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Home » Topics » AI & Machine Learning » The impact of the Internet of Things

The impact of the Internet of Things

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A brief history of IoT and computing

The Internet of Things (IoT) essentially refers to an ecosystem of discrete computing devices with sensors connected through the infrastructure of the internet. The concept may have been bubbling away in the industry for a long time, but the democratisation of computing technology through the availability and affordability of small computing devices has now pushed it firmly into the mainstream. So how did we get to this point?

A brief trawl through the IoT's evolution can be summed up quite simply as things getting smaller – a cycle of miniaturisation that began with computers the size of a room and ended up with a smartphone in the palm of hands.

In essence, it is about the computing power being decentralised, agile and mobile, freed from the confines of the home and office, a traction evident with the arrival of laptop and then the netbook that meant we could work on the go. The smartphone heralded a new era of fast and interactive data sharing and then the proliferation of sensors took things to another level.

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Devices brimming with intelligence – functioning natively within their respective environments to enhance our interaction with the world around us signalled the emergence of the true IoT.

What drives this cycle and the continuous innovation is primarily the constant push and pull of new miniaturisation technology driving further computational decentralisation.

A word about the origins of Industry IoT

In terms of the genesis of industrial IoT, one can look to Richard Morley's invention of the programmable logic controller (PLC) in 1968. This digital computer, adapted for the control of manufacturing processes for General Motors, provided a means to generate and transmit digital information, so that hardware devices could digitally communicate with other interfaces and no longer had to work in isolation.

Throughout the 1990s and early 2000s IoT was a given in industry and largely confined here with the high costs of micro-controllers and sensors proving to be prohibitive from a consumer perspective.

The consumerisation of IoT would require economies of scale to make manufacturing sensors and micro-controllers less costly. These economies would not emerge until small portable computers and smartphones became nearly ubiquitous and saw designing and manufacturing of Systems on a Chip and low power sensors evolve.

Consumerisation of IoT

With the advances in miniature computers and their increased affordability and availability, along with miniature sensors, IoT was ripe for consumerisation. The issue standing in the way of mass adoption of IoT as a paradigm outside of industry has been the control aspect.

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Amazon EX1062 Page 2
Amazon v. Smart Speaker IPR2026-00280

IoT devices represent rudimentary decentralised computing, they are individual self-contained devices that can communicate and receive instruction from other computer devices.

The issue is how do you tell them what to do, and how do you make use of the data that sensors are collecting? Traditionally this had always required some kind of central computer to hold a rule set and act as a command and control server.

However, as the average consumer does not have the will or know-how to set up a control server in their house. IoT would need to shake of much of this complexity to become a mainstream opportunity.

Leveraging mobile

As smartphones became near ubiquitous, it quickly became obvious that the perfect device to act as this command and control server was the mobile that people always have on them.

As a bonus, this device could gather additional context itself using its embedded sensors as well as user location and behaviour. For example, your connected thermostat can know if you are home or not by using the location of your phone. While using the phone as a control device is necessary it did prove lacking as the primary control server.

Smart home

The traction around smart-home technology has been instrumental in cementing the IoT as a genuine consumer proposition, due to an accessibility and advent of affordable IoT devices. Where it used to take a significant investment in capital and labour to set up a connected smart home, now it is a matter of buying off the shelf IoT devices and connecting them together.

Almost any device you use in the home now has a connected smart version from light bulbs and thermostats to tea kettles, fridges, and ovens. Additionally, devices that sense the state of a room are widely available in the form of motion sensors, proximity sensors, thermostats, humidity sensors and more.

The smart home market has settled on the hub approach to controlling your IoT devices which helps account for the different people that use the devices.

These hub type devices are being used to bridge the different communications protocols used by IoT devices and hold and control the ruleset for the house from a central place in the home.

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This means a consistent rule set and performance can be achieved while still giving individual users the convenience of using their mobile phones to interact with the hub and change any rules or manipulate devices around

Amazon EX1062 Page 3
Amazon v. Smart Speaker IPR2026-00280

the house. The release of Alexa and Google home this year has increased the demand for smart home technology amongst consumers.

Wearables

Wearables is a fast-emerging category of IoT, encompassing any computer you wear on your body, usually hooked up to peripheral sensors (heart rate, temperature, barometer, etc.…).

Currently the biggest wearable computing sector is smart watches. Smart watches enable you to gather data on your vital signs and activity levels and run various levels of analytics on this data related to health or activity monitoring.

Being general purpose computers, smart watches can also run software and communicate with your mobile phone. This allows you to have glanceable data on your wrist in addition to the mobile that is in your pocket to help you achieve more while on the move.

As a young category, it is still finding its functional niche. However, the interesting thing with wearables is their potential to be the most seamless of all your computing devices as they blend into the background and present you with data when, where, and in the format, you need it in.

>See also: **Managing and securing the Internet of Things**

Additionally, the rapid emergence of augmented reality presents very interesting potential applications for various wearable technologies such as smart glasses. This technology could potentially provide you with a constant heads up display that overlays useful information onto the real world. The recent news of the return of Google Glass will no doubt boost this sector again. But Google Glass Enterprise, as it's now called, actually has its eyes on industry.

Current state of IoT in industry

Fuelled by greater access to cheap hardware, IoT is used throughout industry product lifecycles with notable success in logistics and fleet management by enabling cost effective GPS tracking and automated loading/unloading.

Furthermore, it has had a major impact on the operational and support side of industry, best exemplified by Rolls Royce. IoT technology has trickled out of the production line and into real time operational support as sensors record telemetry data about the operation of their engines while in flight to analyse data and detect any issues within an individual engine so it can be repaired in time safely.

In the oil and gas industry IoT sensors have transformed efficiencies around the complex process of natural resource extraction by monitoring the health and efficiency of hard to access equipment installations in remote areas with limited connectivity.

Other more discrete IoT devices such as drones are also being used very effectively for monitoring dangerous and hard to reach equipment and

Amazon EX1062 Page 4
Amazon v. Smart Speaker IPR2026-00280

safeguard personnel. Drones are essentially just flying IoT cameras.

>See also: **Internet of Things: a retail perspective**

By embracing near edge processing technology instead of the cloud, the resource industry can now process a significant amount of the data that is generated from the sensors they use in low power, small computers close to the physical location of the sensors themselves. This greatly reduces the amount of data that needs to be sent out over the internet for processing to boost efficiencies.

IoT in the workplace

It seems our homes are outsmarting the office when it comes to the adoption of connected technology, such is the consumer-centric nature of the IoT narrative. Yet we are on the cusp of a more IoT-enabled era in the workplace that will see employees better connect to each other and their environment for enhanced collaboration and productivity.

Industry commentators are already mooting robotic colleagues and the sending of documents via a smart watch as the office of the future, with robo receptionists and automated moving tea and coffee stations already being trialled. While mainstream take up may be some way off, for now applications that drive more intuitive responses to the situational changes are gaining traction.

Embedded sensors that optimise office lighting and temperature are upping the comfort factor and saving energy costs, while motion sensors that can detect room occupancy could put the inefficiency of double-bookings in the past through automatic meeting scheduling.

Personalisation

Remember when bringing the personal touch into the office was confined to a few photos and keepsakes on the desk? Thanks to the IoT things are about to go up a gear. The hyper personalisation now underpinning the consumer experience is starting to filter into our working lives to create a workspace that 'knows' the user and anticipate their routine and preferences thanks to the behavioural data captured.

Think biometric or radio signal based sensor doors that know you've arrived and unlock automatically rendering the swipe card redundant or having your location and schedule tracked and shared so colleagues are updated if you're delayed for a meeting.

>See also: **Enhancing the customer journey through the IoT**

Crucially, for the IoT to become truly transformative in the working environment it demands a cultural shift as well as technical one so that is ingrained throughout organisation rather than working in silos.

Furthermore, data needs to be integrated and analysed fast for actionable insight, so that the right commands are executed across the multitude of complex processes with unprecedented speed, agility, and reliability. Stale, stagnant data soon loses its power.

Amazon EX1062 Page 5
Amazon v. Smart Speaker IPR2026-00280

Challenges with IoT

Security – While the explosion in connected devices has brought seemingly limitless opportunities, progress remains tempered by security challenges in both the enterprise and consumer space. New research shows that the growing number of devices because of the IoT will see the global spend on cyber security technology surpass $1.8 billion by 2020.

High profile hacks and breaches may provide intermittent wake up calls, but the reality is that security remains an afterthought in much of the design of applications exacerbated by the small size of most embedded devices.

Designed for low power consumption with limited connectivity, their often low cost and disposable nature remains a barrier to the incorporation of encryption and other more robust security measures.

Not surprisingly, establishing a standardised security protocol to address the scope and diversity of the devices has become the Holy Grail as the IoT market matures. Solutions that can secure both the device and network while avoiding the kind of draconian interventions that become a barrier to engagement and creativity is a central challenge.

>See also: **It's time to take IoT security seriously**

Apple's response in the form of its smart home accessories line, Homekit, is one option trying to negotiate this tightrope. In a unique move for the connected home platform, the tech titan is shunning the cloud completely and exerting further control by insisting other manufacturers that work with the products must incorporate Apple's approved micro-controller for a sufficient level of encryption and security,

A simple punch in code aims to negate the usual complexity of IoT device set up processes, while a natural language interface will enable able to give commands to devices all over their home as if they were talking to another person in the room. It's a feature aligned to the increasingly naturalistic interaction that users are demanding.

Mesh fuels interconnection

Ultimately, IoT has long been surmised as getting everyday objects to talk to each other and the connection challenge grows exponentially in line with the scope and complexity of the market.

It's why attention is turning to the mesh network as a means of tacking much of the inherent complexity through a framework that can connect all devices directly via wireless nodes.

Without the constraints of phone companies, ISPs, PCs or dedicated hub services, these are free to establish network links with surrounding nodes, transforming the usually complex process of network expansion with easy scalability for improved capacity and performance.

Industries will see how this agile and configurable approach will boost resilience and security by enabling fast responses to the changing security status of device information in the network. Here, the opportunity to

Amazon EX1062 Page 6
Amazon v. Smart Speaker IPR2026-00280

upgrade a specific device as required rather than complete overhaul becomes a cost-effective approach to managing IoT infrastructure.

The future of IoT

AI- fuelled autonomy – A heavy injection of artificial intelligence (AI), will signal the next wave of the IoT by delivering the speed and accuracy of big data analysis required to cope with the 8 billion connected objects Gartner predicts will be in use in 2017.

While the rise and rise of the chatbots are perhaps one of the most visible incarnations of the new machine learning era, this barely scratches the surface. More broadly an AI-driven era of IoT will herald an increasingly seamless experience and heightened interconnectivity as users flit from one device to another, between multiple environments and the physical and virtual world, to create what has been coined the ambient user experience.

>See also: **Modern challenges in store for the Internet of Things**

Underpinned by real-time contextual information, transactions become more immersive, tailored, personalised and the interfaces increasingly invisible as 'things' just happen as the environment responds intuitively and interpretively to the diversity of data without the reliance on analysts.

Wearable sensors and devices which are smart enough to understand the context and monitor our physiology, drive specific health-related goals and alert us to any specific problems are one area ripe for ever greater sophistication.

Society is on the cusp of experiencing a proliferation of sensors which will be seamlessly incorporated into all aspects of everyone's lives, working cognitively while embedded in the mattresses people sleep on or in their car steering wheel to continually monitor people's physical state and report the facts – if individuals want it that way, of course.

Sourced by Khalil Dimachkie, technical strategist, ***Big Radical***

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