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NWP OTIIS: Heterogeneous Data Integration for Operations and Travel Information Sharing

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Trip Start:
 Trip Destination:
 Travel Date:
 Departure Time:
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Goal: Provide comprehensive, up-to-date, corridor-wide road information to travelers



What Would You Like To See?

<input checked="" type="checkbox"/> Road Work	<input checked="" type="checkbox"/> Weather Alert
<input type="checkbox"/> Incident	<input checked="" type="checkbox"/> Traffic Congestion
<input type="checkbox"/> Road Condition	<input checked="" type="checkbox"/> Road Closure
<input type="checkbox"/> Weather	<input type="checkbox"/> Temporary Truck Restriction
<input checked="" type="checkbox"/> Mountain Pass	<input type="checkbox"/> Camera
<input type="checkbox"/> Cautionary Zone	<input type="checkbox"/> RWIS
<input type="checkbox"/> Weigh Station	

Route Summaries		
① Summary Length: 980 Miles Ideal Drive Time: 13 Hours 39 Mins	② Summary Length: 1031 Miles Ideal Drive Time: 15 Hours 27 Mins	③ Summary Length: 965 Miles Ideal Drive Time: 15 Hours 33 Mins
Category: met Alert for Big Timber...	Category: met Alert for Big Timber...	Category: met Alert for Big Timber...
Category: Met Alert for Stearns (Minneso...	active Tue Apr 15 2014 01:00 MDT BRIDGE, DETOUR, 65 MPH RED...	Category: Met Alert for Carver (Minnesot...
Category: Met Alert for Hennepin; Wright...	active Mon Mar 11 2013 01:00 MDT BRIDGE, 45 MPH REDUCED SPE...	active Tue Apr 15 2014 01:00 MDT BRIDGE, DETOUR, 65 MPH RED...
active Tue Apr 15 2014 01:00 MDT BRIDGE, DETOUR, 65 MPH RED...	active Tue Jun 03 2014 01:00 MDT STRIPING...	active Mon Mar 11 2013 01:00 MDT BRIDGE, 45 MPH REDUCED SPE...

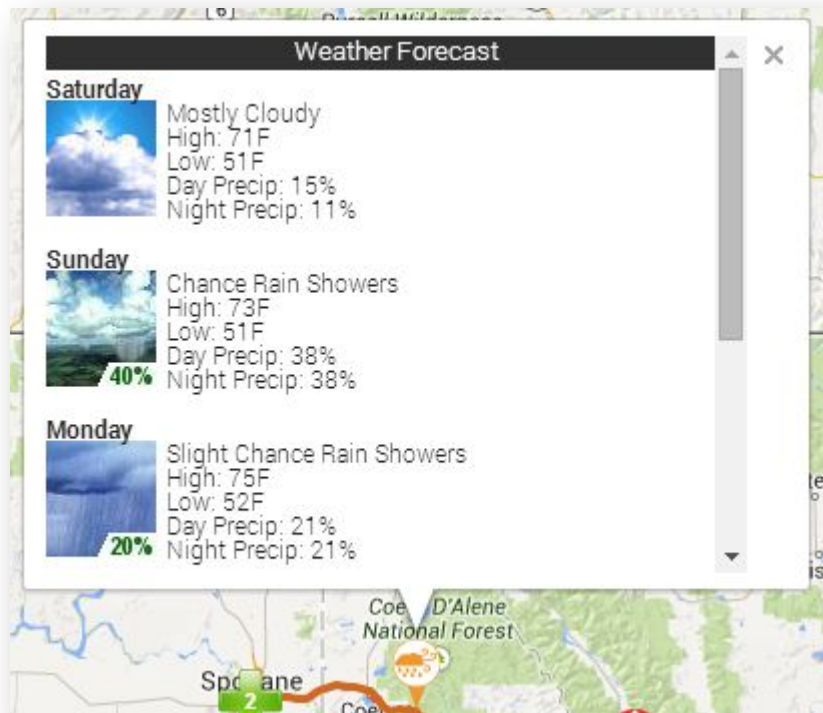
NWP OTIIS – A partnership



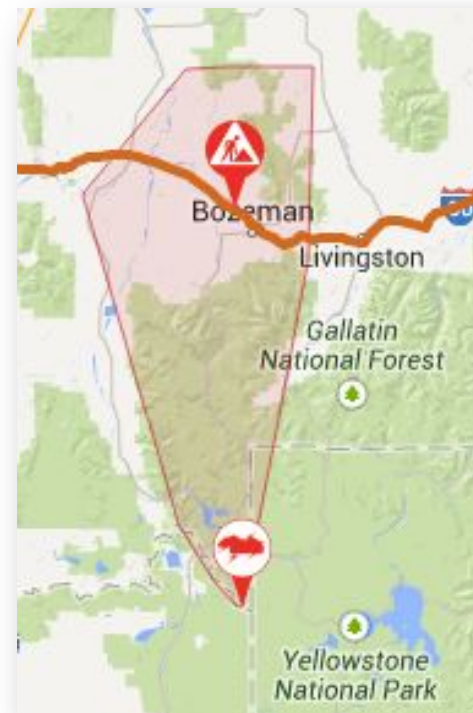
What makes NWP OTIIS unique

- Detailed and up-to-date road data
 - Richer and more accurate information than Google Maps and Waze
- Integration with weather and camera feeds
- Clear road data presentation
 - Categorization into user selectable layers
 - Clear route alternatives
 - Unified experience between website and mobile app
- Open access to data through Application Programming Interface (API)
 - Single corridor-wide data representation schema

Forecasts



Alerts



Other Information

Mountain Passes

Attractions

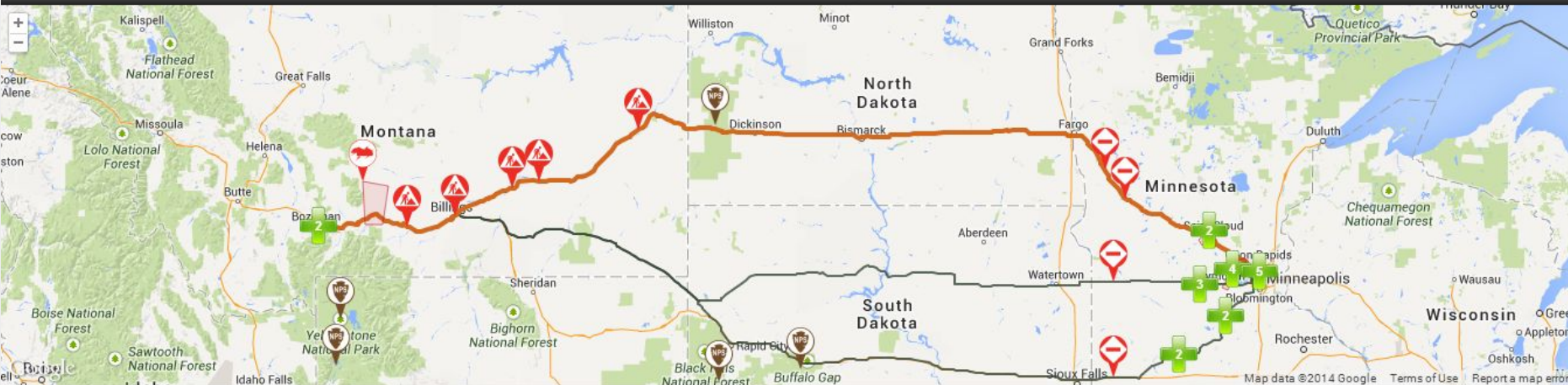


NWP OTIIS Traveler View

Trip Start: Bozeman, MT
Trip Destination: Minneapolis, MN
Travel Date:
Departure Time:
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Google Maps Traveler View

Get directions

My places

A Bozeman, MT

B Minneapolis, MN

Add Destination - Show options

GET DIRECTIONS

Suggested routes

I-94 E	980 mi, 13 hours 40 mins
I-90 E	1,031 mi, 15 hours 27 mins
US-212 E	965 mi, 15 hours 33 mins

Driving directions to Minneapolis, MN

A Bozeman, Mt

1. Head east toward S 7th Ave

2. Take the 1st left onto S 7th Ave

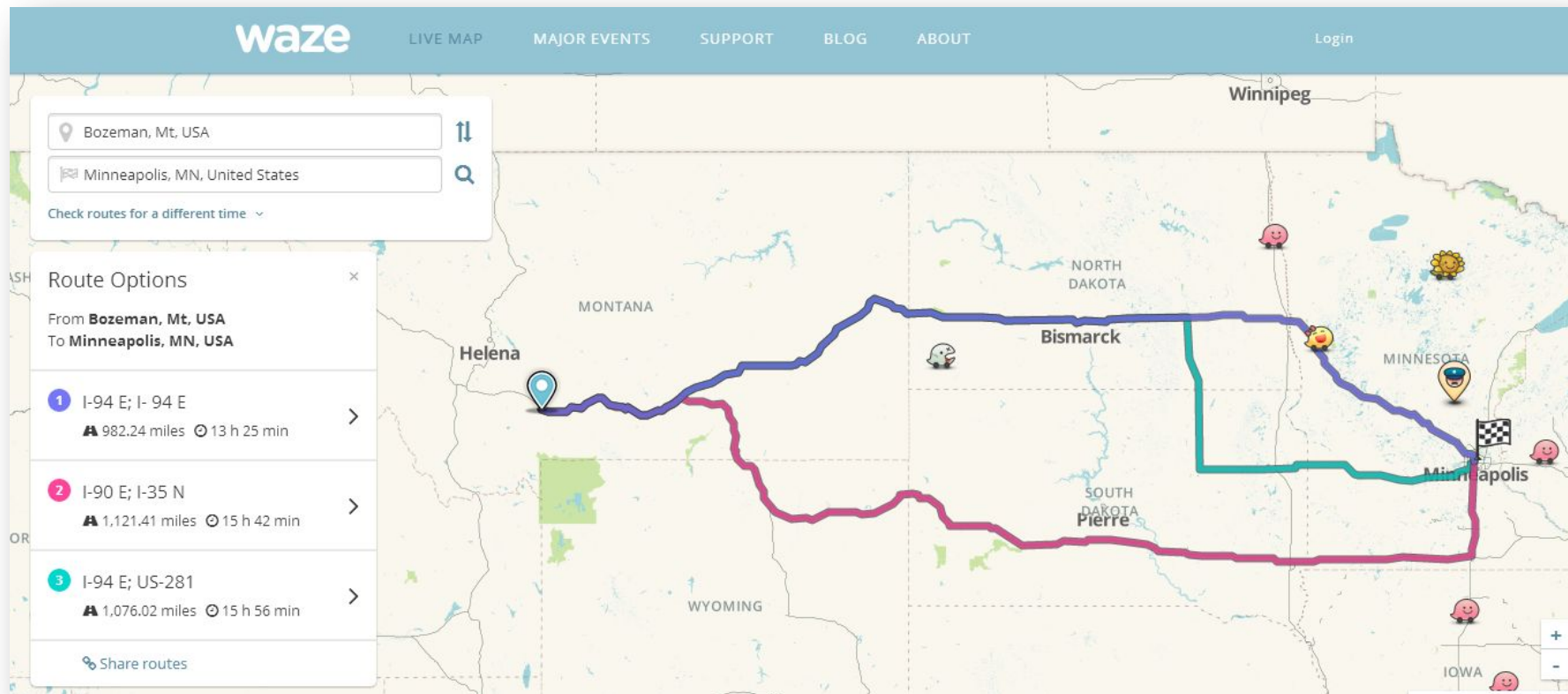
3. Take the 1st right onto W Babcock St

Map navigation controls

Map of Montana, North Dakota, South Dakota, Minnesota, Iowa, Nebraska, and Wyoming. A purple route is shown from Bozeman, MT to Minneapolis, MN. A green route is also shown from Bozeman, MT to Minneapolis, MN. A legend in the bottom right shows traffic conditions: Slow (red), Fast (green).

Live traffic change

Waze Traveler View



The screenshot shows the Waze Traveler View interface. At the top is a navigation bar with the Waze logo and links for LIVE MAP, MAJOR EVENTS, SUPPORT, BLOG, ABOUT, and a Login button. Below the navigation bar is a search area with two input fields: 'Bozeman, Mt, USA' and 'Minneapolis, MN, United States'. A 'Check routes for a different time' dropdown is located below the search fields. The main map area displays a route from Helena, Montana to Minneapolis, Minnesota. The route is color-coded: blue for the initial leg, green for a detour through Bismarck, North Dakota, and a pink line for the southern route through Pierre, South Dakota. The map includes state boundaries for Montana, North Dakota, South Dakota, Minnesota, and Wyoming. Various Waze icons like a carpooling car, a sun, and a checkered flag are visible. A sidebar on the left titled 'Route Options' lists three route choices with their respective distances and estimated times.

Route Options

From **Bozeman, Mt, USA**
To **Minneapolis, MN, USA**

- 1** I-94 E; I- 94 E
982.24 miles 13 h 25 min
- 2** I-90 E; I-35 N
1,121.41 miles 15 h 42 min
- 3** I-94 E; US-281
1,076.02 miles 15 h 56 min

Share routes

Challenges of data integration

- Hard to get all needed data
 - States in different stages of digitizing their information

Solutions:

Good communication
with DOT partners

Integrated with a
separate milepost
to lat/long database

Text pattern matching

Aggregation icons

Keyword search

Unified ontology of road
information

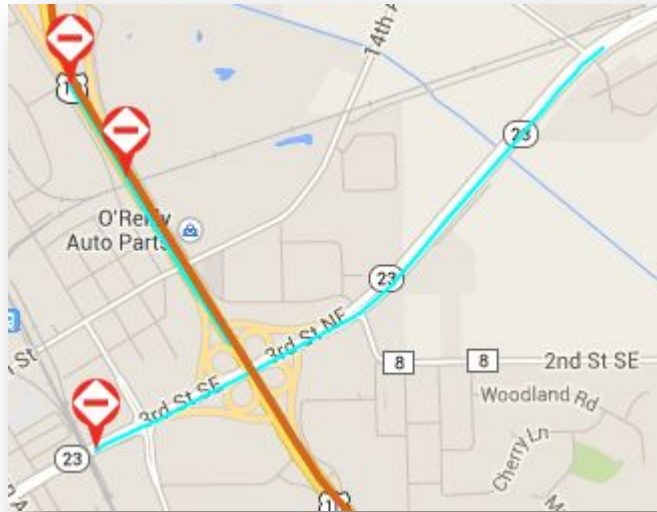
States with different data formats

	Road Work	Truck Restriction	Crash / Incident	Road Closure	Road Conditions	Traffic Congestion	Camera	RWIS
WA								
ID								
MT								
WY								
ND								
SD								
MN								
WI								

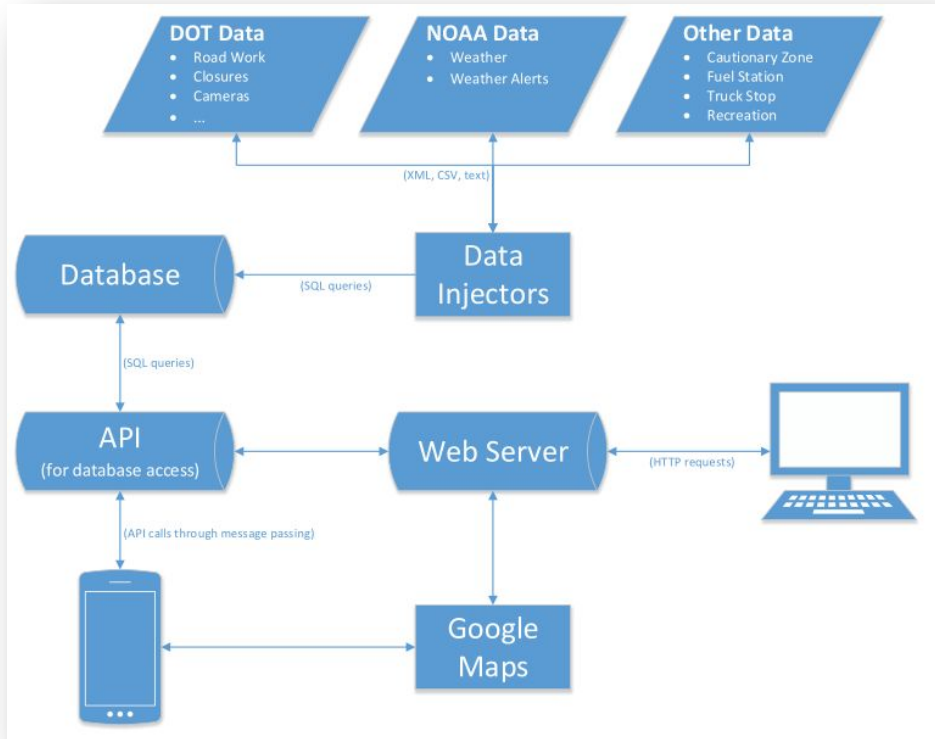
- Heterogeneity of data
- Optional fields
 - TMDD and custom formats
 - Overlapping data
 - ex. truck restriction in accident feed

Functionality Enhancements

Two-point events



Separation of data reporting, storage, and presentation



- Separate data reporting, storage, and presentation
 - Ultimately will be able to support different users
- Consistent sentence construction aids semantic analysis
 - Ex. 'bridge construction' □ easy to interpret
 - Ex. 'bridge spanning the river is under construction' □ super hard!
 - Semantic analysis will always be hard as long as open text fields in data reporting
 - Consistent use of terms can produce both human and machine readable data
- Selective requests to DOTs
 - Standard data reporting formats, i.e. XML, CSV
 - No nested formats, ex. URL inside a description field

- Road information database accessible via Web requests

```
getEvents {  
  segments: '47.70859 -122.32323000000001 ... 47.25278 -122.44427',  
  layers: 'RoadWork',  
  startTimeInSeconds: 'Mon Jun 09 2014 10:00:00 GMT-0600 (MDT)',  
  endTimeInSeconds: 'Mon Jun 09 2014 12:00:00 GMT-0600 (MDT)',  
}
```


NWP OTIIS API Response

```
<eventListResponse>
  <roadWorkList>
    <roadWork>
      <eventID>WA_160533</eventID>
      <path>47.571880341, -122.319869995</path>
      <headline>Construction</headline>
      <headlineDescription>Ramp closures are scheduled.</headlineDescription>
      <impactEstimate>High</impactEstimate>
      <startTime>Fri Jun 06 2014 23:00:00 GMT-0600 (MDT)</startTime>
      <endTime>Tue Jun 15 2014 09:05:23 GMT-0600 (MDT)</endTime>
      <lastUpdated>Tue Jun 03 2014 12:05:23 GMT-0600 (MDT)</lastUpdated>
    </roadWork>
  </roadWorkList>
</eventListResponse>
```

Future work – Near term

- Enhance functionality of NWP OTIIS
- Mobile application
 - Mobile application version of the NWP OTIIS system
 - Route condition alerts pushed to users en route
 - Will collect and make available road congestion information
- Semantic analysis of data feed information
 - Allow more uniform presentation of data across all layers and states
- Order events in lists by travel distance along the route
 - Interleave driving directions with incidents

Future work – Long Term

- Major tasks that **leverage NWP OTIIS data**
- Accident prediction and integration with freight scheduling
 - Proposal under submission to the FHWA EAR program
 - Collaboration with JB Hunt and Watkins & Sheppard
 - MSU-lead team (CS and Civil Eng.) in collaboration with FSU
- Selective active traffic management
 - Suggest alternative routes in real-time through notifications
 - Balance traffic based on observed shifts
 - Keep trucks on highway, but route passenger traffic onto local roads
- Integration with connected vehicles, passenger and commercial

Thank
You