Communications Architecture for the Intelligent Energy Networks

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Netcontrol in brief

- Founded in 1991 at Otaniemi!!!
- Specialist in Energy Network Automation
- 88 employees
- 20M€ revenues, sound profitability
- 5 offices
  - Pitäjänmäki, Helsinki, HQ
  - Västerås, SWE
  - Manchester, UK
  - Oslo, NO
  - Pretoria, South Africa
- 80% of business outside Finland

Co-operation with Aalto ELEC

- Testing at the high voltage laboratory

AALTO UNIVERSITY SCHOOL OF ELECTRICAL ENGINEERING
Department of Electrical Engineering and Automation

Test Report No. 2015hv28 1(1)

Requested by:	Netcontrol Oy Karvaamokuja 3 FI-00380 Helsinki Finland
Order:	Jari Ruotsalainen 20.4.2015
Test specimen:	Netcon 100 Software Release 2.04.000
Test:	Specified below
Standards:	IEC 60255-151 Ed. 1.0 (2009)
Testing date:	18.5 – 29.5.2015

SUMMARY

Type tests performed for Netcon 100 protection functionality according to IEC 60255-151.

Tested protection functions include overcurrent protection (non-directional, forward, and reverse) and earth fault protection (non-directional, forward, and reverse) relating to type tests 6.2.1, 6.2.2, 6.3, 6.4, 6.5.2, and 6.5.3 in IEC 60255-151 as described in report T12432-RP-EN-1.

Witnessed tests:

Test 6.2 Determination of steady state errors related to the characteristic quantity:
+/-10% **PASS**

Test 6.3 Determination of steady state errors related to the start and operate time:
+/-65ms **PASS**

Test 6.4 Determination of steady state errors related to the reset time:
reset time 55ms **PASS**, disengaging time 40ms **PASS**

Test 6.5 Determination of transient performance:
transient overreach 30% **PASS**, overshoot time 90ms **PASS**

The test results relate only to the items tested.

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AALTO UNIVERSITY SCHOOL OF ELECTRICAL ENGINEERING
Department of Electrical Engineering and Automation
High Voltage Laboratory

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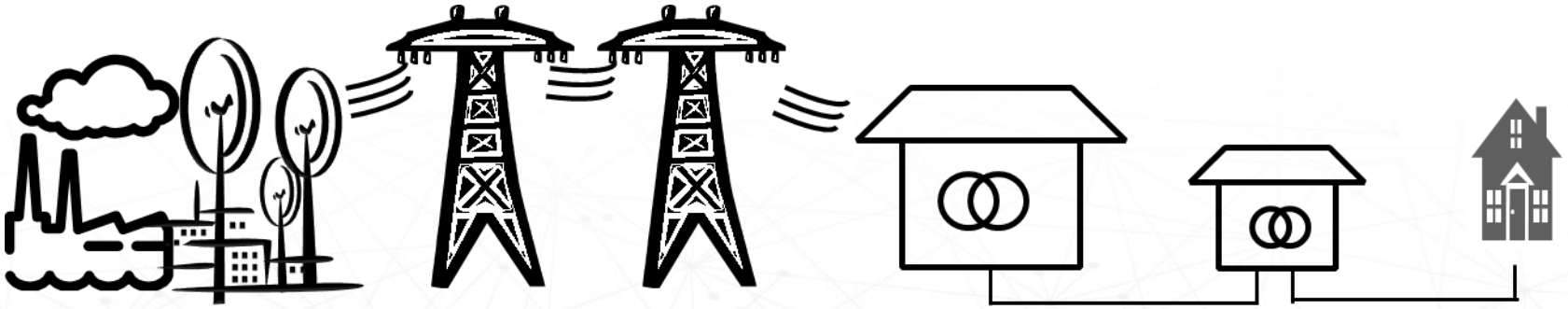
The classic electricity network



Centralised Generation

- Hydro
- Nuclear
- Fossils
- Large Scale Renewables

High Voltage Transmission (100's kV)

Medium Voltage Distribution (10 'kV)

Low Voltage Consumption (400/230V)

Unidirectional Energy Flow

General Grid Management

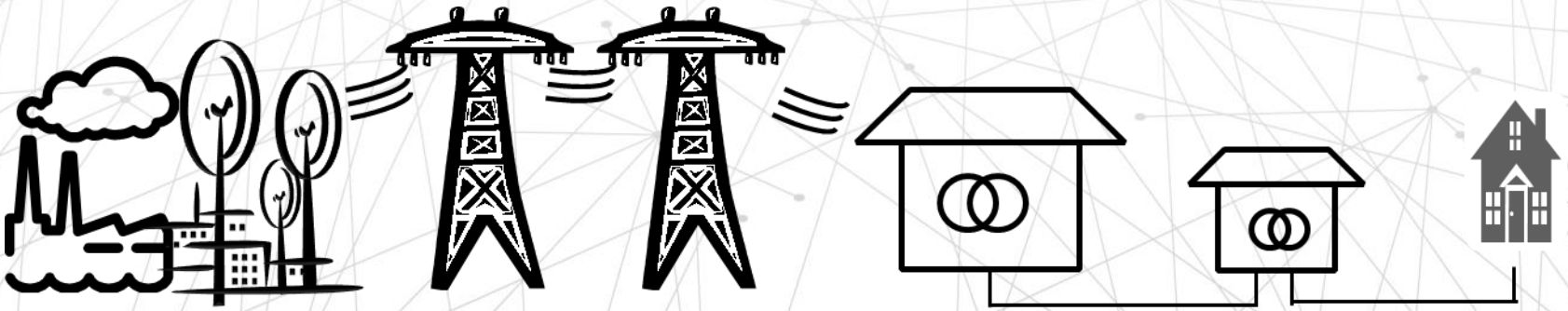
Central Control Room(s)

System Control and Data Acquisition
SCADA, Telecontrol

Statuses
Measurements

Control/Commands
Value settings

- Mission Critical Real-time Application
- 1000’s to 1.000.000’s of data points



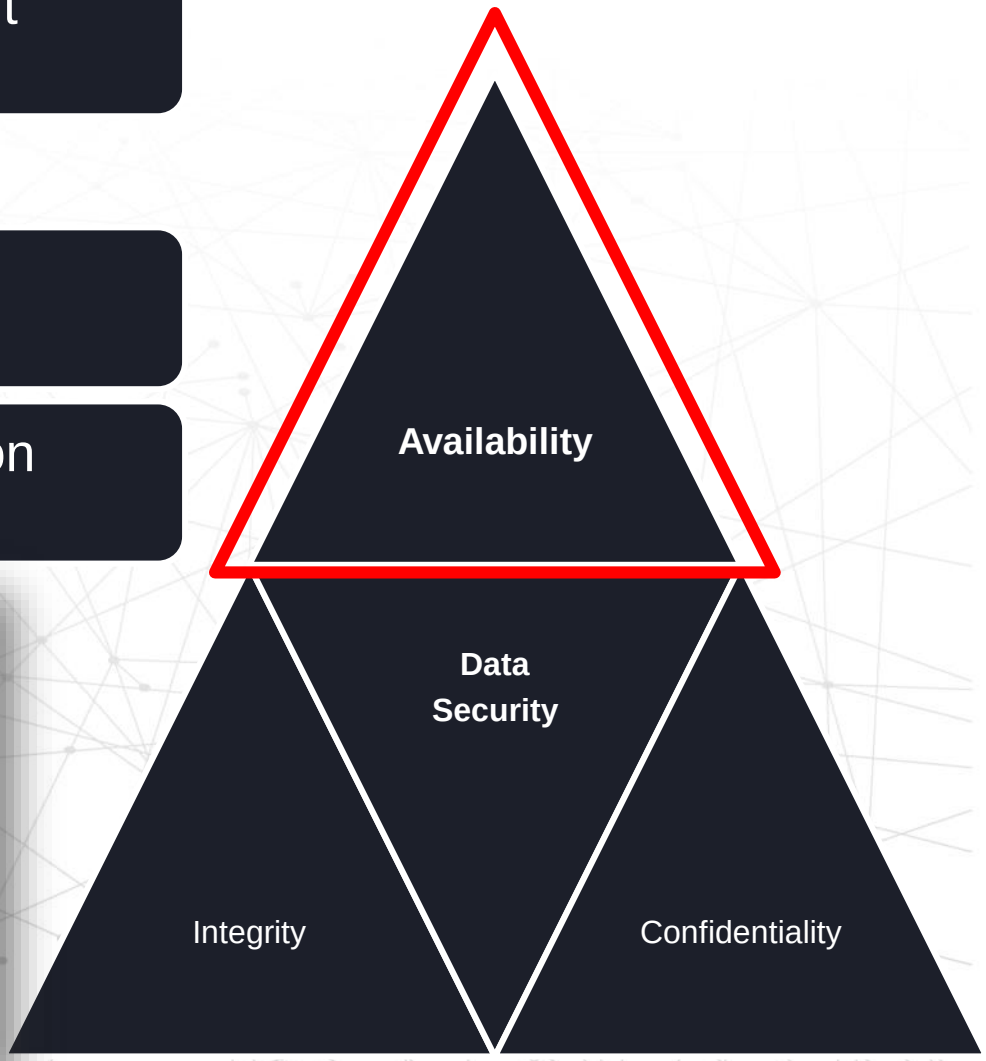
Security on Energy Networks

Availability is the key for intelligent energy networks

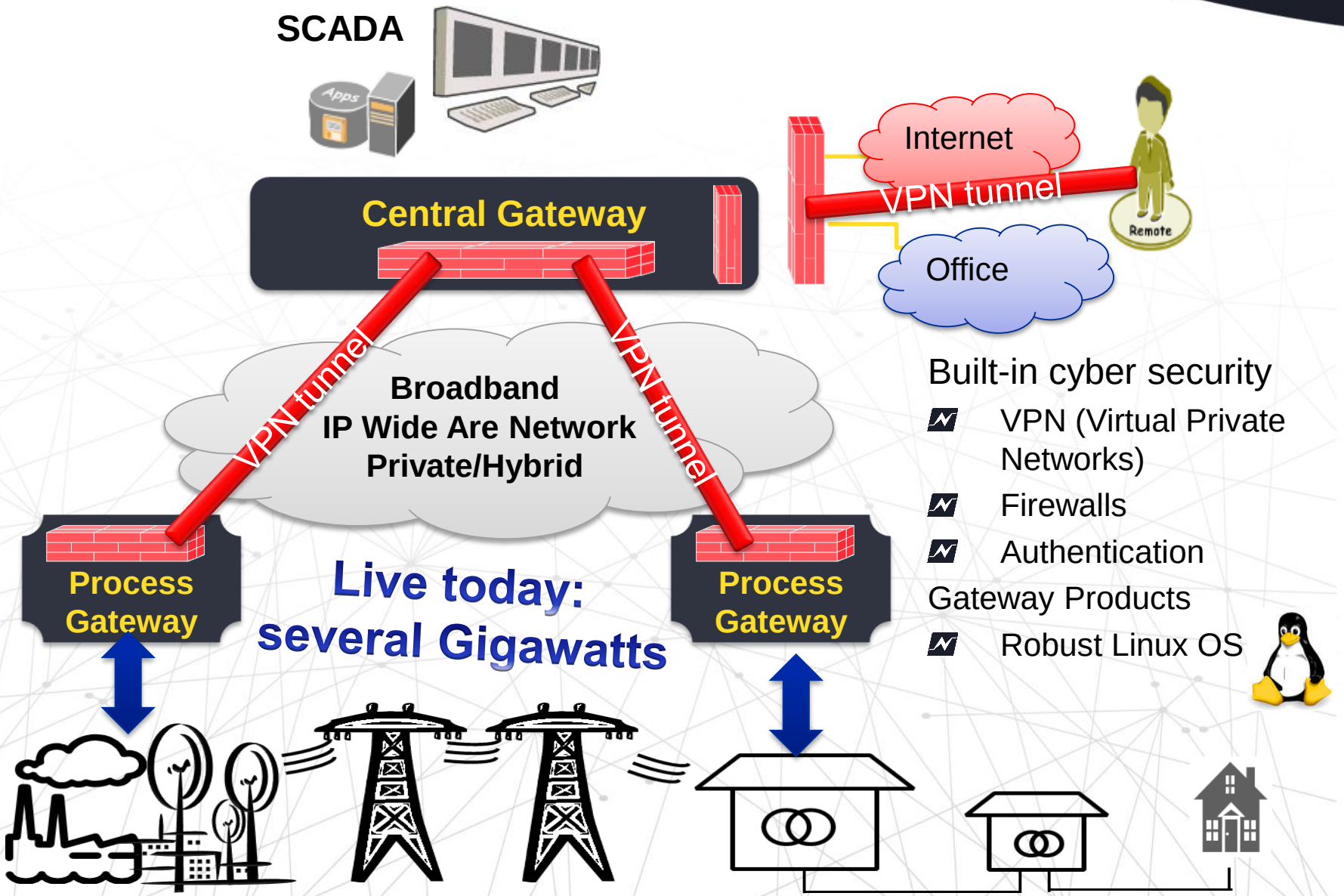
- Power supply
- Command and control, SCADA

Different security priorities from enterprise and home networks

Major impact on the Communication Architecture



ALL-IP Communications Architecture



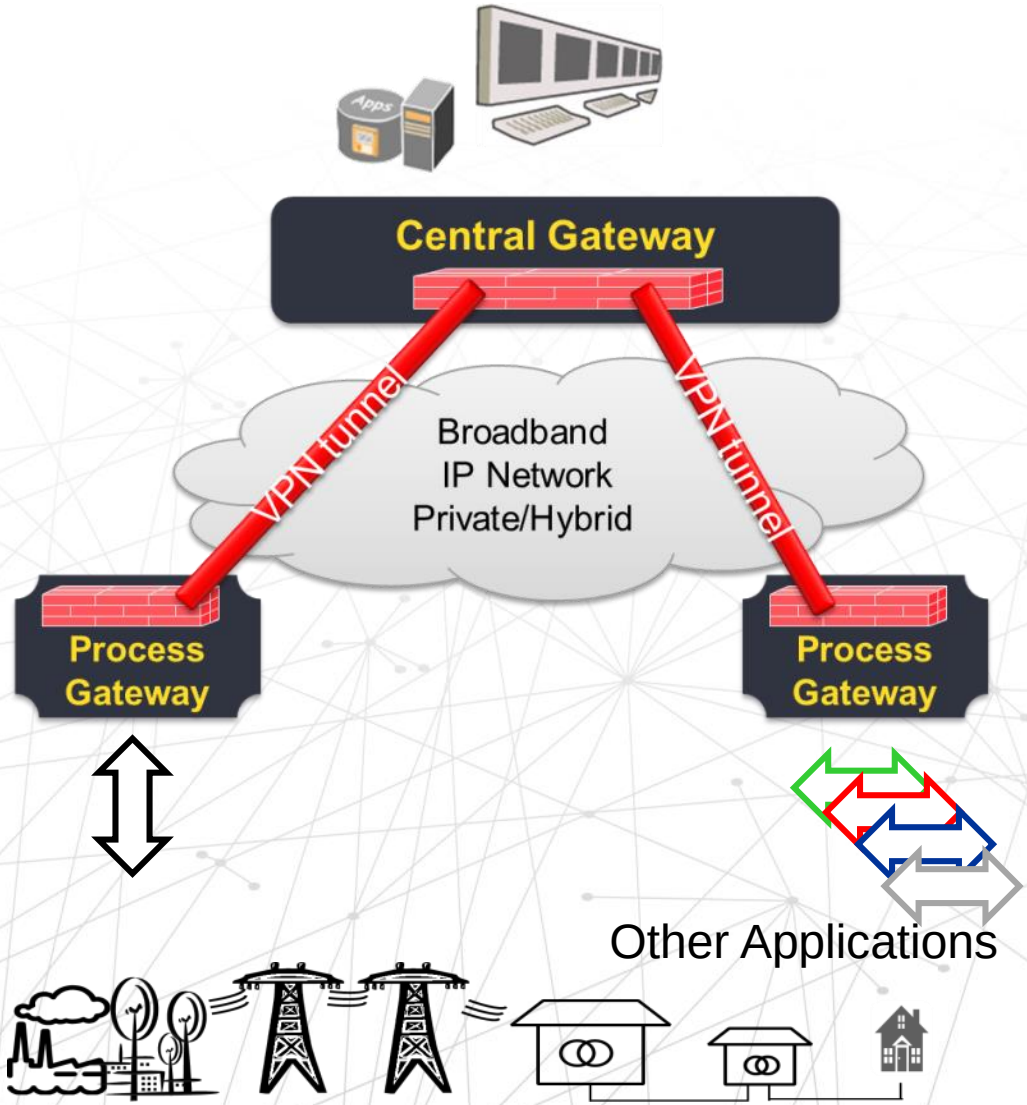
Built-in cyber security

- VPN (Virtual Private Networks)
- Firewalls
- Authentication

Gateway Products

- Robust Linux OS

Multi Service Capability



Application priority classes (COS)

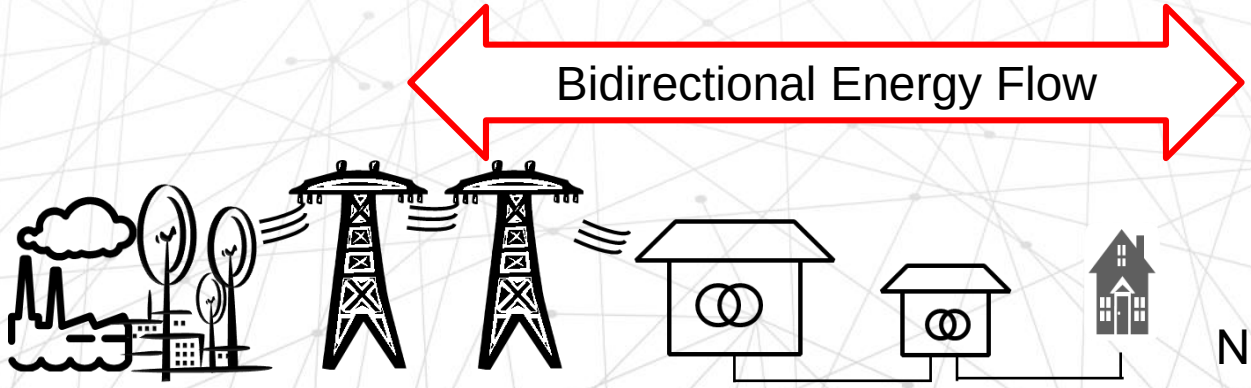
Live example

Class-of-service (COS)	Application
1. Critical	Routing NTP (time service) Network management
2. High	**SCADA** telecontrol Voice network
3. Average	Radio network mgmt. Protection relay tools
4. Normal	Surveillance camera Property Access control Electricity quality

A change is under way…

Introduction of Distributed Energy Resources (DER), “The Grid 2.0”

- A profound change to the 100+ year old grid
- Highly variable loads and distributed generation
- “Procumers”
  - “Consumers become producers”
  - Who is buying – who is selling?
- Controllability and Manageability??

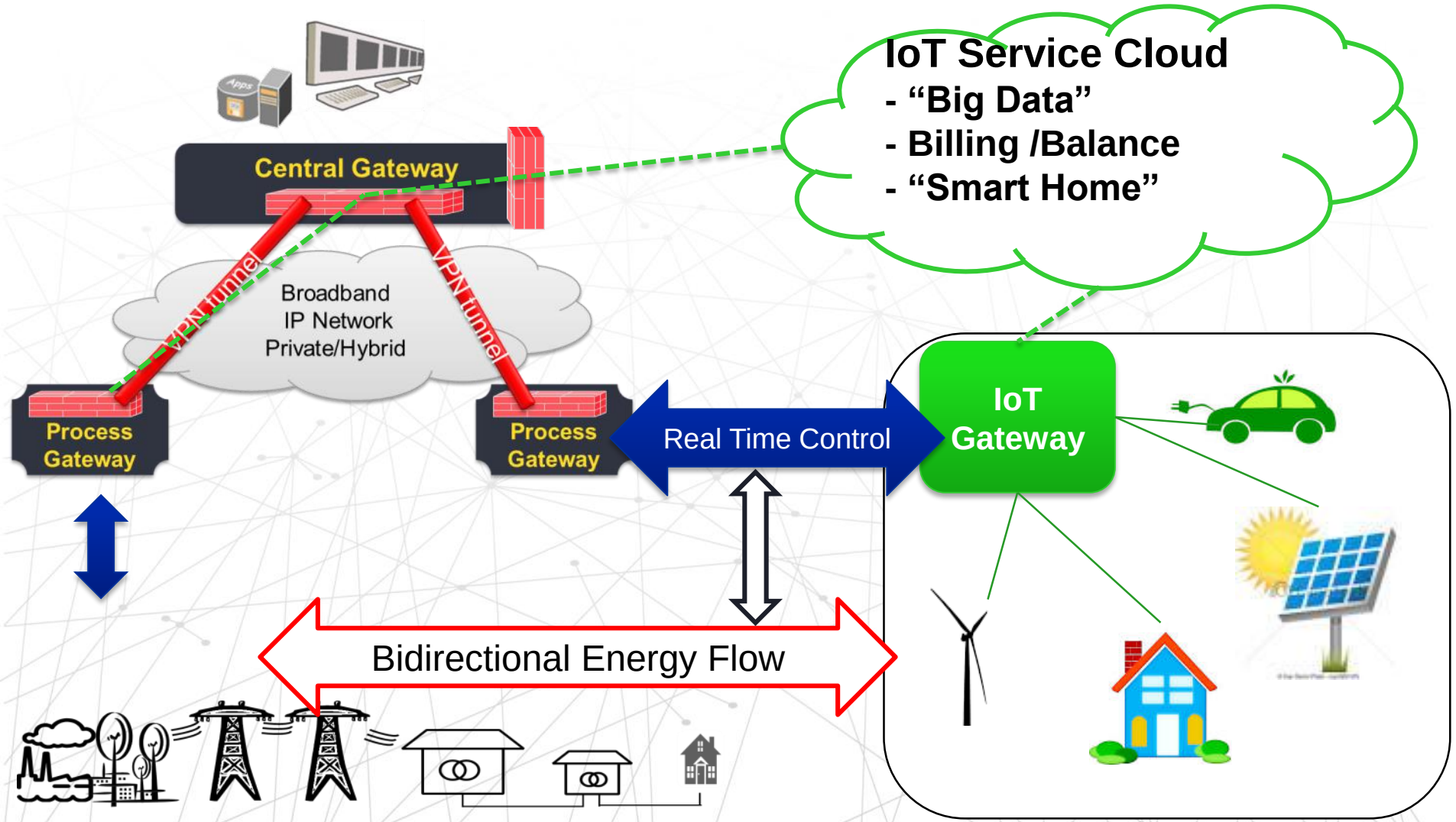


New Consumption/Storages
- Electric Vehicles (EV)
- Other storage

New generation, “Microgrid”
- Wind and Solar Power

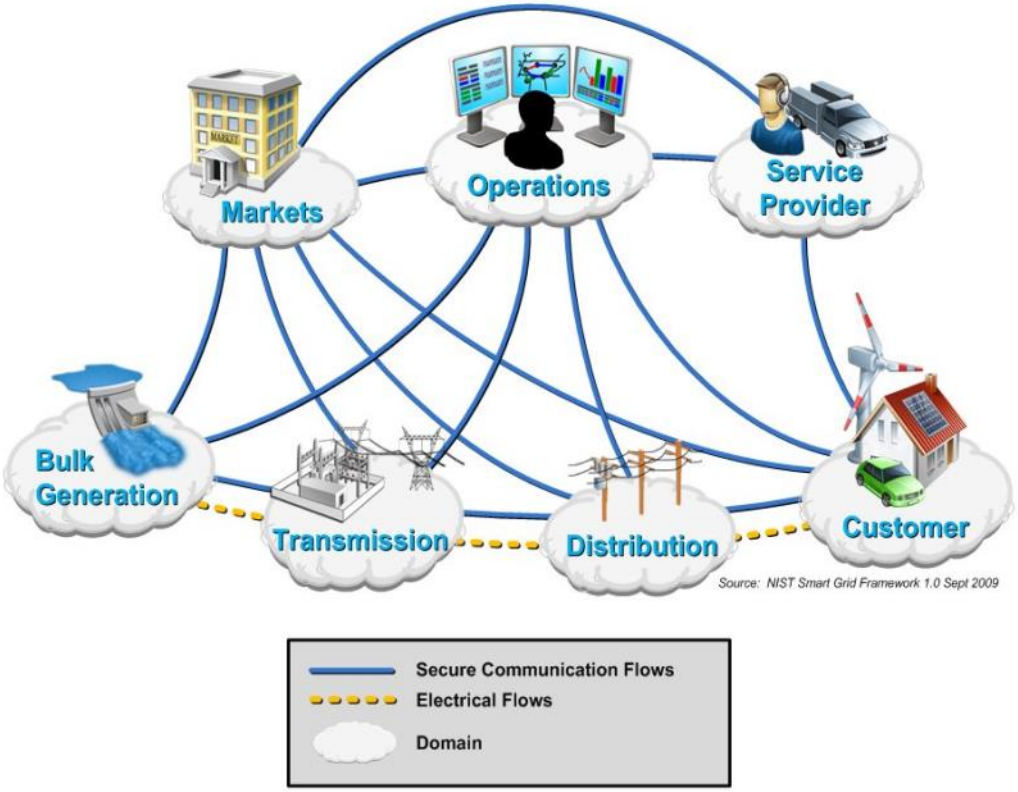
Extended ALL-IP Communications

Real-time applications + **Non real time applications**



Smart Energy Networks are all about communications

NETCONTROL
Energy Network Automation



Mission Critical Real-time Core

Mass Data IoT -Cloud Services

A view by IEEE
More on: smartgrid.ieee.org

The global number of devices being managed by utility companies is projected to grow from 485 million in 2013 to 1.53 billion in 2020.

Source: Ericsson

Future Sustainable Energy…

- A Massive topic
- Covers everything at Aalto Elec

  …and the rest of Aalto too