Department for Culture Media & Sport

Emerging Findings from the BDUK Market Test Pilots

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1. Foreword

By the Minister of State for Culture and the Digital Economy

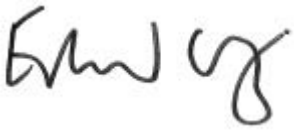
A global revolution is taking place in technology. The World Economic Forum met in Davos in January to discuss the 'Fourth Industrial Revolution' – the new technologies now being developed which will dramatically alter the way individuals, businesses and governments interact in the years to come.

We do not yet know what the impacts of this transformation will be, but one thing is certain: a high speed, high quality communications network will be essential to enable the UK to maximise the benefits of these changes.

In 2013, we started the implementation of a radical programme of investment to make sure everyone in the UK had access to basic broadband, and to take superfast broadband to first 90% of the country this year, and then to 95% of the UK by the end of 2017.

I believe everyone should to be able to share in the modern digital age. The Market Test Pilot programme, launched by then Secretary of State Maria Miller back in 2014, is clearly demonstrating how superfast broadband infrastructure can be delivered to some of the hardest to reach areas of the UK. These Pilots have allowed smaller suppliers to showcase innovative ways of working in these sparsely populated locations. They have developed new partnerships, engaged communities and broken down barriers.

By sharing these emerging findings from the Market Test Pilot programme we're demonstrating that the benefits of superfast broadband can be brought to even more people by different providers with innovative and cost-effective solutions. We hope that these findings continue to strengthen the supplier market in rural areas and increase consumer confidence in the range of solutions available. In this way the UK will continue to lead the way on the digital economy.



The Hon Ed Vaizey MP
Minister of State for Culture and the Digital Economy

2. Executive Summary

By the Chief Executive Officer, Broadband Delivery UK

Broadband Delivery UK (BDUK) is responsible for delivering the Superfast Broadband Programme. This is on track to provide 95% of homes and businesses in the UK with access to superfast broadband[1] by 2017. And thanks to the additional investment available from the contractual gainsharing arrangements, BDUK expects to be able to extend coverage to a further 1% of the UK by 2020. In addition, key suppliers (BT Openreach and Virgin Media) have announced significant new investment in commercial rollout.

BDUK also recognised the need to look for ways to meet the demand for superfast broadband services in the hardest to reach and least commercially viable parts of the UK. It therefore commissioned seven Market Test Pilots to run from June 2014 till March 2016 with a budget of £8 million. The Pilots were set up to look at different ways to deliver superfast broadband in some of the UK's most sparsely populated rural areas, to test alternative technologies and commercial and operational models, and to better understand the capabilities of alternative suppliers to BT Openreach and Virgin Media.

The seven Pilot projects include Avanti and Satellite Internet, who are using superfast-capable satellite; Airwave, Quickline and AB Internet, who are using fixed wireless; and Call Flow and Cybermoor, who are using a mix of fibre and fixed wireless technologies. The Pilots have now been running for over a year and are successfully providing good quality superfast broadband services to some of our more remote households across the UK.

BDUK and the Pilot suppliers have systematically evaluated progress at every stage of the project, generating new information about how to design and deliver the infrastructure to support superfast broadband services in these areas. We have also been asking the customers for their views. On the basis of this information, the Pilots have shown that:

- *Non-fibre based technology suppliers can deliver reliable, superfast-capable broadband speeds and a quality of broadband service that satisfies the vast majority of customers.*
  - All of the technologies being used, including satellite and fixed wireless, have demonstrated that they are capable of providing superfast speeds.
  - Initial feedback from customers revealed that most were positive about their new broadband service. The satisfaction rating was consistently high across fibre, fixed wireless and satellite technologies.
- *Suppliers can successfully mix technologies to deliver cost-effective superfast broadband solutions in hard to reach areas*
  - Call Flow and Cybermoor have mixed fibre (FTTP[2] and FTTC[3]) and fixed wireless technologies to achieve very high coverage of hard to reach areas at relatively low public subsidy per premises.

[1] Superfast broadband here means able to reach download speeds of at least 24Mbps
[2] Fibre to the Premises – where fibre optic cable is run from the exchange directly through to the premises
[3] Fibre to the Cabinet – fibre optic cable is run to the local telephone cabinet, but the final connection from the cabinet to the premises is via copper

  - Call Flow, for example, will achieve more than 96% coverage of three entire rural exchange areas for less than £800 public subsidy per premise passed. Cybermoor, in an even more challenging rural area, will achieve 100% coverage in their area for £1,220 public subsidy per premises passed.

- *Smaller suppliers can bid for, win and deliver open public procurements at competitive costs, including meeting the necessary EU-wide State aid requirements for receiving public funding.*
  - Eleven smaller suppliers[4] have been contracted to deliver the BDUK Market Test Pilots and nine of the BDUK Superfast Broadband Phase 2 projects.
  - Smaller suppliers are increasingly confident in their ability to provide services to the hardest to reach parts of the UK. Some are securing access to new sources of finance to do this.[5]
  - Connecting the most sparsely populated areas will always be commercially challenging; however, there is increasing investment in these areas.[6] Infrastructure suppliers are likely to continue to require some public subsidy to deliver to these loctions.

There are now more than 40 smaller infrastructure providers in the UK, with 70% of these serving rural areas.[7] Take up of superfast broadband services is increasing year on year[8] and higher than the national average in hard to reach areas. The broadband market is growing rapidly, and even in rural areas suppliers are increasingly willing to invest, with some investing up to £1000 per premises passed if they can secure a 40-60% guaranteed service take up.

- *Communities can work together with suppliers to create viable commercial conditions for small projects.*
  - Creating a standardised offer for communities can make this easier. Key learnings have come from projects such as B4RN in the north of England, as well as the large number of less successful community broadband projects. Cybermoor has been looking at community funding models as part of their work in Northumberland and are developing standardised offer known as "Broadband in a Box", which can be promoted to new communities interested in commissioning their own projects.
  - Community engagement is most effective when an area already has a strong sense of identity, such as a village. A local champion can also provide impetus to support a project. Communities have generally engaged enthusiastically with the Pilots; however, the Pilots have shown that projects in sparsely populated areas do not always have a natural community to engage with, or can cut across communities.

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[4] Alternative suppliers to the major Wholesale Broadband Access (WBA) suppliers – BT, Virgin Media and KCom, also referred to as 'altnets'.

[5] Gigaclear, for example, have recently secured €25 million of financing from the European Investment Bank to extend its fibre network in rural areas: http://www.totaltele.com/view.aspx?C=0&ID=492361

[6] Motorola recently announced its acquisition of Airwave, one of the Market Test Pilot project suppliers: https://www.airwavesolutions.co.uk/news-media/news/company-news/article/motorola-solutions-to-expand-managed-support-services-business-with-airwave-acquisition/

[7] Report on UK NGA provision by non-major providers, December 2014, Prism Business Consulting Report for Ofcom: http://stakeholders.ofcom.org.uk/binaries/research/infrastructure/2014/next-gen.pdf

[8] Ofcom statistics: http://media.ofcom.org.uk/news/2015/broadband-speeds-november2014/

- *New partnerships have been fostered, including with other network providers such as Janet[9], Network Rail Telecom, and new installation partners, which will lead to new opportunities to deliver services once the pilots have ended.*
  - The suppliers have all demonstrated flexibility and innovation to find ways to overcome barriers to delivery. These are all influenced by local circumstances and have ranged from small, beneficial deals with landowners on wayleaves or equipment to new relationships between suppliers and public sector infrastructure owners such as Janet, Network Rail Telecom.
  - New commercial relationships have also emerged which are likely to be sustained after the Pilots end. For example, Call Flow and BT Openreach have worked together to trial the deployment of new cabinets at locations requested by non-BT suppliers[10]. If this new sub-loop unbundling[11] product proves viable, it could provide significant new cost-effective FTTC opportunities for suppliers in hard to reach areas.
  - Local Authority support for a project can really drive successful delivery. Their support can help suppliers across a range of areas, including funding, planning permissions, community engagement, local marketing and political support.
  - Compared to the majority of the UK, customers of the Pilot suppliers have had a limited choice of Internet Service Providers (ISPs). However, several of the suppliers are investigating wholesale open access platforms that would offer greater ISP choice and potentially enable partnerships with top-tier ISPs at scale.
- *The flexible and bespoke delivery models suppliers have used on these small projects has not yet been proven on a larger scale*
  - The flexibility that smaller suppliers offer has yet to be proven in large scale projects. Some might need to adapt their design capacity and business models if they wish to grow their capacity in rural areas.
  - However, we are already seeing increasing interest from smaller suppliers in bidding for future BDUK contracts.

BDUK is now discussing with suppliers how to ensure the long term sustainability of their projects and build momentum after completion of the Pilots, particularly in the most rural areas. BDUK will publish a final report later this year. Meanwhile it is already promoting the emerging findings, especially the benefits of working with smaller suppliers, within government and the commercial sector.

Chris Townsend OBE
Chief Executive Officer, Broadband Delivery UK

[9] A publicly funded network of over 5,000 km of optical fibre that serves over 18 million users within the UK research and education sectors

[10] BT already deploys new cabinets called Copper Rearrangement ('CuRe') nodes; the trial allows non-BT providers to replicate the solution to extend FTTC services to premises that could not previously benefit from FTTC.

[11] The BT Openreach products that allow suppliers to control the copper loops between BT cabinets and the premises.

3. Introduction to the Pilots

The initial findings from the Market Test Pilots were published in February 2015. Since then, the projects have moved from feasibility to deployment phase and BDUK has developed this interim findings report to share their notable progress with stakeholders. This report will be updated upon conclusion of the Market Test Pilot (MTP) projects in March 2016.

BDUK has driven the public investment of £1.7billion to extend the reach of superfast broadband to 95% of the UK by the end of 2017. The Market Test Pilot programme was set up to investigate the opportunities, risks and costs of reaching the hardest to reach rural areas still without superfast broadband. Specifically, the programme aimed to:

- generate evidence about the cost of delivering in the hardest to reach areas and different approaches to funding;
- build capacity and capability in the supplier market and knowledge of broadband State aid requirements by disseminating the Pilot findings;
- generate evidence about expected levels of take-up in hardest to reach areas and how it can be incentivised; and
- collect information on performance in the field and user experience for different technologies.

Following market engagement, BDUK launched an open procurement in March 2014 to select and work with suppliers to learn about the technologies and commercial models that are best suited to delivering superfast broadband in the hardest to reach areas of the UK. BDUK invited bids in three different categories:

Technology	Testing technologies that are largely established and understood, but where their effectiveness and commercial sustainability in the unserved areas was unknown or uncertain.
Operating models	Testing novel operating models that increase investment levels through standardisation or aggregation, reducing barriers to the market.
Financial	Testing alternative public/private funding models and the ability to leverage new financing investment.

Findings from the feasibility phase were published in February 2015[12], including details of the one Pilot project that did not progress to the deployment phase. Updated versions of the Pilot suppliers' feasibility reports can be reached from the links provided on BDUK's website[13].

Each project proposed an individual deployment schedule with build and customer acquisition commencing at different times and speeds. At time of publication, six of

[12] https://www.gov.uk/government/publications/superfast-broadband-programme-phase-3
[13] https://www.gov.uk/government/publications/superfast-broadband-programme-phase-3

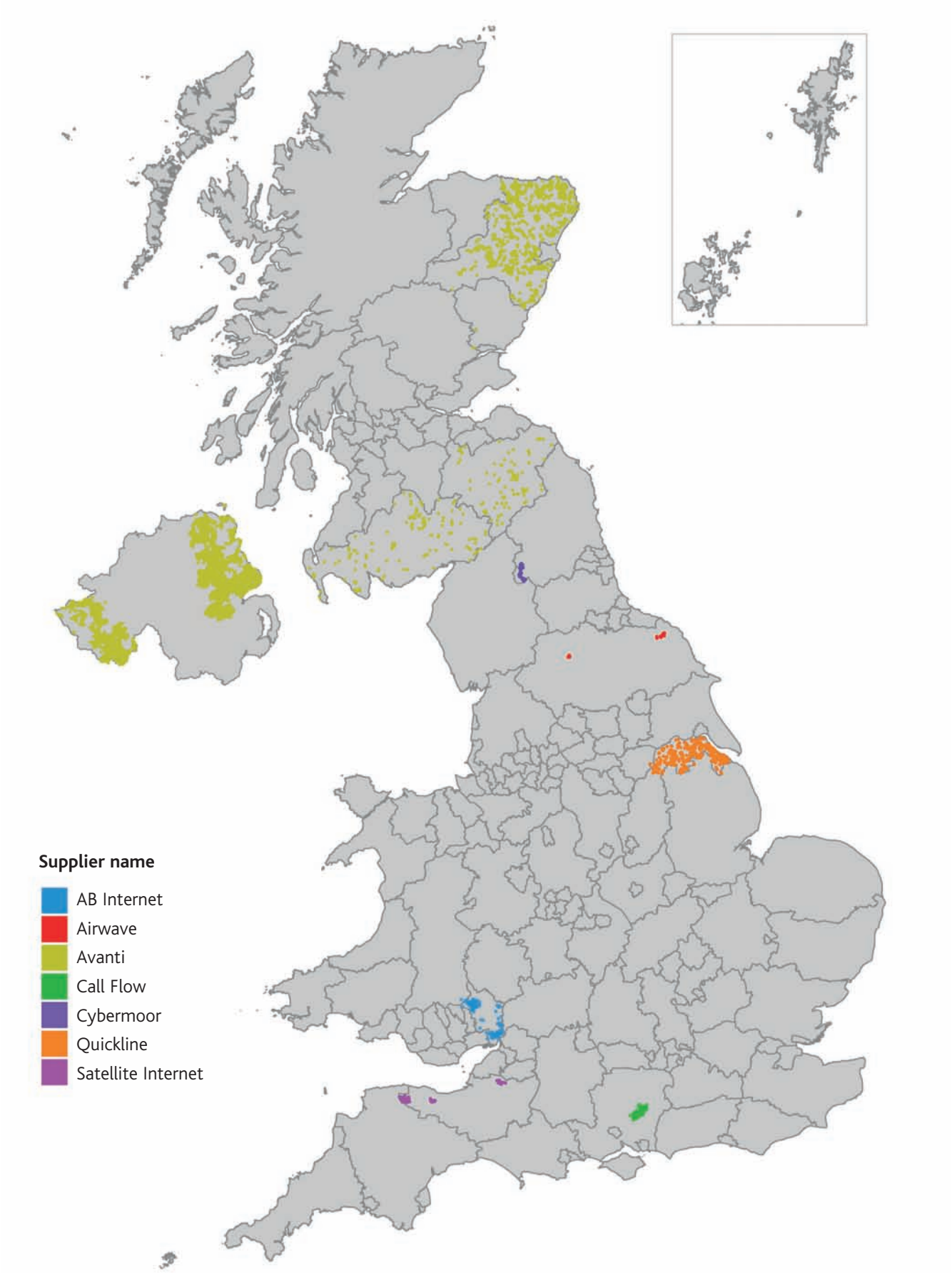
the networks have connected customers, with the first going live in March 2015, and a combined total of over 800 customer connections. The final Pilot will enter deployment early in 2016.

Supplier & project area	Target premises	Access technology	Premises passed at Dec 2015 (% of total)	First premises live	% take up as % of premises passed to Nov 15[14]
Airwave, North Yorkshire	270 premises	Wireless	68%	October 2015	17%
Avanti, Aberdeenshire, Dumfries and Galloway, The Borders, Antrim and Fermanagh	1,000 customers across 23,472 premises	Satellite	30% of target connected (300 premises)	June 2015	3%[15]
Call Flow, Hampshire	1,670 premises	FTTP, FTTC, Wireless	80%	March 2015	13%
Cybermoor, Northumberland	287 premises	FTTP, Wireless	100%	April 2015	24%
Quickline, North and North East Lincolnshire	4211 premises	Wireless	85%	June 2015	8%
Satellite Internet, Somerset	420 premises	Satellite Wireless	13% of premises passed	January 2015	13%
AB Internet, Monmouthshire	1,600 premises	Wireless	0%	N/A	N/A

[14] To provide a fair comparison, take up here is calculated as a % of total premises passed (the number of premises who can get a connection if they choose) at this point in the project, and so it will be possible for this figure to decrease in future as well as increase, if the rate of premises passed overtakes the take up rate.

[15] Avanti take up calculated based on 'estimated premises aware of service' in place of 'premises passed.' This is due to (a) large footprint of satellite services and (b) large intervention area put focussed marketing campaigns. Number of premises aware of service based on number of outbound direct marketing communications issued.

MAP OF THE MARKET TEST PILOT (MTP) AREAS[16]



[16] The map illustrates the geographic spread of the Market Test Pilots across the UK.

4. Structure of the emerging findings

The emerging findings from the Pilots that follow are divided into two broad sections:

Developing a successful business model

This section examines which broad delivery approaches have been most successful in the Pilots to date, and is divided into three sections:

- **The technology or mix of technologies used by the suppliers**, and their relative successes. In particular, this section focuses on the reasons for the successes of suppliers who have chosen to mix technologies.
- **What BDUK has learnt so far about financing and funding methods**, focusing in particular on the viability of social investment, community funding, and benefits in kind.
- **The different delivery models employed by the Pilot suppliers**, including operating models, the benefits of support from Local Authorities, and the potential scalability of the solutions seen in the Pilots.

Detailed deployment learnings

This section focuses on more detailed learnings from each stage of a publicly-subsidised broadband infrastructure project, drawn from across the Pilots. The phases covered are:

- **The pre-planning stage**, including lessons learned related to desktop planning exercises and identifying funding sources prior to bidding.
- **The bidding stage**, focusing in particular on State aid and the bidding process.
- **The planning stage**, focusing on lessons learned on gaining planning approval, securing backhaul and successfully negotiating wayleaves.
- The build stage, including innovative deployment techniques employed by Pilot suppliers.
- **The operating and selling stage**, a key section, summarising take up data so far from the Pilots, and the results of two surveys, one examining customer experience of the different technologies, and the other looking into barriers to take up in hard to reach areas. Both survey reports are attached in full as Annexes C and D.
- **Contract expiry**, and the ongoing commercial sustainability of the Pilot networks.

5. Developing a successful business model

Overarching Key Findings

- To date the Pilots have been most successful where they have been able to incorporate flexibility of approach to their business model, whether this be through their choice of technology, funding or delivery model.
- Three of the seven Pilot suppliers are deploying a mix of technologies; others have multiple deployment options within a single technology approach.
- The 'hybrid' technology approach, particularly merging fibre and fixed wireless, has proved effective in very challenging areas, delivering high coverage percentages while demanding relatively low public subsidy.
- For financing, both social investment and community shares have potential as funding options for suppliers, though neither are yet being used on a large scale.
- Communities can work with suppliers to create viable conditions for broadband rollout. Creating a standardised offer such as Cybermoor's 'Broadband in a box' would make this approach easier.
- A good relationship between the supplier and Local Authority can be a big aid to a broadband project, as the Local Authority can help with marketing and provide guidance on local planning considerations.
- New partnerships have been fostered as part of the Pilot programme, which could lead to new opportunities once the Pilots have ended, such as the Call Flow and BT Openreach collaboration on a CuRe sub-loop unbundling product.
- The potential scalability of the Pilot suppliers' approaches is not yet proven, and successes have not been uniform across all the Pilot projects.

The eight Pilot projects that BDUK selected at the start of this MTP programme proposed a variety of business models, some tried-and-tested by the supplier, and others that extended the supplier's existing approach.

To date, the Pilots have been most successful where the Supplier has been able to incorporate some flexibility in approach. For technology, this flexibility has involved selecting the appropriate technology or mix of technologies to suit the location and commercial constraints. In funding, this has involved harnessing community or social funding, or pursuing benefits-in-kind agreements with landowners to make the available funds go further. In terms of delivery models, this has meant – among other things – working closely with Local Authorities to take advantage of their skills, capacity and influence.

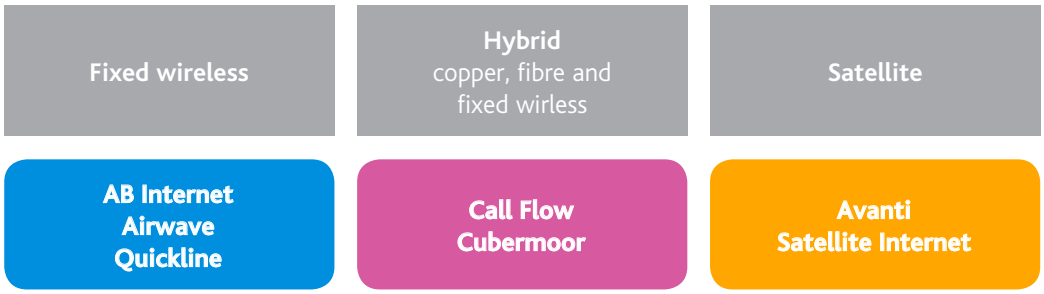
TECHNOLOGY CHOICE

Key Findings

- The Pilots are testing a range of established technologies (fibre, fixed wireless and satellite), often combined to create innovative solutions to specific local challenges.
- All of the Pilot projects are operating in the 2% lowest premise density areas of the UK, presenting a real challenge to the ongoing commercial sustainability of the projects. In addition, the Pilots are often in sparse locations, isolated and distant from neighbouring towns, further increasing costs.
- BDUK's analysis to date suggests a hybrid technical approach can take advantage of technologies' different geographic reach, capital cost and operating cost, allowing suppliers to push towards low premises density at relatively low cost with terrestrial solutions, where satellite might otherwise be expected to be the only viable solution.

The Pilots are testing a range of access technologies and the projects can be grouped together into three broad categories:

Access Technology



Each access technology has its limitations and these are well understood. Some Pilots have developed solutions that deploy a combination of different technologies, and when the supplier also has expertise in a range of options for the build approach these 'hybrid' solutions are proving especially effective in hard to reach rural areas.

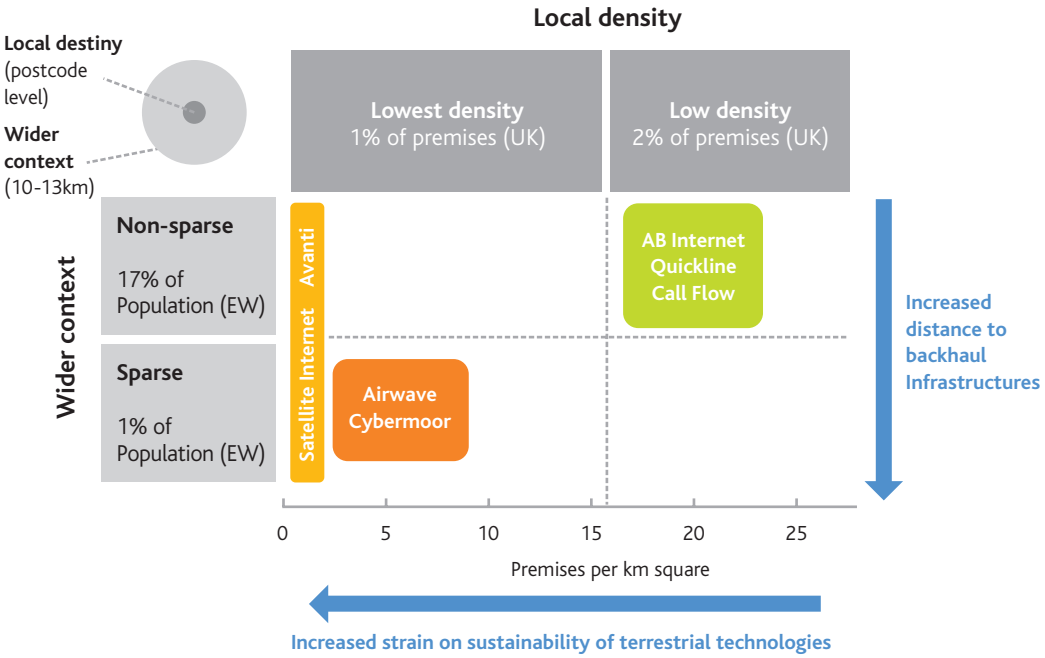
The Pilot projects are innovating to use established technologies in new ways that may prove helpful in extending superfast broadband networks to the hardest to reach areas, such as Call Flow's work with Openreach to develop the current sub-loop unbundling (SLU)[17] offering to allow non-BT operators access to the copper loops at new points in the Openreach network. BDUK has facilitated this collaboration which provides a real opportunity to extend cost effective FTTC solutions to premises that are currently unable to benefit from them. Satellite Internet is combining up-to-the-minute satellite services with fixed wireless distribution technology to deliver 'village pump' backhaul into remote locations. Avanti, meanwhile, is using tried-and-tested commercial routes to market to keep provisioning costs predictable but is trialling latest consumer hardware to deliver superfast speeds over satellite broadband connections.

[17] Sub-loop unbundling – the BT products that allow a supplier to build their own street cabinet next to BT's street cabinet and control the copper loops from that cabinet. The product allows an Altnet to upgrade individual lines to offer superfast broadband to premises, typically where BT has not upgraded their cabinet to deliver FTTC.

The Call Flow and Cybermoor pilots are helping to demonstrate that FTTP is a viable option in even the most challenging geographies for digging fibre and the deployment cost can often be lower than expected even with close to 100% coverage rates. In the case of Cybermoor a high take up at around 60% is required for a sustainable model that can support the high capital cost of deploying the fibre infrastructure, but the success of the B4RN FTTP network, which has achieved this level of take up within its communities and has a similar population density and geography to the South Tyne Valley, is encouraging.

It is possible to group the seven Market Test Pilot projects into three distinct clusters, taking into account the local density of premises and the wider sparsity context of the project area (reflecting the proximity of towns), as illustrated in *Figure 1*[18] below:

Figure 1: Premises density and commercial sustainability



The two competing commercial drivers in the deployment of any broadband infrastructure are the cost of the deployment (capex) set against the return on this investment taking into account revenues, take up rates, debt servicing, operating costs and payback periods.

Rural areas have a lower concentration of premises than urban areas and this premises density measure is firmly linked to commercial sustainability for broadband technologies with the possible exception of satellite. A piece of infrastructure – e.g. a fibre cabinet or a wireless mast – typically reaches fewer customers in low density areas. The operator has to be confident of securing enough marginal revenue to cover the marginal ongoing operating costs of the infrastructure before they commit to the investment.

Figure 1 above shows that all of the Pilots are operating in the 2% lowest premise density areas of the UK, and four of them are in the lowest 1% density, putting significant pressure on the commercial sustainability of the suppliers' broadband infrastructure and explaining why these areas are all in the hardest to reach areas of the UK.

[18] For each project, the local density of white premises was calculated at the postcode level and the wider context was determined by matching postcodes to LSOA and using the sparse/non-sparse definition from the ONS Rural Urban classification RUC2011.

Satellite technologies are able to avoid this difficulty for the most part with a near universal coverage within a given area based on relatively large beam footprints. Their commercial model remains valid whether premises are twenty feet or twenty miles apart.

Sparsity of location and cost of deployment

The sparse or non-sparse categorisation[19] defines the context in which physical settlements are found and considers the surrounding settlements within 30km of the intervention areas. For the purposes of this analysis the sparsity measure is a reasonable indicator for the proximity to existing backhaul infrastructure. Areas with a sparse rural context will often have difficulties sourcing affordable backhaul solutions to the project area.

While the cost of deployment can be reduced in a number of ways (see 'The build stage' in the detailed deployment learning section), a significant cost for non-satellite projects, particularly in hard to reach areas, is backhaul – the connection between the project's infrastructure and the global internet. In addition to these challenges with backhaul, the cost for the civils work for both installing the networks within the project area and for extending electricity connections to where they are needed for active equipment are higher in sparse locations because of the increased distances involved.

The evidence from the Cybermoor and Airwave Pilots in very sparse areas, as set out in *Figure 1* above, would suggest that backhaul and other civils work is likely to be significantly more expensive in terms of the initial capital costs, and often the ongoing operating costs for backhaul rental, than in less sparse areas.

The success of technologies in different areas

The non-satellite projects are grouped into the two clusters shown in *Figure 1* and during the deployment it has been possible for BDUK to identify some consistent patterns that help to characterise the typical issues that will be faced in the hardest to reach areas. The two satellite projects form a third cluster.

- **Cluster 1:** (AB Internet, Quickline and Call Flow) project areas that have a non-sparse context (in reasonable proximity to large towns) with a local density of around 20 premises per km^2. A variety of wireless and hybrid solutions tested in the Pilots appear to be well suited to this type of area.
- **Cluster 2:** (Airwave, Cybermoor) containing sparse areas (isolated and distant from neighbouring towns) with low local density (3-9 premises per km^2). These are extremely challenging locations, where backhaul is likely to be expensive, and there will be limited numbers of potential customers per km^2 to support the cost of the infrastructure. In these areas, evidence from the Pilots suggest that solutions relying on a single technology approach may be cost effective in relatively few locations. Conversely, the flexibility from including hybrid solutions (whether by mixing fixed and wireless technologies, or by using multiple configurations of wireless technology) has the potential to provide a greater level of coverage while remaining relatively cost-effective.

[19] ONS Rural Urban Classifination RUC2011 http://www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/index.html

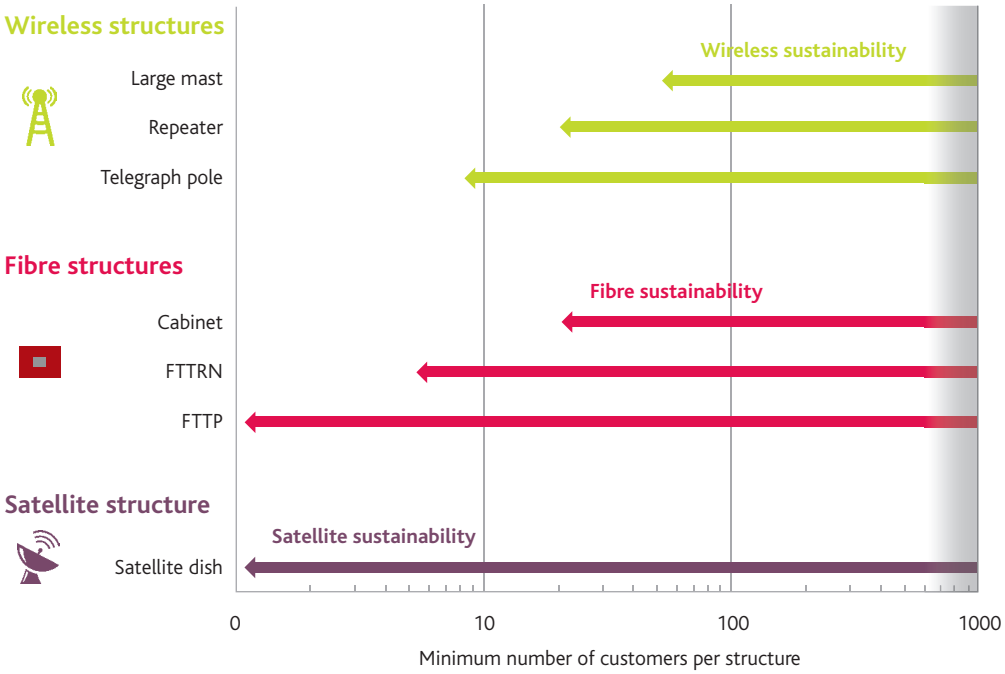
- **Cluster 3:** (Satellite Internet, Avanti) containing areas with very low density (less than 2 premises per km^2) in both sparse and less sparse settings. In these areas, fixed technologies struggle due to the very low density of households often leading to insufficient income to sustain fibre, copper or wireless infrastructure. Satellite is less affected by the density of premises and as such is an effective solution in these types of areas. The passive nature of Fibre to the premises (FTTP) infrastructure reduces operating costs meaning that it can be commercially sustainable in these areas in certain cases, although this is often accompanied by very high capital costs when calculated on a per-premise basis.

Explaining the success of the hybrid approach

Figure 2 below provides a representation of the commercial sustainability of different technical solutions used in the Pilots when mapped against the number of customers served per structure[20]. The figure illustrates how in general suppliers are mindful of the minimum number of customers needed to continue to operate wireless structures and fibre nodes on a commercially sustainable basis when designing their network.

Suppliers also consider other factors when designing their networks, e.g. proximity / overlap with previous investment in the network, solution complexity and support costs as well. For example a supplier may use larger structures to cross-subsidise smaller structures in order to achieve a greater aggregate scale of network.

Figure 2



FTTP : Fibre to the premises, FTTRN : Fibre to the Remote Node

[20] The chart represents the minimum number of customers required for a given structure to be commercially sustainable and is based on BDUK's interpretation of the data available to date from the MTP and other BDUK projects; given the limited data available, it should be treated as indicative only.

BDUK's analysis suggests that in areas of extremely low population density – for example in Cluster 3 in *Figure 1* – it will typically be harder to design sustainable and cost-effective solutions providing high levels of coverage without relying heavily on satellite solutions. Nevertheless, the success of community-based projects such as B4RN in Lancashire demonstrates that this is certainly not always the case.

In areas of less extreme but still very low density, the flexibility of the hybrid approach to technology and build can help provide greater levels of sustainable coverage. This flexibility can benefit both the core network and the access network solution. Typically there will be a preferred technology that is deployed as far as is cost-effective and/or technically feasible, at which point an alternative technology can be used to extend the coverage. In the core network the hybrid approach is vital for connecting each 'island' of unconnected premises together. In the access network the hybrid approach provides a number of options for delivering superfast in the last mile. Together, these have allowed suppliers to drive down the cost of maximum coverage solutions in hard to reach areas. These principles are demonstrated through both the Call Flow and Cybermoor hybrid solutions which will achieve over 96% and 99% coverage of their intervention areas respectively.

Case Study: Code Powers[21]

In the case of ***Call Flow*** the hybrid model is strengthened through the Code Powers that provides the full flexibility for a supplier in its choice of build approach. This element of the model is made possible by the supplier being granted Code Powers by Ofcom. The Code enables these providers to construct infrastructure on public land (streets), to take rights over private land, with the agreement with the landowner or applying to the County Court or the Sheriff in Scotland. It also allows the providers to benefit from the relaxed planning rules and is a prerequisite for making use of BT's ducts and poles (PIA).

Figure 3[22] below illustrates this conclusion. Any one technology has a limit to its sustainability the further you move towards a lower density area with fewer potential customers per infrastructure unit (e.g. a mast or cabinet). By combining multiple technologies, suppliers can take advantage of their different geographic reach, capital cost and operating cost characteristics, which can allow suppliers to push further towards extremely low premises density, where satellite might otherwise be expected to be the only viable solution.

Case Study: Flexibility in the technical solution and build approach can produce cost-effective solutions that deliver very high levels of coverage

Call Flow will achieve 96%+ coverage of three entire rural exchange areas for less than £800 public subsidy per premises on average through its hybrid approach that combines FTTP, fixed wireless and FTTC solutions with multiple

[21] The Electronic Communications Code enables electronic communications network providers to construct electronic communications networks. The Code enables these providers to construct infrastructure on public land, to take rights over private land, either with the agreement with the landowner or applying to the County Court. It also conveys certain immunities from the Town and Country Planning legislation in the form of Permitted Development. The Code is granted to network providers by the Office of Communications ('OFCOM') by a direction made following a public consultation and consideration of the responses to that consultation.

[22] While Figure 3 is based upon data gathered from the Pilots so far, the figure itself is illustrative.

options for build approach. These build options include Physical Infrastructure Access (PIA), and own build through public or private land (new dig or new poles) which provides the flexibility to tackle each local challenge and minimise costly blockages and delays.

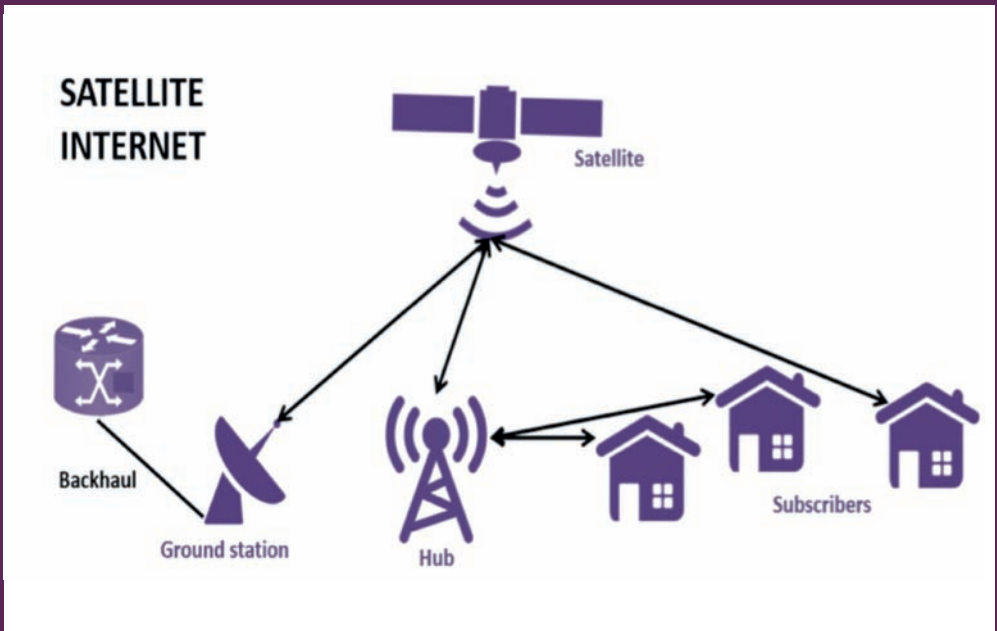
Cybermoor will achieve over 99% coverage of a very sparse and low density area (see *Figure 1*) at £1,220 public subsidy per premises using its mix of 55% FTTP and 45% fixed wireless.

Quickline will achieve 100% coverage of their area at just £475 public subsidy per premises. While Quickline is using only fixed wireless technology, it is displaying flexibility by mixing Line of Sight and Near Line of Sight technology, as set out further in the 'flexibility within a technology' case study below.

A link between two sites might be most effectively achieved by high capacity point-to-point radio links, which could feed fibre access connections to the individual premises. Similarly, a group of premises might be more cheaply upgraded by FTTC to an existing node or new node than by a point-to-multipoint wireless solution, but the backhaul from that node could be via a combination of point-to-point wireless links and fibre sections

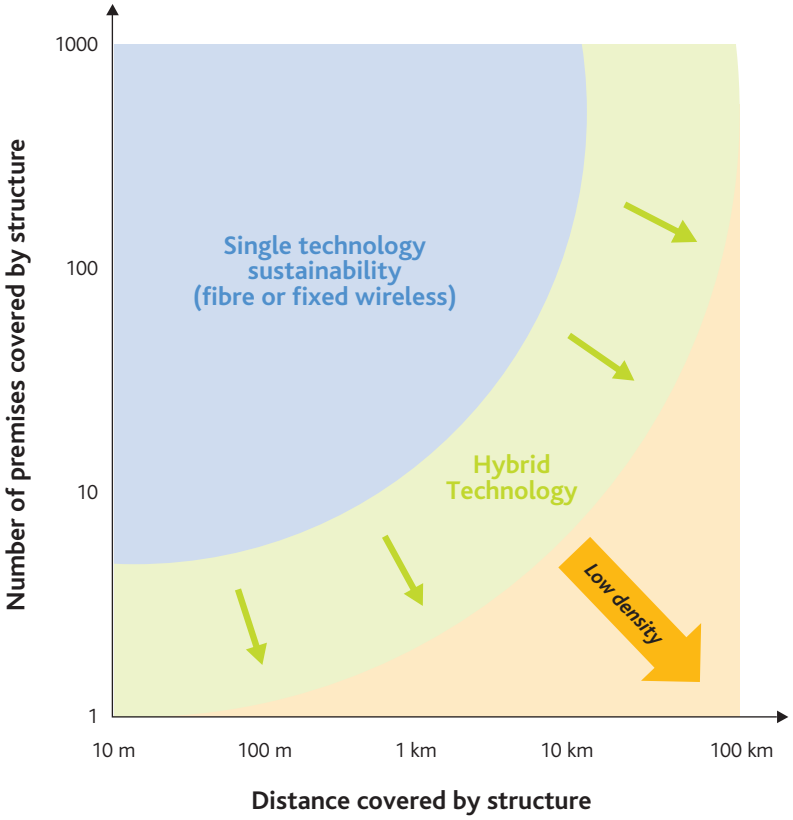
Case Study: Satellite and Fixed Wireless hybrid approach

Satellite Internet have combined satellite backhaul with fixed wireless distribution to leverage the technical and commercial strength of each technology. A superfast satellite service (typically running at 40Mbps) delivered to an otherwise unaffordable location is used to feed a wireless distribution network to cheaply and quickly reach multiple clustered households.[23]



[23] Satellite Internet has also included a degree of future-proofing inherent in their mixed methodology solution. The fixed wireless network they use is today capable of running at up to 150Mbps. This means that a future faster satellite backhaul solution could be plugged into the existing wireless network and instantly distributed, with no need for delay or substantive on-cost.

Figure 3



A hybrid model can equally combine different wireless technologies only, as set out in the case study below.

Case Study: Fixed wireless – the advantages of flexibility within a technology

Call Flow is using a combination of high capacity point-to-point radio in the 71-76 GHz (lightly licensed) E band with fixed wireless access points using both the 5.4 GHz (licence exempt) and 5.8 GHz (lightly licensed) spectrum to achieve cost-effect superfast coverage of a remote exchange area where all the premises are currently connected directly to the exchange (Exchange-Only lines).

For the ***Airwave*** and ***Quickline*** projects, using radio links for both point-to-point and point-to-multipoint applications has lowered unit cost per subscriber substantially by sharing bandwidth at the base stations. By combining the use of licence exempt, self coordinated, and licensed spectrum in peripheral backbone masts, a plan for the backhaul links could be implemented quickly. The topography (natural and manmade) dictated the need for links with multiple hops rather than single hop connections. Furthermore, a flexible approach cleverly exploited the advantages of different link types and spectrum bands to suit the bandwidth requirement, distance between the points, and the desired antenna types, enabling the suppliers to cope with widely varying terrain, urbanisation levels and densities.

FINANCING THE PROJECT

Key Findings

- The social investment market is becoming more established; however the Cybermoor project has shown that it does not always offer a cheaper alternative to a commercial loan, due in part to the costs of intermediaries.
- Community shares offer a way for individuals to invest in enterprises serving a community purpose, and is one of the fastest growing forms of ethical investment. The Cybermoor Pilot has found that the target coverage area may consist of fragmented rather than entire communities, and developing the community cohesion that motivates the members of the community to invest presents a significant challenge to raising local funding.
- Benefits in Kind arrangements with landowners and customers have helped reduce deployment costs across the Pilots

Small suppliers are having increasing success in raising finance to support capital intensive infrastructure roll out but few suppliers have attracted investment to date. The different types of financing that these suppliers have secured includes EIB loans under the Innovfin finance scheme[24], and equity and debt based funding from private investors that include individuals and institutional shareholders. Through the Cybermoor pilot, BDUK has sought to understand more about the potential for a proportion of the overall finance package to come from other sources such as social investors and/or community shares.

All Pilots have used a combination of BDUK grant funding and private financing[25]. The Cybermoor project, the only Pilot selected specifically to explore innovative financing models, is testing options that leverage grant funding and private loans to secure new social investment and community investment into a rural broadband network. The findings in relation to social funding and those in relation to fundraising via a community share offer, which remain quite distinct, are set out below.

Social funding

The social investment market is becoming more established and several brokerage organisations are operating in the market. The EIS/SITR tax allowances are raising the attractiveness of social investment in rural broadband projects both to philanthropic major investors and local investors in individual communities.

Over the course of the Cybermoor project it has become apparent that social funding does not always offer a cheaper alternative to a commercial loan, and that social investors do not embrace risk, but they will lend over a longer term than commercial banks. These investors typically focus their investment via intermediaries whose fees add at least 5% to the cost of the funding.

Through a partnership with the Social Investment Business (SIB), the specialist fund manager responsible for the Digital Dales[26] social funding, which is the only other known social investment deal for a broadband network, the Cybermoor pilot has generated some useful lessons and uncovered some complex challenges.

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[24] http://www.eib.org/products/blending/innovfin/
[25] See Annex 1 – Project summaries – for information on the level of funding that each supplier has received.
[26] http://www.digitaldales.com/

Under the contract between Cybermoor and SIB, the project was successful in accessing grant funding through a DCLG funded programme[27]. However the subsequent activity with which SIB was contracted to provide support – the development of a social investment proposal – was not successful and the project did not meet SIB's requirements to progress to an application for finance from a social investor.

As with Digital Dales, the Cybermoor pilot had to contend with a range of external issues that resulted in a frequently-changing proposal that affected the perceived investment-readiness of the project. SIB's evaluation of the Cybermoor plan concluded that the risk profile was too high, and there was too great a likelihood that a social investor would only receive a portion and not full repayment (including interest) of the initial investment.

SIB suggested that the investment-readiness of a broadband project could be improved through a number of measures such as

- Including a full consultation with local community members at the feasibility stage, and to include a realistic assessment of delivery challenges and timescales.
- Having a signed agreement in place with a backhaul service provider before a project goes ahead, as Cybermoor had managed to do.
- De-scoping[28] the project area from the Local Partnership's superfast broadband contracts to avoid lengthy delays and increased costs.

It was also evident that the role of private service providers within an investment vehicle needs to be clearly articulated if social investors are to support a project where private benefits may outweigh social community benefits. When a private company stepped in to underwrite the funding gap, without which Cybermoor's deployment would not have continued, it gave rise to a conflict with the underlying principles of social investment, and a concern that social investors would be protecting commercial ventures rather than generating a social benefit where there are no existing commercial funders or backers.

In summary SIB believes that once the issues around rural community broadband development are better understood, it is possible that social investors could provide a proportion of the overall finance package. However it was clear that the investors would require a significant level of grant funding from other sources to be included as part of the investment deal into a structure, in addition to the grant funding for the feasibility phase; the social investment would likely be unsecured (very high risk), and would probably constitute a small proportion of the overall investment package.

Cybermoor will include its own findings within the 'Broadband in a Box' product. This template will provide guidance for community projects through the options and reduce the considerable effort required when sourcing social investment, and provide advice on how to mitigate the cash flow constraints that present a notable challenge for community broadband projects.

Community shares

Community shares offer a way for individuals to invest in enterprises serving a community purpose and the primary motivation for purchasing shares in a society is to support the social objectives of the enterprise. The rate of return is a secondary motivation, and any return on capital is better understood as compensation rather than a reward for risk taking.

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[27] Community Assets and Services Grants programme

[28] In the areas where the Local Partnership has ongoing contracts with suppliers (predominantly BT) to deliver publicly funded superfast broadband, the proposed postcodes for the new broadband intervention must be de-scoped from these contracts to avoid overbuild.

An early recommendation from SIB was for the project to consider raising a community share issue in order to demonstrate local buy in to the project and also to mitigate the risk of any investment. Cybermoor was able to take this recommendation on board but not until the delivery of the pilot network was already under way. If the timeline had allowed, then the community share offer would have clarified the level of the remaining finance gap sought from social or commercial investors before any network installation had commenced.

Community shares are one of the fastest growing forms of ethical investment[29] in the UK. Between 2009 and 2014, 246 share offers were launched[30], compared to fewer than 30 for the previous six-year period. In 2015, 80 share offers were set to raise more than £40m through more than 50,000 individual investors. This type of investment is typically used to finance local shops, pubs, community buildings and renewable energy and there are only four known community share offers in the broadband sector[31].

The government-backed Community Share Unit (CSU)[32] has a dual focus on standards and market development in seeking to grow a sustainable community shares market. The CSU has published resources to assist communities, and these include the introduction of the Standard Mark, the Community Shares Handbook and a new online tool called 'Step-by-Step'[33]. This tool helps groups successfully navigate the journey from initial idea to share offer launch – and generates a bespoke report that highlights key areas of action.

Cybermoor has raised only 10% of the target £150,000 investment from the community via the purchase of Community Shares. The share offer was significantly affected by the South Tyne Valley not being an extant cohesive community – rather a series of small groups of premises along a valley. For future projects, time should be allowed for community building which in turn should increase the awareness and enthusiasm of members of the community to invest.

Benefits in kind

Benefits in kind have helped minimise network deployment costs for some Pilots. Some of the Pilots have been able to negotiate very low cost wayleaves and secure the preferred network routes where the landowner has a vested interest in the service being deployed. In others the offer of reduced service costs (or even free service) has allowed the supplier to find suitable low cost locations to house and power critical network infrastructure. A flexibility in negotiating on a case-by-case basis has helped achieve these cost-saving agreements for suppliers.

Case Study: Benefits in Kind

For example, ***Satellite Internet*** has housed the network hub and satellite backhaul in both a village hall and a local hotel. In the first case, a free wi-fi hotspot for the village has been offered in exchange for power and access. In the second, a preferential package has been offered in exchange for housing and powering the network equipment.

[29] Making financial decisions that are good for our environment, good for society and help others, such as supporting sustainable enterprises with a community purpose.
[30] Share offers that were registered with the Community Shares Unit (CSU)
[31] B4RN and Digital Dales pre-date the CSU initiative; Cybermoor and F4RN have interacted with CSU.
[32] Launched in October 2012. It continues as a joint initiative between Locality and Co-operatives UK, with funding from DCLG.
[33] http://stepbystep.communityshares.org.uk/

DELIVERY MODEL

Key Findings

- The project location is a key consideration for the choice of operating model. Suppliers deploying in areas well known to them were able to leverage established relationships with contractors, making them able to bring their Pilot services to market more quickly.
- Local partners, and often the Local Authority in particular, can provide significant support to suppliers. Local Authorities can facilitate mailshots and lend their logo to marketing materials, helping to legitimise the offer of the supplier and thereby driving take up. The Local Authority can also provide valuable guidance on local planning requirements.
- Scalability is a major consideration when attempting to replicate this approach elsewhere on larger projects.
- Community projects have the greatest chance of succeeding where there is a standardised model and community cohesion.
- There is evidence that the supplier market is building new networks based on demand and eligibility, without the need for public subsidy. However, some of the least sparsely populated areas may never be commercially viable and smaller infrastructure suppliers will likely require some public subsidy to deliver to these areas.

Flexibility around the delivery approach is a key theme emerging from the Pilots so far, both for operating models for building and maintaining a network and in regards to marketing and working with communities. In particular, all Pilots have sought to harness the expertise and contacts of Local Authorities to organise community engagement and marketing activities.

Operating model

As well as the technology choices, the supplier's approach to operations in planning, building and maintaining the network will shape the sustainability of a project. Some Pilots have been able to adopt a flexible approach to operations, while for others, optimising an established model that uses a single default approach has been more appropriate.

The project location is a key consideration for the choice of operating model. Some suppliers were asked to deliver their project in a new area, a significant distance from their existing operations. As a result, suppliers have placed more emphasis on desktop planning using radio planning software, and free online mapping tools. A substantial amount of network planning can be achieved from the desk, and this can also make subsequent site surveys more efficient. This element of the planning is largely geographically transportable and scalable to any geographic area.

Those suppliers whose projects were adjacent or in close proximity to their current area(s) of operation, such as Quickline, were able to bring their Pilot services to market more quickly, largely due to the ability to leverage the established relationships with contractors and other deployment partners.

Case Study: Quickline's rapid early deployment

The close proximity of ***Quickline's*** existing area of operation allowed them to build a heterogeneous fixed wireless network which in turn facilitated the rapid deployment of extra coverage and will gain significant operational expenditure savings. Quickline made use of existing infrastructure – both theirs and decommissioned infrastructure from a mobile network operator – to rapidly build localised infill and extend their network.

Similarly, it is evident that once a communications provider has a presence in an area, it is able to find more commercially viable extensions in unserved areas, which in turn reduces any subsequent requirement for public money.

Working with local partners

The Local Authorities, Parish Councils and local community groups have been important partners for the Pilot suppliers right from the start of the projects, which is the point at which the Local Authorities have an ingrained role in defining the intervention areas based on the build plans for their ongoing superfast contracts.

Evidence from the Pilots so far suggests that local partners, and often the Local Authorities in particular, can provide significant support to increase the impact of marketing and wider community engagement. This is particularly useful, as one challenge that suppliers can encounter is the fact that the intervention area may not always consist of complete communities and in practice the supplier is serving fragmented areas that have limited additional common interests.

In regards to marketing, Local Authorities can facilitate mailshots to those that have specifically asked to be kept informed about superfast coverage to their postcode, and can lend their logo to marketing materials, and support community or parish events, which have proved effective in driving take up across the Pilots.

Case Study: Marketing alongside the Local Authority in Aberdeenshire

In Aberdeenshire, the local council led a direct marketing campaign for the Avanti service and the results of Avanti's marketing analysis suggests a strong link between this Local Authority-led marketing and higher take up rates, with 1,800 direct mails leading to over 4% take up in two months.

Where a supplier is working in a new area, the Local Authority can also provide guidance on local planning and term contractors or bureau services for managing temporary road closures and other highways activities. For example Airwave's planning applications were facilitated by NYnet[34] and the local champion, while Satellite Internet worked with the National Parks planning department in Exmoor to ensure that Satellite dish deployment complied with local planning rules and requirements.

[34] NYnet was set up by North Yorkshire County Council to provide a communications network that is capable of delivering multiple high quality services to citizens, business and public sector bodies: http://www.nynet.co.uk/

Working with communities

Communities have generally engaged enthusiastically with the Pilots, with their response mostly positive, although there have been exceptions, and the Pilots have at times encountered difficulties with managing community expectations. Cybermoor, for example, found that enthusiasm for their share offer was high at the start, but that this level of engagement was difficult to sustain, and the target for local funding was not reached. Maintaining support in community projects can be a challenge over time, however, particularly as local communities tend to under-estimate what it takes to make projects happen. Satellite Internet also encountered mixed reactions to their community engagement, as set out in the Case Study below.

Case Study: Managing community engagement

Satellite Internet worked with the Local Authority to develop a three stage approach to community engagement. The first stage commenced with a meeting with District and Parish Councillors to explain the scheme and to facilitate an introduction to the communities. This was followed by a local meeting with presentations, questions and answers. Finally a live demonstration was provided where people were invited to sign up or express interest.

In the first two deployment areas this approach worked well with an initial 26% take up on the first structure. However, in the third area the proposals were not well received with only 4 people out of a community of over 100 signing up for services. The reasons for this appear to be in part a relatively high number of people with a reasonable ADSL broadband speed combined with an active lobbying group opposed to a satellite deployment in the area.

Projects in sparsely populated areas do not always have a natural community to engage with, or can cut across communities, meaning that suppliers planning projects that rely on community engagement should choose their locations with care. Community engagement tends to be most effective when an area already has a strong sense of identity, and there are local champions who can provide impetus to support a project, although this role can also be taken on by the Parish Council.

Cybermoor has been exploring social and community funding models as part of their Pilot in Northumberland. Previous community schemes such as B4RN in the north of England have shown that successful community schemes often rely on developing a standardised model, which can then be rolled out to other areas. In light of this and their own learnings from the Pilot, Cybermoor is developing a standardised offer known as "Broadband in a Box' which can be used by new communities interested in commissioning their own projects.

Case Study: 'Broadband-in-a-box' model

The ***Cybermoor*** project is helping to shape its 'Broadband-in-a-Box' model that provides an accessible and transferable set of tools and guidance for communities. The aim of the model is to consolidate the learnings from this and other community broadband projects such as Digital Dales and B4RN that will help communities plan and implement a broadband project. Access to this guidance is critical at the start of these projects, when unrealistic expectations in relation to timescales, funding and cost planning are typical barriers to success.

Case Study: Creating new partnerships through the Pilots

New partnerships have been formed through the Pilots that could lead to new opportunities once the Pilots have ended:

Call Flow, with BDUK's support, has made excellent progress on developing an existing physical access product, following the 'Statement of Requirement' process with BT Openreach for a new 'CuRe' sub-loop unbundling product. This will allow a supplier to upgrade individual lines to offer superfast broadband to premises, where BT has not upgraded their cabinet to deliver FTTC and/or where previously the copper lines were too long to deliver a superfast service. Call Flow believes this could be of key importance to extending cost effective fibre coverage into rural areas.

For ***Cybermoor***, the collaboration with the Janet network – an extensive UK-wide government funded fibre network that supports over 18 million research and education users – continues to progress well. This collaboration involves Cybermoor significantly upgrading its backhaul links through reciprocal arrangement whereby the Janet Reach programme benefits from important research material in return for an investment in the fibre infrastructure needed to deliver this bandwidth intensive material, and is an important example of successful cross-government collaboration.

Call Flow has also made use of local water contractors when installing new duct, in order to make significant cost savings and drive efficiencies. This approach also meant that local contractors were on hand to deal quickly with any damage caused to existing sewage or water infrastructure which is not unusual when installing new network.

Two of our suppliers, ***Quickline*** and ***Cybermoor***, have recently partnered to deliver an exciting new technical trial with Network Rail Telecom as an extension to the Quickline project. This trial is in the early stages of deployment and aims to demonstrate the feasibility of using the trackside fibre assets to support third party traffic as part of a rural broadband backhaul solution, something that numerous rural broadband projects have been keen to pursue over the past two to three years but with no success to date. BDUK hopes to publish the results of this important development in its final MTP findings report.

Scalability

The scalability of different delivery models in the hardest to reach areas of the UK is one of the most important learnings from the Market Test Pilots, but one that cannot be demonstrated through these small network deployments alone. It is also important to note that while some business models have proved successful in deployment so far, these successes have not been uniform across all the Pilot projects. Not all projects have delivered to their initial cost and timescale estimates, although re-planning has ensured that the overall Pilot objectives are still on course to be achieved. One of the Pilot projects – MLL in Kent – did not continue past the feasibility stage, as set out in the the initial lessons learned report.[35]

[35] https://www.gov.uk/government/publications/superfast-broadband-programme-phase-3

The benefits of the hybrid solutions that have been highlighted earlier in this document are at risk of being outweighed by increased complexity when attempting to replicate this approach elsewhere on larger projects or by a single supplier on concurrent projects. To avoid this happening a supplier must develop clear rules around the selection of one technology or build approach over another to ensure that the successful model can be applied consistently by different network planning individuals in different areas.

We have seen that suppliers that benefit from having Code Powers are able to exercise the most flexibility in their approach to maximise coverage and reduce costs. Similarly, these suppliers' ability to take advantage of the UK-wide measures that have been introduced to help suppliers build their networks, and the products such as duct and pole access that allow them to make use of existing national infrastructure, will increase a supplier's chances of success when scaling their solution to other areas.

As discussed in the wider report, there are some elements to the Pilots' delivery models that demand a high degree of localisation and flexibility, such as targeted marketing and developing a good relationship with the key landowners. This local focus has been one of the reasons for the success of the projects, but they could be a constraint for larger scale projects, where this form of delivery model has not yet been proven. The size of each individual project is likely to be key to the success of the localised elements of the models.

Another implication of the small scale of the Pilot projects is the limited amount of Internet Service Provider (ISP) choice for customers, when compared to the many ISPs reselling the GEA service provided by BT Openreach under the majority of the BDUK projects. While the Pilot suppliers fulfil the same obligations to offer wholesale products to ISPs, the small number of potential customers limits the projects' attractiveness to other ISPs. It should be noted that this does not seem to have affected early customer satisfaction ratings from the Pilots (as set out later in this report). Several of the Pilot suppliers are partnering with wholesale customers (including a top 5 ISP) to investigate ways to make their networks more attractive to more ISPs, but larger scale deployments is likely to be the most important factor.

The potential for roll-out without public subsidy

The broadband marketplace is growing rapidly, and even in rural areas, some suppliers are investing up to £1k per premise passed, given the right circumstances.

An increasing number of suppliers are building new networks based on demand and eligibility, without the need for public subsidy. Virgin Media aims to extend its network to another 4m premises, driven by demand. Gigaclear will invest in new network builds in selected rural areas where they can secure a 30% sign-up level for their services.

However, there remain limitations on the ability of suppliers to reach the hardest to reach areas without public support. Gigaclear, for example, require 400 properties or more, within a community, for their offer to be commercially attractive. Some of the most remote and least sparsely populated areas may never be commercially viable and suppliers are likely to require some public subsidy in order to provide superfast coverage in these areas. For example, Gigaclear was awarded contracts in summer 2015 to achieve very high levels of FTTP coverage in Berkshire, Essex and Gloucestershire with public subsidy invested alongside its own finances.

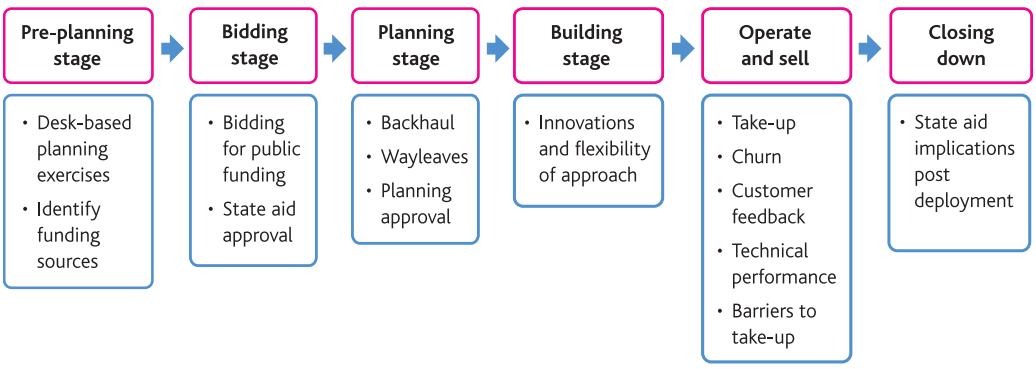
6. Detailed deployment learnings

Overarching Key Findings

- All the technologies being used in the Pilots have demonstrated in customer tests that they are capable of superfast speeds.
- The vast majority (94%) of 93 Pilot customers surveyed feel that their Pilot broadband service is an improvement on their previous service. This level of satisfaction is consistently high across the different technologies.
- Smaller suppliers using different technologies have proved able to win and deliver open public procurements at competitive costs, and have passed the necessary EU State aid requirements to receive public funding.
- The Pilots suppliers have demonstrated numerous innovations in deployment to reduce the public subsidy required.
- When compared to other BDUK funded broadband interventions, the Pilots are performing well so far in terms of take up, and some are performing very well.
- Customer surveys and customer choice of Pilot packages to date suggest that the majority of people in the Pilot areas are generally content with a slower (albeit a step change in speed), cheaper broadband service from the new supplier, rather than opting for superfast.

The range of findings that the Market Test Pilots have presented can be considered in relation to the lifecycle of a publicly funded project as illustrated in Figure 4 below. This part of the interim findings report explores the detailed findings to date under each of the project stages shown.

Figure 4: The Pilot project outcomes in relation to the lifecycle of a publicly funded project



PRE-PLANNING STAGE

Publicly funded broadband infrastructure projects require considerable pre-planning prior to the bidding stage

Key Findings

- Some suppliers were too optimistic in their assumptions around the costs and timing of their network deployment
- Significant resource was required from BDUK to prepare supplier for, and to assist them through, the pre-planning and bidding stages.
- Much of the design in hard to reach areas can be carried out accurately using desktop tools for radio planning, fibre route planning, and detailed mapping.

Before submitting bids to public tenders for broadband infrastructure projects, suppliers need to undertake a rigorous pre-planning stage. This stage involves defining the likely technical solution, identifying project partners where appropriate, estimating the cost of materials and the cost and duration of the activities. Furthermore, a high level financial model is required at this stage that identifies the required minimum take up assumptions and funding requirements.

Some of the Market Test Pilots have been overly optimistic in their assumptions related to costs, timing and take up, meanwhile others have proved more accurate. One finding that is common across the Pilots is the benefit of desk based planning and free software tools, as set out below.

Case Study: The value of desktop planning tools

Desktop planning tools allowed the suppliers to draw up accurate plans at relatively low cost, with less need to conduct more expensive site surveys in each location. Radio planning tools, Google Earth and Google Street View have all helped reduce the cost of on-site scoping. ***Cybermoor***, for example, used a fibre network design tool called buildfibre.com, provided by their partner Rala, which is overlaid onto Google maps.

Finally, the majority of the Pilots have needed significant aid from BDUK in terms of resource to prepare for and successfully navigate the bidding stage, beginning in the months prior to bidding and continuing up until State aid clearance.

BIDDING STAGE

Bidding for public funding

In order to tender for publicly funded work in the UK, public institutions must hold open tenders, for which any potential tenderers can bid.

Key message

- Smaller suppliers have demonstrated they are able to win and deliver public procurements, including gaining State aid approval.
- Suppliers unfamiliar with public procurement should seek guidance to ensure their bids address the public sector's objectives

DCMS asked Tenderers to (i) propose technical, commercial or operational solutions which had the potential to cover a significant proportion of the remaining 5% of unserved areas in the UK with superfast broadband and (ii) to propose methods by which it could be tested whether these solutions were viable.

DCMS evaluated the tendered solutions and awarded single contracts to fund the desk based design and subsequent deployment of Pilot networks for the most economically advantageous solutions. DCMS received 38 bids from 26 suppliers, demonstrating the diversity of interest from the market.

Many suppliers had not bid for public projects before, illustrating the importance to suppliers of gaining experience or seeking guidance in this area.

- Bidders generally described their technical solutions well, although sometimes provided limited descriptions as to how the network design included sufficient capacity, which is required to support State aid approval for the project.
- Weaker bids did not describe a customer acquisition strategy, did not identify the ISP that would be offering services, or otherwise showed a lack of detail or coherence in implementation plans
- Financial models was a key differentiator between bidders. BDUK was looking for plans to be conservative and provide sufficient detail of one-off and ongoing costs to demonstrate commercial sustainability. BDUK also looked for bidders to identify cashflow requirements accurately and demonstrate where commercial sources of funding were coming from, especially where not supported by a bidder's balance sheet.

Since the Market Test Pilot programme began, two of the Pilot suppliers, Call Flow and AB Internet, have successfully bid for further public contracts[36], demonstrating the value of the experience gained by suppliers through the Pilot programme's bidding process.

[36] Call Flow in Berkshire, AB Internet on the west coast of Scotland

State aid

In order to receive government funding, all broadband suppliers must first meet the necessary EU-wide State aid requirements.

Key Findings

- Suppliers must agree potential deployment areas with Local Authorities early in the planning cycle; Local Authorities need to then ensure these areas are de-scoped from any other intervention plans.
- The suppliers required significant support from BDUK to help navigate the State aid process, especially if they did not have prior experience.
- Five Pilots successfully gained State Aid clearance as Next Generation Access[37], all of which included Fixed Wireless elements in the technical solution. Both Satellite projects gained state aid approval as Basic interventions.

Within the BDUK environment, the State aid approval process requires that the postcodes for the intervention area are de-scoped from other intervention projects such as the Phase 1 and Phase 2 superfast contracts. This step is important in giving suppliers confidence that public funds will not be used to support overlapping networks that could compete for the same potential customers and diminish the sustainability of the network.

To meet the State aid approval process, all projects needed to allow for a month-long public consultation period, as well as any time requirement for the local authority to make arrangements to de-scope areas from existing publicly subsidised intervention projects.

In applying for State aid, suppliers needed to be taken through several stages, including:

- understanding why State aid approval is required and what this means;
- classification and mapping of service availability (black, white and grey for NGA and basic broadband);
- help with interpretation of European terms and guidance, especially around what constitutes successful NGA infrastructure; and
- the need to offer wholesale services and third party access to funded infrastructure.

For some suppliers the State aid approval process was efficient, taking around four weeks to complete, while for others it took a period of months, delaying the start of the deployment. Specifying Fixed Wireless Access designs and components to sufficient detail was one of the key reasons for this difference in approval times. The use of unlicensed and lightly licensed spectrum requires careful consideration in terms of contingency planning for network resilience in the event of unexpected and high levels of interference. BDUK can provide suppliers with guidance on this key requirement for State aid approval, and is preparing worked examples to illustrate the level of evidence required.

[37] Next Generation Access, or NGA, is an agreed level of network capable of delivering at least 30Mbps download speeds, as defined in the UK's National Broadband Scheme block exemption: https://www.gov.uk/government/publications/state-aid-decision-on-the-national-broadband-scheme-for-the-uk

PLANNING STAGE

Within the planning stage, the main themes emerging across the projects relate to backhaul, wayleaves, local planning applications and community engagement.

Backhaul

Backhaul in this context refers to the approach to connecting the supplier's local network to regional and national networks for connectivity to the global Internet. This connection can be achieved via fibre, point-point radio links or satellite. Perhaps more importantly, this backhaul infrastructure can be built and owned by the supplier or rented from a third party as a network service. In rural areas, the cost of this backhaul infrastructure or service can form a significant part of the overall project costs and as such, any decision or option to reduce costs can have a fundamental impact on the commercial viability of the project.

Key Findings

- The cost of bringing backhaul into remote areas, has been identified by suppliers as an obstacle to broadband rollout in many rural areas.
- The larger the intervention area, the more chance of proximity to existing network infrastructure, thereby reducing backhaul costs.
- Backhaul that has already been sourced to support one area can be used to support adjacent or nearby areas where cost-effective backhaul might not be available.

For non-satellite technologies, the cost of backhaul connectivity is a fundamental factor impacting on broadband infrastructure deployment. The cost of a backhaul solution can prove a particular barrier in the hardest to reach areas with distance-related pricing and where the nearest suitable break out point in the existing backhaul infrastructure might be a significant distance away. .

The distance from the nearest fibre flexibility node from which an Ethernet backhaul product can be connected determines the availability and the cost of backhaul to the project area. BT Openreach has the largest UK rural footprint for backhaul and many exchanges in unserved target areas are not yet included in BT's 21CN rollout (which typically indicates the availability of Ethernet backhaul products). Some gaps can be filled by other operators such as Level 3, Virgin Media, Vodafone (the former Cable & Wireless network) and Cityfibre.

As these and other operators expand their backhaul networks, as physical infrastructure networks are made available to support their deployment, or as prices for backhaul products fall, more and more clusters could become commercially viable.

Case Study: The difficulty of procuring backhaul in sparse locations

The sparse location of ***Airwave's*** two sites for backhaul connectivity has limited their ability to diversify backhaul. Airwave did not embark on building their own backhaul, preferring to use BT Openreach wholesale offers.

The high cost of deployment if indirect costs are considered (e.g. liability for indemnity costs), and long lead time of leasing backhaul from BT, has prompted

Airwave to explore cheaper alternative solutions from LN Communications to use their own transmission networks. This solution will not only minimise opex costs for Airwave but potentially shorten the deployment timescales compared to those experienced with BT Openreach to date.

The Call Flow Pilot has demonstrated that the number of premises within the intervention area is critical to the ongoing sustainability of the network. The supplier believes that its model works best for an area size of minimum 3,000 premises to allow the retail price to align with typical retail packages in competitive areas. The area does not have to be contiguous, but the 'islands' of connectivity would need to be located at a maximum distance of approximately 4km of each other. The Pilot has shown that the model is sustainable with 1,500 premises per backhaul link, but the retail price point is as a consequence approximately 20% higher than typical urban areas.

Case Study: 'Village pump' model

Satellite Internet has approached the backhaul challenge by using a high capacity satellite link to provide an affordable backhaul via a 'village pump' model into extremely challenging locations. The satellite link, typically 40Mbps but potentially faster, is distributed to multiple consumers using the fixed wireless access network. The specification (and hence cost) of the satellite backhaul link is higher than each individual home might typically expect but is shared across upto 25 end users.

Wayleaves

A wayleave is a legal agreement where a supplier secures the right to install or retain infrastructure on private land, normally involving an annual payment from the supplier to the landowner.

Key Findings

- Early engagement with landowners on wayleaves is essential to ensure a swift roll out programme and securing preferred network routes.
- Emphasising the win-win element of wayleaves, where a landowner might receive early or expedited connectivity or subsidised service in return (Benefits in Kind), can significantly reduce ongoing operational costs.

The Pilots have demonstrated that early notice of potential issues in securing rights of access is needed to allow an infrastructure provider to develop alternative solutions which can prevent the need to submit to onerous contracts and incur excessive costs.

Targeted use of either wayleave or easement (a permanent arrangement) can allow capital costs for property access to be either addressed at initial infrastructure installation (easement tends to be a larger one off payment for access) or directed towards operational expenditure.

The Cybermoor project found that the community meetings that were set up to promote the community share offers have been a useful means through which landowners can be confirmed and engaged positively for the benefit of the project.

Case Study: Negotiating low-cost wayleaves

Call Flow and ***Cybermoor*** have successfully negotiated wayleaves with landowners on long term agreements at low cost, and both projects have also agreed easements with the National Trust. Early scenario planning and identifying alternative routes for deployed infrastructure can lead to preferential rates for securing leases and wayleaves. This also reduces the risk to the programme as, where necessary, alternative solutions are already scoped and planned.

Cybermoor found that negotiating wayleaves with charities proved more challenging than expected – their internal rules seemed to restrict their ability to have a flexible approach towards community enterprises, despite the good intent of the management.

Satellite as a technology tends to avoid the need for wayleaves or access to land.

Local Authority planning approvals

Sometimes planning permission is required from local planning bodies in order to build on land, or change the use of land or buildings.

Key Findings

- Opting to apply for a temporary planning approval can allow a period to establish the value of a particular piece of infrastructure, and begin revenue streams from customers, prior to full approval.
- Engaging with planning authorities in a series of 'pre-planning' stages can help to reduce lead times for planning approval and provide an opportunity to mitigate in advance any concerns from the authorities.
- Extra requirements in order to gain planning approval in a national parks can add significant cost to the site, although this has not been the case in all instances across the Pilots.

The case study below sets out Quickline's process of installing temporary masts while awaiting full planning permission. There are clear advantages to this approach, such as establishing the likely value of a piece of infrastructure and starting revenue streams. However, this also creates a risk of ceasing customer connections from that infrastructure if the planning application is not ultimately successful.

Case Study: Deployment of temporary masts

Quickline has followed a process of putting in temporary masts while awaiting full planning permission in order to connect customers and start up revenue streams.

When a planning application is put into the authority, Quickline deploy a temporary mast as soon as they have landowner agreement. The length of time the temporary mobile mast needs to be deployed for is dependent upon how long the planning authority take processing the application. Once planning application is approved, Quickline transfer customers during the night once the permanent mast has been built so there is minimal impact or disruption to customers.

For smaller sites such as telegraph poles, Quickline have negotiated an approach of installing them and putting a planning application in at the same time. The process for this varies between different local authorities.

Some of the Pilots have successfully used 'pre-planning' stages with Local Authorities as a means to reduce lead times for planning by successfully mitigating planning approval concerns in advance.

Some have also deployed infrastructure in national parks, with mixed implications, as the case study below sets out.

Case Study: Planning approval in National Parks

From the experience of the Pilots, gaining planning approval in National Parks can sometimes add significantly to the cost of a project. In the ***Airwave*** project for example, the cost of site builds at both the concentrator and access level proved to be higher than estimated due to a planning requirement to build dry stone walls around the sites, which increased the cost of the mast sites by approximately 67%.

However, three other Pilots – ***Satellite Internet***, ***AB Internet*** and ***Call Flow*** – are also deploying sites in National Parks, and these sites have not been subject to similar cost increases.

BUILDING STAGE

Once the planning stage is completed building, or network deployment, can begin. The first Pilot projects began deployment in February 2015, and all are due to complete deployment by March 2016.

Key Findings

- Suppliers have proven to be resilient, flexible, skilled and experienced in building the required infrastructures.
- The deployment timescales on some projects has been longer than anticipated at planning stage. In some cases the technical solution or the locations presented a more complex challenge than on the supplier's previous similar deployments; in other cases the suppliers were simply overly optimistic about their build capabilities.

Listed below are a number of measures or approaches that have resulted in cost saving for the Pilot suppliers.

Fixed wireless build

Build sites: The economics of fixed wireless infrastructure are particularly suited to difficult terrain (e.g. areas with lots of hills or many trees) and for areas where the density is low. However, where the density is very low, the business case for fixed wireless faces challenges when in new sites (e.g. National Parks). Building a network in sparse areas can involve substantial cash-flow losses in early years, when the site is being built out mainly because the sites lack backhaul and power and break-even cash-flows at later stages.

Microwave backhaul: the Airwave and Quickline Pilots have been able to demonstrate the benefit of microwave backhaul by making the use of licensed and unlicensed radio link to minimise capex and opex costs. In addition, the suppliers were able to deliver network management securely across the backhaul link exploiting previously un-required functionality inherent on the equipment used.

Temporary masts: the deployment of fixed wireless proved that temporary masts can be an effective tactical approach on almost all ground surfaces and not expensive to install. There is no need to dig up to install these masts, which means a big portion of fixed-capital cost is not incurred in advance of signing up the first customer. On the contrary, these masts help to unlock early revenues whilst waiting to overcome administrative hurdles (i.e. planning approval). Temporary masts also have lower maintenance costs and can be deployed faster than fibre – in some instances, the tower is raised hydraulically and can be set up within two hours. As discussed in the planning stage, however, temporary masts create a risk that customer services will be discontinued from that mast if planning approval is denied.

Dimensioning for coverage: In Airwave's deployment, the number of masts built was decreased from the initial plan achieving economies of scale, although coverage remained the same. Once the sites had been built, the dimensioning of the network meant Airwave was able to reach further premises without the need for additional sites.

Hybrid fibre and fixed wireless build

Use of BT's ducts and poles: By using existing BT Openreach assets through its Passive Infrastructure Access (PIA) products, requirements for costly capital infrastructure investment can be reduced significantly. This method requires careful planning around surveying infrastructure and the potential for capital costs in repair or reinstatement. However it does allow for shifting significant upfront capital costs to operational expenditure. When undertaking surveys for Passive Infrastructure Access, retaining a civils contractor to resolve problems such as blocked ducts on the spot avoiding the need for second visits for repair.

Case Study: Developing the case for new sub loop unbundling (SLU) products:

The ***Call Flow*** Pilot has provided an opportunity to work with BT Openreach to evaluate the feasibility and define the commercial benefits for unbundling BT's copper network at flexibility points beyond the cabinets. Call Flow believes this could be of key importance to extending cost effective fibre coverage into rural areas. The 'proof-of-concept' trial is providing important new learnings on the feasibility of the new products and has provided evidence to support a formal Statement of Requirement (SoR).

New build techniques: The use of impact moles for road crossings, where feasible, reduces the need for costly road closures and civils costs; the use of mole ploughing, and in particular using water contractors for this work, results in very low cost per metre for duct installation and rapid installation when compared to other trenching methods. For rural deployments, using a contractor experienced in water infrastructure can harness the experience of fast, accurate trenching, and means that in the inevitable case that damage is caused to any existing sewage or water infrastructure they have the skills required to repair and continue deployment without significant delay. Not all Local Authorities permit the use of mole ploughs in land under their control, but suppliers are free to choose the build approach where wayleaves have been agreed on private land. Aerial flown fibre can be deployed rapidly on telegraph poles under the relaxed planning rules where road crossings are proving too challenging or introducing unacceptable delays.

Effective desk based planning: much of the design in hard to reach areas can be carried out accurately using desktop tools such as radio planning tools, Google Earth and Google Street View, which can reduce the overall cost of the on-site scoping.

Satellite build

The latest consumer equipment, if dovetailed with the necessary earth station hub equipment (i.e. at the main satellite receiving station), can deliver a robust superfast broadband service capable of meeting the majority of current home consumer demands. Forward planning is required to ensure that the necessary earth station equipment is in place to enable the consumer products to be available.

Infrastructure: For the Avanti Pilot project, the earth station required additional equipment. Where new or additional equipment is needed, this requires careful planning and the lead time for delivery of large pieces of new equipment proved to be significant.

Satellite Internet has combined satellite and fixed wireless technologies. Building the hub equipment to provide the satellite backhaul is technically complex in that a high level of skill and knowledge is required to combine the best of satellite technology with the best of fixed wireless technologies. This approach has allowed a rapid deployment of high speed and even superfast broadband services. It has also required expertise in both satellite and fixed wireless networking technologies. This increases risk both in terms of increasing the level of specialism required to maintain the service and also due to the multiplier effect of running the two technologies back to back. There were significant service outages during the first few days of service as the technologies were deployed. Once fully established and backed up with the correct level of technical expertise, the technology has performed reliably.

Access to suitable locations to install hub equipment required a period of local consumer engagement ahead of confirming the final build and deployment plans, described under the community engagement section above.

Customer Premises Equipment (CPE): Direct to home satellite deployment is quick and cost effective in remote locations with installation being no more complicated than a satellite TV installation. Home installation kits are available for DIY installs although alignment is key to a high quality and reliable connection so some operators avoid the DIY Market.

OPERATE AND SELL

In order to remain commercially sustainable, revenue from customers has to cover the costs of operating and maintaining the infrastructure as well as the costs of service provision. Revenue depends largely on take up by new customers and retention of existing customers.

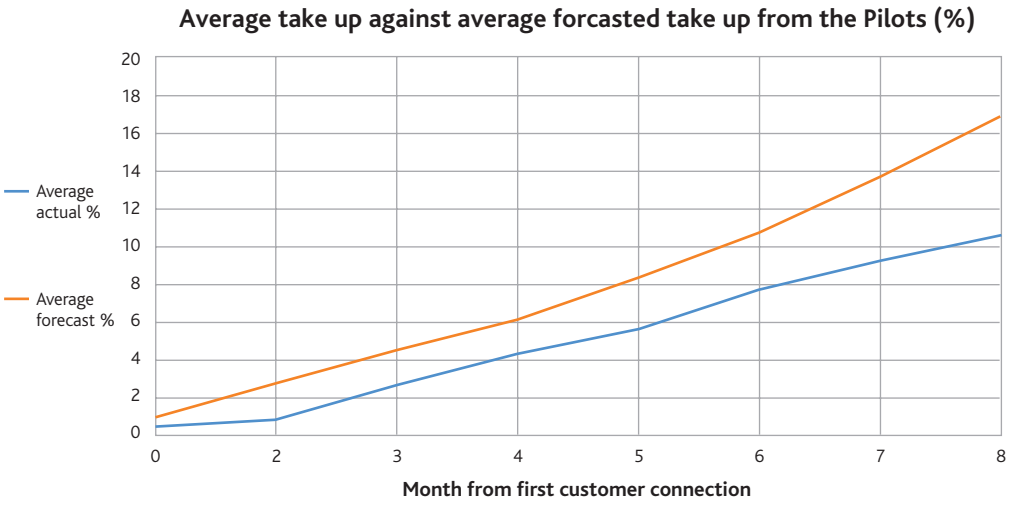
Take up

Key Findings

- When compared to other BDUK funded broadband interventions, the Pilots are performing well in terms of take up, and some are performing very well
- The Pilot suppliers were optimistic about the rate at which the customers would be acquired in the immediate months after deployment.

Set out below are two figures: *Figure 5* and *Figure 6*. *Figure 5* sets out a number of Pilots' take up to date (in % of final premises passed[38]) compared to their forecast take up. The forecasts and actual take up % have been averaged across a number of Pilots, in order to show the overall trend. In each case the actual take up and forecast take up begin from the month of the first customer connection.

Figure 5



As can be seen, while some suppliers were more accurate in their forecasting than others, the average trend is that suppliers overestimated take up after six months slightly, with an average figure of 2.7% between the forecast take up and actual take up at that stage.[39] This means that for the first six months from first customer connection the suppliers' forecast were broadly accurate except for being a month ahead of the actual take up, meaning suppliers were too optimistic about the speed of take up from first customer connection.

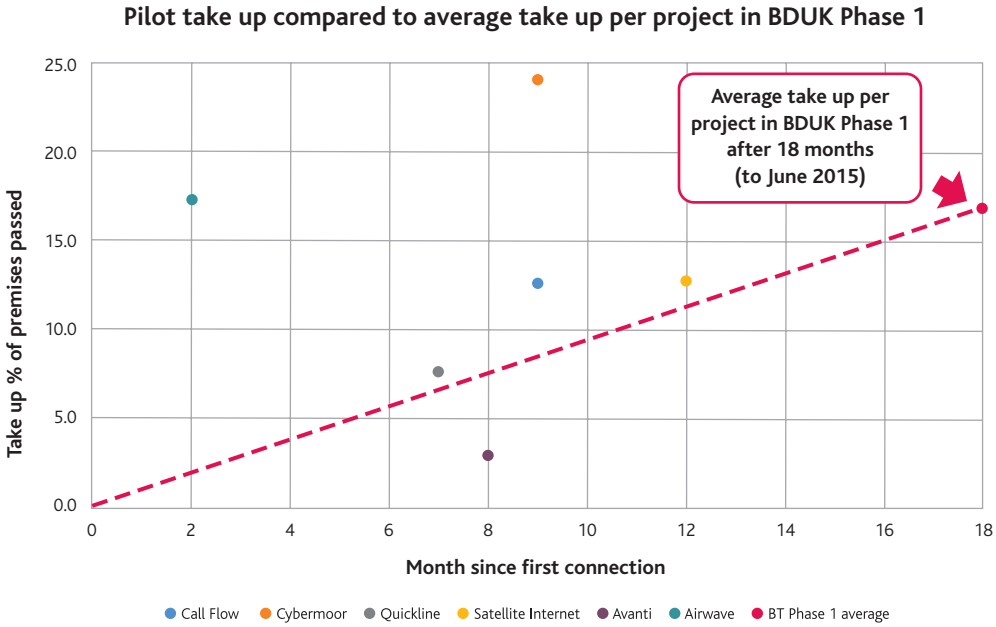
[38] Premises passed here means any premises who are able to access a broadband service from that supplier

[39] This figure was calculated by, for each Pilot, dividing both forecast and actual take up for each month since first connection by the final premises passed target, and turning these figures into percentages. The percentages for each Pilot were then turned into a single average figure across the Pilots.

After month six, however, the actual take up begins to diverge from the forecast take up curve, growing to a gap of 4.9% by month 8. It is unclear why this divergence has occurred, but there are many possible factors limiting take up growth, for example: a lack of demand from customers for higher speeds; a distrust of new technologies; customer satisfaction with their current broadband service; or customers being tied into long contracts with their existing suppliers. The 'barriers to take up' section below explores BDUK's findings in this area.

Figure 6 below shows take up from the Pilots so far by month as a percentage of premises passed by that month – so in each case the take up is a percentile of the total number of premises who could take up a service at that point. To show the diversity in take up so far, all six suppliers who have connected customers are shown. Providing some comparison with the wider BDUK programme, the average take up per project from the 44 BDUK Phase 1 projects is approximated as a linear relationship to reach the average 18 month take-up figure of 16.8%, as at June 2015.[40]

Figure 6



For both the averaged Phase 1 project figure and the Pilot figures, the calculation on the chart is take up divided by premises passed at that point in deployment. This includes the continuous commissioning of new infrastructure (as the projects are still deploying new infrastructure) which takes time to reach high take up percentages.

As can be seen, the majority of the Pilot projects are on track to achieve the 16.8% Phase 1 project average much sooner than 18 months, and Cybermoor and Airwave have already achieved this. However the Pilot suppliers' business cases require a greater level of take-up than the BDUK Phase 1 projects, in general. It should also be noted that, due to the nature of its satellite solution, Avanti is able to target a far greater

[40] Note that this is average take up per project in BDUK Phase 1, and does not take account of differences in the relative size of Phase 1 projects; this means it does not represent take up across the BDUK Phase 1 projects as a whole. The publicly available figures can be viewed here: https://docs.google.com/spreadsheets/d/1Hs00bNsyRV1WoOt-fow3rsNXzpcKg26AsOWvk1bvJRk/edit#gid=0

area, and its take-up target[41] is therefore much lower than the other Pilot suppliers, and could reach a maximum of 10% (1,000 customers connected) on this graph.

Barriers to take up in the hardest to reach areas

Take up for a broadband infrastructure project is rarely 100% of those who could access a service if they chose to. The reasons for this can be grouped into 'barriers to take up'. In order to better understand potential barriers to take up, BDUK commissioned a telephone survey in August 2015. The findings of this survey allowed BDUK to learn more about those who had not subscribed to the MTPs in the five regions where MTPs had already begun connecting customers.

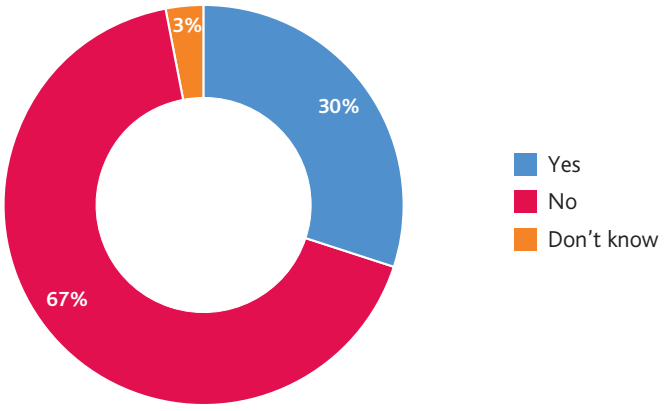
Key Findings

- Awareness of the Pilots was low in September, suggesting improved marketing could drive take up rates.
- Where customers were aware of the Pilot offer, the main reason for not taking a Pilot service was satisfaction with a current provider's service.
- There was lack of knowledge about Internet speeds and a lack of understanding about the practical capabilities of different Internet speeds. This may affect customer motivation to take up a Pilot offer if they are not able to easily understand the impact of faster speeds.
- This message is reinforced by evidence from the Pilots which suggests that when given a choice, customers prefer cheaper, slower packages; particularly if the package offered is 10Mbps.

The results of the Non Subscriber Survey suggest a number of factors with the potential to prevent take up of the superfast broadband service being offered by the MTPs:

A lack of awareness of the Pilots: Meaning that potential consumers do not know about the MTP offer despite living in the eligible area. 67% of respondents either had not heard of the Pilot scheme or were unsure if they had heard about it, compared to just 30% who had. This suggests that there is untapped potential for increased take up with more focused marketing, although it should be noted that this survey was conducted after only four months of deployment in most Pilot areas; BDUK would expect future surveys to show increased awareness.

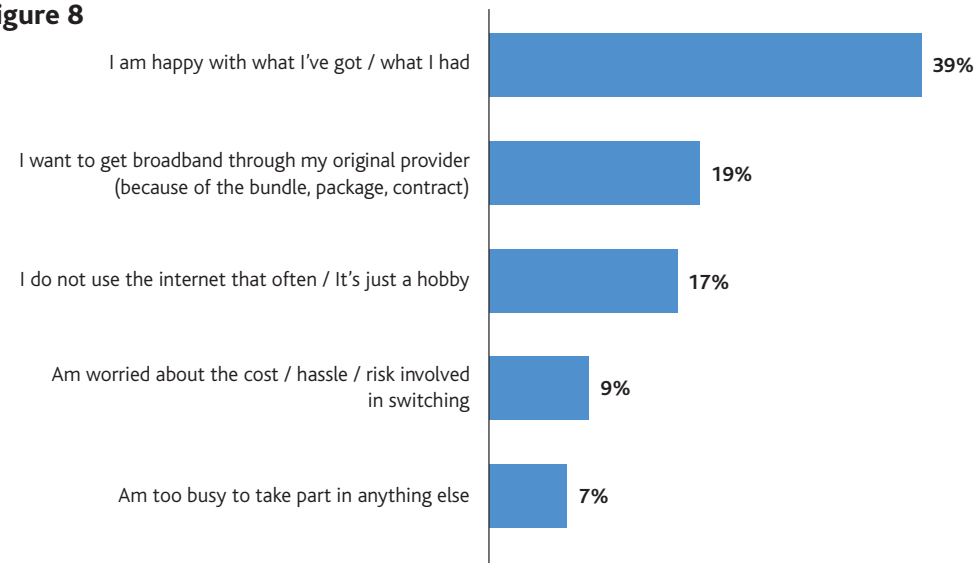
Figure 7



[41] Avanti's take up here is measured as number of customers connected as a proportion of eligible customers who have received direct marketing about the Pilot offer. As Avanti can connect a maximum of 1000 customers, and around 10,000 eligible premises have received direct marketing, they could only achieve a 'maximum' of 10% take up on this graph. Their current take up of around 300 customers therefore corresponds to just 3% on this graph, but actually represents 30% of their target number of connections in the Pilot.

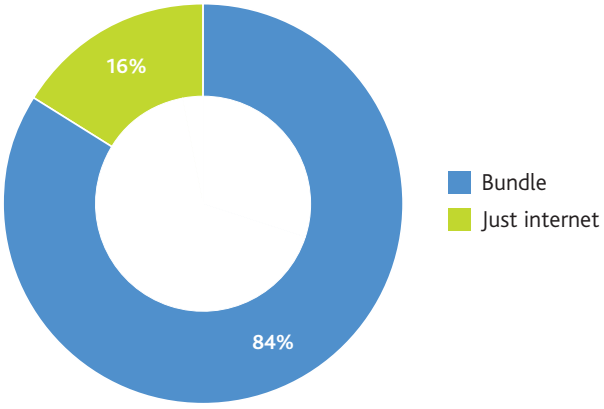
Satisfaction with current supplier: The primary reason for not participating in the scheme (among those who were aware of the MTP offer) was customer satisfaction with a current providers' service. 39% of those surveyed, when asked why they were not or would not be interested in the scheme, said it was because they were happy with the service that they already received. This suggests a lack of incentive among potential consumers, even though they are in an area without high speed broadband.

Figure 8



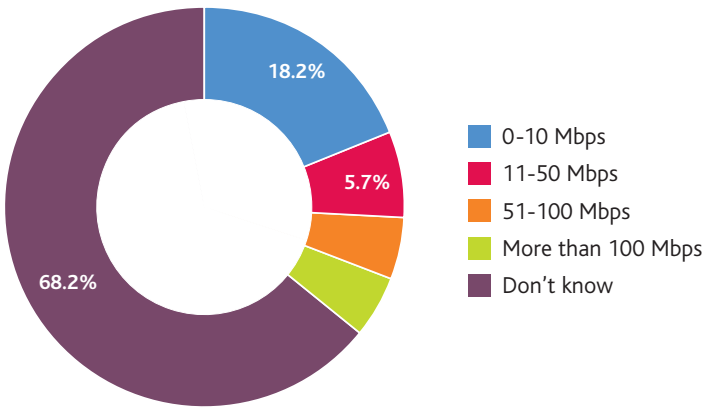
Internet bundles: Well over three quarters of those surveyed (84%) stated that they received their internet as part of a bundle or package. Over half (51%) of those who received their internet through a bundle or package said that they were 'unlikely' to take up the offer of the MTP, suggesting that the existence of bundles with their existing service is a barrier to take up of a Pilot service.

Figure 9



Lack of understanding re Internet Speeds: More than two thirds (68%) of total respondents didn't know what their internet speed was, and over a third (36%) weren't sure what their data usage was

Figure 10



Case Study: Customer package preferences from the Pilots to date

Take up data so far from across the Pilots so far suggest that when given an option, the majority of customers prefer slower (yet significantly improved), cheaper packages to faster, more expensive ones. When offered the choice of a 10Mbps service or a superfast-capable service (above 25Mbps, typically 30Mbps), more than twice as many customers have opted for the 10Mbps compared to the superfast service. This implies (pending a more comprehensive set of data by March 2016) that many customers find 10Mbps an acceptable speed, and might present a challenge to suppliers marketing a purely superfast solution. Due to this apparent customer preference, one of the Pilot suppliers who offers just superfast packages is now considering introducing a 10Mbps service for customers.

Technical performance of the Pilot technologies

All the technologies – whether FTTC, FTTP, fixed wireless or satellite based – were approved based on the expectation that they would deliver superfast speeds (more than 24Mbps)

Key Findings

- All Pilot suppliers have delivered superfast-capable broadband to their customers.
- However, the speed test results collected from the initial customer survey indicate that superfast speeds are not always consistently received by customers who have chosen a superfast service.

Satellite technologies: Avanti and Satellite Internet
The Market Testing Pilots are beginning to capture feedback from consumers using the latest generation of superfast satellite services. At this early stage it is possible to state:

- Download speeds in excess of 24Mbps are routinely possible with upload speeds exceeding 5 Mbps;
- Total data volumes and data caps have become more significant than overall download speeds because it is the total data passing through each satellite at any point in time that is the technology bottleneck, as much as maximum speed;
- Understanding the dimensioning of the wholesale services will be key to ensuring high quality (and consistent) user experience. The average bandwidth allocation per user as a total proportion of available (or allocated) bandwidth on each satellite (effectively the contention ratio) will be a key service level metric to ensure consistent end user experience.

Satellite and fixed wireless technologies: Satellite Internet
This project is delivering superfast speeds through a hybrid technology approach.

Fixed wireless technologies: Quickline and Airwave
Quickline has measured speeds in the field in their Pilot of up to 80Mbps, and has experimented with Line of Sight, Non Line of Sight and Near Line of Sight links, as set out in the case study below.

For Airwave, the live results and subscribers' observations captured from the Airwave 5GHz Point to Multipoint in West Witton are encouraging. A test laptop hosting data throughput measurement software was setup, achieving downlink speeds of up to 50Mbps. Out of the four candidate NGA technologies only 5GHz Point-to-Multipoint has so far been used to connect subscribers. However, all of the remaining wireless technology (i.e. TV White Space, LTE and WI-FI) will be measured in the field through engineering tests.

Case Study: Testing Line of Sight, Non Line of Sight and Near Line of Sight links

The ***Quickline*** Pilot's current deployment is based primarily on the existence of a Line of Sight (LoS) link between the subscriber unit and the access point. Non Line of Sight (NLoS) deployments have been unable to give superfast speeds in the Quickline Pilot because there are insufficient signal levels at the CPE to maintain all but the lowest modulation rates.

Conversely, for near Line of Sight (nLoS) there are indications the Pilot will be able to overcome signal loss in some of the postcodes of intervention area. Quickline's approach to balance the modulation rate suggests subscribers will be able to get superfast speeds with nLoS links, aided by a 28dBi mesh antenna.

Hybrid fixed wireless and fibre technologies: Call Flow and Cybermoor
Both these Pilots have demonstrated the reliability of their solutions in delivering superfast speeds to customers.

BDUK subscriber survey speed test results
As part of the first wave of subscriber surveys conducted by BDUK in August 2015, customers of the Pilot services were asked to conduct speed tests, which were then compared to the advertised speed of the package they had purchased. Of the 27 respondents to the survey who purchased speeds of 30Mbps or more, almost one third (8, 30%) registered speeds of 25+Mbps. However, over one quarter (7, 26%) registered download speeds of 14Mbps or less.[42] BDUK plan to investigate this further with two more waves of surveys planned by March 2016.

Customer experience of the Pilot technologies, customer service and churn

While a minimum level of take up is essential for the commercial sustainability of broadband infrastructure, it is also important for suppliers to retain these customers. The percentage of customers that discontinue their service, or 'churn rate', correlates to customer satisfaction with both the broadband service itself and the customer service compared to the customers' previous experience.

[42] See the BDUK subscriber survey report, attached as Annex C to this document.

Key Findings

- The vast majority (94%) of customers feel that their Pilot broadband service is an improvement on their previous service, and only a small minority (2%) do not intend to retain their Pilot service it if the price remains the same. This level of satisfaction is consistent across the different technologies.
- Both the main benefits and main drawbacks of the Pilot services are rated as the speed, reliability and cost of the new service, although a significantly greater number of customers identified them as benefits.
- Little evidence has been collected so far in regards to customer service – the next waves of surveys will be used to gather information on this.
- Too early to make any observations about churn in the Pilots

Customer experience of the Pilot technologies

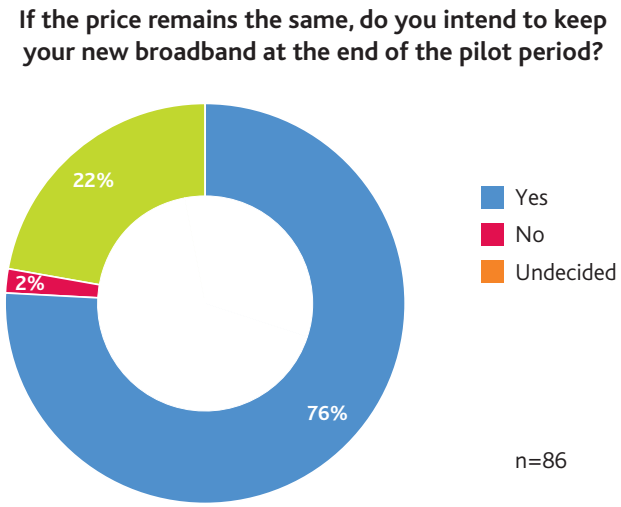
One of the objectives of the Pilots was to gather data on customer experience of the various Pilot technologies. In order to investigate this, BDUK ran an online subscriber survey – for those who had signed up to a Pilot service – from 9th August to 14th September, 2015. Overall, there were 93 responses to the survey from five of six Pilot schemes; 61 from satellite and 32 from non-satellite schemes, including both fixed wireless and fibre customers. The full BDUK subscriber survey report is attached as an annex to this document. BDUK plan to run two further subscriber surveys before the Pilots' deployment ends in March 2016.

Overall, the results show a positive subscriber experience of the Pilot services to date, which is largely consistent across all the technologies being used. While 93 is still a relatively small sample size, and many of the customers had not had their Pilot service for long, the results still indicate a positive technical experience for customers. The larger sample sizes from further surveys will help improve the reliability of these initial findings.

Increased satisfaction with new broadband compared to previous broadband.

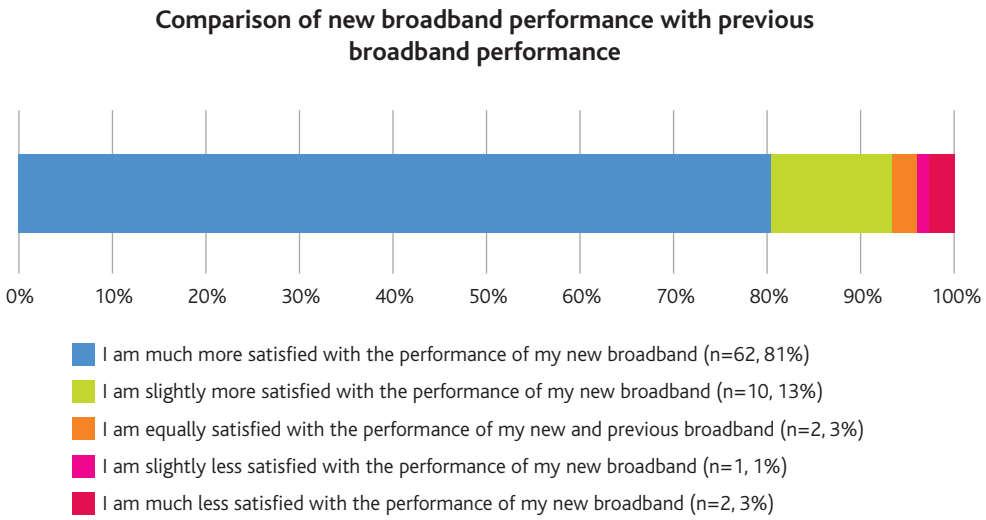
The majority of respondents (94%) were more satisfied with the performance of their new broadband from the Pilots compared with their previous service. This percentage satisfaction is consistent across all technology groups.

Figure 11



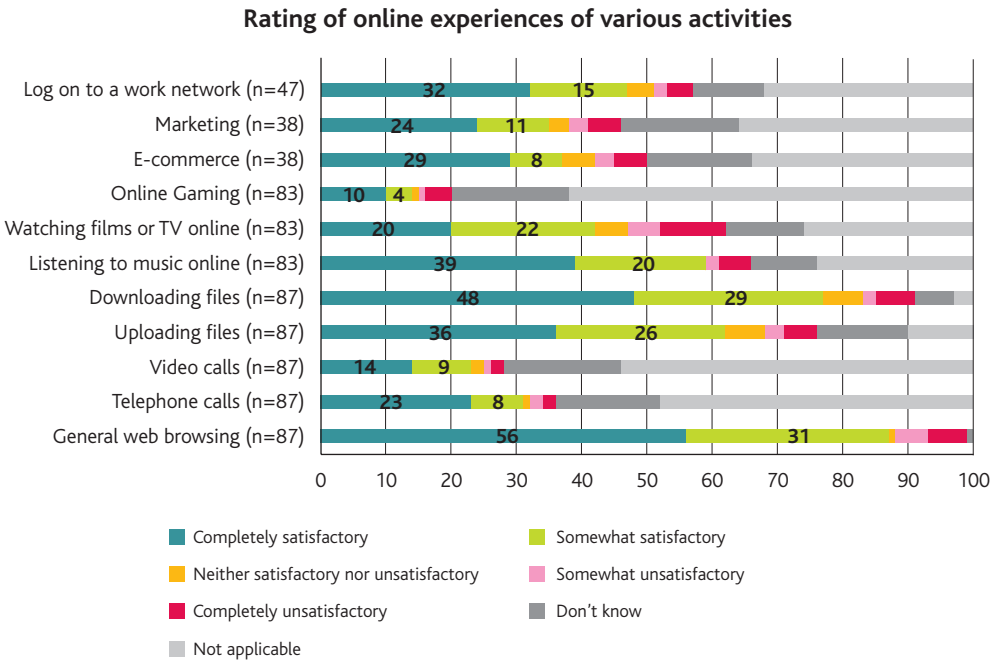
A majority of customers intend to keep a Pilot service if the price remains the same: 76% intend to keep their service at the end of the Pilot service if the price remains the same, while just 2% are sure that they won't.

Figure 12



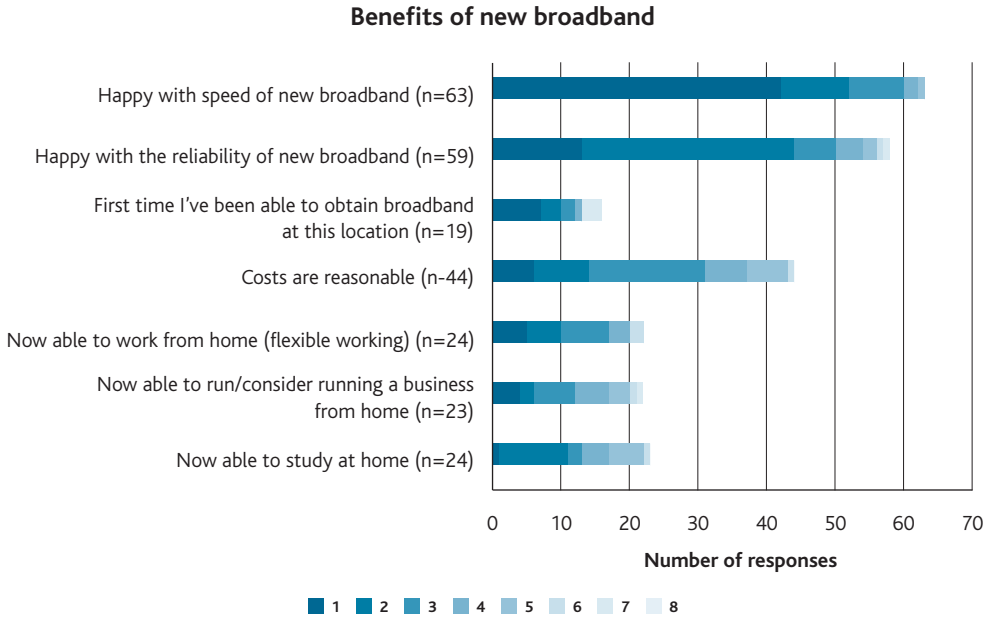
Generally positive online experiences across various activities: Over three quarters were satisfied with general web browsing and downloading files, and well over half were satisfied with uploading files and listening to music online. However, respondents appeared less satisfied with watching films or TV online, with 12 expressing some degree of dissatisfaction.

Figure 13



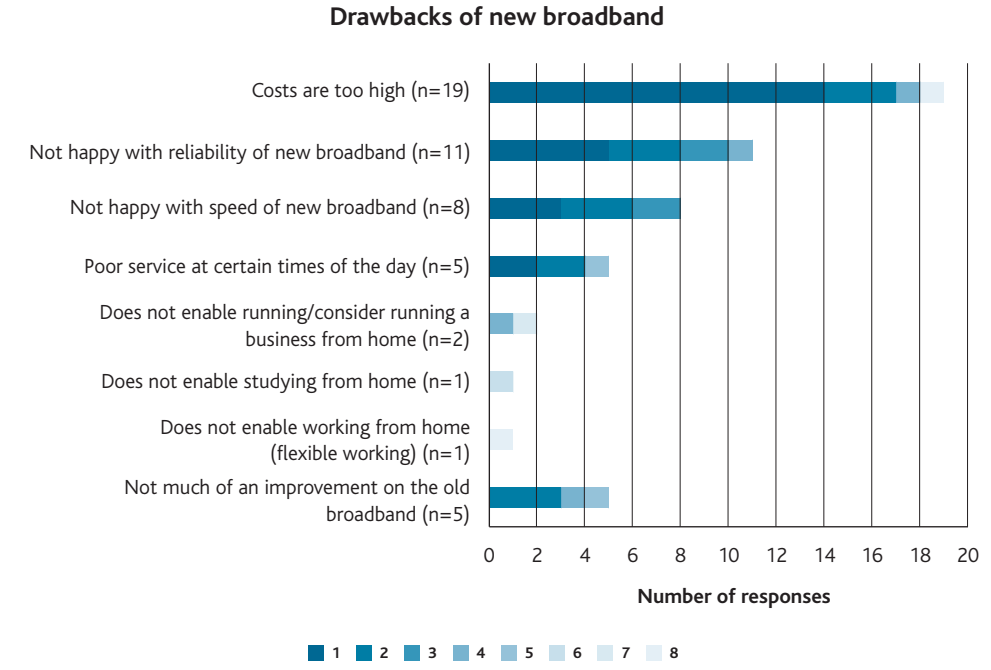
The most popular benefits expressed were speed and reliability, followed by cost. A significant number – 24 – also were now able to work or study from home for the first time, or consider running a business from home.

Figure 14



By far the most common drawback identified was cost. This was followed by unhappiness with the reliability of the new broadband service, and unhappiness with the speed of the new broadband.

Figure 15



The fact that costs, reliability and speed feature in both the top three benefits and costs of the new broadband demonstrates one of the problems with surveying customers of Pilot services – that their response when asked to evaluate their new service will depend on their frame of reference. Those comparing their service to a potential fixed

line broadband service in a city, which they might use – for example – for their work are likely to be more negative than those comparing the Pilot service to their previous home broadband service, where 94% saw an improvement. However, it is clear that a much greater number of customers listed the speed, reliability and cost as a benefit (63, 59, and 44) than listed them as a drawback (8, 11, and 19 respectively).

Customer service experience in the Pilot technologies

There is not currently sufficient evidence regarding the levels of customer service experienced across the Pilots. There were customer service concerns in regards to one of the Pilots, involving outages on the network, but these have since been resolved.

BDUK plan to use the next two waves of customer surveys to collect information on the quality of customer service being delivered by the Pilot suppliers.

Churn

It is too early to evaluate churn across the Pilots at this stage, as customers have generally signed up for a set period, and churn will generally only become apparent when this set period ends.

CONTRACT EXPIRY

All seven Market Test Pilots will finish deployment in March 2016. However, they are expected to continue and maintain service delivery for several years beyond this date. Selection of each Pilot solutions was based in part on their viability and their sustainability beyond the term of the contract.

Key Findings

- It is too early to make an evaluation of the ongoing commercial sustainability of the Pilots.
- However, all suppliers were chosen – at least in part – on BDUK's assessment of the commercial sustainability of their financial model.
- Ongoing sustainability will depend largely on whether Pilot suppliers can achieve their target levels of take up, and the early trend appears positive.

The Market Test Pilots will complete deployment of their infrastructure in March 2016. Continuation of the broadband services will then depend on the the commercial viability of the networks the Pilot suppliers have constructed.

This ongoing sustainability will depend on the balance of ongoing operational costs against revenue, which in turn will depend significantly upon levels of take up. As demonstrated in the technology explanation of the 'Developing a successful business model' section of this report, the Pilots are all deploying in the lowest 2% density of premises in the UK. This fact, coupled with relatively low numbers of potential customers in the target areas, mean that the Pilot suppliers will in many cases need a relatively high level of take up in order for the networks to remain sustainable.

Rates of take up so far look promising, but it is still too early to deliver an assessment on the ongoing viability of the Pilot networks. There is evidence, however, that enterprising suppliers are confident about being able to make these networks in challenging rural areas commercially sustainable in the long term.

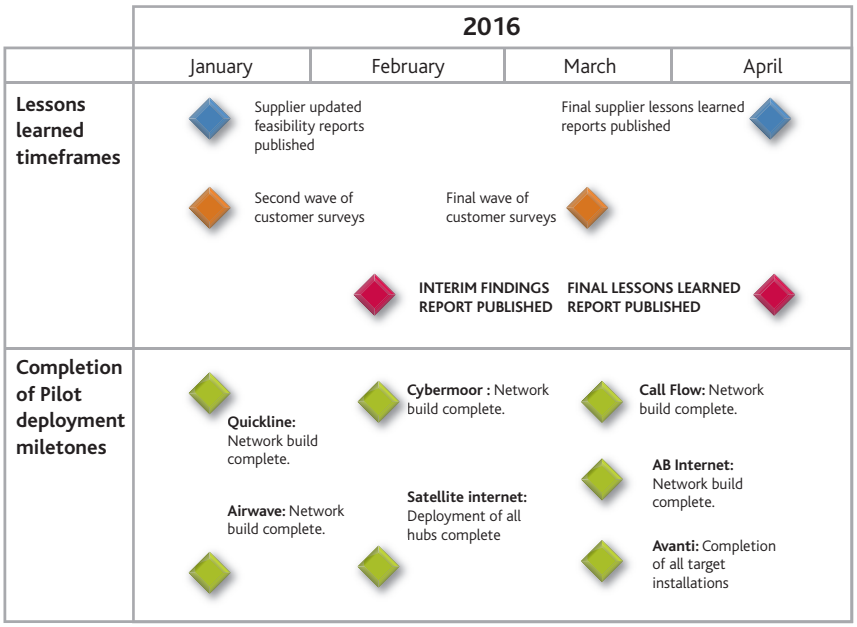
7. Timeframes and next steps

The Pilot projects will continue to build the networks and connect customers using BDUK grant funding until March 2016. Some, if not all, will continue to increase coverage using their own funding resources within the intervention areas beyond this date. The State aid approval that has been given requires that the projects are monitored for seven years in total. Pilot suppliers intend to operate the networks beyond March 2016 and believe they are commercially sustainable in the long term.

BDUK commissioned a programme of customer experience surveys in the Pilot areas in September 2015; their results are attached as annexes to this document. Two further waves of surveys are scheduled between now and the end of the programme to build on the findings from these initial surveys which poll both the subscribers to the new networks and those eligible customers within Pilot areas that have not yet taken the new superfast service.

On the supplier side, each will prepare their final feasibility updates soon after the end of the Pilot programme in March 2016. As before, these learnings from suppliers and customers will inform BDUK's final published findings.

Figure 16



All MTP's are required to adhere to conditions set by State Aid for 7 years unless they choose to close the network

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