International Organization for Standardization
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Международная организация по стандартизации

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Your ref. IETF Category A Liaison
Our ref. ISO/TC204-IETF

Date 2015-11-13

Mr. Russ Housley
Member, Internet Architecture Board
1775 Wiehle Avenue, Suite 201
Reston, VA 20190 USA

Category A Liaison Arrangement Between ISO/TC204 and Internet Engineering Task Force (IETF)

Dear Russ:

In response to the request from ISO/TC204 (ISO's committee for Intelligent Transport Systems) and their Prague Resolution 854, this correspondence confirms the establishment of a Category A Liaison with the Internet Society, which serves as the administrative home for the Internet Engineering Task Force (IETF).

Tutorial of IP in Vehicular Communications

Alexandre Petrescu (speaker)

ITS BoF at IETF 95

April 6th, 2016

Buenos Aires

Contents

- Typical communication requirements in links for vehicular settings
- How IP arrives in automobiles:
  - inside
  - outside
- IP layer in stacks dedicated to vehicular communications
- Multiple channels of DSRC
- 1-IP-hop loopfree topology for V2V and V2I

Selected Accuracy Requirements

TOYOTA InfoTechnology Center, U.S.A., Inc.

- 2-D position: 1.5 meters
- Elevation: 3 meters
- Speed: within 1 km/hour
- Heading: 2 or 3 degrees depending on speed
- Longitudinal acceleration: 0.3 m/sec^2
- Yaw Rate: 0.5 degrees/second
- Size: 0.2 meters

Applies to BSM message

Most of these are specified to be achieved for at least 68% of measurements in “open sky” conditions

Congestion Control (simplified)

TOYOTA
InfoTechnology Center, U.S.A., Inc.

- When to send BSM:
  - Send at 10 Hz during specified "events"
  - If vehicle dynamics and channel conditions cause "suspected tracking error" to become large
  - Otherwise, at a background rate that decreases based on number of neighbor vehicles within 100 meters (10 Hz → 1.6 Hz)
- What power to send BSM:
  - Decreases from 20 dBm → 10 dBm as Channel Busy Ratio grows from 50% to 80%

How IP arrives inside an automobile

Built-in cellular module:

- Live road traffic data
- Map, wheather and SW updates
- Applications store

User's smartphone

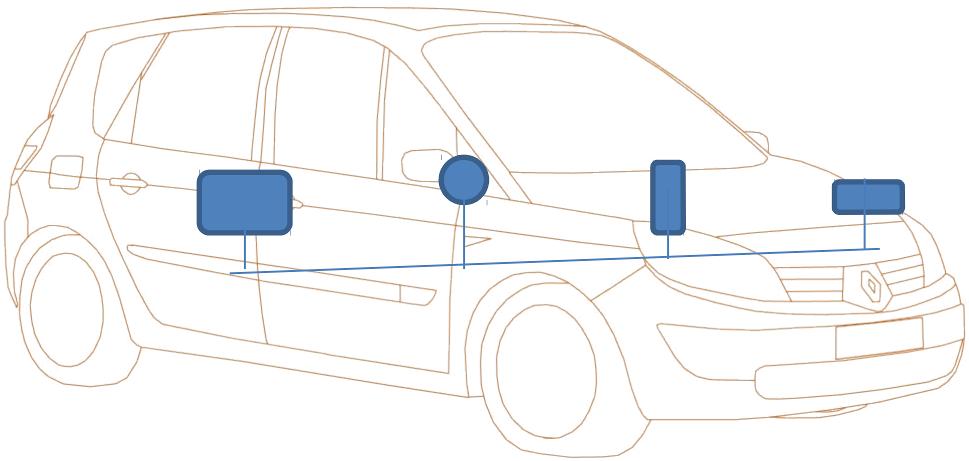
- Share Internet connection
- Mirrorlink – share display and music

Aftermarket OBDII-docked WiFi hotspot

- Remote query of CAN
- Internet access
- *E.g. VINLI, Samsung Connect Auto*

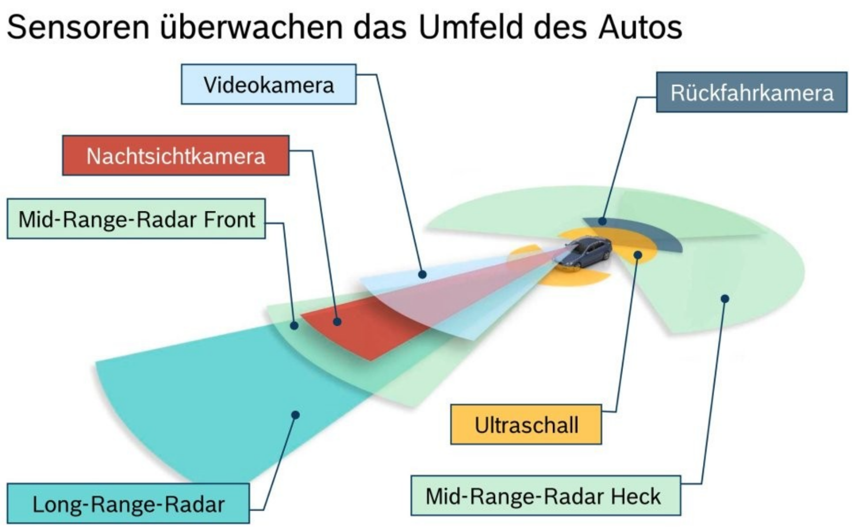
DSRC (EU ITS-G5) for specific applications

- V2V use-cases
- V2I interactions



Future: LTE-V2X/5G connection box, more app-specific boxes

Current situation outside an automobile



Current comm using « bounce » sensors :

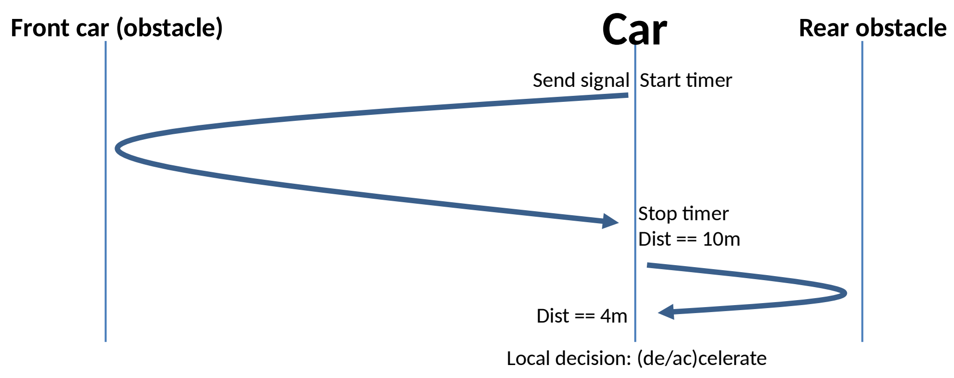
- Ultra-sound
- *-range and HD radar
- Lidar, velodyne
- Video camera

Current applications:

- Assisted parking
- Enhanced rear-view
- Dead-angle
- Enhanced cruise control
- Emergency braking
- Vulnerable Road User and obstacle detection

Drawbacks:

- Dependent on propagation patterns
  - Hard at intersection
- Too many sensors
  - Why no rear long-range radar?
- Ignores other car's intentions
  - Don't follow me!



Bouncing principle

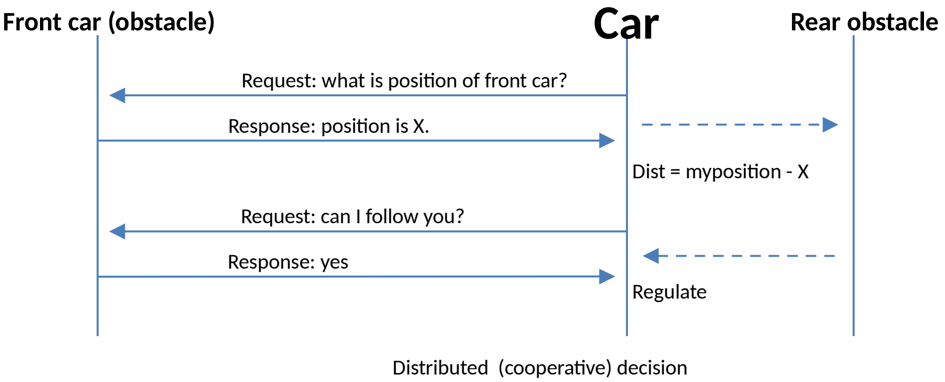
IP arrives outside an automobile

New devices:

- 802.11-OCB (earlier 11p)
  IP-enabled interfaces
- Ultra-precise self localization, a combination of:
  - sattelite sources (GNSS)
  - Fixed stations (WAAS, EGNOS, Real-Time Kinetics)
  - odometers from ABS,
  - short-range ground laser (F1 means to measure speed),
  - inertial centrals (gyros, accelerometers)
- Visible Light Communications (IP-over-foo)

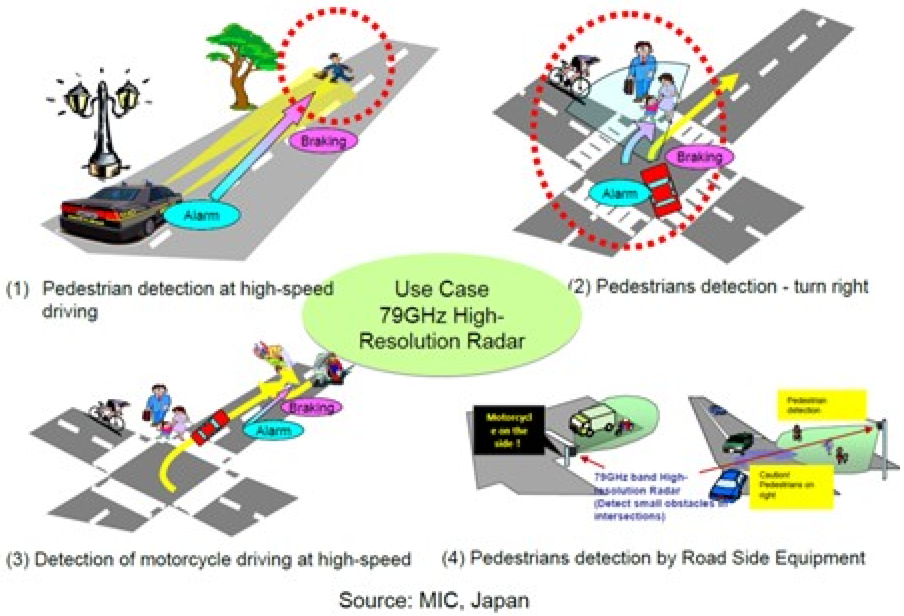
New applications when IP is there:

- *Smoother*, longer, authorized platooning
- Intersection « mirrors »
- Virtual siren
- See through trucks
- more



Message exchange principle

IP used outside an automobile



Samsung safety truck


DAF and TNO demonstrate 'EcoTwin'

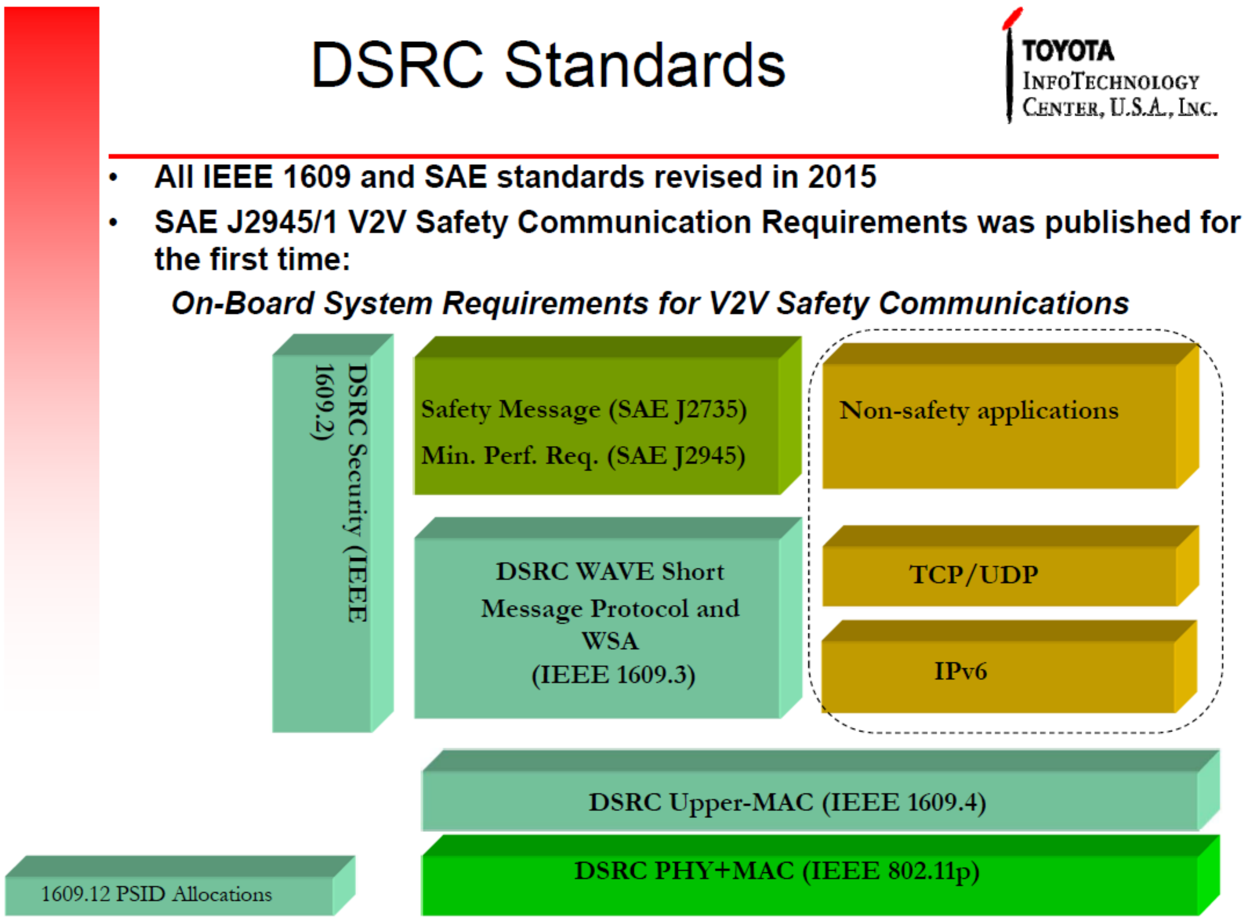
27-03-2015 , Eindhoven

During "Automotive Week", DAF and TNO demonstrated the "EcoTwin" project in front of the Dutch Minis
structure and the Environment, Schultz van Haegen and her Belgian colleague Galant. This demonstratio
N270 near Helmond showed two truck combinations – wirelessly linked via WiFi – driving a short distance


SignalGuru from MobiSys'11

Virtual siren

IP in vehicular SDO stacks



Similar presence of an IP(v6) layer in stacks depicted by:

- ISO CALM
- ETSI TC ITS
- ITU

Cohabitation with other networking layers.

US DSRC Background

- Dedicated Short Range Communication
- Vehicle ad hoc networking
- V2X communication: Vehicle to/from
  - Vehicle (V2V)
  - Infrastructure (V2I)
  - Pedestrian (V2P)
  - etc.
- 5.850-5.925 GHz (5.9 GHz band)
- Primary application categories:
  - Safety, Mobility, Environment, Commerce

ITU PHY/MACs in the DSRC space

Parameter	ETSI (Annex 1)	IEEE (Annex 2)	ARIB (Annex 3)	TTA (Annex 4)
Operating frequency range	5 855-5 925 MHz	5 850-5 925 MHz	755.5-764.5 MHz (Single channel)	5 855-5 925 MHz (Pilot system)
RF channel bandwidth	10 MHz	10 MHz or 20 MHz	Less than 9 MHz	Less than 10 MHz
RF Transmit Power/EIRP	Max 33 dBm EIRP		–	23 dBm
RF transmit power density			10 dBm/MHz	

Reference: ITU document

Message: only IP runs on that many PHY/MACs

Parameter	ETSI (Annex 1)	IEEE (Annex 2)	ARIB (Annex 3)	TTA (Annex 4)
Modulation scheme	BPSK OFDM, QPSK OFDM, 16QAM OFDM, 64QAM OFDM	64-QAM-OFDM 16-QAM-OFDM QPSK-OFDM BPSK-OFDM 52 subcarriers	BPSK OFDM, QPSK OFDM, 16QAM OFDM	BPSK OFDM, QPSK OFDM, 16QAM OFDM, Option: 64QAM
Forward error correction	Convolutional coding, rate = 1/2, 3/4, 2/3	Convolutional coding, rate = 1/2, 3/4	Convolutional coding, rate = 1/2, 3/4	Convolutional coding, rate = 1/2, 3/4
Data transmission rate	3 Mbit/s, 4.5 Mbit/s, 6 Mbit/s, 9 Mbit/s, 12 Mbit/s, 18 Mbit/s, 24Mbit/s, 27Mbit/s	3, 4.5, 6, 9, 12, 18, 24 and 27 Mbit/s for 10 MHz channel spacing 6, 9, 12, 18, 24, 36, 48 and 54 Mbit/s for 20 MHz channel spacing	3 Mbit/s, 4.5 Mbit/s, 6 Mbit/s, 9 Mbit/s, 12 Mbit/s, 18 Mbit/s	3, 4.5, 6, 9, 12, 18 Mbit/s, Option: 24, 27 Mbit/s
Media access control	CSMA/CA	CSMA/CA	CSMA/CA	CSMA/CA, Option: Time Slot based CSMA/CA
Duplex method	TDD	TDD	TDD	TDD

An IP interface?

DSRC Band Plan

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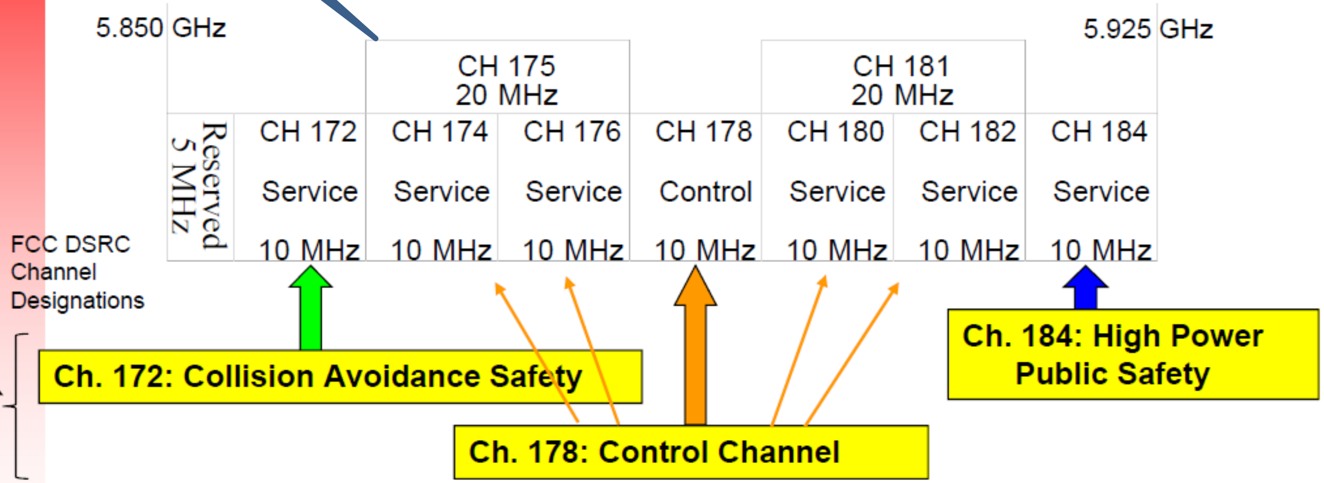
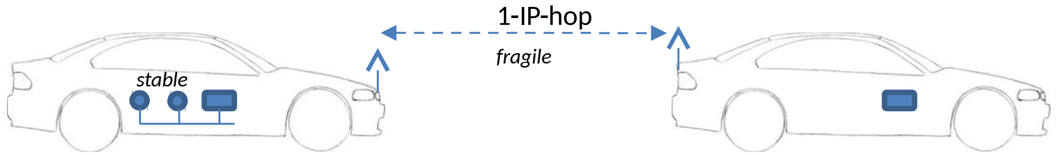
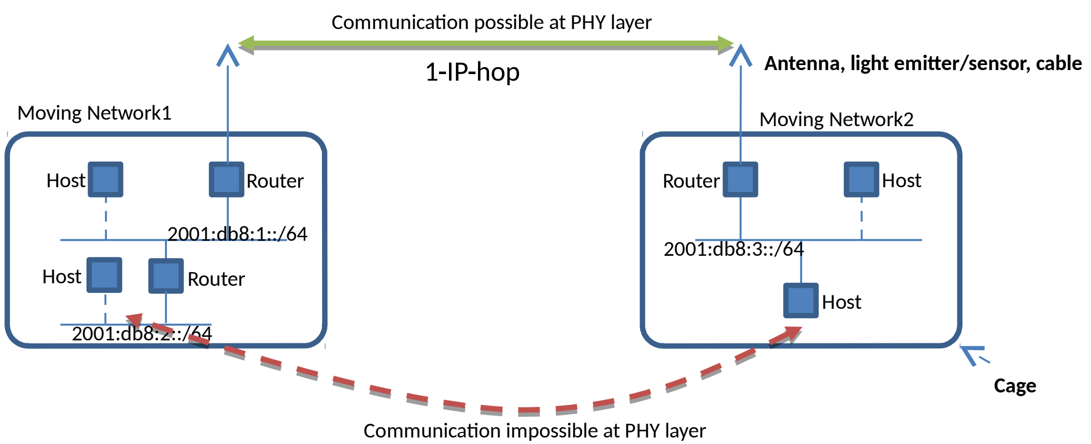
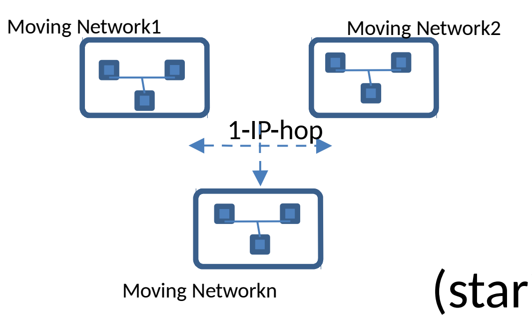


- Ch. 172 likely to be limited to BSM, MAP, SPaT (and possibly a few others)
- Most DSRC applications will use other channels.
- Many of those applications have safety implications and critical communication performance requirements
- Automated Driving-related applications are prominent among these

Topology







(star?) Topology

Acknowledgement

- John Kenney
- Michelle Wetterwald