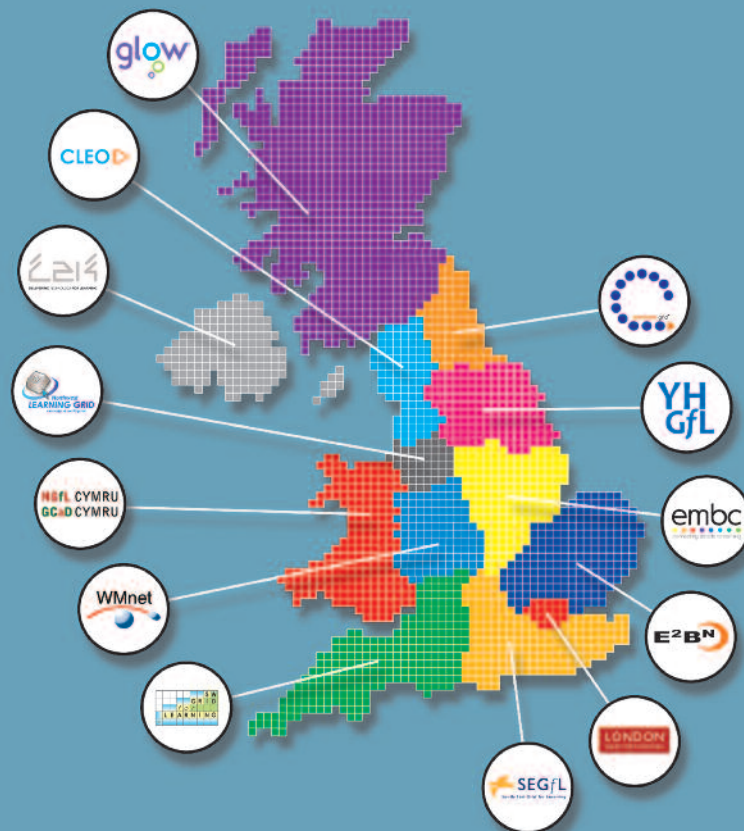




The National Education Network

# Building a Broadband Entitlement

## NEN Strategy Paper 2





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## NEN Strategy Paper 2 December 2009

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# Introduction

It is important that we harness the power of technology to make learning experiences exciting, safe and personalised. In this paper we describe the concept of “Broadband Entitlement”, a wide range of services available to every learner. From a definition of the learner’s Broadband Entitlement the strategic direction and scale of the National Education Network can be refined and centred on the individual child.

The main focus of this paper is the institutional and related local, regional and national infrastructure strategy required to deliver this entitlement. Clearly broadband services must also enable access from wherever learning happens, including the home.

It will be seen that many agencies need to work together including schools, central government and the devolved administrations, the National Education Network, Becta, JANET(UK) and in particular the Regional Broadband Consortia and Local Authorities.

## Building a Broadband Entitlement:

● <b>Next Steps</b>	<b>6</b>
● <b>Defining broadband entitlement</b>	<b>7</b>
● <b>Delivering the broadband entitlement: a partnership approach</b>	<b>10</b>
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This National Education Network Strategy Paper is a result of discussions between the broadband agencies in Scotland, Wales, Northern Ireland and the ten Regional Broadband Consortia representing Local Authorities in England. Becta and JANET(UK) are also thanked for their help in writing this booklet.

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# Next Steps

- **Improve Learning** by embedding Broadband Entitlement, establishing system-wide improvements and increasing the effectiveness of ICT in education.
- **Improve Practice** through the interchange of knowledge across the education sectors including safeguarding, identity and access management, information sharing, resource discovery and learning platforms.
- **Ensure Funding** by engaging with decision makers and funding agencies to make clear the critical enabling role of broadband and the value added by collaborative approaches.
- **Improve Client Intelligence** by enhancing capability and capacity across the education sectors especially in: public sector aggregation, procurement, supplier management, technology pathways and effective design.
- **Ensure Fitness for Purpose** by engaging with telecommunications services providers to inform planning of education network developments.
- **Continue Collaboration** between agencies including DCSF and other government departments, Ofcom, Devolved Administrations, Becta, JANET (UK), RBCs and Local Authorities regarding national strategies including the Public Sector Network.

# I.

## Defining Broadband Entitlement

Every learner should have access to the tools and technology to ensure that their learning experiences are exciting and effective. What does this require of the broadband provision, including access, safety, applications and learning content?

Harnessing Technology: Next Generation Learning 2008-2014<sup>1</sup> (Becta's review and revision of the original e-strategy) sets out the government's strategy for technology in education and skills. It recognises the huge contribution technology has already made and must continue to make. The underpinning role of broadband infrastructure in ensuring the delivery of Harnessing Technology outcomes is clear throughout the strategy's five themes:

- A technology-related **learner entitlement** to enable all learners to access and use technology effectively, closing the gap for disadvantaged learners;
- **Universal access** to powerful learning tools, content and support for family and informal learning;
- Supporting better teaching by fully exploiting the benefits of technology to provide **professional tools and support**;
- **Mobilising leadership** at all levels of the system through nationally recognised leadership networks supporting innovation and knowledge transfer;
- A fit-for-purpose system-wide national digital infrastructure that supports **personal ownership and environmental sustainability**.

The need to reflect local circumstances and requirements (for example, the variations in communications infrastructure and costs) necessitates a variety of approaches to the provision of broadband connectivity for learning institutions across and throughout the UK at country, regional and local authority levels. As a result connectivity technologies, procurement, contractual and management arrangements vary considerably.

This has often resulted in innovative approaches that have enabled delivery and reduced costs substantially, particularly where aggregation between sectors has been achieved. However, it also means that there remains significant variability in the bandwidths, services and performance available to institutions across different regions.

1. <http://publications.becta.org.uk/display.cfm?resID=37348&page=1835>

There is now a recognised opportunity to set a clear national strategy to define in detail the baseline services and performance levels that should be available to support the continued delivery of appropriate broadband services to the schools sector and beyond, ensuring consistent provision for all.

Becta continues to work closely with a wide range of partners to develop the concept of a broadband entitlement. This should set out challenging but achievable nationally agreed minimum services and performance levels that should be universally available to learners and institutions.

## 1.1 Defining broadband entitlement: a Core Service Set and underpinning delivery principles

Becta has defined a Core Service Set to exemplify what should be in place as a minimum level of broadband provision for all institutions. This describes a baseline set of services that schools' and other educational institutions' broadband connectivity should provide to learners and educators.

The Core Service Set is supported by a set of delivery principles that should inform the way these services are provided whilst still affording appropriate regional and local flexibility and choice.

### 1.2 The Core Service Set:

The core service set comprises three strands: connectivity, applications and safeguards, with each strand being comprised of three component elements

#### Connectivity:

- Bandwidth – appropriate to need, scalable and future proof as far as possible, and delivered where it's needed
- Reliability/resiliency/availability – managed, guaranteed services governed by appropriate service levels and contractual arrangements
- Performance – sufficient to provide the required applications (in terms of, for example, response times, latency), including support for demanding applications

#### Applications:

- Access to internet services
- Communication and collaboration tools – email, videoconferencing, VoIP, instant messaging
- Learning resources and tools – content, learning platforms, e-portfolios, MIS, resource discovery and search, online productivity tools

#### Safeguards:

- Security – of networks and data
- Safety – to guard against inappropriate content and contact (filtering, monitoring, authentication and authorisation)
- Policies and procedures – acceptable use policies, security policies, user education, advice and guidance

### 1.3 The Delivery Principles

The accompanying six delivery principles illustrate but do not prescribe the way the core service set should be provided. The need to tailor delivery to accommodate local circumstances and requirements is recognised.

Local knowledge will continue to inform innovative regional solutions, however all delivery models should demonstrate and exemplify the following six qualities:

- **Flexibility** (especially of location & time; providing appropriate access to other users, for example parents)
- **Inclusivity & transparency** (pricing, bandwidth, availability, reliability, performance)
- **Value for money** (supporting delivery efficiencies and economies of scale via aggregating demand, ensuring value for money, reducing the procurement and management burden on institutions)
- **Sustainability & scalability** (service continuity & service level management, the ability to cope with changing and increasing requirements, reflecting and supporting environmental considerations)
- **Quality** (ease of use, appropriate & fit for purpose services)
- **Personalisation** – tailored, differentiated services

It is important that the entitlement is dynamic, developing and changing over time, to prevent the misconception that educational broadband provision is “job done”. Requirements, bandwidths and technologies continue to evolve at ever increasing rates. The core service set provides a useful framework to structure ongoing regular review and reappraisal of school broadband possibilities and requirements. The newly established Education Network Governing Council<sup>2</sup> is responsible for maintaining and reviewing the core service set and delivery principles.

Service providers should be responsible for delivering this core service set in keeping with the delivery principles. The core service set and delivery principles should together provide a challenging but achievable goal for providers of broadband services to schools and other educational institutions.



## 1.4 The wider policy context

Clearly, institutional connectivity must also support wider initiatives and policies such as parental reporting and universal home access. The need to support wider initiatives both now and in future is reflected in the accompanying delivery principles, to ensure that all institutional connectivity arrangements provide the right foundations for current and future policy and strategy.

Alongside these education initiatives there continues to be a significant drive from central government to increase efficiency and drive down costs in public sector service delivery. The Transformational Government strategy<sup>3</sup> encouraged a shared services approach to release efficiencies across the system and support delivery more focused on customer needs. Technology now makes this far easier than ever before, providing public service organisations with opportunities for re-using assets and sharing investments with others. The strategy identified common infrastructure and technology standards and architecture as two key areas for developing a shared services approach. Again, the delivery principles that underpin the Core Service Set are intended to reflect and support such wider government policy and strategy.

Other strategies that impact on educational broadband provision include Government Connect (GC)<sup>4</sup>, the recognised, accredited and trusted secure government network for all LAs in England and Wales, and the increasing use of sensitive personal

information about children and families, required by Children’s Services functions, which place greater emphasis on data security. These shared services objectives of local authorities are requiring local networking provision to develop greater flexibility and reach. The opportunity to adopt common standards and thereby share networked services across local authority and regional services could have a wide impact on connections in institutions. Consistent delivery of such a broadband entitlement will help to ensure the benefits of these far-reaching programmes are realised.

2. [http://partners.becta.org.uk/index.php?section=sa&catcode=\\_sa\\_te\\_en\\_03](http://partners.becta.org.uk/index.php?section=sa&catcode=_sa_te_en_03); 3. [http://www.cio.gov.uk/transformational\\_government/strategy/](http://www.cio.gov.uk/transformational_government/strategy/)  
4. <http://www.govconnect.gov.uk/>

## 2. Delivering A Broadband Entitlement: A Partnership Approach

### 2.1 A national strategy – The National Education Network

The National Education Network comprises the 13 grids of the RBCs and devolved administrations of the UK. While operating and funded regionally, they work in partnership to address national agendas and challenges and to add value through pooled expertise and collaborative development.

The NEN community drives the provision of an integrated digital communications infrastructure and associated services and resources to support the safe, effective embedding of ICT into teaching and learning.

Designed to support data-intensive applications (including videoconferencing and the delivery of media-rich content), the NEN offers a number of unique advantages for schools: it offers a secure and safe environment where issues such as copyright are managed and where teachers, pupils and parents can work confidently together. It is also sized and maintained specifically to meet the bandwidth and media demands of the education sector, within limited budgets.

The NEN is a collaborative partnership between local authorities, working together in regional collaboration with national partners like Becta, DCSF and JANET(UK). These regional partnerships have been developed in various ways by the devolved administrations, Regional Broadband Consortia (RBCs) and local authorities to provide broadband and related services.

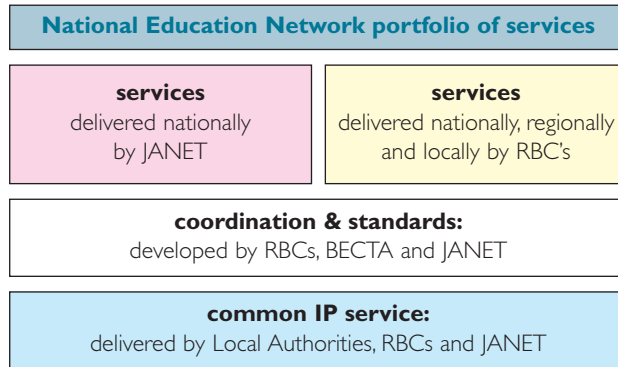
The National Education Network is a:

- community
- way of working
- dedicated network delivering a choice of services to a set of agreed standards

**See [www.nen.gov.uk](http://www.nen.gov.uk)**

## 2.2 The NEN Portfolio of Services

The National Education Network should thus be seen as a portfolio of national, regional and local services, maintained and developed to support all sectors of education:



Taken together, these national, regional and local services begin to frame a consistent set of broadband services for all – a broadband entitlement.

## 2.3 The importance of collaboration

By definition, the NEN is a joined-up system, and it will not work if different purchasing and implementation decisions are made at regional, local and school level without a governing framework of standards and specifications. Establishing interoperability between applications, services and content will be much more difficult, or even impossible, without agreed standards.

An analogy can be drawn with the road system: individuals and organisations are able to make their own choices when it comes to buying vehicles, but the road system on which vehicles travel is regulated by local, national and international rules. So, to create and develop the NEN, local authorities, joined in a regional broadband consortium (RBC), are the preferred solution. This enables system-wide leverage of the benefits of working within an agreed framework of standards and offers the considerable efficiency and financial advantages of aggregated procurement, implementation and management. RBCs and local authorities play an important role here, to ensure broadband connectivity and services are delivered to quality and value principles.

The standards and policy frameworks underpinning the NEN (for example, Becta's requirements for its Accreditation of Internet Services to Education<sup>5</sup> and the policies supporting the UK Access Management

Federation for Education and Research<sup>6</sup>) not only help to ensure that every school has reliable access to a consistent set of broadband resources and services; they will also provide a mechanism to support the further development of the NEN as a whole.

## 2.4 Safeguarding Children Online

All NEN partners fully support the recommendations of the Byron Review<sup>7</sup> and the work of the UK Council for Child Internet Safety<sup>8</sup> in implementing these recommendations, alongside those of Becta's publications *Safeguarding Children in a Digital World*<sup>9</sup>, the toolkit for Local Safeguarding Children Boards (LSCBs)<sup>10</sup> and *AUPs in context: Establishing safe and responsible online behaviours*<sup>11</sup>.

In particular:

- All NEN partners support the need for the continued development of industry codes of practice for tools and services for promoting e-safety in schools and colleges, at home, and in other markets aimed at children and young people.
- All NEN partners have a strong role to play in developing policies and solutions for safeguarding and promoting the welfare of children in an ICT environment in the local area.

All NEN partners also believe that in their strategic leadership roles, e-safety is an essential aspect of every activity, but especially where the provision of content and services to young people is concerned.

## 2.5 Regions and Regional Broadband Consortia

Schools' use of online services has helped transform learning and teaching. The Regional Broadband Consortia (RBCs) in England, with the devolved administrations in Northern Ireland, Scotland and Wales (Regions), have been instrumental in the design, procurement, governance and management of this world-leading National Education Network.

High-quality broadband connectivity has been provided to each of the 28,272 state schools across the UK, whether in remote rural areas, in the Highlands and Islands or in city centres. Local and central government agencies have delivered a complex ICT project on time, within budget and to a higher specification than first envisaged.

5. [http://schools.becta.org.uk/index.php?section=re&catcode=ss\\_res\\_pro\\_bps\\_int\\_04&rid=13440](http://schools.becta.org.uk/index.php?section=re&catcode=ss_res_pro_bps_int_04&rid=13440); 6. <http://www.ukfederation.org.uk>  
 7. <http://www.dcsf.gov.uk/byronreview/>; 8. <http://www.dcsf.gov.uk/ukccis/>; 9. <http://publications.becta.org.uk/display.cfm?resID=25933&page=1835>  
 10. <http://publications.becta.org.uk/display.cfm?resID=35446&page=1835>; 11. <http://publications.becta.org.uk/display.cfm?resID=39286&page=1835>

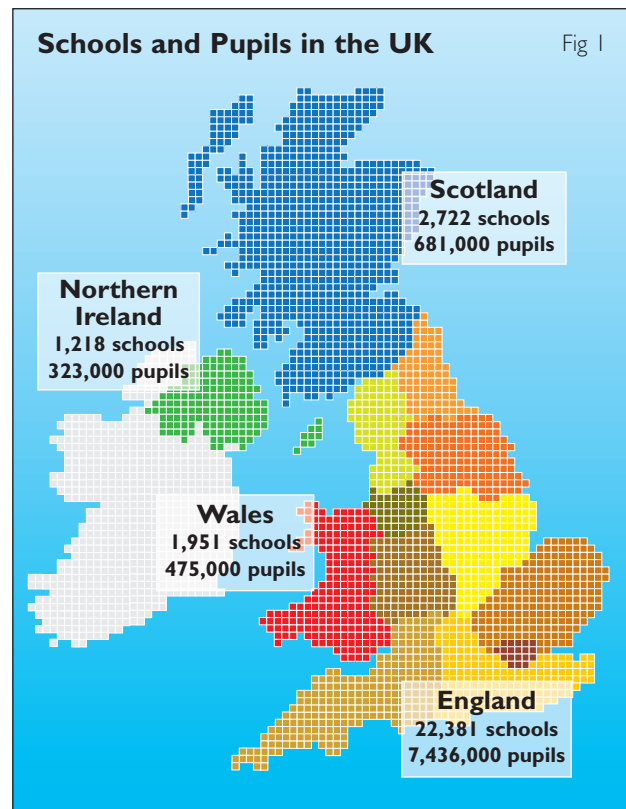
The RBCs were first established in 2000 to develop regional services including learning content and to aggregate broadband demand to achieve value for money. They have been very successful in this – as of December 2006, virtually all schools in the UK were connected to educational broadband. Almost from the start the RBCs collaborated to share knowledge, to agree standards, to interconnect their networks and eventually to form the National Education Network. The project goes far beyond connectivity and includes many areas including educational content, personalised learning, online safety and security.

The RBC Interconnect was established later in the programme, when the roll-out of broadband to schools was already well underway, to provide services including a conduit for IP video conferencing between RBCs and the delivery of common content to schools nationally. The RBC Interconnect was also envisaged as enabling more effective collaboration between schools within separate RBC networks, creating a true National Education Network.

The need to reflect local circumstances and requirements necessitates a variety of approaches to the provision of connectivity across RBCs. In consequence, there are significant differences in the way services are provided and managed across different RBCs.

The roles played by RBCs – in terms of management and administrative functions – also vary significantly. While some have a highly centralised function, managing relationships with service providers and system integrators to deliver core regional connectivity and connections right down to the school level, others have more of a coordinating role, developing and managing procurement routes (typically via the letting of framework agreements) for individual member authorities to purchase through. Others lie somewhere between these two approaches, in that they have procured and manage a central core network and associated services while also letting framework agreements to support member authorities in the implementation of local WAN infrastructure, services and connections to the regional core network. A helpful overview of the different RBC approaches and strategies is available in SEGfL's *Broadband Best Value* paper<sup>12</sup>.

The scale of schools' increasing use of broadband and the opportunities and aggregation benefits of the partnership approach between schools, local authorities, RBCs and JANET is illustrated by JANET's publication *Using the Power of JANET: Information for*



*Local Authorities in England*<sup>13</sup>, with this case study of the London Grid for Learning (LGfL).

“With the high number of schools, LAs, CLCs, Libraries and other educational establishments connected to the network, LGfL Internet traffic is significant. To ensure resilience, LGfL uses multiple suppliers to provide Internet transit to the Consortium. The two JANET interconnect links, each at 10Gbit/s, provide LGfL with fast and reliable Internet transit together with direct access to the National Education Network. LGfL recently agreed to partner with Fronter UK to provide the London MLE learning platform. Hosting of this service is currently within the University of Oslo, which is connected to NorduNet, the Norwegian academic network. Due to the nature of the JANET interconnects into other European academic networks, latency times for London schools to access resources hosted within Oslo are insignificant.”

This partnership approach enables the cost-effective delivery of a high quality service for the institutions LGfL serves, the performance of which could not be replicated via a fragmented, piecemeal approach. This example also illustrates the additional functionality such an approach enables, by providing seamless access to a service hosted elsewhere in Europe.

<sup>12</sup>. [http://www.segfl.org.uk/library/1117021166/final\\_segfl\\_bbv\\_booklet\\_as\\_printed.pdf](http://www.segfl.org.uk/library/1117021166/final_segfl_bbv_booklet_as_printed.pdf); <sup>13</sup>. <http://www.ja.net/documents/publications/localauthorities.pdf>

The East Midlands Broadband Consortium (EMBC) is currently in the third stage of its network development across the region. This most recent development, phase I of which began in 2001, will provide a resilient central server farm and remove single points of failure across the network. It will extend the reach of services through the enablement of additional exchanges and utilise new BT technologies and pricing. Institutions' bandwidth will be increased and will also be provided in more scalable way, with 100Mbps bearers to large schools and 10Mbps or multiple 2Mbps bearers to smaller schools. This will allow edge site link capacity to be increased as required.

Figures 2 and 3 illustrate the scale and reach of EMBC's network. Figure 2 shows the core network infrastructure, while Figure 3 shows the links into the core network from one east Midlands region (South Derbyshire), with resilience maintained across both the core and the regional infrastructure:

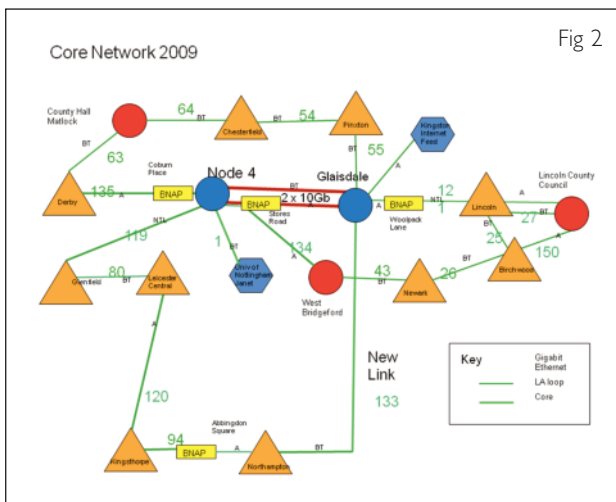


Fig 2

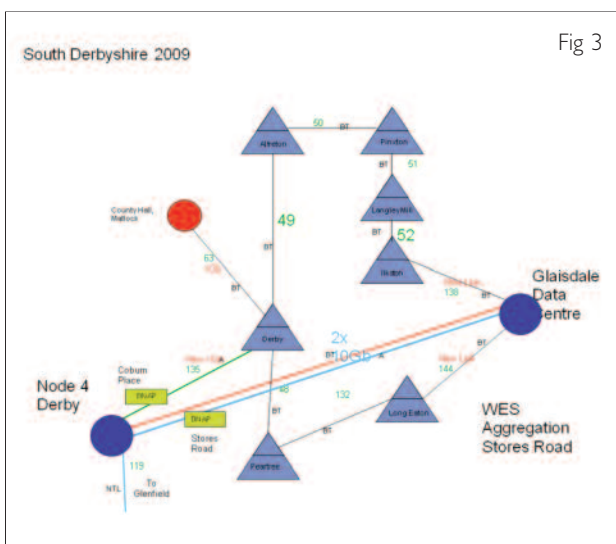


Fig 3

This single, resilient infrastructure can support multiple networks, including regional curriculum virtual private networks (VPNs), county based administrative VPNs, local authority corporate VPNs and library VPNs. This approach provides scalable connectivity, with a high degree of end to end management and control, to ensure the core supporting infrastructure can keep ahead of the increasing capacity requirements of institutions. Centrally provided services include web and email filtering, firewalls, web hosting, videoconferencing and EMBC and local authority SharePoint portals. The network supports third party services as well, which could include applications such as remote network support, CCTV, building control and virtual learning environments (VLEs).

This dedicated, managed broadband connectivity approach supports teaching and learning across an entire region, and will continue to be developed to support new services, applications and related increasing bandwidth requirements.

In summary, there are three key points to recognise in such implementations:

1. Services are provided to many types of organisation (including colleges, schools, HE institutions and local authorities);
2. Substantial engineering effort is involved;
3. Aggregation and partnerships make such high-grade solutions possible within reasonable public-sector budgets.

## 2.6 JANET

JANET is the UK's education and research network. Under an agreement with Becta it provides to the National Education Network:

- The means by which RBC and Local Authority schools networks interconnect to each other, and to the rest of the education community across the UK independently of the Internet.
- High capacity and highly reliable access to the Internet, to other education and research networks globally and to large-scale content providers such as Google and the BBC
- Access to tailored applications such as UK-wide and international videoconferencing, and to security and other expert services

JANET is a world leading network built specifically to provide services to the public sector education and

research community. It is the largest purpose built IP network in the country with over 18 million end users<sup>15</sup> including 9.7 million school pupils and staff.

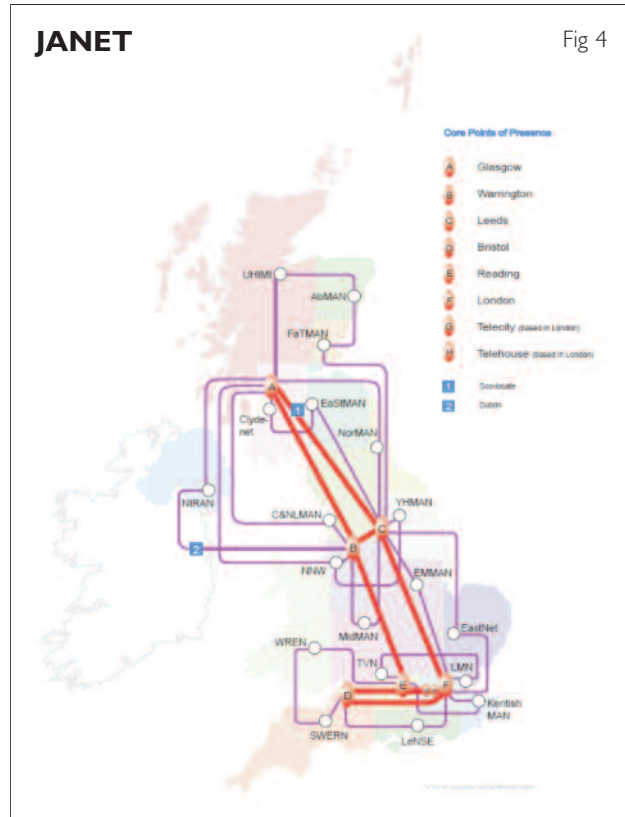
JANET connects universities, colleges of higher and further education, Research Council laboratories and museums. JANET also connects many schools via the RBC's and Regions. Every RBC is connected to JANET as are a number of individual local authorities forming the National Education Network.

The range of activities facilitated by JANET allows individuals and organisations to push back the traditional boundaries of teaching, learning and research methods. For example, JANET's videoconferencing and video streaming capabilities are being used to deliver lectures to remote groups of students.

JANET works closely with RBCs to provide a private national infrastructure and Internet connectivity to RBCs and in some cases directly to Local Authorities on their behalf. The National Education Network portfolio of services is delivered in England by the RBCs, Regions and by JANET.

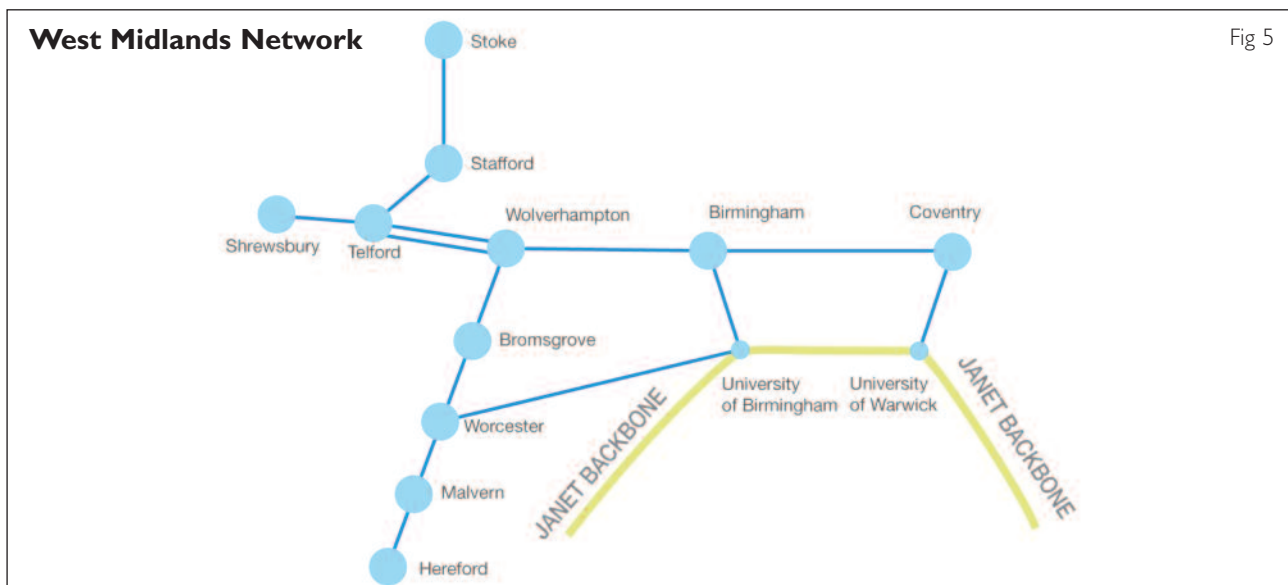
The recent procurement and implementation by JANET of a new regional network across the West Midlands<sup>14</sup> illustrates the scale of what partnership working between JANET, RBCs and local authorities can achieve (Figure 5).

This reliable, resilient, dedicated network connects HE and FE institutions and local authorities across the region. It provides regional interconnection and onward connectivity to JANET and the National Education network. The network is used for the



delivery of Children's Services including education ICT services, and can also be used to deliver other public services. This model of delivery also affords scalability, essential to ensure that the significant and persistent growth of the education and research sectors' bandwidth requirements can continue to be met.

JANET also works closely with RBCs and Becta in the development of the NEN. As such it also provides access to NEN services for local authorities in Scotland (via Glow), Wales (via NGfL Cymru) and Northern Ireland (via Classroom 2000).



14. <http://www.ja.net/company/WMRN.html> & <http://www.ja.net/documents/invitations-to-tender/midman-pqq-final.pdf>  
 15. <http://www.ja.net/company/the-janet-network/index.html>

### 3. Delivering The Broadband Entitlement: Infrastructure Requirements

#### 3.1 Current usage of broadband applications and services – the impact on regional networks

Whilst work is continuing to analyse in detail current usage and predict future school requirements, a difficult task, it is clear that school usage of broadband continues to increase:

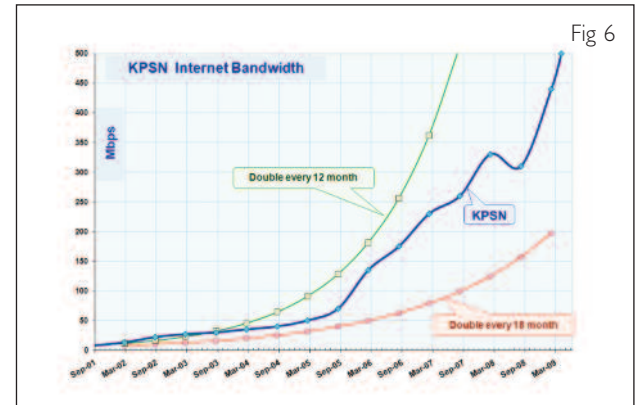


Fig 6

This growth in Kent is typical of many RBC and local authority networks – demand doubling in less than 18 months over the last six years. Some of the bandwidth growth is due to connecting more schools, but the big surge in recent years occurred after most secondary schools had been connected. Another example from the Northern Grid for Learning, shows that RBC transit since the start of term 2008/2009 has grown from an average of 300Mbps to 400Mbps:

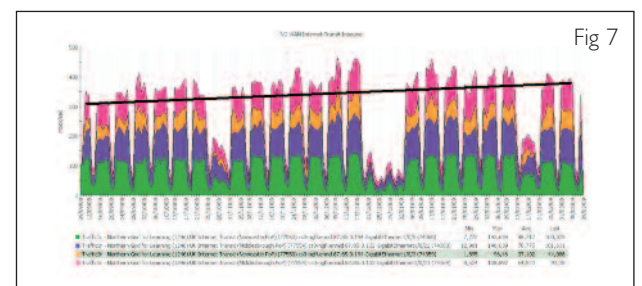


Fig 7

Local authority transit has also grown since the start of term 2008/2009, from averaging around 40Mbps to around 60Mbps for this site:

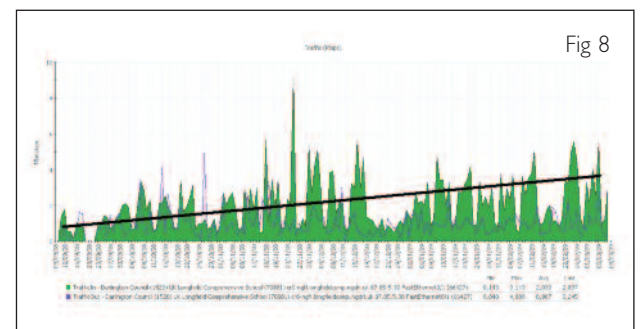


Fig 8

The two charts below (Figure 9) provide a snapshot of West Midlands regional network traffic in February 2009.

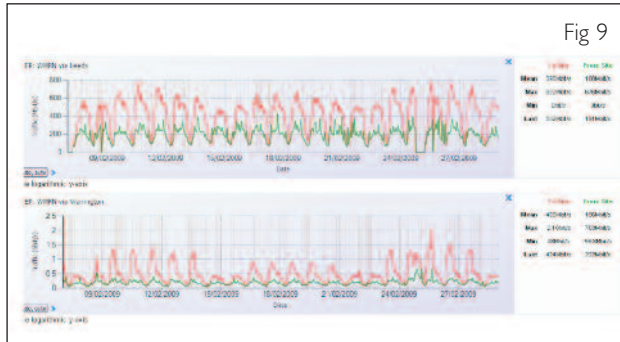


Fig 9

Note that the vertical axis scales are not the same (Mbps on the upper, Gbps on the lower). The impact of schools' traffic shows up quite significantly on one regional connection (Warrington) but not on the other (Leeds). This is because only one local authority's traffic goes through the Leeds router whereas that of another six at the time was going through the other at Warrington. Schools' half term week can clearly be seen on the on the lower graph, but is barely visible on the upper. Traffic on the lower graph is roughly double at peak times. The weekends also show up more markedly on the lower graph. The upper graph is more symmetrical between upstream and downstream. The midday peak between 10am and 3.00pm is also more pronounced on the lower, possibly because the working day goes on longer in HE/FE.

Finally, Figure 12 shows the dramatic increase in bandwidth utilisation across Scottish local authorities via the Scottish Schools Digital Network (SSDN) Interconnect, from January 2002 to December 2008. The upper line shows traffic from the Interconnect, the lower traffic to the Interconnect.

The following charts (Figures 10 and 11), developed by JANET<sup>16</sup>, illustrate how schools' usage of a particularly demanding application – videoconferencing – has and continues to increase dramatically. Videoconferencing requires high quality, symmetric connectivity. The data is generated by monitoring schools' use of the JANET Videoconferencing Service (JVCS)<sup>17</sup>. The chart on the left shows how schools' overall use of videoconferencing has increased from September 2004, while the second chart illustrates this growth month on month across five school years from 2004-5 to the present:

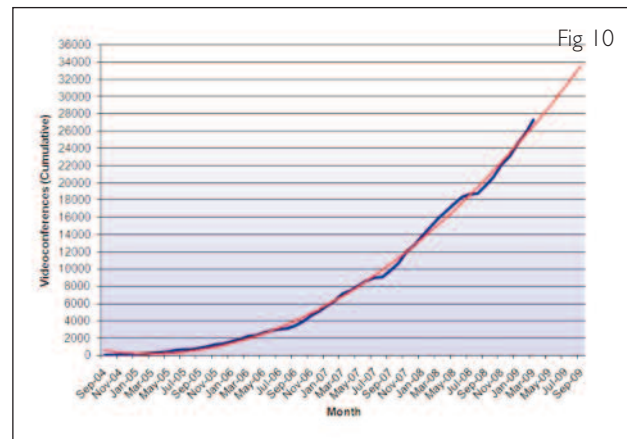


Fig 10

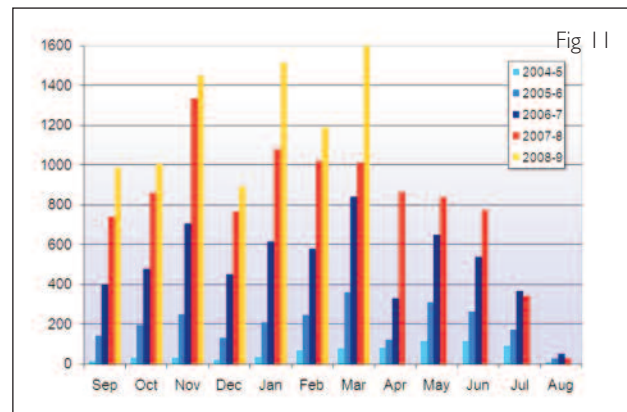


Fig 11

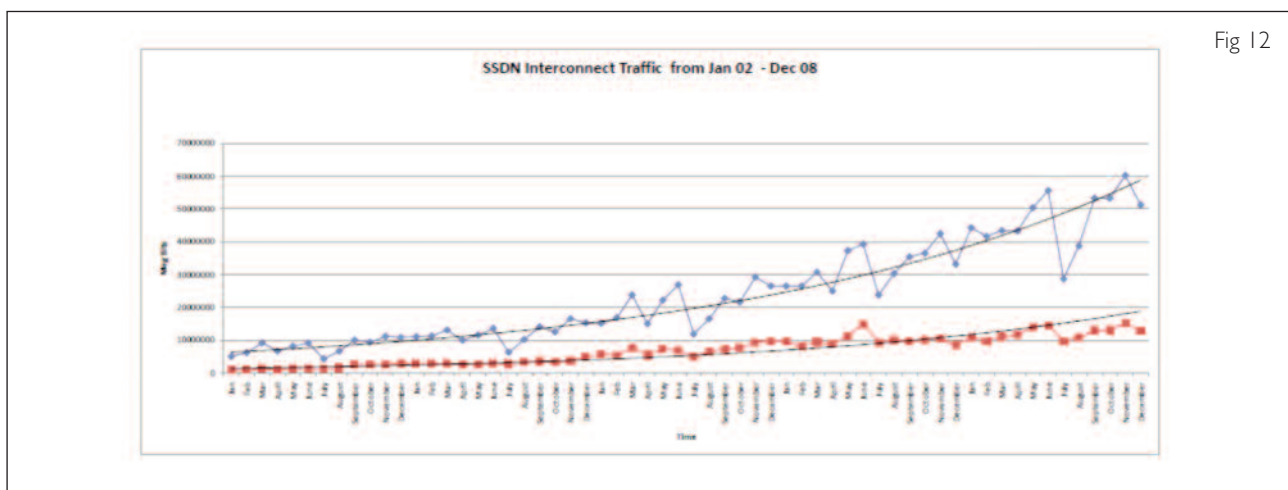


Fig 12

16. <http://www.ja.net/communities/schools/videoconferencing/statistics.html>; 17. <http://www.ja.net/services/video/jvcs/index.html>

Finally, the diversity of applications schools employ videoconferencing for is clearly shown here:

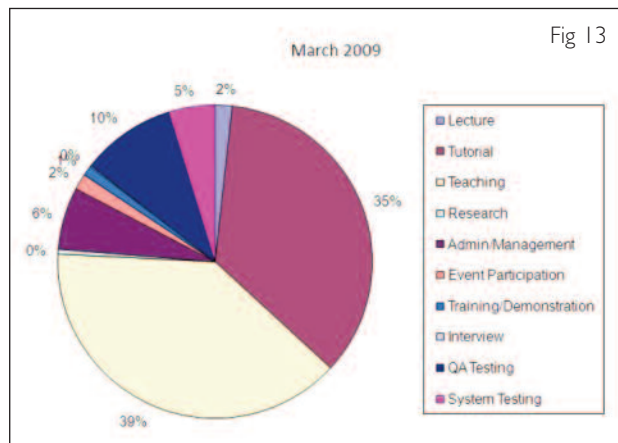


Fig 13

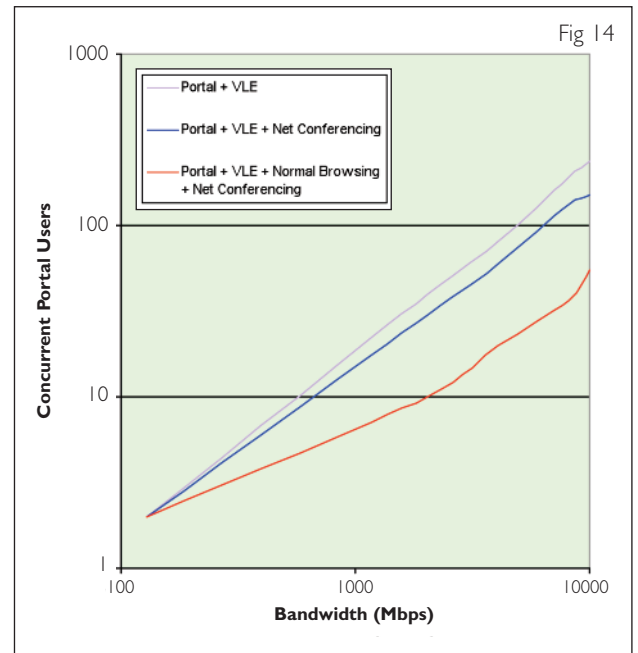
### 3.2 Increasing audio and video use

Audio and video transfer far more data per session as compared with text or still image. While the use of video and audio started at low levels a few years ago, pupils now assume that they can view multi media. These figures from SWGfL show the rapid increase in the volume of audio and video data transferred. Should schools restrict audio and video, which is often exciting material, or should the broadband network respond to the demand?

Increase in data transfer in one year		
Image	20.5%	SWGfL Increase in data transfer by data type from academic year 2007/8 to 2008/9
Audio	287.5%	
Video	55.8%	
<b>Total data transfer 40.0%</b>		

### 3.3 What bandwidths should be provided for end users' institutions?

It is difficult to define precise bandwidth requirements for individual institutions, as these depend on many inter-related factors: the nature of the applications and services being used, likely numbers of concurrent users and infrastructure availability being just three. The following chart was developed in Scotland to provide guidance to end users with regard to the possible impact of the use of the portal to the Glow suite of applications on bandwidth requirements, when used in combination with other applications and services (Figure 14).



Predicting application impacts on an underlying network is not an exact science, so it is difficult to make categorical statements or predictions about the effect of deploying any application, or the bandwidths that should be provided. Expected usage must be based on best estimates and these will vary based on actual usage. However the above chart nevertheless very usefully illustrates the links between concurrent usage, application types and bandwidth requirements. The graph also gives a projection of how delivery of new applications and services may become possible as connection speeds and numbers of users increase.

Hampshire County Council has developed three categories to differentiate schools' broadband usage: web browsing, mixed media and multi media which provides a useful complement to the above:

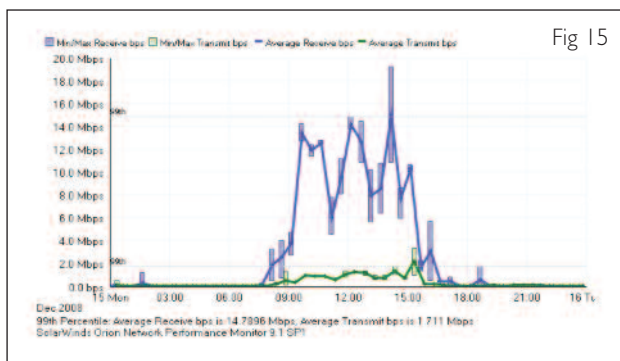
- Schools that fall into the **Web Browsing** category would be visiting sites that have fairly static text and images. They could be visiting their Learning Platform, but won't regularly be using embedded videos or streaming media. The school will also be sending emails that do not regularly have attachments. The school will rarely be uploading information or participating in wikis, blogs and forums.
- Schools that fall into the **Mixed Media** category are doing everything that those in the Web Browsing group are doing but are also embracing the use of streaming media and may have video conferencing facilities. They may be using a digital learning resource such as Learning City or Espresso within scheduled

lessons, rather than pupils using it within all areas of the curriculum on a daily basis. The school will also have the ability to video conference, but will not be doing it on a daily or weekly basis. The school may also be uploading content to sites beyond the school and pupils may be exploring more collaborative tools such as wikis, blogs and forums.

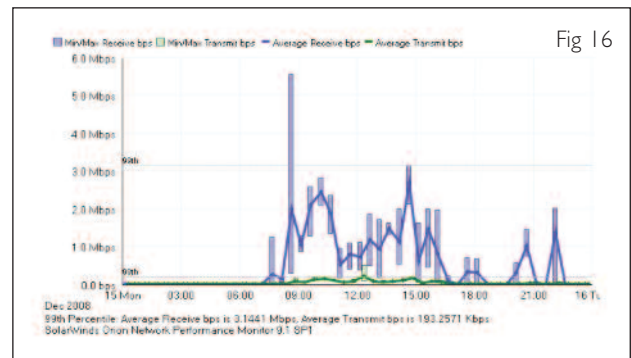
- Schools that fall into the **Multi Media** category have embedded a Learning Platform or digital learning resource into their teaching and learning practices. On a daily basis pupils will access rich multimedia content online. This will involve streaming of videos and/or music and the use of video conferencing on a regular basis, maybe on a whole class event or potentially more than one conference at a time. Pupils in this environment are not only consumers of digital content, they will regularly be creating multimedia content and uploading and sharing it. The use of collaborative tools such as wikis, blogs and forums are a regular part of the school day.

These categories can be used as a guide to inform minimum bandwidth to ensure each user has a positive online experience. Again, the number of devices that may be concurrently using these online services must be considered. This may be easier to judge in a primary school with a 30 station ICT suite than in a secondary school which has PCs in each department, wireless laptops connecting at various locations and potentially pupils connecting independently to the school's network using a range of web enabled devices.

The following graph (Figure 15) shows recent bandwidth usage in one secondary school over a single 24 hour period (Monday 15th December 2008):

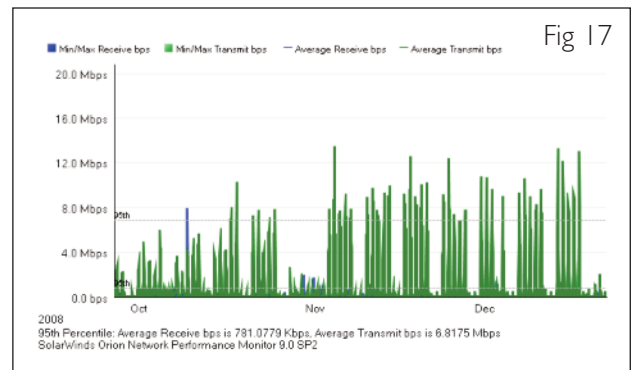


And a chart (Figure 16) for a primary school for the same 24 hour period:

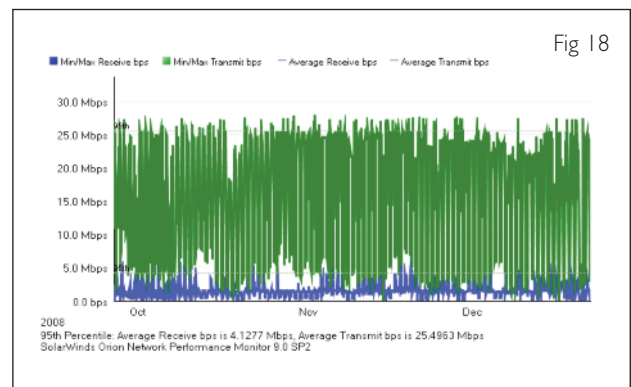


In both of the above it is important to consider peak as well as average demand. It is also important to consider these figures in the light of the overall and continuing growth of schools' bandwidth requirements, as illustrated by the previous chart showing Kent Community Network's Internet bandwidth.

This chart, again for a secondary school, shows bandwidth usage over a three month period. The peaks over 12 Mbps demonstrate the need for the upgrade to a 100 Mbps carrier fibre:



While this chart, again for a secondary school for a three month period, shows the bandwidth generated by surveillance video cameras, set to constantly scan an area. This also provides an example of the kind of innovative application school broadband provision can support above and beyond teaching and learning:



### 3.4 Next Generation Access (NGA) and educational broadband requirements:

Unfortunately educational requirements for bandwidth provision can be expensive to satisfy. The availability of connectivity infrastructure remains variable around the country, limiting possible bandwidths and in some cases making provision of higher bandwidths prohibitively expensive. However, it is clear that all schools require reliable, symmetric and uncontended connections.

While next generation access (NGA) developments and debate such as the recent Caio review<sup>18</sup> continue, it is likely that many schools, particularly those in rural areas, are likely to face challenges in terms of affordability and bandwidth availability for some time to come. This broadband entitlement will provide an important input into NGA developments, articulating both educational requirements and the limitations of current provision, something both Government and the marketplace must address together.

The clear communication of current and future educational broadband requirements to policymakers is particularly important in the light of the Caio review's incorrect assertion that broadband for education is "job done", a view strongly contested by the evidence presented in this paper:

**"Key public sector establishments are connected:** Although the focus of this review is on the development of broadband for homes and businesses, it is worth remembering that key public sector establishments in the form of schools, hospitals or GP surgeries are already virtually all provided with an adequate level of connectivity including, in some cases, through fibre or other forms of NGA."

**This assertion is not supported by the facts.**

There is significant potential for the connectivity marketplace to address educational customers' requirements more effectively. Becta believes that broadband provisioning for schools should be sufficiently dynamic and scalable to support both existing and future demand, as driven by both the need to support increasing numbers of concurrent users and new media-rich applications. Costs must be managed appropriately. Becta is actively pursuing these issues with a range of partners including RBCs, local authorities, suppliers and Ofcom and will continue to do so.

### 3.5 The bandwidth requirements of next generation broadband applications

A recent report published by the Information Technology & Innovation Foundation (ITIF), a US non-profit, non-partisan public policy think tank, entitled *The Need for Speed: the Importance of Next-Generation Broadband Networks*<sup>19</sup>, offers a useful summary of the many advantages of next generation access over existing connectivity:

"Next-generation broadband enables several transformative functionalities that support the development of more compelling, powerful, and useful Web-based applications capable of delivering substantial benefits to consumers, society, academic institutions, businesses, and the economy. The four main functionalities are:

1. dramatically **faster file transfer speeds** for both uploads and downloads;
2. the ability to transmit **streaming video**, transforming the Internet into a far more visual medium;
3. the means to engage in **true real-time collaboration**;
4. the ability to use many applications **simultaneously**.

Taken together, these four transformative functionalities enabled by next-generation broadband mean that the key characteristics of services and applications running on the next-generation Internet will look very different from those running on today's network."

While the above relate primarily to the end-user experience that next generation access enables, there are many additional benefits too. For example, next generation access for institutions can enable more advanced remote support services and support new delivery architectures such as cloud computing. This in turn leads to increased efficiencies in service delivery and administration.

18. <http://www.berr.gov.uk/sectors/telecoms/telecomsbroadband/page10034.html>; 19. <http://www.itif.org/index.php?id=231>

Tables 1 and 2, taken from the same ITIF report, summarise the bandwidth requirements of a range of next generation applications, all of which are applicable in an educational context, together with the key differences between today’s and next-generation Internet experiences:

It is a certainty that more and more new, demanding services will continue to develop, as the bandwidth necessary to support them becomes available. The history of information technology has demonstrated time and time again that new and often unexpected uses are rapidly found for additional memory, storage, processing speeds and, most relevant in this context, transmission speeds. It is very unlikely this trend will diminish in the current climate of increasing broadband usage across the board.

There is a potential “chicken or egg” conundrum here, in that the right conditions must be ensured to enable the deployment of next generation access: customers may be reticent to purchase next-generation broadband services because there are not enough compelling applications that leverage high-speed networks; at the same time, would-be developers of those applications will remain hesitant to develop

them if they fear an insufficient market exists.

However, the evidence presented here confirms that the business case and usage models for broadband provision for education and skills are now strongly established across all sectors. Broadband can increase learner engagement and motivation as well as improve outcomes and is being used more and more to support teaching and learning. As a consequence, many institutions are now starting to reach the limits of their current provision, which in itself is reaching the limits of the current technology employed to deliver the service. The challenge for education is keeping pace with the expectations of learners in relation to access to services and broadband performance.

### 3.6 The impact of concurrent access

Broadband provision must be seen as dynamic, with requirements developing continually, rather than as something that can simply be provided as a one-off exercise. The dynamic nature of broadband requirements is clearly illustrated by the need to

**Table 1:** bandwidth requirements for broadband applications

Application	Upstream speed	Downstream speed
Medium-Resolution Videoconferencing (640x480P)	384-1200 Kbps	384-1200 Kbps
Streaming Video (720P)		1.2 Mbps
Standard-Definition Digital Television (720x480 Interlaced)		4 Mbps
Basic HD Videoconferencing (1280x720 resolution)	1.2 – 4 Mbps	1.2 – 4 Mbps
Telepresence: High-Resolution HD Videoconferencing (1920x1080)	5 Mbps	5 Mbps
Video Home Security Service	10 Mbps	
High-Definition (HD) Digital Television (1440x1080 Interlaced)		15 Mbps
Telepresence: Very High-Resolution HD Videoconferencing (5760x1080)	15 Mbps	15 Mbps

**Table 2:** differences between today’s and the next-generation Internet

Today’s Internet	Next-Generation Internet
Independent: downloading music from all over the world	Collaborative: Creating music with other musicians all over the world
Reactive: websites	Interactive: virtual worlds
Private resources: online backups	Shared resources: online file servers and remote devices
Centralized computing: local data sets and computing	Cloud computing: distributed data sets and computing
One-to-one or one-to-many communication: webcam chats	Many-to-many communication: virtual conferences
Low quality: lower quality audio and video	High quality: high-definition audio and video

support increasing concurrent access, where multiple users in homes or educational institutions need access to a range of different applications at the same time.

EDUCAUSE (a US non-profit association for the advancement of higher education by promoting the intelligent use of information technology) offers a useful description of concurrent usage in their white paper *A Blueprint for Big Broadband*<sup>20</sup>:

“Many recent studies discuss why broadband is necessary for individual broadband applications (discussed below). While these examples are certainly accurate, **the most important point is that consumers will require a multiplicity of these services simultaneously.** It is the aggregation of several of these applications in the home that will drive the future demand for broadband.

Consider the following real-world scenario: A home in middle America may include dad watching a live HDTV football game; daughter using the computer to access streaming video of a college course lecture; son playing a real-time interactive game; mom engaged in a videoconference for her home-based business; grandma, visiting for the holidays, downloading an episode of Masterpiece Theatre; and grandpa hooked up to an uninterrupted medical video feed to a remote monitoring facility. While all these uses are taking place, the home appliances are being monitored and video home security devices are sending video feeds back to an emergency alarm centre. Together, this single home could easily consume 150 megabits of bandwidth with only the uses we can imagine today. Homes of the future will likely include even more imaginative products and services.”

While the above example relates to the home, there are clear parallels with the need to support increasing numbers of users accessing bandwidth-intensive services concurrently within educational institutions. The above example is difficult to quantify accurately in terms of specific bandwidth requirements, given the diversity of applications, but the importance of sufficient underlying capacity being in place to support the requirements of multiple, diverse applications is immediately apparent.

With the roll-out of the Home Access<sup>21</sup> programme, it is anticipated that more and more devices will be used in schools as well as homes, connecting (with the appropriate management and security policies in place and enforced) to network services and resources in both locations. The learner-device access ratio is now 1-1 in some schools. This, alongside continued

increased take-up of media-rich, interactive content and applications, will undoubtedly drive institutional bandwidth requirements upwards, alongside the bandwidth requirements of supporting regional and national core networks serving schools and other places of learning.

There is an important user expectation issue here too: if learners cannot access services and applications in school or college that are at the very least as engaging and as powerful as they experience at home, we risk disengagement and place in jeopardy all the successes of recent years in embedding ICT within teaching and learning.

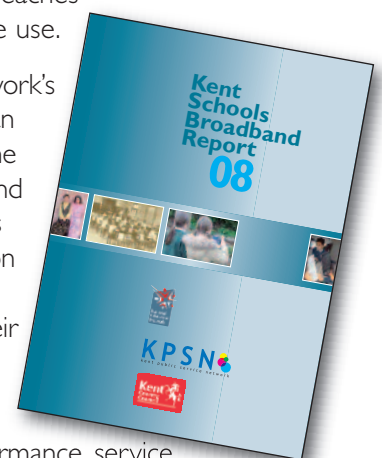
### 3.7 The nature of delivery – performance, reliability and accountability

Schools are entitled to know how their broadband service is performing and the nature of its delivery. This mirrors the increasing calls that consumer broadband services should be made more transparent, to make more explicit service limitations such as bandwidth caps and traffic shaping at peak times to manage demand, over and above the recently reported concerns over headline versus actual connection speeds.

Appropriate terms, conditions and policies at regional and local level should set out the obligations and responsibilities both of service providers and of the institutions and individuals in receipt of the Core Service Set. For example, the provision of network services by a provider should be conditional upon institutions having appropriate mechanisms in place to minimise security breaches and ensure appropriate use.

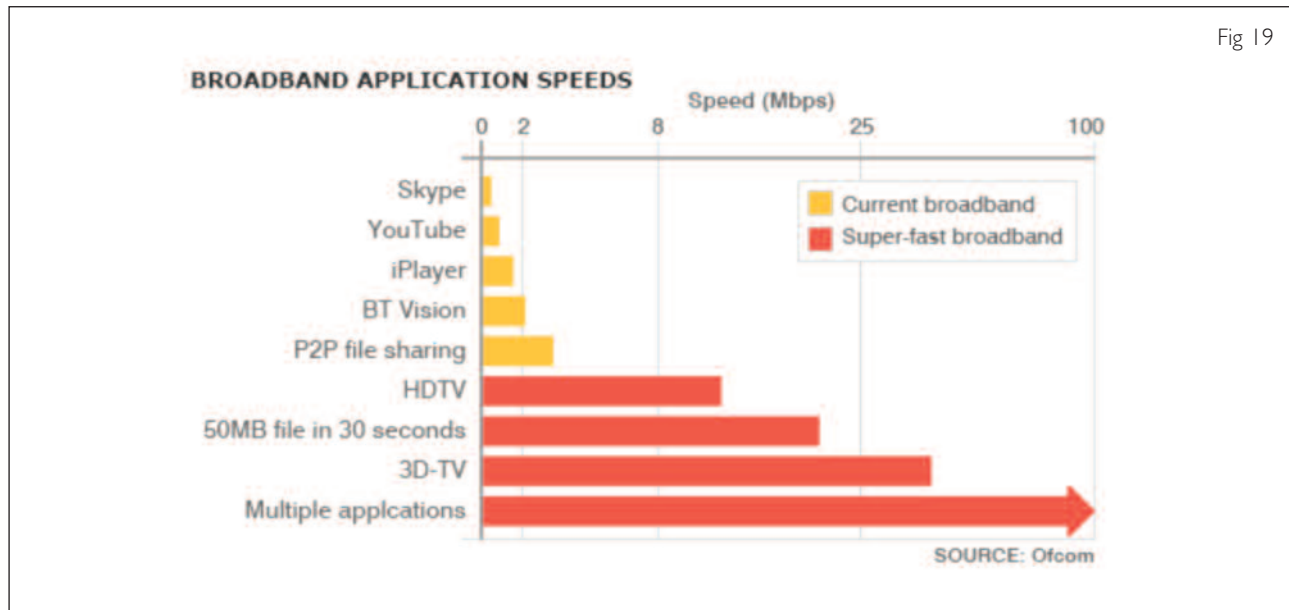
Kent Community Network's 2008 report provides an excellent example of the kind of accountability and transparency all schools should expect in relation to their broadband provision, as part of their entitlement.

It provides a report on bandwidth usage, performance, service delivery and plans for future development, and is clearly but one part of continuous, inclusive dialogue between Kent Community Network and the community of schools it serves.



20. <http://net.educause.edu/ir/library/pdf/EPO0801.pdf>; 21. <http://www.becta.org.uk/homeaccess>

Fig 19



### 3.8 Measuring broadband performance

In terms of broadband performance, SamKnows<sup>22</sup> and Ofcom's<sup>23</sup> recent analysis of the performance of consumer broadband services, undertaken with the intention of demystifying the nature of consumer broadband performance in the UK, provides a useful starting point for considering broadband performance in other contexts too:

"Measuring broadband performance goes far beyond looking at speed (or "throughput") alone. The testing here reflects this, and the study has examined latency, packet loss, DNS resolution, web page loading, VoIP performance, sending of emails and, of course, speeds. The speed measurements delve deeper too, with comparison between web based speeds and typical peer-to-peer speeds, as well as looking at how running multiple streams affects speed."

The four key "motivations" SamKnows identified for conducting their investigation are equally applicable in this context, and seek to address similar territory to that covered in this discussion paper:

- The lack of a truly independent measure of broadband performance;
- The lack of a statistically sound methodology to facilitate such performance testing;
- The continuing perception that performance equals speed (it does not);
- The desire to dispel some myths.

The ongoing debate and investigation of consumer broadband services exemplified by the SamKnows and more recent Ofcom studies, together with the ongoing next generation access (NGA) debate, underline the importance of a dedicated, high-performance, managed broadband network for education and other public services. Such dedicated networks can offer guaranteed performance, are scalable and are much less subject to the commercial and regulatory upheaval and pressures that impact upon the consumer broadband marketplace.

As can be seen in this paper, Regions and RBCs monitor service delivery in some detail. However more work is required to describe the quality of experience educational users should experience in wider performance terms. The best educational broadband needs to be universally available in schools and wherever learning occurs.

22. <http://www.samknows.com/broadband>

23. <http://www.ofcom.org.uk/media/features/brspeeds> (January 2009) & <http://www.ofcom.org.uk/media/features/broadbandspeedsjy> (July 2009)

## 4.0 Actions for Regions and RBCs

- It is essential that educational broadband delivery is monitored and accurately managed to ensure that it delivers the Broadband Entitlement. The quality of educational experience across content, security, access and technical performance are all important and need to be more closely defined.
- Managing some of the largest networks in the UK is a complex task. Educational, government and commercial networking requirements all vary, although industry standard techniques underpin each area. These Regional and RBC networks must be maintained.
- Over ten years, considerable expertise has been developed by staff in Regions, RBCs, local authorities, Becta, JANET(UK), DCSF and the suppliers. The consensus-based collaborative working approach has proved powerful and effective. This major asset must be retained and developed.

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