Broadband: Strategic Implications for Learning and Teaching off Campus

This briefing has been prepared for senior managers in Further and Higher education with responsibility for curriculum development and delivery strategies. It will be useful for Assistant / Vice / Deputy Principals, Pro Vice Chancellors and Heads / Directors of Teaching and Learning. It aims to inform senior decision makers regarding the potential capability of a range of so called "broadband" technologies to support off campus learning and teaching within the next three years (2003-2006).

What is Broadband?

"Broadband" refers to the bandwidth of communications networks such as LANs, ie. their capability to transmit large amounts of data rapidly, measured in bits per second (bits/s). Until recently ISDN2 at 128kbits/s was regarded as broadband, compared with the 64kbits/s bandwidth of an ordinary telephone line. The DTI's current definition of broadband is 2 Mbit/s and above. However, despite being promoted as "broadband", most service offerings cannot yet achieve 2Mbits/s, certainly not at a cost affordable by the mass market.

For the purposes of this briefing therefore, broadband is defined as anything in excess of 128 kbits/s, while recognising that this is likely to change as technology develops and the market matures.

Why is broadband important?

Recent rapid growth in the availability and take up of new broadband technologies in the wider community potentially removes access barriers to e-learning at a time when widening participation to non traditional learners and enhancing student retention rates are high up the agenda. It may also offer institutions a cheaper alternative to current on-campus infrastructure provision.

What are the benefits?

Broadband services offer:

- Always-on connections.
- Fixed price/unlimited access to the Internet (although some broadband tariffs are based on data volume).
- Faster, more reliable data transmission rates.

The net effect is to reduce the potential differences between on-campus and off-campus learning experiences, allowing institutions to plan for off-campus delivery and support on a wide scale.

What are the options?

In the UK there are currently seven major options that could be considered by institutions seeking to determine the best way of supporting off-campus learners.

1. Wireless LANs
2. Broadband fixed wireless
3. Mobile telecommunications
4. Terrestrial ADSL
5. Cable networks
6. Satellite
7. Digital TV (not really a separate technology, but widely available)

What are the issues?

The important issues that might affect institutions' choice of current broadband media are:

Bandwidth

Some technologies are faster than others. In many cases the technology offers a range of speeds depending on a variety of other factors such as cost, number of users, distance.

The amount of bandwidth available defines the limits of potential use. For example, 128 kbits/s is suitable for email, surfing the web and online text based conferencing. It is just about usable for voice over IP, but inadequate for IP based videoconferencing. Note that sometimes the speed of incoming information is not the same as outgoing information, as in the case of Asymmetric Digital Subscriber Line (ADSL), where download speeds greatly exceed upload speeds.

The effect of multiple users

In some cases speed is also affected by the number of simultaneous users, known as the 'contention ratio'. Contention based services share the available bandwidth between the total number of simultaneous users, so the more users on-line the slower the service. Services which do not guarantee contention ratios are likely to perform less well at busy times.

Distance

The strength of signals declines with distance. For some technologies the effect is more acute than for others; for example there is a physical limit to how far ADSL and wireless LAN signals can travel and the available bandwidth drops off with distance. Another effect of distance is latency: the delay between a signal being sent and received. Over short distances latency is negligible, but over longer distances it can cause problems. For example, two-way satellite systems are subject to delays caused by the time taken for signals to pass between the satellite and the receiver.

Security

"Always on" means that individual machines are more vulnerable to attack. This has serious implications not only for the owners of those machines, but for institutional network managers because unprotected off campus machines can provide a relatively easy means of entry into campus networks for unscrupulous third parties. Also, technologies such as cable networks, which are a shared medium, provide further opportunities for hackers to illegally gain entry to the institutional network by "snooping" information packets and their contents. Wireless LANs and Cable modems can also be "snooped". Security concerns need not rule out use of broadband but appropriate data encryption and virus and firewall protection are highly recommended.

Integration into existing network infrastructure

Integration of network access products such as ADSL with existing LANs is likely to require significant effort in terms of upgrading the network to meet the minimum requirements for network access services (in terms of hardware, software versions and software patches). Other issues may be limited availability of skilled network engineers and insufficient information to support off campus learning centres.

Availability

Some technologies are only just becoming available as trials, eg. Third generation (3G) telecoms, and cannot be expected to be widely available in the foreseeable future. Others are well established but limited in their coverage and likely to remain so indefinitely, eg. Cable TV networks. The planning time frame for this report is taken as three years so technologies that fall outside this frame are disregarded.

Cost

Many of the technologies reviewed here are new. They require massive investment in infrastructure and in some cases have also cost their operators billions of pounds in licence fees. Operators need to recover their costs as rapidly as possible and so, not surprisingly, many of these technologies will be priced at a premium to begin with. Thus although services such as two-way satellite broadband are already available, they are unlikely to be taken up by the mass market to the extent that they can be relied upon for educational use in the foreseeable future because of their high cost. Costs generally increase in proportion to speed.

Educational effectiveness

The amount of available bandwidth constrains the range of possibilities open to institutions.

Ordinary telephone lines are fine for simple text email and just about usable for web surfing, but unsuitable for any kind of multimedia application or for moving around large data files. The difference between one way systems (eg. TV broadcasts) and two way systems (eg. Cable modems) is significant also. One way systems are essentially content distribution media. The greater the bandwidth of the return channel from the learner, the more possibilities there are for meaningful interaction.

In terms of speed, availability, cost and suitability for educational use, many of the options reviewed here have to be ruled out. 3G mobile telecoms have the potential to support broadband based learning but they are unlikely to be widely available or affordable within the next three years. All other available mobile services are not broadband. Public wireless LANs may be of some use but are not likely to be widely available over the next three years and likely to be rapidly overwhelmed when they do catch on. Digital TV, although massively popular is not currently being used for more than content transmission, and is too costly for institutions to use as a distribution vehicle (the post is cheaper).

Comparing the options

	Typical bandwidth	Affected by Multiple users	Affected by Distance	Availability 2003 - 2006	Cost: Install/Running	Overall significance
Public WANs	11-54mbit/s bi-directional	Yes	Yes	Low	Not Known	Low
BFWA	512kbit/s down 256kbit/s up	Yes	Yes	Low	£150/£40 per month	Medium
3G	144kbit/s-2Mbit/s bi-directional	No	No	Very Low	Not known but expected to be very high	Low
ADSL	512kbit/s down 200kbit/s up	Yes	Yes	Medium to high	£140/£28 per month	High
Cable	512kbit/s-1Mbit/s bi-directional	Yes	No	Medium	£40/£25 -33 per month	High
Satellite	512kbit/s down 128kbit/s up	Yes	Yes	High	£900/£60 per month	One-way:Low One-way: High
Digital TV	2Mbit/s down	No	No	High	£350/£10-37 per month	Very low

The most feasible and likely contenders for supporting off campus study are ADSL and cable networks. Other services that are likely to have limited niche potential are Broadband Fixed Wireless (for mainly urban areas) and satellite services (for mainly rural areas).

Conclusions

The broadband picture is confused by hype. Not all the options currently available have sufficient bandwidth to justify the term “broadband”, even at the conservative level adopted here and some technologies, such as 3G or two way satellite, are unlikely to be available at an affordable cost for mass application to learning within the next three years. Though TVs may provide a familiar interface and more acceptable social context than PCs for certain categories of users, from an educational perspective two-way interactivity, as well as affordability, are important. So the most ubiquitous broadband application of all, digital TV, is largely irrelevant. The limited (central) interactivity of Sky or similar systems is much poorer (in interaction terms), and the exemplars much weaker, than those from a broadband Web connection even using current broadband offerings.

Despite the promise of more sophisticated technologies, in the immediate future the main vehicles for exploiting broadband in further and higher education are likely to be ADSL and Cable networks. The main value of broadband delivered in this way is “merely” faster access to systems and resources. (A similar situation to the reality of ISDN.) But that apparently quantitative “merely” conceals important qualitative changes. Firstly

vast amounts of time could be saved, or redeployed, by both learners and teachers, in the pursuit of knowledge. Secondly, the (generally) fixed price of always on broadband means that users will be able to use it differently, opening the feasibility of studying online instead of downloading resources for offline study; online activities such as conferencing, simulations and group role plays; and access to high bandwidth applications such as video, audio, videoconferencing, CAD, etc. from the home and workplace. The effect of laptops, PDAs, and in particular wireless broadband, will be to widen the "locus of learning" and bring it back to the normal loci of learning of students across many years, i.e. almost anywhere.

Broadband access from the home and elsewhere reduces the difference between the home and campus. It makes many homes increasingly effective as places of study; and will increasingly raise the issue of the best use of the campus, school or learning centre. For example, will they become arenas for socialisation and for education of the underprivileged?

However, widening access to learning, in more places and to more sorts of people, especially those (still) not familiar with or antipathetic to PCs and formal learning situations – will remain an important goal. Achieving this goal becomes easier as broadband services spread and interfaces become more intuitive and consistent with those used in other parts of daily life (VCRs, games consoles, mobile phones).

Further information

This briefing was prepared by the TechLearn service of the JISC funded Technologies Centre. The Centre exists to encourage and support the investigation, development and proving of the applications of new technologies in support of the whole education process in the communities of those that fund the Joint Information Systems Committee. It can be contacted at www.technologiescentre.ac.uk

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