THE PROMISE OF M2M: HOW PERVASIVE CONNECTED MACHINES ARE FUELING THE NEXT WIRELESS REVOLUTION

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ABSTRACT

As people and devices with electronic systems become more inter-connected, machine-to-machine (M2M) technology is poised to become a powerful force in the 21st century. There are billions of electronic devices in the world today that are well-suited to take advantage of M2M technology. These devices range from security surveillance cameras casting a watchful eye on the street below, handheld medical devices that scan and transmit vital data to a healthcare professional miles away, to smart home appliances such as refrigerators, stove tops, climate control systems, etc. that add safety, convenience, and comfort to the home. There is an abundance of electronic devices waiting to benefit from M2M technology with enhanced productivity and performance for businesses and users alike.

This paper defines the concept of M2M, cites examples on how M2M is being implemented in various businesses/industries, and discusses how some of the partners in M2M are beginning to offer innovative solutions.

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THE CONCEPT BEHIND M2M TECHNOLOGY

Just as the Personal Computer changed the way humans would forever interact with a machine (to research, gather, and store electronic information), machine-to-machine (M2M) devices promise a future where smart machines are able to "communicate" to each other without human interaction resulting in an unprecedented change in many aspects of our lives.

In the most basic sense, M2M is one smart device talking to another smart device via a communication network. In order to function, each device must be outfitted with a communication module and in many cases a sensor for data collection. With numerous advances in wireless communication and in the base-band processor technologies, these devices can easily be placed in diverse locations many miles away from one another, or from a central control system. But in order for these devices to communicate and transmit data over long distances an IP, terrestrial, or satellite-based network must also be in place, usually this is through a GSM or GPRS/EDGE network, or one of the emerging cellular standards such as HSxPA or LTE.

Today some of the most common applications for M2M include remote monitoring; measurement and condition recording; fleet management and asset tracking; and in-field data collection, distribution, and storage. At this time, M2M is still in its early phases of adoption among businesses. But as it gains wider acceptance, we'll see new and more innovative applications emerge in just about every business sector, such as in medical (tiny silicon chips implanted under the skin to monitor blood-alcohol concentration), to military where very small electronic devices can be dropped from an airplane above to monitor ground conditions, weather, and even enemy troop movement.

To better understand where M2M is today, Figure 1 depicts a basic M2M setup. The basic setup consists of an electronic machine; this could be a CT scanner in a hospital or a printer in a remote office — anything that can function as a stand-alone device and incorporates a communications module. The wireless module can be built into the system or integrated as an add-on component. The primary function of a wireless module is to transmit and receive data via an air link of some kind. For many M2M applications, ideally, a base-band processor responsible for maintaining a communication link would also leave sufficient headroom and processing power to manipulate and store the data it collects before it transmits to another device or to a back-end server. The good news is that the cellular network infrastructure often used for M2M communication is already in place. It's the same network that many wireless-enabled devices such as mobile phones use today.

Another key component of an M2M setup is the back-end system such as a control station responsible for aggregating the data for enterprise use. And finally, with the use of various security and authentication software, the Internet gateway regulates who does and does not have access to the M2M communications data. The gateway is also an important link from the device to the outside world via the Internet and eventually to the ultimate destination such as a service center or monitoring station.

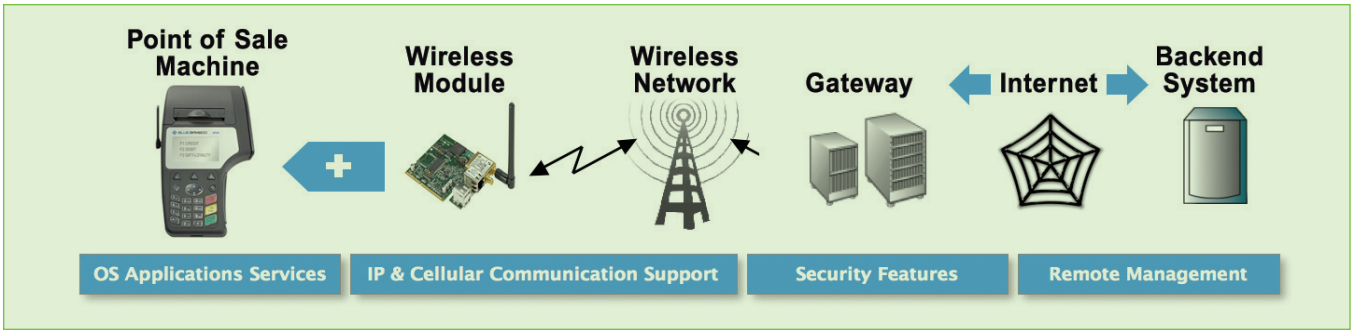


Figure 1. A basic M2M setup already in use today.

CURRENT AND POTENTIAL INDUSTRY SEGMENTS

Most of the M2M systems in place today have a few basic common characteristics. The devices are generally always connected to a wireless network which is often located in remote areas with limited accessibility. The devices, while operating within their defined network, collect useful data through the use of sensors for processing and transmitting to a back-end system via a wireless connection.

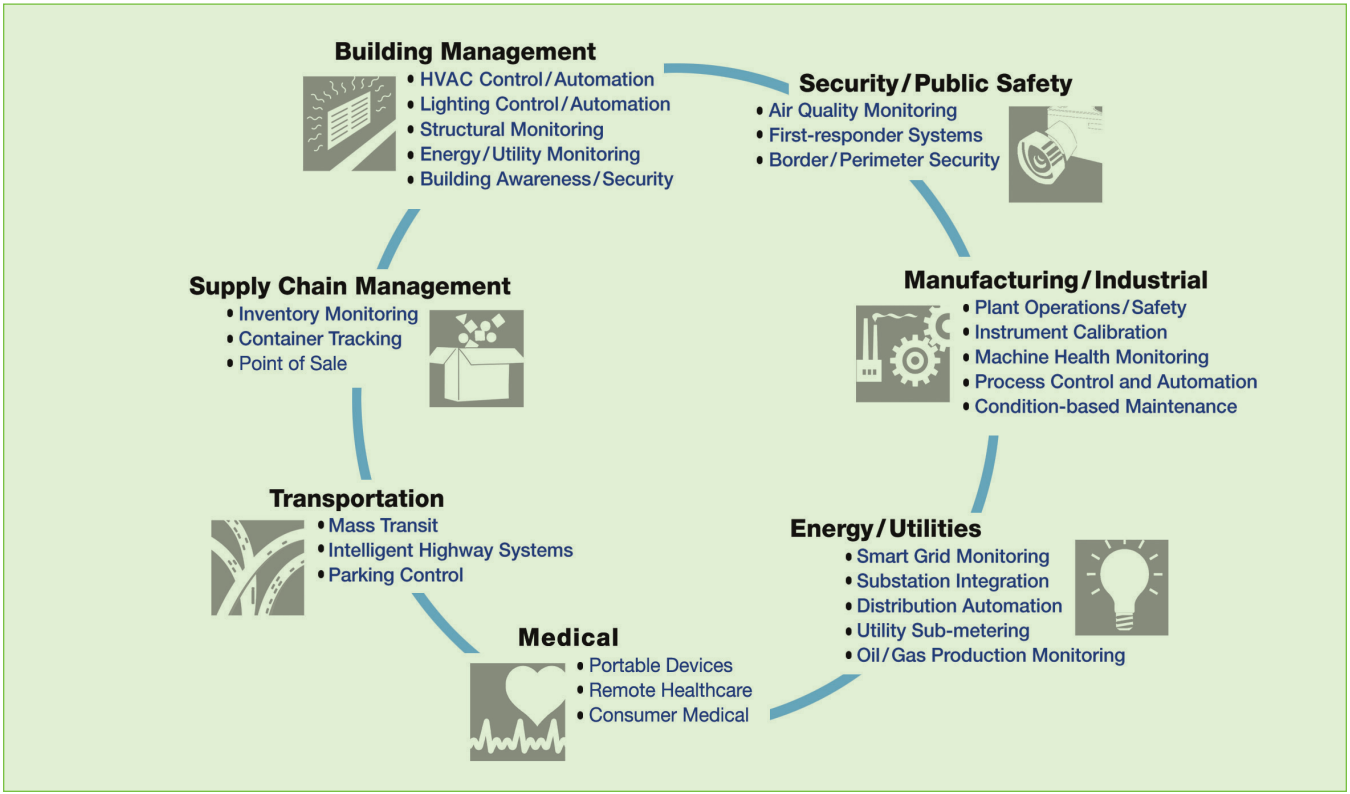


Figure 2. Current and rapidly growing M2M segments.

Figure 2 is a snapshot of the both current and potential M2M segments. Some segments are progressing much faster than others. Evidently electronic devices are used in every facet in a broad spectrum of industries. Unfortunately, most of these devices are confined to a closed network with limited range and scope, or working

with no connectivity (to other such devices or enterprise system) at all. It's no secret that many of these devices could benefit from some sort of wireless connectivity adding the ability to reliably transmit real-time data from the field for business efficiency.

M2M is more than just connected wireless devices sharing data remotely, it's also about collecting and distributing the desired data efficiently — often in real time — using the most suited wireless spectrum available and connected to a back-end system placed anywhere in the world. Further, one of the key factors to M2M, a primary distinction that makes this technology extremely useful for many applications, is its ability to give users access to a particular device via an embedded Web Server, which allows it to be re-configured remotely with users never having to leave the control system or comfort of their home or office. This certainly makes practical applications of M2M far more exciting and effective.

EXAMPLES OF M2M AT WORK TODAY

M2M is the result of many diverse technologies coming together. It's about key technology advancements in pivotal industries. For example, wireless baseband processors are now available in smaller die-sizes and have smaller geometries. They have more robust capabilities (many with multi-band support), operate in extreme environments, and are less expensive. Sensors have come a long way too, as they can do so much more today in much smaller sizes using a fraction of the power. There have been several advancements in battery technology as well such as improved capacitance which allows longer intervals between charges.

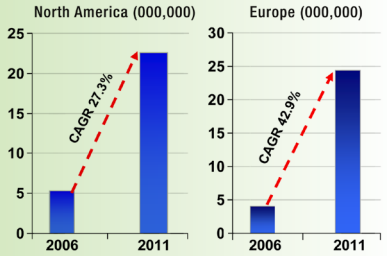
Companies have already started to take advantage of these new innovations in technology developing their own M2M solutions. The following examples are how a few companies in various industrial segments are adding M2M technology to improve business performance, functionality, or add new services. These companies are opening up new revenue streams or creating higher margins of profit — at a nominal cost.

TRANSPORTATION/AUTOMOTIVE

Asset tracking (Figure 3) is a very real and profitable M2M application used in the transportation industry. High-priced cargo that moves from ship to warehouse or warehouse to store is often equipped with M2M modules for security and time of delivery considerations. Having an M2M system in place allows the company to locate and monitor exactly where the cargo is at all times. In addition to the security, M2M modules can transmit weight of the cargo and other factors pertinent to the cargo.

M2M CONNECTIONS EXPECTED TO SURPASS MOBILE PHONES

M2M connections in North America and Europe will increase 426% and 595% respectively between 2007 and 2011.



According to Berg Insight, the number of M2M connections could rise to about 200 billion to 250 billion connections within the next few years. The reasoning behind this prediction has to do with the fact that mobile phones are special purpose devices only – primarily used for one-to-one communications. M2M devices are devices that are used for a myriad of purposes in all areas of commerce and industry. Further, a relatively small percentage of all microprocessors deployed are in today's personal computers, and the rest of these silicon chips are found in embedded systems. Most of these embedded systems are not yet connected, but can greatly benefit from connectivity. So, it's not so much about building brand new applications and systems, but rather, taking the existing applications and opening them up to a wireless network and tapping into a new range of functionality that can increase business efficiency and be beneficial to all parties involved.

Source: Berg Insight

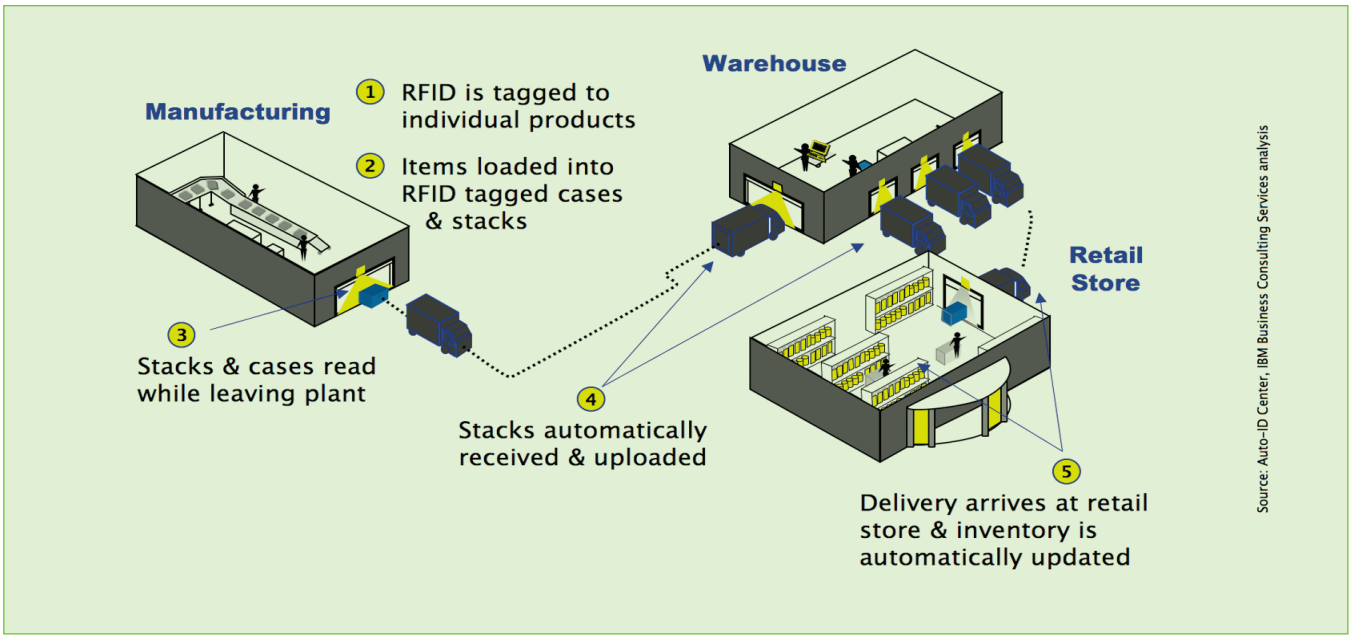


Figure 3. Asset tracking is one area M2M has fulfilled its promise.

In the automotive industry, General Motor's OnStar service is an excellent example of another type of M2M system. OnStar can remotely diagnose engine trouble, contact emergency services, or provide roadside assistance with a simple press of button located inside a GM vehicle.

THE SMART HOME

It seems the 'smart home' has been talked about forever. Years ago there was promise of a totally connected home where every gadget in the home talked back and forth. At the time, the smart home was an idea that only affluent home owners could pursue. That notion has changed dramatically with the onset of so many different in-home devices using wireless technology today. The automated home through M2M technology can include lighting, smart appliances, smoke alarms, climate control/HVAC systems, entertainment, and security. What we see happening in the smart home are more and more consumer electronic devices that can easily be connected to one central control panel or computer. Another movement making the smart home a reality is the establishment of home "intranets" — home networks, that connect these devices, and in turn, connect to a larger outside network if necessary. Standards and new types of local area networks are evolving quickly in this area.

Within the smart home, other segments are opening up as well. With energy and global warming a serious issue, automated homes are now being equipped with 'smart meters' which allow the homeowner to monitor energy use. Smart metering also allows a home that generates its own energy, to deliver any surplus energy back to the power company and be credited the amount on the next utility bill. Often referred to as 'smart grid metering,' this type of M2M system is also beneficial to the utility company as it allows the company to quickly identify service interruptions and does not require a team of individuals to visit each home and record the information manually. In fact, the United Kingdom has mandated that by 2020, all houses and essentially all buildings with utilities be equipped with smart meters to collect and feed data back to the utility service without human interaction or supervision.

Another M2M segment that's growing within the automated home is remote healthcare. M2M can provide home-monitoring systems that allow people who need care to stay in their own home. M2M can monitor a patient's vital signs (previously this would've required a nurse or healthcare professional) and alert the hospital or care facility of a condition before it becomes critical. The goal with this type of M2M system is to reduce dollars spent by moving an individual out of a home and into a facility or hospital. It is far more economical to introduce this technology into the home to enable remote elderly care than to have the elderly move to a healthcare facility. M2M systems can monitor a patient's condition while they are sleeping in bed (sensors can be placed in the patient's mattress) and daily activities throughout the home can also be monitored.

ENVIRONMENTAL

By now, it should be clear that M2M helps businesses improve efficiencies, bring valuable services to their customers, introduce automation, and lower the overall costs of doing business. A market unique to M2M is environmental monitoring. M2M in this segment is expected to grow quickly in the coming years with climate change as a focal point and the need to monitor carbon and other particulate emissions.

A few M2M use cases pertinent to environmental monitoring include:

- State and government officials measuring air quality in hard-to-reach locations
- Remote water management of rivers, lakes, and sensitive areas such as wetlands and coral reefs
- Chemical monitoring to benefit agricultural/produce growers
- Flood management control
- Remote monitoring of water and waste management

The key to climate monitoring is no human intervention is required. The goal is to maintain a "hands off" approach while effectively monitoring any kind of change — no mater how miniscule — and taking the appropriate action.

BUILDING MANAGEMENT

Remote utility management is an area that has seen intense growth now that energy costs are high and businesses are doing everything possible to keep operating costs down. With M2M, a building's lighting, heating, and air conditioning can be controlled remotely. Sensors can detect movement and in a given amount of time, lights can be turned off and the room temperate can be altered. Think of the many hotels in hotter climates that require air conditioning in the rooms. Ideally, when a guest checks in, a signal is sent from the front desk to the room and the AC automatically begins to cool the room. Conversely, upon check-out the room AC automatically lowers to a more idle state saving the hotel on energy costs.

In fact, a company located in Toronto, Canada, specializes in replacing the old analog thermostats in hotels in the United States and Canada with a more modern M2M-type thermostat. The company claims its M2M replacement is 35% more energy efficient than the old analog device.

MEDICAL

The use of wireless technology is not only growing in medical facilities, but in smart, portable medical devices as well. These portable devices are often equipped with bio-sensors that range from collecting relevant medical data to monitoring the medical condition of a patient. However, because these devices are equipped to transmit patient data,

there is a heightened consideration for security, reliability, and patient data integrity while the data is being transmitted from one device to another using either short range, point-to-point connections (Wi-Fi, Bluetooth, ZigBee, and ZiWire) or a long-range network. Needless to say, there are a number of M2M devices in place today quietly going about their business saving lives and making life easier for both the patient and the doctor/medical care provider.

Perhaps one of the more innovative medical M2M applications to come about recently is the PillCam developed by a company in Israel. A capsule is swallowed by the patient, which has a very small embedded camera. This procedure is essentially a type of gastro-intestinal endoscopy test. The pill snaps pictures as it travels through the internal organs. The pictures are sent wirelessly to a data receiver worn by the patient. The images are then downloaded to a monitor for diagnosis.

POINT-OF-SALE/ELECTRONIC KIOSKS

The most pervasive of this type of M2M application are the Point-of-Sale (POS) credit card terminals at retail outlets and restaurants. Once a card gets swiped, data is communicated wirelessly over a secure network. This type of M2M technology is becoming ever more common in businesses throughout all parts of the world.

Another example, more on the cutting edge, is what the soft drink company Coca-Cola is doing. The company has built wirelessly controlled self-serve drink dispensers able to handle over 100 varieties of sodas, juices, teas, and waters. These radio frequency identification (RFID) based dispensers give Coke a huge advantage in the marketplace. The customer not only has more choices, but the company can monitor purchases in a given area to help it understand consumer behavior. As the wireless data is fed back to company headquarters, the company can better plan promotions and introduce new products. And from an operational standpoint, when a RFID-tagged drink cartridge runs low or malfunctions, the company can quickly address the issue — remotely, saving many man hours and actually having fewer vehicles on the road.

The M2M applications mentioned here only begin to paint a picture of the full potential of M2M and the broad spectrum of different technologies it encompasses. In just a few short years, it's anticipated that hundreds of millions of electronic smart devices will be communicating wirelessly back and forth to each other. If these early years are any indication of what's to come, being proactive in M2M now makes good sense to many businesses that are looking to benefit from these technologies.

A BETTER MOUSE TRAP!

Scientists, scholars, philosophers, and inventors have argued for centuries on whether the basic mouse trap could ever be improved. With the advent of M2M, pondering such a question may now be a moot point.

A company called Rentokil, from the United Kingdom, may have finally put this age old debate to rest. The building services firm had the idea of adding a very small sensor and wireless module to the many mouse traps it placed in buildings throughout London. The goal was for this M2M mouse trap to notify the staff when a rodent was caught. Because of its simple wireless transmission (the traps communicate to the central hub, which is connected to the Internet via a mobile network) employees no longer had to physically visit each and every trap. Imagine what a set-up like this would mean to a large building with hundreds of traps.

Among the places that now feature the M2M mouse traps is Wembley stadium. The company reports that not only are regular inspections greatly minimized, but it's now able to track rodent activity and forecast where the next outbreak might occur.

DEVELOPING TRENDS AND GROWTH PATTERNS

Expectations are high in M2M opportunities for a number of reasons. Some might say we are in the throes of a wireless/communications revolution where it's all about being connected anywhere at anytime on any device — at a nominal cost. This thinking plays perfectly into the growth of M2M. A few drivers worth considering include:

1) The infrastructure is already in place: The current 3G network, and the upcoming WiMAX and 4G technologies, use the necessary infrastructure that today's top cell carriers already have in place. Little to no infrastructure modifications are required in order for a carrier network to host these devices. What is required, however, is to make sure the device is certified by the carrier. So if a software developer plans to deploy an M2M module on the Verizon network, Verizon will require that certain system requirements be met. These are carrier mandated tests to make sure that once this device is enabled, it won't cause any disruption to the Verizon network.

Even though telecom carriers want to make sure you go through the proper system testing before you deploy the device in their network, essentially, you're making use of the same GSM or WDMA etc. standard the carrier is using. Whether your M2M device will be transmitting data only, or both data and voice, provided that there's sufficient bandwidth allocations, there are no ancillary requirements from the network to support the transmission.

2) Many of today's embedded systems can benefit from M2M functionality: Around the world there are literally billions of machines that are well-suited for M2M technology — and only a small percentage of those machines are connected today (Figure 4). Explosive growth for M2M devices is expected.

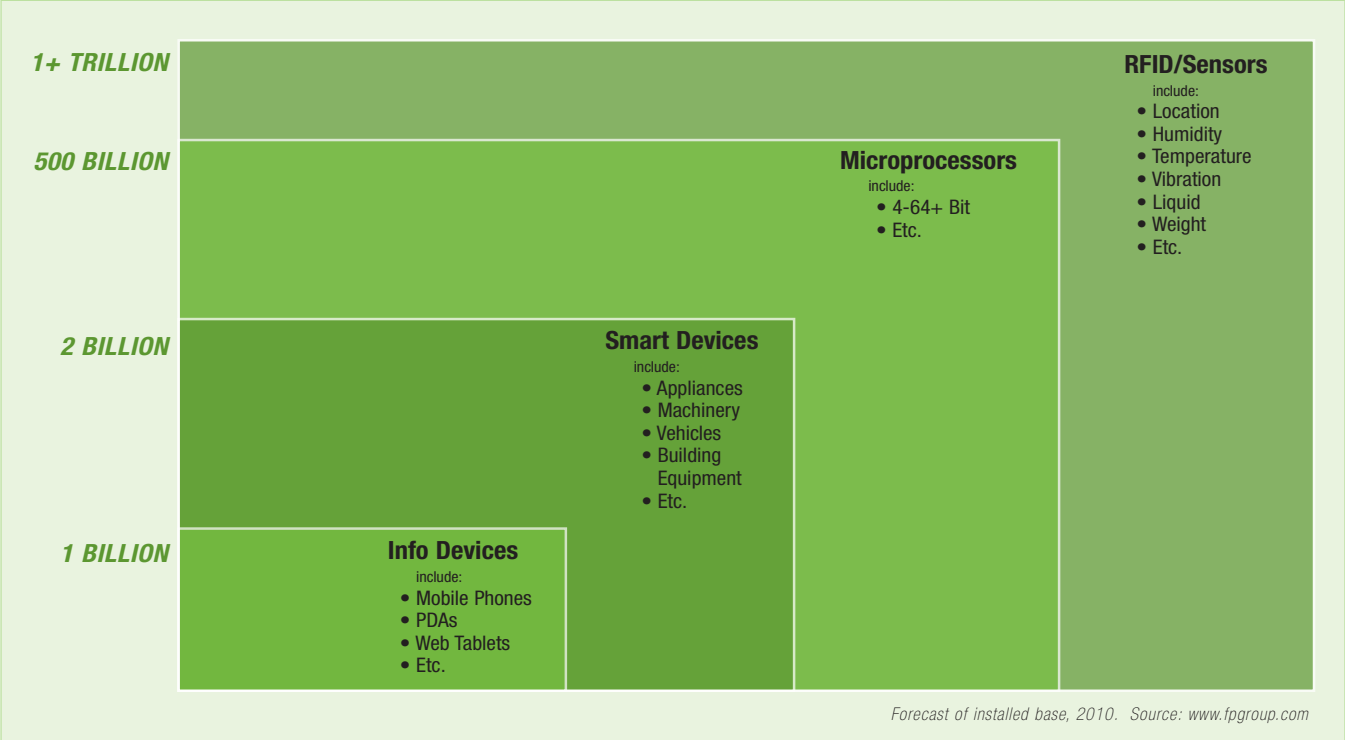


Figure 4. There are literally billions of devices in the world today that can take advantage of M2M communication.

3) The cost of network access has gone down, so has the cost of base-band silicon: Figure 5 shows how the cost of network access has dropped significantly over the past years. Looking at 2G/2.5G network years ago and comparing it to emerging 4G and mobile broadband, the costs have come down from $20 per megabyte to a mere .07 cents today — and that's for the broad-spectrum, high-performance capabilities of a 4G network. Also, the cost of base-band SoCs just a few years ago would have required a sizeable royalty to deploy a wireless baseband subsystem. But today, you can purchase a desired baseband solution and various system modules at inexpensive prices.

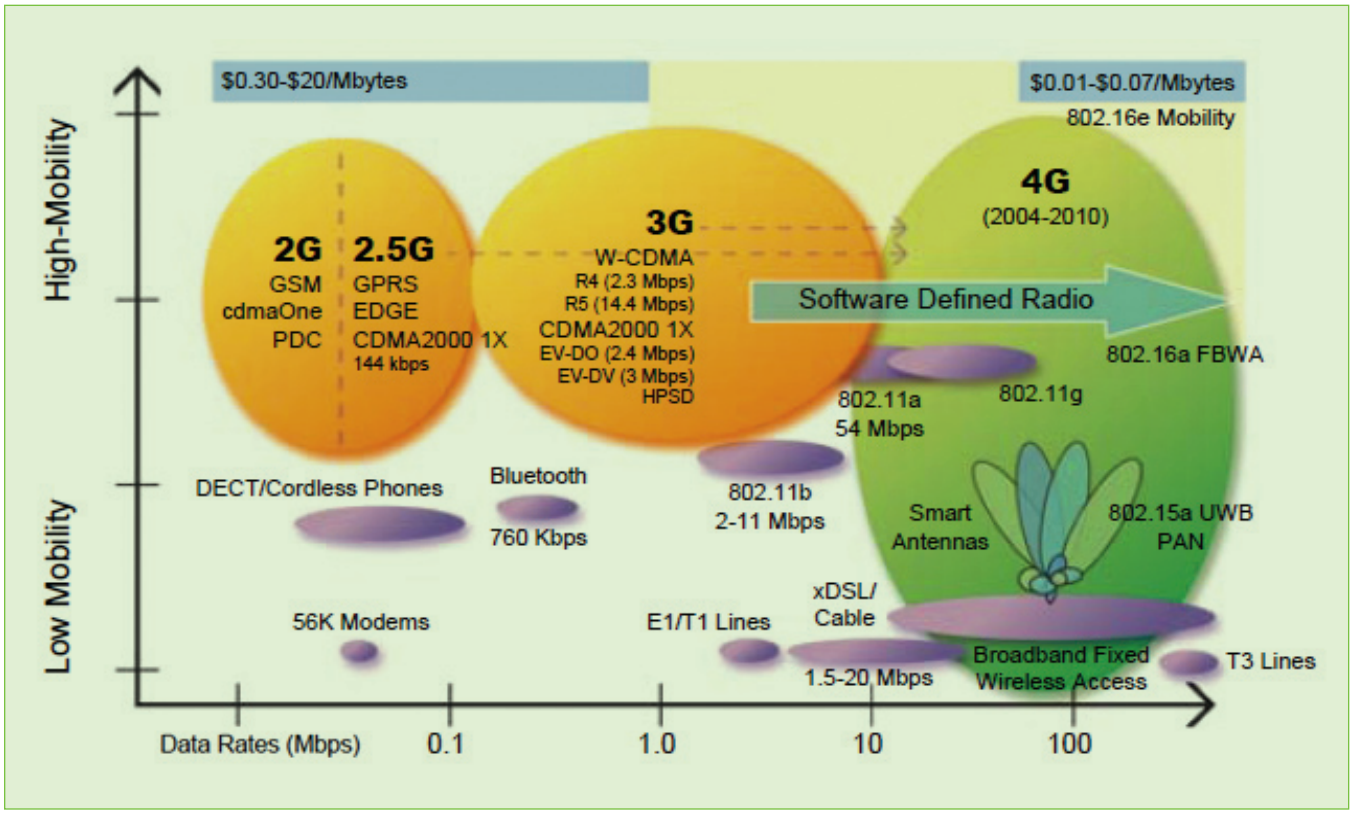


Figure 5. The evolution of 2G to 4G and how the technology increases while the cost per Mb drops significantly.

4) Availability of pre-integrated modules: There are a number of module vendors today that provide M2M modules, which include protocol stacks and real time operating systems along with different types of pre-integrated M2M applications. For example, one vendor, CCww Ltd., based in the United Kingdom, offers a range of certified M2M wireless modules with integrated software. Firmware and built-in software capabilities on these modules are becoming more commonplace.

5) Government mandates are driving M2M adoption: M2M growth varies by vertical market and geographies. Large scale adoption is often driven by government mandates or regulatory compliance. One such mandate is in the United Kingdom, where the government has required that all homes and buildings using utilities be equipped with automated meter reading devices by 2020. In the United States, government pressures for a national energy policy will no doubt, push M2M in new and exciting directions.

THE M2M ECOSYSTEM AS IT EXISTS TODAY

- **Module vendors:** Provide reference design platforms that offer various turn-key solutions to enable quick deployment of M2M applications. Platforms often include baseband, RF, and smaller "home grown" applications via a software developers kit (SDK).
  Companies involved: Sierra Wireless/Wavecom, Centerion Wireless, InterDigital, Telit, Motorola, Enfora, Wavesat, CCww Ltd.
- **Chip vendors:** Baseband chipset providers and developers of microprocessors IP and SoCs.
  Companies involved: ARM, Texas Instruments (OMAP), Infineon
- **System integrators:** Integrators are essentially design houses that are expert in M2M design and deployment. An integrator takes the module from a module vendor, and adds software components from various software providers. Once this is completed, an integrator will build an application that suits a customer's unique needs.
- **End users:** Companies that use M2M technology in their business infrastructure — can be products, services or a combination of both.
- **Network operators:** Commercial telecommunications carriers who offer network access to enable wireless M2M communication.
  Companies involved: Sprint-Nextel, Orange, T-Mobile, Verizon, AT&T, SK Telecom

Today's M2M deployments are done primarily by a limited number of system integrators. Because integrators play such a critical role bringing many technologies together, there is a limited number of commercial off-the-shelf (COTS) solutions available. But this will change in the coming years as more and more functionality will be used in these devices and standards are established.

CURRENT CHALLENGES

While there is keen interest in M2M and great value in building such a system, there are nevertheless, unique challenges. These challenges are both technical and non-technical in nature. In fact, M2M is being challenged most by a set of non-technical issues rather than the physical hardware or infrastructure. Major obstacles today have more to do with lack of communication among key players in the industry and the reluctance of some companies not to change the way they currently do business.

1) Complexity of the value chain

The value chain in the M2M space is still fragmented at best. Part of the reason is the industry is still rather young. As a result, there is no clear dominant player on either the silicon or software side. There have been some rather impressive mergers on the silicon side; Sierra Wireless acquired WaveCom, and Siemens spun off its wireless business unit, to form a new company called Centurion Wireless Group, which is now a joint venture between Siemens and T-Mobile.

Mergers and acquisitions are a normal by-product as an industry grows and matures. This particular trend needs to play out further as there are no key players on either the software or silicon side to help drive standards or organize industry user groups.

2) Module commoditization

With increasing competition among module vendors and price pressures from Asian manufacturers, module prices continue to drop. Already we are seeing high-end 3G modules starting as low as $30 per unit based on quality and performance. Low-end 3G modules are available for as little as $15 per unit. For applications where quality is paramount, customers prefer to use a module that has a proven track record, whereas new players may have less impetus on quality at this point. The cost of software plays an important role in determining the total bill of materials (BOM). Therefore, a cost-effective commercial software solution often makes better business sense than developing in-house.

3) Costs of initial deployment

At this time, a vast majority of new M2M solutions implemented are based on the unique needs of the customer. Normally, an independent third party (often a system integrator) will assess the M2M system under consideration and collect the hardware and software required. Once both the hardware and software have been assembled together, the system integrator will work with the commercial carrier who will be providing the network services.

These systems are often highly customized and not scalable. As a result, many of the small businesses find it difficult to justify the ROI associated with the initial deployment costs of M2M system. As M2M matures, it is believed that commercial carriers focused on M2M markets will soon provide more of the packaged solution and managed services — and forge partnerships with silicon partners, which will ultimately lower the costs of the M2M system. Module vendors, baseband chipset providers, and software vendors all work together to offer a number of cohesive and highly competitive turnkey product offerings.

4) M2M device certification

M2M device certification is costly and burdensome. The challenge for certification is that often times module vendors will certify their modules in the confines of their own M2M system. In some cases the company building the M2M infrastructure is not mindful of the requirements for system communications and will deploy an application on top of the module that while it may function intermittently, it will not work with a carrier's network as expected. Inevitably, the company has to rework the system and seek additional certification services to have it tested to make sure the module adheres to the certification requirements of the carrier who is going to provide the network. This means extra cost and delays to system enablement.

Furthermore, the lack of standardization in pertinent technologies is a concern in the M2M space. There are many different protocols available for both short- and long-range wireless transmission. Unlike mobile phones where there are established organizations that mandate operability requirements, such as the Open Mobile Alliance (OMA), there are no regulations or standards in place if device "A" sends a data packet to device "B" deployed on a different network. The data may go through, but there's no guarantee that it will be properly interpreted. And if it does go through, how complex of a process was it to convert the signal from device "A" to a signal that device "B" could receive? There is no clear initiative for cross-network interoperability within the M2M space (in the United States, at least), but there are discussions in the right circles to improve device/network interoperability, and as needed, necessary standards will be established that all can follow.

5) Long development cycles

M2M design and development cycles are long, which is an indication that the industry has room to improve. Five to ten years ago, if you looked at the mobile phone industry, you would've seen similar trends where the design cycles were between 18 to 36 months long, whereas now they've come down to what is in some cases less than nine months. The same trend is occurring in the M2M space. Again, it is expected that various COTS solutions will help speed time to market. Also, module vendors are building modules that are scalable across a range of applications, as opposed to a "one off" solution built only for one customer's specific need.

The M2M ecosystem consists of many of the same players that are active in the mobile phone market, particularly the network operators and silicon providers. With each passing day, the same silicon vendors that provide baseband silicon for mobile phones are beginning to provide solutions in the M2M space. Many of these companies specialize in building state-of-the-art modules, which are essentially turnkey solutions for M2M deployment. The latest solutions coming out of these companies (Infineon and Texas Instruments) include baseband silicon, a general purpose processor for application processing, and a combination of sensors and device interfaces ranging from automated metering to telemetics.

6) Software challenges

Many modern M2M applications pose complex design and software challenges and therefore demand a pre-integrated and well-tested software solution in order to minimize the risks. Wireless does pose unique challenges of its own, but unlike some of the other proprietary technologies, having an OS architecture that is optimized for wireless communication systems and one which has already deployed in over a billion wireless devices can certainly address M2M software integration issues.

TODAY'S M2M TOOLS AND TECHNOLOGIES

As alluded to earlier, it's believed that telecom carriers will continue to play a critical role in M2M. It makes good practical sense (business sense, too) that these carriers develop partnerships with both software and silicon providers.

Two M2M carriers in particular, Kore Telematics and Aeris Communications, have started to bundle packages together for their customers where a turnkey wireless module is combined with a data plan to run on a certain cellular network. These carriers are acting as intermediaries for the large cellular network providers. In some cases, these companies will approach a large cellular provider, say Sprint, and purchase a certain bandwidth in order to offer a subsidized solution to their customers. In doing so, the components can be configured and certified to be used on Sprint network, which expedites the building and deployment of an M2M system. More examples such as this are growing by the day.

On the software side, vendors who currently provide embedded solutions for mobile and portable devices have begun to offer solutions for M2M markets as well. Mentor Graphics, one of the industry's leading embedded software providers, maintains a dominant position in the wireless/telecommunications sector. The company offers a full range of software products from its flagship Real Time Operating System (RTOS) called Nucleus, a variety of Nucleus middleware components (USB, GUI, etc.), to a full suite of Eclipse-based software development tools for such activities as compiling, simulation, and debugging.

When building the M2M infrastructure, system developers must support the unique needs of the application under development, whether it's security monitoring, remote management, data collection, etc. To handle these tasks, a powerful and robust operating system is required. And given the nature of some of these applications, real-time, deterministic behavior coupled with a small footprint is often highly desirable. Further, power and performance tradeoffs can't be overlooked in many of the battery operated M2M devices. Consequently, an OS that can offer superior performance in constrained power systems is a must.

Considering the immense demands of today's M2M systems, selecting the right OS can be a difficult process. For complex M2M applications, a full-featured operating system with support for security; authentication software; tight integration with communication subsystems; secure storage and database functionality; OpenMAX compliant multi-media support; and customizable user interface (UI) technology is often needed. A company is faced with a few options on how to acquire an OS. M2M customers can outsource the OS and have a third party developer create the entire OS. A company can also choose to build their own propriety OS in-house — that is if they have the staff and expertise. Finally, they can choose a commercial off-the-shelf (COTS) solution, like the Nucleus OS, which has been deployed and proven in many wireless applications to date.

In addition to Nucleus OS and middleware components, Mentor offers pre-integrated applications that are exclusively tailored for any M2M module or device. Mentor's Nucleus WebServ, an implementation of the Hyper Text Transfer Protocol (HTTP), can push static or dynamic content to any device that's part of the M2M infrastructure. It allows a device to be remotely configured or controlled using a basic Web Browser client. Just like other Nucleus components, Mentor's WebServ product is particularly advantageous for M2M solutions with considerable strengths.

Nucleus WebServ advantages include:

- Flexibility in managing an M2M device from anywhere using a standard Web browser
- Eliminating the need to physically access remotely placed M2M device for diagnostics and/or troubleshooting
- Reduces administration costs and back-end system costs while providing on-demand access to valuable information
- Built-in system efficiencies, practically eliminates the risk of human/user error
- Enables countless business models to be pursued by allowing end customers access to dynamic data and live information

On the silicon side, new partnerships and co-developments are being announced on a regular basis. In fact, a few months ago, Telit Communications announced its first dual-processor product incorporating Atmel silicon with the ARM-based processor. This particular silicon solution is aimed directly at some of the most demanding M2M applications.

ARM is also heavily involved in making the 'smart home' a reality with its ARM-based architecture. Some of the latest devices for the smart home enable users to browse the Web and stream multimedia content directly to their TVs. This type of functionality requires high-performance processing and display capabilities, which ARM's Cortex-A8

and Cortex-A9 processors provide — also applicable to many portable applications — these types of processors are ideal for the M2M-enabled home for both content sharing and 'always-on' connectivity between devices.

As stated earlier, there are challenges in the M2M space. It's still early, but it's easy to see through these early developments, that M2M will become a dominate technology as time marches on.

CONCLUSION

Some industry pundits describe M2M trends pushing us to the brink of a wireless revolution; what we have here is something truly exciting — and revolutionary. With the latest advancements in telecommunications (and in silicon), there are a multitude of wireless capabilities built into very small, yet powerful multi-band SoCs. Many of the functions within these systems are controlled by device management (DM) software, which means it will be easy to manage and upgrade an M2M system over an air link with very little cost or effort.

The mobile phone industry was the first industry sector to help M2M get started. As a result, many of the same players: handset developers, software & silicon providers, and network operators are actively involved today. Many of the solutions offered by these companies easily apply to M2M.

Developing today's M2M solution offers a compelling value and clear benefits to many businesses. However, on the other hand, it can also pose significant challenges in assembling the right technologies and services required to successfully deploy such a solution effectively and efficiently into a legacy system. Taking into consideration many pros and cons discussed in this paper, potential customers and developers can only decide for themselves on what the right course of action might be. Indeed, it seems the "sky is the limit" both literally and figuratively in what one might be able to accomplish in this space as we continue to exploit the wireless paradigm. Perhaps it's time for an imminent wireless revolution fueled by M2M communications — only time will tell how it will shape the way humans live and work on this planet.

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