Integration of Intelligent Connected Vehicles to the Cloud

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May. 16th 2018

Intelligent Connected Vehicles

What is an intelligent vehicle?

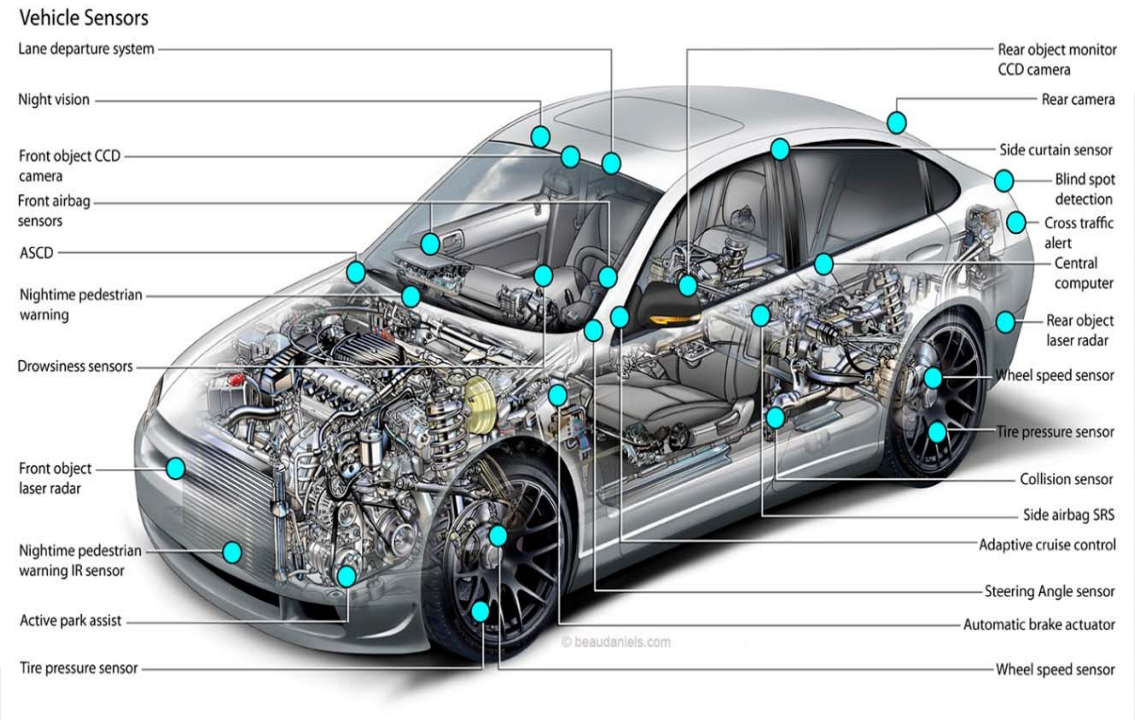
Sensing and Processing Capabilities

- Active Safety Features
- Better Driving and Travel Experience

Intelligent Connected Vehicles

What kind of sensing?

- 60-100 sensors today
- Projected to over 200 in 5 years



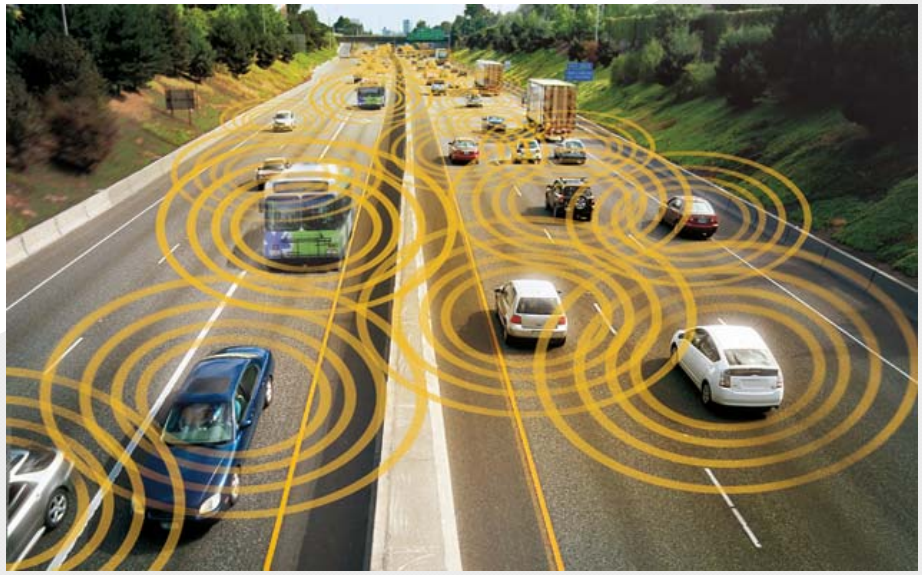
Credits https://www.behance.net/gallery/51718817/Connected-car

Intelligent Connected Vehicles

What is a Connected Vehicle?

- Vehicles communicate with each other to avoid accidents
- "See" other vehicles beyond sensors capabilities

Collaborative Advanced Driving Assistance Systems(ADAS)

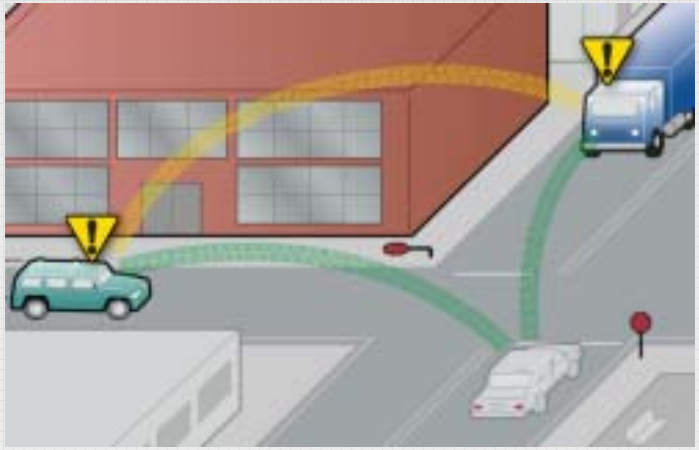


Intelligent Connected Vehicles

What is a Connected Vehicle?

Why communication allows Collaborataive Advanced Driving Assistance Systems(ADAS)?

- To see occluded obstacles
- To talk to infrastructure



Intelligent Connected Vehicles

How is it possible?

- Interoperability (standards for Communications)
- Free frequency bands

Some of the current vehicles on the road already have communication capabilities

And others...

Intelligent Connected Vehicles

Opportunity?

Take advantage of available data to share useful information

Intelligent Connected Vehicles

Opportunity?

Examples:

Municipalities

Transportation authorities

Optimize road maintenance

Optimize snow removal operations

Intelligent Connected Vehicles

Opportunity?

- ✓ Informed decision making road conditions in real time (for snow removal, salting)
- ✓ Economies ($$$.$$$$)
- ✓ Reduction of salting beneficial to environment
- ✓ Limitation of salting vehicles helps a more fluid traffic

Intelligent Connected Vehicles

Challenge?

- Non-Safety Data Communication should not hinder safety-related communications

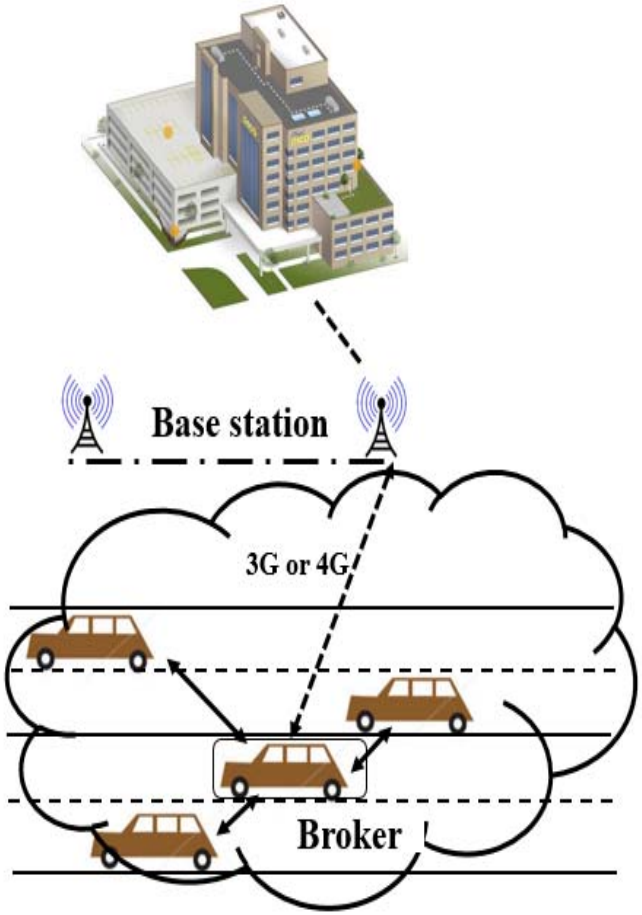
  Safety related messages very demanding in channel usage (each 10 ms)

- Communication should be coordinated to participate in data sharing with the cloud (big data)

Vehicular Cloud Computing

Define a framework :

- Vehicles cooperate with each to establish a cloud and provide services (data-as-a-service) to the cloud.
- Vehicles can simultaneously be services consumers and providers.

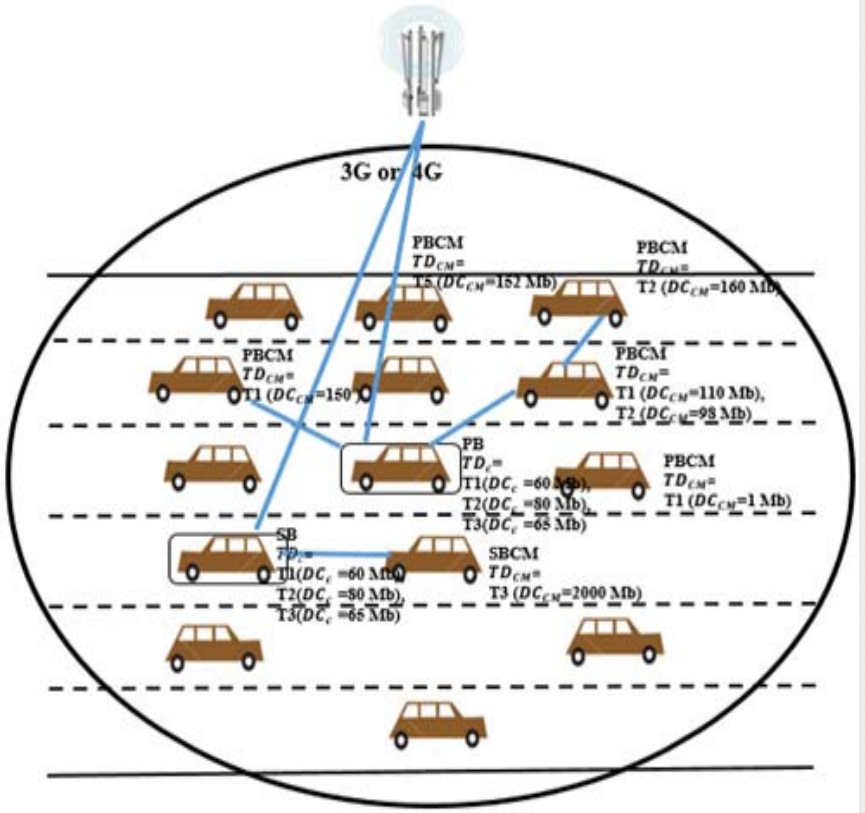


Vehicular Cloud Computing

Resource Discovery: what resources and data are available at each vehicle

Cloud formation: to form clouds in a way to ensure cloud stability and quick service discovery.

Transmissions scheduling: to achieve the maximum throughput and the minimum delay by optimized transmission scheduling.



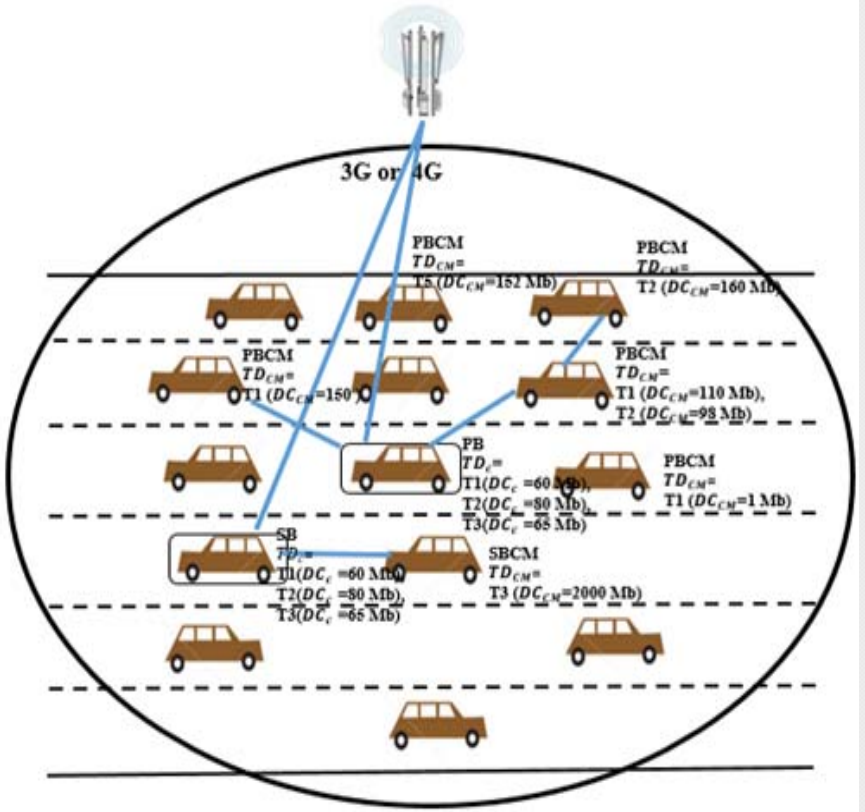
Vehicular Cloud Computing

As vehicles move, they dynamically form clouds

A broker is dynamically chosen

The broker schedules transmissions inside vehicular cloud and with outside cloud

The broker can perform other Operations: data trimming, aggregation, (ML) etc

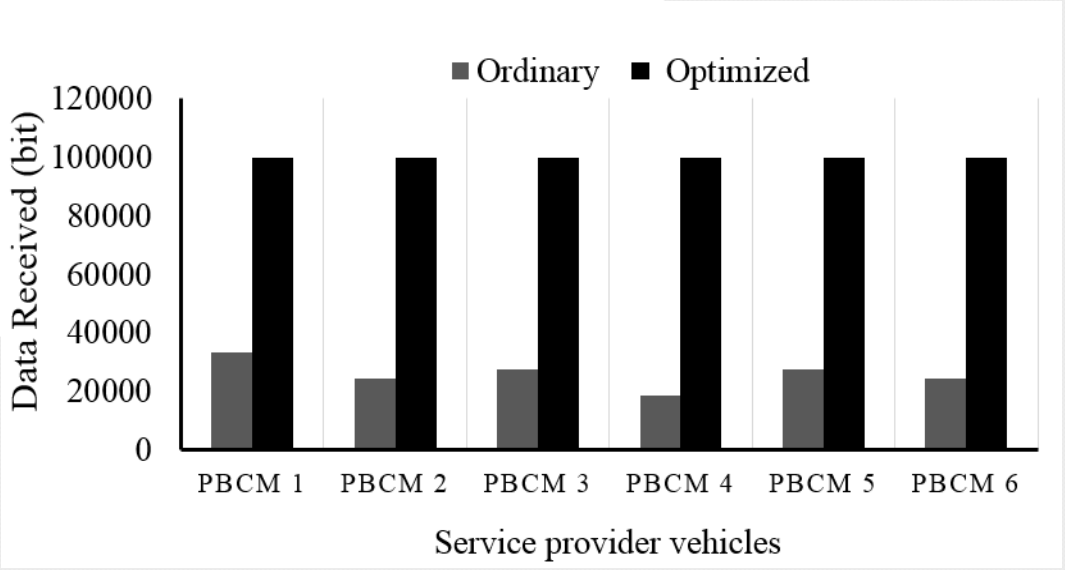


Vehicular Cloud Computing

Results

We studied the capabilities of the framework

Significantly higher data rates

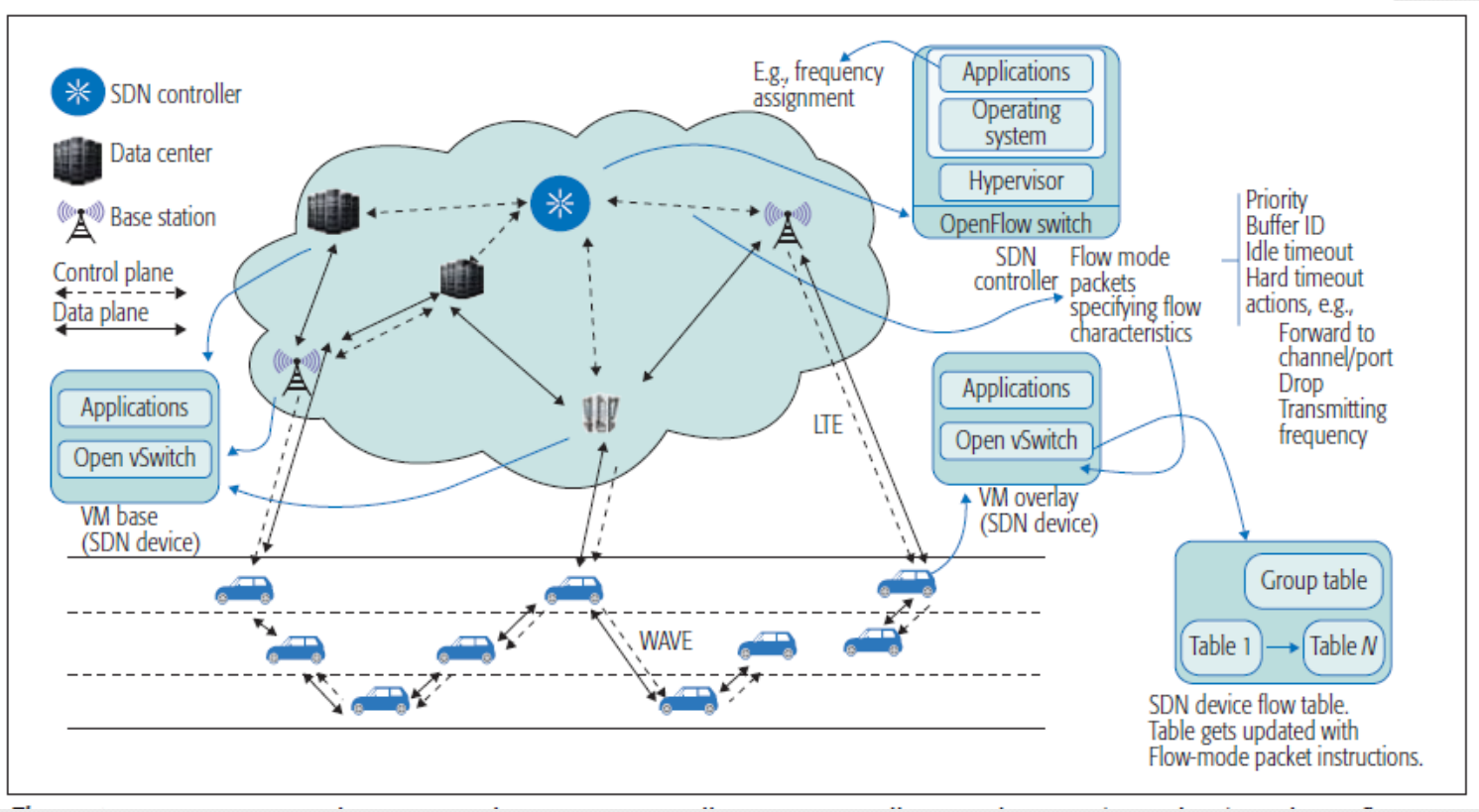


Data-as-a-Service

Vehicular Cloud Computing

Results

We studied the capabilities of the framework Software Update Over the Air



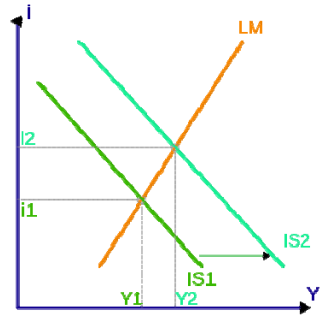
Vehicles-as Consumers-of Services

Vehicular Cloud Computing

Conclusions

- Other aspects not presented here:
  - Economic Models for Vehicles Participation in Data Sharing
  - Security

- As more vehicles have communication capabilities on the road there is an opportunity to tap in available data to provide useful services



Thank You