IoT Connectivity for UK Housing

## Introduction

The Internet of Things (IoT) offers housing providers the opportunity to radically transform how they deliver their services.

One of the biggest opportunities exists where consumer IoT technology can be leveraged to offer residents advanced ways to interact and manage their homes while also providing a range of asset management benefits to social landlords. *For an in depth look into the potential for Smart Thermostats to offer value to social landlords see our guide-* [Smart Thermostats: Market Analysis for Social Landlords (June 2015)](https://uploads.strikinglycdn.com/files/145114/d870fdbf-bb5e-4d15-87c8-1aeb6f8dcd99/Smart%20Thermostats%20Market%20Analysis%20For%20Social%20Landlords%20June%202015.pdf)

In order to realise this potential, these devices need to talk to each other and talk back to the internet. As it stands this is not yet straight forward. One of the areas where there is most diversity and confusion is in the underlying connectivity that enables the IoT to work. In this emerging market a multitude of connectivity protocols exist, some which are interoperable and other that are less so.

In this paper we look at everything from broadband to z-wave to explain what all of these technologies are and what they mean for the solutions you might buy. While we will not make specific recommendations, our simplified overview will help you understand the potential pros and cons of adopting certain technologies as part of your IoT strategy.

## Understanding Connection Types

In IoT, a wide range of sensors, and devices are connected to the internet. There are various technologies that provide that connection. These can be grouped into two categories: **wide area connections**, and **local area connections**.

It is possible to run an IoT deployment by linking all of the sensors via a local area connection, and using a single wide area connection to report back to the internet. In remote or isolated areas or where a single device is located it can make sense to give that individual device a wide area connection.

### Wide Area Connections

A wide area connection (WAN) is a network that transmits data over long distances. A mobile phone network is a good example of a WAN.

All of the technologies in this section can transmit data over distances of several miles or more. Typically, this would be used to exchange data with the landlord via the internet.

While some of these WAN technologies are widespread, many are new, and have not yet reached critical mass. Of the ones that are best known, many are typically owned and managed by tenants, making their use for IoT problematic.

This section covers some of the WAN technologies you could use in an IoT implementation.

#### Resident Broadband connection

**A broadband internet connection consists of a copper or fibre optic connection from a property to the wider internet. A router or modem sits inside the property and controls the flow of data. There are different types of broadband – cable, ADSL, fibre and more. Each individual’s options will vary depending on speed requirements and local availability.**

**Pros:** Ofcom estimates that 80 per cent of UK adults have a broadband connection at home. In a housing context, this means broadband connectivity is widespread, and potentially available for an IoT implementation. Broadband is also a relatively low-cost solution.

**Cons:** 80 per cent availability is good, but not good enough for reliable implementation. The number of people with broadband will rise, but for the time being, there will still be black spots where broadband connectivity is unavailable to housing providers.

Additionally, private broadband connections may not be available for IoT data transmission. The tenant may prefer that their connection is not available, or may have concerns about security and capacity. In some cases, it might be necessary to offer an incentive to the tenant in the form of benefits for keeping the device connected. Buy-in will be required for this to be a long-term option.

A domestic connection is also unlikely to be under the control of the housing provider, unless it is owned, managed and paid for by them. The connection could therefore be terminated, switched off or restricted without warning, making it an impractical option for on-going critical data transmission particularly if service delivery is reliant on it.

#### Lease Line

Like a broadband connection, a lease line provides a physical internet connection to a building. A lease line will usually be a fibre connection with the option of high speeds at low contention. These types of connections are typically used by businesses to connect their offices to the internet. Lease lines in housing are likely to be installed where the housing provider wants to provide an additional service such as WiFi for residents as an alternative to each resident purchasing their own broadband connection or a Video on demand entertainment offer.

**Pros:**

A lease line offers high bandwidth data transmission and typically come with a minimum service level agreement making them an extremely reliable option. As a lease line will be owned by the landlord there will be no issues with obtaining access to use the connection.

**Cons:**

Lease lines are expensive, they are only realistically viable for IoT if their primary use is to deliver other high bandwidth services to the building or its residents. Additional local area network hardware will be required to make the connection between devices in the home and the lease line.

#### Cellular data network

**All mobile phones and smartphones connect to a cellular data network. In the UK, we use the GSM standard.**

**Data can be sent at various speeds, from 2G (slowest) through to 4G (fastest). The next generation, 5G, is due to be launched in 2020.**

**Pros:** GSM is the most viable long-range connection technology due to the abundance of transmitters across the country. In the UK, mobile cellular networks use GSM technology to transmit data, and [coverage is good](http://maps.ofcom.org.uk/mobile-services/) across the majority of populated areas.

Modern 4G data connections cover most of the UK’s cities, and offer speeds comparable with mid-range home broadband. The next generation of GSM connectivity, 5G, will be capable of supporting hundreds of thousands of simultaneous connections, all at speeds in excess of today’s 4G connections.

**Cons:** Modern IoT applications require fast connections, but have a relatively low data throughput requirement. In other words, they need to be able to report small amounts of data very quickly.

Currently, cellular technology provides a very high capacity for data, since it’s designed for transmitting voice communication and downloading large files. The high bandwidth provision may be an unnecessary expense for some types of IoT installations.

While industry estimates state that more than 95 per cent of the country has 3G coverage, some properties are located in areas only covered by slow 2G, which offers one-tenth of the connection speed of 3G.

#### Sigfox

**Sigfox is a long-range cellular network protocol designed especially for data transmission for the Internet of Things. It uses ultra narrow band (UNB) technology to transmit small amounts of data – a system that was initially used in the First World War, yet still drives innovation today.**

**Typical applications for Sigfox include sensors fitted in kitchen appliances such as washing machines to detect leaks, where it is beneficial to understand their state and any repairs or malfunctions. The sensors use very little power, so there is rarely a need to change their batteries.**

**Sigfox is a French company that licenses its technology to Arqiva brand in the UK. It has transmitters in 10 British cities to date.**

**Pros:** Low power, low cost communication technology is essential for the IoT to function, and this is what Sigfox is designed for. Unlike a regular cellular connection, it provides low throughput capacity, which is ideal for the small chunks of data transmitted via IoT sensors.

For example, one message sent via Sigfox is around 12 bytes, which is equivalent to two or three English words. On a single set of AA batteries, it’s estimated that one sensor could run for 20 years. This makes them useful for logging data in areas that may be difficult to reach, such as rubbish chutes, plant rooms full of HVAC equipment, or energy meters.

**Cons:** Sigfox has a range of around 30 to 1,000km with a clear line of sight, but in a worst case scenario, it may only transmit data over a 3-10km distance. This makes Sigfox a potentially troublesome solution for rural environments, or challenging terrain.

Additionally, transmitters are not yet widespread enough to offer full UK coverage, although other European countries are moving ahead more quickly with transmitter installation.

There is also a compatibility issue between Sigfox and other similar technologies, which could hamper scalability in the long term. Placing sensors in awkward locations raises the question of how batteries will be replaced.

Perhaps the biggest concern is the limited transmission capacity. A single Sigfox sensor is only capable of transmitting 140 messages per day, which means that it cannot transmit real time data. It therefore could not transmit an immediate alert in an emergency (for example, if a smoke alarm were activated).

#### LoRa

**LoRa is a low power LAN solution developed by Semtech. It offers two-way communication using a cellular infrastructure, and is optimised for low cost deployment. Sensors are small and draw little power.**

**LoRa has its own LoRaWAN protocol, and it promises battery life up to 10 year per sensor. Each transmitter feeds its data to a gateway device, which then forwards it over the internet to the user.**

**Pros:** LoRa is another viable low power WAN option for IoT, and a good alternative to Sigfox for long range transmission; signals travel up to four miles in perfect conditions. LoRa is designed for battery operated devices, and all transmissions are encrypted using 64-bit and/or 128-bit keys.

Its makers say it is ideal for usage in cities and rural areas, and it is equally suited to gathering data from urban environments as it is to agricultural deployments and smart home use. Unlike Sigfox, LoRa does not require third party fixed transmitters to relay data. This should mean that LoRa could be better for use in housing. For example, a single receiver could be placed on the roof of a block, and that receiver could act as a relay for other sensors in individual homes in the vicinity. This would mean that one internet connection could serve all devices in the block.

LoRa does not rely on ultra narrow band communication, so it can send more data than other solutions. It can transmit that data more frequently, too.

**Cons:** LoRa is essentially a competitor to other low power cellular WAN products, and it’s unlikely that the two technologies would ever be compatible. The onus is on the user to conduct research into both solutions prior to choosing one to invest in.

LoRa is not an open source technology, which could mean it is less flexible, and less attractive for developers wishing to code custom solutions for the hardware. Compared to Sigfox, it is less developed, less proven, and at an earlier stage of development.

#### Satellite

**Satellite WANs have been in use for the last 15 years, and have sustained popularity in remote locations where a wired internet connection is impossible to install. Satellite broadband hardware takes the form of a dish and a router, with the dish requiring a clear line of sight to the southern skies in order to send and receive signals.**

**Pros:** Satellite is the only realistic option for some UK homes in remote areas. This in itself makes it an essential in these cases. It provides a good level of service where there is no other way to get online, with a connection that is fast enough to carry out most tasks.

There is no need to have a telephone line, so while the cost is high, it is normally all-inclusive. Data limits apply, much like mobile phone contracts, and there are cost implications for exceeding them.

**Cons:** There are few housing providers managing rural buildings that would be good candidates for a satellite WAN. Even if satellite were an option, installation is likely to be impractical.

Installation of a satellite broadband connection requires a large, highly visible dish to be mounted on the property. For best results, the router needs to be placed as close to the dish as possible to minimise the amount of copper cable between the dish and the router. Placing a router on the ceiling of the top floor of a building may be impractical. Subsequently, extending that signal throughout the property may require additional hardware and maintenance.

While satellite download speeds are comparable with an ADSL broadband connection, upload speeds are far slower. Additionally, latency is poor, because it takes around one second to bounce from one satellite to the other. This means that satellite broadband does not provide good real time connections. If the weather is poor, the connection may slow down, degrade, or drop out completely.

A satellite broadband connection costs far more than a typical wired connection, with bills ranging into the £1000s per year, per connection.

#### Weightless

**The Weightless Special Interest Group (SIG) owns Weightless, and counts companies such as ARM and Neul as board members. The technology operates in the ‘TV white space’ spectrum; these unused frequencies are sandwiched between bands used for digital TV transmissions.**

**There are currently two variants of Weightless: Weightless-W, launched in 2013, and Weightless-N, launched in 2015. A third is due to be added. All three standards offer the same benefits: low power transmission over long distances.**

**Neul, a part of the Huawei brand, is a “major contributor” to Weightless. It is currently building a test network in Milton Keynes to showcase its own Weightless platform.**

**Pros:** Weightless is an open standard, and SIG hopes that other companies will develop for it to help it gain traction. Neul is one example of a company that is building its own solutions on Weightless, and projects like this could help Weightless gain that all-important critical mass that it needs to be market leader.

For users, open standards mean that the technology is more likely to survive the test of time. If more projects use Weightless in future, the consumer is likely to benefit with more choice and better compatibility between devices.

**Cons:** Weightless is still in its infancy as a technology and standard. Neul has not deployed any transmitters, does not have a completed website, and has not yet shown its Weightless solution Iceni in action. As such, the Weightless protocol is not yet deployable in the UK, although the Milton Keynes trial may advance its position.

Even if the technology is promising, it could be several years before SIG has inspired enough companies to develop the necessary infrastructure. As such, Weightless remains a theoretical option for UK housing providers.

## Local Area Connections

A local area connection (LAN) is a network that transmits data over short distances. Your home WiFi network is a good example of a LAN.

All of the technologies in this section can transmit data ‘locally’ – for example, within the same room, or the same building. Each one requires a WAN connection (for example, a home broadband connection) in order to relay that data to the internet.

This section covers some of the LAN technologies you could use in an IoT implementation.

#### WiFi 802.11

**WiFi technology allows devices to exchange data without cables. WiFi is ubiquitous among hardware providers, and many devices are sold with WiFi hardware on board. WiFi is normally used in conjunction with a broadband, lease line or satellite WAN connection.**

**Pros**: WiFi is a widespread technology, with huge user adoption across all platforms and devices. This massive scale makes it easy and cost-effective to connect devices and transmit data between them, either on a permanent or temporary basis.

The technology is also inexpensive, requiring a compatible wireless router and the aforementioned WAN connection. No license is needed, and all devices use the same 802.11 standard, so reliability is generally good. It offers the potential for high bandwidth transmission between home automation platforms and devices, including dozens of smart thermostats, sensors, and healthcare focused devices.

**Cons:** WiFi requires a fast, ‘always-on’ WAN connection, and the same caveats apply regarding access to tenant WiFi connections as they do to domestic broadband. It is more likely that a WiFi network will need to be installed purely for the implementation of IoT, which adds significant cost. Either that, or tenant buy-in may be required.

In large buildings and communal areas, a shared connection may not work as desired because of the difficulty in transmitting signals through thick walls. The sheer number of WiFi networks, and devices, means that the chance of interference is high.

WiFi usually requires sensors and devices to have a fixed power supply as batteries cannot power these devices for much more than a couple of days. This makes it unsuitable for temporary and remote sensors and adds costs to the installation of devices.

While security is generally adequate on private WiFi networks, public WiFi networks do not provide good security for many applications, and can be the cause of data theft and hacks. It would be inadvisable to run an IoT implementation over any network that offers public access (for example, a guest network in a communal block of flats); instead, a private VLAN would be needed to shield IoT traffic from prying eyes.

#### Wireless M-Bus

**M-Bus, or Meter-Bus, is a wireless protocol designed for gas, water and electricity metering. It can be used for other situations where two-way communication is needed,.**

**One of the main applications for M-Bus is district heat metering, allowing housing providers and utility companies to read individual or bulk meters remotely.**

**District heat metering at an individual property will soon be a UK statutory requirement under the** [**Heat Network (Metering and Billing) Regulations 2014**](http://www.legislation.gov.uk/uksi/2014/3120/pdfs/uksi_20143120_en.pdf)**.**

**Pros:** M-Bus is a European standard. It allows meters to be read remotely using a handheld unit, doing away with the need to enter a property to read the dials. It is also a proven technology, having been deployed in several countries.

**Cons:** The M-Bus system is not capable of creating a network. In order to collect data, the operator must collect it using a handheld device, or download the data over a secondary WAN connection.

#### ZigBee

**ZigBee is an open standard for wireless communication, developed on the principles of Bluetooth. ZigBee has definitions for more than 130 different types of devices across more than 1,000 different products. In fact, ZigBee is specifically designed for complete vendor interoperability, making it potentially useful for home automation purposes.**

**The ZigBee protocol is already in use in set-top boxes, energy management products and lighting systems, all of which can operate as a mesh network in the home.**

**Pros**: Devices using ZigBee have a battery life lasting several years, making the solution ideal for home automation and monitoring. Communications are encrypted, making it less likely that malicious users could intercept them. It can support an unlimited number of sensors in a network, and has a promising ecosystem in place, with household names like Bosch already baking ZigBee support into their appliances.

ZigBee can transmit data over greater distances than Bluetooth; up to 100 metres, in ideal conditions. This makes it ideal for larger properties, where BLE would fail to transmit across the required distance. It also means that ZigBee can reliably link sensors like smart radiator valves to smart thermostats and energy monitoring platforms, particularly if the valves are located a considerable distance away from a router.

ZigBee signals are also more likely to penetrate the thick, concrete walls that are commonplace in some types of social housing.

**Cons**: Compared to Bluetooth, ZigBee is new technology. To compete with its famous competitor, it has a formidable battle ahead in making a name for itself commercially.

In addition, some users claim that device interoperability is patchy, suggesting that there is still work to be done in refining the standard.

#### Bluetooth Low Energy

**The common Bluetooth standard requires a lot of power – something that IoT devices cannot provide. Bluetooth Low Energy, or BLE, is the Bluetooth Consortium’s answer to the problem. It’s a trimmed down version of Bluetooth, originally named Wibree, and is now marketed under the Bluetooth Smart brand, in reference to its deployment in smart devices.**

**BLE is already in use in home sensor products, such as the Blue Maestro Tempo environmental sensor. It’s backwards compatible with Bluetooth 4.0, making it an interesting option for compatibility with modern smart phones and tablets.**

**Pros:** BLE is based on the recognisable Bluetooth brand. It’s already being used in household appliances, and it is highly resistant to interference from other devices.

BLE and Bluetooth 4.0 devices can talk to each other, meaning that BLE has the ability to connect with existing hardware. Interestingly, this means it can interact with residents’ own personal devices, making it more likely to achieve buy-in from them. A fitness wristband worn by a tenant, linked to a smartphone, can then integrate with personal health platforms and apps as part of a comprehensive Bluetooth ecosystem.

**Cons:** While users claim better range than Bluetooth, BLE still operates across very small distances – a few metres at most. This can cause the connections to be unreliable and prone to failure. While non-critical applications are unlikely to suffer, anything that needs constant connectivity – such as a smoke alarm – would not be a good candidate for BLE.

Additionally, BLE has a capacity limit, meaning that very large deployments will eventually run out of space for new devices. While mesh compatibility is promised, it is not yet implemented in the current BLE standard.

#### Z-Wave

**Z-Wave is a product of the Z-Wave Alliance and promises compatibility with around 1,000 devices. It offers home automation functionality, with sensors able to transmit data over approximately 100 metres in a mesh formation. Overall, Z-Wave functions in a similar way to ZigBee, and it has gained ground in the US thanks to its use in security systems.**

**Pros:** Z-Wave solutions are quick and efficient to deploy. For example, a housing provider can purchase replacement light switches with Z-Wave technology built in, giving them a seamless and uncomplicated route to a smarter home.

Z-Wave sensors are ideal when transmitting through thick concrete walls in some types of accommodation, making the protocol useful in buildings where WiFi would not be reliable. Users report robust performance and an easy upgrade from non-smart devices, with most devices requiring only simple installation.

Z-Wave can be used in smart TRV valves for heating control and energy monitoring, as well as home security and environmental monitoring devices. Its makers claim that a sensor will run for a year on one battery.

Finally, it’s worth noting the mesh network. The more sensors you add, the better the coverage, making Z-Wave great for large buildings where sensors could potentially be spaced wide apart.

**Cons:** Z-Wave is sensitive to the location of neighbouring devices, due to its mesh formation. If one device moves, the network may be interrupted. As such, it is not ideal for changing environments, such as portable devices, or items that are moved around the home.

A Z-Wave network is limited to a maximum of 232 devices. Depending on property size, housing providers may find that they hit the limit quite quickly.

#### Thread

**Thread is developed by The Thread Group, a consortium that includes Google, Samsung and ARM. This high profile group aim to create an industry standard for wireless IoT connectivity.**

**Thread is built on the IPv6 system, so each device receives its own IP address, much like the rest of the internet.**

**Pros:** In the battle to define a standard, the backing of a company like Google is not to be ignored.

In terms of its technology, Thread claims to offer a self-healing network, ensuring all devices work even if one part of the mesh network fails. The encryption is marketed as ‘banking class’, making it theoretically impenetrable to hackers.

**Cons:** Thread networks are limited to 250 devices on each network, which may make deployment in large housing complexes impractical.

While IPv6 is currently Thread’s main selling point, other protocols are likely to integrate IP-based addressing in future revisions, making it less of a distinction. The developers behind BLE say they’re already working on IPv6, for example. IP systems also offer a disadvantage in terms of power consumption, in that they need to ‘check in’ occasionally to ensure they’re still part of the same network. For critical systems, any failure in an IP-based system could be catastrophic.

### Conclusion

Connectivity technology for IoT is changing and developing rapidly as can be seen in the number of new and emerging technologies featured in this guide. As these new technologies gain traction there is some risk that existing technologies could become redundant.

Due to this lack of a fixed set of protocols, housing providers should be cautious when procuring solutions. However the development of hubs that support multiple protocols and new software platforms that allow sensors to talk back using a variety of communication channels will aid interoperability and backward compatibility.

Right now, housing providers should seek solutions which cater for the specific requirements that their IoT installation requires. This will take into account required battery life, location of the sensor etc. For early adopters, cellular and fixed broadband connections are likely to be most viable, providing they are available at the location. Absorbing the additional costs of these types of connections at this point may be necessary to demonstrate the future value IoT solutions offer to housing businesses.

As IoT technology enters mainstream, we should see a more defined set of protocols with many of the newer technologies maturing and offering new viable connectivity options that are currently not implementable at scale.