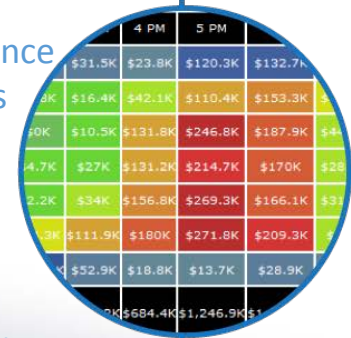


RWIS Data Integration for Improved Decision Making



Performance Measures



Planning



Operations



Communications



RITIS: Enabling Decision Making & Effective Communication

Learning Objectives

At the end of this presentation the participants will be able to:

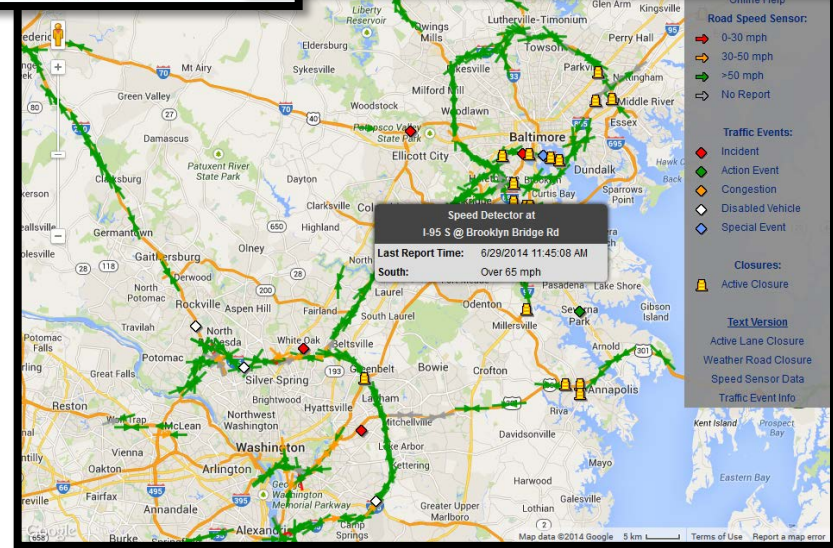
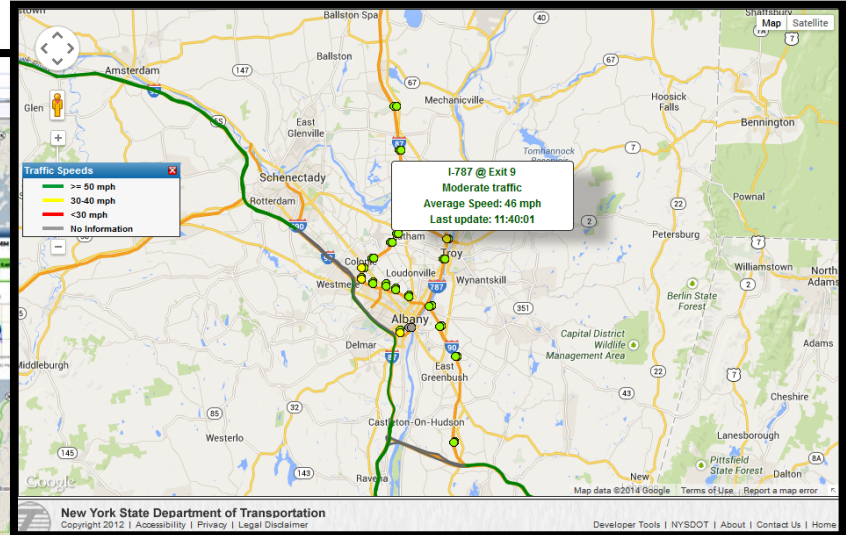
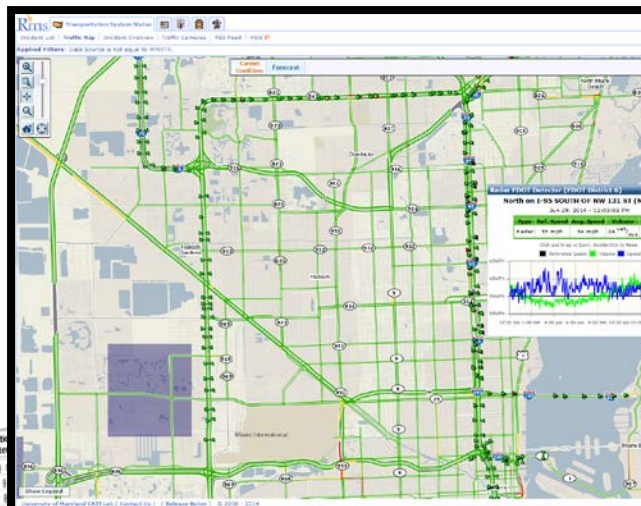
- Understand the importance of RWIS data integration for operations.
- Discuss use of technology to improve winter weather operations.
- Explore other uses of RWIS data in combination with other data sources.



Goal: Translate Data into Actionable Information

	lane_id integer	speed double precision	volume double precision	occupancy double precision	quality integer	measurement_start timestamp with time zone
1	8978	57	14	5	0	2014-06-29 11:37:57.698-04
2	8978	58.8	26	8	0	2014-06-29 11:36:56.818-04
3	8978	62.4	16	6	0	2014-06-29 11:35:56.863-04
4	8979	56.4	11	7	0	2014-06-29 11:36:56.818-04
5	8979	58.2	17	9	0	2014-06-29 11:35:56.863-04
6	8979	53.4	14	8	0	2014-06-29 11:35:56.863-04
7	8980	57	27	19	0	2014-06-29 11:36:56.818-04
8	8980	52.8	31	17	0	2014-06-29 11:37:57.698-04
9	8980	65.4	22	11	0	2014-06-29 11:36:56.818-04
10	8981	51.6	13	6	0	2014-06-29 11:37:57.698-04
11	8981	54	9	9	0	2014-06-29 11:36:56.818-04
12	8981	49.8	18	13	0	2014-06-29 11:35:56.863-04
13	8982	56.4	16	8	0	2014-06-29 11:37:57.698-04
14	8982	52.8	14	7	0	2014-06-29 11:36:14.944-04
15	8982	65.4	21	7	0	2014-06-29 11:37:17.753-04
16	8983	67.8	25	25	0	
17	8983	67.8	26	26	0	
18	8983	65.4	24	24	0	
19	8983	68.4	31	31	0	
20	8984	55.2	24	24	0	
21	8984	55.2	23	23	0	
22	8984	55.8	31	31	0	
23	8984	55.8	10	10	0	
24	8984	58.2	14	14	0	
25	8985	57	12	12	0	
26	8985	55.8	9	9	0	
27	8985	55.8	20	20	0	
28	8985	63.6	18	18	0	
29	8986	63.6	28	28	0	
30	8986	63	27	27	0	
31	8986	63	13	13	0	
32	8987	57	10	10	0	
33	8987	57	6	6	0	
34	8987	57	5	5	0	
35	8987	58.8				

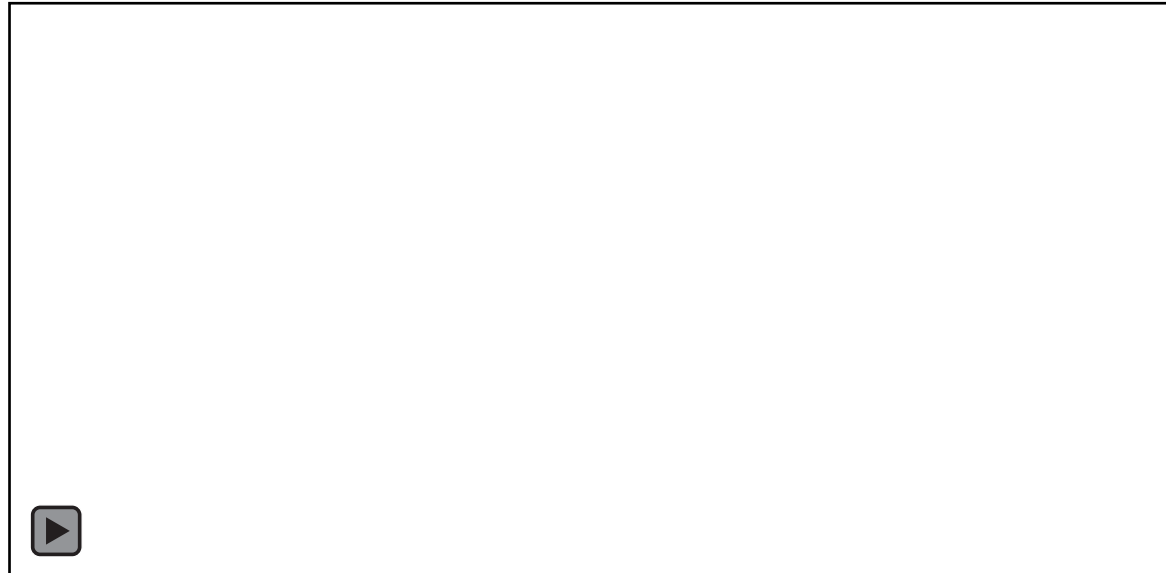
location_id integer	primary_road integer	intersecting_road integer	default_speed integer	region integer	lat double precision	lon double precision	description text
2	1	12	0	65	2	39.0602120	-76.3244350 I-95 S
3	2	12	0	55	2	39.2961710	-77.3240700 I-270
4	3	12	0	65	2	39.3216070	-77.3241800 I-270
5	4	12	23	55	2	39.3216070	-77.4094400 I-270 NB MD 151
6	5	12	0	65	2	39.2217350	-77.2848400 I-270 SB MD 151
7	6	12	0	55	2	39.2217350	-77.2901000 I-270 SB MD 151
8	7	12	0	65	2	39.2217350	-77.2901000 I-270 SB MD 151
9	8	12	0	65	2	39.2217350	-77.2901000 I-270 SB MD 151
10	9	12	0	55	2	39.1197220	-77.1964900 I-270 SB MD 151
11	10	12	0	65	2	39.1839710	-77.3516400 I-270 SB MD 151
12	11	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
13	12	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
14	13	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
15	14	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
16	15	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
17	16	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
18	17	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
19	18	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
20	19	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
21	20	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
22	21	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
23	22	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
24	23	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
25	24	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
26	25	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
27	26	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
28	27	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
29	28	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
30	29	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
31	30	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
32	31	3	0	55	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
33	32	3	0	65	2	39.2638870	-77.1125540 I-495 NB Merrimack Tree
33	33	2	0	65	2	39.1589190	-76.8301150 I-95 SB MD 32



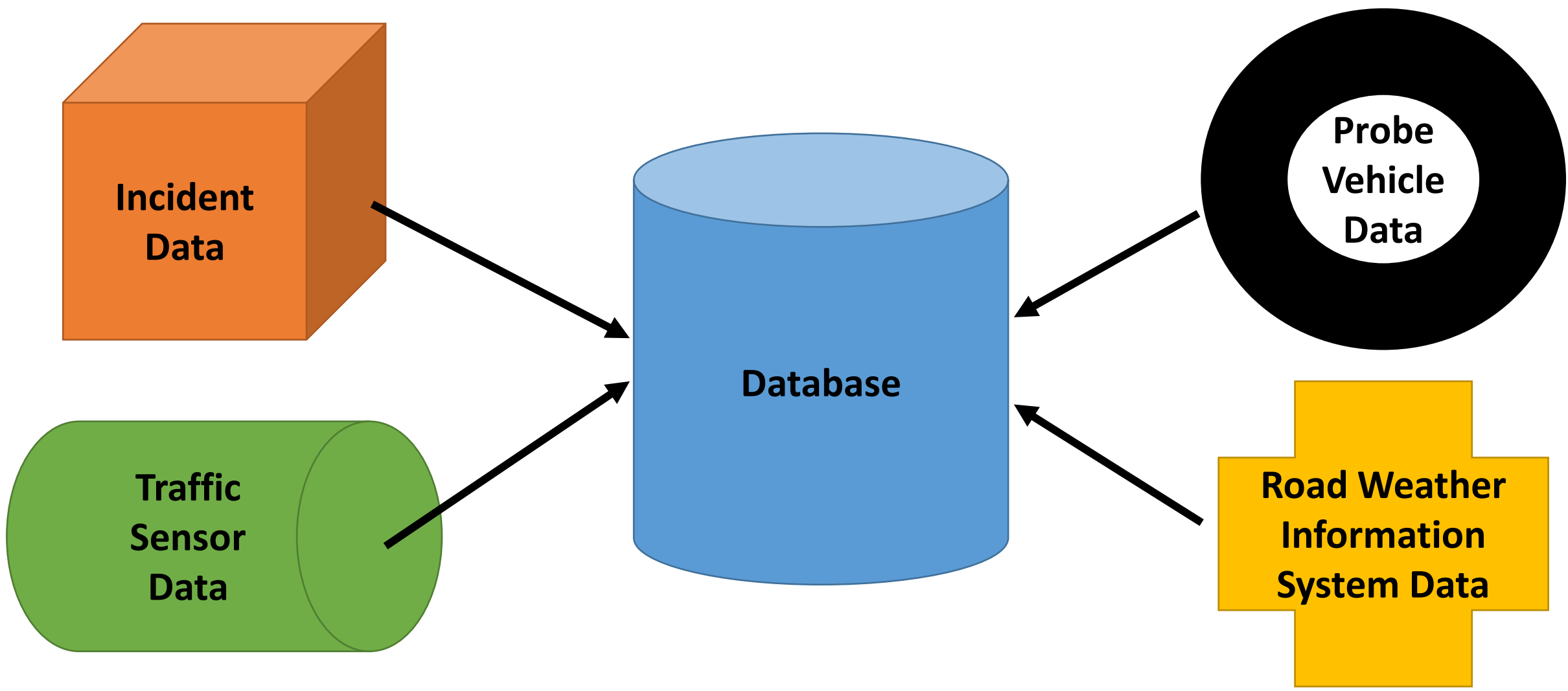
MD SHA CHART

Challenge #1 – Big Data

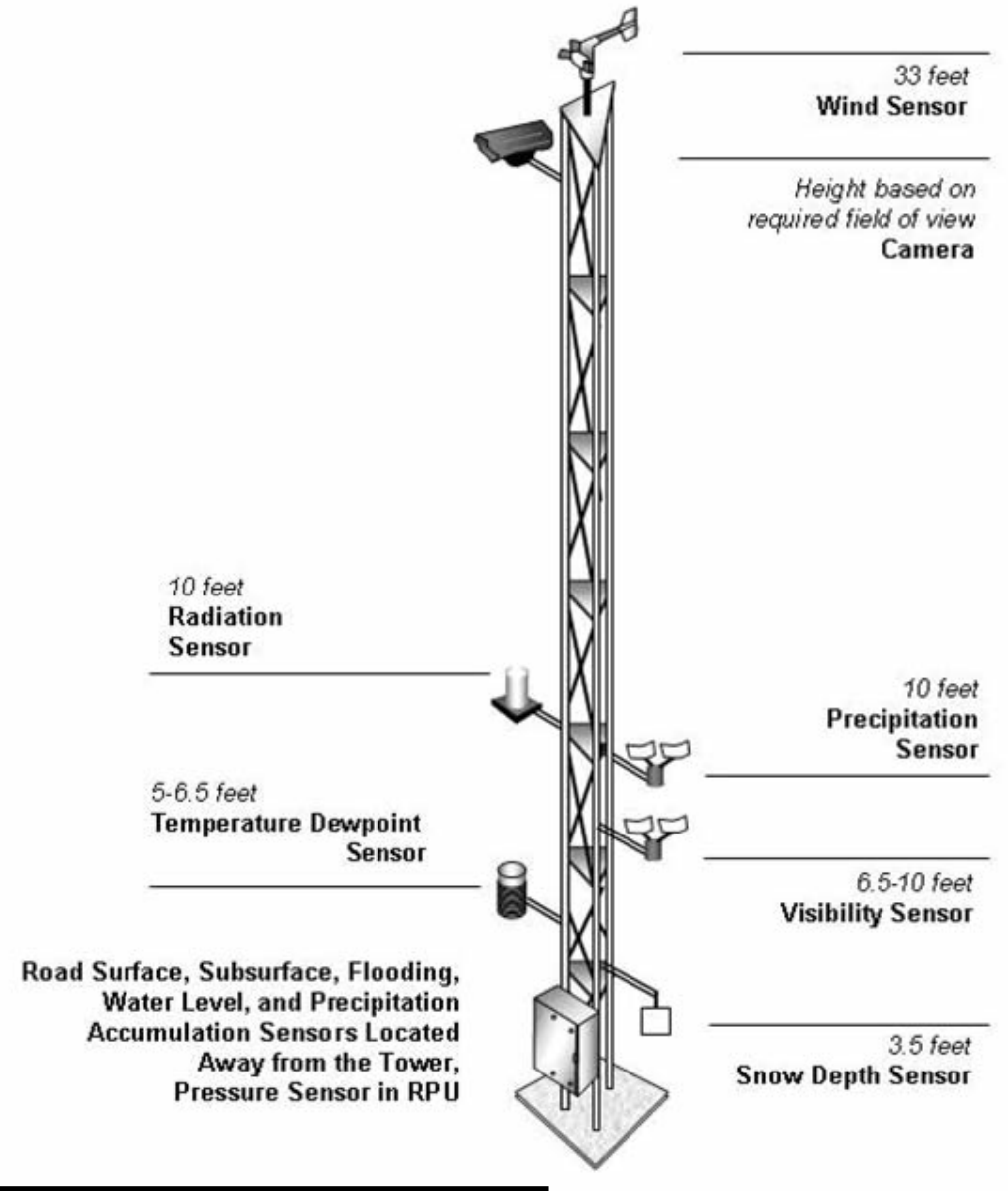
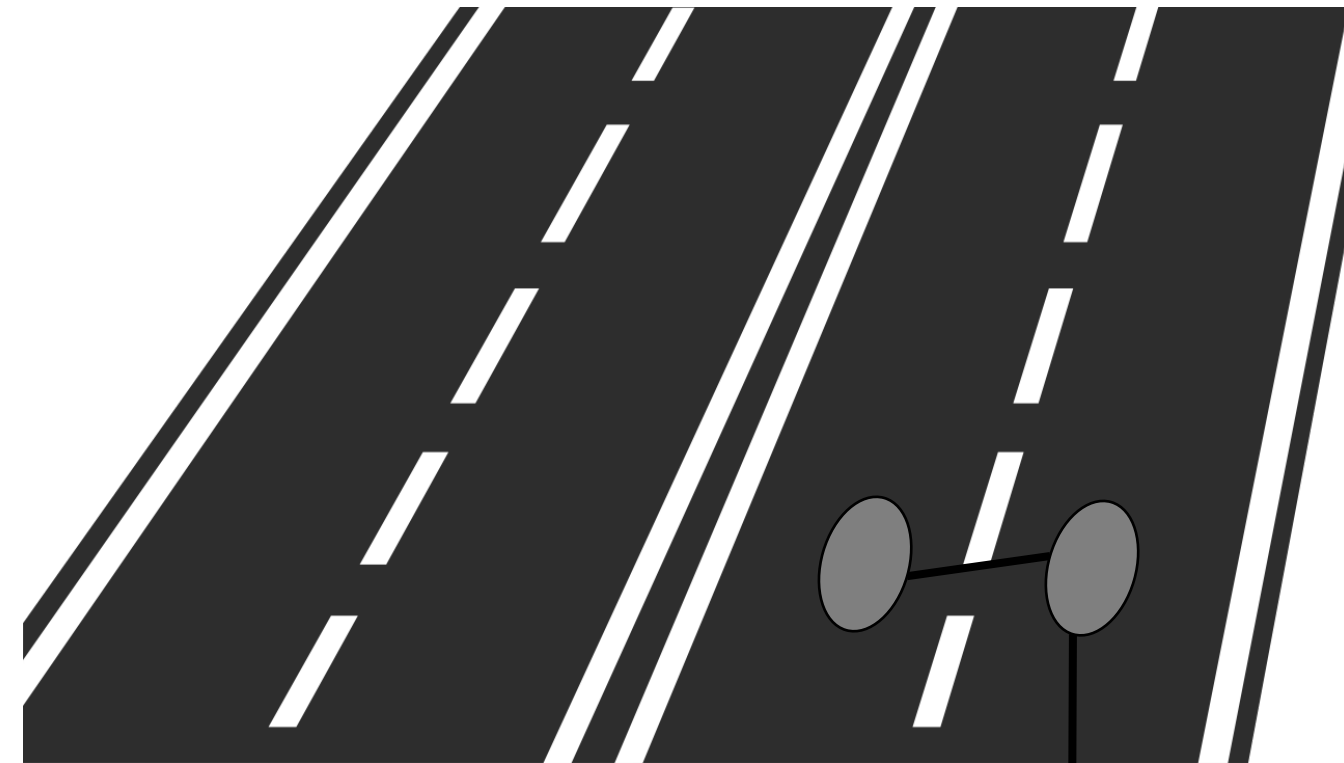
- Traffic accidents: 40,000 records per day: 0.001 Gb/day
- Traffic detectors: 35,000,000 records per day: 5 Gb/day
- Probe vehicle data: 4,200,000,000 records per day: 550 Gb/day
- CCTV, weather, radio, etc: NO,STA,TSK,EPT records per day: ??? Tb/day
- V2X & Automation data: ?,???,???,???,??? records per day: ??? ?b/day



Challenge #2 – Disparate Data Formats



What is RWIS?



Why Does it Matter?

Road Weather Conditions	Weather-Related Crash Statistics		
	Annual Rates (Approximately)	Percentages	
Wet Pavement	1,170,000 crashes	18% of vehicle crashes	75% of weather-related crashes
	544,700 persons injured	17% of crash injuries	81% of weather-related crash injuries
	5,700 persons killed	13% of crash fatalities	77% of weather-related crash fatalities
Rain	739,200 crashes	12% of vehicle crashes	47% of weather-related crashes
	357,300 persons injured	11% of crash injuries	53% of weather-related crash injuries
	3,400 persons killed	8% of crash fatalities	47% of weather-related crash fatalities
Snow/Sleet	232,600 crashes	4% of vehicle crashes	15% of weather-related crashes
	75,700 persons injured	2% of crash injuries	11% of weather-related crash injuries
	900 persons killed	2% of crash fatalities	12% of weather-related crash fatalities
Icy Pavement	197,300 crashes	3% of vehicle crashes	13% of weather-related crashes
	67,300 persons injured	2% of crash injuries	10% of weather-related crash injuries
	700 persons killed	2% of crash fatalities	10% of weather-related crash fatalities
Snow/Slushy Pavement	168,400 crashes	3% of vehicle crashes	11% of weather-related crashes
	49,500 persons injured	2% of crash injuries	7% of weather-related crash injuries
	600 persons killed	2% of crash fatalities	9% of weather-related crash fatalities
Fog	38,700 crashes	1% of vehicle crashes	2% of weather-related crashes
	16,300 persons injured	1% of crash injuries	2% of weather-related crash injuries
	600 persons killed	2% of crash fatalities	9% of weather-related crash fatalities
Weather-Related *	1,561,400 crashes	24% of vehicle crashes	
	673,200 persons injured	22% of crash injuries	
	7,400 persons killed	17% of crash fatalities	

What Can Be Done?

Road Weather Variables	Roadway Impacts	Traffic Flow Impacts	Operational Impacts
Air temperature and humidity	N/A	N/A	<ul style="list-style-type: none"> ▪ Road treatment strategy (e.g., snow and ice control) ▪ Construction planning (e.g., paving and striping)
Wind speed	<ul style="list-style-type: none"> ▪ Visibility distance (due to blowing snow, dust) ▪ Lane obstruction (due to wind-blown snow, debris) 	<ul style="list-style-type: none"> ▪ Traffic speed ▪ Travel time delay ▪ Accident risk 	<ul style="list-style-type: none"> ▪ Vehicle performance (e.g., stability) ▪ Access control (e.g., restrict vehicle type, close road) ▪ Evacuation decision support
Precipitation (type, rate, start/end times)	<ul style="list-style-type: none"> ▪ Visibility distance ▪ Pavement friction ▪ Lane obstruction 	<ul style="list-style-type: none"> ▪ Roadway capacity ▪ Traffic speed ▪ Travel time delay ▪ Accident risk 	<ul style="list-style-type: none"> ▪ Vehicle performance (e.g., traction) ▪ Driver capabilities/behavior ▪ Road treatment strategy ▪ Traffic signal timing ▪ Speed limit control ▪ Evacuation decision support ▪ Institutional coordination
Fog	<ul style="list-style-type: none"> ▪ Visibility distance 	<ul style="list-style-type: none"> ▪ Traffic speed ▪ Speed variance ▪ Travel time delay ▪ Accident risk 	<ul style="list-style-type: none"> ▪ Driver capabilities/behavior ▪ Road treatment strategy ▪ Access control ▪ Speed limit control
Pavement temperature	<ul style="list-style-type: none"> ▪ Infrastructure damage 	N/A	<ul style="list-style-type: none"> ▪ Road treatment strategy
Pavement condition	<ul style="list-style-type: none"> ▪ Pavement friction ▪ Infrastructure damage 	<ul style="list-style-type: none"> ▪ Roadway capacity ▪ Traffic speed ▪ Travel time delay ▪ Accident risk 	<ul style="list-style-type: none"> ▪ Vehicle performance ▪ Driver capabilities/behavior (e.g., route choice) ▪ Road treatment strategy ▪ Traffic signal timing ▪ Speed limit control
Water level	<ul style="list-style-type: none"> ▪ Lane submersion 	<ul style="list-style-type: none"> ▪ Traffic speed ▪ Travel time delay ▪ Accident risk 	<ul style="list-style-type: none"> ▪ Access control ▪ Evacuation decision support ▪ Institutional coordination

National Weather/Speed/Incident Integration

Applied Filters: Data Source is not equal to WMATA. [Set Filters](#) [Use Night Colors](#) [Fullscreen](#)

Current Conditions Forecast

Show Layer List
Show Unmapped Incidents

Weather Station for Teton Pass

Station 1 of 2
[BACK TO LIST](#) [NEXT](#)

Jun 29, 2014 12:55 PM

PREV

W 1.9 MPH E

Gusts up to 8.1 MPH

Temperature

Air 58°F

Surface 79°F

Next

Road Surface

Surface Status: Dry

Road Salinity: --

Visibility: 1.24mi

Poor ————— High

Precipitation

Rate: 0.00in/h

Accumulated Depth: --

Weather Alert for Lake County

Weather Alert 1 of 9
[PREV](#) [BACK TO LIST](#) [NEXT](#)

Flood Warning issued June 26 at 10:26AM EDT until July 02 at 2:00PM EDT by NWS Chicago

[Display More](#)

INRIX Probe Data

[BACK TO LIST](#) [HERE](#)

US-101 Northbound @ SHORELINE BLVD
 Santa Clara County, CA 94043 (Jun 29, 2014 - 10:06 AM PDT)

Length	Speed	Avg. Speed	Ref. Speed	Conf Score	Travel Time
0.01 mi	65 mph	65 mph	65 mph	High	0:00 min

Click and Drag to Zoom. Double-Click to Reset.

■ Confidence Score

■ Reference Speed

■ Average Speed

■ Speed

Prev (US-101 Sou...) 3 of 16 (US-101 Sou...) Next

Emergency Roadwork

Incident 81 of 88
[PREV](#) [BACK TO LIST](#) [NEXT](#)

MD 225 WEST AT PINE ST
 Charles County, Maryland

-Road Maintenance Operations
 -Emergency

Started: 6/3/2014 8:31 AM
 Updated: 6/3/2014 8:32 AM

West East

[Join Incident Chat Room](#)

Description

CONTACT # 240-299-4950.
 ROADWORK IS ONLY ON THE SHOULDER

MIKE ADVISED HE HAS AN EMERGENCY BLANKET PERMIT. PROVIDED SHA # D5-500029E-2011-2015.

Media
[Add File/Link](#)

Show Legend

MILES

0 50 100 150 200

Jun 29, 2014 - 1:07 PM

Real-Time Situational Awareness

Current Conditions **Forecast**

Injuries Involved

Incident 1 of 96
PREV BACK TO LIST NEXT

I-95 INNER LOOP PRIOR TO EXIT 7 MD 5 BRANCH AVE
Prince Georges County, Maryland

-Injuries Involved
Started: 2/13/2014 7:37 AM
Updated: 2/13/2014 10:04 AM
4 Responders on the Scene
Inner Loop Outer Loop

Description
blue ford md Saa2157
vehicle up righted
TRACTOR TRAILER LOADED WITH FROZEN FOOD
9004 AND OCRI ADVISED

Weather Station for I-495 SB exit 2
Station 1 of 6
PREV BACK TO LIST NEXT

Feb 13, 2014 7:04 AM

Temperature
Air 31°F Surface 20°F

Wind
12.4 MPH
Gusts up to 25.5 MPH

Visibility
1033.5ft

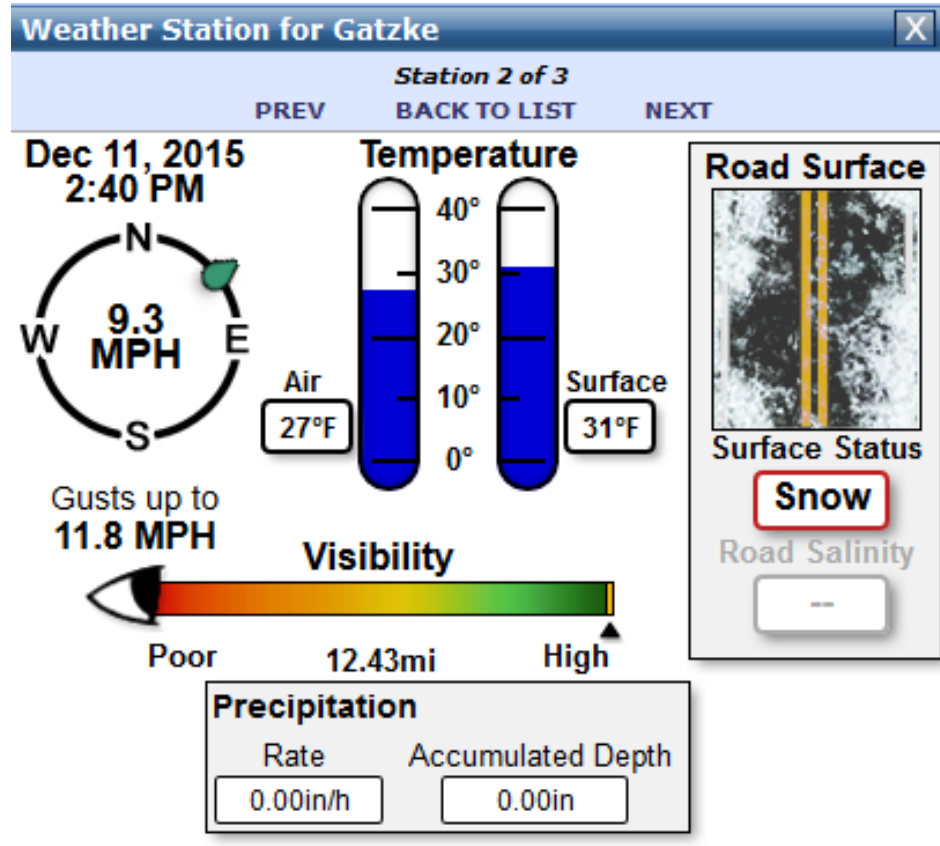
Precipitation
Rate 425.20in/h Accumulated Depth 5.65in

Nearby FITM Plans
I495 Exit 4 to Exit 7
I495 Exit 7 to Exit 9
I495 Exit 9 to Exit 11

Surface Status
Chem
Road Salinity

MILES
0 30 60 90 120

RWIS Measurements



Weather Station for Gatzke
 Station 2 of 3
 PREV BACK TO LIST NEXT

Station Code 330-55
 Contributor MN_State_DOT
 Coordinates 48.4364, -95.731233
 Dec 11, 2015

Observation Type	Time	Value	Complete	Manual	Sensor Range	Climate Range	Step	Like Instrument	Persistence	IQR Spatial	Barnes Spatial	Dew Point	Sea Level/Pressur	Precip Accum
Other														
Pavement Sensor														
Precipitation Sensor														
Pressure Sensor														
Sub Surface Sensor														
Sub-Surface Temperature	2:40 PM	33.8°F	●	●	●	●	●	●	●	●	●	●	●	●
Temperature Sensor														
Air Temperature	2:40 PM	27.32°F	●	●	●	●	●	●	●	●	●	●	●	●
Temperature Sensor Table														
Dew Point Temperature	2:40 PM	24.8°F	●	●	●	●	●	●	●	●	●	●	●	●
Relative Humidity	2:40 PM	87%	●	●	●	●	●	●	●	●	●	●	●	●
Maximum Temperature	2:40 PM	32°F	●	●	●	●	●	●	●	●	●	●	●	●
Minimum Temperature	2:40 PM	26.6°F	●	●	●	●	●	●	●	●	●	●	●	●
Wetbulb Temperature	2:40 PM	26.6°F	●	●	●	●	●	●	●	●	●	●	●	●
Visibility Sensor														
Visibility	2:40 PM	65616.798ft	●	●	●	●	●	●	●	●	●	●	●	●
Wind Sensor														

Relationship View

Station [Back to station map](#)

I-83 @ I-695

August 24, 2011  September 7, 2011

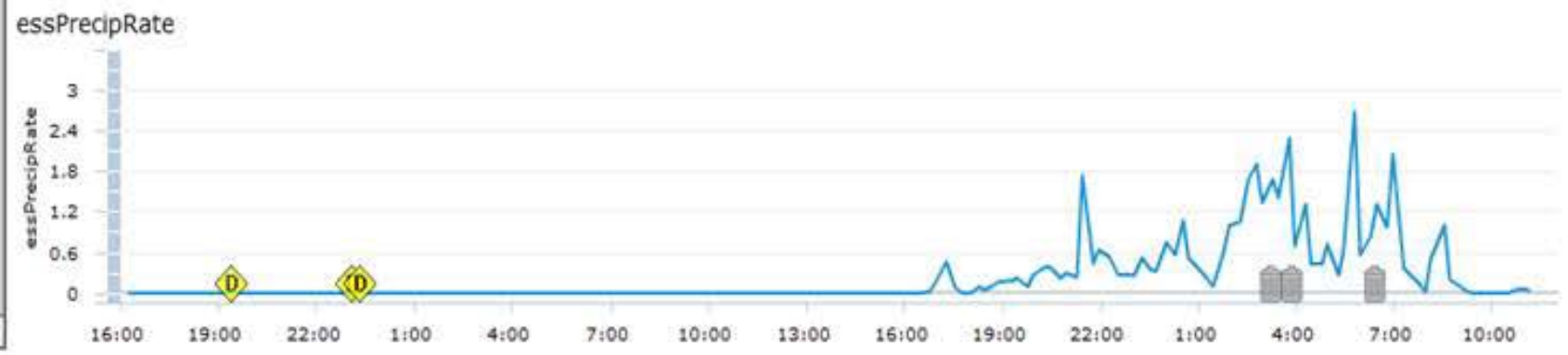
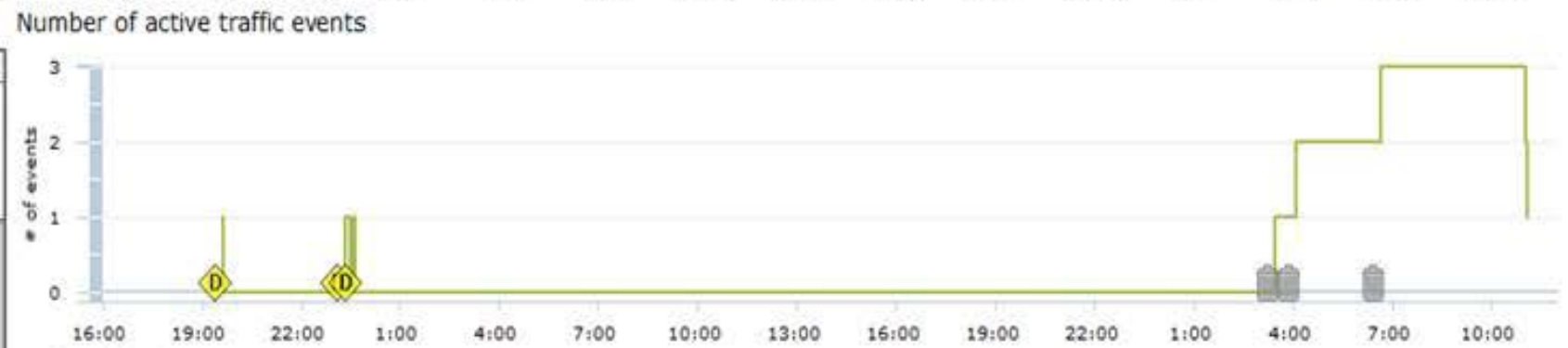


Data for station I-83 @ I-695 between August 26 12:00 PM and August 28 8:00 AM



Observation

- Speed
- Traffic events
- essAdjacentSnowDepth
- essAirTemperature
- essAtmosphericPressure
- essDewpointTemp
- essIceThickness
- essInstantaneousSolarRadiation
- essMaxTemp
- essMinTemp
- essMobileFriction
- essPavementSensorError
- essPavementTemperature
- essPrecipRate



Learning Outcomes

- Understand the importance of RWIS data integration for operations.
- Discuss use of technology to improve winter weather operations.
- Explore other uses of RWIS data in combination with other data sources.



Thank You!

Nikola Ivanov

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301-405-3626