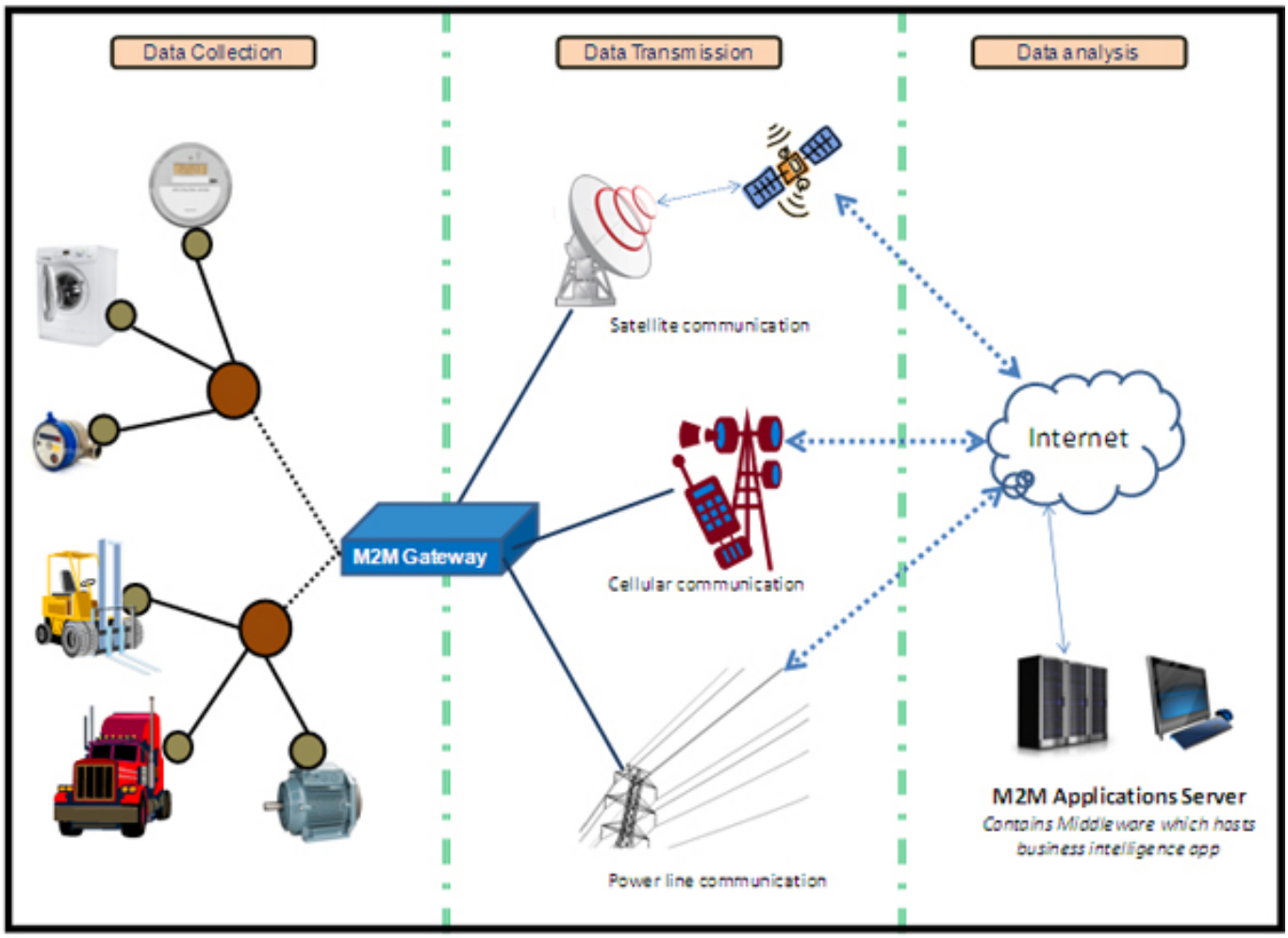
Machine to machine communications – The Facebook of smart devices

Ramanuja Konreddy, Senior Product Marketing Engineer, MCU32 Division, Microchip Technology

Imagine a bike that sends its location to your smart phone if moved; a camera that can talk to a GPS module and suggest scenic locales when you are on a hike; a refrigerator that would send you a reminder text message when the milk runs out; a smart meter that can turn on your washing machine during off-peak hours; a treadmill that can transfer the heart rate and other vital signs to your healthcare provider; industrial equipment in a remote location which can alert its manufacturer when it needs maintenance or repair. The possibilities are endless and the benefits are enticing in a world of connected devices that smartly interact with each other. In the last two decades, the various advancements in the wireless industry enabled people all over the world to connect. Within the next decade we will witness a revolution where a diverse range of devices across various sectors will be able to communicate with each other to provide unprecedented services to mankind while saving on cost, improving efficiency and minimizing labor. The underlying technology that is driving all this is called Machine to Machine Communications (M2M).

What exactly is machine to machine communications?
In simple terms, it is a technology that enables devices to interact with each other over a wired or wireless communication network without any human intervention. M2M technology usually employs sensors, actuators, MCUs and/or RF Transceivers that acquires data from an end device or an event which is then transmitted via a communication network (either Global System for Mobile Communications GSM/General Packet Radio Service GPRS, powerline or satellite) to application software that processes the received data into meaningful information. The three basic stages of M2M technology are illustrated in Figure 1.



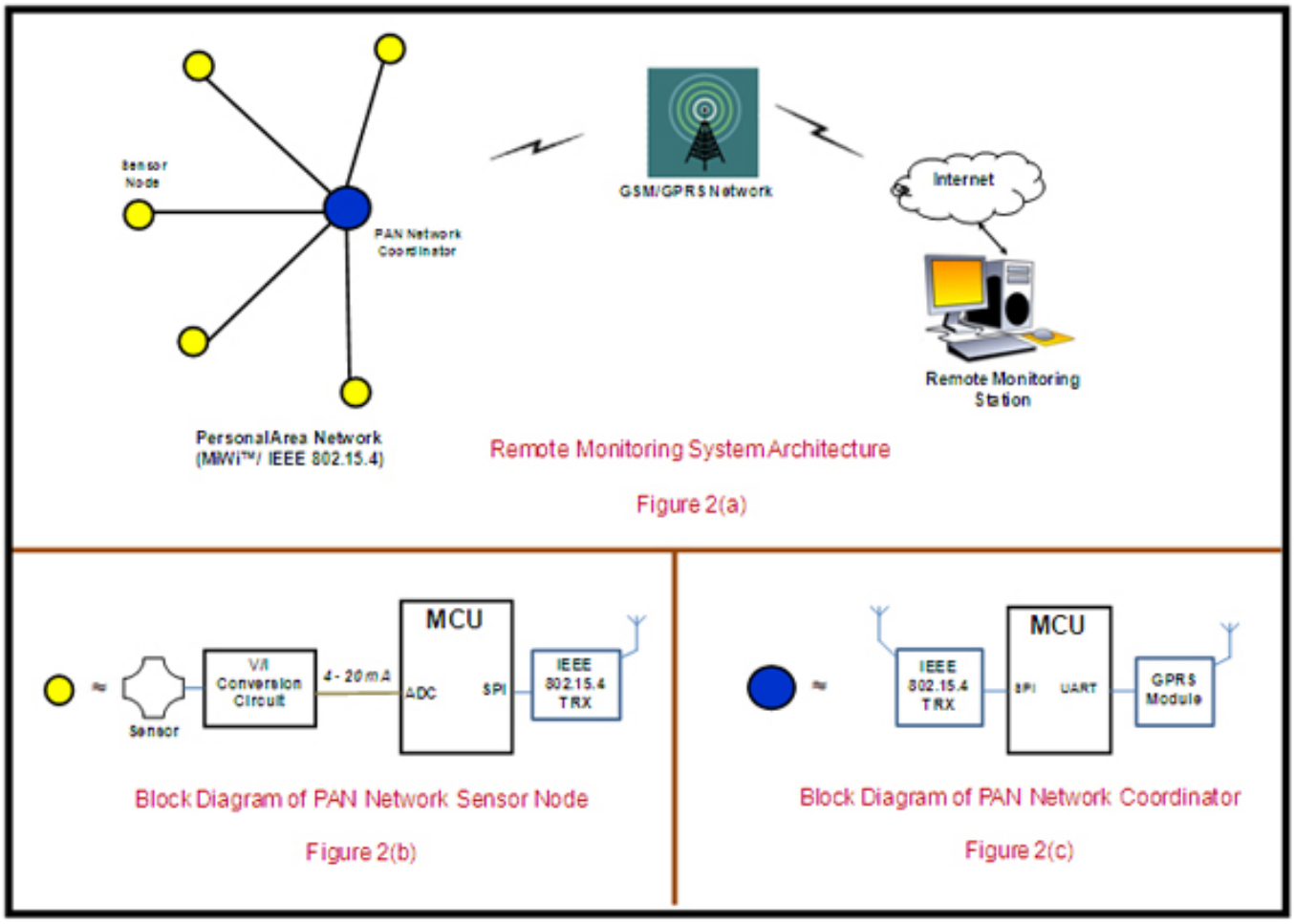
With powerful sensors, advanced embedded microcontrollers and ubiquitous wireless networks industrial applications are seamlessly incorporating M2M technologies, some of which are described in the next few sections.

Remote monitoring system for industrial equipment

The remote monitoring system utilizes various sensors to detect parameters such as vibration, fluid leak, mechanical wear, temperature and mechanical noise to evaluate the equipment health. Each of these sensors are represented by a yellow dot in Figure 2(a) called node and are connected in a star topology to the network coordinator represented by blue dot forming a Personal Area Network (PAN). The PAN network coordinator which acts as a M2M gateway between the PAN Network and the GPRS network, transmits the data to the remote monitoring station. Anytime any of the parameters go beyond the normal operating threshold values, the remote monitoring station sets up an alert leading to preventative maintenance.

Implementation of sensor nodes and PAN network coordinator – a high throughput microcontroller will ease the design

Figures 2(b) and 2(c) show the implementation of the sensor node and the PAN network coordinator.



The sensor parameters of the equipment are transmitted via 4-20mA current loop, a robust sensor signaling standard for industrial process and control. The MCU receives these parameters through its Analog-to-Digital Converter (ADC) and runs a PAN Protocol Stack such as MiWi to interface with the IEEE802.15.4 transceiver that sends the processed sensor data to the PAN network coordinator.

At the heart of the PAN network coordinator is an embedded MCU that is responsible for driving communication for the entire PAN network. It interfaces to both IEEE802.15.4 transceiver and GPRS module through the serial ports. The flash memory of the MCU stores the map of the entire MiWi PAN network, assigns the network address and establishes link to new sensor nodes. It also translates the PAN protocol data to GRPS format to send over the GPRS network. The MCU controls the GPRS module using Attention (AT) commands for data transmission. A high throughput MCU with good amount of memory, wide range of peripherals with Direct Memory Access (DMA) support, free MiWi Protocol Stack and GPRS Library is all that is needed to ensure a stable connection between the PAN network and GPRS network.

Fleet management – a popular M2M application

M2M technology is widely implemented to manage the fleet of commercial vehicles. Vehicles are tracked and communicated using the GPS and GPRS/GSM modules that are installed in them. The GPS module provides the position coordinates of the vehicle whereas the CAN bus collects the data from various modules of the vehicle such as Antilock Brake System (ABS), Engine Control Unit (ECU) and airbags to send it to CAN/GPRS Gateway. A 32-bit microcontroller drives

the CAN/GPRS gateway and it interfaces to the CAN bus, as well as the GPRS and GPS modules. It translates CAN data format to GPRS format and sends the data over the GPRS network to Fleet Management Station.

Today more devices rather than humans are connected via Internet and this gap can only widen in future given the trends in the wireless industry. In addition to rapid scalability of silicon and pervasive communication networks, the advent of technologies such as high speed 4G and Internet Protocol version 6 (IPv6) have set the world on the edge of another revolution where M2M devices are forming a whole new layer of smart connectivity that can transform the way we live, work and play.

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