White paper

internet of things

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Atos

Internet of Things

The Internet of Things (IoT) is expected to be the next revolution following the World Wide Web. It will provide new bridges between real life and the virtual world. The Internet will no longer be merely a network of 'human brain', but will integrate real-life objects, sensors and physical activities.

The associated technologies: wireless, miniaturization, batteries, networking, etc. are now mature and cost effective enough to enable objects to become connected and usher in this new era.

The opportunities are huge and so are the challenges:

"One trillion nanoscale sensors and actuators will need the equivalent of 1000 Internets: the next huge demand for computing!"
Peter Hartwell (HP).

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Special thanks to James Fernandes for his valuable contributions to this paper.

About the Atos Scientific Community

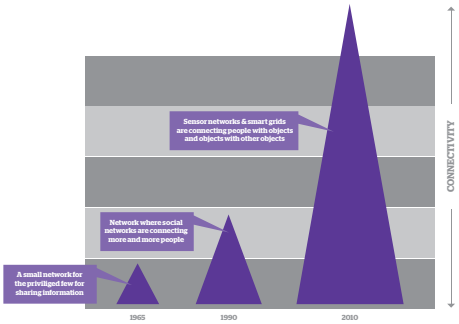
The Atos Scientific Community is a network of some 90 top scientists, representing a mix of all skills and backgrounds, and coming from all geographies where Atos operates. Publicly launched by Thierry Breton, Chairman and CEO of Atos, the establishment of this community highlights the importance of innovation in the dynamic IT services market and the need for a proactive approach to identify and anticipate game changing technologies.

Introduction

After a long and tiring day at the office with the drive home going to take the better half of an hour, the last thing anyone would want is to navigate the rush hour traffic. Wouldn't it be nice if the car could simply drive itself? Such a 'smart vehicle' would be able to navigate by itself aided by an online signaling system. As soon as the vehicle pulled into the individual's driveway, it would signal 'smart home' to put the coffee-machine and air-conditioning on. By the time the individual turned the key in the door, the living room temperature would be a pleasant 20° and the coffee ready. All they'd have to do is relax on the couch. The above example is neither science fiction nor industry hype. It is just one of the things that the 'Internet of Things'[1] (IoT) has in store.

The Internet has evolved significantly since its inception as an academic network of computers for a chosen few. Today, it is all-pervasive and a source of information for everyone.

Figure 1: Evolution of Internet



The Internet has become a consumer-oriented, interactive network, featuring shopping gateways, e-tailing portals and entertainment; among other offerings.

Communication over the Internet is no longer predominantly initiated by human operators searching for information. Increasingly, 'smart objects' like mobile phones are doing so independently.

The IoT is not yet a tangible reality, but given the resources and attention being devoted to it through various initiatives around the world, it seems probable that the concept will become a reality, in one form or another, in the very near future.

Sun's John Flower quantifies this evolution in terms of two mega trends:

- Reduced costs have brought with them the viability of connecting almost anything to the network.
- This ubiquity of access will make it so that people's notions about what they interact with will change dramatically.

These new information networks promise to create new business models, improve business processes and reduce costs and risks.

Vision-IoT

The vision of the IoT is to fuse the physical and digital worlds by bringing different concepts and technical components together. It aims to create a seamless network of billions of wireless identifiable objects that communicate with one another. This vision promises to create a new ecosystem in which smart devices would be able direct their transport, adapt to their respective environments, self-configure, self-maintain, self-repair and eventually even play an active role in their own disposal. They would be able to harvest the energy needed for their sustenance, adapt to changes in the environment and deal with unforeseen circumstances. The IoT promises to raise the quality of human life to a whole new level.

Today, technological advances have brought this vision a step closer to reality. Small mobile transceivers are already finding their way into smart devices enabling new forms of communication, not only between humans, but between humans and objects and between the objects themselves.

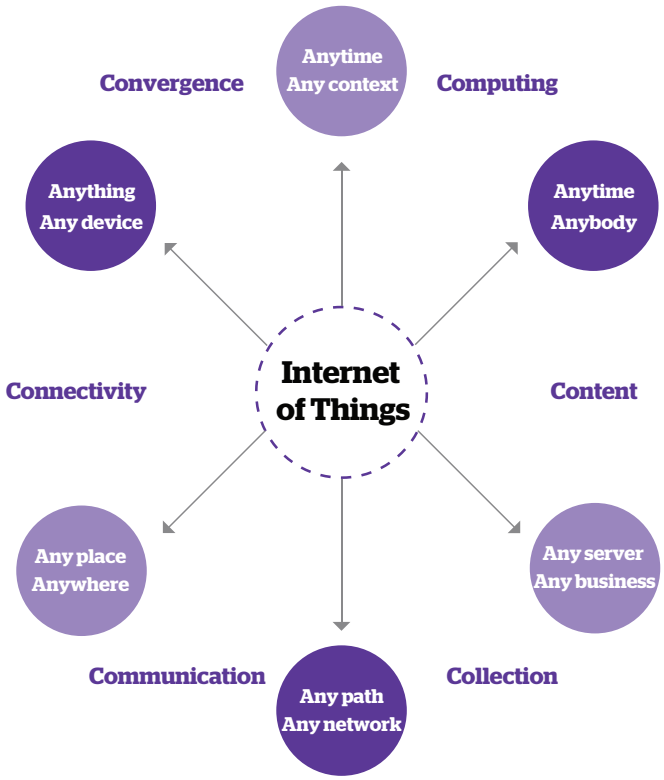
Objects equipped with miniscule identifying devices have the potential to transform everyday life. Such a system can make inventory management practically a thing of the past. Physical theft and loss would be impossible due to the fact that location of a device is known at all times. Smart meters can have a huge impact on the way energy consumption is managed and thus reduce demand on sources of energy.

What is a Connected Object

In computing, the IoT, also known as the Internet of Objects, refers to the networked interconnection of everyday objects. It is described as a self-configuring wireless network of sensors whose purpose would be to interconnect all things.[2] In the IoT, an object is connected to other objects over the Internet either as a source of information or as a consumer. Some objects are also equipped with small computers and can process the information they receive.

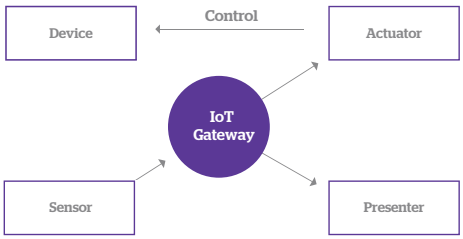
The IoT aims to create bridges between the 'Internet world' and the 'real world': When an object is connected to the Internet, the object creates a bridge between these two worlds.

Figure 2: Vision - IoT



When a unique address is added to such an object, and this address maintains a presence over the Internet, it becomes a connected object. This presence could be through an abstract reference or by directly connecting through Wi-Fi, Ethernet or 3G, thereby enabling the object to exchange information over the Internet.

Any object can be connected to the Internet, either in an active mode or in a passive mode.



Passive mode - In passive mode, the object carries identification, for example, through a barcode, RFID chip or some other machine-readable means of identification, but it is not connected to Internet. At some point, something like a 'tag reader' identifies the object and 'publishes' information on the Internet. The main benefit is the ability to enrich a context with the knowledge of the presence of the object at a particular place, at a particular time and within reach of particular users.

Active mode - The other types of objects are 'active' because more electronics are embedded in them to realize actions. These can be:

- **Sensors:** These objects have the capacity to measure something (position, temperature, air quality, movement, electricity consumption, etc.). In some cases, they may also have a degree of memory, enabling them to record a certain number of measurements. For example, a sensor attached to a vehicle broadcasts its speed, size and location to other vehicles in the vicinity.
- **Presenters:** These objects have the capacity to present some information to a human via a screen, basic lights or sounds. For example, an object reader in a vehicle keeps track of the speed and location information broadcast by the gateways in the vehicles around it. This information can be used to inform the driver that the vehicle ahead is slowing down (or speeding up).
- **Gateways:** These objects play the role of enabling communication between devices. For example, they may communicate with various sensors, aggregate data, push it toward the Internet, and in return, will get other data to send to a presenter. For example in the case above, an indicator (presenter) in the dashboard informs the driver of the decreasing distance between the two vehicles. Here, the communication gateway is wired. At the same time, it also sends a signal to a regulator device (actuator) which controls the supply of fuel to the engine.
- **Actuators:** These objects receive commands via gateways from somewhere on the Internet. Executing the command, the object changes its internal state or its behavior. For example, again in the case above, on receiving information from the gateway, the actuator device cuts the supply of fuel to the engine, automatically slowing down the vehicle, thus maintaining a safe distance between it and the vehicle ahead.

Of course, an active object can handle more than one of the described actions. For example, in a network of sensors, each sensor may also be a gateway which allows it to communicate with another sensor and build an ad-hoc meshed network for simplified and cheaper Internet connectivity.

Enablers of the Internet of Things

The below section briefly highlights some of the factors that enable the IoT.

Human beings - They can act both as consumers and producers of data.

Smart devices - Technological advances and reduction in the cost of manufacturing has enabled the widespread use of smart devices.

Communication networks, for example, Wi-Fi, GPRS, 3G, WirelessHART, Zigbee, Bluetooth, etc., are the key denominator as they make a lot more options available to the IoT.

Cloud computing - Cloud computing is able to scale rapidly to meet the growing demand resulting from the IoT in terms of storage and computing power.

Nabaztag

The 'Nabaztag' is a fun object that can connect to the internet via Wi-Fi. By moving its ears, changing colors, making sounds or speaking it can provide the weather forecast or the number of unread mails, for example: http://www.nabaztag.com/en/index.html. The ears act as sensors as well as presenters. Nabaztags can also communicate with other Nabaztags at other locations and have them respond to information sent from the first Nabaztag.

Objects for Intelligent Homes

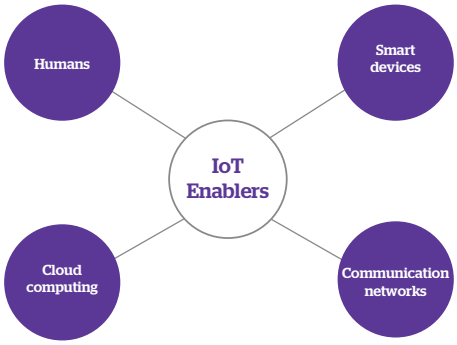
WideNoise

http://www.widetag.com/widenoise/about

WideNoise is the iPhone and iPod Touch application that samples decibel noise levels, and displays them on a worldwide interactive map. It is also able to send this data to Twitter to be followed by other users.

Objects for a Greener Planet

Figure 4: IoT Enablers



Opportunities

Any technology evolution has an impact on industry and that remains true for the IoT as well. It brings a whole new paradigm for companies and industries to take advantage of.

IT Opportunities in Integration Solutions

Data Collection and Brokerage
Connected objects would generate an incredible amount of data to be transferred, processed and stored. If historical data also needs to be stored, this problem is multiplied many-fold. Datacenters would need to scale accordingly to handle this. This presents a great opportunity in the field of data collection and brokerage.

With technological advances in the field of cloud computing, it may be a viable solution to the data storage and processing problem. With the huge amount of data generated, the brokerage platform also needs to be able to provide expiration of data. It should be possible to configure timelines for the data to expire and for the data to be archived.

The real-time nature of the IoT places a huge demand on the processing capabilities of a data broker. Quantum computing[4] can play a major role in addressing this issue. According to physicist David Deutsch, the parallelism associated with quantum computing allows a quantum computer to work on a million computations compared to just one in a conventional computer. A 30-qubit quantum computer would equal the processing power of a conventional computer that could run at 10 teraflops. Quantum Computing is a relatively recent development, but quite a few successful experiments have been carried out.

A concrete example for data collection and brokerage, today, is the Pachube community. Pachube is a small start-up which has created a community of people sharing their entire sensor data. All data published on Pachube is publicly available.

Collaborative Decision Making

As seen above, vast amounts of data would be generated by the IoT, much of which would be needed in decision support situations. Automation tools would be required to go through the data and help provide decisions and predictive analysis. At the same time, there is also a need to share and present the data to support human decision making. Collaborative Decision Making (CDM)[5] is an approach that facilitates decision-making functions Opportunities by providing timely and accurate information essential for operational planning. This data can also be used to formulate 'Pattern-Based Strategies' by analyzing usage and consumption patterns. And it provides the facility for predictive analysis in the event of unforeseen circumstances or disruption to operations and processes. This would be an asset to the aviation industry where expensive buffers are incorporated into scheduling to absorb the consequences of unforeseen circumstances. It would translate roughly into a couple of million Euros saved per year.

Integration

Seamless integration of smart devices will play a vital role. For IT companies, there is an opportunity to provide an integration backbone platform:

- Supporting different communication standards and protocols operating at different frequencies.
- Allowing different architectures, centralized or distributed.
- Able to communicate with other networks.
- That should offer a high-level interface supporting Web-Service standards.
- Real-time service-oriented architecture (SOA) would be a promising solution. It will help if each device offers its functionality as a standardized service that allows other systems to discover the services dynamically and invoke them easily.

IT Opportunities in Various Sectors

The IoT will impact most of an organization's existing customers. IoT innovation will bring a new dimension to the existing business models across all sectors. Opportunities exist in many sectors, some of which are illustrated below. Although this doesn't cover all sectors, it provides an overview of how users of today's Internet will move into the IoT.[6]

Smart Cities
Smart Cities aim to make public service infrastructures and business processes significantly smarter (i.e. more intelligent, more efficient, more sustainable) through tighter integration with Internet networking and computing capabilities. Sensors deployed throughout the city gather information about goods consumed, facilities used and other information pertaining to the life of the community. This information is given to the city council to take appropriate steps to improve the quality of life in the city.

Smart Meters

http://www.metering.com/

Smart meters with connection to the Internet would provide customers with 'signals' about their electricity consumption, thereby encouraging them to adjust their consumption habits. It will help reduce emissions and bills.

Objects for Intelligent Homes

Automotive Industry

Some limited connecting capabilities have been seen appearing in high-end cars in the past years, for instance, real-time traffic information. Expanding these capabilities to make the car a truly connected object will allow it to contact the manufacturer to diagnose a malfunction in real-time, or even better, anticipate it; be informed of road hazards; negotiate charging prices with power stations[7]; and book maintenance operations. Vehicle-to-vehicle (V2V) communication will open the road to collaborative driving, addressing traffic issues from a global, rather than an individual standpoint, and will help find optimal solutions, relieving congestion and also averting collisions, leading to a decrease of road casualties. Google is developing self-piloted cars that are able to run 1,000 miles without human aid and about 14,000 miles with minimum human intervention.[8]

Aviation Sector

In the aviation sector, the IoT can provide systemstatus monitoring for aircrafts via sensors that measure various conditions, such as pressure, vibration, temperature, etc. This data then provides access to trends, maintenance planning and condition-based maintenance. RFID tags could be used for aircraft parts helping to prevent counterfeiting. At least 28 accidents or incidents in the United States have been caused by counterfeits. There is important ongoing research about intelligent materials especially for aviation. These materials can detect and communicate with the maintenance team when the structure is damaged.

Efficiency at airports could be achieved by providing luggage tagged with RFID which helps in tracking the movement of luggage during transit.

Energy Sector

In the energy sector, the IoT will help manage and monitor energy consumption. Smart appliances will be able to operate optimally, conserving energy and at the same time satisfying the end user's need.

Smart meters will send signals to customers to regulate their power consumption. This would result in lower power consumption and also lessen the burden on existing sources of energy.

Sensors placed at strategic nodes in a gas pipeline would send signals to the control center informing the controller about the pressure and volume of gas flowing through at the node at a given time.

Manufacturing

A lot of manufacturing companies are making use of RFID for tracking and tracing. Managing inventory is improved and easier. Tagging a device also helps to avoid counterfeiting. Sensors attached to products can give information about their health allowing the user to decide when that device should be recycled. The Ford factory in Cologne, Germany, currently uses bar codes tagged to the hood of a car to help determine the make of the car during production. The robots on the assembly line read the information on the bar code and then determine which parts are needed for that particular car. The parts are then sourced from the inventory. This allows Ford to use the same assembly line to manufacture different cars.

RFID for Tracking and Tracing

http://www.rfidjournal.com

Both Procter & Gamble (P&G) and Wal-Mart use RFID tags to monitor goods from the time they leave the warehouse to the time they are bought by a consumer.

P&G and Wal-Mart hope to enrich their existing supply chain management system with this innovative solution.[3]

Objects for Tracking and Tracing

Challenges

Today, connected objects are still in their early stages and there are still many challenges to be overcome before the benefits of connected objects can be fully realized.

Addressing and Tagging

The IoT should be able to tag or address about 50 to 100 trillion objects. To achieve this, the current IPv4 protocol will be insufficient. A key challenge is to agree on a common way of addressing and identifying objects.

It is also important to have unique UIDs (userids), even for mass- produced objects (i.e. all objects coming out of a factory will have their own unique UID, not a common one). The relationship between objects, such as raw material (one UID) becoming refined material (another UID) or parts (each with their own UID) that are then assembled as a car (again a different UID) also needs to be considered to enable us to follow these relationships and thus maintain traceability.

Connectivity

When dealing with the IoT, one usually concentrates on the devices themselves. Connectivity is often missed, which is a big mistake. Connectivity in the IoT will mostly be wireless, using many possible solutions (Wi-Fi, GPRS, 3G, WirelessHART, Zigbee, Bluetooth, etc.) As each of these solutions has different pros and cons, they will likely all coexist in the future. (Zigbee requires very little power, but has a limited range; 3G has almost complete coverage, but is expensive both in terms of hardware and usage).

When using 3G, there is usually a cost associated with the usage of data transmission. It is therefore important to optimize communication with devices.

An adaptive ad-hoc network with mesh-routing capabilities is also a promising answer for the connectivity issue. In such a network, each 'object' is also a router capable of routing messages from and to other sensors. Such an approach allows the connectivity cost to be reduced and also simplifies the deployment phase. However, objects need to have more computing power in order to act as 'gateways'.

Openness and Data Model Standards

Today, many examples of connected objects exist and some are already in production, like automatic meter reading, customer electronics, etc. All rely on a vertical and closed ecosystem.

But this represents a short-term vision, as history has always shown that Challenges more standardization and openness creates new ecosystems, with many more opportunities for all actors in the end. If all connected objects and sensors were to be accessible in a more 'open' and 'standard' way, then, the same objects would have more than one 'connected usage'. That would be a good incentive for end users to exploit the opportunities provided by more connected objects which in turn would be an incentive for service providers to develop new services using these objects. The 'extra cost' for a connected object would be shared by all the services and functionalities brought by its open connectivity.

There are two major areas of standardization for the IoT:

Semantic: This will describe how to communicate with objects and what to expect from them. As there could be many different kinds of objects, which are possibly (and hopefully) long-lasting, then the semantic must be time-proof.

Communication protocols: As pointed out by Elgar Fleisch, a global standard protocol, identification and addressing scheme for bridging the last mile from the Internet to the smart object would be required. For the IoT to be adopted widely, a standard needs to be established which serves as guidelines for individual implementations and interactions between them.

Security and Privacy (vs. Simplification)

Security
One of the key components used in the IoT, RFIDs, are the ones most susceptible to attack. The situation becomes more difficult when the attack is of an active nature. Secure identifying protocols are being developed to counter these threats[10].

Another alternative is to provide tagged devices with unique UIDs. As the device transitions from one phase to another, the UID associated with the device also changes. This also calls for other devices and actuators in the 'trusted' network to be made aware of the device's changed UID.

Privacy
One of the main concerns that the IoT has to address is privacy. The most important challenge in convincing users to adopt emerging technologies is the protection of data and privacy. Concerns over privacy and data protection are widespread, particularly as sensors and smart tags can track users' movements, habits and ongoing preferences.

There are two main approaches for addressing:

- EPC (Electronic Product Code) name space is a coding scheme that was introduced for RFID in order to complement the barcode scheme operated by the GS1. EPC allows for the unique identification of objects and not for classes of objects, unlike barcodes which are identical for all similar objects.
- IPV6 is the future scheme of the Internet-addressing scheme which can provide each individual person on earth with more than 40 billion objects. Each address is coded using 128 bits as opposed to 32bits as with the existing Internet protocol.

Open Geospatial Consortium (OGC) is developing interoperability interface specifications for the real-time integration of heterogeneous sensors and the information infrastructure.[9]

SWE (Sensor Web Enablement) is an OGC open standard which is drawing attention outside the geo-information world.

Invisible and constant data exchange between things and people, and between things and other things, will take place unknown to the owners and originators of such data. IoT implementations would need to decide who controls the data and for how long. The fact that in the IoT a lot of data flows autonomously and without human knowledge makes it very important to have authorization protocols in place to avoid misuse of data. To promote a more widespread adoption of the technologies underlying the IoT, principles of informed consent, data confidentiality and security must be safeguarded. These kind of issues are addressed by the EPC-IS group.

Moreover, protecting privacy must not be limited to technical solutions, but encompass regulatory, market based and socio-ethical considerations. Unless there are concerted efforts involving all government, civil society and private sector players to protect these values, the development of the IoT will be hampered if not prevented. It is only through awareness of these technological advances, and the challenges they present, that we can seize the future benefits of a fair and user-centric IoT.

Hardware

The price and availability of the required hardware is today the key challenge preventing companies and end users from having more 'connected objects'. Today the limitations on the hardware are:

- Battery life: Having connected objects can ease everyday life, but if one has to 'think' of recharging all everyday objects, it will become too much work compared to the benefit.
- Hardware size: the new connected objects should not be much bigger than their non-connected counterparts.
- Radio connectivity: this element is of course crucial. If a user is using RFID, which is becoming quite cheap and may not require batteries, then they will have to install extra equipment to 'discuss' with objects.

Architecture

Analysts differ on the kind of architecture[11] that the IoT would use. Would it be event-driven or model-driven?

Would it be a combination of both? Model-driven and functional approaches will coexist with new approaches able to handle exceptions and unusual evolutions of processes.

It can be expected that there will be more than one logical sensor/actuator network where things communicate directly with server applications. There will be many fields of independent sensor/actuator (sub)nets, for example a subnet of smart electricity meters of a utility company or a subnet of air pollution measurement points in a city. The subnets will be managed by independent operators that provide their data over the Internet, either themselves or via mediators. The role of the mediator is to provide a uniform interface for all sensors and actuators and their heterogeneous interface technologies.

Different Complex Event Processing (CEP)[12] and Business Process Management (BPM)[13] models also need to be considered when deciding on the overall architecture for the system. Data and context brokers aggregate and correlate events that draw attention to changes in sensor measurements. They operate like complex event processors and can initiate actions to trigger functions in IoT applications or to control actuators, depending on conditions met in the stream of events. IoT applications use the aggregated results derived from event streams.

Computing Power

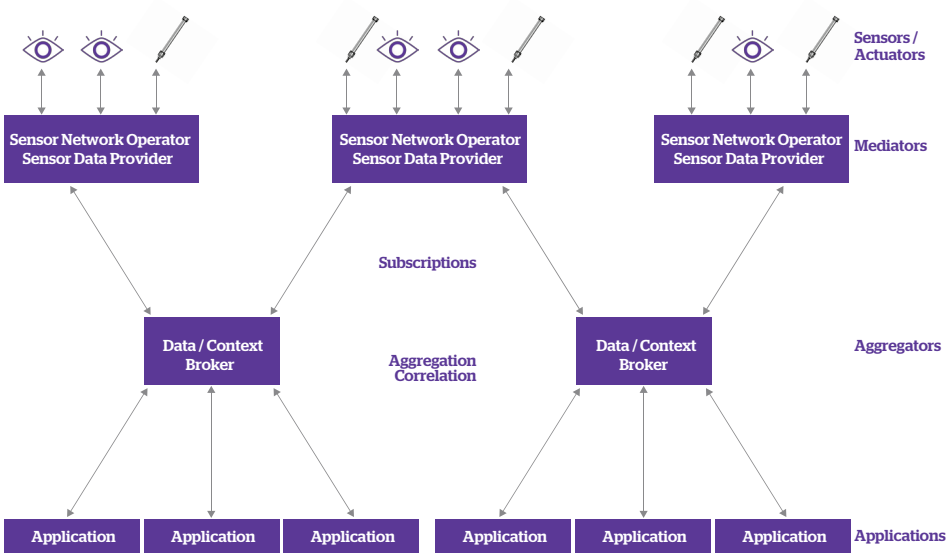
The real-time nature of the IoT also poses a challenge in the amount of computing power required since about 50 to 100 trillion objects would share data. This is completely different from a normal desktop where a user uses a computer for a specific need. Contemporary computing models based on human-computer interaction are inadequate and inappropriate for ubiquitous computing. Vastly parallel systems capable of performing calculations orders of magnitude higher would be required. Cloud computing enables dynamic distribution of workload among elements of the cloud based on the availability of storage and computing facilities.

There is an open-source project called Arduino (http://www.arduino.cc/) which is designing a cheap, easy-to-use platform (hard + soft) for connecting objects.

Such devices can be useful for realizing proof of concepts and for large projects, as there are no associated license fees or royalties.

Figure 2: Arduino Board

Figure 6: IoT Architecture



Internet of things maturity: from experiments to industrialization

Based on the study[14] of IoT implementations in various organizations, it has been observed that organizations have moved from the experimental to the commercial stage. Today, organizations have started adopting the IoT to replace key functions in their lines of business.

As IoT implementation matures, human intervention is to a large extent reduced and the Internet of machines increases. Based on the projects implemented in the area of the IoT, implementation can be associated with different innovation levels. Each IoT implementation could be associated with one of the following levels:

- **Level 1: Measurement or basic Level:** Organizations make use of automation for data recording only. There are no automated actions executed based on these measurements. For example, electricity meters for a power grid company.
- **Level 2: Automation level:** Organizations use the above information and automatically execute business processes. This level includes deciding which systems, processes or operations will leverage the data. For instance, energy providers could install smart meters and inform consumers in real time about their energy consumption. To move from level 1 to level 2, organizations need to undertake sufficient data analysis in level 1 so as to achieve maximum return on investment.
- **Level 3: Business innovation level:** Organizations are able to take their business to the next level using IoT innovation. They integrate IoT in their products or offerings. This often requires cooperation and planning among different people and organizations that have an interest in the data and the intelligence coming from it, for example, product manufacturers, retailers and their suppliers. In this way, everyone in the data chain gets what they need in a manner most likely to yield tangible improvements to business. Another example is energy providers that could have a smart grid setup allowing providers to provide electricity using different sources of energy which they could control using the IoT.
- **Level 4: Anytime anywhere level:** Organizations make cloud computing an enabler of the IoT. Here, data and services reside in a massively scalable cloud and can be accessed easily from any connected device over the Internet. Physical location and underlying infrastructure details are transparent to users. Anytime, anywhere access to IT resources is delivered.

The most important and difficult step in moving up this chain is identifying a business service for the IoT. The organization needs to identify a problem that warrants the use of the IoT. The cost of the IoT needs to be justified. The return on investment needs to be assessed. One does not take a cannon to hunt a rabbit.

Once this has been achieved, moving up the stages is relatively easy. For example, after the IoT has been used to automate the supply chain management process, the same can be used as a service offering.

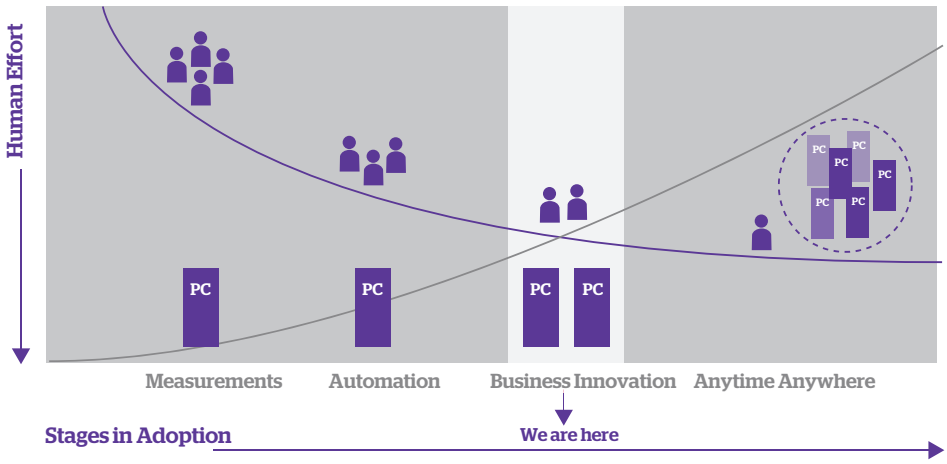
Mirror/Stamps

From the same company that made the Nabaztag comes the Mirror, which consists of an RFID reader connected to a PC. Every time an object is put on the mirror, or passes in front of the mirror, it triggers a special action :

- Putting keys on the mirror > updates status to announce the user is home.
- Presenting umbrella > reads the weather forecast out loud.
- Show a book > connects to the website http://www.violet.net/_mirror-givepowers-to-yourobjects.html

Objects for Intelligent Homes

Figure 7: IoT Adoption Stages



Current status within Atos

Atos already has a bevy of successful IoT implementations. In the research done by CERP-IoT (European Research projects)[15], Atos features as one of the top 10 leading organizations working in the IoT area.

The following section provides information about the IoT projects which Atos has carried out:

- The ERDF project in France for automatic metering is already a huge project that has opened many opportunities for the Group internationally. In France, for the automatic metering of electricity, Atos is managing 3 million wireless devices and has developed a variety of optimization techniques to reduce costs.
- Atos leads the work on early warning systems for natural disasters. DEWS (Distant Early Warning System) is an innovative system for the disaster management cycle, providing unparalleled early warning capabilities based on heterogeneous and remote sensor platforms. DEWS includes a standard interface to sensor platforms (OGC's SWE standard), optimized choice of simulations for tsunami wave spreading and run-up, or warning distribution via more than 10 communication channels, among others.
- Atos is also participating in TRACEBACK, an integrated project of the European Union's Sixth Framework Programme of Scientific and Technological Research, Priority 5 'Food Quality and Safety'. TRACEBACK's main objective is to develop a well-functioning generic solution for traceability and information management within food chains, including objective monitoring based in micro-devices.[16]
- In July 2010, Atos unveiled its Smart Mobility offering focused on anticipating the needs of the user and providing tailored information on and organized around four areas: customer, citizen, employee and community. The key element of the offer is the 'context broker platform' which aggregates all the data and allows for relevant correlation and decisions to be made in order to assist the end user.
- Atos also has a dedicated competency group for RFID which enables organizations to optimize the tracking and tracing of their products. One of the successful implementations of RFID is GlobeRanger's iMotion solution for FloraHolland. This solution helps capture the location of flowers in moving trolleys and makes this information instantly available to the auction's IT systems and employees.
- Logistics optimization through RFID. This project realized by Atos Worldline for ISS[17] makes it possible to closely monitor the use of equipment in a logistics chain. The result is substantial optimization of and a reduction in equipment. This project received the SITL prize for the best logistics information system in 2008.
- Atos recently launched Atos Worldgrid based on the company's deep industry knowledge in Smart Energy and Utilities. Atos Worldgrid is able to bring together software, hardware, and network and communication capabilities in order to create and operate truly smart utility systems. Its aim is to provide maximum optimization for energy management, creating the Internet of Energy.
- Atos Research & Innovation in Spain has a Lab dedicated to the IoT with several ongoing projects and a solid background.

The above examples show that Atos has already built up a significant amount of expertise in the IoT field. Going forward,

- It should now make concentrated efforts to build an integration platform which will address the challenges seen above.
- With the launch of Atos Sphere (cloud computing platform), Atos already has the infrastructure and experience with cloud computing. It should now extend the IoT experience with the cloud-computing platform.
- Atos should be an active member in standard committees for the IoT like ETSI[18], European IoT research group.
- Atos should gear up for the vision created for the IoT[19] over the next five to ten years. This looks very challenging. A dedicated team needs to be set up to provide support and guidance for future IoT implementations in Atos.

Conclusion

The Internet of Things breaks the basic norm for communication today, which focuses on humanentered data. Technologies like RFID, Wi-Fi, real-time localization and sensor networks empower computers to perceive the world for themselves.

The rise of machine-to-machine (M2M) communication will bring an unprecedented need for network infrastructure, and foster the advent of a new generation of devices, pioneered by the Nabaztag, which have connectivity as their raison d'être. As more and more objects from daily life are being embedded with computing capabilities, personal computers as we know them will become a tool of the past. Who will need one anyway when the walls of a house can browse the Internet?

The IoT will be disruptive by nature and businesses and organizations have little choice but to adopt it. Now is the time for CEOs, CIOs and decision makers to understand the potential of the IoT and reap the associated benefits in terms of economic growth and individual wellbeing, thus making the Internet of Things an Internet of Things for People.

Atos is committed to dedicating more effort to the IoT and take ubiquitous computing to the masses.

Notes

1 http://docbox.etsi.org/ERM/Open/RFIDWorkshop200806/RFID03_06a3_ITU_SPU_Internet_Of_Things_(IoT)_definition.txt

2 http://en.wikipedia.org/wiki/Internet_of_Things

3 http://www.computerworld.com/s/article/284160/Procter_Gamble_Wal_Mart_RFID_Effort_Effective

4 http://computer.howstuffworks.com/quantum-computer.htm

5 http://en.wikipedia.org/wiki/Business_intelligence

6 www.future-internet.eu

7 or fuel price with gas stations if electric vehicle adoption is slow

8 http://www.dailytech.com/Google+Developing+SelfPiloted+Cars/article19846.htm

9 http://www.opengeospatial.org/projects/groups/sensorweb

10 http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6TYP-50SXC59-1&_user=10&_coverDate=08/16/2010&_rdoc=1&_fmt=high&_orig=search&_origin=search&_sort=d&_docanchor=&view=c&_acct=C000050221&_version=1&_urlVersion=0&_userid=10&md5=2a4eb4ca061d45c89902b7fb9535ea82&searchtype=a

11 http://en.wikipedia.org/wiki/Internet_of_Things

12 CEP - Complex Event Processing (http://en.wikipedia.org/wiki/Complex_event_processing)

13 BPM - Business Process Management (http://en.wikipedia.org/wiki/Business_process_management)

14 http://www.readwriteweb.com/archives/ibm_internet_of_things.php

15 http://cordis.europa.eu/fp7/ict/enet/documents/iot-cluster/iot-clusterbook2009.pdf

16 http://atos.net/en-us/newsroom/en-us/press_releases/2008/2008_09_25_01.htm

17 http://www.atosworldline.de/De/Newsroom/Press_Releases/2008_press_releases.htm

18 www.etsi.org

19 http://cordis.europa.eu/fp7/ict/enet/documents/iot-cluster/iot-clusterbook2009.pdf

About Atos

Atos is an international information technology services company with annual 2011 pro forma revenue of EUR 8.5 billion and 74,000 employees in 48 countries. Serving a global client base, it delivers hi-tech transactional services, consulting and technology services, systems integration and managed services. With its deep technology expertise and industry knowledge, it works with clients across the following market sectors: Manufacturing, Retail, Services; Public, Health & Transports; Financial Services; Telecoms, Media & Technology; Energy & Utilities.

Atos is focused on business technology that powers progress and helps organizations to create their firm of the future. It is the Worldwide Information Technology Partner for the Olympic and Paralympic Games and is quoted on the Paris Eurolist Market. Atos operates under the brands Atos, Atos Consulting & Technology Services, Atos Worldline and Atos Worldgrid.

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