evs 27

The 27th INTERNATIONAL ELECTRIC VEHICLE SYMPOSIUM & EXHIBITION.

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technische universität dortmund

Communication Networks Institute
Prof. Dr.-Ing. C. Wietfeld

Evaluation of OCPP and IEC 61850 for Smart Charging Electric Vehicles

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Agenda

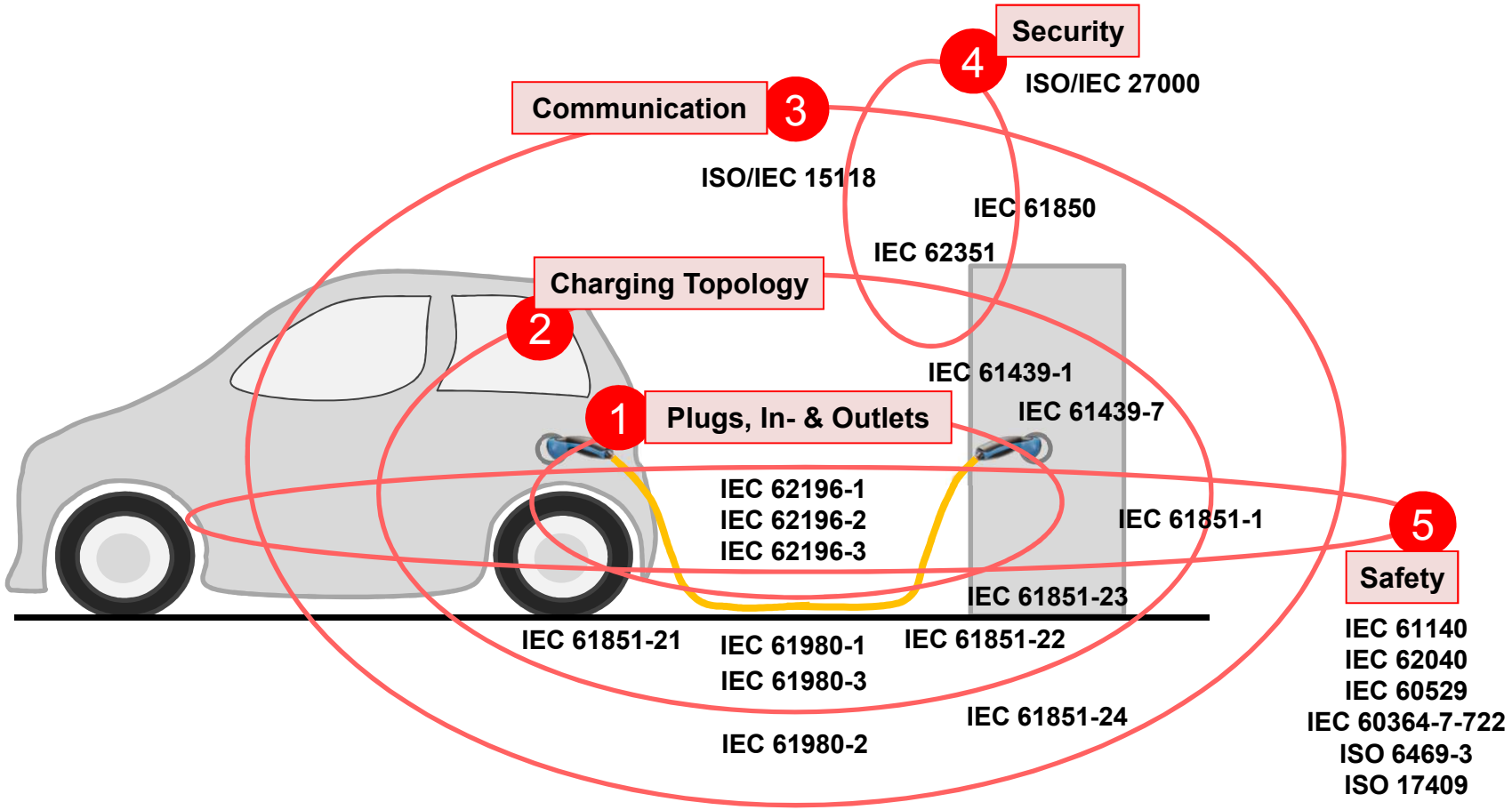
- Introduction to EVSE Backend Communication
- Standardization Landscape for V2G Communication Interface
  - Focus on ISO/IEC 15118
- State of the Art Backend Communication
  - Open Charge Point Protocol (OCPP)
  - IEC 61850-90-8 E-Mobility Object Model
- Comparison of OCPP & IEC 61850-90-8
- Lessons Learned
- Outlook

Introduction to EVSE Backend Communication

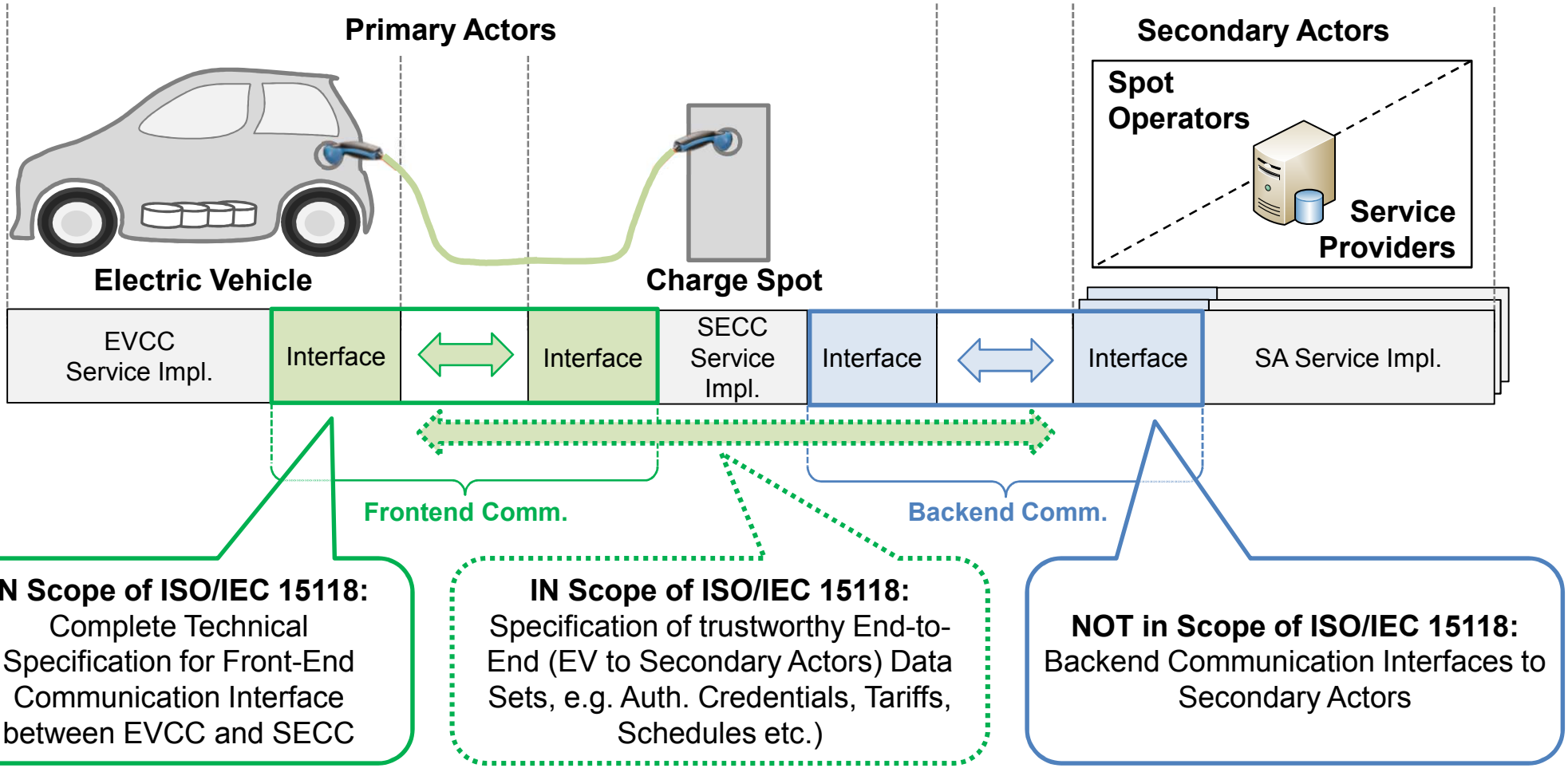
- Use Case Overview for EVSE Backend Communication
  - Today's / Short Term Use Cases
    - Charge Authentication (incl. Roaming)
    - Billing of Charging Processes
    - Remote Customer Support
    - Charge Spot Reservation
    - Infrastructure Operations
    - Asset Management
  - Mid- & Long Term Use Cases
    - Smart Charging Support for Local Infrastructures (Local Scope)
    - Smart Charging Support for Grid Services (≥ Regional Scope)

➢ Mid- & Long Term Use Cases enabled by ISO/IEC 15118 Support

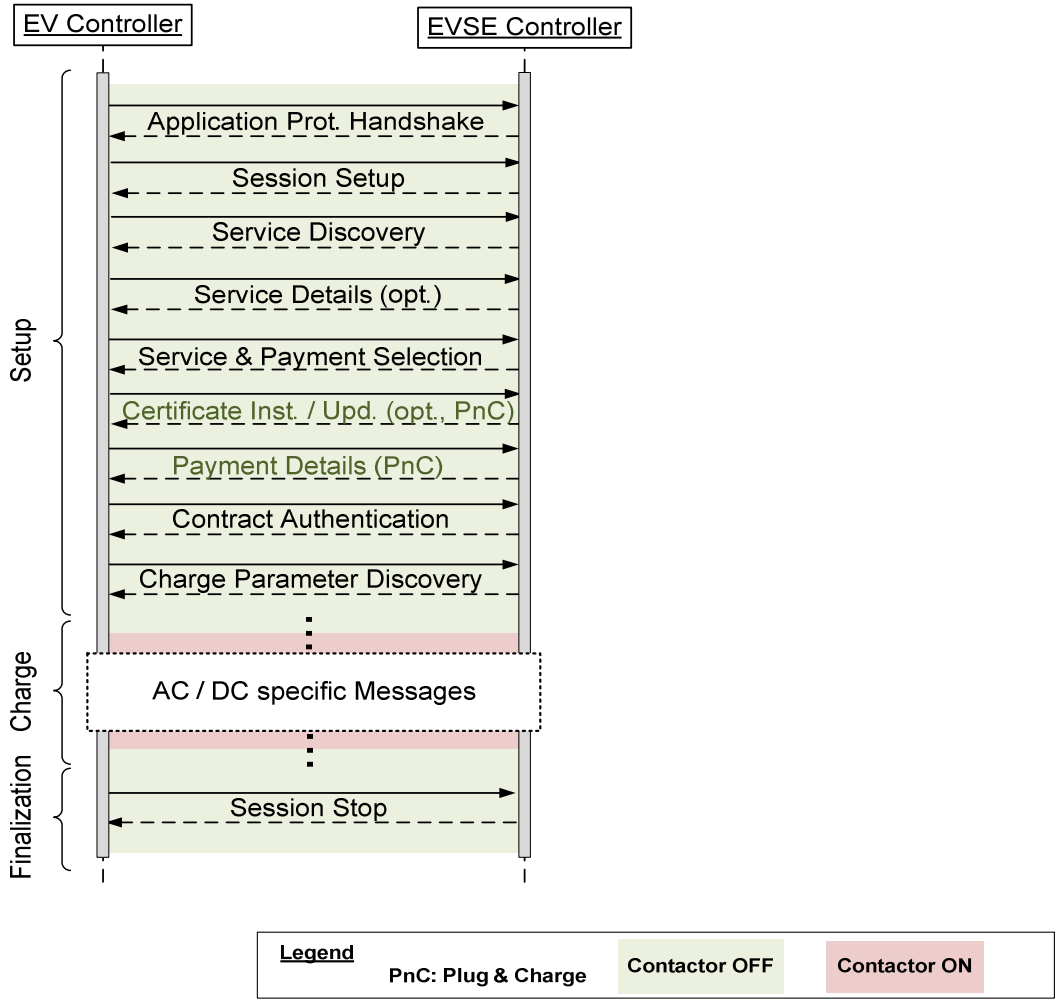
Standardization Landscape of E-Mobility V2G Interface



Scope of ISO/IEC 15118 Vehicle-to-Grid Communication Interface



V2G CI Message Sequence Chart – Backend Relevance



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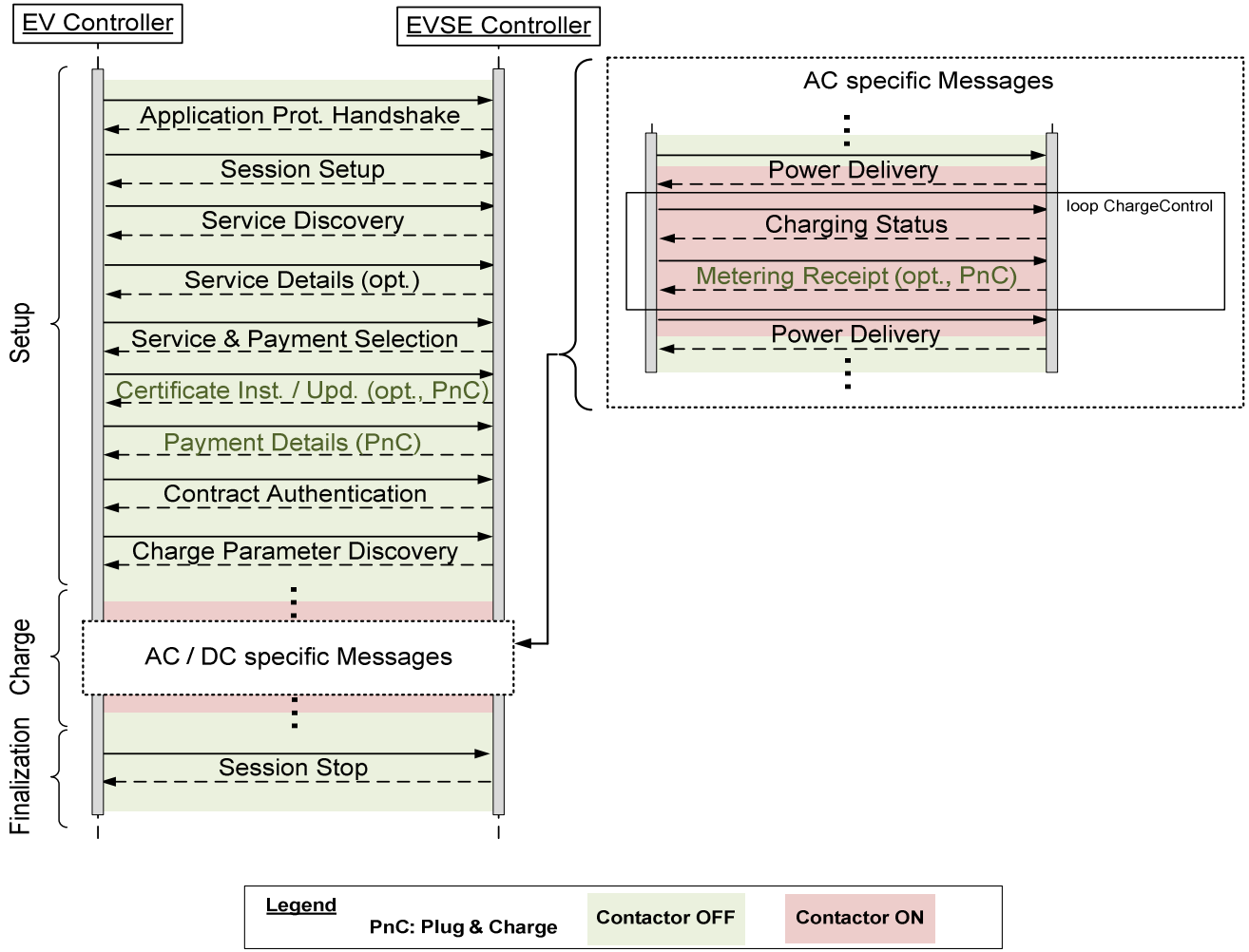
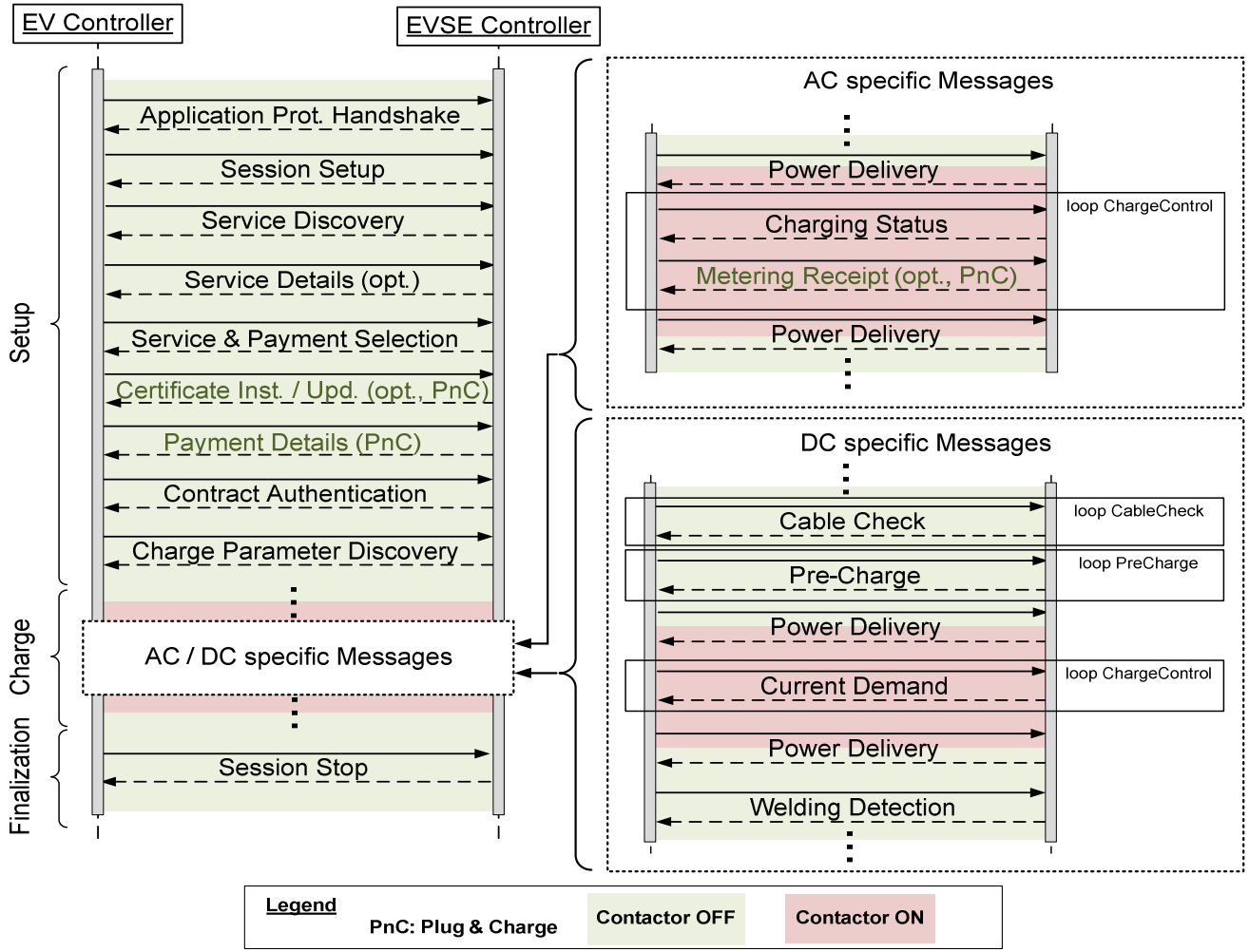


V2G CI Message Sequence Chart – Backend Relevance



Open Charge Point Protocol (OCPP)

OCPP
Open Change Point Protocol

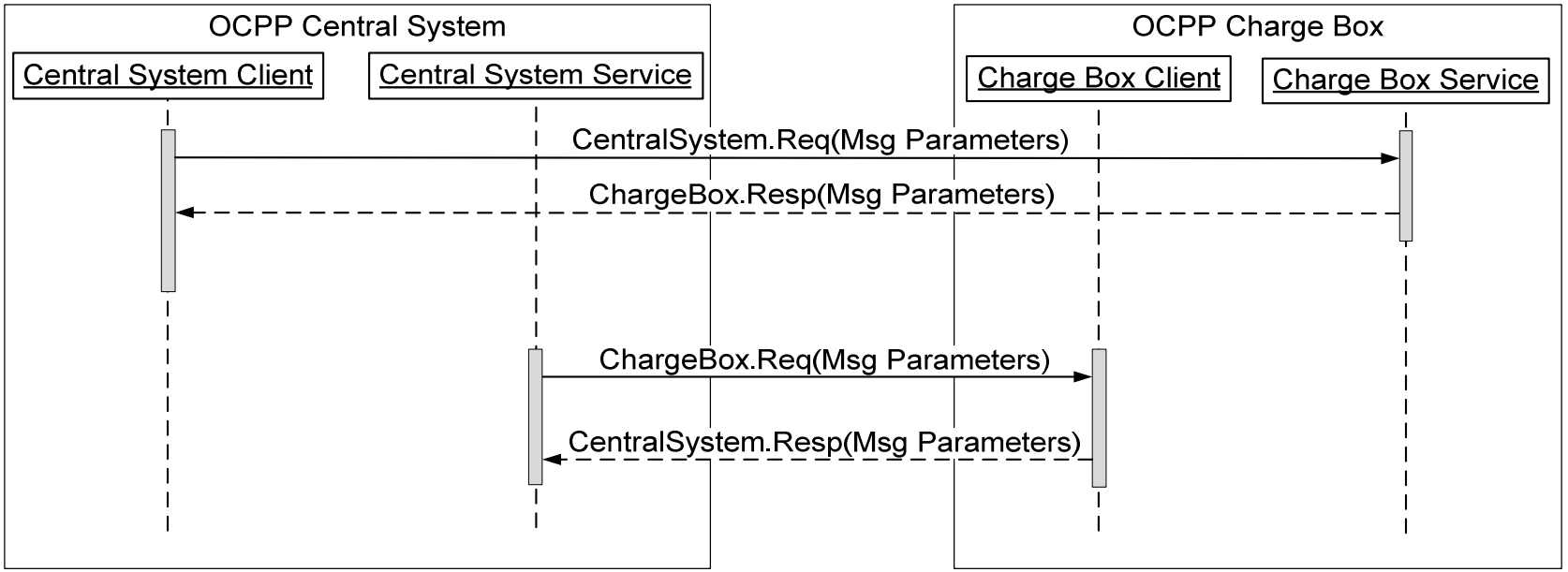
- Introduction through e-laad in 2009
- Official Release Version 1.5 defines:
  - Charge Point Service (CPS) → 14 Operations
  - Central System Service (CSS) → 9 Operations

Service	Supported Operations
OCPP Charge Point Service (CPS)	Cancel Reservation Change Availability Change Configuration Clear Cache Data Transfer Get Configuration Get Diagnostics Get Local List Version Remote Start / Stop Transaction Reserve Now Reset Send Local List Unlock Connector Update Firmware

Service	Supported Operations
OCPP Central System Service (CSS)	Authorize Boot Notification Data Transfer Diagnostics Status Notification Firmware Status Notification Heartbeat Meter Values Start / Stop Transaction Status Notification

➢ OCPP 1.5 scope limited to set of most important “short term” use cases

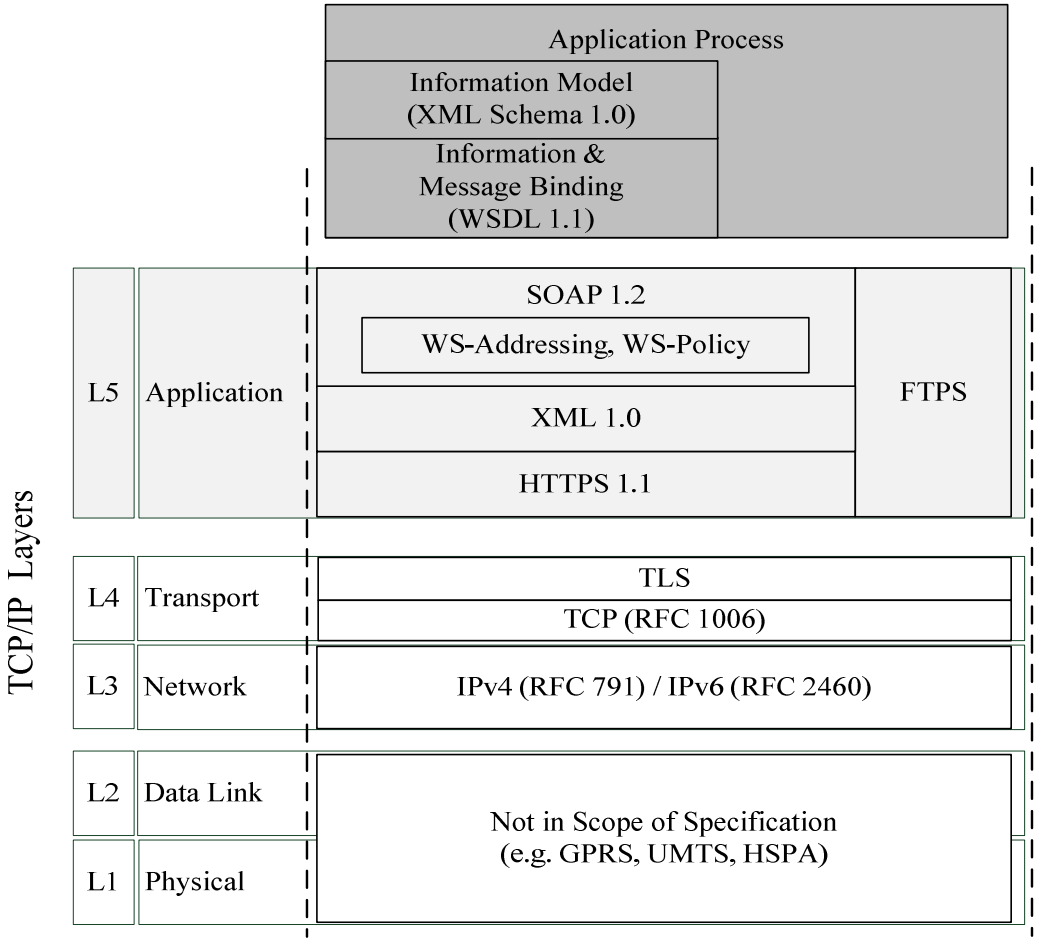
OCPP Protocol Design Paradigms



- Bi-directional Client-Server Web Service Architecture
  - Limited to Request Response Message Exchange Patterns
- Mostly atomic operations
  - No predefined sequences as opposed to ISO/IEC 15118

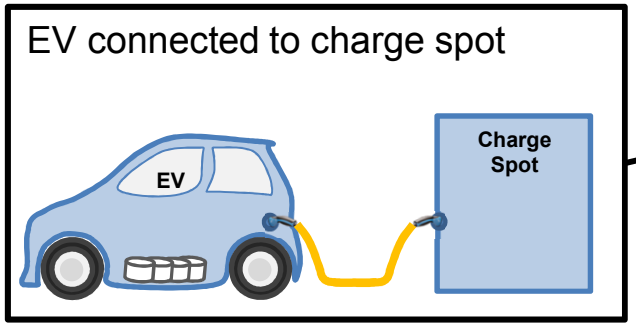
OCPP Protocol Stack

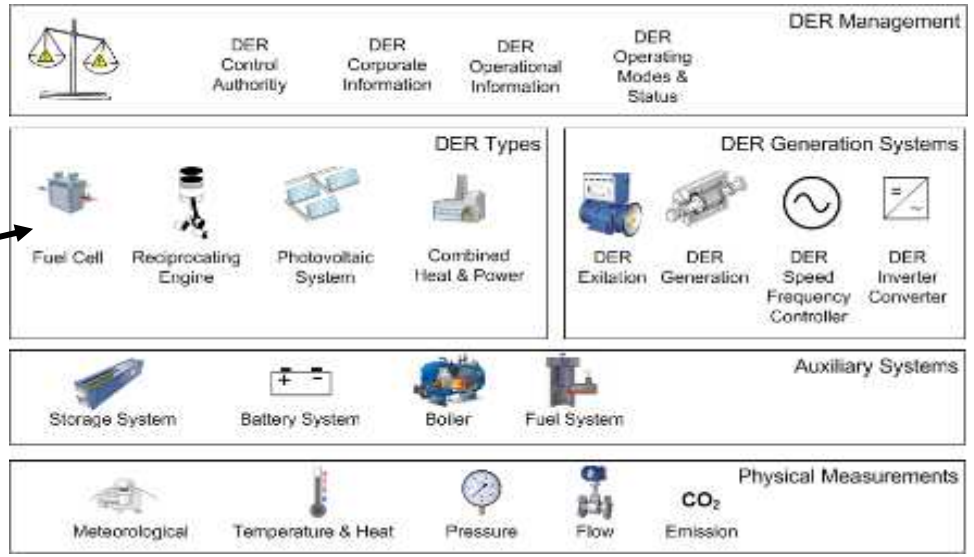
- OCPP 1.5 adopts SOAP-based WS Messaging Architecture
- Information Model and Message Binding based on XML Schema and WSDL
- FTPS used for Firmware Update and uploading Diagnostics Data
- Channel to EVSE may be secured by HTTPS (SSL / TLS)



IEC 61850 - Communication Networks and Systems for Power Utility Automation

- IEC 61850 defines series of standards for automating grid assets
  - According to IEC Roadmap IEC 61850 is Core Standard for future Smart Grid Deployments
- Initial Application Area:
  - Intra- and Inter-Substation Automation Domain
- Today‘s supplementary Application Area:
  - Growing Domain of Distributed Energy Resources (DERs)



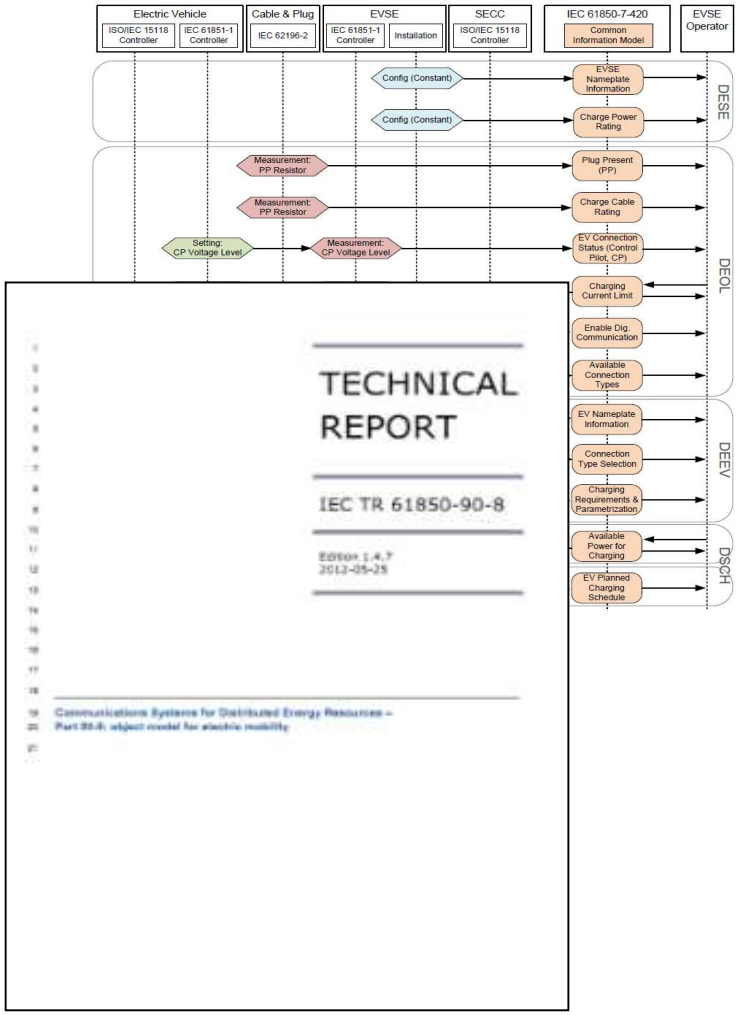


➢ Modelling of DERs necessary

IEC 61850-90-8 E-Mobility Object Model (1/2)

- DER Information Model for EVs
  - AC & DC Charging
  - Bottom Up Modeling Approach based on E-Mobility V2G Interface Standardization Landscape
  - Harmonized with other types of DERs supporting portfolios with heterogeneous DERs

- Scope considers more “mid & long term” use cases:
  - Integration of EV as DER in the Grid (Operational State of EV-based DER)
  - Charge Negotiation / Smart Charging

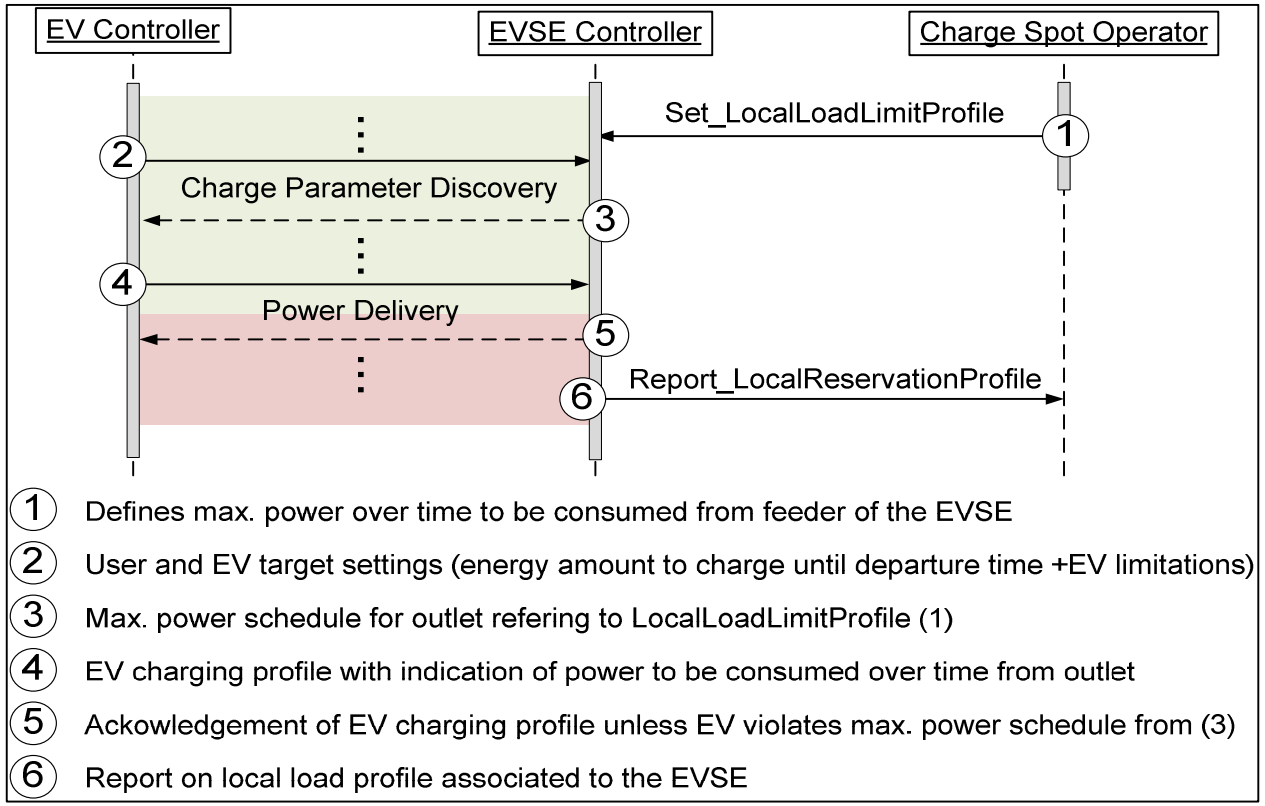


Source: IEC TR 61850-90-8: Communication System for Distributed Energy Resources – Part 90-8: Object Model for Electric Vehicles

IEC 61850-90-8 Operations & Load Profile Propagation

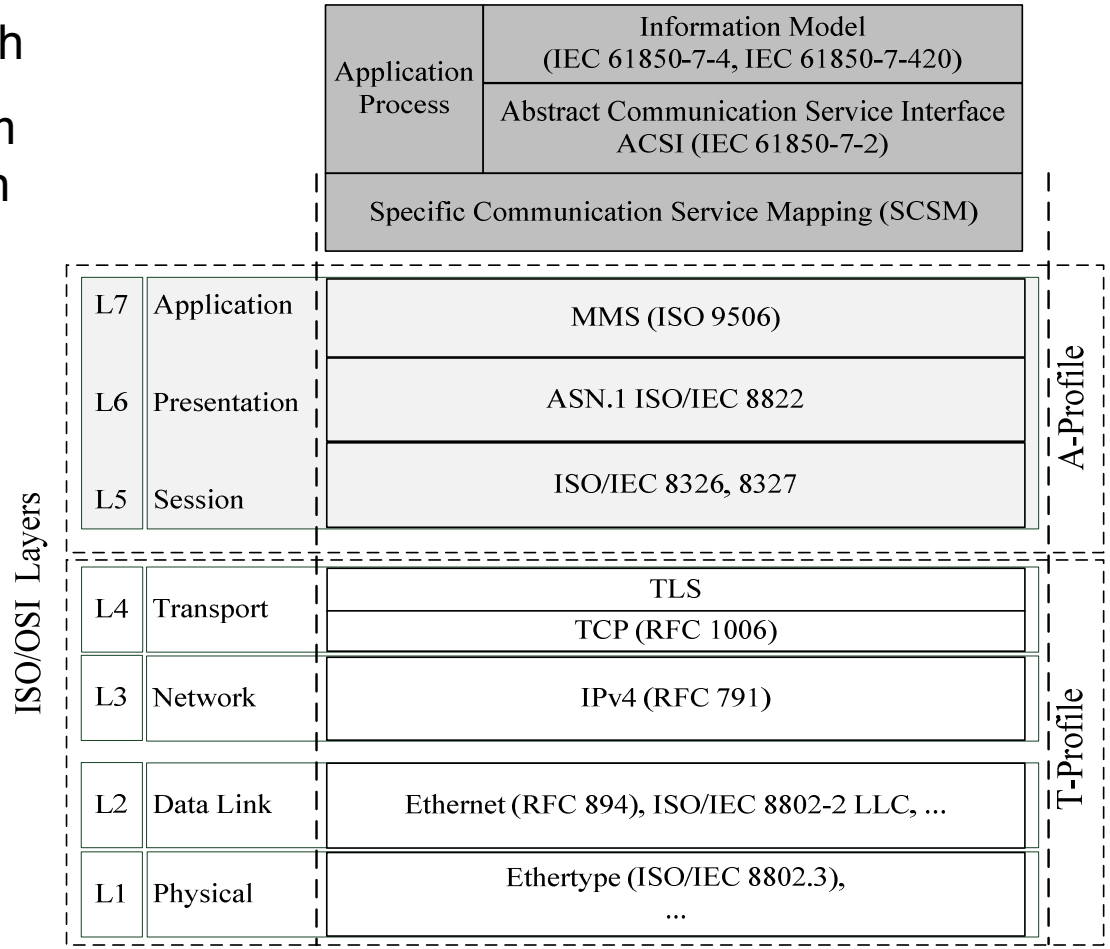
IEC 61850-90-8 Operations:

Service	Supported Operations
IEC 61850 Charge Point Service	Get EVSE (& EV) Nameplate Get Charge Power Rating Get Charge Cable Rating Get Plug Present Get (Available) Connection Type Get State (A, B, C, D, E, F) Enable / Disable Dig. Comm. Get User Target Settings (Energy Amount & Departure Time) Get EV Charge Power Rating Set Local Load Limit Profile (EVSE/Station Limits) Report Local Load Reservation Profile (EV/EV Pool Reservation)



IEC 61850 Protocol Stack

- Object-oriented Modeling Approach
- Client-Server Messaging Paradigm for less time critical Messages with TCP/IP Stack
- ACSI in order to abstract from concrete SCSM Implementation like MMS
- Communication Channel secured by TLS
- Supports Role Based Access Control (RBAC) through IEC 62351

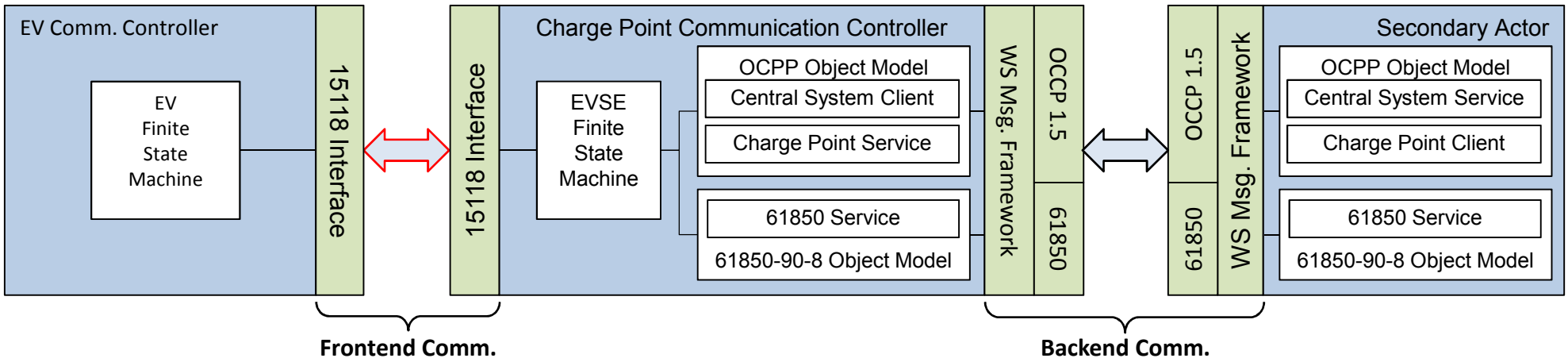


Comparison of OCPP 1.5 & IEC 61850-90-8

Criteria	OCPP 1.5	IEC 61850-90-8
Functional Scope	• Support for operational tasks (e.g. authentication & transaction handling, metering, reservation etc.) • Support for maintenance tasks (e.g. status notifications, configuration & firmware mgmt., diagnostics etc.) • No Grid Services / Smart Charging Support • No RBAC Support	• Limited support for operational tasks (e.g. no authentication & transaction handling, reservation etc.) • Limited support for maintenance tasks • Grid Services / Smart Charging Support • RBAC Support
Technical Issues / Drawbacks	• Huge Message Overhead due to Plain Text SOAP-over-HTTP Binding e.g. resulting in complex Heartbeat Mechanism	• Inflexible and cumbersome MMS binding mechanism (WG17 working on WS-based binding mechanism)
Specification & Standard Maturity	• Specification does not clearly formulate requirements (conformance issues) • Lack of specification and conformance details is dealt with open reference implementation	• Specification does not clearly formulate requirements • Complexity of IEC 61850 (long learning curves) • Complex and time consuming standardization process

Lessons Learned

- Combined approaches of OCPP and IEC 61850-90-8 would offer:
  - Added value in terms of functional coverage (short, mid and long-term use cases for operations, maintenance tasks, and grid services)
  - Consideration of EVSE- and Grid-Operator's business focus'
- Integration options:
  1. Leverage IEC 61850-90-8 E-Mobility Object Model as Meta Model for Smart Charging in OCPP
  2. Integrated approach with separate OCPP and IEC 61850-90-8 services and unified WS-based binding mechanism



Outlook

- Roadmap for OCPP 2.0
  - Consideration of ISO/IEC 15118 Smart Charging (schedules)
  - Advanced diagnostics
  - Optimized transport mechanisms (for e.g. bandwidth optimization)
  - More detailed compliance definition

- eMI^3 Group
  - WG5 currently consolidates requirements for charge spot backend protocols
  - Various backend protocols were proposed / nominated
  - WG5 goal: Drafting of backend protocol description based on lessons learned from consolidation process

➢ Keep IEC compliance for harmonized grid integration of EVs with other types of grid assets e.g. heterogeneous DER portfolios

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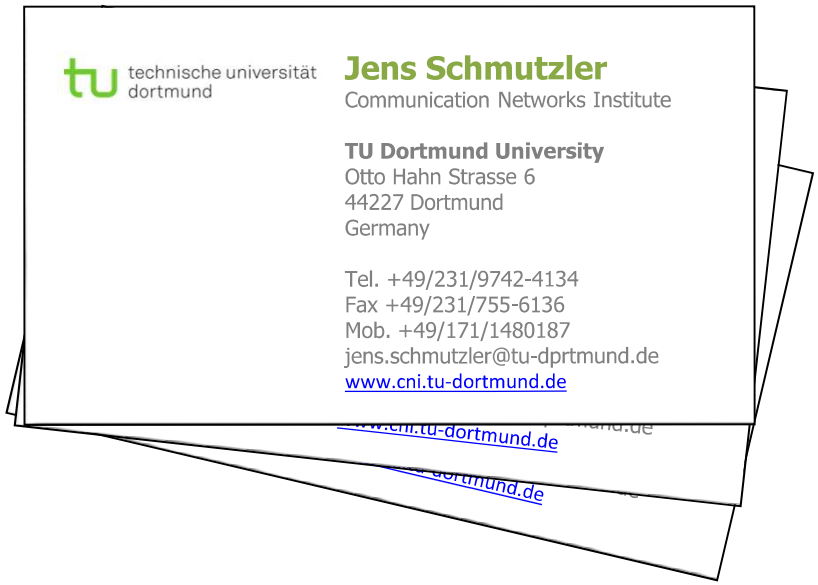
Thank you for your attention



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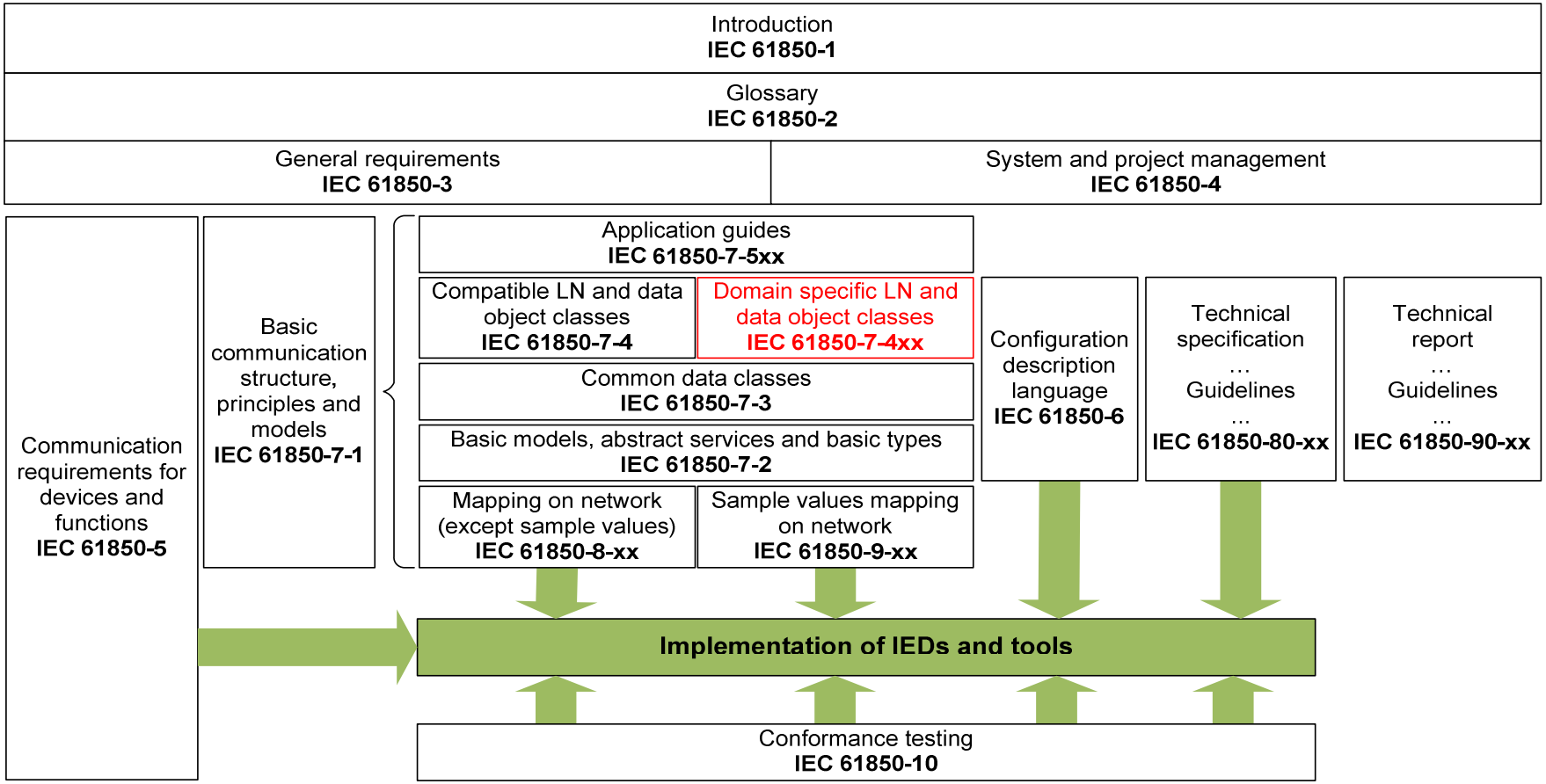
Backup

IEC 61850 Standard Overview

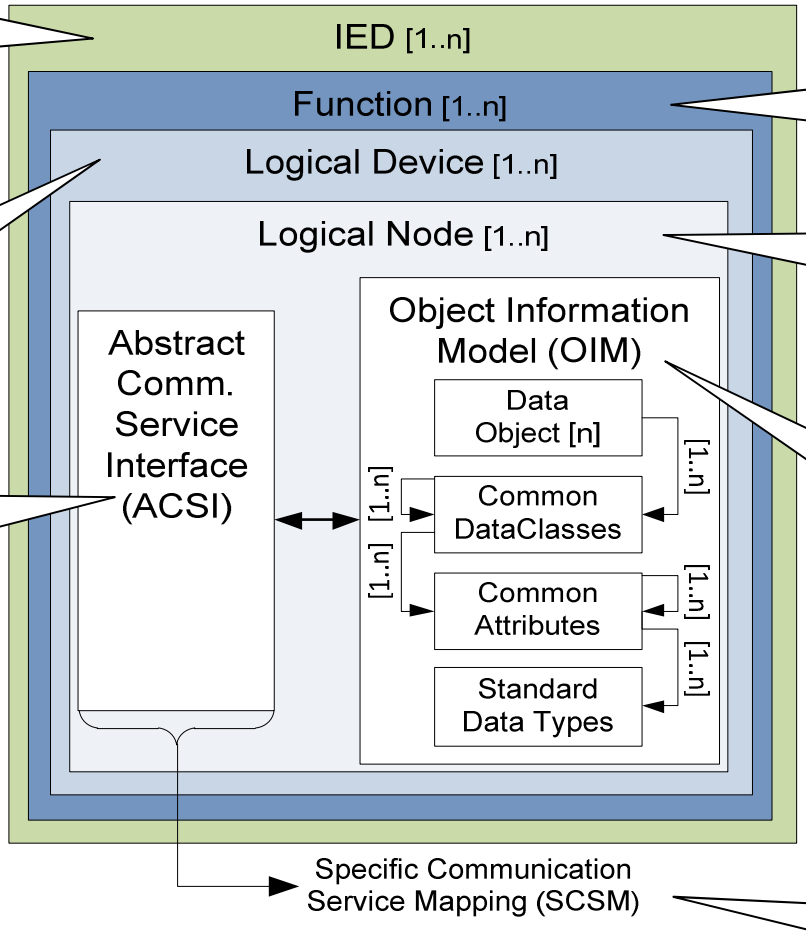


IEC 61850 Information Modeling

Device with *local* intelligence: e.g. control / monitoring capabilities, advanced communication means or electrical protection functions

Abstract logical view on the IED topology (Group of Logical Nodes)

Defines the services on top of the OIM. Binding the Logical Node and its Object Information Model to service and communication interfaces



Function of the IED: e.g. protection, (self-) monitoring, auto-reclosure, control and communication

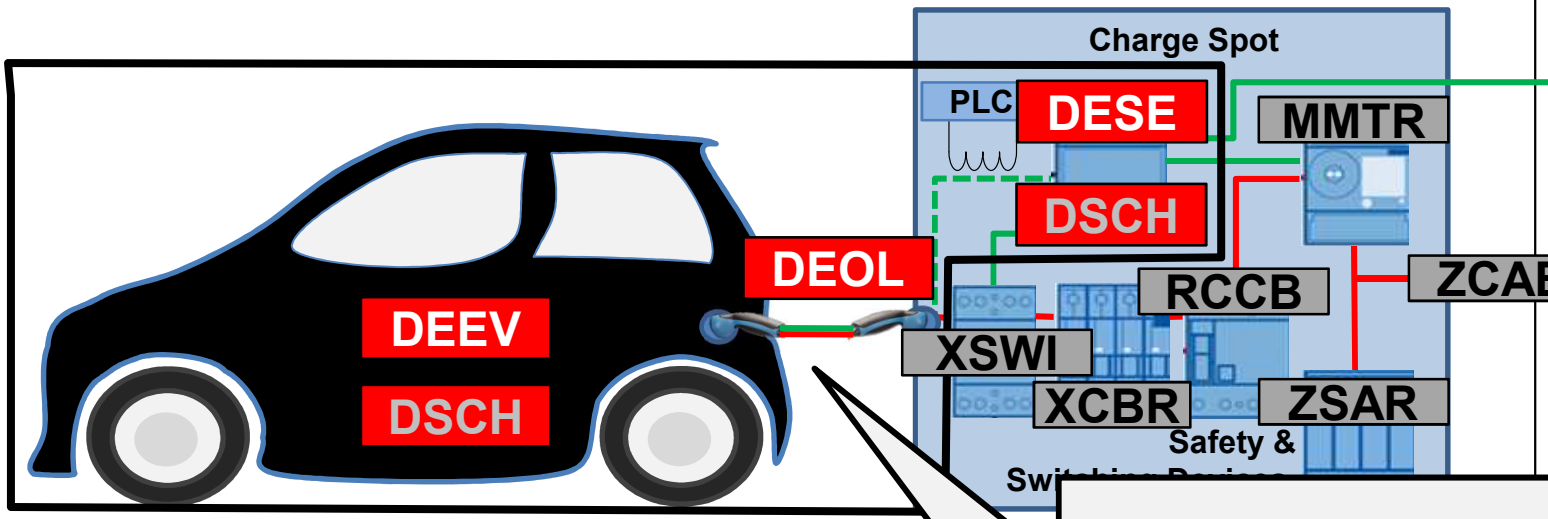
Describes one functional entity as Logical Nodes according to IEC 61850-7-4 & IEC 61850-7-420 specifically for DERs

Object Information Model (OIM) of a Logical Node according to its type definitions

Underlying communication protocol stack for IED communication functions

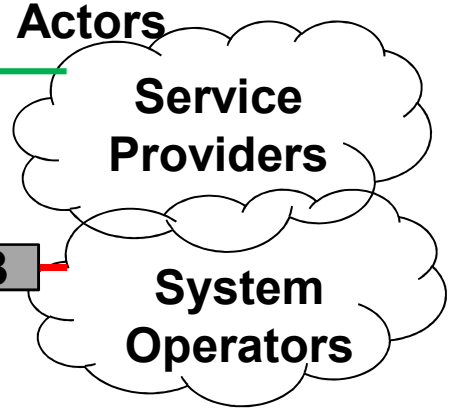
IEC 61850-90-8 E-Mobility Object Model (2/2)

Proposed E-Mobility Object Model for IEC 61850-7-420



- **DESE**: EV Supply Equipment
- **DEOL**: EVSE Outlet
- **DEEV**: Electric Vehicle
- **DSCH**: Energy & Ancillary Service Schedule
- **MMTR**: Circ
- **XSWI**: C
- **XCBR**: Circ
- **RCCB**: Resid
- **ZSAR**: surg

Secondary Actors



All relevant E-Mobility Standards for the Vehicle-to-Grid Interface mapped to IEC 61850-7-420 with four new/adapted Logical Nodes:

→ DESE: EV Supply Equipment
→ DEOL: EVSE Outlet
→ DEEV: Electric Vehicle
→ DSCH: Energy & Ancillary Service Schedule