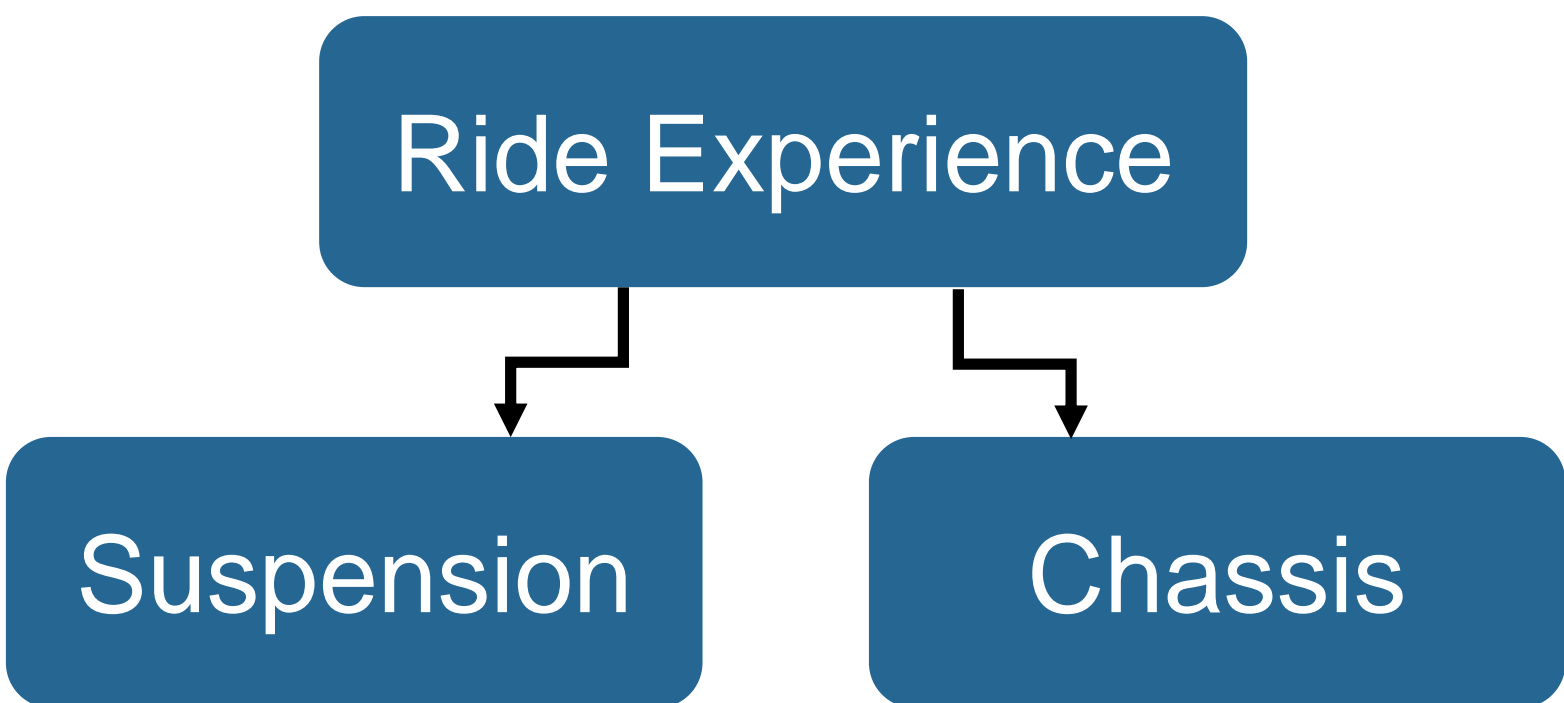


Hybrid Cloud-Based Platform to Improve Ride Metrics of Vehicles

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Motivation

- Improving vehicle ride experience is one of the main concerns in automotive industry.

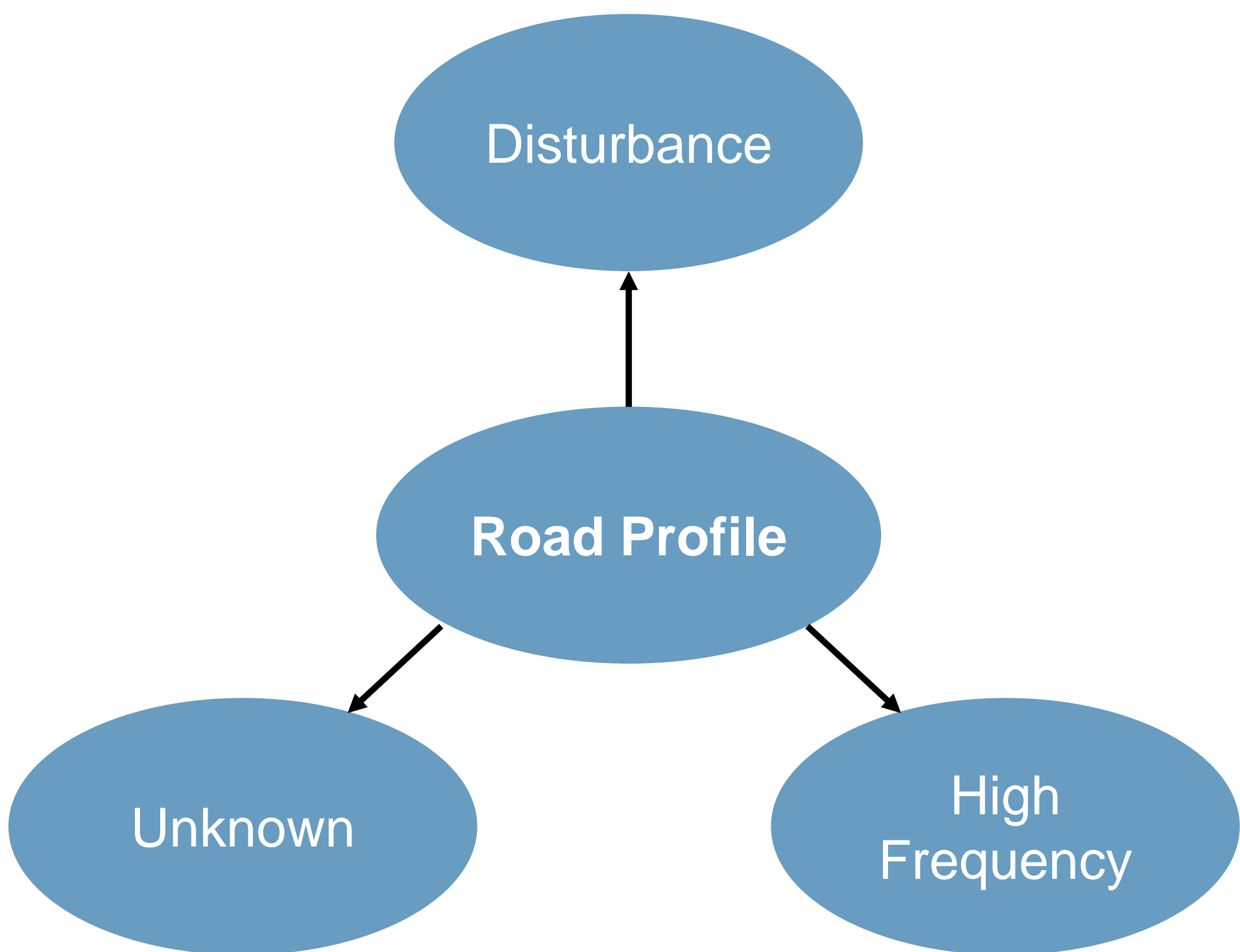


- Control Algorithms for both suspension system (semi-active/active) and chassis stability have been developed.

Simple Algorithms	Modern Algorithms
<ul style="list-style-type: none"> Easy To Implement Less Computation Limited Performance 	<ul style="list-style-type: none"> Complicated High Compilation Better Performance

Problem Statement

- Only issue with modern control algorithms is road profile since it is unknown.
- Road profile is treated as disturbance in modern control methods. Therefore, disturbance rejection methods are used
- Disturbance rejection adds up to controller complexity.

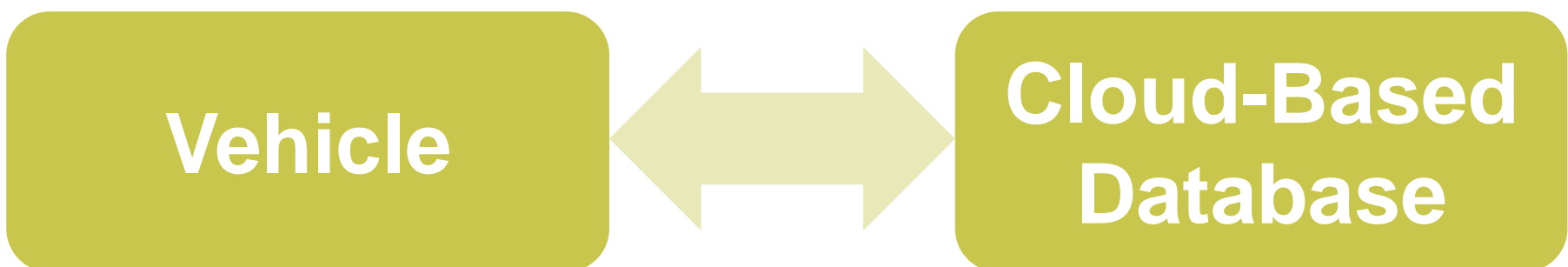


Approach

- A hybrid cloud-based platform is proposed to send the most updated information of the road to vehicles.
- The platform contains two subsystems:
 - Cloud-based database of road information
 - Vehicle-to-vehicle (V2V) communication

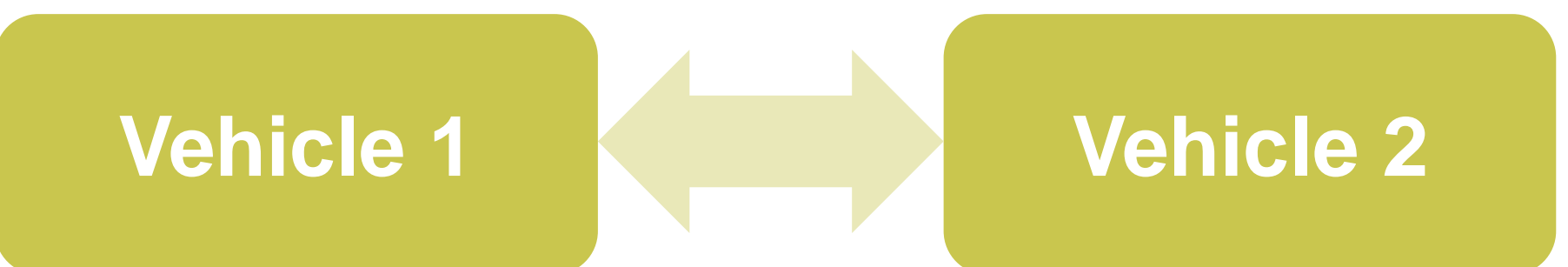
Cloud-Based Database

- Connecting to a cloud-based database of road-profiles, a vehicle has access to the most recent road information.
- having the road-profile known reduces the computation load needed by the processor to calculate and apply the control input to either the suspension or the chassis.
- The vehicle can send road information to the cloud -based database as well if is equipped with a road profile measuring sensor.
- Syncing the vehicle with the cloud-based platform allows updating the database on the fly and having the most recent road information available to other vehicles connected to the cloud system.



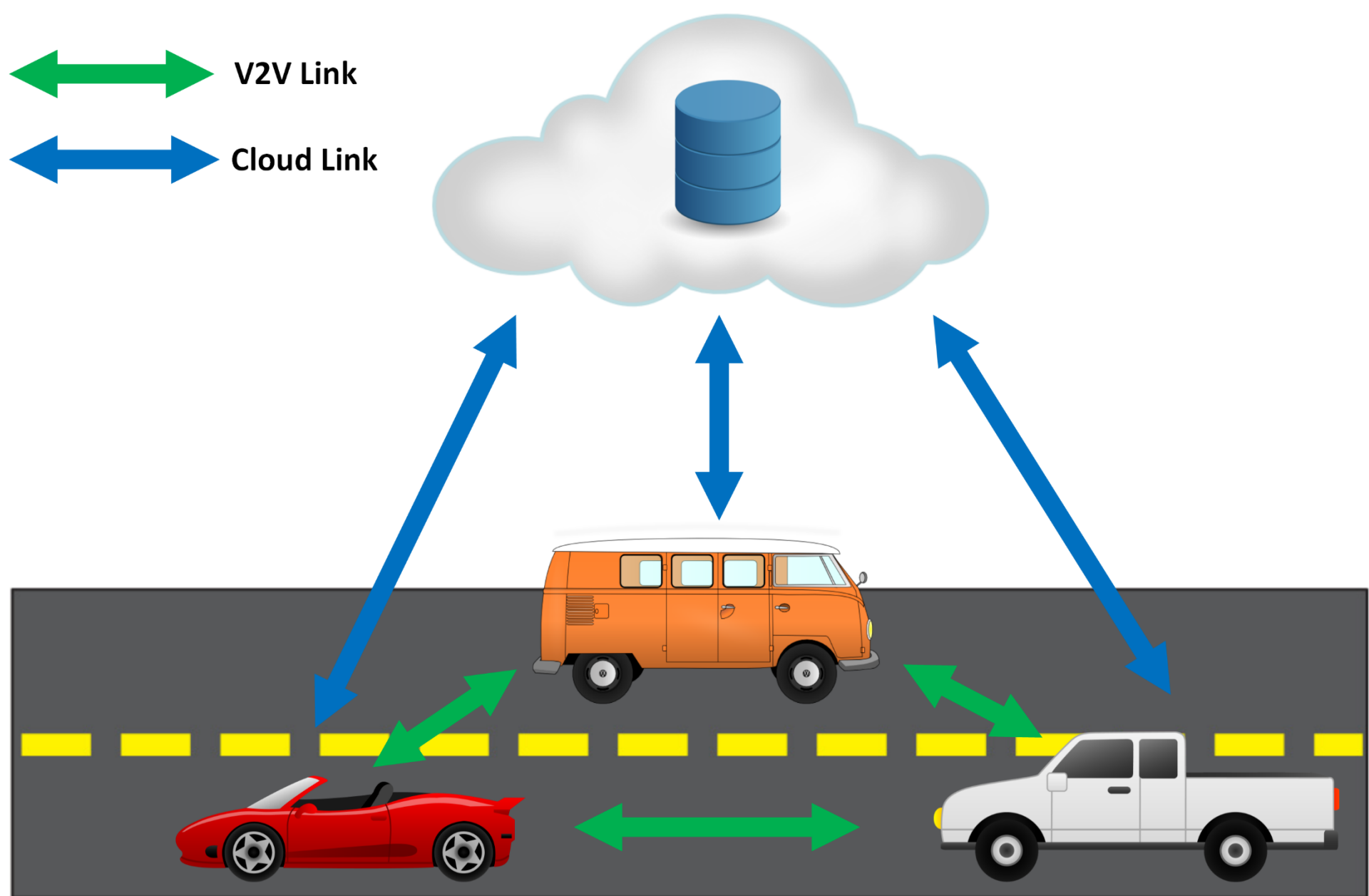
V2V Communication

- V2V protocols can be used to transfer data between nearby vehicles.
 - close vehicles can transmit local road information
 - If there is any malfunctioning with a vehicle cloud connection, it can get connected to the cloud-based database through a nearby car.



Hybrid Solution

- Each vehicle is connected to a cloud-based database of road-profiles as well as to its nearby vehicles.
- The road information on the cloud is available to all vehicles and updated frequently to the most recent road profiles information.
- A correction algorithm is in place to ensure the validity of road-information being sent to the cloud-based database.



Potential Impact to CPS

Cloud-based systems are getting popular as the data is available almost everywhere by wireless carriers

As the National Traffic Highway Safety administration (NHTSA) is announcing its decision to begin taking the next steps toward implementing V2V technology in all new cars and trucks, V2V is becoming more common and the platform will be available for many applications.

The proposed hybrid cyber-physical platform improves ride metrics of vehicles by having an accessible database of road-profiles ready and frequently updated. Eventually, enhanced ride metrics are the outcome of the introduced cyber-physical platform.