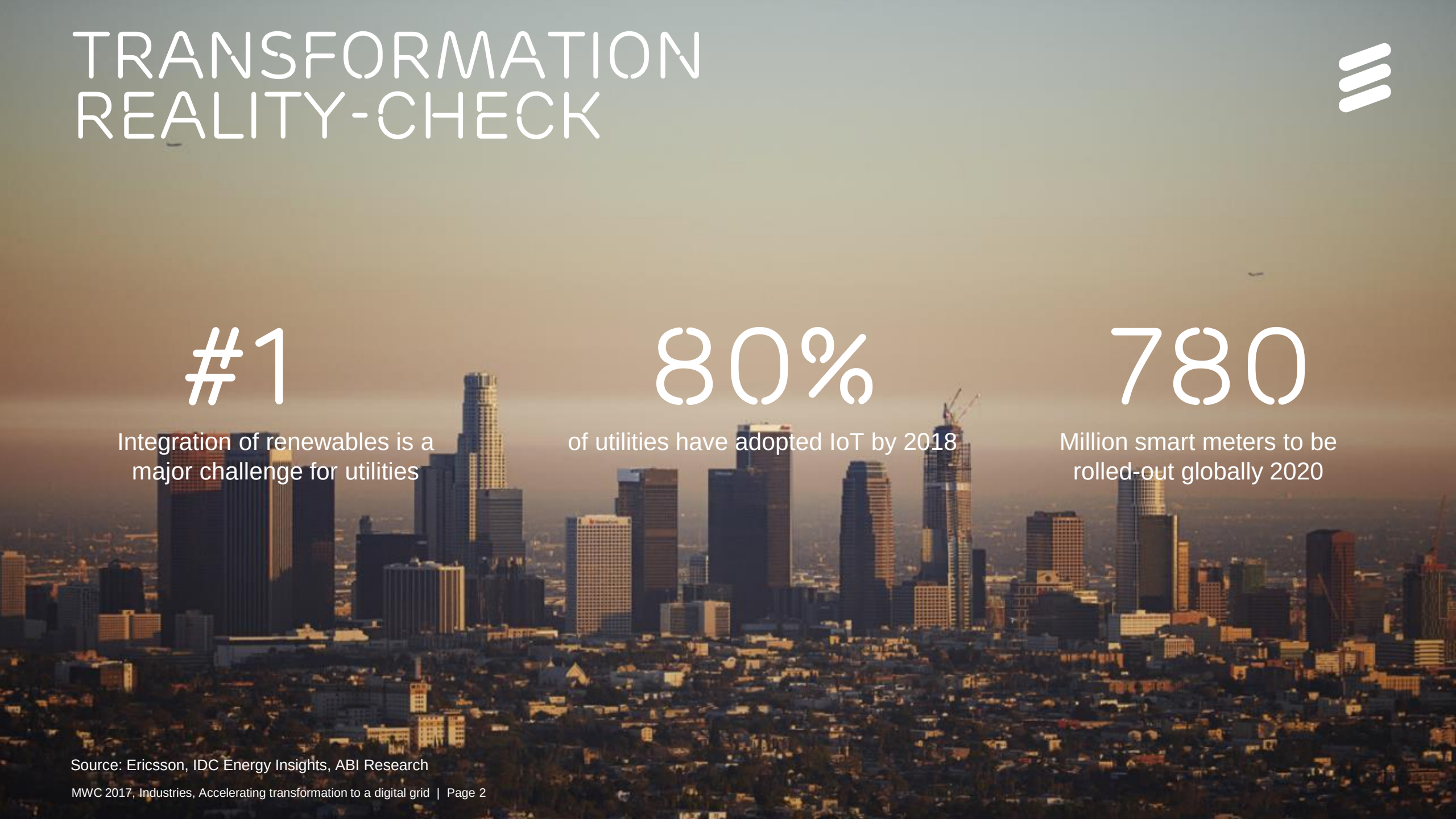
IMPROVED GRID OPERATIONS IN A DIGITAL GRID

Luis Molero Castro
Utilities Business Consultant, Region Mediterranean
Ericsson

APRIL 3RD, 2017

TRANSFORMATION REALITY-CHECK



#1

Integration of renewables is a major challenge for utilities

80%

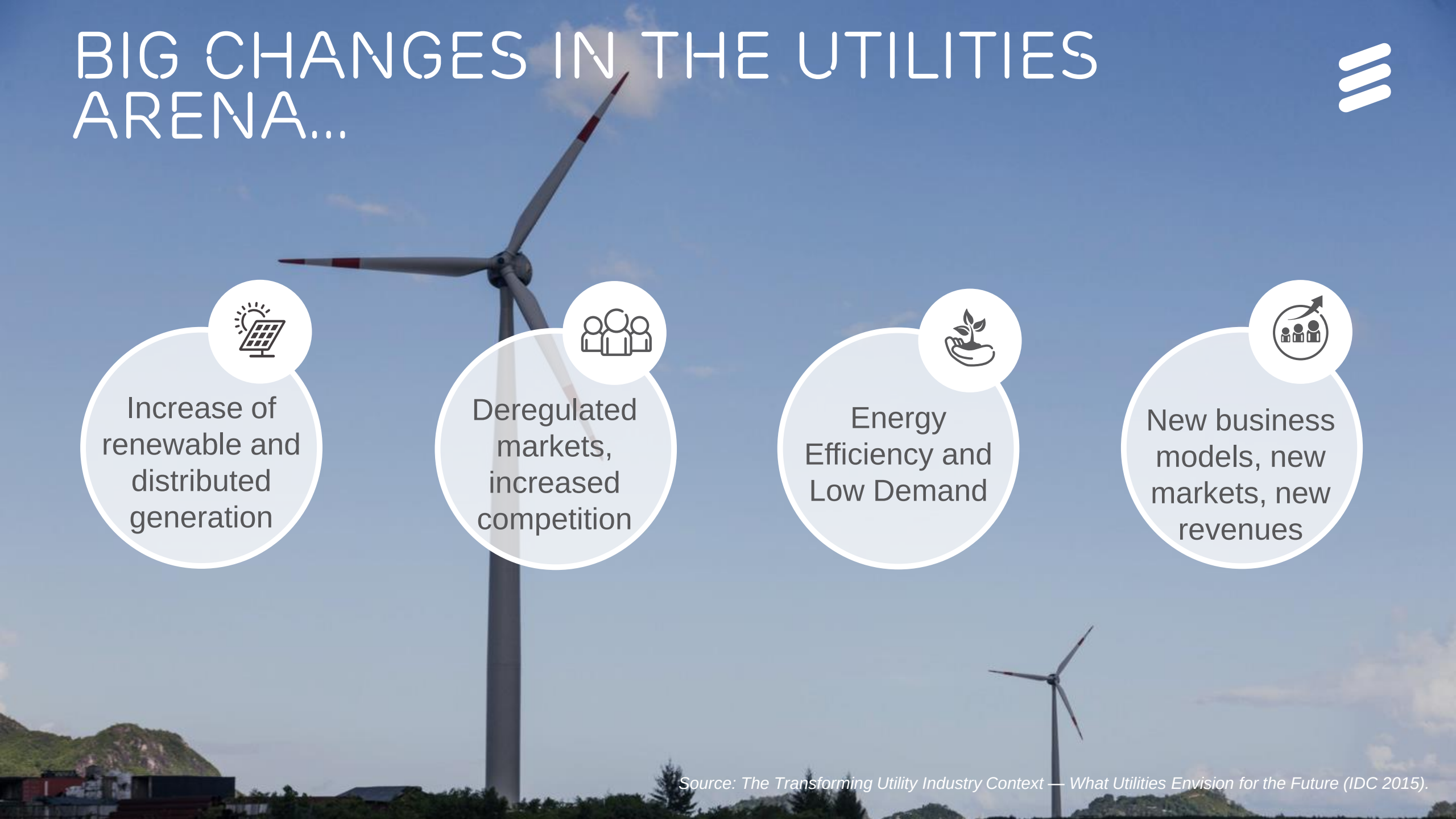
of utilities have adopted IoT by 2018

780

Million smart meters to be rolled-out globally 2020

Source: Ericsson, IDC Energy Insights, ABI Research

BIG CHANGES IN THE UTILITIES ARENA...



- Increase of renewable and distributed generation
- Deregulated markets, increased competition
- Energy Efficiency and Low Demand
- New business models, new markets, new revenues

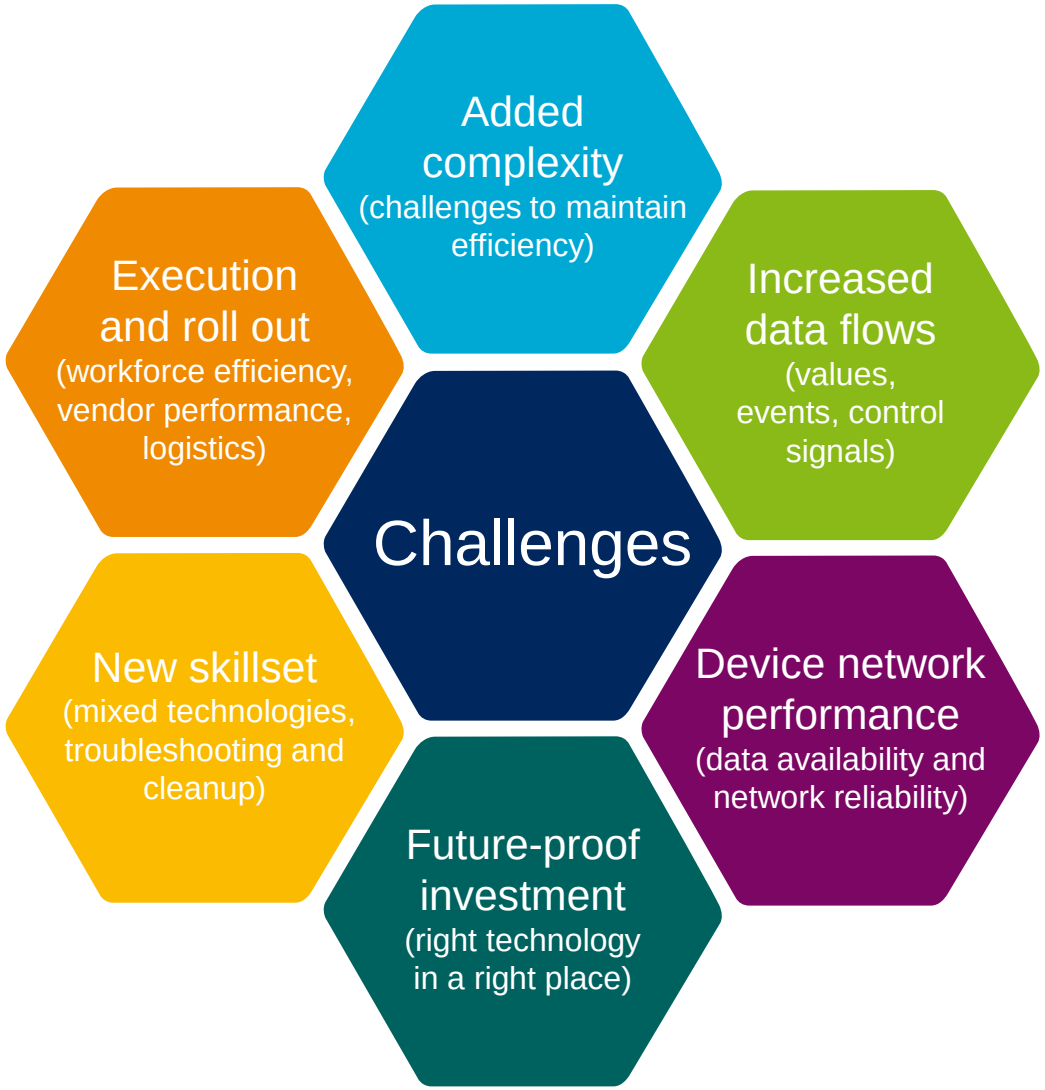
Source: The Transforming Utility Industry Context — What Utilities Envision for the Future (IDC 2015).

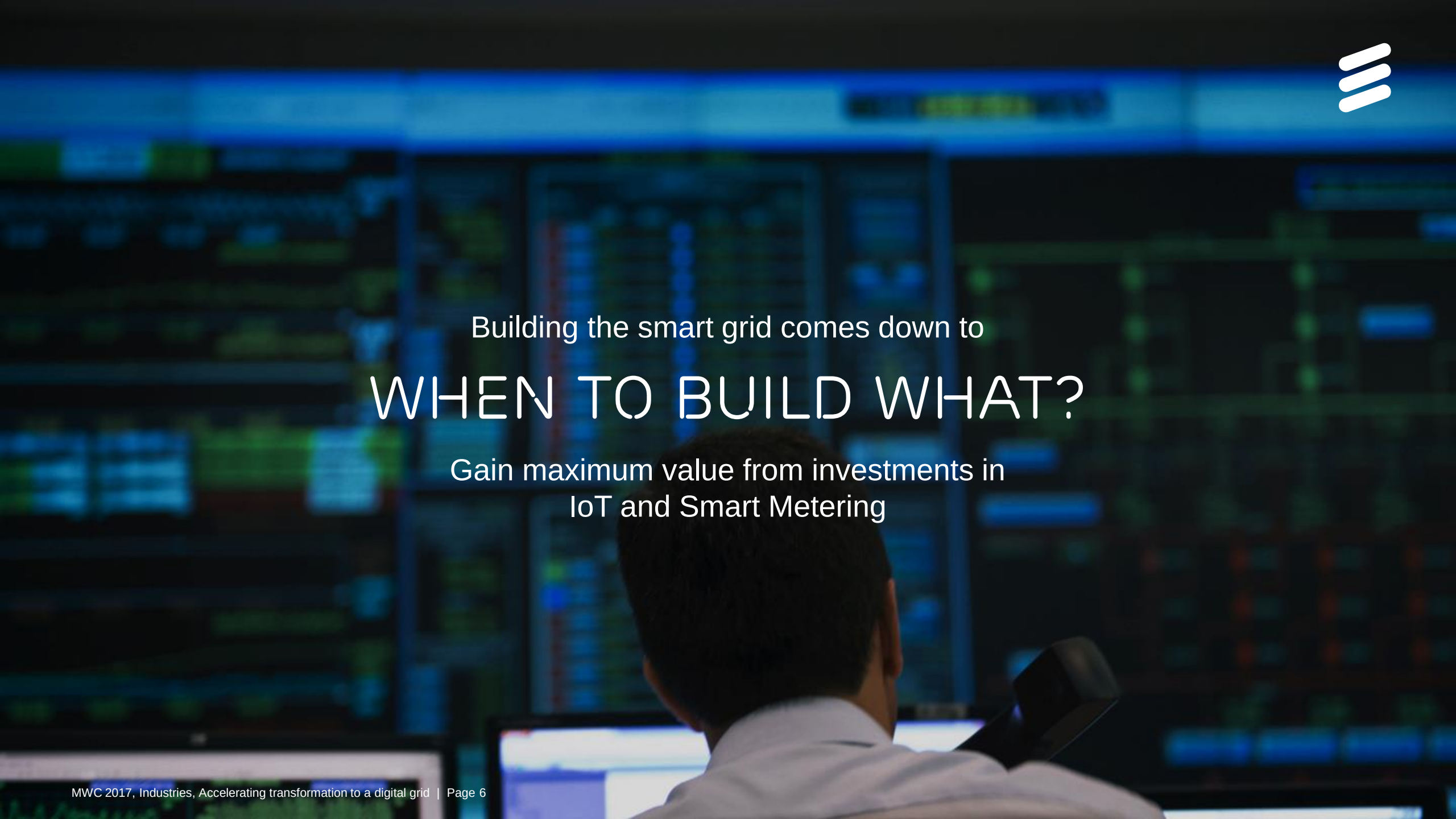
...ARE TRANSFORMING THE INDUSTRY...

1. Customers – participating and active
2. Assets – connected and intelligent
3. Data – turned into value-add information
4. Capabilities – on-demand
5. Secure – resilient and trusted

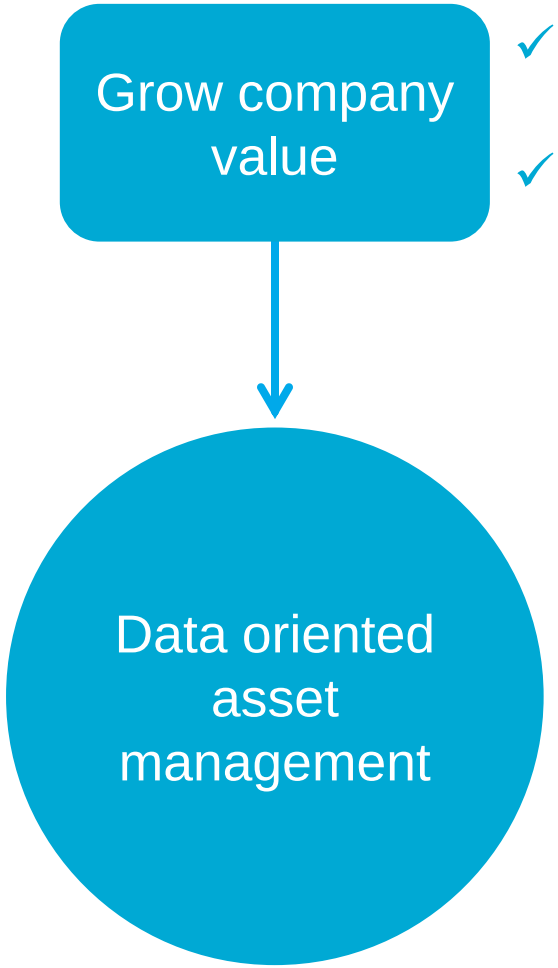
MANAGING METER NETWORKS

FROM TECHNOLOGY THROUGH TO SKILLSETS TO EXECUTION AND ROLLOUT



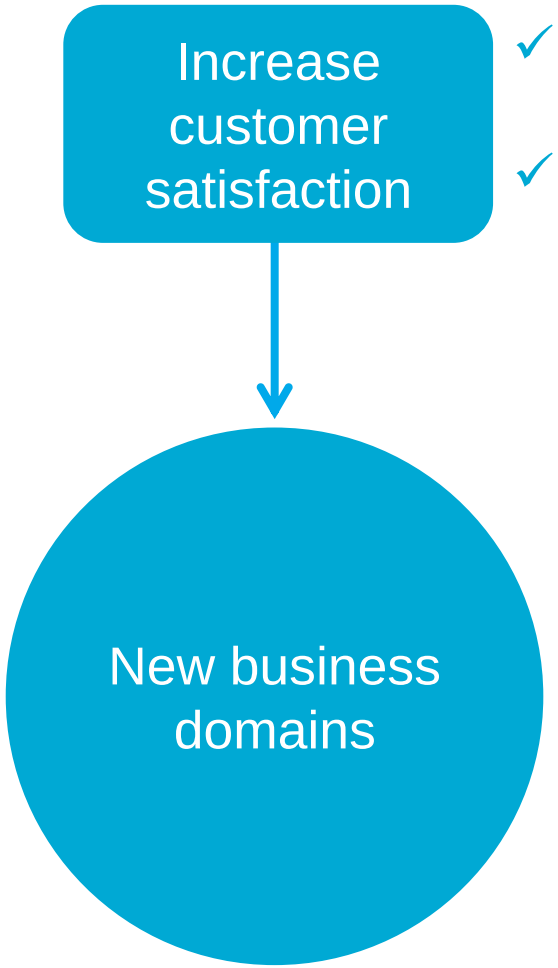

Building the smart grid comes down to
WHEN TO BUILD WHAT?
Gain maximum value from investments in
IoT and Smart Metering

TWO TRACKS IN EXTRACTING VALUE FROM DATA



- ✓ Maintain existing asset efficiency
- ✓ Effective distribution services

› Improving existing business efficiency by implementing new data capabilities



- ✓ Cultivate new revenue streams
- ✓ Grow new busines

› Electric Mobility
› Demand Side Management
› Production Management

Source: Ericsson, Elektrilevi, GridMind

ENERGIZING ESTONIA
ELEKTRILEVI, ESTONIA

As an EU member, Estonia had committed itself to improving energy efficiency by 20% to 2020. The nationally owned electricity distributor Elektrilevi will play a key part in achieving the ambitious goal.

Ericsson helped Elektrilevi put together a roll-out of smart meters across the country between 2012 and 2017. Completing the set-up of supporting systems in record time, Ericsson has rolled out 625 000 smart meters in total.

Networks IT Media Industries

“As everyone in the industry knows, meters ‘talk’ a lot. Therefore, the challenge is to convert this huge data flow into useful and trustworthy information which can be put to proper operational use.”

Mait Rahi, Program manager

“Using technology components that “just work”, in an flexible project framework will deliver results much faster and in a cost effective manner than current traditional approaches

Maintaining momentum and ultimately getting the most out of data will require parallel work in thinking of the organizational structure and processes – this will have a positive impact beyond just a single project”

Kaspar Kaarlep, Head of Digital Network Technology, Elektrilevi

ELEKTRILEVI
LARGEST NETWORK OPERATOR IN ESTONIA

- 90% of the marketshare
- Part of the Eesti Energia Group
- State-owned international energy company
- Operates in the Baltic countries and Poland, also in the international liquid fuels market
- Unique experience and technology in relation to processing oil share and energy production

ASSET BASE

Measurement points	676 190
Primary substations	271
MV/LV substations	24 009
Secondary (switching) substations	219
35 (110) kV transformers	194
6-35kV lines	29 786
0,4kV lines	36 175
Total of lines	65 961

FINANCE 2015

Sales mln €	249,2
EBITDA mln €	106,8
Investments mln €	93,3
ROIC %	8,80 %
Sales GWh	6 521
Network losses GWh	326
Network losses %	4,8 %

Eesti Energia

ENERGIZING ESTONIA (1/2)

[Elektrilevi, Estonia]

THE CHALLENGE

- Replacement of 625k meters in 4y period to meet regulatory targets
- Turn-key project including technology and rollout planning, mass rollout, expiry rollout and maintenance of meter network until the end of the project.
- IT support infrastructure deployment

TURN-KEY ROLLOUT

THE SOLUTION

- Ericsson as prime contractor responsible for project execution and rollout management, end-customer communication (on-site and call center), responsibility for all integrations and IT developments, SLA level and Meter warranty
- Subcontractors for AMI, installation and logistics

EFFICIENT MANAGEMENT

THE RESULT

- On time and right scope delivery
- Homogenous modern metering asset base
- Above target reduction of losses
- Meter network operational costs reduction
- Metering data for power grid operations optimization and investmet planning

EXCEEDING TARGETS

ENERGIZING ESTONIA (2/2)

[Elektrilevi, Estonia]

THE DRIVER

- Electricity market is opened for all customers since Jan 2013
- Estonia's legislation in accordance with 2020 goal: all electricity meters replaced with smart meters by Jan 2017
- Last meter was installed on 7th of Nov 2016.

REGULATION AS KEY DRIVER

PROJECT SCOPE

- Prime Contractor for turn-key Project execution (625.000 MP's)
- Rollout Management
  - Priority setting and follow-up on installation progress
  - End-customer communication (on-site and call center)
- Integration of AMR system into Elektrilevi IT landscape

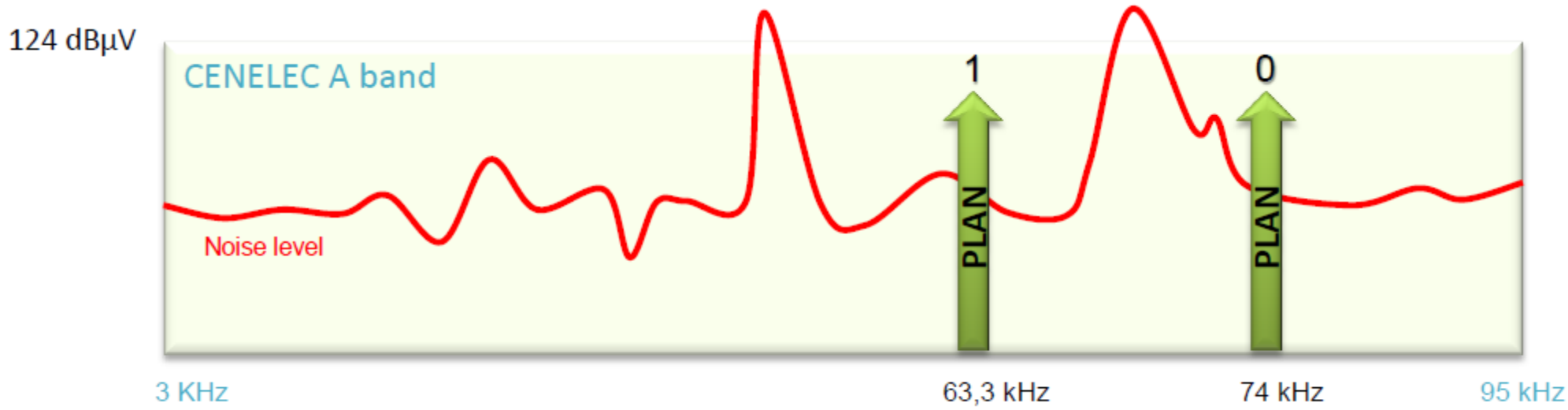
TURN-KEY PROJECT

TECHNOLOGY

- Communications Technology
  - Protocol based on DLMS/COSEM
  - PLC Communication: PLAN+, SFSK
  - Wireless communication: GPRS/UMTS
- Technology highlights
  - Interoperability and security (IDIS HLS)
  - Push messages from Meters to System
- 10.500 PLC Concentrators (44%)

TESTED TECHNOLOGY

TODAY PLAN(+) PLC
TECHNOLOGY OVERVIEW

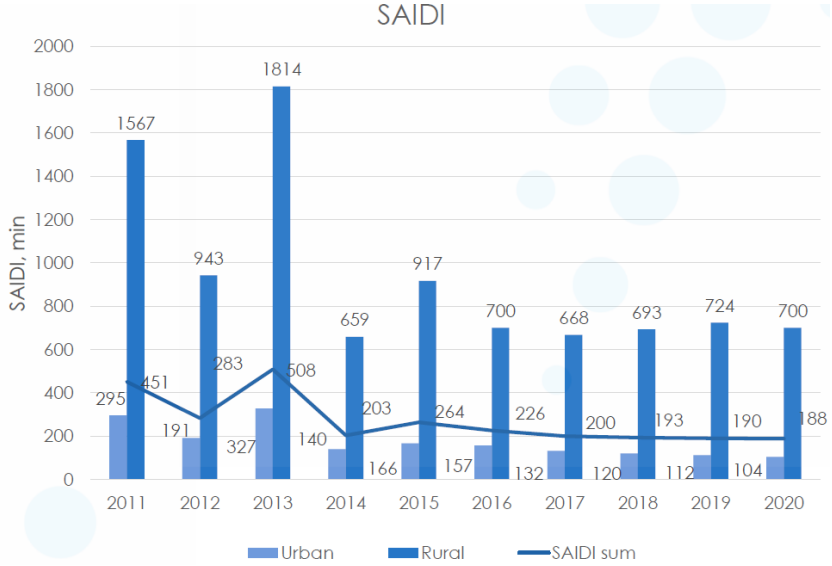


- PLAN(+) S-FSK (Spread Frequency Shift Keying)
  - 1 carrier using 2 frequencies at 63,3 kHz and 74 kHz for robustness
  - Baud rate: PLAN 1200 b/s and PLAN+ 2400 b/s
  - Signal Levels within the limits of Cenelec A Band, EN50065-1

GRID OPERATIONS
CURRENT SYSTEMS WITH HIGH MAINTENANCE COSTS

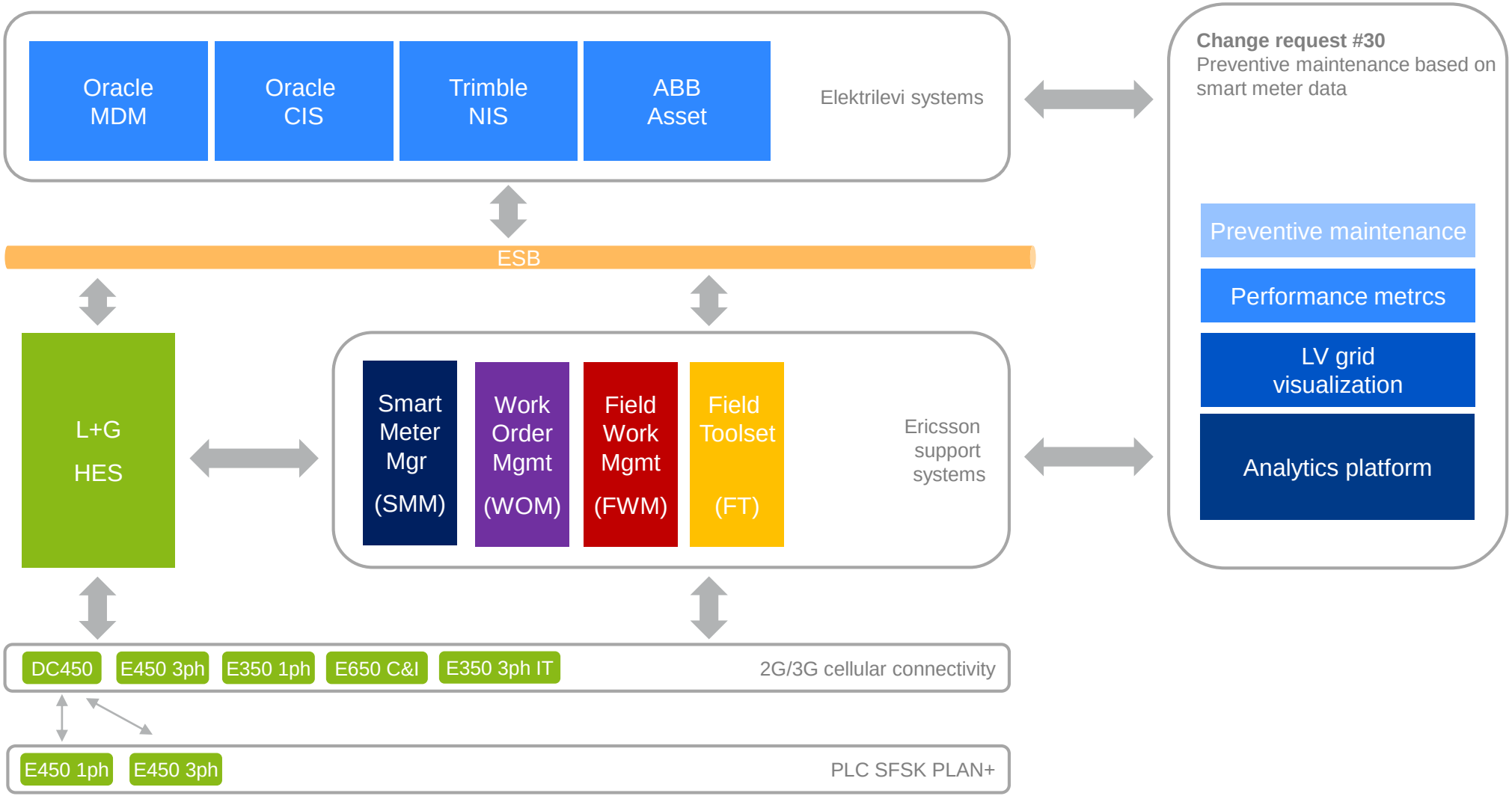
- Fault Location System
  - Locating multi-phase short circuit faults in the distribution network. Most useful for faults on remote lines
  - Measurements sent by an IED are collected by a SCADA system and transferred to a DMS system which then automatically displays the location of the short-circuit fault on the screen of the operator
- RNA (Reliability based Network Analysis)
  - Module of Trimble NIS
  - Network Reliability modelling and analysis on the basis of its elements, condition, environment and topology
  - Location of critical parts of the nework
  - Evaluation and comparison of planned network models in accordance to reliability parameters

- Main grid operation processes:
  - Grid monitoring
  - Fault location
  - Grid state restoration
- Main challenges:
  - Extreme weather
  - Legacy overhead lines
  - Lots of forests and trees

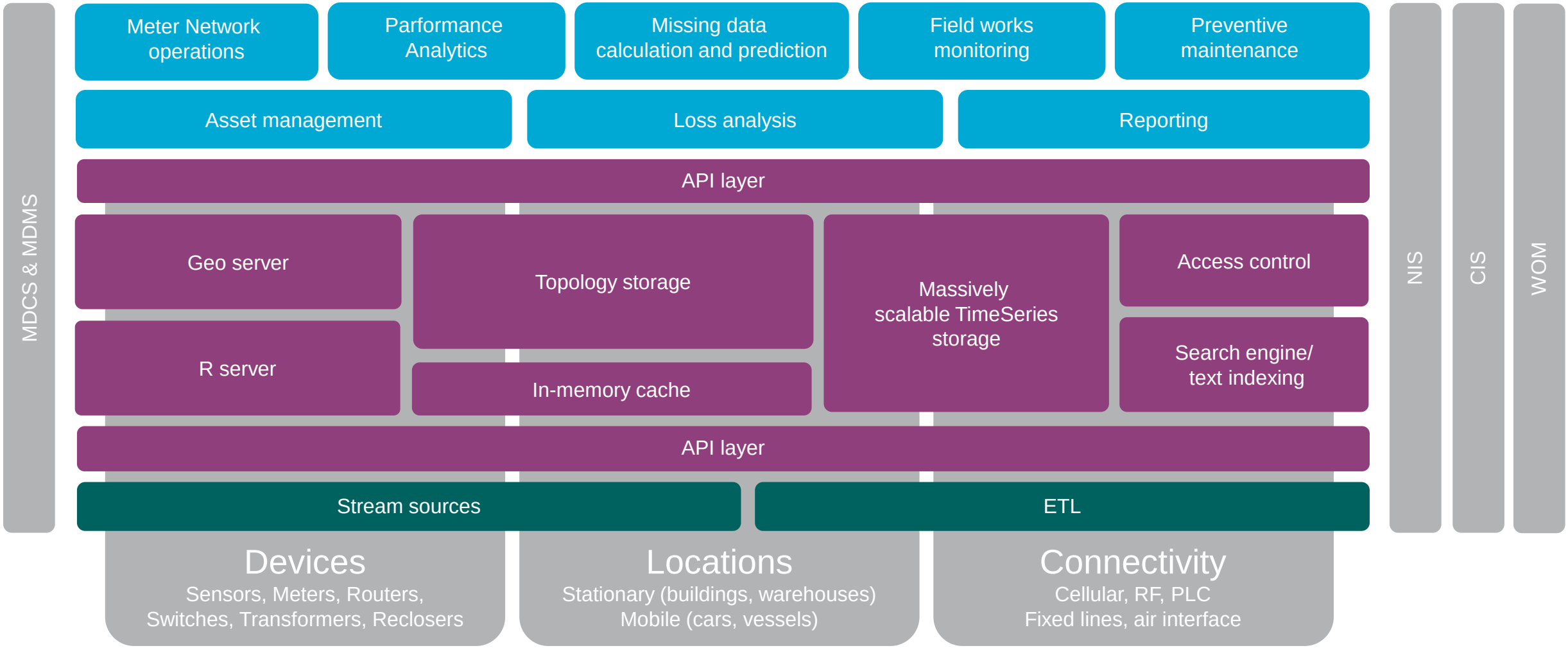


IT SUPPORT SOLUTION

ELEKTRILEVI SMART METER PROGRAM



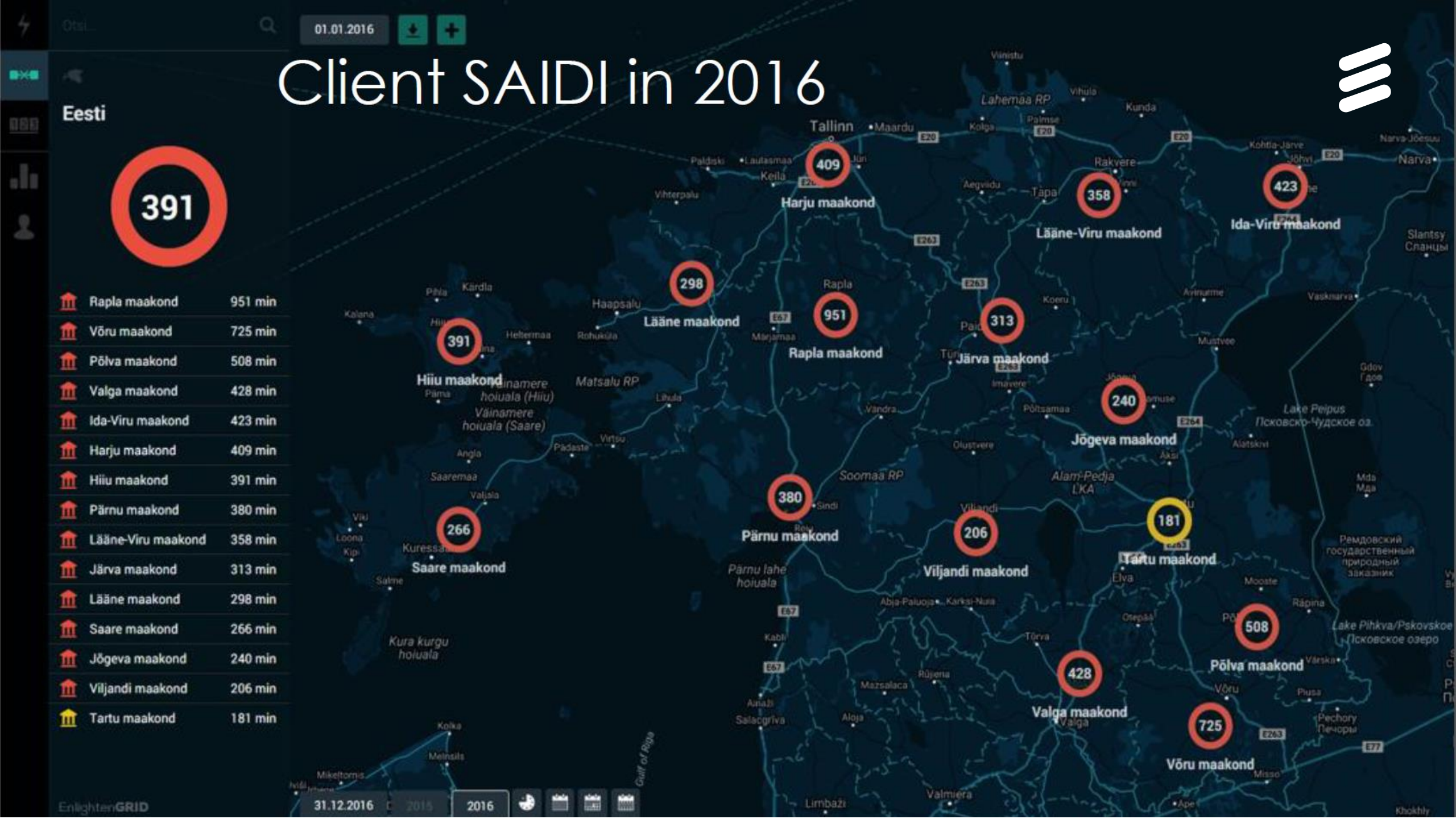
GRID OPERATIONS OPTIMIZATION
SMART METER MANAGER ARCHITECTURE



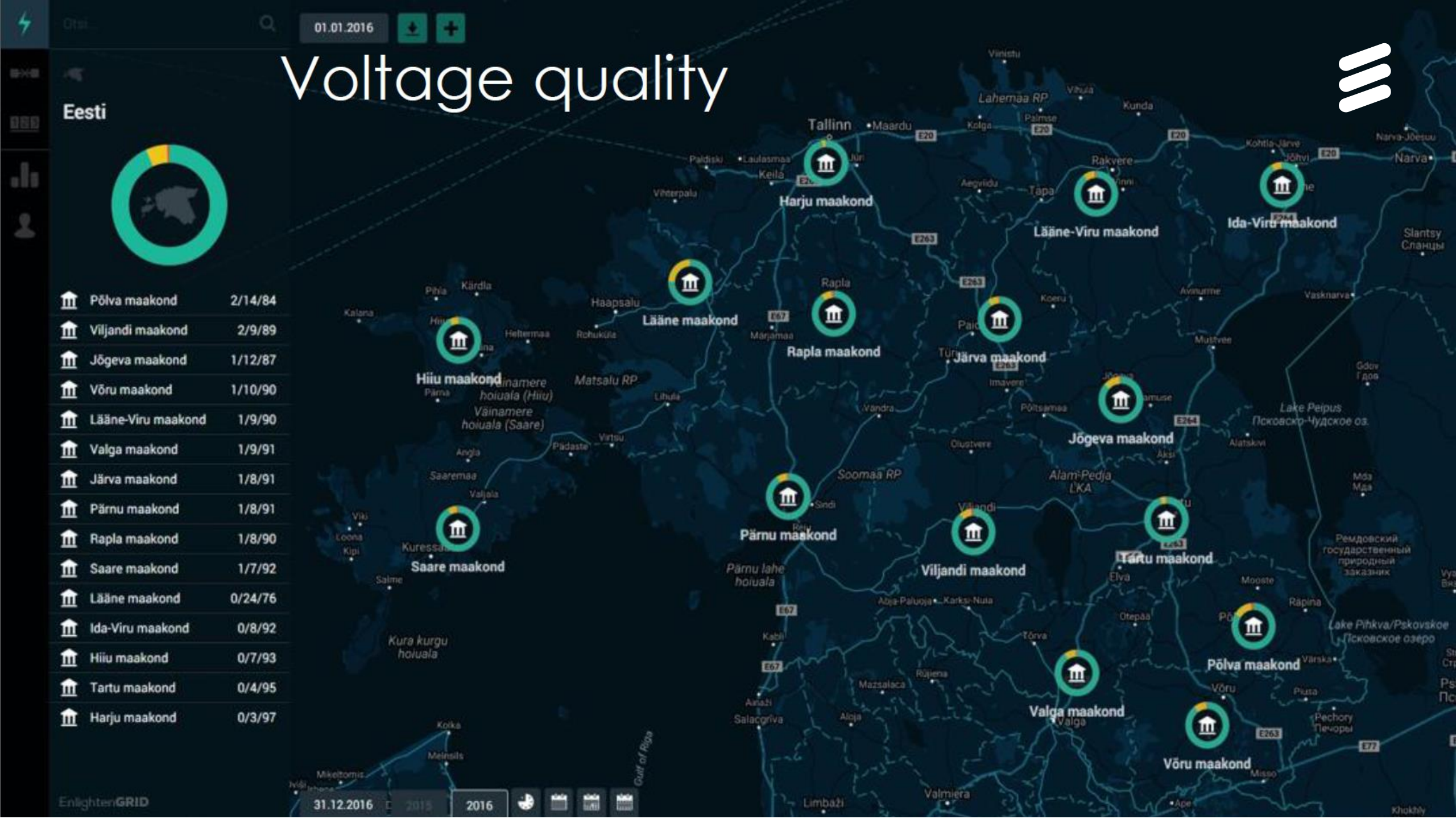
KEY BENEFITS

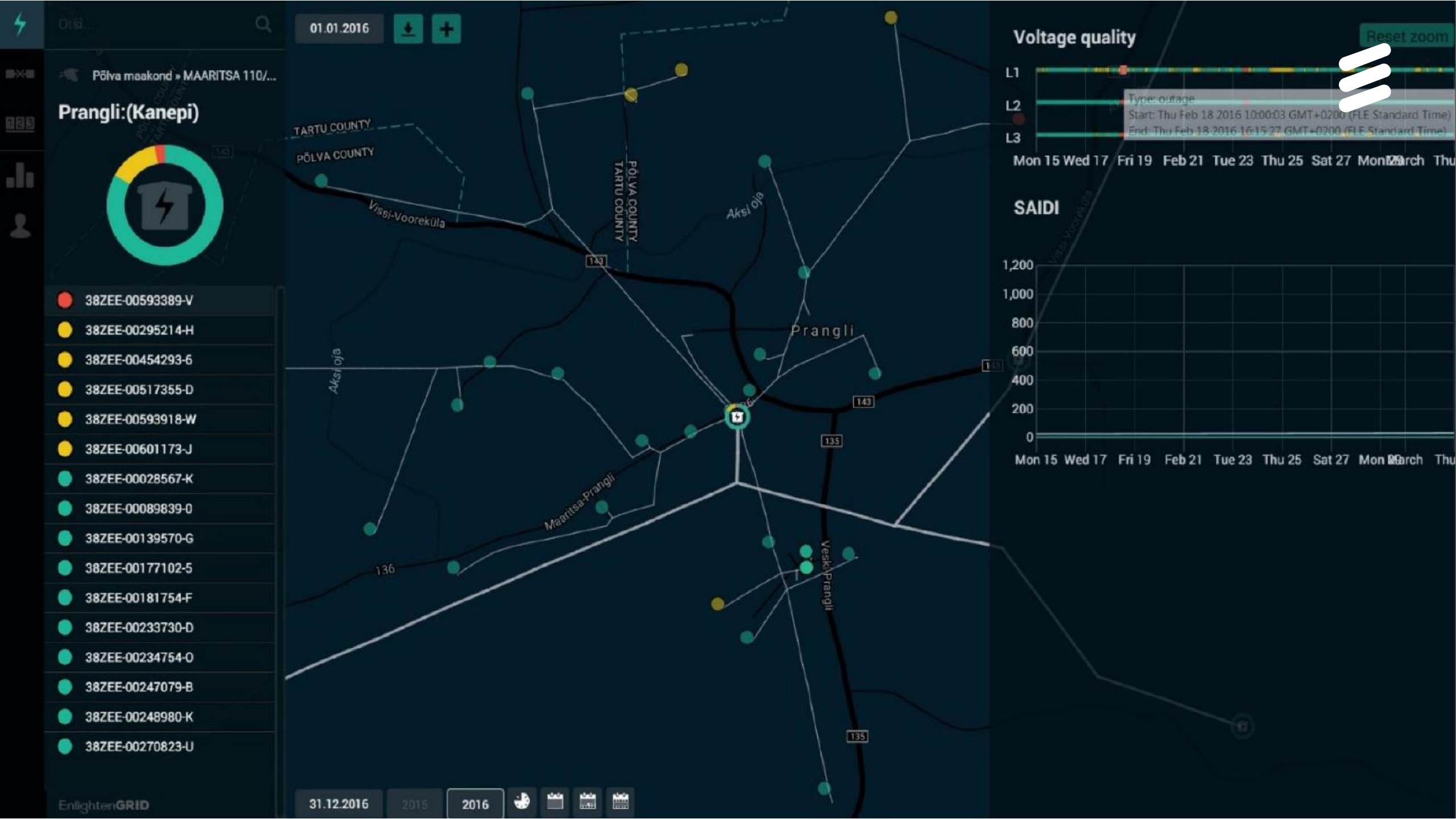
- Always know the state, configuration and location of field assets
- Strictly controlled performance of the network
- Efficient network troubleshooting
- Back office automation through maths and machine learning
- Modern architecture and massive scalability
- Open and meter vendor agnostic

Client SAIDI in 2016



Voltage quality




Otsi...
Põlva maakond » MAARITSA 110/...
Prangli:(Kanepi)
38ZEE-00593389-V
38ZEE-00295214-H
38ZEE-00454293-6
38ZEE-00517355-D
38ZEE-00593918-W
38ZEE-00601173-J
38ZEE-00028567-K
38ZEE-00089839-0
38ZEE-00139570-G
38ZEE-00177102-5
38ZEE-00181754-F
38ZEE-00233730-D
38ZEE-00234754-O
38ZEE-00247079-B
38ZEE-00248980-K
38ZEE-00270823-U
EnlightenGRID
01.01.2016
TARTU COUNTY
PÕLVA COUNTY
Vissi-Vooreküla
Aksi oja
Prangli
Maaritsa-Prangli
Veski-Prangli
136
143
135
31.12.2016
2015
2016
Voltage quality
Reset zoom
L1
L2
L3
Type: outage
Start: Thu Feb 18 2016 10:00:03 GMT+0200 (FLE Standard Time)
End: Thu Feb 18 2016 16:15:27 GMT+0200 (FLE Standard Time)
Mon 15 Wed 17 Fri 19 Feb 21 Tue 23 Thu 25 Sat 27 Mon
Thu
SAIDI
1,200
1,000
800
600
400
200
0
Mon 15 Wed 17 Fri 19 Feb 21 Tue 23 Thu 25 Sat 27 Mon
Thu

MAIN BENEFITS

- **Quality assurance for newly built substations**
  - Preventable faults and quality issues
- **Planned outages instead of unplanned outages**
  - 4x shorter outages for same fault
- **Proactive approach in preventing power quality penalties**
  - Reduction in compensation claims and quality penalties
- **Investment based on actual detected problems**
  - Estimated 5,1M€ could be saved annually
- **Accurate SAIDI data for solving customer calls**
  - Known SAIDI: 218,7 min
  - Actual SAIDI from smart meters: 391 min

PLC PRIME MANAGEMENT SYSTEM

[IBERDROLA, SPAIN]

ERICSSON, a global leader in communications technologies, is implementing a Network Management System for IBERDROLA's PLC PRIME communications network, combining the ERICSSON know-how in communications networks and OSS, with the IBERDROLA expertise in electricity business.
This platform will help extend the benefits of smart metering to any country where the market-proven PRIME standard is the selected low voltage communications technology.

Networks IT Media **Industries**

"Smart Metering is the first step towards smart grids, improving grid visibility and operations, and facilitating consumers to evolve into active participants in the energy market. This collaboration with Ericsson, as a global ICT player, will help us improve our smart metering operations and unleash the business benefits of smart metering."

Miguel Angel Sanchez Fornie, Head of Smart Grids, Iberdrola

PLC PRIME MANAGEMENT SYSTEM

[IBERDROLA, SPAIN]

THE CHALLENGE

- Smart Metering deployment mandate: 100% (11M meters) by end of 2018
- Limited visibility on low voltage PLC (PowerLine Communications) issues
- Scalability of solutions for nationwide deployment

FROM SMART METERING TO SMART GRIDS

THE SOLUTION

- Fully scalable near-real time management system to monitor PLC PRIME networks through data concentrator (base node)
- Alarm generation towards external fault management systems
- Meter and data concentrator firmware upgrade

IMPROVED VISIBILITY ON PLC ISSUES

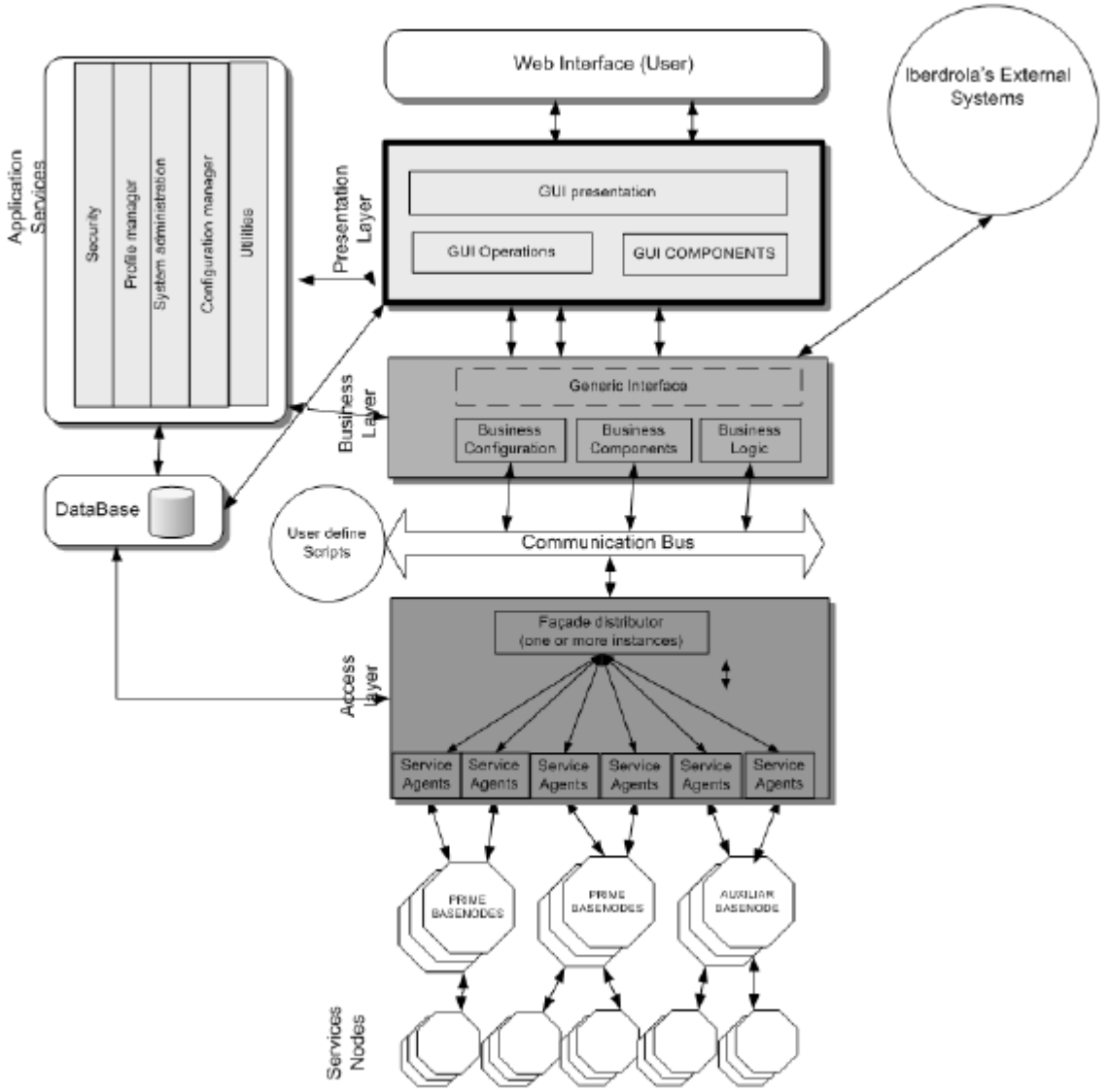
THE RESULT

- Intermittent PLC noise has been detected in some low voltage lines
- Previously undetected meter errors (such as faulty configuration or firmware) have been detected and solved

IMPROVED SMART METERING OPERATIONS

SYSTEM ARCHITECTURE

- PLC PRIME is an open & market proven PLC technology for smart metering (over 12 million PRIME meters deployed in more than 10 countries)
- The proposed system will be used, as part of Iberdrola's NOC, by the communications department
- Using SNMP, the system will access data concentrators in near real time to monitor PLC PRIME networks, extract topology information, trigger alarms, etc.
- Initially connecting up to 200.000 points, its design is scalable enough to manage 11 million service nodes (meters) in the future

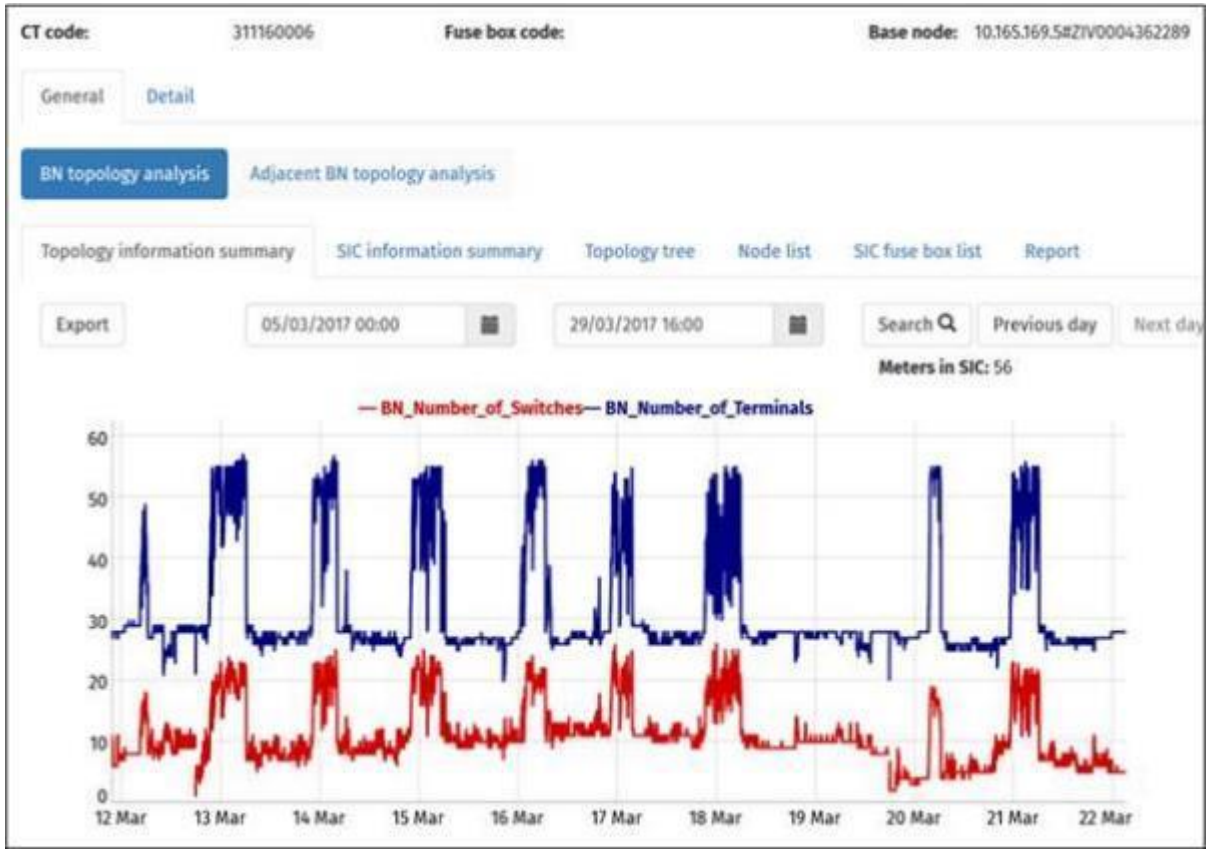


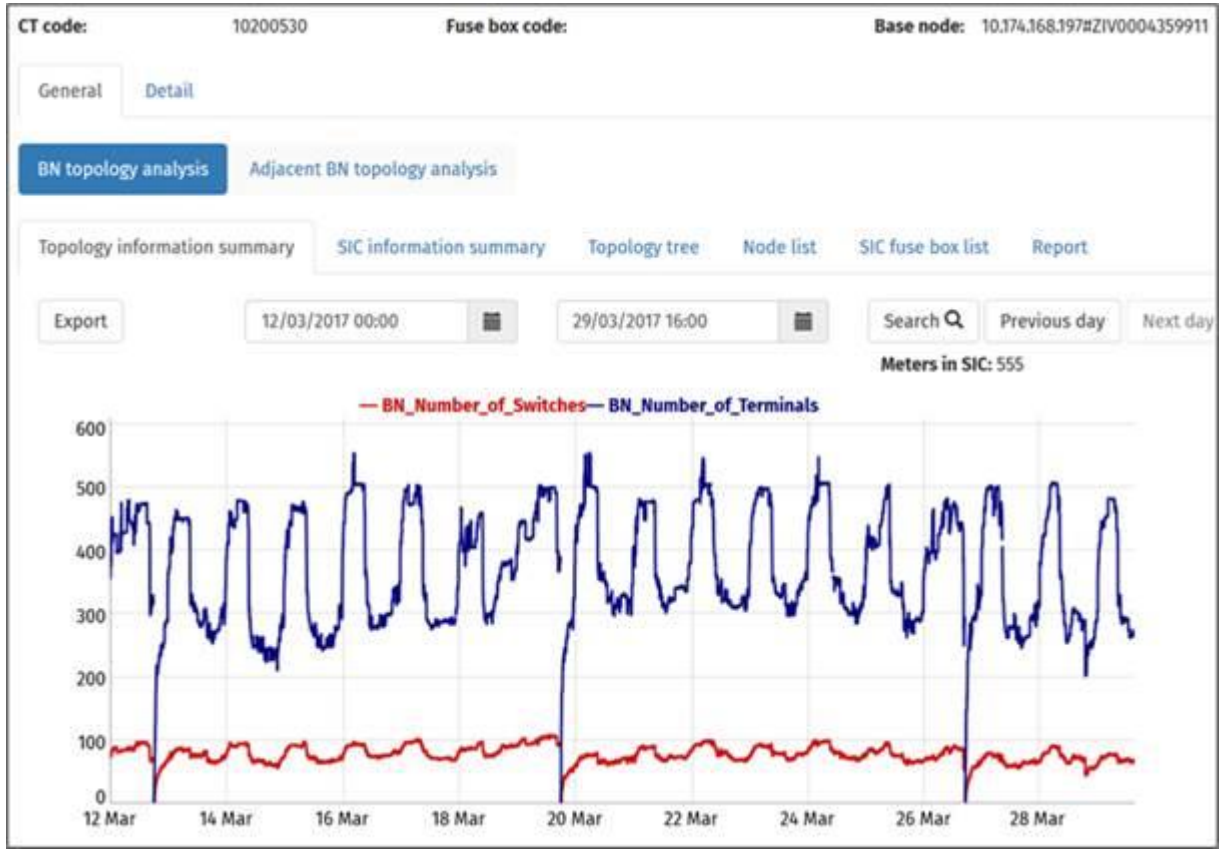
SNMP MANAGEMENT CAPABILITES

- SNMP = Simple Network Management Protocol
  - Communications protocol used for network monitoring and management.
  - SNMP exposes management data in the form of a management information base (MIB) which describe the system status and configuration. These variables can then be remotely queried (and, in some circumstances, manipulated) by managing applications.
- MIB supported by Iberdrola's base nodes normally cover:
  - Instantaneous PLC connectivity values: network uptime, number of active connections, number of terminal/switch nodes, number of switching levels, number of nodes per level, etc.
  - Interval values: topology changes, average availability, etc.
  - Advanced values: topology view with detailed information of all registered nodes (MAC, state, LNID, LSID, availability, coverage, etc.), PLC channel occupation, and MAC values (beacon slots occupation, number of RX/TX control packets, number of RX/TX data packets, etc.)

BUSINESS BENEFITS (1/3)
REAL TIME VISIBILITY TO MONITOR LV NOISE EFFECT

› Near-Real Time (NRT) SNMP visibility allows to monitor PLC status and detect spurious communications issues even if they do not impact readability KPIs





BUSINESS BENEFITS (2/3)
IMPROVED VISIBILITY AT LOWER PROTOCOL LAYERS

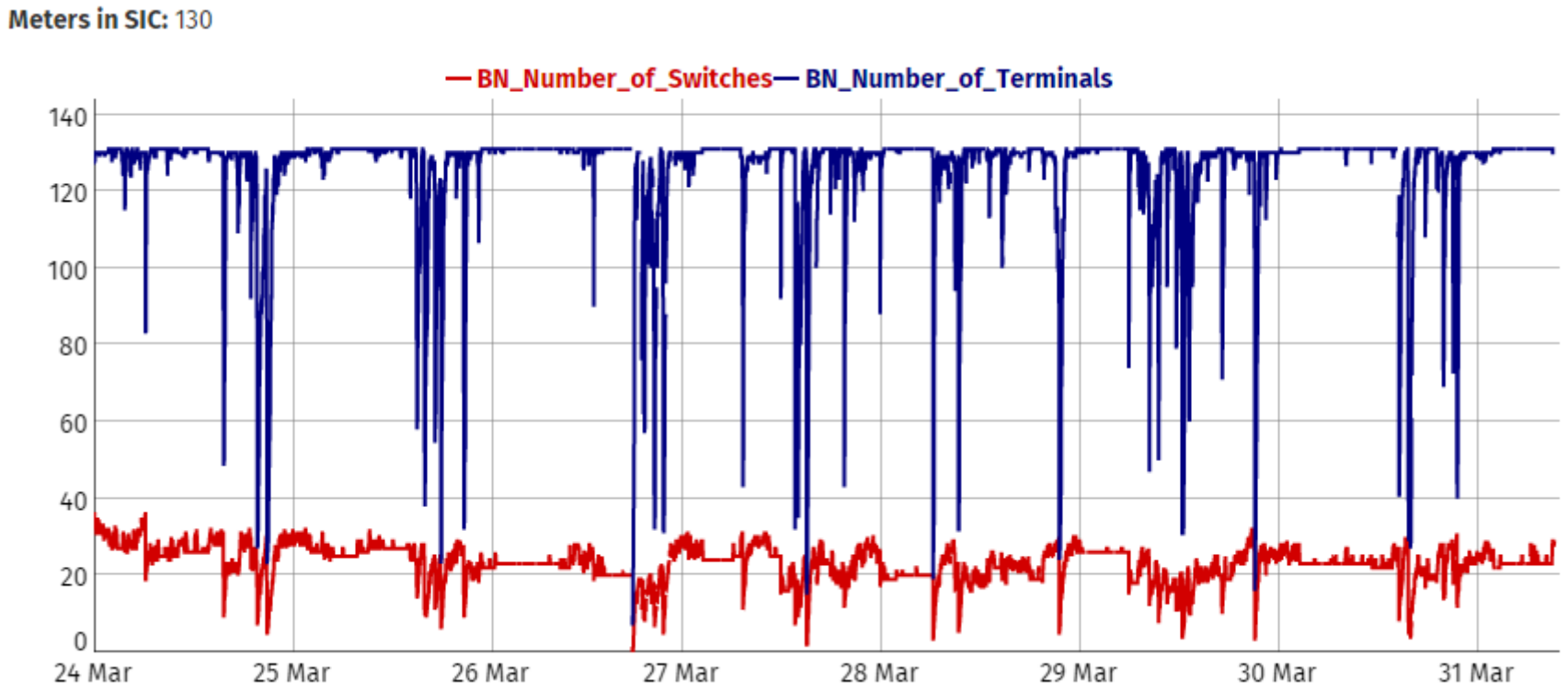
› Detection of registered meters with problems to communicate at DLMS level

Detalle de CT

Fec. Informe	Con incidencia	%Exito Router	%Exito Switch	%Exito RTU	%Exito DC	%Exito N1	Total PS CN CT	% Exito lecturas 505	% Exito curva carga 502	% adecuación CT
30/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
29/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
28/03/2017	130321	--	100%	--	100%	100%	431	90%	90%	100%
27/03/2017	130321	--	100%	--	100%	100%	431	91%	87%	100%
26/03/2017	130321	--	100%	--	100%	100%	431	91%	90%	100%
25/03/2017	130321	--	100%	--	100%	100%	431	91%	90%	100%
24/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
23/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
22/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
21/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
20/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
19/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
18/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
17/03/2017	130321	--	100%	--	100%	100%	431	91%	91%	100%
16/03/2017	130321	--	100%	--	100%	100%	431	91%	90%	100%
15/03/2017	130321	--	100%	--	100%	100%	431	90%	90%	100%

BUSINESS BENEFITS (3/3)
REAL TIME VISIBILITY TO MONITOR DC ISSUES

› Identification of problematic data concentrators, which suffer from frequent resets (due to internal error in some DC models).



E2E SMART METERING SYSTEM

[IEC, ISRAEL]

Israel is starting its smart metering rollout. ERICSSON has been selected by IEC to deploy the “tariff” smart metering pilot for 120.000 customers.

The aim of the trial is to gain information about customer behavior in response to various tariffs, to understand better the potential for demand management and to provide the basis of a cost-benefit-analysis for full roll-out of ~2.7m smart meters.

“This is a great opportunity for Ericsson to contribute to the digitalization of our country’s energy system, helping achieve not only metering benefits, but also important grid operational benefits, contributing to a safer and sustainable energy system, and facilitating active participation of the end customers.”

Ofir Ron, KAM I&S Ericsson Israel

Networks IT Media **Industries**

E2E SMART METERING SYSTEM

[IEC, ISRAEL]

THE CHALLENGE

- IEC is determined to implement a smart metering system as part of their vision to become a smart energy utility
- After a technology pilot, where PRIME and S-FSK was tested, IEC now wants to test customer behavior in response to various tariffs

CBA FOR FULL ROLLOUT

THE SOLUTION

- E2E Smart Metering architecture: MDC/MDM, NOC, MOC, & WFM
- Strong cybersecurity
- All system integration towards IT (CRM, billing, ERP) and OT (OMS, NIS, FMS…) systems
- 120.000 1-ph and 3-ph meters and 1.270 data concentrators

END TO END SOLUTION

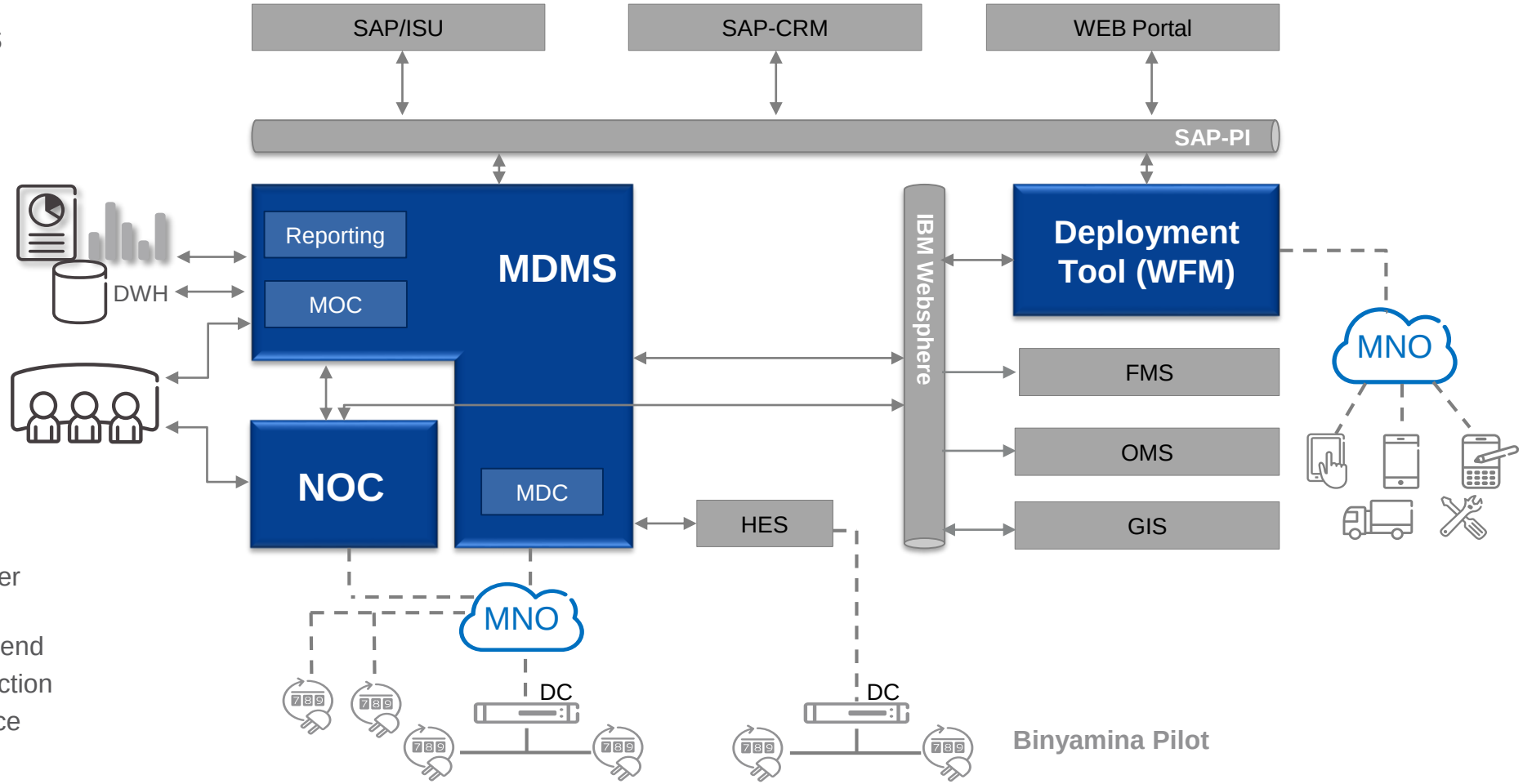
THE RESULT

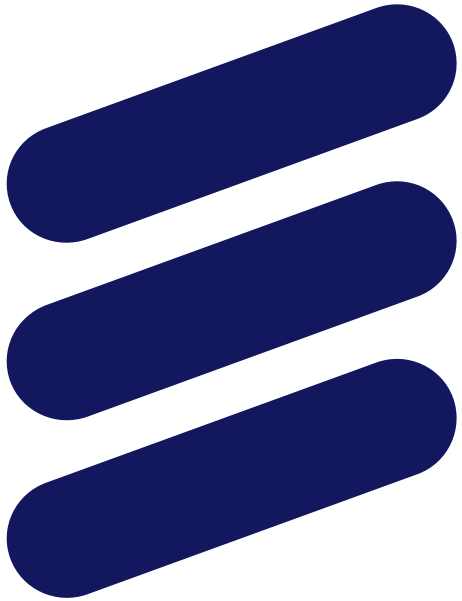
- High level of meter readability (>97%)
- Advanced tariffs, including ToU
- Meter data used to improve fraud and outage management

IMPROVED READING & GRID OPERATIONS

END TO END SOLUTION
IT/OT INTEGRATION

- Improved grid operations
- Filter & forward events towards OMS:
  - Finished / non-finished power failure
  - Finished / non-finished over / under limit voltage
  - Meter neutral loss
  - DC power down events
- Filter & forward events towards FMS:
  - Dc and Meter / terminal cover opened / closed
  - Strong DC detected begin / end
  - Communications fraud detection
  - Current / voltage / impedance detection





ERICSSON