RSE Ricerca Sistema Energetico | we move

Charging Infrastructure Controller for electric vehicles
CEI PAS 57-127

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IEC TC 69 JWG15
26.04.2023

AGENDA

- Business case
- CEI PAS 57-127
  - Smart charging – V1G
  - Requirements of CIR-RO communications
  - System use cases
  - State Machine
  - Communication services and patterns
  - Data Model
  - Cybersecurity profiles
  - Experimentation

EV diffusion in the Italian vehicle fleet by 2030

VEHICLE FLEET

- two scenarios of EV penetration wrt the total vehicle fleet by 2030
- EV distribution by municipality, province and region based on several factors, including current EV penetration, per capita income, air quality and garage availability
- subdivision of vehicles by commercial segment and definition of the main characteristics on the basis of current and prospective commercial data

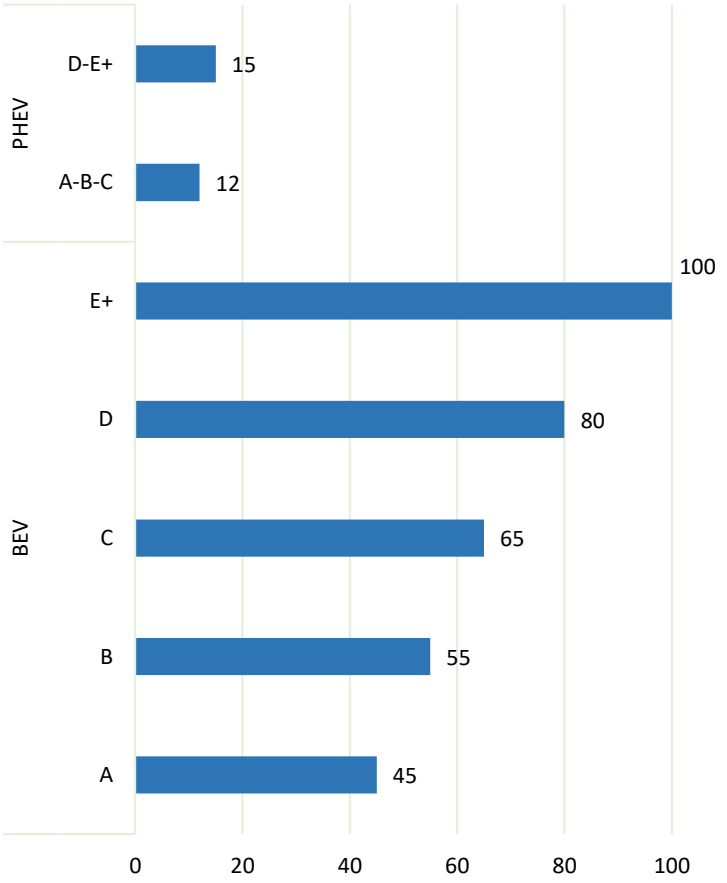
BASIC SCENARIO — Italian policy

[Mln]	URBAN AREA	RURAL AREA	TOTAL
BEV	0.85	3.15	4
PHEV	0.43	1.57	2

EVOLUTIVE SCENARIO — European policy Fit For 55

[Mln]	URBAN AREA	RURAL AREA	TOTAL
BEV	1.34	4.96	6.3
PHEV	0.25	0.95	1.2

BATTERY CAPACITY [kWh]



Expected charging profile for EV

EVOLUTIVE SCENARIO

By processing the charging profiles for each use case, a total charging profile is reconstructed, weighing the contribution of each charging method based on its penetration

The total charging profile for the Italian system, on a weekday in the cold season, has two peaks of 3 GW:

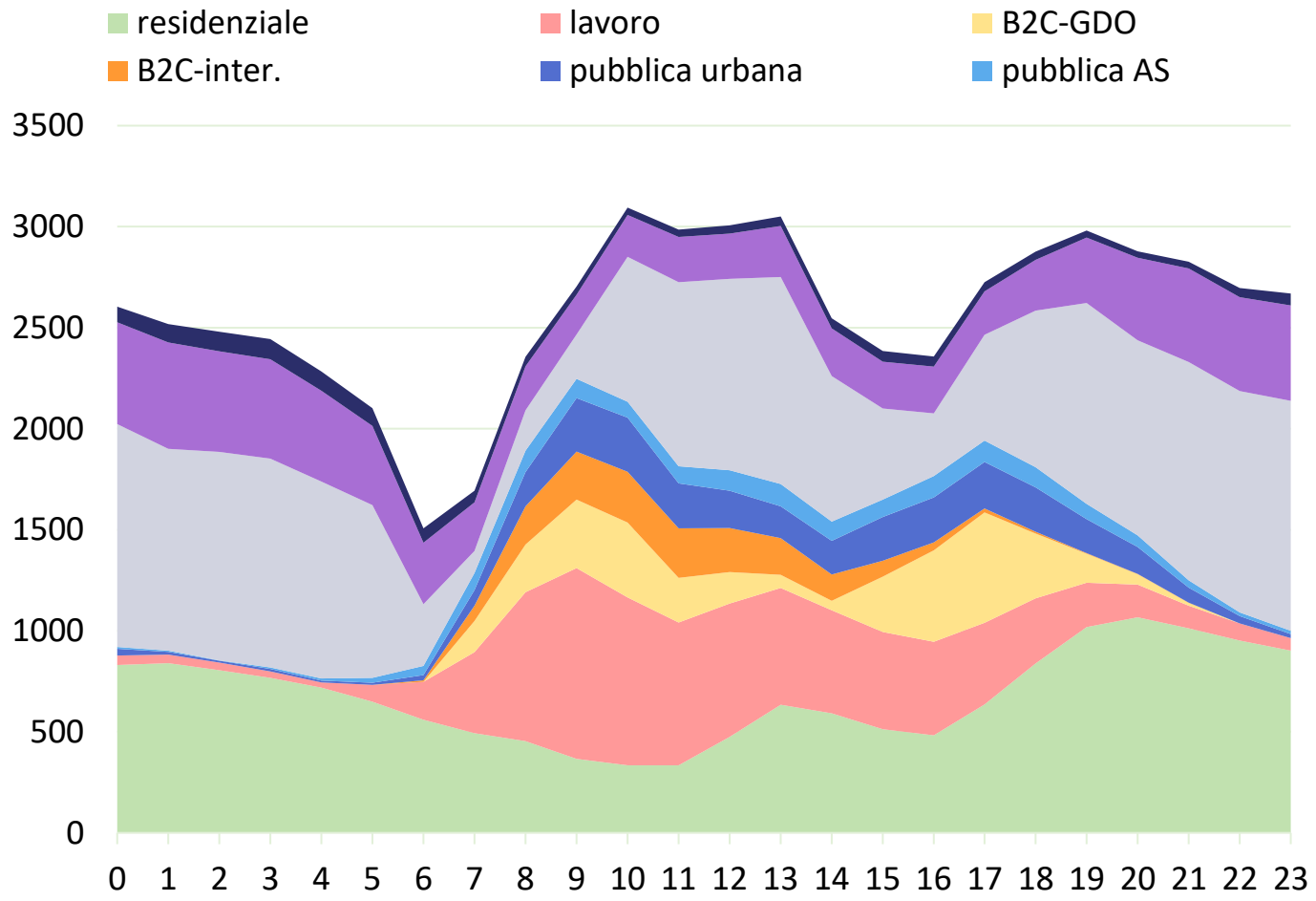
one around noon,

the other in the evening period

EV CHARGING OVER TOTAL (2030):

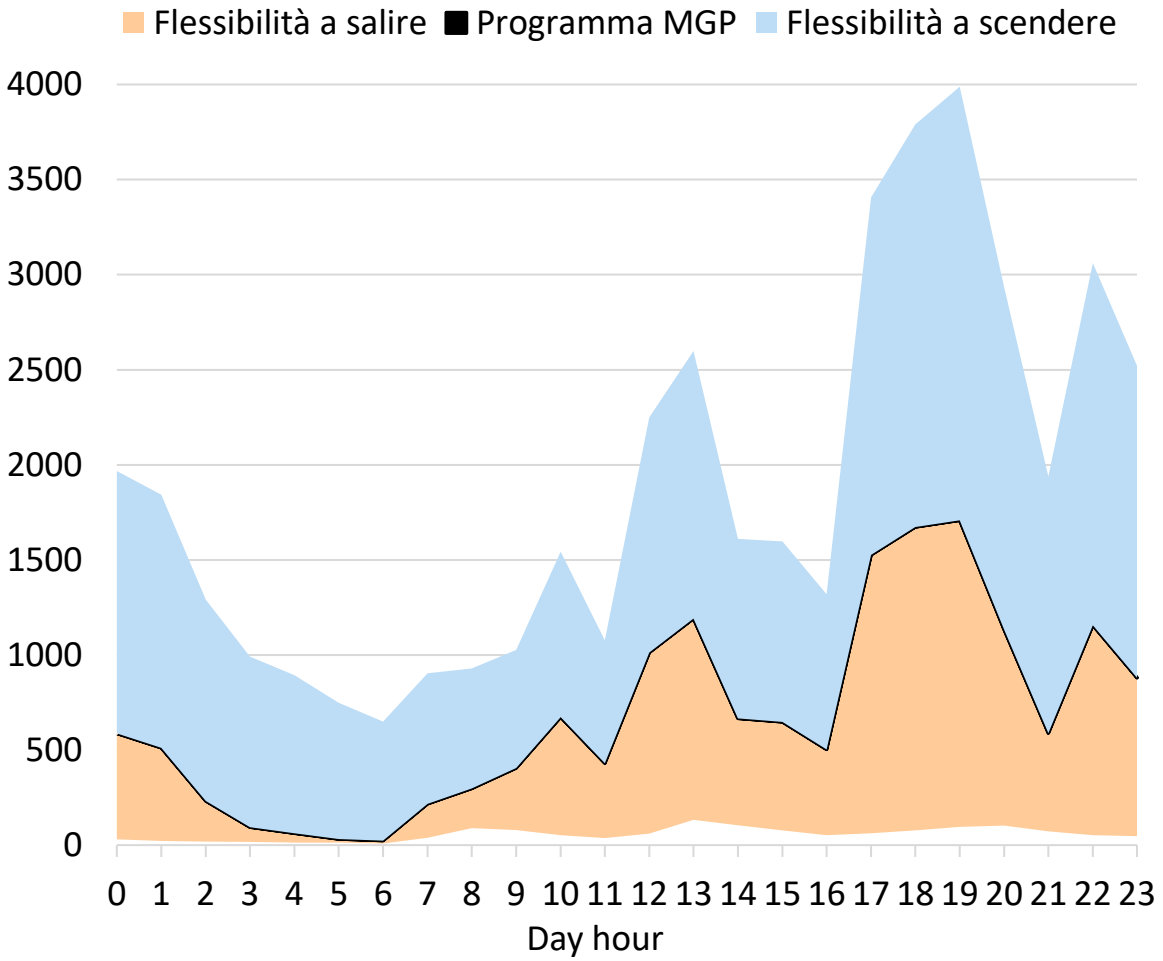
ENERGY DEMAND:	LOAD PEAK:
15,5 TWh of 366 TWh Italian System (4,2%)	**3,1 GW** of 60 GW Italian System (5,2%)

DHM PROGRAM (ITALY, WEEKDAY, WINTER) [MW]

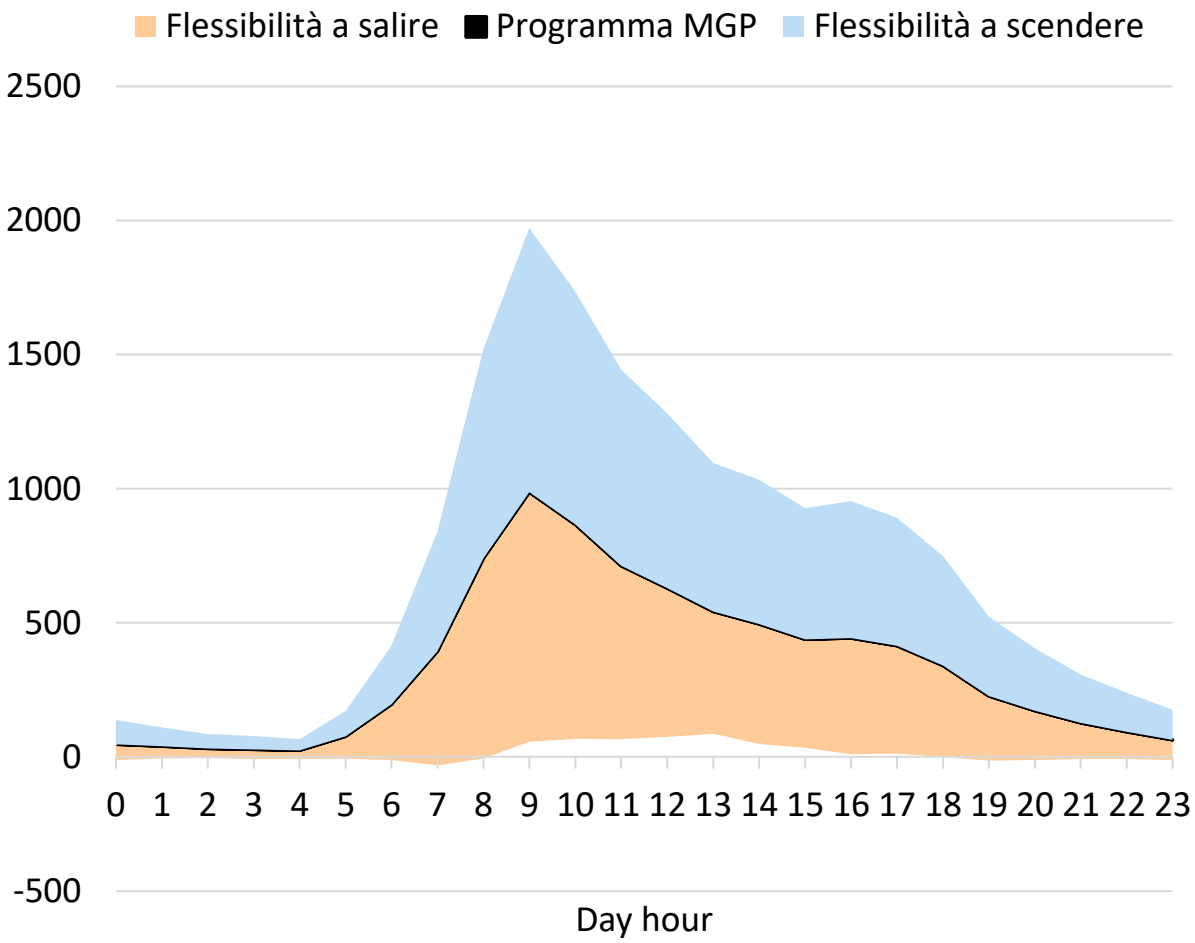


The residential area and the working area

RESIDENTIAL (AGGREGATED ITALY) [MW]



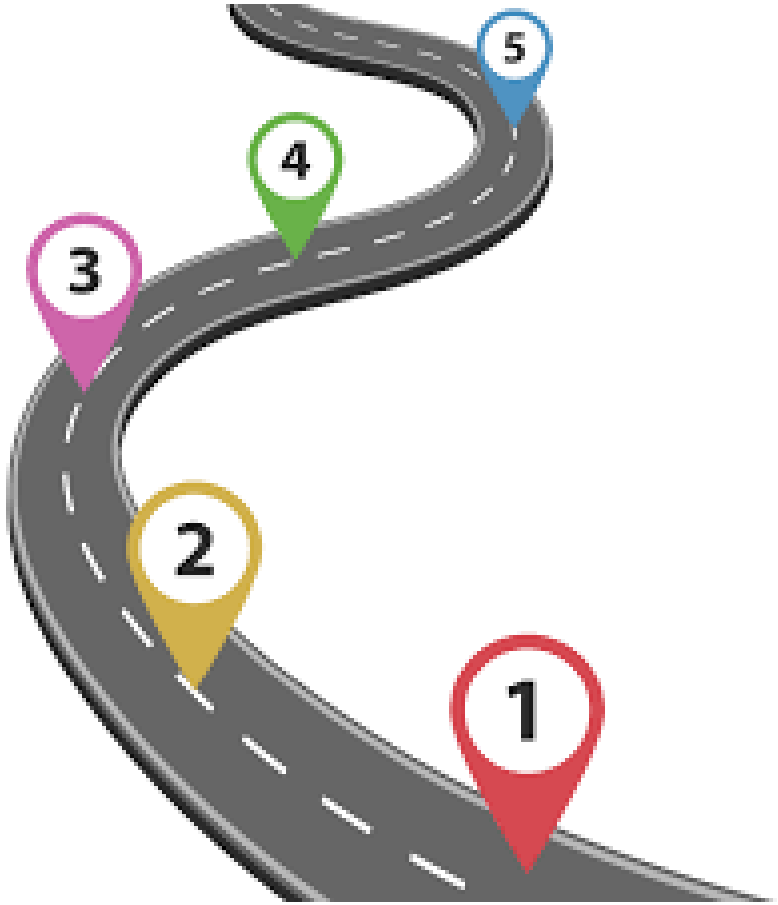
WORKING (AGGREGATED ITALY) [MW]



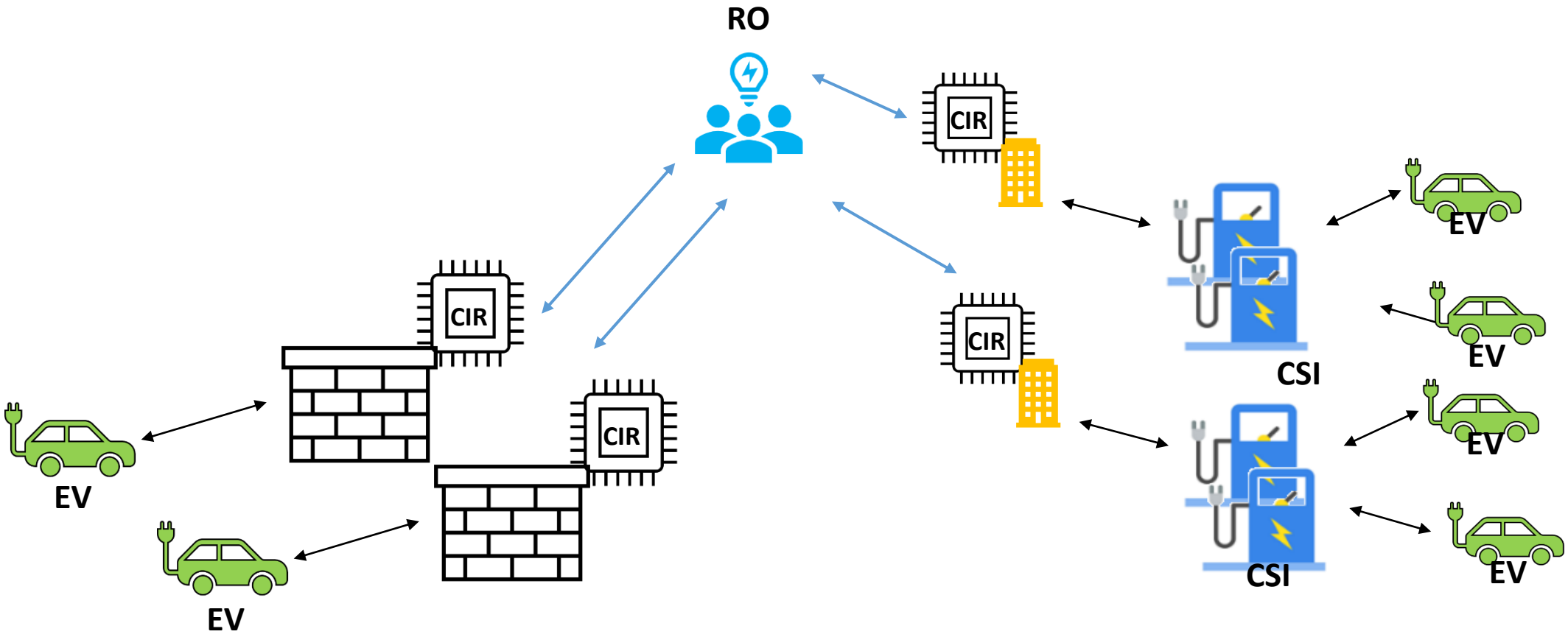
JWG PAS – MEETINGS AND TOPICS

CEI JWG PAS: TC 57, TC 316, TC 13, TC 69, TC 120
15 meeting – from november 2021 to january 2023

1. CEI Norm 0-21 Annex X
2. Alignment with IEC work
3. Application perimeter
4. General requirements
5. Communication protocols
6. Cybersecurity protocols
7. Use cases
8. State machine
9. Data model
10. Digital certificate management



CEI PAS 57-127 – APPLICATION PERIMETER

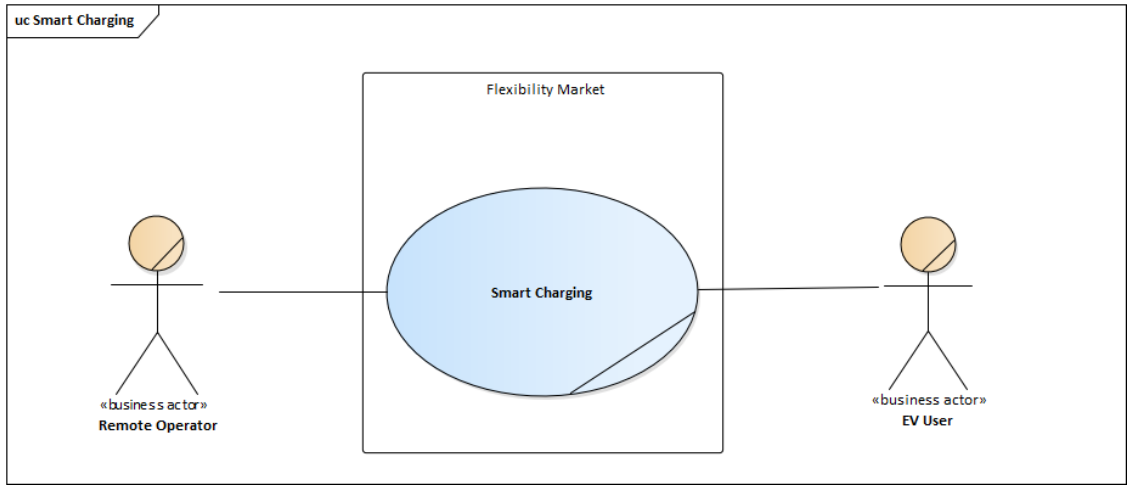


REQUIREMENTS

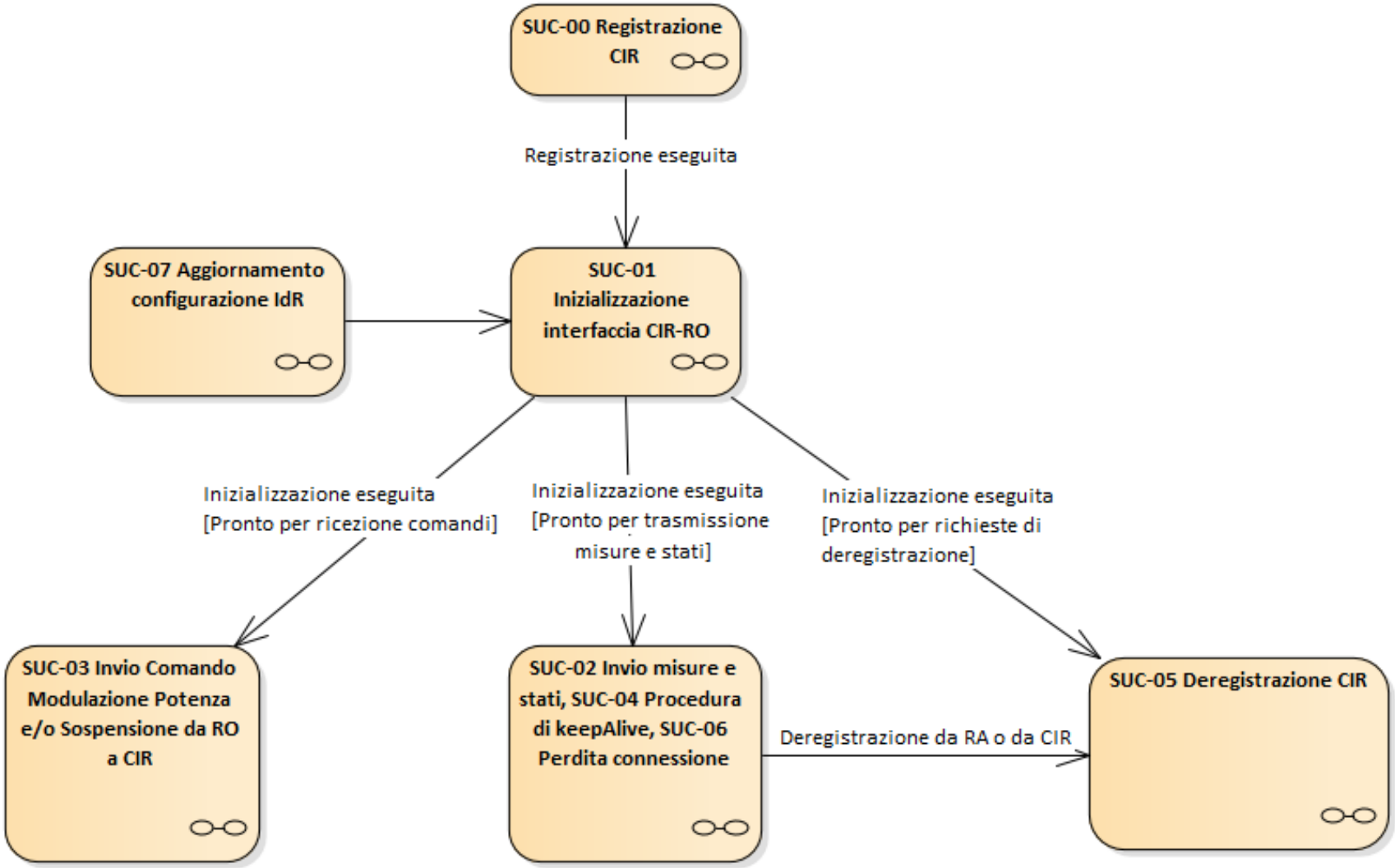
- R1: **Interoperability** of CIR-RO communications using diverse type of smart charging devices
- R2: **Cybersecurity by design** of CIR-RO communications with threats to data confidentiality, integrity and availability
- R3: **Scalability** of communication infrastructures with high numbers of charging points
- R4: **Portability** of the smart charging service from a RO to another RO
- R5: **Voluntariness** of the user to activate (opt-in) or disactivate (opt-out) the smart charging service
- R6: **Simplicity** of the data exchange solutions implemented by market devices with limited hardware and software resources

CIR-RO COMMUNICATIONS – SYSTEM USE CASES

- Standard specification according to IEC 62559-2
- SUC-00: CIR enrollment
- SUC-01: Interface initialisation CIR-RO
- SUC-02: Sending of measures and states
- SUC-03: Receiving commands
- SUC-04: KeepAlive
- SUC-05: CIR deregistration
- SUC-06: Lost connection
- SUC-07: Configuration update



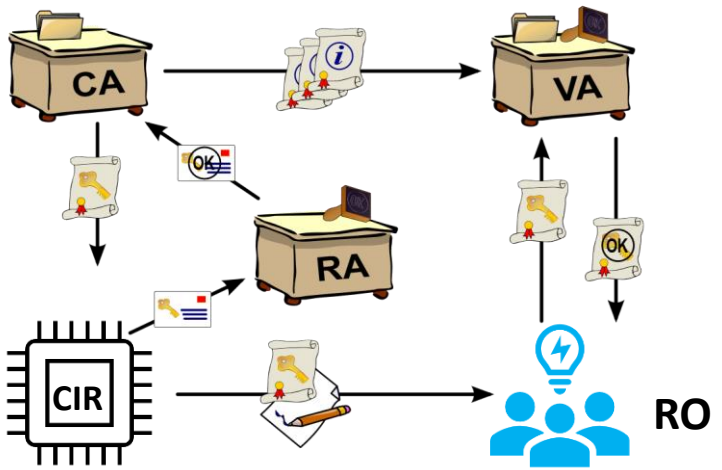
STATE MACHINE

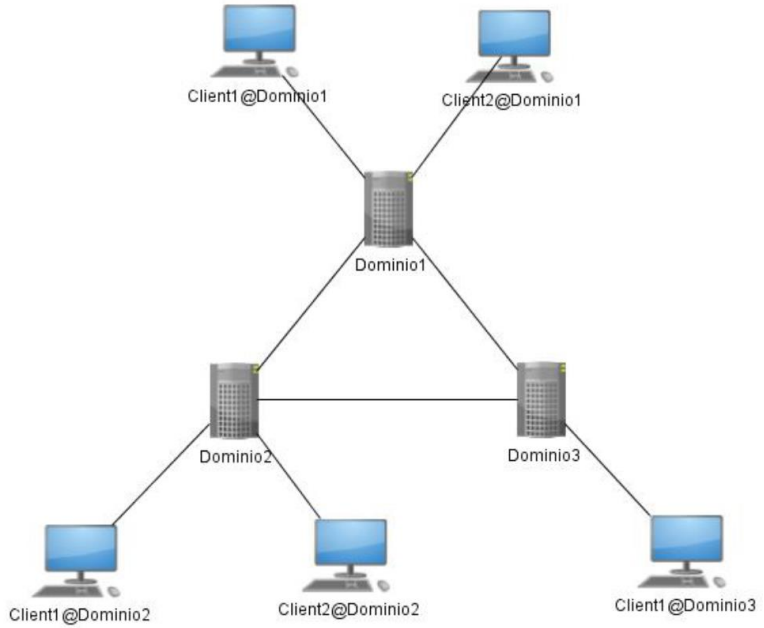


CIR-RO COMMUNICATION SERVICES

- EST (Enrolment over Secure Transport, IETF RFC 7030)
  - CSR sent through a TLS session
  - IEC 62351-9

- XMMP (Extensible Messaging and Presence Protocol)
  - standard IETF since 2011 (RFC 6120, 6121, 6122)
  - Allows two XMPP client nodes of exchanging structured data in XML format
  - XMPP clients are not connected directly but through intermediate XMPP server nodes that perform the communication routing
  - In case of high numbers of clients, federated (hierarchical) architectures of XMPP servers are introduced





CIR-RO DATA EXCHANGE – COMMUNICATION PATTERN

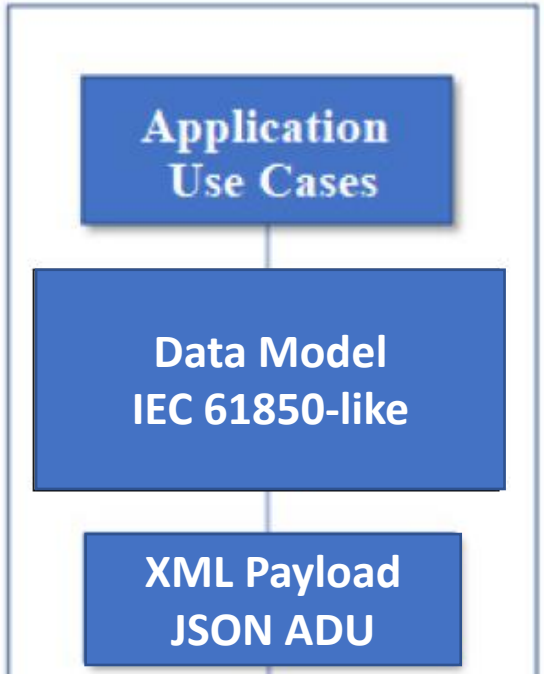
- pattern publish/subscribe (XEP 0060)
  - High resilience to faults and anomalies
  - High efficiency
  - High scalability
- The publishers send the messages to the server through stanzas of type *iq*
- The servers distribute the messages to the subscibers through stanzas of type *message*

CIR-RO DATA MODEL

- Application messages encoded in JSON format (IETF RFC 8259)
- Application Data Units enclosed in CDATA section of XML structures

```
<CEI-021-AllegatoX-XMPP">
<CEI-021-AllegatoX-JSON>
<![CDATA[
… Application Data Unit 1 …
]]>
```

- Data object semantics based on IEC 61850
- Naming conventions
  - ***Data Object*** **= "LDName/LNName.DataObjectName.DataAttributeName"**
  - **Application Data Unit = "LDName/LNName.DataSetName"**



CIR-RO DATA MODEL – IEC 61850 profile

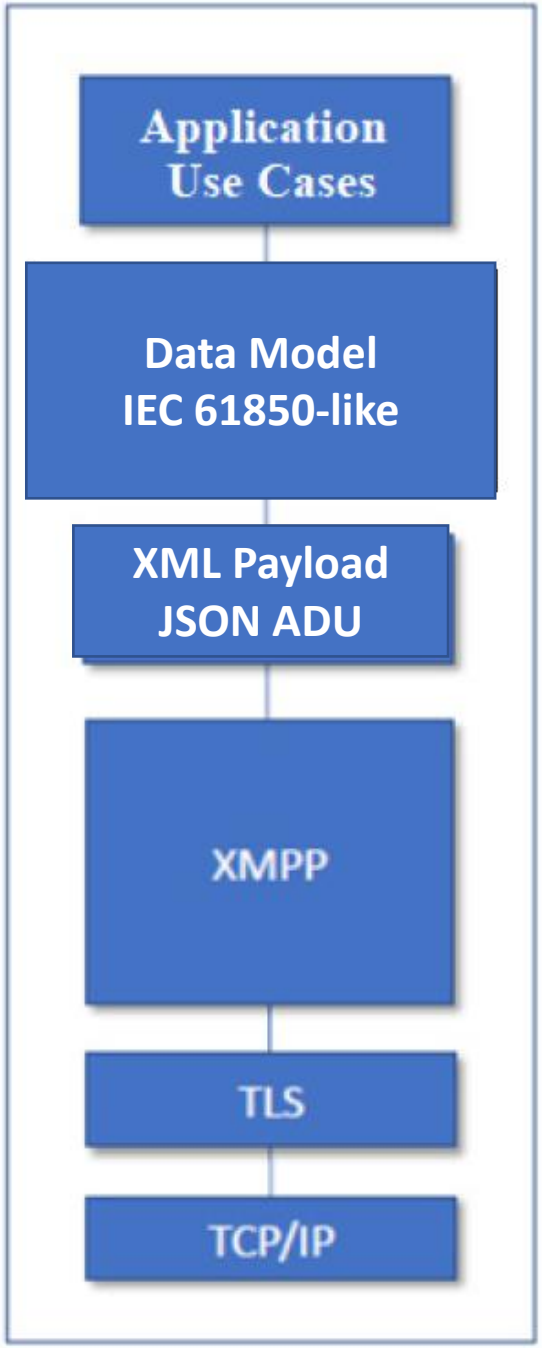
Logical Device	Descrizione
LD_CIR	Contiene tutti i Logical Nodes relativi all'impianto monitorato/controllato dal CIR

Prefix	Logical Node	Descrizione LN	Data Object	Data Attribute
–	LLN0	Nodo Logico Zero	Loc	stVal
CSI	MMXU1	Misura	TotW	mag
M1	MMXU1	Misura	TotW	mag
M2	MMXU1	Misura	TotW	mag
M1	DWMX1	Definizione dei limiti di potenza di una DER	WMaxSpt	setMag
M1	MMXU1	Misura	Hz	mag
M1	DWMX1	Definizione dei limiti di potenza di una DER	Ttli	operTimeout
CSI	DESE1	Monitoraggio e controllo di CSI	Beh	stVal
CSI	DAGC1	Modulazione di Potenza Attiva	Beh	stVal
CSI	DAGC1	Modulazione di Potenza Attiva	Flmod	stVal
–	LPHD	Informazioni su Device Fisico	PhyHealth	stVal
CIR	LTMS1	Informazioni sul sincronismo del Device Fisico	TmSynErr	stVal
CSI	DWMX1	Definizione dei limiti di potenza di una DER	WLimPctSpt	ctlVal
CSI	DWMX2	Definizione dei limiti di potenza di una DER	WLimPctSpt	ctlVal
CSI	DESE1	Monitoraggio e controllo di CSI	ClcStr	ctlVal
CSI	DESE2	Monitoraggio e controllo di CSI	ClcStr	ctlVal
CIR	GGIO1	Definizione di I/O fisici e logici generici	SPCSO1	ctlVal

Dataset	Descrizione
DS_S_States	Dataset Stati e Allarmi - Invio Spontaneo
DS_C_Meas	Dataset Misure - Invio Ciclico
DS_S_Meas	Dataset Misure – Invio Spontaneo

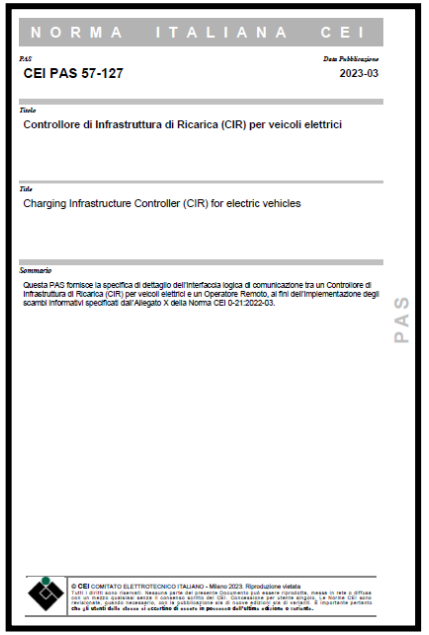
CIR-RO CYBERSECURITY PROFILES

- TLS (Transport Layer Security) profile
  - IEC 62351-3 profiles
  - XMPP supports TLS (IETF RFC 6120 integrated by IETF RFC 7590)
  - Detailed and restricted parameters, applied to the STARTTLS activation mechanism of XMPP
- SASL (Simple Authentication and Security Layer) profile
  - IETF RFC 6120
  - SASL EXTERNAL authentication mechanism, based on digital certificate exchanged during TLS negotiation
  - The CIR client certificate sent to the XMPP server contains Jabber ID (JID) used for the authentication (XEP 0178 “Best Practices for Use of SASL EXTERNAL with Certificates”)



RESEARCH ACTIVITIES

- Research Italian Program RdS
- Project 2.7 Sustainable mobility and interaction with the energy system
- Project 2.1 Cyber Security of energy systems
- Collaboration agreements with stakeholders: CIR manufactures, CIR developers, CIR Remote Operators
- Activities
  - Setup of XMPP server infrastructures
  - XMPP client integration , CIR and RO
  - Functional testing
  - Cybersecurity conformance testing


NORMA ITALIANA CEI

CEI PAS 57-127

2023-03

Controllore di Infrastruttura di Ricarica (CIR) per veicoli elettrici

Charging Infrastructure Controller (CIR) for electric vehicles

Sommario

Questa PAS fornisce la specifica di dettaglio dell'interfaccia logica di comunicazione tra un Controllore di Infrastruttura di Ricarica (CIR) per veicoli elettrici e un Operatore Remoto, ai fini dell'implementazione degli scambi informativi specificati dall'Allegato X della Norma CEI 0-21:2022-03.

PAS

Conformance Testing

IEC 62351