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 Diverion

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 9,000 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 t, t, and t, mark temporary signals 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
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
Daily Northbound Volumes –US-231 NB approaching Lafayette

Week -4  Week -3  Week -2  Week -1  Week 0  Week 1  Week 2

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

**Temp Signals**

**Cong shifts to 231**

**231/18 Flasher change**

**231 Signal Timing**

**Several Incidents**

**I-65 N Detour Route**

- **> 10 Miles 0-14 mph**
- **Most measures implemented**
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
“All roads lead to Romney”

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…

I-65 Detour Route
...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.

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

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

**Before Retiming**

- No data*
- Free with 75s NB Max

**After Retiming**

- No data*
- Free with 75s NB Max

*Old controller prior to retiming

O = signal on detour route

*Old controller prior to retiming
I-65 Detour Route

Data logging issue corrected after retiming

Before Retiming

After Retiming

*Data logging issue corrected after retiming
Public Safety Dialog

I-65 N Detour Route

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[Graph showing traffic patterns over a month, with different routes and their miles driven at various speeds.]
Queue

Forms

Back of Queue Crash

8 hour closure

More 4 way stop queueing

Conversion to flashing yellow

Police waving vehicles through

Free flow conditions

Queue Crash

8/8/2015 (Saturday)

8/9/2015 (Sunday)

8/10/2015 (Monday)

8/11/2015 (Tuesday)
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.

**Detour Diary: How bad was the detour really?**

- 12:44 p.m. See y'all in like ten hours when I get through this detour.
- 10:09 a.m.: About to go drive the short detour for myself today. This is the one I actually get driven off the side gates, which is a real stretch. Don't be fooled.
- 10:34 p.m.: The real reason people in Lebanon, Indiana and the surrounding areas should take the detour.
- 1:53 p.m.: I'm going to kick something.
- 2:33 p.m. It would be faster to take one of these guys!  

[Image of a road detour sign and a car driving on a detour route]
Questions?

Thank you!!

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