How Crowds, Clouds and Cars are Improving Transportation System Management, Operations, Planning and Performance Measurement

Rick Schuman – October 23, 2014

INRIX

The INRIX Solution

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INRIX Driving Intelligence Platform

Driving a Revolution in Big Data & Analytics around the Movement of Things

Massive Input Data

- Consumer vehicle GPS data
- Historical traffic data
- Fleet data
- Parking data
- Mobile data
- Incident data
- Event data
- Road sensors
- Weather data
- Cell Tower Data

Technology Platform

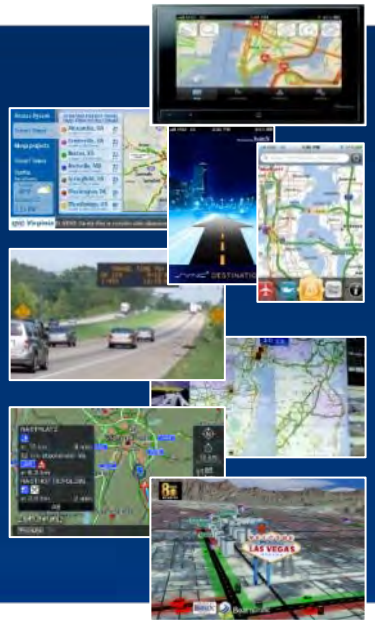
Applications & Solutions

UBIQUITOUS

ACCURATE

PREDICTIVE

ACTIONABLE



- Over 600 different providers
- 1.75B data points per day ingested
- Supporting over 1 Billion API calls per month
- Processing petabytes of data
- Delivering to cars, devices and analytics portals in <50 seconds

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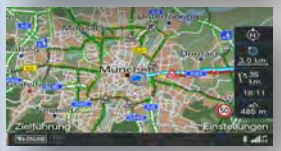
Solutions Across Multiple Vertical Markets

Differentiated Product Offerings Tailored to Specific Vertical Needs

Automotive Suite

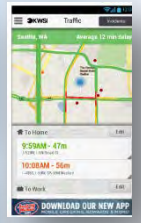
Cloud-based traffic information & personalized driver services globally

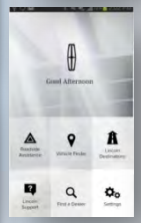




Mobile & Internet Suite

Traffic insights anytime, anywhere via mobile apps & services





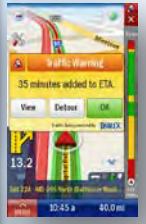

Public Sector Suite

Traffic platform for planning, analysis and operations of road networks



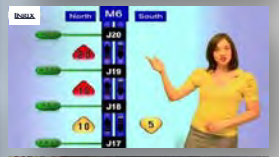
Fleet & Commercial Suite

Traffic, driver behavior & route intelligence



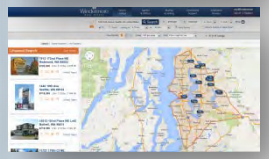

Media Suite

Real-time & predictive traffic and congestion info for broadcast media


Enterprise Suite

Investment decisions based on traffic analytics

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Today's Global Leader

INRIX Connected Driver Network

The Largest Driver Network in the World – 175M and Growing

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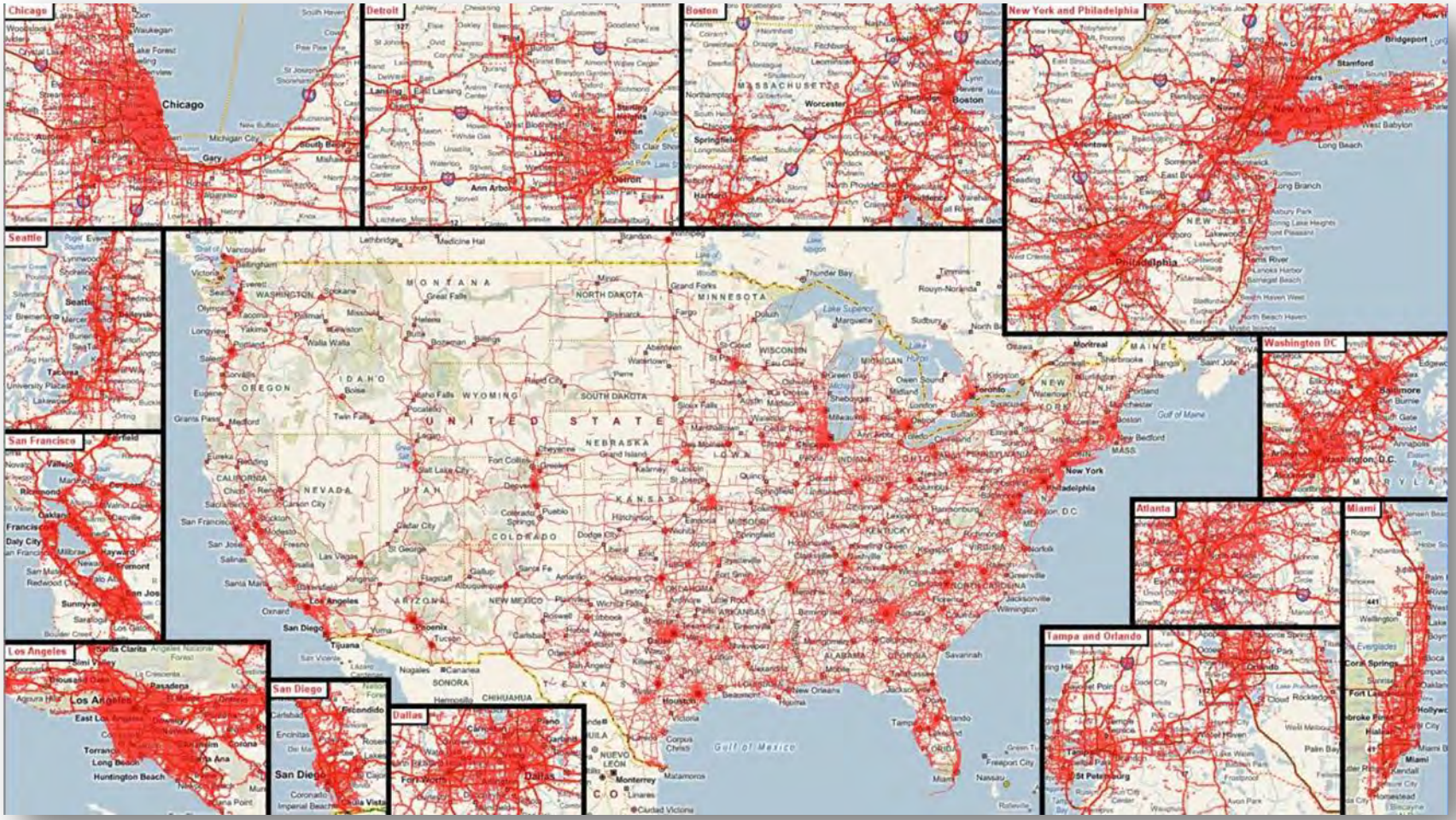
INRIX Connected Driver Network

North America, Spring 2010



Examples of 15-Minute Real-Time Snapshots

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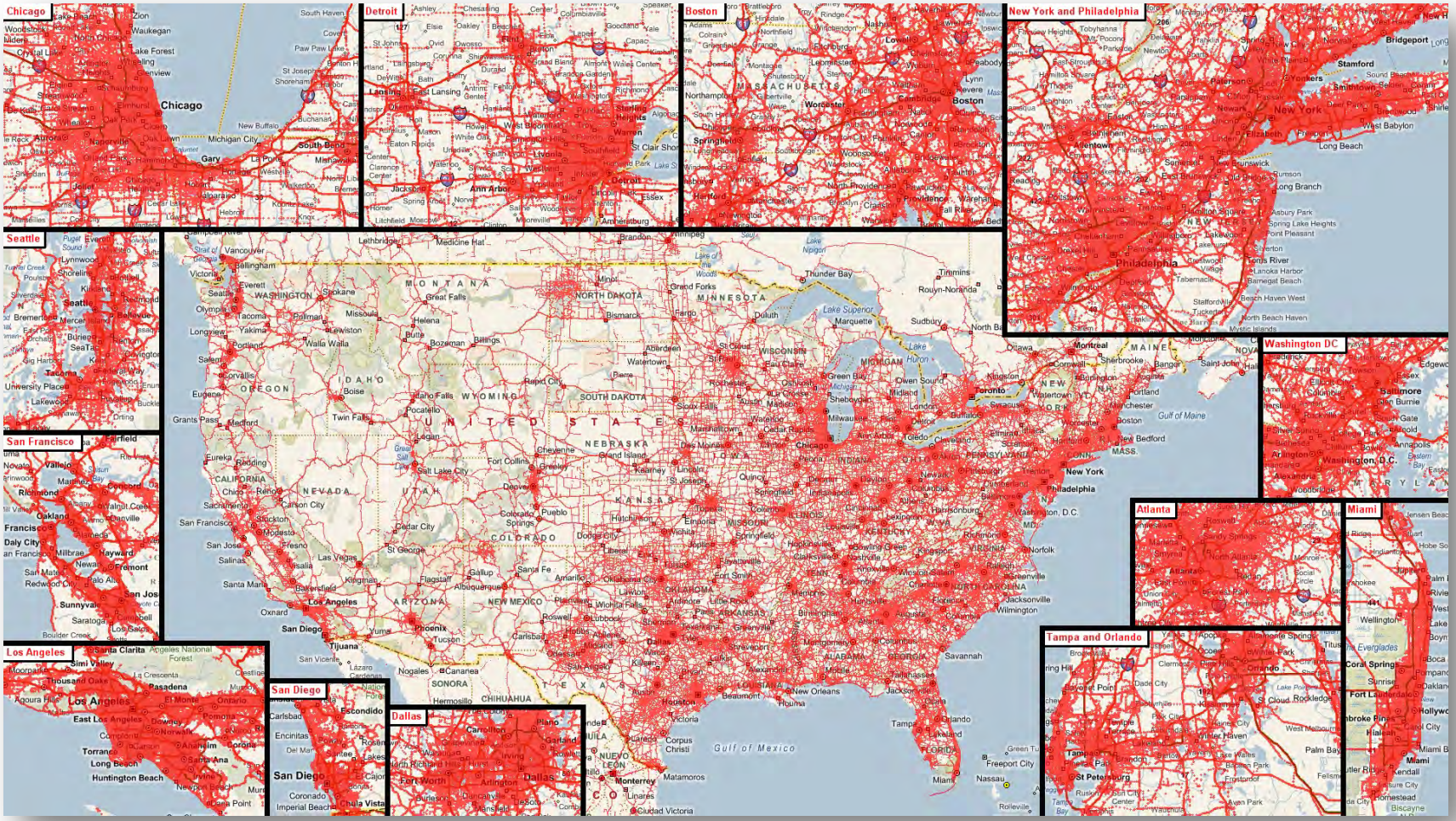
INRIX Connected Driver Network

North America, Spring 2014



Examples of 15-Minute Real-Time Snapshots

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Quality

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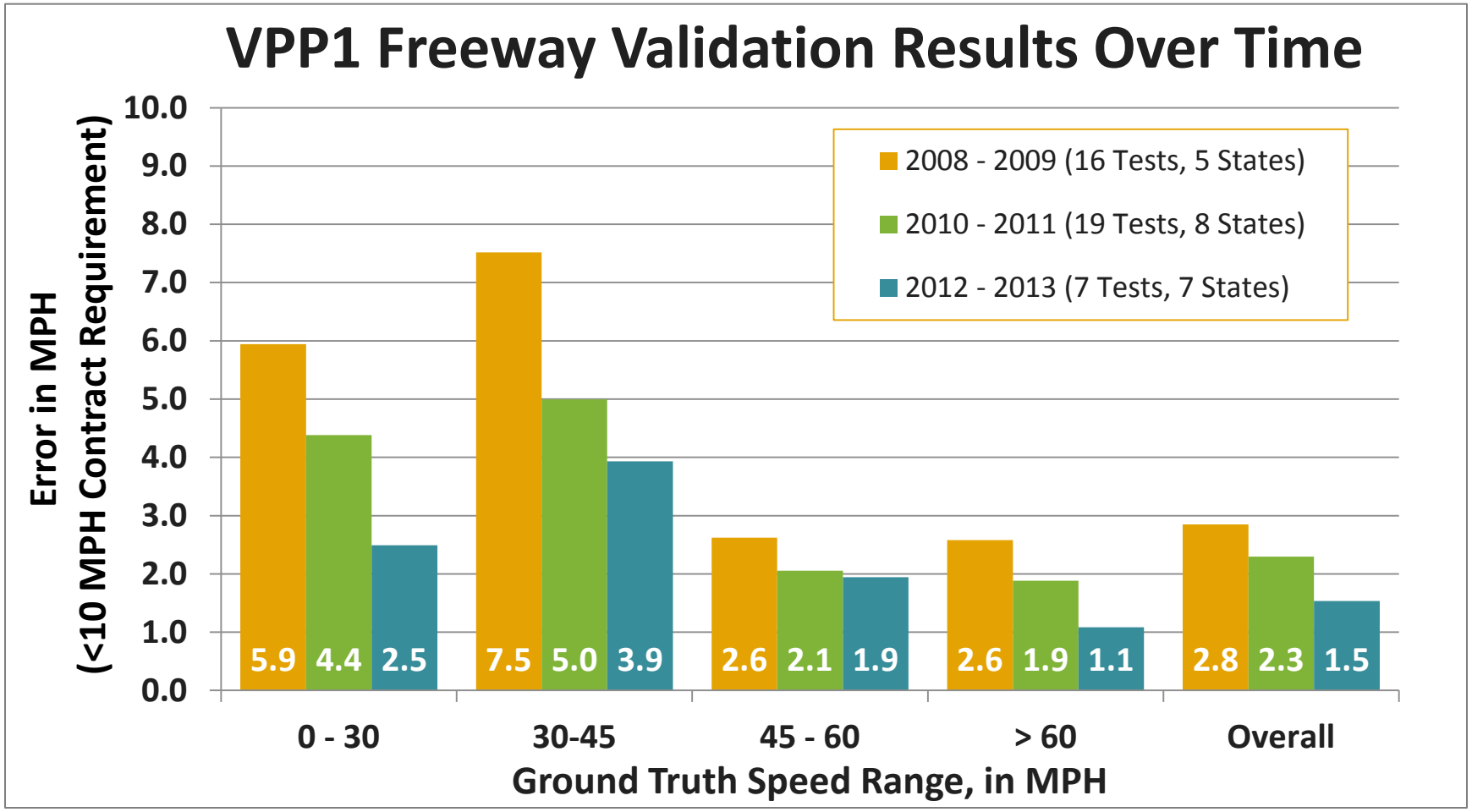
INRIX Quality Statement

On average, 20 million separate quality checks are made around the globe

- **Solving Traffic Everywhere** is the INRIX goal. Delivering the most accurate, most granular information directly to drivers
- Proven highest **automotive-grade quality** as selected by BMW, Audi, Ford and 200 other customers
- INRIX uses a proprietary **Quality Engine** to measure traffic flow quality globally, combined with a program of customer drive tests
- 100% of input data is used to measure quality, meaning INRIX can **validate every** section of road in every country for **every** hour of **every** day.

Today's Accuracy



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INRIX Incident Quality

Common Incident Data Challenges	
Missing Incident Detail & Specificity	Detail is not provided or incident message is incomplete or meaningless
High Latency	Data is often up to an hour late, even if correctly captured
Poor Geo-Referencing	Accurate incident locations/descriptions, are not linked to other known data sources such as traffic flow
Limited Coverage	Strong coverage in urban areas, but little coverage on arterial roads or on rural roads
Missing Road Closures	Planned and unplanned closures (and re-openings) are often missed completely resulting in routing directly into closed roads

INRIX XD Incidents

Superior & Highly Adaptive Data Set

Unrivaled Coverage

Accurate Road Closures

Road Coverage

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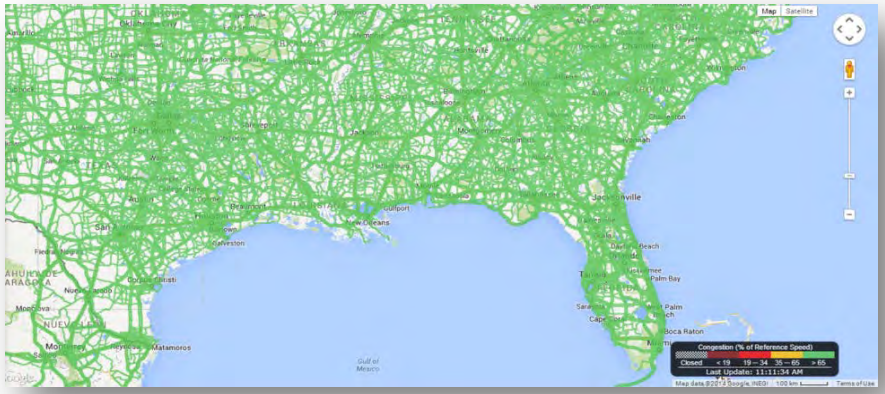
INRIX Road Coverage Options

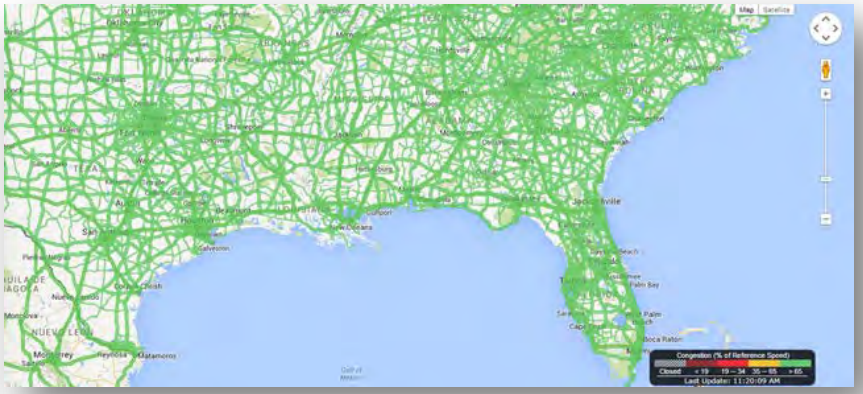
TMC Segments

- Original Reporting
- Not designed for traffic reporting
- Quasi-standard (sort of)
- Issues: Gaps, overlaps, long segments, new roads
- Data archive from 2009

INRIX XD™ Segments

- Similar to TMC Segments
- Designed for traffic reporting
- Designed for easy integration
- More coverage, granularity
- Addresses TMC shortcomings
- Data archive from 2014





Segment = Virtual Sensor

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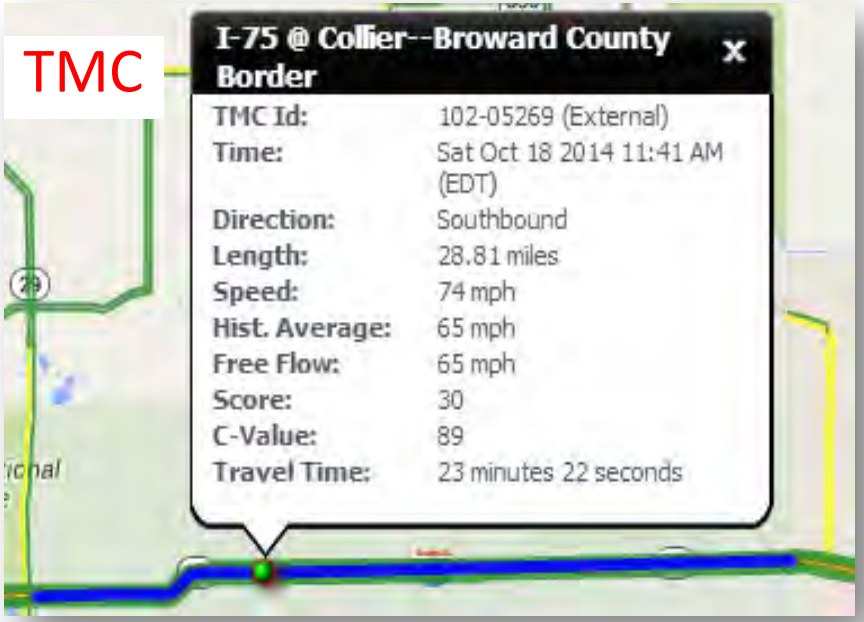
INRIX XD™ Segments

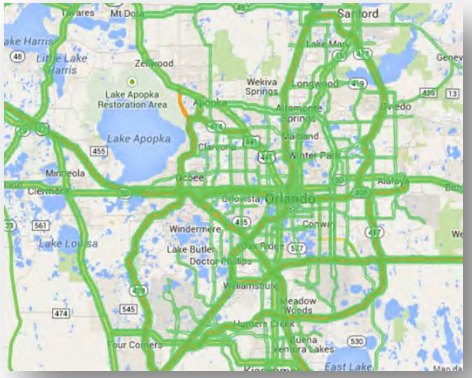
- Fixed segments, fully populated data, updated every minute
- Agency option to use TMC segment sets, XD segments sets or Hybrid sets
- TMC and XD Sets pre-defined and/or can be defined by user
- Key Benefits of XD Segments
  - ~25% More Coverage in FL – large increases in ramps and arterials
  - Better segment granularity – typical segment length ~1 mile (1.7 mile max)
  - Sub-segment granularity optional – data and tiles



Segment Statistics - Florida

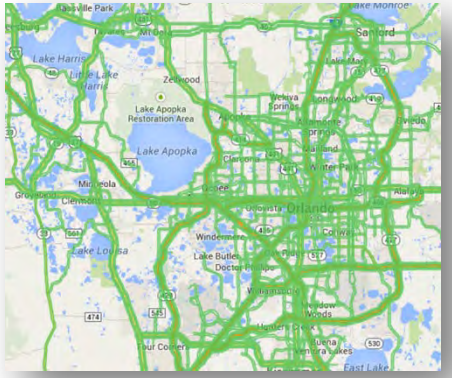
TMC

- Freeways
  - ~3300 virtual sensors
  - ~2230 miles
- Interchanges
  - ~400 virtual sensors
  - ~90 miles
- Arterials
  - ~30,000 virtual sensors
  - ~15,000 miles
- **Total**
  - **~33,000 virtual sensors**
  - **~17,800 miles**



XD™

- Freeways
  - ~5500 virtual sensors
  - ~2250 miles
- Interchanges
  - ~8300 virtual sensors
  - ~850 miles
- Arterials
  - ~63,000 virtual sensors
  - ~22,000 miles
- **Total**
  - **~77,000 virtual sensors**
  - **~22,300 miles**



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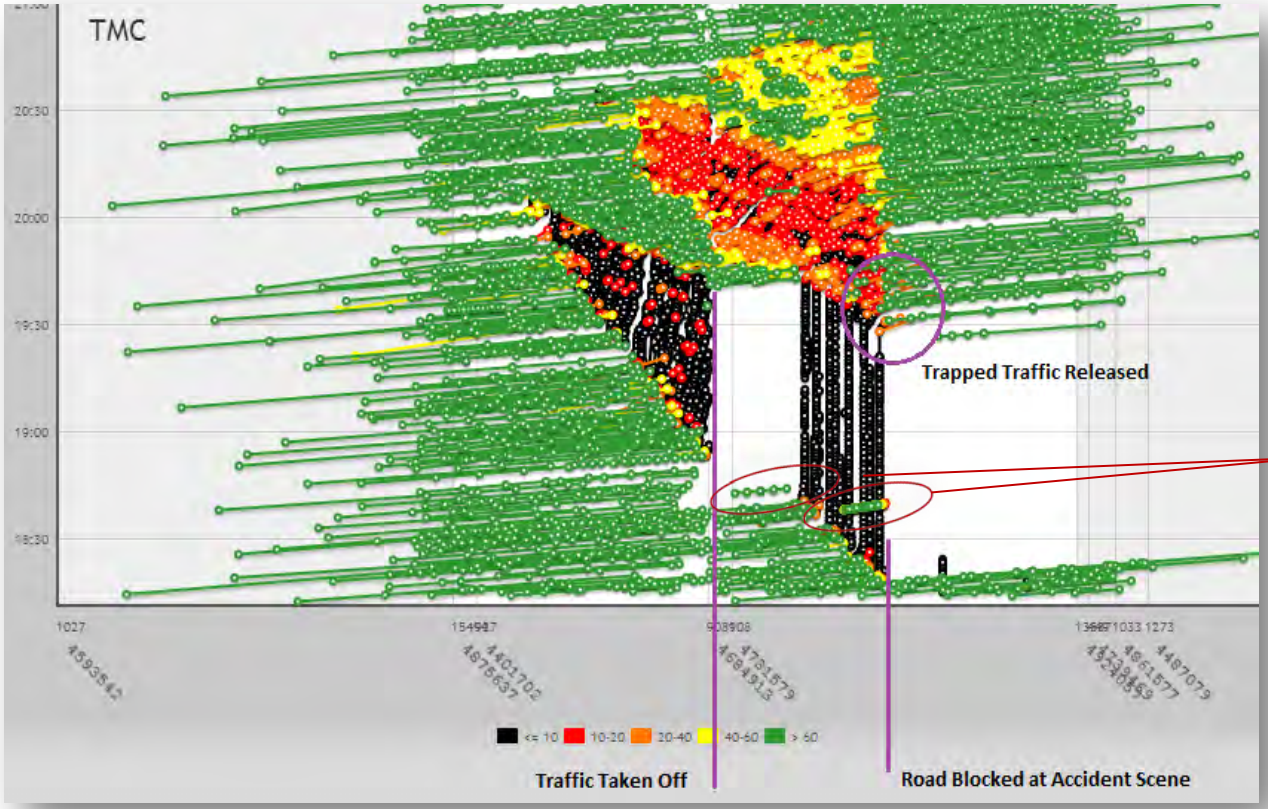
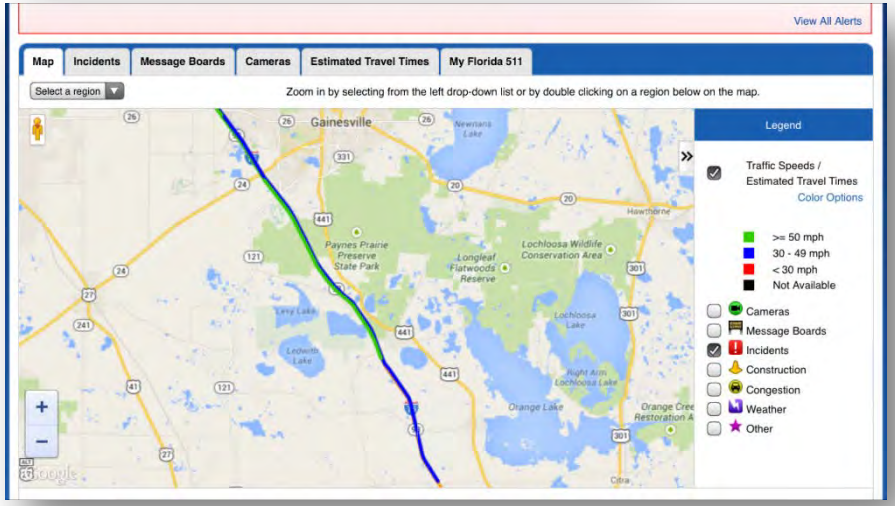
Data Profile – I-75, FL - Aug 04, 2014

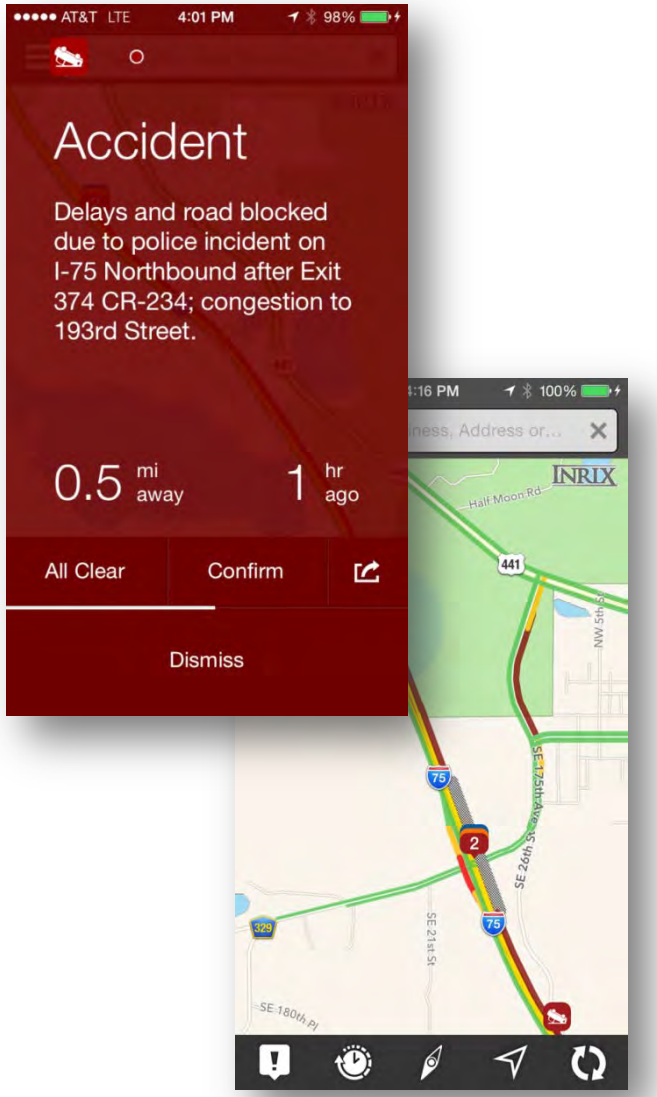
- INRIX historic data shows original incident occurs around 18:20 UTC (14:20 local)
- Accident location is 3.5m upstream of Exit 368 (~ MM372)
- Closure enforced at exit 368 from 14:55 local
- Vehicles take up to 45 minutes queuing to exit, up to 7km/4.5 mile queue
- Trapped traffic is released within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



XD in Action – I-75 August 4, 2014

INRIX Traffic Mobile App shows XD Traffic Data





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Products

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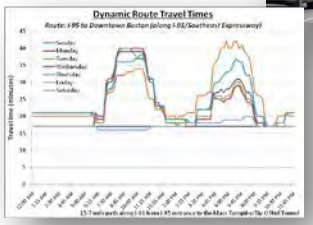
INRIX Public Sector Suite

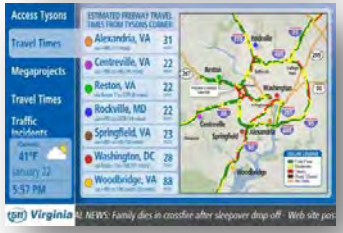
A traffic platform for planning, analysis and operations of road networks

Real Time Traffic

Effectively manage daily roadway traffic

- Traffic Speeds, Travel Times
- Traffic Tiles (Maps)
- Traffic Incidents
- Traffic Cameras
- Drive Time Polygons
- XD Monitoring

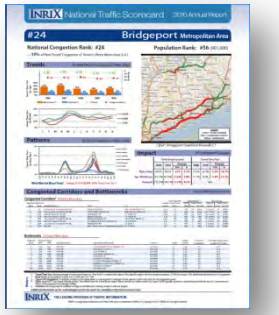




Historical Traffic

Determine how to best leverage infrastructure investments to optimize long term flow

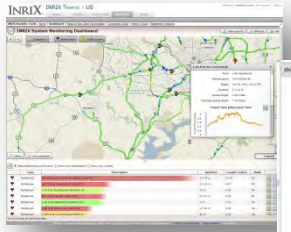
- Traffic/Freight Profiles
- Traffic Data Archive
- OD: Trip Records, Matrices

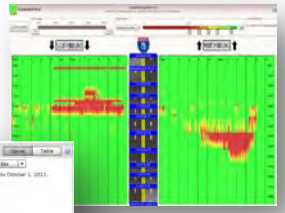


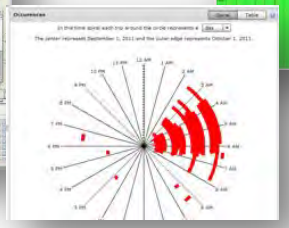
Analytics

Assessing performance of roadways and impact of investments in infrastructure

- Traffic Monitoring Dashboard
- Bottleneck & Congestion Analysis
- Historical Traffic Analysis



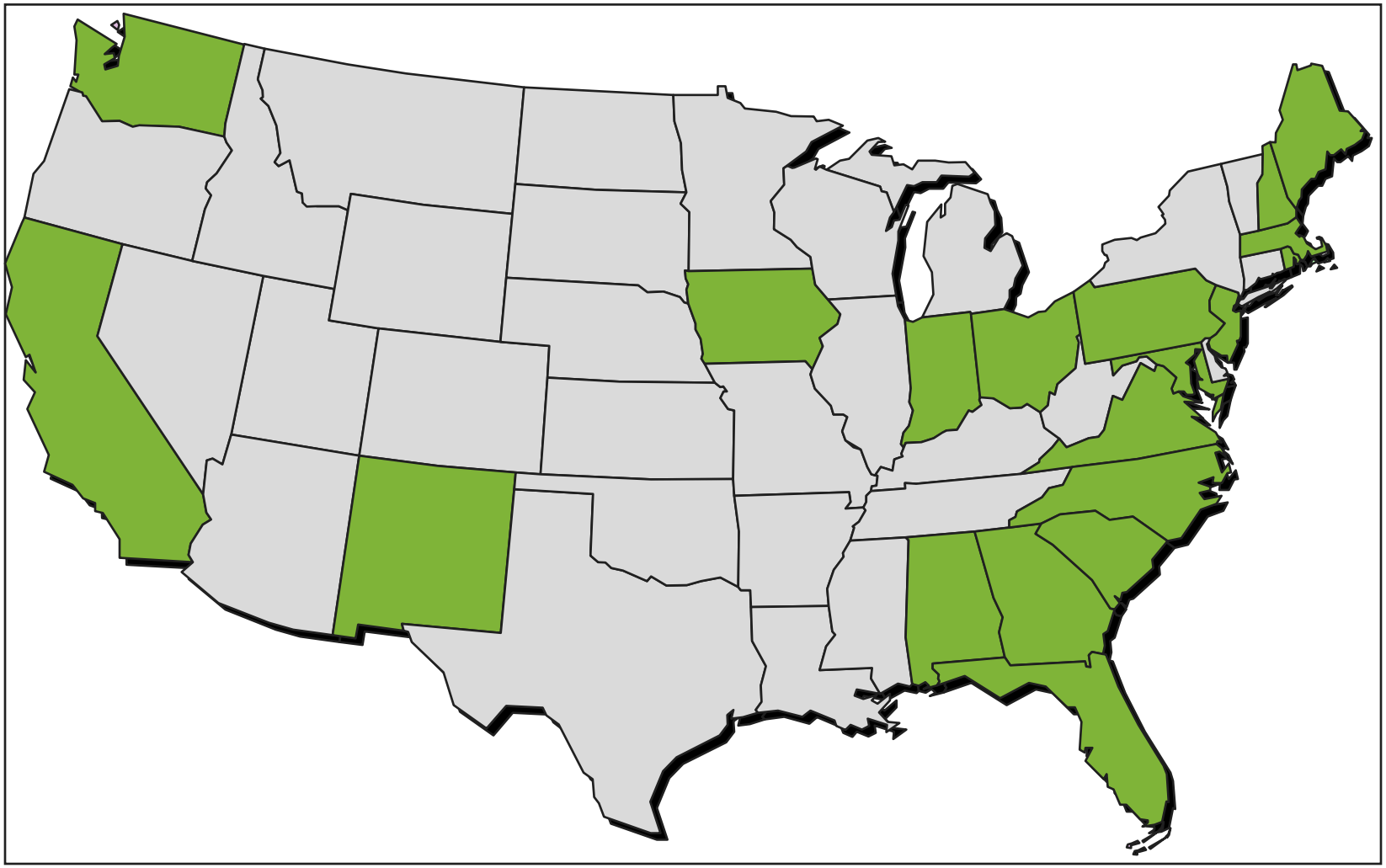




INRIX

19 States with INRIX Data

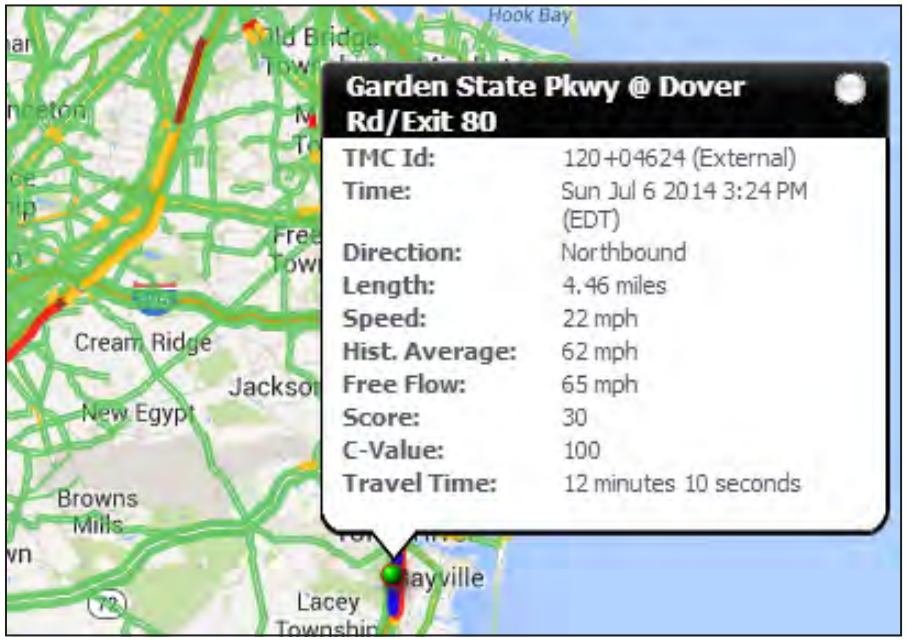
Agencies/ Services Accessing INRIX Real-Time APIs



INRIX

Core Real-Time Data API

- Current Speed/Travel Time data
- Updated every minute
- From current conditions based on input from the INRIX Traffic Intelligence Network
- Reported in Segment Sets (pre-defined or user created)
- Segment sets can be XD, TMC or Hybrid



Field	Definition
TMC Code	Definition of the roadway link
Speed	Current real time speed in MPH on the road segment
Average	Historical average speed in MPH on the road segment. This is the typical speed for the current day of week and hour of day (in 15 minute increments)
Reference	Reference speed in MPH on the road segment. This is the proxy of the free flow or uncongested speed on the roadway, defined as the 85th percentile of calculated speeds throughout the entire day
Delta	Difference between average and current speed on the road segment
Traveltime minutes	Time required to travel across the road segment
Congestion	Level of congestion on the road segment calculated from the ratio between the current speed and the reference speed: • "3" = Free Flow • "2" = Moderate Congestion • "1" = Heavy Congestion • "0" = Stop and Go
Score	This is a score between 10 and 30 that defines how the speed on the road segment was calculated: • "30" = Speed is calculated from real time data only • "20" = Speed is calculated from a blend of real time and typical/average speed on the road segment • "10" = Speed is calculated only from typical/average speed on the road segment
Confidence	This is a rating from 0 to 100% that defines INRIX's confidence on the real time speed on the road segment

Adding "Volume Estimate"

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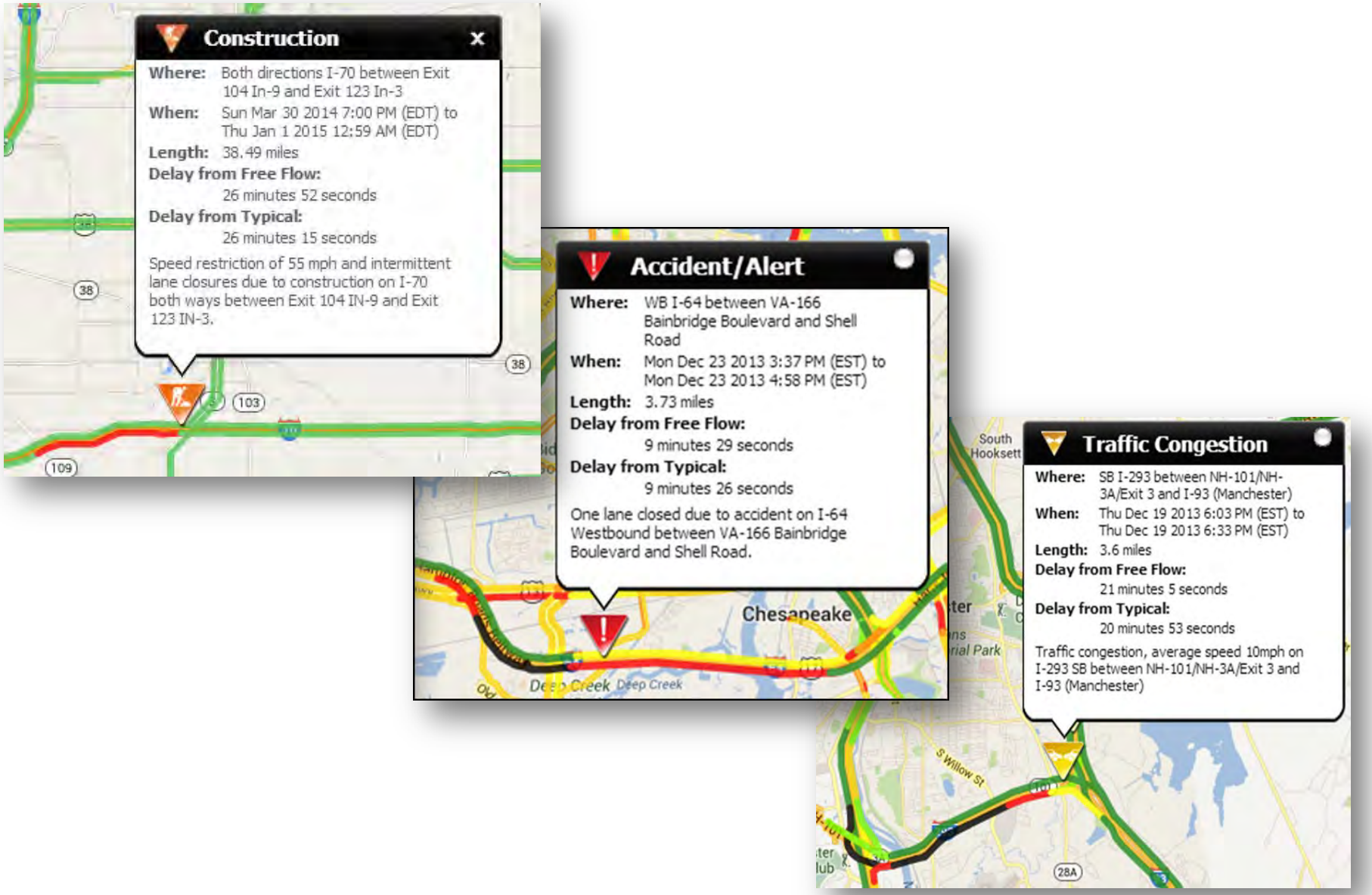
Incident API



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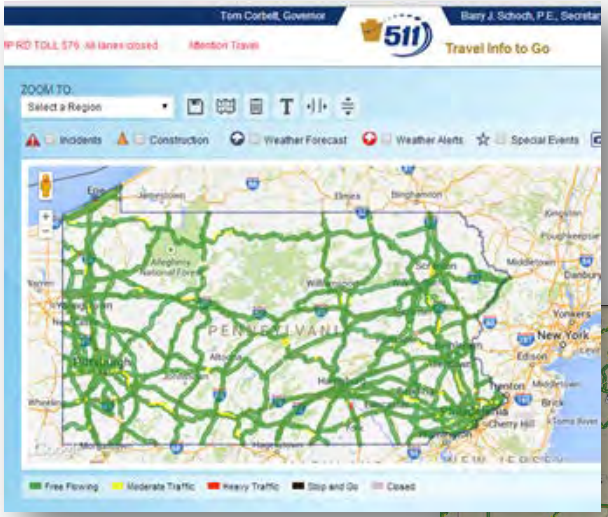
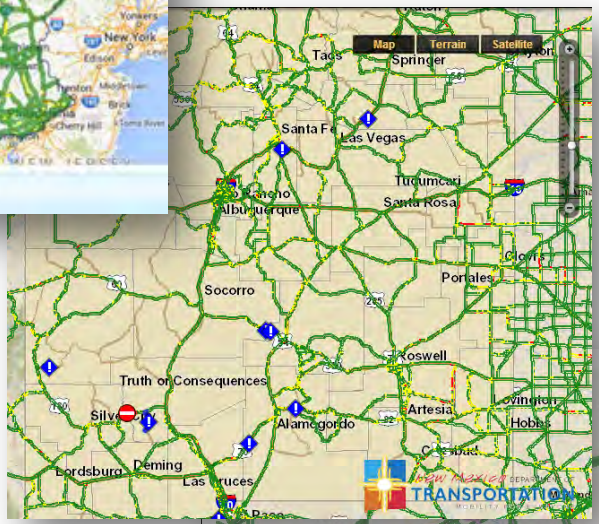
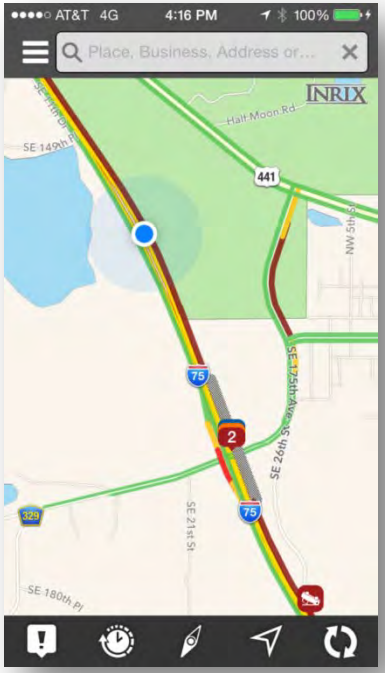
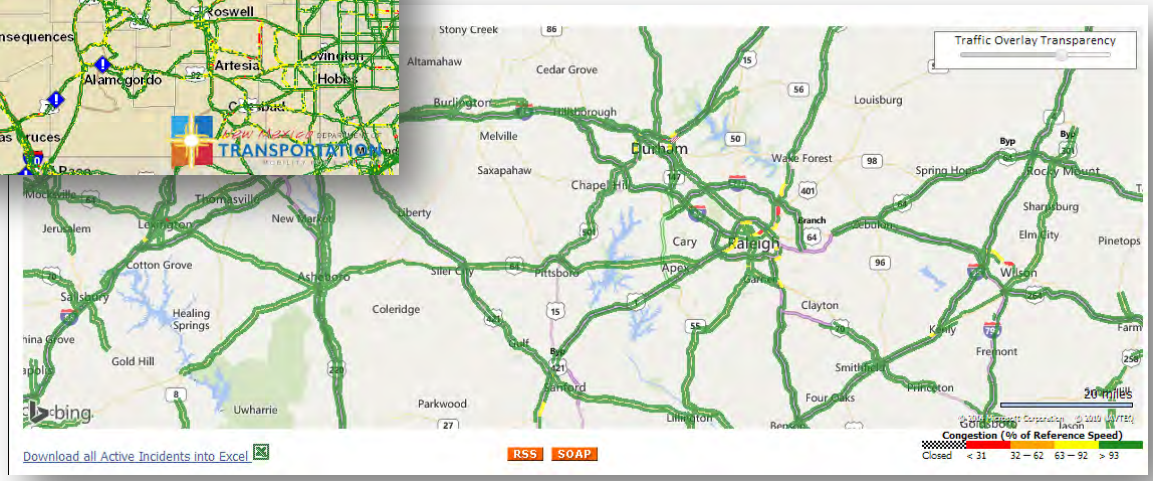
Traffic Maps/Tiles API









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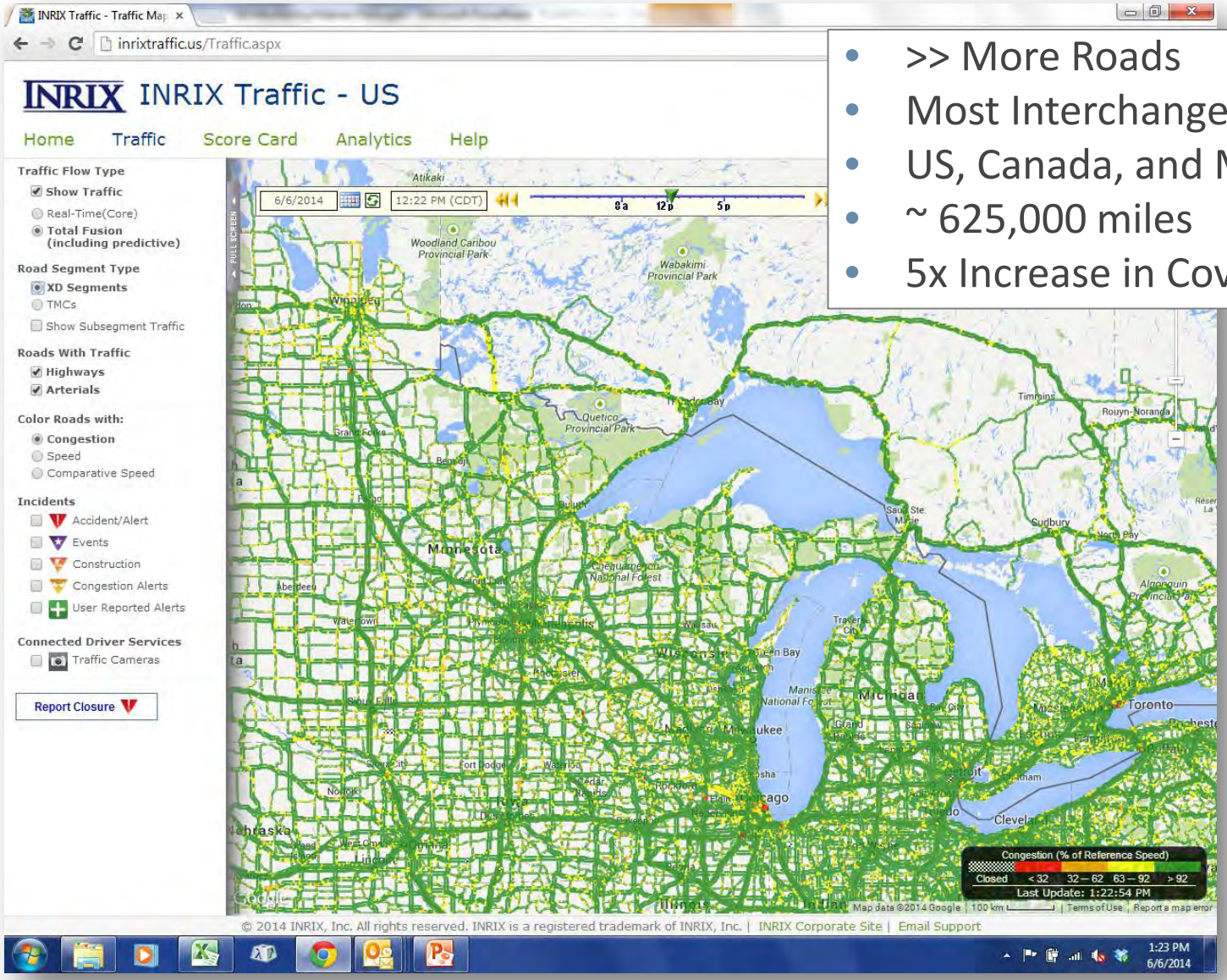
XD Monitoring – Road Coverage



- >> More Roads
- Most Interchange Ramps
- US, Canada, and Mexico
- ~ 625,000 miles
- 5x Increase in Coverage

INRIX Traffic Cameras

Real-Time Images of Traffic Conditions

Key Features

Coverage

- Access to over 30K traffic camera images globally
- Aggregation of feeds from state and local Department of Transportation (DOT)
- Updated every second

Optimization

- Standardized API for mobile or in-vehicle consumption
- Optimized for low bandwidth connectivity

INRIX is giving drivers the choice to visually confirm traffic conditions, in or out of vehicle.

Mercedes-Benz

MAPQUEST

INRIX

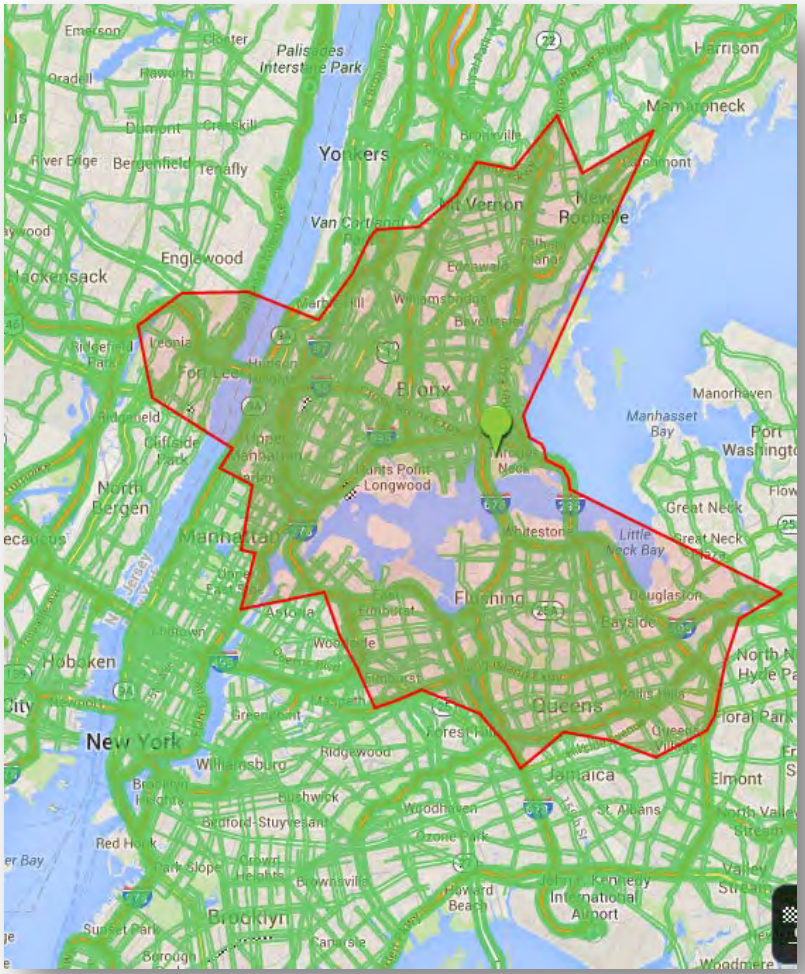
Traffic Cameras

- Nearly 20,000 Cameras
- From 42 states, 238 cities
- Aggregated by INRIX Partner Vizzion
- Always looking to add more

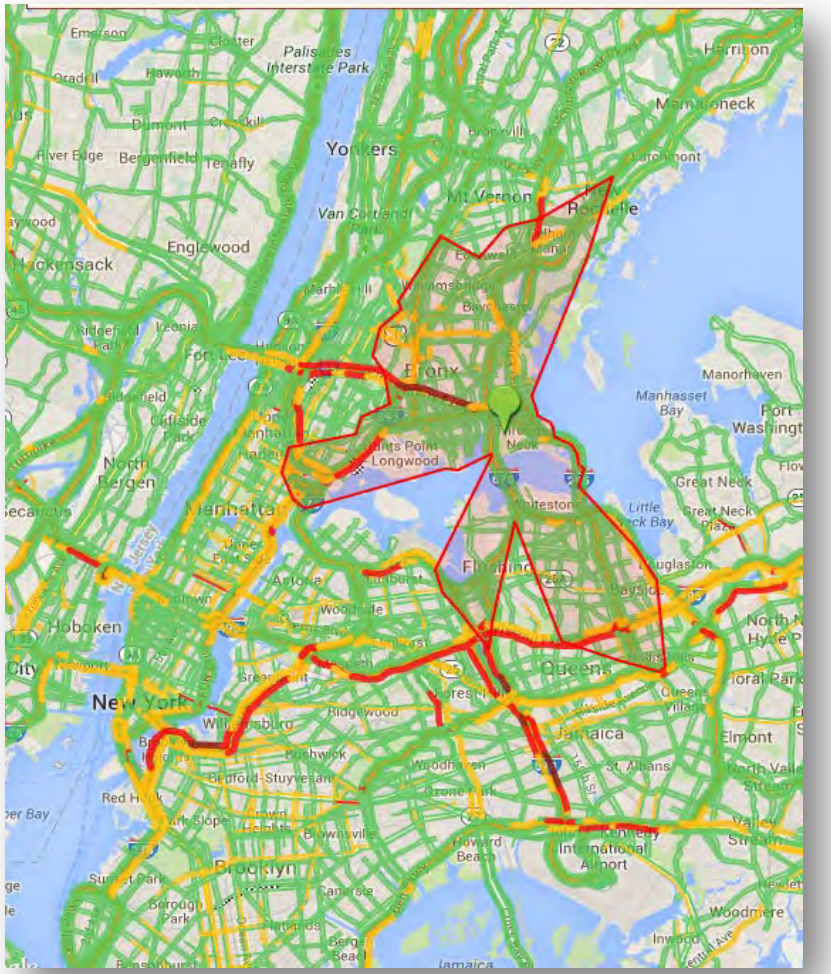
INRIX

Drive Time Polygon API

PM Rush Hour Range



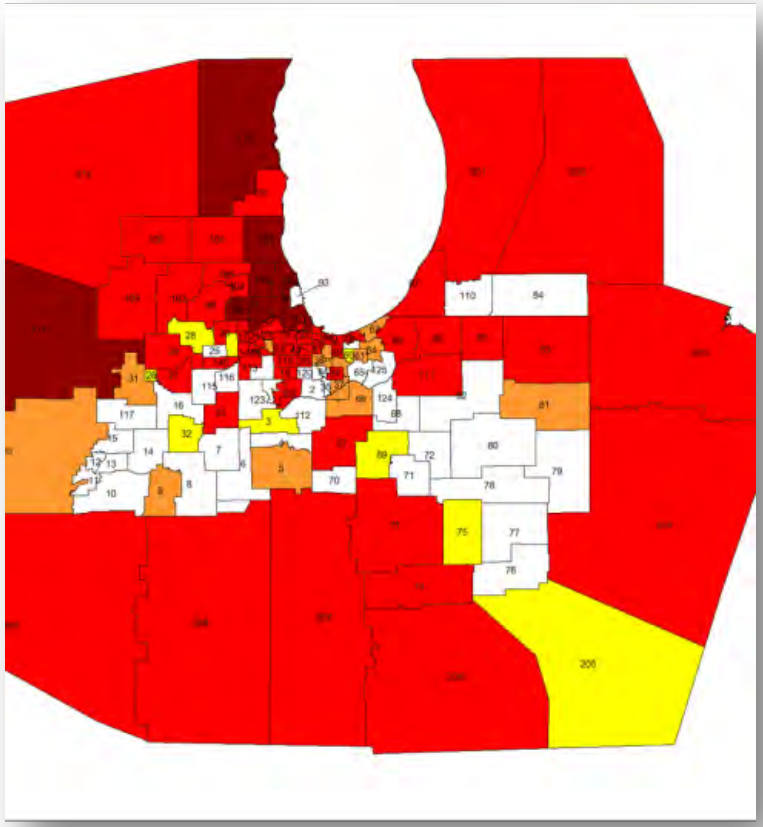
Overnight Range



INRIX

GPS Freight OD: Chicago Freight Study

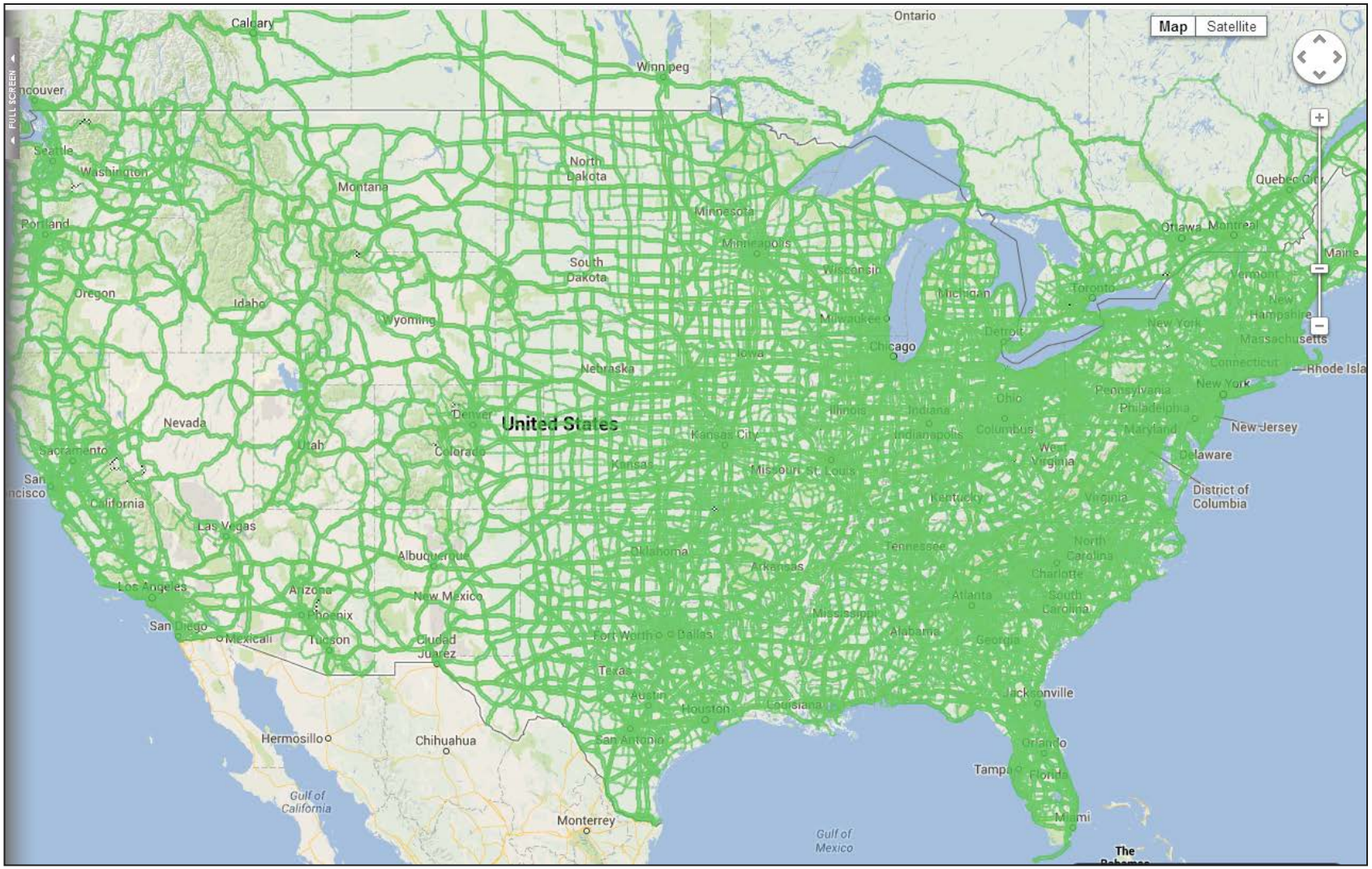
- Study Area:
  - Greater Chicagoland Area, and beyond
  - 154 zones
- Study Period:
  - July – Sept 2013 (3 months)
- Total Data Points Analyzed:
  - ~1.5 billion
- Freights Trips Identified:
  - 4.8 million
- Results provided as OD Matrix



INRIX Analytics – Home Page

INRIX Analytics

1 minute “live” archived data, from January 2011 on 400,000+ miles of US roads



Example Uses of INRIX Data/Tools

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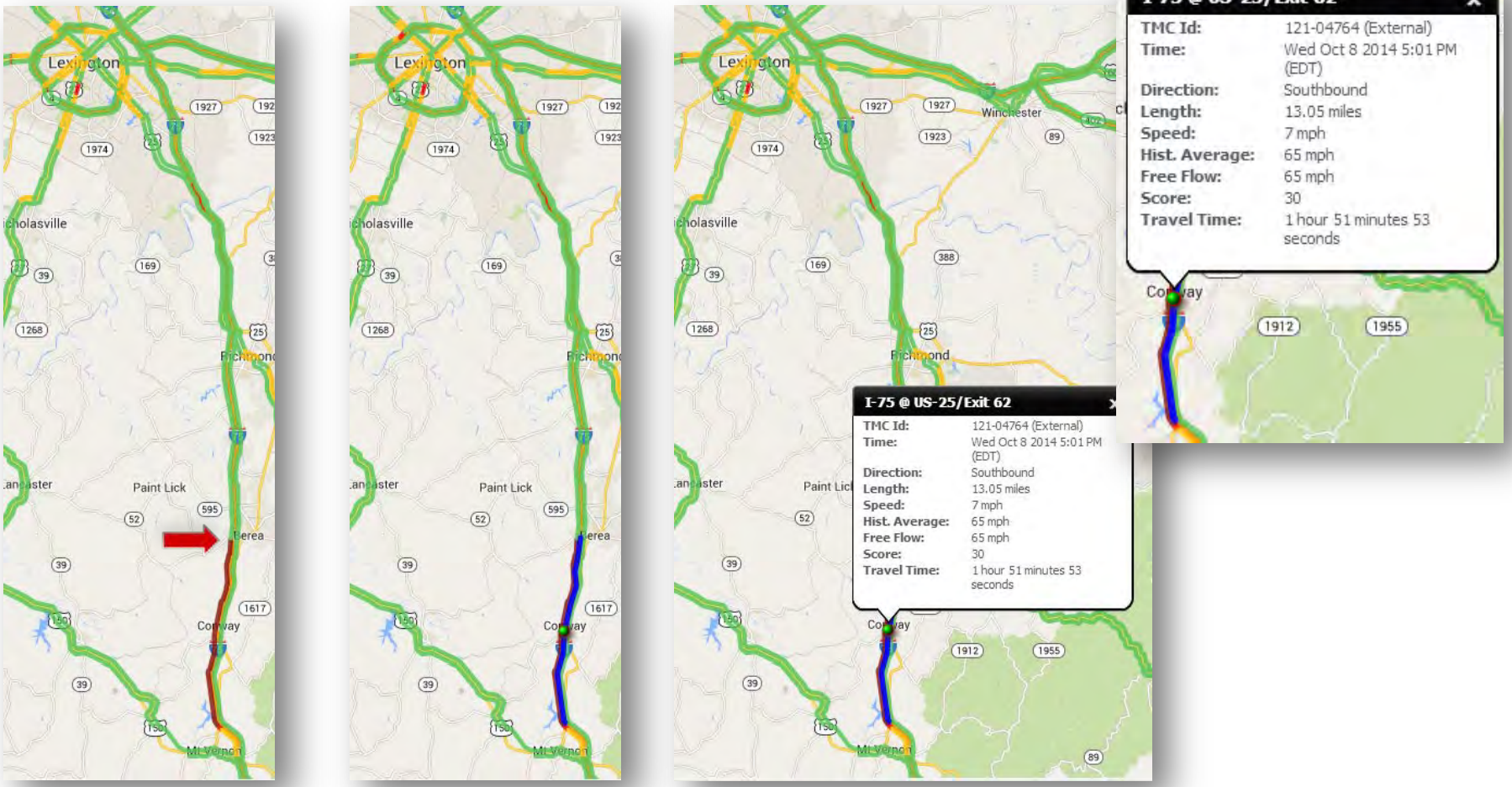
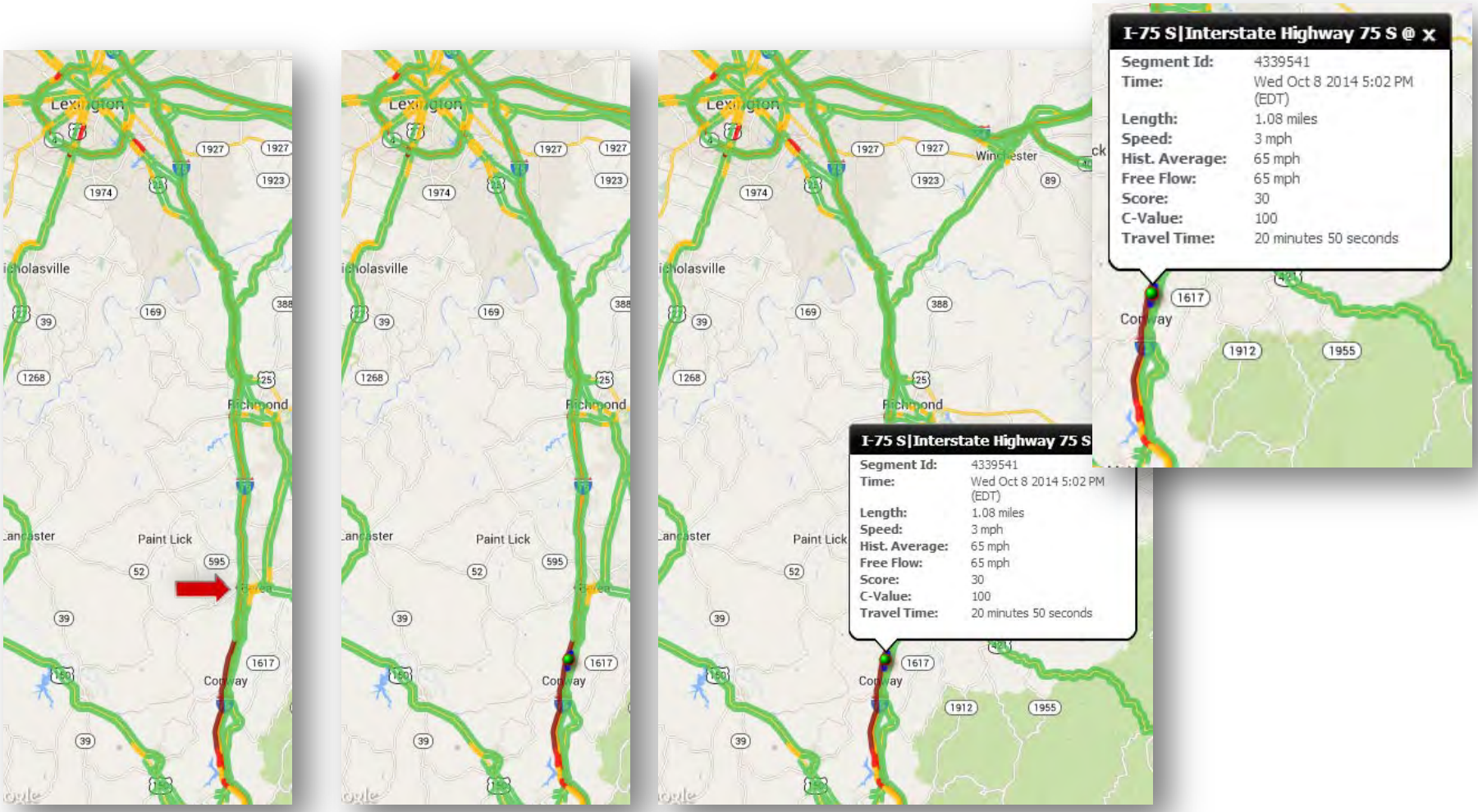
Queue Monitoring – TMC Segments



INRIX

Queue Monitoring – XD Segments



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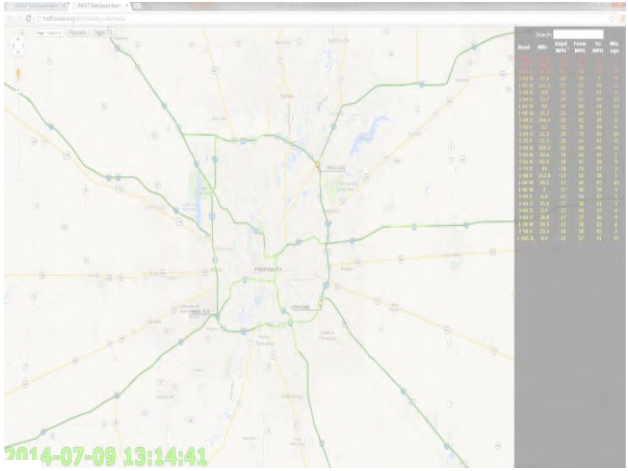
Incident Detection Application

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

Direction of Travel

Segment 2

Segment 3

XD Segments

Real Time Data
(every minute)

70 MPH

68 MPH

35 MPH

Delta Speed

-2 mph

-33 mph

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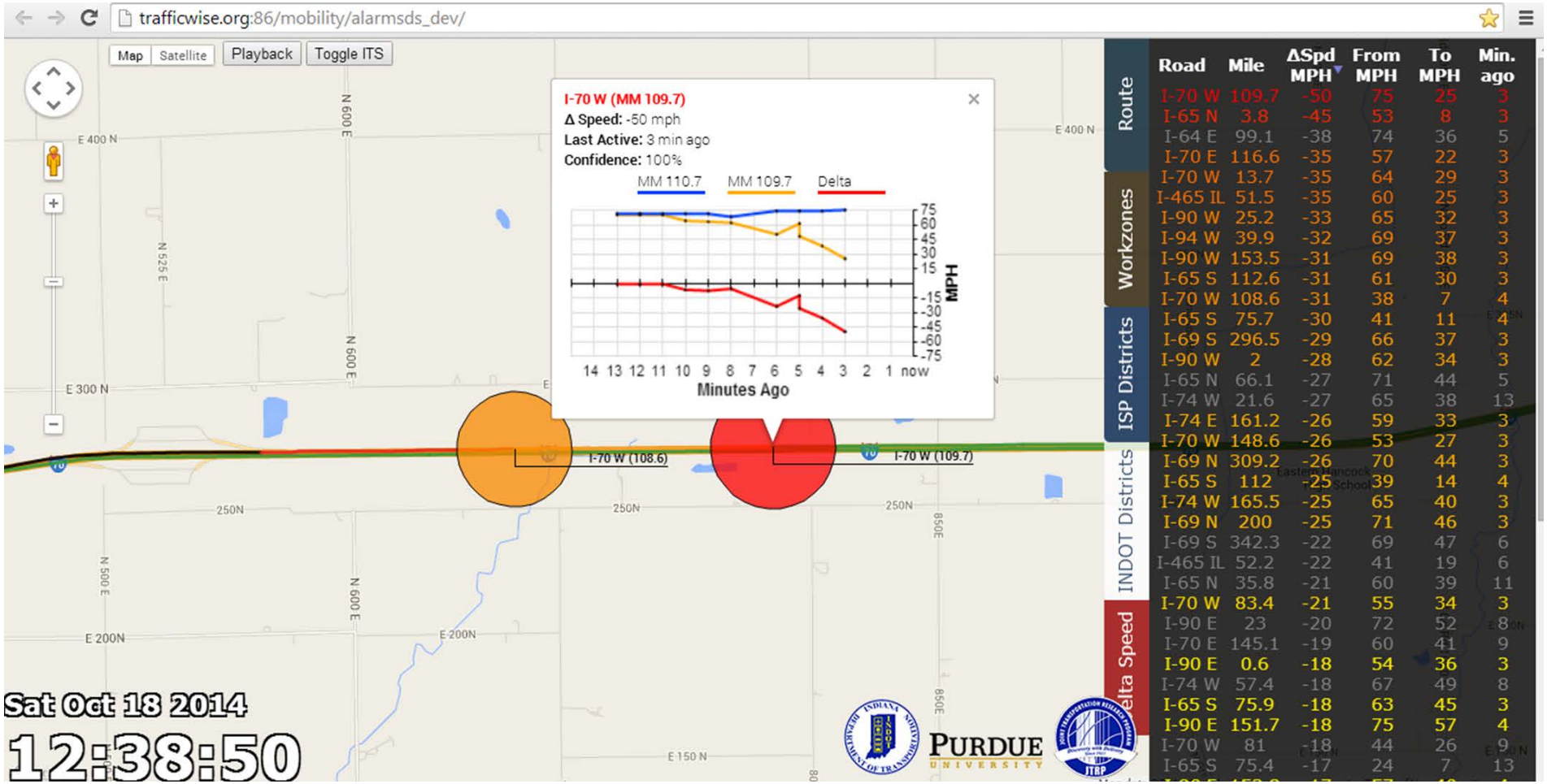
XD Segments Supporting Queue Detection

(Indiana DOT/Purdue) – "Game Changing Fidelity"



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

http://youtu.be/5eFwSBGZkqI

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Examples of Analytics/Archived Data Uses

- Statewide Reports
  - "Texas 100 Most Congested Corridors" – TTI/TxDOT
    - http://www.txdot.gov/inside-txdot/projects/100-congested-roadways.html
  - Indiana Mobility Report – Purdue/INDOT
    - http://docs.lib.purdue.edu/imr/
  - Maryland Mobility Report – MDDOT/MDSHA/UMD
    - http://sha.maryland.gov/OPPEN/2013_Maryland__Mobility.pdf
  - Bottlenecks on the Florida SIS – FDOT/CDM Smith
    - http://www.dot.state.fl.us/planning/systems/programs/mspi/pdf/Executive%20Summary-letter%202-15-13.pdf
    - 2014 ITE Transportation Planning Council Best Project Award winner

- Metropolitan Area Reports
  - DC Congestion Management Process (MWCOG)
    - www.mwcog.org/cmp/
  - Baltimore Quarterly Congestion Analysis Report (BMC)
    - http://www.baltometro.org/downloadables/CMP/CMP_Congestion_2013Q3.pdf
  - Philadelphia Area "Using Operations Data for Planning in the Delaware Valley: First Steps" (DVRPC)
    - http://www.dvrpc.org/reports/11049.pdf

Arterial Retiming Cost – Benefit Analysis using Crowd Sourced Data

PURDUE UNIVERSITY

MARCH 2012

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Before Retiming

Week 13

APRIL 2012

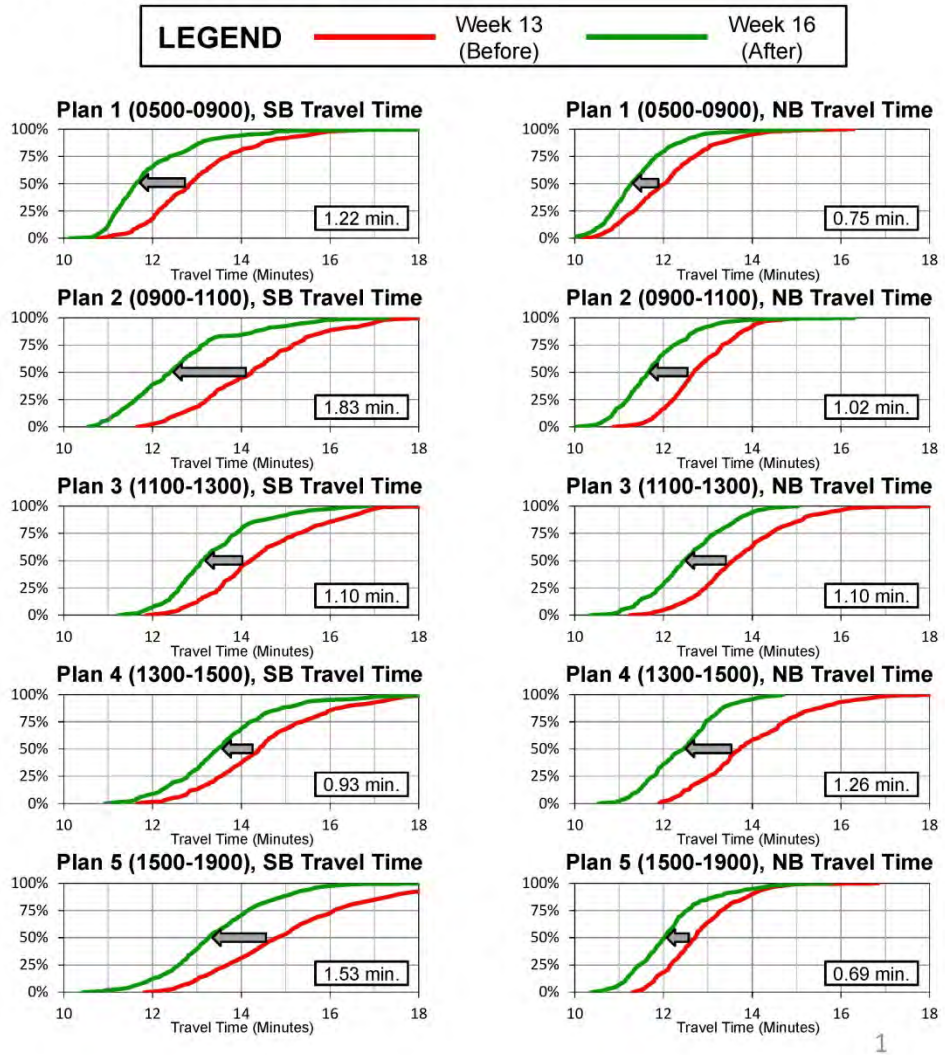
S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Retiming

Week 15

Week 16

After Retiming



Arterial Retiming Cost – Benefit Analysis using Crowd Sourced Data

PURDUE UNIVERSITY

Using TTI Travel Time Savings Calculations: Expected Yearly Savings are $2.7 Million

	Plan	Median TT Savings (min)	% of Daily Traffic	TT Savings (h)	TTI Travel Time Savings ($)	CO2 Reduction (tons)	CO2 Emission Savings ($)
North US 31	Plan 0 (0000 – 0500)	0.79	2.2%	1987.34	$ 46,941.69	16.77	$ 368.96
	Plan 1 (0500 – 0900)	1.22	7.2%	9925.88	$ 234,453.24	83.76	$ 1,842.82
	Plan 2 (0900 – 1100)	1.83	5.3%	10877.93	$ 256,941.12	91.80	$ 2,019.58
	[illegible]00)	1.1	6.7%	8246.25	$ 194,779.77	69.59	$ 1,530.98
	[illegible]00)	0.93	6.6%	6886.14	$ 162,653.47	58.11	$ 1,278.47
	[illegible]00)	1.53	13.5%	23311.22	$ 550,620.34	196.72	$ 4,327.91
	[illegible]00)	0.91	7.1%	7319.89	$ 172,898.62	61.77	$ 1,359.00
	[illegible]00)	0.58	2.2%	1462.30	$ 34,540.02	12.34	$ 271.49
		0.75	7.6%	6420.27	$ 151,649.25	54.18	$ 1,191.97
		1.02	5.5%	6316.57	$ 149,199.92	53.31	$ 1,172.72
	[illegible]00)	[illegible]	7.0%	8627.08	$ 203,775.18	72.80	$ 1,601.69
	Plan 4 (1300 – 1500)	1.2[illegible]	[illegible]%	9881.93	$ 233,415.21	83.39	$ 1,834.66
	Plan 5 (1500 – 1900)	0.69	14.2[illegible]	[illegible]1040.76	$ 260,787.26	93.17	$ 2,049.81
	Plan 6 (1900 – 2400)	0.45	7.9%	401[illegible]	$ 94,906.91	33.91	$ 745.97
	Total		**100.0%**	**116321.6**	**$ 2,747,562**	**981.64**	**$ 21,596.03**

- INRIX has provided data to I-95 Coalition States since 2008 under VPP
- Currently 40,000 miles of data provided in 10 states in real-time
- Six states (RI, NJ, MD, VA, NC, SC) receive statewide data in real-time
- Supports countless uses, e.g.:
  - Travel Times on DMS: NJ, PA, MD, VA, SC
  - 511/Travel Info: NJ, PA, MD, VA, NC, SC, GA
  - Planning/Perf Reports: several MPOs, several states
- All data feeds VPP Suite – including archived data to January 2011
- UMD verifies data quality – world's largest public domain validation
- Contract available for FDOT (and all I-95 member agency) use

VPP Services Compared to Typical Applications

VPPII Services	Application: Travel Times on Message Signs	Performance Measurement	511/Traveler Information	Traffic/Incident Monitoring
Segment Speed/Travel Time Data API				
XD Segments				
XD Subsegments Option				
TMC Segments				
TMC Subsegments Option				
Traffic Tile API				
XD Segments				
XD Subsegments Option				
TMC Segments				
TMC Subsegments Option				
Other APIs				
RTSMIP Alert API				
Route Travel Time API				
Virtual Sensor ("Speed at a point") API				
i95.inrix.com Monitoring Site				
Site with TMC Segment Maps				
Site with TMC, XD and Sub-segment Maps				
UMD VPP Suite				
Full Statewide TMC Coverage				

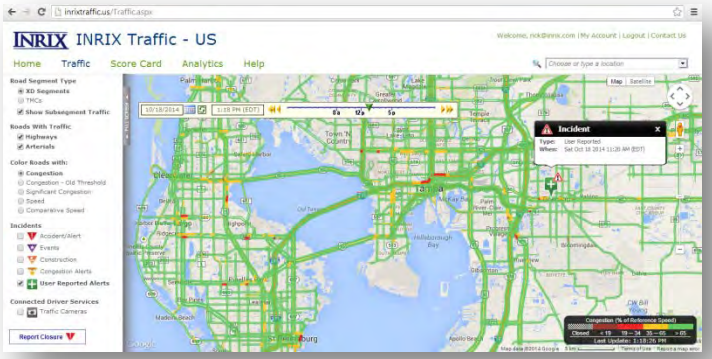
Suitability				
NA	Low	OK	Good	Ideal

All features available in base fee for contracted coverage

INRIX

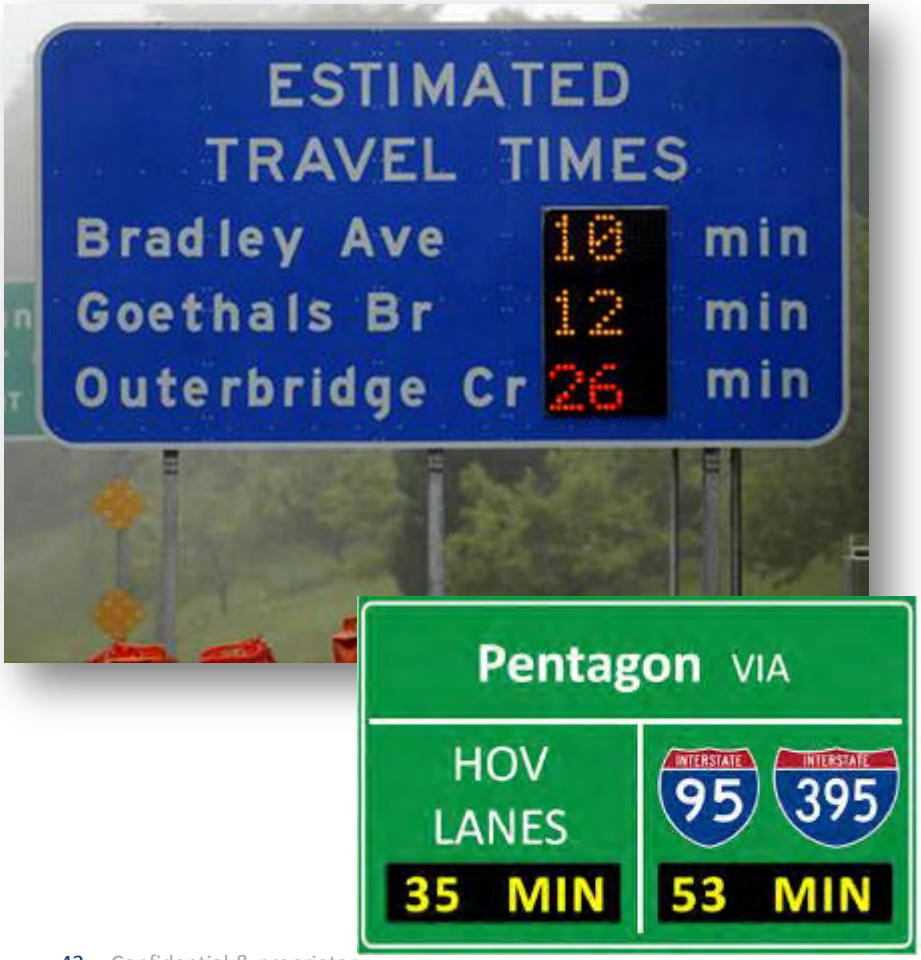
Free Tools and Trials

- Free tools
  - INRIXTraffic! Mobile App
  - INRIXTraffic.us Monitoring Site
    - For Transportation Agencies
  - I95.inrix.com Monitoring Site
    - For I-95 Corridor Coalition Members
- Trials
  - XD Monitoring
  - INRIX Analytics
  - Both trials available via INRIXTraffic.us



Thank You!

- Rick@inrix.com
- **Visit us in the Exhibit Hall**



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