Cyber Security Risk Mitigation: NES Solution
From the innovative minds at Apple and Echelon we built Networked Energy Services with leading minds and technology to usher in a new era of smart energy to make the world a better place.
THE SMART GRID PEOPLE: BORN FROM INNOVATION TO MODERNIZE THE GRID

Networked Energy Services Corporation (NES) is a global smart energy leader in the worldwide transformation of the electricity grid into an energy control network. Over 20 years, hundreds of millions US R&D investment

Utility Administration Services (UAS) is a global NES VAR (Value Added Reseller) and OSGP Alliance Member. The UAS business is positioned to service the 400Volt Power Grid with world class solutions to achieve Grid Modernization in South Africa and Africa. UAS has a passion to reduce non-technical losses and implement micro grid control to improve efficiencies throughout the value chain and create a more competitive business environment that attracts investment into the region to stimulate the economy, accelerate electrification projects and create jobs.
Vision & Mission

VISION

Our vision is to help usher in a new era of grid safety, reliability and efficiency with our 3 tier, proven, open, multi-application platform. To reduce non-technical losses and implement micro grid control to improve efficiencies throughout the value chain and create a more competitive business environment that attracts investment into the region to stimulate the economy, accelerate electrification projects and create jobs.

MISSION

Our mission is to develop, produce, and market the world’s most reliable, economical, and versatile device networking infrastructure technology and products (based on the NES System architecture), enabling our customers to increase operating efficiency, save energy, provide control, improve safety, and provide comfort and convenience.

“We have the honor and responsibility to usher in a new era of energy efficiency and our people are dedicated to delivering innovation to achieve this mission.”

Michael Anderson, President & Chief Executive Officer, NES
• **Networked Energy Services ("NES")** is the former Grid Modernization division of Echelon Corporation.
• Echelon was founded by A.C. “Mike” Markkula, employee #3 at Apple, 2nd Apple CEO and Apple board member.
• NES has more than 25 years of power line communication expertise, 5th generation of world-leading PLC technology.
• USA headquarters
• R&D Centers located in Silicon Valley, Fargo (USA) with a new R&D center to open in the European union
• Regional Offices are located around the world (Americas, Europe, and Middle East)
• Products are Designed in California, Produced in the EU (Poland)
• Partners include Oracle, Mitsubishi Electric, Schneider Electric, Microsoft, Apator, Panasonic, etc.
NES Production: Designed in California, Built in the European Union

- Our world class CEM, Jabil, is one of the largest manufacturing companies in the electronic industry. Our plant is located in Northern Poland.
- Scalable production for millions of smart meter devices per year.
- EU MID and ISO Certified including ISO 9001, ISO 14001, and OHSAS 18001.
- Global markets supported: IEC (and BS) and ANSI.
- Expansion factories planned for the Middle East, Latin America and South Africa.
- Local Manufacturing Plant for Local Content (UAS/NES/HCI).
NES Production:
Locally Produced NES Smart Meters

- The Production Plant is designed and approved and will be established in the S&J Industrial Village, for local and international production.
Why Invest in a Smart Grid?

- Reduce carbon foot-prints
- Improve distribution management and decision support software
- Self-healing network
- Automated control for distribution, manage renewables, distribution challenges
- Sensing and measurement technologies
- Increased efficiency
- Manage peak loads
- Customer engagement

BEFORE SMART GRID
One-way power flow, centralized interactions

AFTER SMART GRID
Two-way power flow, distributed interactions
Key Business and Investment Drivers

MARKET DRIVERS

- Empower consumers to optimize energy usage & costs
- Animate markets by leveraging technology investments
- Provide system-wide efficiency
- Diversify fuel and resources
- Ensure system reliability and resiliency
- Reduce carbon emissions

UTILITY DRIVERS

- Improve outage detection and restoration times
- Provide customers with information they can use
- Successfully integrate customer-sited DER
- Automate customer service transactions
- Improve voltage control and system efficiency
- Reduce carbon emissions
- Reduce non-technical loss
- Manage energy demand as a resource
NES Solution Introduction
NES Solutions
Patagonia Energy Applications Platform™

Patagonia Software

• **System Software** provides overall system control, data collection, and configuration for smart meters.
• **Operations Manager** provides management, analysis, and control for millions of NES smart grid devices.
• **Low Voltage Grid Manager** analytics maps low voltage grid topology for back office and distributed applications.
• **Energy Balancer** analytics identifies transformer utilization improvements and identifies meter mis-wirings.

Patagonia Device Hardware

• **Intelligent devices which sense, measure, & control mission critical distribution grid transactions including smart metering.**
• **Distributed Control Nodes** installed anywhere on low voltage power line, below secondary transformer to manage complex networks and applications.
• **Embedded technologies & APIs** to enable plug and play devices and software to broaden the overall capabilities of the NES system.
The Patagonia Energy Applications Platform™

Platform Leveraging the Latest in Embedded Technologies

Field Area Network

Distributed Control Nodes
- Linux-based
- Correlation of data from devices
- USB connectivity to other devices & networks
- LV Grid Mapping
- Apps for local data processing and delegated control from head-end

Utility DSO

Patagonia Software
- Analytics coordinating across all levels of architecture
- Specific applications for specific operational needs and outcomes
- Multiple communication protocol support (PLC, GPRS)
- Expanded integration and device communications ability
- Multiple protocol support (DLMS, OSGP, ANSI)
- Operational KPI reporting for smart meter operations

Any TCP/IPNetwork

NES Grid Sensors / Smart Meters

Grid Sensors / Smart Meters
- New communication media underneath OSGP
- GPRS/UMTS point-to-point, Wireless Meshing
- BPSK proven, reliable PLC technology
- High speed PLC (G3)
- Secure (AES encryption, key management services)
- Future ready with computing resource head room for new capabilities
- Other protocols transported by OSGP, i.e. DLMS
- STS 1 and STS 2 Vending Options

The Patagonia Security Platform in an integral part of every process of the NES Solution
Patagonia EAP Analytics

- A new approach to analytics applications
- Deployed anywhere and processing data locally with distributed computing
- Low voltage grid connectivity mapping
- Deliver a specific outcome for a specific grid problem
- Improvement of Revenue Collection
- STS 1 or STS 2 Vending
- Street Lighting Control
A real World Threat: High-Skill High-Focus Cyber Attacks

“[...] affected up to 225,000 customers in three different distribution-level service territories [...]”

TLP: White

Analysis of the Cyber Attack on the Ukrainian Power Grid

Defense Use Case

March 18, 2016

“The impacted companies rate these incidents as high or critical to the reliability of their systems and business operations.”
Is **ransomware** profitable? Ask this vendor:

<table>
<thead>
<tr>
<th>Period</th>
<th>6 months (allegedly)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Received</td>
<td>$121M (BTC189,813)</td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td>$94M (BTC148,312)</td>
</tr>
</tbody>
</table>

*Source: McAfee Labs Threats Report, September 2016*

**Why so successful?**

- Weak security
- Availability is critical

*2015: high-impact campaigns against utilities in Scandinavia*
This pitfall is nothing new...

“Too many products are merely "buzzword compliant"; they use secure cryptography, but they are not secure.”
- Bruce Schneier

At NES, we use secure building blocks, such as cryptography, and go to great lengths in making sure our design, implementation and use of them are sound.
European Commission, Expert Group, 2010-2012

“The smart meter is becoming a key node for managing information about the electricity system and final customers. However, Industrial Control Systems, and not the smart meters, draw today the primary cyber security focus.”

At NES, AMIs are considered part of critical infrastructure and we develop our AMI products accordingly.
Who knows AMI technology best?

... the people who developed it...

... and the people who hacked it ...

At NES, we combine our extensive practical experience of AMIs with domain-specific information security expertise. Talk to us!
“For debugging purposes...”

If your technology forces you to turn off its security measures, then you are not using the right technology.

“In case we can’t meet performance requirements (SLAs)”

At NES, performant security is an integral part of our products, it is always on, and cannot – by design – be turned off.
At NES, we go beyond compliance using a risk-based approach to security and use NIST’s Cybersecurity Framework as a tool to do so.
At NES, we invest in strong preventative measures while still providing detection and recovery capabilities enabling timely incident response.
Mitigating Security problems smart solution?

NES Solution provides you with exactly what is required to Mitigate Cyber Attack Risks:

Using Secure Building Blocks, such as cryptography, and go to great lengths in making sure the complete design, implementation are sound.

We combine our extensive practical experience of AMIs with domain-specific information security expertise.

We go beyond compliance using a risk-based approach to security and use NIST’s Cybersecurity Framework as a Tool to do so.

AMIs are considered part of the critical infrastructure and we develop our AMI products accordingly.

Performant security is an integral part of our products, it is always on, and cannot – by design – be turned off.

We invest in strong preventative measures while still providing detection and recovery capabilities enabling timely incident response.

With NES solution your Cyber Attack Risk is Mitigated.
Security is not Optional!

- **ALWAYS ON**
- Strengthens the ability to **prevent**, **detect**, and **respond** to misuse of grid assets and malicious behavior
- Exceeds utility and governmental requirements as well as current **industry state-of-the-art**
- Based on hardware-accelerated AES, and the latest open standards and recommendations
- Enables protected mid-tier grid applications and data pre-processing
- Integrated with the utility’s IT security system
- Efficient, Reliable and Comprehensive protection
- Physical tamper protection
Our comprehensive solution approach is more **cost effective** and a **stronger** security implementation than the **DLMS** security protocol implementation choices system integrators consider. The NES end to end security implementation is consistent and more efficient across all OSGP devices implementing stronger security mechanisms than “piece part” **DLMS** systems while increasing system availability and device commissioning times using **10x less bandwidth**.

<table>
<thead>
<tr>
<th>SECURITY GOALS</th>
<th>NES / OSGP</th>
<th>DLMS Lowest Level</th>
<th>DLMS Low Level</th>
<th>DLMS High Level MD5/SHA1</th>
<th>DLMS High Level SHA256/GMAC/ECDSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confidentiality</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Integrity</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Availability</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Detection</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
</tbody>
</table>
Patagonia Intrusion Detection

Single events from various devices are costly to correlate with IT security event management systems. The NES field area network autonomously identifies suspicious communication between devices, creates a single security alarm for multiple events, and locks down suspicious devices.
We are the Smart Grid Security Experts. The Patagonia Security Platform is an integral part of every process of the NES solution.
Presentations And references
Cybersecurity White Paper, Smart Grid Security Pitfalls and NES Patagonia Security

Cybersecurity White Paper
Cyril W. Broffin, Jr.
Project Advisor, MIT Energy Initiative

MIT ENERGY INITIATIVE UTILITY OF THE FUTURE
15 December 2016

1 This document consolidates and slightly augments the cybersecurity, resilience, and security measures found in the Executive Summary and Chapters 1, 2, 3, 4, and 5 of the MIT Utility of the Future report. The deficiencies and challenges identified in this document provide information not included in the MIT Utility of the Future report.

NES Patagonia Security
Networked Energy Services Corporation (NES)
November 2014

Smart Grid Security Pitfalls
Emil Gurevitch, Networked Energy Services (NES)
Webinar 2016
NES is a member in the Open Smart Grid Protocol (OSGP) Alliance

- The OSGP Alliance is a global non-profit association dedicated to promoting the adoption of the Open Smart Grid Protocol (OSGP) and infrastructure for smart grid applications towards a future proof modern smart grid.
- OSGP is a modern, more efficient, network-centric, smart grid application layer protocol providing most cost effective end to end communication costs.
- Most deployed best performing PLC technology systems operate >99% reliably.
- Most proven protocol used by many utilities in various countries.
- Millions of interoperable devices are up and running reliably for more than 10 years.
- Highest industry AMI protocol security standard deployed with active intrusion detection.
Metering Standards

OSGP Alliance’s OSGP meters are designed to meet the needs of residential and commercial energy consumers. All OSGP meters provide the same, rich set of functions including load profiling, time of day pricing, power quality measurements, display of energy consumption, remote disconnect of electrical services, prepaid metering, and maximum power limiting.


Gen 4 Poly phase meter disconnect is UC 4 Compliant

http://www.etsi.org/
**Application Layer**

For the Applications Layer, OSGP adapts the ANSI C 12 table structure for a networking protocol, not just for meters but for other utility related devices as well. At the application layer, ETSI TS 104 001 provides an efficient table-oriented data storage and command system that provides for not only smart meters and related data but for general-purpose extension to other smart grid devices. Much like SQL databases provide an efficient and flexible query language for enterprise applications, OSGP provides an efficient and flexible query language for smart grid devices. As with SQL, OSGP support reading and writing of single attributes, multiple elements, or even entire tables. This is an important capability of the protocol, which enables it to be very bandwidth efficient. As a modern protocol developed for use in networked smart grid systems rather than one adapted from point-to-point dialup or optical connections, OSGP includes capabilities for an adaptive, directed meshing system. This intelligent meshing system enables any OSGP device to serve as a message repeater, further optimizing bandwidth use by repeating only those packets that need to be repeated. OSGP also include both authentication and encryption for all exchanges to protect the integrity and privacy of data as is required in the smart grid. OSGP enables the Smart Grid to assist customers better manage their energy use, while also enabling utilities ensure a high level of reliability and service to their customers. OSGP helps DSOs more effectively and efficiently manage their networks including handling future challenges associated with the additions of renewable energy sources, electric vehicles and distributed generation.

**Networking Layers**

For the Networking Layer, OSGP uses EN14908-1 with extensions for security, authentication, and encryption. The intermediate layers of the OSGP stack leverage the ISO/IEC 14908 control networking standard, a field-proven multi-application widely used in smart grid, smart city, and smart building applications with more than 100 million devices deployed worldwide. ISO/IEC 14908 is highly optimized for efficient, reliable, and scalable control networking applications. The low overhead of ISO/IEC 14908 enables it to deliver high performance without requiring high bandwidth.

**Physical Layer**

At the Physical Layer, OSGP uses ETSI TS 103 908 as its power line communication standard, but it is not tied to a specific communications physical layer. Since it builds on ISO/IEC 14908, which is media independent, OSGP has the possibility to be used with any current or future physical media. The many protocol and optimizations efficiencies described earlier enable OSGP to deliver high performance and reliability over media with moderate raw data rates, providing OSGP with an implementation cost advantage over less efficient, higher bandwidth systems. Given the focus on efficiency, reliability, cost-effectiveness, and risk reduction, OSGP today uses ETSI TS 103 908 as its physical layer. ETSI TS 103 908 provides a very high power line link budget, a more meaningful measure of performance than raw data rate since it relates to the capability of packets to reliability transmitted and received over extended distances under very harsh conditions and thus drives how much useful work can be performed over the channel. Although a new standard, products that conform to ETSI TS 103 908 prior to is formal adoption have been on the market for many years and about 40 million smart meter and grid devices have successfully been deployed worldwide, providing confidence that ETSI TS 103 908 meets the real-world challenge present on the power grid.
**RELIABILITY with the smallest electrical impact**

INSITUTE OF ENERGY – SMART GRID CEE EXPERTISE LAB TESTS

**表格 9** 注册的读数周期和最大读表数允许的时间读数

<table>
<thead>
<tr>
<th>Type</th>
<th>[kb/s]</th>
<th>Time of read</th>
<th>Number of meters read within 15 min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>single read[s]</td>
<td>energy profile[s]</td>
</tr>
<tr>
<td>DLMS + S-FSK wg IEC 61334-5-1</td>
<td>2,4</td>
<td>1,5</td>
<td>8</td>
</tr>
<tr>
<td>DLMS + OFDM PRIME</td>
<td>42,9</td>
<td>0,7</td>
<td>1,2</td>
</tr>
<tr>
<td>OSGP</td>
<td>3,24</td>
<td>0,07</td>
<td>1</td>
</tr>
</tbody>
</table>

OSGP: 2.3W/meter
PRIME/OFDM: 8 - 10W/meter
Difference: 4W – 8W/meter * 5M meters -> 30 – 40MW
Why Choose NES?

PROVEN & RELIABLE
NES offers utilities a Safe Choice. NES has the largest reference base powering more than 40M smart meters around the world.

SECURE
NES adopts comprehensive multi-layer security platforms as a vital national security requirement for countries.

INTEROPERABLE
Open Smart Grid Protocol (OSGP) certified and G3-PLC certified. Proven interoperability with other certified products.

REDUCE COSTS
Local intelligence and data points allow utilities to troubleshoot and predict more network problems.

OPEN STANDARDS
Open Standard and extensible at every level of the architecture.

FUTURE PROOF
Best ROI: Beyond AMI, add more applications and services over time.

MULTI APPLICATION
Open Standard and extensible at every level of the architecture.
Where NES Technology is Deployed

- **Italy**: Powers 30 million meters
- **Poland**: 330K meters
- **Sweden**: 600K meters
- **Austria**: 175K meters
- **USA**: 680K meters
- **Finland**: 600K meters
- **Denmark**: 200K meters
- **South Africa**: 15K meters
- **Russia**: 410K meters
- **Denmark**: 50K meters
- **South Africa**: 26K meters
- **Switzerland**: 60K meters
- **Germany**: 24K meters
- **Netherlands**: 75K meters

Actual projects running for years, with industry-leading reliability and performance
RELIABILITY, without compromising Security.

<table>
<thead>
<tr>
<th>Customer</th>
<th>Reliability</th>
<th>Technology</th>
<th>Contenr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Energa</td>
<td>86 – 92%</td>
<td>PRIME</td>
<td>Encrypt 128 15’ profiles Not supporting HAN</td>
</tr>
<tr>
<td>Tauron Distribucia</td>
<td>100%</td>
<td>OSGP</td>
<td>Encrypt 128 15’ profiles HAN</td>
</tr>
<tr>
<td>RWE Stoern Operator</td>
<td>95%</td>
<td>IDIS</td>
<td>Encrypt 128 15’ profiles</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Customer</th>
<th>Reliability</th>
<th>Load Profile Data</th>
<th>Readings</th>
<th># of Meters</th>
</tr>
</thead>
<tbody>
<tr>
<td>VATTENFALL</td>
<td>99.7%+</td>
<td>Yes</td>
<td>Daily readings Daily values</td>
<td>600,000</td>
</tr>
<tr>
<td>SEAS-NVE</td>
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<td>Yes</td>
<td>Daily readings Hourly values</td>
<td>390,000</td>
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<tr>
<td>NRGI</td>
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<td>Yes</td>
<td>Daily readings 15 minutes values</td>
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<tr>
<td>ENERGIMIDT</td>
<td>99.7 – 100%</td>
<td>Yes</td>
<td>Daily readings 15 minutes values</td>
<td>170,000</td>
</tr>
</tbody>
</table>

Data Acquisition @ + 99.7%
### Highest RELIABILITY of Any System, Worldwide

<table>
<thead>
<tr>
<th>Customers</th>
<th>Reliability</th>
<th>Load Profile Data</th>
<th>Readings</th>
<th># of Smart Grid Devices</th>
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</thead>
<tbody>
<tr>
<td>Enel</td>
<td>99.7%</td>
<td>Yes</td>
<td>Daily Readings</td>
<td>30.000.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily Values</td>
<td></td>
</tr>
<tr>
<td>Tauron Dystrybucja</td>
<td>99.7 - 100%</td>
<td>Yes</td>
<td>Daily Readings</td>
<td>330.000</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>15 min Values</td>
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<tr>
<td>Vattenfall</td>
<td>99.7 - 100%</td>
<td>Yes</td>
<td>Daily Readings</td>
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<tr>
<td></td>
<td></td>
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<td>Hourly Values</td>
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<tr>
<td>Seas-NVE</td>
<td>99.7 - 100%</td>
<td>Yes</td>
<td>Daily Readings</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>15 min Values</td>
<td></td>
</tr>
</tbody>
</table>
The Patagonia Platform enables grid applications which improve results and ROI over time, based on LV grid mapping, sensor data and PLC stats to deliver actionable information to the user.

- Power Quality, outage detection, resolution guidance, restoration reporting
- Voltage and load heat maps for capacity, calculation, and identification of hot spots
- Transformer protection, load monitoring, efficiency based on load, voltage and temperature
- Efficiency and theft monitoring
- Failure prediction, monitor loss
Management and Improvement of Non-Technical Losses

• NES enables utilities to connect to their customers, who become active participants in energy conservation
  - Wireless or wired local communications including ZigBee, Wireless M-Bus and C-Band
  - Empowers customers to reduce usage by approximately 20%

• NES helps utilities with power outage avoidance and restoration
  - Over 270 grid health measurements provided

• Energy Balancing Application
  Balancing of Electrical Grid ensuring Localized identification of losses

• NES helps reduce operating costs, and compete more effectively
  - Customer complaints drop by more than 50% for one utility; to 10x their target
  - Experience a 25-30% reduction in operating expenses
  - In 2016, one NES utility customer reduced operational costs by more than $80M by eliminating field visits for disconnects and reconnects
How does NES help utilities?

- Identify and reduce electricity theft and meter tampering
  - Reduce tampering by at least 50%
- Improves Volt/VAR control application and provides micro grid management
- Integration with Oracle and SAP Systems
- Reliable Revenue collection
  - Post Paid
  - Prepaid (STS1 or SS2)
- NES supports the following applications:
  - Time-of-Use Calendar
  - Prepayment Feature
  - Power Quality Measurements
  - Load Profile
  - Consumption Based Tariff
  - Remote Disconnect
  - Event Log
  - Demand Metering
Grid Visibility

Control Nodes
- LV Grid Mapping
- Location identification of fault
- Compare voltage measurements to Deviation status where no grid sensors are used
- Push status on change

Most grid health measurements for residential meters
(271 grid health measurement elements)
- Outage detection counters
- Sag, swell, number of over-current occurrences
- Power factor
- Measure signal strength across the power line
- Maximum and minimum frequency
- Phase loss
- Total Harmonic Distortion (THD) events

Data Center Software
- Presentation of Voltage deviation fault location
- Integration of GIS and LVGM
- Application logic for installations without local processing on Control Nodes or sensors, status is identified when data processed

Grid Sensors/Controllers
- Voltage measurements
- Load Profiling
- Alarms based on voltage deviation setting
- Push alarm on change
Additional Value add on the same infrastructure

**Integrated Street Lighting Control** via LMM Modules or NES meters all on the same smart secure metering system.

**Key benefits**

- Autonomous / Scheduled Lighting Control
- Enables dynamic, luminance-based street light control
- Replacement for existent ripple control-based street lighting solutions
- Enables individual control for distinct regions, municipalities, etc.
- Enables detailed analysis of street lighting consumption by use of GMD’s DDM
- Extendable to support dimming an lamp based lighting control
- Optimization of system operation and maintenance
- Compatible to exiting advanced metering / smart grid infrastructures

The GMS Street Lighting Control supports scheduled and dynamic, light sensor-based street light control. In combination with the Load Management Module (LMM). GMS Street Lighting Control allows to transfer traditional ripple control-based street lighting systems into AMI and Smart Grid environments.
Additional Value add on the same infrastructure

Integrated Water meter data over the secure PLC Network

- Connect up to 4 M-Bus meters
- Integrated option
- EN 13757-2 and EN 13757-3 standards compliant
- Short-circuit protection
- Allows management of M-Bus auxiliary meters by NES network
- e.g., gas, water, heat...
- NES meter acts as M-Bus master

A Smart Metering solution for Water, Gas and Heat Meters with the same Security.
Solution Objectives Keeping Pitfalls In Mind.

Deploying an Effective Secure Smart Grid

GRID VISIBILITY

MANAGEMENT and IMPROVEMENT OF NON-TECHNICAL LOSSES

MICRO GRID CONTROL

DATA ACQUISITION + 99.7%

DYNAMIC TARIFF ON STS2

SECURE NETWORK: CYBER and DATA SECURITY
Tauron – Poland (330,000 smart meters)
Project Smart City Wroclaw
Smart Metering, Interoperability and Customer Interface

OUTCOMES:
• Interoperability and interchangeability of smart meters from multiple OSGP vendors
• Outstanding performance measured by KPIs
• Power quality data
• Real time energy consumption data for customers and sales companies
• Power failure management
• Theft Detection
• Remote Switching
• Load balancing of substations
Vattenfall – Sweden (600 000 smart meters)

Most Cost Effective Smart Metering System

OUTCOMES:

• Most cost effective smart metering system within Vattenfall: more functionality, yet lower cost than other systems
• Customers can better manage their energy usage with load profile data
• Load-limiting function to better manage customer usage
• More effectively managed the distribution network with use of outage information and power quality data
• Integrated smart grid functionality
Caruna – Finland (600 000 smart meters)
Smart Metering Program Provides
Monitoring and Control To Manage Peaks and Enhance Reliability

OUTCOMES:

• Meets regulatory requirements
• Hourly load measurements
• Web reporting to customers
• Demand response support
• Electricity balancing
• Open and extensible meters support a grid controlled charging post:
  - Charging post controlled via meters C-Band or ZigBee connection
  - Direct EV charging to off-peak hours, potential to save **20-30% of peak load in grid**
Duke Energy – USA (680 000 smart meters)
Remote Service Disconnect and Reconnect

OUTCOMES:

• In 2016, Duke eliminated over 624,000 field visits for disconnects and reconnects
• This resulted in a large financial saving to the utility operations; approximately $81M in savings in 2016
• Eliminated the need to manage more than 600K house keys for these indoor meters
• Operational benefits include avoided maintenance cost, avoided fuel cost, deferred capital and loss reduction
SEAS NVE – Denmark (400 000 smart meters)
Smart Metering Infrastructure Supports
Energy Management to Reduce Peak Loads & Generation Requirements

OUTCOMES:
• Outstanding system reliability & performance
• SEAS-NVE consumers used **16% less energy** after smart meters were installed
• Integration of solar system within the low voltage network
• Allowed utility to expand peak generation capacity
• Power quality data allows utility managers to better monitor & troubleshoot problems in the grid
• Reduced network maintenance cost
NRGi – Denmark (200 000 smart meters)
Smart Meters Enable Outage Avoidance and Reduced Maintenance Costs

OUTCOMES
• Load balancing to increase asset life and reliability
• Using unique system capabilities:
  - Accurate, automatic mapping of loads to transformers
  - Per phase voltage measurements
  - Independent load profiles
  - Phase identification
  - Over 270 grid health measurements
• Lower cost & improved service:
  - Detected faulty neutral before it failed
  - Isolated over voltage cause by solar panel installations
  - Diagnosed over voltage caused by old welding equipment in a customer’s garage
LINZ STROM – Austria (150 000 smart meters)

Automatic and On-Demand Energy Savings and Peak Reduction

OUTCOMES

• Per meter configurable maximum power limit:
  - Automatically monitored and enforced by NES smart meters
  - Control peak loads and defer investments in additional generating capacity
  - Disconnect switch used for customer change, non-payment and prepay metering

• Meter based or standalone direct load control of individual circuits:
  - On schedule or on demand
  - 4 channel load control device monitors line frequency and automatically sheds loads to prevent collapse
## UAS Products Portfolio

### Sensing & Measurement
- **IEC Single Phase Smart Meter**
- **IEC Poly Phase Smart Meter**
- **Poly Phase P2P Smart Meter**
- **IEC CT Smart Meter**
- **ANSI Smart Meter**
- **DCN 3000 Data Concentrator**
- **CPM 6000 \ CPM 6010 Control Point Module**
- **LMM 2540/PL**

### Analytics
- **Low Voltage Grid Manager**
- **Energy Balancer**

### Data Collection & Network Management
- **System Software**
- **Operations Manager**
Why Choose NES?
Proven, Open, Multi-Application, Insightful

NES power line communication technology has connected 40 million smart grid devices since 2000, more than any other Industrial IoT PLC technology.

Proven Partner

Open and extensible at every level of the architecture

Open Standard

Multi Application

Beyond AMI; add more applications and services over time

Best ROI

Reduce costs
Improve reliability

Insights into low voltage grid & distributed computing allow utilities to troubleshoot and predict network problems cost effectively

Insight
Our Partner Innovent has a specialised leasing and life cycle management solutions for rapidly depreciating assets. Founded in 2003 we have over 10 years’ experience in providing tailor-made financial solutions for our clients.

InnoVent carries a AA Empowerdex BEE rating certificate with a LEVEL 1 (168.75% of every R1.00 spent) contribution. We have over 200 clients with over R 2 Billion assets under management. We currently have offices in South Africa, Zimbabwe, Tanzania, Zambia and The United Kingdom.

See Below Funded Solution powered by InnoVent
Acquisition of Smart Meters Proposal

Innovation and invention. This is what we do best.
**Proposal for Rental – Off Balance Sheet**

InnoVent have the pleasure in submitting the proposal to you for the rental and asset management of your equipment. We are available to discuss the proposal with you in detail should you require further clarity. We also draw attention to the fact that variations to this proposal can be made in line with your needs.

We have also included a brief overview of our products and offerings, which we hope you will find interesting.

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**Leasing of smart Meters over 60 Months**

<table>
<thead>
<tr>
<th>Funding Required</th>
<th>R 51 000 000.00 (Indicative) Estimated @ 20 000 meters before installation and CIU.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of equipment</td>
<td>Smart Meters</td>
</tr>
<tr>
<td>Finance Type</td>
<td>Pay for use</td>
</tr>
<tr>
<td>Term</td>
<td>60 months</td>
</tr>
<tr>
<td>Payment Frequency</td>
<td>Quarterly in Advance</td>
</tr>
<tr>
<td>Rental (Excluding Insurance)</td>
<td>R 3 253 625.06 X 20 Fixed Payments (R 1 084 541/m @ 20 000 meters @800 kWh Ave per household = +- 7 c/kWh)</td>
</tr>
</tbody>
</table>

-Note: The current prime lending rate is 10.5%
Products and Services

Pay-for-Use-Rental

Typically, this involves equipment which has no real resale value at the end of its useful life, depreciates rapidly.

InnoVent will take a residual position in the equipment at the inception of the rental contract, giving clients full use of equipment for which they never have to pay full cost.

Insurance Services

Further to the finance offerings, InnoVent also offers clients comprehensive and competitive insurance products for the assets, mitigating the cost of replacement in the event of loss.

Flexi-Tech Renewal™

InnoVent is able to offer its clients an upgrade path through technology renewals without increasing the repayments or additional upfront outlays of cash, subject to agreed-upon conditions. The benefits of this solution include:

- No penalties are charged to clients for refreshing/swapping out
- No increases are made in rental payments
- Responsibility lies with InnoVent for disposing of equipment refreshed or replaced
- Clients are able to stay abreast of technology
- TCO is kept at a minimum as only current technology is used
Tech - Buy Back™

InnoVent can buy back clients’ existing equipment, and rent the same equipment to the client at attractive rates, based on our residual model. This means that clients never have to pay for the full cost of the equipment, as InnoVent assumes the ownership on the equipment.

Complete Asset Management

InnoVent offers clients world-class asset tracking tools, which are proven to ensure better control of assets, as well as increase overall governance and accountability. This ensures timely action should assets be lost or stolen.
GRAP 13, Leases Criteria

The lease of the Smart Meters to the Utility will be governed by GRAP 13 which deals with the lease of Assets to Government entities. The new lease standard IFRS 16 is not yet applicable to Government entities.

Under GRAP 13 the Utility will enjoy the benefits of off-balance sheet finance for the lease of Smart Meter – the lease agreement will be an Operating Lease which means the rental payments will be classified as operating expenditure rather than Capex, this is mainly due to the fact that the following requirements for the lease to be classified as a Finance lease are not met:

a. the lease transfers ownership of the asset to the lessee by the end of the lease term - The ownership of the asset will remain with InnoVent at the end of the lease.

b. the lessee has the option to purchase the asset at a price which is expected to be sufficiently lower than the fair value at the date the option becomes exercisable for it to be reasonably certain, at the inception of the lease, that the option will be exercised – The lease is a pay for use rental and there is no option for the Utility to purchase the asset at the end of the lease.

c. the lease term is for the major part of the economic life of the asset even if title is not transferred – The lease if for a period of 5 years whilst the economic life of Smart Meter is normally 15 years and this equates to 33.33%. Hence the lease term is not for the major part of the economic life of the Smart Meters.

d. at the inception of the lease the present value of the minimum lease payments amounts to at least substantially all of the fair value of the leased asset – The present value of minimum lease payments is 87% which does not amount to substantially all of the fair value of the smart meters. It is generally accepted that a present value exceeding 90% would amount to all of the fair value of the leased asset

e. the leased assets are of a such a specialised nature that only the lessee can use them without major modifications – Based on the nature of the asset, smart meters. Any lessee will be able to use them without major modifications.
f. **the leased assets cannot easily be replaced by another asset** – Smart Meters can be easily replaced by traditional meters or other smart meters.

g. **if the lessee can cancel the lease, the lessor’s losses associated with the cancellation are borne by the lessee** – All InnoVent’s lease agreements does not provide the lessee with an option to cancel the agreements, if the Utility cancels the contract they will bear all the risks.

h. **gains or losses from the fluctuation in the fair value of the residual value accrue to the lessee** – InnoVent bears all the residual value risks.

i. **the lessee has the ability to continue the lease for a secondary period at a rent that is substantially lower than market rent.** – If The Utility wants to extend their lease it will be at the original rental amount or at an amount that will NOT be substantially lower than the market rent.
In January 2016 the International Accounting Standards Board (IASB) issued IFRS 16 a new lease standard that will be effective for accounting periods beginning on or after 1 January 2019.

IFRS 16 eliminates the classification of leases as either operating leases or finance leases, instead it introduced a single lessee accounting model similar to finance leases. Applying that model, a lessee is required to recognise:

(a) assets and liabilities for all leases with a term of more than 12 months, unless the underlying asset is of low value; and

(b) depreciation of lease assets separately from interest on lease liabilities in the income statement.

The lease of Smart Meters to Ekhuruleni Municipality will be governed by GRAP 13 and currently IFRS 16 will not affect all government entities. However, if IASB in future, issue another lease standard for Government Entities similar to IFRS 16 the lease of Smart Meters will not be affected mainly due to the following exemption introduced in IFRS 16:

**Lease of low value assets exemption**

- Smart Meters will be regarded as low value assets as the underlying value of the individual asset when new is less than US $5 000.00

Therefore, if Ekhuruleni Municipality elects to apply the “Lease of low value exemption”, the lease will continue to be classified as an operating lease and they will continue enjoying the benefits of off-balance sheet financing.
THANK YOU
Questions and Answers.

Working with you for a smart secure solution is what we do.

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We know that NES will offer more software based solutions. What are the types of applications that will be delivered to utilities, and how will they be beneficial?