



Realising the value of connectivity

Platforms, protocols and devices are all available right now: how can they be creatively combined to provide new business opportunities?

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Realising the value of connectivity

The ubiquity of communications infrastructure, in all forms, means that connectivity is a given. The possibilities that the ready availability of connectivity brings, however, are seemingly endless and have great potential to be further exploited. Already we have seen major industries disrupted by the application of connectivity strategies which have fundamentally changed their business models, and it is likely that this trend will only continue as the number of connected devices carries on growing. In this article we will explore what connectivity could mean for your business and how you can harness the power of connectivity to improve your product offerings.

Growth in connectivity gathers pace

Connectivity has been fundamentally changing how organisations do business since the 1990s, for example when Rolls Royce first used satellite communications to enable a managed service business model. The connectivity trend continued to gain momentum throughout the 2000s (see figure 1), in particular since 2005 when smartphones introduced a whole new dimension to concepts of connectivity.

Since then, the availability of connectivity has enabled a range of new gadgets and medical devices to be spawned, for example, the Nest thermostat which learns your behaviour to optimise your heating system for energy efficiency and, in the medical space, Alivecor which provides an iPhone attachment that enables you to take an ECG measurement remotely. We've also seen other interesting technologies piggyback off existing wireless

infrastructure available in most homes (WiFi), such as Amazon Dash, which provides a OneClick ordering experience for essential supplies.

This trend is only set to continue. It's expected that by 2020 there will be an average of 7 connected devices per person in the world (see figure 1). This figure is easy to contemplate. A smartphone, a connected heating system, a couple of Amazon Dash buttons, a connected car, a connected lightbulb, a fitness monitor...already seven devices. And while the rise in connectivity is currently fuelled primarily by consumer companies, the resulting decrease in cost is also opening up new opportunities for industrial applications. We now expect to see a plethora of connected devices with the advent of Industry 4.0: the 4th industrial revolution where connected factories will become common place.

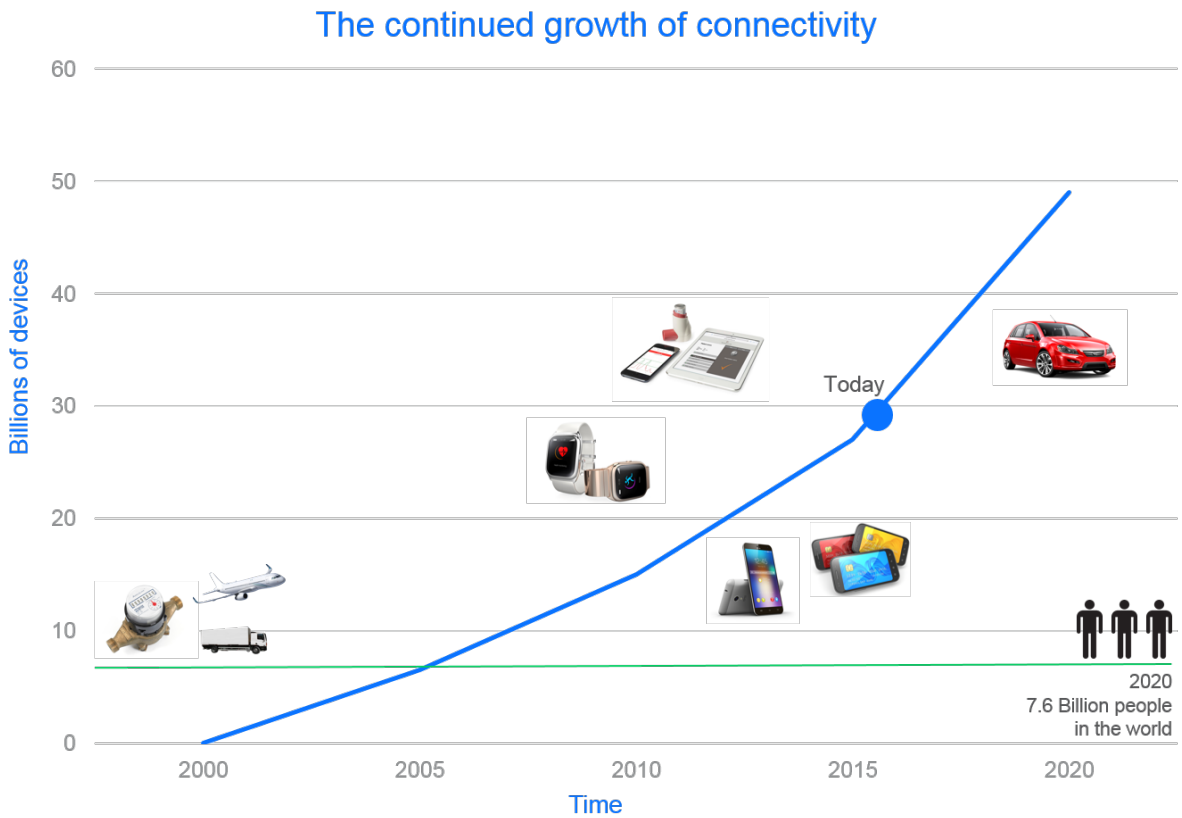


Fig 1. The continued growth of connectivity (Data source: Cisco)

Connectivity as part of a broader ecosystem

While advances in technology and cost reduction have enabled connectivity solutions to proliferate, it is important to remember that connectivity is only one part of a wider technical ecosystem. In order for connectivity to add value it has to be connecting something meaningful and doing something useful with the intelligence. This requires a framework of technologies, as identified in figure 2 below.

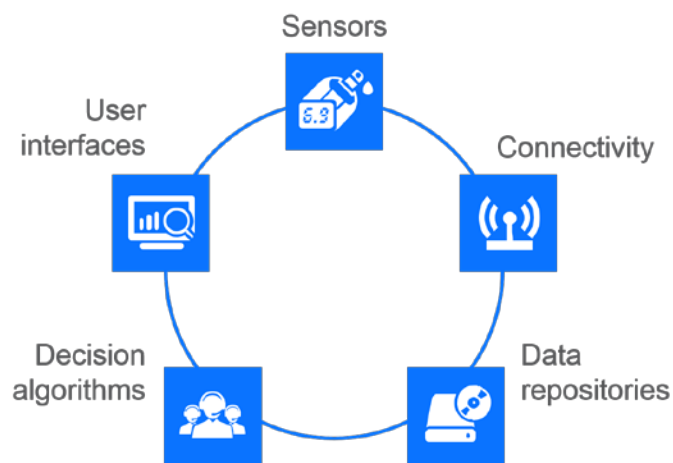


Fig 2. Connectivity is only one part of the puzzle

Sensors are a crucial part of the connected world as they provide the upstream data to be connected. While the development of low cost commoditised sensors is enabling proliferation of connected devices, there is a real opportunity to differentiate through bleeding edge developments in sensing (see our recent paper on [compressed sensing](#)).

The volume of data being produced from all of these sensors requires data repository infrastructure and then, more importantly, what to do with that data? Here, algorithm and mathematical modelling techniques and technologies can help to create actionable insights that help us make sense of this connected world and allow autonomous decisions to be made.

And finally user interfaces – whether mobile, desktop, wearable or some other as yet unimagined interface – make up the ecosystem. This part of the framework is also a key area of innovation.

Effectively this technology ecosystem creates a closed loop feedback cycle whereby activity can be monitored, the data evaluated and feedback given. In a consumer environment, there are obvious scenarios (such as Nest and Fitbit) that this promotes, but the same cycle has uses in other sectors where the feedback can be around an inanimate object rather than a person, for example process optimisation.

So what?

So why does all of this matter? Connectivity, together with the wider ecosystem, can

provide a step change in business model. The closed loop feedback cycle can fundamentally change user behaviour and therefore how business is carried out and the products and services which can be offered. It can enable several different types of business change, for example:

Positive reinforcement and behaviour change

- Monitor compliance: Who is using it? Where is it being used? How much has been used? Feedback to user to ensure correct use
- Reduce man power: How long did the job take? Train users and provide incentive driven schedules
- Promote eco responsibility: Educate user on best practice to reduce environmental burden

Creation of new revenue models

- Lock-in revenue: Just in time (JIT) ordering systems
- Service offerings: Don't just sell products, sell an ongoing service to maintain revenue

Improved margins and efficiencies

- Condition monitoring: facilitate on demand repair of key infrastructure, minimise downtime
- Process optimisation: improve how well plant operates and monitor the entire process from start to finish, reduce measurement lag through introduction of new sensors

Where is the value?

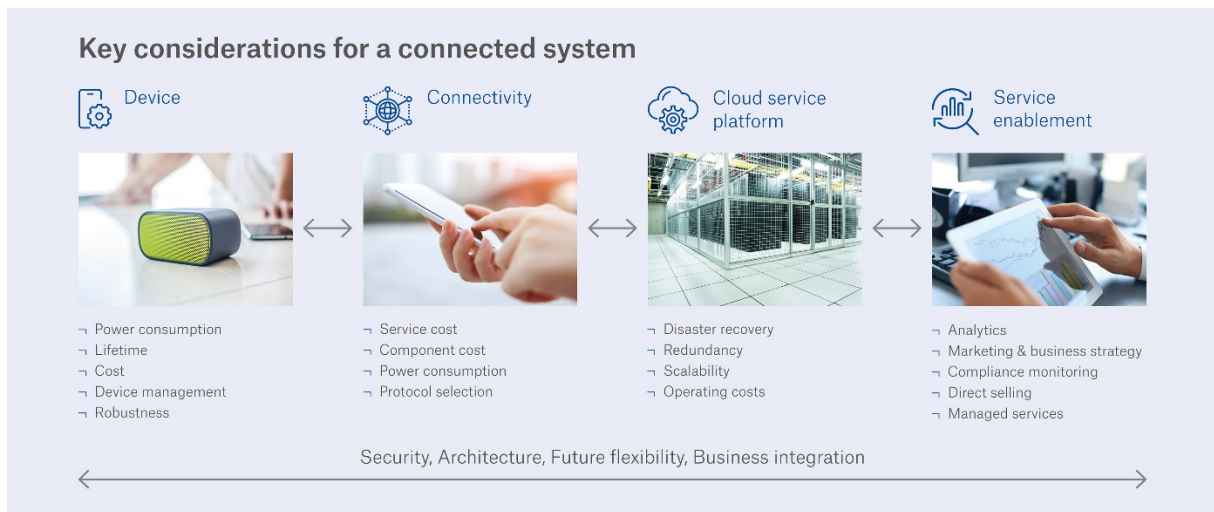


Fig 3. Typical elements in a connected system. Service enablement is where the value is obtained

Figure 3 shows a typical incarnation of a connected system. In order to appreciate where the value of connectivity lies it is important to consider that many of the technology elements already exist.

Many devices, connectivity protocols and cloud platforms are already available and there is a lot of innovation happening in these areas, combining existing platforms with new sensing technology and development of low cost systems. This leaves Service Enablement as the key value driver.

Service Enablement is taking collected data and turning it into a useful outcome, whether actionable insights (eg asset tracking, misuse detection etc), new business models (such as lease based or managed services) or new opportunities (eg maintenance contracts or direct consumer relationships) – see figure 4. If any of these resonate with your business area then you could benefit from a connected system.

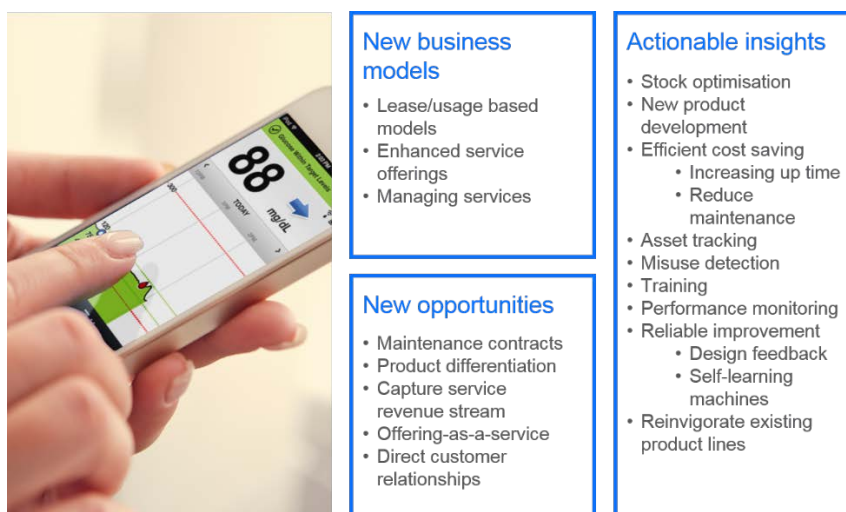


Fig 4. Actionable insights

Where should I innovate?

Although the value will come from enabling new services, the whole ecosystem still needs to be considered when developing a connected system. But what are the right areas on which to focus your innovation? With the increasing number of connectivity platforms (communications, data repositories and decision algorithms), the barriers to entry are high and innovation in these areas is most likely to be undertaken by platform providers, such as Amazon, Apple, Google and Microsoft. However other areas, such as the user interface and the sensors, provide opportunities for technical innovation that will enable you to really differentiate your product.

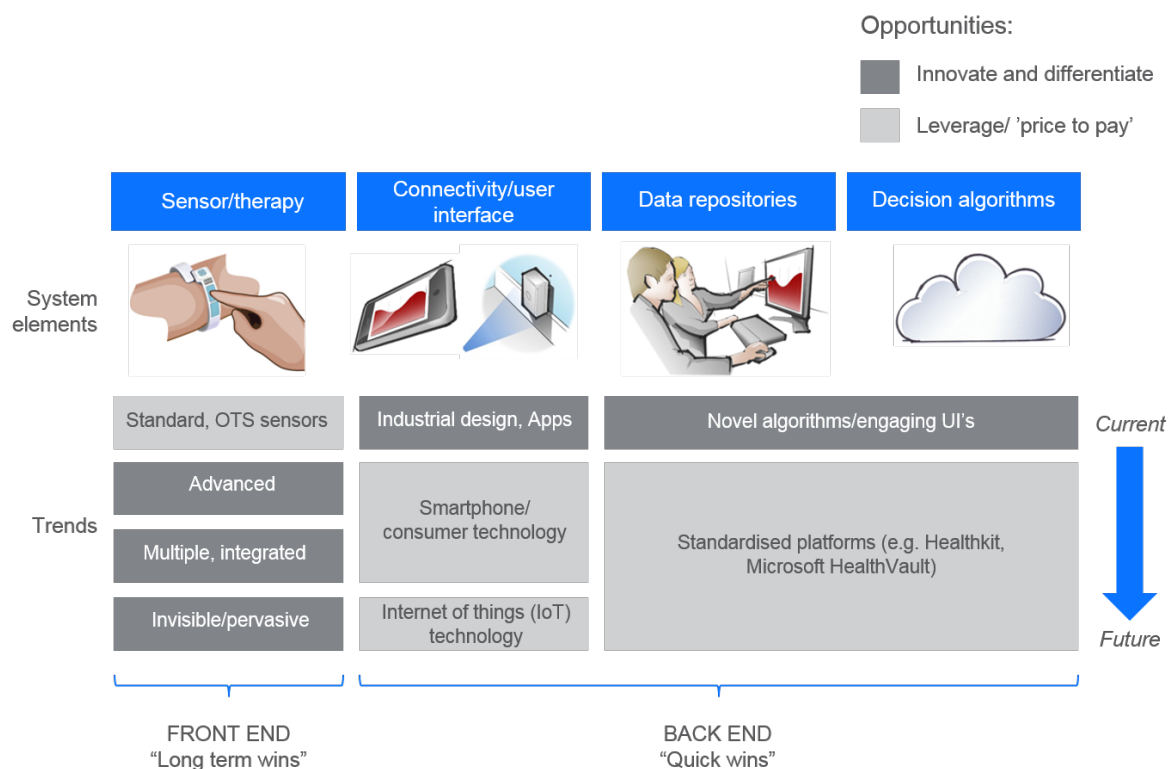


Fig 5. Innovation in the connected world

How you deal with the data provides an opportunity for technical innovation through algorithm development and novel user interface engagements. Algorithms allow actionable insights to be found from your data sources. This really is an area for innovation as your business will have a specific dataset. This could benefit from a fresh mathematical and algorithm perspective.

The area where we expect most technical innovation is in the design of sensing systems. While there are many sensing platforms already being developed, many of these use widely available sensors which are low cost and can provide valuable insight, but do not allow for any customisation. There is opportunity here to differentiate by considering the key sensing need and developing an appropriate solution, whether that be a new sensing technique for measuring chemical

composition or a novel low cost way of detecting flow using acoustic technology. Don't be constrained by the norm!

In the future we would expect this transition to continue, from these more advanced and specific sensors, to the use of multiple sensors to enable data fusion, and then on to sensors which are everywhere and appear invisible to the user. This trend is already beginning with the advent of wearable tattoos which are able to sense temperature and skin conductivity to enable an almost invisible sensor.

What are the next steps?

The development of connected systems is not only for engineers, scientists and mathematicians, it is also for business and marketing leaders. Insight can be gained from what is technically possible but a key driver must be the business need.

From a business perspective, before embarking on a development using connectivity a company needs to consider the following to ensure success:

1. Understand the problem you are trying to solve
2. Define business need and model
3. Determine connectivity roadmap
4. Determine suitable technology

5. Develop a connectivity system

- Start small – develop quickly
- Evolve capability

Once the business need is understood and the business model and connectivity roadmap defined, you can then embark on a development. While selecting appropriate technologies is not challenging to engineers working on connected solutions, connectivity is a fast moving world and so demands short development timescales. There is a need to be agile and adjust your ideas and technical solutions to match the speed of technology change. This is a barrier for many companies who follow a strict development process.

In order to get the value from connectivity it is important to put in place a well-founded connectivity strategy from which actionable insights can be found. These will provide opportunities to enable new services for your business.

In our next article we'll be exploring in more detail the wireless technologies available for your connectivity solutions and how to choose the most appropriate technology for your development.

How Sagentia can help

Sagentia can help you add connectivity to bring about business change whether through the facilitation of workshops between business leaders and technical experts; development of rapid prototype systems to prove innovation; development of novel sensing technologies; or complete connectivity systems. We would welcome the chance to discuss the opportunities in your business.

About the author

Mark Tuckwell is Head of Electronics, Software and Systems at Sagentia. He has a particular interest in connectivity and sensors which is reflected in his current and previous work.

Mark has a PhD in Low Power Circuits for Analog Communication from Imperial College London where he also studied for a Masters in Electrical and Electronic Engineering.

Mark has worked in a variety of industries including:

- a start-up (Nujira) in the mobile phone industry designing chipsets for novel power efficient communication circuits for 4G mobile phones;
- design of world-wide secure government communications systems;
- and design and implementation of electrical and control systems in the chemical industry for ICI (Imperial Chemical Industries)

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