Universal Service Provisioning using Next Generation Access Technologies

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ABSTRACT

The provision of Next Generation Access (NGA) services to the "final third" of the UK population is recognised as a serious technical and financial challenge. Poor broadband access is one of the major problems for rural communities inhibiting engagement in the Digital Economy for the unserved communities. In this paper, we describe the challenges for Universal Service Provision and explore key Next Generation Access technologies that can be combined to provide cost-effective rural broadband.

1. UNIVERSAL SERVICE PROVISIONING

Despite widespread access to broadband across the UK, many do not have access–communities and individuals, mainly in rural areas, have had long-standing difficulty acquiring broadband connectivity. The plight of these rural communities has been highlighted in the UK Government's Digital Britain report. As a part of a strategic vision seeking to position the UK at the leading edge of the global digital economy, this includes a recent recommendation for a 2 Mbps uncontended Universal Service Commitment for all by 2012 [1].

Rural broadband is generally believed to be more expensive than urban broadband for three reasons: distance, remoteness and scale economies. Rural dwellings and businesses are normally further away from the point of supply than their urban counterparts. The point of supply for rural wired broadband is typically a local exchange building or radio access base station. Many solutions, especially the most economical, operate only up to modest distances. Table 1 compares a range of available DSL technologies.

The Future Internet research agenda [2], published by the EC identifies several short, medium and long terms research challenges, that relate to rural communities. Optical fiber will likely be the only wire-line access technology capable of providing the capacity needed for future broadband Internet. The FI research agenda recommends a focus on optical networks in two distinct areas [2]:

- First, the evolution of backhaul and transport networks used to provide very high bit rate connections to and between local hub sites and major ISP sites, as well as the transoceanic/ intercontinental connections which are essential to the backbone Internet architecture.
- Secondly, the provision of a high-speed fiber optic connection to the home, the street cabinet or very local access point.

Table 1: Comparison of DSL technologies

Technology	**Max Upstream Capacity**	**Max Downstream Capacity**	**Max Distance**	**Downstream Capacity @ Max Distance**
Asymmetric DSL (ADSL)	**640 Kbps**	**12 Mbps (0.3km)**	**5.4 km**	**1.5 Mbps**
ADSL 2+	**1 Mbps**	**26 Mbps (0.3km)**	**3.6 km**	**4 Mbps**
Single-line DSL (SDSL)	**3 Mbps**	**3 Mbps (0.3km)**	**2.7 km**	**2 Mbps**
Very-high data rate DSL (VHDSL)	**16 Mbps**	**52 Mbps (0.3km)**	**1.35 km**	**13 Mbps**

The need for increased backhaul capacity and connection speed will be driven by an increased demand in the metro and access network. This access network increase is in turn driven by the increased take-up of high speed internet services for business, residential and mobile customers.

This agenda is primarily oriented at dense markets – where fibre can be installed/upgraded to serve multiple users. 'fibre to the home' (FTTH), 'fibre to the curb (FTTC), Gigabit Passive Optical Network (GPON) will provide capacity at 100s Mbps to a large number of users directly to their homes. These higher rates are stimulating new high data-rate services such as HDTV or video on demand. Such advances in optical transmission are expected to deepen the divide between rural and densely populated urban users.

The cost of connection to new customer locations can be dominated by the cost of digging trenches. This cost can be of the order of £50 per metre. Since this is the same of the cable type, there may not be a significant difference between the installation of copper and fibre to a new location. Alternative methods to reduce installation costs may use existing underground ducts, telegraph poles, or line of sight radio links. It is estimated that providing full FTTH would cost around £29bn for the whole of Britain, whereas providing FTTC would cost around £5bn [4].

Digital Futures'10, October 11 – 12, 2010, Nottingham, UK.

Broadband services depend not only on the "last mile" to the customer, they also depend on platforms with high basic costs but a capability to serve many, perhaps a few hundred or more, connections. They also rely on interconnection from the exchange to the local ISP point of presence and corresponding access to the high-capacity backbone optical network. While backbone networks can provide high capacity, they are most economic when capacity is fully utilised. Remote communities incur higher costs for connection between the exchange and backhaul to the backbone network. Rural broadband often therefore does not offer economies of scale, raising unit costs.

In rural areas, although the service requirements are the same, the delivery mechanism often needs to be different. While it is commonly agreed that the majority of users can be met using existing technology, there is currently a small proportion (~10%) of unreached rural users, who cannot be addressed using existing wired/wireless access. These can be divided into three categories:

- **Grouped**: The grouped category considers users clustered within the near-reach distance.
- **Scattered**: A scattered community is where a group of users lie beyond the near reach distance.
- **Isolated**: Isolated users do not lie within the reach of an exchange using existing technologies.

Long-range wireless, and technologies such Worldwide interoperability for microwave access (WiMax), Power line communications (PLC), satellite access etc offer potential solutions to reach these communities. Each technology introduces cost for deployment and operation and has requisites, e.g. need for line of sight etc. Hence, several transmission technologies may need to be combined, e.g. hybrid terrestrial/satellite communication system architectures. Such services can reduce transmission costs and increase efficiency, flexibility and dependability.

2. SATELLITE BROADBAND ACCESS TECHNOLOGY

The ability of the satellite to provide global coverage has enabled satellite to be a key enabling technology to provide broadband access to areas and locations that cannot be reached by other technologies such as wired and wireless.

The Digital Video Broadcast (DVB) Return Channel via Satellite system (DVB-RCS) is the key European standard published by the European Telecommunications Standards Institute (ETSI) [3]. The specification leverages the highly successful DVB standards for TV distribution to provide a bidirectional geostationary satellite network. Work is presently underway to define a next generation RCS system (DVB-RCS-ng) with improved efficiency. The proposed next generation DVB-RCS-ng is expected to be standardized in 2011. This improves the efficiency of return link and will incorporate a redesign of the Medium Access Control (MAC) layer and IP packet handling to make the system better integrated with ISP networks. DVB-RCS- ng will also support the commonly used IP based protocols and applications providing interoperability. Together these are expected to increase performance and reduce the cost of terminal production and operation. The advances in terminal design have been matched by significant advances in satellite design – with the emergence of a new generation of spacecraft and the introduction of satellites with multiple spot beams that can provide much higher capacity. The launch of Hylas-1 and Hylas-2 will present an unprecedented increase in total available capacity across the UK [5].

The cost of providing rural broadband could be reduced by combing wireless architectures with DVB-RCS. Service providers can provide broadband connectivity by using a hybrid RCST + WIFI or WIMAX equipment to deliver service to underserved rural communities (Figure 1). The solution provides extended coverage and this can be a cost-effective solution than wired technology in areas with lower population densities. These solutions can be deployed quickly, that can be deployed much quicker than possible when laying cable, allowing fast response to new market needs.

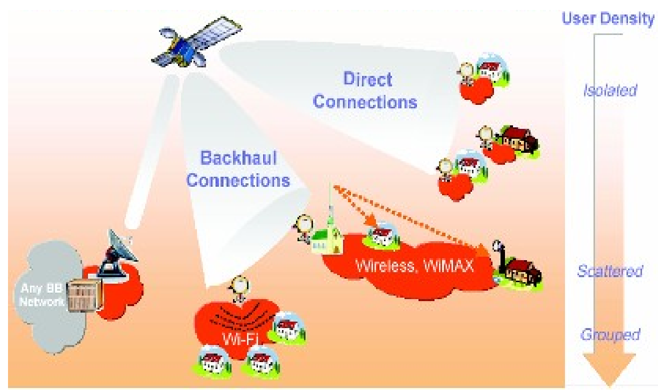

Figure 1: Connecting the rural user community to Internet

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