



Bringing Intelligence to the Edge: Indra and Intel

If you can imagine in a world in which you can communicate with your refrigerator, your TV and your home alarm, you are visualising the world of the Internet of Things (IoT) – the concept of connecting devices, be they large power transformers, smart meters, pacemakers or even front door sensors, to the Internet in order to monitor, engage with and optimise their use through the data they are able to provide.

That world is closer to being a reality than you might imagine.

Intel estimates that by 2020 there will be more than 200 billion devices connected to the Cloud and each other. As more devices are interconnected and able to communicate with one another, the amount of information being generated and processed on a daily basis is growing exponentially.

ABI Research estimates that more than 233 exabytes of data was captured in 2014¹. This is not a reflection of the amount of information generated, but still represents a figure so vast that only 10% of this data was transmitted to the Cloud. The company further predicts that by 2020, more than 1,600 exabytes, or 1.6 zettabytes* will be captured annually.

According to ABI Research, the only plausible way to handle that volume of data is to run more of the analytics and other data processing locally.

* One zettabyte equals one billion terabytes

Four year's ago, Indra, a leading consulting and technology multinational in Latin America and Europe, started research activities in order to design and develop a platform that would enable utilities to offer their clients the ability to manage their different devices and applications, especially those that related to energy, comfort or security in the home.

Leonardo Benítez, Director of Smart Energy for Indra explains that intelligent IoT gateways are the centrepiece of the solution, providing a device that can connect all the different appliances and apparatus in the house and transmit their information to the cloud to bring value-added services to their clients.

"We have worked with Intel for many years in other areas, but our work with them on an IoT gateway is fairly new. Energy has a lot to do with the Internet of Things, especially with the IoT paradigm being incorporated into the business solutions of the utility, and we realised that Intel has a really good offering in this space," Benítez says.

He continues: "When we started analysing the solutions that Intel has to offer and spoke to different people inside the company, we were really amazed by the solutions and the possibilities we could realise from working together – and it was a good fit. We have a good relationship with Intel and we decided to work with them to develop a powerful gateway that will not only support the present needs of the utility, but also the future needs."



An IoT gateway is a device designed to connect legacy industrial devices and next-generation intelligent infrastructure to the IoT. They can include technologies and protocols for networking, embedded control, security and manageability on which third-party applications can run.

The utility of the future will see:

- an increase in the amount of data generated due to the proliferation of sensors across the network;
- moves to enable more 'transactive' energy, brought about by increasingly deregulated markets which will enable transactions over the utility network between the different users of that network;
- a desire to be able to communicate with any number of devices to better control and manage the grid.

The importance of this gateway is that it not only enables energy and/or security monitoring, but through the 'future proofing' of its design, will remain relevant for 10 to 15 years.

"We are very excited about the possibilities that Intel is able to bring to our solution" Benítez says.

How does the solution work?

If you look into the smart home market, there are a lot of solutions out there that offer a traditional gateway service in which the gateway collects data from different devices and uploads it to the Cloud where the information is processed and instructions sent back via the gateway.

The offering by Indra is a unique proposition in that the gateway, or smart node as it is sometimes called, is able to not only collect the data and move it to the Cloud but –perhaps more importantly – is able to process some of this data at the edge.

According to Andrew Rogers, the founder of SpaceCurve: "The term "intelligence at the edge" means doing useful processing of the data as close to the collection point as possible and allowing systems to make some operational decisions there, possibly semi-autonomously. This is in contrast to backhauling the data feed to a data center and then processing it there before pushing operational decisions back to the edge platform."

"We are very excited about the possibilities that Intel is able to bring to our solution"

Intelligence at the edge is important for a number of reasons:

1. Lack of available bandwidth on IoT platforms to allow for the rapid processing of data at a centralized point. As a result, data may be prioritized or discarded to allow only the most vital data along the necessary pipeline.
2. In order to rapidly process information and enable almost instantaneous decision making, the ability to process information at the source without moving it to a central point is vital.
3. The cost of transferring information, sorting it, and running the necessary data processing on it at a central location can be prohibitive.

"The benefit of having intelligence at the edge is that you are able to process information and add value at the home or premises," Prithpal Khajuria, Senior Product Manager of Energy Solutions for Intel explains. "We can support many use cases today and additional in future".

An example being implemented by Indra is a home security solution which integrates security cameras and sensors. By installing a sensor at the front door of a home, the gateway is able to send a text message or email when the door is opened or closed, or is able to activate a security camera. Additionally, once the security camera is activated, it can photograph the person entering the premises and email the photograph to a pre-determined recipient. This is a simple use case, but implementation of this solution using a traditional gateway would require that when the door is opened, a signal is sent to the Cloud. The information is then processed in the Cloud and instructions sent back to the camera, telling it to take a photograph.

"This could take up to 3 seconds and by that time whomever has entered your home will be out of the frame of the camera," Benítez explains.

By enabling processing on the edge, the information is processed in situ and the instructions are able to be processed and acted on immediately.

The gateway

Working with Intel, Indra is able to offer two types of gateways.

A smart home gateway, driven by the Intel® Atom™ processor. The Intel® Atom™ processor E3800 product family is a system-on-chip (SoC) designed for intelligent systems. These SoCs delivers outstanding compute, graphical, and media performance while operating in an extended range of thermal

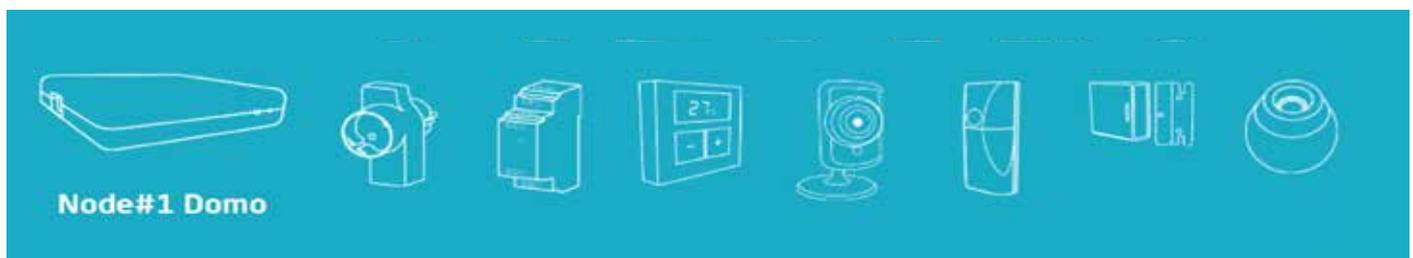
conditions. These SoCs are based on the Silvermont microarchitecture, utilizing Intel's industry-leading 22nm process technology with 3-D tri-gate transistors, which deliver significant improvements in computational performance and energy efficiency. Highlights of the product family include high I/O connectivity, integrated memory controller, virtualization, error correcting code (ECC), and built-in security capabilities within a thermal design power (TDP) range of 5W to 10W.

For industrial applications and big consumers, which require connection to traditional sensors and also to local supervisory control and data acquisition (SCADA) systems, which may be controlling a variety of processes in a factory – the Intel® Quark™ processor is utilised. The low-power, Quark processor is designed for rapidly growing IoT markets such as industrial, energy and transportation. The processor core at the heart of the system-on-a-chip (SoC) is a 32-bit, single-core, single-thread Intel® Pentium® instruction set architecture (ISA) compatible CPU operating at speeds up to 400 MHz. The SoC also includes support for DDR3, PCIe, Ethernet, USB device, USB host, SD, UART, I2C, PIO, SPI, JTAG, Arduino IDE and open source Linux. Intel Quark features error-correcting code (ECC) for a high level of data integrity, reliability and system uptime for equipment required to run at all times such as on industrial factory floors. Additionally, support for industrial temperature ranges helps meet the requirements for industrial control and automations applications in factories, the smart grid and transportation infrastructure.

The options for utilisation are varied and far reaching, and nodes can be added to a variety of grid equipment such as secondary and/or primary substations.

Both Indra and Intel believe that by placing smart nodes at the network level on the low voltage and medium voltage grid, or onto substations or transformers, a truly smart grid can be realised.

The Indra/Intel IoT gateway solution enables seamless interconnection of home automation or home security devices, with secure data transfer between devices, sensors and the Cloud where appropriate.





A straightforward solution...

Benefits for utilities

The solution currently being deployed by Indra is able to pull information from a variety of the different sensors and send filtered and processed information to the Cloud every five seconds. Indra has determined that a comparison of cloud capabilities versus the capability at the edge could see the edge providing triple or quadruple the capability of the Cloud.

Transactive energy

The capability of edge intelligence and processing will make the process of managing transactive energy far more effective.

In the future it will be possible to sell electricity from solar panels on the roof of a house to neighbours, or use that power for electric vehicle charging or storage in battery arrays. As new solutions are added to the grid, the percentage of processing capacity needed will naturally increase. However, the system designed by Indra has redundancies designed into it to manage simple use cases; and the more complex use cases anticipated in the future.

The term 'transactive energy' is used here to refer to techniques for managing the generation, consumption or flow of electric power within an electric power system through the use of economic or market-based constructs while considering grid reliability constraints. The term transactive comes from considering that decisions are made based on a value. ⁱⁱ

"It doesn't always make sense to process that information in the cloud, but with different smart nodes communicating with one another, and making decisions on the edge, we are able to process transactions a lot faster, says Khajuria.

In order for the gateway to process information, a powerful processor is needed within the gateway. The partnership with

Intel has provided the solution to the internal processing challenge. By providing a powerful processor at a cost competitive rate, the solution become far more accessible for domestic and business applications.

Khajuria continues: "We share the vision of processing information in the edge with Indra; of moving the Cloud to edge devices and away from more traditional methods which include utilising big servers in a central location or processing centre.

"The Cloud will actually become all these devices, talking to one another and making decisions on the edge."

The technology will give home owners new option for changing the settings or temperature controls on air conditioners or smart thermostats in response to energy costs. A revolutionary option is that control of certain loads within a house could be given over to a utility.

Benítez expands on this by explaining: "You as a client could determine what can/should be switched off, in order for the utility to manage demand. If a utility needs to reduce load, this needs to be done rapidly so having these pre-programmed rules enables rapid response to load management. Because these types of decisions need to be made in milliseconds, edge computing is vital for the speedy response is needed. This is why we believe this is a very powerful opportunity.

"The ability that we have to control all the different consumption points gives us the ability to offer the service to an aggregator or directly to the utility. So if for example a utility wants to reduce the load for an hour, because there is a generation challenge, and you need to reduce demand in order to be more competitive instead of adding more generation onto the grid, a customer is able to give the utility the ability to reduce demand by, for instance, allowing utilities to change settings on air conditioning or heating, or disconnect the swimming pool pump or water heater; but can at the same time prevent the utility from switching off the oven or fridge. Those rules can be pre-programmed into the device and you can give that ability to utilities as a way for them to reduce demand. This technology now enables you to do that."

Khajuria picks up the thread, saying "The solution effectively turns homes into virtual power plants."

Energy management and new services

A recent report by McKinsey ⁱⁱⁱ highlights that "if selected existing technologies were deployed to the fullest by 2020, a new home could consume around 90% less energy, whether gas or electricity, from the grid than it does today."

Furthermore, if the same technologies were applied to existing homes, savings of 35% - 40% could be achieved. Utilities therefore have the opportunity to extend their current offering to clients and protect their revenue and bottom line through adapting to new necessities, reducing fossil fuel powered generation and mitigating the effects of climate change.

It is generally agreed that failure to adapt to the changing utility landscape could see utilities fighting for territory from non-traditional utility players and McKinsey have estimated that margins could drop by between 10% and 30% depending on the level of deployment.

For utility and industrial applications however, it is all about the bottom line, efficiency and operational improvements.

In Spain, for example, the cost of energy fluctuates on an hourly basis depending on the power pool price. In this scenario, the ability to control production; to move production from one hour to another can make a big difference to the bottom line. This ability to manage this is therefore very important.

The ability to shift energy consumption whenever you don't need it and even give demand management capabilities to the utility makes a very powerful business case.

It is possible, in these kinds of markets, for the gateway to be pre-programmed to disconnect appliances or certain industrial applications based on price point. Pricing is pushed to the gateway by the wholesale market, giving customers the ability to define certain price points within which they are willing to switch off machinery or shift certain processes.

This kind of ability while initially focused on electricity, can of course be translated to gas or even water consumption. There are plans in the UK, for instance, to move to smart water meters and in the future water may very well have variable pricing depending on seasonal or resource availability.

Other applications

Intelligent IoT gateways will be able to

manage water metering, in addition to other applications such as health or fire monitoring, as well as remote switching of appliances or applications.

The use cases are limitless and can be translated across any number of industries such as energy, water, gas, health or security. As technology develops, more opportunities will become apparent. As sensors become less expensive, more devices will be connected and able to process information at the edge.

"For utility and industrial applications however, it is all about the bottom line, efficiency and operational improvements."



About Indra

Indra has been operating in the utility industry for more than 20 years, offering solutions that reflect the changing market paradigms, the way utilities deal with their clients and the rapidly changing role of technology.

About Intel

Intel (NASDAQ: INTC) is a world leader in computing innovation. The company designs and builds the essential technologies that serve as the foundation for the world's computing devices. As a leader in corporate responsibility and sustainability, Intel also manufactures the world's first commercially available "conflict-free" microprocessors. Additional information about Intel is available at newsroom.intel.com and blogs.intel.com. For Intel's conflict-free efforts, see conflictfree.intel.com.

Our experts:

Leonardo Benítez is director of smart energy in the energy market, which includes Indra's activities in the utilities subsector of electricity and gas, as well as their offering in the area of "smart" services.

He holds a degree in electrical engineering from Universidad de la República (Uruguay) and a degree in computer science from Universidad ORT. He has earned a Masters in Energy Business by Club Español de la Energía and is a member of the Advisory Board of Futured (Spanish Technological Platform of Smart Grids).

Prithpal Khajuria joined the Internet of Things Group (IOTG) of Intel Corporation as senior product manager of energy solutions in May 2015 to develop and deliver IoT Solutions for the utility industry.

Prithpal is working with the ecosystem of equipment manufacturers, automation and software vendors, as well as utilities and service providers to develop and deploy connected devices, edge platforms and cloud architectures for operational excellence and transformative businesses. Prithpal has 15 years of experience providing advanced solutions to the global energy industry.

More information: <http://www.waterylab.com/>

Intel, Atom, and Quark are trademarks of Intel Corporation in the United States and other countries.

i) Competitive Edge from Edge Intelligence IoT Analytics Today and in 2020, ABI Research paper, May 2015.

ii) http://www.gridwiseac.org/about/transactive_energy.aspx

iii) Battle for the home of the future: How utilities can win http://www.mckinsey.com/insights/energy_resources_materials/winning_the_battle_for_the_home_of_the_future