» Whitepaper «

Simplifying M2M

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M2M is a hot new trend in the electronics industry. Machine-to-machine connected computing solutions are rolling out worldwide and across all industries. Many OEMs will want to launch M2M services, either for their own use or the use of their customers. Kontron is working with the leaders in the M2M ecosystem to break down the complexity of the M2M value chain. Kontron's purpose is to make it easier for OEMs to launch smart services that take advantage of cloud computing enabling them to better serve their customers with innovative solutions.

Kontron's new Smart Services Developer Kit for M2M development and deployments was designed in collaboration with Intel, and is a plug and play hardware and OS/middleware software platform that is ready for smart services development.

This paper is developed to help OEMs and smart services developers understand:

» M2M Market Trends and Usage Models
» M2M Impact on the Enterprise
» Kontron M2M Solutions
» M2M Challenges, Technologies and Future Developments

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M2M: The Next Big Thing

Whether you believe the 50 billion connected devices forecasted by AT&T by 2020 or the 1 Trillion connected devices projected by IBM for 2015, it is safe to say that M2M is an exploding marketplace that brings new challenges and opportunities to companies worldwide. Often dubbed the Internet of Things (IOT), the current M2M market may seem fragmented. Even though M2M has been in existence for more than a decade, at TIA 2011 Intel estimated that only 100M true M2M deployments exist today. At the same event Intel also predicted that over 1 million innovators are working on smart services development. During TIA 2011, Wirefree predicted that the use of M2M devices will grow to 100 devices per person.

A combination of factors is propelling the explosive growth of M2M applications enticing a plethora of suppliers to enter the market:

» New transaction based billing models from operators are enabling a reasonable economic model for M2M. The cost of 3G modems is also decreasing further enabling deployments.
» Networks are being expanded to be able to handle the huge number of low transaction devices
» The availability of cost effective standards-based connected computing M2M systems for use as gateway appliances and general purpose infrastructure components simplify solutions development and deployment.
» The availability of Connected Device Platforms (CDP) that enable enterprise high-volume self-service provisioning of M2M data connections over cellular networks and manage network data billing plans to ensure accurate expense transaction accounting.
» The availability of M2M Application Platforms (MAP) that quickly and easily enable enterprise high value IT transactions between the device monitored (behind the modem) and the enterprise back-office applications like Trouble Ticket, Quality, Maintenance and Asset Management systems.
» M2M software solutions and services frameworks are readily available to provide autonomous device management since devices are usually unattended at the site of deployment.

The average revenue per user (ARPU) has long been an important metric for network operators. Often ranging in the neighborhood of US$50-60 per user per month, however, that economic model will not work in the M2M deployments. Operators now are estimating the number to be around $5-10 per device per month, which is more realistic based on the level of services the operator provides. Still, with so many devices rolling out in years to come, a new spectrum of technologies will be needed in many countries if operators are to maintain the quality of service expected by customers. It isn't M2M alone that is driving this need – it is also the pervasive usage of video by end-users in all markets.

The new "standard-based" M2M devices are replacing proprietary purpose built devices. Purpose-built M2M monitoring devices were deployed in many initial departmental rogue M2M deployments and by operators in networks. These devices are being replaced by standards based architectures that reduce the dependence on a single vendor, provide advanced intelligence, and allow for more easily scalable solutions.

Lastly, software and services for M2M make it easy for the OEM to deploy M2M smart services. These solutions are now proven and supply the autonomous device management and reusable functionality that significantly reduces the cost and time for a new deployment. These software and service providers are able to offer cost effective ready-to-go horizontal solutions across many vertical market deployments.

M2M Trends

There are several M2M trends that OEMs and smart services developers need to understand.

Device functionality and usage models are typically split into three categories:

» **Indirect Nodes and Sensors** – These devices provide monitoring services, and frequently use WPAN 802.15.4 or WLAN 802.11 wireless communication.
» **Direct Nodes** – This device operates in a stand-alone capacity to send and receive data from the cloud, and may use multiple radio technologies to accomplish their mission.
» **Gateways** – These devices aggregate data from indirect nodes and sensors and deliver commands back using multiple radio technologies while acting as an on ramp to the Cloud on behalf of many indirect nodes and sensors in a localized area.
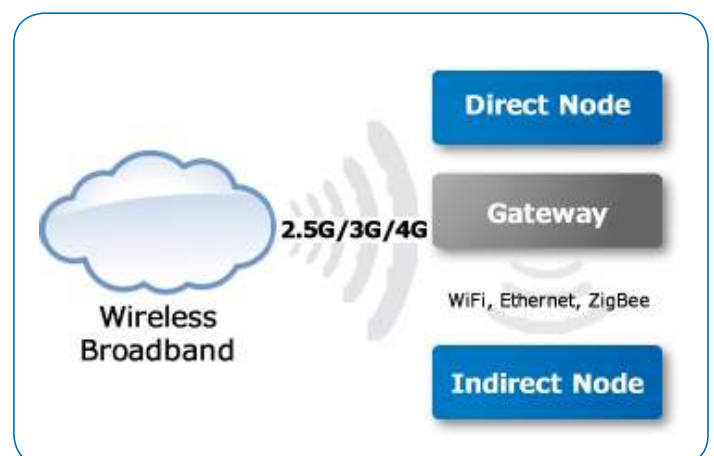

Image 1: M2M usage models

Innovative solutions from horizontal providers of M2M Application Platforms (MAP) are enabling over-the-air provisioning and software updates for devices as well as implementing the policy and security to protect data and privacy. Remote management is one of the keys to M2M success. In addition to these basic requirements for a MAP, key functions described here are Dashboards, Enterprise Connectivity and Secure Remote Access.

Dashboard usage is up. Companies need real-time data provided in such as way as to enable decisions, and an infrastructure in place to rapidly change implementations of devices. In the past, dashboards would be created manually using reports generated from corporate databases. New services provide rapid drag-and-drop creation of dashboards to CEOs and to operational entities enabling them to make rapid decisions and take actions to control costs and optimize resources. M2M is becoming integrated into the enterprise operation; stand alone M2M islands are disappearing since they do not offer ease of integration to corporate databases and ease of creation of new dashboards.

Direct enterprise integration and connectivity is becoming a must have: In addition to feeding into corporate dashboards, this data must easily be incorporated into the enterprise business applications such as ERP or operations databases. Until the C-level execs can see the 'right' information in their back office systems (SAP, IBM, Oracle), M2M value is limited. Value is significantly increased when device data is easily integrated into the business process, instead of remaining in a stand-alone silo data environment. Ideally no coding is required, simply point and click and you're moving meaningful data to these complex business systems. In the past, the solutions that have been implemented to move critical data from source devices into enterprise systems often have many twists and turns. Business decisions can only be as good as the information on which they are based. A significant benefit of Machine-to-Machine based communications solutions is the capability to deliver accurate data in near real-time, based upon actionable events directly to the enterprise host processing systems to support timely and informed business decisions. Solutions for billing, asset management, data collection, process operations, and customer care all benefit from having the most efficient possible linkage between data source point and information consumption decision points.

Secure remote access: Dashboards and Enterprise integration are very important, but what are you going to do with that information when problems need to be resolved? The old way of doing things by sending field personnel out to diagnose and fix problems is costly in labor and vehicles. Truck rolls can add significantly to Opex costs. When problems can be fixed remotely the enterprise, or contracted service staff, saves on Opex costs while cutting response times.

Solid audit trails and secure remote access can also open opportunities for incremental value added services that will further and improve internal or external customer satisfaction. Finally, secure remote access can enable enhanced collaboration by a worldwide team.

Vertical markets are expanding: Initial M2M deployments have been focused on the energy industry and smart meter deployments. This has been accelerated by the European Commission mandates for Smart Grid and Smart Metering technology. Video infotainment and auto telemetry are growing markets. Industrial, building and home automation industries are expected to begin deploying M2M as well. Another important vertical market is the medical equipment industry where there will most likely be subset markets that deploy M2M; for example in-home patient care versus in hospital care or assisted living options.

The Impact of M2M on the Enterprise

The premise of M2M networks is that data is collected so that it can be acted upon in a timely manner. Actionable data is needed by CEOs and by operation teams across industries. In the past, the remote device data was gathered into remote hubs with a remote application making decisions. At some point, a summary of activity was sent to the enterprise. Now, this data can be moved directly to the business systems to streamline the business process. Some of the real life examples of actionable deployed M2M usages include:

» Industrial automation aggregation of HMI SCADA data
» Equipment fault, detection, diagnostics and predictive maintenance
» Remote access and support
» Building automation
» Water management for industrial processes, wastewater and utilities
» Manufacturing productivity
» Renewable energy
» Logistics for consumables replenishment & automated billing
» Quality monitoring & traceability
» Security information

Next let's look at the impact M2M can have in specific situations.

Image 2: Some wind turbines use hundreds of M2M nodes.

Energy

Data from nodes is added to corporate databases via secure transactions over the cloud so that analytics can be generated via smart services and middleware software. For instance, in the use of energy analytics, a business can view the cost, carbon footprint of their energy usage. This is useful for a multi-national company to see the summary and then drill down by country, region, building and department. Energy offenders can be identified and corrective action can be taken. For example, an air handler that is clogged may consume far more energy than other units. Energy usage is being tracked by occupancy hour and delivered on dashboards on a real time basis. This kind of information can help companies reduce costs, diagnose symptoms and make changes that impact the business. Energy Star ratings are necessary for some NA rentals so close attention to energy is becoming a norm for businesses.

Image 3: M2M use is growing in factory automation

Factory Automation

Another area that is starting to use M2M data is factory automation and equipment. Overall equipment effectiveness (OEE) is frequently used as a KPI (key performance indicator) by manufacturers. Loading, availability, performance and quality metrics can be delivered as dashboard indicators for total effective equipment performance (TEEP). A plant may receive a dashboard as a smart services solution that provides the plant's performance compared to other plants in the company, whereas the CEO may need the combined information to understand the overall business on a real time basis. Dashboard tools utilizing M2M SCADA data are available now from companies, such as ILS Technology. As some industries struggle to keep up with the brisk post-recession demand for their products, real-time asset optimization can increase revenues and avoid opportunity loss.

Dashboards can also be distributed to field service people before a truck roll to ensure they understand the probability diagnostics and can bring the likely replacement parts. It will also enable many first time programs for equipment whose health and status can been monitored from M2M to realize cost reductions for vertical market implementations that are enhanced through M2M smart services.

Logistics for Consumables Replenishment

Whether it's monitoring for tanks, printers, vending or many other machine types that are fed consumables by the OEM, there is big revenue on the line that can be increased by automating the logistics for timely replenishment and automated billing. This automation is effected by M2M remote monitoring solutions which are quickly enabled by an M2M Application Platform.

Quality Monitoring & Traceability

Quality and end-to-end traceability is becoming more and more prevalent as federal and corporate mandates are being made to ensure the quality and safety of products. Food & Beverage, one industry example, is driven by the FDA standards but also by their executives to control their liabilities during a recall. Having an M2M solution which provides end to end tracking of the quality, location and chain of custody of the products can minimize the impact during a recall and can ensure a quality product is being delivered. It's kind of like tracking the progress of your FedEx package but with a lot more information to monitor along the path.
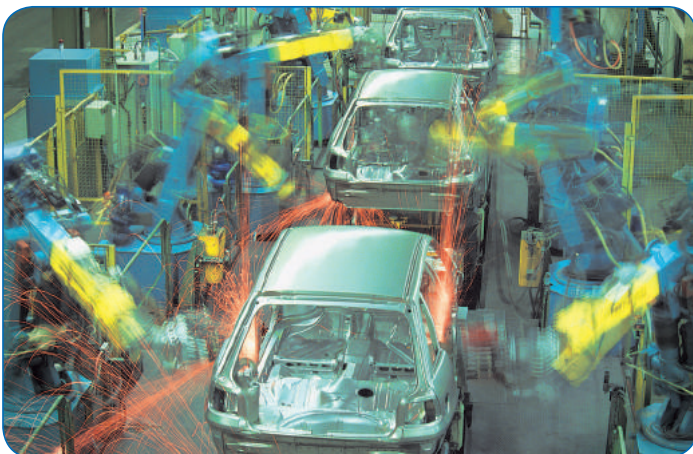
Remote Access and Support

Utilizing these tools, some customers have created a scalable and secure virtual support network that enables all remotely located managed devices to appear as if they are on the same physical LAN as the support or Service Organization's operations center network. This allows support users to perform on-demand remote remediation and predictive maintenance with-out the need to create and administer complex VPNs, or onsite/remote personnel.

Building Automation

Some customers have enabled a Sustainable Building Technology program which utilizes superior commercially available technologies to fully monitor and make available Smart Building data points from over thousands critical points. This allows central monitoring and control of complex system to simple items such as being able to change the times that AC is on from a central point out to several different AC control systems.

Kontron's M2M Solutions

Kontron recognizes the benefit of general purpose, open systems technology and provides server systems and AdvancedTCA blades for the M2M data center use. Kontron also offers a M2M system that can be used as an embedded Direct Node or a Gateway appliance external to the monitored asset.

Kontron is working with its M2M ecosystem partners to simplify the complexity of the M2M value chain. By offering smart service developers an application-deployment-ready systems platform based on the state of the art Intel® Atom™ processor, Kontron streamlines the development of smart services by readily supporting up to 90 percent of the work required to develop an M2M application.

Kontron M2M Solution offers "Swiss Army Knife" Approach

The Kontron M2M system provides a high level of functionality so that developers can use a single SKU for testing and smart services deployment. The Kontron M2M system/appliance in the kit is designed for high volume manufacturing and for OEM flexibility. For high volume deployments of the M2M system, Kontron will work with its OEM or operator customers to semi-customize the system to ensure that any features of the M2M system that are not needed are removed to reduce costs without requiring major design efforts.

By working in collaboration with Intel and our ecosystem of MAP partners in the device development cycle, engineering teams identified the key requirements for a "Swiss Army Knife" scalable edge node/gateway system. This client device, deployed next to the monitored assets, can interrogate the asset, analyze the data locally to create actionable information, generate the transaction of this information and efficiently transmit the information to the cloud. The joint team focused on developing a small M2M system chassis that measures about the size of a box of Altoids®, and can be easily mounted to the point of use as needed with the provided mounting bracket.

Image 4: Kontron M2M System is a little bigger than a box of Altoids

Next the team determined the optimum chipset capabilities that feature high computing performance in a small footprint. The power window is low and the device is fanless to meet reliability and low power deployment needs. The device also supports A/V requirements. Many M2M devices need an advanced graphics engine to provide a rich visual experience and high definition audio to support HMI (human machine interface) for dual function devices or for developer testing. The team selected   Kontron's COM Express® compatible nanoETXexpress ®-TT family of Computer on Modules (COMs), which are the size of a credit card, as the ideal candidate for the device computing board. A custom carrier board provides the supporting I/O to take advantage of the Intel® Platform Controller Hub EG20T.
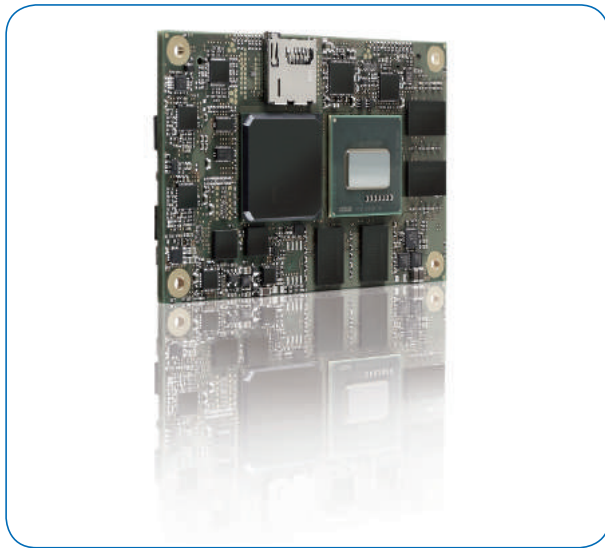
Image 5: Kontron's nanoETXexpress-TT COM

Kontron has designed the M2M Smart Services Developer Kit to be a plug and play developer and deployment solution that is ready for immediate use by smart service developers. A "Swiss army knife" design approach is appropriate for the development device since it also supports multiple forms of wireless communications. Kontron's M2M Smart Services Developer Kit supports 300 Mbps Wi-Fi through put with 802.11 b/g/n at 2.4GHz band and 5GHz band for 802.11a. An integrated 802.15.4 WPAN transceiver flexibly supports a wide range of protocols and network topologies, such as 6LoPAN, Wireless HART, ZigBee® and others, using a unique 802.15.4 MAC layer interface. Additional protocol-specific certifications may be needed prior to broad market M2M deployments.

Drivers are already included in the Kontron M2M System for the PTCRB-approved 3G 5521gw module from Ericsson, which is pre-installed for further smart service connectivity development in selected SKUs. By using pre-certified modules, such as the Ericsson 5521gw module, the timeframe for gaining operator approval for the device on the operator's network is also reduced. Kontron offers the flexibility of two standard development kits, one with the Ericsson module and one with no broadband module, so that other pre-certified 3G/4G modems and drivers may be added to the Kontron M2M System for additional connectivity development and local needs. In both cases the developer must add the SIM.

If a particular application doesn't require all of the radios for production units adjustments are easy to make without sacrificing time to market readiness due to the flexibility of the Kontron M2M System production-ready design. The following illustration shows the board stack in the Kontron M2M System with the drop-in module option.

The following shows the interaction between the carrier board and the computer on module.
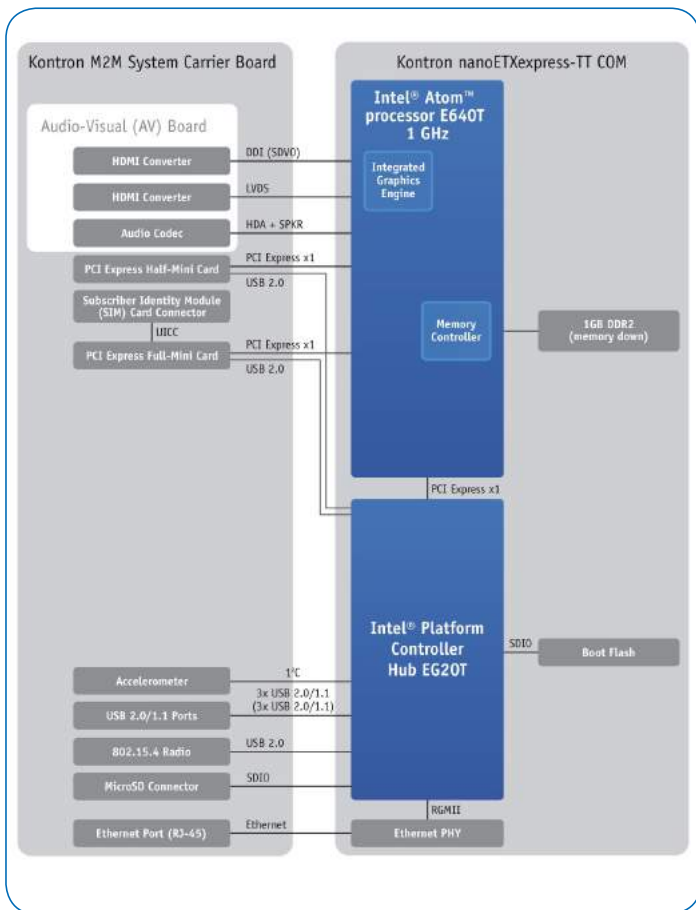

Image 6: Kontron M2M Smart Services Development Kit M2M System Block Diagram
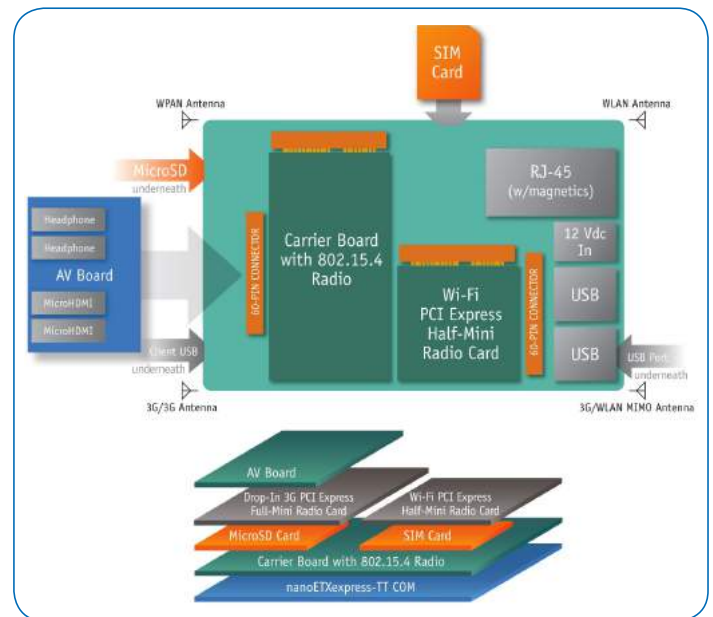

Image 7: Kontron M2M System Carrier Board and Board Stack (including optional 3G radio)

M2M Software Platforms below the Application

One of the benefits of selecting an open Intel Architecture platform is the rich ecosystem of software partners that have already developed software to support M2M smart services.

From OS through middleware, software companies can provide the OS and the horizontal hosting services needed for provisioning and updating the M2M system. The Kontron M2M System is preloaded with a 90-day free trial of Wind River Linux 4.1. The kit also includes a Wind River LiveUSB drive with adapter that provides the software stacks and drivers to support immediate wireless connectivity testing. The pre-flashed drive containing Wind River software is optimized for developing, running, debugging and prototyping embedded software directly onto the Kontron M2M System using Wind River development tools.

Kontron also has partnered with MAP companies that provide middleware and services SDK (software development kits) for development and for deployment. The differences are explained as follows:

» **Development SDKs:** Middleware and services partners help companies who want to develop their own code and integrate the complete solution. Device APIs and Cloud Application APIs are provided to develop agent code and application connectivity. Toolkits are provided to integrate and troubleshoot connectivity with cellular modems.
» **Deployment SDKs:** Middleware and services partners provide a complete turnkey solution which includes cellular connectivity and existing relationships with the world's largest carriers. There is no coding required, only configuration using a graphical design tool with point and click, drag and drop for quick time to field trial and golden image release for semi-custom volume production by Kontron.

Development SDK providers, like Eurotech, and Deployment SDK providers, such as ILS Technology, have partnered with Kontron to ensure that their horizontal solutions are ready for OEM use with the Kontron M2M System. Both companies already have extensive experience in M2M deployments requiring policy and security controls for a wide variety of industries and provide the licensing of their OSGi framework and cloud hosting services, helping OEMS have their image ready for semi-custom high volume smart services solution production using Kontron's M2M System. The efforts and SDKs from MAPs make it easier for the application/service developer to implement a cloud service using multiple radio technologies. There is a trial of the Eurotech SDK solution included in the Kontron M2M Smart Services Developer Kit. ILS Technology's SDK solution can be accessed via www.ilstechnology.com/kontron.

Since Kontron's hardware solution is standards based, other software companies can also enable their middleware and cloud hosting services on the Kontron platform as well.

Technology Enhancements for M2M

The needs for M2M are driving technology protocol innovations.

» EXI: Efficient XML Interchange uses a binary XML format and generally reduces the verbosity of XML documents, and may reduce the cost of parsing. Efficiency is considered key for M2M.
» CoAP: Constrained Application Protocol optimizes HTTP to reduce traffic on the network.
» 6LoWPAN: Internet Protocol v 6 Over Low Power Wireless Personal Area Networks defines encapsulation and header compression mechanisms that allow IPv6 packets to be sent to and received from over 802.15.4 based networks for Smart Grid and other implementations.
» WirelessHART: Highway Addressable Remote Transducer is an open-standard wireless mesh networking technology developed by HART Communications Foundation. The protocol utilizes a time synchronized, self-organizing, and self-healing mesh architecture. The protocol currently supports operation in the 2.4 GHz band using IEEE 802.15.4 standard radios. The HART Protocol was developed in the mid-1980s by Rosemount Inc. for use with a range of smart measuring instruments. Originally proprietary, the protocol was soon published for free use by anyone, and in 1990 the HART User Group was formed. In 1993, the registered trademark and all rights in the protocol were transferred to the HART Communication Foundation (HCF). The protocol remains open and free for all to use without royalties.

M2M Challenges

Several challenges exist in deploying global M2M solutions:

» **Operators are still regional and require certifications.** Generally, operators insist on certifying every device on their network. As M2M devices proliferate, this could delay deployments as devices wait in queue for certification. Besides certification, with so many operators, global deployment could necessitate 30-40 operator agreements. MVNO (Mobile Virtual Network Operator) organizations are available to provide services that assist OEMs in obtaining certifications and provide a one-stop-shop for agreements.

» **Cost of mass provisioning:** The M2M industry needs to develop easier methods for provisioning M2M devices other than SIM cards. An example of how this can be accomplished is the Kindle e-reader from Amazon, which is a form of push provisioning that is starting to be used for smart metering.

» **Protecting sensitive data:** M2M devices need to be serviced remotely by accessing the device and changing settings. This kind of activity may require companies to open temporary tunnels for field service access to selected sections of data, yet restrict other data, for privacy and security reasons. For example, patient records should not be accessible when updating software on a medical device.

» **Change in customer service paradigm:** The old rules of CSRs handling a number of subscribers will be broken for M2M. That is because customer service representatives will need to manage 1,000+ M2M devices on the network. Unlike the smartphone business, there are no people on the client side to bring a device in for service. The devices must work 7/24 for multiple years. Any need for truck rolls breaks the economic model for the smart service provider.

» **Tariff issues and taxes:** A US recipient of a cellular bill is familiar with the Universal Service Fund (USF) applied to their bill. So far, M2M devices that are not used for voice calls or SMS have been exempt from this fee. With states and countries looking for revenue sources, M2M may become a target. Excessive fees could break the M2M economic model so care must be taken to understand the latest information on these issues.

» **Standards and technologies are in development:** Over the next several years, industry leaders will work together to create new standards and technologies for M2M. Some are already in development by ETSI in Europe and by TIA in the US.

Mission Critical Deployments

Some M2M deployments are considered mission critical. In cases when patient health is at risk or the deployment will involve other mission critical assets, manufacturing equipment quality of service issues come into play and service level agreements may require five 9s performance and redundancy of the hosting service's data center, as well as enhanced security and policy control.

Expanding M2M to Emerging Nations

M2M deployments have been initiated in Brazil, India, China and Korea where these countries have the financial resources to make M2M deployments viable. M2M initiatives in the Middle East stalled during the economic downturn. Other countries, such as most in Africa are not considered viable candidates in the short term due to political unrest and strained financial resources.

From Smart Systems to Smart Cities

Several initiatives have been started around the globe to build Greenfield smart connected communities or convert areas into smart cities enabling optimum usage of energy resources in a geographical area. These innovative programs will connect and manage the Smart Grid and will drive new pricing models as consumers optimize their usage for the benefit of the community. They will also drive M2M deployments in home and business buildings.

Getting to Standards

There are several horizontal groups working on M2M standards. All groups consider security and privacy as priorities in their efforts.

» ETSI has been working on M2M standardizations and is considered to be ahead of other groups.
» TIA TR 50-1 is the group that is driving M2M standards for the United States. There is also a smart device security ad hoc group subcommittee recently formed.
» CCSA in China has a TC 10 initiative for M2M.
» GISFI in India is working to harmonize with global standards, yet also achieve India-specific use case needs, such as food supply chain.

Some of the standardization efforts will result in embedded SIM as a new smaller form factor and changes in M2M addresses/identifiers. The biggest change is the deep evolution of the cellular network to make it more efficient for data transmission.

Kontron's Role in the Future of M2M

Kontron is a proven leader in providing embedded computing solutions and platforms. As the M2M marketplace expands, Kontron is well-positioned and has the technological experience to offer COTS, semi-custom and fully custom robust M2M system and building block solutions that are optimized for market use. By working with our partners, Kontron is able to simplify the M2M supply chain for its customers making it easier for them to get to market quickly and accelerate their time to revenue in the development of innovative M2M solutions and services.

With the introduction of higher wireless bandwidths and the advent of 4G LTE-based wireless networks, carriers worldwide see significant potential for M2M enterprise and consumer applications and services. With respect to their wireless and telco cloud computing network infrastructures, Kontron is already well positioned with telecom and network equipment vendors in supplying the market with standardized COTS open communication platforms (OCP). This portfolio includes carrier-grade, high-density 10G and 40G AdvancedTCA and MicroTCA platforms and component hardware, as well as, carrier grade and mission-critical rackmount servers.

By optimizing Kontron products for the M2M market needs, Kontron is ready to serve its customers' M2M needs from the edge node to the cloud.

About Kontron

Kontron is a global leader in embedded computing technology. With more than 30% of its employees in Research and Development, Kontron creates many of the standards that drive the world's embedded computing platforms. Kontron's product longevity, local engineering and support, and value-added services, helps create a sustainable and viable embedded solution for OEMs and system integrators. Kontron works closely with its customers on their embedded application-ready platforms and custom solutions, enabling them to focus on their core competencies. The result is an accelerated time-to-market, reduced total-cost-of-ownership and an improved overall application with leading-edge, highly-reliable embedded technology.

Kontron is listed on the German TecDAX stock exchange under the symbol "KBC".
For more information, please visit: **www.kontron.com**

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