NRG5

Enabling Smart Energy as a Service via 5G Mobile Network advances

5G-PPP Phase 2 at EuCNC Oulu

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ENGINEERING

Insights behind …

MOTIVATION

The state of the art is actually for substation-level/pumps monitoring via SCADA, without considering real time energy consumption or energy production feedback from prosumer, which would allow a finer-grained prediction of the demand and an improved load balancing of the energy networks.

! ***NRG5*** and **5G** initiative are challenged to guarantee optimal communications of the **energy grid** improving the Smart Energy Network especially in the **last mile** that represents an ideal vertical for extensive 5G deployment, where different applications with different requirements have to be managed

- **NRG5** aims at eliminating current and anticipated limitations of network infrastructures by making capable to support ENERGY Flexibility & Storage at Large Scale.

Massive IoT application

[**Advanced metering applications** enabling the massive and lock-in free integration of end-users' infrastructure requesting more stringent capacity and privacy]

Mission Critical

[Improving **Smart Grid Applications** requiring more stringent latency , highest availability and security]

- Under NRG5 **ENERGY Flexibility** is defined as:
  - Huge number of Smart Meters and sensors
  - Smart Grid stabilization (robustness by virtualization and self-healing by design) Energy virtualization & flexibility

SCOPE

NRG-5 Vision

NRG-5 will achieve its objectives by **encapsulating the key challenges of security, resilience and high availability** in *3 project principles*

1 Trusted and scalable *"Plug 'n' Play" vision*

NRG-5 will research towards truly distributed self-discovery and self-organization mechanisms and decentralized identity and key management schemes by combining inherited physical encryption functions (such as **PUF**) of the low-end constrained devices with distributed key management mechanisms based on ledger technologies (such as blockchains)

2 There is no "one-size fits all"

NRG-5 will introduce the concept of **Critical Infrastructures' Service Level Agreement (CI- SLA)**, as an extension to security SLAs, combining the ability of the network (from security and resilience perspective) to support zero delay energy infrastructure assets' communication, high availability and self-healing requirements.

3 *Sustainability via 5G PPP cooperation*

NRG-5 will build on 5G PPP Phase 1 results along with **state-of-the-art cooperative virtualization technologies** to deliver a utility-oriented Management and Orchestration framework for the provisioning 5G services to core utilities operations and contribute new concepts and prototype implementations of potential 5G networking functionality to the 5G Initiative WGs for discussion, consideration, pre-standardization and later product development.

NRG5 Challenges

Real-time mesh transmission and **distributed data protection** from smart meters

More accurate DR prediction using **Big Data analytics** (including weather, faults and eMobility requirements)

Real time dynamic energy (re-)routing to support service flexibility and continuity

Smart meters and aggregators gateways **MTC evolution** towards shorter measurement intervals

Dynamic deployment of VNF to offer services on demand, increased security/robustness and no single point of failure

Virtualization of **distributed energy generation**, storage and consumption

Main Specific Objectives

Co-design between **vertical (energy) and ICT players** including collaborative research fostering exchange of ideas and alignment

Challenge the 5G developments of Phase I and ensure **end-to-end performance enhancement** and **critical service guarantee** (latency, coverage, reliability, availability, data rate)

Flexibility, distributed security and privacy guarantees towards a secure and user-centric distributed critical infrastructure

New business models and business roles on ownership, operation, maintenance as well as usage between energy and telecom/IT actors for enabling trust and control over communications of the critical infrastructure and the eco-friendly development

Experimentation in active cooperation with a critical "vertical" sector , with real time requirements, driving the innovative requirements, demonstration and validation.

Use Case

Realizing decentralized, trusted lock-in free “Plug & Play vision”

- Provide a framework that will allow for easy, real-time, **automated devices identification** so that network auto-configuration can be achieved automatically. **Unified AAA** should be achieved in a homogeneous manner, to reduce the chances of AAA misconfigurations among different services of the same or different tenant, to address **multi-tenancy under geographically unbound mobility scenarios**. Last, **secure communications** should be achieved irrespectively of the network service provided and the physical entity initiating the connection.

Enabling aerial Predictive Maintenance for utility infrastructures

- **Low-delay, 5G-enabled Predictive Maintenance** may significantly help in more **efficient operation, accidents avoidance and fast restoration** of energy networks, leading to reduced maintenance costs and increasing the QoE offered by the Utilities to the citizens.

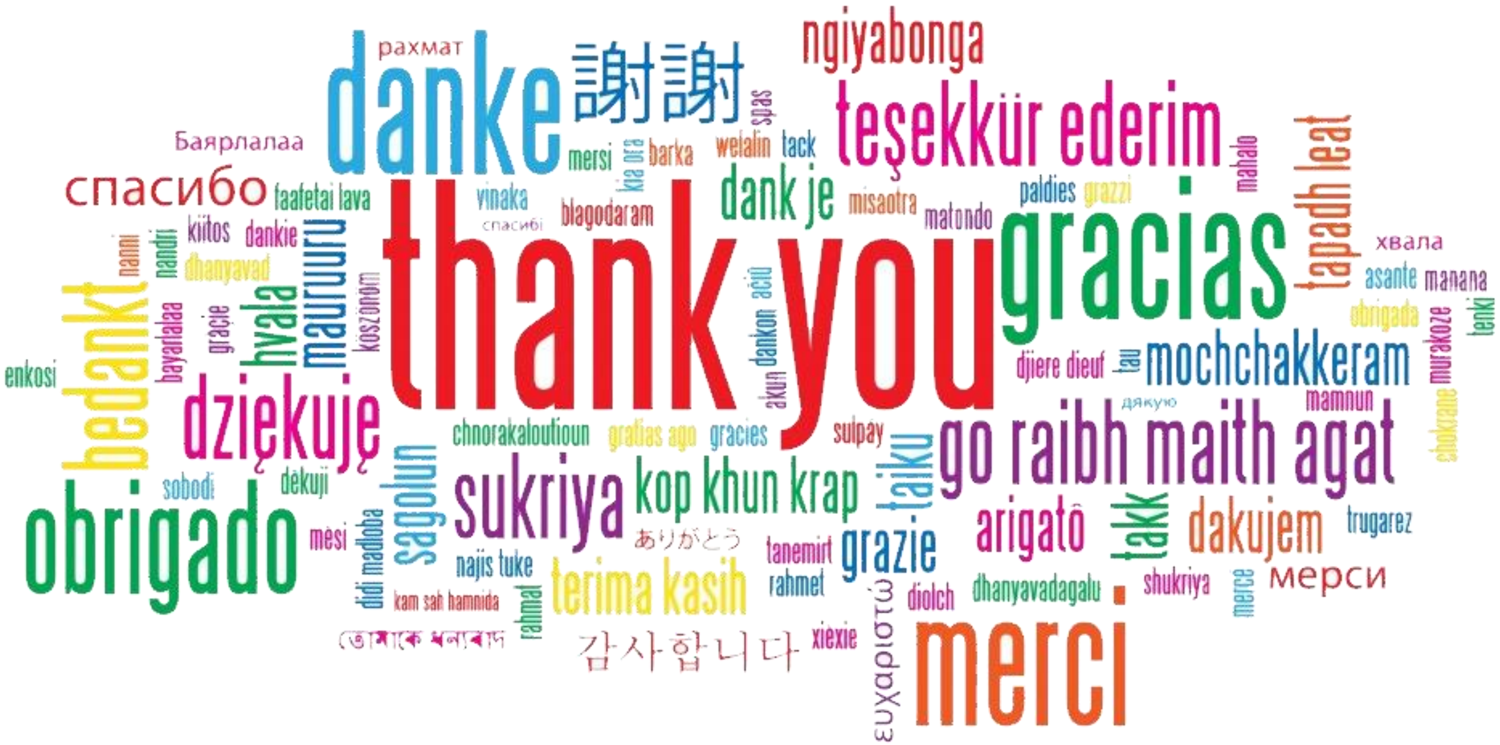
Enabling resilience and high availability via Dispatchable Demand Response (DDR)

- The stability and resilience of the energy grid in the presence of high share of RES, greatly depends on the fast response. Given that most of the times storage is not available on-site, **ultra- low (below 5ms) response from the energy operation centre is of vital importance**. The enablement of large scale DDR requires extreme (for today’s standards) communication requirements as metering and associated computational processes should be performed at very high frequencies.

Main expected results

NRG-5 will provide to the 5G PPP/5G initiative security, resilience and high availability mechanisms to meet critical infrastructures' (such as Smart Energy) 5G needs, expressed as:

- A set of ***requirements, prototypes and blueprints*** highlighting the limitations of current network infrastructures and the need for a ***decentralized, trusted, scalable and lock-in free plug 'n' play mechanism*** supporting vast numbers of hardware constrained devices that belong to different administrative domains.
- *A **software stack for 5G prototypes*** (i.e. smart meters, diagnostic devices, EVs, EV chargers, drones) and ***traceable VNFs*** to demonstrate ***mMTC, uMTC*** and ***xMBB*** communications, end-to-end ***security*** and ***MCM*** to enable secure, scalable and energy efficient communications
- An ***micro-cloud extended Mobile Edge Computing (xMEC)*** open source software stack**,** facilitating *automated analytics-based deployment of MTC-related and utility-centric VNFs*.
- An ***extended* 5G ETSI-MANO framework integrating analytics** in the orchestration and management processes addressing smart energy applications' VNF optimal sizing and chaining.
- ***State of the art 5G laboratories, real life trials demonstrators (both electricity and gas) and smart energy proof-of-concept applications*** validating the 5G results via energy use cases.
- Recommendations on ***scalability, resilience and high availability*** to address short, medium and long term requirements along with business models to handle ***CI-SLAs***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