A living network

by Mario Rizzante, Chairman, Reply

The world of M2M, the Internet of things - as well as the other Internets of people, energy media, service and the many yet to be invented - depend upon the pervasive, ubiquitous, availability of networks. The Internet, in all its forms, will be the operating system of our smart cities and therefore, our lives connecting us with all 'things' around us. We still need to build applications and services to serve us better; it's a living network a work in progress!

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The 'network', the Internet, has been the foundation of our businesses since its inception. On it we have built our present and are building our future. The Internet is evolving and we are involved in the work of the future Internet, as defined by the Future Internet Public-Private Partnership, which sees a proliferation of different internets and, specifically, an Internet of Things (*IoT*), Internet of People (*IoP*), Internet of Energy (*IoE*), Internet of Media (*IoM*) and Internet of Service (*IoS*). The vision is to drive a merger of a common global IT platforms, of different networks and of connected people, computers, smart objects, smart vehicles, homes and 'things' in general.

IoT and Machine-to-Machine (*M2M*) are terms that have often been used as interchangeable expressions, but in reality M2M is a subset of a much larger ecosystem. M2M refers to a system, normally wireless and with a SIM, where a device (sensor or meter) communicates a parameter (temperature, energy measurement, etc.) to an application that turns the information into an action. Think of a modern vending machine communicating to the central system that its stock of soda cans is running low. Internet of Things refers instead to an infrastructure of physical and virtual objects that communicate, self-configure into networks that are interoperable and have a 'sense' of the environment and the context in which they operate. In this sense, IoT is not simply a pervasive computing system, a communication technology, RFID or a Wireless Sensor Network, but an integrated ecosystem of all of the above and much more.

The Internet of Things has been the focus of Research and Development centres around the world. Very large investments are in place to develop knowledge, specific expertise and assets to best serve clients in need of an end-to-end solution applicable to their business. We have seen the launch of a few proprietary platforms and different vertical solutions, each dedicated

to a specific application in a given target market. The issue with some of these earlier proprietary implementations is that they are closed to other systems and uses.

It is not possible to make use of these applications or the data they generate for other purposes, or even interact with similar systems. A glucose meter that communicates with my smartphone and stores the data on a server somewhere in a format not readable by other systems is of limited use. Given the need to respect a patient's privacy, the data should be available to authorised doctors, the local hospital or health care system that have an electronic patient record.

Applications with similar purposes should be interoperable with similar sensors, independently of the brand or application. To accelerate the development of custom solutions, we need software and hardware platforms that maximise the reuse of standardised key components and use standard protocols to remain interoperable. The use of standards such as TCP/IP, Web Services and communication technologies such as WiFi, NFC, and ZigBee is essential to produce standard and interoperable solutions. The use of open source hardware such as Arduino or Raspberry PI allows for rapid prototyping and low cost solutions. The goal should be that the rest of the network sees each object as a service - in particular, a web service, so that many different simpler services can merge or mesh together to seamlessly create higher level, more complex, services.

By 2020, billions of devices will communicate, interact and most likely have a digital image of their status on the network. This will not only create a massive amount of data, but also the need for powerful engines to make sense of this staggering quantity of heterogeneous information. The latter has been the driver of the development of context awareness technology, which we believe to be the essential attribute of a true Internet of Things.

Context and location are fundamental inputs to make sure the billions of connected devices collaborate to produce value added data for higher-level services. Sensors, objects and their services generate data in need of correlation and contextualization. For example, the temperature going up in a room can mean completely different things depending on the context: an alarm if it is rising at an unusual rate; the fact there is a meeting, if a projector is functioning and more people are inside, etc. Understanding the context, and automatically taking decisions derived from the analysis of data coming from different and heterogeneous sources, is at the root of M2M technology.

In the aforementioned example, based on the context, the central building automation system can decide to intervene with a fire prevention action or simply turning up the air conditioning. Imagine a smart irrigation system capable of deciding on its own not to water one day because of forecasts of rain the next. This system puts together sensors in the garden with weather info web services. Imagine a painting in a museum, or your own TV, communicating with your smartphone to enhance your viewing experience and providing additional, personalized and contextual information. All of this is not far-fetched and has been part of the deployment of IoT commercial solutions.

The above examples show how the Internet of Things is closer to reality than most people think. The journey ahead is still long, but many solutions have real commercial viability now. Take mobile payment platforms as another example. The idea that, depending on the situation I find myself in, different ways of paying for goods or services will be presented, is a great convenience for the end user. If close to a bus stop or at a movie theatre my digital wallet proposes the option to buy a ticket for that specific use, the ticket is immediately delivered in its digital form to my wallet. Utilising this method, I have greatly simplified my purchasing and payment habits and, at the same time, created an opportunity for a business ecosystem (banks, credit cards, services, business, loyalty programs) to develop.

Cars are another interesting and concrete example of smart objects, which will go from just receiving information (GPS, radio broadcast), to becoming two-way smart nodes of our cities. Next generation infotainment systems already on the market will communicate with central data aggregators or vehicle-to-vehicle, to exchange critical data and services. From CO2 emissions to battery status, from remote door lock/unlock to remote maintenance, to e-call in the case of an accident, these are all real life examples of the value of a connected car. We already pay tolls electronically on many highways without stopping, or congestion charges in major metropolitan areas and using the same system to pay when parking our cars.

Today, connected vehicle systems integrate smartphones and tablets with the local car network, allowing the exchange of services. Compatibility among systems is insured by common operating systems. An LTE smartphone connection to the network will allow us to enjoy our favourite streaming radio broadcast or movie in the back seat, whilst the modem inside the car will communicate mission critical data, such as malfunctions, or will connect to the Public Service Access Point to get help in the case of accident.

Furthermore, another large part of this invisible digital layer, on which we are building the cities of the future, is the Smart Grid. The network infrastructure that will close the gap between the utilities network and the Internet, allowing energy to be generated, transported, stored, when it's needed and where it's needed, and bought and sold at the best possible price. The data related to this process will follow the same path and serve both businesses and private citizens at the same time.

Smart electrical meters are already a reality, gas and water smart meters will follow shortly; in home displays will aggregate and give feedback to us as accurately as possible on how much, and how, we are using our energy in real time. The very next step will be to implement demand/response systems capable of closing the gap between who produces energy and who uses it, taking action on the feedback received. Profiling the energy user and controlling the environmental and climate parameters allows the generation of energy only when it's needed and also to coordinate and manage the distribution of energy coming from different, preferably renewable, sources. The availability of this kind of data generates new commercial opportunities for agents, such as traders and virtual energy operators.

We think of the Internet, in all its different forms, as the operating system of our smart cities and therefore, our lives. This operating system will continue to evolve and become part of our daily life, connecting all 'things' around us. It's up to us to build its applications and services to make it serve us better. We are working hard at building a living network! ●