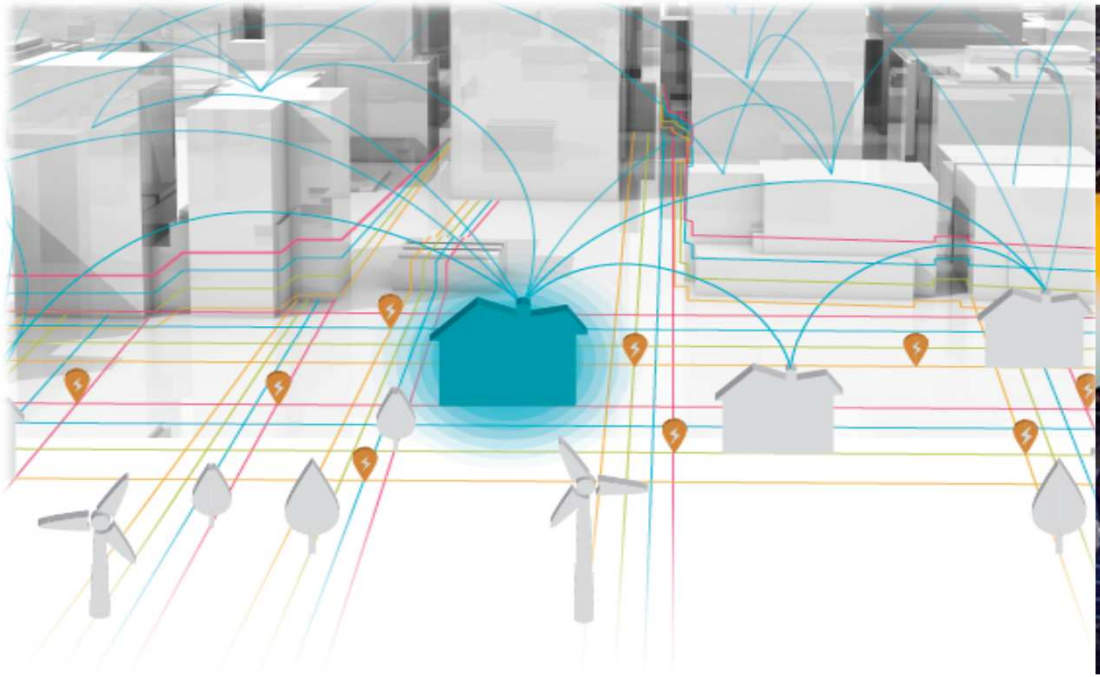

Indra Energy Market

DIGITAL IOT ENERGY SERVICES FOR THE SMART HOME WITH INDRA.NODE#1

26th October, 2015.

indra

ORACLE OPEN WORLD 2014 September 28 - October 2 San Francisco, CA

OURSELVES.

Leonardo Benitez is the Head of the Utilities Division in INDRA, a technology company headquartered in Spain, with presence in more than 140 countries and a broad product & services portfolio in the Energy & Utilities Sector.

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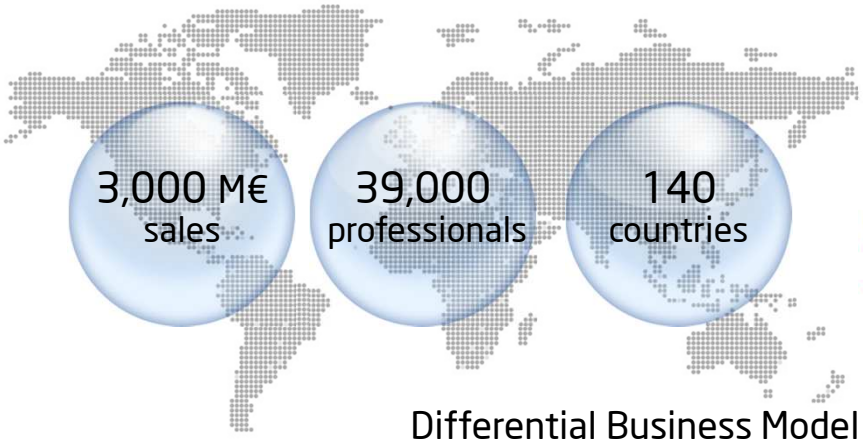
INDRA PROFILE

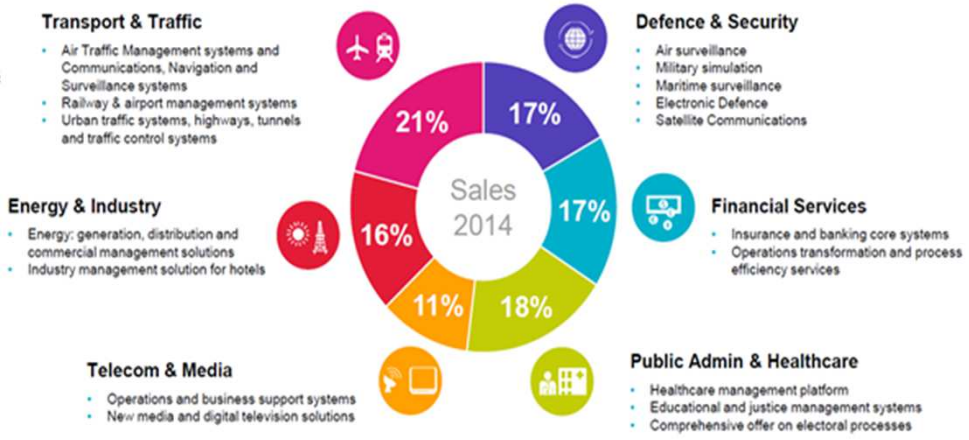
No. 1 IT company in Spain and one of the leading companies in Europe and Latin-America, with a high growth in USA, AsPac & Africa

Own Technology **R&D investment: 6-8% of sales**



Differential Business Model based on Innovation

Presence in all vertical sectors **Diversification**



INDRA ENERGY PROFILE

Key figures

- 380 M€ revenues
- 5,000 professionals
- Current operations in +45 countries
- Over 500 on-going projects

Value proposition

Knowledge

Over 25 years experience in projects and services in the sector of energy companies.

Partnership

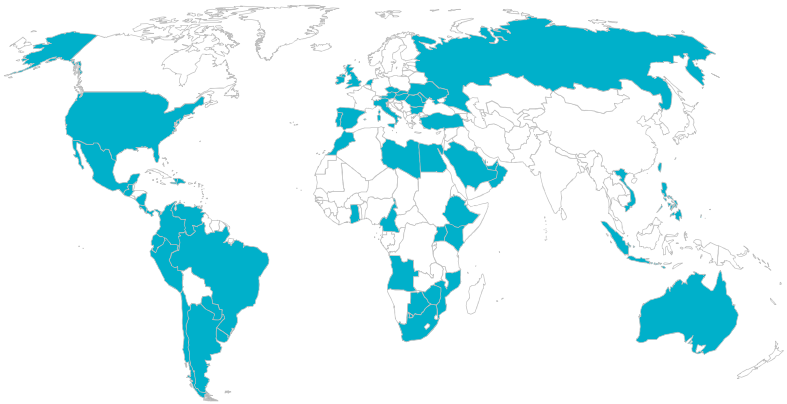
Indra is a **partner of key software vendors** within the energy sector. Some of them are:

ORACLE · GE · Allegro · OSIsoft · esri · SAS · salesforce · SAP

End-to-end services: Consultancy - Digital Transformation - IT Solutions & services - IT Outsourcing - BPO

- InGEN (Plant Management): Generation & Renewable Energy; Energy Management
- InGRID (Distribution Management): Transmission & Distribution; Energy Services
- InCMS (Customer Management): Retail /Customer Management
- InDROP (Water Solutions): Water Specific Solutions

Sample current operations: geographies and main clients



AMERICA: Exelon (USA), Chevron (USA), Sempra (USA), NRECA (USA), Repsol (USA), AES (Global), CFE (Mx), Pemex (Mx), Mitsui (Mx), Ecopetrol (Col), Electrocosta/caribe (Col), EPSA (Col), Petrobras (Br), Eletrobras (Br), Elektro (Br), Light (Br), Sedapal (Per), Petroperú (Per), YPF (Ar), CGE (Ch), Corpoelec (Ve), Petroecuador (Ec).

EUROPE: Enel (Global), GNF (Global), CEZ (Global), Repsol (Global), Eon (Sp), Iberdrola (Global), Acea (It), Terna (It), Galp (Pt), EDP (Pt), REE (Sp), RWE (ChR), GE (UK).

AFRICA: ONEE (Ma), KPLC (Ke), Eskom (SA), ECG (Gh), EDM (Mz).

ASIA-PACIFIC: Meralco (Ph), Mayniland (Ph), PLN (In), Caltex (Au), Origin (Au).

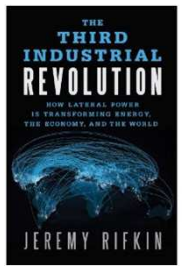
THE WORLD IS CHANGING

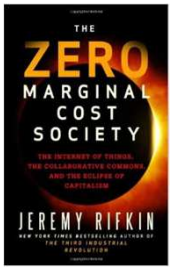
- ✓We live in a world surrounded by **new trends** and subject to **structural changes** where **the evolution of technology** plays a differential role. Actions that were once unthinkable are now part of our daily life.

- ✓Because the physical world and cyberspace are deeply related by the meaning of the term "**information**", now it's a common place refer to this new emerging world as "**Infosphere**".

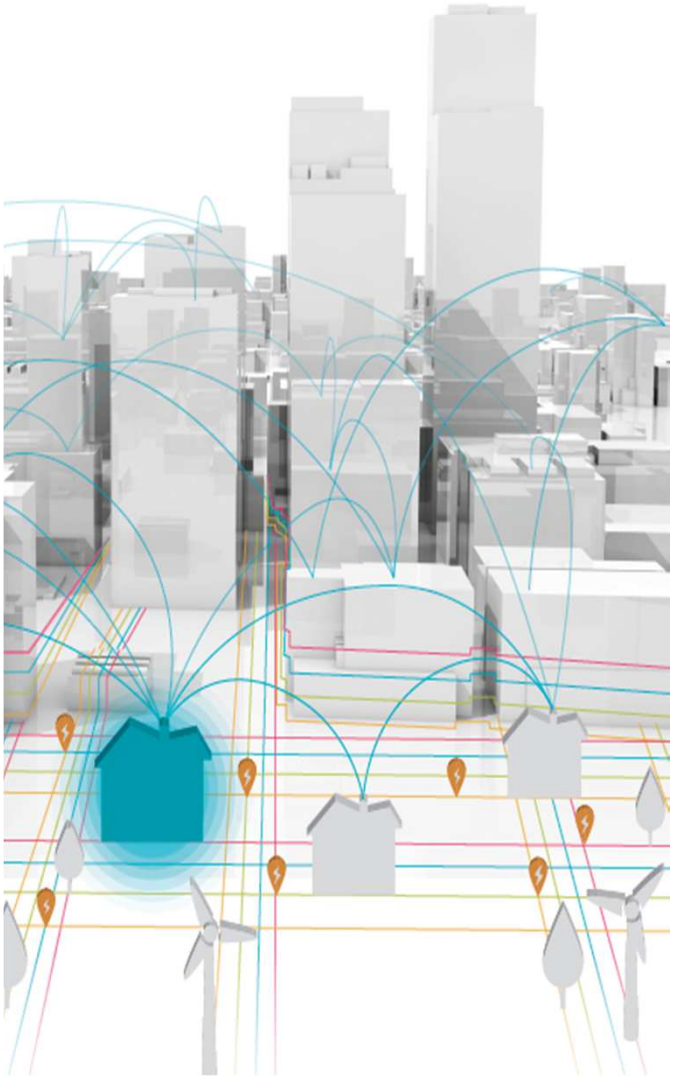
- ✓Transformation towards a **digital, intelligent world** will only be possible if **we modify** the way we **produce**, **distribute** and **consume energy**.

> "A new way to deal with **energy** is the main **assumption** of a **digital world**."
>
> J. Rifkin





THE INFOSPHERE APPROACH TO THE ENERGY MARKET



- 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 microgrid 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.

TRANSACTIVE ENERGY

"A set of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using value as a key operational parameter."

GridWise® Architecture Council

TRANSACTIVE ENERGY

CONTROL FRAMEWORK

- Disaggregation of control to account for local optimization & decisions
- Multi-tier control coordination
- Scalability for large number of participants

COORDINATION MECHANISMS

- Simplified mechanisms for integration of:
  - Markets
  - Advanced Grid Controls
  - DERs
  - Energy Services
  - Responsive Loads

MARKET MECHANISMS

- Reflect value in exchangeable terms (price)
- Effectively allocate available resources and services in real-time

CONTROL GATEWAYS & SENSORS

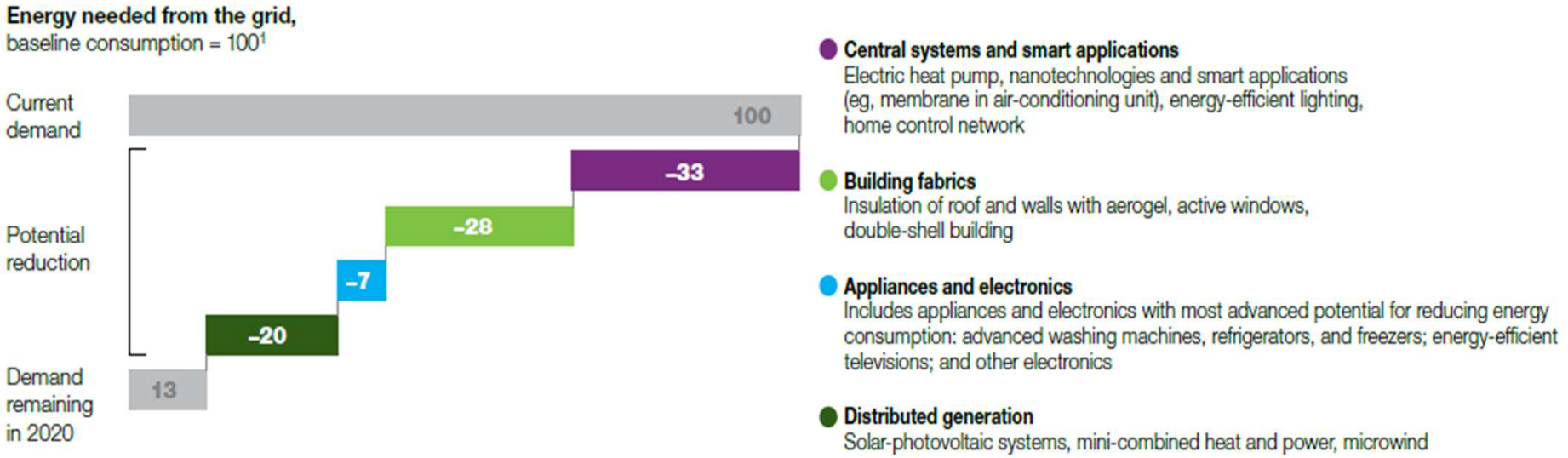
- Low-cost control and communications gateways and sensing/control devices.
- Extensive participation of end-use prosumers, devices & systems
  - Smart Home
  - Electric Vehicle
  - Batteries & Storage

GridWise® Architecture Council

UTILITIES & THE HOME OF THE FUTURE

Consumption behavior is changing very rapidly due to the application of new technology (1)

- A new home could consume **90% less energy (whether electricity or gas)** and far less water in 2020 from the grid than it does today.
- For existing homes, the **energy saving opportunity may reach 35 to 40 percent** of the present consumption.
- **Utility margins may fall by 30%** in a scenario where homes become almost energy neutral.
- Business as usual is **no longer an option** for most Energy Utilties.

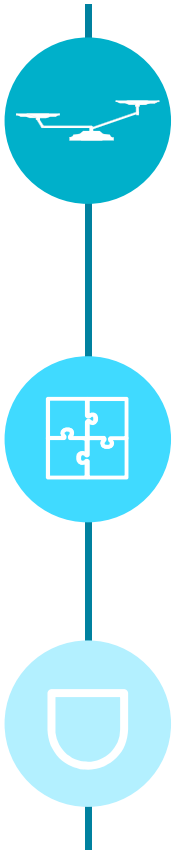


(1) Source: Battle for the Home of the Future (G.Busnelli, V. Shantaram, A.Vatta - Mc.Kinsey & Company)

UTILITIES NEED TO INTEGRATE THE PROSUMER IN THE MODEL

Utility role as an energy supplier is **necessary** but **not sufficient. Tomorrow's energy** must be **intelligent**, and a **change in** the value chain position is required.

Consumers are increasingly well **informed**, **connected** and **committed to sustainability**, and they demand new value-added services.



Enable new Smart Energy models

- Prosumption / Distributed generation
- Integration of electric vehicles and battery storage
- Demand-side management
- Integration with Smart Grids

GRIDWISE™ Transactive Energy

Create new value added services

- New revenue sources to overcome shrinking margins and demand reduction
- Opportunity to build new business lines on top of the natural services of the Utility
- Opportunity to create loyalty in existing clients and attract new.

Smart Energy Services

Defend yourself against competitors

- Intrusion of other companies in the energy business (eg.: Telcos, Escos)
- New digital players taking positions at homes

New Competitors

SMART HOME FACILITATES THE APPEARANCE OF TRANSACTIVE ENERGY EVOLVED MODEL ENABLING THE RISE OF PROSUMERS

Smart Home allows to:

Prosumption/ Distributed Generation

Operate **generation systems** located in **consumption points** (PV panels)

- **17%** Prosumption power installed Germany[1]
- **20%** Prosumption PV power installed USA[2]

Plug & Play Infrastructure Development

Manage **electric vehicles charging points** at homes through de-centralized energy sources (PV, batteries)

- **20M** of Electric Vehicles **2020**[3]
- **80K**[4] Tesla **Batteries** reserved in 5 days

Demand Response Management

- **50M** smart meters **USA**[5]
- **<30GW** Savings /year[6] **USA**

Install **smart meters** and **energy efficient devices**

Set **Demand Response** models to assure the supply-demand balance

Smart Network Management (Smart Grid)

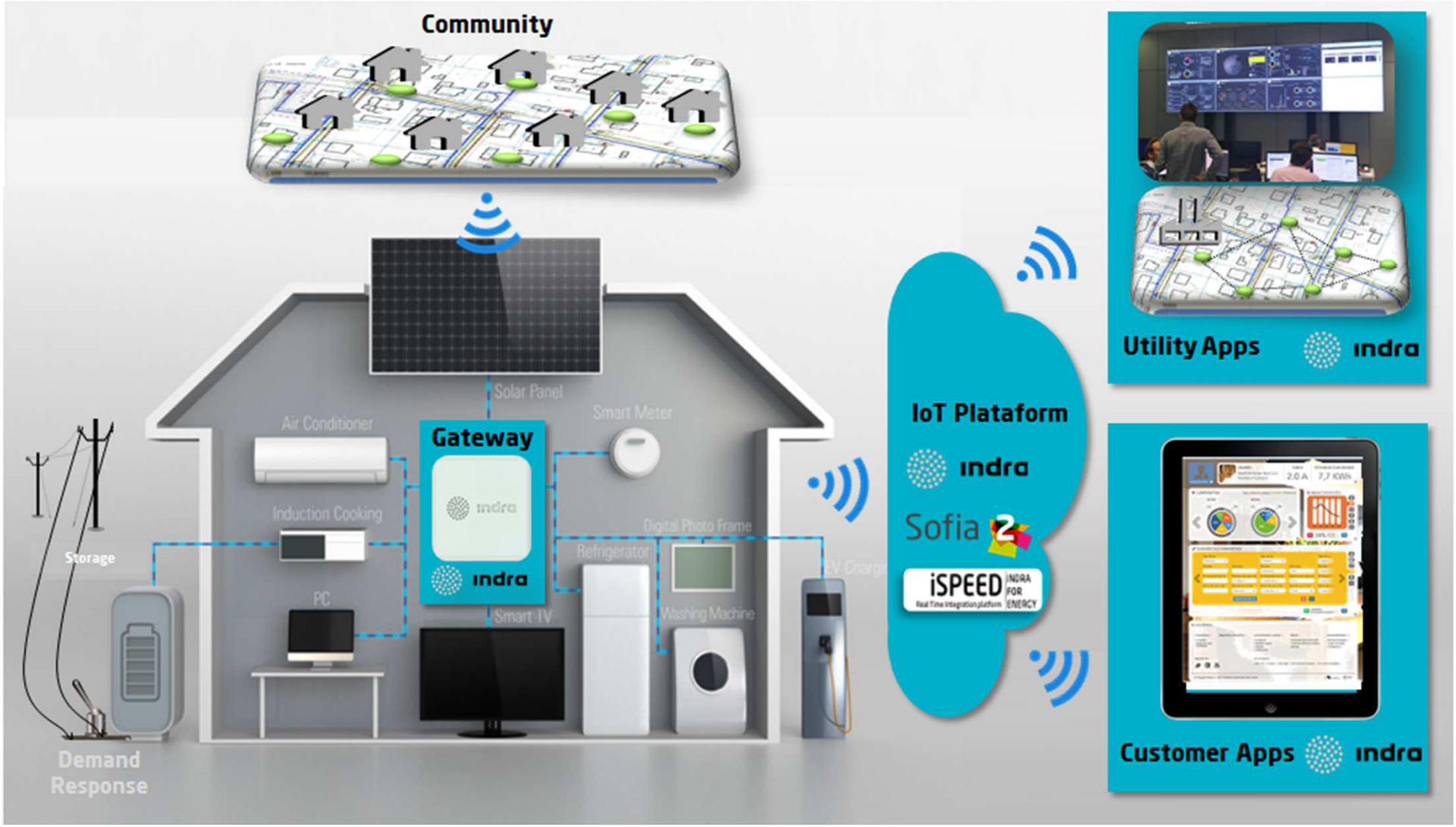
- **4,1 GW** worldwide capacity of **Microgrids** 2020[7]

Control **end-to-end Smart Grids** through **sensors**, **controllers** and **actuators**

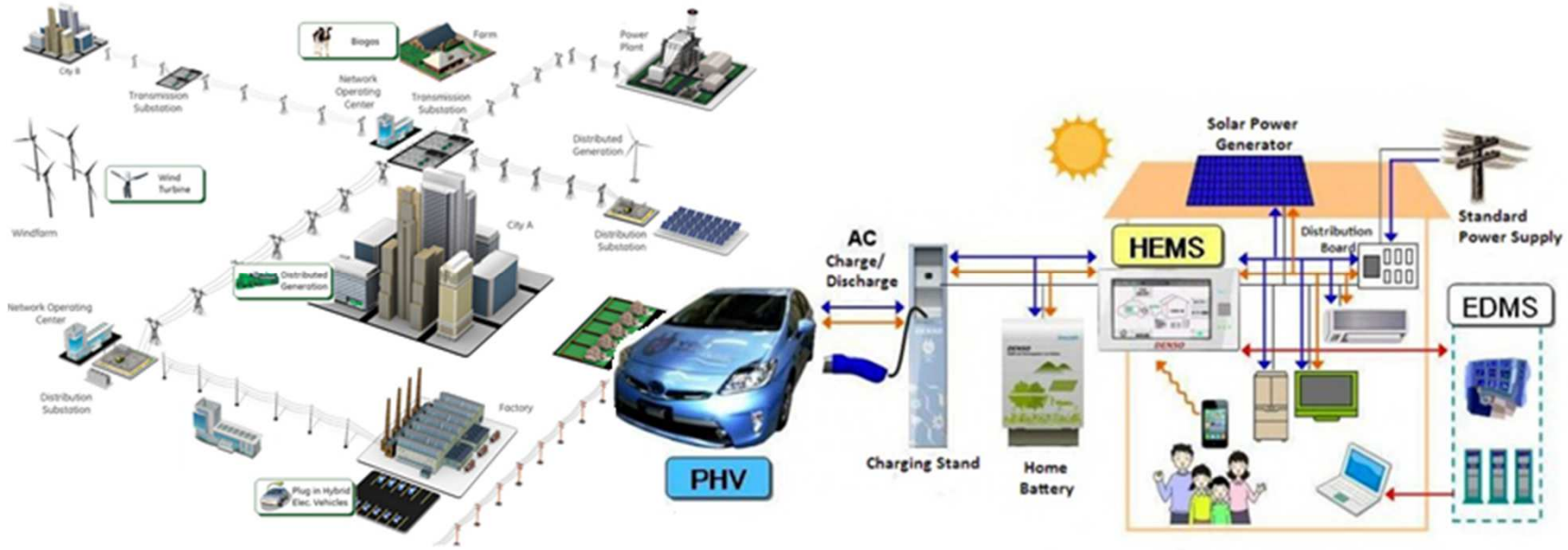
(1) Source: Analysis by The Boston Consulting Group. Data: Eurostat, SEIA, EIA, IEA, Department of Energy & Climate Change of United Kingdom, ANEEL, EPE
(2) Source : Datos de GreenTech Media
(3) Source : International Energy Agency, Electric Vehicle Landscape to 2020
(4) Bloomberg: Tesla's Battery Grabbed $800 Million in Its First Week
(5) Source : American Recovery and Reinvestment Act (ARRA)
(6) Source : Smart Energy Demand Coalition & Federal Energy Regulatory Commission (includes both companies and individuals)
(7) Navigant Research Report

Digital IoT Energy Services for the Smart Home with Indra.Node#1

SMART HOME PLACES PROSUMERS IN THE CENTRAL POSITION OF THE SMART ENERGY ECOSYSTEM



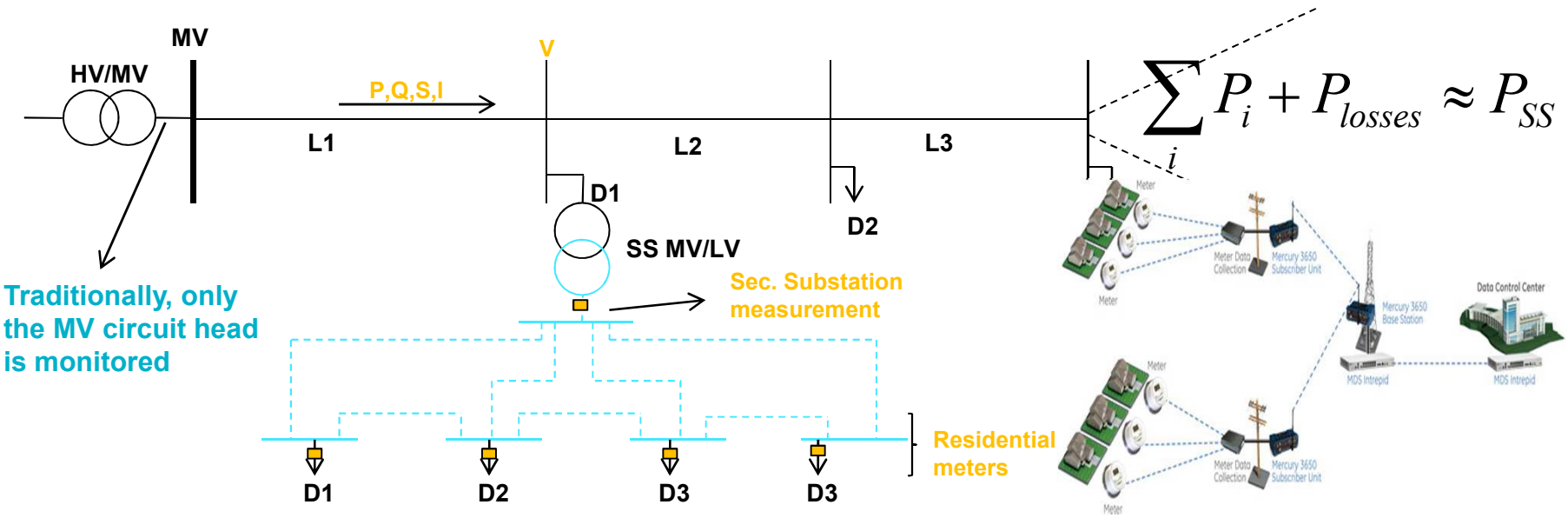
INTEGRATED WITH THE SMART GRID



The **Transactive Model** relies 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 based on their perception of the true value of the service**.

AND ALLOWING TO MAKE THE NETWORK VISIBLE

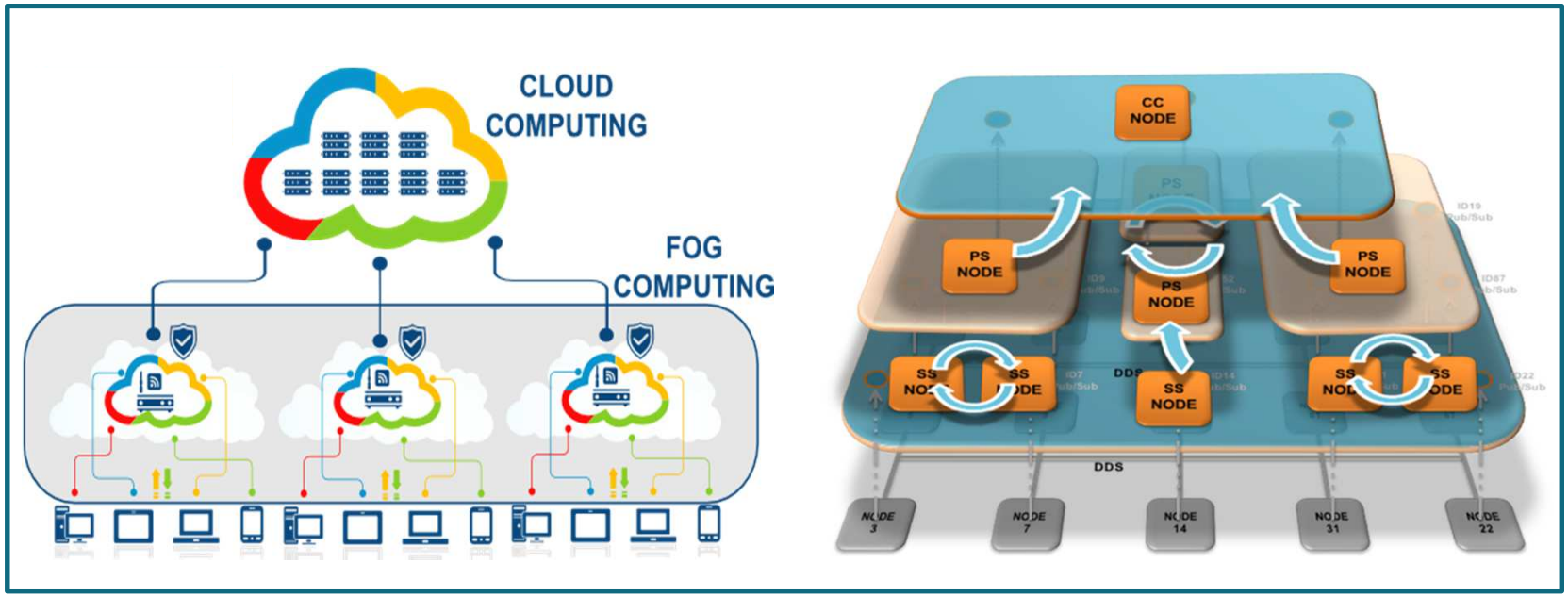


In a traditional system, **only MV feeder breakers are monitored** (through the Scada System). Consequently, **nodal demand can only be estimated** based on the installed capacity. In a Smart Grid, consumptions come from **Smart Meters** as well as other information captured from **multi-purpose sensors**.

- 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.

DECISION NEED TO BE TAKEN AT THE EDGE OF THE NETWORK, MOVING INTELLIGENCE FROM CLOUD TO NODES.

To make **transactive energy** possible, **processing capabilities (HW & SW)** needs to be deployed at the different levels of the distribution network (primary & secondary substations, MV & LV lines) and **integrated with Smart Homes** and the Utilities Control Centers.



Layers of intelligence at the edge of the network to perform analytics and make decisions on-site, instead of communicating and processing everything in the cloud.

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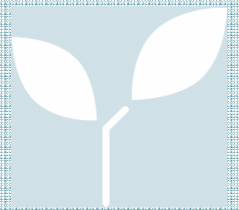
KEY POINT: BEYOND GATEWAYS AND CLOUD (NODE#1 + IOT PLATFORMS).

COMMISSIONING THE FIRST DEPLOYMENT: ISSUES AND CHALLENGES.

THERE ARE REGULATORY, SOCIAL AND ECONOMIC ELEMENTS THAT ARE AN INCENTIVE TO EXPLOIT THIS OPPORTUNITY

ENERGY EFFICIENCY



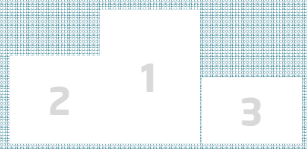
25.000 Million € [1]

Until 2020 in Europe and USA

Increasing regulatory momentum

- **Europe** directive **2012/27/ EU:** The EU has set itself a **20**% **energy** savings target by **2020**
- **USA: PURPA** promotes measures and incentives for users and utilities; **ARRA** invested **$4.500M** to **finance** the installation of **smart meters[4]**

COMPETITION



60.000 Million € [2]

Smart Home market value in 2018

Appearance of first Smart Home solutions

- **2014: SUMA Energy Efficiency Fund I** has disbursed a size of between **€30.000 and 40.000 million.**
- **2014: Telefonica** will license **AT&T** home security technology for limited trials in Europe.
- **2015: British Gas** acquires **AlertMe** for **£44M** in order to lead the UK's **Smart Home** market.

CLIENTS

1.060 Million devices[3]

Connected to a Smart Home system in 2017

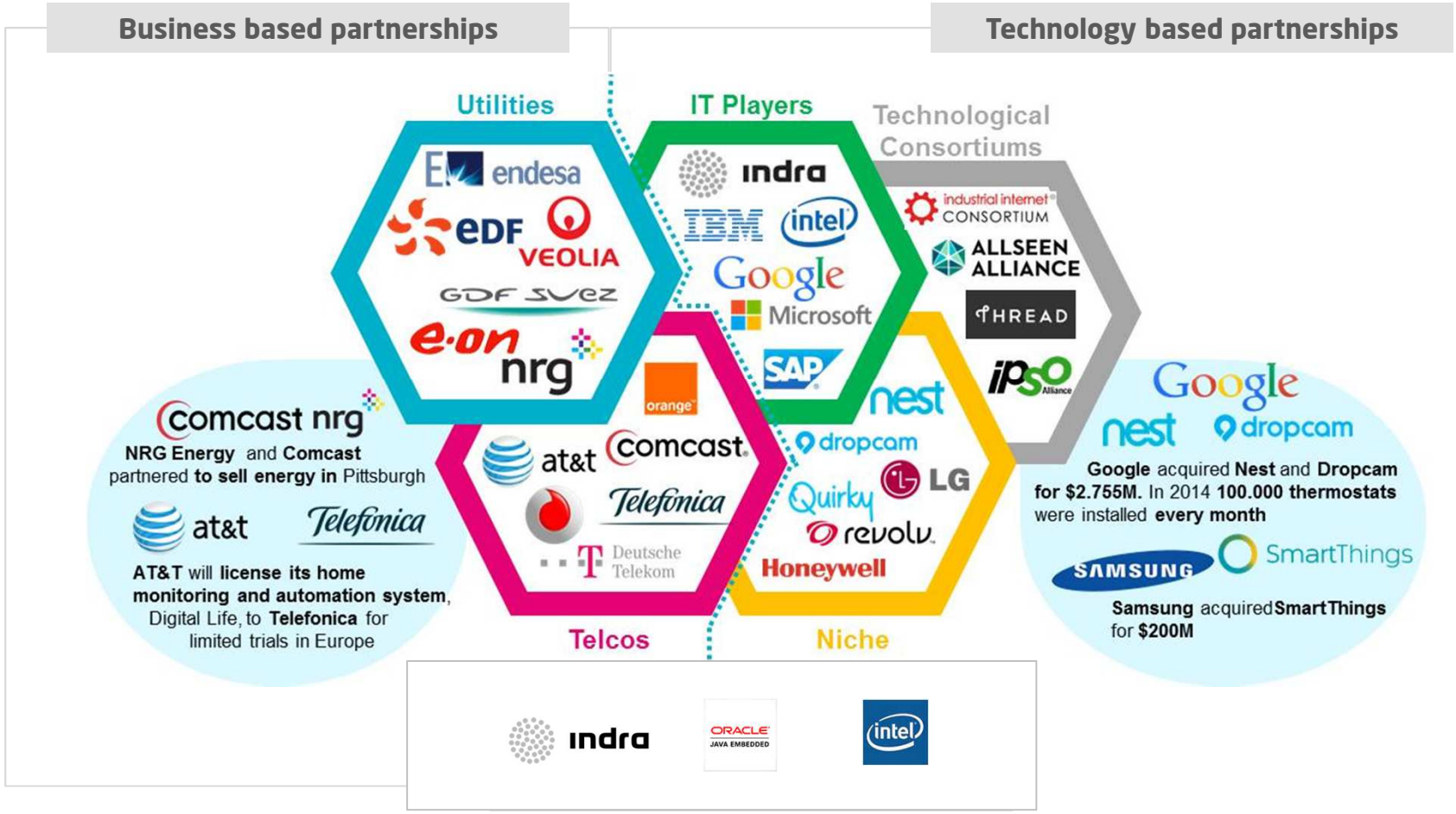
Demand of energy efficiency devices

- **Nest** deployed more than **100.000 thermostats every month** through 2014
- **Telefonica** reaches an agreement with **UK Government in 2015** to deploy **53M smart meters** during the next 15 years

(1) Source: Smart Energy Orkestra y BCG Study - Efficiency Market in tertiary sector in Europe for 2020 = 14.500M€ (Δ 13% annual) and in USA=10.400 M€ (Δ 10% annual)
(2) Source : Juniper Research finds- Existing market will be doubled in 2013 (33B$) at yearly rate of 8B$
(3) Source : Gartner
(4) Source : American Recovery and Reinvestment Act of 2009 (ARRA)

PLAYERS ARE MAKING STRATEGIC MOVES TO ACHIEVE A LEADING POSITION…

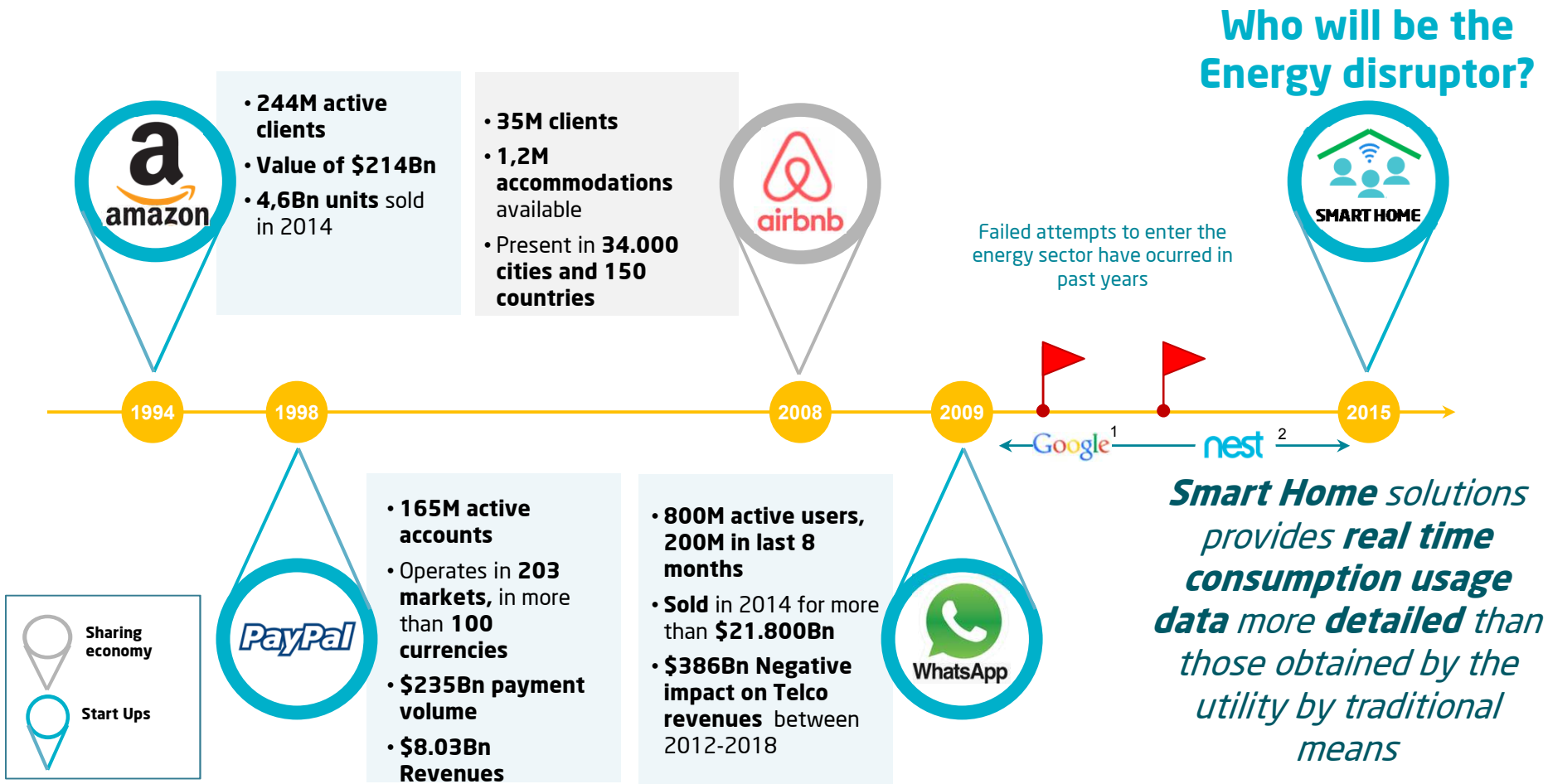
The market is **characterized by a large number of specialized players**, whom engage in **acquisitions and alliances to complete the offer** of services and products to the end user[1].



1 Source: Indra Business Consulting analysis (web sites, news, …)

… AND THIS COULD BE THE ONSET OF DIGITAL DISRUPTION IN THE ENERGY MARKET

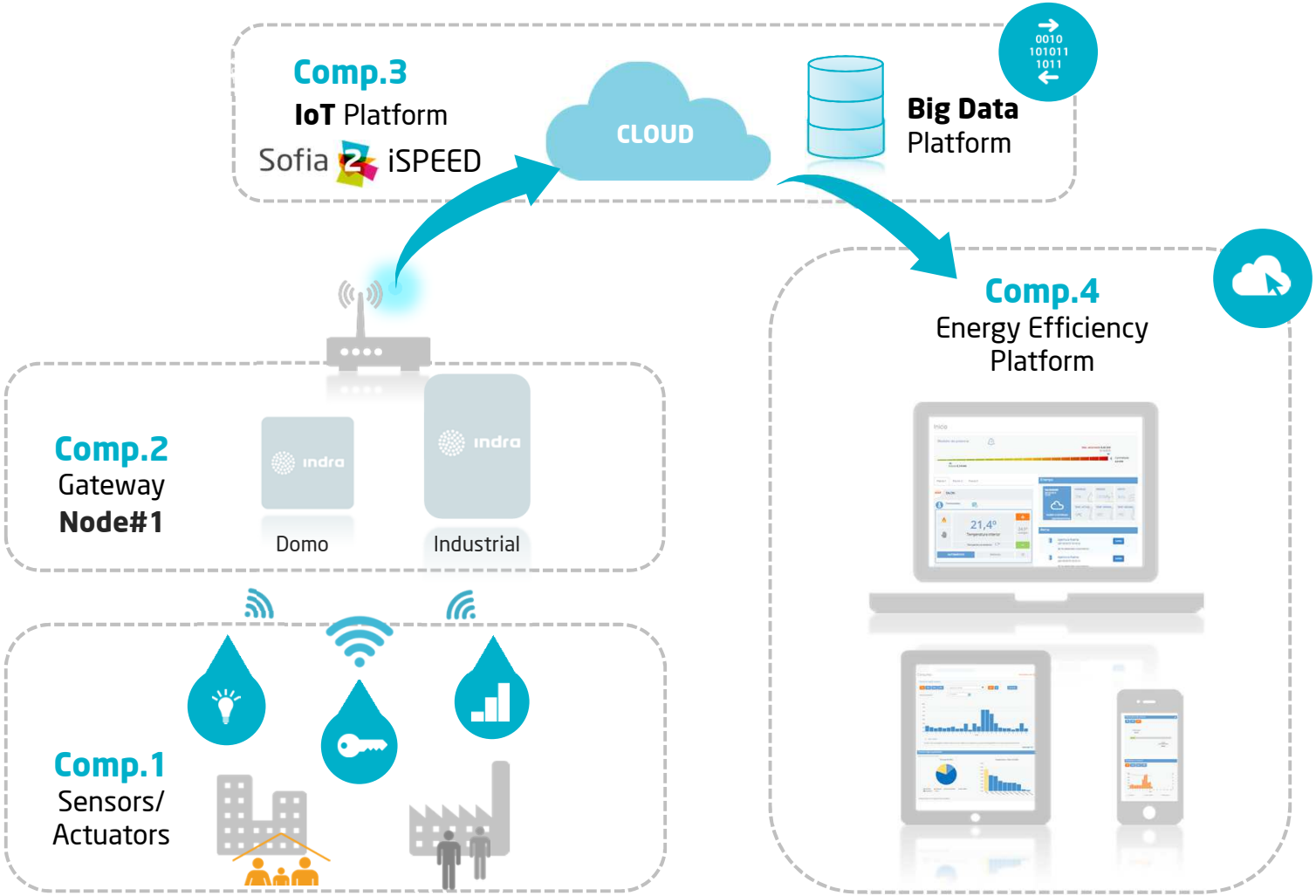
Leading companies have been challenged by **niche and StartUp companies,** which are able to **break into their market** with apparent ease by offering better **user experience and an optimal use of resources.**



Note 1: In 2009 Google launches PowerMeter, the solution for data gathering from smart meters and its storage in the cloud with very low acceptance on the market
Note 2: Nest Europe and several utilities tried to commercialize Nest's products with low acceptance. Google's new strategy involves a Gateway or Hub.

KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

ICT HARDWARE & SOFTWARE COMPONENTS FOR AN ENTERPRISE IOT SMART ARCHITECTURE.



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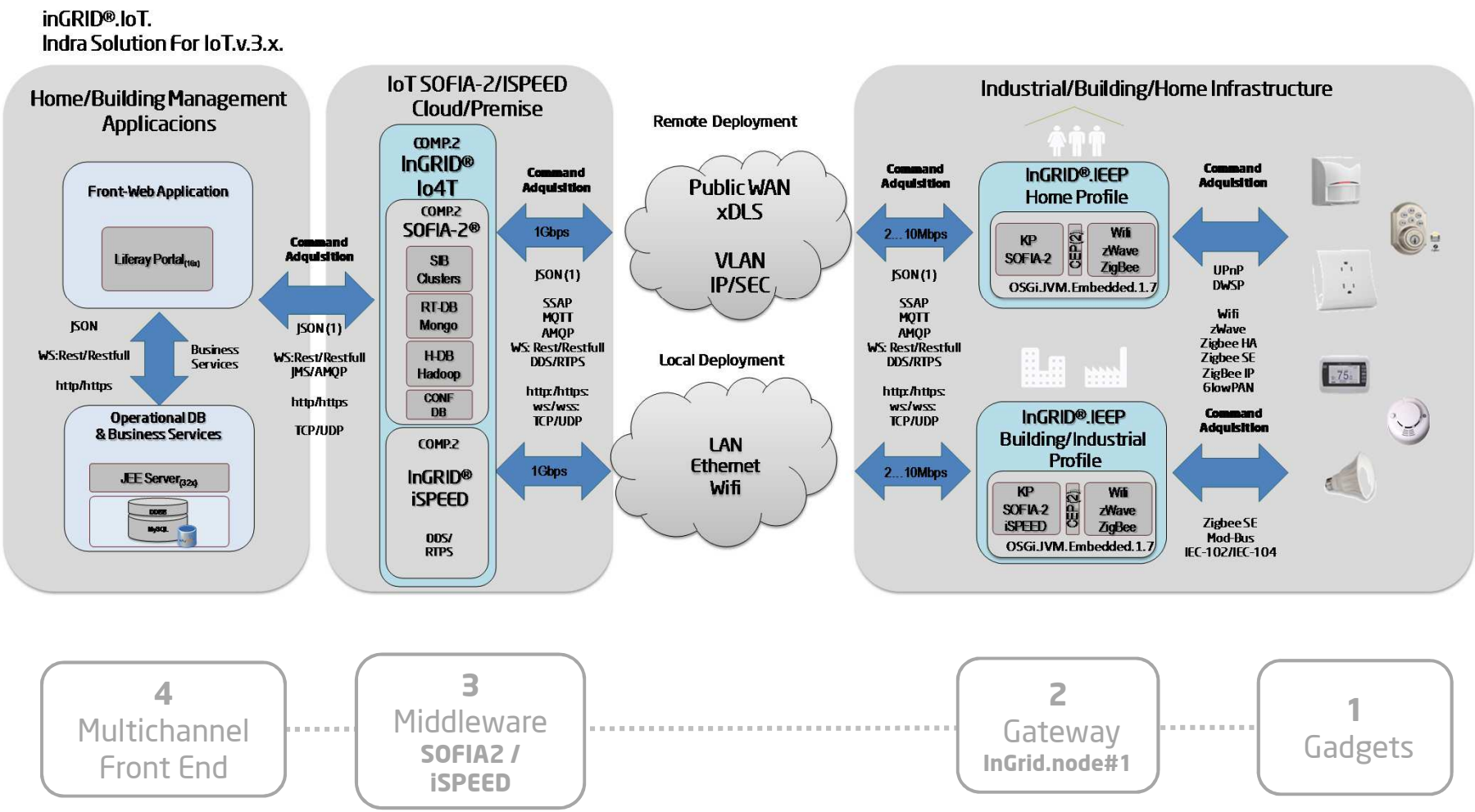

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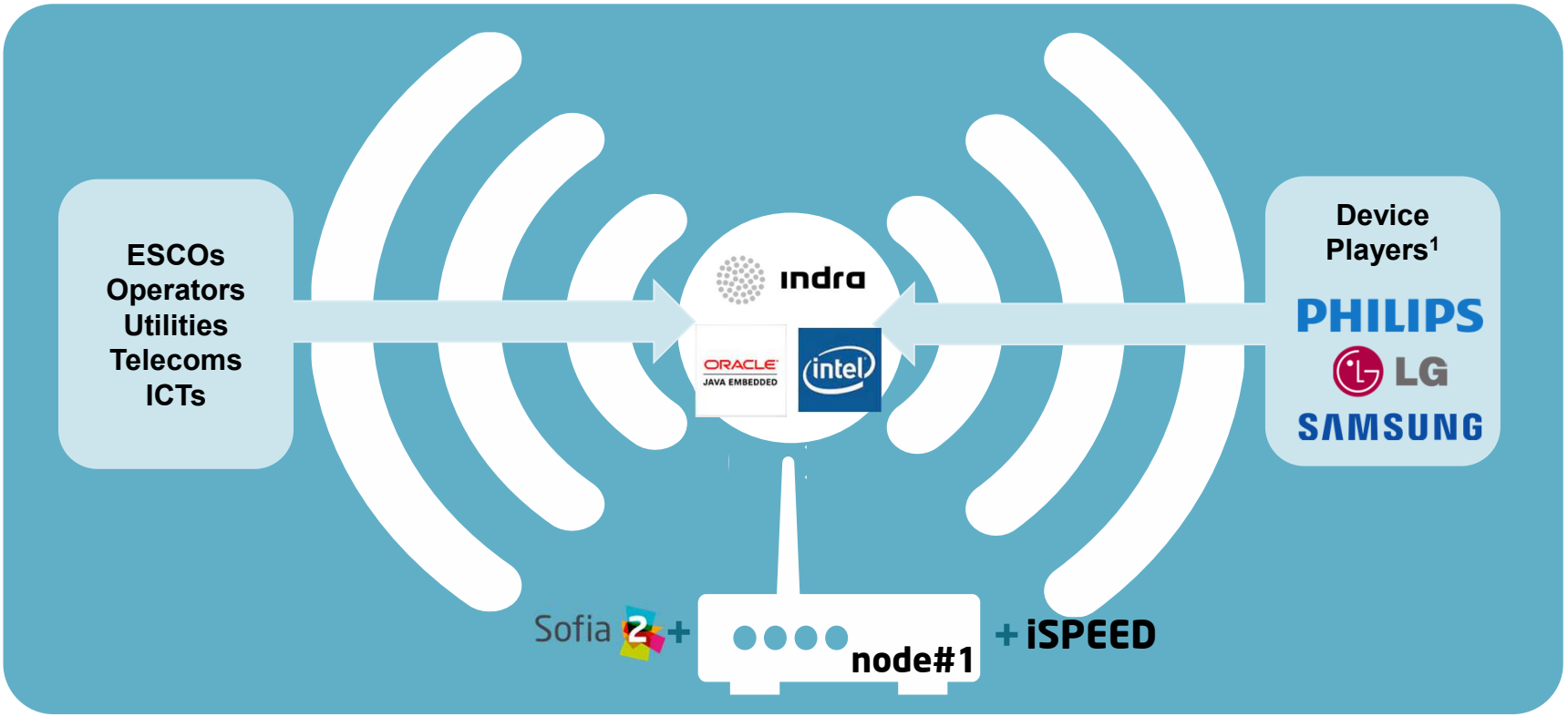
AN INTELLIGENT NODE CLOSE TO THE CUSTOMER, WITH ENOUGH POWER TO MAKE SMART DECISIONS WHEN NEEDED.



Note 1: A global ecosystems was developed fwith more that 13 companies providing devices.

KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

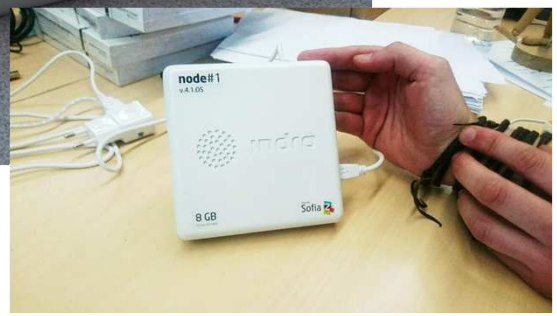
AN INTELLIGENT NODE CLOSE TO THE CUSTOMER, WITH ENOUGH POWER TO MAKE SMART DECISIONS WHEN NEEDED.

*In two different flavors, **Industrial** and **Domestic**...*

A global ecosystem is in development with presently more than 15 companies providing devices ad integrated in the platform.

KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

AN INTELLIGENT NODE CLOSE TO THE CUSTOMER, WITH ENOUGH POWER TO MAKE SMART DECISIONS WHEN NEEDED.



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AN INTELLIGENT NODE CLOSE TO THE CUSTOMER, WITH ENOUGH POWER TO MAKE SMART DECISIONS WHEN NEEDED.

Main processor	Cortex A8 dual core Allwinner A20 @ 1.4Ghz
Graphic proccesor	GPU Mali 400Ghz MP1
System Memory	Onboard DDR3 1Gb
System Flash Storage	Onboard 512KN SPI Flash for Boot Loader Onboard 4 GB eMMC Flash
Ethernet	10/100 base-TX PHY chip
Zigbee	2 x TI - CC2538 Zigbee (CC2538SF53)
Internal I/O Connector	2 x COM Connectors (supports Tx/Rx) 1 x I²C, 8 x UART 4 x SPI Connector for Programming SPI Flash ROM 1 x Internal Mini Card Slot (8Gb,16Gb,32Gb, 64Gb) 1 x Front Panel Pin Header for Power LED
System Front I/O Connector	1 x Power Bottom 1 x Power LED 1 x HDMI
System Rear I/O Connector	2 x USB HOST,1 x USB OTG 1 x DC-in Jack 1 x RJ-45 LAN Port 1 x USB 2.0 OTG Port
System Power	18W AC Adapter
System Chassis Dimension	100 x 100 x 20mm (with RAL-9010 White)
System Operating System	Embedded Linux Yocto.
System Operating Temperature	0 ~ 60°C
System Operating Humidity	0 ~ 95% relative humidity; non-condensing)
Compliance	CE, RoHS, FCC
System Accesssary	1 x Power Cord 1 x AC Adapter with EU Plug

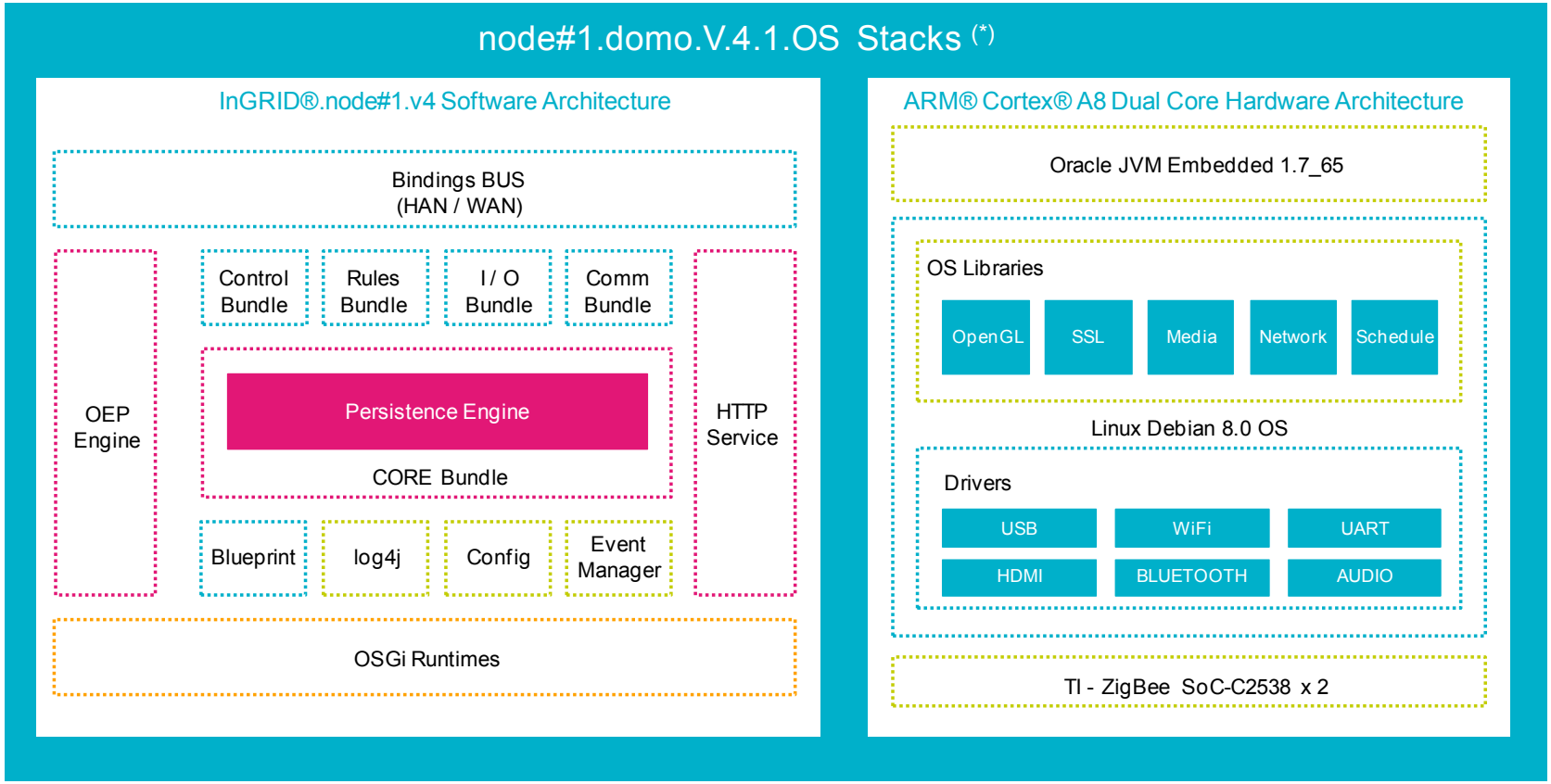
KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

AN INTELLIGENT NODE CLOSE TO THE CUSTOMER, WITH ENOUGH POWER TO MAKE SMART DECISIONS WHEN NEEDED.

Java COMPATIBLE ENTERPRISE EDITION

ORACLE JAVA EMBEDDED

Modular Software Architecture based on Linux, Java and OSGi containers.



(*) node#1.domo follows ENERGOS-PGDIN. *Supporting Business Workflows in Smart Grids: An Intelligent Nodes-Based Approach.* IEEE Transactions on Industrial Informatics, 2012, April.

KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

WITH A NEW VERSION AT THE END OF 2015 BASED ON INTEL IOT TECHNOLOGY (ATOM & MOON ISLAND).

Item		Domestic
System	CPU	Intel® Atom™ Processor E3815 (1M Cache, 1.46 GHz, 5W)
	Chipset	N/A
	Memory	1 GB DDR3L 1066/1333 MHz, SO-DIMM
	Graphics	Intel® Atom™ Processor build-in
	LAN	Gigabit Ethernet, RJ-45 x 1
	Storage	eMMC 4G Micro-SD slot x 1
	BIOS	AMI/SPI
Add-on Device	ZigBee	2 x TI cc2538 (256K Flash)
	Wireless	Not Included
	GPRS Modem	Not Included
Graphics / I/O	Graphics Chipset	Intel® Atom™ Processor Build-in
	Graphics Display	Micro HDMI x 1
	Storage	Micro-SD slot x 1 (Internal connector)
	USB	USB3.0 x 1, Micro USB connector USB device x 1, Micro USB connector
	Display I/O	Micro HDMI x 1
	LAN I/O	Gigabit Ethernet, RJ-45 x 1
	Power I/O	Micro USB
ME Environment	Thermal Solution	Fan less
	Power Requirement	5V DC 2A (for Micro-USB power in)
	Operating Temperature	0°C ~ 40°C
	Storage Temperature	-40 °C ~ 80 °C
	Operating Humidity	0% ~ 90% relative humidity, non-condensing
	Certificate	CE & FCC Class A
Others	OS Support	Yocto Linux 8.0

KEY PONT: BEYOND GATEWYAS AND CLOUD (InGRID.node#1 + IoT Platforms).

TWO FLEXIBLE IOT/II PLATFORMS, FOR DEALING WITH DECISIONS WITHIN SECONDS AND MILISECONDS.

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COMMISSIONING THE FIRST DEPLOYMENT: ISSUES AND CHALLENGES.

CHALLENGE: 175.000 SMART HOMES DEPLOYED IN 2 YEARS

Together with one of the **TOP 3 Power Utilities of Spain**, with **10MM users**, during this month, Indra is commissioning the first deployment of the **Enterprise IoT Smart Home Platform** based on **SOFIA-2** and **Node#1.domo** with the following functional scope

- Managing Energy and Budget **Consumption** in real-time and appiied to every customer.
- **Security** capabilities with motion, open/close windows sensors and IP cameras.
- Managing **Confort** with Smart Thermostats.
- Supporting **alarms**, **programs** and complex **scenarios**.

and technical constraints:

- **175k smart homes** in the following **2 years**, going-live on **November 2015** which considers **8,5%** of the total potential market.
- **10 smart devices per home** (smart plugs, amperimeter clamps, smart thermostat, valves, sensor, etc).
- All the information in quasi-real-time, **sending signal every 5 sc**.
- Number of concurrent gateways to be supported: **6k.**
- **Throw output < 5"** , including big-data query in a $2 \cdot 10^9$ data rows space.
- **85k** concurrent weekly-programs executed in less than **30 sc**.
- **18k** instant alarms processed in less that **2 sc**.
- **Smart Home software CPU usage** at gateway level less than **5%**.
- **Smart Home software Memory usage** less than **512Kb**.

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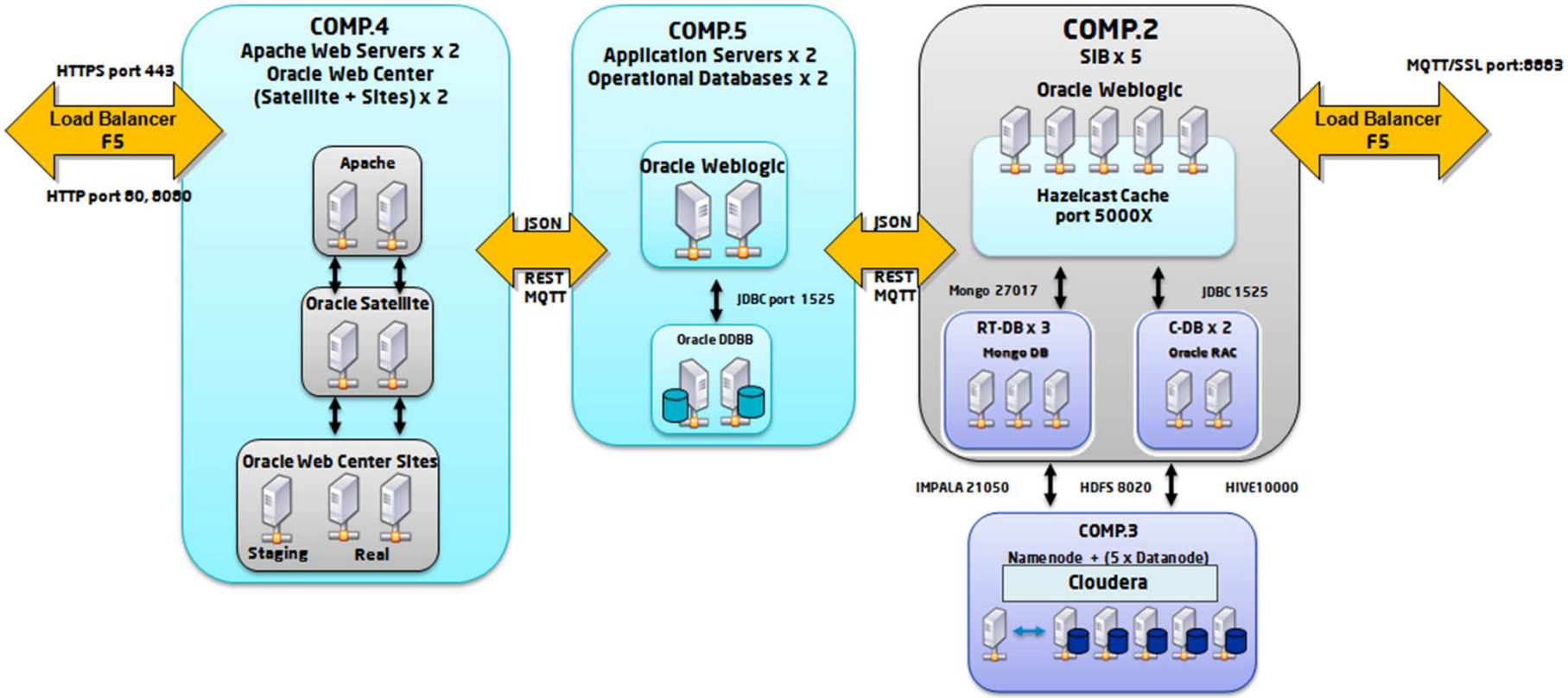
The following infrastructure was designed for November 2015 going-live, being able to support at least **8,5%** of the final scope.



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Which in **numbers means**...

COMP.2	*IoT Front-End*					
	Servers	Chip Set	Cores/Chip Set	RAM/Chip Set GB	Total RAM	Total Cores
Weblogic	5	Intel® Xeon® 2,4 GHz	6	30	150	30
Mongo	3	Intel® Xeon® 2,4 GHz	6	33	99	18
Oracle DDBB	2	Intel® Pentium® 2,6 GHz	2	16	32	4
					281,00	**52,00**

COMP.3	*BigData*				
	Servers	Chip Set	Cores/Chip Set	RAM/Chip Set GB	Total RAM
NameNode	1	Intel® Xeon® 2,4 GHz	12	33	33
DataNode	5	Intel® Xeon® 2,4 GHz	6	30	150
					183,00

COMP.4	*Portal Layer*					
	Servers	Chip Set	Cores/Chip Set	RAM/Chip Set GB	Total RAM	Total Cores
Web Servers	2	Intel® Xeon® 2,4 GHz	4	16	32	8
Oracle Satellite	2	Intel® Xeon® 2,4 GHz	4	16	32	8
Oracle Web Sites (Real)	2	Intel® Xeon® 2,4 GHz	8	32	64	16
Oracle Web Sites (Stagging)	1	Intel® Xeon® 2,4 GHz	8	32	32	8
					128,00	**40,00**

COMP.5	*Business Layer*				
	Servers	Chip Set	Cores/Chip Set	RAM/Chip Set GB	Total RAM
Weblogic	2	Intel® Xeon® 2,4 GHz	8	64	128
Oracle DDBB	2	Intel® Xeon® 2,4 GHz	4	32	64
					192,00

Total Cores at Back-End	**158,00**
Total RAM at Back-End(GB)	**784,00**

At the Back-end, provided as IaS at a well known could infrastructure.

But change the point of view and focus where really matters!

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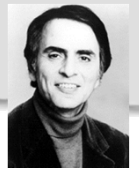
Remember that in the field, there will be...

COMP.1	***node#1.domo***					
	Servers	Chip Set	Cores/Chip Set	RAM/Chip Set GB	Total RAM (GB)	Total Cores
OSGi container R.5 Java Embedded 1.7.67 OEP Embedded 11g	8.500	ARM® Cortex 8®	2	1	8.500	17.000
					8.500,00	**17.000,00**

Total Cores at the Field	**17.000,00**
Total RAM at the Field(GB)	**8.500,00**

And if **Smart Home Software** deployed uses less than 5% of capacity...

> […] If it's just for **Smart Home Software**, seems like an awful waste of computational power.
>
> 
>
> Carl Sagan

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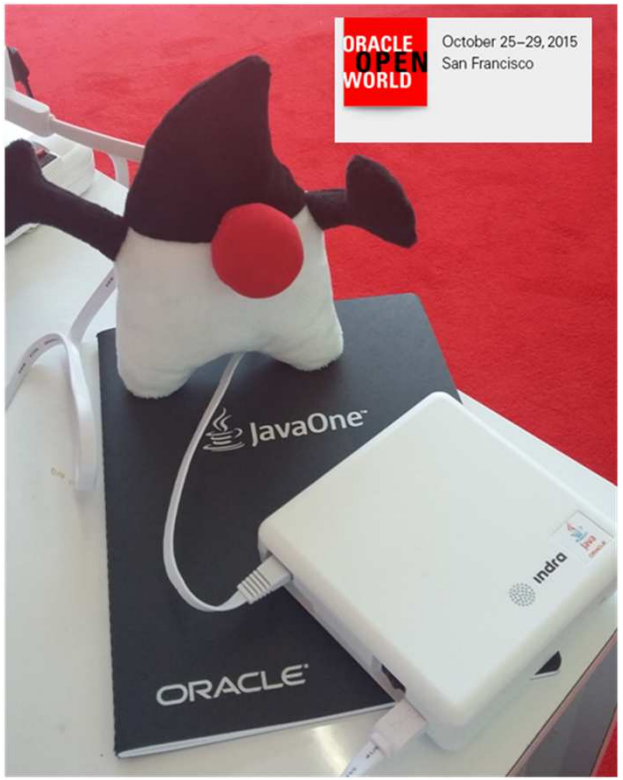

INDRA

WORLD IS CHANGING

NEW ENERGY MARKET MODELS.

PROSUMER AS THE MAIN DRIVER.

SMART HOME AS THE REAL ARENA.

KEY POINT: BEYOND GATEWAYS AND CLOUD (NODE#1 + IOT PLATFORMS).

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ANNEX: PLATFORM DEMO

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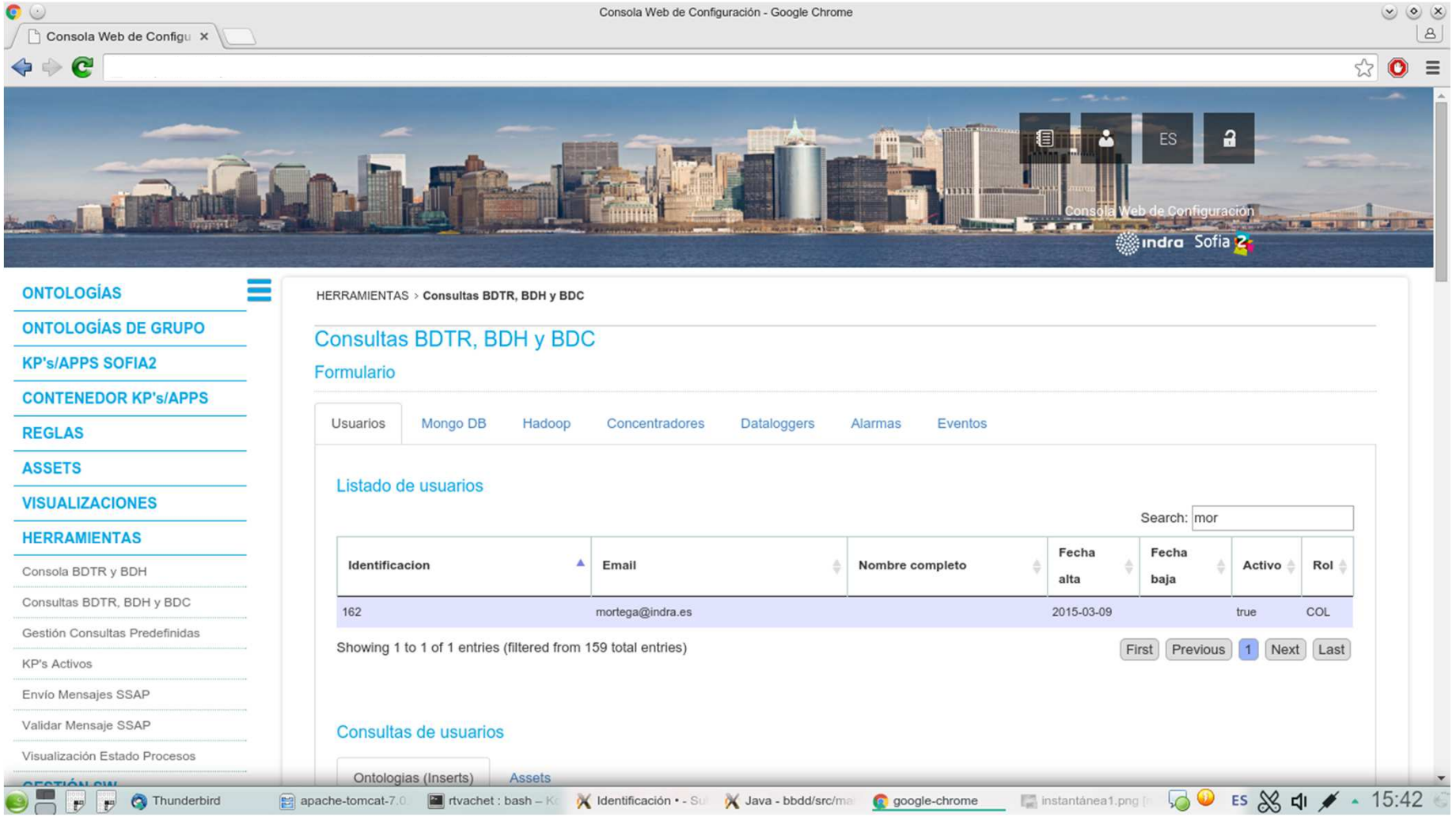
SUPPORT CONSOLE (MAIN SCREEN)



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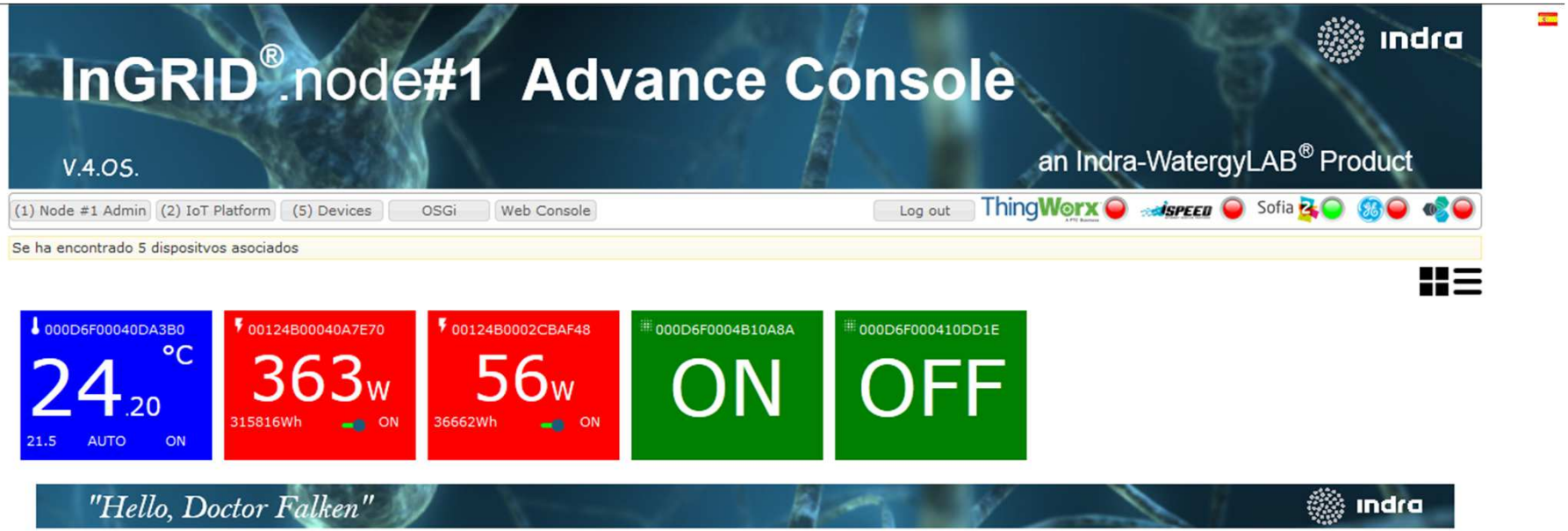
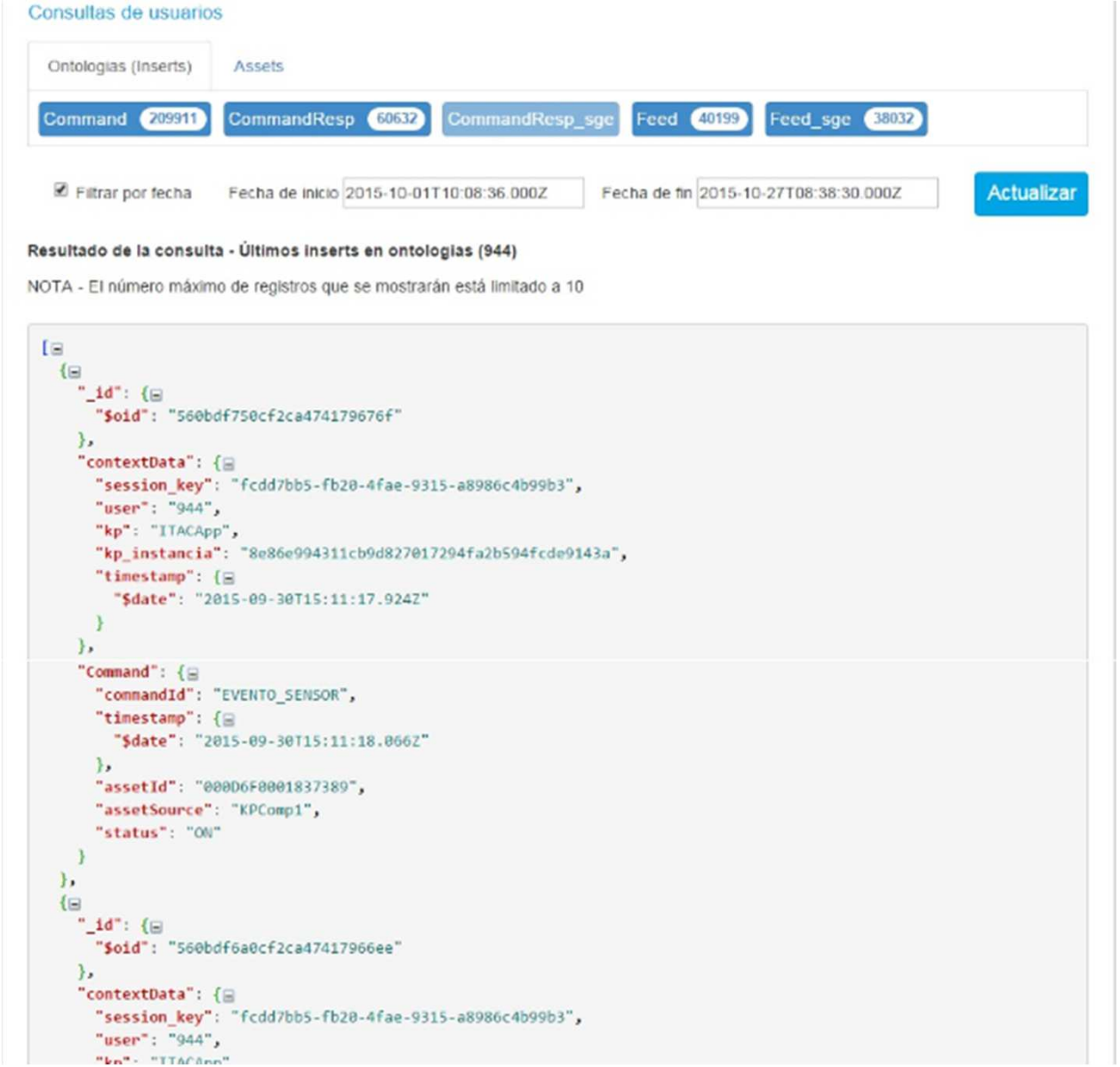
SUPPORT CONSOLE (I)



ANNEX: PLATFORM DEMO.

SUPPORT CONSOLE (II)



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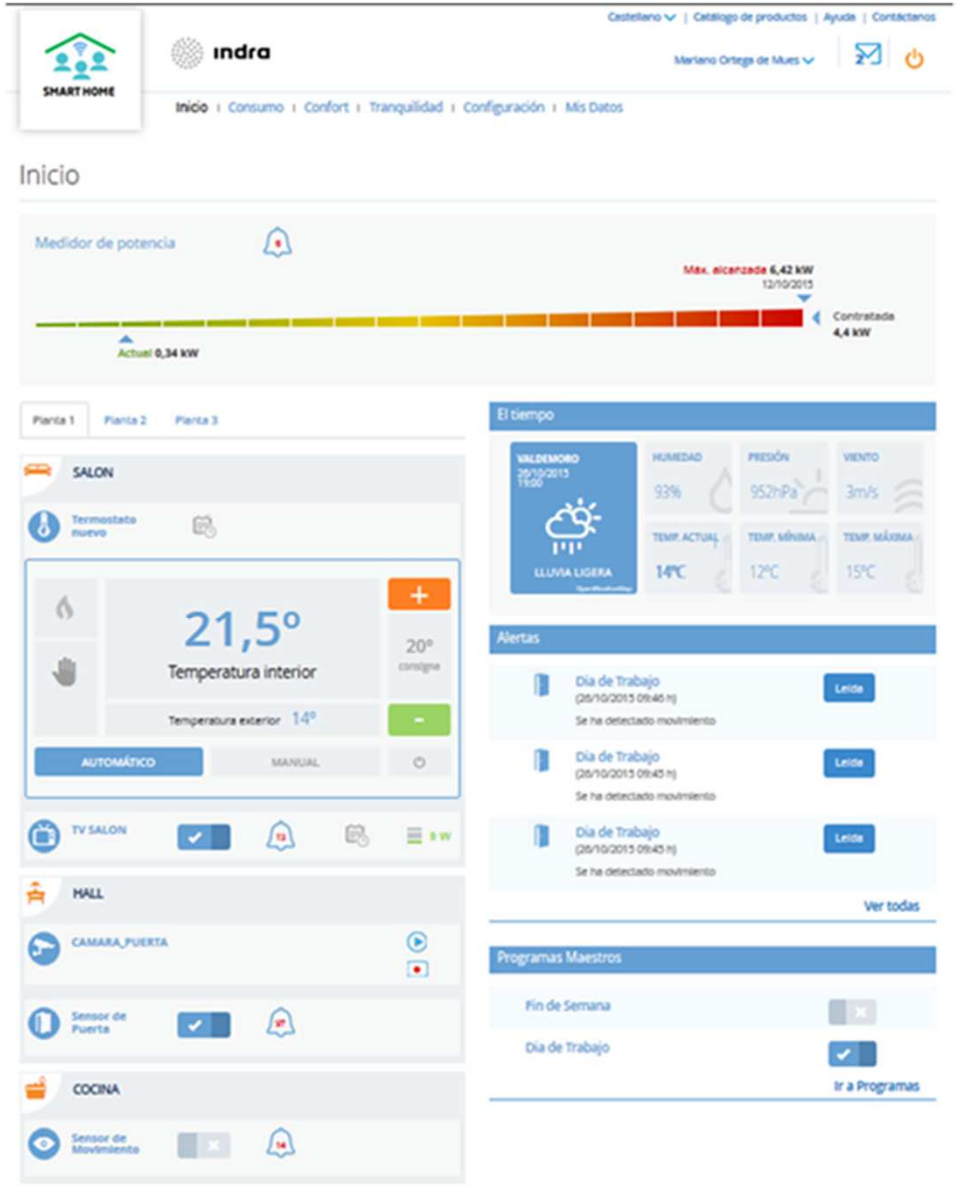
THE CLIENT PORTAL



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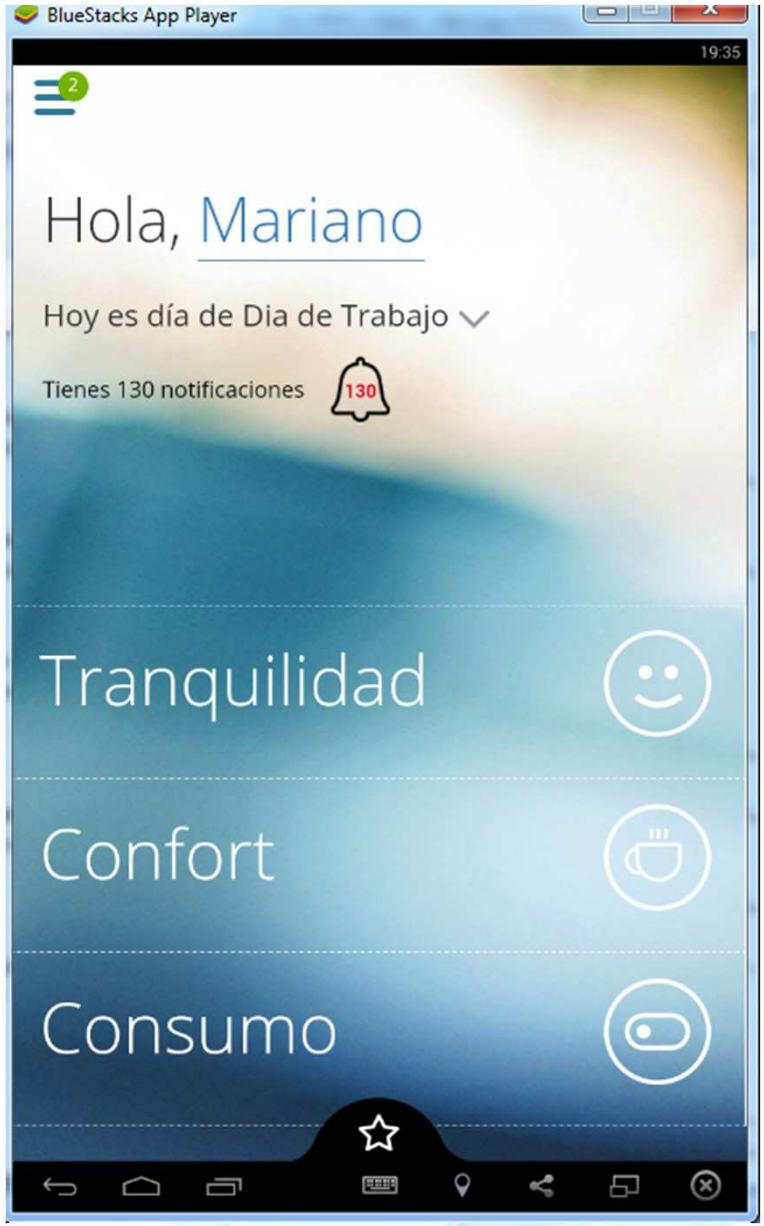
MOBILE APP



Thanks and visit us at

Demo will be
for the first time open to the public

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