Plug-in Electric Vehicle Battery Sensor Interface in a Smart Grid Network for Electricity Billing

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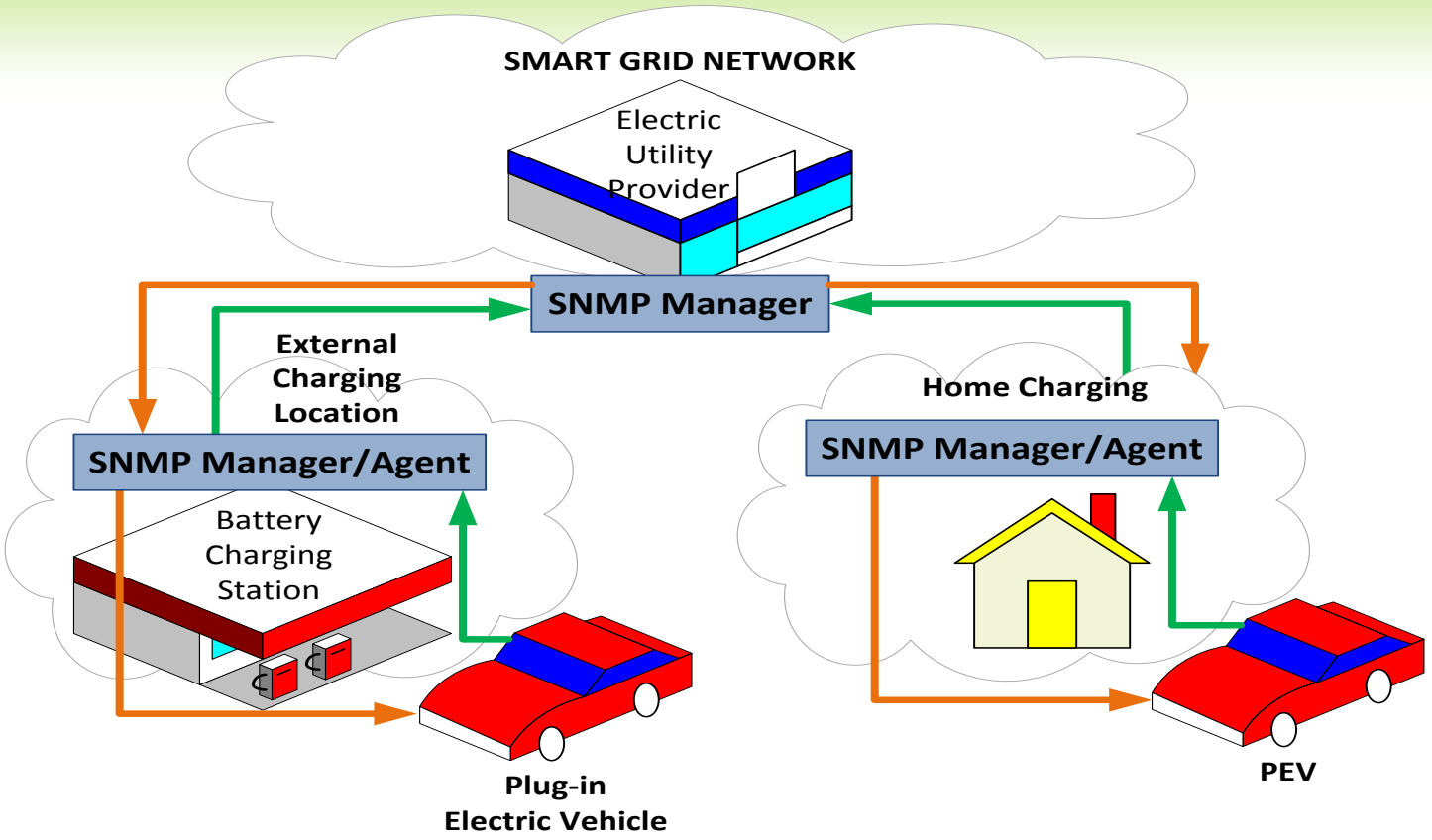
Motivation


SMART GRID NETWORK
Electric Utility Provider
SNMP Manager
External Charging Location
Home Charging
SNMP Manager/Agent
SNMP Manager/Agent
Battery Charging Station
Plug-in Electric Vehicle
PEV
SNMP response Agent → Manager (Trap, Get)
SNMP request Manager → Agent (Get, Get_Next, Set)

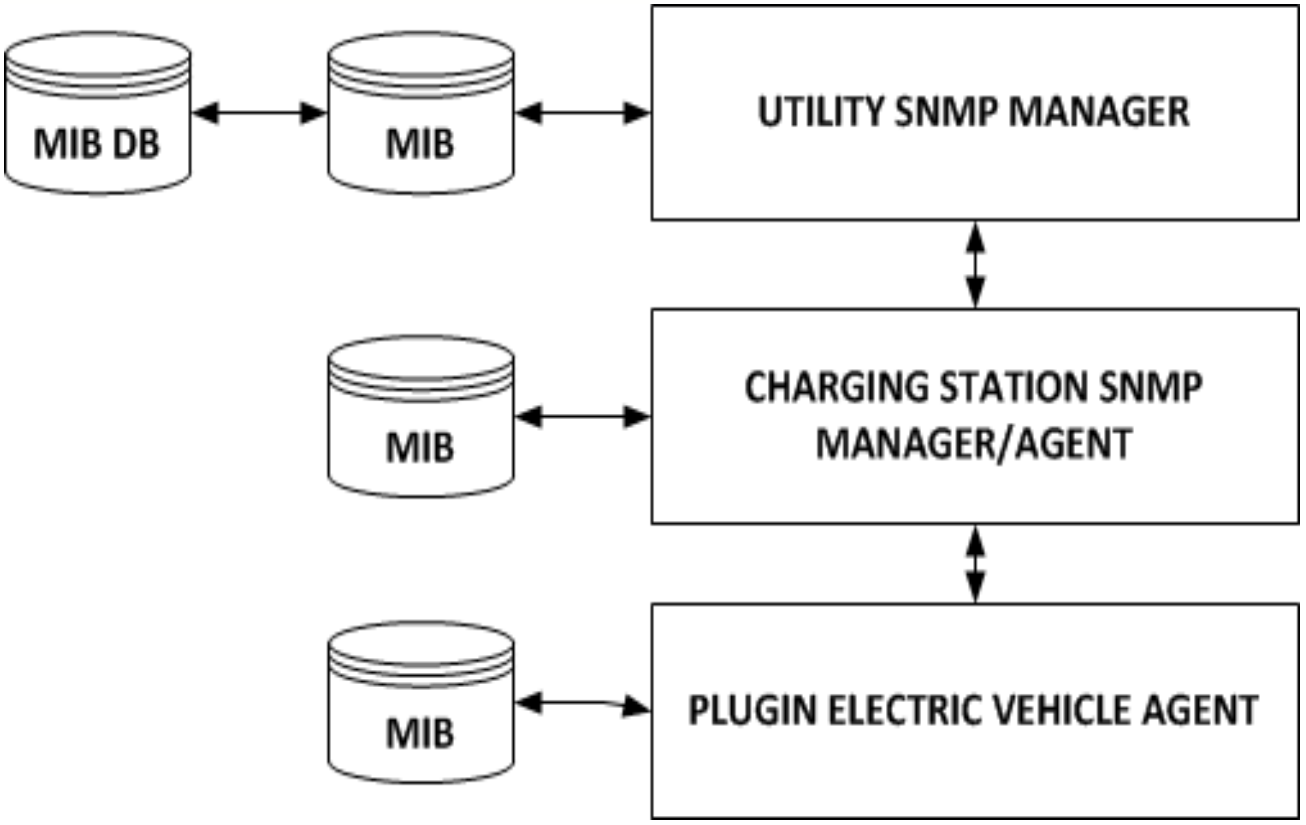
OUTLINE

- Anticipated Billing Problem
- Organizational Model
- SNMP Architecture
- Management Information Base (MIB)
- Exchange of Information
- Conclusion

Future Use of the Smart Grid

- We propose a Simple Network Management Protocol (SNMP) management information base (MIB) for a Plug-in electric vehicle (PEV) .
- It utilizes charge-level sensors to intelligently bill electricity usage per subscriber independent of the location of the charging.
- We propose the design of a sensor information exchange that would identify and collect data from a PEV at a charging station and make this data accessible to the utility company.

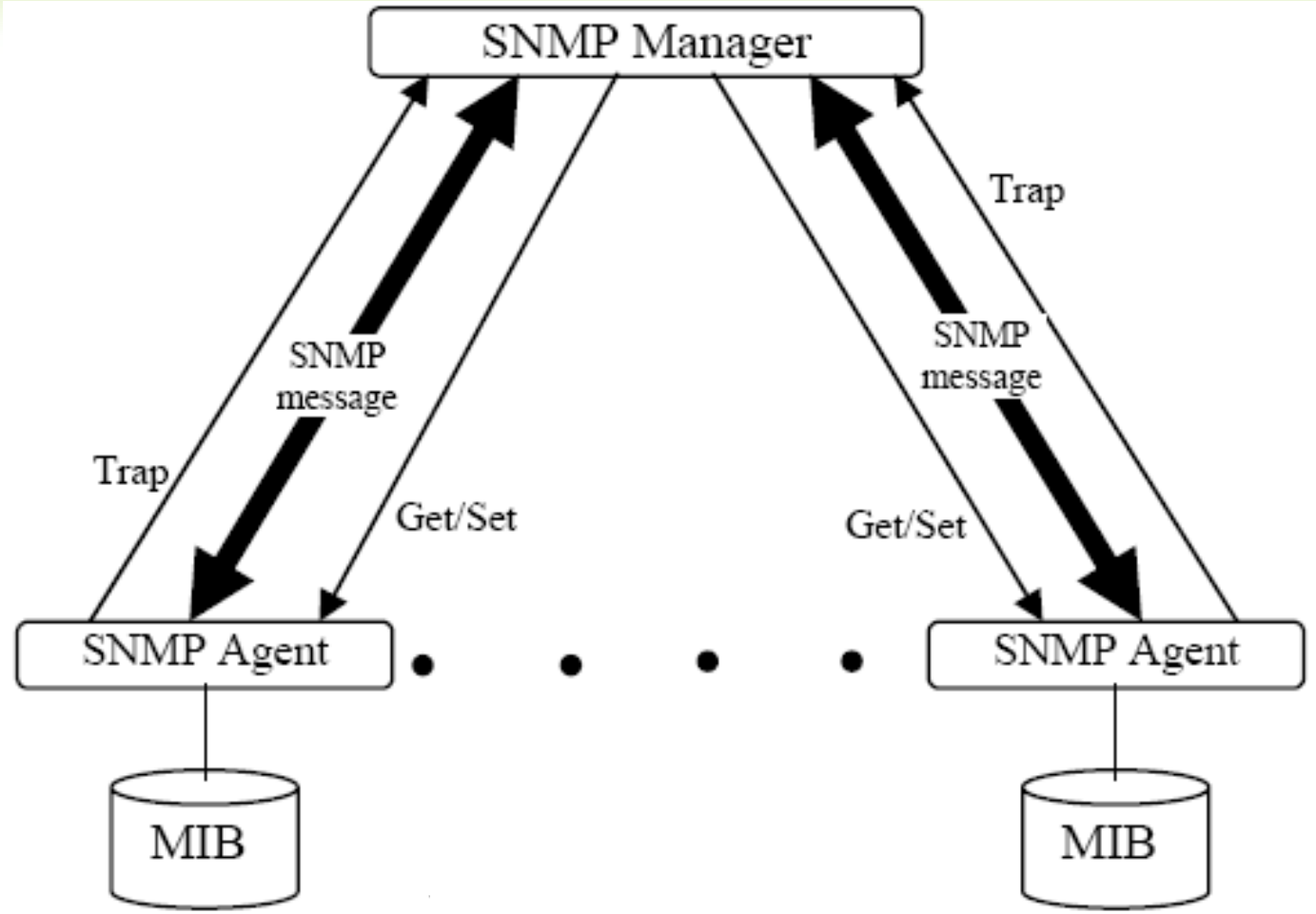
Organizational Model of PEV Management System



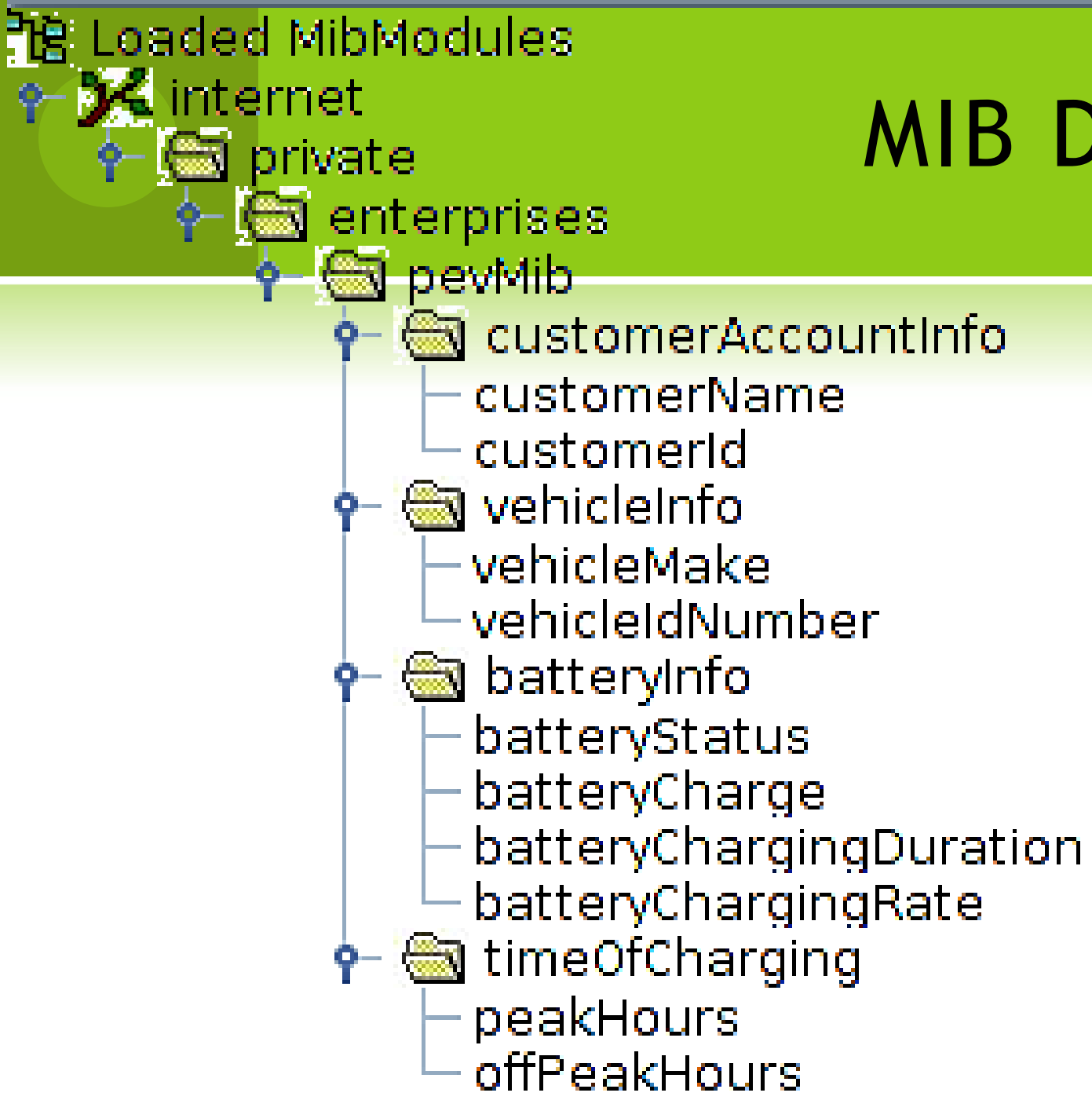
Three Tier Model

- The managed element has an SNMP process running and is called an agent.
- The manager uses data collected by the agent towards intelligent billing according to the consumed power by the PEV charging .
- The intermediate layer is acting as both an agent and a manager.
- MIB resides on all the network management components but Management Data Base (MDB) resides only on the manager

SNMP Architecture



MIB DESIGN


Loaded MibModules
internet
private
enterprises
pevMib
customerAccountInfo
customerName
customerId
vehicleInfo
vehicleMake
vehicleIdNumber
batteryInfo
batteryStatus
batteryCharge
batteryChargingDuration
batteryChargingRate
timeOfCharging
peakHours
offPeakHours

Charging Model

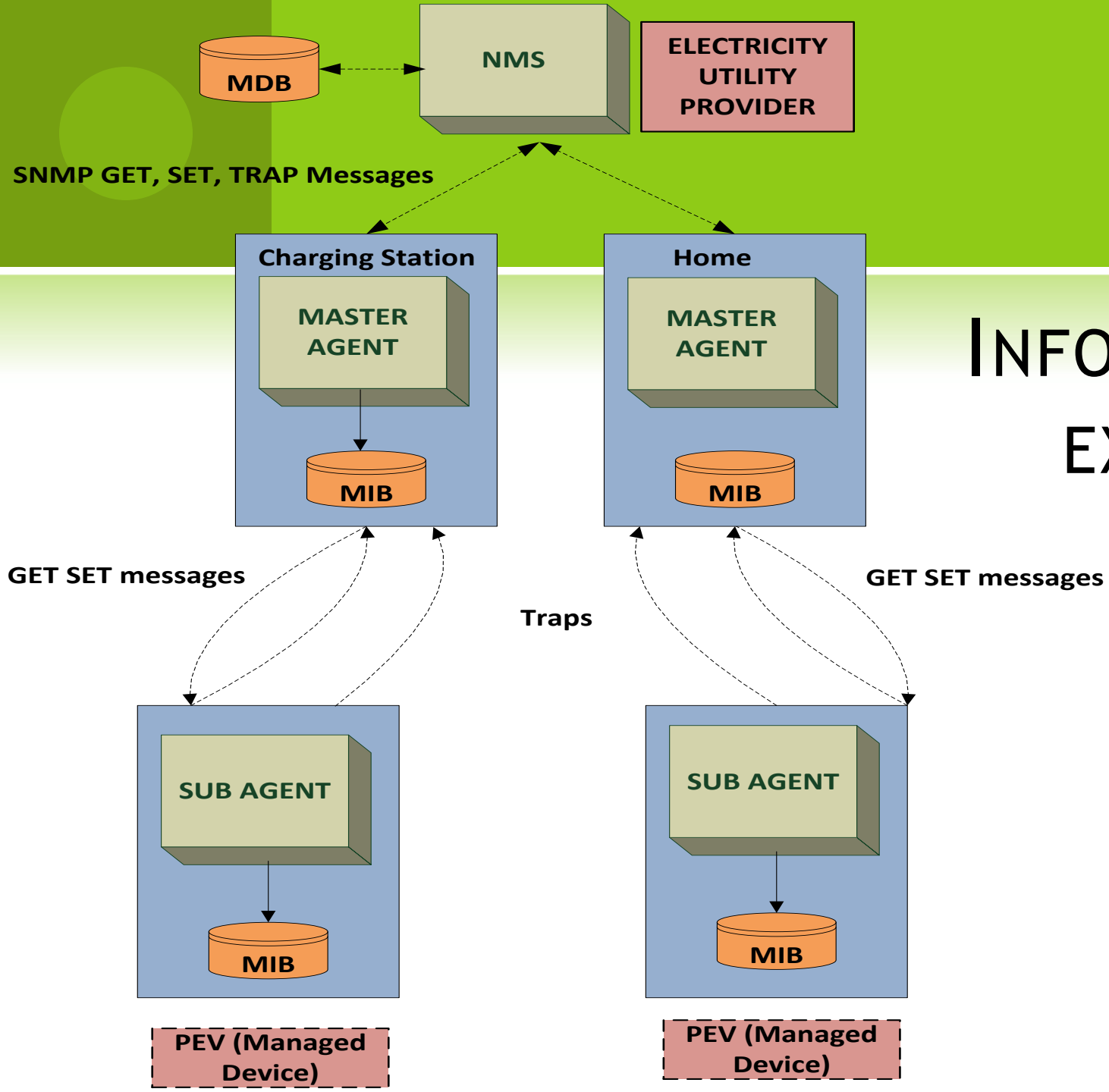
Data Communication Technology

Charging Station	• Proposed: Zigbee • Optional: USB, Ethernet, RS232, 802.11
Battery Charger	• Proposed: CAN-BUS • Optional: USB, RS232, Ethernet, 802.11
Battery Management System	• Proposed CAN-bus • Optional: USB, RS232, Ethernet, 802.11

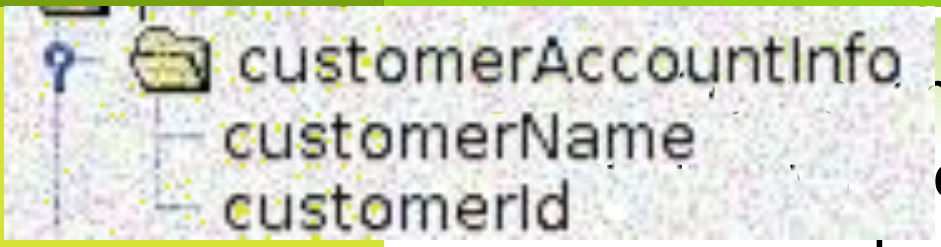
Sensors used in PEV

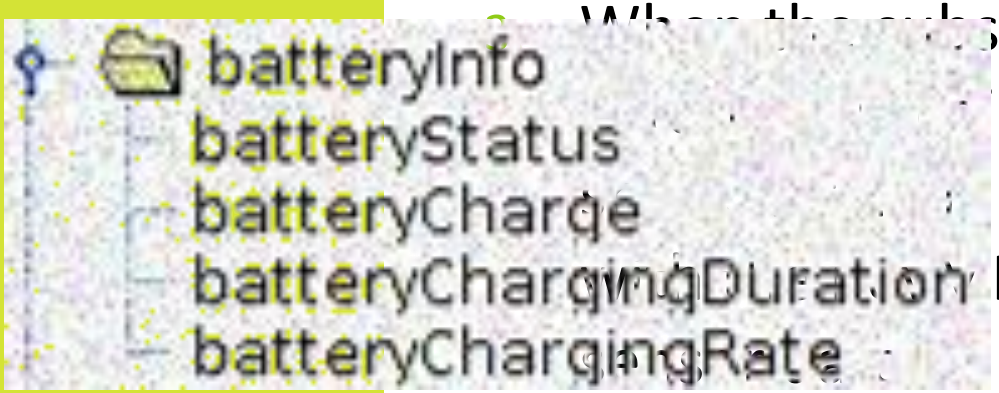
Sensor	Measured Quantity	Data Communication Feature
Delphi	Voltage, Current, and Temperature	Local Interconnect Network (LIN) OR Controller Area Network (CAN)
Hella Intelligent Battery Sensors	Voltage , Current, and Temperature	Bus capability for LIN

Information Exchange



Sequence of Events-I





harged at the home charging
e the subscriber has a
nent address registered by the
rovider.

ith the customer account
fo (unique id).

scriber connects the PEV at an
ng location such as work or
the utility provider is notified
IB and the battery charge

Sequence of Events-II

4. Depending on the charge status (full, or needs charge), the subscriber will be billed (charged for the consumption, or credited for the stored energy transfer to the smart grid).
5. Smart grid network handles all authorization transactions through SNMP messages that identify the subscriber.
6. Battery status sensor measurements are logged into the subscriber account at the utility provider database.

Conclusion

- Dynamic nature of the smart grid poses a challenge to manage subscriber functions effectively. We addressed this problem by designing MIB for PEV that collects electricity usage information of the subscribers using SNMP protocol .
- Our approach provides the flexibility to the subscribers to connect to any charging interface and for utility to identify and bill them accordingly.

Questions