Trustworthy Framework for Mobile Smart Meters

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GOALS

- **Support** electric transportation via Electric Vehicles (EVs) .
- **Provide** monitoring of electricity charging via **mobile smart meter (MSM)** on-board unit of EV.
- **Secure** wireless communication between MSM and utility.
- **Enable** tamper-resistance of MSM's local storage.
- **Preserve** location privacy of EV driver.

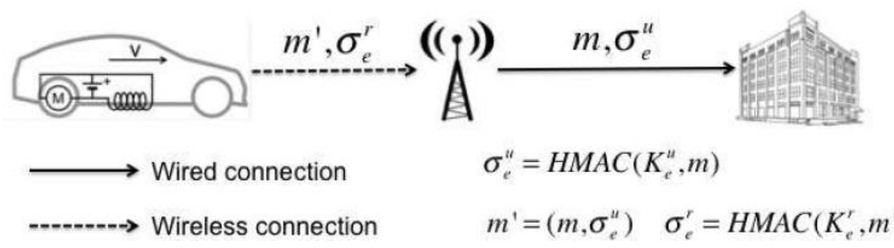
FUNDAMENTAL LIMITATIONS OF VEHICULAR NETS

- **Intermittent connectivity.**
  - EV may not connect continuously to utility company.
- **Short contact time.**
  - Due to EV high mobility, duration of contact time between EV and Road Side Unit (RSU) or another EV may be short.
- **Open wireless communication media.**
  - Anyone can overhear transmitted data.

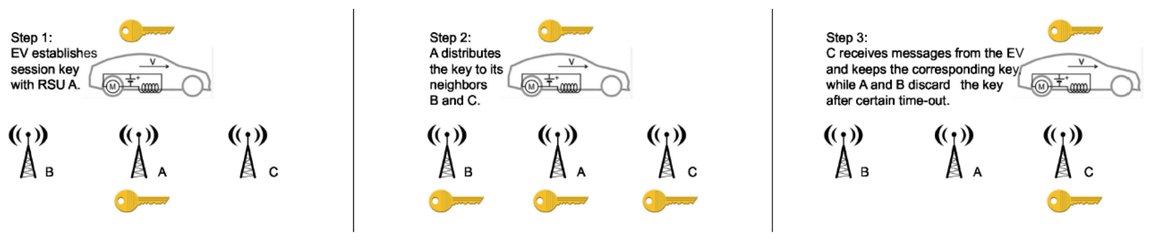
RESEARCH CHALLENGE: RT AUTHENTICATION

- Secure EV-Utility (EV-RSU) and EV-Charging Pad communication via **Real-Time (RT) Authentication** under
  - **Resource constraints.**
    - Limited computation power of MSM.
    - Limited time available for authentication.
  - **Varying electricity-charging environment.**
    - Charging in parking lot; at home; on roads.

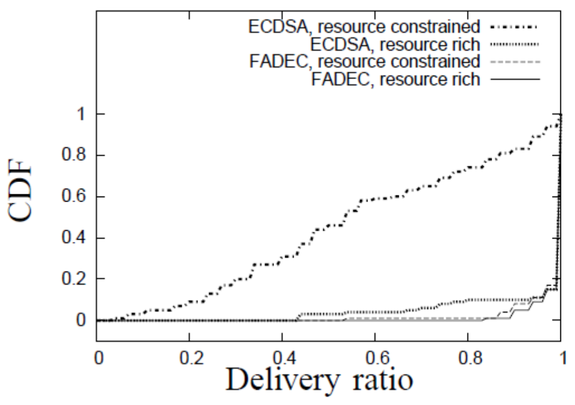
FADEC: EV-UTILITY AUTHENTICATION

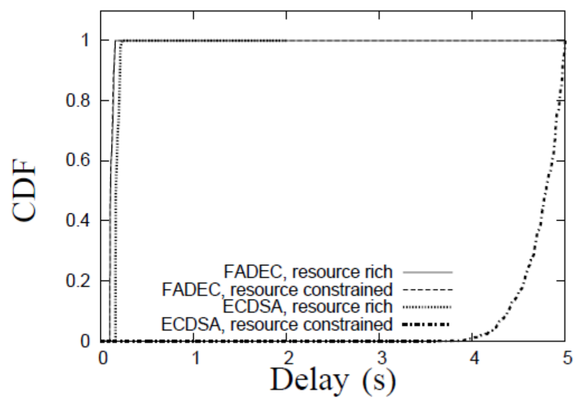


- FADEC establishes symmetric session key for EV-RSU communication, and provides seamless handoff by allowing EV to use same session key with sequence of RSUs.

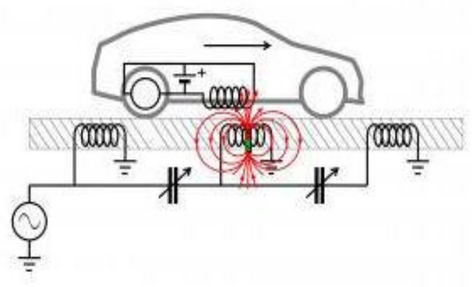


- FADEC reduces authentication time and allows more data to be delivered in time from EV to the utility.

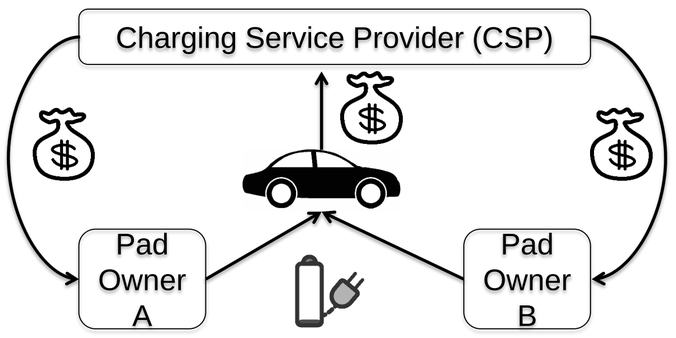




PORTUNES: EV-CHARGING PAD AUTHENTICATION

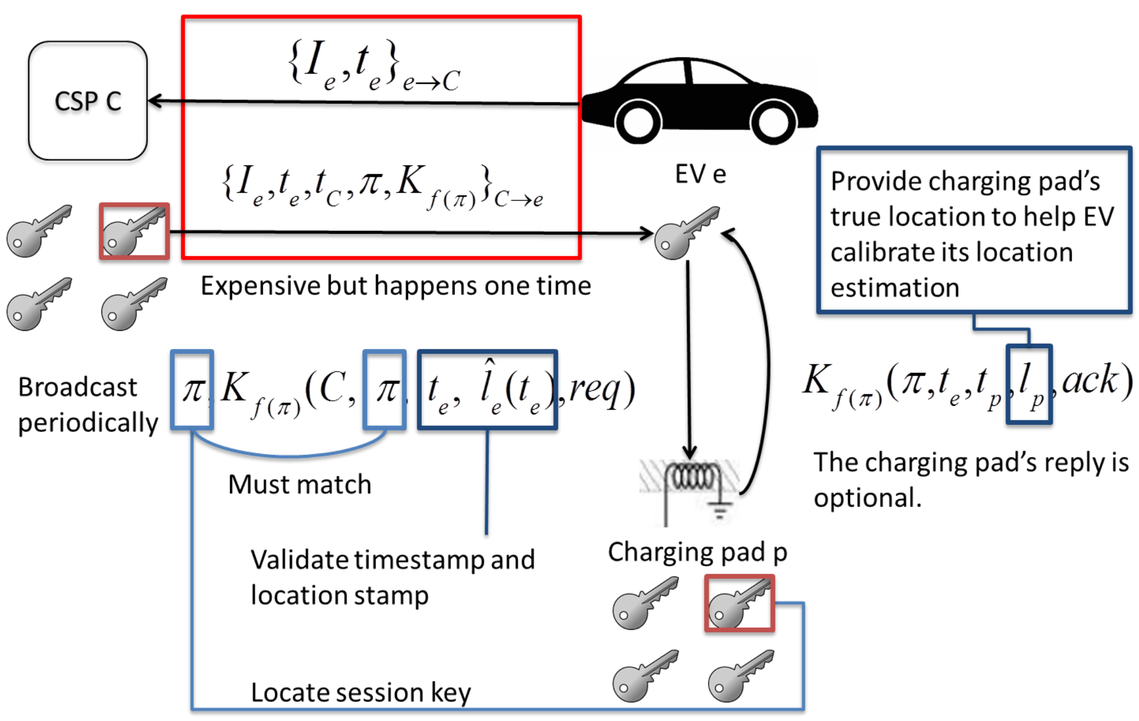


- E-pads need charging parameters (efficiency).
- E-pads switch on when EV connects with electric coil and switch off when it disconnects (efficiency).
- Only authenticated EVs charge (accounting/billing).



- EV subscribes to utility.
- Utility bills EV monthly.
- E-pad owner provides dynamic charging service.

- **Portunes: Fast Real-Time Authentication through Key Pre-distribution.**
  - Utility pre-distributes session keys to e-pad owner and charging e-pads.
  - EV obtains session key before entering dynamic charging section.
  - EV authenticates with charging e-pads using obtained session key.



FUTURE WORK: ADAPTIVE AUTHENTICATION

- **Changing authentication depending on EV location.**
  - Authentication with smart meter when charging at home.
  - Authentication with charging e-pads and utility while moving.
  - Authentication with aggregator in parking lot for V2G.
- **Detection and prediction of EV/driver context changes.**
  - Predict EV's destination and inform utility to prepare for potential demand.
  - Predict EV's movement pattern and pre-distribute session keys to charging pads for dynamic charging.
  - Predict EV's total parking time in parking lot to optimize V2G operation.

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