Sharing Traffic Signal Timing with Vehicles: A Non-DSRC Survey

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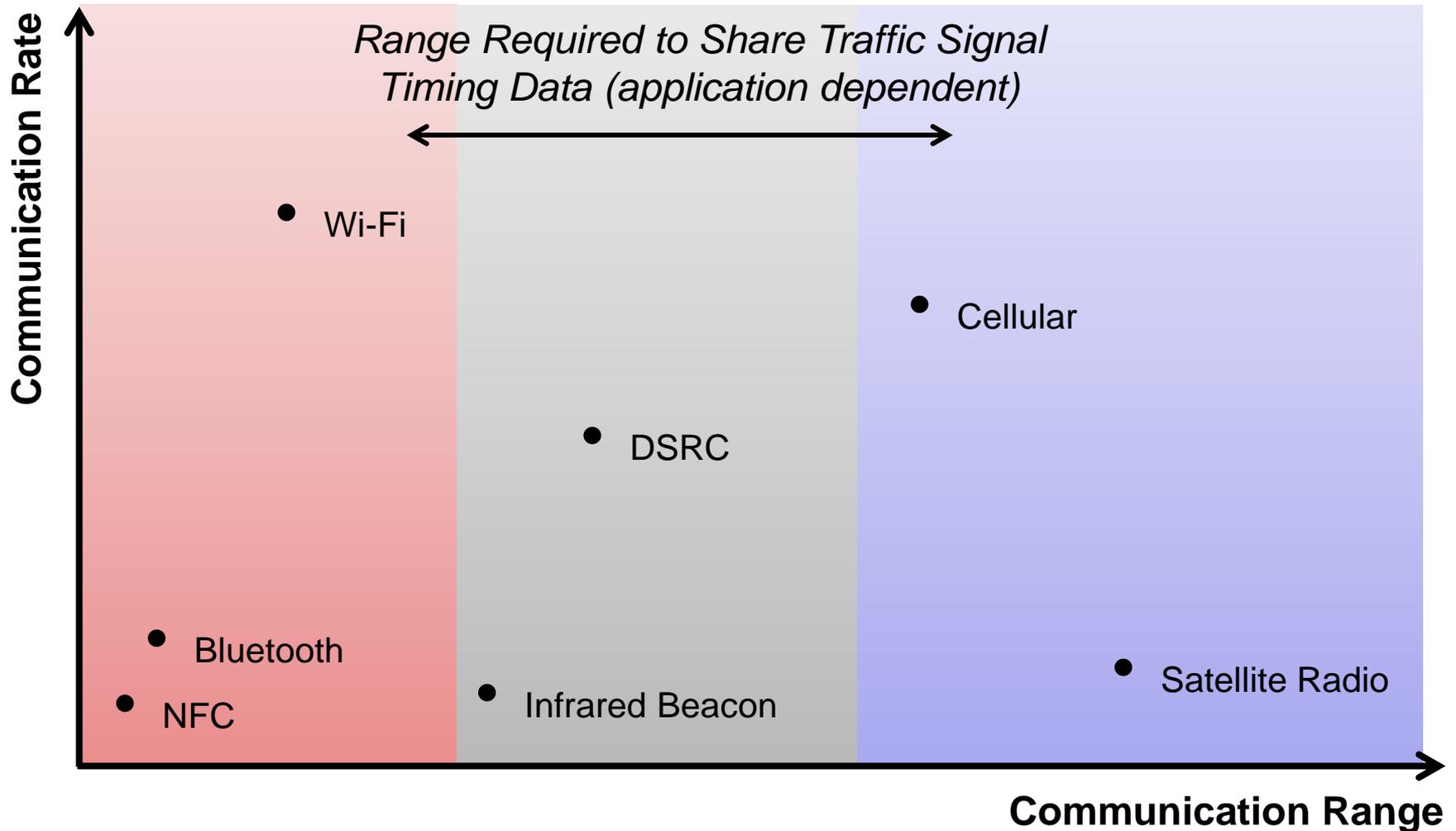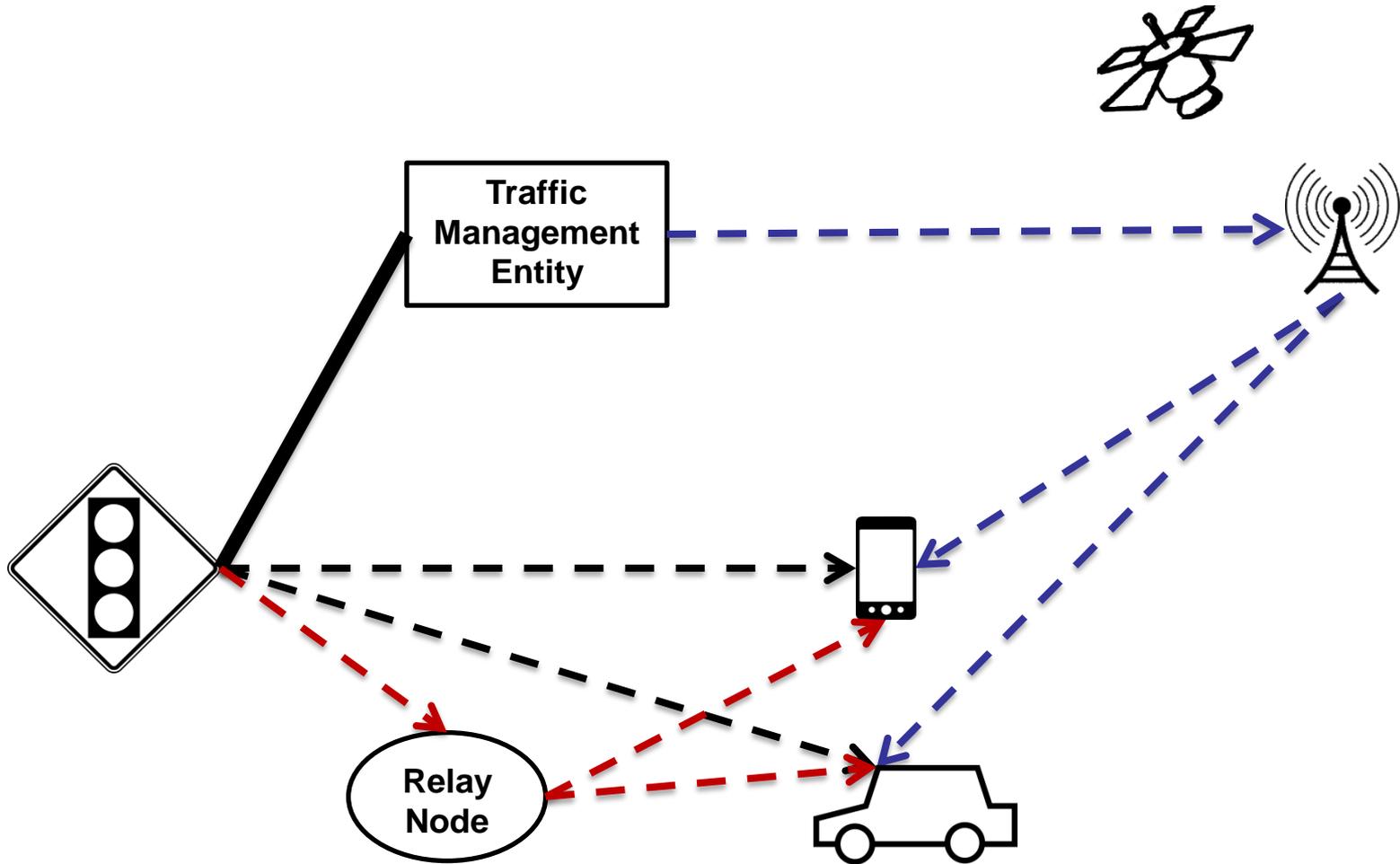# Sharing Traffic Signal Timing with Vehicles: A Non-DSRC Survey

Overview

- **Comparison of DSRC and non-DSRC in applications for sharing traffic signal timing data with vehicles**

- **Non-DSRC-based applications for sharing traffic signal timing data**
  - In-vehicle cellular application: Audi's Online Traffic Light Recognition System
  - Smartphone application: Connected Signals' App "EnLighten"
  - Infrared beacon application: Honda's Driving Support System

- **Stakeholder perspectives on sharing traffic signal timing data**

- **Conclusions**

Performance of DSRC and its Alternatives

Range Required to Share Traffic Signal Timing Data (application dependent)

Communication Rate (vertical axis)

Communication Range (horizontal axis)

- Wi-Fi
- Cellular
- DSRC
- Bluetooth
- NFC
- Infrared Beacon
- Satellite Radio

Diagram not to scale, for illustration only

Diagram of Sharing Traffic Signal Timing Data

In-Vehicle Cellular Application: Audi's Online Traffic Light Recognition System

- **Deployment Status and Plan**
  - Led by Audi's team in Germany
  - Initially part of European sim^{TD} project
  - First U.S. demonstration at CES 2014
  - Ongoing field trials in Europe
  - No immediate deployment plan in U.S.
- **Claimed Environmental Benefit**
  - CO_2 emission reduction of up to 15%
- **Technical Evaluation**
  - A computation engine combats false positives
  - Good performance with fixed time signals
  - Degraded performance with actuated, adaptive signals or signal preemption

CD 1 Track 01
11:04
02.06.2010
40
33090 km 1.9
3 +21.0°c

CD 1 Track 01
11:04
02.06.2010
33 s
33090 km 1.9
1 +21.0°c

Signal timing sheet

Traffic signal status every second

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Figure from Audi's Press Release

Smartphone Application: Connected Signals' App "EnLighten"

- **Deployment Status and Plan**
  - Service available in over 50 U.S. municipalities
  - Currently being rolled out city by city
  - Facing concerns over driver distraction
  - Also may provide traffic signal timing to OEMs
- **Claimed Environmental Benefit**
  - 5% fuel savings (rudimentary analysis)
- **Technical Evaluation**
  - "Cloud sourcing" scheme for inferring signal status may be developed using position and speed of cell phones, but GPS on mobile devices lacks requisite accuracy
  - Works with fixed time signals only

Signal timing sheet

Traffic signal status every second

Figure from Connected Signals

Infrared Beacon Application: Honda's Driving Support System
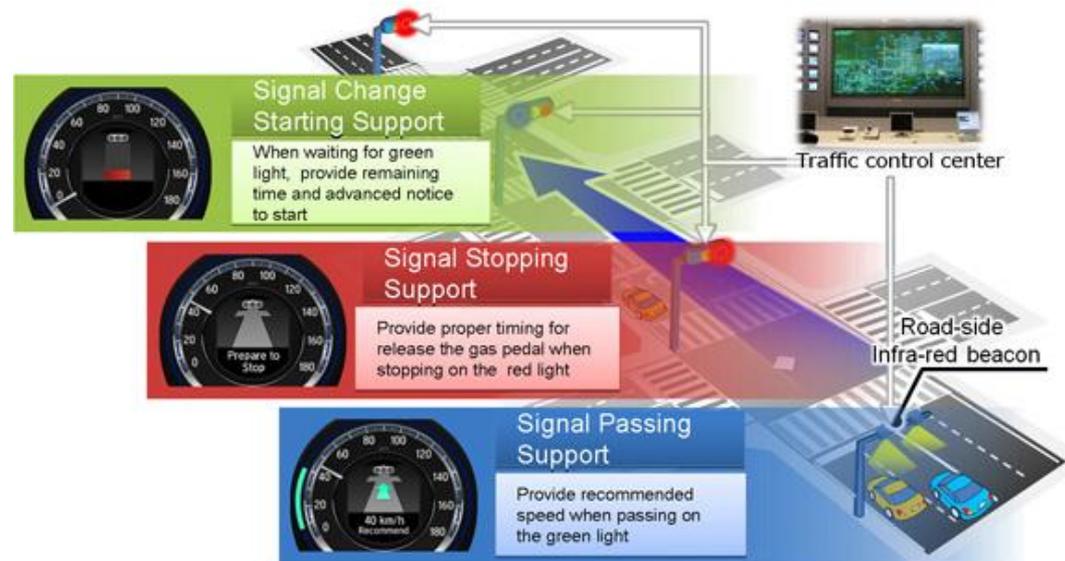
- **Deployment Status and Plan**
  - First public demonstration in April 2014 in Japan
  - No known demonstration or deployment plan for the U.S.
- **Claimed Environmental Benefit**
  - Potential emissions reductions being analyzed
- **Technical Evaluation**
  - No need for a centralized computation engine
  - Likely works with all types of signals
  - Line of sight is required between vehicle and beacon

Signal Change Starting Support — When waiting for green light, provide remaining time and advanced notice to start

Traffic control center

Signal Stopping Support — Provide proper timing for release the gas pedal when stopping on the red light

Road-side Infra-red beacon

Signal Passing Support — Provide recommended speed when passing on the green light

Traffic signal status

Figure from Honda's Press Release

Stakeholder Perspectives on Sharing Traffic Signal Timing Data

- **Technology Vendors/Developers**
  - Many automotive OEMs, smartphone developers, and traffic content aggregators are advocates of sharing traffic signal timing data
  - Navigating different data sharing policies in different localities is a major challenge

- **Traffic Signal Device Manufacturers**
  - Most traffic controllers are able to accommodate requests made by these applications for signal status
    - Up to ten times per second

- **Transportation Agencies**
  - Some see a "legal firewall" as necessary to prohibit local caching of signal timing data
    - Others don't see it as an obstacle to deployment
  - Some are concerned that these apps may cause driver distraction or weaken cybersecurity

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Conclusions

- **Early demonstrations suggest potential reductions in fuel consumption and vehicle emissions**
  - Originally intended for convenience and mobility
  - Support limited types of traffic signals and data types
  - Environmental implications need to be studied further
- **Other technologies for sharing traffic signal timing data may also warrant further investigation**
  - i.e. FirstNet, camera-based traffic light detection
- **Policy and technical challenges remain, but are being addressed**
  - Liability, driver distraction, and cybersecurity
- **DSRC and non-DSRC technologies may serve as complementary pathways for sharing traffic signal timing data**

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