Moving Traffic using Adaptive Traffic Control System

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Palm Beach County
Why Adaptive?
Selection Criteria
Case Studies
Limitations of Existing System
Benefits of Adaptive Control System
Before/After Results
Conclusions
Next Steps
WHY ADAPTIVE SIGNAL CONTROL SYSTEM?

WHY WE NEED ADAPTIVE SYSTEM?

- Reduce retiming costs
- Can only do so much with TOD
- Improve Capacity
- Try New Technology
- Reduce stops, delays
- Lower Maintenance Costs
- Handle Traffic Variations
ADAPTIVE SIGNAL CONTROL SYSTEM

- Proactive system
- Continuously monitor travel conditions and collect data
- Adjust timing in real-time
- Handle fluctuations
- Provide additional options to handle unique needs
SELECTION CRITERIA

☑ Ease of Installation
☑ Low Maintenance
☑ Compatibility With the Existing Controllers
☑ Recovery from Pre-emption
☑ Dynamic Phasing
☑ Cycle Length Flexibility
☑ Special Event Management
☑ Fail Safe Options
☑ Easy to Revert Back to TOD
In-Sync Adaptive Traffic Control System deployed!

- Two Corridors
  - Okeechobee Boulevard, Downtown West Palm Beach (11 signals - Deployed in 2015)
  - Northlake Boulevard (14 Signals – Deployed in 2016)

- Data collection with BlueTOAD and MVDS units

- Total cost for adaptive: $800,000 (approx)
Complexities:
1) Varying traffic volumes & demand (EBL AM Peak ~ 1,170 vph @ Tamarind/Parker)
2) 11 traffic signals in 1.0 mile
3) Preemptions - CSX, FEC & Intra-coastal
4) Convention Center and Performing Arts Theatre
5) Downtown (shopping, restaurants, movies, pedestrians, 2-way to 1-way change)
6) Parking Garage
7) Special Events (High School Graduations, SunFest, Boat Show, 4th on Flagler, etc)
Complexities:
1) Varying traffic volumes and demand
2) 14 traffic signals in 3.12 miles
3) R/R preemption
4) Shopping and Industrial
5) School traffic
6) I-95 Interchange traffic
ESTABLISH GOALS

- Pre-emption recovery
- Bi-directional progression
- Reduce delays to minor movements
- Throughput improvement
- Handle traffic fluctuations
LIMITATIONS WITH EXISTING TOD PLANS
### Weekdays

**Vehicle Counts**

- **Time:** 11:00 AM
- **Counts:**
  - 12:00 PM: 400
  - 1:00 PM: 300

**Period Lengths**

- **Period Length:**
  - 10:00 AM: 150
  - 11:00 AM: 200

### Weekend

**Vehicle Counts**

- **Time:** 11:00 AM
- **Counts:**
  - 12:00 PM: 200
  - 1:00 PM: 150

**Period Lengths**

- **Period Length:**
  - 10:00 AM: 100
  - 11:00 AM: 150

### Time 1st Car waiting

<table>
<thead>
<tr>
<th>Time</th>
<th>Duration</th>
<th>Movement</th>
<th>Phase 1 (BL)</th>
<th>Phase 2 (WT)</th>
<th>Phase 3 (SL)</th>
<th>Phase 4 (NT)</th>
<th>Phase 5 (WL)</th>
<th>Phase 6 (ET)</th>
<th>Phase 7 (NL)</th>
<th>Phase 8 (ST)</th>
<th>Period</th>
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<tbody>
<tr>
<td>08:00:08 AM</td>
<td></td>
<td>Ped Called</td>
<td>Q</td>
<td>W</td>
<td>Q</td>
<td>W</td>
<td>Q</td>
<td>W</td>
<td>Q</td>
<td>W</td>
<td>200</td>
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<td>08:00:11 AM</td>
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<td>40</td>
<td>5</td>
<td>5</td>
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<td>30</td>
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<td></td>
<td>40</td>
<td>15</td>
<td>3</td>
<td>29</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>161</td>
<td>0</td>
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<tr>
<td>08:00:29 AM</td>
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<td></td>
<td>40</td>
<td>23</td>
<td>2</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>30</td>
<td>169</td>
<td>0</td>
</tr>
</tbody>
</table>
• Turned off the System for two weeks in August-September, 2016

• INSYNC in ‘Detector Only’ mode to collect data

• Data Collection
  ➢ Field Travel Runs
  ➢ BlueTOAD data (Travel Time)
  ➢ MVDS Data (Vehicle Throughput)
  ➢ INSYNC Wait Time Data
BEFORE/AFTER RESULTS - OKEECHOBEE BLVD

**Travel Time Reduction**

- **Okeechobee Blvd (Eastbound)**
  - AM: 3.7%
  - Midday: 8.8%
  - PM: 6.7%
  - Weekend: 2.2%

- **Okeechobee Blvd (Westbound)**
  - AM: 21.3%
  - Midday: 10.1%
  - PM: 32.4%
  - Weekend: 25.6%

**Vehicle Throughput**

- **Okeechobee Blvd (Eastbound)**
  - AM: 3.1%
  - Midday: 7.6%
  - PM: 7.5%
  - Weekend Peak: 21.7%

- **Okeechobee Blvd (Westbound)**
  - AM: 0.5%
  - Midday: 3.4%
  - PM: 7.1%
  - Weekend Peak: 0.5%
BEFORE/AFTER - NORTHLAKE BLVD

Northlake Blvd (Eastbound)

Travel Time Reduction

Northlake Blvd (Westbound)

Bi-directional Progression

Northlake Blvd (Eastbound)

Vehicle Throughput

Northlake Blvd (Westbound)
## INSYNC DELAY COMPARISON

### AM Peak

<table>
<thead>
<tr>
<th>Location</th>
<th>Phase1</th>
<th>Phase2</th>
<th>Phase3</th>
<th>Phase4</th>
<th>Phase5</th>
<th>Phase6</th>
<th>Phase7</th>
<th>Phase8</th>
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</thead>
<tbody>
<tr>
<td>Okeechobee Blvd.</td>
<td>EBLT</td>
<td>WBT</td>
<td>SBLT</td>
<td>NBT</td>
<td>WBLT</td>
<td>EBT</td>
<td>NBLT</td>
<td>SBT</td>
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<tr>
<td>Before (sec)</td>
<td>90.7</td>
<td>169.2</td>
<td>103.3</td>
<td>129.3</td>
<td>89.9</td>
<td>82.1</td>
<td>130.2</td>
<td>117.1</td>
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<td>After (sec)</td>
<td>57.40</td>
<td>170.29</td>
<td>97.89</td>
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<td>143.64</td>
<td>69.37</td>
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<td>-5</td>
<td>7</td>
<td>54</td>
<td>-13</td>
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<td>6</td>
</tr>
<tr>
<td>% Difference</td>
<td>-37%</td>
<td>1%</td>
<td>-5%</td>
<td>5%</td>
<td>60%</td>
<td>-16%</td>
<td>12%</td>
<td>5%</td>
</tr>
<tr>
<td>Okeechobee Blvd.</td>
<td>EBLT</td>
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<tr>
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### PM Peak

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<th>Phase3</th>
<th>Phase4</th>
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<th>Phase6</th>
<th>Phase7</th>
<th>Phase8</th>
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</thead>
<tbody>
<tr>
<td>Okeechobee Blvd.</td>
<td>EBLT</td>
<td>WBT</td>
<td>SBLT</td>
<td>NBT</td>
<td>WBLT</td>
<td>EBT</td>
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<tr>
<td>Before (sec)</td>
<td>121.8</td>
<td>82.0</td>
<td>61.1</td>
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<td>79.5</td>
<td>109.3</td>
<td>120.2</td>
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<tr>
<td>After (sec)</td>
<td>132.03</td>
<td>88.24</td>
<td>72.53</td>
<td>110.49</td>
<td>94.35</td>
<td>89.52</td>
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<td>117.83</td>
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<td>6</td>
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<td>11</td>
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<tr>
<td>% Difference</td>
<td>8%</td>
<td>8%</td>
<td>19%</td>
<td>3%</td>
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<tr>
<td>at Sapodilla Ave.</td>
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### AM Peak

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<td>EBLT</td>
<td>WBT</td>
<td>SBLT</td>
<td>NBT</td>
<td>WBLT</td>
<td>EBT</td>
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<tr>
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<td>86.5</td>
<td>40.4</td>
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<td>59.3</td>
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<td>After (sec)</td>
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<td>49.02</td>
<td>52.03</td>
<td>55.57</td>
<td>34.03</td>
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<td>-26%</td>
<td>-44%</td>
<td>-31%</td>
<td>-61%</td>
<td>-30%</td>
<td>-38%</td>
<td>-63%</td>
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### PM Peak

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<tr>
<th>Location</th>
<th>Phase1</th>
<th>Phase2</th>
<th>Phase3</th>
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<tbody>
<tr>
<td>Northlake Blvd.</td>
<td>NBLT</td>
<td>SBT</td>
<td>EBLT</td>
<td>WBT</td>
<td>SBLT</td>
<td>NBT</td>
<td>WBLT</td>
<td>EBT</td>
</tr>
<tr>
<td>Before (sec)</td>
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<td>66.7</td>
<td>97.2</td>
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<td>83.0</td>
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<td>62.4</td>
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<tr>
<td>After (sec)</td>
<td>66.22</td>
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<td>48.17</td>
<td>38.46</td>
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<td>-9.9</td>
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<td>-26.6</td>
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<td>% Difference</td>
<td>-35%</td>
<td>-15%</td>
<td>-38%</td>
<td>-21%</td>
<td>-42%</td>
<td>-20%</td>
<td>-48%</td>
<td>-43%</td>
</tr>
</tbody>
</table>

### Okeechobee Blvd.
- AM Peak: 30%, PM Peak: 30%

### Northlake Blvd.
- AM Peak: 37%, PM Peak: 22%
Okeechobee Blvd. & Sapodilla Ave.
Lakeview Ave. & Olive Ave.

BEFORE

AFTER

INSYNC OPERATIONS (CONT'D.)
WB Okeechobee Blvd between Rosemary Ave and Quadrille Blvd
WHAT WE LEARNED!

- Saturated means Saturated!
- Phase sequence may violate driver expectation
- Cross coordination could be challenging
- Higher initial cost for field equipment
  - Approx. initial implementation cost - $35,000/intersection
- Initial system setup and fine-tuning process could take time!
- Maintenance cost for field components
  - unknown at this stage
- Dynamic phase sequence (N. Lake & McArthur) – Artificial Intelligence vs Real Intelligence
- Pre-emption Recovery – Faster compared to TOD plans (1 cycle vs 2 to 3 cycles)
Average Travel-Time Savings (weekdays)

Okeechobee Blvd: 92 veh-hrs/day = $1544/day

Northlake Blvd: 196 veh-hrs/day = $3290/day

Total Annual Savings: $1.2 M (approx)
“In the past 3 weeks, something got changed. My 12 minute commute now takes 20 minutes. In addition, all the cars expecting to make the U-turn into MacDonald's, can't turn because the lanes haven't moved at the lights, so that lane gets backed up, compounding the problem. It just seems like lights are out of sync! “
(Email from a citizen received during BEFORE Conditions assessment on Northlake Blvd, 09/07/16)

“The new traffic system cleared the Convention Center egress traffic and also kept the traffic on Okeechobee Blvd progressing through the traffic signals in a way not experienced before.”
(Director of Event Services – PBCCC, 2/23/2015)
Further investigations needed:

• Benefits during shoulder peaks
• Queues – Before/After
• Why higher delays during PM Peak
• Double cycle option at minor intersections
• Address shadow effect using thermal cameras
• Safety study – Before/After
Questions?