

University for Continuing Education Krems
Department for Integrated Sensor Systems

Examples from R&D on inter-operation demands beyond connectivity

IEA-EGRD workshop on developments in demonstrations, tests and standardization

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The presented work achieved financial support via the R&D project DiPS4EV@work, funded in the 5th call of the KLIEN *Zero Emission Mobility* program, managed by the FFG as project #899909. www.dips4ev.work



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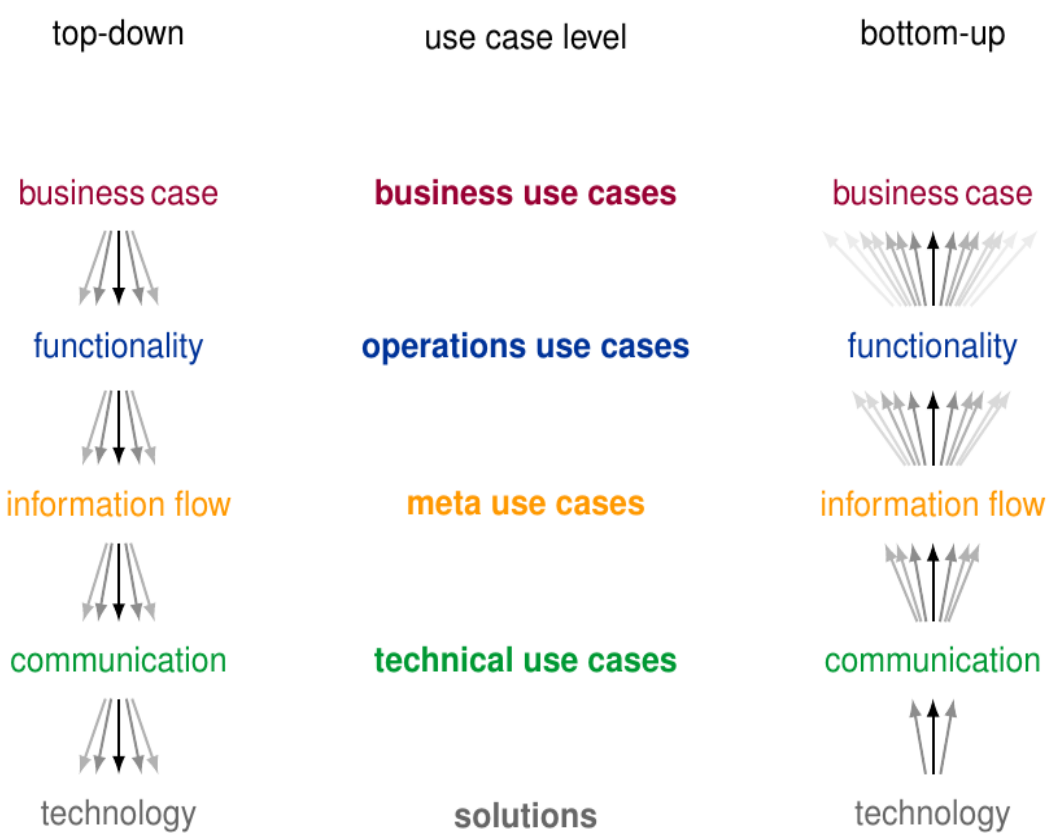
Contents

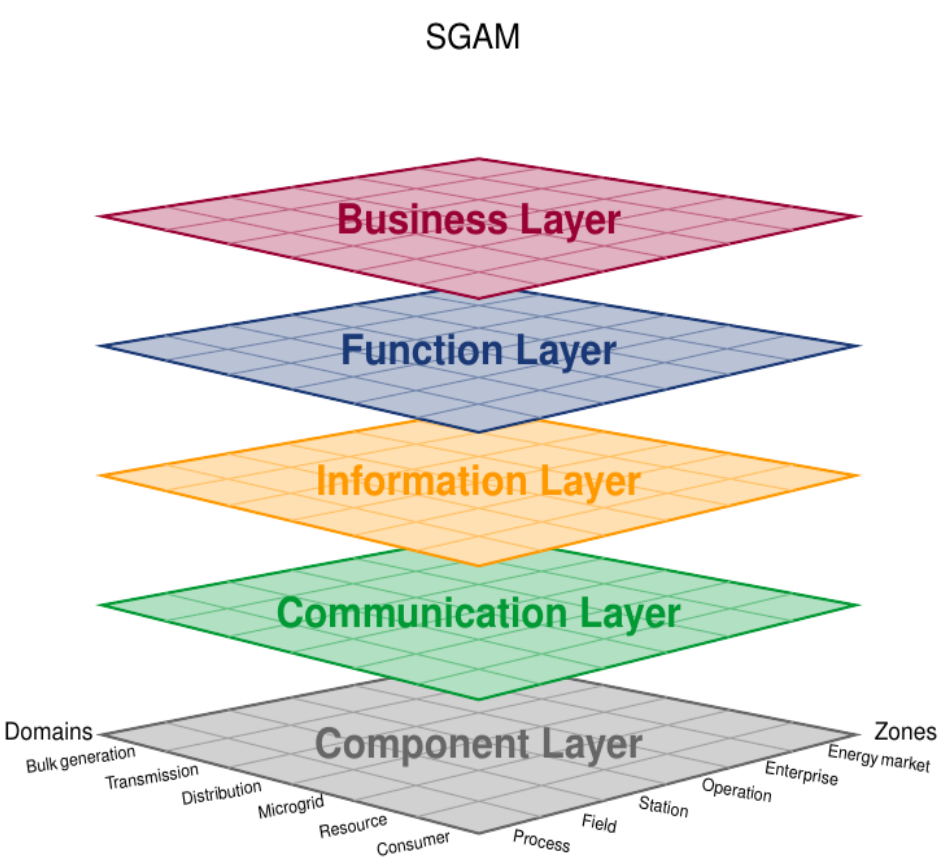
1. **Structured development**
   → SGAM and Use Case method
   → layered use cases & specs
2. **Inter-Operation Examples**
   → IEC 60870 and IEC 61850
   → Transaction-Needs
   → Normalised services
3. **Integrating the Energy System**
   → Smart Grid needs cooperation
   → IES Approach to Interoperability
4. **Summary**
   → What doesn't help
   → A better approach?

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Looking at SGAM and the Use Case Methodology IEC 62559-2

Development → top-down versus bottom-up





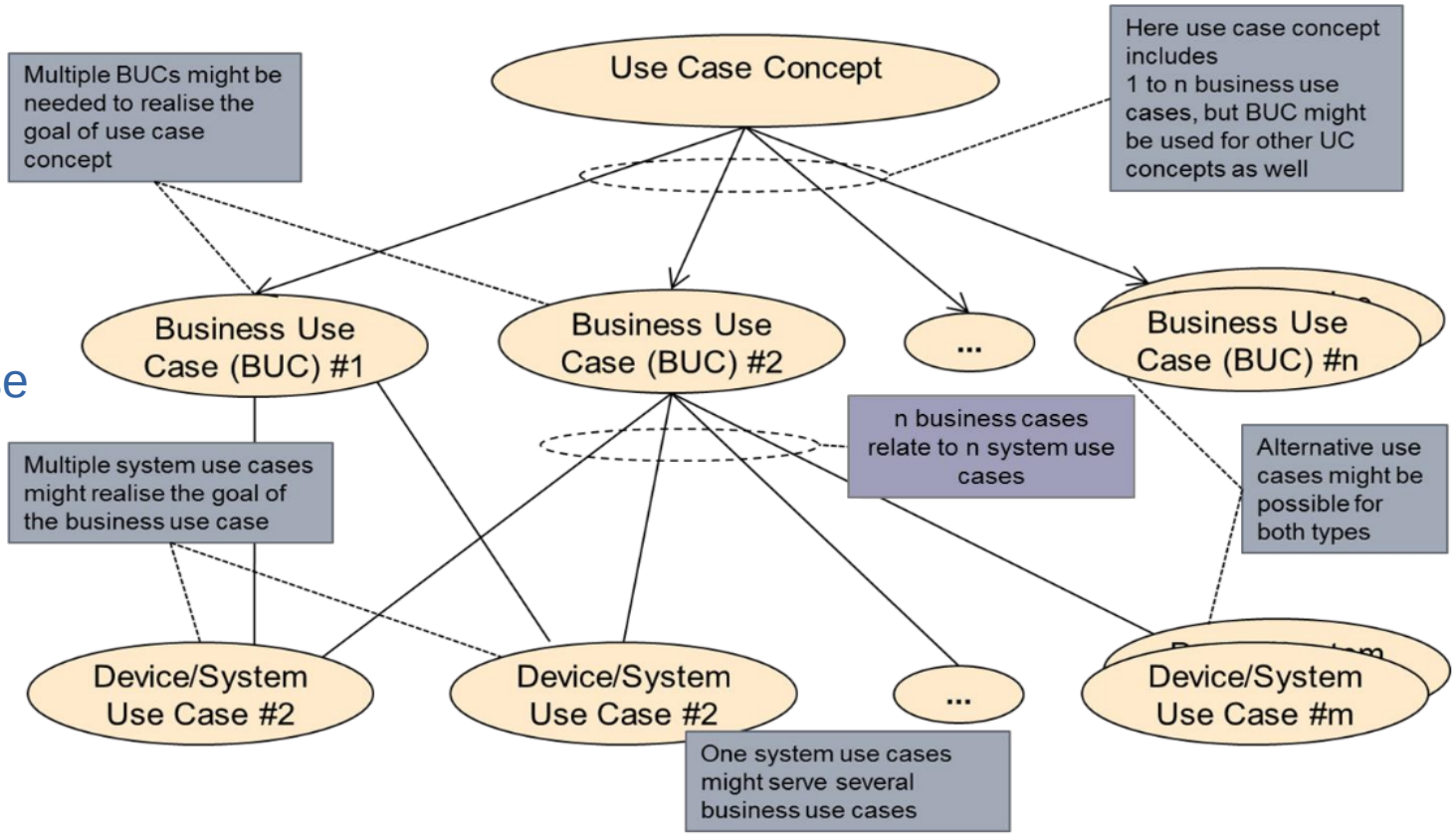
Use Case scope → „lower“ serves „upper“ → Layering

business use case

operations use case

meta use case

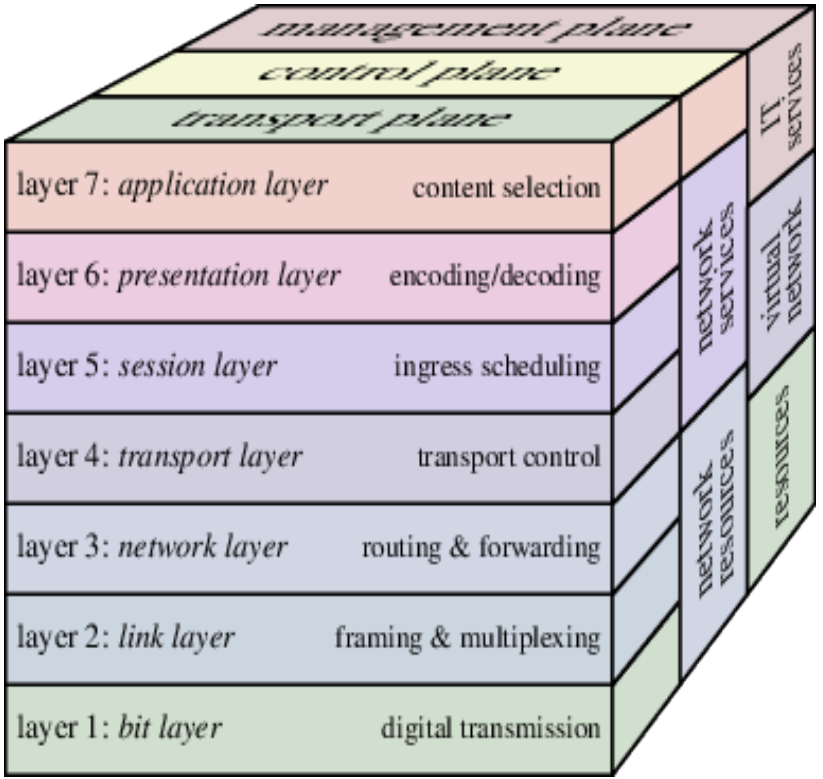
technical use case



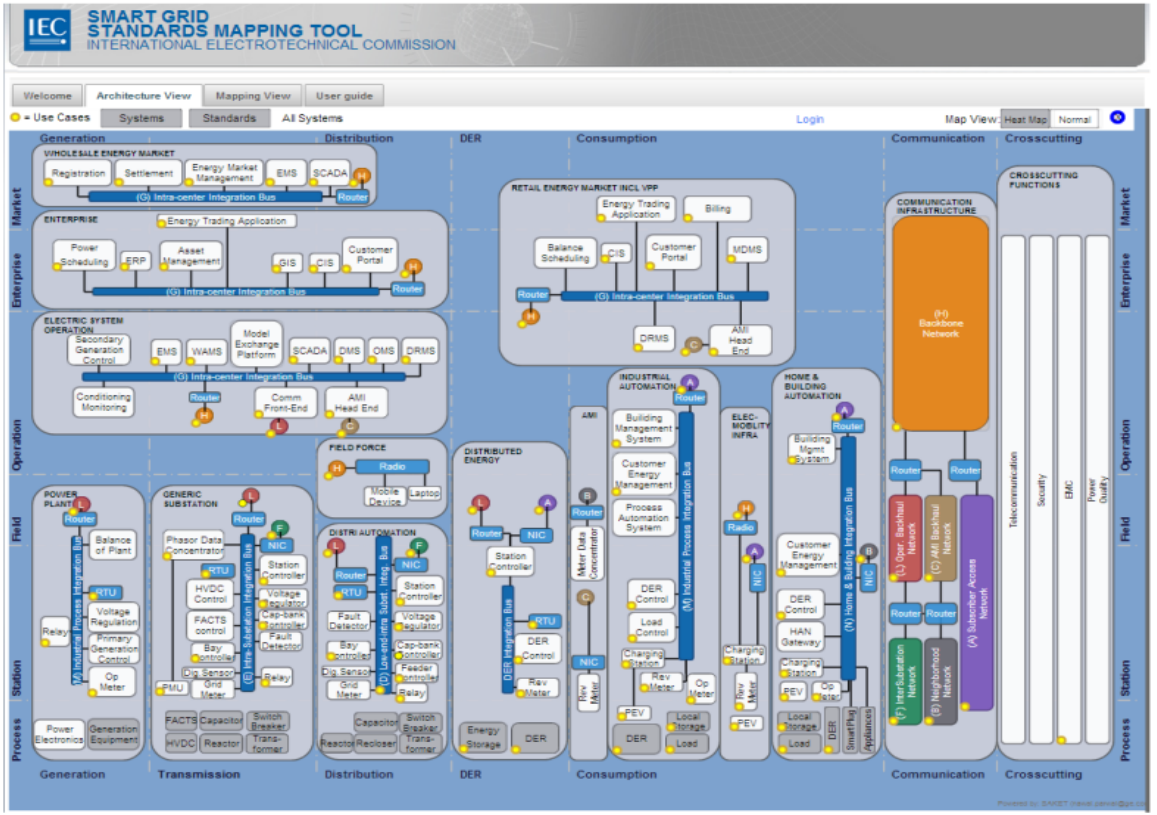
Note: What is **a Use Case must be somehow useful** -> can be named by an **active verb**

(c) CEN-CENELEC-ETSI Smart Grid Coordination Group: SGAM User Manual - Applying, testing & refining the Smart Grid Architecture Model (SGAM) - Version 3.0

Communication Layer → flexible stack of standards?



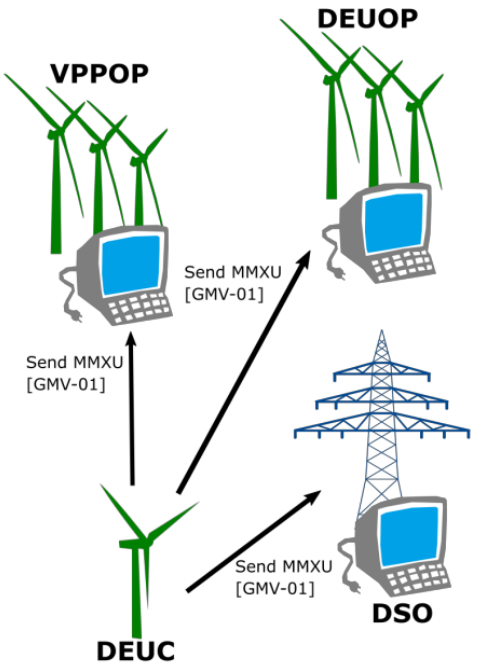
ITU-T X.200: The OSI model for digital communication
(Open Systems Interconnection model)

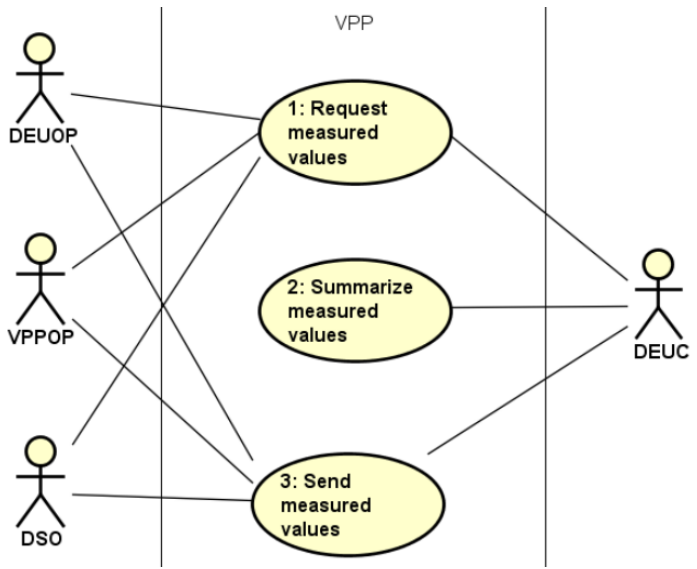


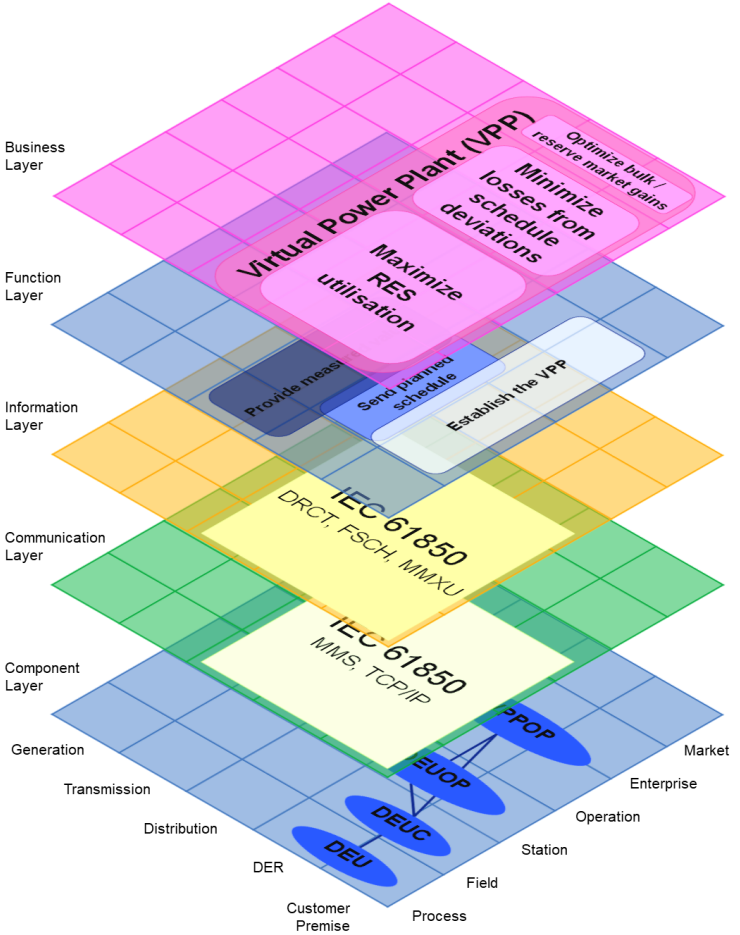
IEC Smart Grid mapping tool (Source: http://smartgridstandardsmap.com/

Examples on specifying standards' usage toward achieving interoperability

VPP: Virtual Power Plant – Energieforschung – IES Austria







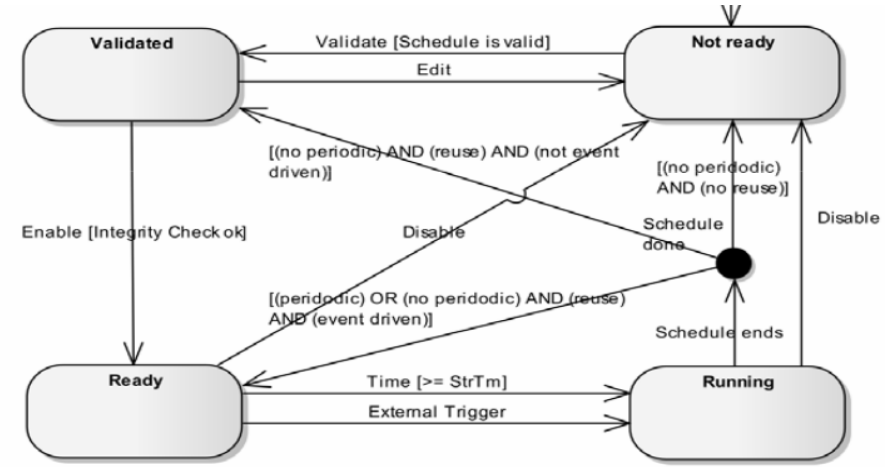
1. Collect asset & env. conditions
2. Predict demand & generation
3. Distribute planned schedules
4. Monitor power & energy flow
5. Calculate deviation from plan
6. Trigger schedule corrections

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PROTOCOLS/FORMS: TF-VPP – Send Power Schedule – IES Austria

The content of the SCD file to set the state of the schedule includes:

```
<LNodeType lnClass="FSCH" id="FSCH" desc="Schedule">
        <DO name="VldReq" type="SPC"/>
        <DO name="EnaReq" type="SPC"/>
        <DO name="EdtReq" type="SPC"/>
        <DO name="DsaReq" type="SPC"/>
</LNodeTyoe>
<DOType cdc="TSG" id="SPC">
        <DA name="ctlModel" bType="Enum" type="CtlModelKind" fc="CF" dchg="true"/>
        <DA name="ctlVal" bType="BOOLEAN" type="BOOLEAN"/>
        <DA name="origin" bType="Originator" type="Originator" fc="ST" />
        <DA name="ctlNum" bType="INT8U" type="INT8U" fc="ST" />
        <DA name="T" bType="TimeStamp" type="TimeStamp" fc="ST" />
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        <EnumVal ord="1">direct-with-normal-security</EnumVal>
        <EnumVal ord="2">sbo-with-normal-security</EnumVal>
        <EnumVal ord="3">direct-with-enhanced-security</EnumVal>
        <EnumVal ord="4">sbo-with-enhanced-security</EnumVal>
</EnumType>
```



OA: 0
COT: 6
Schedule 2: TotW = 80 (in %)
Control field: I (3,3)
Number of objects: 1
Tms: 2019-01-28 6:01pm

IOA: 0 0 104

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
APCI Start (68) / APDU Length (24)																	0	1	0	0	0	1	0	0	0	0	0	1	1	0	0	0
Control field	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
DU identifier	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0
ASDU Addr																	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IOA									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0
CRC/TotW	0	1	0	1	1	0	1	0	0	0	0	1	0	0	1	/	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
Timestamp									0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	1	0	0	1	0	1	0	0	0	0	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	1	1	0	0	0	0	0

Hex: 2D090050
CRC: AAB5 1010101010110101

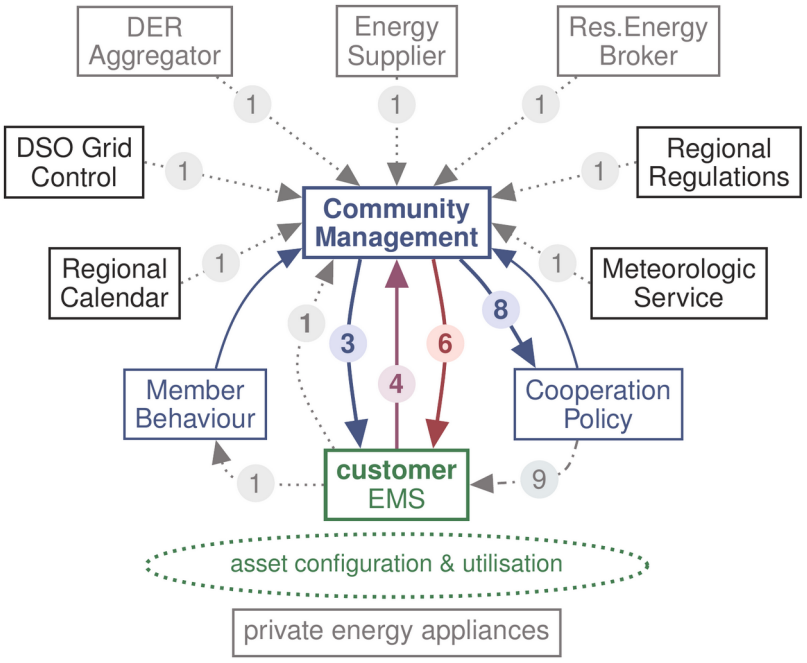
- Configuration-Files
- State-Machines
- Bit-Patterns

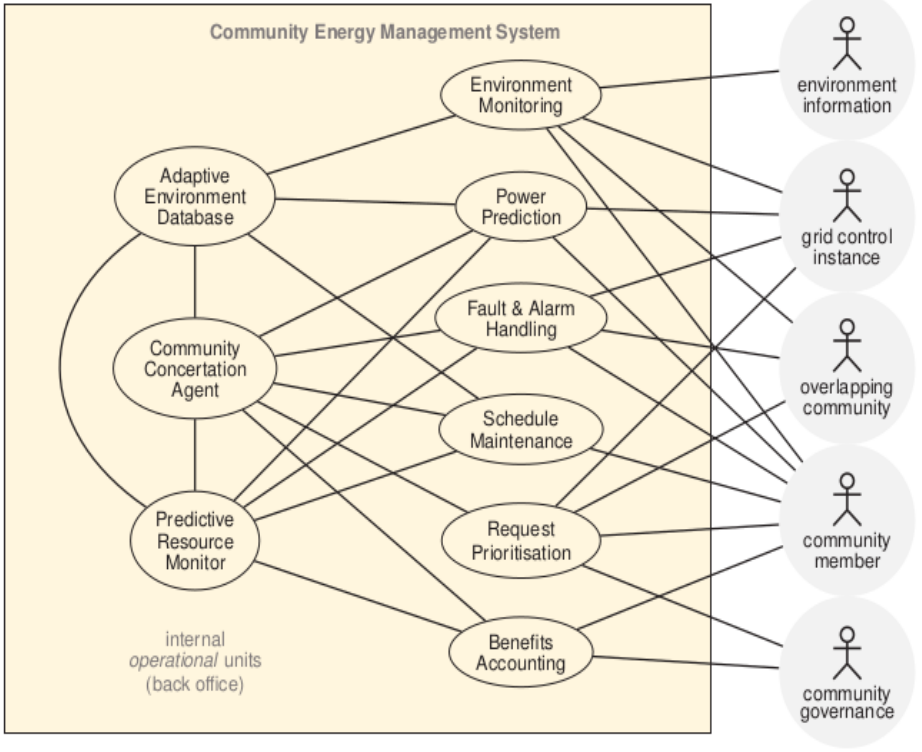
…

- as detailed as required

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LEC: Local Energy Community – Energieforschung – cFlex

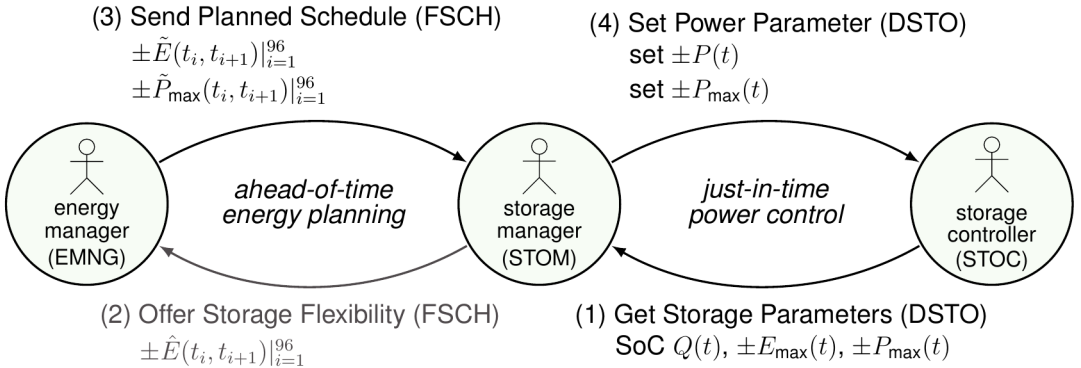




- Prediction and Scheduling of Community Member Power Demand and Production
- Reliable Monitoring and Control of Energy Flows to/from Community Members
- Fair Sharing and Compensation of Community Energy Supply

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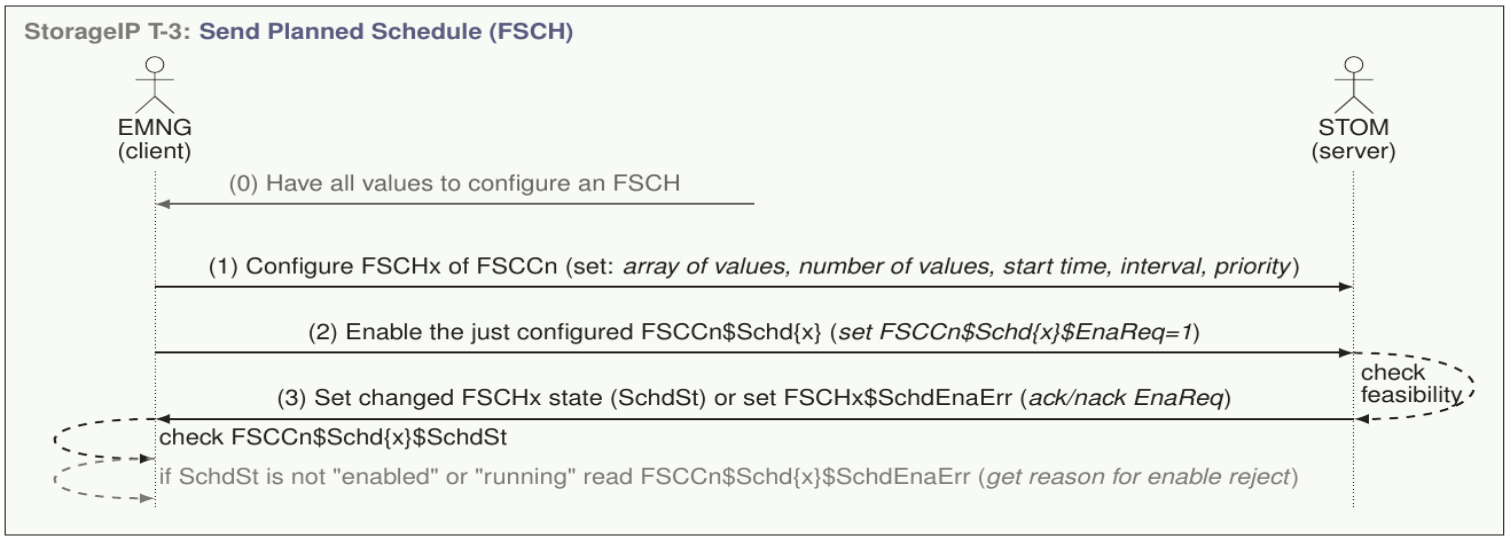
PROCESSES: TF-LEC – Control Energy Storage System (ESS) – cFlex



Actors Involvement in Use Cases

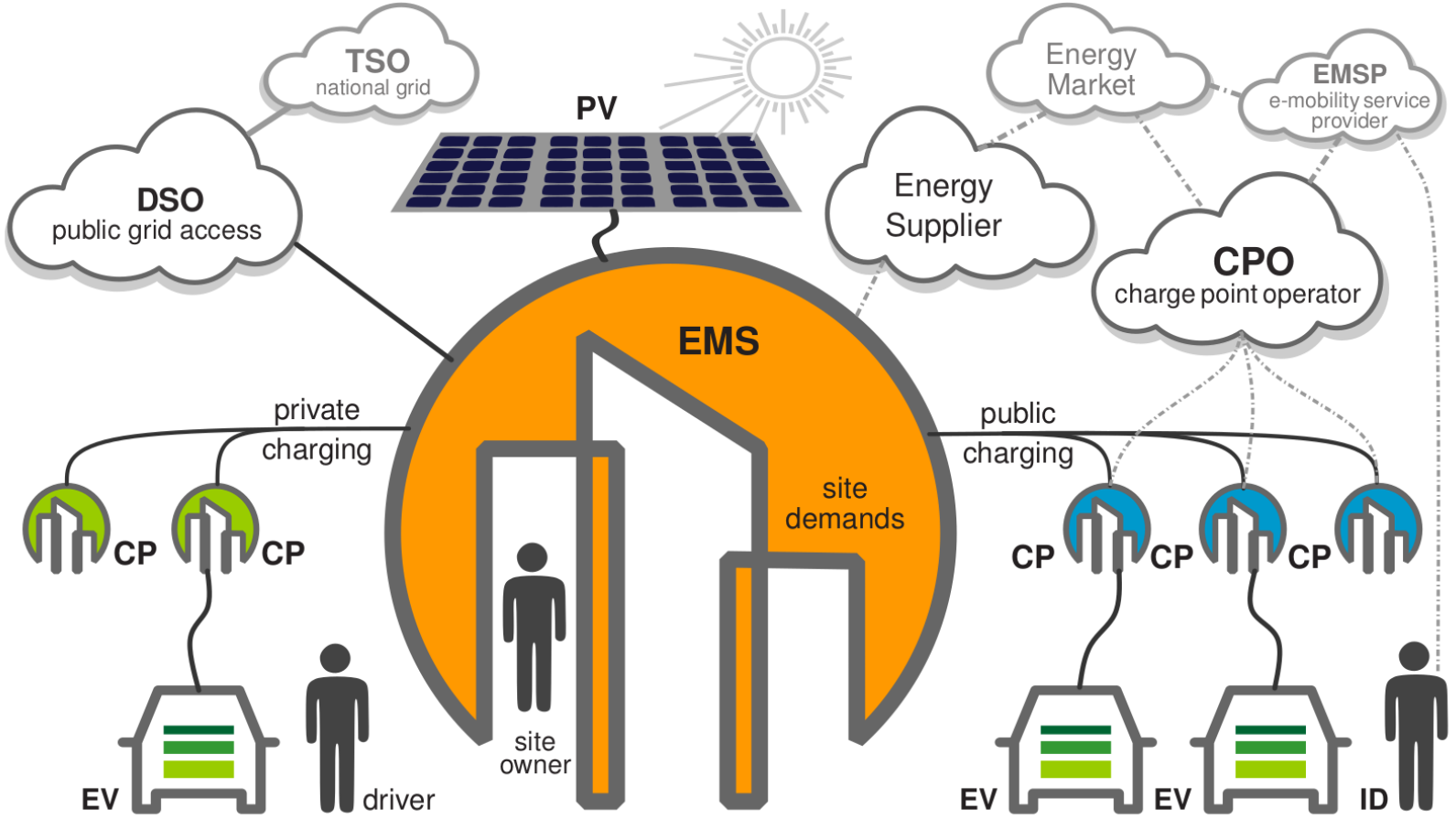
Required Information Exchange

Sequence Diagrams



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Smart EVC: Smart EV charging – KLIEN ZEM DiPS4EV@work



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SCENARIO: TF-EVC – Smart EV charging – ZEM DiPS4EV@work

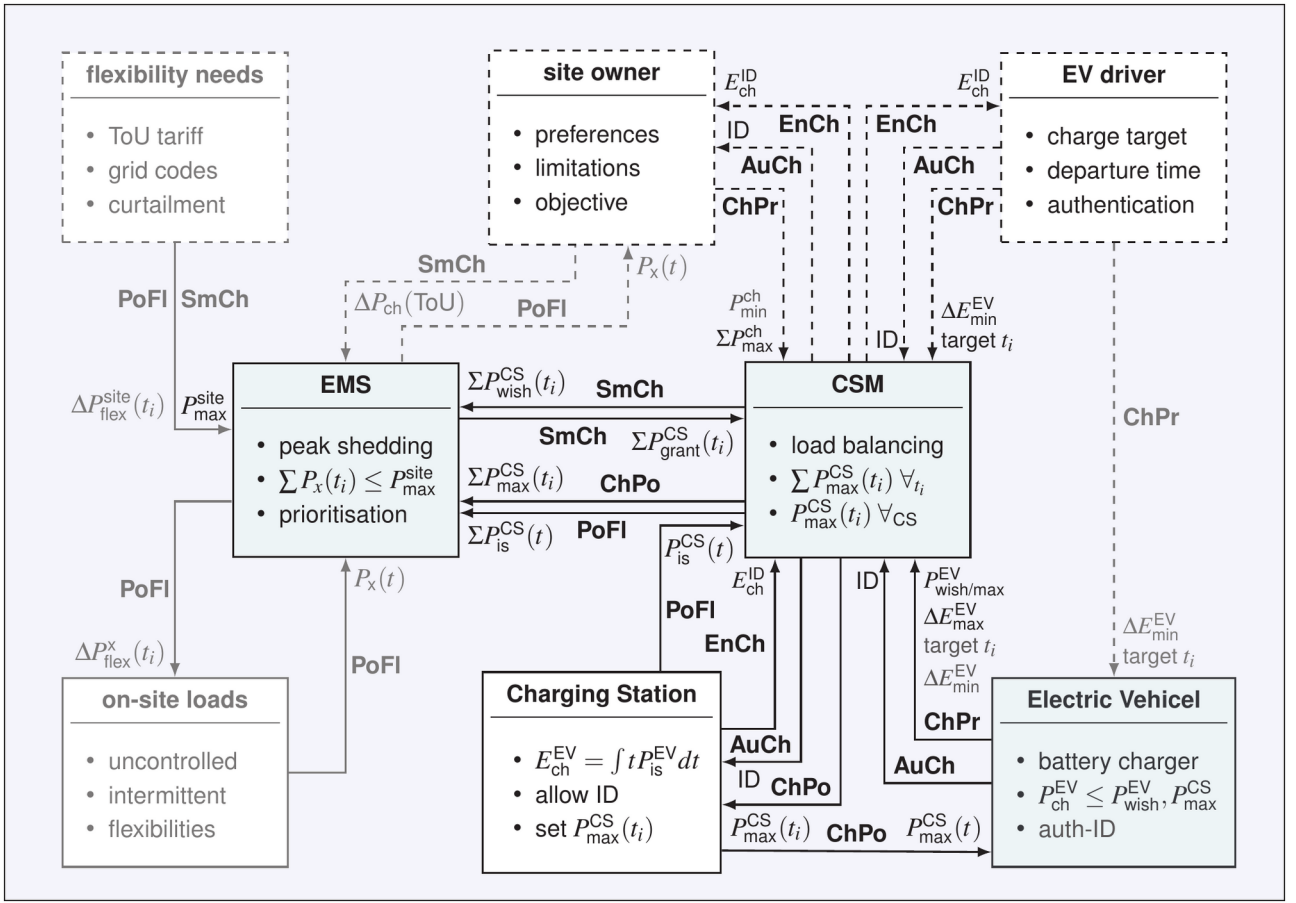
Business Use Cases:

- Billing
- Accounting
- Optimising

Operations Use Cases:

- Get Charging Preferences
- Authenticate Charging
- Record Charged Energy
- Assign Charging Power
- Monitor Power Flow
- Smart Charging

Actors-Transactions-Diagram



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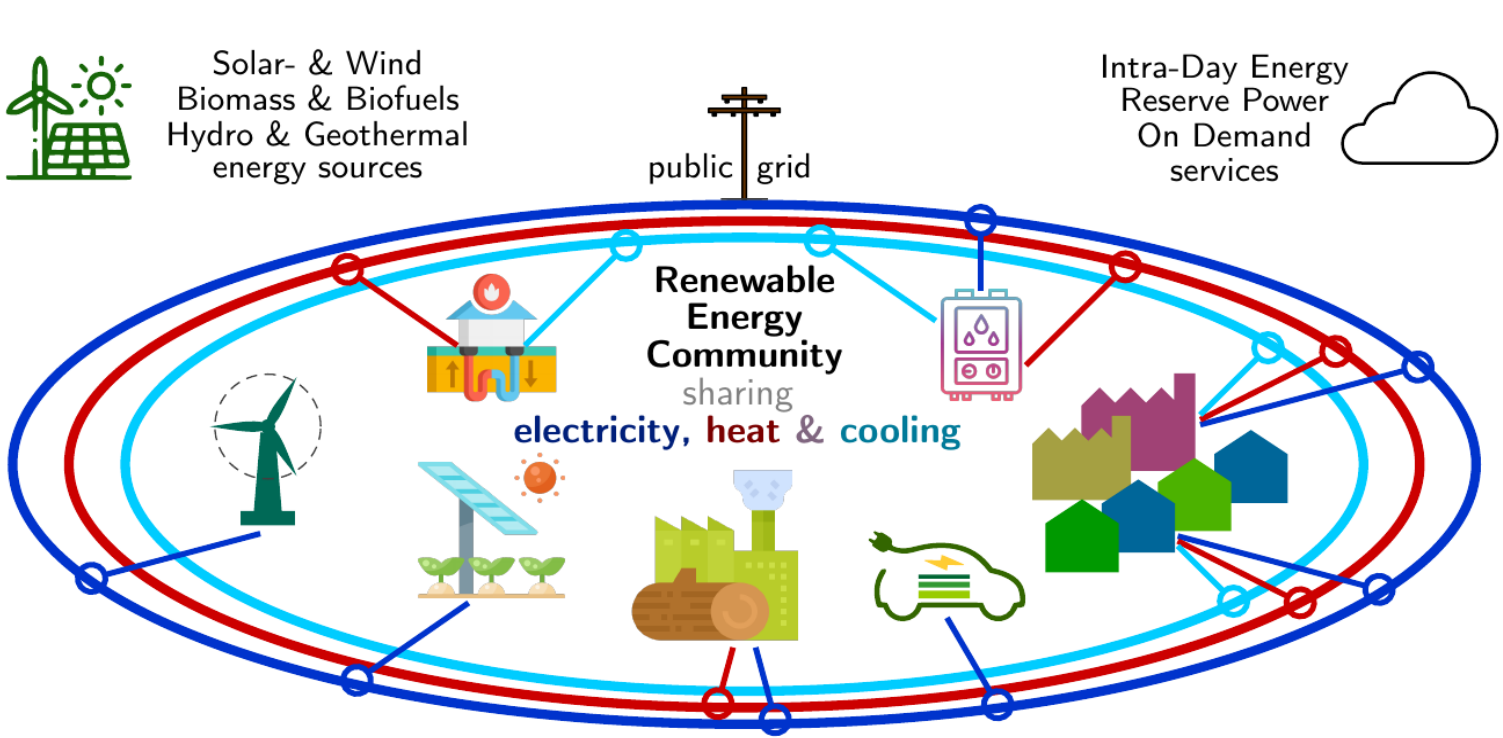
Smart EV sharing: Smart EV re-charging – KLIEN 6th ZEM – cleanBEVsharing



clean **BEV** sharing

Recharge shared BEV with maximally green energy
– shift recharging but do not risk to loose a booking
– schedule recharging to optimise BEV availability
– offer recharging flexibility for adequate compensation
– offer V2G discharging as temporary supply flexibility
– incentivise booking when BEV is not required for flexibility

Renewable Heat Energy Community – Cross-Sector – Reallabor Waldviertel



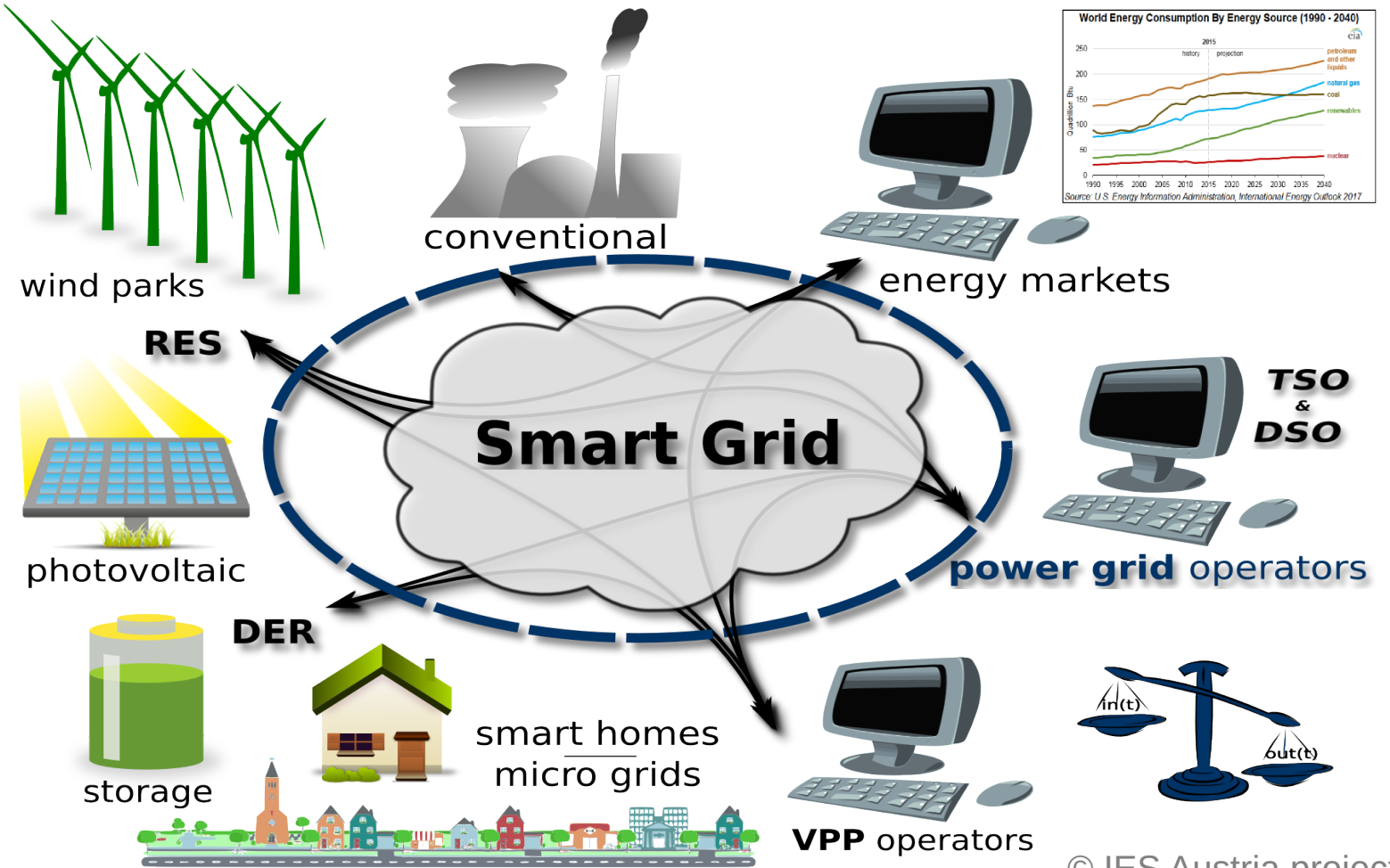
reallabor WALDVIERTEL

Coordination of traditionally independent energy systems
– integrate different/opposing control paradigms, timing, units, and nomenclatures in general

Integration Profiles specify Inter-Operation means

The Smart Grid – is clever and shall add flexibility

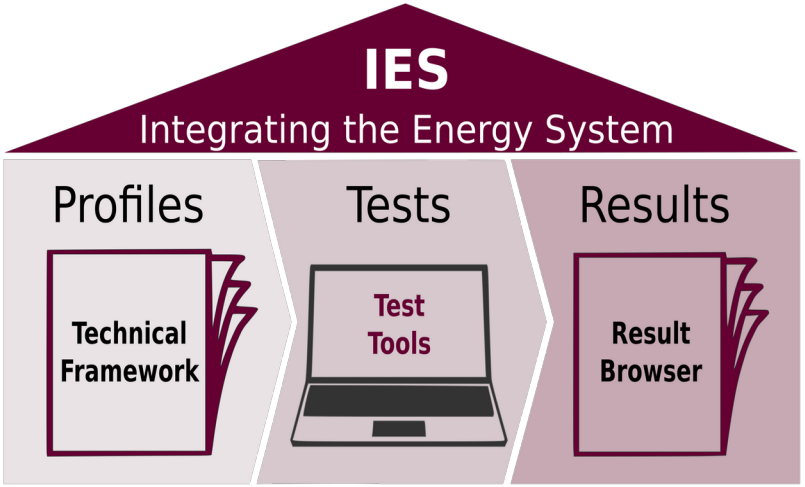
inter-system **services that link silos**

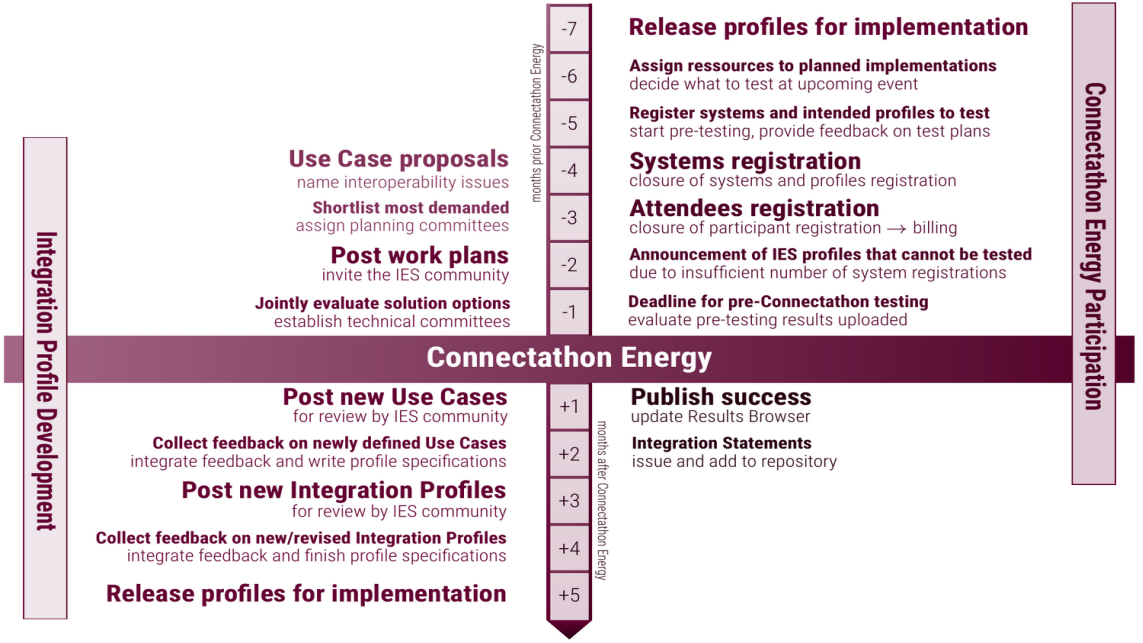


is not possible without **interoperability**

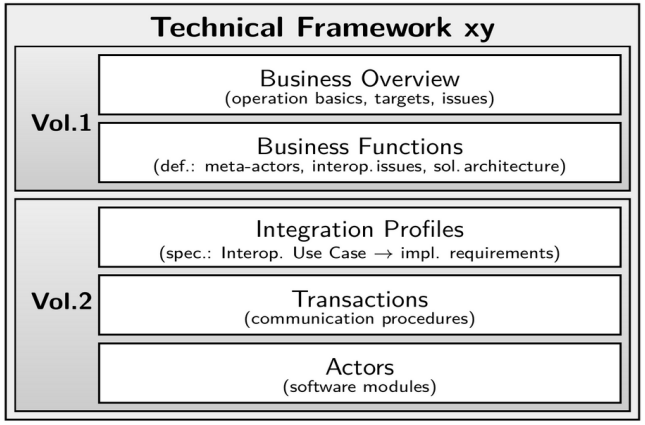
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Integrating the Energy System by Integration Profiles



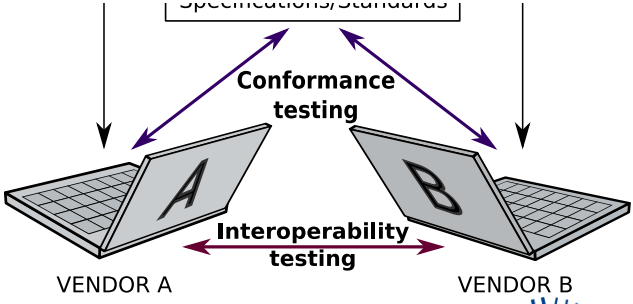


Domain Overview



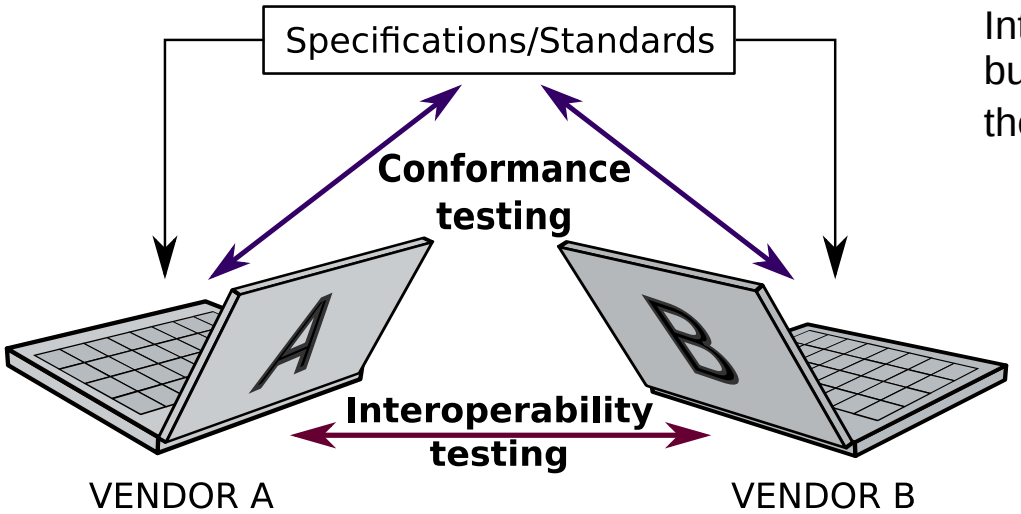
▶ The IES Cookbook

https://door.donau-uni.ac.at/o:3656

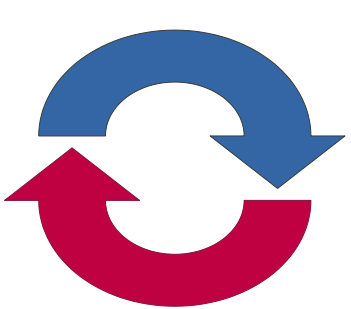


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Testing of interoperability and specification compliance



Integration **Profiles may be the 'brain'**,
but the **Integration Testing is the 'heart'**,
the motor that keeps the brain working!





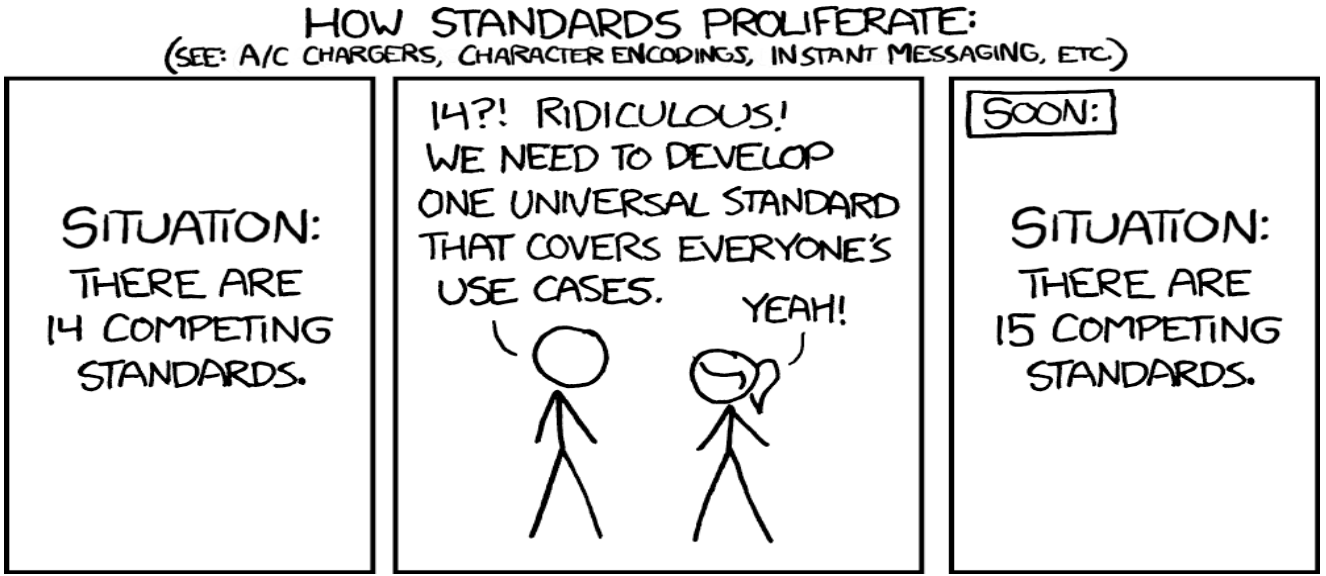
What happens at a so-called Plugfest –> independent systems become connected
-> **the developers** – the engineers themselves – **test their prototypes** peer-to-peer
-> to finally get an **Integration Statement** => event though that is **no Certificate!**

Once we have compiled some interesting Integration Profiles to implement and test
-> this could equally work in the energy sector for all the **smart devices** to be integrated
-> check out the **European Collaboration Network for Interoperability Testing...**

Summary

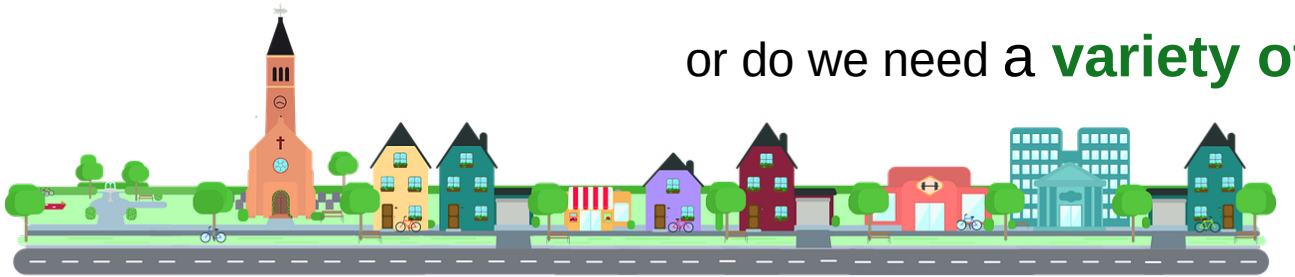
Question

do we need to standardise a **better „house”** that fits all known needs



https://xkcd.com/927

or do we need a **variety of „bricks”** for a smooth evolution



Standards define the elements to build on



- Standardising **digital interfaces and services** is the basis for the digitalisation but **does not guarantee interoperability** -> they **support the digitalisation**; but **reliable access** to **correct data** and **expectable responses** are difficult to assure.

- Interoperability covers:
  - **legal** –> what is allowed / enforced / needed — laws & regulations
  - **operational** –> required quality / sequence / timing — **operation** standards
  - **semantic** –> mutual interpretation of shared information — **onthology** standards
  - **syntactic** –> equal digital encoding / framing / encryption — **technical** standards
  - **technical** –> same communication medium / channels / protocols — best practice

- **Variety of stackable tools** (bricks) shall flexibly **support diverse Smart Grid services and use cases**
- **Open² environment** (house) needed to integrate and support **technical and operational opportunities**



holistic or layered
static or flexible
where to go...



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Department for Integrated Sensor Systems

Thank you!

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Department for Integrated Sensor Systems
Center for distributed systems and sensor networks

The presented work achieved financial support via the R&D project DiPS4EV@work, funded in the 5th call of the KLIEN *Zero Emission Mobility* program, managed by the FFG as project #899909. www.dips4ev.work