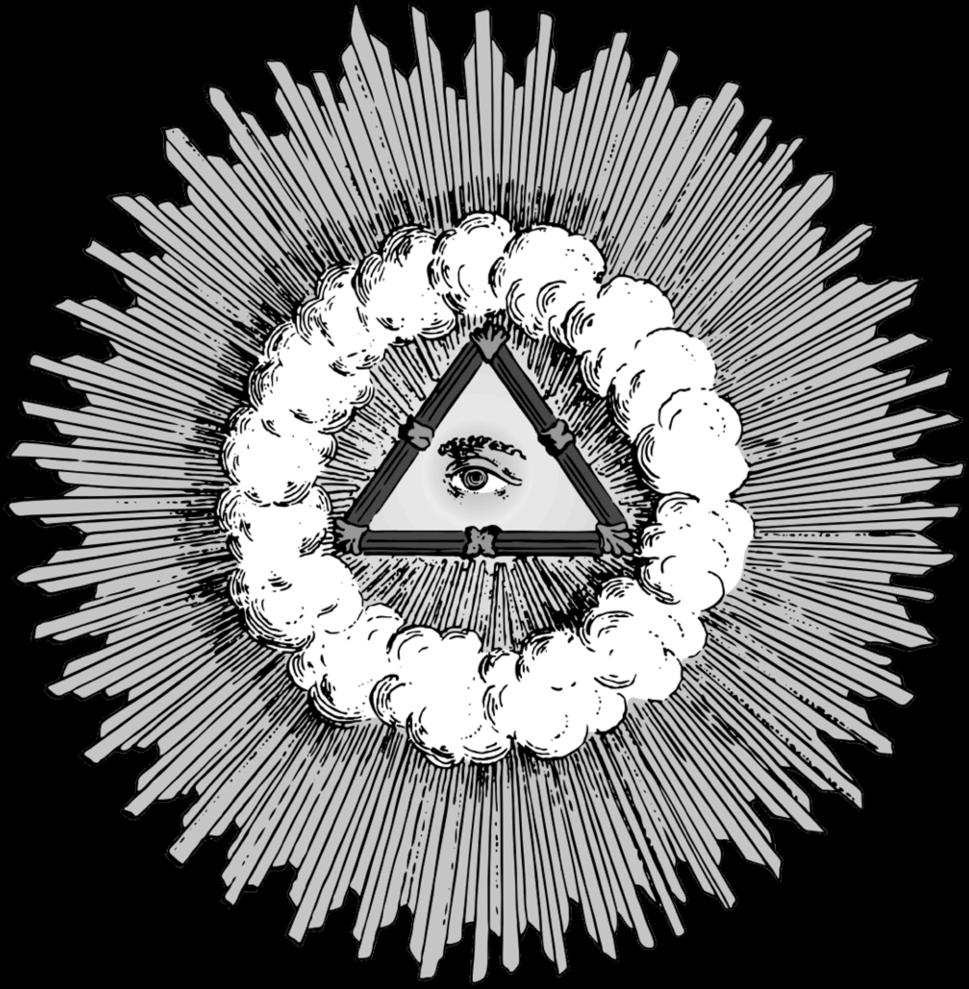


Privacy in DSRC connected vehicles

Defcon 21 – August 3, 2013

whoami

- BSEE, digital communications
- Many years as a network engineer
- Santa Clara University Law student
- Research assistant providing technical expertise on privacy audits and reviews
- Contracted by auto consortium to review privacy of proposed vehicle to vehicle safety network

Standard Disclaimer

IANAL (Yet)

Non-Standard Disclaimer

A current NDA covers some of my work here (but not very much)
The focus will be on published information and standards.

What is This Project?

- DSRC: Dedicated Short Range Communications
  - (Where “short” == 380m)
  - Multi-channel protocol
    (only considering safety channel operation)
- Vehicle to Vehicle
- Vehicle to infrastructure
  - Not having to wait for a light on an empty street again.

Will it Maintain Privacy?

- Probably not, but it could
- Developed for functionality
- Few, small, general privacy and security reviews
- More PR on giving up privacy

Why is It being Developed?

Photo: Jason Edward Scott Bain

- Safety

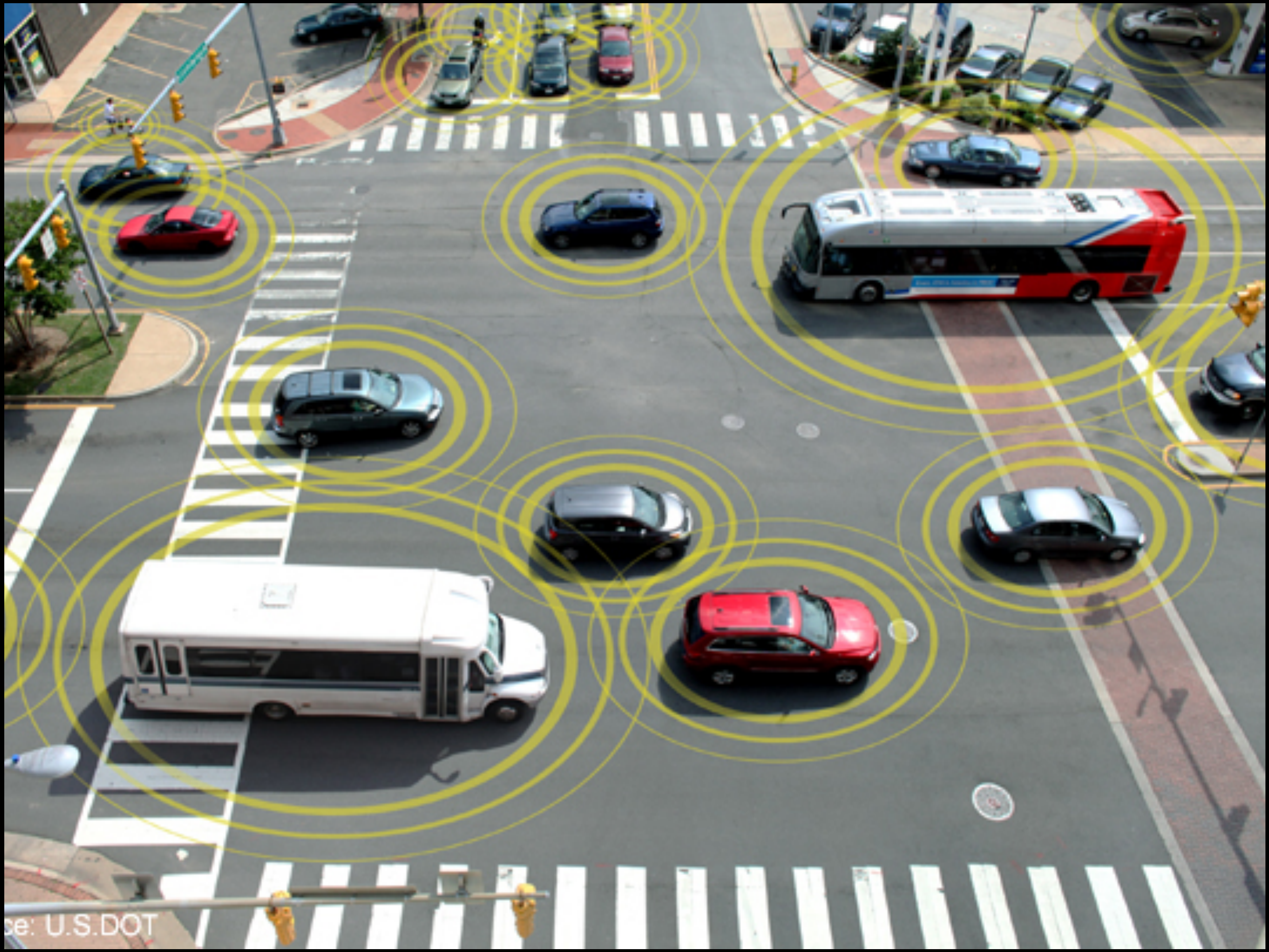


Photo: US Dept. of Transportation

How the safety features work

Non-trivial Impact on Auto Deaths

- World Health Organization estimates 25% of vehicle deaths each year can be prevented.

- Fatigue and distracted driving accidents reduced.

- Blind Corners, fog and limited visibility accidents reduced.

Photo: Public Domain

Will This really Happen?

IT ALREADY IS

How Soon?

- Large Scale function tests complete
- Hardware is already being shipped.
- National Transportation Safety Board said to mandate this last week.
- Has already deployed in trucks in Europe

What is DSRC

- Basic safety messages sent out every 1/10 seconds.
- All message carry a standard glob: values for pre-defined vehicle trajectory and operational data.
- Cars process data and warn driver.
- Equipment integrated into vehicle

Photo: US Dept. of Transportation

AfterMarket Installation

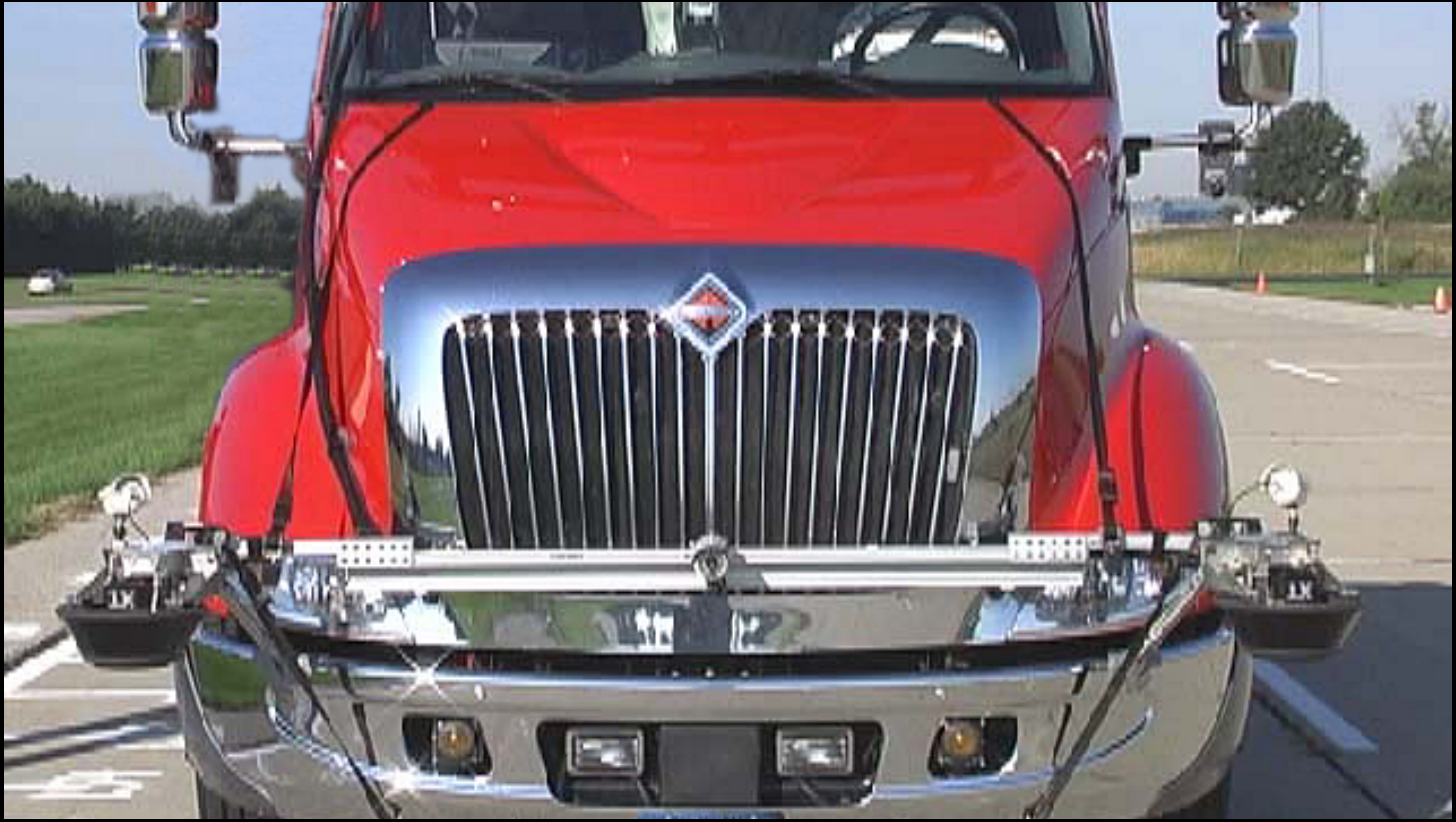


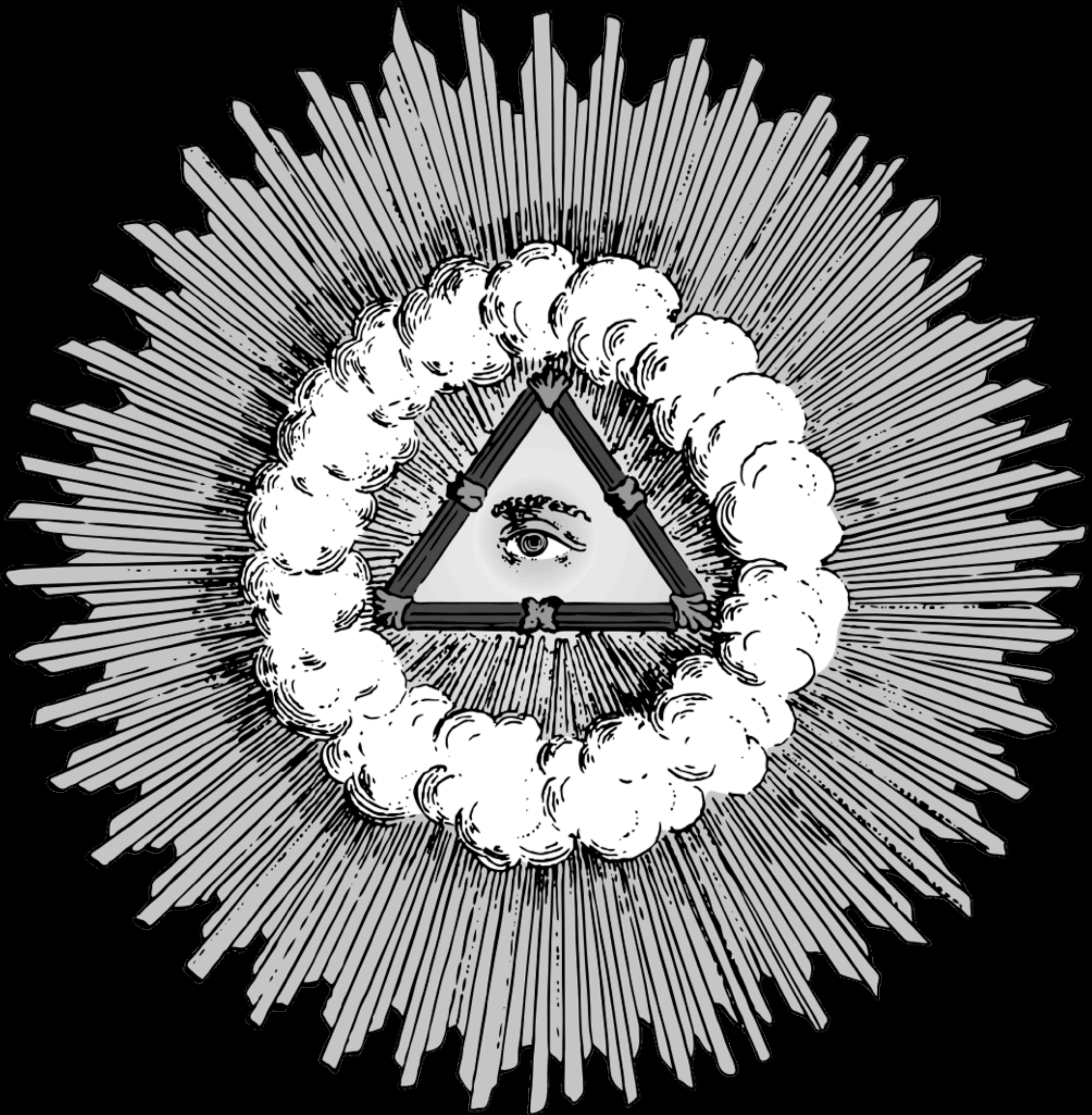
Photo: NIST

- A little cumbersome

What DSRC is not

Photo: US Dept. of Transportation

- CANbus
- OnStar (or any other remote service)
- (Direct) support for autonomous driving *mechanisms*.



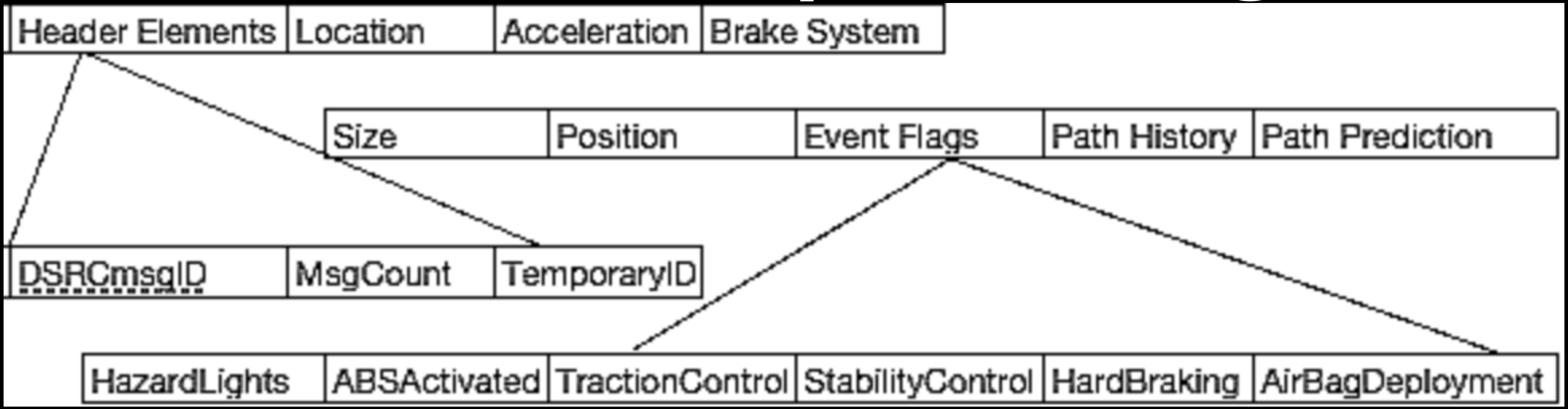
Technical details

Radio protocol

- 5.9GHz reserved in US and Europe
- Signaling standard: IEEE 802.11p / 1609.4 / 1609.3
- Channels reserved for specific functions
- Protocol does not require source address for vehicles
    - Recommendations include using certificates
    - Privacy challenges at each layer

Photo: NASA

Basic Safety Message



Header Elements | Location | Acceleration | Brake System

Size | Position | Event Flags | Path History | Path Prediction

DSRCmsgID | MsgCount | TemporaryID

HazardLights | ABSActivated | TractionControl | StabilityControl | HardBraking | AirBagDeployment

- Standard: SAE J2735
- ~50 fixed data elements
- “only” interface to radio
  (on this channel/band)

Parameters for effectiveness

- Density
  - Benefit derived from other vehicles' use
  - Greater usage means greater effectiveness
- Confidence
  - Most messages must be trustworthy
  - People must trust information broadcast

Validity?

- All messages are cryptographically signed
- Signing certificates issued by central authority
- Issued based on system fingerprint
- Revocation for "malfunctioning" equipment
- System should invalidate itself if internal checks

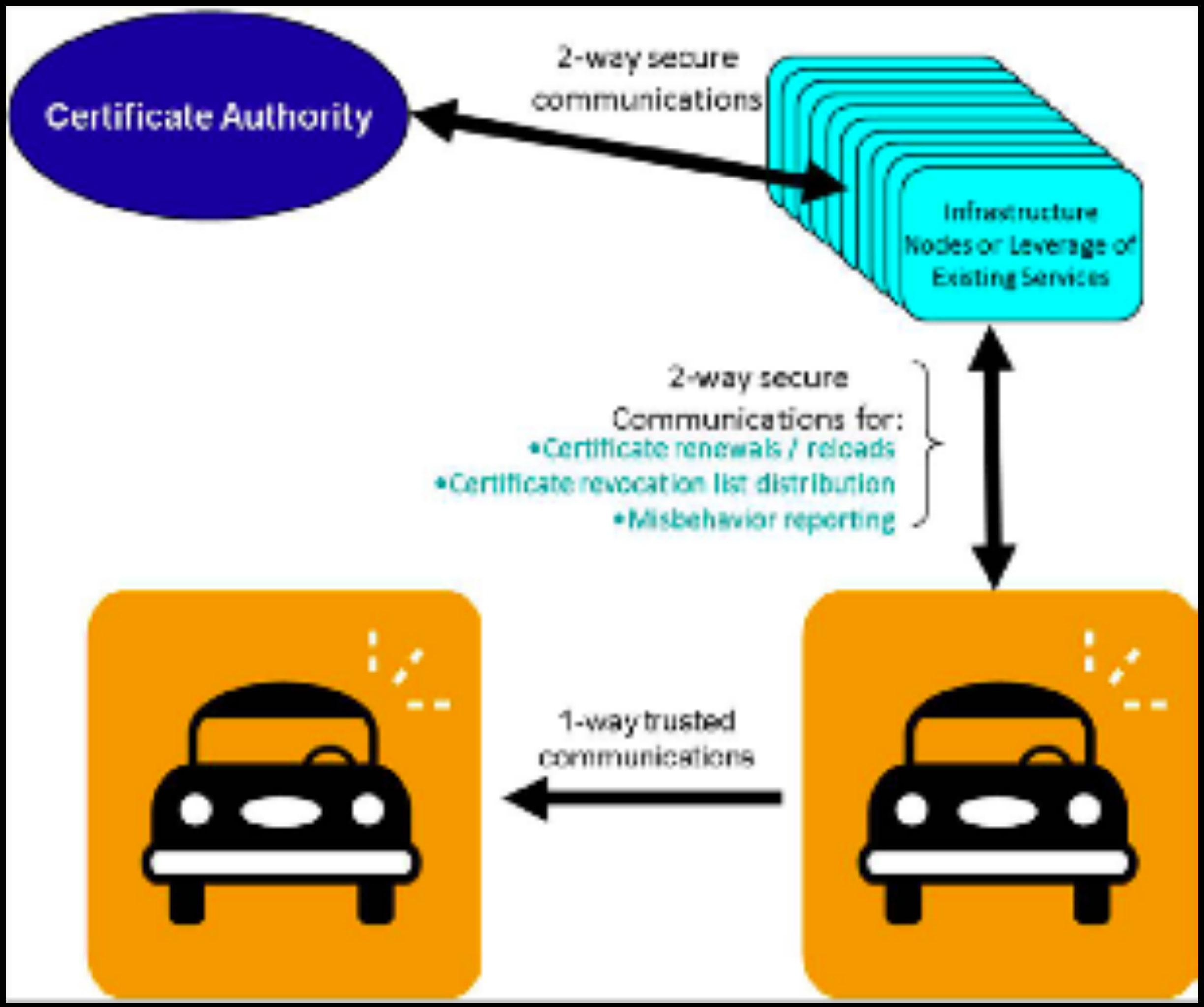
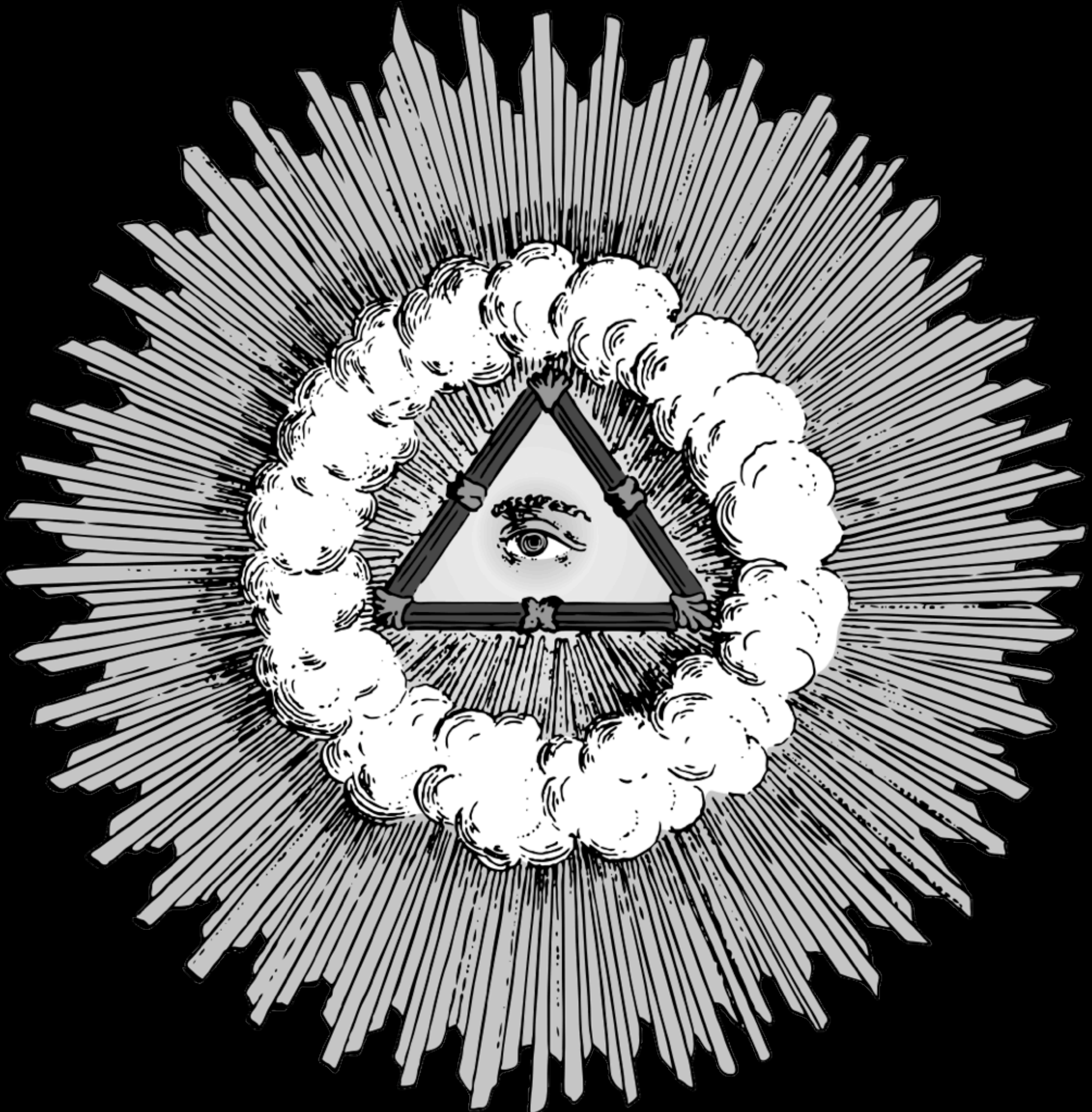

Certificate Authority
2-way secure communications
Infrastructure Nodes or Leverage of Existing Services
2-way secure Communications for:
•Certificate renewals / reloads
•Certificate revocation list distribution
•Misbehavior reporting
1-way trusted communications

Image source: US Dept. of Transportation

Certificates

- Limited time use to prevent tracking
  - Reused?
- Periodically refreshed (and malefactors reported)
  - How often?
- Permanent blacklist

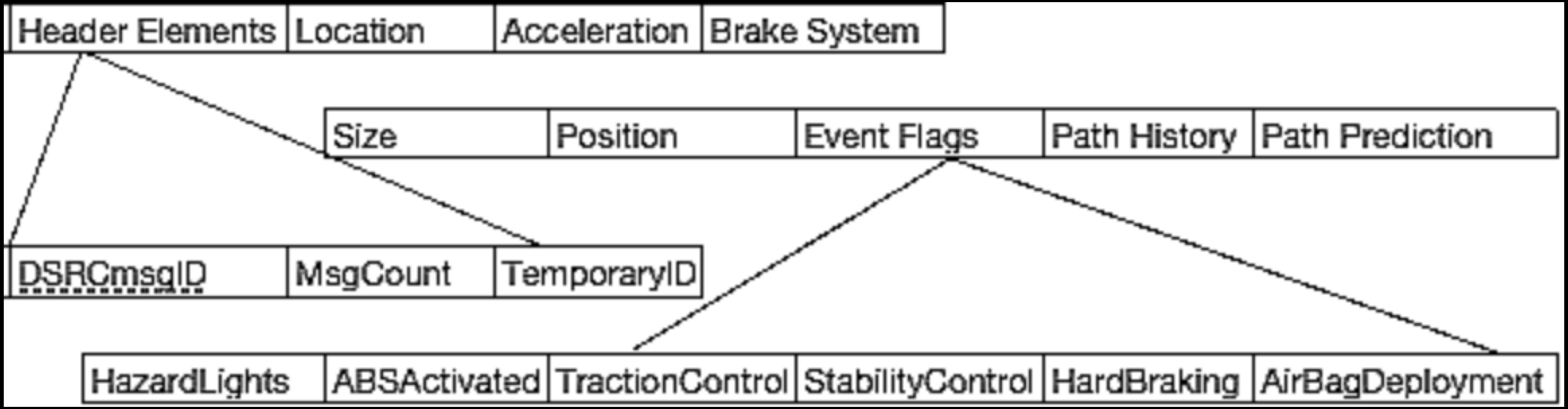


Privacy?

MAC Layer

- Changeable source (for vehicles) / no destination
- Unrouteable! (mostly)
- No significant privacy concern *as is*.
- ***Any*** algorithm to make network routeable will make vehicles trackable.

BSM



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- “Temporary” ID could become persistent with bad app
- Open source apps suggested for processing and acting on message data

Certificates

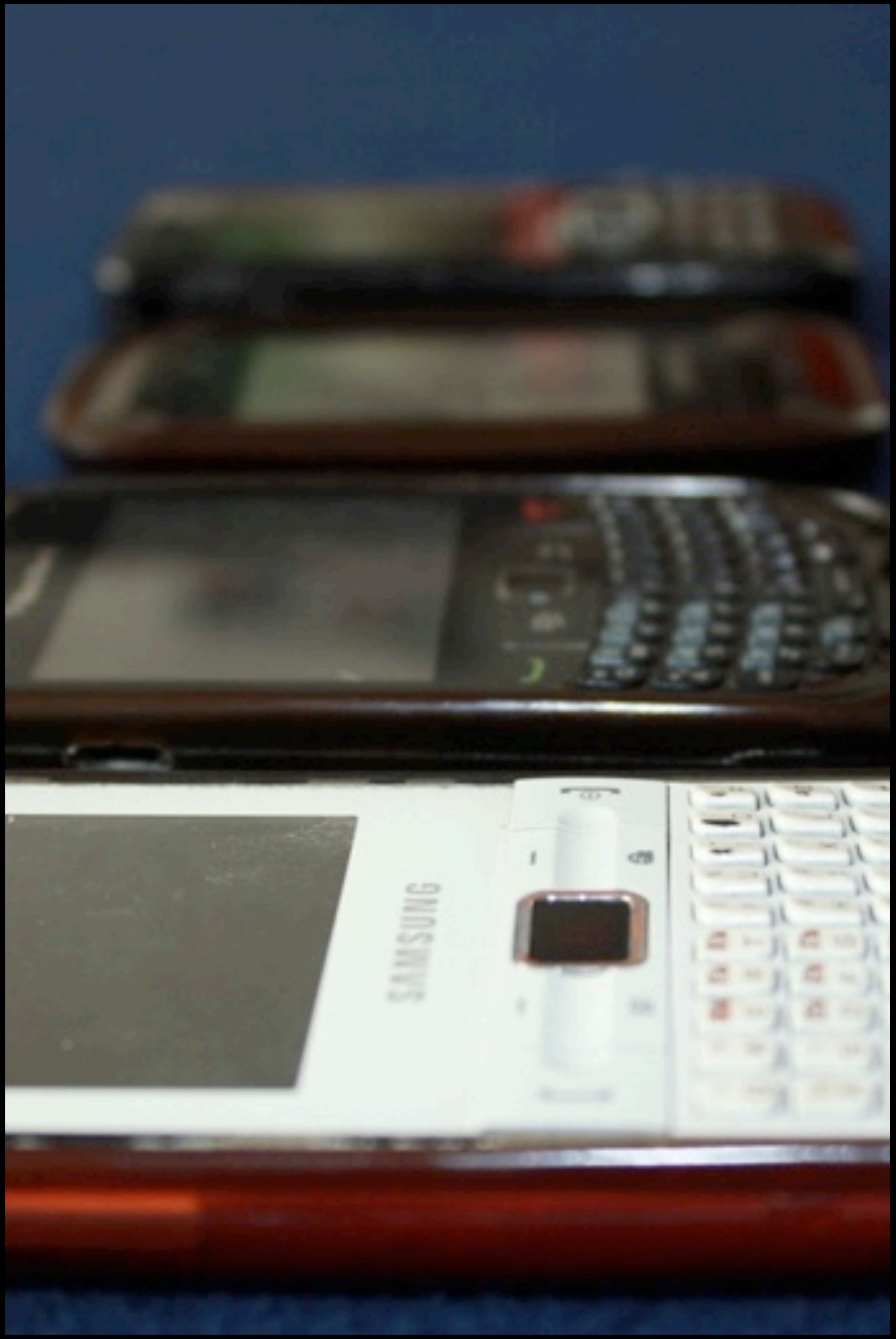
- Identity/Validity conflict
    - Solution: constantly changing certificates
    - Revocation by fingerprint
- Issuing authority?

Fingerprints

- “No” correspondence between fingerprint and car
- “hard coded” into device
- If “revoked”, entire unit must be replaced

Photo Credit: NIST

Certificate Delivery



- Haven’t figured out how certificates are delivered to vehicle
- Proposals include cellular, wifi, infrastructure links
- So many opportunities for failure

Worrisome Noise

- Manufacturers want to use this system for commercial apps
- Advertising and other “funding” schemes to pay for CA
- Fixed infrastructure potentially operated by data brokers

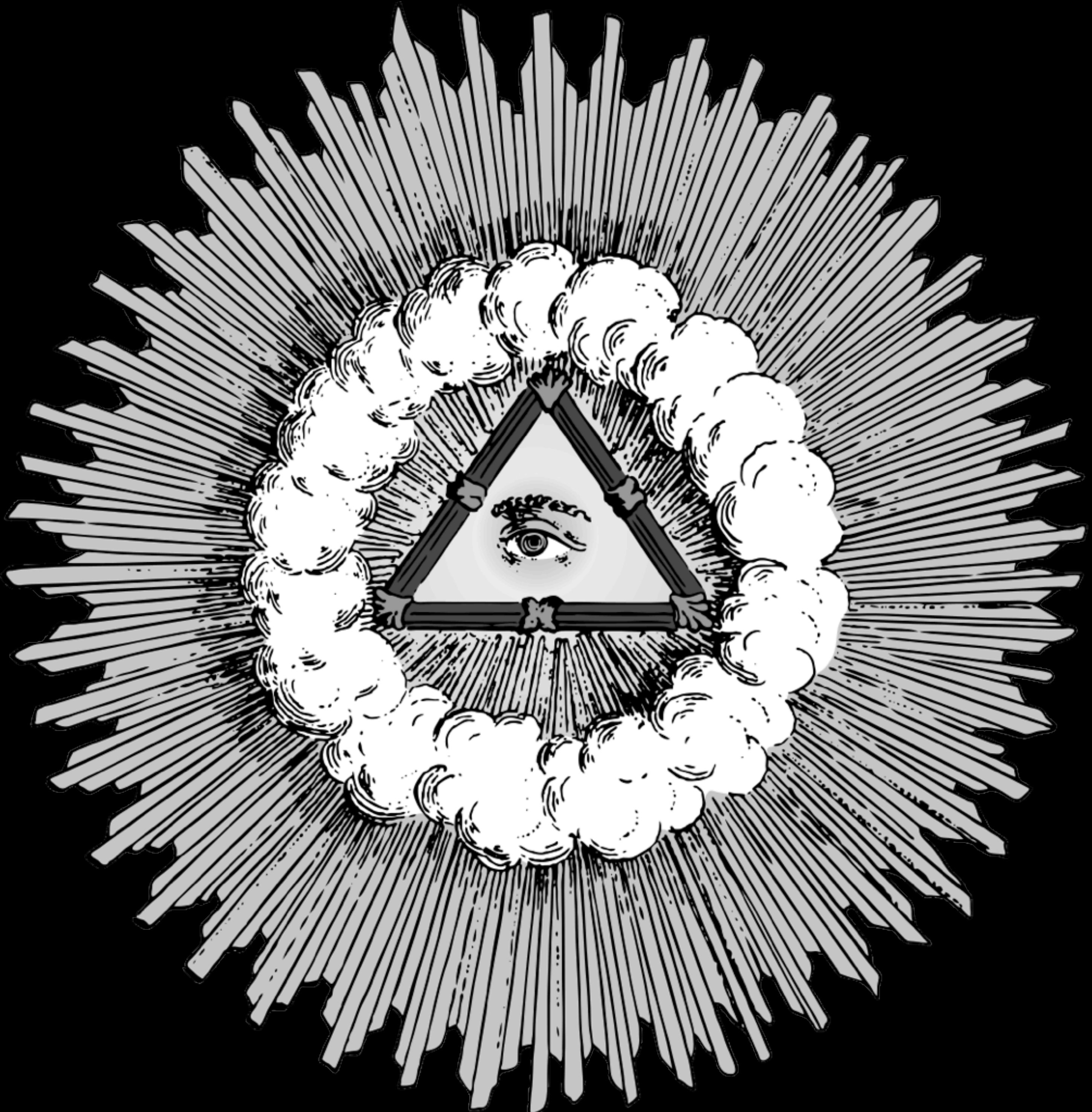
Problem: Law Enforcement

- What can they do with this?
- Correlate location, speed to independent identification? (cameras?)

Photo Credit: Alex E. Proimos

What you Can Do

- Hack the radios
  - Commercially available now
- Hack the protocols
  - Dataset available at www.its-rde.net
- Become politically engaged
  - Most decisions are not being made by elected officials
  - Help find a way to fund the infrastructure without selling out!



Thank you

Acknowledgements

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- DC 650 (especially Charles Blas) who gave me a reality check with current security and privacy capabilities

Contact

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