



NEN Response to DCMS:

Digital Communications Infrastructure Strategy consultation

September 2014

NEN – The Education Network

Over ten million pupils learn through fast, responsive and safe broadband services provided by The NEN – The Education Network, which comprises the Regional Broadband Consortia (RBCs) in England and the Scottish, Welsh and Northern Ireland broadband agencies. Other public sector agencies including local authorities increasingly use these regional networks, benefiting from their reach into rural areas, capacity and reliability. The NEN agencies provide a complete broadband service based on schools' requirements, which include effective learning practice, safeguarding, procurement and supplier management based on demanding technical specifications.

The NEN regional agencies have designed and implemented long-term, sustainable strategies for broadband for schools and the wider public sector, minimising the cost to the public purse through the aggregation of demand for broadband infrastructure and related services. The benefits of this approach are many. These include:

- Providing broadband services that deliver educational policy.
- Developing and sustaining long-term ICT strategies for education.
- Delivering an entitlement to good broadband services.
- Reducing the cost to the public purse through public sector collaboration.
- Minimising the Total Cost of Ownership to schools.
- Sharing of expertise U.K.-wide through the National Education Network.
- Ensuring that pupils are safe on-line through policy, education and infrastructure.
- Widening choice for schools through increasing the range of learning content available.

The NEN community is pleased to respond to DCMS's Digital Communications Infrastructure Strategy consultation. The paragraphs below describe current developments in provision of communications infrastructure to schools, and how we see this important area developing in the future. We also offer some suggestions on how the model developed so far in this area could be expanded and developed to provide improved economies of scale and user experience across the public sector and in the wider economy, and the potential role for Government in making this happen.

For further information please contact us via the form available at:

<http://www.nen.gov.uk/contactus/>

Executive Summary & Recommendations

- The history of broadband development demonstrates that the access bandwidth requirements and broadband usage of schools generally and large secondary schools in particular are far in excess of those of typical households and small to medium enterprises (SMEs). As such their requirements remain ahead of the broadband performance and capability generally available in the commercial marketplace.
- Schools continue to make more and more use of broadband: they are now reliant upon broadband services for many day to day teaching, learning, operational and administrative purposes. The particular requirements of schools mean that flexibility of provision is key, in terms of scalability, pricing and the ability to migrate to new technologies and suppliers.
- All schools require functionality, performance, reliability and service levels beyond those offered by residential broadband services as performance failures or degraded performance adversely affect schools' abilities to deliver timetabled events and scheduled teaching and learning.
- At present, a significant number of schools in rural locations are disadvantaged, facing a delay in, or indeed absence of, roll-out of newer and more capable technologies. This has an impact on the educational opportunities these schools can provide, as described in the recent British Education Suppliers Association (BESA) report and reported by the BBC¹. Without effective public sector intervention, and indeed without that intervention providing the stimulus for the completion of a well-considered national connectivity strategy, there will continue to be a discrepancy in the educational achievements of learners in urban and rural areas, and a consequential long term economic impact on the most acutely affected regions and the whole of the U.K.
- As an example, of 274 schools in Cornwall, despite considerable public and private sector investment in infrastructure amounting to over £130 million, and the roll-out having been underway for over three years, today a quarter are still unable to access superfast broadband, and rely on basic broadband technologies and even satellite solutions in order to make use of the resources and value available via the internet.
- The NEN Technical Strategy Group believes most primary schools' current and likely future access bandwidth requirements can be met by Next Generation Access (NGA, up to 100Mbps) broadband services, where available. It is important to distinguish between access bandwidth and the services that need to be delivered over that bandwidth. The successful use of NGA services to provide broadband services to primary schools is described in NEN Information Sheet 2, *Fibre to the Cabinet (FTTC) for Schools: Opportunities & Possibilities*².
- However, this is not the case for secondary schools. These now typically require enterprise-level connectivity in the order of 1Gbps. The NEN Technical Strategy Group believes that every secondary school with 1,500 pupils or more now requires 1Gbps connectivity, to meet both current and near future broadband requirements. Bandwidth use continues to increase year on year so secondary schools will require connectivity in excess of 1Gbps in the not too distant future.
- Such speeds are far beyond those achievable by currently deployed NGA technologies and services. Gigabit services are very unlikely to become as widely available as the NGA services currently being deployed for some considerable time, if at all. While NGA services are becoming increasingly

1. ¹ <http://www.bbc.co.uk/news/technology-29424313>

² http://www.nen.gov.uk/wp-content/uploads/2014/02/NEN_InfoSheet_2_FTTC_for_schools.pdf

commoditised in terms of availability and affordability, 1Gbps connections remain an expensive option with limited deployment for schools at present. Where they are currently deployed, gigabit connections are delivered on a single purchase point to point basis and are often very expensive as a result.

- A new procurement approach which aggregates secondary school demands for 1Gbps and higher connectivity with other public sector demands for faster speeds would offer significant cost savings and benefits. In particular, this would facilitate the upgrade of the local and regional infrastructures serving schools and other public sector institutions, providing access to the Internet as well as a range of other bespoke services.
- Future government policy and strategy development should consider the establishment of suitable mechanisms, procurement vehicles and funding models to facilitate the aggregation of public sector demand for gigabit connectivity. The marketplace in its current form will not deliver affordable gigabit connectivity for some time to come, if at all. A strategic approach is needed to ensure that future requirements beyond 1Gbps can continue to be met cost-effectively.
- Aggregation of demand at a sufficiently high level would encourage the telecommunications marketplace to respond with new services and pricing. These would offer far better value for money than purchases by individual or small clusters of schools. This approach would enable all secondary schools and other public sector institutions to enjoy the performance advantages offered by gigabit services, removing the current constraints from their broadband capabilities and future proofing their connectivity for many years to come as their connectivity demands continue to grow. Providing gigabit connectivity to schools and other site as “anchor institutions” would also drive the more widespread availability of gigabit services generally.
- Anchor institutions are those public sector bodies such as schools, colleges, Local Authorities and healthcare facilities which tend, once established, to be long-lasting with a significant presence in their local communities. They tend to have predictable purchasing habits and requirements with a likelihood to enter into longer contract periods if cost savings can be achieved as a result. This means the requirements of schools and other public bodies can help to achieve a tipping point for broadband investment, especially if a suitable aggregation mechanism is employed that takes into account schools’ and other institutions’ likely increased demand for bandwidth over a contract term.
- The current situation resembles the situation in schools approximately 15 years ago, when schools required access bandwidths beyond those which were widely available or affordable for individual purchase by schools at the time. This was as a result of the particular needs of schools not being able to be met affordably for individual institutions by the marketplace, chiefly as a result of schools’ requirements for multimedia content and the need to support multiple users simultaneously. This necessitated aggregation of school broadband demand to make 2Mbps connections for primary and 8Mbps connections for secondary schools affordable and sustainable, leading to the establishment of local and regional broadband networks by local authorities and Regional Broadband Consortia (RBCs). Through aggregating the demand for connectivity these networks achieved significant savings both in terms of procurement and running costs, delivered a wide array of benefits and continue to provide a wide range of broadband services to schools today.

- Other countries have acknowledged the need for gigabit connectivity for schools in their national broadband plans and policies. *Connecting America: The National Broadband Plan*³ published by the U.S. Federal Communications Commission in 2010 included the following goal:

“Every American community should have affordable access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals and government buildings. Schools, libraries and health care facilities must all have the connectivity they need to achieve their purposes. This connectivity can unleash innovation that improves the way we learn, stay healthy and interact with government.”

- There is no directly equivalent ambition for schools set out anywhere within current U.K. broadband policy and strategy.
- A plan that positions schools, as well as other public institutions, as ‘hubs’, both commercially and technically, within a national connectivity strategy and serving as part of the mechanism for distributing connectivity services to the community may address many of the key considerations in the provision of a fibre-rich infrastructure across the U.K..
- The rest of this paper sets out schools’ broadband requirements in terms of access bandwidth, performance, reliability and service levels. Further information about school broadband connectivity is available at <http://www.nen.gov.uk>.

³ <http://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf>

1. Introduction: school broadband requirements

1. The requirements for a school broadband connection are very different from those at home, whether this is a small school with less than 100 pupils or a large school. Schools' requirements are based on curriculum delivery and the administrative and operational needs of the school. These represent very different usage patterns, but both require a high level of reliability and performance. Loss of internet connectivity will disrupt both administration and teaching throughout the school.
2. Factors that need to be considered when evaluating a school's requirements for a broadband connection include:
 - What bandwidth does the school need to support the services it uses?
 - Does it need as much upstream as downstream bandwidth?
 - What total volume of data is used each month?
 - The importance of connection management.
 - The impact on connectivity requirements for multi-site or cluster working.

2. What bandwidth does a school need?

3. The line speed and capacity of the school connection has to be modelled to meet the educational, management and communications usage which are dependent on the size of the school and the applications being used both to deliver teaching and learning and to support the management and operation of the school.
4. Schools' use varies depending on the educational strategy and management practices of the institution. The following lists some of the typical uses but is not exhaustive. When assessing broadband requirements, it is important to fully understand the applications currently supported or likely to be required to deliver the educational and management outcomes of the school's strategic development plans.
 - Pupil Internet Access for research – browsing including video and images.
 - Staff use for class teaching including real time applications (talking books, iPlayer, You Tube).
 - Staff mail with attachments.
 - Pupil email.
 - School office functions including management information systems (MIS).
 - School portal, website or virtual learning environment (VLE).
 - Pupil use of cloud based functions such as VLE, Google Apps, Office 365 etc.
 - Cross school or cross site working and support for ICT.
 - IP communications VoIP, Video, Skype
 - Closed Circuit TV.
 - Schools operational systems, remote access and reporting for functions such as energy consumption, catering systems etc.
 - Multi-Agency requirements.

5. The following model is based on providing each active user the equivalent to a home ADSL (2Mbps) service at times of peak usage. This is a useful minimum benchmark in calculating the capacity of the school connection and in keeping with the government's aspiration that minimum 2Mbps services should be available across the whole of the U.K., as set out in the government's 2010 strategy document *Britain's Superfast Broadband Future*⁴.
6. This is a conservative estimate: Ofcom research shows that the average actual download speed of a U.K. residential fixed broadband connection increased from 12.0Mbps to 17.8Mbps between November 2012 and November 2013⁵.
7. Providing the equivalent of this 2Mbps service for each school active device at times of peak usage gives the following results:

For a secondary school with 1600 pupils and 400 connected devices:

- 2Mbps per user download for a school with 400 devices = 800Mbps. Allowing for 1 in 10 devices being active simultaneously at times of peak demand means that the connection capacity should be 80Mbps.
- The requirement for a 100Mbps connection for a secondary school has already been exceeded in that the best connected schools in the U.K. have 1Gbps connections.

For a primary school with 200 pupils and 40 connected devices:

- For a primary school with say 40 devices = 80Mbps and assuming 1 in 10 devices are simultaneously active at times of peak usage = 8Mbps
- Measurements taken in primary and special schools with good educational broadband use indicate that actual usage shows peaks over 10Mbps.

Average growth of bandwidth utilisation in U.K. schools is estimated as 30% p.a.:

Downstream bandwidth requirement				
School	Devices	2012 connection	2015	2017
Secondary	400	80Mbps	176Mbps	297Mbps
Primary	40	8Mbps	18Mbps	30Mbps

8. The above figures are neither overstated nor unrealistic on an international basis. A report by the U.S. State Educational Technology Directors Association (SETDA), *The Broadband Imperative*⁶, recommends at least 100Mbps per 1000 students and staff in 2014-15 for US schools, rising to at least 1Gbps per 1000 pupils and staff by 2017-18.

⁴ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/78096/10-1320-britains-superfast-broadband-future.pdf

⁵ <http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/broadband-speeds/broadband-speeds-nov2013/>

⁶ http://www.setda.org/wp-content/uploads/2013/09/The_Broadband_Imperative.pdf

3. Does a school need as much upstream as downstream bandwidth?

9. Upload speed demands are dependent on the type of usage – if cloud computing is not widely used and most traffic is web browsing then the upstream traffic will be significantly less than the downstream traffic. A reasonable assumption is that the upstream bandwidth is a quarter of the downstream bandwidth for this scenario.

- For the 400 device school, this gives a requirement of 20Mbps and for the 40 device school = 2Mbps.
- Therefore to provide a straightforward internet browsing environment, schools must have at least 80:20 Mbps and 8:2 Mbps in the above scenarios.

However, if pupils are using cloud based services – Office 365, a remote VLE, Google Apps etc. then the school will need to have significantly more upstream bandwidth, say 100Mbps and 10Mbps in the above scenarios. This points to a minimum requirement of 100:100Mbps (say a 100Mbps Ethernet Service) for the larger school and a 10:10 Mbps (say 10Mbps symmetrical Ethernet, 10Mbps symmetrical LLU or an asymmetrical 40:10 Mbps or 80:20 Mbps FTTC service) for the smaller school.

Upstream bandwidth requirement				
School	Devices	2012 connection	2015	2017
Secondary	400	20Mbps	44Mbps	74Mbps
Primary	40	2Mbps	5Mbps	8Mbps

4. What total volume of data is used each month?

10. Ofcom reports that the average data downloaded on uncapped superfast broadband services in June 2013 was 55GB, whereas customers on uncapped ADSL2+ technologies downloaded an average of 26GB⁷. Schools need to ensure that any contract entered into for the provision of broadband services does not have a data cap to avoid unexpected and potentially large bills or a suspended service when the cap is reached.

11. Watching videos or downloading images takes large volumes of data. Taking iPlayer streaming as an example: by default BBC iPlayer TV programmes are streamed at a high quality rate of 1500kbps (1.5 Mbps). The video quality can be reduced from high to standard 800kbps quality video by de-selecting the "HQ" option from the media player controls during live or on-demand TV playback. This will play a reduced bitrate video that can be used if the internet connection is not fast enough to play the high quality video. At the higher definition this means that for a 4 minute movie 45MB of data will be transferred.

- One 4 minute video per pupil per week for a secondary school = **288GB per month**
- One 10 minute video per class per day for a 6 class primary school = **13.5GB per month**

⁷ http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/infrastructure-report/IRU_2013.pdf

NB this type of usage again underwrites the initial assumption of 2Mbps per active user at peak times.

5. The importance of connection management

12. The availability of broadband to a school is an essential component in the operation of the school. A fully managed service is an essential element in achieving high availability and corresponding service level agreements from the suppliers. This implies:

- The service is supported by a 7x24 Operations Centre which monitors connectivity and both flags and instigates actions to repair faults on that basis thus ensuring that unless a school visit or in school action is required the fault fix is progressed immediately and the connection downtime is kept to a minimum. Frequently faults occur out of normal business hours and can be fixed before the start of the next business day.
- A support desk taking calls and with full online ticket reporting so that schools can see and trace progress with reported faults, poor performance and change requests. The desk should take calls both on-line and by phone and needs to be available at least during the working day (8.00 am to 9 p.m. weekdays and Saturday a.m.).
- An on-line portal showing the performance and availability of the connection.
- On-line billing

6. The impact on connectivity requirements for multi-site or cluster working

13. Many schools want to operate as a member of a cluster. This may be a multi-campus school, a group of schools in an academy trust or a cluster of schools working together with a single managed wide area network across its members. Being part of a fully managed wide area network enables this to be provided in a straightforward and cost effective way without traversing the Internet. The alternative of installing separate point-to-point connections between sites may be expensive.

14. Some sites are multi agency not only being the location for the school, but perhaps a library, a medical centre or other public sector services. Being part of a managed Public Services Network (PSN) enables connectivity to each of the agencies to be delivered over a single broadband connection with each agency having control over its own virtual wide area network and different security levels to be applied as required.

7. Quality of Service

15. A managed network will also enable Quality of Service (QoS) to be implemented across its infrastructure to enable better performance and the support of voice, video and priority applications. Typically 6 level QoS may be implemented:

Priority	Class	Description
1	Voice	Voice IP Telephony
2	Video	Broadcast Video, Real-Time Interactive Video (Cisco Tele Presence), Multi-Media Conferencing, Multimedia Streaming
3	Signalling	Call Signalling
4	Priority-Data	Transactional Data (ERP, CITRIX), Network Management and Control
5	Scavenger	YouTube, iTunes, Bit Torrent, Xbox Live.
6	Best-Effort	Bulk Data (E-mail, FTP, Backup Apps, Content Distribution), Nonconforming Data to above Classes

16. Where the broadband provider provides a fully managed connection with Quality of Service this enables a wider range of quality services to be supported including voice and video services, different types of applications with time dependent requirements to be supported across the network (CITRIX) and the full bandwidth of the schools circuit to be available across the network when capacity is available and demanded by the site (peak demand).
17. Further information, advice and guidance about broadband connectivity for schools is available at <http://www.nen.gov.uk>.