# Technology for the Future of the Internet of Things


image: RS

Does that look a complex image? It's meant to represent the Internet of Things. Let's see what makes IOT possible and what the opportunities are.

The talk around IOT applications can appear excessive, premature perhaps and long on hyperbole. Let's have a look under the hood at what's making these commentators make such predictions and why it's looking more like a discussion of *when* not *if*.

The technology pieces are certainly coming into place, and application opportunities for some customers are clearly apparent. For some customers and developers the talk about IOT seems irrelevant as they've been doing it for decades already. For others, they can't see that it will ever be relevant to them.

So what is going on that to create such a diverse new industry, can it really work, and will it really impact our lives that much?

## *What Makes IOT Possible?*

Bringing a new technology to market and making it a success is somewhat contingent on the factors that make user adoption and success more likely. We'll have a look at application success later, in the meantime we can take a close look at the key components that make IOT possible.

The ultimate enablers of an IOT world are the low level components that make a solution viable for remote sensing. There are several pieces of this story that have made astounding progress.

**Remote Processing**

The viewpoint of the 'second half of the chessboard' has a critical implication for the cost of devices. The usual commentaries focus on the doubling of computer power every 18-24 months, and hence data storage or network capacity.

Make no doubt processor power impacts IOT also, in order that the volume of data generated can be aggregated, stored and analysed (or analysed and then stored in some cases), and decisions enabled from resulting knowledge. The importance to IOT is how extraordinarily cheap processing power has also become for remote devices.


Image: ARM

Well known is the Raspberry Pi (over 7 million devices

sold, with a reported third going to industrial applications), there is now a version available for US$5 – better value than a latte folks! There are alternative options to the Pi that trade off power, cost and interfaces. Some of these are specific to IOT applications. The common factor is incredible processor power at almost trivial cost. Also, not to overlook is that very many of these devices utilise processor cores from ARM, the company that dominates mobile processing.

**Communications Everywhere**

Apart from hardware choices, the next major headache for developers has been the selection and cost of providing communication between a remote device and wherever data is needed for taking decisions.


Connectivity used to mean expensive dedicated wired lines (many telcos have made such services obsolete instead offering fibre access). 2G and 3G has been attractive as remote data devices can piggyback on the public infrastructure rolled out for consumer service, but often the subscription costs have been unpalatable for remote sensor applications with numerous devices. Another alternative has been private or proprietary communication services, such as point-to-point wireless data modems – these are helpful to solve the problem of geographic coverage.

The current and future options for wireless communication are the second important enabler for IOT. Communications is an incredibly diverse subject, with the common goal of efficient use of scarce radio spectrum that is useful and economic.

Hence there are many different solutions, each with advantages and disadvantages. How do you select between Bluetooth, BLE, ANT, Zigbee, Z-wave, Thread, Sigfox, LoRaWAN, 3G, 4G/LTE, cellular NB-IOT, wifi and long-range wifi, Ingenu, and a further list of proprietary and private systems that are all contenders? Many of these are directly positioning themselves as suitable for IOT applications. Nothing wrong with that. The engineering questions to consider: Will it work in the application, will it be cost-effective and how do I actually implement it? Time to read datasheets and get the spreadsheets out.

**Power Budgets**

A further consequence of these trends in computing and communications is the intersection with progress in battery technology. It is now entirely practical to consider IOT devices that have batteries that will last the service lifetime, or work in combination with energy harvesting from the environment, e.g. solar, water, wind, or even harvest electrical energy. Don't overlook that non-rechargeable cells can meet the lifetime needs with simpler designs.

It's possible to consider service-free devices and battery lifetimes that exceed that of the application. In some cases it may be found that largest cost in a product design is providing power. More datasheet reading and spreadsheet work to do.

**Sensors and Actuators**
Creating real world IOT applications also means having the ability to interact with physical stuff. This requires sensors, transducers, actuators and the like – components that interface between the physical world and the electronic system.

For instance measuring heat, pressure, chemical presence, position, taking a sound, image or video recording, or making a change in the world by motor, actuator, light, sound. It is these devices that enable systems to monitor and interact with the real world. Detecting if you need more milk for your fridge, if a predator is stalking a Kiwi bird, if smog levels are rising or falling, or where your expected parcel actually is.

There are literally tens of thousands of sensors and transducers available from vendors for every imaginable application. Those manufacturers also recognise the impact that IOT is having and strive to produce new versions at lower cost. It is also an opportunity for new vendors to create transducers for novel applications – biochemistry is an example.

## *A Connected World*

In summary, the components for IOT are in a sweet spot enabling new applications: Low cost, low power, high performance, readily connected, and massively scalable. Combine this with advances in cloud computing, security and analytics and you get the ability to rapidly develop remote device applications – systems that interact with the physical world, are autonomous with sophisticated analytics. The long established trend of more processing power at lower cost will underpin the growth of IOT applications.


Image: IBM

Industry, consumers and investors are increasingly aware of the capability, value and novelty that is possible and want to be a part of what is being created. For industries, business and consumers not sure of what impact IOT can have on them, now is the time to start looking.

**Go create!**

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