Use Cases discussed by ISO/IEC Joint Working Group Vehicle-2-Grid Communication Interface

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2017-07-11

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Motivation

- This presentation tries to summarize the discussion of relevant use case for charging electric vehicles (EV).
- The standard family ISO 15118 describes only the result of the discussion and shows the solution worldwide experts found.
- The ISO 15118 use cases have been specified after defining the requirements of the stakeholders.

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Use Case Modelling

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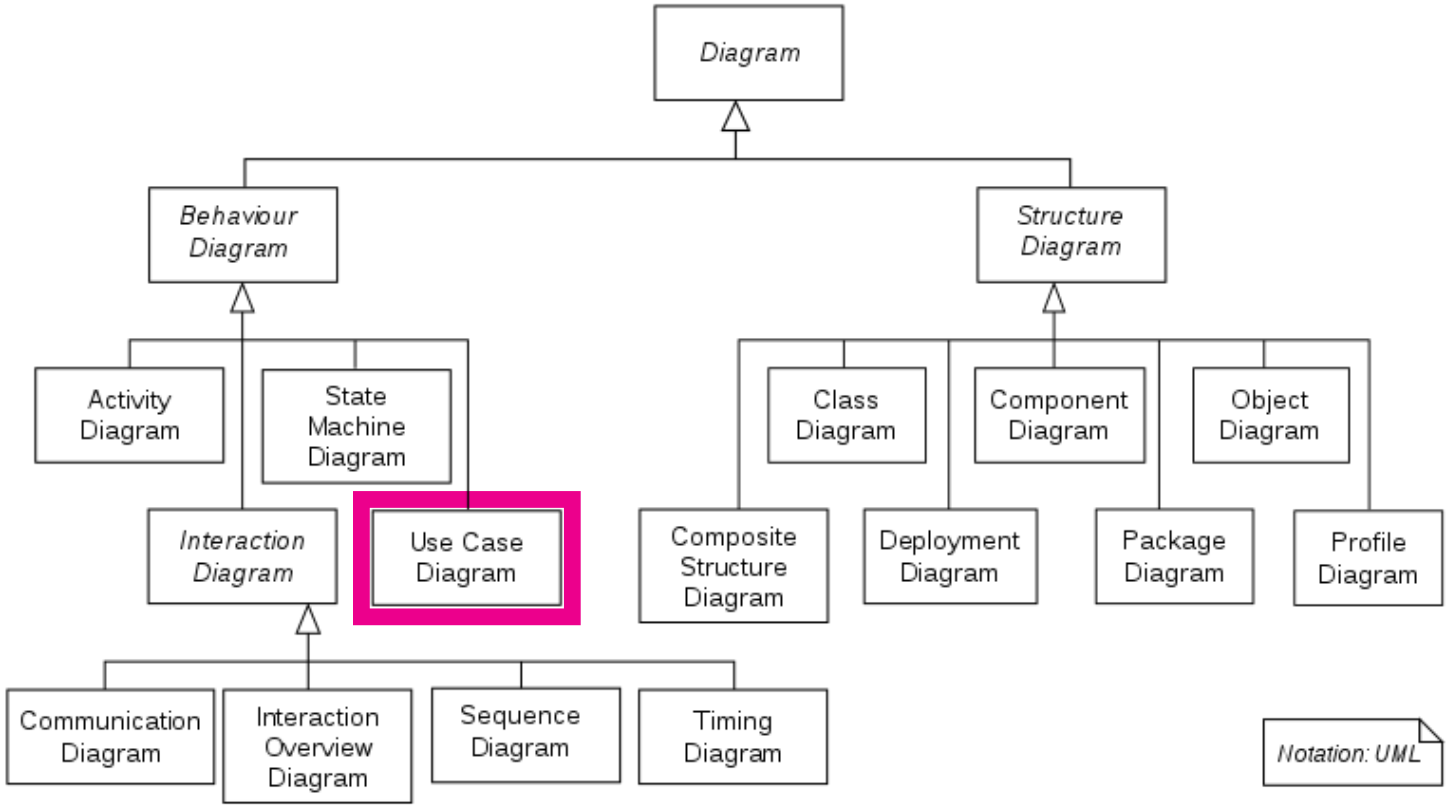
Diagrams Unified Modeling Language (UML)



Source: https://en.wikipedia.org/wiki/Unified_Modeling_Language

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What is an Use Case (UC)?

In software and systems engineering, a use case is a list of actions or event steps, typically defining the interactions between a role (known in the Unified Modeling Language (UML) as an actor) and a system, to achieve a goal. The actor can be a human or other external system. In systems engineering, use cases are used at a higher level than within software engineering, often representing missions or stakeholder goals. The detailed requirements may then be captured in the Systems Modeling Language (SysML) or as contractual statements.

Use case analysis is an important and valuable requirement analysis technique that has been widely used in modern software engineering since its formal introduction by Ivar Jacobson in 1992.

Source: https://en.wikipedia.org/wiki/Use_case

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Typical Use Case structure

No	Type	Description
1	Use case name	
2	Use case ID	
3	Objectives	
4	Description	e.g. includes (included (sub) UC), triggers, basic flow, alternative flow
5	Actors	
6	Prerequisites	
7	Requirements	
8	End conditions	

Reading: Cockburn, Alistair. Writing Effective Use Cases. Addison-Wesley, 2001

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IEC 62559-2:2015 “Use case methodology — Part 2: Definition of the template for UC, actor lists and requirements list”

1 Description of the Use Case

- 1.1 Name of the Use Case
- 1.2 Version Management
- 1.3 Scope and Objectives of Use Case
- 1.4 Narrative of Use Case
- 1.5 General Remarks

2 Diagrams of Use Case

3 Technical Details

- 3.1 Actors
- 3.2 Triggering Event, Preconditions, Assumptions
- 3.3 References
- 3.4 Further Information to the Use Case for Classification / Mapping

4 Step by Step Analysis of Use Case

- 4.1 Overview of Scenarios
- 4.2 Steps - Scenarios

5 Information Exchanged

6 Requirements (optional)

7 Common Terms and Definitions

8 Custom Information (optional)

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Example of a Sequence Diagram

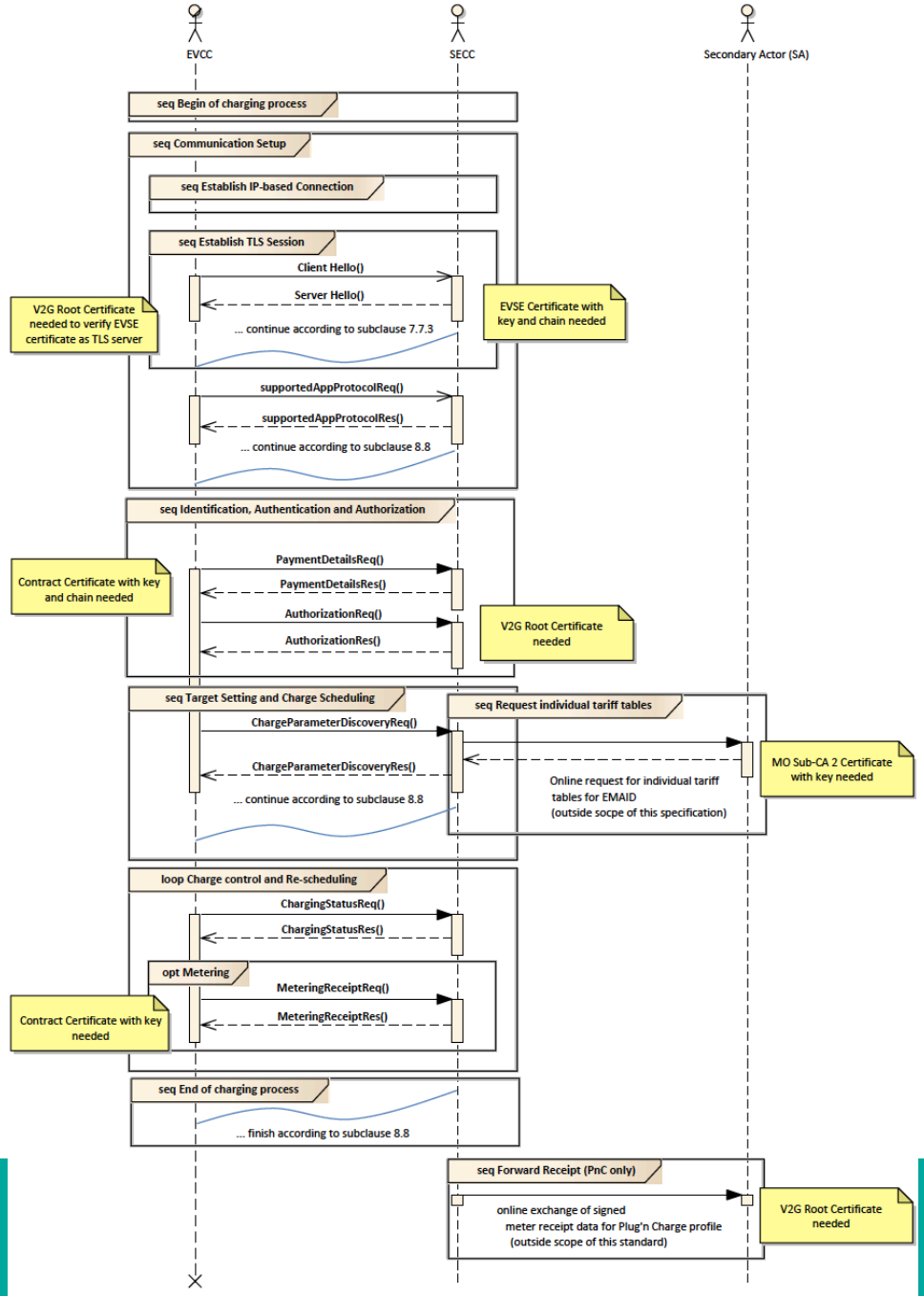

Figure 5 — Example for online communication

Source: ISO 15118-2:2014

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Actors / Roles

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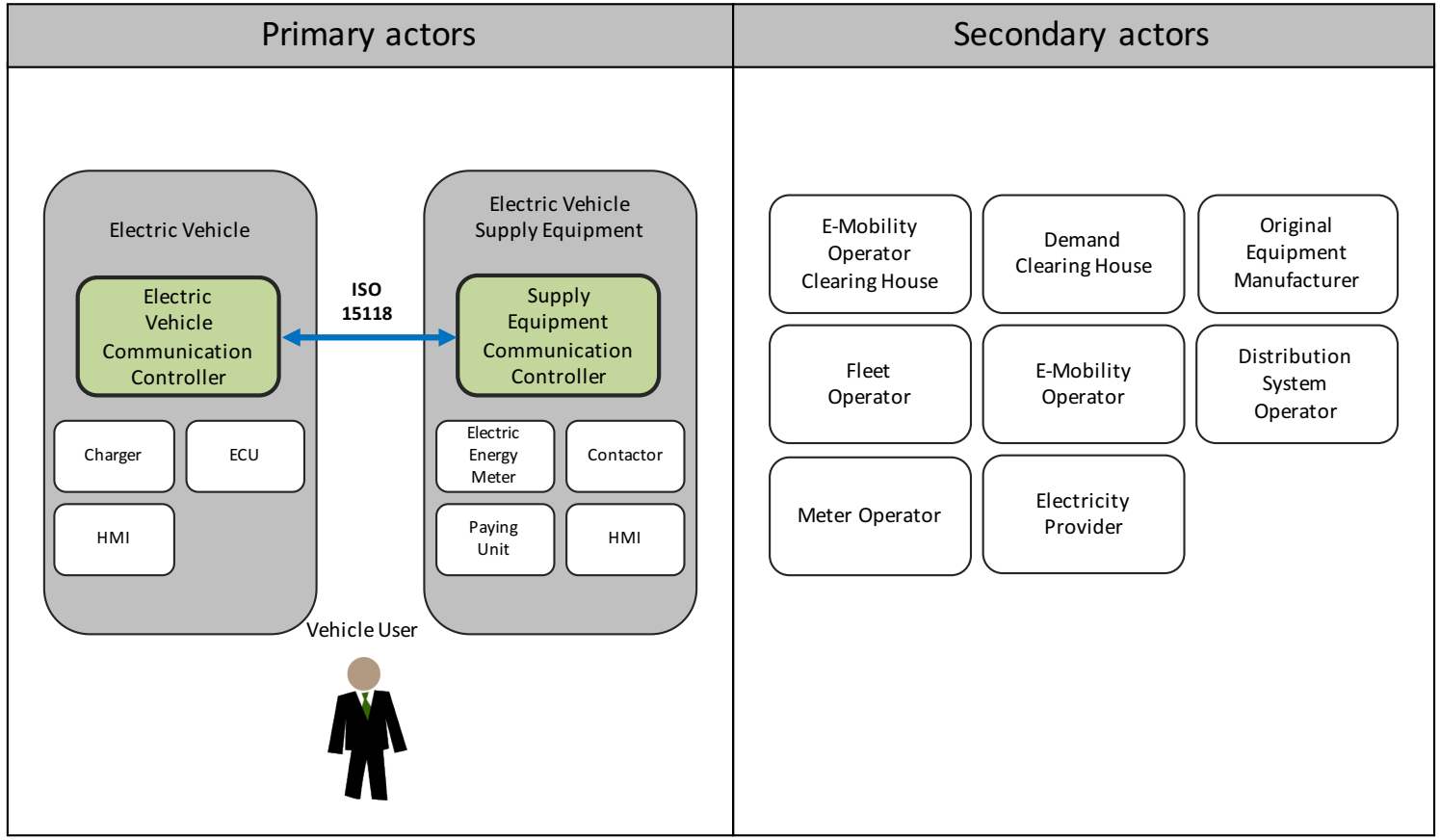
Roles discussed within ISO 15118



- Primary actors are involved directly in the charging process
- Secondary actors are involved indirectly in the charging process
  - They may exchange information between each other.
  - Relevant data structures between primary and secondary actors together with requirements on information security are defined within ISO 15118

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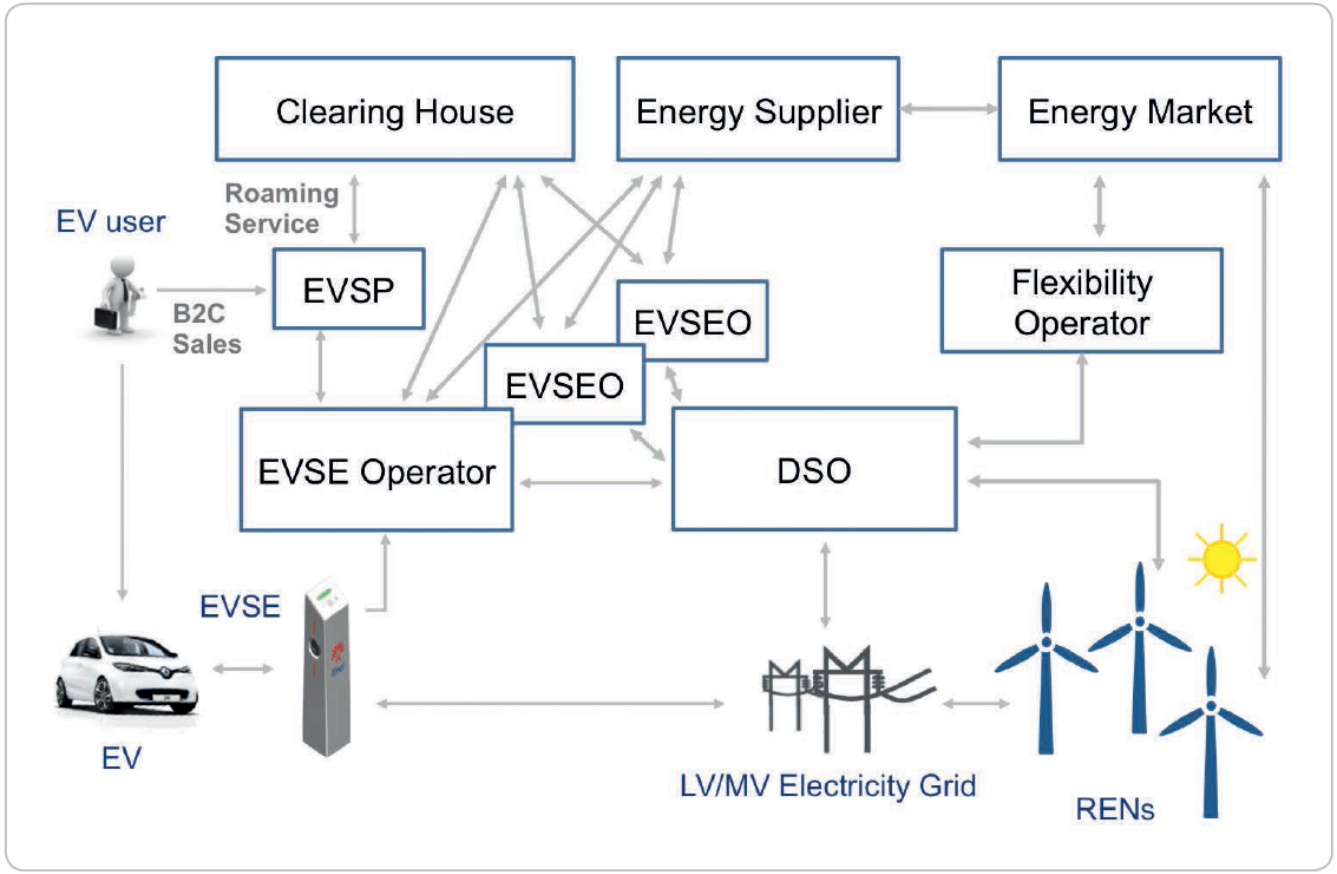
PlanGridEV: Communication between actors

- Typical communication structure between stakeholders



Source: http://plangridev.eu/

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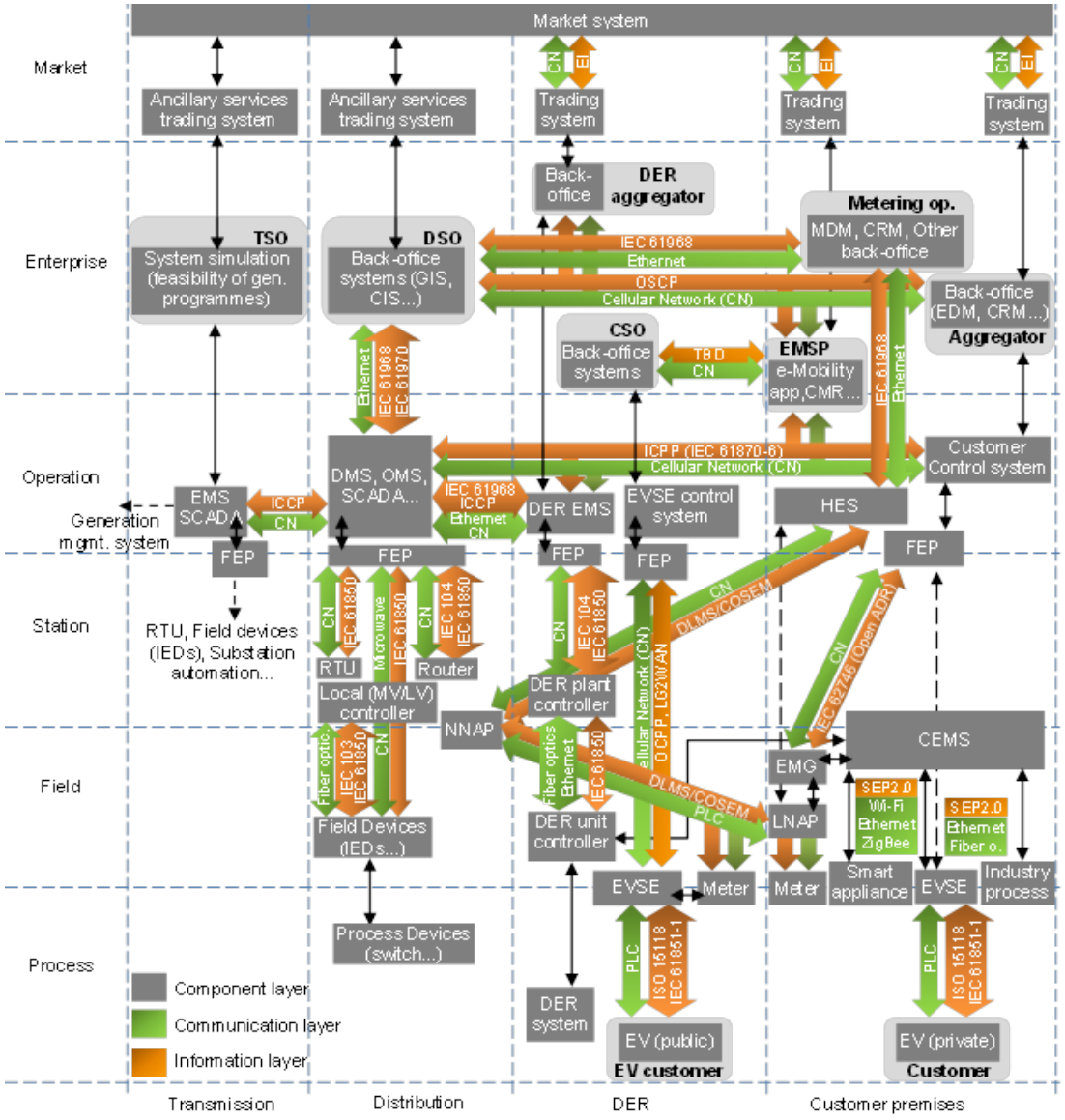
PlanGridEV: Smart Grid ICT Architecture Proposal

- (Zoomable) Comprehensive ICT architecture proposal from EC project "PlanGridEV" (http://plangridev.eu/datas/150824_SRG_PGEV_D33_ABSTRACT_editor.pdf)



Source: http://plangridev.eu/

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E-Mobility Stakeholders have a lot of requirements

- EV Driver
- Charging Service Operator (CSO)
- E-Mobility Operator (EMO)
- House owner, site host
- EV Fleet operator
- Distribution System (grid) Operator (DSO, IOU)
  - Meter reading provider
- Centralized power production
- Decentralized power production
- Vehicle manufacturer (OEM)
- Regulator

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Requirements for EV Drivers

- Charge EV's battery by respecting technical restrictions
  - Fast charging: Now and as fast as possible
  - Scheduled charging: Time until departure is longer than time needed for charging
- Make handling of a charging session as easy as possible with support for
  - Automatic authentication
  - Anonymous charging
  - Legacy authentication (e.g. RFID, credit card, cash)
  - Compatibility without high-level communication
- Charge as cheap / much GHG free electricity / own produced electricity … as possible
- Earn money by supporting "security of supply"
  - Voltage and/or frequency stabilization
  - Short-term storage of PV energy ("Charge at noon, use at night")

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Requirements for E-Mobility Operator (EMO)

- Provides authentication credentials with or correlated with an E-Mobility Authentication ID (EMAID), e.g. an RFID token, name & password, electronic certificate
  - For electronic certificate handling a Public Key Infrastructure (PKI) should be implemented.
- Provide price information for a charging session to the EV
- Update price information for a charging session to the EV
- Provide information about customer contract features, e.g. participation in grid-integrated charging or energy feedback (”Reverse Power Transfer” (RPT))
- Provide roaming (charging at EVSE of several CPOs) for his customers
- Get technical data of a charging session from his customers for billing

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Requirements for Charging Service Operators (CSO)

- Authentication for services with costs, incl. roaming
- Support for Plug-’nd-Charge (PnC) (payment for charging without manual authentication)
- Provide individual price information (tariffs)
- Provide information about individual availability of energy
  - Grid capacity information
  - (Renewable) energy production
- Provide services for earning money by supporting “security of supply”
- Provide trustworthy meter readings
- Be a trusted party for utilities
  - Ensure proper operation of a grid connection point
  - Monitor compliance with agreed charge profile
- Support “safety” relevant signalization according to SAE J1772 / IEC 61851-1

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Requirements for house owner or site host

- Authentication for services with costs, incl. roaming
- Support for Plug-’nd-Charge (PnC)
- Provide individual price information (tariffs)
- Provide information about individual availability of energy
  - (Home / Facility) Energy Management System (incl. local energy production and local demand) and/or grid capacity information
- Provide services for earning money by supporting “security of supply”
- Provide trustworthy meter readings
- Be a trusted party for (H/F)EMS

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Requirements for EV Fleet operator

- Combination of requirements from EV driver and house owner / site host
- Aggregation of charging sessions, locations, contracts, accounts, customers etc. could be done in a reporting system

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Requirements for Distribution System (grid) Operator

- Customer authentication for services at a grid connection point (GCP)
- Provide individual price information (e.g. TOU tariffs)
- Provide information about availability of energy at GCP for negotiating charge plans
  - (Home/Facility) Energy Management System (incl. local energy production and local demand) and/or grid situation (e.g. free capacity) and/or power production (e.g. fluctuating renewables)
- Provide information for services supporting "security of supply"
- Trust an EVSE as a trustworthy party
  - Get access to trustworthy meter readings
  - EVSE supervises agreed charge plans
- Support bundled (grid and sales in one hand) and unbundled (grid and sales owned by separate companies) utilities

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Requirements for Centralized power production

- Provide information about individual availability of centralized energy production
  - → Could also be provided by DSO
- Provide services for earning money by supporting “security of supply”
  - → Could also be provided by DSO
- [Provide individual price information (tariffs) → normally done by energy resellers]

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Requirements for Decentralized power production

- Provide information about individual availability of decentralized energy production
  - → Could also be provided by DSO or a EMS
- Provide services for earning money by supporting “security of supply”
  - → Could also be provided by DSO or EMS
- [Provide individual price information (tariffs) → normally done by energy resellers or EMS]

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Requirements for Vehicle manufacturer (OEM)

- Specification and usage of international standards for delivering EVs worldwide, like ISO 15118
  - Enable EVs to use ISO 15118 PnC
  - Enable EVs to respect utility relevant requirements
- Support new business models, like EV fleet management

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Requirements for Regulators

- Avoid high investments in electricity infrastructure
  - Avoid high peak load of not-scheduled (dump) charging
  - Claim coordination of charge plans with needs of utilities
- Allow benefits for grid-respecting charging
- Allow utilities' investments in electricity grids for hot-spots with high EV demand

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Other Requirements

- International accepted support
- Integrate information / cyber security by design
- Provide future enhancements
- Offer upgrade of existing EVSE
- Support as many Demand Response Management Systems as possible an any level, e.g. EMS, transformer, (sub) grid area
  - Provide / use interfaces / API that are easy to understand / implement
  - Provide compatibility and conformance tests
- Respect „Keep it small & simple“ (KISS), e.g.
  - Concentrate on one area and provide (easy) interfaces to others
- Reduce complexity: Try to solve problems on the lowest level possible, shift it to an upper level only if it is necessary
- Support renegotiation, triggered by
  - Utility
  - EV driver
  - Environmental changes

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Glossary

- AC: Alternating Current
- ACD: Automatic Connection Device
- CSO: Charging Service Operator, sometimes also called Charge Point Operator (CPO)
- DC: Direct Current
- DCH: Demand Clearing House
- DSO: Distribution (grid) System Operator
- EMO: E-Mobility Operator
- EMOCH: E-Mobility Operator Clearing House
- EMS: Energy Management System
- EV: Electric Vehicle
- EVCC: EV Communication Controller
- EVSE: EV Supply Equipment
- FPT: Forward Power Transfer
- GCP: Grid Connection Point
- HEMS: Home Energy Management System
- HPGP HomePlug Green PHY
- HSM: Hardware Security Module
- IEC: International Electrotechnical Commission
- ISO: International Organization for Standardization
- IT: Information Technology
- JWG: ISO/IEC Joint Working Group “Vehicle-to-Grid Communication Interface” (JWG V2G CI)
- OEM: Original Equipment Manufacturer, *here*: EV manufacturer
- PnC: Plug-’nd-Charge authentication of ISO 15118
- RPT: Reverse Power Transfer
- SA: Secondary Actor
- SECC: EVSE Communication Controller
- SLA: Service Level Agreement
- TOU: Time-of-Use tariff
- UC: Use Case
- VAS: Value Added Services
- VGI: Vehicle Grid Integration
- WPT: Wireless Power Transfer

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Backup
Overview ISO 15118

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Ideas and history of ISO 15118

- Initiated by large European car manufacturers (OEM), utilities, data integrators, research institutes and (potential) charging station manufacturers in November 2008 with the goals:
  - Develop a bi-directional communication protocol for charging EV at EV Supply Equipment (EVSE, aka *charging point* or *charging station*)
  - Providing (automated) authentication methods, which could also be used for micro-payment
  - Allows consideration of power production (especially of fluctuating renewables), electric grid situation and sales tariffs, re-negotiation of charge profiles are possible
  - Respect information (cyber) security, data privacy, data reduction and data economy
- Specification started in March 2009 at ISO and IEC with liaison to SAE (first joint meeting in November 2009 at Troy, MI).

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F2F Meetings and Web Conferences for Coordination of ISO/IEC 15118 Joint Working Group

- 2008: Kick-off meeting preparation phase (2008-11-25)
- 2009: 14 Face-to-face and 2 web meetings; Highlights:
  - March: Hand over all material to ISO/IEC 15118 Joint Working Group Vehicle-to-Grid Communication Interface (JWG V2G CI)
  - September: First meeting at SAE Headquarters
  - November: Split into 4 parts and project teams (PT)
- 2010: 6 F2F meetings, several web meetings at each PT
- 2011: 4 F2F meetings, several web meetings at each PT, one meeting at SAE HQ
- 2012: 3 F2F meetings, several web meetings at each PT, one meeting at SCE, Westminster CA
- Since 2013: 2 F2F meetings per year, several web meetings at each PT

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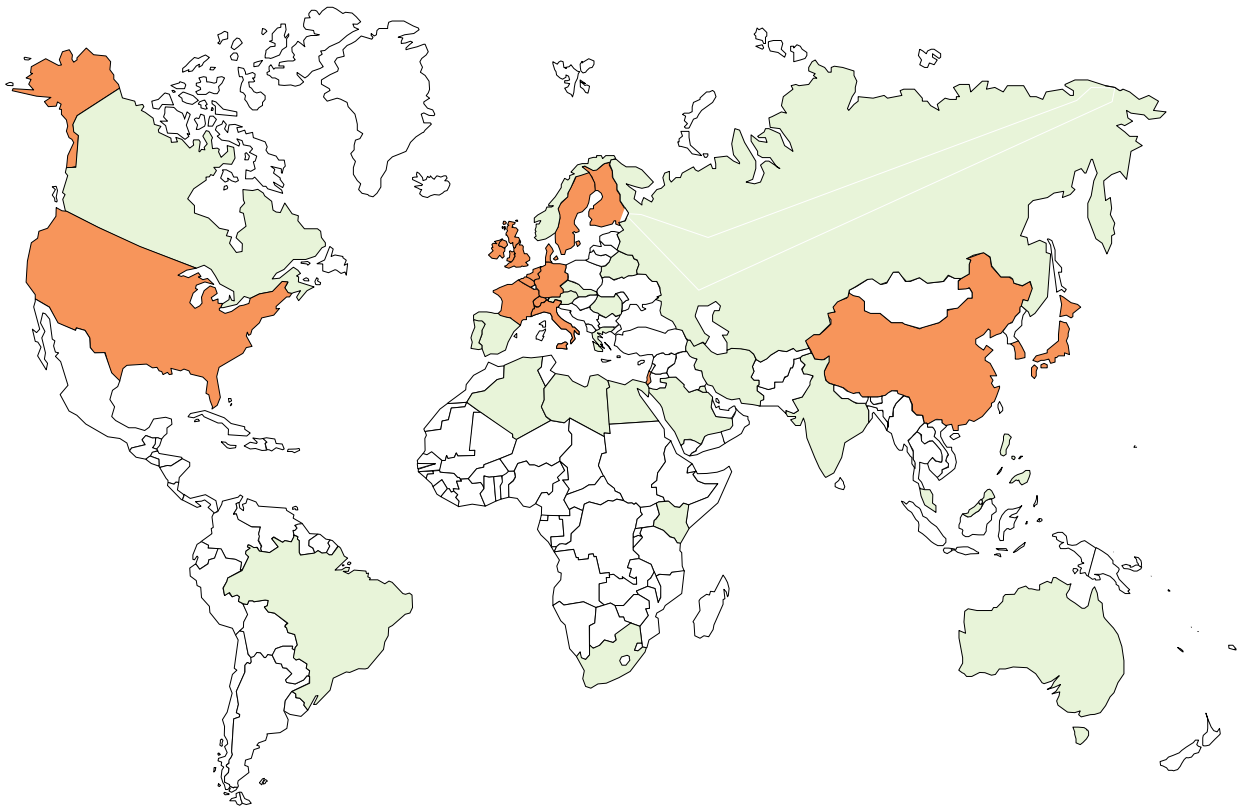
Broad Spectrum of Participants shows high acceptance for expected Market

Registered experts:	138
Active countries:	13
Passive („reading“) countries:	20
Number of official comments to ISO 15118 documents:	~5800



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ISO/IEC 15118 JWG PT Structure for Edition 1

International Organization for Standardization

Chairman:
Michael Schwaiger (BMW)
Secretary:
Eric Wern (VDA)

International Electrotechnical Commission

Chairman:
Paul Bertrand (for EDF)

7 Application
6 Presentation
5 Session
4 Transport
3 Network
2 Data Link
1 Physical

PT 1: Use cases
Sven Jundel (RWE)

PT 2: Messages, Sequences & Timing
Stephan Voit (RWE)

PT 3: Protocols
Andreas Heinirch (Daimler)

PT 4: Communication technologies
Hervé Szychter (Renault)

PT 5: Security Analysis and Measures
Sebastian Kaluza (BMW)

PT 6: Conformance Tests
Jens Schmutzler (TU Dortmund)

PT 7: Wireless Communication
Paul Bertrand (for EDF); Xi Zhang (Siemens)

PT: Project Team

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ISO/IEC 15118 JWG PT Structure for Edition 2

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International Electrotechnical Commission

Chairman:
Paul Bertrand (for EDF)

7 Application

6 Presentation

5 Session

4 Transport

3 Network

2 Data Link

1 Physical

PT 1: Use cases
Paul Bertrand (EDF)

PT 2: Messages, Sequences & Timing; Protocols
Benjamin Pulic (for BMW)
Peter C. Thompsen (Qualcomm)

PT 4: Communication technologies
Not active on Edition 2

PT 5: Security Analysis and Measures
Sebastian Kaluza (BMW)

PT 6: Confor-mance Tests
Jens Schmutzler (TU Dortmund)

PT 7: Wireless Communication
Xi Zhang (Siemens)

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Structure of Norm ISO 15118 „Road vehicles — Vehicle to grid communication interface“

- **Part 1**: General information and use-case definition (International Standard (IS) available since 04/2013, CD of Edition 2 since 06/2016, DIS planned for 09/2017)
- **Part 2**: Network and application protocol requirements (IS available since 04/2014, CD2 of Edition 2 since 03/2017, DIS planned for 10/2017)
- **Part 3**: Physical and data link layer requirements (IS available since 05/2015)
- **Part 4**: Network and application protocol conformance test (CD2 available since 02/2015, FDIS planned for 08/2017)
- **Part 5**: Physical layer and data link layer conformance test (CD available since 08/2015, FDIS planned for 08/2017)
- **Part 6**: General information and use-case definition for wireless communication (DIS available since 09/2015, integrated into Part 1 Edition 2)
- **Part 7**: Network and application protocol requirements for wireless communication (integrated into Part 2 Edition 2)
- **Part 8**: Physical layer and data link layer requirements for wireless communication (DIS available since 04/2016, FDIS planned for 07/2017)

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More information about ISO 15118

Remark: ISO and IEC standards are protected by copyright and NDA. Therefor only headlines can be provided here.

- International Standard (IS) of ISO 15118-1:2013 Edition 1 is available at http://webstore.ansi.org/RecordDetail.aspx?sku=ISO+15118-1%3a2013
- Committee Draft of ISO 15118-1 Edition 2 is at the time available for members of JWG only
- Introduction to ISO 15118: “ISO 15118 Manual” (https://www.v2g-clarity.com/en/iso15118-masterclass/ebook/)
- Java based open source implementation of ISO 15118 for EV and EVSE: https://www.v2g-clarity.com/en/risev2g/

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Revisions

Ver	Date	Changes	Author
1.0	17-07-10	Initial version	SV

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