Department for Culture Media & Sport

Emerging Findings from the BDUK Market Test Pilots

Annex A:

Individual Market Test Pilot Summaries

February 2016

Contents

Airwave – project summary

Context

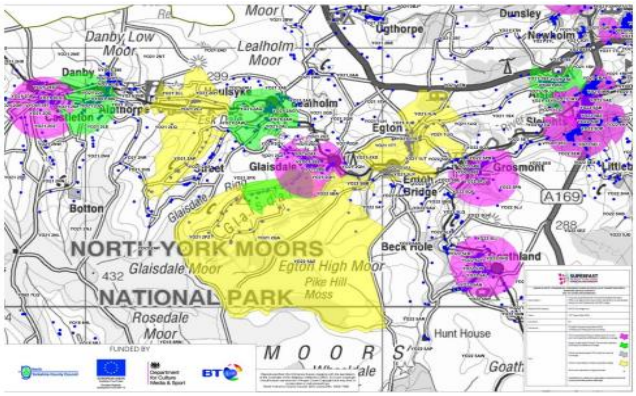
BDUK Lot 1: Technology

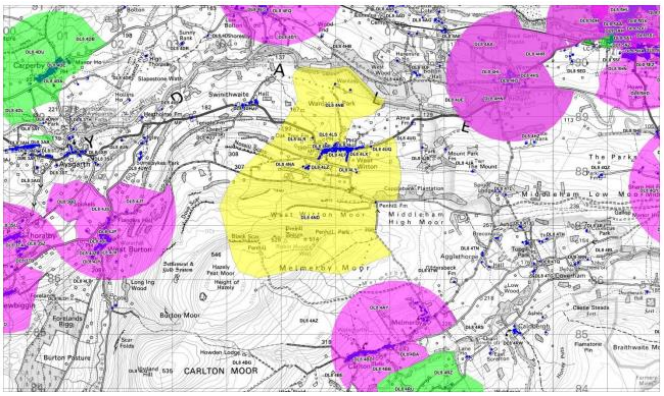
NGA technologies: Point-to-multipoint broadband fixed wireless access at 2.4Ghz or 5.8Ghz, Wi-Fi at 2.4Ghz, LTE small cells, and TV white space.

Locations: The Esk Valley and The Upper Dales.

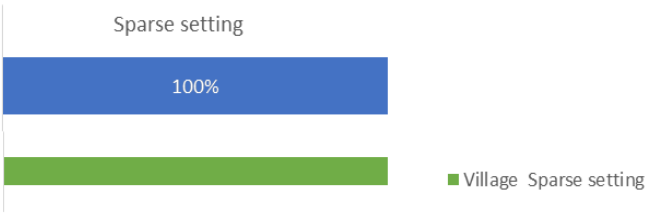
Project area: 45 km2

Premises density: 8.4 premises per km2





Rural context within the RUC2011[1]



Project size

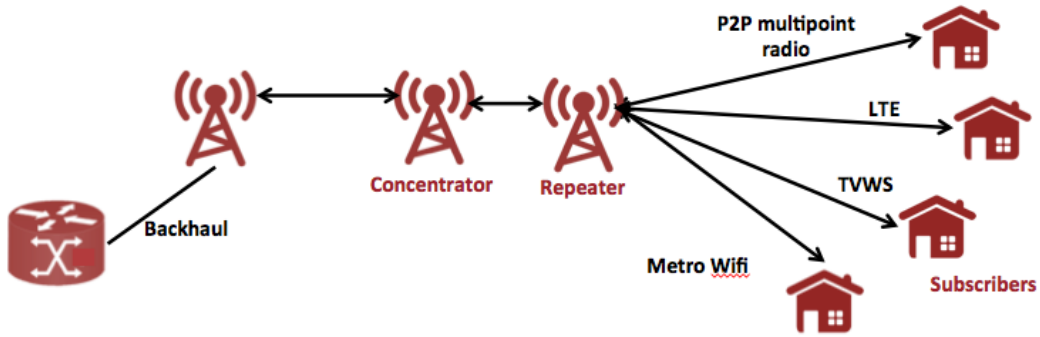
Premises cleared for State Aid (intervention area)	376
Forecast premises passed by the pilot	270 (72% of the intervention area)
Forecast premises connected by March 2016	60 (22% of the premises passed)

Summary project costs

BDUK funding for infrastructure capital costs	£1,286,133
Total infrastructure capital costs	£1,614,204
Public subsidy per premises passed	£3,421
Cost per premises passed (intervention area)	£5,979
Cost per premises passed (intervention area + overspill)	N/A

[1] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

High level solution



Original objectives of the Pilot

- To test the viability of four technologies for the last mile (to premises) of a broadband network. The four technologies are:
    - 5GHz point to multipoint;
    - TV White Space point to multipoint;
    - Wi-Fi; and
    - LTE (Long-term evolution).

Headline findings to date

- Airwave have concluded from their feasibility report that both 5GHz point-to-multipoint and LTE technology appear to be capable of meeting NGA requirements for the last mile to premises of a broadband network.
- TV White Space point-to-multipoint technology does not meet the NGA requirement at this time; however, Airwave conclude that it could potentially offer an excellent method to provide capacity over difficult terrain or through foliage cover, and evidence suggests that future generations of this technology can be expected to be NGA compliant.
- Wi-Fi also appears to be NGA capable for the last mile with low numbers of users, i.e less than 10.
- The current number of premises passed is estimated at 270 with a further 48 possibly covered but subject to survey. These numbers do not include premises outside the current intervention are postcodes, which could increase the coverage of the network with little or no extra cost, and will be reviewed later in the pilot.
- Radio network planning has worked well. Airwave has found a good correlation between the manual site surveys conducted to verify the network and automatically-generated modelling, provided that the latter uses high-resolution digital surface model terrain data.
- The test results and observations captured from the Airwave Point to Multipoint Testing in West Witton achieved downlink speeds of greater than 50Mbit/s (124 premises out of 182 premises). The drive test used a laptop connected directly into the NPE which was mounted to a fixed extendable mast coupled to the drive test vehicle.
- The network was dimensioned to target potential subscribers within 1.3 km of the base station/mast – 4 base stations are envisaged with each of them covering 50 premises.
- The planning applications were not entirely straightforward, particularly because all the new sites are in National Park areas, but the community almost unanimously approved it. Involvement from Superfast North Yorkshire and the National Park authority eased what were complex planning applications due to some of the sites being located in a National Park.
- Design of the core network was based on siting the network hubs close to BT exchanges which faced enormous issues when commissioning backhaul.
- The cost of building sites, at both the concentrator and access levels, proved to be higher than estimated – due to the planning constraints, for example the requirement to build 'dry stone walls' increased the cost by approximately 67%.
- Where it has been possible to do so Airwave have opted for the cheaper alternative of taking power from landlords' existing distribution board.

AB Internet – project summary

Context

BDUK Lot 1: Technology

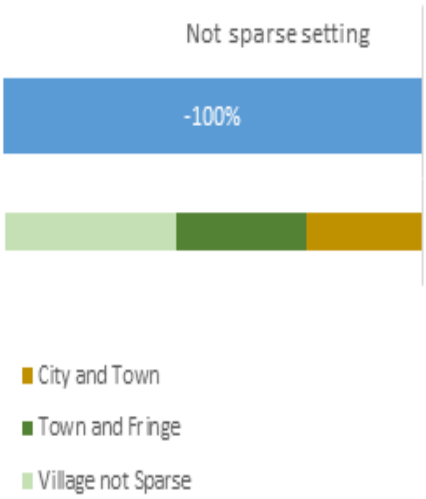
NGA technologies: Fixed wireless superfast rural broadband network.

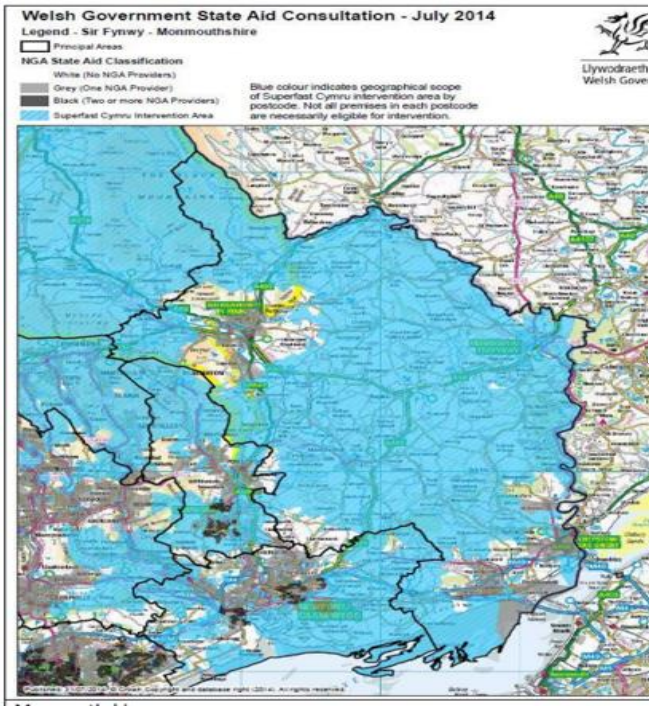
Locations: Monmouthshire

Project area: 87 km2

Premises density: 19.5 premises per km2

Rural context within the RUC2011[2]





Project size

Premises cleared for State Aid (intervention area)	1,696
Forecast premises passed by the pilot	1,600 (94% of the intervention area)
Forecast premises connected by March 2016	288 (18% of the premises passed)

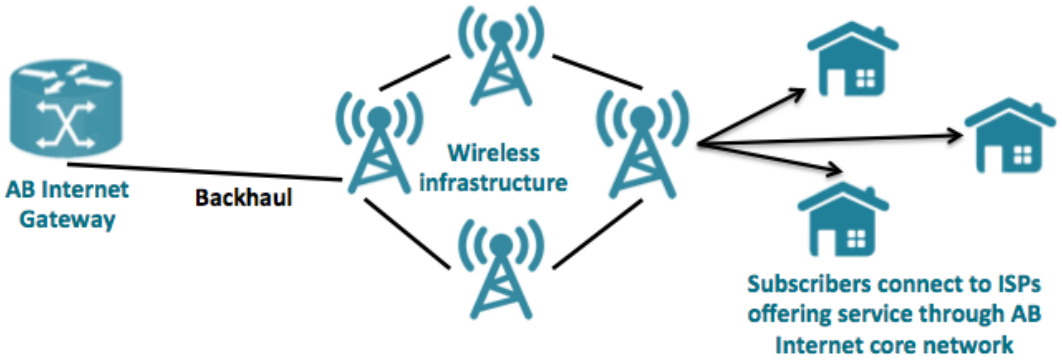
Summary project costs

BDUK funding for infrastructure capital costs:	£593,200
Total infrastructure capital costs:	£636,159
Supplier contribution:	£42,959.78
Investment ratio:	93%
Public subsidy per premises passed:	£370.75
Cost per premises passed (intervention area):	£397.59

[2] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

Cost per premises passed (intervention area + overspill):	NA

High level solution



Original objectives of the Pilot

- To educate the market about FWA networks and to establish their NGA credentials as well as their suitability to be deployed in the final 5%.

Headline findings to date

- The feasibility stage has confirmed the assumptions of the commercial model and deployment is viable in the remaining 5% and especially in challenging geographies.
- State aid approval for fixed wireless solutions as NGA compliant is possible but complex, and suppliers need support if they are to develop compliant solutions.
- Having the contingency site for backhaul proved to be worthwhile as it allowed the supplier to mitigate the refusal of the original site identified.
- Project management and maintaining good progress can be difficult, especially with small suppliers that have less capacity to manage internal resourcing challenges that come about due to winning other business, managing staff time off etc.
- Supplier optimism, combined with lack of detailed understanding of the constraints, especially state aid, led to unrealistic planning assumptions at the outset and subsequent project slippage.
- Support of local authority is essential, especially during the site acquisition and planning application processes.
- The lack of mandatory response times for consultants in the pre-planning stages – for example archaeologists - can delay planning approval submissions and threaten the timely deployment of the network.

Call Flow – project summary

Context

BDUK Lot 1: Technology

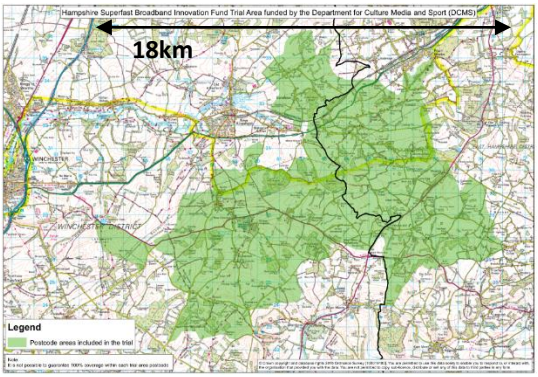
NGA technologies: FTTP, FTTC, FWA

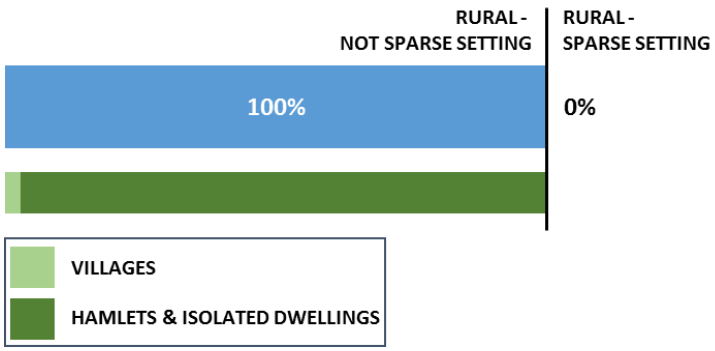
Location: Hampshire

Project area: 98 km2

Premises density: 17 premises per km2

Rural context within the RUC2011[3]





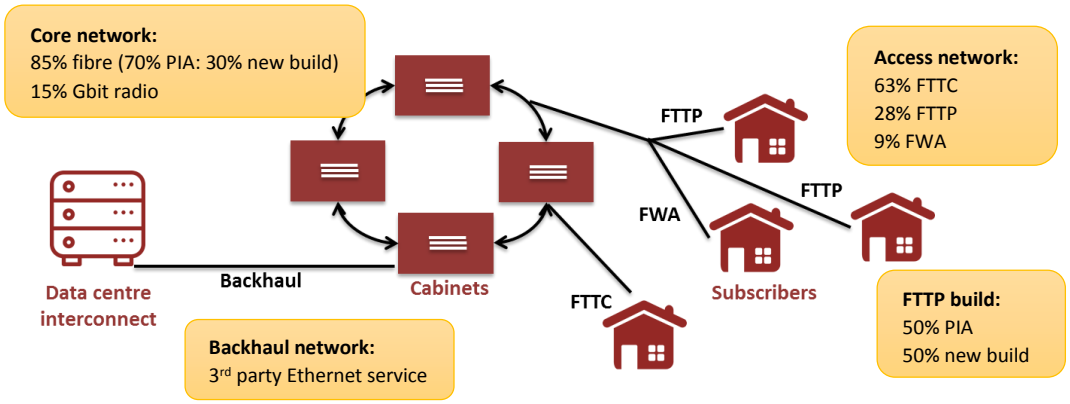
Project size

Premises cleared for State Aid (intervention area)	1,670
Forecast premises passed by the pilot	1,610 (96.4% of the intervention area)
Forecast premises connected by March 2016	225 (14% of the premises passed)

Summary project costs

BDUK funding for infrastructure capital costs	£1,258,560
Total infrastructure capital costs	£1,258,560
Public subsidy per premises passed	£782
Cost per premises passed (intervention area)	£782

High level solution



[3] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

Pilot objectives

- Illustrate how the Call Flow hybrid delivery model can achieve high coverage (>95%) of whole rural exchange areas in the Final 5%.
- Evaluate whether the technical solution and commercial model can be effective and sustainable in delivering superfast broadband solutions to the Final 5% on a larger scale.
- To test the value of different build options in reducing the cost of deploying fibre and wireless superfast networks through the use of existing infrastructure and different types of new network build.

Headline findings to date

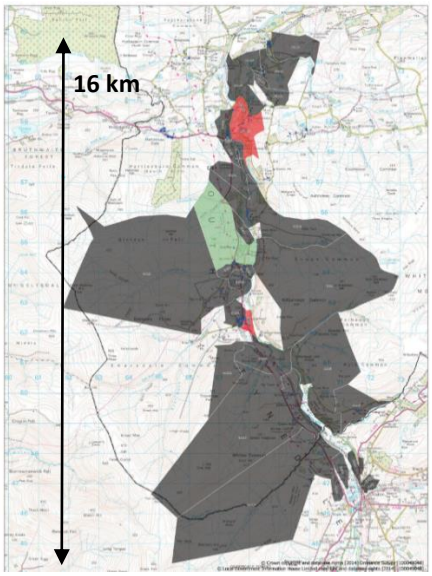
- The pilot has demonstrated a 'hybrid solution' that successfully reaches NGA white premises across three whole rural exchange areas that Call Flow believes to be typical of the Final 5%. The hybrid solution has two dimensions: access technology and build approach.
- Each access technology has its limitations and these are well understood. Combining the technologies in a way that the strengths of each complement each other is an effective method to reach dispersed rural areas.
- Multiple options for build approach that combines Physical Infrastructure Access (PIA) with own build through public or private land (new dig or new poles) adds further flexibility to tackle each local challenge and minimise costly blockages and delays which are common when using a single delivery model.
- The pilot has applied innovations that can deliver increased value for money in deployment and operations: mole ploughing, impact mole, use of water contractors for civils work, successful PIA deployment, and the proof-of-concept trial with Openreach to investigate new SLU products.
- The ability to unbundle BT's network at flexibility points beyond the cabinets could be of key importance to extending cost effective fibre coverage into the Final 5%. A 'proof-of-concept' trial that Call Flow is conducting in partnership with Openreach is providing important new learnings on the feasibility of these new products and has provided evidence to support a formal Statement of Requirements (SoR).
- Cost per premises ranges from £545 to £800 on a sliding scale between 63% and 96.4% coverage of the intervention area for an access technology ratio of 63% FTTC: 28% FTTP: 9% FWA.
- Once a communications provider has a presence in an area, finding commercially viable extensions in the Final 5% then reduces some subsequent requirement for public money.
- The commercial model has benefited from successful negotiations of low cost wayleaves and an easement agreed with the National Trust.
- The size of the intervention area is critical to the success of the model. At 1,500 premises per backhaul link it is possible to cover the ongoing costs as modelled and be commercially viable. The optimum size appears to be minimum 3,000 premises to ensure that retail price can always align with the market retail packages.
- The coverage area does not have to be contiguous. The model is based on identifying a suitable point to bring in the backhaul, and then planning the capex build that connects each 'island' together to this backhaul to form a core network. This can be achieved with fibre where PIA or suitable Highways verges/private land are available. High capacity radio links are effective in connecting 'islands' within 4km as part of the core network. Lower capacity radio links can be used to connect smaller islands from up to 10km away.
- On this pilot and on commercial deployments Call Flow has found that backhaul - in the form of the regulated wholesale inputs – has been available within reach of the planned network. The backhaul can be picked up at any point along the new network which provides important flexibility for planning the backhaul.
- Call Flow believes that the economies of scale that come with a larger project area are essential in the Final 5% to achieve financially viable networks in the short term. In the medium term, isolated smaller networks that cannot leverage the supplier's existing infrastructure can achieve financial viability as subscription rates reach 30% - this level is not unrealistic over 3 years.
- For these types of isolated installations there is a need for the network to bias expenditure towards Capex to achieve the most resilient network possible and minimise Opex costs. As the network grows, this bias can change in line with the commercial model being deployed because of the increased availability of locally skilled engineers to maintain the network.

Cybermoor – project summary

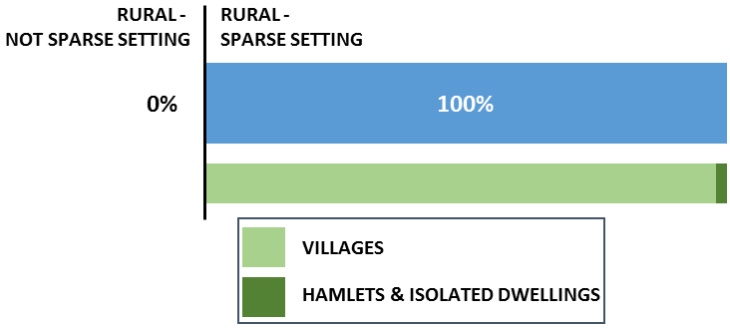
Context

BDUK Lot 3: Financial
NGA technologies: FTTP, FWA
Location: Northumberland

Project area: 87 km2
Premises density: 3.3 premises per km2



Rural context within the RUC2011[4]



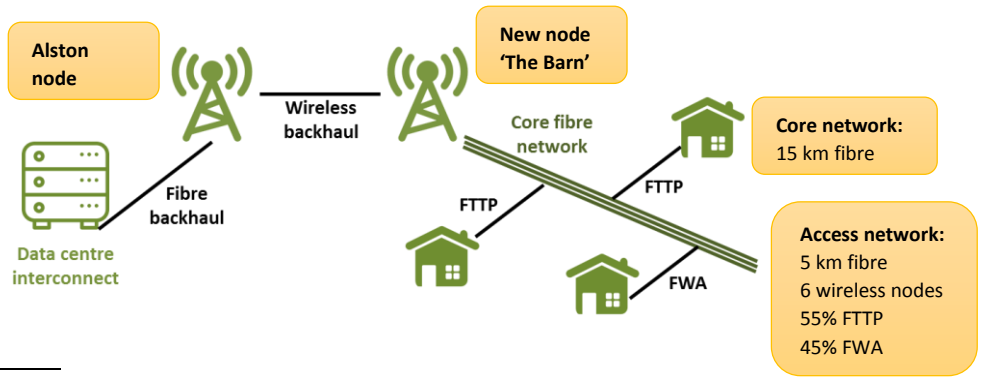
Project size

Premises cleared for State Aid (intervention area)	287
Forecast premises passed by the pilot	287 (100% of the intervention area)
Forecast premises connected by March 2016	215 (75% of the premises passed)

Summary project costs

BDUK funding for infrastructure capital costs	£350,000[5,6]
Total infrastructure capital costs	£550,000
Public subsidy per premises passed	£1,220
Cost per premises passed (intervention area)	£1,915
Cost per premises passed (intervention area + overspill)	n/a

Infrastructure solution



[4] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

[5] The BDUK grant for deployment is £430,000. A portion of this was allocated to developing preliminary designs for 7 community networks. The BDUK grant for the South Tyne Valley network that has progressed to full deployment is £350,000.

[6] This does not include the recent variation to test a new backhaul link in collaboration with JANET (Joint Academic Network).

Pilot objectives

- Develop an innovative financing solution that uses grant funding to leverage social investment and community investment into fibre to the premise (FTTP) and wireless networks (FWA) in rural communities.
- Deliver preliminary network designs, costs and feasibility studies for seven separate communities in Northumberland.
- Deliver one fully funded, deployed and operational community NGA network in Northumberland that demonstrates the financing solution.

Headline findings to date

- Community projects face a dual challenge: to source sufficient investment and cash flow. Without access to favourable loan rates from commercial banks, the community needs resources to fund the feasibility stages while robust evidence of the risks and returns can be developed for potential investors.
- The project has been unable to secure social investment loans within the time constraints of this pilot programme and the community share offer is expected to raise only 20% of the target.
- BDUK and Cybermoor remain engaged with social investors and the Community Shares Unit (CSU) to build on the learnings from this pilot and understand the requirements for establishing repeatable and scalable financing models for community projects. Communities will be able to draw on this guidance and standard models through Cybermoor's 'Broadband in a Box' template.
- The social investment market is becoming more established and several brokerage organisations are operating in the market. The brokers' fees add at least 5% to the cost of the funding, which presents a significant challenge to including social investment as part of viable commercial model.
- 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.
- Communities may need to aggregate their delivery requirements in order to attract a wider field of social impact investors. BDUK could be required to act as a single counterparty rather than require the investors to work with individual community projects that are likely to be too small to attract social funding.
- Cybermoor has reduced the network costs to ensure the deployment could still be completed with the reduced funding level, and achieved this by introducing FWA in place of some FTTP. The BDUK contribution to the capex has increased from 54% to 64% as a result.
- Backhaul availability and cost is an important driver for commercial sustainability. Cybermoor is developing proposals for government support to bring affordable fibre links from appropriate break out points in existing infrastructure to within proximity of the community (typically 5 to 10 km).
- There is evidence that separating the backhaul from access network costs could also be critical for attracting social funding. The pilot has demonstrated that access network costs per premise tend to be consistent across different areas, whereas the backhaul can increase the overall costs substantially from one project to the next.
- The network deployment has been successful and is reaching NGA white premises in a remote and sparse area that has a particularly challenging geography for digging fibre. The network is on target to achieve close to 100% coverage of the intervention area by Q4 2015.
- BDUK is using this project to explore ways to leverage existing digital capacity from JANET, the high-speed network for the UK research and education community. The collaboration between Cybermoor and JANET should result in high-capacity fibre backhaul to the pilot network, replacing the extant wireless backhaul link.
- Managing community expectations is essential. Enthusiasm is high at the start, but maintaining support in community projects can be a challenge; communities can underestimate the input needed on the projects.
- The pilot intervention area has been altered a number of times because BT's Phase 2 plan was being defined in parallel. This has helped demonstrate how far the capital cost per premises is pushed up as a result of reduced eligible properties.
- The target take up of 75% is at the top end across the pilots. In validating this assumption, Cybermoor points to the B4RN network, which has achieved around 80% take up and has a similar population density and geography to the South Tyne Valley.

Quickline – project summary

Context

BDUK Lot 1: Technology

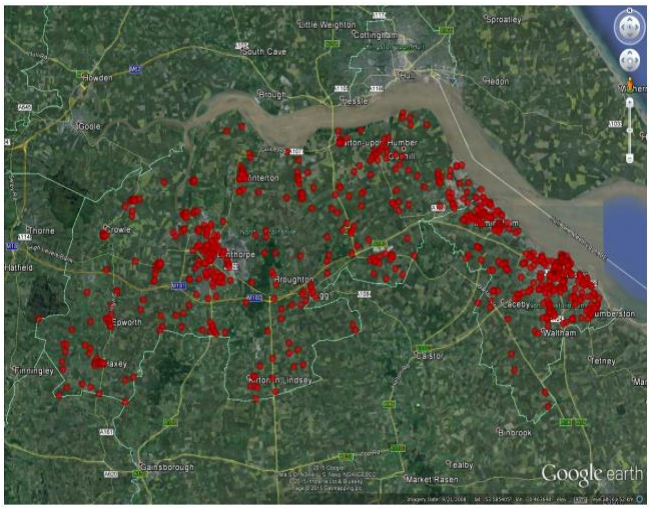
NGA technologies: Testing a range of line of sight, near line of sight, and non-line of sight technologies to build a superfast wireless network.

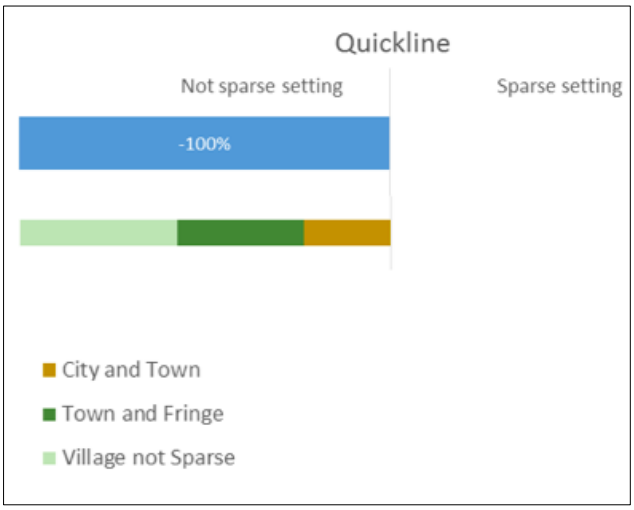
Locations: North and North East Lincolnshire

Project area: 320 km2

Premises density: 13.2 premises per km2

Rural context within the RUC2011[7]





Project size

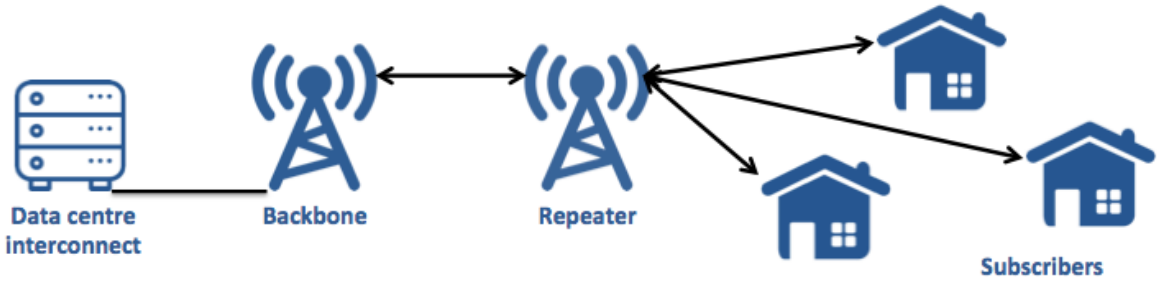
Premises cleared for State Aid (intervention area)	4,211
Forecast premises passed by the pilot	4,211 (100% of the intervention area)
Forecast premises connected by March 2016	2,305 (55% of the premises passed)

Summary project costs

BDUK funding for infrastructure capital costs	£2,000,000
Total infrastructure capital costs	£2,447,037.87
Public subsidy per premises passed	£475
Cost per premises passed (intervention area)	£581
Cost per premises passed (intervention area + overspill)	N/A

[7] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

High level solution



Original objectives of Pilot

- To work with Hull University, Quickline aim to demonstrate that a wireless solution to Superfast Broadband delivery to the currently unserved last 5% of UK premises is possible, and with the right funding models can be made available at appropriate cost.
- To test a range of a range of line of sight, near line of sight, and non-line of sight technologies in the Pilot.

Headline findings to date

- Good wireless propagation models exist which, when linked to terrain databases such as Ordinance Survey maps and maps such as Google Earth, provide excellent link planning tools, enabling a significant proportion of wireless planning to be undertaken in the office.
- The repeaters locations plotted to cover the number of subscribers that can be served from any one these sites is limited by the requirement for superfast speeds and the performance of the technology that they are able to deploy.
- Most of the repeaters making the connection to subscriber's homes have been designed in the centre of the intervention area to target the specified postcodes - 40 sites with sectors provide direct coverage to the postcode areas.
- The topography (natural and manmade) dictates the need for doglegged links rather than more direct connections.
- The use of existing assets/infrastructure offers a compelling case for cost savings to small suppliers such as Quickline. This can be either old cranes or existing masts decommissioned by MNOs.
- The key advantage Quickline is finding is the opportunity to own assets that have already significantly depreciated, thereby offering Quickline a steady revenue stream from the services offered. In fact this is allowing Quickline to convert significant parts of their capex into opex and in the process also achieve a faster rollout.
- To achieve high availability for all sites, Quickline have fitted each cabinet with an uninterruptable power supply that outputs in DC, and calculated power consumption based upon a worst case scenario. Their power equipment and generators have been designed to be remotely monitored and to be light enough to be safely carried by a single person; additionally, they have been designed so that the works can be undertaken by any competent person, rather than necessitating an engineer trained to navigate the inside of the cabinets.
- The extent to which NLOS can be successfully deployed has been radically reduced, because there are far fewer reflective surfaces that are common in such areas. Instead, nLOS connections are more commonly the result of trees and foliage in the more rural environments.

Satellite Internet – project summary

Context

BDUK Lot 1: Technology

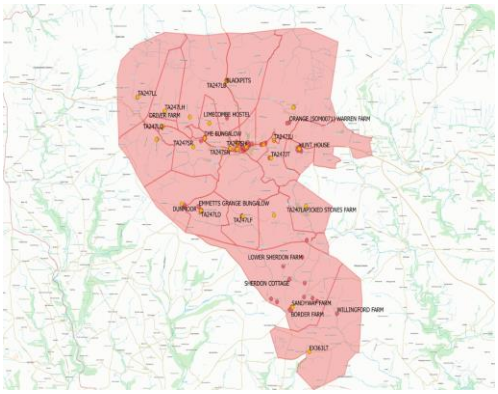
Basic technologies: Satellite backhaul with fixed wireless distribution; satellite direct to home.

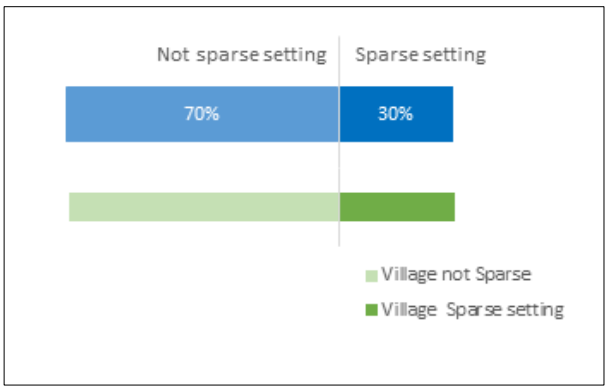
Location: Exmoor (x 2) and Mendip (x 1).

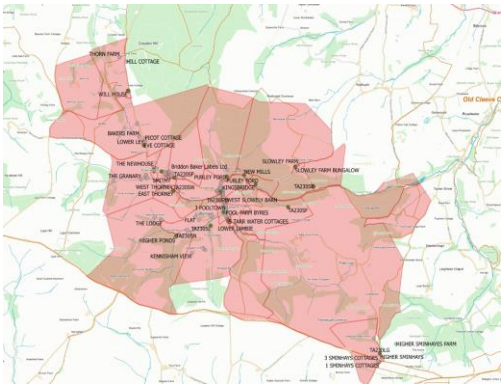
Project areas: 111 km2

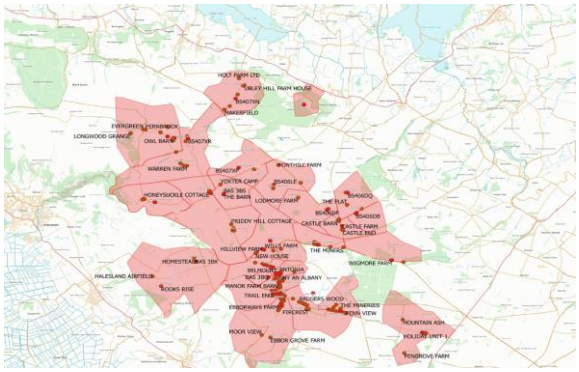
Premises density: 4 premises per km2

Rural context within the RUC2011[8]









Project size

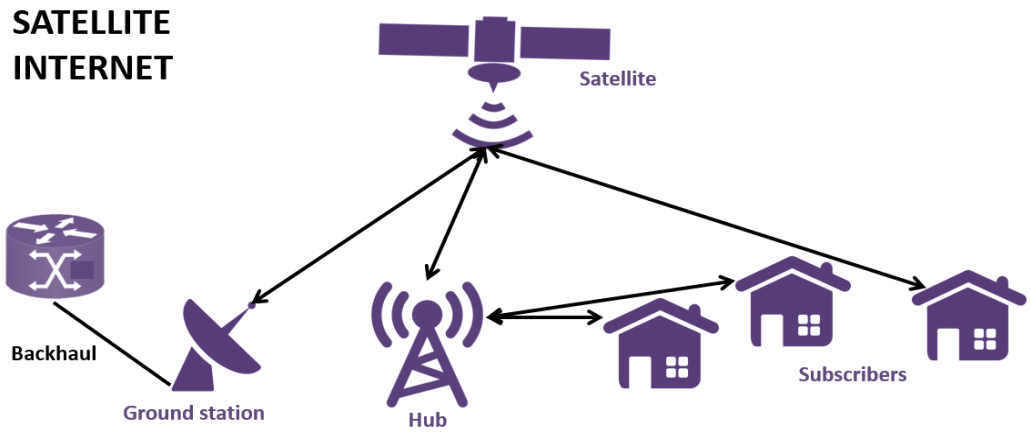
Premises cleared for State Aid (intervention area)	420
Forecast premises passed by the pilot	280 (66% of the intervention area)
Forecast premises connected by March 2016	200 (48% of the premises passed – Note, this may well be lower given smaller areas. Take up was expected to reach circa 25% which would give 105 premises connected)

Summary project costs

BDUK funding for infrastructure capital costs	£84,750
Total infrastructure capital costs	£84,750
Public subsidy per premises passed (Avg)	£313.00

[8] www.ons.gov.uk/ons/guide-method/geography/products/area-classifications/2011-rural-urban/

High level solution



Original objectives of Pilot

- To demonstrate two superfast-capable satellite delivery models:
  - Satellite as a backhaul providing a superfast broadband downlink into a Satellite Distribution Node to be shared using a fixed wireless access network (SDN);
  - Satellite direct to home on the same service levels as the wireless offering (DTH).

Headlines of findings to date

Technical and commercial

- The cost benefit analysis of using the hub infrastructure compared with direct to home deployment has still to be completed but early findings suggest that the break-even point is around 30-40 premises which may well place too much contention on the hub;
- Challenging geographies (low premises density combined with poor line of site due to trees, other foliage and uneven terrain) has resulted in the need to deploy additional wireless distribution equipment which in turn drives up both cost and complexity of the satellite backhaul / wireless distribution solution;
- Additional wireless costs further stretch the commercial viability of the SDN approach;
- Direct to home satellite may well prove favourable in many locations due to more certainty over both cost and performance, improved deployment speeds and lower cost per premises;
- Satellite technology has advantages, including a capability to deploy a superfast service to almost any property quickly and an easily budgeted unified fixed cost per premises, less obtrusive customer equipment and ability to upgrade backhaul service thereby offering improved services without wholesale reengineering of the distribution network.

Engagement

- A very direct marketing approach is needed to drive demand and, even then, take-up can be slow. Direct mail shots are effective, especially if supported by the local authority. Knocking on doors is even better.
- Three key reasons have been identified behind slow take-up. In order of significance, these are:
  - Cost of service in comparison to traditional terrestrial superfast services, even if these are unavailable
  - Existing arrangements and contracts in place
  - Uncertainty of performance of satellite broadband
- There is an incorrect assumption that if a community adopts an alternative technology (e.g. satellite) deployment, they will somehow forfeit their place for further public funding should a fibre based (NGA) solution become available.
- Feedback from customers using the live service is generally very good with 85% currently suggesting that they would recommend the service to a friend.

Avanti

Project summary

BDUK Lot 1:	Technology		
NGA technologies:	Satellite broadband wholesale platform		
Locations:	Northern Ireland: Antrim and Fermanagh; Scotland: Aberdeenshire; Dumfries and Galloway and the Borders.		
Project areas:	Scotland 1,476km2, Northern Ireland: 2,349km2	Density:	Scotland 1 premises per km2 Northern Ireland 9 premises per km2

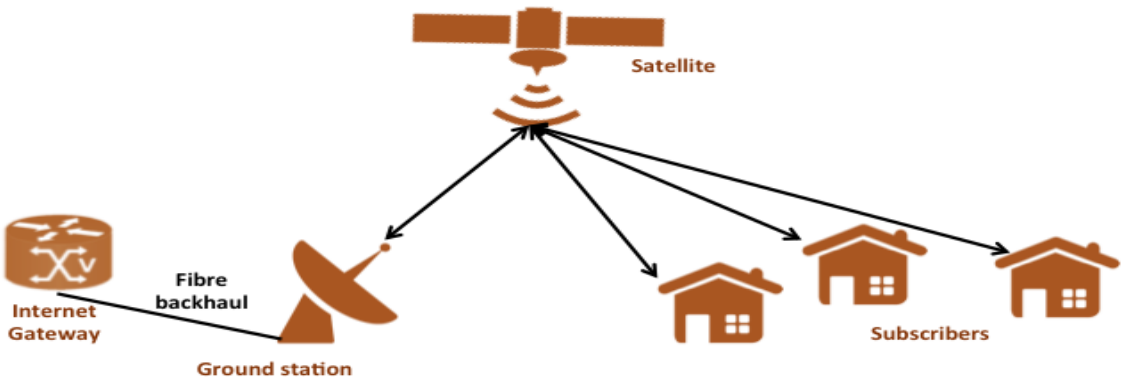
Project size

Premises cleared for State Aid (intervention area)	23,472
Forecast premises passed by the pilot	All of the intervention area plus most of the UK.
Forecast premises connected by March 2016	1,000 (capped by project)

Summary project costs

BDUK funding for infrastructure capital costs	£850,000
Total infrastructure capital costs	£954,000 with supplier contributions to date.
Public subsidy per premises connected	£850 (expected to reduce to circa £550 with state aid clawback)

High level solution



Objectives of Pilot

To establish a new superfast broadband wholesale platform across the UK to deliver 30Mbps services to customers in the pilot areas of Northern Ireland and Scotland.

Headline findings to date

Technical capability:

- Superfast download is possible. Dimensioning of the service is key to consumer experience although satellite operators are reluctant to either share or commit to specific service levels without upfront commitments to data volumes. A target of 150Kbps per user is the current best guess estimate of the minimum capacity dimensioning required to deliver usable and sustainable superfast broadband services.
- Consumer feedback of a good service, running well is positive.

- Lead time for state of the art satellite equipment (CPE and ground station equipment) needs to be factored into deployment plans.

Engagement:

- Previous consumer experience of satellite broadband services can create a barrier to entry for updated satellite services.
- Marketing and localised awareness campaigns are essential to achieving high levels of take up.
- Local Authority endorsement of the scheme, especially through direct mail, is key to demand stimulation.

Key cost metrics

Network costs	• Ground station hub equipment: These should be recoverable and sustainable from service revenue in a steady state environment.	
	• Satellite. Typically already sunk.	
Connectivity costs	• CPE (Dish and modem):	Typically £250-£300
	• Installation:	Typically £120-£200
	• Connection fee:	Typically £20-£25

Analysis – commercial model & scalability to the final 5%

Satellite technology is currently on a cusp with regards domestic residential broadband services. Affordable consumer equipment (CPE) is now available to support the delivery of superfast services. However, the main cost drivers that need to be covered by service revenue are both the satellite costs (build, launch and operate costs) and the earth station hub equipment. Given the finite capacity of any given satellite, once launched, the costs to be retrieved are relatively stable and predictable. The satellite industry seek to recover these costs to provide a positive cash return as quickly as possible by charging a cost for data throughput on the satellite at any given point in time. This translates to a consumer pricing model where services are priced more on data usage rather than speed.

It is currently unclear as to whether state aid subsidy for CPE alone is sufficient to deliver a service acceptable to the consumer. Additional public subsidy for networking costs (ground station upgrades in particular), combined with subsidised CPE, make it much easier to deliver a sustainable pricing model going forwards.

Development of the learning outcomes

- **Subsidy required –** between £300 and £800 depending upon the utilisation limits of satellite earth station equipment, still to be identified, as and when capacity limits are reached.
- **Technical capability –** Superfast download is possible. Dimensioning of the service is key to consumer experience although satellite operators are reluctant to either share or commit to specific service levels without upfront commitments to data volumes. A target of 150Kbps per user is the current best guess estimate of the minimum capacity dimensioning required to deliver usable and sustainable superfast broadband services.
- **OSS / BSS offerings –** There are well developed between satellite operators and retail service providers.
- **Consumer preferences for different services at different price points –** Evidence is still being gathered. Current breakdown is as follows:

	Download speed	Upload speed	Data cap	Take up
Small	10Mbps	½ Mbps	10GB per month	57%
Medium	24Mpbs	2Mbps	20GB per month	22%
Large	30Mbps	5Mbps	30GB per month	21%

- **Behaviour of satellite Retail Service providers (RSPs) –** To date, the service providers have been the most driven in terms of driving demand and scheme take up.
- **Service performance and consumer feedback –** Initial feedback good. Full results still needed.