GIS Interest Group Webcast

An International Perspective of ADMS and the Impacts of Preparing and Maintaining Data

Jared Green
Technical Leader

Guest Vendor: Indra
March 23, 2017

Guest Presenters:

Eloy Gonzalez Ortega and Benito José Vela Martín

Eloy González Ortega is a respected executive in the energy industry with over 20 years of successful experience working for global corporations within the Utilities Sector (Distribution & Retail), mainly in Latin America, Africa, Europe and Asia. Since 2001, he has led the Energy Distribution Division at Indra Software Labs in charge of overall development of OT / IT systems for Utilities focusing on the energy distribution domain.

In 2009, he also became the head of the Energy Innovation Division at Indra Software Labs in charge of overall R&D projects and activities in the energy area, both at the national and international level, with focus on Smart Grids, Advanced Metering Infrastructure and Energy Efficiency, and most recently, Transactive Energy Markets following the novel IoT paradigm. In this role, he has supervised multidisciplinary ICT research environments for the past few years, participating in national and EU Smart Grid projects and knowledge working groups with focus on OT / IT system integration and Smart Grids business development. In this sense, he is an expert on disruptive innovation, always on the lookout for advanced technologies and their potential economic impact, together with the paradigm shift they represent.

He is an skilful and capable executive in the Energy industry with deep experience and understanding of the functioning of competitive energy markets and their various impacts in organizational and business processes. Through the years, he has acquired a deep knowledge on the needs of the global energy markets, such as current utility requirements, policymaker's agendas, regulatory treatments and new business opportunities. He is an specialist in the following areas: general management and business development in the energy sector, growth management, corporate development and strategic definition and implementation and, the policies for establishing the vision, strategy and leadership of energy businesses and corporations.

Eloy collaborates on a regular basis with local & EU policymakers and regulators. His current positions have given him the opportunity to establish close relationships with industry, academia and government bodies, both at the national and international level and he also participates regularly to different standardization bodies and technical committees in the energy sector.

He holds degrees in Aerospace Engineering (B. Sc., M.Sc.) from The University of Texas at Austin.

Guest Presenters:

Benito José Vela Martín

Graduated in 1996 as an Electrical Engineer, Benito has got more than 20 years of experience in multiple technology industries including power/energy, telecommunications and automation, with a large history of project management and leading cross-functional teams in developing and delivering quality products and services to success.

Benito's experience with Energy Management Systems began in 1995 with a focus on SCADA/EMS systems for REE, Iberdrola, GNF (formerly Unión Fenosa), and other Utilities. After six-years working in the Telco domain (2000-2006), he returned to Schneider Electric (formerly Telvent) into the Distribution Management, SCADA, OMS and GIS delivery team, providing systems and services that enable and facilitate smarter distribution networks in Latam, Africa, Europe and China. From 2010 to 2012, Benito was the Electrical SCADA's (OASyS) product Owner, as part of the Schneider Electric's ADMS product development team. He has also been leading the ADMS delivery teams in Australia and New Zealand (2012-2014), as well as the Maintenance and Support team for Latam and Iberia (2014-2016).

In 2016 Benito joins Indra's Energy team as the InGRID ADMS's Product Manager. His responsibilities now center on ensuring that Indra is a leader in developing modern Electricity Networks management solutions, representing a powerful proposal for the Utilities needs, supporting: asset management, network development and maintenance, network operation, incident/outage resolution, workforce management, reporting and data analytics.

ENERGY & UTILITIES

An International Perspective of ADMS and the Impacts of Preparing and Maintaining Data

March 2017

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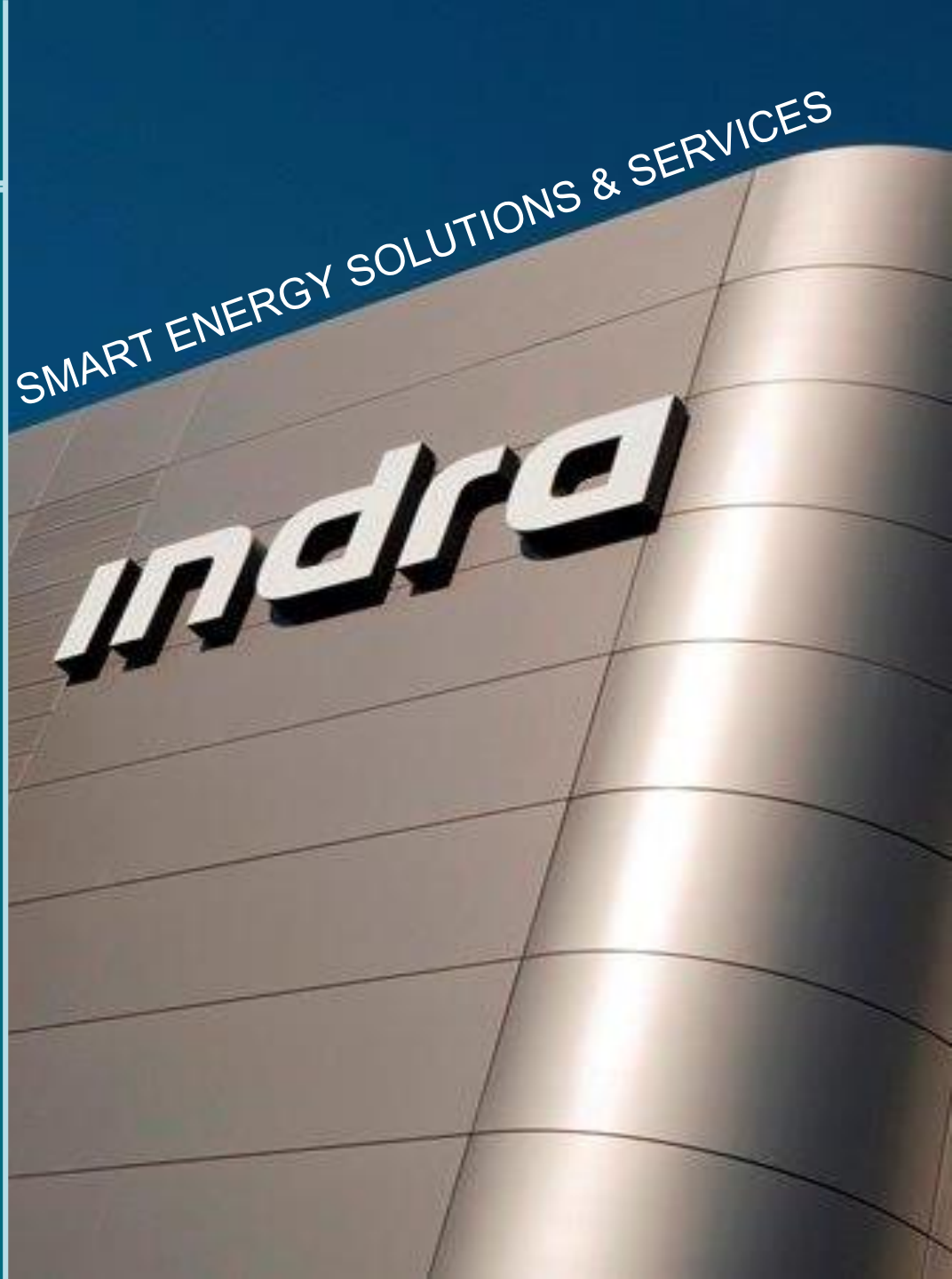

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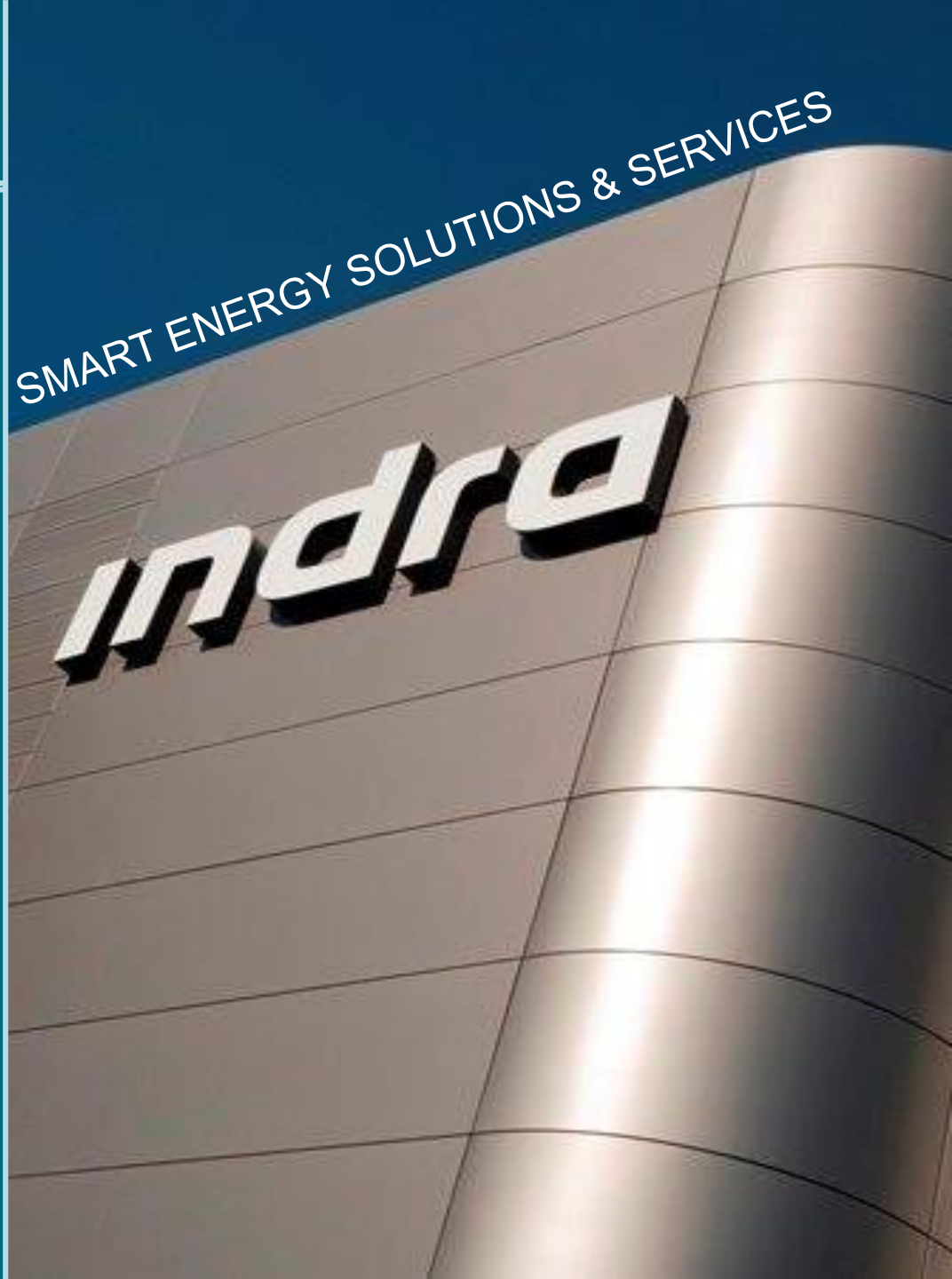
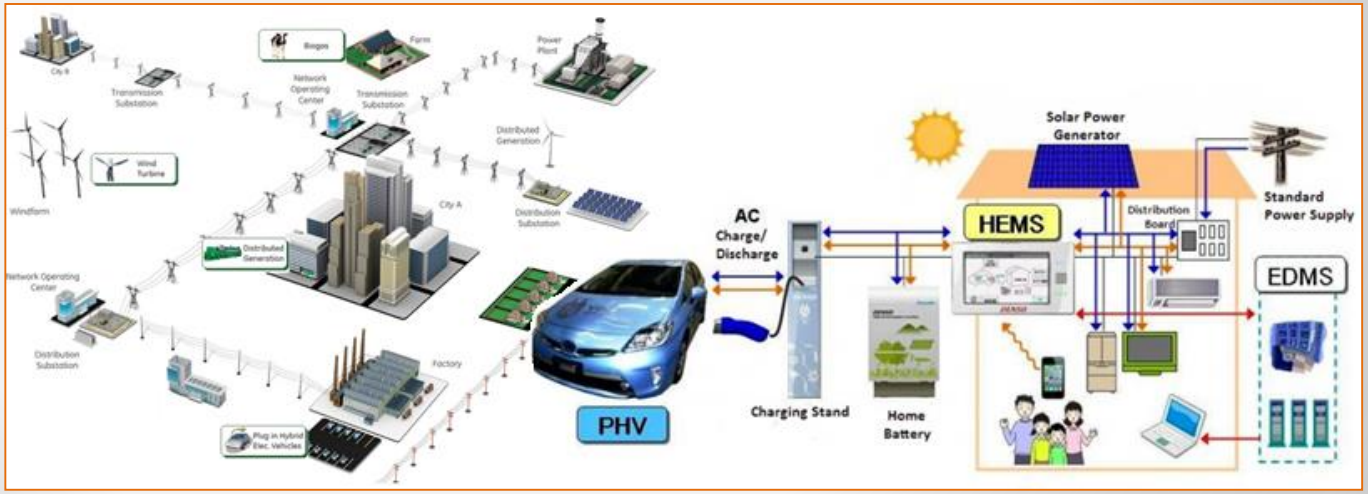


→ HOW THE FUTURE LOOKS LIKE FOR THE UTILITIES SECTOR

The Grid is becoming more complex and growing faster than our control methods and tools can handle. Global energy goals cannot be met without changes in how we control complex systems.

Physical infrastructure being added to the grid (solar panels, wind turbines, customer-owned micro-grid systems and energy storage, demand response-enabled thermostats and smart appliances) is nearly impossible for existing utility control systems to manage.

Much of it is in the hands of customers, not utilities.
Many of these systems act too quickly and in too great a volume to actually monitor and manage in real time.



→ HOW THE FUTURE LOOKS LIKE FOR THE UTILITIES SECTOR

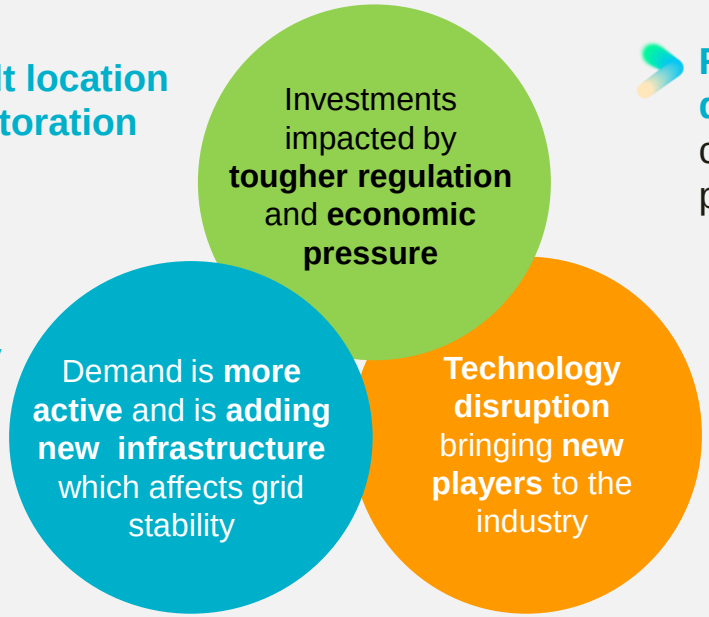
The Grid is becoming **more complex and is growing faster** than our control methods and tools can handle. Goals can't be met without **fundamental changes in how we control a far more complex system**.

New **cyber-security threats**

Difficulties in **fault location and service restoration**

Risk of quality deterioration & loss of control on voltage profiles.

Losses in efficiency due to dynamic load unbalances

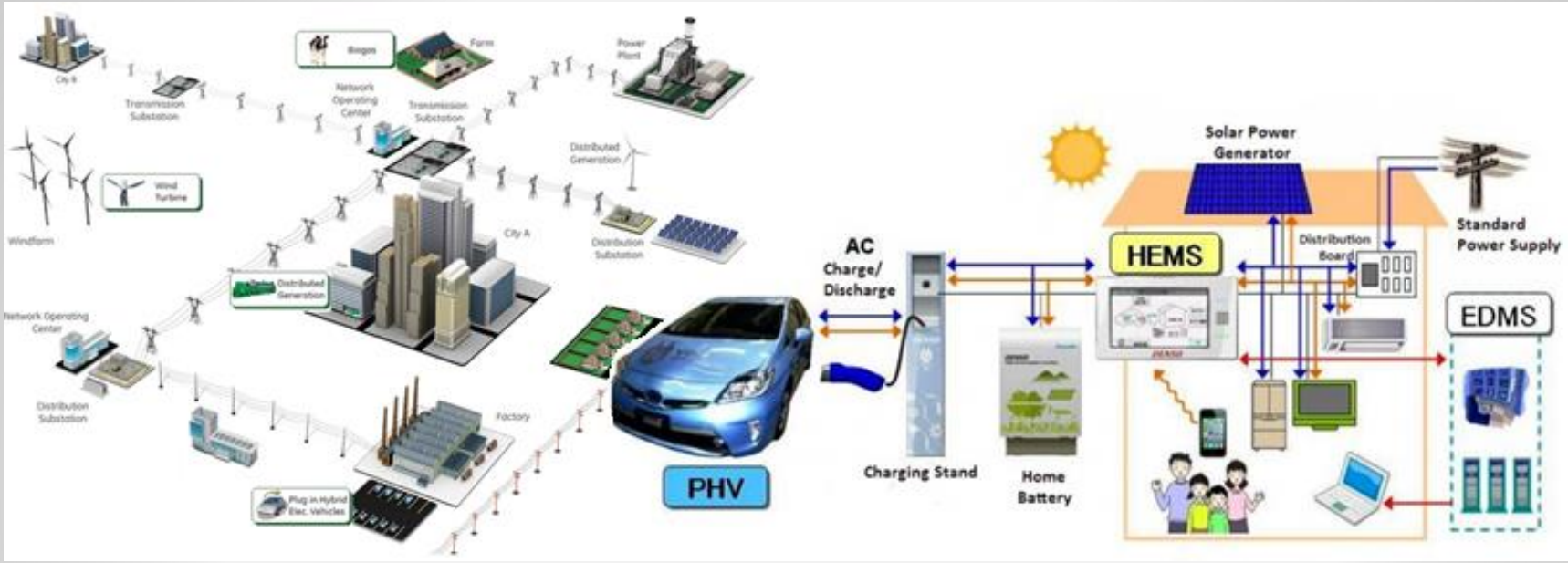


Need to operate **closer to design limits**

Difficulties in forecasting network flows hindering operation planning

Need to **monitor and integrate active customers** in the grid operation

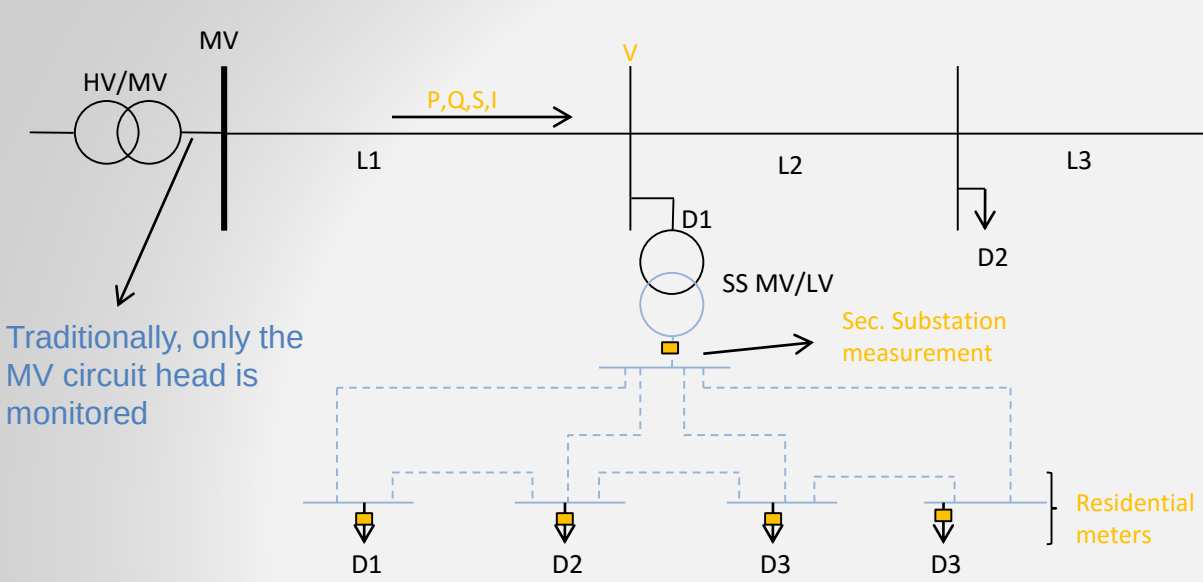
Challenges for Utilities



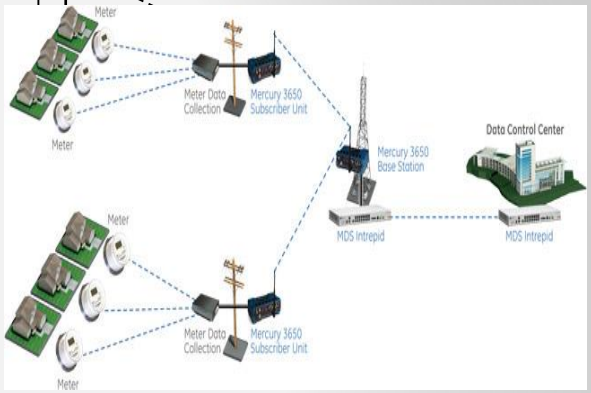
Future networks will depend on a smart grid to ensure **resilient and sustainable delivery of energy to support many functions**. A smart grid ensures the following objectives:

- **Remote monitoring of network facilities**, allowing the automation of diagnosis and operations as well as self healing mechanisms.
- Allows the **secure and reliable integration of distributed generation.**
- Safe management of the **EV recharging infrastructure and e-storages.**
- Interacts through **HEM systems**, allowing citizens to **monitor** their utilities consumption (water, gas, power, etc.) and **make decisions.**

Making the Network Visible



$$\sum_i P_i + P_{losses} \approx P_{SS}$$



In a traditional system, only MV feeder breakers are monitored (through the Scada System). Consequently, nodal demand can only be estimated based on the installed capacity. In a Smart Grid, consumptions come from Smart Meters as well as other information captured from multi-purpose sensors.

- Monitoring technical losses, detecting potential non-technical losses.
- Collecting grid data to be used in the ADMS for analytics, protection coordination, reactive power compensation, service restoration, etc.
- Interacting bi-directionally with consumers and HEM systems, allowing the implementation of demand management schemes.

→ UTILITIES TRENDS: TOWARDS AN ACTIVE SMART GRID

Trends on Grid Management

TRADITIONAL GRIDS

HV:
MV:
LV:

Progressive automation of the whole grid

Merge of IT & OT infrastructures

SMART GRIDS

Decission level

Clients, Workforce, Energy, Topology

Assets, Geo info

ANALYTICS & BUSINESS

REAL TIME

TRANSACCTIONAL

STATIC INFO

Increase of real time data acquired from multiple sources and by different means

AMI | GRID AUTOMATION | DISTRIBUTED GENERATION | DEMAND RESPONSE

DRIVERS

IMMATURE ENVIRONMENT

with technological renewal, increase in the number of customers and regulatory pressure:

- ✓ Enhancement of supply reliability
- ✓ Energy losses reduction
- ✓ Energy sales increase

MATURE ENVIRONMENT

with rigorous customers about the quality of supply:

- ✓ Efficiency
- ✓ Sustainability

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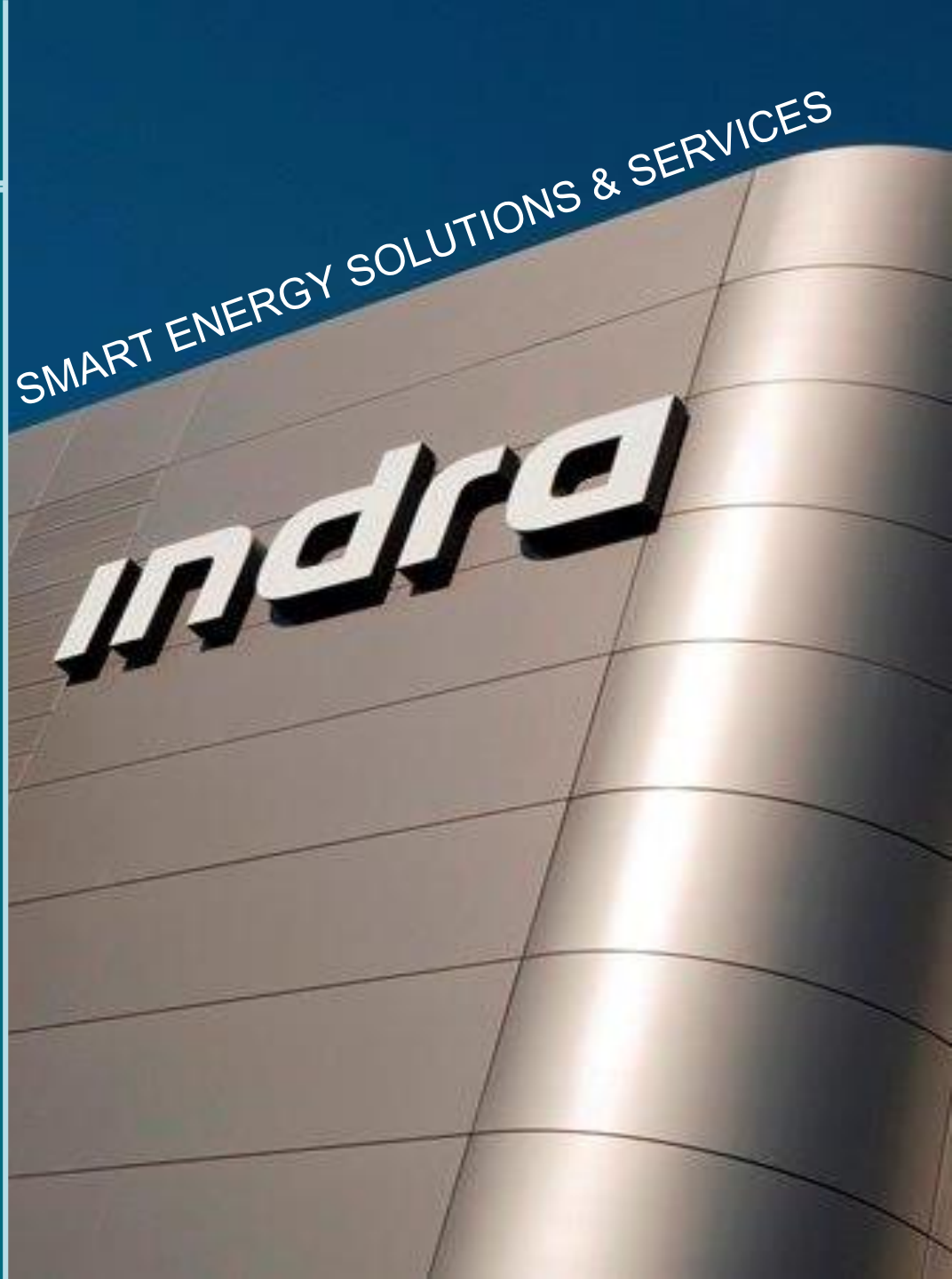
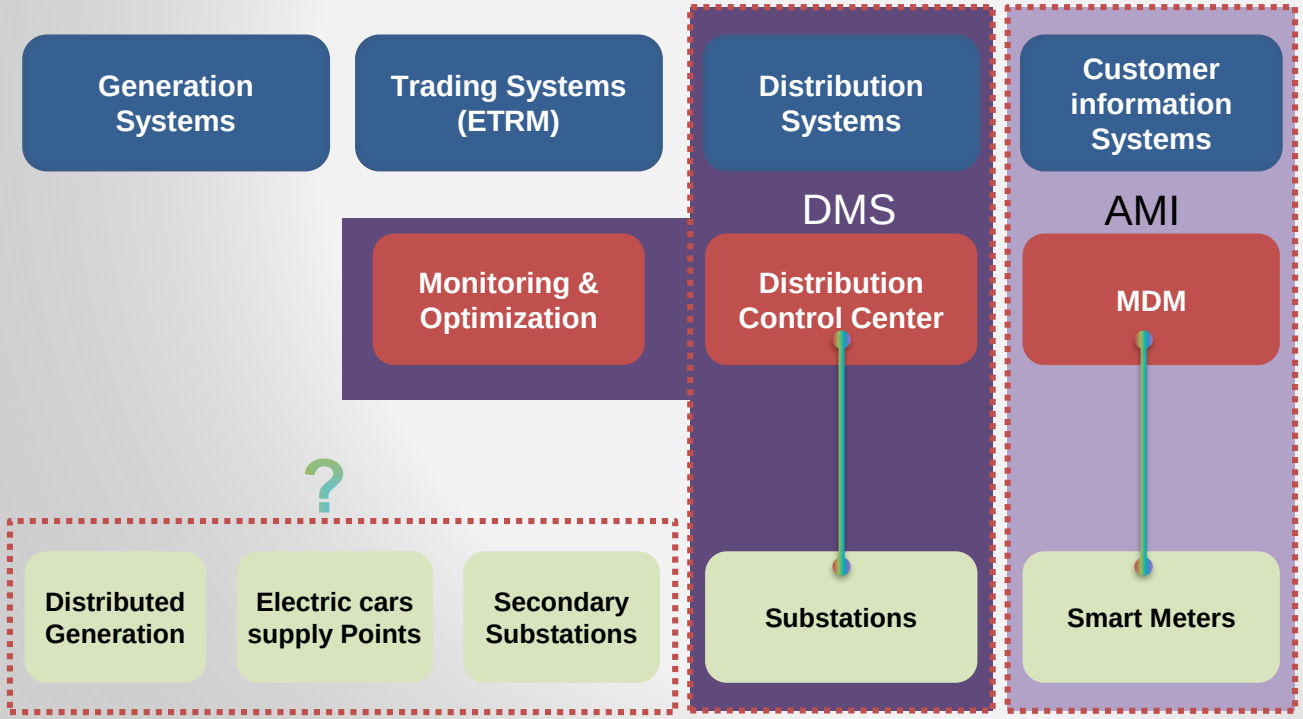


→ INDUSTRIAL IOT: NEW TECHNOLOGIES TO SUPPORT GRID TRANSFORMATION

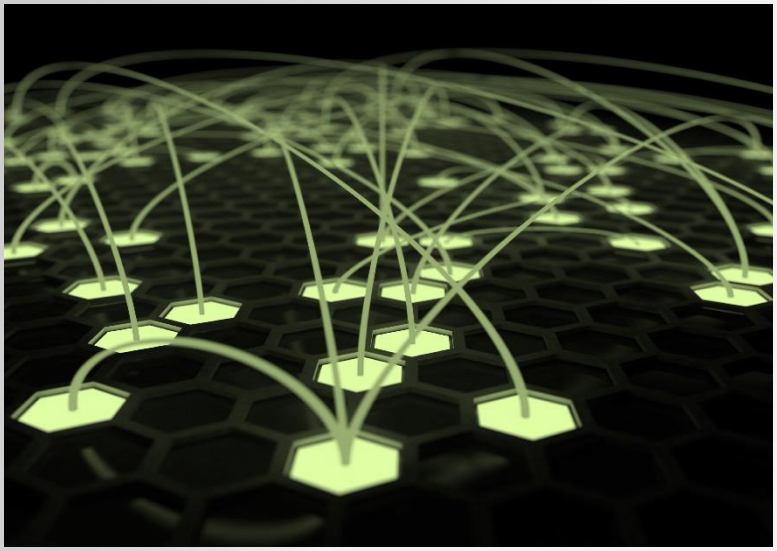
Existing **grid monitoring and control infrastructure** was not designed for this fundamental transformation

Actual control infrastructure is based on **traditional Scada / M2M Platforms,** like the ones deployed to control Primary Substations or Smart Meters. These **"Silo-ed" platforms** have struggled to provide enterprise-wide solutions and generate valuable insights as **back-office integration is expensive and time-consuming**.



- Scarce visibility of the MV & LV network
- Lack of control on DERs
- Costly upgrade of existing infrastructure
- Integration difficulties of isolated systems
- Scarce or no intelligence in field devices

→ INDUSTRIAL IOT: NEW TECHNOLOGIES TO SUPPORT GRID TRANSFORMATION



Utilities **need real-time monitoring & control infrastructure** to achieve situational awareness for the 21st century grid which **IoT enables at a much lower cost** than solutions based on SCADA / M2M technology

New requirements

- Proactive Operations
- Situational Awareness
- Fast Edge Decisions
- Seamless Interoperability
- Modularity / Scalability
- Hybrid Central/Distributed
- Zero Touch Deployments
- Refined Utility Skillsets

Technology approach

1. Internet Protocol
2. Translation
3. Common Data Model
4. Cyber-security
5. Edge & Cloud Analytics
6. Big Data

Industrial IoT

→ INDUSTRIAL IOT: NEW TECHNOLOGIES TO SUPPORT GRID TRANSFORMATION

Edge Devices

- Primary & Secondary Substations
- Grid Sensors,analyzers, Fault detectors, etc.
- Demand Management (Home, Building, Industry)
- Distributed generation Storage, EV infrastructure

Edge Intelligent Nodes

RT Unified Data Space

iSPEED

RT Monitoring & Control

ADMS

RT Grid Analytics

RT Grid Analytics

RT Grid Analytics

SCADA

OTS

AMI

Grid Analytics

Big Data Analytics

Analytics
Security
Integration
with Backend

Requirements

- Intelligence
- Multi-protocol
- Flexible sw. deployment
- Remote admin.

- Unified data space for devices, assets & systems
- Availability of Critical information in Real Time
- Secured & reliable communication

- Comprehensive monitoring of MV/LV/HV
- RT Analytics
- Scalable analysis to MV/LV
- Open support to new grid analytics functions.

- Big Data
- Performing Analytics on massive data
- Open discovery of trends & causality

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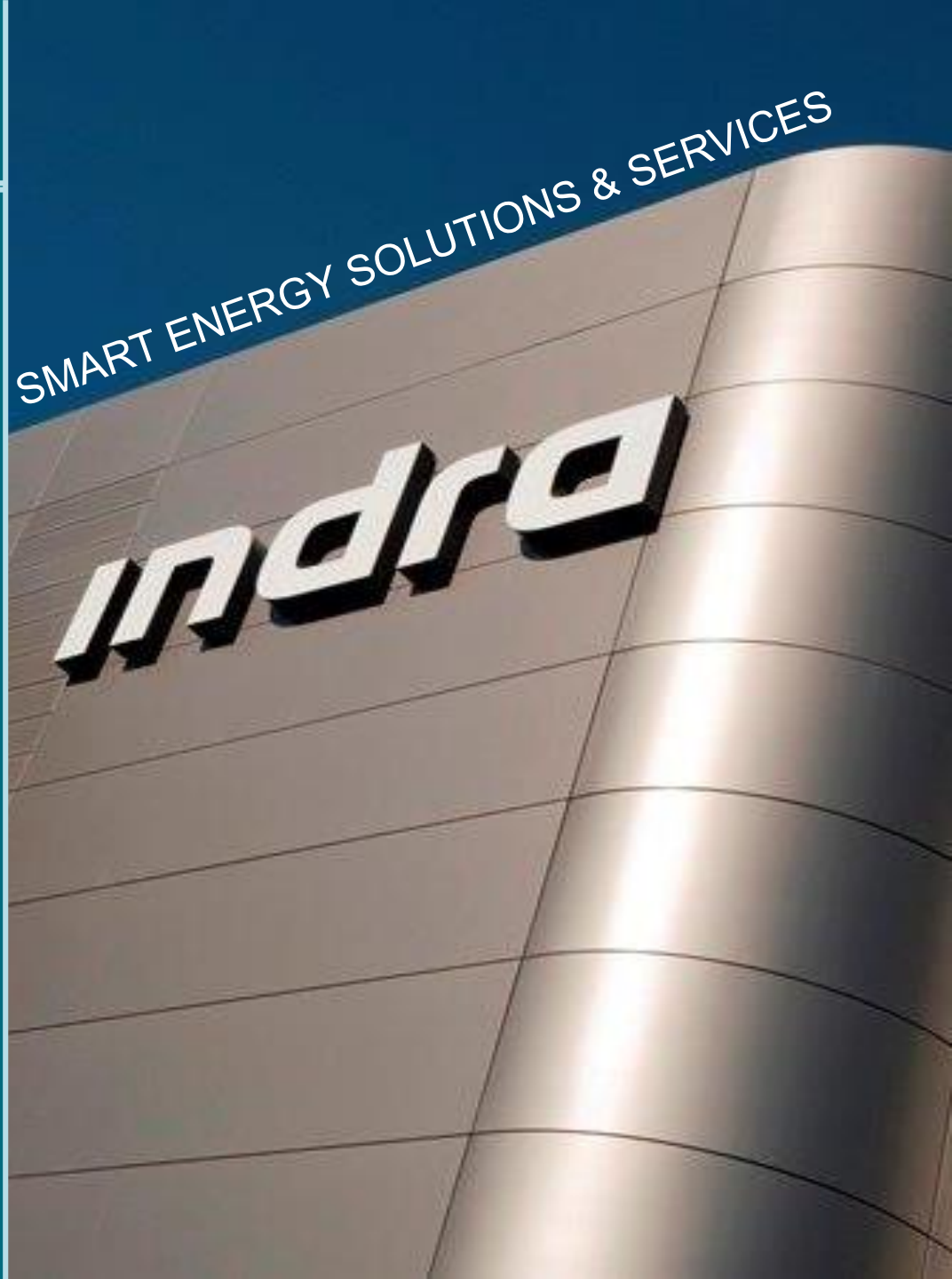


→ ADMS AT THE CORE OF CLOSED-LOOP MISSION CONTROL ECOSYSTEMS

Real Time Monitoring and Control Layer - Supporting open analysis, predictive operation & optimization of the grid

Grid Analytics

RT Monitoring & Control

RT Data Space

Edge Int. Nodes

Devices

Real-Time Analytics

Grid State I/O Management

Real-Time Analytics

Pre-built
- Topology
- State estimation
- Etc.

User-defined or 3rd party

Analytics Container Manager

Advanced DMS

Grid Management

Grid Data Model

Advanced ADMS Functions

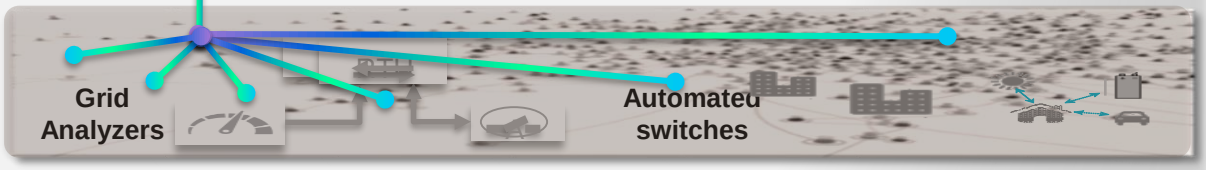
Open FMB / OT Bus

OTS
Grid & DER RT simulation

Head-Ends

SCADA

AMI



- Connectivity engine for network analysis
- OTS capabilities for what-if analysis and operator's training
- RT Analytics container with pre-built algorithms
- Application Connectors for RT data visualization & control

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→ ADMS AT THE CORE OF CLOSED-LOOP MISSION CONTROL ECOSYSTEMS

Real Time Analytics

Grid Analytics

RT Monitoring & Control

RT Data Space

Edge Int. Nodes

Devices

Power Analytics Administration UI

ADMS

Power Analytics (server)

Server 0 … **Server n**

Topology Engine

RT Shared Memory
Read/write, execution control

Grid Topology
Islands identification

Optimal maneuvers proposal

Analysis results

Measurements
Topology events

Algorithm Manager
/write, execution control

HPC MPI/OpenMP control

OPF
Volt/Var ctrl
Serv
Restauration
…

3rd party algorithm libraries

State Estimation

Power Flow

DDS publish

Open FMB / OT Bus

- Comprehensive grid RT monitoring HVMV/LV
- Massive open, distributed And scalable analysis
- Continuous Analysis and optimization.

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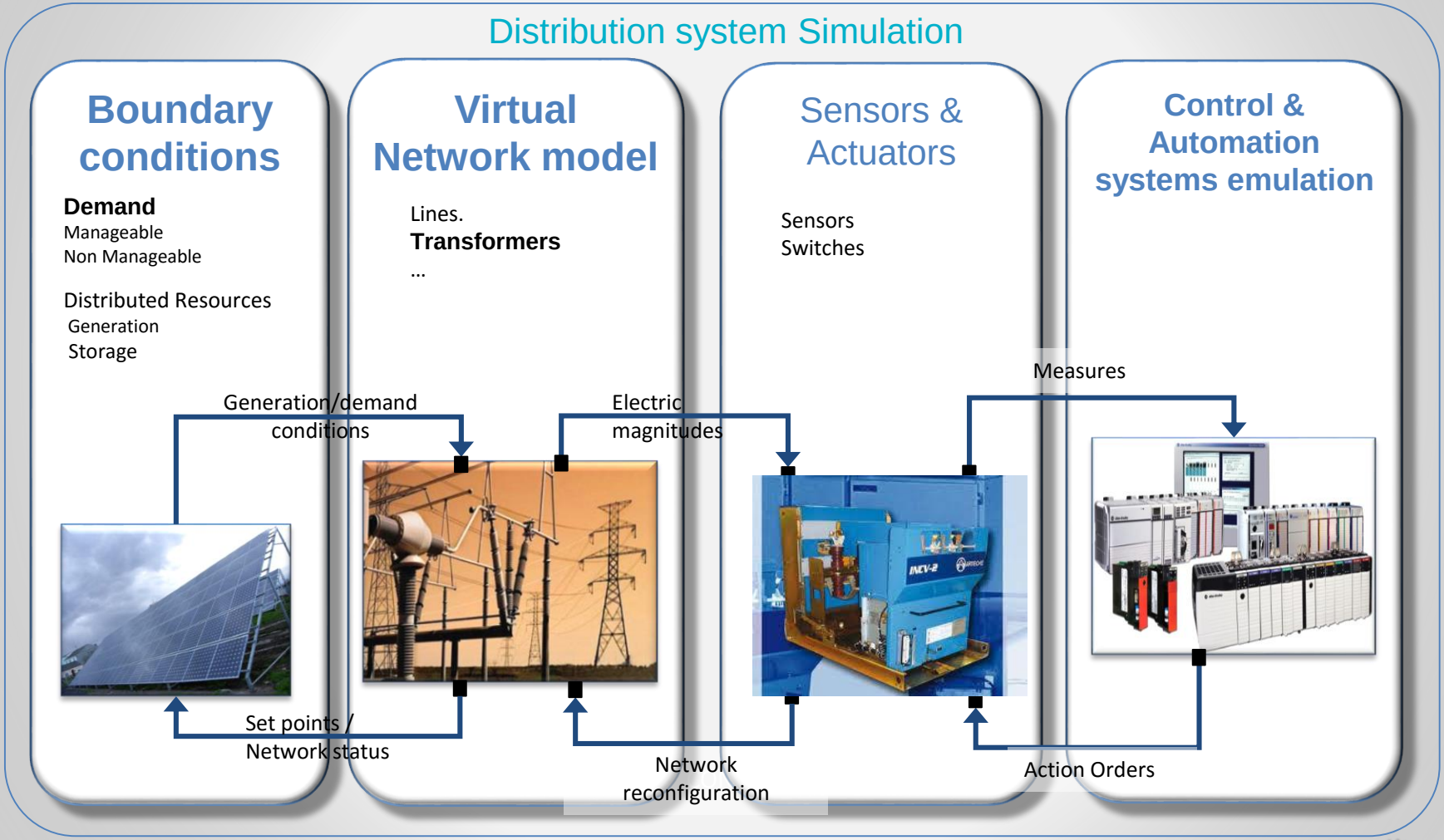
OTS - Smart Grids Simulator

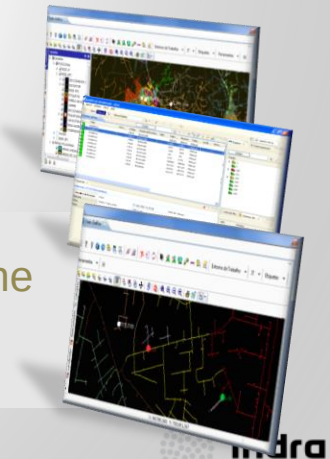


Advanced Distribution Management System Key Capabilities

Advanced DMS is a system designed for the management and supervision of the grid in a reliable and safe manner.

Power Grid Complete Control

- ✓ Use of GIS information for network operation and outage management purposes
- ✓Anticipation and Solution Proposals for planned and unplanned incidences.
- ✓ Availability of technical and management tools ready to be used on any network situation.
- ✓ DMS and OMS functionalities.
- ✓ Simulations



Advanced DMS provides information at any moment on what is happening in the network, when, where and how to proceed to solve an incidence as quick as possible.

→ ADMS AT THE CORE OF CLOSED-LOOP MISSION CONTROL ECOSYSTEMS

REAL TIME MONITOR

General overview of the status of the power network and its current incidences

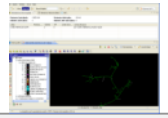
COMPLAINTS MNGT.

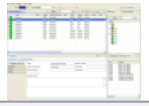
Customer complaints entering is possible with Operation, which provides a complete complaints management tool with functionalities as:
- Fault proposal
- Automatic association

The link with the Commercial Database assures that during the course of an incidence, the customer complaints regarding a fault will be received and directly associated to the incidence.

INCIDENCES / NON PROGRAMMED ACTIONS MNGT.

Management of the whole non programmed events, providing to the operator the tools and information needed for a quick and safe resolution:
- Integration with SCADA provides automatic incidences generation and remote control abilities.
-Manual incidences creation from customer complaints.
-Incidences monitoring thorough parameterised workflows
-Fault proposal, events prioritization, crews mngt., contingency plans, energy flows calculations



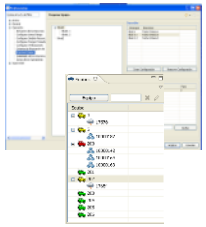


OPERATION PLANNING & PROGRAMMED ACTIONS MNGT.

Short, medium and long-time planning of actions over the network

CREWS MNGT.

Maintenance, location and assignment of crews for the network operation

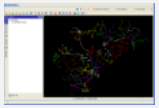


OPERATION TOOLS

Besides the graphic displays, the system enables a set of tools to facilitate the network operation:
-Connectivity queries (upstream, downstream,…)
-Queries over the installations data, searching and location
-Switching
-Labelling

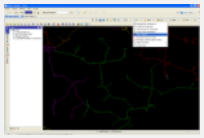
SIMULATION ENVIRONMENT

Providing a simulation environment over the current or non current status of the network. It provides the ability of defining operational procedures or foreseeing decisions before carrying out the actual switching in the operational environment



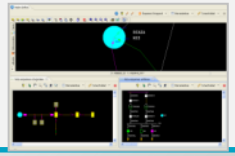
TECHNICAL MODULE

A set of tools regarding electricity calculations: Energy Flows, Short-circuit, Risk Maps (energy losses, voltage drops), using nominal figures, load profiles or SCADA valour's.



GRAPHIC DISPLAY

Different Graphic displays of the network, according to the operator needs and including GIS functionalities (zooming, pan, etc).:
-Positional
-Orthogonal
-Schemes



OMS Functionality

DMS Functionality

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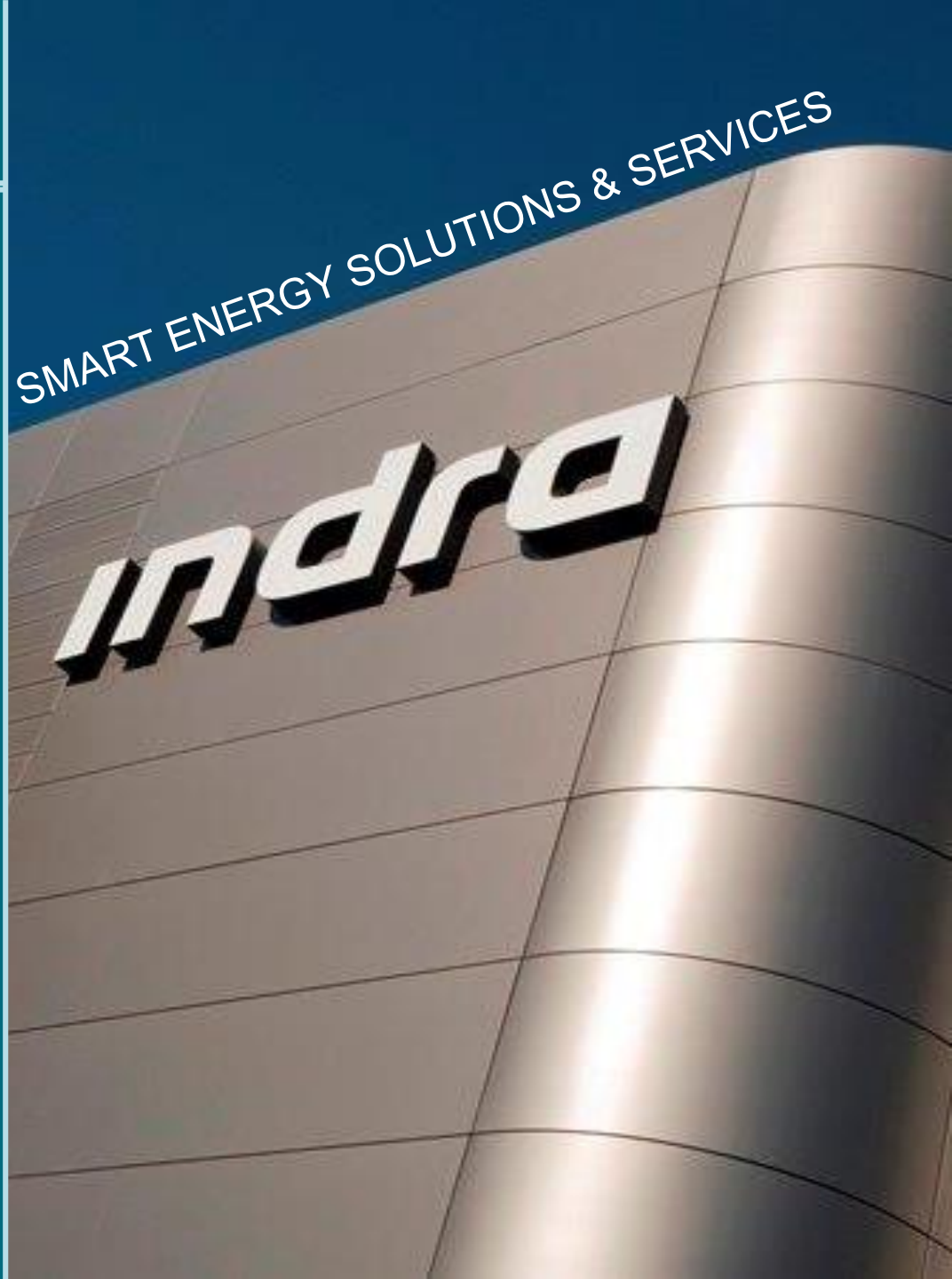
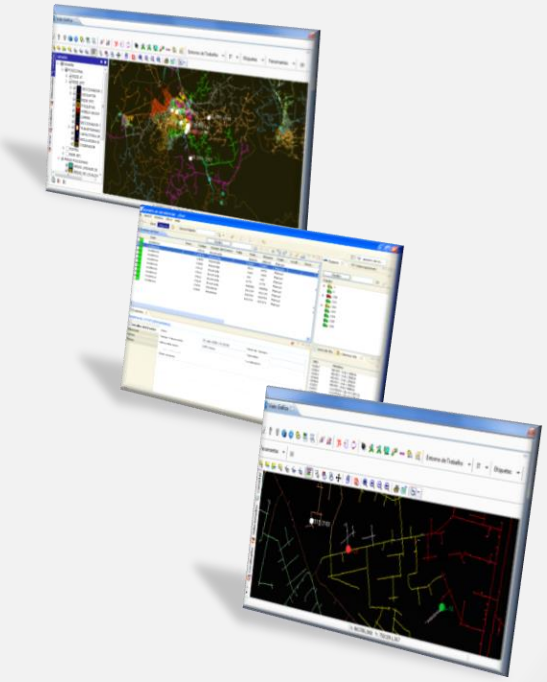


→ LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

Market drivers: Why are utilities implementing ADMS ?

- **Cost** of non-delivered energy and non-technical losses
- New **cyber-security threats**
- Legacy SCADA/DMS/OMS system **obsolescence**
- **Regulators** developing policies that increase reliability and renewable energy
- Need to operate **closer to design limits**
- Utilities looking for higher **network reliability**
- **Grid Resiliency** to natural disasters and weather
- Need to **monitor and integrate active customers and DERs** in the grid operation



→ LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

ADMS fundamentally changes how a utility operates and maintain its Grid Data

- It requires **organizational changes** and new Utility's staff **skills**
- A proper **Change Management**, and Utility's internal communications, is a must.
- An ADMS deployment requires a dedicated, **cross-functional** team
- **IT/Security** guys have a relevant role
- **Lack of accurate network data** will jeopardize an ADMS project
- **Integration** with 3rd party (Legacy) systems and data is difficult
- **Grid Data Tuning** is a continuous and never-ending task for proper ADMS functionality use

LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

Typical “Project issues” found during an ADMS implementation:

- Thinking that ADMS is the **solution to all Utility’s problems**
- **No well-defined** Utility’s functional requirements
- Thinking that ADMS is… ADMS + AMI + AVL + CRM + IVR + …
- **No well-defined** ADMS Project’s scope
- Forgetting that the Utility’s Grid **data quality** will directly impact in the ADMS project results
- Utilities **staff un-prepared and un-skilled** for the ADMS implementation

→ LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

Typical “Grid Data issues” found during an ADMS implementation:

- **No digitalized data** - mostly in Africa, Latam, Asia
- Lack of **accurate** information about installed Grid assets
- **Grid growing** faster than Grid digitalization
- Abuse of “**default**” values, when real data is unknown
- Lack of information about small **generators**
- Utilities **procedures and staff un-adapted** to the new, and more exigent, data requirements

LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

Preparation and implementation strategies used in ADMS deployments:

- Take your time to prepare **good functional requirements**
- Take your time to select your **ADMS provider** – Look for a partner, instead of a provider
- Take your time to prepare **good blueprints**
- Take your time to collect **accurate Grid data**
- Do not use ADMS project to justify other Utility's investments
- Provide the required **training** to the Utility's staff – implements your own **Change Management** strategy
- Take your time to implement a **Grid Data Quality** assurance procedure
- Consider a **previous pilot project**, with a small set of the network

LESSONS LEARNED: IMPACTS OF PREPARING AND MAINTAINING DATA

Grid Data maintenance and tuning is an every day task:

- **GIS** is the first point for **Grid Data quality assurance**, but not the only one
- Implement a minimum set of GIS **QA rules**: connectivity verification, missing attributes, unreasonable and non-consistent values checking, etc.
- Implement a GIS approval **workflow** and checklist before sending the Grid Data to the ADMS system
- Use the **ADMS Staging** zone to debug DMS results before moving the new grid data to production
- Provide **training** to the Utility's operators with the new grid data – use an OTS (Operator Training Simulator)

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