Clark County STEVE
Arterial Performance Project
Clark County’s Signal Timing Enhancement, Verification, and Evaluation (STEVE) project is exploring arterial performance measures that will inform signal operations.

- You’ve got the data from sensors, now what?
## STEVE Performance Measures

<table>
<thead>
<tr>
<th>Measure</th>
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<tbody>
<tr>
<td>Travel time</td>
</tr>
<tr>
<td>Travel time reliability</td>
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<tr>
<td>ROR/GOR</td>
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<tr>
<td>Percent arrival on green</td>
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</table>
Travel Time

- AM Peak (7-9am)
- PM Peak (4-6pm)
- Travel Time Record
- Median Travel Times

Start Time: 2/15/2018 6:00 PM
Median Time: 43 s
Number of Trips: 57
Which is better?

- **Lower average speed**
  - but 80%+ have a 1 minute variance in travel time

- **Higher speed**
  - but 80%+ have a 4 minute variance in travel time
Red Occupancy Ratio/Green Occupancy Ratio ($ROR_5/GOR$)
AKA Split Failure
Percent Arrival on Green
Percent Arrival on Green
Potential Graphic to Compare Performance

- Can compare at a glance seeing how changes in corridor timing affect different parameters
- Would like to see competing interests such as corridor performance vs. side street
- Maybe a quadrant means a specific category?
Evaluation Tools

- ATMS Central system sensors
- Bluetooth Data Collection
- Floating Car
- 3rd Party Data (Google, Bing, etc.)
Travel Time with Bluetooth Study

Study done Feb. 15, 2018

- 9 drivers
- 2 hr shifts
- 5 shifts
- Drivers used apps from iTunes and the Android Play Store
- Free gpx software to edit files
Floating Car Travel Time

Results

- Average – pretty consistent
- Range (Reliability) – varied a lot
- Volume – consistent during day but PM peak increases about 25% above average daily volume then drops more than 50% with only slight improvement in average and reliability
Travel Time Statistics

Results

- Typical run resulted in the following key findings for data:
  - Approximately 50 runs in a 2 hr block per direction.
  - Travel Time Standard Deviation was approximately +/- 15% of average travel time.
  - With range of travel times, calculated speed reliability is 70% that speed is +/- 1 mph. But about 85-95% reliability speed is +/- 2 mph. 99% + speed is +/- 3 mph.
Floating Car Study

- Plethora of data. Approximately 550 one-way routes over the five, 2-hr time periods.

- **LOTS** of data processing time needed to remove travel times on the ends and turn this into one-way routes.

- Not really a practical way to evaluate performance measures, but helpful to compare other data gathering technologies such as Bluetooth.
Clark County currently has 13 permanent devices and 5 portable. Partner agencies have 13 permanent devices and 14 portable.

Just added 49 permanent Clark County and 7 permanent partner agency Bluetooth spring of this year (STEVE project).
BlueMAC

- Use a vendor called BlueMAC to aggregate Bluetooth data to develop reports about travel time as well as origin-destination.
- Bluetooth picks up the MAC address, which is unique to the device.
- Some MAC digits are automatically “sanitized” for a measure of anonymity.
The Bluemac Solution

1. Detect at Bluemac 1
   - Store MAC, timestamp and signal strength

2. Detect at Bluemac 2
   - Store MAC, timestamp and signal strength

3. Match MACs
   - Calculate travel time and speed for segment

Bluetooth Low Energy
- Range typically 30-100 feet
- Advertising devices
  - (phones, fitness bands, watches, key finders)

Bluetooth Classic
- Range typically 30 – 400 feet
- Discoverable devices
  - (phones, in-car entertainment)

- Add Multiple Segments Together for Route
- Use Network of Bluemacs to Determine O/D
- Provide Filtering to Remove Noise, Increase Accuracy
Bluematic and Clark County

- Deployed two sets of Bluemacs to detect Bluetooth classic and Bluetooth Low Energy signals
- Bluetooth Low Energy Sensors have been used by Bluematic for several years, this is a great example of why it works
- All collected MAC addresses were truncated, obfuscated for this study. Salted hash is available for added security
Results

• Over 1,000 matches from end to end during 14 hour study
• Over 30,000 unique hits across individual units
• Able to track floating car fleet through use of iBeacons on vehicles
Results

- Filtered out slowest 15% to account for anomalies resulting from travelers stopping along corridor (gas stations, restaurants, drop offs)
- BLE captures more peds & cyclists so standard filtering results in slower speeds
- Resulting speeds between 2% - 8% of the Floating Car Speeds in 15-minute groups
- Front end filtering will give necessary accuracy as well as enable ped/bike tracking
How Bluemac fits

- Bluemac data can easily be used to replace Floating Car studies and surveys with 24x7 reporting
- Bluetooth was consistently more accurate than crowd sourced data with far more granularity. ML Ready.
- Can feed a live system and be used for before/after studies with full access to aggregated and raw data
- Cost effective and easily deployed
Questions?

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