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FUTURE COMMUNICATIONS

Insight Service
DIGITAL TELECARE
Scottish Local Government

Current digital telecare architecture has several elements that have the potential to evolve as new communications technologies mature, roll out, and become integrated into digital telecare products. There are two different types of connectivity in a telecare system: short range in property network, and the wide area network connection between the home hub and ARC or other service provider.

This Insight Service is predominantly focused on the alarm trigger in home hub systems that are approved for BSI standard alarm-based systems. However, there is a growing commercial tier of hubless pendent alarms, non-critical alarm systems and non-voice sensor-based monitoring systems that are available commercially. Some of these solutions have a BSI standard or will achieve one in the coming years: these may change the commercial landscape and could usher in more products, systems, and connectivity into the digital telecare market. Any system deployed for social alarm functionality should ensure that the vendor or developer has a device that is approved to recognised standards. It should be noted that there is also significant growth in devices that provide similar functionality to BSI standards-based systems but are focused on non-critical alert systems, e.g. contacting a carer or family member rather than the ARC based alarm model.

CURRENT GENERATION TELECARE

The options for connectivity are restricted by what is available in the current generation of digital telecare hubs. Most current generation telecare boxes available on market have an external antenna connector enabling different types of antenna - internal or external to the property – to be connected to boost the signal and enable a more reliable connection. In the present generation of digital telecare devices, voice communications can be carried either though an IP network such as Voice over Internet Protocol (VOIP) or through a separate cellular voice network. The choice of connectivity options is limited to what is supported in the hardware. The current generation of telecare only supports 2G and 3G cellular connectivity and some telecare hubs have an ethernet port to allow wired access to a broadband router.

WIDE AREA CONNECTIVITY OPTIONS

The following table contains Wide Area Connectivity options. It should be noted that not all applications detailed are currently available with current generation telecare hardware.

Communication Type	Range	Peak power consumption	Bandwidth	Can carry voice	Telecare uses/applications
LoRaWAN	Up to 5km urban +10km Rural	Low	Very low (<11 kbits/s)	No	Hub less battery powered sensors in property (door sensors, PIR, indoor environment), people tracking wearable, secondary comms link (WAN fallover)
Sigfox	Up to 5km urban +10km Rural	Low	Very low (<1 kbits/s)	No	Hub less sensors in property (door sensors, PIR, indoor environment), people tracking wearable
NB-IoT	Up to 5km urban +10km Rural	Medium	Low (250kbits/s)	No	Hub less sensors in property (door sensors, PIR, indoor environment), people tracking wearable
LTE Cat-M	Up to 5km urban +10km Rural	High	Low (375 kbits/s)	Yes	Voice enabled wearables, people tracking, hub backhaul, hubless sensors, VoLTE
Cellular (3/4/5G)	<10km	High	High (<1Gbit/s)	Yes	Telecare hub backhaul, hubless alarm devices, VOIP, Cellular broadband backhaul
Broadband	Requires connection to property	Mains powered with battery back up unit (BBU)	High	Yes	Telecare hub backhaul, VOIP
Satellite	N/A	Mains powered with battery back up unit (BBU)	High	Yes	Telecare hub backhaul, VOIP

Broadband
Out of all of the communications options from telecare hub to ARC, broadband is the only one that offers the option of a wired/fibre connection. This is commonly referred to as fixed line broadband. There are also cellular or satellite broadband options that potentially offer flexible communication options. These are covered in more detail in later sections (cellular and satellite) whereas this section specifically focuses on fixed line broadband.

The Scottish Government's £579M Reaching 100% (R100) Programme is a commitment to provide access to superfast broadband of at least 30 Megabits (Mbps) per second to every home and business in Scotland. The programme is focused on delivering fibre connections to properties with no or poor connectivity. R100 will also benefit cellular technologies as it will enable high bandwidth connections to cellular masts in remote sites.
A broadband connection can be used with multiple current telecare solutions to send telecare data and also carry voice connection. The current generation of telecare uses Voice Over Internet Protocol (VOIP). There are multiple different vendors of domestic broadband services. Furthermore, there is an increasing number of initiatives from Local Authorities, the Scottish Government and Housing Associations to provide a broadband connection to previously digitally unconnected residents with the view to provide more digital services.

The Scottish Government has recently introduced a scheme for properties that do not have access to superfast broadband through current commercial options. Vouchers of up to £5K are available for investing in infrastructure and other technologies to secure better connectivity, and a number of connectivity solutions are available from an approved vendors list. This scheme is due to run until 2025.

Voice Over IP (VOIP)
Traditionally, most landline services are delivered to people over the Public Switched Telephone Network (PSTN), using copper. With a reduction of technical knowledge on copper-dependent systems and the unavailability of spare parts, companies are already preparing to move to an all IP world where telephone services will be delivered over a broadband connection, often referred to as Voice over IP (VoIP). As detailed by Ofcom, these providers must have a solution that can enable VoIP battery backup unit (BBU) in the event of a power failure. Ofcom has an ongoing programme of work to address the regulatory and operational implementations of VOIP. VOIP requires a bandwidth of 85 - 100 Kbps per concurrent VoIP call, which means it can be carried over a number of wireless standards and even low bandwidth broadband connections.

Wireless Communications
Connectivity and networking describe the (often) wireless technology used to transfer information from the sensors/telecare hub to an alarm receiving centre. To connect and talk to each other, telecare devices need some form of connectivity. There is a wide range of wireless technologies that enable this connectivity, each with their own strengths and weaknesses. Choosing the right communications technology will ensure the telecare application runs smoothly, at the lowest cost, and with the best power efficiency. The standards that are included in the current hardware will limit the options available for connectivity. Criteria for wireless technology choice include:

- Range;
- Power requirements;
- Data rate;
- Communication module cost;
- Connectivity cost;
- One/two-way data transfer;
- Compatibility;
- Ecosystem requirements.

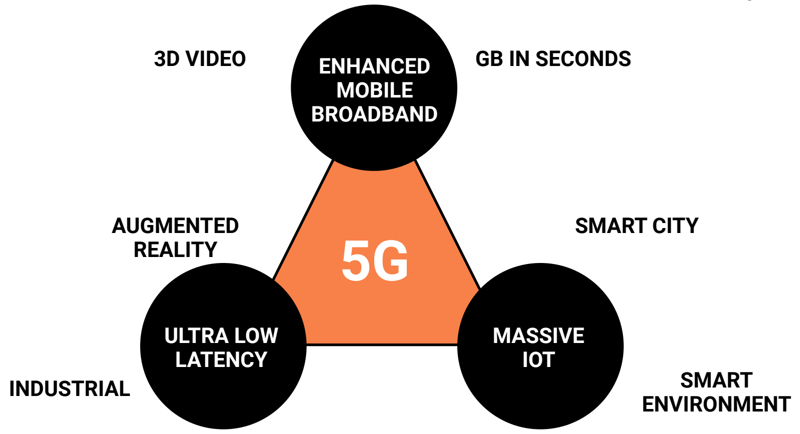
Cellular
Other than fibre or fixed-line broadband, cellular connectivity remains the only other option for providing the geographical footprint needed for digital telecare services. Cellular networks have been in development for decades and are continually evolving. The increased use of smartphones and data driven services in the last decade have seen networks stretched to their limits in urban areas, initially on 3G then 4G. With early deployments of 5G underway across the globe and with 5G evolutions on the horizon, we will see the network operator investments over the years flourish with the adoption of cutting-edge applications that were never possible on legacy networks (2/3/4G).

5G
5G can mean different things to different people and the technology is not as straightforward as 4G in terms features and capabilities. 5G standardisation was mainly driven by underpinning use cases other than mobile broadband, figure 3. The current picture shows that mobile broadband remains the main commercial driver for network operators. This is likely to continue for some time, so significant amounts of effort is being focused on improving the capacity and spectral efficiency to accommodate the ever increasing number of users along with their need to consume more data at higher speeds. As it applies to telecare, in the longer term, 5G could potentially enable better rural connectivity and has the flexibility for community groups to setup their own networks if no coverage is provided by network operators.

This statement from Qualcomm sums up 5G very well – *"5G is the 5th generation mobile network. It is a new global wireless standard after 1G, 2G, 3G, and 4G networks. 5G enables a new kind of network that is designed to connect virtually everyone and everything together including machines, objects, and devices. 5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra- low latency, more reliability, massive network capacity, increased availability, and a more uniform user experience to more users. Higher performance and improved efficiency empower new user experiences and connects new industries."*

Legacy Networks

Figure 3



When we talk about legacy cellular networks, we refer to existing 2G, 3G and 4G networks. The UK's mobile network operators have spent decades deploying, upgrading and supporting these networks that have served UK citizens and industries well over the years. They remain the primary method for communication when outside the home or workplace. Where you use these services will impact your perception of how well these networks perform. For instance, users in remote areas may have the poorest experience due to lack of infrastructure and investment from mobile network operators. Whereas, urban dweller are more likely to enjoy their mobile experience due to the enhanced capacity the deployed infrastructure can provide. This 'in-to-out' deployment strategy of the mobile network operators is unlikely to change when it comes to 5G. However, we are likely to see a significant boost to the UK's rural connectivity with 4G due to the UK Government's efforts to bring together the UK mobile network operators by part funding the expansion of the 4G footprint to cover 95% land mass by 2025. This will complement the Scottish Government's 4G infill programme where a number of sites across remote locations have been funded to bolster connectivity in communities plagued by poor 4G and 3G mobile coverage. It is expected that these programmes will bring 4G to 91% of land mass in Scotland by 2025.

Some UK mobile network operators have already indicated they will retire their 3G and/or 2G networks in the coming years. With 4G carrying up to 85% of the UK's data as of 2018, it makes little business sense to maintain them much longer especially with large scale 5G deployments on the horizon. We could potentially see 3G being switched off in the next 3-5 years with 2G following anywhere between 2025 and early 2030. This would leave 4G as the main fallback for connectivity across the whole country and could theoretically serve the majority of cellular based IoT devices with the inclusion of NB-IoT and Cat-M1 within the 4G infrastructure.

Due to the future geographic reach of 4G and long-term roadmap, it is expected that most telecare vendors in future will supply hardware with 4G connectivity.

Satellite

Satellite connectivity remains in most cases a last resort for providing connectivity to areas where there is no suitable fixed line broadband and no mobile broadband coverage. As of January 2020, it is estimated that 7% of premises in Scotland are unable to access superfast broadband coverage from a fixed network, of which 3% are unable to access broadband services. Like mobile networks, capacity is shared between premises served by the same spot beam. Until recently, most of these services are provided by carriers using geostationary satellites with broadband download rates of up to 30 Mbit/s. Latency of these networks is the main technical issue - much higher than broadband services, due to the round-trip time for data packets to travel between the earth and the geostationary orbit at approximately 36,000km above earth. However, recent developments in satellite technology have seen a renewed interest in Low Earth Orbit (LEO) satellite constellations. With these satellites being deployed at an orbit much closer to the earth means they can provide lower latency services. The major trade off for this type of system is the number of satellites required to ensure a continuous connection is much greater when compared to traditional systems. The types of services offered may partly depend on the final cost of satellite receivers for LEO constellations which maybe more expensive than traditional connectivity method. Nevertheless, they could still be less expensive than the total costs of installing a fixed or wireless connection in hard-to reach rural premises.

LPWAN

Low Power Wide Area Networks (LPWANs) are a newer class of connectivity designed specifically to meet the needs of the Internet of Things (IoT) and battery-operated sensor applications. Commonly used LPWAN standards are the unlicensed LoRaWAN and Sigfox and the emerging cellular standards NB-IoT and CAT-M.

This communication standard is a potential hybrid as hubless devices are emerging that communicate from a device to a Wider Area Network without the need of a telecare hub in the property. This could lead to the emergence of a new form of telecare device in wearable form factors. They all have three main technological attributes:

- **Long range**: The operating range of LPWAN technology varies from a few kilometres in urban areas, to over 10km in rural settings. It can also enable effective data communication in previously infeasible indoor and underground locations;
- **Low power**: The communication protocol is optimised for power consumption, meaning LPWAN transceivers have the potential to run on batteries for 5+ years;
- **Low bandwidth**: Typical data rates are very low, within the ranges of 100 bits/s to 350 Kbit/s. The only real constraint for developers with LPWANs is the low bandwidth, although this trade-off allows battery operated devices a long-life, while maintaining long range communication .These two features are essential to realise most IoT and remote sensing applications. For the majority of sensing applications, large amounts of bandwidth are unnecessary as only small amounts of data are generated by the sensors.

Cellular LPWAN

NB-IoT and CAT-M are the standards used by cellular operators to target Internet of Things (IoT) markets and will form the key part of the 5G IoT offering from cellular providers. They differ from cellular in that they have better power efficiency and a lighter protocol suitable for IoT applications. These are still relatively new networks which are currently rolling out worldwide.

NB-IoT

NB-IoT is the lower bandwidth cellular LPWAN IoT standard. It is designed for fixed device location use for low power battery device operation. It has higher bandwidth than LoRaWAN and Sigfox however this comes with higher power consumption for transmitting and receiving. Furthermore, it has better signal strength than standard cellular networks which will enable better signal strength in buildings and better geographic coverage.

CAT-M

Cat-M1 has higher data bandwidth than the other LPWAN standards. The increased bandwidth also comes with the trade-off of the highest power consumption of the LPWAN technologies. The higher bandwidth means that Cat-M can carry a voice connection (VoLTE) which opens up multiple different use cases that are not currently achievable with other LPWAN standards. It is expected that this technology will be integrated into wearables and health and telecare applications. The Cat-M standard also supports roaming between cells by using the same protocol as the current cellular networks.

Unlicensed LPWAN- LoRaWAN

LoRaWAN is designed with the aim of achieving long battery life whilst being capable of communicating over long distances. Typical use cases are for sensors in the home, wearables, and asset tracking. It is also being used as a resilient backup communication option where cellular is the primary communication method. In the event of cellular failure, signals can be sent through LoRaWAN to send alert or status updates which increases service reliability. The LoRa gateway is responsible for passing messages from connected devices to the internet. It is an open, licence-free technology which means anyone can buy a gateway and setup a network to talk to devices. There are also network operators deploying LoRa networks where the deployment is managed by the operator and users charged on a monthly basis for connection.

Sigfox

Sigfox was the first LPWAN network to achieve significant network coverage with large amounts of the UK and Europe covered by the network. The infrastructure is owned and managed by Sigfox therefore any new deployment needs to be deployed by and managed through the Sigfox infrastructure. It is similar to LoRaWAN in types of application that can be used on network.

CONCLUSION

The move to digital telecare systems will bring many more future options for connectivity as products and services evolve. These different options will have advantages for deployments in different connectivity scenarios such as area with poor mobile connectivity, they will also enable different types of telecare services. It is important when looking at new communications pathways to ensure that the communications pathway has been approved for use with the specific telecare hardware and that it is compliant with the BSI standards.

This Insight Service has been delivered by CENSIS.

If you have any questions relating to this Insight Service or the wider digital telecare work, please get in touch with the Digital Telecare for Scottish Local Government Team.

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