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The IoT Opportunity is here!

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ABSTRACT

Wireless IoT (machine-to-machine communications) adoption has begun in select industries including transportation, utilities, manufacturing, surveillance, and healthcare – that is now bound to catalyze its rapid diffusion across other industries. Cellular IoT solutions offer tools to integrate devices, applications, people and companies in a collaborative manner for improving overall performance and efficiency. It is a powerful engine for business intelligence, delivering insight into asset performance that can potentially revolutionize business models.

This whitepaper provides a comprehensive review of the state-of-the-art for Wireless IoT communications and services.

INTRODUCTION

The ubiquity of wireless data networks (GSM/GPRS and now 3G), the rapidly decreasing costs of modems (esp. GSM/GPRS), the widespread acceptance of the GSM standard, and the improvements in data rates and latency (3G), are all making Wireless Machine-to- Machine (IoT) communications a cost-effective and reliable enabler for a variety of industrial applications and services beyond voice-centric handsets that connect an enterprise's machine assets with its IT infrastructure and workforce through wireless data communication. There are potentially billions of machines/equipments that could be networked using wireless technologies. Data acquired from such remotely connected machines can thus be transmitted via the wireless network and the Internet to the organization's back office systems, and transformed into useful information for processing. Such a model can be extended to a wide range of industries such as medical, retail, security, transportation, and utility. This may range from a static machine such as a household electric utility 'smart' meter to Tracking and Telematics, where the machine is moving (e.g. a medical device on a patient). Short distance connectivity technologies such as Bluetooth, wLAN, ZigBee etc. could be used in conjunction with cellular wireless to broaden the range of potential cost-effective solutions. Cost/benefit analysis is key to winning adoption among enterprise customers. The adoption of Wireless IoT is especially gaining momentum in Europe. Telenor, a Swedish mobile operator, expects the number of wireless IoT connections to exceed regular handset deployment by 2008, driven by the deployment of remote 'smart' metering of electricity meters connected to Telenor's GPRS network[1]. Wireless IoT is thus beginning to grab attention and gain traction. Verizon Wireless (VZW) is now pushing MVNO programs and IoT devices aggressively into its portfolio of products[2].

CELLULAR IoT

IoT is poised to revolutionize the way in which businesses with machine assets will work. Adoption has begun in selected industries, including transportation, utilities, manufacturing, surveillance and health care.

Cellular IoT is about creating a network of automated remote-monitoring systems over large distances. It is a powerful engine for business intelligence, delivering insight into asset performance that can potentially revolutionize business models. An optimized IoT solution is targeted at lowering total cost of ownership, and must be designed to be a collaborative, flexible, and scalable platform solution. Revenues from Cellular IoT services are projected to quadruple, from ~ $2B (2006) to >$8B (2012)[3]. The study predicts increasing variety in the IoT market's business models.

APPLICATION AREAS FOR CELLULAR IoT

INDUSTRY	*EXAMPLE APPLICATION*	BENEFITS
Medical	*Wireless Medical Device*	Remote Patient Monitoring
Security	*Home Alarm & Surveillance*	Real-time remote security & surveillance
Utility	*'Smart' Metering*	Energy/Water/Gas Conservation
Manufacturing	*Industrial Automation*	Productivity & Cost Savings
Automotive	*Tracking Vehicles*	Security Against Theft
Transport	*Traffic Systems*	Traffic Control for Efficiency
Advertising/Public Messaging	*Billboard*	Remote Management of Advertising Displays
Kiosk	*Vending*	Remote Machine Management for efficiency & cost savings
Telematics	*Fleet Management*	Efficiency & Cost Savings
Payment Systems	*Mobile Transaction Terminals*	Mobile Vending, Efficiency
Industrial Automation	*Over-The-Air Diagnosis And Upgrades*	Remote Device Management for Time Savings and Reduced Costs

Table 1: Application Areas for Cellular IoT

BENEFITS OF CELLULAR IoT SERVICES

IoT adoption promises businesses the opportunity to reinvent their business processes from end to end. Applications and use-cases vary, and each IoT deployment can thus be unique. The organization must therefore discover the unique opportunities afforded it from the operational data available in real time. Data from remote monitoring of patients, for example, may be exploited to improve hospital-patient relationship management. Enterprises could apply business intelligence and data mining systems to remotely acquired machine data and derive insightful information to create new business

opportunities and services to increase revenues and at the same time improve customer relationship and loyalty.

The major benefits of Cellular IoT are:

- *New Revenue Opportunities:* IoT opens up new revenue streams particularly for wireless operators and MVNOs. IoT contracts are longer term compared with subscribers, and machines would not be expected to churn or require expensive support as voice customers would. Although the amount of data transmitted from each device is small, it becomes significant when multiplied by tens of thousands of times.
- *Security*: Optimized information control and reliability
- *Cost Savings*: Lower Total Cost of Ownership via decreased maintenance costs, resource costs, and intervention delays. Deployment, management, application and storage can all be managed via Web Services reducing customer support and site visits.
- *Productivity*: Optimized equipment uptime and minimized equipment downtime
- *Real-time monitoring*: Remote control and continuous real-time monitoring for instant response
- *Innovation and Differentiation*: New revenue streams from value-added services
- *Competitiveness*: Improved QoS and customer satisfaction

IoT services are generally vertical solutions tailored to serve the specific needs of a company with the ultimate goal of increasing the performance and competitiveness of the company through increased efficiency or better service. While some solutions may be designed to address internal problems in the interest of improving processes and efficiency, a majority of the solutions are aimed at serving the customer base of the company.

As such, solutions should be designed to grow along with the company and its needs. Technology advances or changes in the business environment may thus create an opportunity to introduce new applications or services.

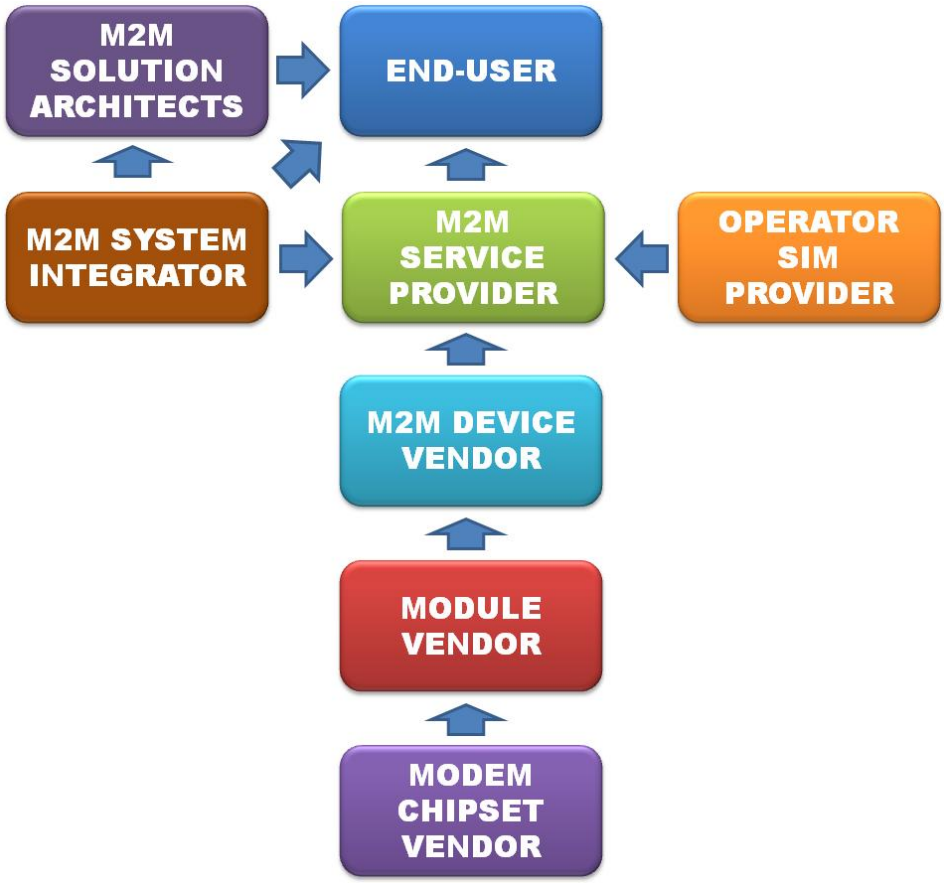
Due to the dynamic environment and changing nature of IoT solutions, they are not necessarily narrow vertical applications isolated from the external world; rather IoT solutions offer tools to integrate devices, applications, people and companies in a collaborative manner for improving overall performance and efficiency.

CELLULAR IoT VALUE CHAIN

The Cellular IoT value chain is shown in Figure 1 below. The key players are:

- **Chipset Vendors**, such as TI, Infineon, ST-Ericsson, Qualcomm, etc
- **Module vendors**, such as Enfora, Infone, Kyocera Cellular, Murata, Mobicom, Novatel Cellular, Panasonic Elec. Devices, Semco, Siemens, Sierra Cellular, SIMCOM, Telit Communications, and Wavecom.
- **IoT Device vendors**: This is somewhat of a gray area. While there are independent device manufacturers, IoT service providers usually source or manufacture the end-equipments themselves. For example an electric metering device may be manufactured by the utility company that installs the meter.
- **Operator SIM Provider,** usually provides only the cellular service that goes with the IoT service. While this provides only wireless connectivity and leverages installed infrastructure, some operators have moved further up the value chain to provide a full IoT service (see below).

Figure 1: Cellular IoT Value chain



- **IoT Solution Architects/Consultants** are central to the success of the project. They are responsible for architecting the entire IoT solution and platform including business case, requirements definition, systems design, selection of partners, and planning and managing the implementation. As such, they need to be versatile in understanding the needs of the customer, be conversant with all the elements in the value chain, and architect an optimized, collaborative, and expandable platform solution including appropriate 3rd party products & solutions.
- **IoT Application and System Integrators**, usually provide skills in integrating IoT devices and data into a company's integrated IT infrastructure and back office systems such as ERP, and may integrate 3rd party partner solutions to compose the whole solution. Implementations are thus managed as IT projects.
- **IoT Service Provider** usually offers the IoT service to the end user, bundling the end-equipment and the operator SIM/service. The major wireless operators in Europe and North America and elsewhere in the world are targeting the IoT market with different business models. Around half of all European operators provide data-only SIM cards. Whilst some provide only wireless connectivity, others have moved further up the value chain to provide a full IoT service such as Orange, and Vodafone (via dedicated reseller of IoT airtime, Mobius). Some IoT service providers may offer value added Solution Architecting/Engineering and System Integration services. U.S. carriers support IoT over CDMA or GPRS networks, but none has taken the step Orange has. U.S. carriers are generally working through service and solutions providers. Some companies such as Numerex and Jasper have become MVNO operators just for IoT.
- **End User** is the company that implements the IoT application and service**.** They may sometimes choose to be the total system integrator bringing in solution architects and consultants to assist with the implementation.

TYPES OF IoT SERVICE PROVIDERS

There are 3 different classes of IoT service providers.

- *Traditional Mobile Network Operators (MNOs)*: These include Verizon, AT&T, T-Mobile, Orange Business Services, Vodafone (through resellers), Sprint, O2, etc.
- *Mobile virtual network operators (MVNOs)*, that does not own its own spectrum and usually does not have its own network infrastructure. MVNOs have business arrangements with traditional mobile operators to buy minutes of use (MOU) for sale to their own customers. Further, MVNOs may find it attractive to migrate to the MMO model (below).
- *Specialized IoT Mobile Operators (MMO)*, who aggregate MNOs' base stations, but own key network infrastructure elements, giving them more control over the provisioning, service level agreements, and management functionality. Examples

are Aeris, KORE Telematics, Jasper Cellular, Wyless, and Qualcomm Cellular Business Solutions (QWBS)

CELLULAR IoT BUSINESS MODEL

An IoT service provider typically has the following components either singly or in a bundle:

- IoT device with a monthly rental and access fee
- Connection fee, including set up and activation of SIM card
- Usage based charges – monthly flat rate, or per amount of transmitted data.

Some IoT service providers may additionally offer value added services in the form of:

- Solution architect and engineering services
- System Integration & Services

The market is still somewhat in a state of flux and the Operators are beginning to introduce staggered/sophisticated pricing plans to maximize their IoT revenues.

Wireless MVNOs are a unique type of player in this market; they can act as resellers of wireless data services on behalf of operators, also managing roaming arrangements for IoT solutions that traverse international boundaries. For example, UK-based Wyless is active worldwide, and Aeris.Net operates in North America.

IoT BENEFITS FROM 3G AS WELL

With the projected rapid growth of 3G networks around the world, 3G wireless modules are projected to capture ~30 percent of the IoT communications market by 2012[1]. The arrival of UMTS promises wider bandwidth to support the transmission of bulky data such as video sent from surveillance cameras.

Potential 3G IoT applications include:

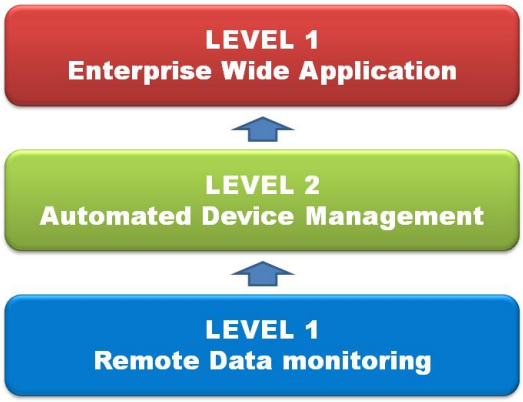
- Fixed-wireless terminals that use cellular backhaul
- Multimedia content delivery, to POS terminals and digital-marketing displays
- Video surveillance, without the need for cabled connections
- High-speed vehicle electronics connectivity, including real-time navigation information
- Remote information display, used, for example, in digital mobile advertising

LEVEL OF COMPLEXITY OF WIRELESS IoT APPLICATIONS

IoT deployment is typically initiated on a pilot program before being scaled to large scale implementations. The level of complexity and sophistication in the deployment can vary. One might see 3 different levels of deployment:

- **LEVEL 1**: Simple remote data collection and monitoring such as by SMS and 1-way GPRS
- **LEVEL 2**: This would involve something on the order of Automated Device Management with, for example, 2-way GPRS data traffic. It may include limited integration with IT infrastructure (e.g. Database). An example would be wireless medical device for remote health monitoring.
- **LEVEL 3**: Enterprise wide deployment with end-to-end automation & management and support of access terminals, along with extensive integration with IT infrastructure including database, ERP, CRM, automated billing, automatic report generation, workflow management, etc. An example would be 'smart' metering of utility energy meters in a city.

Figure 2: Level of complexity of IoT Deployment



WIRELESS IoT DEPLOYMENT CHALLENGES

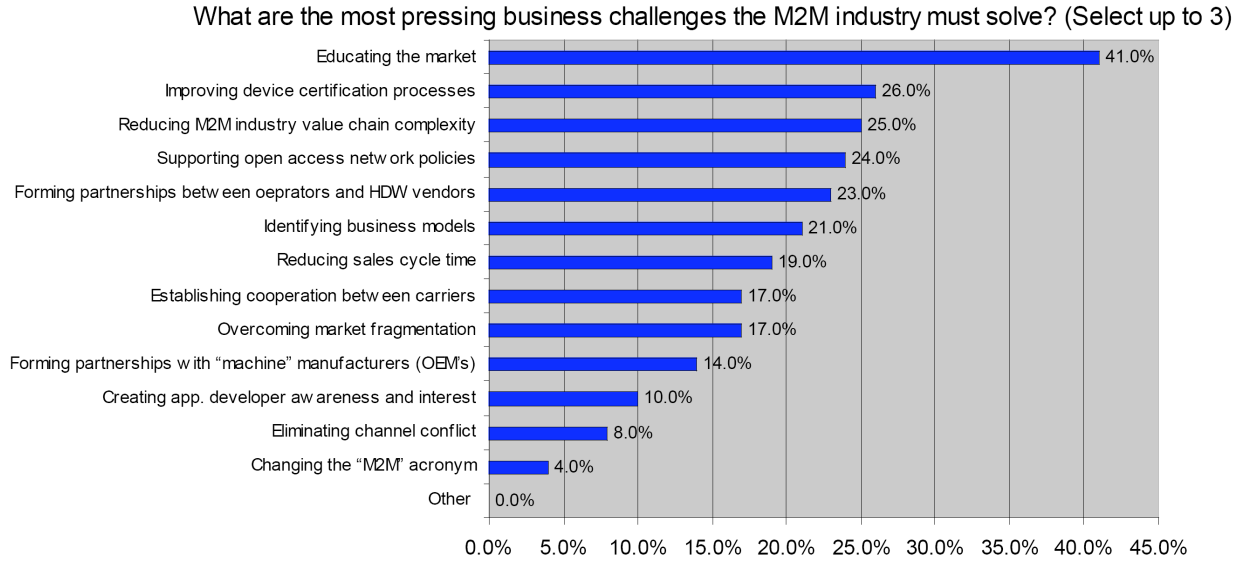
While the promise of wireless IoT is significant, there are many challenges and hurdles in terms of deployment.

- **Lack of Market Awareness:** Cellular wireless is usually associated handsets. Most companies are unaware of the potential of cellular wireless for IoT applications.
- **Complexity of Technology:** The complexity of providing an end-to-end Wireless IoT solution necessitates a clear understanding of the business case,

performance objectives, the key players and the relationships among them. Improving device certification can go a long way in making it easier for adopters to implement IoT applications. Within the IoT value chain, each component supplier faces implementation challenges in its respective area. The role of the Solution Architect/Consultant is thus key in bringing together all facets including 3rd party providers, and managing an efficient implementation of the solution for maximum ROI.

- **Initial deployment cost:** The route to market is not straightforward and solutions must be built from scratch each time. IoT service deployment cost for enabling tens of thousands of devices each will amount to a significant sum. System integration costs are perhaps likely to emerge as the most expensive component. Cost/benefit analysis is therefore key to winning adoption among enterprise customers.
- **Operator complexity:** One of the biggest hurdles is the dependence on the cellular service provider for the cellular service. Data plans for IoT service are usually priced with a separate business model from the traditional data plans for smartphones and/or consumer computing devices. Operators would therefore like to ensure that IoT devices are not abused for voice/data traffic other than the intended purpose of machine-to-machine communications.
- **Operator ROI concerns:** The issue for carriers has been that IoT today amounts to relatively a small amount of money for each device. Seeing low ARPU, even if it represents potentially millions of users, makes carriers hesitate in setting aside resources for IoT. Partnerships between operators & hardware vendors and cooperation among operators can catalyze IoT adoption.

Figure 3: Key hurdles challenging IoT adoption (Source: Yankee Group, Feb, 2008)[4]



AN EXAMPLE WIRELESS IoT APPLICATION – "SMART" METERING

Metering is a fundamental business enabler for the Utility sector companies such as Electricity providers. Electricity is a basic need for virtually every household and business. In the wake of liberalization of energy markets and with growing public awareness and interest in energy conservation, automated meter management or "smart metering" for intelligent metering services is gaining prominence, starting with Europe and now in the US. The vision behind smart metering is that when these meters are collaborating with an in-home display that shows current energy usage, as well as with a communicating thermostat and software that collects and analyzes the information, consumers can see real-time how much consumption drives cost – this awareness will thus will increase the tendency to consume less.

In fact, in the UK, where older homes vastly outnumber new "green" homes (as they do in most cities of the world), Smart Meters are fostering such energy-saving behaviors as[5]:

- Installing highly efficient windows
- Insulating under roofs
- Installing solar water heaters
- Using incandescent light bulbs little and replacing most or all bulbs with compact fluorescents
- Giving up using an electric tea kettle, a notorious energy hog

Some 50 million old meters in the United States are likely to be replaced by advanced meters by 2010 at a cost of about $18 billion, according to a recent analysis by Deutsche Bank[6]. Worldwide, only 6% of electricity, 8% of gas, and 4% of water meters are even automated. In fact, in the electric industry alone, 500 million meters worldwide could be replaced over the next 10 years.

In Europe, Sweden, Finland, Denmark, Netherlands, Norway, and Ireland have mandated (or are in the process of mandating) smart metering. Sweden is the pioneer and is on track to implement smart metering for all electricity meters by 3Q-2009. Governments in Austria, Ireland, Spain and the UK are also encouraging use of automated meter monitoring[7].

Close at home in the US, the government is mounting aggressive initiatives for energy conservation including "smart grid" initiatives[8], where electricity is delivered from suppliers to consumers using digital technology to save energy, reduce cost and increase reliability. About $4.3B in outlays to upgrade the nation's energy grid has been included in the Obama administration's $787B economic stimulus package. Such a modernized electricity network is being promoted by many governments as a way of addressing energy independence or global warming issues, and may well represent one of the fastest growing sectors in the GreenTech market. Texas law requires rapid smart-

meter deployments. See how one proposed “smart grid” would let the user and the utility company manage power flow[9].

Utilities are thus spending billions of dollars outfitting homes and businesses with the devices, which wirelessly send information about electricity use to utility billing departments and could help consumers control energy use. Recently, companies such as Itron and Digi International have introduced wireless IoT solution bundles optimized for energy services providers[10,11]. This was instrumental in the launch of TXU Energy’s iThermostat™ energy conservation program[12,13], and the platform is designed to support traditional demand response systems in addition to AMI (Advanced Metering Infrastructure) and Smart Grid solutions. The Digi International’s iDigi™ Energy platform, for example, includes the hardware, hosted software and services necessary to quickly and easily integrate meters, load control modules, displays, relays, thermostats and other energy assets commonly required for demand response, AMI, and other Smart Grid offerings. Energy service applications connect to the hosted software component of iDigi™ Energy via a simple Web Services interface, thus simplifying the development and deployment of energy management services.

Similarly, Smart power grid company Echelon Corp (ELON.O) and T-Mobile USA DTEG.N announced an alliance to use T-Mobile's wireless network to link "smart meters" to utilities[14]. Echelon has also entered into a similar alliance with Duke Energy in the development of Duke’s “Utility of the Future” smart metering network[15].

Likewise, trials are underway in several states by many other utilities such as PG&E Corp (a San Francisco Utility), Connecticut Light & Power Co, Southern California Gas, Delmarva Power (Delaware). GE, in partnership with Florida Power & Light and Cisco began rolling out smart meters in Miami[16].

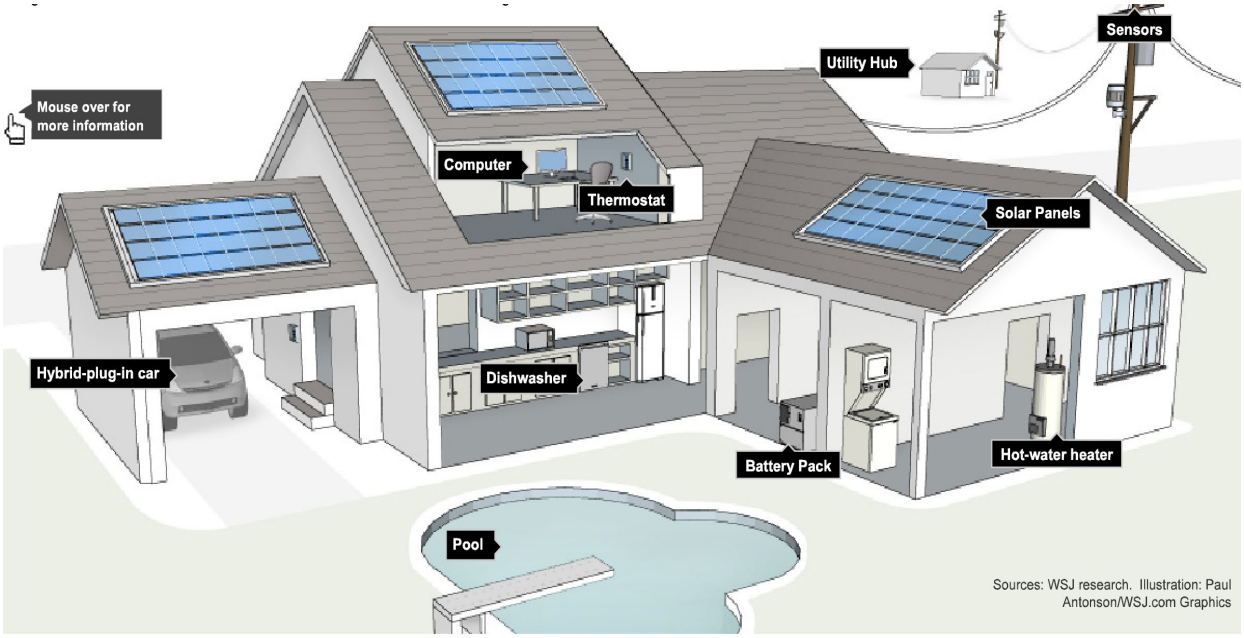
Other notable smart grid infrastructure providers actively pursuing this space are Smartsynch[17], Silver Spring Networks[18], eMeter[19], EnergyICT[20], Siemens[21], GE[16], and Itron solutions[10]

On the IT infrastructure side, many players are announcing initiatives to support Smart Grid deployment. IBM has announced plans to speed up Smart Grid deployment with $2 Billion in Financing from its lending and leasing arm, IBM Global Financing[22]. The company also donated its Smart Grid Maturity Model to the Carnegie Mellon Software Engineering Institute to help foster wider adoption of this model. Maturity models are a road map to help users take a technology or practice to its full use[23]. Google has launched a project to provide homeowners with free software that would communicate with such smart meters and allow for the monitoring and analysis of energy consumption trends[24].

Despite the promise of smart metering, only a handful of operators are taking the lead. Historically, U.S. utilities have generally focused their business strategies on large capital investments prioritizing mature technologies with well-proven benefits, such as power plants and high-voltage transmission lines. The utility industry is naturally risk averse - it counts on evolution, not revolution. The cutting-edge smart grid technology

concept therefore is perceived as revolutionary by the traditionally risk-averse utility industry. Recent policy developments, such as the Energy Policy Act of 2005, are however forcing a cultural shift at many utilities towards focusing on improving reliability, increasing efficiency, and giving customers more control over their energy consumption.

Figure 4: How a proposed "smart grid" would let the user and the utility company manage power flow (Source: WSJ Online, April 27, 2009)



COMPUTER	On their home computers, consumers can set parameters to tell the utility how they want to use their home appliances, monitor real-time electricity use and view charts to track consumption and their costs.
THERMOSTAT	The utility company could reach into the customer's home and turn down the thermostat.
WATER HEATER	Likewise, the utility company could reach into the customer's home and turn down the water-heater which could also be programmed to price and environmental signals.
SOLAR PANELS	Solar panels could provide a supplementary energy supply that is sent to be stored in a battery pack.
BATTERY PACK	The battery pack stores solar energy that may be used to run household appliances.
POOL	Could be programmed to respond to price/environmental signals, & optionally to run only with solar power.
DISH WASHER	Consumer may choose to program the pool pump to cycle only when energy prices hit a threshold.
UTILITY HUB	This is the intelligence hub for the electric utility.
SENSORS	Sensors along power lines give utility company real-time view of electricity flow. An over-taxed sub-station can trigger automatic notification to residents to regulate power use.

SUMMARY

Wireless IoT represents an almost infinite opportunity. It is here, and up for grabs! Adoption has begun in selected industries, including transportation, utilities, manufacturing, surveillance and health care. Smart Grid initiatives have sparked a lot of interest and investment in smart metering applications. Many companies, big and small, have jumped into the fray. Wireless Operators are now beginning to understand the importance and potential of IoT to businesses and to their own future. Wireless IoT is thus poised to achieve a critical mass that is bound to catalyze the rapid diffusion of Wireless IoT applications into a wide range of industries.

For further reading, see:

Key factors for a successful IOT deployment strategy

REFERENCES

[1] The European Wireless M2M Market, Berg Insight, 2007.
[2] Verizon: Wholesale M2M Solutions, 2008. (http://www.verizonwireless.com/pdfs/mvno_brochure.pdf)
[3] ABI Research Report on M2M Applications and Services, 2007.
[4] Yankee Group Presentation on "Industry Research: Cellular M2M Services, CTIA 2008.
[5] Trying to build a Greener Britain, July, 2008. (http://www.nytimes.com/2008/07/20/world/europe/20greenhouse.html?ex=1374292800&en=da42c673d7f70835&ei=5124&partner=permalink&exprod=permalink)
[6] Chip companies all charged up over smart meters, Electronic Business, June, 2008 (http://www.edn.com/article/CA6572681.html)
[7] Smart Metering and Wireless M2M, Berg Insight, 2007.
[8] US Department of Energy Smart Grid Program, 2009 (http://www.oe.energy.gov/smartgrid.htm)
[9] "Smart Meter, Dumb Idea?" The Wall Street Journal Online Edition, April 27, 2009 (http://online.wsj.com/article/SB124050416142448555.html#project%3DGRID09%26articleTabs%3Darticle)
[10] Itron, 2009 (http://www.itron.com/)
[11] Digi International iDigi™ Data Sheet, 2009. (http://www.idigi.com/pdf/ds-idigi-energy.pdf)
[12] Digi-TXU Joint Media Announcement, April 2009. (http://news.thomasnet.com/fullstory/557906)
[13] TXU Energy iThermostat™ Program, 2009. (http://www.txupartners.com/thermostat/)
[14] Echelon-TMobile Joint Announcement, April 2009 (http://www.reuters.com/article/technologyNews/idUSTRE53M0UG20090423?feedType=RSS&feedName=technologyNews)
[15] Echelon-Duke Joint Announcement, 2008 (http://tdworld.com/info_systems/highlights/echelon-duke-energy-smart-meters/)
[16] GE Smart Grid Technology, 2009 (*http://*ge.ecomagination.com/smartgrid)
[17] Smartsynch http://www.smartsynch.com/
[18] Silver Spring Networks http://www.silverspringnetworks.com/
[19] eMeter http://www.emeter.com/
[20] EnergyICT http://www.energyict.com/
[21] Siemens https://www.energy.siemens.com/cms/00000105/en/solutions/smart_metering/Pages/Default.aspx
[22] IBM To Speed Up Smart Grid Deployment With $2 Billion In Financing, May 1, 2009 (http://money.cnn.com/news/newsfeeds/articles/djf500/200905011107DOWJONESDJONLINE000494_FORTUNE5.htm)
[23] IBM: Smart Grid Tools for All, March 30, 2009 (http://earth2tech.com/2009/03/30/ibm-smart-grid-tools-for-all/)
[24] Google's PowerMeter, 2009 (http://www.google.org/powermeter/howitworks.html)

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