

White Paper

# Machine-to-Machine (M2M) Gateway: Trusted and Connected Intelligence

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## Abstract

This white paper makes the case for the M2M gateway and highlights its role in supporting connectivity, intelligence, scalability and security in M2M networks. Different M2M scenarios require different connectivity options: wired and wireless, broadband and slow serial data. The majority of M2M devices normally remain off to save power, meaning connectivity should be low cost and low energy—but this is not the hallmark of cellular networks. The M2M gateway is key in this respect: for connecting those clusters of low-energy, low-cost M2M devices that will be deployed around buildings, campuses and city streets. Since M2M equipment will be on the Internet and will often be deployed in publicly accessible areas, security is required to help with both physical tampering and malicious network attacks. The Freescale QorIQ family of processors covers all these aspects.

## Table of Contents

- 2 Introduction
- 2 Why M2M Gateways?
- 3 Challenges in Designing M2M Network Solutions
- 4 Freescale's M2M Gateway Solutions
- 5 M2M at Home
- 5 M2M for Commerce
- 5 M2M in Healthcare
- 6 M2M for Infrastructure
- 6 M2M in Buildings
- 7 Conclusion



## Introduction

In the year 2020, the world will be more connected, wireless networks will connect more machines than people and Machine-to-Machine (M2M) technology will help us to be more energy and cost-efficient, safer and more secure. This is the era of connected intelligence.

The number of mobile connections is forecast by the GSM association to grow to 50 billion by the end of the decade. There will be several trillion wirelessly connected things, according to the Wireless World Research Forum. This increased use of mobile and M2M technology will deliver as much as \$100 billion of annual savings thanks to material and energy efficiency savings ([smart2020.org](http://smart2020.org)). The social and economic benefits are clear.

It is tempting to assume that cellular will hold the answer to M2M connectivity, but stop and ask yourself this question: Are cellular networks designed for M2M or are they more about broadband connectivity for people?

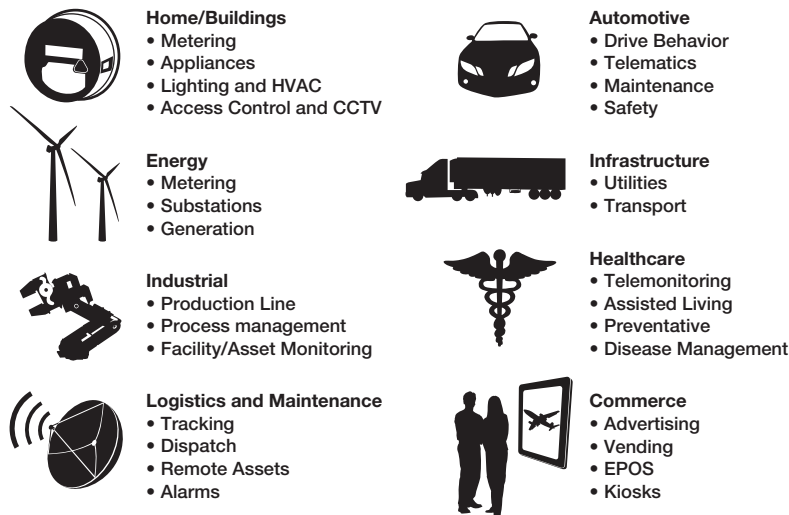
It is the latter, isn't it?

It is worth noting that M2M devices communicate differently than humans and that there will be many more billions of them than us. These devices will communicate on a regular, optimized schedule and when they do speak, they don't say very much. So if machines and humans communicate so differently, why should machines and humans share the same networks? Perhaps one day that will be possible. Perhaps 5G cellular will deliver a common network approach. For the foreseeable future, M2M gateways will prevail in many scenarios.

### Why M2M Gateways?

M2M is a new opportunity that helps us be safer, more secure, more cost- and energy-efficient. M2M technology can also be used for revenue generation and customer retention. It is good for business. Figure 1 demonstrates a broad range of sectors that represent a diverse set of connection challenges and variable conditions “on the ground.”

**Figure 1: M2M Gateway Applications**



M2M gateways offer the following key benefits:

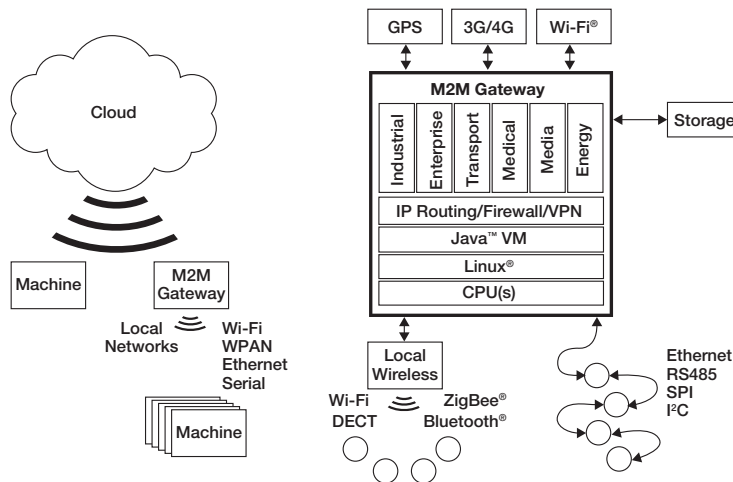
- Can be applied and scaled to multiple settings (e.g., home, industrial, office, campus, city and retail)
- A local intelligent node turns raw data into useful information
- A hub for cross-sector service and application convergence or “joined-up thinking”
- A secure node bridging broadband WAN and local area sensor networks, wireless and/or wired, which can even connect legacy-installed sensor/actuator nodes
- An aggregation node for a multitude of low-energy, low-cost sensor/actuator nodes

### Challenges in Designing M2M Network Solutions

A QorIQ M2M gateway module of the kind shown in figure 2 can be implemented in a credit-card-sized footprint. The design supports a variety of wired and wireless connectivity options and delivers the computing performance required to help alleviate some of the key challenges faced by M2M service providers:

- Scale: Wherever you have clustering of M2M devices of sufficient scale, you have the potential to overload the cellular network. This could be anything from buses parked at a garage at the end of the working day to packages arriving at a distribution center. They don’t have to be data-hungry devices; a localized peak in signaling traffic alone might be enough to cause failure at a cell level. Use of a gateway can alleviate signaling (and data) congestion.
- Security: M2M device deployment will be widespread and they will often appear in fairly public places. As such, they will be susceptible to both physical and network intrusion. Recent publicity around the growth of malware attacks directed against smart phones is testament to this.

**Figure 2: Typical M2M Gateway**



Standalone machines connect directly to a wireless broadband network.

M2M gateways bridge one or more locally networked devices to a wired or wireless broadband connection. The local network can be wired or wireless.

The M2M gateway will host various applications and networking stacks, running on virtual machines, one or more CPU cores.

A trusted software platform is key to preventing theft of data, functionality and of product uniqueness.

- **Data deluge:** Even if only transmitting small amounts of data once a day, millions of such devices will generate a mass of data—not all of it necessarily useful. Service providers may prefer that only useful data is transmitted, which is where a gateway performing some sensor or algorithmic translation can help by filtering out unnecessary data.
- **Distributed intelligence:** An intermittent connection, the need for filtering of data or for autonomous operation at a local level requires local storage and processing of data.
- **The “rebound” effect:** Increased deployment of M2M technology must not cancel out the original cost and energy efficiency benefits. Low-power and cost-effective nodes are the key factors. A gateway can help with scaling, bridging between low-energy wireless networks and mainstream network infrastructure.

### Freescale's M2M Gateway Solutions

The QorIQ processors for M2M applications range from single-, dual- and quad-core processors designed on 45 nm and 28 nm technology for low-power implementation. A rich set of integrated I/O controller options help minimize component count and module footprint. QorIQ platforms built around Power Architecture® cores or ARM® Cortex®-A7 cores are enabling a new era of networking innovation where reliability, security and quality of service for every connection matters.

Below are some of the key QorIQ processor features which address each of the above-mentioned challenges in designing M2M platform solutions:

- **Connectivity:** Multiple Gigabit Ethernet and PCI Express®, RS232, RS485, USB, UART, SPI and I<sup>2</sup>C controllers allow direct connection to ZigBee®, Wi-Fi® and 2.5G/3G modem chipset ports or to local wired and wireless sensor networks.
- **Security:** Trusted boot platform and integrated security engine have single pass encryption/message authentication for common security protocols (e.g., IPsec, SSL, etc.). Trust architecture platform helps protect against software intrusion and software cloning by incorporating advanced end-to-end code signing and intrusion-prevention capabilities.
- **Packet processing:** Multiple 10/100/1000 Ethernet ports support advanced packet parsing, flow control and quality of service features, as well as IEEE® 1588 time stamping and are ideal for managing the data path traffic between the LAN and WAN interfaces.
- **Local storage:** USB, SATA or SD/MMC interfaces provide options for local storage—which is key for local data analysis filtering and decision making.
- **Advanced energy management:** This feature provides power-saving modes for managing energy consumption in both dynamic and static power modes, which includes the traditional nap, doze plus jog (dynamic frequency scaling) and packet lossless deep-sleep modes.

## M2M at Home

Regulation on power dissipation of home-based networking equipment is now common, and for good reason. There is more that can be done. Energy savings made as a result of effective home automation can be enhanced by bundling functionality and services onto a single M2M-enabled digital home gateway which can support IPTV, broadband wireless, media storage and distribution, medical and home automation and more. A virtualized software platform can allow different service providers or utilities to run concurrently on the same box without interference. Visualization and control can be achieved by connecting via smartphone, TV, tablet or netbook. Freescale's M2M at-home solutions using QorIQ processors provide an excellent price/performance blend while simultaneously supporting a rich mix of networking capabilities for home area networks.

## M2M for Commerce

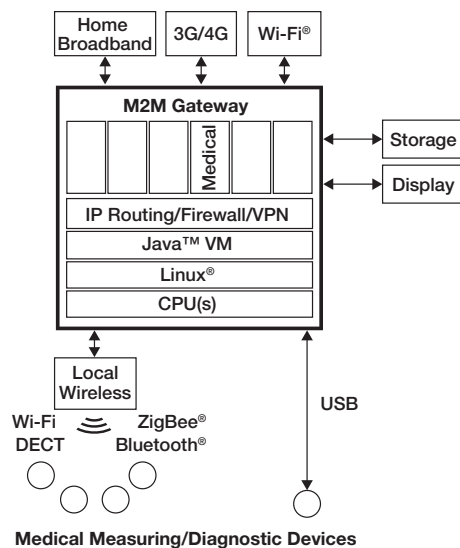
Deployment of digital signage and self-service kiosks and checkouts is growing rapidly. The addition of sensors and short-range wireless to digital signs has turned them from screens into interactive displays, providing stimulus for advertisers who can now target and connect with new customers. Near field communication (NFC) technology allows users to interact with advertisements via their smart phones, while sensor technology can be used to identify demographics (and in the future, the mood) of passers-by and react accordingly. Due to its connectivity and high-performance features, general purpose applications can add digital signage capabilities on QorIQ processors with no additional hardware expense.

## M2M in Healthcare

An aging population, increase in monitored illnesses like diabetes and heart disease and insurance mandates around hospital stays and visits have led to an increase in home-based health monitoring. This thought is now being matched by the onset of portable devices which monitor patients away from a hospital or doctor's office. The added comfort of the patient is matched by cost savings for health care providers and insurers.

Devices that monitor a patient's vital signs at home can operate as a direct M2M device, via a gateway of the type mentioned in the previous M2M at Home section, or a dedicated telehealth hub (see figure 3). In either case, measured data such as blood pressure, heart rate, body temperature, respiratory rate, blood glucose and cholesterol can be accumulated, processed and, if desired, sent periodically to the healthcare provider. Freescale's M2M in healthcare solutions using QorIQ processors enable encrypted communication through trust architecture which helps provide a secure link between patient and doctor ensuring that private information does not get stolen.

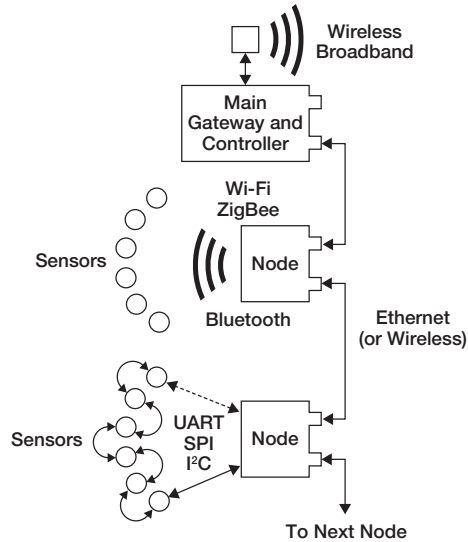
Figure 3: M2M in Healthcare



### M2M for Infrastructure

Much of our transport, civic and industrial infrastructure (e.g., road, rail, tunnels, bridges, waterways and pipelines) asset base is still monitored and maintained using very labor intensive processes. M2M technology has real potential to provide more cost-effective autonomous techniques to help with remote monitoring and preventive maintenance. While their needs often differ, they face one common problem: The cost involved in clean-up operations and insurance payouts after subsidence, land-slip or breached canal embankments is usually huge. While open spaces lend themselves well to using wireless technologies, it is not uncommon to find fiber laid along the lengths of rail-track, roadways, canals etc., that could form part of the solution infrastructure (see figure 4). QorIQ processors' key features such as connectivity, storage and packet processing, make them an ideal choice for transport M2M gateways for infrastructure.

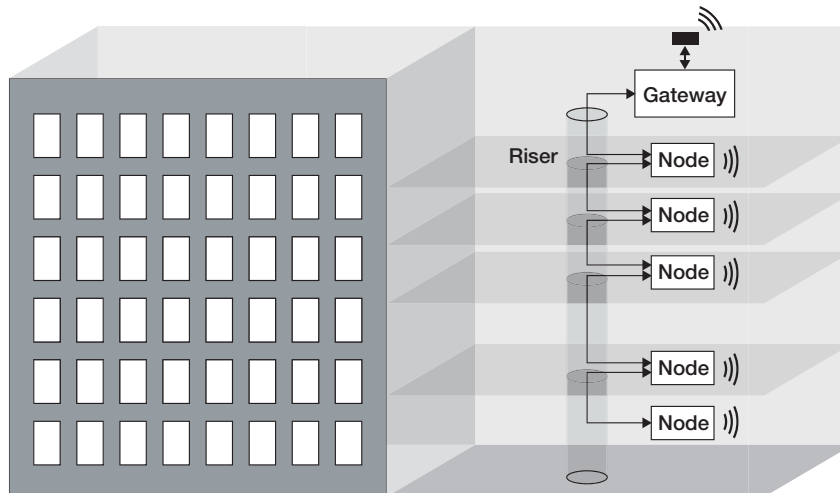
**Figure 4: M2M Instrumentation Network for Large Infrastructure**



### M2M in Buildings

Buildings represent another area where energy efficiencies can be made. In offices, hotels or campuses, it is reasonable to suggest that people do not have the same motivations as they do at home to conserve energy. The potential for M2M to automate is magnified for buildings because the goal is not only to save energy but also to implement security (see figure 5). CCTV and secure access systems like card swipe, card proximity or something more advanced like iris scanning, have an increasing role to play in securing our towns and cities.

**Figure 5: M2M Instrumentation Network for Buildings**



New buildings constructed with glass and steel as well as old stone constructions often suffer from poor in-building wireless coverage. A compelling option for in-building M2M networks could be a combination of wireless with wired networking. Daisy-chained Ethernet, for example, can scale the height/length of a building with lower costs compared to the more traditional star or switched network. Wireless can extend network reach across individual rooms or floors. Freescale's QorIQ processors with their advanced energy management and security features, along with strong support for various industrial networking protocols, make them an ideal solution for building M2M gateways in buildings.

## Conclusion

While the particulars of each use case may vary, the rationale for using M2M is consistent: safety, security, power and cost savings.

Freescale's QorIQ solutions are ideal for each of these applications. The potent combination of advanced packet processing, energy management and integrated I/O flexibility with trusted boot will allow developers and integrators to quickly deploy wired and wireless M2M systems they can trust. When considering the volume of M2M nodes and gateways which will be deployed, often in reasonably accessible places, trust and security are vital. For more information on QorIQ communications processors, please visit [freescale.com/QorIQ](http://freescale.com/QorIQ). A vibrant portfolio of processors designed to deliver performance, connectivity and reliability extend from the QorIQ P1 family to the QorIQ T1 family, which integrates an eight-port gigabit Ethernet switch for wire-rate switching, to the QorIQ LS1 family, which retains all the networking prowess of Freescale's PowerQUICC and QorIQ processors but is built around ARM cores.



For more information, please visit [freescale.com](http://freescale.com)

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