Codrington Internet Provision

Technology Ideas by Dr Terry Barnaby

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Introduction

The village of Codrington in south Gloucestershire is one of many rural communities that is being left behind with next generation broadband internet provision. We are living in the age of the information revolution and fast and reliable internet access is becoming increasingly necessary for business and homes. The requirements of this internet provision will surely grow significantly as new technologies and ways of using it and working unfold.

Unfortunately the local council has concentrated on upgrading more urban areas with BDUK money rather than focusing on small businesses and rural areas. This has left Codrington and other rural villages with nothing. This may be mainly due to the BDUK/councils focus on short term value for money. Although superficially this sounds reasonable, I wonder this may have played into BT/Openreach's hands a bit as some of these urban areas would probably have become commercially viable for BT/Openreach by now as installation methods and prices fall.

The villages that have been “upgraded” in South Gloucestershire have been upgraded with FTTC technology. Although good for dense urban areas, for rural areas with dispersed housing and businesses it is a very poor solution. FTTC technology uses existing telephone copper wires for the final connection and this can only provide decent bit rates over a maximum of about 600 metres.

I am an engineer, small business owner and farther who has been repeatedly restricted and frustrated by the internet provision in South Gloucestershire. My business has been limited in what it can provide its customers and my kids badger me all the time !

Although I am not a telecommunications engineer and don't know the technical details or current market costs of installations, I know some and this is a short document providing my ideas on the best way to provision Internet in the South Gloucestershire village of Codrington and other such rural areas.

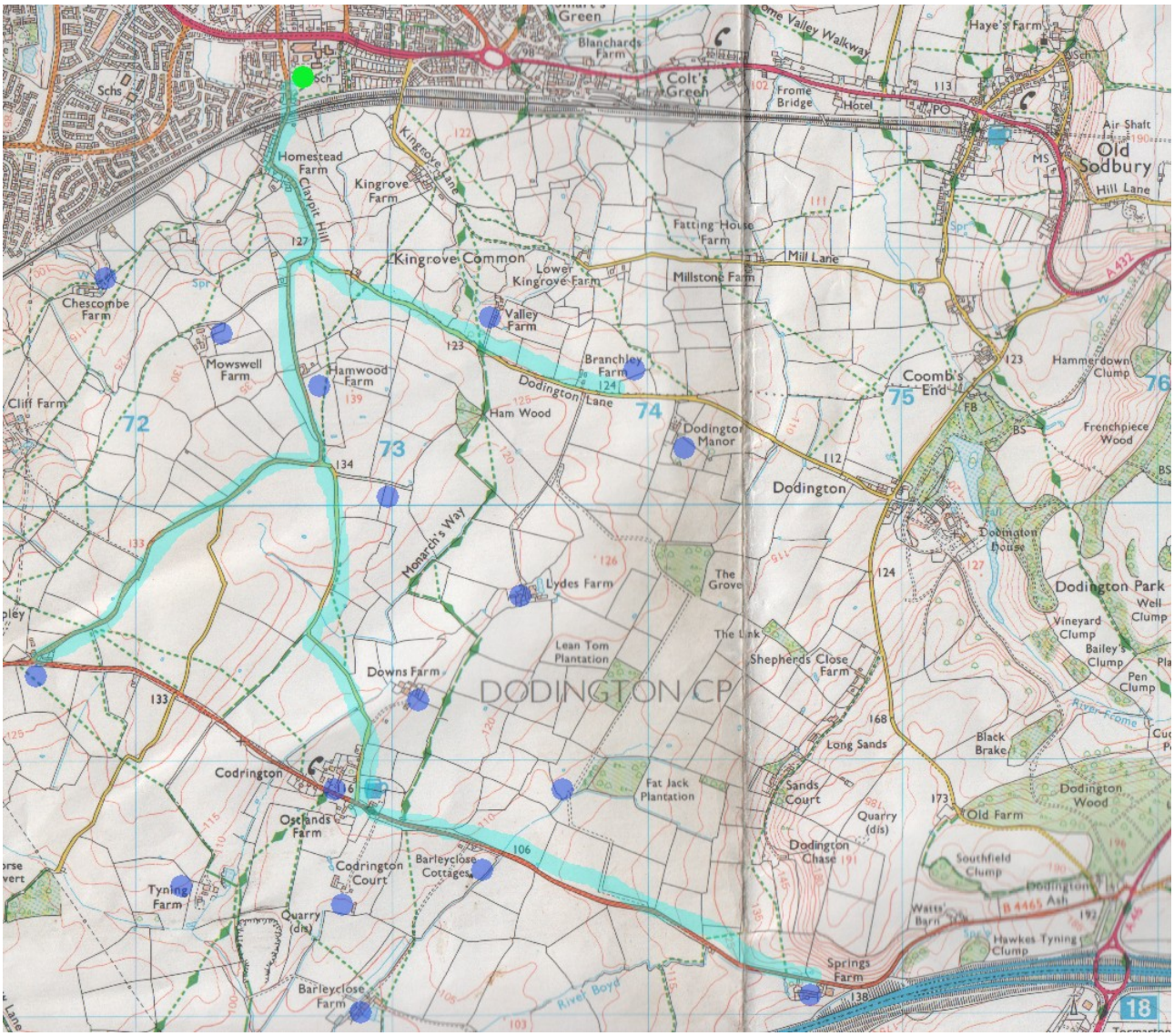
Installation in the Village of Codrington

The village of Codrington is situated less than 2 miles from the nearest BT/Openreach fibre enabled cabinet, (cabinet 29 on the Chippng Sodbury exchange). I believe there is ducting all the way from this cabinet to the village which contains BT/Openreach copper cabling (100 pair and 10 pair cables?) and fibre optic cable bundles by another company (Colt ?). There may also be fibre optic cables used by yet another company passing through the village. A new 100 pair telephone multi-core cable cable was installed in this ducting about 12 years ago so it is likely to be free of debris. So installing the main fibre optic cable bundle should be relatively inexpensive. The village and neighbouring area properties are almost exclusively connected by overhead telephone cables. On route to the village there are a number of properties off on side roads and there are further properties on past the village.

This situation seems to be very suited to FTTP technology. A fibre optic bundle can be run in the underground ducting form cabinet 29 at Chipping Sodbury to the village of Codrington branching off at the various roads and groups of premises on route. The fibre can then move to the existing overhead cabling structure and split as necessary (cost versus sharing) to be connected to each property. To reduce costs, in some cases, maybe the new FTTRN technology (back powered from the premises) which uses the existing copper wiring, or point to point radio links can be used for the last few hundred metres to some properties, especially if underground cabling is used as installing fibre underground is much more expensive to do.

Obviously this will cost a reasonable amount to install. However I would have thought it is likely to be cheaper than a FTTC installation in this situation and provide a much better, future proofed system that is easier to maintain and so is likely to be much cheaper in the medium to long term. Some points:

- Most properties are connected by overhead cabling. This reduces the cost of FTTP installation significantly. The often quoted high price of FTTP is primarily due the difficult and variable costs of underground final premises connection.
- No street cabinet is needed for the FTTP, reducing system installation and running costs.
- No need for local power sources (unless a repeater is needed for the more distant properties).
- More reliable. Reliability is a core issue for current rural Internet primarily due to water ingress into copper based cables..
- Being fibre, long term maintenance costs will be lower.
- If IP telephones are used, existing copper cable can be removed and sold possibly reducing installation costs further, simplifying the network and will reduce on-going maintenance.
- Properties could be asked for a sum of money to offset overall installation costs. The standard BT phone line installation charge is, I think, £130. Maybe that should form a basis for fibre Internet installations (although I would be happy to pay more) ?



- Cabinet 29 in green
- Blue dots are single or groups of properties. Ther are additional properties not marked.
- The most properties are situated in the village of Codrington as a clump.
- The blue lines, I think, are the BT/Openreach cable routes both in ducting and overhead cables.
- The (Colt?) fibre travels from Chipping Sodbury up to the A46 and beyond through Springs Farm.

FTTP vs FTTC Technology

The recent updates to UK Internet infrastructure are based on the FTTC technology where fibre optic cables run to an updated cabinet close to a set of premises and then runs to the individual properties over the existing copper telephone lines. Although technically this method is far from ideal and can only be considered as a stop gap method, it is relatively cheap to do where there are existing cabinets, underground cabling to houses and numbers of properties in close proximity such as in towns, cities and suburban areas. It has enabled the quick and cost effective roll-out of quite fast Internet services to a large percentage of the country. The cabinets also serve as a junction and control box to provide faster copper based services such as G.fast and eventually connect each

premises directly with fibre.

There are many opinions on the target speeds for Internet provision. Taking a releasable mean of some of these, lets say the near future Internet requirements are:

- At least 100 Mbits/s downlink speed. This will fast become a basic minimal requirement. Some suppliers such as Gigaclear will provide 1GB/s. Some countries are aiming much higher. Singapore is trialling 10Gbits/s home broadband. The UK's 25 Mbits/s medium term target is a bit too low in my opinion and the 2 Mbits/s for all laughable.
- At least 100Mbits/s uplink speed capability. Uplink speeds are not often mentioned, but for businesses and other creative users uplink speed is critical. Current BT/Openreach/Virgin provision is based on home users watching video and consuming information. But businesses need to provide services, send out information to customers, provide home worker access etc. Increasingly homes will be used for home working and decent and reliable video communications will become more common.
- Low latency (< 50ms ?). For many interactive applications latency is important, it is the time it takes the data to actually be communicated. Some future Internet services are likely to require this, some do already.
- Reliability. The system has to be reliable. Current copper based rural systems are not reliable mainly due to water ingress and the state of the old cables sometimes in use. The nature of this unreliability is often intermittent faults that are very difficult and expensive to track down and very difficult for the user to handle.
- Reasonable install and running costs in-line with other UK customers. Personally I don't see any reason why customers shouldn't pay a reasonable installation cost especially in rural areas where installation is more costly and difficult. However I suspect take up will be lower and this might actually make the medium term costs of providing the service higher.

These I think should be the minimum that the system should be able to provide. Different ISP packages could limit the speeds based on cost to individual customers. Ideally there should be the ability for the system to handle >1 Gbits/s links (up and down) where wanted at a realistic price premium.

For rural communities FTTC technology is most often a poor and I would have thought expensive method. In rural areas the premises are more spread out over an area often with individual or groups of properties situated some distance from each other. The distance of the copper wire to these properties from the cabinet makes fast and reliable internet impossible.

A few villages in South Gloucestershire have been updated using FTTC This has been good for the houses close to the cabinet but for a lot of the local properties it has been a disadvantage rather than benefit and they are slowly coming to realise they won't get anything. I think the only current realistic way of providing next generation internet infrastructure to rural communities is FTTP. With FTTP fibre optic cables are run all of the way from the exchange to the premises. It is a genuine fibre optic broadband technology.

Some aspects of FTTC and FTTP for rural applications.

- The speed of data transfer on copper cables is severely restricted by the length of cable.

Maximum length of FTTC copper cable for 50 Mbits/s is about 600m. This assumes a good quality thick wire copper pair with normal levels of cross talk between cable pairs and interference. In most rural locations the distance between properties is much greater than this and/or the cable is of low quality. To achieve a reasonable 100 Mbits/s speed up/down link probably a maximum cable length of 200m is needed. Fibre optic cables can easily provide 10's of Gigabits (100 x 100MBits/s) both up and down link (with appropriate hardware at each end) over many 10's of km depending on the type of optical cable used.

- Uplink speeds. The cross-talk between cables restrict the ability of copper cabling to provide varying uplink speeds between customers. All customers are restricted to the same uplink speeds because of this. Fibre optic cables do not have any significant crosstalk allowing businesses and particular homes to have the higher uplink speeds they need.
- Reliability is a major issue in rural areas. Copper cables are severely affected by water ingress. This is the main issue affecting reliability in rural areas especially with some of the older cable installations present. Also the type of fault is often intermittent and so difficult, expensive and time consuming to fix. Fibre optic cables are much more resistant to failure with water ingress.
- Copper cables are strongly affected by electromagnetic interference. The longer the cable the more significant this is and rural cables are often long. Fibre optic cables are not affected by electromagnetic interference. Interference can also be caused by faulty household equipment. In our set of shared offices a single laptop power supply unit was severely affecting 10 companies Internet connections. It took us 6 months to track this down, BT/Openreach couldn't do this they didn't have the systems in place and enough suitably trained people to investigate this type of issue.
- Lightning strikes on overhead copper cables can destroy household and business systems connected to the internet. Rural properties are susceptible to this. I myself have had our premisses internal routers, network switches, and three computers destroyed by this. Fibre optic cabling does not have this issue.
- FTTC systems and future G.Fast systems need local power sources and consume a relatively high amount of power, all of the time, to “push” the data through the copper cables. There are on-going costs to proving this power as well as environmental costs.
- FTTC is much cheaper to install than FTTP for most properties in the UK. This is primarily due to the very high costs of installing the last few metres of the cables underground to the individual properties. This involves digging up roads, pavements and gardens as often no ducting was used or ducting is blocked. However, in rural areas most properties are connected by means of overhead cables. Much of the touted high costs of FTTP are not applicable as there is no need for installing new underground cables to properties. With FTTP the high cost of installing cabinets and their electronics is not needed. As technologies are improved and installers trained, this will further reduce the cost of FTTP installations.
- Overhead lines can be readily replaced with fibre. Fibre is actually cheaper that its copper equivalent as far as I am aware. There are costs in doing this, but as a lot of the overhead wiring is probably due for replacement anyway, this is probably not that high. The telephone service can be run over the fibre optic cable using IP technologies and a suitable in house

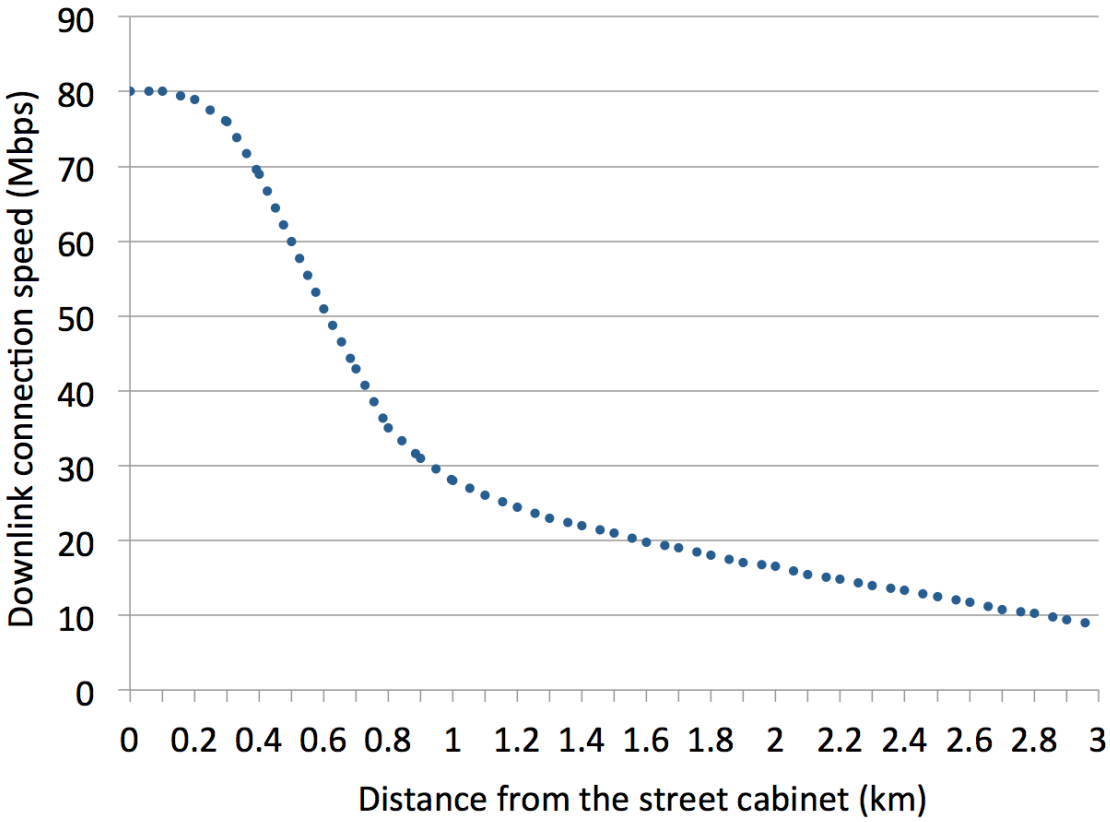
router that connects to the in premises telephone wiring. Thus the old copper cables can be removed and their scrap value recovered. There is an issue with training the installers on how to connect fibre, but this should be relatively easy to overcome and needs to be done anyway.

- FTTP can provide guaranteed bit rates more or less irrespective of distance. One issue with current ADSL and FTTC systems is that a guaranteed bit rate cannot be provided by ISP's. This leads to customer confusion and issues.

Carriers are starting to see that the overall running costs of a pure fibre network are lower than copper, especially in spread out communities. For example:

> Verizon: fibre is MUCH cheaper than copper, we're going all-FTTP. Verizon has put the latest numbers on its fibre-versus-copper experience, and found that glass beats metal on all counts. Without giving a timeframe, the company has told a conference in Orlando that its experience across seven central offices (CO, or for Australians, telephone exchanges) areas is so compelling it's going to …
>
> - **Real estate** – savings are in the order of 60 – 80 per cent, since instead of 13 floors for a big exchange, a fibre-to-the-premises area needs just two;
> - **Energy savings** – are between 40 and 60 per cent, in accordance with the company's prior experience, for example in 2008 numbers cited by Australia's communications minister Malcolm Turnbull;
> - **Reliability** – DSL users suffering rain-driven outages will raise a hollow laugh to hear that Sampath claimed fibre is 70 to 90 per cent more reliable than copper. This results in 60 per cent fewer costly truck rolls on the fibre network, and savings of 40 to 60 per cent on maintenance.
>
> Sampath also claimed that fibre drive business opportunities worth around 60 per cent of the investment value in new revenue. “We've proven time and again this pays for itself. It is sustained pay back”, he told the conference.

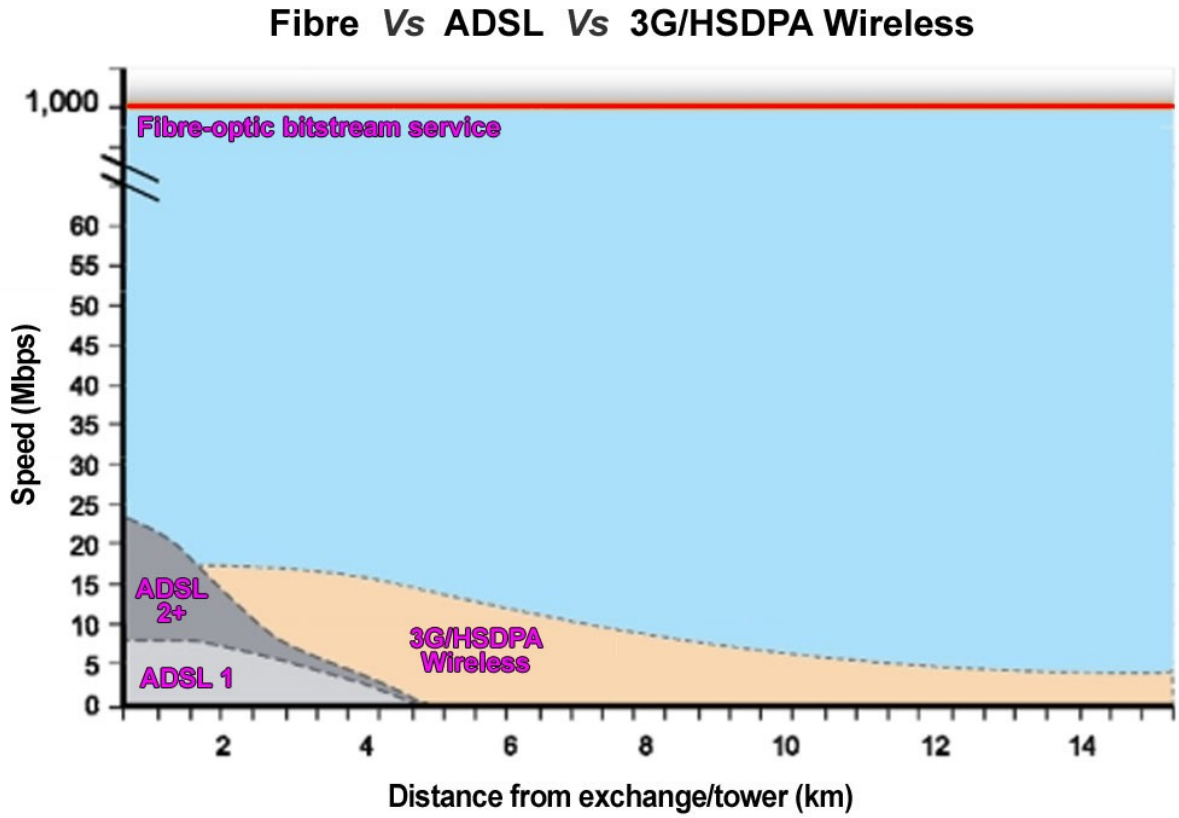
Careful thought on the structure of the fibre optic network will need to be performed. There is a cost benefit to using splitters (PON) on a fibre optic cable to reduce the number of individual cables going back to the closest cabinet, but these do impose contention (sharing) of that split fibre and thus provides reduced average bit rate during heavy use for the customers sharing that individual fibre. Point to Point (PTP) is obviously the best, future proofed technology but is a little more expensive to install.

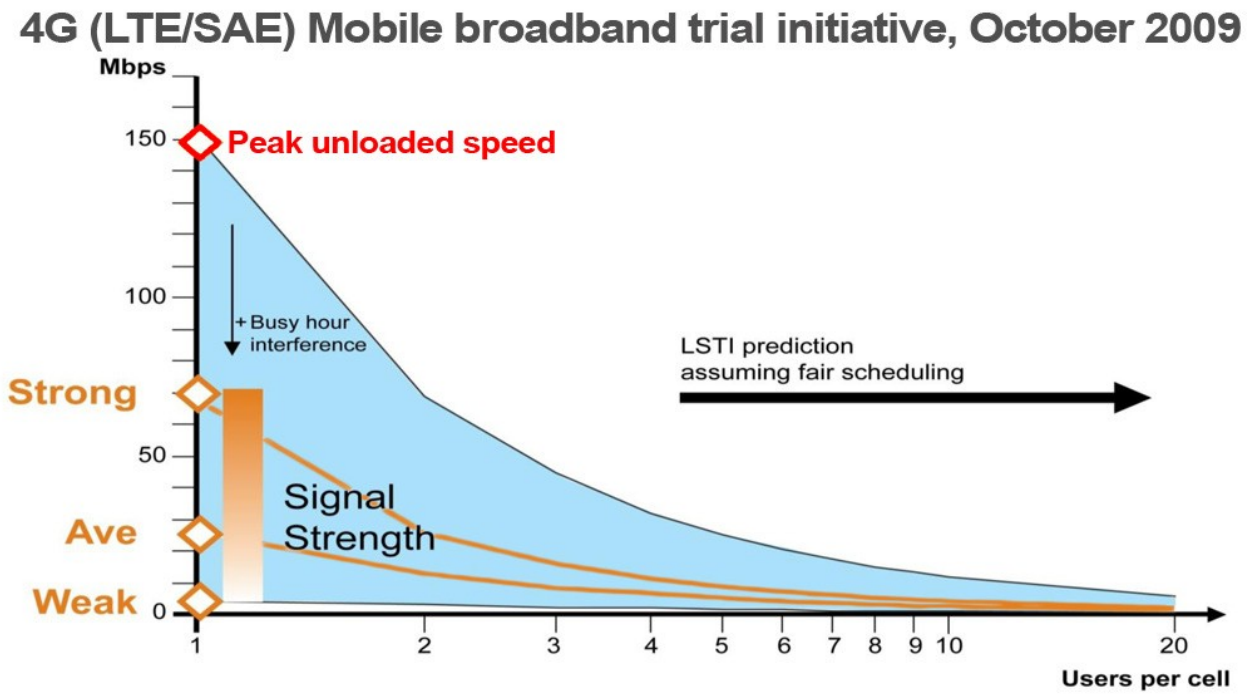


FTTC speeds versus copper wire distance (Optimistic at the high distance end!)

Other Methods

- **Satellite Broadband Internet:** This is only suitable for a small number of very remote premises. Its overall speeds are low and its links highly contended (shared), uplink speeds are low and highly contended and latency is high. Running costs are high and reliability not good.
- **Cellular Data Networks:** 4G networks have relatively low data rates especially uplink speeds unless you are very close to the mast and there are only a few local users. They are highly contended (shared) networks. If the mast is close enough to get decent 4G, then the fibre is close enough to have a direct connection. Reliability is not good and currently most packages are very restricted in the amount of data that can be transferred. There is poor coverage in most rural areas.





- **Other wireless technologies:** Generally all shared radio links have speed issues due to contention (sharing), uplink speed issues and reliability issues (rain, snow, interference, sun-spots etc). They can be good for point to point links for some hard to reach (costly to reach) premises. Reliability is not good.

UK Internet Infrastructure Costs

Providing proper Internet infrastructure in the UK is a reasonably costly exercise. However, the benefits to the commercial/business world, promoting new technologies and products, for reducing

transport issues and home services will more than likely offset these costs in a relatively short period of time. Imagine proper interactive, 3D video conferencing for businesses and home use that actually works. This alone would reduce road/rail traffic by an amount saving costs elsewhere. Start up companies could develop new services for a high quality country wide Internet system that could then be sold around the world improving exports and adding further to the payback benefits. This is essential infrastructure work needed in the UK that is not getting the attention needed.

The amounts being spent in the UK by central government are in the order of £1.2 billion for the whole country (private companies are also investing however). The HS2 rail scheme, which will only benefit a small proportion of the UK, is being assigned around £50 billion … Much less than this sort of level of money could revolutionise Internet provision in the UK for all.

BT/Openreach is investing a large amount of money itself into the UK's Internet infrastructure. However it is a commercial company and thus obviously has to make profits within its own business model. The benefits to the UK and cost reductions elsewhere in the UK's economy (reduced transport infrastructure for example) are not taken into account. This needs UK level funding as that is where a lot of the longer term benefits reside.

BDUK has helped, although BT/Openreach's monopoly and opaque planning/costings regime has, I think, restricted its effectiveness. One issue is BDUK's focus on Value for Money (VfM) in the short term. This results in BDUK funding locations that are relatively easy to upgrade the most people. Although this sounds reasonable, I think with the way BT/Openreach and other such companies operate this is unlikely to offer VfM in the medium/long term. These commercial companies will work there way from the easiest/most cheapest/most profit laden areas moving to the harder to access areas last. Now there is a danger with public funding on a similar basis, in that BDUK will just fund those slightly harder to reach areas than BT/others are not doing at the moment but those that BT/others would do with their private funding within a reasonably short time anyway. Based on this, VfM in the medium/long term would very likely be had by BDUK/Councils funding the slightly harder to reach areas first and moving down to the easier areas as BT and others come at it from the other direction.

Ofcom unfortunately made a ruling that Internet providers could call their hybrid fibre/copper FTTC and other such Internet provision solutions fibre broadband. Proper FTTP fibre broadband is a significantly different and vastly superior product. The name “fibre broadband” should be reserved for a genuine fibre connection. This would also promote customer demand for this product speeding up the provision of a decent UK's Internet infrastructure.

Really I think the current situation where commercial companies decide on, plan and provision the UK's Internet infrastructure is untenable. Companies, quite rightly, are mainly interested in their companies profits both short and long term and will only provision what will give them the best profit not necessarily provide the best system to UK businesses and citizens. These companies are more interested in creating an Internet system to provide services, such as sports channels, to customers, than a proper bi-directional communications system to suit the countries needs as there is additional payback from providing these services. Although the FTTC systems have been excellent at providing a faster Internet to a lot of the population in a relatively quick time and at reasonable cost, I think the time now has come to push to provide a proper, true, fibre service (FTTP) to customers rather than interim systems.

I don't think the splitting off of Openreach from the BT group would help a great deal. I think we

could really do with a system where there is overall control and planning from an organization whose interests are UK PLC and its citizens. This organization, who would consult with provisioning companies, businesses, citizen groups and technology experts, could lease, license or other such the installation and management of the system to the communications companies such as BT/Openreach and others and provide public money, where required, on a UK wide basis. Ownership of the ducting and overhead cable space would need to be considered (could be taken under public ownership ?). Or at least BT/Openreach should not charge other companies exessive money for using these. This could in turn overseen by a government infrastructure department not the department of Culture, Media and Sports. Maybe BT/Openreach should be somehow forced to allow other companies to install FTTP to businesses and houses using the existing ducting and overhead cable space with only realistic maintenance costs being paid where applicable. This would allow companies to compete and new technologies developed for installation of the final few meters of fibre to properties. Also councils should be forced not to charge rates on this infrastructure.

I think something like this is the only way a proper internet structure in the UK can be provisioned.

Companies

As well as BT/Openreach, who are the biggest player as they own most of the ducting and cabling to houses (ducting/overhead cable space should be in UKPLC ownership !), there are a few smaller companies involved.

- **Vigin media:** Like BT they are a company that will make a significant amount of their income from selling services over the Internet like pay to watch TV. They are thus more interested in homes and homes in quantity than rural village homes and businesses.
- **Gigaclear:** This appears to be an independent company that have setup rural FTTP systems in the Cotswalds area. They provide up to 1Gbits/s up/down services. I think they are restricted by BT's duct/overhead cable space ownership and various planning/business rates issues.
- **Others:** ?

Web links

- http://www.ispreview.co.uk/index.php/2016/02/gigaclear-and-hyperoptic-highlight-problems-with-uk-broadband-and-bt.html
- http://www.theregister.co.uk/2015/05/20/verizon_fibre_is_so_much_cheaper_than_copper_were_going_allfttp/
- http://www.increasebroadbandspeed.co.uk/2013/chart-bt-fttc-vdsl2-speed-against-distance
- http://www.theregister.co.uk/2015/05/21/singapore_to_trial_10gbps_home_broadband/
- http://www.ispreview.co.uk/index.php/2015/02/bt-fttrn-superfast-broadband-tech-trial-goes-live-north-yorkshire.html