INDOT Agency Factoids
(System/Comm.)

• Number of signalized intersections- **2570**
  – **200** connected by fiber
  – **300** connected by radio
  – **0** connected by twisted pair
  – **225** connected by cellular
  – **1500** not connected to communication

• Number of engineers/technicians devoted to signals. **8 engineers, 32 Technicians**
  – **Currently 2 vacant engineer positions (1 Engineer level, 1 Managing Engineer level)**

• Central System Vendor **None, Closed loop systems function as central system**

• **300** signals collecting high resolution data

• **Greater than 10 years** collecting high resolution data
Agency Factoids (Detection)

- Length of stop bar detectors on minor movement. 51 ft
- Use of dilemma zone or other detection on arterial main line. Both stop bar detection and dilemma zone detection used (5 seconds in advance of stop bar)
- Detection Technologies used. All in pavement, no above pavement
- “Lane by Lane” or “Lane Group Detection” Lane by lane
- Link to detection standard number scheme
- # of Signals with Emergency Vehicle Preemption. 100 maint. by others
- # of Signals with RR Preemption. 75 with pre-empt
Using Real-Time Probe Vehicle Data to Manage Unplanned Detour Routes

By Margaret McNamara, Howell Li, Stephen Remias, Lucy Richardson, Edward Cox, Deborah Horton, and Darcy M. Bullock

The unexpected closure of an interstate is a massive undertaking involving a variety of stakeholders. Such was the case in August 2015, when pier settlement of the Wildcat Creek Bridge on I-65 N in Indiana, USA required an unplanned closure of a 37-mile stretch of the interstate for approximately 31 days. The detour route had little existing intelligent transportation systems (ITS) infrastructure to assist engineers with managing operations. To fill this information need, real-time crowdsourced probe vehicle data were used to create real-time dashboards hosted on a website for use by Indiana Department of Transportation (INDOT) engineers and public safety officials to monitor mobility and queueing on the 62-mile detour route. This paper describes how the real-time dashboards were used to proactively identify congestion problems, as well as measure the impact of mitigation measures.

Route Diversion
The southbound bridge was too narrow to support bidirectional traffic, so the northbound traffic was diverted onto US-52 at mile marker 141 (Lebanon, IN) and returned to I-65 just north of Lafayette at Exit 193 (Figure 1a). This stretch of interstate usually carries an average annual daily traffic of 24,000 vehicles, including about 9,500 trucks, and it is an important connector between Indianapolis, IN, and Chicago, IL, USA.

Figure 1 shows the area of the closure and detour, with callouts marking the location of the closed bridge. The detour consisted of US-52, SR-28, and US-231, shown in Figure 1a. INDOT deployed fifteen dynamic message signs (DMS) that were used to direct drivers, advising them of turns and potential queues. Additionally, there were 40 traffic light signs marking the direction of the detour and 19 other signs, including warning signs for traffic lights and work zones. Figure 1b, callouts ii, iii, and iv mark temporary signs that were installed, and callout v marks a four-way stop that was converted to a two-way stop, which are discussed later in the article.

Figure 1. Maps of Detour Route

Immediately after the closure, DMS near Indianapolis (and later in adjacent states) were used to advise drivers of the closure and encourage Chicago-bound traffic to take I-74 to I-67 in Illinois.
Interstate Diversion

Bridge Closed on Aug 6 (AADT ~ 35000) Trucks ~ 5000

NB I-65 closed from MM 141 to 178 (~ 37 miles)

Diversion Route
Northbound I-65 Bridge Closure...
Repairs In Progress
Making Real Time Decisions and Separating Fact from Fiction

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2 years of work to clog Lafayette’s major artery

By Hannah Smith-Kiefer
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What could be worse for drivers than intermittent lane closures? Try 145 in the summer, fall and winter — for the next two to three years. Big changes — and big construction headaches — are coming to the stretch of the interstate that passes through Lafayette. Road work on I-65 will continue into fall 2017. Drivers should brace themselves for lane restrictions, ramp closures, narrower lanes, reduced speeds and longer travel times.

Wondering just what will be happening, and how bad it will get? Read on...

What changes are coming?

Crews will widen I-65 from two lanes in each direction to three lanes in each direction. To do this, workers will place the two new lanes in the current median space and add a center dividing strip to separate the two directions. The two current lanes will lose a shoulder to make way for the new lanes. The shoulder of the road won’t have to be widened, although it will be reinforced during the first few weeks of the project so lanes can be temporarily shifted.

See NIGHTMARE, Page 4A
How Bad? Ineffective, Absurd…

Using Metrics to change the narrative.

- Reporter drove official detour right after the closure, wrote article for local newspaper
- Took 4 hours to drive ~60 miles
- Said “Moral of the story is that the INDOT detour route is essentially ineffective.”
- “Plan for it to take an absurd amount of time.”
Traffic Summary
US-52 N (I-65 to SR-28)

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary
SR-28 (US-52 to SR-231)

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary
US-231 (SR-28 to US-52)

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary
US-231 N (US-52 to SR-18)

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary

US-231 N (SR-18 to I-65)

Segment Speed Profile

Cumulative Traffic Ticker
Traffic Summary

Total

Segment Speed Profile

Cumulative Traffic Ticker
Daily Northbound Volumes –US-231 NB approaching Lafayette

Airport | River

<table>
<thead>
<tr>
<th>Week -4</th>
<th>Week -3</th>
<th>Week -2</th>
<th>Week -1</th>
<th>Week 0</th>
<th>Week 1</th>
<th>Week 2</th>
</tr>
</thead>
</table>

- Initial I-65 Closure
- Second I-65 Closure
- I-65 Reopened
- Weekend
US-231 @ River Road – Typical Week Before and After
(Week of 7/25 vs. Week of 8/15)
Detour Route Dashboard

I-65 N Detour Route

- Cong shifts to 231
- 231/18 Flasher change
- 231 Signal Timing
- Several Incidents

> 10 Miles
Most measures implemented

> 10 Miles
0-14 mph
Signalization Impact

ISP Dispatch, Mon INDOT changed from 4 way stop to 2 way stop

Temp signal at 52/28 addressed

Temp signal at 28/231 addressed

Now chasing second order effects
SR 28/US 231 Temporary Signal
SR 28/US 52 Temporary Signal
Temporary Signal at US 231 & SR 28- Romney

- 2 phase signal
- Installed cell modem for remote access
- Monitored remotely and adjusted splits based on INRIX/Google traffic queuing
INRIX/Google traffic was monitored continuously throughout the day. If queue on detour route was seen past CR 100E, pattern was changed remotely to give more time to E/W phase. Resulting in…
...alleviating the queue on the detour. This would increase the queues to the north and south, so splits were always being monitored and adjusted to try and balance the queuing, although queues on the detour route were of more importance.
Temporary Signal at US 52 & SR 47

- Safety concern at US 52 & SR 47
  - 2 way stop controlled E/W
  - High crash history prior to closure
- Signal installed to increase safety
  - Constructed overnight, ~12 hours
- Special detection installed to limit dilemma zone issues, red light running
Temporary Signal at US 52 & SR 47

- Installed speed sieve detection to extend phase safely for all vehicles travelling 40-70mph
- NB phase ran free with long min and longer max
- Eventually would gap out when no vehicles were approaching, serve SR 47 vehicles safely
Before the Detour

3 signal system coordinated all day, but coordination was for US 52 E/W.

5 signal system coordinated only during AM and PM peaks.

Was 2-way stop controlled E/W. A temporary 2-phase signal was constructed during the I-65 closure.

All 3 signals south of Wabash River weren’t running in coordination due to distance between signals and light volume on 231.
During the Detour

Coordinated all signals and ran same plan 24/7. 150 second cycle, large split for NB. Offsets were aligned solely for northbound progression.

Temporary signal was programmed with progressive splits allowing more time for WB interstate volume, changed during day based on traffic monitored remotely.
Retiming the Greater Lafayette Corridor

- All signals were retimed during the first week of the closure
- Coordinated every signal, only caring about northbound progression
- 150 second cycle length, heavily favoring northbound phase, (or westbound on north end)
- Adjusted offsets with goal of all signals having > 90% arrivals on green
Before Retiming

No data*

Free with 75s NB Max

After Retiming

No data*

Free with 75s NB Max

*Old controller prior to retiming
Before Retiming

I-65 Detour Route

= signal on detour

US 231 at Airport Rd
AOG: 10596/13396 (79.86%)

US 231 @ Martin Jischke Dr (Intramural Dr)
AOG: 11343/13612 (83.96%)

US 231 @ S River Rd
AOG: 8547/14083 (60.69%)

After Retiming

US 231 at Airport Rd
AOG: 14542/15229 (95.49%)

US 231 @ Martin Jischke Dr (Intramural Dr)
AOG: 14804/15464 (95.73%)

US 231 @ S River Rd
AOG: 12892/16444 (78.4%)
Before Retiming

<table>
<thead>
<tr>
<th>Location</th>
<th>Before Retiming</th>
<th>After Retiming</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 52 @ US 231 (East Jct)</td>
<td>AOG: 5819/9887 (58.86%)</td>
<td>AOG: 9226/10242 (90.08%)</td>
</tr>
<tr>
<td>US 231 @ Lindberg Rd (CR 200 N)</td>
<td>AOG: 8679/12489 (69.49%)</td>
<td>AOG: 12531/14712 (85.18%)</td>
</tr>
<tr>
<td>US 231 @ SR 26 (State St)</td>
<td>AOG: 13709/14612 (93.82%)</td>
<td>No data*</td>
</tr>
</tbody>
</table>

*Data logging issue corrected after retiming
Queue Forms
Back of Queue Crash
8 hour closure
More 4 way stop queueing
Police waving vehicles through
Conversion to flashing yellow
Free flow conditions
I-65 Diversion Scenario

Bridge Closed on Aug 6
(AADT ~ 35000)
Trucks ~ 5000

NB I-65 closed from MM 141 to 178 (~ 37 miles)

We saw the **overall** route performance…
What were the details?
Blue Tooth Data Collection Locations...
Did Motorists Favor the Detour Route?

- **Signed Detour**: 65.6% (Median = 64 min)
- **Alternate #2**: 13.2% (Median = 65 min)
- **Alternate 1**: 21.2% (Median = 65 min)
Using Metrics to change the narrative.

- Improvement to drive ~60 miles from 4 hours to about 64 minutes
- Bad news stories stopped being published
- Many reports of driving detour with zero to one stop!
- Media advocating use of the detour.
Questions?

Thank you!!

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