OpenAWAM: 
*Open-Source Bluetooth Travel Time System*

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**AWAM: Bluetooth or WiFi address matching**

*Space Mean Speed* as measured by devices in the field

Device must be “Discoverable” to be read

Vehicle averaged 30 mph
Alternatives to AWAM Systems

• Travel time information from Google et al.
• Equipment to read transmissions from V2V equipped vehicles

For Moreno Valley, a large capital expenditure is not warranted, nor can we afford it
What is OpenAWAM

• “OpenAWAM” is the name of a new open-source software project you can deploy today

• Field hardware costs less than $200 per unit + installation labor

• Must have some form of network communication available at each field site

• Central software is deployable under Windows or Linux, and under active development to add features

• Requires “sweat equity” (staff time in lieu of capital investment)
OpenAWAM vs. Commercial Systems

- OpenAWAM
- Either OpenAWAM or Commercial Product
- Neither
- Commercial AWAM Product

Staff Time vs. Capital Dollars
OpenAWAM System Block Diagram

Field Node
Mounts to traffic signal pole

Existing Ethernet switch (generally in controller cabinet)

Standard Ethernet TWP cable

Anonymization occurs in field node by hashing using CRC32:
0A:6B:BC:94:E6:21 → 0x04C11DB7

Field

Central

OpenAWAM Central Software

Data Dissemination

Data Archival
Field Node

- **Bluetooth adapter**
- **USB port**
- **Network port**
- **“Raspberry Pi” computer**
  - SD card slot
  - Power port
- **Power over Ethernet splitter**
  - DC out
  - LAN out
  - Power + data in
- **Ethernet patch cord**

**Item** | **Cost**
---|---
Raspberry Pi | $35
Case | $9
SD card | $5
Bluetooth adapter | $36
PoE adapter | $25
Enclosure | $30
Cables and connectors | $20
**Total (before tax)** | **$160**

- **Install facing center of intersection, below vehicle indication (approx. 9’ height)**
- **Install between vehicular and pedestrian indications, facing into intersection**

*4” x 8” plastic enclosure—Mount to traffic signal pole*
Field Node Hardware

Frederick/Alessandro field node: Installed June 2013, pictures taken September 2015
Why a $36 Bluetooth adapter?

- Whip antenna provides gain in the horizontal direction
- Equipment installation provides for vertical orientation of the antenna
- Mounting height at 9’ optimizes:
  - Selection of signals from vehicles going in all directions (higher might miss cars going right underneath)
  - Mounted high enough to prevent tampering by casual vandals
  - Accessible by standard 7’ ladder for maintenance
- 300’ range
Location of Field Nodes for Testing
Travel Times

- Real-time data available today
- Map with real-time updates is in the works
- Next steps:
  - O-D matching
  - Refine travel time estimates
Field Node Reliability

Conclusion:
$200 field nodes are not 100% reliable but have exceeded expectations

• First version (deployed in 2013): All nodes have had equipment swap-outs. Least reliable element is the SD card
• Third version of Raspberry Pi allows for booting from USB. Currently evaluating reliability of this device
• Many different options for providing the field node capability exist
Next Steps

• Refine matching algorithm
• Create dynamic map
• Deploy more field nodes
• Query database for historical data
• Query database for route choice

Thank you City of Moreno Valley for letting me work on this.

Brave individuals seeking to try out OpenAWAM should contact the author.