

Project EDISON - Networking in a V2G project



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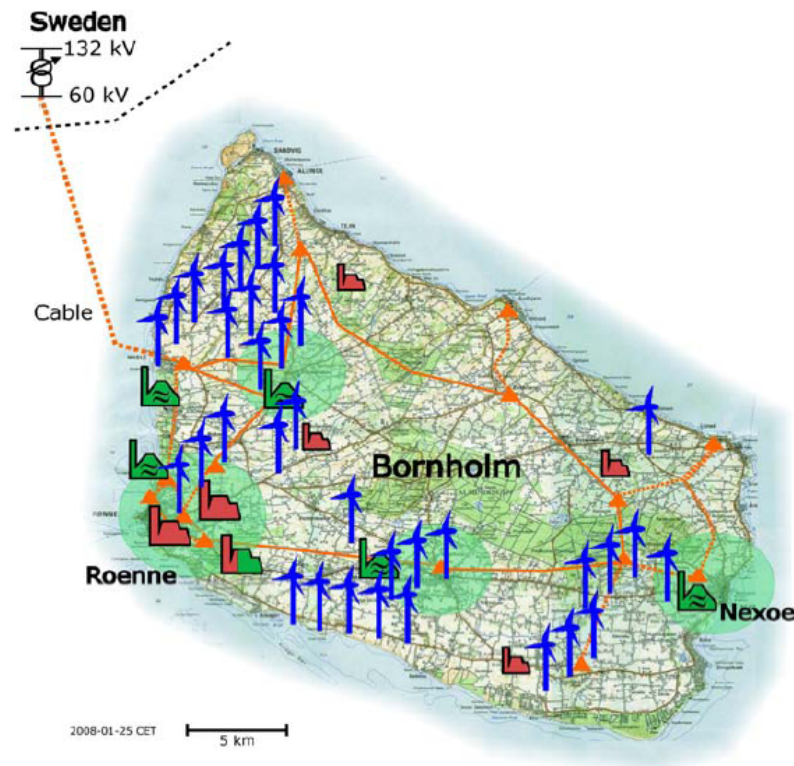
The Fully Networked Car
Geneva, 3-4 March 2010



Introducing Project EDISON (2009-2011)

Electric vehicles in a distributed and integrated market using sustainable energy and open networks

- **Goal:** Design of an energy system for an entire country that will support a large proportion of EVs and volatile renewable energy sources
- **Partners:** Danish Energy Association, Dong, Eurisco, IBM, Oestkraft, Siemens, Technical University of Denmark
- **IBM's Role:** Development a management system to control charging of EVs in accordance with the availability of wind energy while enabling optimal use of the electricity grid



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Authentication requirements

- o User @ Charging Spot
 1. Access to the Charging Spot power outlet
 2. Locking/Unlocking of the Charging Plug

- o User @ EVPP
 1. Identification of an EVPP User
 2. Energy Accounting for billing

- o Charging Spot @ EVPP
 1. Charging Spot identification
 2. Meter reading

Authentication methods

- User @ Charging Spot
 - RFID / contact-less smartcard
 - Offline enforcement with revocation list

- User @ EVPP (many possibilities)
 - RFID / contact-less smartcard / over the wire
 - Online authentication

- Charging Spot @ EVPP
 - Secure online identification needed, e.g. certificate-based with secure key storage

Networking in V2G - information exchange

Independent of the control strategy the following data has to be exchanged

- Authentication
- Safety information
- Location information
- Charging control signal
- Energy accounting data
- User requirements

Networking in V2G

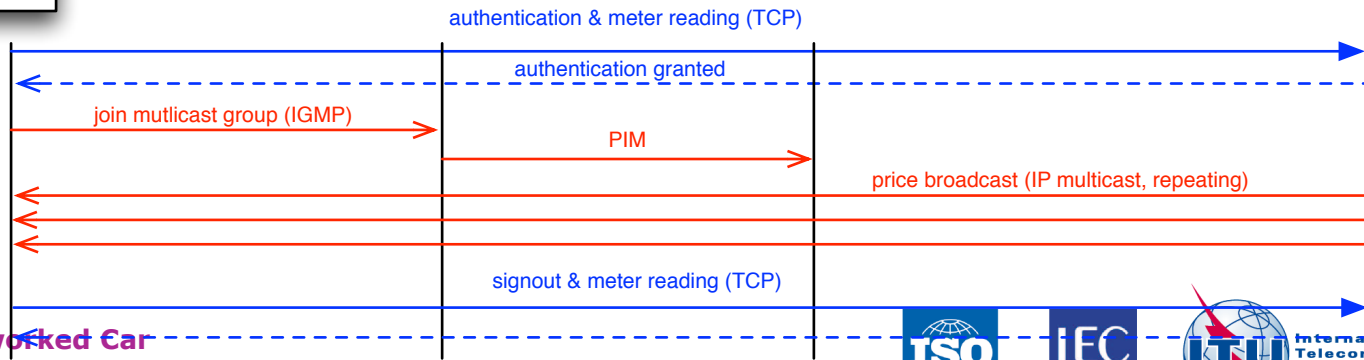
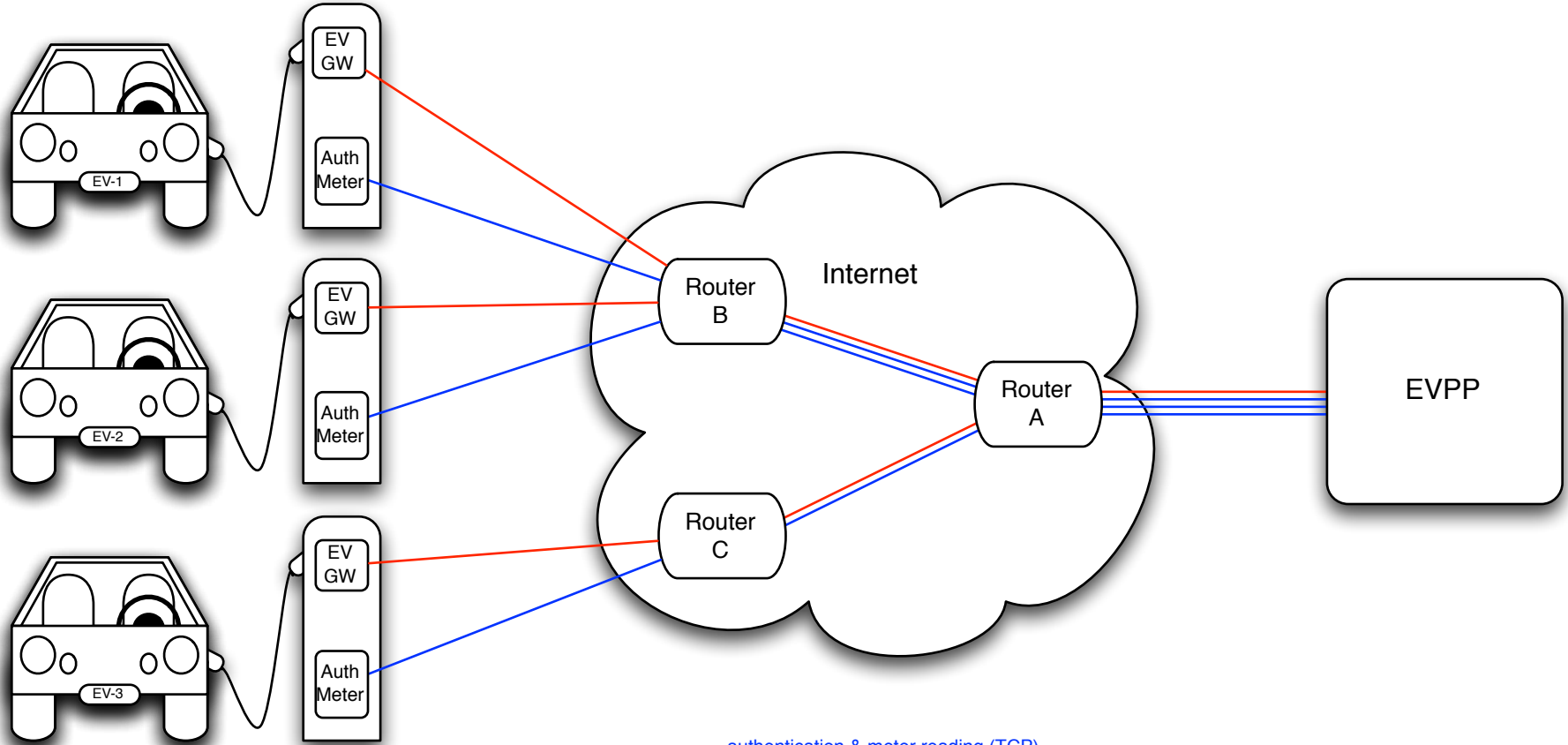
- Two fundamentally different control mechanisms can be envisioned
 - Indirect distributed control for charging and feedback (V2G) with broadcasted stimulus - open loop control
 - Direct centrally controlled charging and feedback (V2G) - closed loop control
- Different control mechanisms need different communication patterns

Networking in V2G - indirect distributed control

- Charging and feedback decision are done at the endpoints, no central control instance
- Charging and feedback are controlled by a broadcasted stimulus, for example
 - Frequency
 - Price per kWh
- Security properties for stimulus
 - integrity, authenticity, non-repudiation
 - freshness (replay protection)

Networking in V2G - indirect distributed control

- a price broadcasting over IP multicast example -



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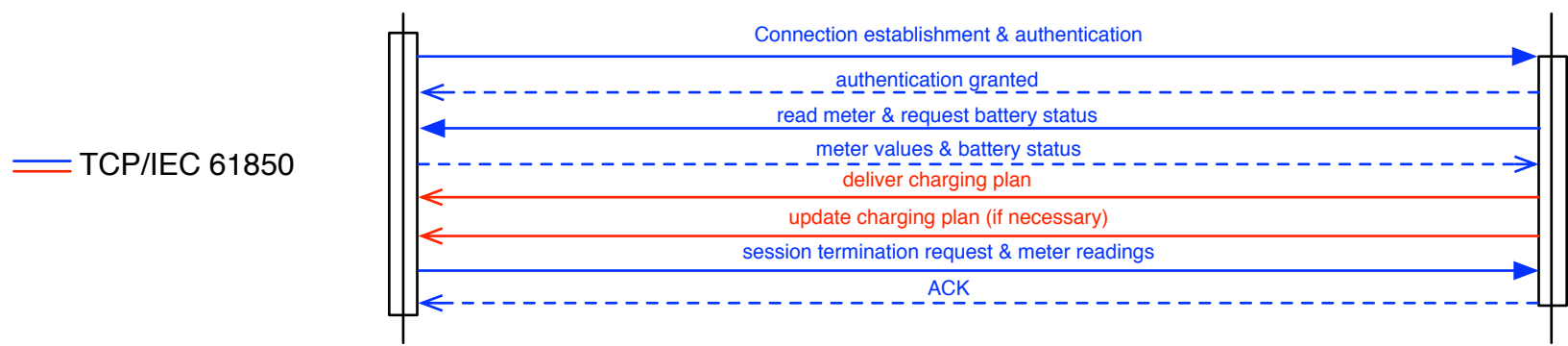
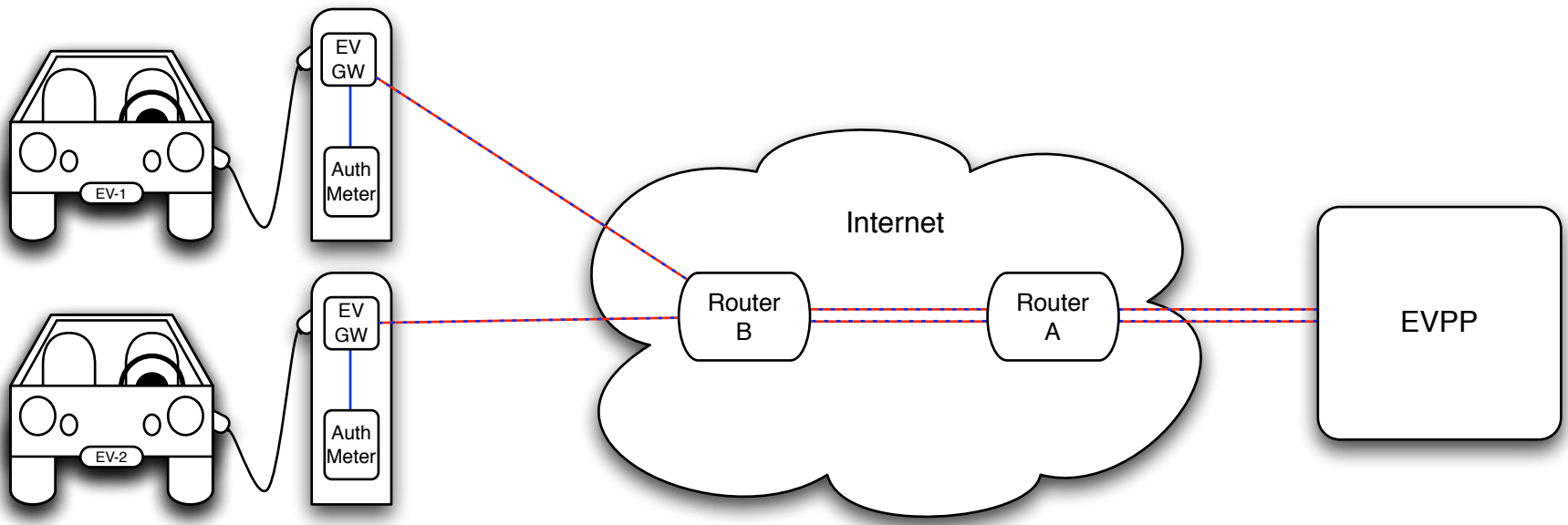


Networking in V2G - direct central control

- Charging and feedback decisions are done in a central control system, optimized for a single EV and the grid
- Charging and feedback are controlled by session-based communication between the endpoint and the EVPP
- One-to-one connections allow closed loop control
- Security properties same as with indirect distributed control

Networking in V2G - direct central control

- a direct TCP connection for the whole session (simplified) -

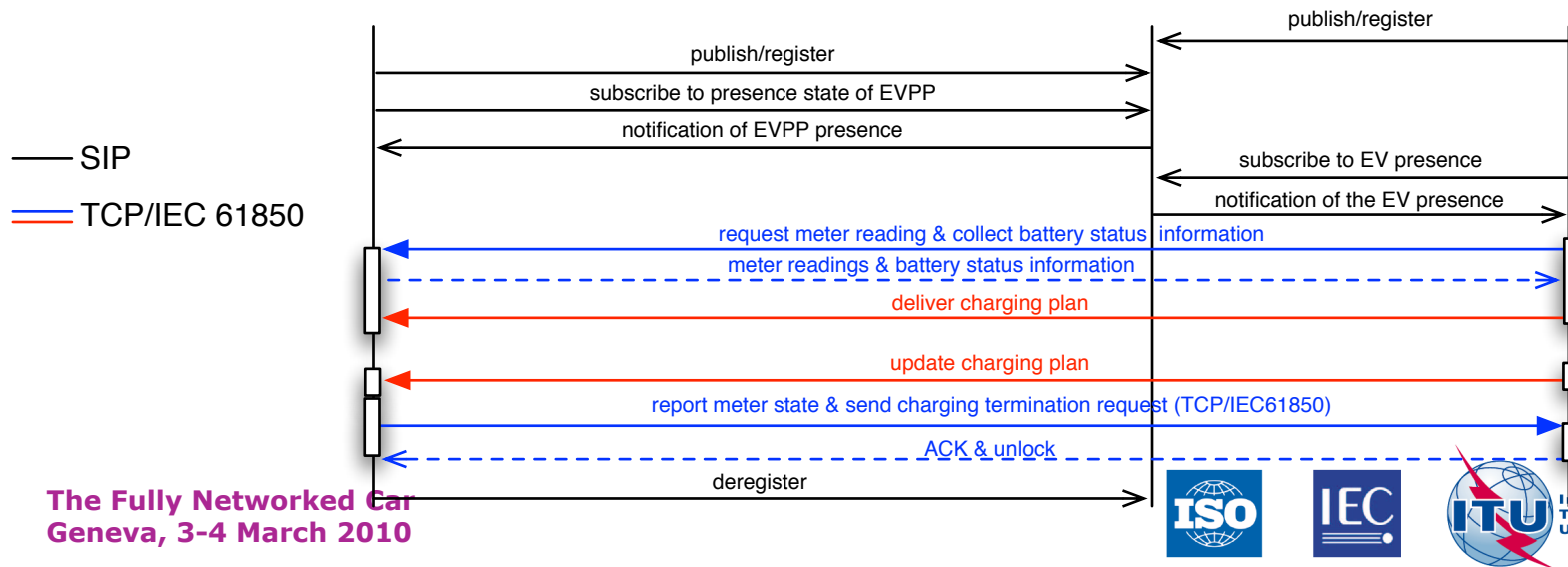
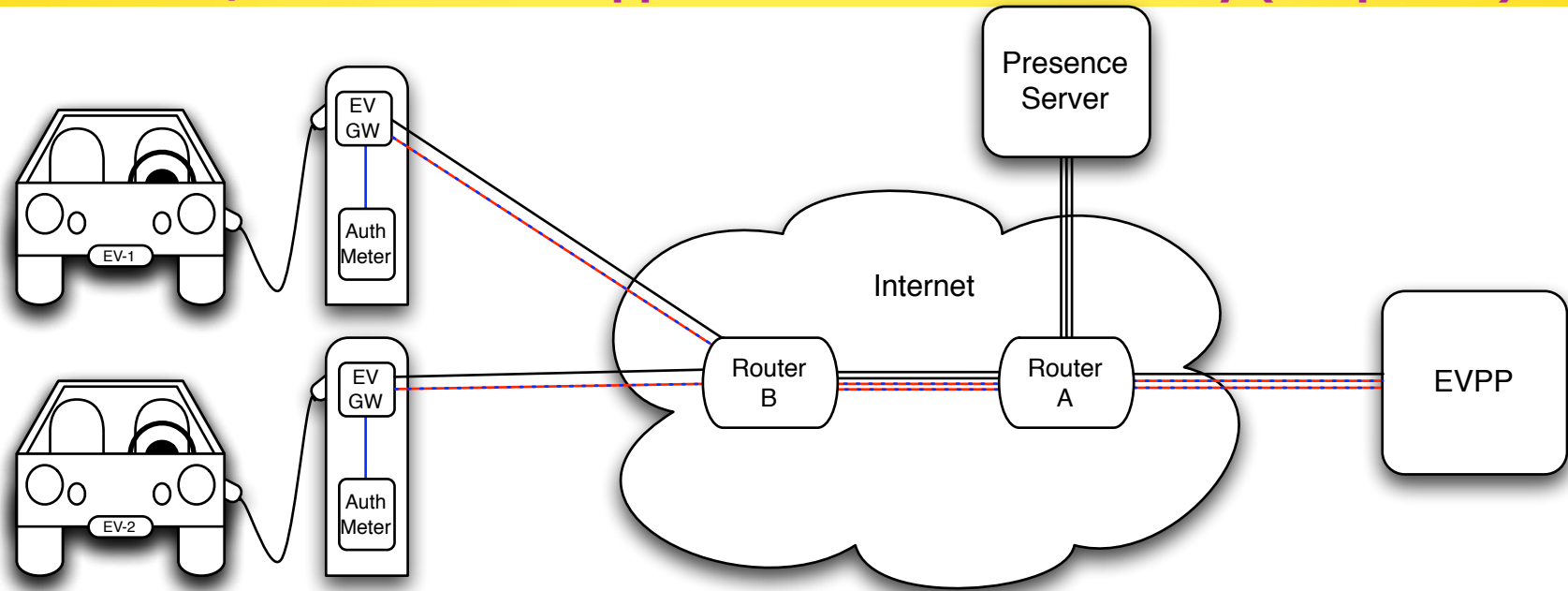


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Networking in V2G - direct central control

- a SIP/SIMPLE based approach for more scalability (simplified) -



Networking in V2G - direct vs. indirect control

SIP/SIMPLE direct session-based control

- standardized, scalable and proven technology
 - SIP/SIMPLE
 - IEC 61850*
- security built into the standardized protocols
- robust to network outages due to pre-distributed charging schedules
- infrastructure is more complex and needs to be more powerful

* small extensions needed

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Multicast distributed control

- Networking concept is very simple and easily deployable
- No central control instance needed
- Security is not built-in into the used standard protocols
- Local pricing might end-up in a scalability issue
- integration and synchronization of price signal and metering is complex

