



A Comparison of Communication Mechanisms in Vehicular Edge Computing

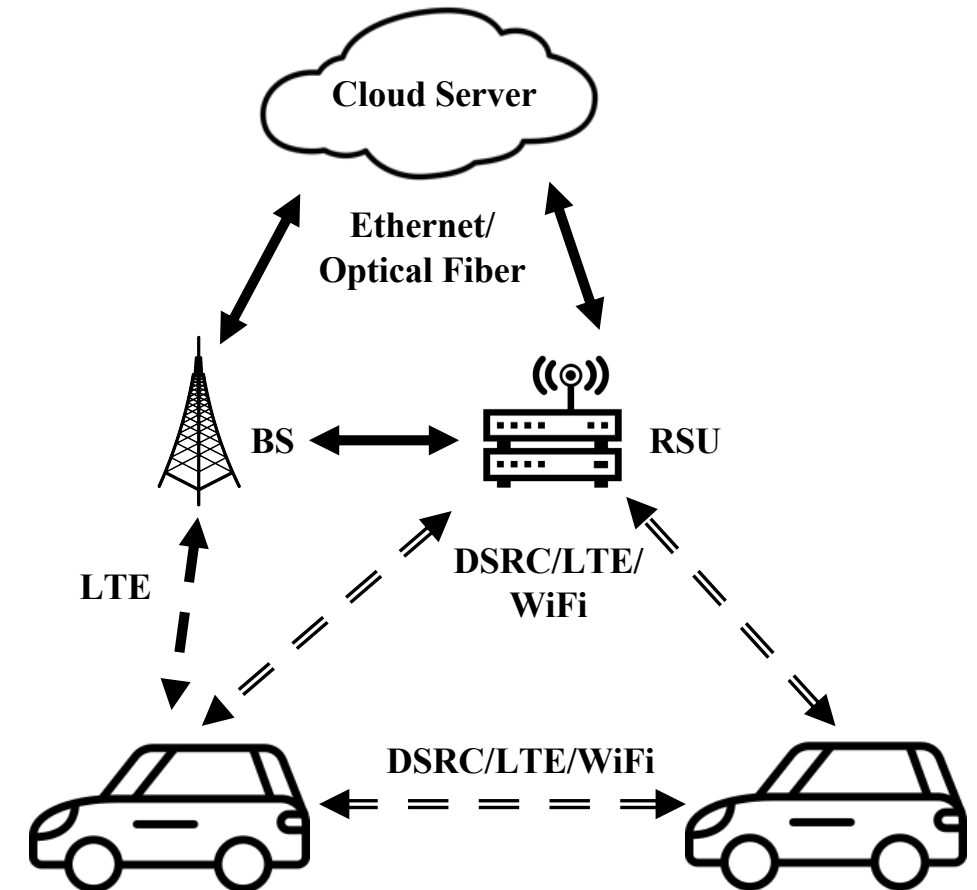
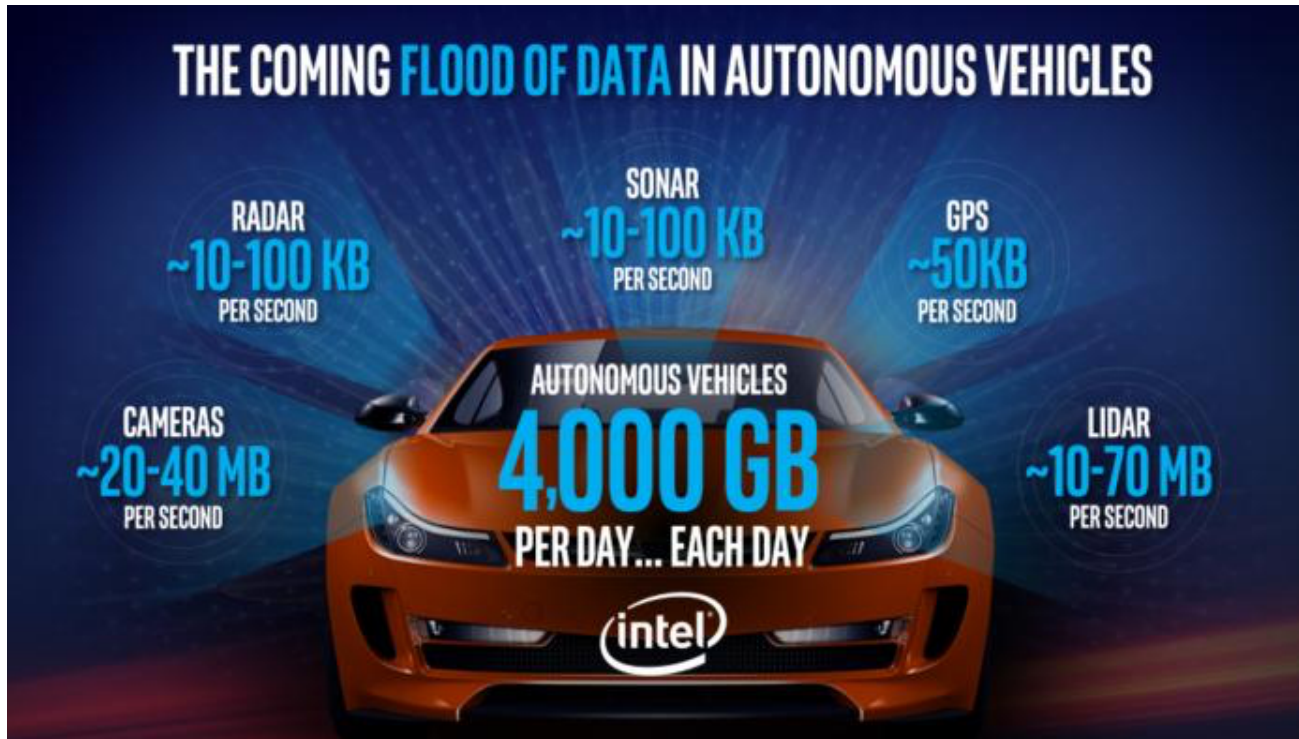
Liangkai Liu, Baofu Wu and Weisong Shi

Wayne State University
<http://thecarlab.org>

Outline

- Motivation
- Contributions
- Experimental Setup and Prototype
 - Wi-Fi, LTE, DSRC
- Comparisons and Evaluation
 - latency, power dissipation, system utilization
- Future Work

Motivations



DSRC: Dedicated Short-Range Communications

Contributions

- To the best of our knowledge, our work is the **first** comparison of communication mechanisms of *LTE*, *Wi-Fi*, and *DSRC* using real VEC applications.
- An end-to-end communication prototype is built which can support *LTE*, *DSRC*, and *Wi-Fi*. On top of the prototype, *ROS*, *Socket*, and *Ping* messages are implemented.
- We evaluated the communication prototype in *latency*, *power dissipation*, and *system utilization* and get three observations for the real deployment of VEC applications.

Experiment Setup

- Computation Device
 - Intel Fog Reference



- Communication Devices
 - Wi-Fi router
 - USRP B210 board + VERT
 - Mocar DSRC RSE + OBE



Wi-Fi Router



USRP B210



VERT-2450

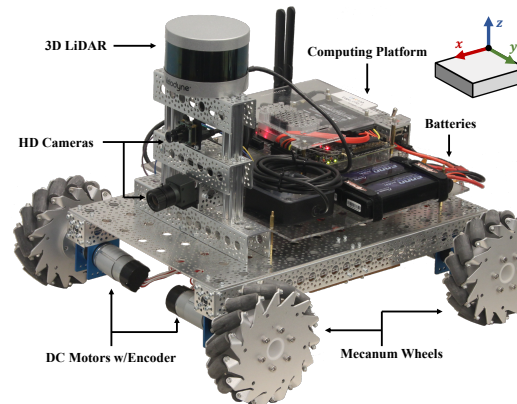


DSRC RSE



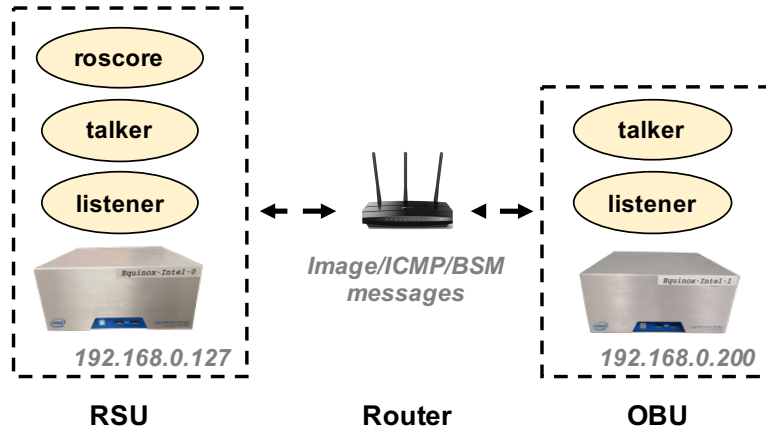
DSRC OBE

- Autonomous Driving Robot
 - HydraOne

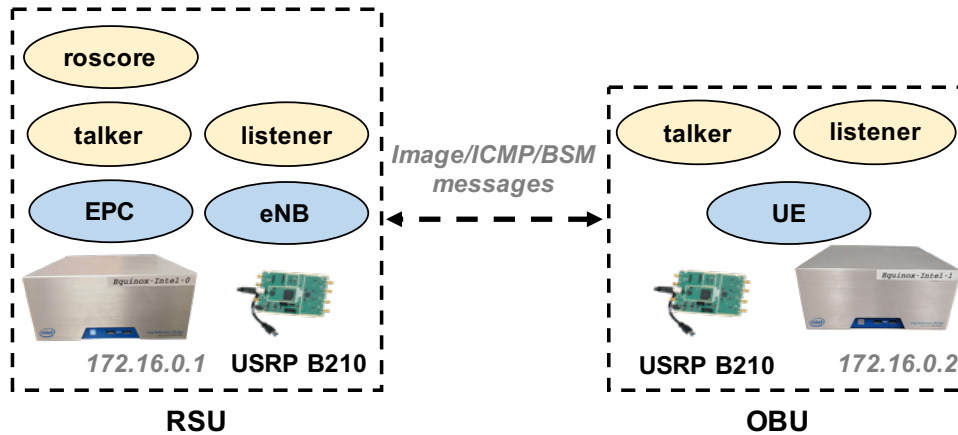


<https://thecarlab.org/hydraone/>

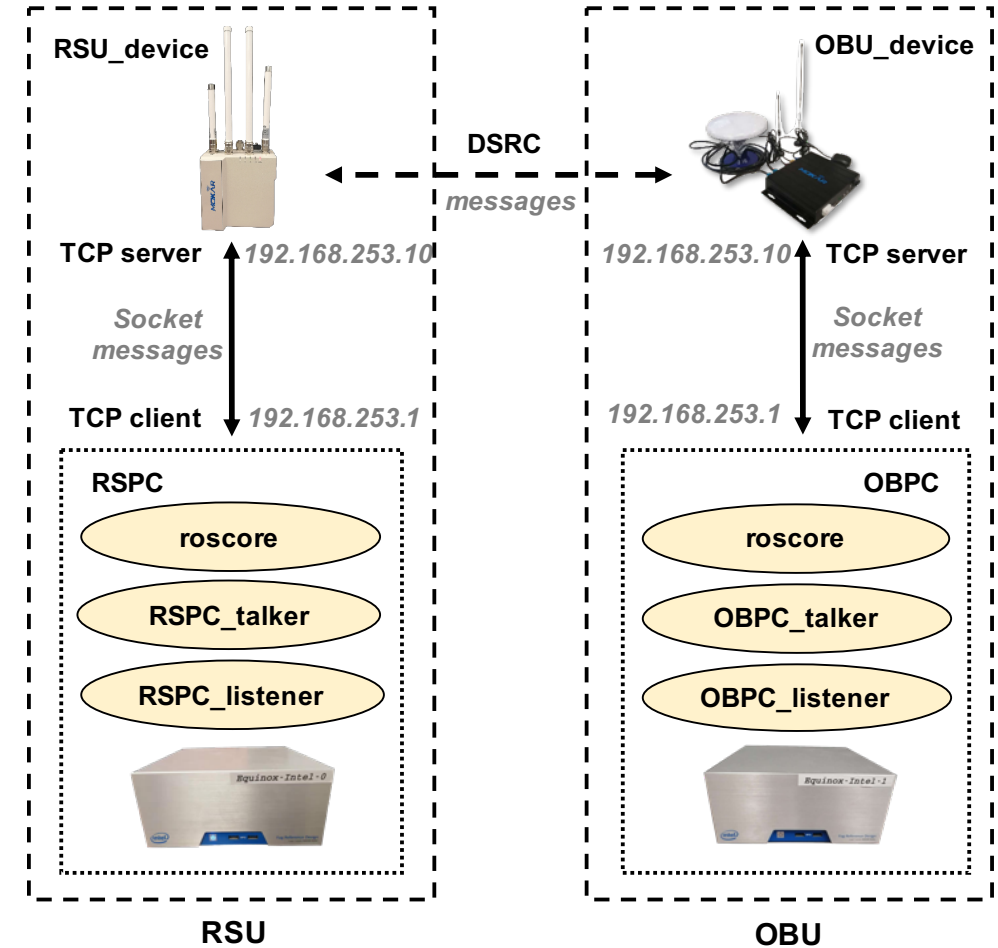
End-to-End Prototype



Wi-Fi



LTE



DSRC

Comparisons

- Messages
 - ICMP-based: Ping message
 - Robot Operating System (ROS) messages:
 - Basic Safety Message (BSM): from DSRC protocol
 - Image
- Metrics
 - End-to-End latency
 - Power dissipation
 - System utilization

End-to-End Latency

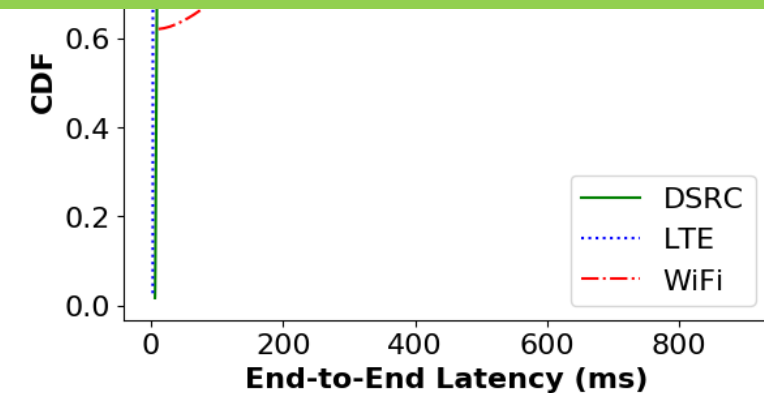
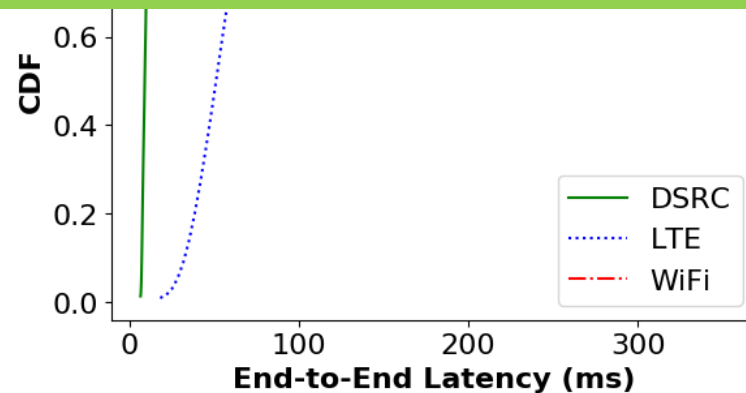
Average End-to-End Latency

Latency (ms)	LTE	Wi-Fi	DSRC
BSM	3.12	67.96	8.46
image	6174.32	1733.90	-
Ping	25.02	50.49	-

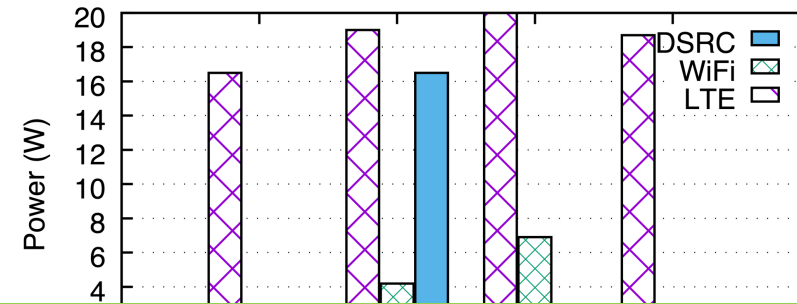
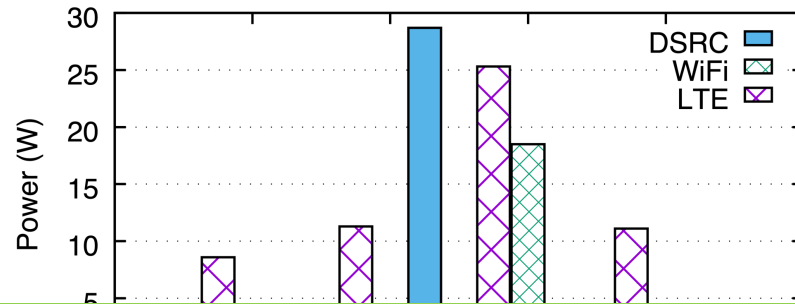
Latency of BSM with different speed

Latency (ms)	LTE	Wi-Fi	DSRC
0 m/s	3.12	15.06	8.88
3 m/s	657.28	12.99	9.12
5 m/s	1071.52	16.18	9.21

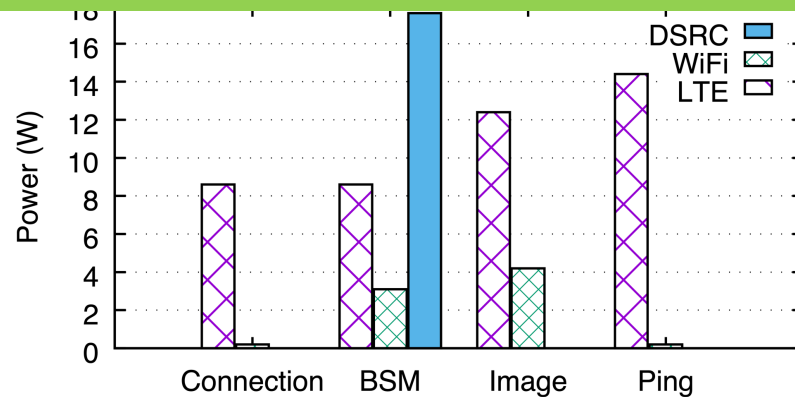
Observation 1: A communication mechanism which can provide sufficient and stable bandwidth is still missing.



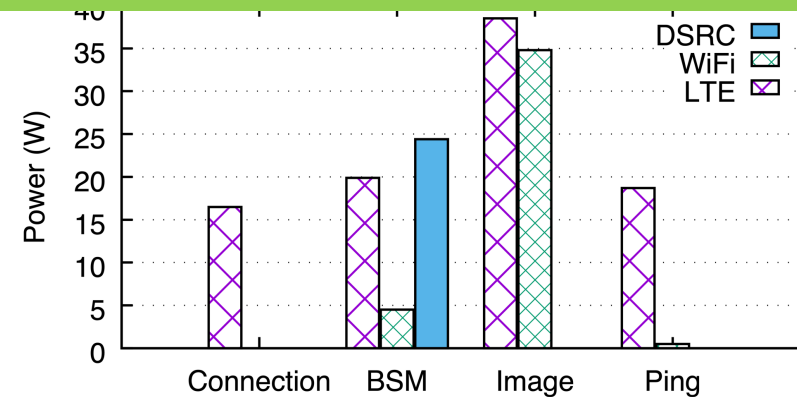
Power Dissipation



Observation 2: There are non-negligible power dissipation for communication connections for LTE and DSRC.



OBU as Receiver



RSU as Sender

System Utilization

Overhead of LTE

Metrics	RSU		OBU
	ros master	eNB	UE
Memory (Mb)	50.364	1599.532	1488
CPU (%)	2.22	27.73	23.56



1GB memory

Raspberry Pi 3B+

Observation 3: The usage of *srsLTE* as well as *ROS* introduces non-negligible system overhead.

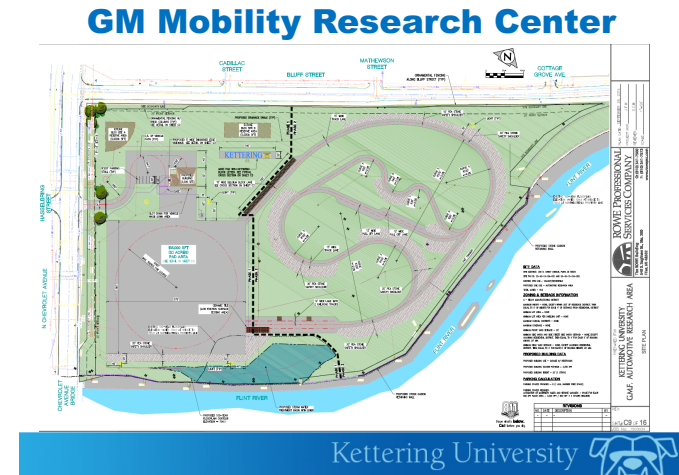
Future Work

- Outdoor experiments

- C-V2X, 5G included into the comparison

T-Mobile **verizon**✓

- Accelerator-based devices included into RSU



Thanks!
Q & A

Email: liangkai@wayne.edu