

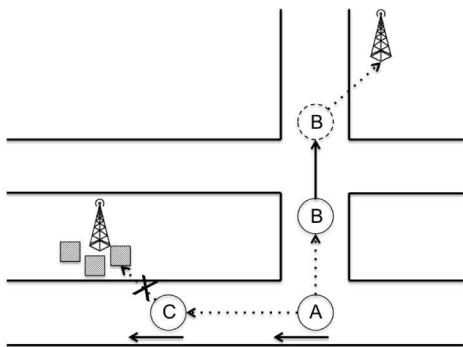
Mobile Smart Meter Background

- Each electric vehicle (EV) is equipped with a **mobile smart meter**.
- The meter monitors the battery status of the EV.
- The meter communicates with the utility office to exchange information for:
 - Route suggestion.
 - Demand hotspots prediction.
 - Real-time pricing.

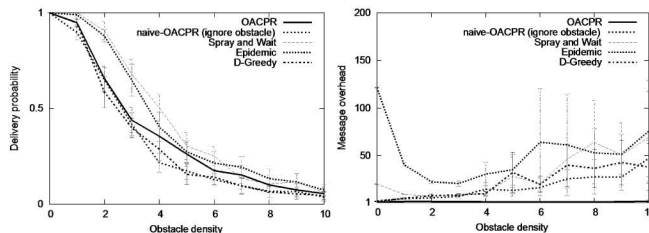
Challenge: Reliable Reporting System between EV and Utility Office

- The high mobility of an EV poses challenges to reliable reporting between the EV and utility office.
- The routing protocol takes hints about the surrounding environment to help message forwarding.
- Some possible hints:
 - Locations of signal-blocking obstacles.
 - Average message latency along a road segment.
 - Network congestion.

Approach: Obstacle-Aware Cyber-Physical Routing



- The EV learns the location and size of signal-blocking obstacles from the digital map.
- The routing protocol estimates the **delay**, i.e., the time needed for a car to carry the message until it can relay it to a roadside unit, taking into account both the EV's planned trajectory and the existence of obstacles.
- The message is forwarded to a car with a smaller estimated delay whenever possible.



Future Plans

Challenge: Authentication

- The EV should authenticate itself to charging units for correct billing.
- Different charging scenarios pose different requirements to the authentication scheme.
 - At charging station.
 - At home.
 - During wireless charging on-the-move.

Challenge: Privacy & Security

- Messages between the EV and utility office contain **sensitive information**.
- Everyone overhears **wireless communication**.
- Status reports sent by the EV to the utility office include **private information on the driver's location**.

Challenge: Optimization and Route Planning

- The EV may optimize a path according to certain metrics: distance to travel, power consumption, time to travel, etc.
- The utility office may suggest/plan path(s) to EVs with suitable charging stations and divert traffic away from high-demand hotspots.

Challenge: Communication over Heterogeneous Networks

- Charging at home: the mobile smart meter talks to the home smart meter over **ZigBee**.
- Charging at a charging station: the mobile smart meter talks to the utility office through **WiFi**.
- Wireless charging while moving: the mobile smart meter talks to the utility office through a **cellular network**.

