



SEEEI – Electricity 2017

Fast & Secure Switching via LTE Mobile Networks

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MV/LV networks becoming Smart Grids: Changes / Implications

- ✓ Proliferating DER injection
 - Customer's premises as “**Hot Spots**”
 - Stability of the MV/LV grid becoming jeopardised
- ✓ Real-time/fast communications with network end-points getting pre-requisite
- ✓ Interconnected market participants
- ✓ Life-time security for the assets
- ✓ Transparency of physical losses
- ✓ Move from DSM towards DMS in LV networks
- ✓ Communicating meters with real-time interval metering
- ✓ Increasing energy storage ability

- ✓ A „**Virtual Power Plant**“ is a cluster of distributed energy managed as a whole:
 - Pooling of producers
 - Aggregation of consumers
- ✓ As a complex system scheme VPP embraces;
 - Real-time communication
 - Monitoring and control
 - Trading & optimised demand/supply balancing
 - Portfolio-Management, provision of reserve energy
 - Energy exchange

Four Reasons for Fast Communications

1. Dynamic Demand/Supply Response
2. Prioritised switching during critical grid situations in real-time
3. Increased overload due ubiquitous high security functionality throughout the distributed system
4. Communication network monitoring and quality of service provision in real-time

Risk Consideration, Security Impact: High Level Approach for Secure Products



$\text{Risk} = \text{Threat} \times \text{Vulnerability} \times \text{Consequences}$



Common Criteria CC EAL 4+ Compliant
Inherent Security:

- Integrated Security Module
- PKI based Double-end Authentication
- All TLS protection
- Life-Cycle Security



DMS Enhancement



- ✓ Distribution Management Systems generally provide observability and controllability of medium voltage distribution grids
- ✓ The growing amounts of distributed generation in low and medium voltage grids require an **efficient and secure operation**, particularly in time critical situations in order to maintain the stability of the energy system
- ✓ Widely distributed controllable equipment like generators, storage and responsive loads today are thus to be **managed in real-time via fast and secure communication channels**, preferably through a dedicated network
- ✓ Existing DMS can be extended to include new functionalities that build on real-time data acquisition and on control schemes by ensuring coordinated functionality at the distribution grid end points

Grid Control Schemes Blurring with Service Offering

✓ Demand/Supply Response Applications:

- Load management (e.g. Heating)
- Equipment/ renewables management
- Tariff-/event driven load & renewables management
- Public lighting
- Car charging at end customer's premises

✓ Critical Grid Applications:

- Distribution Automation
- Time critical control in LV distribution networks
- Time critical control in MV distribution networks

✓ Services to End Customers:

- Monitoring services via the secure platform
- Secure access of independent service providers
- Remote maintenance of equipment/devices

A red oval containing the text 'Demand/Supply Response Critical Grid Applications' in red.

Demand/Supply Response
Critical Grid Applications

A blue oval containing the text 'Service Offering' in blue.

Service Offering

CC^{*)} certified secure Gateway SGH-S

CC compatible secure Grid Unit GCU-S

1

2



- ✓ Deployment in MV/LV distribution networks
- ✓ Installation in sec sub-stations and end at customer's equipment

1



2



^{*)} CC: Common Criteria

Secure Gateway/Grid Control Platform: Communication Channels

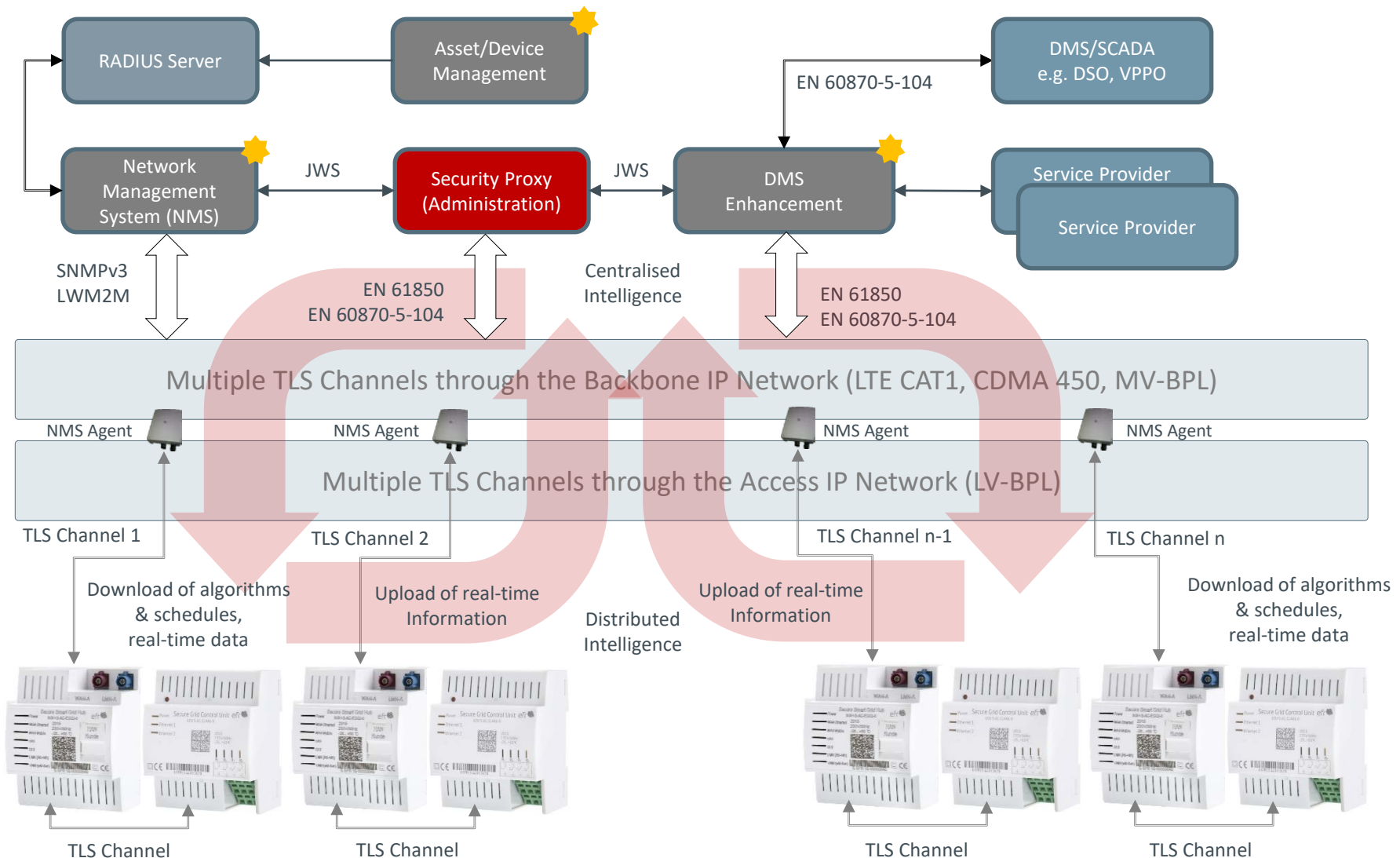


- ✓ Ethernet interfaces:
 - ETH1 for secure LAN
 - ETH2 for secure WAN
 - Integrated Ethernet Switch
- ✓ Mobile Carrier Options:
 - LTE CAT1, 800/1800/2600 MHz with 2G Back-up
 - CDMA 450 MHz (EV DO)
- ✓ Integrated Broadband Mains Option:
 - Frequency band between 2 to 10 MHz
 - Dynamic Network Management
- ✓ RS 485 bus interface for meter & sensor communication



- ✓ Separate IPv6 addresses, APNs and TLS channels for payload and network management
- ✓ IPv6 address assignment:
 - Stateless Auto Address Configuration SLAAC
 - Script controlled assignment of the fixed interface ID
 - Automated address notification by keep-alive messaging
- ✓ Parallel SAE bearers for payload best effort, prioritised payload and management
- ✓ QoS support: LTE QCI and ARP (Allocation and Retention Priority)
- ✓ LWM2M (OMA) and SNMPv3 protocol for Device Management, performance monitoring, congestion control
- ✓ IEC 61850 Protocol with Scheduling extension for grid control
- ✓ Extremely low latency and very high message throughput
- ✓ High availability

Fast & Secure Smart Grid Management



Controlled Group of PV-Injections



Devices Groups Use Cases Settings Reports Measurements About

Logout

Device ID	Power-[kW]	EEG Status-[%]	Billing Compensation
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
✓ eefr1600001094	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001087	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001081	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001061	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001071	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001058	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001060	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001078	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001074	Export-[kW]	Export-[%]	Export ▾
✓ eefr1600001062	Export-[kW]	Export-[%]	Export ▾

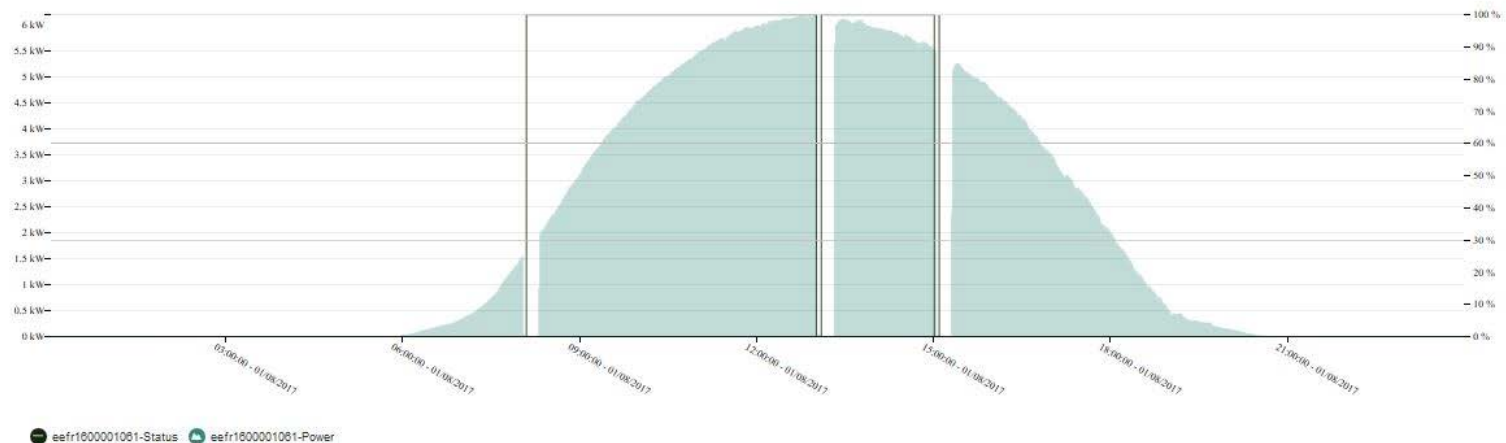
Group Name	Devices	Export
<input type="text"/>	<input type="text"/>	<input type="text"/>
✓ 1062	Devices	Export
✓ EMTG, beide IMS	Devices	Export
✓ 1058	Devices	Export
✓ 1078	Devices	Export
✓ 1073	Devices	Export
✓ 1083	Devices	Export
✓ 1060	Devices	Export
✓ 1059	Devices	Export
✓ 1067	Devices	Export
✓ 1061	Devices	Export

Power and Status ▾

Hint: Use [Alt]+Mouse selection for zooming, doubleclick to return

Refresh

Meter Chart: Power and Status



Switching Schedule



LTE App control page

Add a test execution instance

Choose a test case

UC-1/UC-2/UC-3: Switch one/group of dev

EEG-State

0%

Execution time

10-08-2017 10:08:16 Now+10s

GroupId

Testgroup 10

Add it to the scheduler

Test schedule

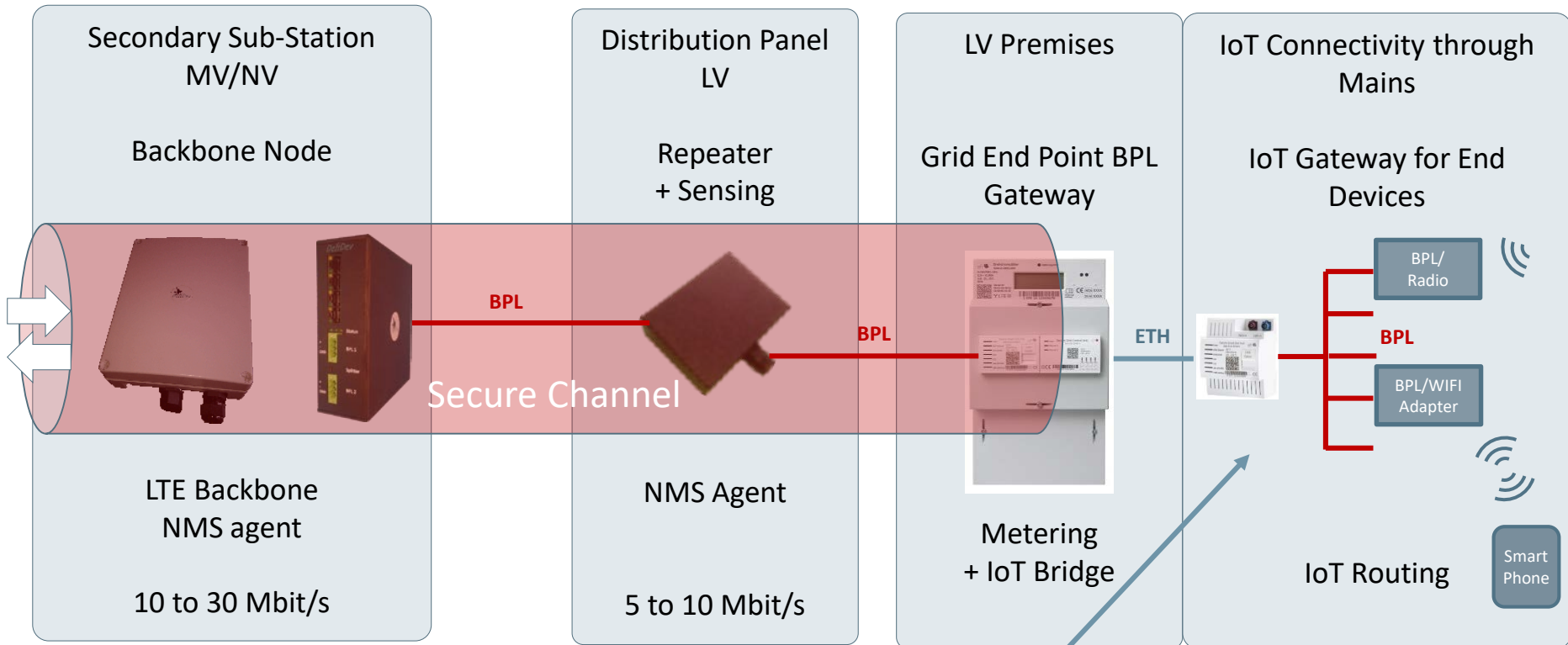
Load Save ClearAll

Filter showed results						
UC-Name	GroupId	EEG-State	Pushs /min	Datetime	UC-Status	actions
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 10	0%	-	10-08-2017 10:08:16	scheduled	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 10	0%	-	10-08-2017 10:03:16	scheduled	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 10	0%	-	10-08-2017 10:00:16	scheduled	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 10	0%	-	10-08-2017 09:52:16	running	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 2	0%	-	10-08-2017 09:51:01	executed	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 2	100%	-	10-08-2017 09:49:43	executed	x
UC-1/UC-2/UC-3: Switch one/group of devices wC	Testgroup 2	30%	-	10-08-2017 09:48:42	executed	x

Execution flow grid

DeviceId	Test start	WU sent	TLS GWA	REQ odd	RES odd	REQ pc	RES pc	IEG1860	REQ1 r	RES1 r	REQ pd	RES pd	REQ2 odd	RES2 odd	UC End
eeefr1600001...	0	236	12130	-	-	45	14336	-	-	-	-	-	-	-	-
eeefr1600001...	0	216	12757	-	-	183	15578	-	-	-	-	-	-	-	-
eeefr1600001...	0	201	11924	-	-	46	14295	-	-	-	-	-	-	-	-
eeefr1600001...	0	193	-	-	-	-	-	-	-	-	-	-	-	-	-
eeefr1600001...	0	184	11606	-	-	127	13656	-	-	-	-	-	-	-	-
eeefr1600001...	0	174	13424	-	-	114	14374	-	-	-	-	-	-	-	-
eeefr1600001...	0	160	12890	-	-	29	15359	-	-	-	-	-	-	-	-
eeefr1600001...	0	150	13722	-	-	191	13327	-	-	-	-	-	-	-	-
eeefr1600001...	0	141	13005	-	-	24	14391	-	-	-	-	-	-	-	-
eeefr1600001...	0	130	-	-	-	-	-	-	-	-	-	-	-	-	-

BPL Product Hierarchy, Comprehensive Connectivity, IoT Routing



- ✓ Radio Node Connection, e.g. wireless M-Bus to collect multi-utility data
- ✓ WIFI Connection, e.g. for local control and monitoring via „Smartphone“

- ✓ IPv6 in every BPL Device with stateless auto-configuration, router advertisement and certificates for DNS SEC
- ✓ Radius authentication in the backbone node for BPL repeaters and end devices
- ✓ SNMPv3 using (D)TLS in every BPL device with certificates
- ✓ SSH tunnelling and SCP in the backbone node for managing repeaters and end devices with certificates
- ✓ „Tagged Traffic“ within the BPL network and „Untagged Traffic“ in the end device
- ✓ „Network Management System“ NMS for the dynamical control of the BPL network

Public Lighting Control combined with WIFI-Hotspot Provision

Single control

Lamps with integrated control

Sec Substation
MS/NS

BPL-Backbone-Node



Backbone-Network
10 to 30 Mbit/s

WIFI-Hotspot

WIFI-Hotspot

LV cable

BPL Communication

Group control

Lamps with group control

Distribution panel with
Smart Meter
Gateway + Control Unit

WIFI-Hotspot

WIFI-Hotspot

Cable junction

Cable junction

LV cable

Thank you very much for your attention!



Your contact to EFR...

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