EXPLORING THE INTERNET OF THINGS FROM END TO END

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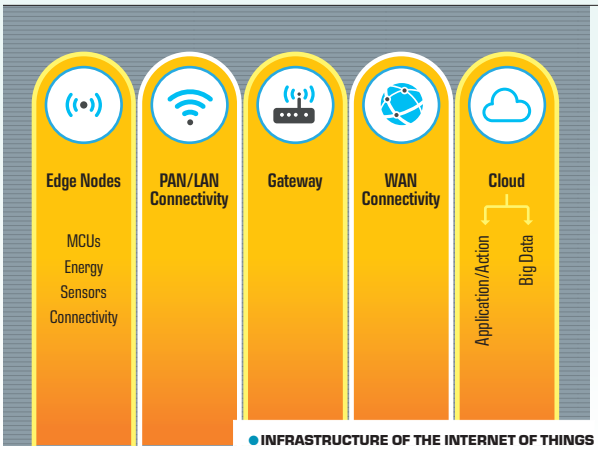
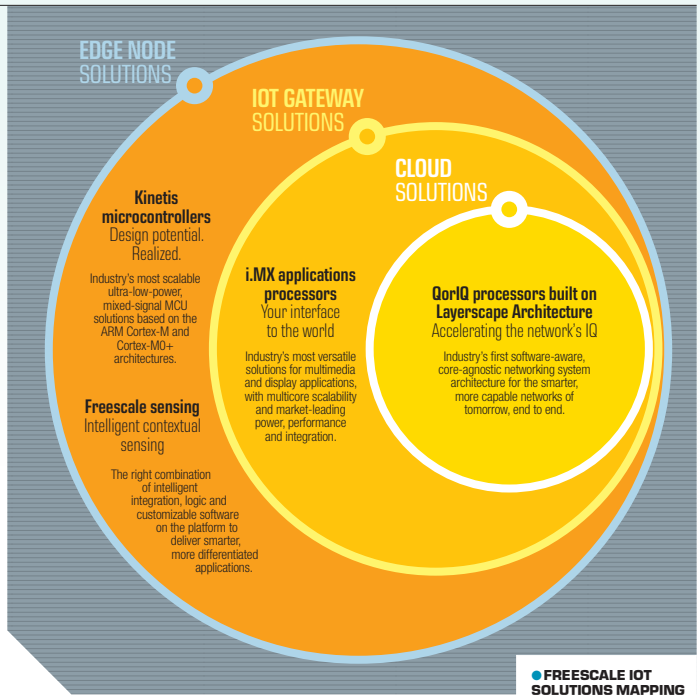
In the recent past, devices were singular entities going about their tasks in silent anonymity. Sure, some industrial systems and computers within networked environments collected data and created a community of sorts, but nothing like what we have today.

WE NOW HAVE CONSTANT CONnectivity and devices that trade massive amounts of data; data that holds secrets we are only beginning to tap. Transportation, healthcare, agriculture, machine-to-machine communications, and entertainment are segments that are already reaping an information harvest that was unimaginable 10 years ago. The glue that holds the promises of this technology together is the Internet of Things (IoT), a confederacy of devices, networks, and processing power that has vast potential to make life better by addressing truly global problems. Freescale has been a pioneer at every level of the IoT phenomenon and offers all of the fundamental IoT building blocks under one roof.



INFRASTRUCTURE OF THE INTERNET OF THINGS

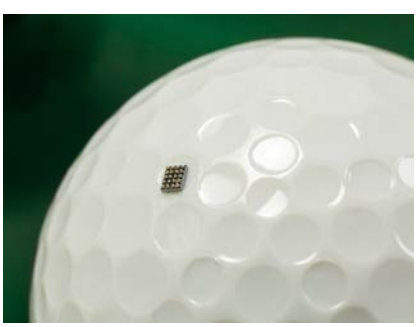


FREESCALE IOT SOLUTIONS MAPPING

Edge nodes

Sensors measurements and monitoring

The story of IoT begins at the edge node, the entry point for all information. This information collection is the primary role of the edge node and the possibilities for measurement are limited only by the imagination. Temperature, pressure, motion, position and many other factors can be measured, processed and transmitted.



We can easily recognise many edge node devices as integral parts of our lives, and the many forms of edge node devices are leading the growth of the IoT space. Smart phones, thermostats, entertainment and health tracking devices are a few familiar manifestations. While these applications are well understood, there are other devices that will soon impact life as we know it. For example, automobiles monitor road conditions and informatics around driving. Cities are beginning to implement integrated traffic, weather and infrastructure monitoring systems that offer the potential of improved safety and transportation efficiency. Healthcare providers are using monitoring devices to collect vital information such as blood pressure and blood sugar levels. These devices need the ability to sense information, process it and maintain connectivity with gateways.

The endpoint in edge nodes is usually composed of sensors, an embedded processor (typically an MCU), a connectivity method and an energy source. The demands of endpoint devices are familiar. They are ideally low power in order to operate for long periods between charging or battery replacement. Their structures must provide low complexity for interoperability and must be robust and industrial grade for prolonged use and reliability. These devices must be unobtrusive so that they can be incorporated into a small form factors and low cost for rapid development and implementation.

There are two primary classes of edge node devices: those that are battery powered and those that receive a steady stream of energy. The device's requirements will form the design parameters and as a result the power source. Is an edge node in a remote location where power will not be available? Is the device mission critical in such a way that its data collection could have an impact on safety or a company's bottom line? Is the reporting of information only required at intermittent cycles or is a steady stream of data communication required? Those that operate on a battery must push the absolute limits on power management technologies in order to both collect data and then transmit this information on a regular basis, and also maximise the time between battery charging or replacement.

● KINETIS KL03 MCUS FOR EXTREMELY LOW POWER, SMALL FORM FACTOR APPLICATIONS

With the proliferation of intelligence and connectivity in previously unimagined applications, time-to-market pressures will intensify in the IoT space. Freescale is the only supplier that delivers IoT solutions from the edge node, to the network to the cloud. We are focused on providing application-specific reference designs and platforms that empower developers with real-world implementations and enable rapid design prototyping. ■

PROCESSING

The processing at the end node level is gaining importance as devices have more sophisticated processing power and hence the ability to communicate important trends or differentials. Once data has been gathered, sensors usually conduct basic algorithms such as threshold detection and simple data analysis. This is important as the IoT landscape is moving from higher-level, cloud-based processing to a distributed intelligence model in which data-driven decision making is migrating toward the edge nodes. The ultimate goal is that they will begin to learn, adapt and act independently in a predictive manner. For example, in a healthcare application the processing might involve triggering communication if blood pressure is above an advisable level, but a constant transmission of blood pressure values that are within limits and are not changing is unnecessary. In a smart city application the sensing could involve monitoring and making sense of temperature, moisture wind or infrastructure changes. The key is that these devices operate based on the exception, not the rule. Constantly reporting a non-changing value is of little importance. That the value is changing, and maybe by how much and how quickly, is much more relevant information.

Freescale's embedded processor solutions deliver optimised performance and power to match virtually any IoT application, from battery-powered consumer devices to cars, homes, civil engineering and industrial automation. Freescale offers the smallest package for an MCU, the CSP that measures only 2x2mm with the full capability of a 32-bit microcontroller and the low-power performance of the ARM Cortex-M0+, that not only will improve the accuracy of the acquired data, but also improve the battery life and achieve the smallest form factor so that the patient can forget he is wearing a device at all.

● KINETIS KW2X MCUS FOR EDGE NODE APPLICATIONS

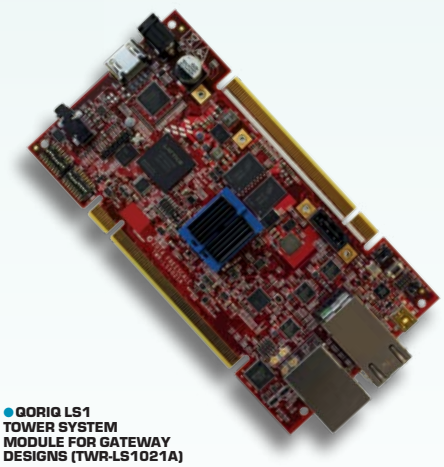
***Freescale** offers a wide array of software-operating systems, protocol stacks, middleware and application software that assist in overcoming development hurdles, and we engage the right partners to further streamline development and reduce risk.*

CONNECTIVITY

The key to IoT is the connection of disparate devices with multiple hardware and software approaches. Without dependable connectivity the web of developing information is dead in the water. A product can be designed to reliably connect to a certain set of gateways or other devices. But, in the real world, a device may connect to any number of unknown products, which is why standards and compliance are critical.

Freescale has worked hard in developing and engaging in partnerships and important standards bodies. Freescale connectivity solutions work seamlessly with a number of protocols. On the consumer side Freescale has been a partner and developer with consortiums such as Wi-Fi, Bluetooth Smart, ZigBee, 6LoWPAN and HPGP. On the industrial side Freescale has been instrumental in Wireless Hart, ISA100, EtherCAT, and Modbus. Freescale's networking processors are designed with a systems view to deliver high-performance connectivity that scales with the needs of the emerging infrastructure demands of the IoT market.

The future of connectivity will involve the forward looking partnerships such as Thread. These partnerships will allow a host of devices to not only network but create mesh environments where information moves in a web across devices. This type communication requires processors that can meet demanding throughput requirements with robust real-time, point-to-point communication.



● QORIQ LS1 TOWER SYSTEM MODULE FOR GATEWAY DESIGNS (TWR-LS1021A)

GATEWAY

As with many elements of IoT, the gateway is also a shape-shifting component, free from form factor constraint. Gateways are not required to assume a standard form and can manifest in different ways. Even a cell phone can act as a gateway in some instances. The gateway is not a one system fits all, there are a range of possibilities, depending on the additional functions that they gateway may perform.

The gateway allows for the transferal of data through a variety of protocols. As the gateway appliance takes information, it applies a minimal level of processing and further conveys data on its way to further processing. This ecosystem of the gateway is composed of a number of complex relationships including software, processors, security and protocols.