Abstract

The Indiana Department of Transportation (INDOT) manages over 1800 centerline miles of interstate that can be profoundly impacted by weather, crashes, and construction. Real-time performance measurement of interstate speeds is critical for successful traffic operations management. Agency managers and Traffic Management Center decision makers need situational awareness of the network and the ability to identify irregularities at a glance in order to manage resources and respond to media queries. One way to access this level of detail is crowdsourced probe vehicle data. Crowdsourced probe vehicle data can be obtained by collecting speed data from cell phones and GPS devices. In Indiana, approximately 2673 predefined interstate segments are used to generate over 3.8 million speed records per day. These data can be overwhelming without efficient procedures to reduce and aggregate both spatially and temporally. This work introduces a spatial and temporal aggregation model and an accompanying real-time dashboard to characterize the current and past congestion history of interstate roadways. The primary high level view of the aggregated data resembles a stock ticker and is called the “Traffic Ticker.” The data archive allows for after-action review of major events such as ice storms, major crashes, and construction work zones.

Crowdsourced Probe Vehicle Data

The crowdsourced probe vehicle data are obtained from a third-party vendor and are calculated from GPS locations and headings of cell phones and similar devices. Speeds are reported each minute for a segment. For analysis, the median of each fifteen-minute bin is used.

Traffic Ticker

http://tinyurl.com/trafficticker

i. Miles of interstate operating below 45 mph, colored by district
ii. Abnormal congestion due to a winter storm (see below)
iii. Miles of interstate operating below 45 mph, colored by road
iv. Miles of interstate colored by speed bin - yellow for 35-45 mph, orange for 25-34 mph, red for 15-24 mph, and pink for 0-14 mph
v. Timestamp of last data
vi. Interstate selection
vii. District selection
viii. Congested speed threshold selection (defaults to 45 mph)
ix. Date range (defaults to past week)

Traffic Ticker for Fort Wayne (shown in black) shows magnitude but not location of congestion. The dashboard at left provides drill-down capability from Traffic Ticker to show spatial distribution.

Winter Weather

Winter storms disrupt travel due to low visibility and unsafe roads due to snow and ice. The graph at right shows Jan.-Mar. of 2015. Callout i shows normal congestion of around 20 miles, and callouts ii, iii, and iv show three large winter storms that all affected different parts of the state.

Over February 1 and 2, 2015, a winter storm swept across the upper half of the state, with snow depths as high as 17 inches in the northern two districts, Lagrange and Fort Wayne, on the morning of the 2nd. Storm-related congestion had largely subsided by noon on Feb. 2nd.

I-70 Crash

On April 21st at 1750, a crash on I-70 W in the Crawfordsville district caused a queue of two miles. At 1830, a secondary crash occurred at the back of the queue, causing a truck fire and closing the interstate.

The queuing shown in the delta speed alarms site above was a result of the second crash. The speed profiles to the right compare the day of the crash with the cleanup the following day. The crashes caused queuing for 20 miles and the cleanup effort for 16 miles for as long as 2 hours. The impact from both of these efforts on mobility can be seen in the data, and action can be taken to avoid dangerous back-of-queue situations in the future.

http://tiki.ecn.purdue.edu/mobility/deltaapproach:

- Speed profile, day of crash
- Speed profile, day of cleanup

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On August 7, 2015 (seven days after TRB Paper #16-0622 was submitted), a 37 mile stretch of I-65 N from MM 141 to 178 was closed due to a structural settlement of a bridge. Traffic was detoured onto a series of rural 2- and 4-lane roads and a suburban arterial. The traffic ticker methodology described in this poster was implemented within 8 hours of the closure to provide state and local agencies with a real-time dashboard and prioritize traffic management activities. This poster documents the resulting impact of two temporary signals, retaining of the US-231 corridor, and conversion of US-231 and SR-18 to a two-way stop. Further details of this initiative are described in the December 2015 issue of ITE Journal.

Detour Route: Signs and Signals

The route of the detour is shown at right, with traffic diverting onto US-52 at Lebanon and following SR-28 to US-231 back to I-65 N.
- Temporary signals were installed at
  - US-52 and SR-28
  - SR-28 and US-231
  - US-52 & SR 47
- The four-way stop at US-231 and SR-18 was also converted to a two-way stop
- The balloons mark the location of
  - 15 dynamic message signs (DMS)
  - 40 trailblazing signs,
  - 19 others (traffic light warning signs, work zone warnings, etc.).

Dynamic Message Sign (DMS)  Trailblazing  Other

Signs and Signals

Coordination with Public Safety

Five phases of Detour Route Management:
1. Identification of Diversion Route
2. Trailblazing
3. Temporary Signals and Flasher changes
4. Optimization of Signal Timing
5. Incident Management

First 9 days of closure

Severe congestion (~15 mph) eliminated

Detour route segments, colored to match graph

Change from red to yellow

ISP changes SR-18 from 4-way to 2-way stop and 90 minutes later, queue is cleared.