stations (ESS)
52,471 Individual Sensors
* 81 Vehicles

Clarus Connection Status
- Connected (37 States, 5 Locals, 4 Provinces)
- Connected plus vehicles (1 state)
- Pending (4 States, 3 Locals, 1 Province)
- Considering (3 States, 1 Local)

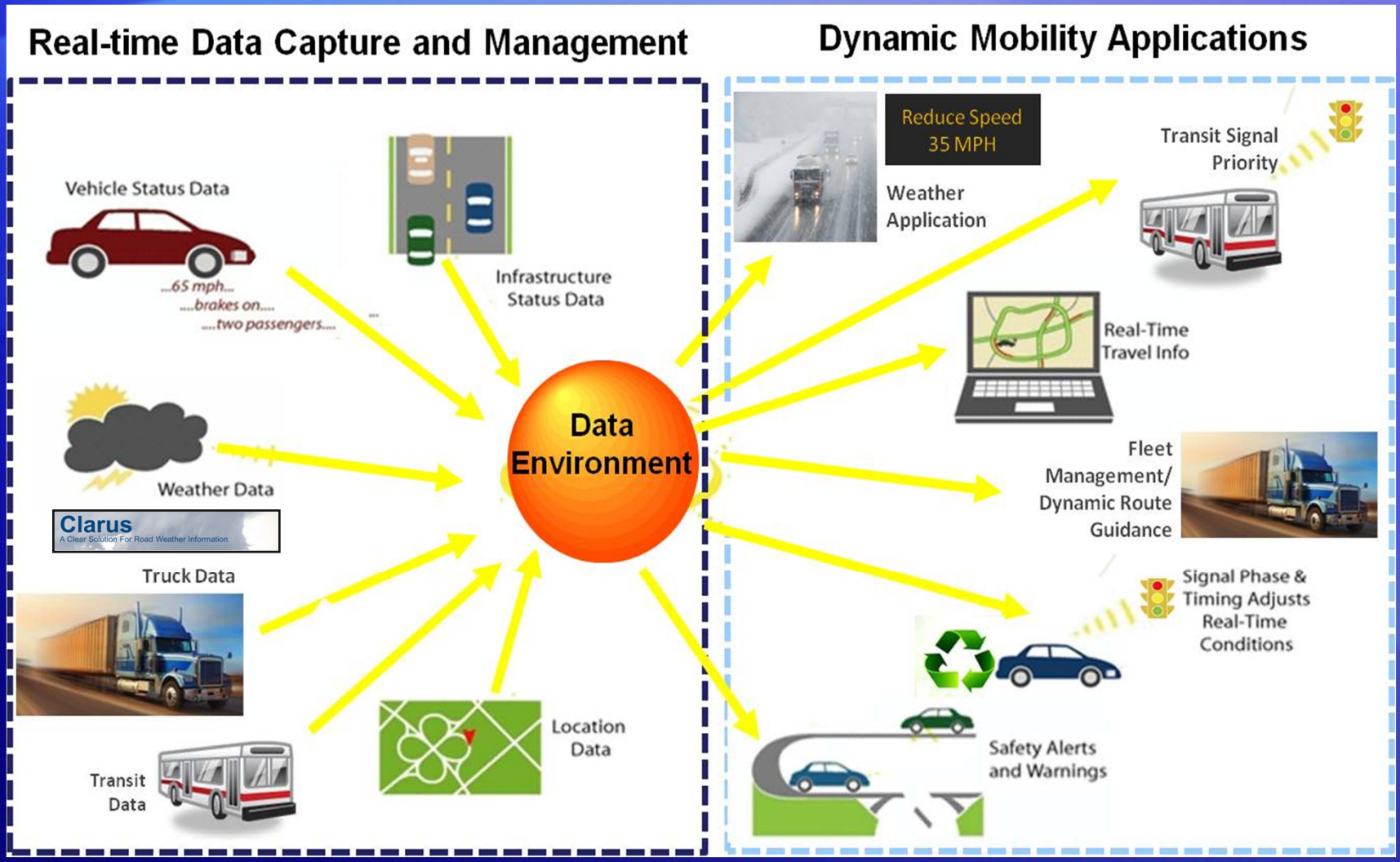
Clarus System Observations



Timestamp (UTC)	Observation Type	Ind	Value	Unit	Conf	Complete	Manual	Sensor Range	Climate Range	Step	Like Instrument	Persistence	IQR Spatial	Barnes Spatial	Dew Point	Sea Level Pressure	Precip Accum
2011-03-21 17:23	essAirTemperature	0	22.30	C	100%	●	–	●	●	●		●	●	–			
2011-03-21 17:23	essDewpointTemp	0	12.80	C	100%	●	–	●	●	●		●	–	●			
2011-03-21 17:23	essRelativeHumidity	0	55.00	%	100%	●	–	●	●	●		●	–	●	–		
2011-03-21 17:23	essSubSurfaceTemperature	1	-51.10	C	63%	●	–	●	✗	●	–	✗	–	✗			
2011-03-21 14:38	essSurfaceFreezePoint	0	0.00	C	100%	●	–	●		●							
2011-03-21 14:38	essSurfaceIceOrWaterDepth	0	0.00	mm	100%	●	–	●		●							
2011-03-21 17:23	essSurfaceStatus	0	3.00		100%	●	–	●									
2011-03-21 17:23	essSurfaceStatus	1	2.00		100%	●	–	●									
2011-03-21 17:23	essSurfaceTemperature	0	32.60	C	91%	●	–	●	●	●	✗	●	–	●			
2011-03-21 17:23	essSurfaceTemperature	1	-51.10	C	58%	●	–	●	✗	●	✗	✗	–	✗			
2011-03-21 14:38	icePercent	0	0.00	%	100%	●	–	●		●		–	–	●			
2011-03-21 17:23	precipIntensity	0	2.00		100%	●	–	●									
2011-03-21 17:23	precipType	0	2.00		100%	●	–	●									
2011-03-21 17:23	windSensorAvgDirection	0	205.00	deg	100%	●	–	●		●		●					
2011-03-21 17:23	windSensorAvgSpeed	0	5.83	m/s	100%	●	–	●	●	●		●	●	–			
2011-03-21 17:23	windSensorGustDirection	0	184.00	deg	100%	●	–	●		●		●					
2011-03-21 17:23	windSensorGustSpeed	0	11.11	m/s	100%	●	–	●		●		●	●	–			

The Connected Vehicle

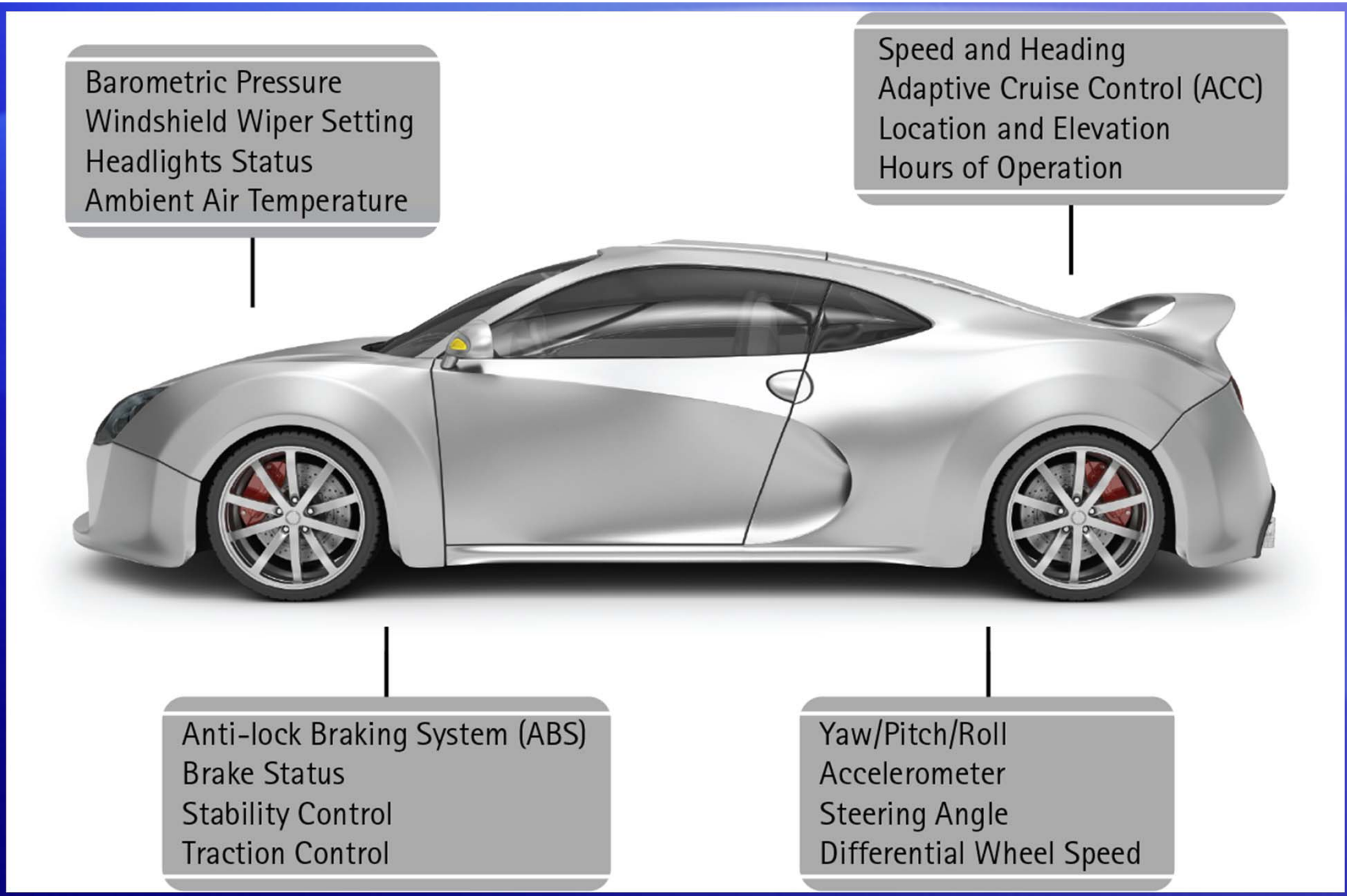
Improving Road Weather Awareness



Connected Vehicle Scenarios

Daily operations - Recurring congestion and peak ridership conditions (i.e., the baseline for activities)	
Major traffic incident Extended closures/fatalities/ major structural damage occurring on either freeway or arterials with impacts for freeway, arterial, transit, and parking management	
Major Evacuation Major evacuation of large numbers of people caused by unpredictable events (e.g., wild fire, terrorist attack)	
Major Winter Weather Event Major winter weather event (ice and snow) with a regional impact	
Special Event Planned major event impacting corridors and downtown area	

Connected Vehicle "Anytime, Anywhere Road Weather Data"



Weather & the Connected Vehicle

Obtain a thorough picture of current weather and road conditions by including mobile sources

- Higher resolution observations that spatially augment fixed sensors
- Take advantage of existing standards and on-board sensors

Improve weather-related decision support tools to mitigate safety and mobility impacts of weather

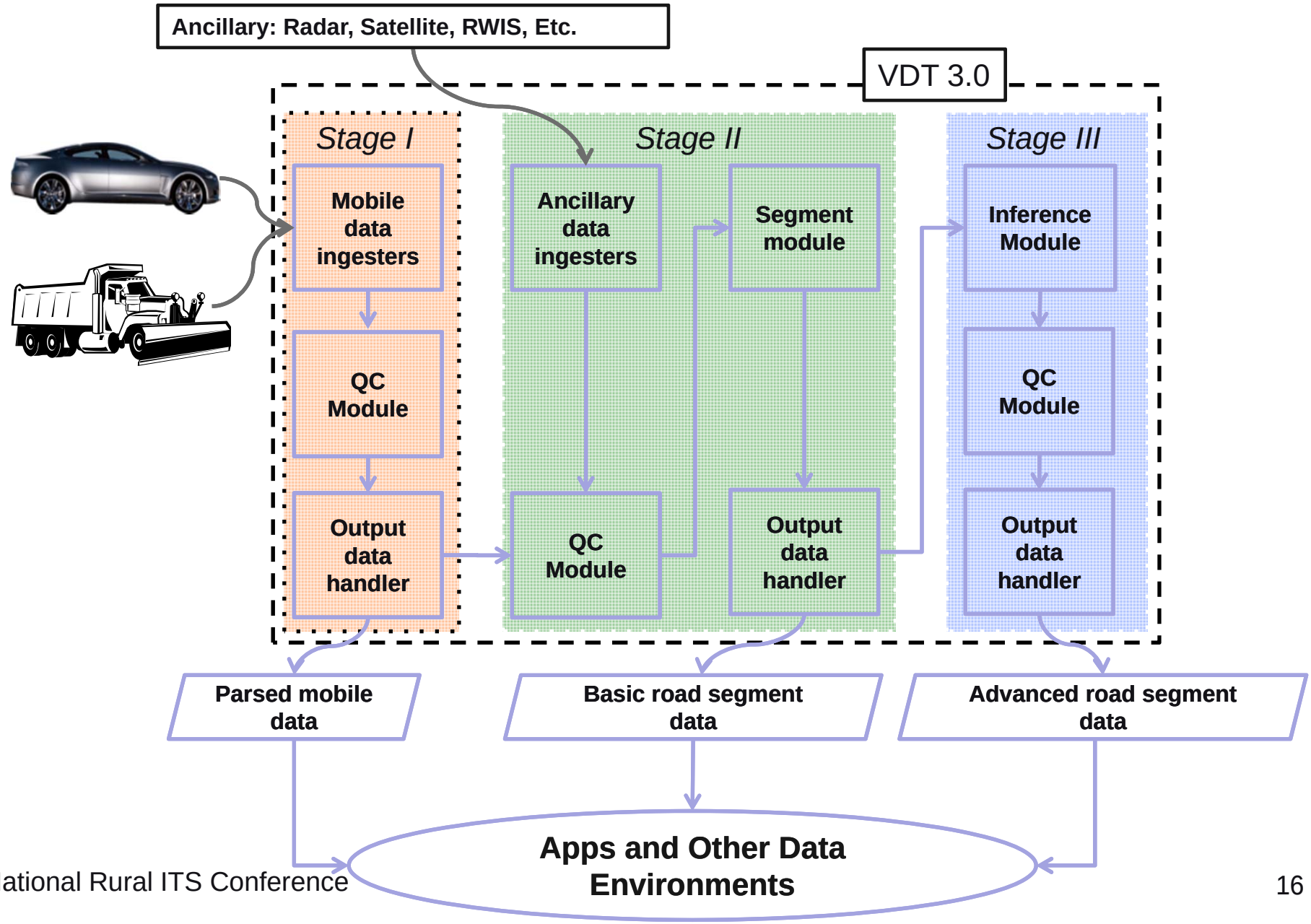
- Based on ability to better detect and forecast road weather and pavement conditions

Vehicle Data Translator (VDT)

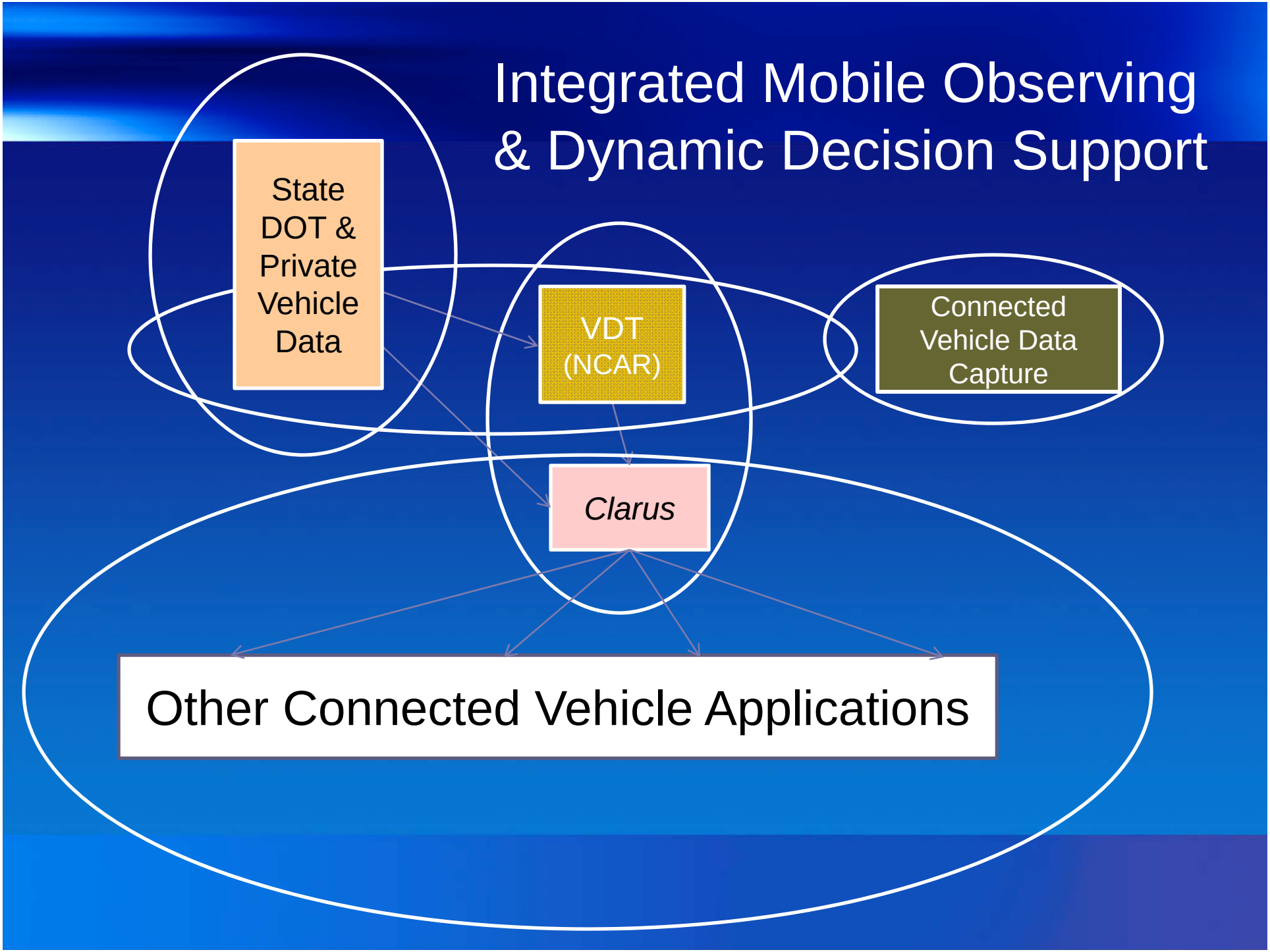
VDT Objectives

1. Develop and improve the Connected Vehicle "Anytime, Anywhere Road Weather Information"
2. Better Characterization of current weather and road conditions
3. Accurate Quality Checking and/or Quality Control of vehicle data
4. Development of inferred road segment specific weather and road-weather information for end-user applications

Vehicle Data Translator (VDT)



Integrated Mobile Observing & Dynamic Decision Support



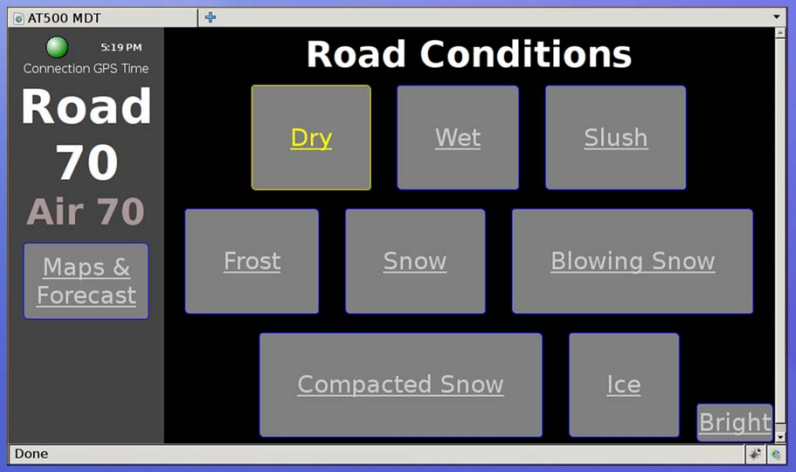
What Can You Do With VDT-based Data?

There are any number of road weather dynamic applications that could use vehicle-based observations:

- State DOT-based applications
- Transportation-specific applications
- Broad Weather & Transportation applications

State DOT-based Applications

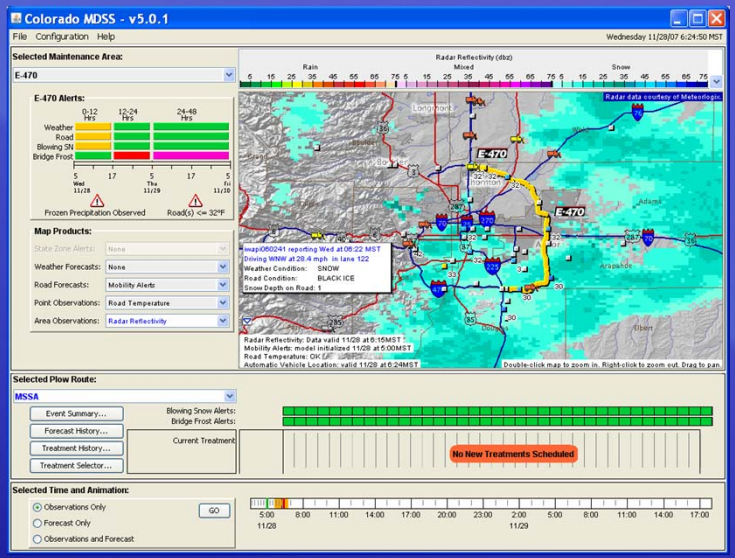
- **Observation assimilation**
  - Fill in the gaps between fixed stations
  - Collect real-time pavement temperatures



VDT-based data

- **Maintenance Decision Support**
  - What are the current roads conditions?
  - Accurate pavement temperature modeling

- **Manage Maintenance Actions**
  - End of Shift Reports
  - Materials Management



Transportation-specific Applications

VDT-based weather alerts:

- Impending weather hazards
- Alerts from other vehicles
- Re-routing

*Simulated screen – designed to not distract the driver

Broad Transportation Applications

VDT-based data

Winter Maintenance –
Which roads have been treated?

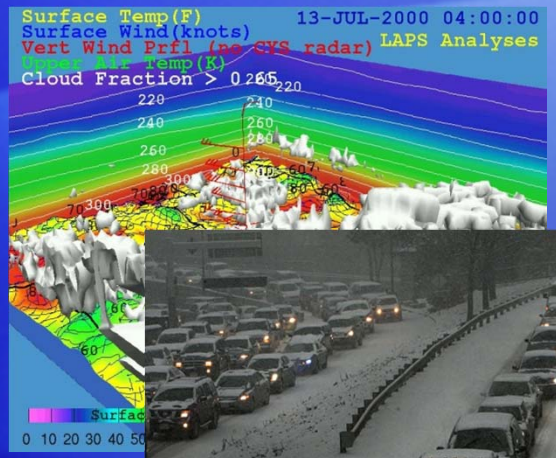
Route Specific Impact Warnings for…

School Buses

Truckers

EMS

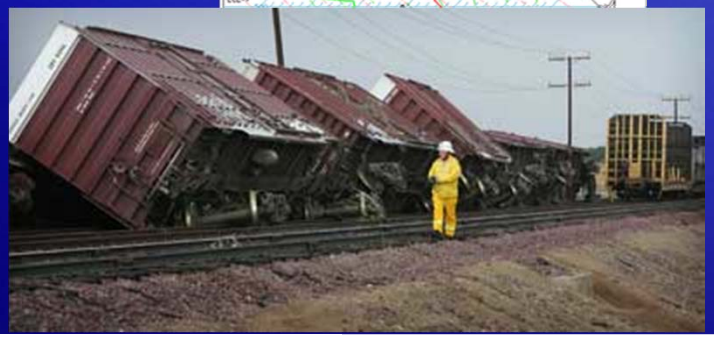
Weather-related Applications



Numerical Weather Modeling

Traffic Modeling and Alerting

Weather Modeling – complex terrain



Other surface transportation users

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