Perspective

M2M: the Internet of 50 billion devices

Machine-to-Machine (M2M) communications is a healthy sector that's expanding rapidly and generating significant revenues for mobile network operators (MNOs). Devices outnumber subscribers by an order of magnitude, but the term doesn't do justice to the concept and the market it represents.

By Bob Emmerson, European Editor of M2M Magazine

A rose by any other name would smell as sweet (Shakespeare), but we really need a definition in order to convey the breadth and depth of the M2M concept. This one (edited slightly) comes from Numerex:

"M2M uses a device (sensor, meter, etc.) to capture an 'event' (temperature, inventory level, etc.), which is relayed through a network (wireless, wired or hybrid) to an application (software program), that translates the captured event into meaningful information (e.g., items need to be restocked)."

There are many more devices than people so we are talking about an enormous market in which numerous opportunities are opening up for vendors, solution providers, systems integrators and MNOs. It's opening up because M2M technology will increasingly underpin key areas of the economy, for example, the smart (green) grid, networked homes, healthcare in the home and transportation (usage-based auto insurance and the emergency eCall system for cars).

MNOs play a pivotal role

Until recently most MNOs have taken an indirect, albeit pivotal role in the value chain. Their networks transport the data traffic from the sensors to the back-office systems, i.e. they carry the bits. But M2M technology is moving into consumer sectors such as smart meters in the home, so the numbers shoot up and there is an emerging business case for a direct role and thereby a more profitable position in the value chain.

However, in order to be a direct player, MNOs need a middleware platform, hence the recent partnership announcements between AT&T and Jasper Wireless, KPN and Jasper Wireless, and T-Mobile and Sierra Wireless. Vodafone has developed a platform, which it launched in July 2009, and both Orange and Telenor have their own platforms.

Migrating from being an indirect player to a direct player like Orange and Telenor will take time, so we can expect to see the process speeding up via acquisitions, e.g. platform vendors will be bought. MNOs also need systems integration resources to become a direct player in the enterprise space.

The value chain

The M2M value chain is somewhat complex and a typical solution can involve five or more vendors. Sensors are used to measure a particular parameter and they can operate independently, e.g. switch lights on and off and they can communicate directly with other sensors over short distances. However, an embedded module is normally used to transmit the measured data and in a wide-area wireless scenario the communications medium will be a cellular network.

Application software running on an M2M platform is then used to convert raw data into useful information. For example, the application might display the location of vehicles on a map or it could aggregate the input of tens of thousands of smart meters and transfer the result to a back office billing system.

There are numerous vertical applications and they broadly divide into six categories: Telematics/Fleet

Management; Consumer; Healthcare; Energy/Utilities; Security and Industrial/Building Control.

Self-powered sensors

Sensors need to be powered and batteries are often employed, but a technology known as energy harvesting takes the necessary power from its surroundings: for example, from linear motion, light, or differences in temperature. The amount of energy obtained in this way is enough to send a wireless signal a short distance (10 to 30 meters inside buildings) and perform a task, e.g. turn on a light. Efficient energy converters, ultra-low-power electronic circuitry and a reliable wireless protocol characterize the technology.

The EnOcean Alliance has created an open specification designed to ensure interoperability between self-powered sensors. The receivers/gateways are wired powered as they are constantly "awake" listening for traffic. EnOcean claims that self-powered sensors enable businesses to achieve savings up to 40% in energy and operating costs. To date components that employ this technology are in use in more than 100,000 buildings worldwide.

Embedded modules

Modules, both wireline and wireless, are normally embedded inside equipment and in many cases the environment will be severe. For example, Huawei's EM700 3G embedded module, the world' s first industrial strength M2M embedded module, has been designed to endure extreme conditions, such as temperatures ranging from -30°C to +75°C. It is also resistant to very high and low humidity (5%-95%), shock, air pollution and congested wireless network traffic.

Firmware Over-the-Air (a technology that fixes device software remotely) is an interesting feature. In addition there are multiple interfaces that allow connection to other devices, voice and SMS services, and support for mainstream operating systems such as Windows 2000, XP, Vista and Linux.

The primary task of an embedded module is to convert analog sensor data into IP packets for transmission over a communications medium, e.g. GPRS or 3G. In addition there are intelligent wireless modules that allow part of the application to run in Java directly on the embedded baseband processor. For example, the application may send healthcare data at regular intervals, e.g. every 15 minutes, but if the measured parameter exceeds a pre-set limit then local intelligence will kick in and an alarm will be sent immediately.

Embedded SIMs

M2M SIMs have a smaller chip than those used for regular mobile communications. They are embedded in the device or on the wireless modules and they provide the identity of the networked devices (aka assets). They can be connected via a socket or be soldered to the printed circuit board. The environmental parameters for SIMs are the same as the modules, i.e. temperature range, vibration, humidity tolerance, etc.

SIM vendors as well as MNOs are working with ETSI and 3GPP on finalizing the specifications for a new form factor. A compromise of both removable and soldered solution is under study in order to address compatibility

with both the existing SIM supply chain as well as automated pick and place systems.

In the future we are likely to have a product range that divides into three sectors: (1) consumer grade SIMs for regular applications; (2) reinforced SIMs for use in harder environments where removability, device compatibility and time to market are the decision drivers; and (3) industrial grade devices for use in extreme/harsh environments.

Middleware platforms

Middleware platforms establish a link between the network and companies' business processes, thereby providing real time visibility and control to the customer. In a nutshell, the primary purpose is to give software developers an application view of the end-to-end M2M data, i.e. platforms remove the need to understand what is going on at bits and bytes level.

Middleware is basically a set of services; you can think of it as an M2M operating system, albeit a proprietary one right now. Functionality will typically include provisioning the devices, activating and deactivating SIMs remotely as well as routing, buffering, formatting and managing the M2M data flow.

MNOs can and have built their own platforms, but it represents a significant investment. Moreover it takes time and the market isn't going to wait, hence the prognosis that we can expect more partnerships followed by acquisitions.

The platform may also have a graphical user interface that allows customers to see how their devices are performing and when relevant it provides detailed analysis of network behavior and makes sense of the data that has been collected at all levels of aggregation.

Wireless Logic provides a similar facility via a web portal known as SIMPRO that works alongside the company's four main Virtual Private Networks (VPNs), which run over the networks of O2, Orange, T-Mobile and Vodafone. Functionality includes the ability to monitor, activate, and produce real-time data reports for all installed SIMs.

MNOs tapping the market

The global M2M market is healthy and expanding, so there are endless opportunities for all parties in the value chain. MNOs are particularly well placed since they play a pivotal role and they can maximize the opportunity without making additional infrastructure investments. However, there are underlying challenges that should be addressed, principally the need to look beyond their traditional business and operational models.

Cellular communications

M2M data can be communicated over any regular medium. Ethernet, for example, is employed in factory floor scenarios as well as Wi-Fi, but for wide area deployments cellular is the obvious preference, particularly those that are international and where the assets may be mobile.

Each module in a cellular deployment has an IP address. In future, when homes have smart utility meters, there will be millions of devices communicating with a central facility. And this is just one application. Thus, it's clear that M2M is going to generate a tremendous amount of data traffic, which is why MNOs are getting serious about this space. However, there are issues.

In most applications there will be short bursts of data at regular short intervals. Therefore when a million and more devices are going on an off line to carry short bursts of data it becomes impractical to allocate IP address in the regular dynamic way. The overhead is far too high; therefore the devices are given a static address. This means that the data is transported over a secure VPN.

As more and more M2M applications are deployed around the world the number of communications-enabled devices will run into tens of billions. One widely quoted statistic is a figure of 50 billion devices by 2010 versus 6.5 billion people. Therefore MNOs will migrate to IPv6, which supports 2128 addresses, in order to accommodate tomorrow's traffic.

As well as having a gigantic address space, IPv6 has additional features, one of which is network security. The Internet Protocol Security (IPsec) is integrated into the design of the IPv6 architecture and IPsec is mandated as a fundamental interoperability requirement.

Ubiquitous access and global connectivity

Cellular networks provide ubiquitous access and global connectivity, but MNOs are just one player–albeit an important one–in the value chain.

As indicated earlier, most MNOs have played an indirect role in the development of M2M applications; their role has been that of a bit pipe. The key link in the value chain is the middleware platform and the companies who have created a platform in order to provide a managed, secure, wireless data service.

These companies are often called Mobile Virtual Network Operators (MVNOs), but this term can be confusing. Regular MVNOs buy wholesale airtime from MNOs, which they use to retail competing services, mainly voice and SMS, to their subscribers. They are called MVNOs because they don't own base stations, but their managed M2M services are not competitive. The business relationship is that of a partner and the M2M data services

they market generate additional revenue for the MNOs.

Wyless is one such company, they operate in over 120 countries and therefore they refer to themselves as a "global network enabler". Wireless Logic is another, they talk about "SIM aggregation". In both cases they partner with Tier 1 MNOs in order to offer robust, secure access wherever and whenever it's needed.

Note that this service involves establishing VPNs across the networks of different operators, establishing roaming agreements and negotiating local tariffs. This is the service that they offer to the application developers and in most cases the service is coupled to a middleware platform. Therefore the combination allows developers to focus on their core competence and the MNOs only have to deal with companies that understand data communications.

MVNEs: what are they?

An MVNE is a Mobile Virtual Network Enabler; it's a company that provides infrastructure and services that enable M2M MVNOs to offer services to their end-user customers.

The key benefits are: lower CAPEX (shared platform); lower OPEX (shared resource poll); and quicker time to market (the requisite platform is in place).

Aspider Solutions is an MVNE that offers M2M enabling services to MVNOs. Key features include: real-time SIM card management, real-time cost control, fraud management and IP number management. However, MVNOs have full control and ownership of their SIM cards.

The platform can be enhanced with specific functionality, for example: fraud management; setting credit limits; ticketing system; tools for analyzing traffic; network monitoring; automated SIM ordering; and reporting. In addition there are comprehensive data collection and data handling services.

MVNOs use the platform to create their M2M solutions, but Aspider also offers value-add services. These include: verification/validation of GPS data; network initiated remote wake-up services for disconnected (un-ping-able) devices; enhanced roaming services with bearer testing and improved border crossing roaming algorithms for tracking and tracing applications.

Early bird MNOs

Telenor, the incumbent operator in Norway, runs its M2M activities via a separate company, Telenor Connextion, and more recently they created Telenor Objects, which is running an ambitious, forward-looking initiative.

Right now M2M solutions are running on proprietary platforms, but Telenor Objects is predicting a shift from vertically integrated and closed solutions to a layered, open approach. The basic idea is to enable communications–between devices, systems and software applications–through a new infrastructure that employs Object Service Enablement Functions.

This new, open infrastructure would provide services and features common to many applications, thereby reducing complexity, development effort and maintenance costs. There would also be significant operating cost savings since the resulting managed service infrastructure could be shared across many independent applications.

However, the really big benefits would come from the ability to allow sensor information to be shared in a secure manner across any application and to allow any device to connect to any application. This means that new applications could be created on the basis of installed devices, i.e. there would be no need to keep on reinventing M2M wheels.

The value of object networks would increase exponentially with the number of nodes. This is a variation of Metcalfe's Law, which states that the value of a telecommunications network is proportional to the square of the number of connected users of the system. Telenor Objects expects this development to result in hyper growth when a critical mass is reached, which is what happened with the Internet.

Looking ahead

Although M2M represents a relatively small niche market within the telecommunications market, it hit the media headlines in 2009 following the smart grid announcements of the Obama administration and the resulting impact on the environment.

M2M also has the potential to address other key concerns, e.g. the fact that populations are aging and health care costs are rising. In addition to healthcare in the home, the industry has developed and implemented usage-based auto insurance solutions and the emergency eCall system for cars.

The niche is therefore set to grow significantly and as a result it will generate a huge amount of additional data traffic and thereby generate significant new revenue streams for the MNOs, even if they continue to play an indirect role. However, it is clear that the Tier 1 operators will move up the value chain in order to optimize the huge revenue opportunity. This development has started, one example being the partnership between AT&T and Jasper Wireless.

Editor: Yao Haifei julia.yao@huawei.com