Roadside-assisted V2V messaging with 5G mobile edge computing

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The University of Tokyo

2017.09.18 IEEE 5G Summit

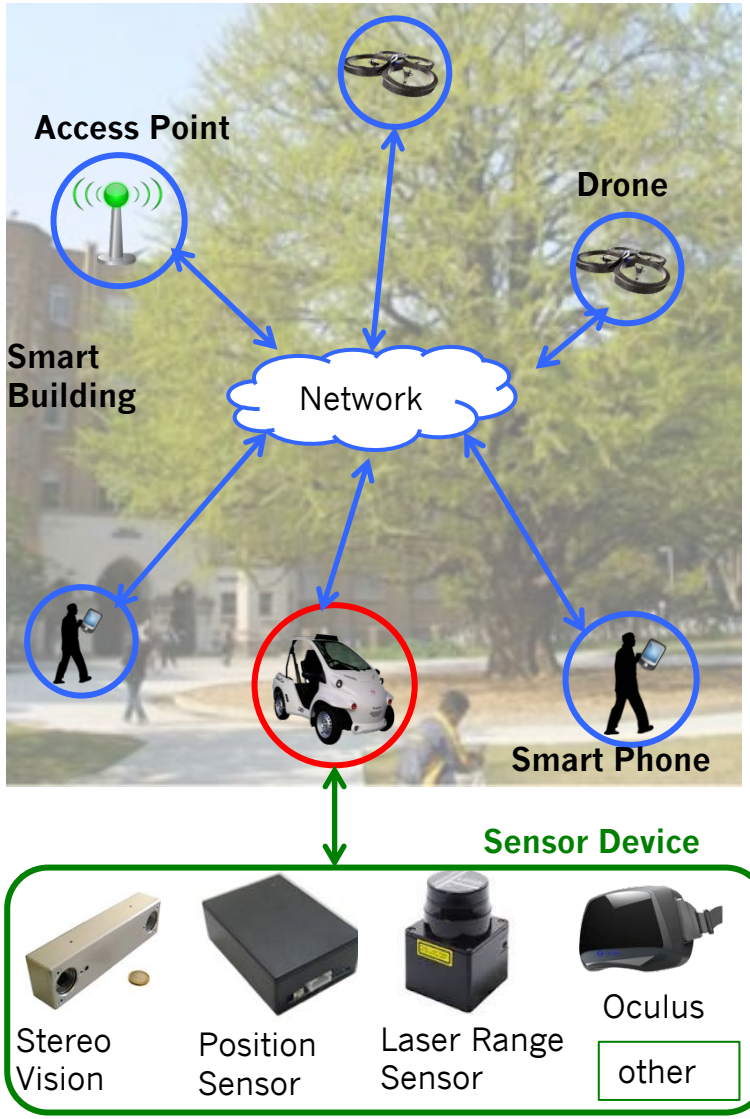
Outline

1. Autonomous vehicles (Our activity)
2. Communication for Autonomous vehicles (Our research proposal)

Autonomous Vehicle

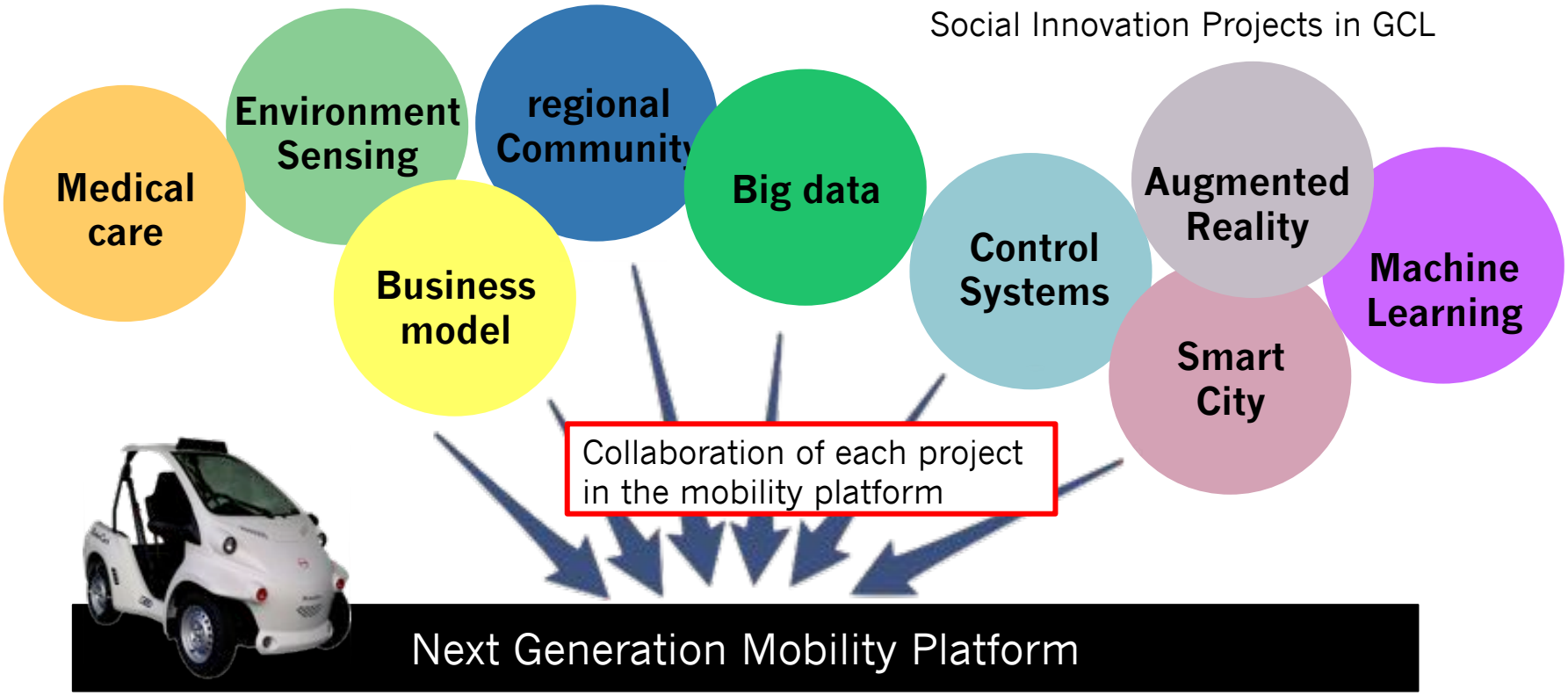
Mobile Unit for Smart Campus Transportation

- Ph.D Education Program
- Beyond road mobility
- Harmonization of human and mobility device in the life
- Focus on mobility service constricted upon autonomous driving but not autonomous driving it self



GCL MUSCAT

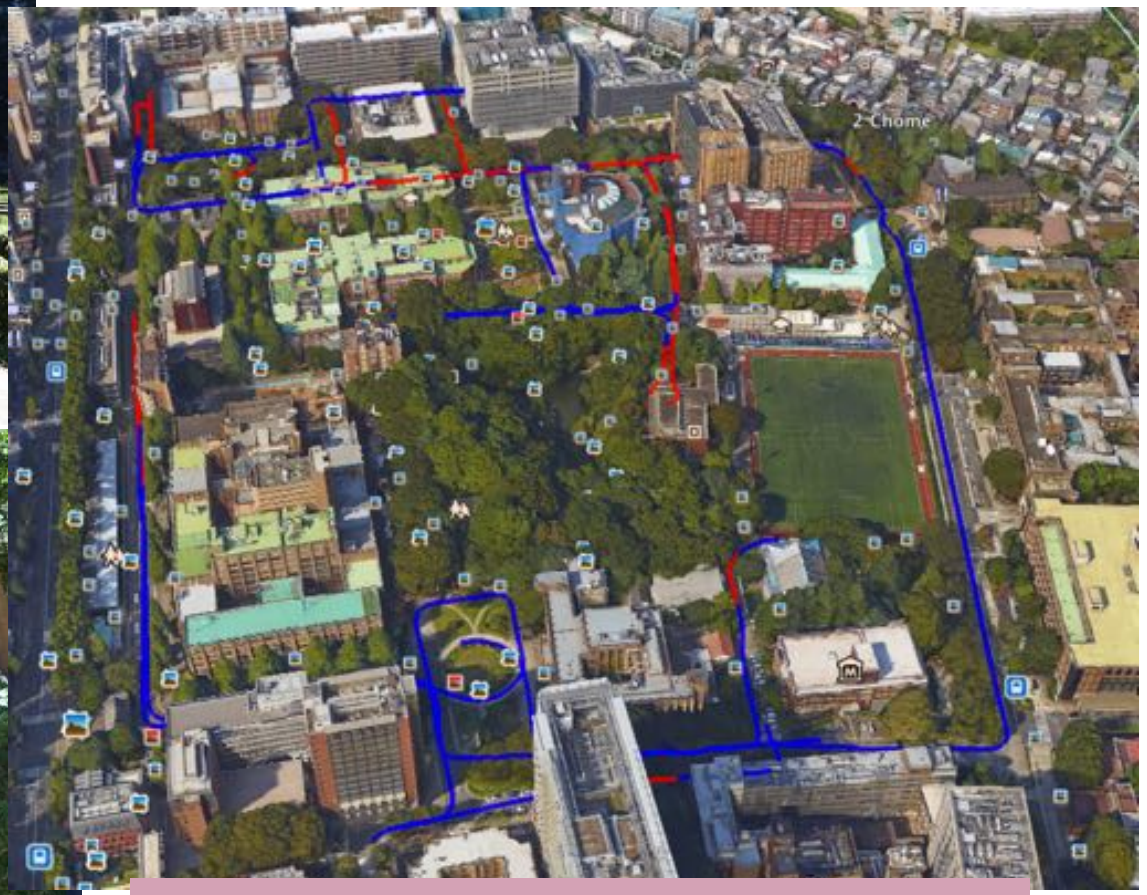
Next Generation Mobility Platform



- Validations, experiments, and demonstrations
- Of each GCL course students,
- On common mobility platform,

Point Cloud Measurement

mobile mapping system



Hongo Campus, University of Tokyo

Field Test

System Configuration

Acceleration
Braking
Steering

CAN

Controller

Ethernet

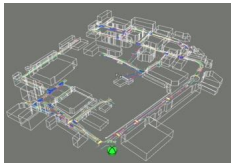
Ethernet

Velodyne
VLP-16

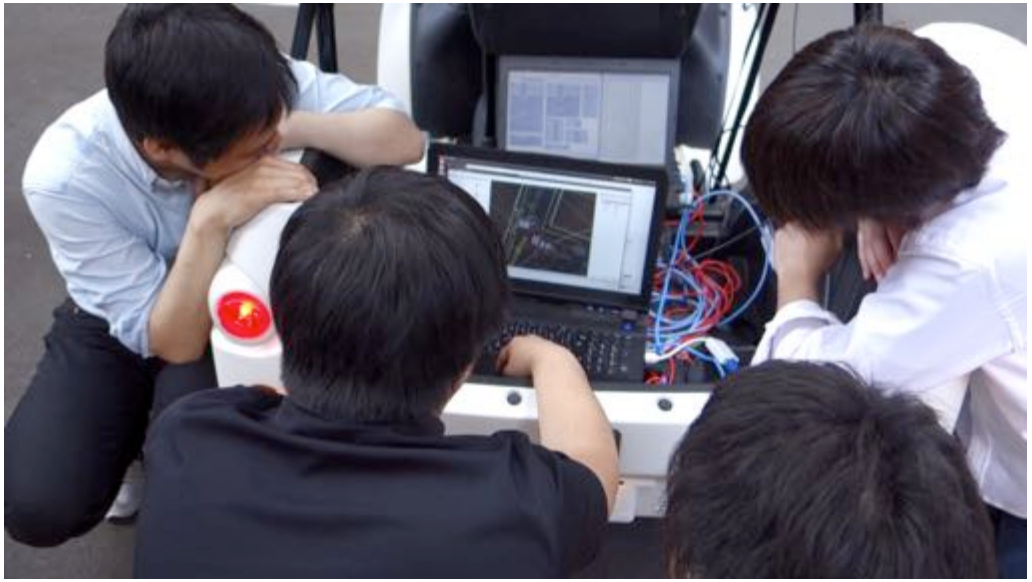
USB

Stereo camera

Sensing	Detection
Localization	Planning

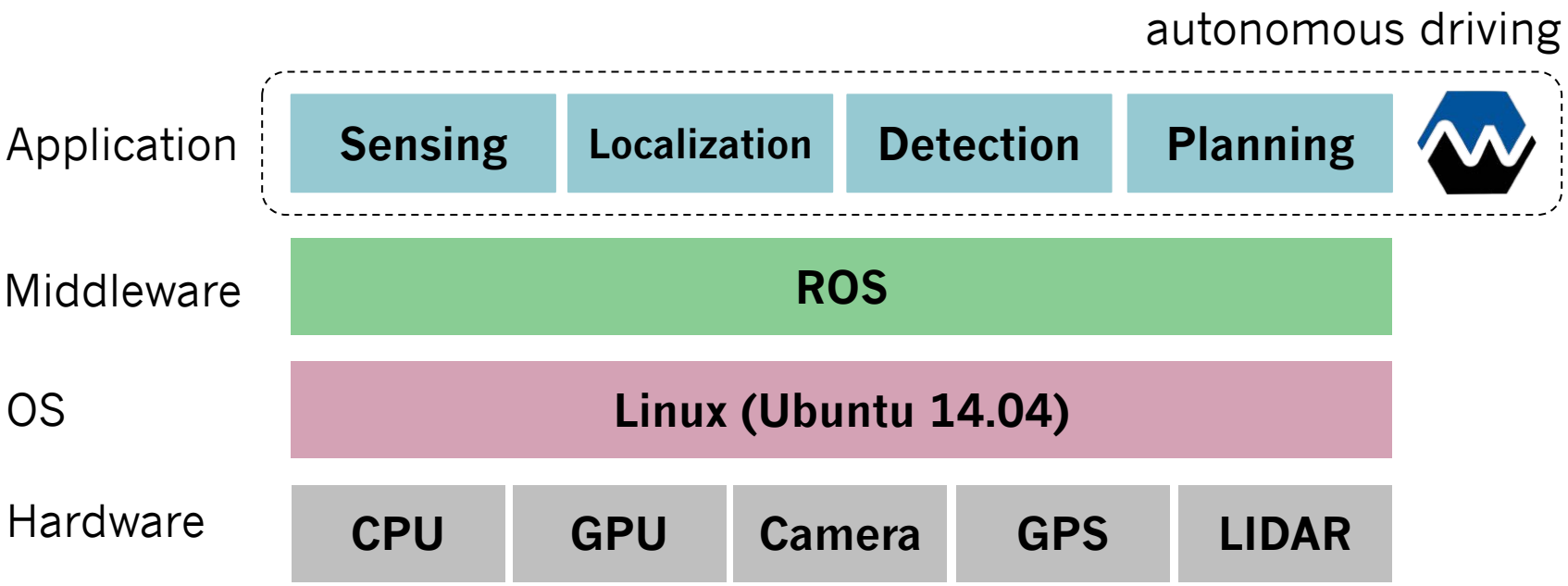


3D map
(Point Cloud &
Vector data)



AutoWare

- Open-source software for urban autonomous driving
- Providing basic autonomous driving function based on ROS
- https://github.com/CPFL/Autoware



AutoWare

Interact
Move Camera
Select
Focus Camera
Measure
2D Pose Estimate
2D Nav Goal
Publish Point
Time
ROS Time: 1494474049.01
ROS Elapsed: 71.68
Wall Time: 1495186078.70
Wall Elapsed: 226.03
Experimental
Reset
Left-Click: Rotate. Middle-Click: Move X/Y. Right-Click: Move Z. Shift: More options.
9 fps

MUSCAT Workshop

MUSCAT Workshop

Cooperative Intelligent Transportation Systems

Cooperative Systems
Systems where multiple entities share information and tasks to achieve common objectives.

+

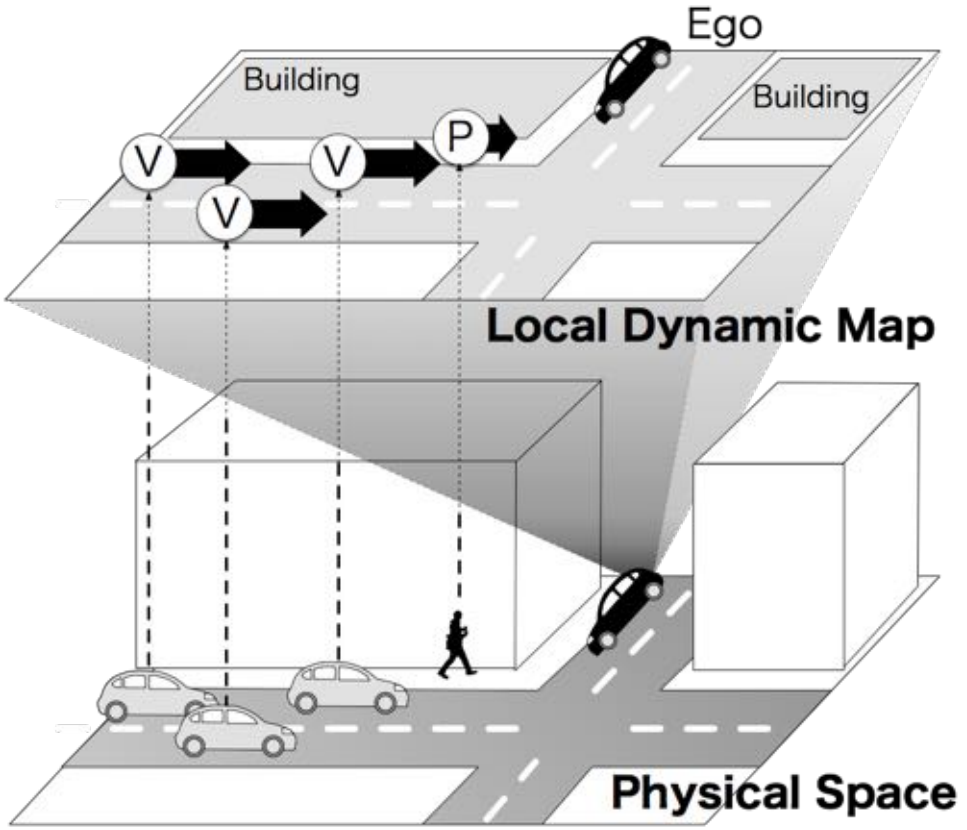
Intelligent Transportation Systems

Systems that realize safe, efficient and comfortable human mobility.

- **Cooperative Intelligent Transportation Systems**
  - Systems where multiple ITS Stations share information to achieve better road safety, traffic efficiency and comfort

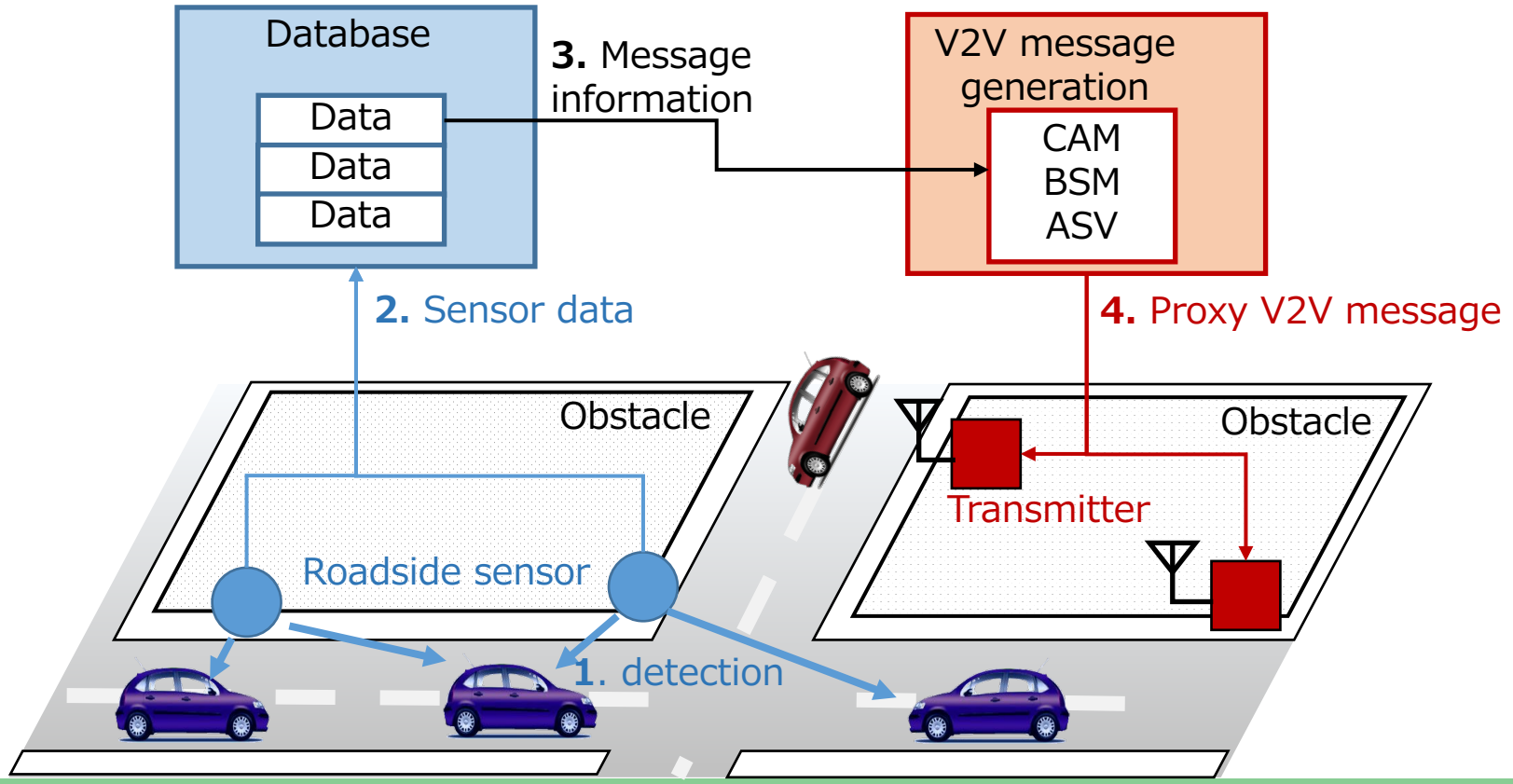
V2V Messaging

- Standards
  - **EU**: Cooperative Awareness Message (CAM) - IEEE802.11p
  - **Japan**: Advance Safety Vehicle Message (ASV) – IEEE802.11p
  - **US**: Basic Safety Message (BSM) – 760Mhz
- Issues
  1. Mixed Environment
  2. Obstacles
  3. Wireless range
  4. Malicious message



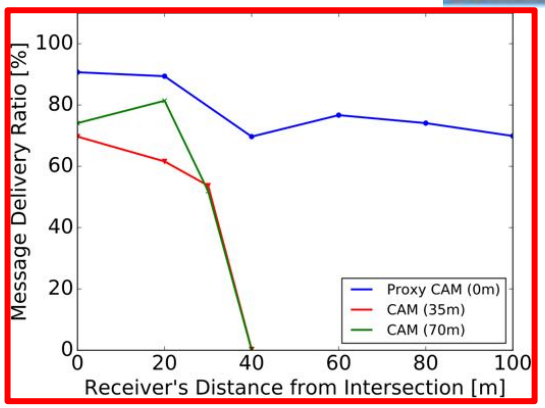
Proxy CAM

- Object detection by the road side sensor
- Proxy message transmission on be half of the object

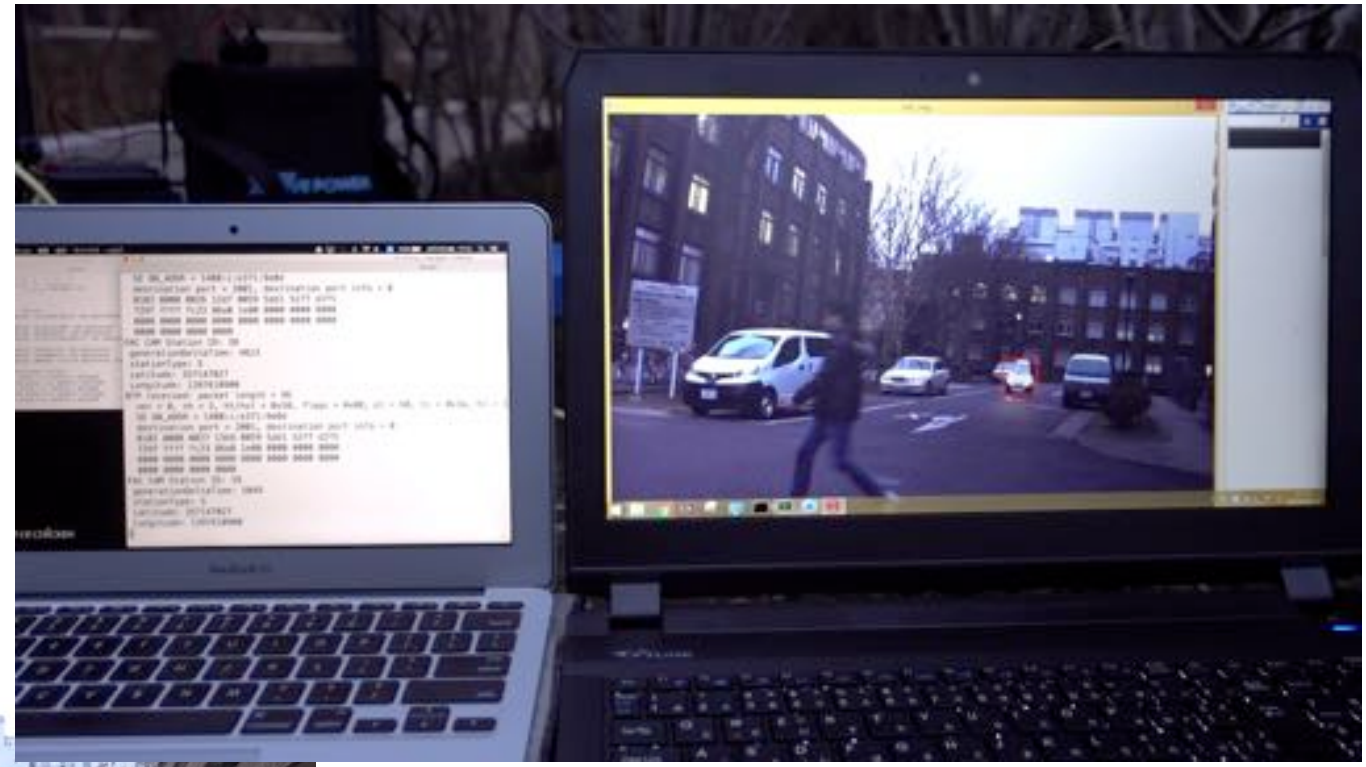


Proxy CAM

Tomoya Kitazato, Manabu Tsukada, Hideya Ochiai, Hiroshi Esaki,
"**Proxy Cooperative Awareness Message: An Infrastructure-Assisted V2V Messaging**", The Ninth International Conference on Mobile Computing and Ubiquitous Networking (ICMU2016), Germany, October 4-6, 2016

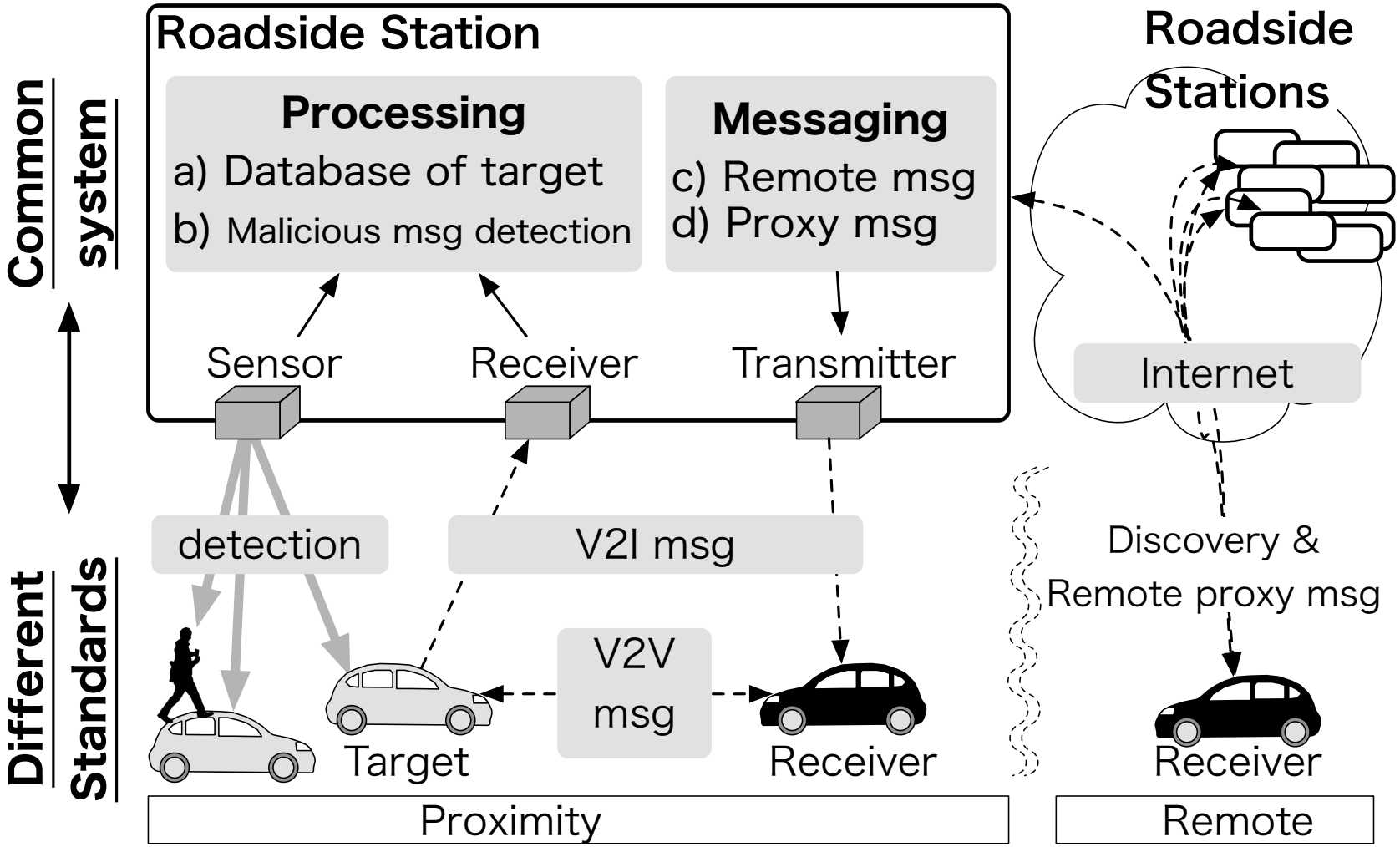


Demonstration



Tomoya Kitazato, Manabu Tsukada, Hideya Ochiai, Hiroshi Esaki, "**Proxy Cooperative Awareness Message: An Infrastructure-Assisted V2V Messaging**", The Ninth International Conference on Mobile Computing and Ubiquitous Networking (ICMU2016), Germany, October 4-6, 2016

Proposed system



- Manabu Tsukada, Roadside-Assisted V2V Messaging for Connected Autonomous Vehicle" , The Thirteenth International Conference on Wireless and Mobile Communications (ICWMC 2017), Nice, France, July, 2017.

Conclusion

- Roadside-Assisted V2V Messaging
  - a real-time cyber-physical system that integrates sensing technology with V2Vand V2I networks and combines ITS and cellular media with IPv6
  - a common solution for different standards in the EU, US, and Japan
- Future works
  - field operational tests
  - large-scale performance evaluation of the system using simulation
  - high technical compatibility needed to co-locate with 5G mobile edge stations

Thanks

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