DFW Experience With Rhythm Adaptive Signal Control

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What is it?

• The InSync adaptive system from Rhythm Engineering integrates with all existing traffic signal systems – see: http://www.rhythmtraffic.com/

• InSync provides two modes of operation:

1) VIVDS (video detection) - supports coordination and control already programmed in the local controller

2) Adaptive Control - uses vehicle calls to call and extend phases based on current demand and while maintaining coordination under supervision of a facilitator (master)
InSync Hardware Overview

• The Rhythm “InSync processor” is a Windows XP computer that interfaces the detector rack as a VIVDS system.

• InSync is a Windows app running on each “InSync processor”. One intersection is designated as the Facilitator (master).

One InSync processor is designated as the Facilitator for adaptive control.
City of Richardson Experience
Weekday AM Period

East Richardson Signal System Network
“InSync processor” Windows Remote Desktop

- InSync app provides local status and control at each signal.
- InSync provides supervisor control at the signal designated as the facilitator master.
- Embedded web server provides a web interface to program, monitor and query the VIVDS system at each intersection.
InSync Time-of-Day Schedule

- A time-of-day schedule is set at each cabinet
- The Facilitator is programmed to run "Fixed" periods (cycles) by time-of-day or "Adjustable" periods under adaptive control

Day-of-Week / Time-of-Day entries select the configuration

Configuration plans are programmed here
Existing vs. Rhythm TOD Schedules

TOD schedules and period length implemented by Rhythm Engineering closely matched the existing TOD schedules and cycle lengths in the before case.

InSync references the offset to the beginning of the last tunnel within the period.

NEMA references the offset to beginning of the first green (TS2 First Green).
CentralSync is Rhythm’s offline program that models time-space relationships for the adaptive configuration.

Intersection spacing is derived from Google Earth coordinates.

The user specifies speed (or travel time) and a Fixed Period for the corridor.

The user manually adjusts the offset and duration of each tunnel in the model.

The user is responsible for leaving enough time outside of the tunnels to service the demand for the non-coordinated phases. Rhythm has recently implemented a “watchdog feature” to kick the intersection free if phases are skipped for 2+ periods.
Phase utilization at Campbell/Plano for 2 Thursday morning periods 7:15-8:30AM. 9/1/11 (160" Period / InSync adaptive); 9/8/11 (160" Cycle / Synchro TOD plan) Phase times captured from InSync history logs (CSV data) imported to Excel
Comparison of Floating Car Data – AM Period
Comparison of Floating Car Data – PM Period
Final Deployment – Rhythm Adaptive System
Period (Cycle) Adjustability Test – Off Peak

Offpeak - Adjustability 100'' - 200''

Diagram showing period (cycle) adjustability with two lines: one for adjustability on and another for adjustability off - fixed TOD period.
Period (Cycle) Adjustability Test – PM Peak

PM Peak - Adjustability 120" - 200"

- Adjustability ON
- Adjustability OFF - Fixed TOD Period
City of Grapevine Experience
Adaptive Locations Deployed

46 of 52 Locations Installed (June-Dec 2010)

- 6 locations were deferred due to conflicts with DFW Connector project construction
  - Main St / SH 114 interchange (2 signals)
  - Texan Trail / SH 114 interchange (2 signals)
  - William D. Tate Ave / SH 114 interchange
  - William D. Tate Ave / Mustang Dr

- SH 26, Pool Rd to Baylor Pkwy – currently not running adaptive mode due to TxDOT widening projects
Before / After Data Collection

• May 2010 vs. October 2010
  (both before the construction intensity ramped up)

• Six time periods per day measured
  – AM Peak 7:15 AM to 8:45 AM
  – AM Off-Peak 9:00 AM to 11:30 AM
  – Midday Peak 11:45 AM to 1:00 PM
  – Midday Off-Peak 1:30 PM to 4:00 PM
  – PM Peak 5:15 PM to 6:45 PM
  – PM Off-Peak after 7:00 PM

• Multiple runs averaged for each time period
  (at least 3-5 per direction)
Coordinated Directions – *Northwest Highway*

### Northwest Highway Before After Comparison

<table>
<thead>
<tr>
<th>Peak Period</th>
<th>Direction</th>
<th>Average Travel Time (Seconds)</th>
<th>Average Number of Stops</th>
<th>Average Speed (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
<td>After</td>
<td>Change</td>
</tr>
<tr>
<td><strong>Weekday AM</strong></td>
<td>EB</td>
<td>541.2</td>
<td>493.6</td>
<td>-8.8%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>685.0</td>
<td>489.0</td>
<td>-19.8%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>653.1</td>
<td>481.3</td>
<td>-14.3%</td>
</tr>
<tr>
<td><strong>Weekday AM Off Peak</strong></td>
<td>EB</td>
<td>441.0</td>
<td>409.8</td>
<td>-7.1%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>497.2</td>
<td>422.6</td>
<td>-15.0%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>460.1</td>
<td>418.2</td>
<td>-11.3%</td>
</tr>
<tr>
<td><strong>Weekday Midday</strong></td>
<td>EB</td>
<td>479.0</td>
<td>434.8</td>
<td>-8.4%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>456.8</td>
<td>484.0</td>
<td>6.0%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>467.8</td>
<td>459.3</td>
<td>-1.8%</td>
</tr>
<tr>
<td><strong>Weekday Midday Off Peak</strong></td>
<td>EB</td>
<td>499.2</td>
<td>421.6</td>
<td>-13.8%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>597.8</td>
<td>416.8</td>
<td>-30.3%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>543.5</td>
<td>419.2</td>
<td>-22.9%</td>
</tr>
<tr>
<td><strong>Weekday PM</strong></td>
<td>EB</td>
<td>781.6</td>
<td>450.0</td>
<td>-41.7%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>611.4</td>
<td>604.2</td>
<td>-1.2%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>690.5</td>
<td>530.1</td>
<td>-23.8%</td>
</tr>
<tr>
<td><strong>Weekday PM Off Peak</strong></td>
<td>EB</td>
<td>492.0</td>
<td>387.6</td>
<td>-21.2%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>470.8</td>
<td>438.6</td>
<td>-7.2%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>481.3</td>
<td>412.1</td>
<td>-14.4%</td>
</tr>
</tbody>
</table>

- **Red Circle**: Decrease in operations
- **Orange Circle**: Less than 10% increase in operations
- **Green Circle**: Greater than 10% increase in operations
## Coordinated Directions – State Highway 26

**STATE HIGHWAY 26 Before After Comparison**

<table>
<thead>
<tr>
<th>Peak Period</th>
<th>Direction</th>
<th>Average Travel Time (Seconds)</th>
<th>Average Number of Stops</th>
<th>Average Speed (MPH)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Before</td>
<td>After</td>
<td>Change</td>
</tr>
<tr>
<td>Weekday AM</td>
<td>EB</td>
<td>320.4</td>
<td>298.4</td>
<td>-6.9%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>296.0</td>
<td>237.4</td>
<td>-19.5%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>308.2</td>
<td>267.9</td>
<td>-13.1%</td>
</tr>
<tr>
<td>Weekday AM Off Peak</td>
<td>EB</td>
<td>274.0</td>
<td>209.4</td>
<td>-23.6%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>224.6</td>
<td>210.4</td>
<td>-6.3%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>249.3</td>
<td>209.9</td>
<td>-15.3%</td>
</tr>
<tr>
<td>Weekday Midday</td>
<td>EB</td>
<td>237.4</td>
<td>241.0</td>
<td>1.5%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>204.6</td>
<td>196.8</td>
<td>-3.8%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>251.0</td>
<td>218.9</td>
<td>-12.5%</td>
</tr>
<tr>
<td>Weekday Midday Off</td>
<td>EB</td>
<td>284.4</td>
<td>226.4</td>
<td>-20.4%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>272.2</td>
<td>190.4</td>
<td>-30.1%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>278.3</td>
<td>208.4</td>
<td>-25.1%</td>
</tr>
<tr>
<td>Weekday PM</td>
<td>EB</td>
<td>276.0</td>
<td>237.0</td>
<td>-13.2%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>304.8</td>
<td>325.2</td>
<td>6.7%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>288.2</td>
<td>281.1</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Weekday PM Off Peak</td>
<td>EB</td>
<td>249.6</td>
<td>216.6</td>
<td>-13.2%</td>
</tr>
<tr>
<td></td>
<td>WB</td>
<td>273.2</td>
<td>106.8</td>
<td>-55.0%</td>
</tr>
<tr>
<td></td>
<td>Average</td>
<td>261.4</td>
<td>206.7</td>
<td>-20.9%</td>
</tr>
</tbody>
</table>
Average Improvement
Before vs. After Measures for All Time Periods

- Northwest Hwy, SH 114 to Grapevine Mills Trail
- SH 26, Pool/Brumlow to Baylor Pkwy

<table>
<thead>
<tr>
<th>Category</th>
<th>Northwest Hwy, SH 114 to Grapevine Mills Trail</th>
<th>SH 26, Pool/Brumlow to Baylor Pkwy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Travel Time</td>
<td>15%</td>
<td>17%</td>
</tr>
<tr>
<td>Number of Stops</td>
<td>43%</td>
<td>66%</td>
</tr>
<tr>
<td>Average Speed</td>
<td>20%</td>
<td>22%</td>
</tr>
</tbody>
</table>
Challenges

- **Video Detection**
  - Rhythm has its own proprietary video detection software
  - System is *still* vulnerable to false positives when fixed object shadows result in calls
  - Vendor is continuing to improve software

- **Processor makes timing decisions on cycle-by-cycle basis using available data**
  - Software logic works well, but cannot make “right” choices 100% of time
Other Challenges

• On-going Maintenance
  – Keeping cameras clean, aimed, focused
  – More hardware in cabinet to look after
• Keeping Expectations Realistic
  – Grapevine is in the heart of one of the most congested urban areas in U.S.
  – Adaptive system benefits are real and noticeable, but no system can make the traffic disappear.
Grapevine Summary

- Many intersections were setup quickly
  - City staff has made minor adjustments since
  - Rhythm staff went back again about a year after installation for some additional fine-tuning
  - Continued monitoring / adjustment necessary
- DFW Connector has significantly impacted traffic flows
- Major arterials
  - System has improved operation (before/after data validated that)
- Minor arterials – City staff has reduced coordinated operation during off-peak periods
- System will continue to improve with software upgrades
  - Contract provides free software updates for 5 years
Fort Worth Experience with Adaptive Traffic Signal Control
Goals of Project

Evaluate InSync System

Progression throughout the day

Adapt to fluctuating traffic
Elements of the System
University Drive

• TCU events
• TCU football
• Fort Worth Zoo
• Colonial Golf Tournament
Bryant Irvin Blvd

- Big Box Retail
- Small Retail
- IH-20
- Hotels
- Restaurants
Results

• Systems are operational
• Systems are providing Progression
• Added functionality to Controller
• Data Collection Underway
Questions ?

http://www.fhwa.dot.gov/everydaycounts/technology/adsc/