Lifetime Digital Homes – New Homes

Output of the DAP HealthHub project
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F A S T

Purpose and aims

To support the installation of integrated assisted living data, power and telecommunication infrastructure platforms in homes.

Audience: commissioners and designers of new homes, particularly within the social housing sector as they are likely to be early adopters. Those interested in installation practice.

Aims to:

- Establish scope of functionality beyond data network to encompass a level of building management/ control of devices
- Establish performance criteria
- Support decision making about current options
- Highlight reference documents and good practice

Purpose and aims – policy and practice

This options review and guidance document is an initial step towards sector consensus on the development of a standards approach.

- The is currently low awareness by commissioners of the need for and benefits of establishing effective practice in the in-home data, power and communications element of the integrated end-to-end system.
- Existing practice for telecare installations has been to retrofit at point of need, at relatively high cost.
- The approach builds on well-adopted practice in use of the Lifetime Homes guidance (although this took 30 years to achieve!)
- Limited resources of participating authors.
- This approach was considered to be the best approach to cascading information and effecting change in practice.

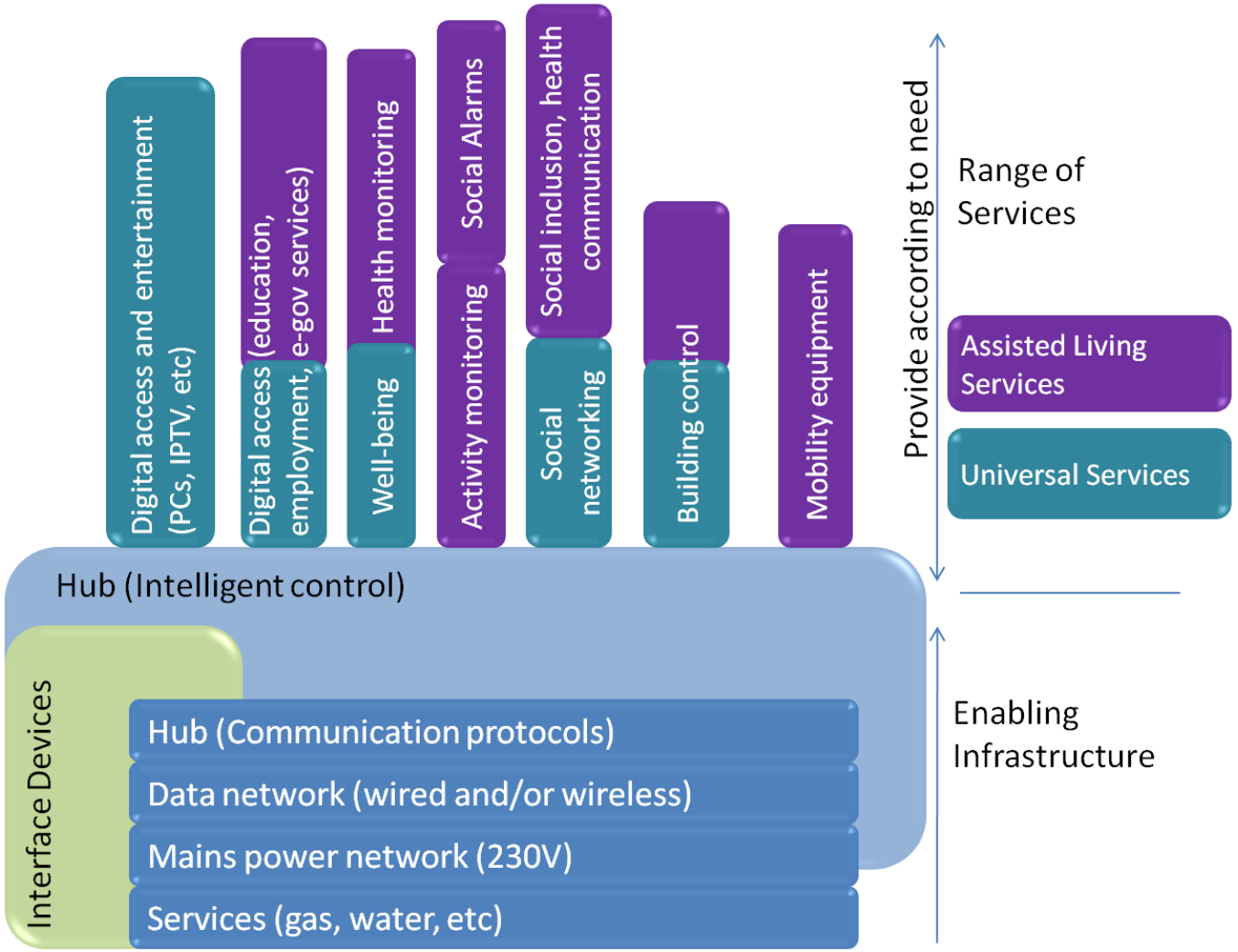
Functionality of infrastructure

People require two key functions in relation to assisted living:

- The flow of data in, out and around the home
  (activity monitoring, health information, phone calls, IPTV, etc)
- Building control
  a) to control devices which are normally connected to mains power, such as lights, thermostats and electrical appliances,
  b) to control objects that are not normally connected to mains power, such as doors, mobility equipment, windows and curtains;
  c) to control devices that use services such as gas and water, such as ovens, radiators and baths.

How much control should be enabled by installing an integrated infrastructure in new build homes is the subject of the paper.

Universal and Assisted Living services



Infrastructure considerations:

- Communications protocols enabled by the infrastructure
- The hub or gateway element:
  - Use as a communications hub
  - Use as an intelligent hub to control the home/ home services
- The interface between data, power and services networks

It is expected that, in practice, a mix of different types of devices may be required (wired, wireless) and that a mix of different data connection topologies and protocols may be employed.

Some data infrastructure options

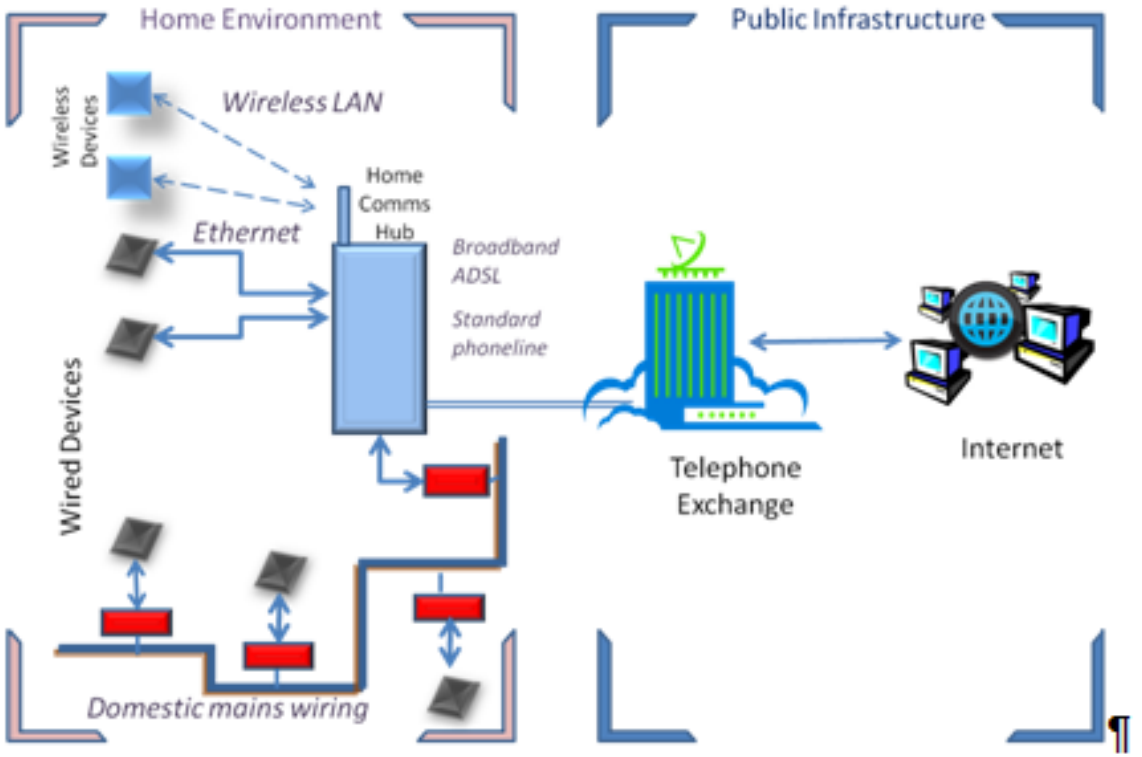


Figure 4 As an alternative to wired Ethernet cable, power line communications may be used

Options to be considered for hard wired home infrastructure include Ethernet cabling and the use of power line with adapters (red) which allow Ethernet devices to be networked back to the hub using the existing mains cabling. See section 5.4

Communication protocols

- Communication transport standards fall into three geographies: body or personal area networks, networks in the home, and wide area networks, although they can overlap significantly.
- These networks can be wired or wireless, broadband or narrowband, analogue or digital.
- There will be no single “Next Generation” network and related infrastructure; we can expect multiple standards and wireless frequencies and a world of digital heterogeneous IP networks.
- Telecare (social alarms) equipment in the UK (must conform to BS 8521) use a wireless communication protocol that is non-interoperable with other PAN and WLAN systems. For the immediate future, for most emerging telecare alarm systems a proprietary hub for telecare services is required, additional to mainstream communication and entertainment hubs.

The hub or gateway element of infrastructure

There are two aspects of the “hub” that need to be considered:

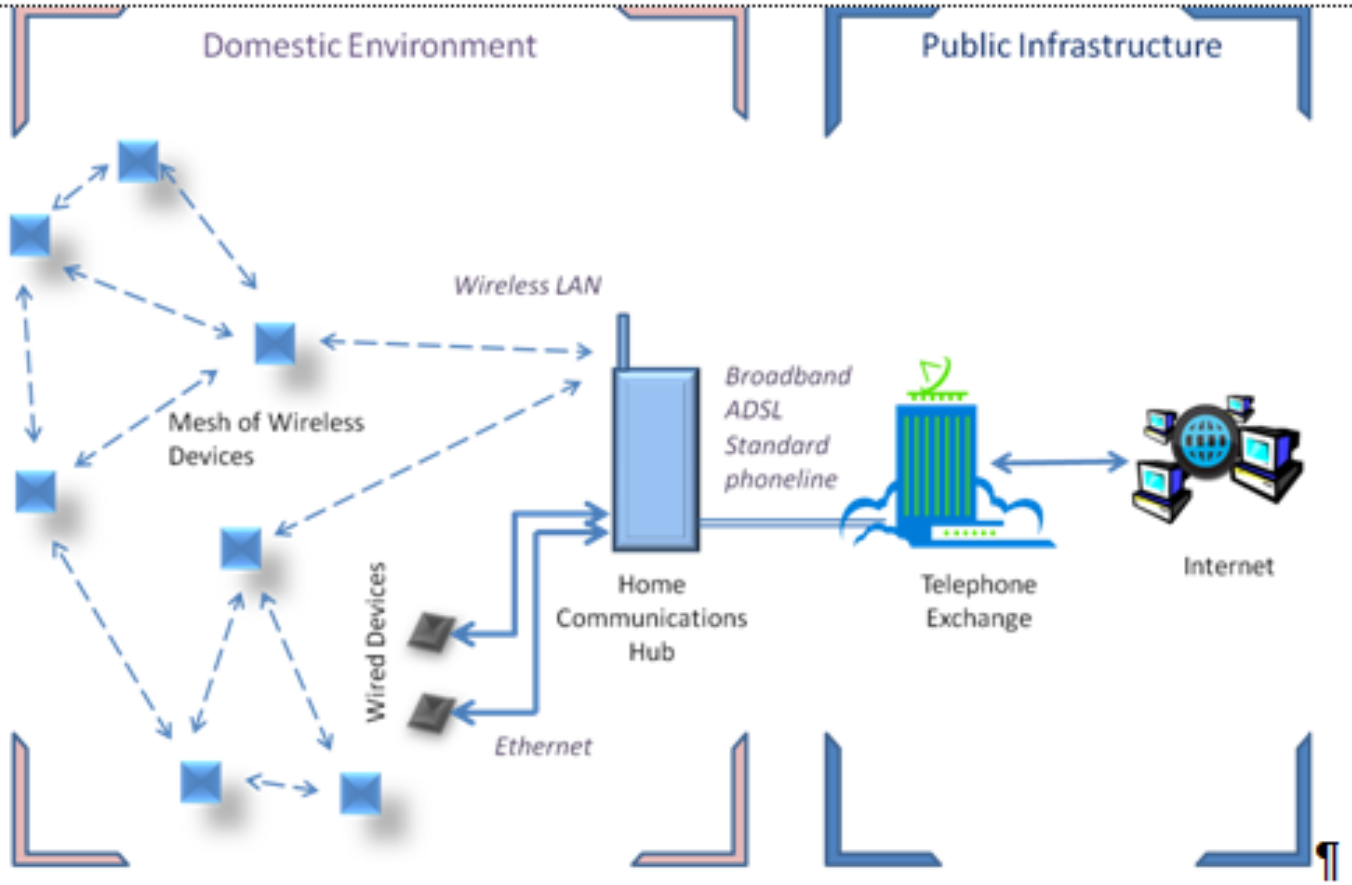
- **Communications hub:** The most basic function for a hub is connectivity to the external world, acting as an interface between external and internal communications protocols.
- **Intelligent hub:** In order to function as an intelligent system, a home data network solution may need an intelligent hub which could be a set-top box, digital radio, proprietary server, PC, internet gateway or a mobile device. The intelligent hub may be required to carry out the following functions:
  - device management (alerts when devices are not working) and remote device and system fault diagnosis;
  - intelligent analysis of data;
  - data storage and data transmission management;
  - integration with mainstream devices such as intercom, phone, TV, etc.;
  - reception and display of information from outside the home;
  - remote control and programming of devices and services within the home.

The hub or gateway element of infrastructure

An alternative to an intelligent hub is a **distributed intelligence** approach.

- Each device (switch, control, actuator, sensor, etc.) is connected in a network and each device has its own address on this network, and may be addressed by any other device.
- Such systems include Zigbee and KNX.
- Setting up such a system requires the act of associating devices together to perform the required function.
- A distributed intelligence approach may be combined with a central intelligent hub in a hybrid system.
- Zigbee is the most well-known example of a protocol that supports mesh networking. A mesh is simply a collection of wireless access points (“nodes”) that can relay messages between each other, thereby extending the network beyond the range of a single access point.

The hub or gateway element of infrastructure



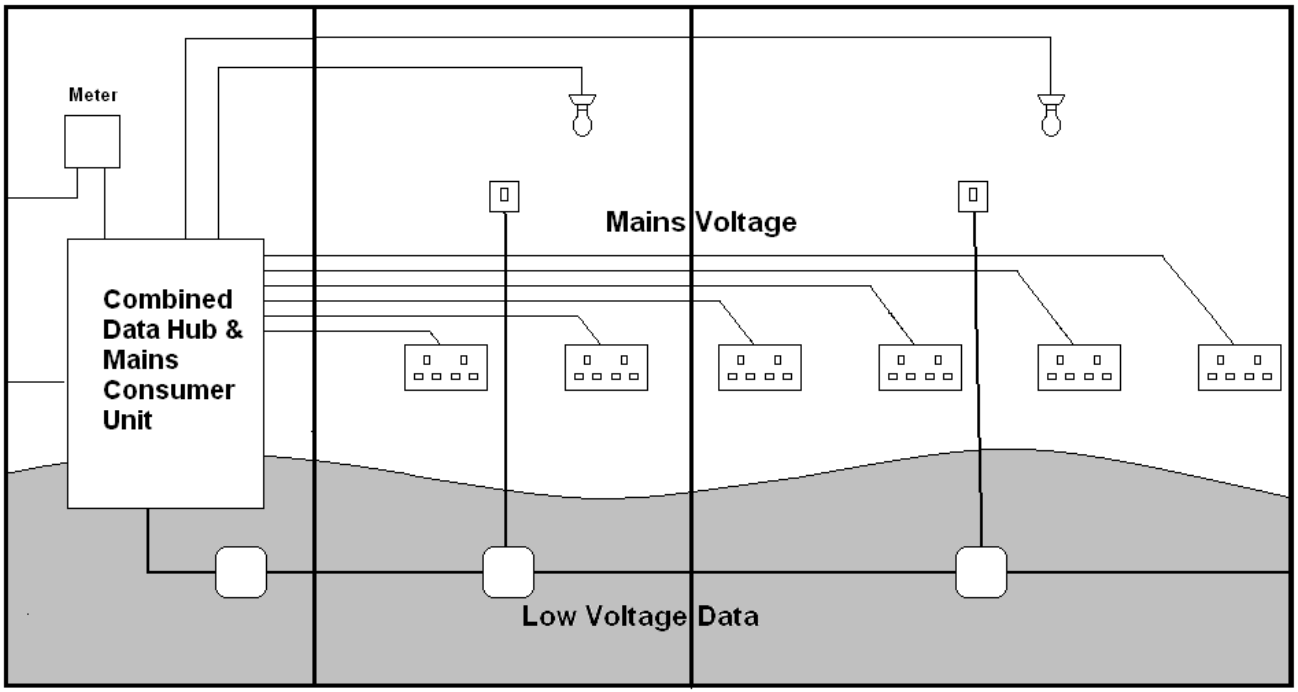
Figure·5·Example·of·a·home·wireless·mesh¶

In·larger·houses·a·mesh·network·can·help·to·extend·the·range·and·robustness·of·a·wireless·installation.·The·mesh·may·be·fixed·or·dynamic·and·self-healing·so·that·changes·and·faults·are·automatically·accommodated.¶

Interface between data, power and services networks

- In order to achieve building control at levels (a) to (c), it is necessary to consider the interface between data networks, power networks and the gas and water systems and devices.
- The data messages must impact on the mains power system that then effects a change, through operating a switch or valve, on the gas and water flow. There cannot however be a direct interaction between low voltage hard wired data infrastructure and devices and the mains powered devices and circuits.
- An interface between data and power networks can be in the form of discrete items plugged or wired into the mains circuits.
- Given the potentially considerable data management requirement, it may be decided that a comprehensive data and power network is worth installing with these needs in mind.

Illustrations of interface between power and services, e.g.



The key point is that there cannot be a direct interaction between mains powered devices and circuits and low voltage hard wired data infrastructure and devices.

Performance criteria (for assessment of infrastructure options)

Key Criteria	Performance aspects
Effective anywhere	•Must work in any home •Work at any place in the home
Interference-proof	•Be immune from interference from other signals •Co-exist with other networks and devices, support interworking, ideally also support inter-operability[1]
Secure	•Be secure from unauthorised acquiring of information or control of home services functionality •Ensure the system does not create disproportionate barriers to installation and use •Based on standardised existing protocols
Resilient	•Provide and maintain an acceptable level of service in the face of various faults and challenges to normal operation (a fall-back approach). •Take account of foreseeable impacts from residents, contractors and other individuals (including common approaches to DIY, wear and tear impact, potential for unlawful removal of infrastructure elements, etc)

Performance criteria

Key Criteria	Performance aspects
High capacity	•Enable the broadest range of services including those requiring high band-width communication
Adaptable	•Capable of easily altering functionality if an individual's needs change, in response to the differing needs within a household and between one tenant and the next. •Upgradeable so that additional features can be added without obsolescence of the installation and capable of adding functionality.
User-centred	•Support the status of the resident owner of the home, who is the first in the hierarchy of access and control management [2] •Minimise the need for users of the system to learn new behaviours or skills •Support non-specialist programming, set up and familiarisation
Cost-effective	•Minimise the cost of installation, maintenance, operation and altering functionality •Minimise power consumption requirements and the use of batteries. •Minimise the requirement for specialist practitioner support and the requirement for training of staff.

Options review against the performance criteria

- Analogue phone line and analogue-digital hybrid networks:
  - these networks do not offer sufficient benefits in terms of resilience to outweigh the lack of capability (breadth of services that can be enabled) now that external communications networks are moving from analogue to IP based and the overall resilience of end-to-end communications is in any case compromised.
- Wireless networks (PAN and WLAN):
  - provide a solution that does not limit normal living, that can be low-cost to install, and flexible enough to easily adapt the system to changing circumstances. An in-home communication network that depended solely on a wireless network has a significant risk of connectivity failure however once installed and tested, the risk of problems arising later is reduced.

Options review against the performance criteria

- Wide Area Network (WAN) mobile communications:
  - the benefits of mobile communications devices for real-time, anywhere transmission of data are considerable. This has to be balanced against problems with reliability of transmission of data.
- Wired mains power line communication (PLC):
  - Transmitting data through the mains power line circuit within the home can provide a low cost data network. There are disadvantages in terms of integration between home ring circuits, with interference on the line, with vulnerability to DIY faults and potential health and safety risks related to working with high voltage power line.

Options review against the performance criteria

Wired data cabling: single and multiple point provision per room

- Fixed wire data (Cat) 5, 6 and 7 and fibre optic) cabling to a single point per room, supplemented with wireless access points and devices, is likely to be a cost-effective solution providing resilience to a system that is lacking from a network that would depend on wireless alone or one dependent on power line for the data network. Additional costs at point of build are minimal. There are running costs associated with replacing batteries for wireless devices.
- Fixed wire data cabling to multiple points per room, plus mains power wiring where required, is a more expensive installation option which provides greater building control and resilience within the system. Greater control and adaption of the building will incur some costs but these are low compared to retro-fitting integrated systems at a later stage.

Options review against the performance criteria

- Building control and home automation protocols
  - Though building control systems such as KNX potentially offers many benefits to people needing the full range of assisted living services, the cost of installing the system and the likelihood of not gaining maximum benefit from the system due to lack of suitably skilled installers and programmers, may make this inappropriate for general-purpose low density social housing.
  - If a building is already equipped with hard wired data cabling such as Cat 6/7 or fibre optic then the installation of a building management system such as KNX is likely to be far less costly than installing it in a home that does not have the necessary data wiring infrastructure.

Options appraisal

			Performance Criteria							
		See section	Anywhere	Interference-proof	Secure	Resilient	Capable	Adaptable	User-centred	Cost-effective
Technology	Telephony/ analogue	5.1	A	G	G	G	R	R	G	G
	Wireless networks	5.2	R	R	R	A	G	G	G	G
	Mobile networks	5.3	A	A	A	A	A	G	A	G
	Mains power line	5.4	A	A	A	A	A	G	G	G
	Data cable, single point per room with wireless devices	4.5.1 3.3.7.	G	G	G	G	A	G	G	G
	Data and power cable, multiple point per room	4.5.2	G	G	G	G	G	G	G	A
	Data and power cable with BMS control system	5.6	G	G	G	G	G	G	A	R

Next steps

1. Dissemination on the FAST website
2. Funding is being sought to work with:

- Sector experts
- Sector professional bodies, 3rd sector, government departments, etc

To secure:

- Testing, validation/ amendment and endorsement by the sector
- Agreement for joint development with partners to incorporate changing practice
- The progression of workforce development for installers and programmers

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