EEBUS
OVERVIEW OF USES CASES
The global language for energy in the Internet of Things
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STATUS AND ROADMAP (1)

STEP 1 - Building Connectivity

STEP 2 - Grid Connectivity
STEP 1 - Building Connectivity

STEP 2 - Grid Connectivity
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STEP 3
Cloud Connectivity
# Overview EEBUS Connected Domains

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**Upcoming use cases in definition/development**

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E-VEHICLE (EV) USE CASES

Reduce recharging costs, realize real zero carbon dioxide emission foot print and prevent potential grid issues through EVs
1. Coordinated EV Charging

Enables communication of EV’s departure time, minimum energy required and optimal energy (or maximum capacity) to the energy manager. The energy manager takes all demands into account and submits incentive tables to the devices. Through an incentive table the EV knows how much power is available at what costs and at what time (costs may be monetary and ecological, e.g. carbon dioxide emission). In addition the maximum power curve over time is submitted. Based on the incentive table and the maximum power curve the EV creates its charging plan at low monetary or ecological costs and sends it back to the energy manager. A renegotiation may be triggered by all devices, e.g. if energy demands of the EV or the energy cost through more available PV energy has changed.

*Added value:* Through different energy resources at very different costs (e.g. cheap PV energy, PV energy at no costs during PV power curtailing, cheap grid energy during overproduction period) the costs of operation of an EV may be decreased significantly. In case of PV power curtailing the EV is recharged at no costs and zero carbon dioxide emission becomes true. Future option: The energy manager could send the energy demand forecast to the grid.
2. Overload Protection by EV Charging Power Curtailment

Enables the system to limit the maximum charging current of the EV on each phase depending on the electrical connection. As well the connection itself is monitored. In case there is no connectivity the EV will only operate within defined safety parameters typically set by the charging station (EVSE).

*Added value:* The power consumption of the EV may be reduced to prevent grid issues or even fuse brake through limiting the maximum current. The strong requirement to react within 4s will be fulfilled.
3. **Optimization of Self-Consumption during EV Charging**

Enables communication of optimal power level to indicate how much self produced power is available on each phase depending on the electrical connection. In addition the connection itself is monitored.

*Added value:* EV can adjust its consumption to the actual self-produced PV energy to benefit from more cheap PV energy and less carbon dioxide emission to realize much better or even zero carbon dioxide emission foot print.

4. **EV Charging Electricity Measurement (Current, Power or Energy)**

Enables communication of charging current, power or energy of the EV

*Added value:* Energy manager or corresponding device may consider actual energy demand of the EV
5. EV Charging Summary

During and after the charging process a summary may be requested by the EV. The summary provides information of the power consumption as well as the costs of the charging process.

*Added value*: 100% transparency on costs of operation and efficiency of EVs recharged by cheap PV energy or through cheap grid power (future option: flexible tariffs)

6. EV Commissioning and Configuration

Enables communication of the EV’s:

- Identification
- Communication standard (between EV and charging station)
- Asymmetric charging support (different currents on each phases)
- Manufacturer data (e.g. serial number, device and vendor name)
- Charging power limits

*Added value*: Exchange of relevant data to integrate EVs into the smart home
7. EVSE Commissioning and Configuration

Enables the system to communicate EVSE type specific values, e.g. manufacturer, device type or serial number of the EVSE to the energy manager.

*Added value:* Provide relevant data to integrate charging stations into the smart home
Go for perfect integration of HVAC devices into smart home and decrease costs of operation through cheap PV energy
1. **Optimization of Self Consumption by Heat Pump Flexibility (DHW Flexibility)**

This Use Case explicitly describes the combination of a PV system and an electrical heat pump system with the goal of optimizing the electrical power consumption of the heating system according to the available PV power in order to reach economic or ecological goals.

*Added value:* To make sure the heat pump is running at the lowest costs it should be integrated into the energy management. This feature enables the coordination of cross domain processes.
2. Monitoring of Temperatures

This Use Case collection enables the energy manager to monitor temperatures of an HVAC system. Energy costs may be saved by reducing the temperatures during non-use of rooms. The energy demand of the HVAC system may be estimated by comparing the actual temperatures to the setpoints.

Depending on the capabilities of the HVAC system one or more of the following temperatures may be monitored:

- Room heating temperature
- Room cooling temperature
- Domestic hot water (DHW) temperature
- Outdoor temperature
3. **Configuration of Temperatures**

This Use Case collection enables the energy manager to configure temperatures of an HVAC system. The energy manager may adjust the setpoints according to a user input or based upon algorithms that consider energy optimization tasks as well as consumption profiles.

Depending on the capabilities of the HVAC system one or more of the following temperatures may be configured:

- Room heating temperature
- Room cooling temperature
- Domestic hot water (DHW) temperature
4. Monitoring of System Functions

An HVAC system function (heating, cooling, ventilation or domestic hot water) may be visualized e.g. status by an external appliance or display unit such as HMI (human-machine-interface) or tablet/smartphone.

Depending on the capabilities of the HVAC system one or more of the following temperatures may be monitored:

- Room heating temperature
- Room cooling temperature
- Domestic hot water (DHW) temperature
5. Configuration of System Functions

An HVAC system function (heating, cooling, ventilation or domestic hot water) may be configured by an external appliance or display unit such as HMI (human-machine-interface) or tablet/smartphone.

The HVAC system may support overrun operations that override the current operation mode temporarily.

Depending on the capabilities of the HVAC system one or more of the following system functions may be configured:

- System function heating
- System function cooling
- System function DHW (domestic hot water)
6. Visualization of Heating Area Name

Enables the HVAC system to communicate the

• Heating circuit name
• Heating zone name
• Heating room name

of a HVAC room.

*Added value:* The names can help identify the heating circuit, heating zone or heating room during installation or maintenance.
WHITE GOOD USE CASES

Go for standard based comfort functions and zero carbon dioxide emission footprint as USP
1. **Flexible Start**

Enables the system to start a pre-selected program of a device. The user will select the end time of a program right at the device which communicates end time, selected program and its power profile to the energy manager. The energy manager determines the timeslot of the program at the lowest energy costs between now and the pre-defined end time.

*Added value:* The energy manager may run the devices at the lowest energy costs or even for free during PV power curtailing with zero carbon dioxide emission footprint.
Combine PV energy systems with all kind of home devices to increase self consumption and autarky rate
1. Monitoring of Inverter

Enables the energy manager to monitor data provided by any type of inverter, such as PV, battery, hybrid, etc. The inverter provides information like identification, state, power production or data points needed for diagnosis or efficiency calculation.

*Added value:* An energy manager may read all energy relevant values from the inverter to consider those in energy management or to show detailed status information.
2. Monitoring of PV String

Enables the energy manager or user interface to read PV string specific data like momentary power production, voltages, etc., as well as debugging data like insulation resistance of a PV module through the connected inverter.

*Added value:* An energy manager may analyze the behavior of the PV system like decrease of power generation or determine the share of the respective DC sources like PV or battery which the AC current is actually generated from. Thus, an energy manager could determine the energy price accordingly or draw conclusions about the type of generation.
3. Monitoring of Battery

Enables the energy manager or user interface to read battery system specific data such as identification information, the state of the battery, power/current/voltage, or nominal values.

*Added value:* An energy manager may read all energy relevant values from the battery to consider them in energy management like recharging of an EV independent of the availability of grid energy or to show detailed status information.
4. Visualization of aggregated Photovoltaic (PV) Data

Enables the communication of basic PV system information

- Nominal peak power $P_{DC,\text{nom}}$
- Current power production $P_{AC}$
- Cumulated yield [kWh]

*Added value:* Devices (e.g. heat pump, energy manager) may read the most important energy values of PV systems for visualization or to consider those for basic energy management functions.
5. Visualization of aggregated Battery Data

Enables communication of the
- Charge or discharge power of a battery
- Charging level of the battery in percent (SoC)

*Added value:* Energy Manager may read most important energy values of battery systems to consider those in energy management, e.g. to offer fast recharge to the EV.
GRID INTERACTION
USE CASES

Decentralized power generation combined with set points to enhance grid stability
1. **Monitoring of Grid Connection Point (Submeter or Smart Meter)**

Enables communication of

- How much power, energy or current is fed into the grid and how much power (energy or current) is consumed from the grid
- Maximum power that is allowed to be fed into the grid

*Added value:* General purpose use case for monitoring of submeter or smart meter. E.g. if PV energy exceeds maximum feed-in power this function enables the energy manager to offer energy to the connected devices at no costs with zero carbon dioxide emission foot print by not power curtailing the PV system. In addition the autarky rate will be increased.
2. Monitoring and Control of Smart Grid Ready Conditions

Enables system to read and write “SmartGrid-Ready Status”

*Added value:* Digitalization of relay contact. Set 1 of 4 different states, e.g. “SmartGrid-Ready Status” to “SG Ready Condition 3” digitally through EEBUS.
3. **Power Limitation at Grid Connection Point (\(P_{\text{Lim}}\) Setpoint)**

Enables the system to limit the power consumption through set point or power profile over time (e.g. zone or smart home)

*Added value:* If the energy demand of a zone is too high and the network cannot provide the energy the energy manager can reduce the power consumption of the entire zone by sending power targets to the connected devices.
GENERIC USE CASES

Ecosystem functions
1. Monitoring of Power Consumption

Enables the energy manager to monitor the current power consumption of an appliance. It can be ensured that (e.g.) the allocated energy resources (based on the reported demand of the device) are not exceeded and the EMS may react in time to avoid an overload situation.

*Added value:* An EMS knows the current power of consumption of the appliances and may manage the overall energy demand according to the capacities provided by the local and public grid.
2. Use Case Discovery

Enables the discovery of supported use cases of the connected devices

*Added value:* All devices, especially the energy manager, know about the systems possibilities. In addition a smartphone app may use the functionality to show the interoperability of the connected devices.
1. **EV State of Charge**

   Enables the EV to communicate the percentage of charge and the battery capacity to the energy manager to calculate how much battery capacity is already charged and how much capacity is left to charge.

   *Added value:* To increase self consumption it is important to the energy manager to know how much capacity is available, e.g. when PV forecast indicates that the PV power will exceed the grid feed-in limits, the surplus costless energy can be stored into the battery and zero carbon dioxide emission becomes true.

2. **EV Charging Fallback**

   Enables the system to configure safety values for the recharging process which are set by default if the communication to the energy manager is not available.

   *Added value:* System avoids overload through the default maximum power value
3. Fleet EV Charging

Enables the energy manager to identify the EVs and their demands prior to the recharging process. The energy manager will send maximum power curves to the corresponding EVs.

*Added value:* Enables fleet management in commercial applications

4. Bi-directional EV Charging (V2H/V2G)

Enables the system to use the EV battery in the first step for vehicle to home (V2H) and in the second step vehicle to grid (V2G) applications.

*Added value:* EV may be used to increase self-consumption and autarky rate (V2H). Even undersupply scenarios on the grid side can be covered by the battery of the EV (V2H/V2G). Cumulated flexibility of EVs can be offered on flexibility platforms for adherence to schedules or for grid stabilization (V2G).
5. Incentive Table based Power Consumption Management

Enables the energy manager to use of the devices' (e.g. heat pump) flexibility by influencing the operation process through the price of energy (incentive table) to optimize the total power consumption of the house or realize power set points from the grid.

*Added value:* Devices know about when green, cheap or costless energy is available and can change the operation mode accordingly. In case of PV curtailment, surplus costless energy can be used by the device. On the other hand, a device can operate without loss of comfort by accepting the energy price valid at that time.
6. **Overload Protection by Current Limitation**

Enables the system to limit the maximum power consumption of an HVAC device and monitor the connection itself. In case there is no connectivity the HVAC device will only operate within defined safety parameters.

*Added value:* The power consumption of the HVAC device may be reduced to prevent grid issues or even fuse brake through limiting the maximum current.
7. Control of Inverter

Enables the system to control PV or battery inverters. With PV inverters, e.g. setpoints received from the grid such as P, Q, cos ϕ can be implemented for grid support or with battery inverters the charging or discharging process can be triggered by an energy manager to offer e.g. fast recharge of the EV. Grid-supporting inverter functions provided by the inverter itself (and called by technical connection rules) will not be effected unless the energy manager has received a setpoint from the grid.

*Added Value:* Relevant parameter may be set by the system to support the grid by operating the inverter within received setpoints. To increase self consumption, it is important to the energy manager to charge or discharge the battery, e.g. when PV forecast indicates that the PV power will exceed the grid feed-in limits the surplus costless energy can be stored into the battery to realize zero carbon dioxide emission footprint.
8. **Energy Demand Forecast**

Enables the system to send an energy demand forecast to the grid

*Added value:* Grid will be notified about the energy demand of a zone (e.g. building) and may use this information to optimize the energy support.