



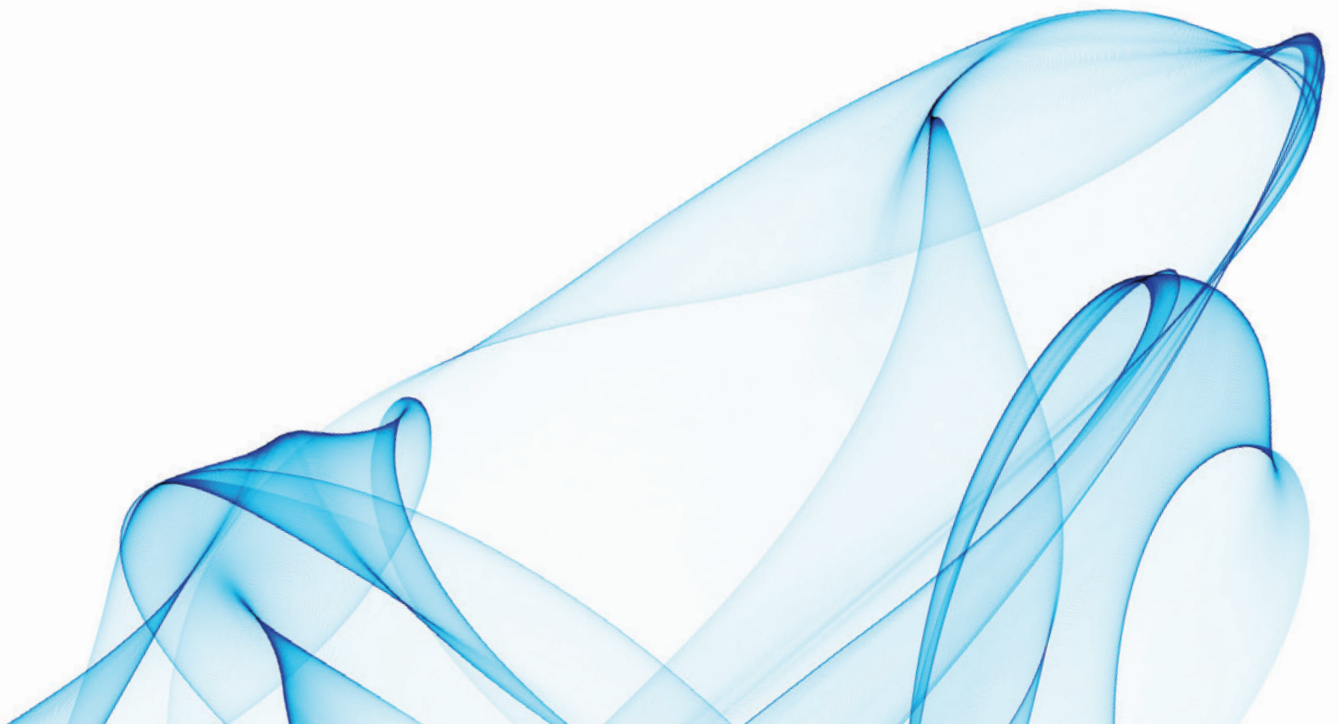
indra

ENERGY & UTILITIES

In**GRID** **ACTIVE GRID MANAGEMENT**

Industrial IoT based real time monitoring & control infrastructure

indracompany.com



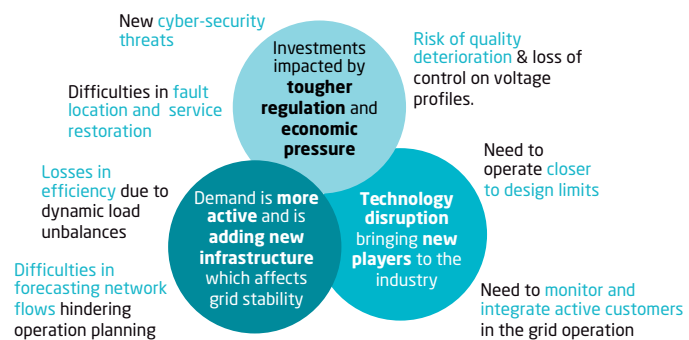
InGRID ACTIVE GRID MANAGEMENT

Support of the dynamic operation of the distribution network

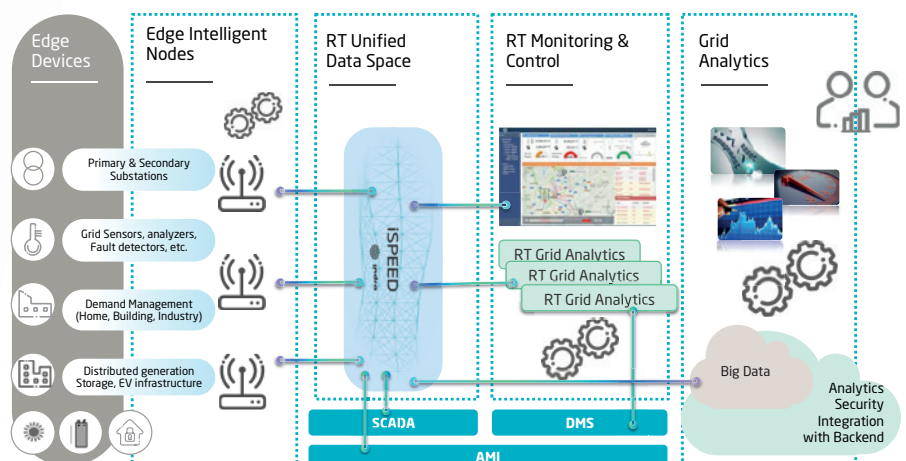


InGRID AGM is Indra's solution for the Management of the Active Grid. The Grid is becoming more complex and is growing faster than the conventional control methods and tools can handle.

Dealing successfully with the challenges coming with this new paradigm is a goal that cannot be met without fundamental changes in how we control a far more complex system. Existing grid monitoring and control infrastructure was not designed for this fundamental transformation.



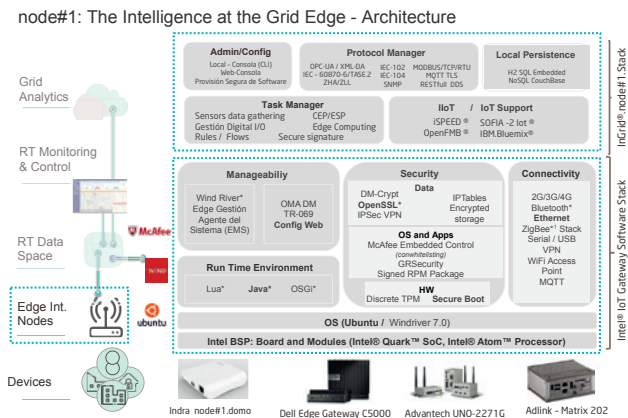
Utilities need real-time monitoring & control infrastructure to achieve situational awareness for the 21st century grid, which IoT enables at a much lower cost than solutions based on traditional SCADA technology (due to the fact that Back-Office integration is expensive and time-consuming), using more scalable and distributed components.



Indra has developed, in partnership with Intel, an open architecture to achieve this goals enabling:

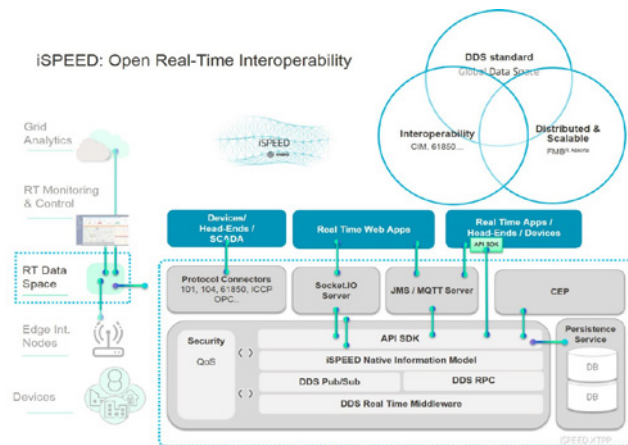
- Proactive Grid Operation.
- Situational Awareness.
- Fast Edge Decisions.
- Seamless Interoperability.
- Modularity / Scalability.
- Hybrid Central / Distributed decisions.
- Zero Touch Deployments.

The proposed architecture is composed of 4 basic levels, in a modular architecture:



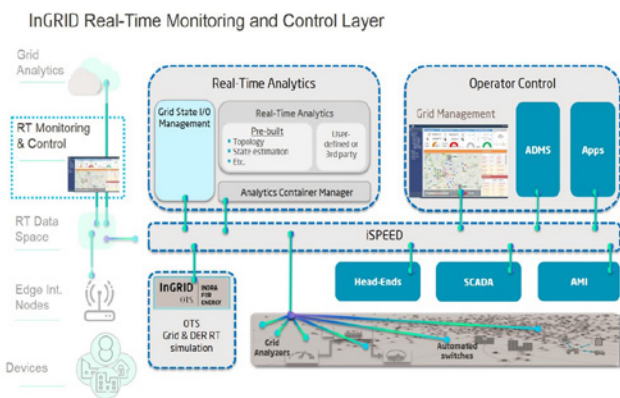
ISPEED: open, real-time interoperability (OT Service Bus). It is a distributed, real-time bus, capable of managing millions of signals per second, integrating all kind of devices and systems in a common infrastructure and providing a secured and reliable communication.

node#1: the intelligence at the Grid Edge. It is a powerful IOT Edge device with Indra software stack that allows interoperable data capture and real time data processing. It also supports multiple protocols.



InGRID Real-Time Monitoring & Control Layer: providing open, scalable and distributed real-time monitoring analysis and control layer covering HV, MV and LV networks. It includes the following features:

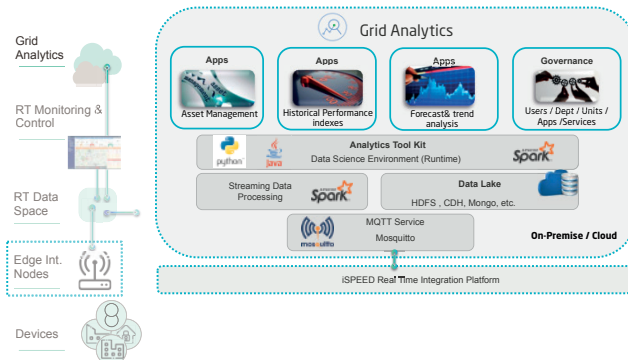
- Connectivity engine for network analysis.
- OTS capabilities for what-if analysis.
- Open real-time analytics container.



Big Data Analytics: improving assets performance monitoring and grid management. It includes the following features:

- Integration with IoT Platforms.
- Big Data capabilities.
- Data discovery & machine-learning algorithms.
- Analytics on massive data repositories.
- Open discovery of trends and causality.

Big Data Analytics: Improving Assets Maintenance, Monitoring Global Trends and Predicting the Evolution.



Active Grid Management Use Case: MV/LV Monitoring

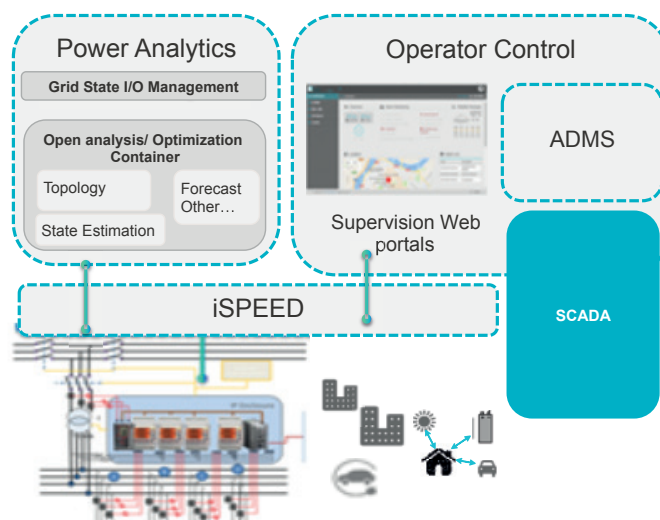
THE NEED

Disruptions are happening in the MV/LV levels: **distributed generation, EV, storages integration, prosumers demanding active roll...** precisely where utilities have scarce or non-existent monitoring nor control capacity.

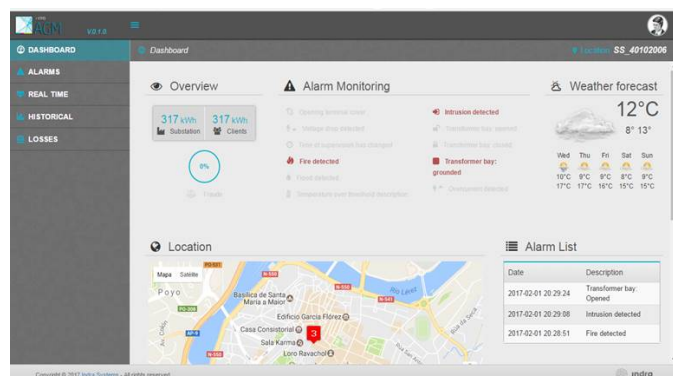
Extending **current SCADA** monitoring & control to MV/LV is proving **technically challenging**, and **expensive** given the "last mile problem" which multiplies the number of points and **assets to manage x 1000** and the number of **signals to manage by x 10000**.

THE SOLUTION

- Integration of MV/LV grid measurements and sensors feed into a comprehensive operation.
- Real Time monitoring of the MV/LV grid flows, demand/ generation, status and events (faults, voltage).
- Real Time monitoring of SS assets identifying potential risks: transformers, water, fire, intrusion.



InGRID AGM - Monitoring Portal: Distribution System Operators (DSO) develop MV/LV situational awareness and the grid becomes visible and smarter.



Min Volume / Max value information provide

- Automatic calculation of Performance Operation indexes: voltage /intensity limits, losses, reactive power, quality...
- Flexible Alarms and warnings generation.
- Measurements Consistency Checks.
- Assets security .
- Detailed communication of SS information under anomalous conditions minimizing the volume of unnecessary information sent.
- Domain balance calculation and generation of Fraud/losses alarms.

Ready to support advanced distributed control functions

- Transformers advance temperature control.
- 24 hours forecast of transformer load evolution.
- Automatic Location and isolation of faults based in available information: Smart Meters (CT), protections, Fault detectors.
- Automatic control of Volt/Var acting on distributed generation & tap changers available in the domain.
- Automatic distributed generation connection/ disconnection control under fault condition.

Active Grid Management Use Case: Distributed Energy Resource (DER) Integration

THE NEED

Increased penetration of **Distributed generation, Storage, Electric Vehicle** and **new business models** based in aggregation of DER are starting to impact significantly in grids' reliability and efficiency:

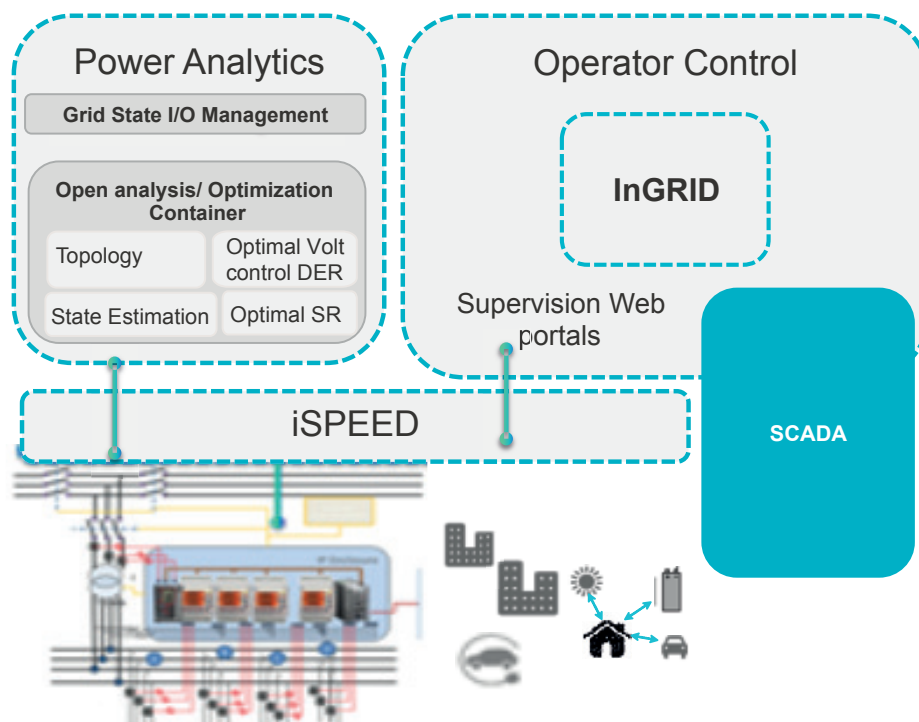
- Quality deterioration: Loss of control on voltage profiles.
- Difficulties in fault location and service restoration.
- Losses in efficiency due to dynamic load unbalances.
- Changes in power flows through MV/LV.
- Transformers/lines out of the design conditions shortening assets life and increasing failure rates.
- Difficulties in forecasting network flows hindering operation planning.



THE SOLUTION

1. DER exchanging information in RT with DSO.
2. DER monitoring and control capacity as an extension of DSO.
3. DSO actively coordinates DER in grid operation:

- DER as voltage control agent.
- Active assets in service restoration.
- **RT monitoring MV/LV lines quality and performance with DER.** Voltage /intensity limits, losses, reactive power, quality, risks, breach of operational limits.
- **Preventive operation.** Next minutes/hours forecast of grid evolution identifying near-future risks enabling response planning.
- **Automatic Voltage control using DER.**
- **Acting on:** Transformers taps, FACTS, and DER available in the domain.
- **Coordinated Service Restoration based on DER** to enable faster restoration.
- **Automatic and optimal Request and coordination of DER or Aggregation grid services** in Transactive Local markets.

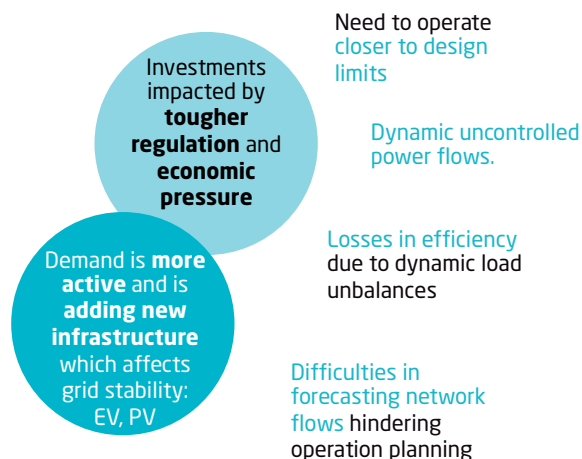


Active Grid Management Use Case: Asset Condition Monitoring

THE NEED

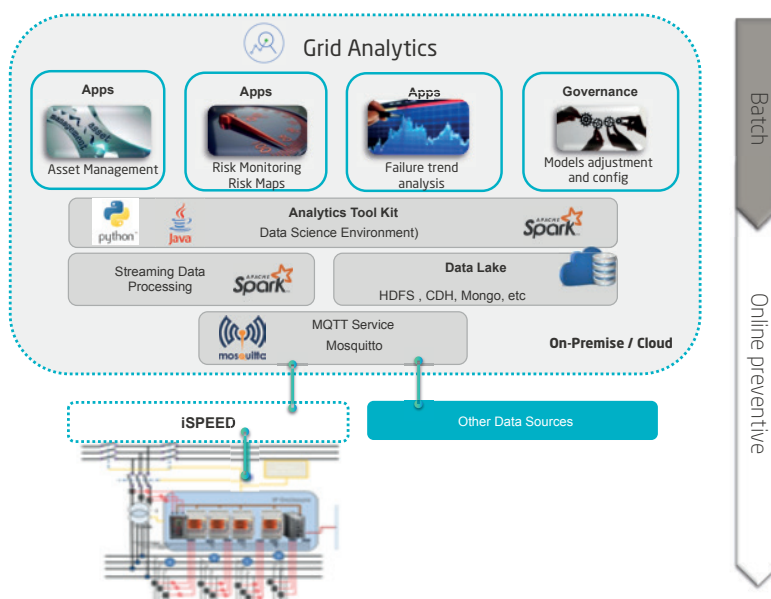
The appearance of DER in the MV/LV out of the control of the grid operator, produce severe disturbances in the power flows and quality parameters on MV/ LV, **forcing grid elements to work out of design conditions, shortening its life and directly impacting the reliability of the supply.**

Under these circumstances is basic attaining a cost-effective strategy to dynamically monitor and prevent the risk of failure of the grid-distributed assets.



THE SOLUTION

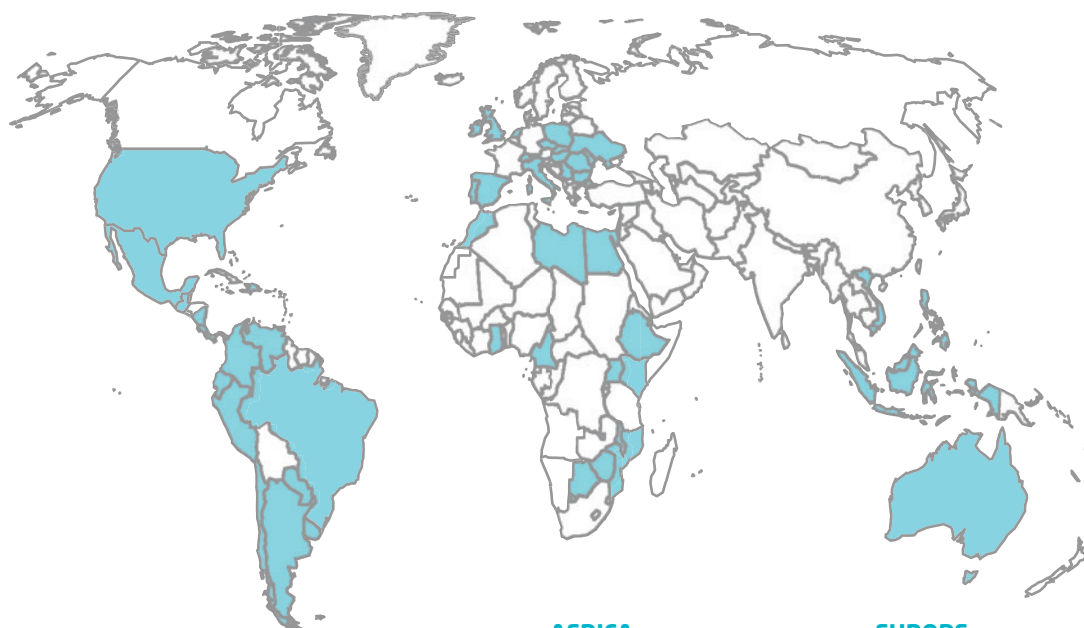
Assets conditioning models adjustment based on **advanced pattern recognition algorithms** and cumulative degradation due to out-of-design operational conditions.



- Failure risk maps.
- RT evaluation of failure risk: early warning of equipment failures.
- Automatic protecting actions.
- Monitoring based on:
 - **HV/MV Primary substation transformers and automatic switches:** electrical, thermal & partial discharges measurements, gas measurements.
 - **MV/LV transformers:** Electrical measurements (MV/LV analyzers) + transformer temperature + ambient temperature.



Over **140 Utilities** use Indra's technology solutions.



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Ecopetrol (Colombia)
Cemig (Brazil)
Elektro (Brazil)
OSE (Uruguay)
UTE (Uruguay)
AES SUL (Brazil)
CPFL (Brazil)
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Cadafe (Venezuela)
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Disnorte-Dissur (Nicaragua)
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PLN (Indonesia)
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GNF (Spain/LATAM)
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Viesgo (Spain)
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- ✓ More than **100 million customers** managed through Indra's commercial systems.
- ✓ More than **700 Energy Companies** are managed with Indra's solutions.
- ✓ More than **70 Utilities** use our Distribution Systems.



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