

# Developing the Internet of Things

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# Part 1: A domestic technology revolution



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# Part 1: A domestic technology revolution

**The pace of technological change in recent years has been breathtaking, bringing developments that have transformed the lives of many consumers. At the heart of this is the Internet of Things (IoT) - the network of interconnected sensors embedded in household objects now bringing what would previously have been considered the technology of sci-fi films right inside our homes and into our everyday lives.**

The technology research group Gartner estimates that there are currently about 6.5 billion connected devices in the world. By 2020, it predicts there will be nearly 21 billion. This is a conservative estimate – Juniper Research suggests the figure in 2020 will be closer to 40 billion, while Cisco claims it will be nearer 50 billion. The economic

impact of the IoT is expected to be huge; the consultancy IDC foresees a global market worth \$1.7 trillion in 2020. But despite the vast potential for technology like autonomous heating, integrated electronics and smart security to restructure, and reinvigorate, day-to-day living, businesses have on the whole been underwhelmed by the

extent to which consumers have embraced the IoT. Behind this reluctance lie a number of issues, such as cost, a lack of integration and safety, the resolution of which is key to convincing consumers that the IoT can deliver enormous benefits to their lives.

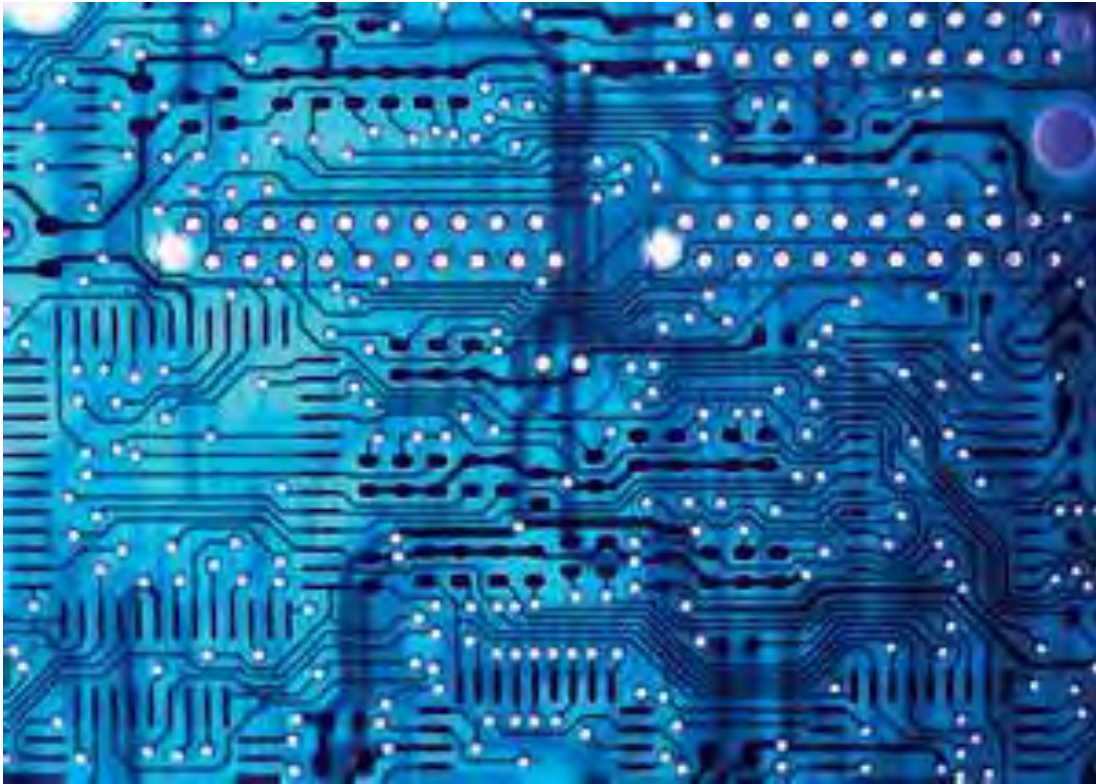
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# Part 2: New Technology



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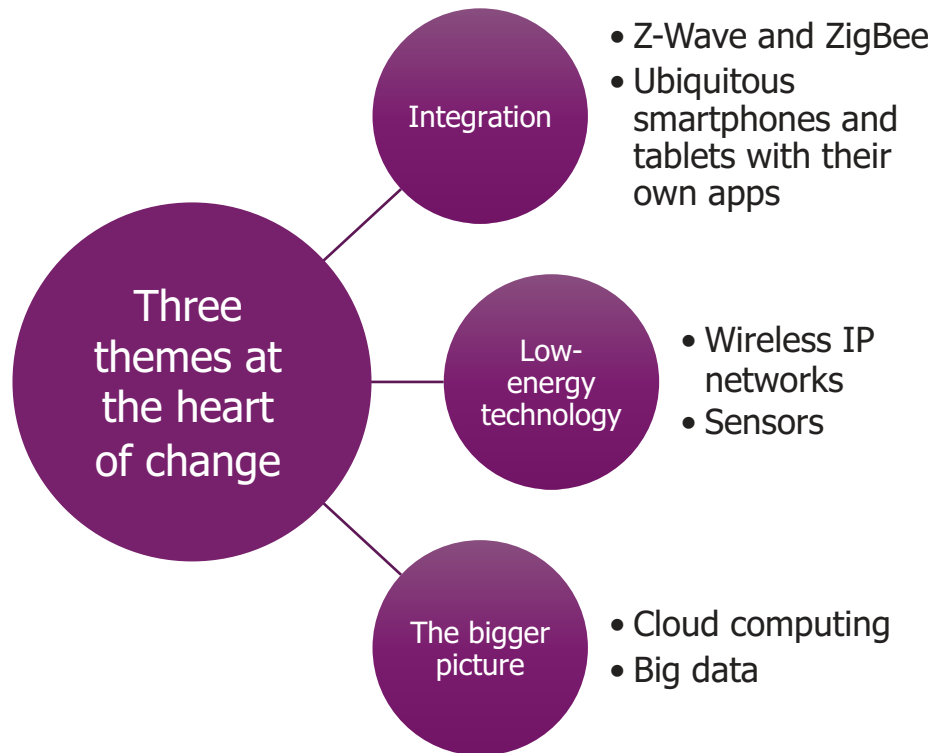
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# Part 2: Low-cost, low-energy technology is key

**The speed with which the Internet of Things has become a part of the day-to-day lives of some consumers has been facilitated by a number of technological factors.**



Any piece of new technology is commercially redundant unless it can be fully integrated into an appliance at low-cost, using the minimum energy required. The near-universality of wireless technologies Z-Wave and ZigBee and modular robots by Robosynthesis have allowed for efficient remote monitoring and

control. At the same time, thanks to the ubiquity of smartphones and tablets, consumers are now able to operate IoT devices with apps. Moreover, low-energy wireless networks and sensors, combined with cloud computing, has made a relatively low-cost customer experience a reality.

# Part 3: Utilities



# Part 3: Utilities a major target of the IoT

At the forefront of the domestic IoT revolution are utilities. Heating, lighting and electricity in particular have been affected by the introduction of sensors that monitor the performance of appliances. For example, lighting can be controlled with a smartphone and can be switched on and off by sensors detecting when the customer leaves or enters a room. Likewise, smart meters can be

controlled remotely and integrated into the Smart Grid to deliver efficiency gains, making use of high solar panel output, for instance, during the middle of the day. Although uptake has been slow, 70% of UK consumers are interested in home gas and electricity usage monitoring. Ultimately, the use of the IoT with utilities offers consumers a cheaper, smarter service.

- Heating – Nest’s Learning Thermostat
- Lighting – Philips Hue, LIFX and Lightwave RF
- Electricity – Smart meters (e.g. Belkin WeMo Insight and Buzzerfly) and integration with the Smart Grid
- Telecoms – Global SIM cards (e.g. Vodafone)
- Gas – Monitoring of gas level in tanks
- Water – Smart water meters, remote measurement of water pressure

# Part 4: White goods



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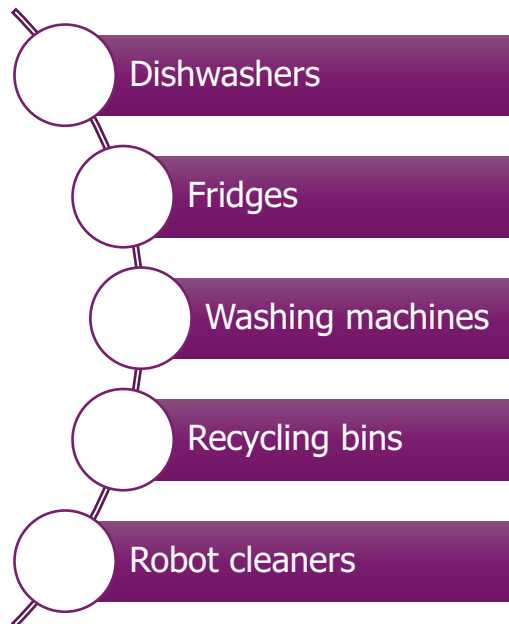


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# Part 4: The automation of white goods is here and now

**The example of a smart fridge that notifies the consumer when milk is running low might have become something of a cliché in the Internet of Things world. However, when McKinsey notes that household chores take up the equivalent of \$11 trillion a year in consumer time, a figure expected to climb to \$23 trillion in 2025, putting the IoT into the heart of kitchen life is a prospect that deserves serious attention.**



The automation of chores is where the Internet of Things will deliver the most value inside the home. Sensors implanted inside everyday objects will mean, for example, that councils are alerted when recycling bins are full. Consumers will no longer have to spend hours hoovering, checking when food goes out of date, or mowing the lawn. They may even not have to ever go shopping again, as simply swiping the barcode of a used item across a scanner on the fridge

will automatically reorder that good. This would appeal to the 'autonomous customer' and follow as a natural stepping-stone for the 57% of online consumers who prefer self-service. It is estimated overall that the IoT will be able to reduce the chore workload of consumers by 17%, amounting to an average of 100 hours for each household per year.

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# Part 5: Electronics and entertainment



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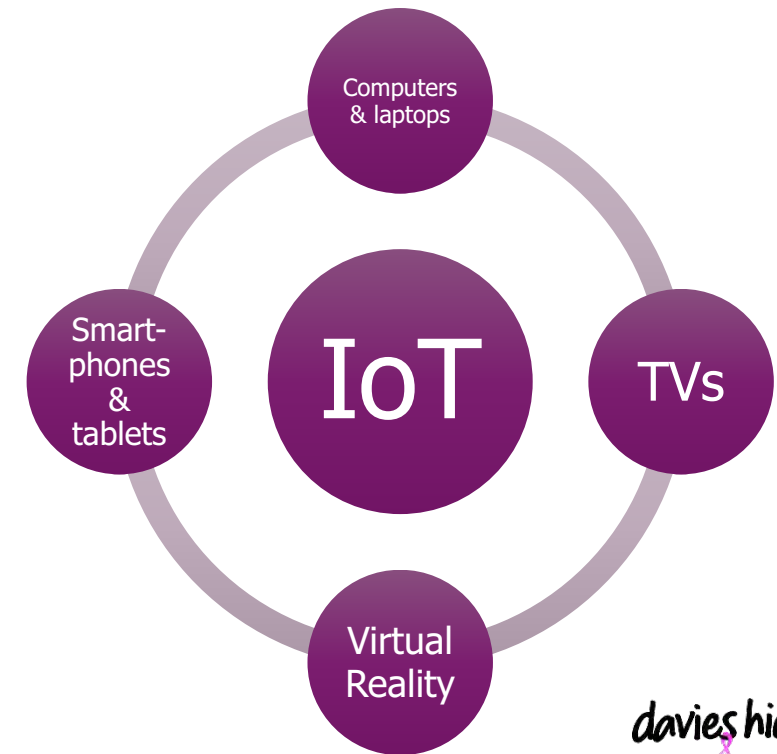
# Part 5: Electronics as we've never seen them before

**The home entertainment industry is undergoing a remarkable transformation thanks to the Internet of Things. Televisions are genuinely smart, phones are more powerful than they've ever been, and true virtual reality is finally here.**

Smart TVs will be operated with motion and voice control, while Samsung has announced its TVs will become smart hubs, from which consumers can control all other connected items in their homes.

Smartphones, in addition to wearable devices such as the Apple watch, will soon be a staple part of exercise, monitoring the consumer's activity levels. It is also likely that smartphones and tablets,

in addition to TVs, will act as the centre of a smart, connected home, allowing the user to control aspects of their day-to-day life simply through apps. But undoubtedly the most impressive application of the IoT in the domain of electronics has been virtual reality, which businesses hope to harness as a means of providing a unique customer experience.



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# Part 6: Home security



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# Part 6: You'll never lose your keys again

**The Internet of Things is driving major changes in terms of security at home. It is predicted that electronic door locks and cameras monitoring our houses will soon be the norm.**

The security of one's house and the safety of the people inside it is perhaps the biggest concern of any homeowner. It is therefore unsurprising that the potential market for the IoT to drastically improve domestic security and safety is huge. The days of physical keys will soon be long gone. The IoT will deliver electronic keys that can be operated by a code, fingerprint or even facial recognition. And while physical

keys are still in operation, a sensor that will show the location on a customer's smartphone can be fitted to the keyring. In addition to smart locks, Nest is now selling outdoor cameras that notify the homeowner via text message when someone is entering the house or trying to break in. 73% of UK consumers are open to this idea. It is even thought that old smartphones will be used as home cameras, so that

parents can keep track of their children or be alerted when they are close to the swimming pool, for instance. In addition to keys and cameras, sensors will be fitted to gas pipes that alert both the homeowner and the gas company when a leak is detected, enabling pro-active Smart Service. Moreover, it is hoped the lives of the disabled and the elderly will benefit from the IoT.

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# Part 7: Cars



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# Part 7: Cars

**A lot has been made of the potential for the Internet of Things to fundamentally reconfigure the car market. Autonomous vehicles have been particularly hyped. While this is certainly an exciting prospect, the IoT is also enabling more mundane, but nevertheless essential changes in the industry.**

Although all types of vehicles are included in the estimate, McKinsey's prediction that the use of IoT systems in vehicles can yield \$210 to \$740 billion per year globally by 2025 is staggering.



Monitoring performance	<ul style="list-style-type: none"><li>• Improved design</li><li>• Pre-empt faults</li></ul>
Damage & theft reduced	<ul style="list-style-type: none"><li>• Low-speed collisions avoided</li><li>• Consumer notified of break-in</li></ul>
Autonomous cars	<ul style="list-style-type: none"><li>• Fewer road incidents</li><li>• More time for consumers</li></ul>

In terms of cars, connected sensors will be able to keep track of the performance of the vehicle. It will thereby be able to proactively prevent problems before they occur by notifying both the owner and the manufacturer. Such interaction with the manufacturer will deliver improved and safer design over time. Moreover, cars will break automatically to avoid collisions, which 60% of UK

consumers are interested in, while the police will be automatically contacted about theft, helping to lower consumers' insurance premiums. Although the prospect may seem somewhat unsettling to some at the moment, the Internet of Things will be key to the development of fully autonomous cars in the long-run.

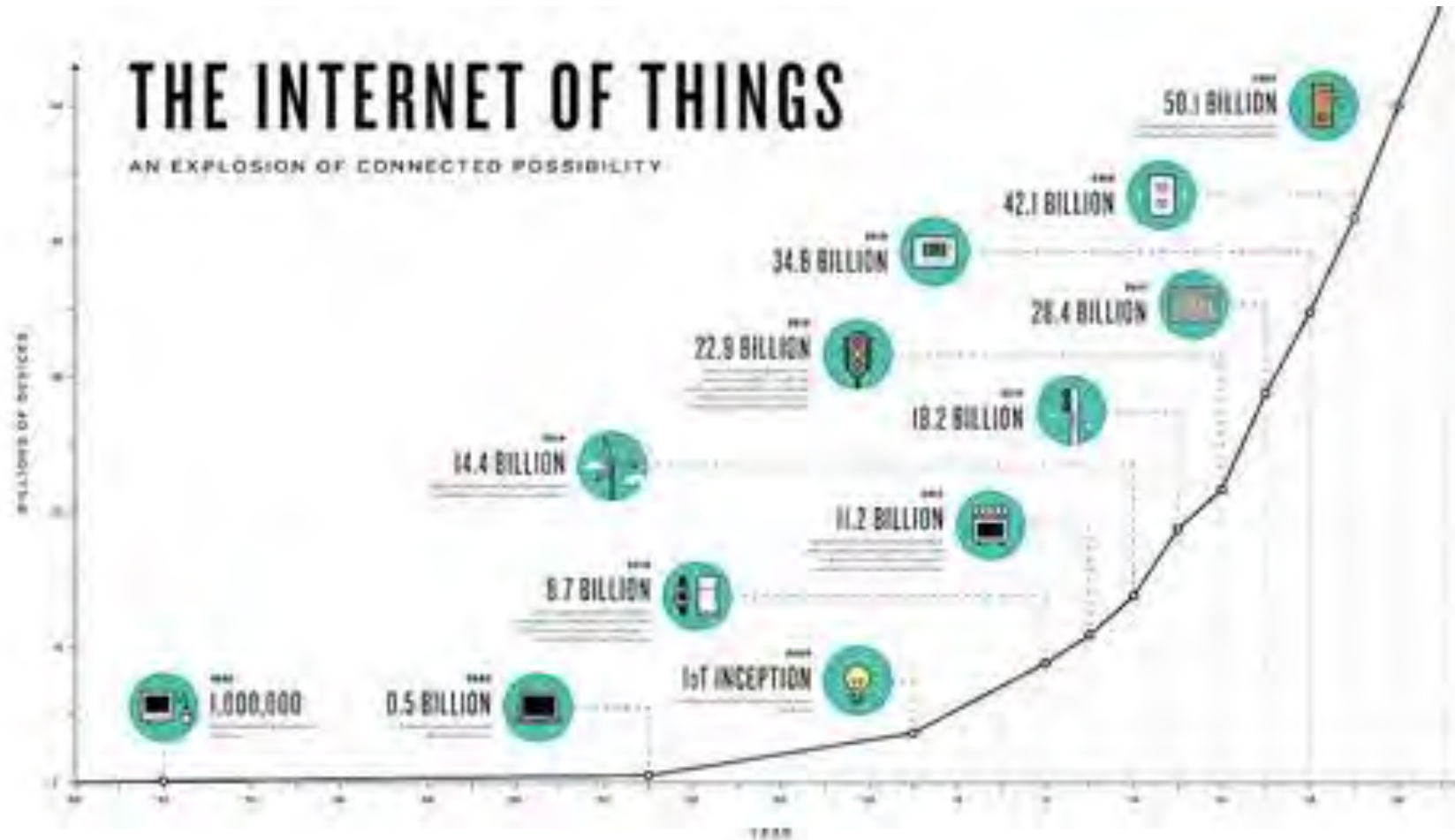
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# Part 8: An unfulfilled revolution?



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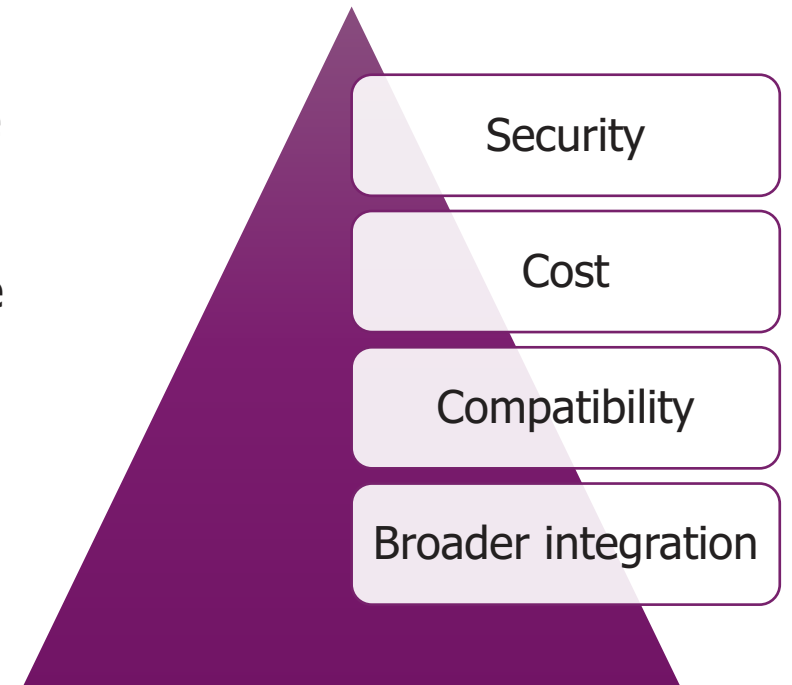


# Part 8: An unfulfilled revolution?

**The Internet of Things is clearly behind changes fundamentally affecting the lives of consumers. So why is it that so many customers are still so reluctant to fully embrace the IoT?**

Ultimately, major IoT companies have been disappointed by recent uptake figures. Despite the relentless hype about connected devices, it seems the excitement has failed to rub off on a surprisingly large proportion of the consumer population. Only 3% of homes own a smart thermostat, while only 2% use smart lighting systems. The figures for home cameras and smart home appliances are

similar. Although smart TVs, smartphones and wearables are more popular, it is clear there are factors making consumers hesitate to create a smart home with connected devices playing a central role in their day-to-day lives. Their main reservations concern cost, compatibility, integration into a broader infrastructure and, perhaps most significantly, security.



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# Part 9: Barriers to consumers



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# Part 9: What's stopping consumers?

## Security



For many, embracing the Internet of Things is a loss of privacy too risky to undertake. Indeed 91% of consumers surveyed in our research were concerned that new technologies could be used to threaten their privacy. Repeated reports of hackers meddling with autonomous cars or gaining access to home cameras certainly pose very real and legitimate barriers to widespread use of connected devices. But changes are moving in the right direction – manufacturing companies are now recognising the importance of safeguarding their devices at the hardware level, rather than simply implementing quick-fix software solutions.

## Cost



At the moment, the price of many IoT items simply makes the prospect of a smart home unfeasible. For instance, although the fact that 18% of all vacuum cleaners retailing at more than \$200 in the United States are robot cleaners may seem to indicate an encouraging shift towards greater adoption of the IoT, the reality is that most people are not prepared to pay over \$200 for a vacuum cleaner. Nevertheless, the increasing competition in the market for domestic connected devices should drive prices down, making a smart home attainable for a much greater number of consumers.

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# Part 9: What's stopping consumers?

## Compatibility



Consumers are also reluctant to accept the IoT because of businesses' piecemeal approach. Currently, the fact that multiple apps are required to operate a smart home inconveniences consumers, while incompatibility problems between Apple and Android, for instance, pose difficulties for customers. That said, Samsung's SmartThings hub and Amazon's Echo speaker both indicate progress towards greater integration.

## Broader Integration

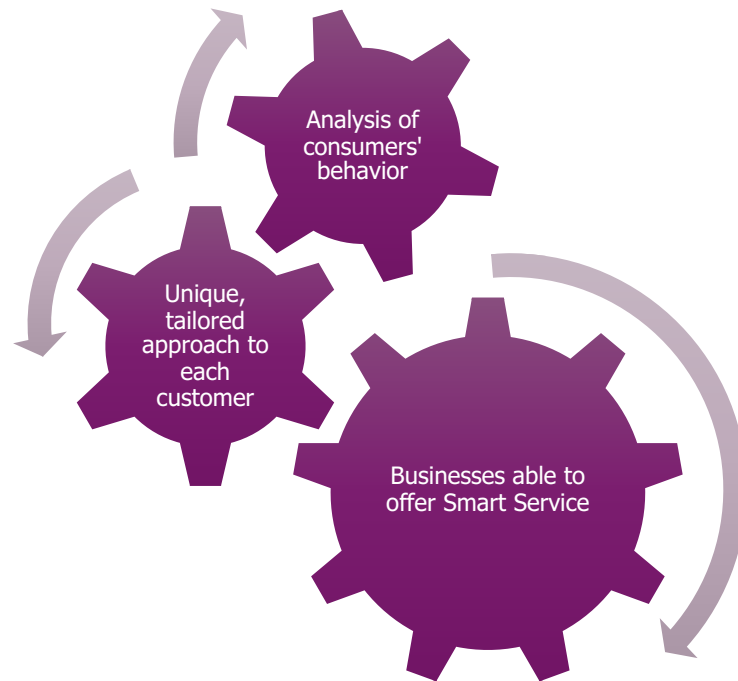


The full power of the IoT is currently being failed to harness because of a lack of integration with a broader, nationwide connected infrastructure. Although the first signs of a smart grid are starting to emerge, encouraged by the government's £10.9 billion smart meters programme, truly smart cities are still in very initial stages of development. There is more work to be done on behalf of the government in particular to facilitate faster broadband, for example, before the IoT can take hold to the fullest extent possible.



# Part 10: The IoT is bringing Smart Service to life

**The Internet of Things will also be able to offer drastic improvements in customer service. Moreover, it has great potential to reduce the carbon footprint of homes, resulting in a more sustainable society.**



At heart of the IoT is the potential for a far more personalised customer experience. By analysing each consumers' habits with sensors and big data, businesses will be able to tweak their service to fit the behaviour of every single customer. For instance, warm water for a shower will be switched on as soon as the user's phone detects they've woken up. They'll then be able to switch on the kettle with their phone and the water will be kept at the right temperature until the individual arrives in the kitchen.

Although some consumers may perceive such monitoring of their behaviour as overly intrusive, businesses must ensure it is delivered in a secure way. This will help to build trust, as 65% of consumers trust companies more with good service. At the same time, consumers will be able to simultaneously save on utility bills and reduce their footprint thanks to smart use of energy.

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# Summary

**It is overwhelmingly clear that the Internet of Things is not just hype. It has the greatest capacity since, some would argue, the Industrial Revolution to fundamentally redefine the lives of consumers.**

Before the full potential of the IoT can be fulfilled, a number of significant obstacles must be overcome. Most notably, security flaws and an invasion of privacy deter customers, while the cost of many connected devices remains too high. Moreover, a lack of compatibility and wider infrastructural integration remain issues. But the signs of

improvement are undoubtedly there – competition in the market is putting downward pressure on prices while the need for protection at the hardware level is well understood. Based on this positive evidence, consumers' reluctance to embrace the IoT should soon disappear. The benefits of a smart, interconnected home are

indisputable. Chore automation, reduced energy bills, greater security and revolutionised home entertainment will be the norm. The challenge for businesses remains to deliver a unique, low-cost, non-intrusive Smart Service. No small feat, but the rewards promise to be vast.

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# Summary: Top 8 Opportunities



Smart electronics. The ability for vacuum cleaners and fridges, for instance, to act independently will free up vast amounts of time consumers to use more productively. This will prove particularly beneficial in the developing world.



Chore automation. The ability for vacuum cleaners and fridges, for instance, to act independently will free up vast amounts of time consumers to use more productively. This will prove particularly beneficial in the developing world.



Connected utility meters. Smart meters are already taking off and, propelled by the government's initiative, will help create a more sustainable society and lower consumers' bills



White goods optimization. Dishwashers and washing machines that are able to act autonomously when electricity prices at their lowest points will reap great rewards in terms of their environmental impact and financial burden on consumers



Smart Service. The Internet of Things will be the major driving force behind a shift towards truly unique, pro-active Smart Service, thanks to problem prevention and service adaption, facilitated by sensors and big data.



Greater security. Home cameras and facial recognition locks present the greatest threat to privacy. But ultimately the opportunity for greater security will overcome this worry, given companies handle consumers' details responsibly



Autonomous cars. The technology necessary for self-driving cars is approaching fruition, but consumers are still reluctant to fully let go of the wheel



Smart cities. So-called 'smart cities' will no doubt bring great benefits, but they are still a long way off



Thank you

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