

SUPERHIGHWAYS FOR EDUCATION

The Way Forward



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CONTENTS

Ministerial Foreword

Section 1 - Executive summary

Number of responses

Main messages from the consultation

Piloting superhighways in education

The way forward

Section 2 - The outcome of consultation

Introduction

Schools

Professional development

Further education

Higher education

Adult education and education in the workplace

Infrastructure, applications and services

Internet services for education

Tariffs

Standards, protocols and technologies

Compatibility between networks

Security

Intellectual Property Rights (IPR)

Rural areas

The international dimension

Section 3 - Piloting superhighways in education

Section 4 - The Way Forward

What the Government will do

What industry can do

What schools, colleges and responsible authorities can do

Appendix A - Institutions, associations and other organisations responding to the consultation paper

Appendix B - Access to this paper through the Internet

HMSO's Internet preferences and navigational aids for this title

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[Back to contents](#)

[Back to previous section](#)

[On to next section](#)

[Back to other HMSO pages](#)

[Back to DFE home page](#)

[Prepared 6th November 1995]

Appendix B

Access to this paper through the Internet

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[Prepared 6th November 1995]

Ministerial Foreword



The Rt Hon Michael Forsyth MP
Secretary of State for Scotland
[select thumbnail for larger picture, 70K bytes]

The Rt Hon Sir Patrick Mayhew QC MP
Secretary of State for Northern Ireland
[select thumbnail for larger picture, 100K bytes]

The Rt Hon William Hague MP
Secretary of State for Wales
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The Rt Hon Gillian Shephard MP
Secretary of State for Education and Employment
[select thumbnail for larger picture, 54K bytes]

In April this year we published a consultation paper seeking views from the education service and industry about the potential for superhighways for education. We were looking ahead to the medium and long term. It was the first consultation of its kind on information technology in education and we have been delighted with the response. We should like to extend warm thanks to all who responded. Their views will certainly inform and underpin our plans for future development.

The response to our call for pilot projects was also very encouraging. We are pleased to announce that twenty three innovative projects will go ahead, with evaluations being funded by the UK Education Departments. All sectors of education, and the whole of the UK, will be involved. These projects and the lessons we learn from them will help to shape the use of new technologies in education, and of the superhighways to come.

Our particular thanks go to those in industry and their partners in education and training who have framed the proposals for pilot projects. Clear signals have emerged from the consultation which industry and the education service will want to take into account in developing these (and future) pilot projects. This paper sets out those messages. It offers important pointers about the development of applications and services for education, about the local infrastructure in schools and colleges, about the standards for which the education service and suppliers should be aiming, and about the pricing of services.

As events since our consultation paper have shown, more opportunities are becoming available through use of the present infrastructure and systems. The number of new services for education is increasing while the data transmission speeds needed are decreasing. Power to cost ratios are changing rapidly. We have some key goals immediately before us: to raise general levels of IT capability; to develop 'network literacy'; and to ensure that the right advice, support, training and equipment are available as increasing numbers of networked applications come on stream. Real achievement in this field will not come about as a result of hasty measures designed to provide instant solutions. We must allow the sound regulatory structures which the Government has put in place to do their work. We must encourage competition in infrastructure and service provision to ensure choice and affordability. Above all we need dialogue and understanding between the education service and those industries developing superhighways and their services, so that the needs of education can be identified and fully taken into account. The Education Departments' Superhighways Initiative is doing all this - and more.

So as to leave no doubt about the Government's commitment to superhighways for education, we set out in the final section of this paper our plans for the way forward, starting with what can be done now. We do so, not as an isolated initiative, but as an integral part of the Government's drive towards higher standards and quality of provision in education, training and

employment - for example through the UK's National Curricula, through the benefits of greater institutional autonomy, and through the promotion of lifetime learning. We are committed to improving the UK's international competitiveness by raising standards and attainment in education to the highest levels. This education initiative is a vital part of that process. It will underpin initiatives to come on the development of superhighways in training and employment. The UK Education Departments will work closely with other Government Departments to ensure a co-ordinated approach to support programmes affecting the education and wider communities.

[Prepared 6th November 1995]

Executive summary

Number of responses

1. Over 400 organisations, associations, institutions and individuals responded to the UK Education Departments' consultation document Superhighways for Education which was published in April. Of these some 20% responded via the Internet. Many welcomed the Education Departments' Superhighways Initiative as providing a focus for a coherent strategy which could identify appropriate services, technologies and standards for education superhighways as a developing process. For the purpose of the consultation the term 'superhighway' was taken to mean a broadband network capable of transferring large amounts of information at high speed between users.

Main messages from the consultation

2. Clear potential was seen for superhighways in every sector of education. The main messages to emerge were that:

- the skills of network literacy must be recognised and developed;
- the development of high quality on-line applications and services for education, combined with secure means of paying for those services and of safeguarding intellectual property rights, must be encouraged;
- there is a need to develop the infrastructure of equipment and connectivity while recognising that at this stage there are no simple answers to infrastructure issues, or those of technical standards and protocols. Responses on the whole favoured a progressive migration from narrow to intermediate and broadband technologies;
- appropriate measures need to be taken to support professional development in schools and further education;
- in higher education the experience of the SuperJANET project indicates considerable potential, although there is concern about bottlenecks in international connectivity;
- high initial costs and tariff levels are the main deterrents to schools joining networks. Education respondents sought the development of more flexible and affordable charging arrangements;
- several Internet services tailored for education have now been launched in the UK, and take-up by schools and colleges during the year is expanding rapidly;
- some concern remains about the accessibility of undesirable material on networks, although various means of controlling and combatting the use of such material are in hand;
- universal access to broadband communications is seen as vital if rural areas are not to be disadvantaged.

Piloting superhighways in education

3. The objective of piloting superhighways in education is to establish their potential to enrich the delivery and experience of education, and how they may help young people meet the challenges of employment. Twenty three pilot projects will be evaluated with funding from the UK Education Departments. Projects cover a wide range in scale and focus, with all education sectors involved, and a substantial number of industry sponsors. The National Council for Educational Technology (NCET) and the Scottish Council for Educational Technology (SCET) will manage the evaluation of the projects, most of which will run until the Spring of 1997. The outcomes of evaluation will be disseminated widely with a view to informing developments both within education and industry.

The Way Forward

4. To ensure that the take-up of superhighway developments in education is successful, our UK priorities must be:

- i. to continue to raise the general level of information technology (IT) capability in schools, further education (FE) colleges, and initial teacher training;
- ii. to develop network literacy in preparation for broadband superhighways;
- iii. to develop high quality on-line educational applications and services;
- iv. to provide appropriate advice, support and training for teaching staff;
- v. to develop and build up the infrastructure of equipment and connectivity.

5. For its part, the Government will:

- i. support and encourage the piloting of new communications technologies in education, and ensure that advice on the use of these technologies is made available;
- ii. make available resources to enable continuing provision of equipment and training in the delivery of IT capability;
- iii. look to the School Curriculum and Assessment Authority (SCAA), and other relevant national bodies, to take full account of the developing importance of network literacy;
- iv. liaise with industry to promote the development of additional educational on-line applications and services; and encourage the close co-operation of industry and the education service;
- v. look to the Teacher Training Agency (TTA), and other relevant bodies in other parts of the UK, to review arrangements for teacher training to ensure that they keep pace with technological developments;
- vi. work with the Higher Education Funding Councils (HEFCs) to review progress on the SuperJANET project, and disseminate outcomes of the project as widely as possible, so that the implications for other education sectors and for product and service development by industry can be considered.

6. The Government will also work at national, European and wider international level to ensure that the interests of UK education are taken into account.

7. The Government will look to the telecommunications companies and providers of on-line services to ensure that schools, colleges and other institutions are not deterred from connecting to networks because of high service or product costs. It will also look to industry to work closely with the education service in identifying opportunities and needs which can be met by broadband applications and services, and to co-operate with the various education sectors in the development of products and services.

8. It will be important that teachers, governors and others in education institutions and authorities look carefully at the purposes for which they need on-line communications, and that where decisions are taken to invest in narrow and intermediate band technologies they ensure that:

- i. the significance of networking literacy for all pupils, students and young people is appreciated, reflected in school and college development plans, and realised through management policies;
- ii. terminals acquired are sufficiently powerful to cope with higher rates of data transmission, and advances in compression techniques;
- iii. internal network installations are of sufficiently high bandwidth, or are installed in such a way as to be readily up-gradable;
- iv. full account is taken of the significance of networking, both in initial teacher training and in continuing professional development;
- v. they consider the implications for security of access by users, including young children, to worldwide sources of information, so that appropriate technical and disciplinary safeguards encourage responsible use.

The outcome of consultation

Introduction

1. The Education Departments' paper Superhighways for Education (1) defined broadband communications by function and quality (two way transfer of instantaneous video, still images, audio and text - to multi channel television standard). It included specific questions for consultation for both education and industry and called for responses in writing or on the Internet. Out of some 430 responses, some 20% were received via the Internet. Responses came from a wide range of bodies and individuals, including some 14% from schools, some 13% from further education, and some 14% from higher education. Responses were also received from local education authorities, subject and professional associations, and from the telecommunications, broadcasting and IT hardware, software and service industries. A list of the organisations, associations and institutions which responded is at Appendix A.

2. The following analysis of the responses broadly follows the order of questions in the consultation paper, but takes into account other issues which were raised in consultation.

Schools

3. Respondents generally agreed that on-line communications, and particularly broadband communications, had potential to support every area of the school curriculum as well as many areas beyond it. But the success of superhighways in schools was seen as dependent upon a number of factors. These were:

- appropriate integration within teachers' schemes of work;
- better indexing and cataloguing mechanisms than those currently available for broadcast material;
- expert staffing and technical back-up;
- underpinning by appropriate definition within the National Curricula in more detail than the current definitions of IT capability;
- the development of inter-personal skills to avoid the risk of isolating learners;
- the installation of local area networks within schools capable ultimately of enabling multiple access to external broadband communications.

4. There was widespread acceptance that the challenge to schools would not simply be a matter of acquiring the technology, but of cultural change eventually affecting the whole institution. It was seen as important that equal opportunities were provided for access by girls as well as boys. One of the major potential catalysts for change was seen as the integration of superhighway use into examination course syllabuses.

5. Particular potential was seen in the area of special educational needs (SEN) to help pupils with communication, sensory and other disorders to participate on more equal terms. Improvements in access to appropriately differentiated facilities for both less able and very able learners were also perceived as potential advantages. There were possibilities for developing links between schools and homes, hospitals and detached centres, as well as between special and mainstream schools. Video conferencing could have a particular part to play in such links, as could the facility to make available simultaneous transcripts for profoundly deaf learners. The development of appropriate interfaces for visually impaired learners, and means of navigation for those unable to use the keyboard or mouse were seen as particular challenges. There was concern to ensure that the siting of superhighway facilities within schools facilitated access by pupils with special needs.

6. In education administration superhighways could help with the gathering and exchange of statistical and financial information; access to databases on educational law, Government circulars and guidance; rapid and simultaneous communication to all schools in an education authority, or between individual schools; and in more effective communications between schools and local and central government. Potential was also seen in the area of traveller education. While these were seen as achievable goals in the medium to long term, concerns were expressed about transitional arrangements. It was suggested that effective development depended on all institutions having access to technology that was compatible across the education system.

7. Responses covered a broad range of services which could be developed for schools. Some supported networking applications based on Integrated Learning Systems, but with a clear preference for the management of learning to remain in the hands of the teacher. Access to on-line libraries of CD-ROM material was seen as another major potential area of use, if copyright issues could be resolved. Significant scope was seen for widening access, through distance learning, to minority subjects and those

where teaching groups might otherwise be non-viable. Beneficial opportunities were also identified for teachers to exchange ideas and receive advice about curriculum, teaching, training and administrative issues.

8. Concerns about schools' use of broadband networks focused largely on problems associated with access to unparalleled amounts of information, with some respondents also noting the need to guard against access to unsuitable material. Many respondents were aware of services that were currently available, or being developed, to make access to the Internet for schools easier and more secure. Several emphasised that schools would need to be helped to develop strategies to assist the development of responsible attitudes to access. The need for parents to be kept up to date with developments was emphasised. Significant concern was expressed about unpredictable on-line costs, and about the costs associated with cabling within school buildings and the provision of suitable numbers of terminals.

Professional development

9. The development of teachers' expertise and confidence in using services to be provided through superhighways was seen to depend on a number of factors:

- acceptance by school and college management of the importance of network literacy;
- high management expectation of staff;
- well-run training and development;
- easy access to systems, including systems for home use by teachers; and
- appropriate technical back-up; and expert support, both from sources within and outside school.

10. Training needs were not restricted to curriculum development and delivery, but extended to methods of tutorial support, pupil and student management, administration, and school and college governance. A need was seen to find the right balance between the use of superhighways for in-service training, and the delivery of local support and training through traditional methods. Respondents welcomed the quality of support provided by IT advisory teachers and saw a need for a funding system that would encourage the development of local support structures in the UK which, with the NCET, SCET, SCAA, ACAC, TTA (2) and the Curriculum and Advisory Support Services in Northern Ireland, could identify and promulgate good practice. Broadband services were seen as important to those providing local support, as well as to schools and colleges themselves. Industry's involvement in developing support and training arrangements was generally welcomed. Some respondents emphasised the need for initial teacher training institutions to be fully involved in superhighway developments, perhaps through specifying minimum training requirements for new teachers in network literacy.

Further education

11. Many of the comments on issues affecting schools arose also in relation to FE, particularly those relating to professional support and training. Key potential areas for the exploitation of on-line services in FE were information services for prospective students; access to specialised learning materials; remote access to tutorial support; and the integration of work - particularly pre-vocational work - with local secondary schools. Video conferencing and remote participation facilities offered a major step forward in access for students with disabilities, remote access to industrial environments and expertise, and conversely the provision of training for industry-based students. Some respondents supported the use of remote participation facilities to provide a 'virtual college', thus potentially reducing accommodation costs, though the continuing need to provide for the social development of students and peer group stimulus was important and should not be overlooked.

12. The Further Education Funding Council's Committee on Learning and Technology, chaired by Professor Sir Gordon Higginson, is due to deliver its final report by the end of 1995. The committee has taken account of the current use of technology in the FE sector, the impact of new technology on the learning process and the benefits to students and employers. The committee is expected to make recommendations relating to the development of a high speed wide area network and to measures which will help staff and students to become more skilled in the use of new technologies and the use of courseware.

Higher education

13. Experience with the SuperJANET project, Europe's first true broadband educational network, attracted much interest. Since it is now only half-way through its four year span, respondents considered it premature to expect radical changes in styles of teaching, learning and administration in HE. But evidence from the use of SuperJANET so far has indicated not only potential for enhancing activities traditional in HE, such as the delivery of lectures, experimentation and the publication of journals; but also its use in research projects where traditional methods of gathering data or transmitting information were too slow or unduly time-consuming, for example in global atmospheric modelling, analysis of remote sensing image data, molecular modelling and brain imaging.

14. Concern was expressed by a number of respondents in HE about international connectivity. Where research has needed access through SuperJANET to international sources of data, problems of speed of supply have arisen because international data rates are generally slower than those for SuperJANET itself. The narrowness of international bandwidth, particularly with the growth in the use of the World Wide Web, was considered a serious restriction for nearly all higher education institutions, particularly those involved in research.

15. While the development of metropolitan area networks linked to SuperJANET was generally welcomed, opinions differed on whether SuperJANET should be expanded to include FE and schools. Some respondents felt that because the network was based within education, SuperJANET would be a good system on which to build schools' access. Many FE colleges were already connected to JANET: this had proved valuable where FE colleges were teaching HE students. Others however felt that schools and other bodies did not need to connect to JANET or SuperJANET to communicate electronically with higher education institutions; and that Internet suppliers could provide links at lower cost, particularly given the large investment required for switching technology and local area networking of sufficient capacity to take the high data rates used by SuperJANET. A risk was also seen that the extension of SuperJANET to schools could compromise the quality of networking necessary to support the mission of higher education institutions. Some respondents felt that expansion to industry would be more consistent with the research focus of the project.

16. There was concern among commercial providers that any offer of JANET provision to schools would restrict innovation through competition. Such a step might also be disadvantageous to schools because there would be no commercial incentive for continuing technical support, and schools would lose the advantages of discounted combinations of access provision and content ('bundling') which commercial bodies could provide. Access centres for school and college visits to SuperJANET sites were however seen as a possible step towards raising awareness and developing broadband curriculum-based applications in advance of the widespread availability of broadband connections to schools and colleges.

Adult education and education in the workplace

17. Responses indicated that networking offered considerable potential for access to specialist, and perhaps standardised, materials in the assessment of literacy and numeracy skills. Such facilities could also become useful in the maintenance and transfer of records of achievement - increasingly important in the context of lifelong learning (and of traveller education). In terms of applications for lifelong learning, broadband networks were seen to offer the prospect of Integrated Learning Systems for adult literacy and numeracy, and the potential of 'on-demand' literacy and numeracy television programming, with access to advice-giving services, and details of courses on-line. Continued emphasis on educational television programming by both the BBC and Channel Four Television would help to raise awareness of what could be done. For example the BBC's night-time service, The Learning Zone, contained a focus on the use of new technologies, including superhighways, both in and beyond schools. Superhighways would require their own kind of literacy. Ensuring universal opportunities to develop this network literacy was likely to become almost as important as addressing basic literacy and numeracy, and called for early recognition of the potential social and economic consequences of neglect of this area of learning. The importance of library services being connected to education superhighways was stressed in this context.

18. Interactive tutorial support and remote assessments of competencies were seen as important potential benefits of broadband networks for workplace training. The current Internet was seen as useful for marketing such services, but problems in its use, combined with issues of security, payment and intellectual property rights protection, limited its potential as a vehicle for delivering quality interactive training modules.

Infrastructure, applications and services

19. Responses indicated that by the time of the consultation paper, several hundred schools and colleges had been connected to cable networks for the purpose of television reception and telephony. The Cable Communications Association (CCA) had earlier announced that the cable industry in the UK would offer a free standard connection to every school passed by their networks to ensure access to the information superhighway. The CCA also indicated that it would liaise with programme providers, educational authorities and cable operators to ensure the provision of quality educational services around the country. A range of educational material was already available via cable TV. The majority of cable operators were engaged in developing local programming services. The consultation made clear that this was considered to be an opportunity to develop a localised educational content, either in terms of TV output or using cable for telecommunications links between local educational institutions. Some cable operators were considering developing their own Internet services for local users, which would provide access to the Internet at much higher data transfer speeds than currently available.

20. In terms of future services, the cable industry indicated that it would be able to offer high speed data transfer on a fibre-optic

broadband network; the integrated delivery of video, voice, data and other services; full two-way interactivity; real-time, high speed video-conferencing; on-demand video and other services. The extent to which these services would be used by the educational community would depend on demand and their relevance to specific educational needs. But it was clear that high speed computer linkage over cable was already possible. The development of Radio Frequency (RF) modem technology in combination with cable offered access to the Internet and other services at speeds of up to 10 Mbit/s.

21. In terms of other Public Telecommunications Operator (PTO) involvement in the provision of broadband educational applications and services, BT's strategy is to work with content providers to develop applications which use a range of existing services, from narrow to intermediate and broadband. Other responses also supported a progressive migration by schools and colleges from narrow to intermediate and broadband to allow time for the development and refinement of educational applications and services, the development of teacher confidence and expertise in their use, and for broadband technology to become robust in an educational context beyond higher education.

22. There was concern about how the quality of educational superhighway applications and services could be guaranteed, with a suggestion of kite-marking by appropriate professional bodies. Given that multimedia authoring was time-consuming and expensive, it was also suggested that cost-benefit factors needed to be considered carefully before opting for multimedia solutions.

Internet services for education

23. Narrowband connections to the Internet by educational institutions were growing. By the close of consultation, in excess of 800 UK schools and colleges were estimated to have Internet connections. Connections are currently estimated to be over 1100. This year, both before and since the close of consultation, a number of Internet services specifically designed for education have entered the market. Estimates suggest that about 2000 schools and colleges are likely to be connected to the Internet before the end of the year. The growth of Internet services, tailor-made for education and including features designed to prevent pupil access to undesirable material, was generally welcomed. Experience of using these narrowband, tailored, managed and supported services was seen as likely to generate important lessons for the broadband education services which could develop from them, and alongside them. It was noted that UK Internet access to sites with valuable educational material was at times difficult, particularly in the afternoon when US schools used the system. It was considered to be desirable that bandwidth should keep pace with the expansion of the system.

Tariffs

24. High set-up costs and tariff levels were seen as the main deterrents to schools and colleges taking advantage of on-line services. In schools a considerable proportion of equipment was over five years old and unsuitable for connection to networks. Replacement and connection would involve not only new, more powerful equipment, but also subscriptions and staff training costs. Once equipment was installed, fear of unlimited telecommunications bills inhibited willingness to use the technology. The availability of free local telephone calls had enabled the Internet to be more widely exploited by users in the USA. It was clear from the consultation that while PTOs and other providers recognised these constraints, they saw the need to secure returns sufficient to permit the development of a wider range of applications and services in what was likely to become a highly competitive market. Nevertheless the responses indicated a preparedness to consider various formulae for fixed cost and flexible charging, for example site-licensing according to numbers of terminals, line leasing arrangements, and facilities for monitoring and capping charges.

Standards, protocols and technologies

25. Responses made clear that the standards, protocols and technologies used in education superhighways would be common to other services, such as for business and entertainment. However differing interfaces for education might be required, depending on the needs of the sectors concerned. There was however no consensus on the nature of the standards, protocols and technologies to be used. The MPEG (3) and JPEG (4) standards for encoding moving and still pictures respectively, ATM (5) for broadband switched transmissions, the TCP/IP (6) protocol for wide area working, and various infrastructure technologies from Hybrid Fibre Co-axial cable to radio frequency solutions, were all thought to be important. Opinions differed as to whether attention should focus on the standards, protocols and technologies available now, or those currently in the process of development.

26. Responses showed awareness that much of the responsibility in this area lay with worldwide bodies, such as the International Standards Organisation, International Telecommunications Union, and the Digital Audio Video Council (DAVIC). To the extent that Government involvement was appropriate in the area of education, a balance needed to be struck between a prescriptive approach which could prevent early access to new opportunities, and a free-for-all which could create

fragmentation, confusion and inefficient use of resources. Achieving the necessary balance would call for a flexible but consistent strategy across the education service to identify appropriate services, standards and technologies as a continuing, developing process. Many respondents welcomed the Education Departments' Superhighways Initiative, and particularly its programme of pilot projects, for this reason.

Compatibility between networks

27. The UK cable industry was designing its full service network to inter-operate, so that a terminal on one network could access information stored on another. This was regarded as a matter of commercial necessity, given the expense of providing duplicate storage of information. Other PTOs in the UK and abroad, including BT, were working on similar lines, so that ultimately compatibility would be achievable both nationally and internationally, although not every desired form of access and network interconnection would be available in the short term. Many of the major UK companies in the field were campaigning for compatibility across Europe, and taking part in pan-European trials. While full compatibility was recognised to be the objective by many respondents, there was concern about how this was to be achieved. It was felt that not only must networks be compatible, but that they must remain in phase as changes were introduced. This suggested that the education community must be active in specifying its requirements, and encouraging suppliers to meet those requirements.

Security

28. Concerns about access to undesirable materials were acknowledged earlier in this paper. As to mechanisms to limit access to such materials, and prevent malicious 'hacking', responses and opinions varied. While suitable mechanisms were seen to exist, difficult decisions were needed on the balance between the principle of open access and the case for security. A need was also seen for systems to keep up with stratagems to circumvent them. On balance, however, respondents were optimistic about this aspect, drawing attention to means of preventing users from accessing addresses known to be suspect; of allowing access only to a set of known and trusted servers; and of allowing incoming connections only from trusted addresses. The use of encryption, virus-checkers and filters which blocked access on the basis of changeable pre-set text could also be instrumental in minimising malicious hacking and undesirable use. Many of these systems were automatic and could alert the administrator to breaches of the network rules. Responses indicated that affordability was a key factor. While such services were available, they could be expensive and schools and other institutions would have to consider the cost-benefit implications of deploying them in contrast to, or in combination with, approaches which encouraged the development of user responsibility based on institutions' codes of practice or school discipline frameworks. It was felt that this was an area which would merit more detailed guidance as network use developed.

Intellectual Property Rights (IPR)

29. Respondents generally agreed that education superhighways would not fully develop until arrangements for the protection of IPR and for payment for on-line use of intellectual property were in place. Pending a satisfactory way of generating real money payments for on-line applications and services, those creating them would not be prepared to allow their valuable products to be used other than in closed networks, for which payment could be guaranteed. Respondents noted that products must be cheap enough to encourage on-line education customers to purchase equipment and connectivity, as well as the applications themselves. Superhighways would reach many customers. Products on them should therefore have low distribution costs compared with more traditionally distributed intellectual products. This might well permit reasonable profit margins while keeping costs to the consumer relatively low. Some concern was expressed about the possible imposition of a duty on service providers to police the observance of copyright. This was seen as likely to increase service costs and to deter the provision of services, particularly in education which was seen as an area in which a substantial measure of freedom to reproduce materials was important. A model was already in place in the UK through licensing arrangements to record broadcasts for educational purposes. But ultimately, given the nature of superhighways, it was felt that copyright and licensing issues must be resolved at a world level.

Rural areas

30. Responses reflected a wide diversity of opinion about solutions to providing superhighway access in rural areas. Many made the point that access must be universal for education users, and expressed worries that rural areas would be the last to be franchised, and might well never be connected to cable networks. One suggestion was that those setting up services might encourage rural custom by charging flat rates for connection, regardless of location. Others indicated that networking between clusters of rural schools was a significant potential gain.

31. The cable industry indicated that it was working towards the use of the radio spectrum in order to provide broadband access

to rural areas. It was possible for Local Delivery Operator (LDO) franchise licencees to use Multi-Point Video Distribution Systems (MVDS) to deliver digitally encoded multimedia signals over a bandwidth comparable to that of cable delivery. While MVDS could provide a broadband broadcast path from the headend to the user, truly interactive systems would also require a substantial return path. Work on this, also within the radio spectrum, was in hand. The most likely outcome was expected to be a broadband path to the customer, with an intermediate return path at ISDN speeds (7) from the customer. Intermediate band (ISDN) was already in bi-directional use in rural areas, providing pilot video conferencing projects over the telephone network. Several respondents took the view that while ISDN could not provide multiple channel high quality video, it could be useful in rural areas as a fast network connection to the Internet.

32. In view of the ability of satellites to provide a 'footprint' covering the whole of the UK, this technology was presented as a possible solution to rural access, with the suggestion of a dedicated national educational satellite. However there were no indications as to how such a satellite might be viable without considerable public subsidy, or attractive to service and applications providers. Issues such as how to provide a service with full interactivity, beyond use for limited experimentation, earth sensing or direct broadcasting, remained to be resolved. Some scope was however seen for the use of satellite-derived information, captured at a central point and relayed over networks, as part of a wider system which might serve education users. Also the prospect of world-wide cellular communications networks based on satellite technology offered the long term possibility of two-way high bandwidth communications to remote areas. This would have applications in education as well as in other fields, but with investment being driven by commercial impetus.

The international dimension

33. As noted above, certain key problems - cross-border compatibility, intellectual property rights, operating standards and protocols - require international resolution. In terms of the consultation, it was readily appreciated that a major opportunity would be provided by an international network which would allow the predominance of English to be exploited, not least because it was the language of international commerce and computing. Particular opportunities lay in the potential for providing on-line courses in English as a foreign language, and in the development of links with Commonwealth countries to exploit similarities in curricula, examinations and the organisation of schools and further and higher education. It was felt to be important to register the lessons learned from earlier international experience, particularly that projects to introduce high technologies must place sufficient emphasis on training and adequately define the educational goals. Maximising the opportunities presented by the current and prospective European Union (EU) and G7 initiatives was also seen as important for education in the UK.

(1) Copies of the consultation paper can be obtained from HMSO (ISBN 0 11 270898 6), price 4.95 [pounds sterling]. [Back](#)

(2) National Council for Educational Technology (NCET), Scottish Council for Educational Technology (SCET), School Curriculum and Assessment Authority (SCAA), Curriculum and Assessment Authority for Wales (ACAC), Teacher Training Agency (TTA). [Back](#)

(3) MPEG - Moving Photographics Experts Group [Back](#)

(4) JPEG - Joint Photographics Experts Group [Back](#)

(5) ATM - Asynchronous Transfer Mode [Back](#)

(6) TCP/IP - Transmission Control Protocol/Internet Protocol [Back](#)

(7) Integrated Services Digital Network (a network providing end-to-end digital connectivity) [Back](#)

Piloting superhighways In education

34. The objective of piloting superhighways in education, as any other new technologies, is to establish whether they offer the potential to enrich the delivery and experience of education, are likely to help young people meet the challenges which they will face when they enter employment, and provide them with skills which they will need for lifetime learning. Associated with these factors are others to do with cost and effectiveness, and with social and moral implications for individuals, families and educational institutions.

35. In selecting the pilot projects for evaluation under this initiative, the Education Departments have had regard to three main criteria based on:

- the educational clarity and relevance of the project;
- the type of technology to be used, with a minimum threshold of intermediate band technology;
- commitment by proposers to full sponsorship of project costs so as to ensure continuing commitment to the development of on-line applications and services for education.

36. The following projects were selected for Government funded evaluation as meeting these criteria, and providing a range and balance of projects across education sectors and the UK. They are categorised according to their main emphasis and sector focus, although many of them span different sectors. Some contain features which are not described here.

Curriculum projects based mainly in the primary and secondary sectors

The Education On-line Network: sponsored by BT, ICL and the School of Education at the University of Exeter, the project will involve a secondary school and ten primary schools in South Bristol. It will pilot a national network model that provides schools with an affordable desktop-to-desktop managed network based on broadband technology. This will enable the delivery of on-line interactive education services and applications. It will cover the whole curriculum, with a particular focus on English, mathematics, modern foreign languages, science and art. The provision of specialist and minority courses, initial and in-service teacher training, streamlining of administrative costs, and sharing of resources between the primary and secondary phases will also be features of the project.

IntraNet: sponsored by Microsoft, INS Ltd and MAST Systems Ltd the project will link 20 schools, including one special school, across three local education authorities in south London using the Microsoft Network. Four FE colleges are also involved. The project will focus on basic communications skills, languages, history and the sciences using intermediate and broadband technologies. The project will provide the institutions involved with the means and the guidance to allow them to make effective use of these technologies in the curriculum.

Journeys through Space and Time: this project, involving The Photographers' Gallery, Artec - The Arts Technology Centre, and a primary school, will use photographic and digital technologies actively to involve children at Key Stages 1 and 2 in creative explorations of personal and global histories. In curriculum terms, the project will support history, geography, English, art and IT. The children will produce a multimedia programme using images, text, music and voice for distribution over the Internet using broadband links.

The Kent Broadband Learning Project: based on co-operation between Kent LEA, Kent TEC, Research Machines, United Artists and BBC Education, the project will focus on English and modern foreign languages, and will involve one primary and two secondary schools. In addition to broadband cable television, the project will incorporate a trial of RF modem technology, designed to carry data over the cable system at rates up to 10 Mbit/s. This will potentially offer high speed access both to the Internet and to a CD-ROM server.

The Knowledge Superhighway: based in Birmingham the project will involve six secondary schools and will cover all National Curriculum subjects, in-service training, home learning and the provision of minority features. Sponsors include Novell UK, Birmingham Cable, Systems Integrated Research (SIR), ICL Computers, and Acorn Computers. Among the technologies used will be ISDN2, cable networking providing a minimum speed of 2 Mbit/s, and Integrated Learning System software.

Modern Communications for Teaching and Learning in Argyll and Bute: a partnership between Argyll and Bute Division of Strathclyde Region, the Faculty of Education of Strathclyde University and BT, this project will assist small rural schools through the use of desktop conferencing for teaching and learning and for curriculum and staff development. Forty schools are using VC8000 systems with ISDN2 connections. Staff are committed to a programme of staff development and participation in

working groups developing additional curricular material.

Powys LEA Project: this project builds on the Rural Wales Network. Its focus is on enabling primary, secondary and special schools to use digital connections to share in the development of a World Wide Web server which will have a direct intermediate band line to an Internet access provider. All schools involved will produce World Wide Web pages for school, county and world-wide access. These pages will be cross-curricular in nature, involving the use of IT, English, Welsh, Art and Design as well as focusing on local history and geography.

Superhighways for Able Children in Small Rural Schools: a consortium of Northern College, AVC Enterprises, GPT and other commercial suppliers and the education authorities of Highland, Western Isles, Shetland, Orkney and Grampian regions. This is a demonstrator project combining broad and narrowband technology for the delivery of learning materials and associated staff development. The main aim of the project is the evaluation of a network to support and challenge pupils in remote rural primary and secondary schools throughout Scotland. The main focus will be on the development of collaborative learning to support simulation and problem-solving approaches to learning and teaching in mathematics, technology and language for pupils aged 8 - 14.

Superhighways - Opening the Door to Satellite Remote Sensing: supported by the INTEL Corporation, this project in Dyfed will provide support to teachers to introduce remote sensing to enhance the teaching of Geography at Key Stage 3 and above. It will also provide in-service training for remote sensing from the Satellite Centre, and on-line access to a large archive of remotely sensed images, image processing software and support to use them. Through ISDN the project also aims to deliver remote sensing enhancement modules to National Curriculum studies. The eight pilot schools will be resourced to allow simultaneous video-conferencing and data sharing.

Mainly vocationally focused projects for secondary school pupils, FE students and adult learners

Broadband Support of GNVQ Information Technology Courses: supported by the CBI Education Foundation, NYNEX CableComms, UBI Placement Service, IBM UK, the University of Salford and others, this project forms part of GEMISIS 2000, a major superhighways initiative in Salford. The project will deliver GNVQ IT courses by the use of broadband technology and will involve the use of video-conferencing, interactive multimedia teaching resources and narrowcast magazine programming via personal computers linked to the NYNEX broadband cable network. A particular feature will be the linking of the schools and colleges involved to the business community.

Cumbria Broadband Pilot: this initiative led by Cumbria LEA, with sponsorship from BT, involves connecting schools and colleges in Cumbria to a managed network, with ISDN facilities and an Internet gateway. The project will investigate the use of video-conferencing, the enrichment of the GNVQ Manufacturing programme, the enhancement of A-level Communication Studies, and the development of the IT skills of parents and others in the community.

GEMISIS 2000 Schools Project: based in Salford this project will pilot the use of interactive broadband cable technology in over 30 schools and colleges. The project is supported by NYNEX CableComms, Salford City Council and University College, Salford. Features will be curriculum development, the development of network literacy and the use of superhighways in education-business links.

The LIFE Programme - Learning via Interactive and Flexible Education: Based in Burnley FE College, this project unites further education and schools into a centrally managed ISDN local network. It will provide a basic introduction to telematics for year 11 pupils in the Burnley Borough; curriculum enhancement for FE college students; a source of careers advice and guidance; and aims to create a nationally recognised telematics certificate at NVQ level II. Among the technical features will be ISDN, video-conferencing, video mail, shared use of CD-ROM facilities and use of satellite facilities.

London Colleges Multimedia Initiative: a partnership involving the London TECs, and colleges across London. The aim is to develop a broadband network linking open learning centres within these institutions. These will subsequently expand to employer sites and centres of employment. The focus is on increasing the competitiveness of business within the region through access to flexible, high quality vocational training provision.

Students Across Europe: A partnership focusing on foreign language teaching in secondary schools and colleges. It will involve one school each in England, France, Germany and Spain. The project partners include Monkseaton Community School, North Tyneside Council, Tyneside TEC, Sunderland and Newcastle Universities, United Artists, Research Machines, BBC Education, Bard Entertainments and Yorkshire International Thomson Multimedia. Various technologies will be used, including ISDN2, voice conferencing, video conferencing and CD-ROM.

Superhighway for Education in Hertfordshire: the project's focus is mainly on the delivery of the curriculum at Key Stages

3 and 4. Its purposes will be to raise attainment in education and training, and to increase participation by the adult community in lifetime learning, with an emphasis on 'new literacy'. The project will be based initially on the establishment of multimedia learning centres in five schools in Hertfordshire with broadband links to each other as well as multimedia technology. Sponsors include Hertfordshire LEA, Hertfordshire TEC and the CRT Group.

Projects focusing mainly on teachers' professional development

The CLASS Superhighway Project: based in Northern Ireland and supported by SIMS Ltd, ICL (UK), Coopers and Lybrand, the Northern Ireland Centre for learning Resources, and the Education and Library Boards' Regional Training Unit. The CLASS (Computerised Local Administration Systems for Schools) project will select an existing in-service training course for one of the SIMS computer-based school management units, modify it for distance learning use and deliver, support and assess it using ISDN2 video-conferencing. The project will involve teachers, non-teaching staff and managers in four pilot schools.

Teachers Managing Learning: Based in Cambridgeshire, on a partnership of various LEA agencies, professional support and development centres and schools, this project will establish a broadband network using ISDN30 linking a number of sites around the county. The focus will be on teacher-designed work in curriculum areas and on the management of learning. Applications will include video conferencing, remote control and remote access.

Projects based on links between schools, homes and the wider community

Acorn Home-School Links Project: supported by Acorn, Online Media and a number of other companies including Cambridge Cable, SJ Research, ATM Ltd, ICL and SIR, this project is based in eight schools and a number of homes in the Cambridge area. It will include the use of on-demand educational programming, and distance Integrated Learning Systems for homework and revision. It will also explore the attitudinal, pedagogic and management implications of superhighways for teachers.

Highdown Information Hub: a community learning project based on three schools and a number of homes in the Reading area. The project is sponsored by Microsoft, ICL LifeLong Learning Ltd, and TeleCential Communications Plc. It will focus on GNVQ, English, mathematics, science, geography and design and technology and will offer a trial of alternative dial-up and cable modem technology.

Superhighways in Education: this partnership involving Research Machines, Telewest Communications Group, and Essex LEA will pilot the feasibility and value of broadband technology to schools and homes. It will focus on language and cultural studies, and will include the use of a digital library, inter-school links, broadband Internet access and home-school links. It will be based initially in two schools in Essex, and an LEA centre.

Projects based in higher education

MATTU (Minimal Access Therapy Training Unit) Live Links: focused on the use of on-line access to operating theatres for teaching purposes, this project is led by the Royal College of Surgeons. Companies involved include Mercury Communications Ltd, Internet Video Communications Ltd, Video South Ltd and BT. The project involves the use of live interactive TV links to operating theatres using 2 Mbit/s transmissions via the Mercury Switchband service. The link provides access to unidirectional video and bi-directional audio for demonstrations and interactive discussions with surgeons during operations.

VODER - Video On Demand Educational Resources: a developmental pilot project sponsored by Microsoft, BBC Education Resources, the Open University and Hughes Telecoms to develop a control system enabling teachers to locate TV-based material more quickly than by current means, and to gain greater access to this material by fast targeting of appropriate programming and immediate delivery. The project will also pilot the delivery of OU courses via on-line services. Some 200 learners will be involved in the project, which will focus on in-service training in the techniques of teaching and learning with multimedia.

37. The evaluation of the projects will be managed by the National Council for Educational Technology in England, Wales and Northern Ireland, and by the Scottish Council for Educational Technology in Scotland. The duration of the projects will in general be about one year. In commissioning the evaluations of the projects, the Education Departments will require the evaluators to have regard to the implications of the projects for those with special educational needs, for the professional development of teachers, and for institutional administration and management, where these are not among the main features of the projects. The results of the evaluations will be disseminated, with a view to informing developments both within the education service and in industry. In the interim the Departments will be monitoring developments carefully with a view to encouraging additional projects as necessary.

[Prepared 6th November 1995]

The way forward

38. Evaluation is crucial to the medium and long term development of superhighways in education. It is clear from industry and other responses to the consultation paper that the expanded use of superhighways and associated determination of technical standards will be largely market-driven. A substantial amount of infrastructure development, service provision and applications development is already on stream for the home market. This is also beginning to take education into account, and the programme of evaluation under this initiative will provide a further important focus on education needs.

39. To ensure that the take-up of superhighway developments in education is successful, our UK priorities must be:

- i. to continue to raise the general level of IT capability in schools, FE colleges, and initial teacher training;
- ii. to develop network literacy in preparation for broadband superhighways;
- iii. to develop high quality on-line educational applications and services, which include appropriate means of finding and organising content such as video material;
- iv. to provide appropriate advice, support and training for teaching staff in the use of on-line educational applications and services;
- v. to develop and build up the infrastructure of equipment and connectivity, both within and between education institutions, including internationally.

What the Government will do:

40. The Government welcomes respondents' recognition that the Education Departments' Superhighways Initiative seeks to provide a coherent strategy across the whole education service, and one which takes into account the needs of the several sectors involved. To help to achieve the UK priorities outlined above, the Government will:

- i. support and encourage the piloting of new communications technologies in education, including SEN and rural schools, and ensure that advice on the use of these technologies (including advice on tailored access to them) is made available through the NCET, SCET, the Further Education Development Agency (FEDA) and other bodies;
- ii. make available resources, through specific grant schemes such as Grants for Education Support and Training (GEST), funding for local authorities and other means, to enable the provision of equipment (including computers, upgradable internal network installations and servers), and training in the delivery of IT capability.
- iii. look to SCAA, and other relevant national bodies, to take full account in their work of the developing importance of network literacy;
- iv. liaise with industry, in the light of the outcomes of the pilot projects under this initiative and other developments, to promote the development of additional educational on-line applications and services as necessary; and to this end will encourage the close co-operation of industry and the education service;
- v. look to the TTA in England, and other relevant bodies in other parts of the UK, to review arrangements for teacher training to ensure that they keep pace with technological developments. The TTA has already identified as a priority support for teachers to exploit the potential of IT.
- vi. work with the HEFCs to review progress on the SuperJANET project, and disseminate outcomes of the project as widely as possible, so that the implications for other education sectors and for product and service development by industry can be considered.

41. The Government is currently assessing the implications of superhighways for training. The assessment involves a wide range of vocational education and training interests. Results will shortly become available, and will provide a basis for further discussion and consultation. They will help to identify options for stimulating the effective application of broadband networks in developing skills and competence in work.

42. In Wales, the Government will continue to give attention to the development of educational technology in support of Welsh medium education.

43. The Government will work at national, European and wider international level with those concerned with intellectual property rights, payment mechanisms, standards, protocols, international connectivity and the compatibility of technologies, to ensure that the interests of education are taken into account. The Government will also promote UK involvement in the various EU and G7 initiatives in the field.

What industry can do

44. Given the investment which the Government will make in fostering the right conditions for the development of superhighways in education, it will look to the telecommunications companies and providers of on-line services to ensure that schools, colleges and other institutions are not deterred from connecting to networks because of high service or product costs. A rich market in narrowband connection services to the Internet, tailored for the education sector, is already developing. Competition between these services will help to keep costs down and make them more attractive to the educational customer. Issues that customers will expect to see addressed are the predictability of charges, their 'controllability' in terms of customers being able to set their own cost ceilings, and the absence of 'lock-in' conditions and hidden extras.

45. It will also look to industry to work closely with the education service in identifying opportunities and needs which can be met by broadband applications and services, and to co-operate with the various education sectors in the development of products and services that meet their needs, while giving a reasonable return on investment. The education sub-group of the DTI's Multimedia Industry Advisory Group is currently considering the scope for action by industry to stimulate the market for multimedia in education. Its work will give further direction to this debate.

What schools, colleges and responsible authorities can do

46. Given the relative affordability of narrowband compared with wider bandwidth networking, the financial autonomy of educational institutions, and their growing keenness to be on-line, it is likely that institutions will move progressively towards wider bandwidths, beginning with narrowband and intermediate band technologies. As in the early days of IT in schools, when institutions acquired successively more powerful generations of computer technology, so institutions are likely to begin with what is affordable at today's prices and subsequently upgrade their on-line systems. The difference is likely to lie in the pace of change which is proving to be much quicker for communications technology than for stand-alone devices. In these circumstances it will be important that teachers, governors and others in education institutions and authorities look carefully at the purposes for which they need on-line communications, and that where decisions are taken to invest in narrow and intermediate band technology they should ensure that:

- i. the significance of networking literacy for all pupils, students and young people is appreciated, reflected in school and college development plans, and realised through management policies;
- ii. terminals acquired are sufficiently powerful to cope with higher rates of data transmission and advances in compression techniques;
- iii. internal network installations are of sufficiently high bandwidth or are installed in such a way as to be readily upgradable;
- iv. full account is taken of the significance of networking both in initial teacher training and in continuing professional development. On the basis of the experience of the introduction of IT into schools, institutions would be wise to plan on the basis of at least the same amount of investment in training and technical support as they do for equipment, connectivity and software;
- v. they consider the implications for security of access by users, including young children, to worldwide sources of information. In addition to any technical safeguards, appropriate institutional codes of practice (or provision within school discipline frameworks) will be needed to encourage responsible use.

47. Advice on many of these issues is already available from the NCET, SCET, FEDA and other bodies. The Government looks to the Joint Information Systems Committee of the Higher Education Funding Councils to continue to take a lead in advising universities and colleges on appropriate strategies for higher education. Further advice will be made available in the light of developments.

Appendix A

Institutions, associations and other organisations responding to the consultation paper

The total number of responses was 431 including a number of individuals who are not listed here. Some organisations sent more than one response but are represented by one entry below.

Education Responses

Action for Governors Information and Training (AGIT)
Andover Cricklade College
Arnold and Carlton College, Nottingham
Association for Colleges
Association for Language Learning
Association for Science Education
Association of Principals of Colleges
Association of Teachers and Lecturers
Association of University and College Lecturers
Balerno College Community High School, Midlothian
Bangor High School
Barnet College
Barnsley College
Barnsley Metropolitan Borough Council
Bartley Green School, Birmingham
Bedfordshire County Council
Belfast Education and Library Board
Belfast Institute of Further and Higher Education
Bilston Community College, Wolverhampton
Birmingham City Council
Birmingham Diocesan Board of Education
Birmingham Group of Colleges
Bolton Metropolitan Council
Bolton School Girls' Division
Bournemouth and Poole College
Bradford Metropolitan Council
British Universities Film and Video Council
Bromsford School
Broxtowe College, Nottingham
Buckinghamshire College
Burnley College
Business and Technology Education Council
Cambridgeshire County Council
Cardinal Wiseman School, Birmingham
Catholic Education Service
Central College of Commerce, Glasgow
Central Foundation Girls' School
Central Regional Council
Centre for Information Technology in Education (CITE)
Centre for Micro Assisted Communications (CENMAC)
Cheltenham and Gloucester College of Higher Education
Cheshire Local Education Authority
Chichester College
Christchurch School
City of Sunderland Local Education Authority
City of Wakefield Metropolitan District Council
Clwyd County Council

Coleg Llandrillo College
Coleg Normal
College Employers Forum
College of North East London
College of St Mark and St John
Committee of Scottish Higher Education Principals
Convent of Mercy Primary School, Co. Down
Council for Education in World Citizenship
Coventry Local Education Authority
Cranfield University
Cranford Community School
Cumberland School
Cumbria County Council
Curriculum and Assessment Authority for Wales (ACAC)
Davenant Foundation School, Essex
De Montfort University
Derbyshire Local Education Authority
Devon County Council
Dorridge Junior School, Solihull
Douay Martyrs School, Uxbridge
Dudley Local Education Authority
Dumfries and Galloway Regional Council
Durants School, Enfield
Dyfed County Council
East Birmingham College
East Down Institute of Further and Higher Education, Co. Down
ECCTIS 2000
Edgehill University College
Edinburgh's Telford College
Education Lecturing Services
Education95
Elm Bank Teachers' Centre, Coventry
European Schools Project
Farnborough College of Technology
Fife College
Filton College, Bristol
Frank Wise School
Further Education Development Agency (FEDA)
Further Education Funding Council (FEFC)
Geographical Association
George Abbot School
George Orwell School, Islington
Glasgow Telematics Consortium
Gloucestershire Strategic Education Forum
Grampian Regional Council
Grant Maintained Schools Advisory Committee
Grimsby College
Guildford College of Further and Higher Education
Halton College
Hamilton School, Buckinghamshire
Hammersmith and West London College
Hampshire County Council
Hatfield High School
Hereford & Worcester County Council
Hereward College of Further Education
Hertfordshire County Council
Hertfordshire Forum for Education and Training
Horsforth School, Leeds
Hulme Grammar School for Girls

Humberside County Council
Ilkley Grammar School, West Yorkshire
Information Technology for Teacher Education (ITTE)
Institute of Education, University of London
James Watt College of Further and Higher Education, Greenock
Joint Information Systems Committee
Keele University
Kent County Council
Kincorth Academy, Aberdeen
Kineton High School, Warwickshire
King Edmund School
King's College London
Kirklees Metropolitan Council
Langside College, Glasgow
Lauder College, Dumfermline
Leeds City Council
Leicestershire County Council
Lewes Tertiary College
Linlithgow Academy, West Lothian
Lisnagarvey High School, Lisburn
Liverpool City of Learning
Liverpool John Moores University
Llangefni Secondary School, Gwynedd
London Borough of Bexley
London Borough of Havering
London Borough of Hounslow
London Borough of Sutton
Long Eaton Community School, Nottingham
Longdendale High School, Cheshire
Lothian Regional Council
Loughborough University
Loughborough University of Technology
Maharishi School, Lancashire
Manchester City Council
Mathematical Association
Metropolitan Borough of Sefton
Microelectronics Education Unit Cymru
Microelectronics Educational Development Centre
Micros and Primary Education (MAPE)
Mid Kent College
Middlesex University
Monkseaton Community High School
Montagu School, Northamptonshire
Moseley School
Mount Carmel School, Islington
Mount Gilbert Community College, Belfast
Movilla High School, Co. Down
National Association of Governors and Managers
National Association for Information Technology in Further Education (NAITFE)
National Association for the Teaching of English (NATE)
National Association of Advisors for Computers in Education (NAACE)
National Association of Teachers of Travellers
National Union of Students, Scotland
National Union of Teachers
National Union of Teachers Wales
Nene College, Northampton
New College, Durham
New College, Swindon

Norfolk College of Arts and Technology
Norfolk Traveller Education Service
North Devon College
North East Worcestershire College
North Eastern Education and Library Board Antrim
North West Institute of Further and Higher Education
North Yorkshire Local Education Authority
Northern College, Aberdeen and Dundee
Northern Ireland Centre for Learning Resources (NICLR)
Northern Ireland CLASS Project
Northern Ireland Council for the Curriculum Examinations and Assessment
Northern Ireland Education Information Service
Northumberland Federation of Parent Teacher Associations
Open Learning Unit, Hounslow
Open University
Opsis
Our Lady's Grammar School, Co. Down
Oxfordshire County Council
Park Community School, Havant
Pembrokeshire College
Perth College
Poltair School, Cornwall
Pool School and Community College
Portree High School, Isle of Skye
Powys County Council
Professional Association of Teachers
Royal County of Berkshire
RSA Examinations Board
Saint Catherine's College, Armagh
School Curriculum and Assessment Authority (SCAA)
School Library Association
Scottish Consultative Council on the Curriculum
Scottish Council for Educational Technology (SCET)
Scottish Council for Research in Education
Scottish Examination Board
Scottish Further Education Unit
Scottish Parent Teacher Council
Seaham Comprehensive School
Searchlight on Education
Selly Park Girls School, Birmingham
SEMERC
Sheffield College
Sheffield Hallam University
Shenley Court School, Birmingham
Shrewsbury School
Shropshire IT Support Services
Solihull Local Education Authority
South Bristol College
South Downs College
South Eastern Education and Library Board Ballynahinch, Belfast
South Glamorgan County Council
South Tyneside Metropolitan Borough Council
Southampton Institute
Southern Education and Library Board Armagh
St Andrew's College
St Joseph's Convent Grammar School, Co. Tyrone
St Peter Smithills Dean CE Primary School, Bolton
St Vincent College, Hampshire

Staffordshire University
Stevenson College, Edinburgh
Stowe School, Buckinghamshire
Stranmillis College, Belfast
Strathclyde Regional Council
Swansea College
Thomas Bennett Community College, West Sussex
Thornleigh Salesian College
Thurso High School, Caithness
Turves Green Boys' School, Birmingham
Tynemouth College
UK Education and Research Networking Association (UKERNA)
Universities and Colleges Information Systems Association (UCISA)
University College London
University College Salford
University of Birmingham
University of Bradford
University of Bristol
University of Cambridge
University of Dundee
University of East Anglia
University of Edinburgh
University of Exeter
University of Glamorgan
University of Glasgow
University of Hertfordshire
University of Kent
University of Leeds
University of Leicester
University of Liverpool
University of Newcastle
University of Oxford
University of Plymouth
University of Portsmouth
University of St Andrew's
University of Strathclyde
University of Sunderland
University of Surrey
University of Teesside
University of the Highlands and Islands Project
University of the West of England
University of Ulster
University of Wales
University of Wales College of Medicine
Walsall College of Arts and Technology
Wandsworth Borough Council
Weald College, Middlesex
Welsh Funding Councils
Welsh Joint Education Committee
West Glamorgan County Council
West London College Partnership
West Nottinghamshire College
Western Education and Library Board Omagh
Wheelers' Lane Boys' School, Birmingham
Whitchurch High School
Wilmslow High School
Woolwich College, London
York Staff Development Centre

Industry Responses

ABLAC Learning Works Ltd
Acorn Computers Ltd
Anglia Television Ltd
Apricot Computers Ltd
AT&T (UK) Ltd
BBC
BBC Cymru Wales
BP Oil International
British Educational Suppliers Association (BESA)
British Telecommunications Plc
Cable Communications Association
Cable Corporation
CableTel South Wales Ltd
Careers Plus
CBI
CDR Group
Compass Technologies Ltd
Create Promotions Ltd
Cumana Ltd
Data Base (Nottingham) Ltd
Data Broadcasting International Ltd
Dialnet Plc
Education Interactive
Ellipsis London Ltd
Esso UK Plc
ExpLAN Computers Ltd
Interalpha
International Computers Ltd
KCS Premier
Kirklees Interactive Telematics Partnership
Microsoft Ltd
Network Learning Ltd
North Tyneside Education Business Partnership
Nynex Cablecomms Ltd
PlainTalk Publishing
Project Connect Ltd
Research Machines Plc
Reuters
S4C
TeCComS
Telewest Communications Plc
Unilab Ltd
Unipalm Ltd
Upstream Presentation Ltd
Yorkshire International Thomson Multimedia

Other Responses

Association of Metropolitan Authorities (AMA)
Basic Skills Agency
Birmingham Training & Enterprise Council
British Dyslexia Association
British Film Institute
British Medical Association
Centre for Micro Assisted Communications (CENMAC)
Chamber of Commerce Milton Keynes

Christian Action Research and Education
Commission for Local Administration in England
Devon and Cornwall Training & Enterprise Council
ENABLE - Scottish Society for the Mentally Handicapped
Energy Education Forum
Enterprise Ayrshire
Fawcett Society
Hertfordshire Forum for Education and Training
Independent Television Commission
Institute of Careers Guidance
Library Association
Liverpool City of Learning
Museum Documentation Association
Museums and Galleries Commission
National Deaf Children's Society
National Institute for Medical Research
NW England Steering Group (IRIS Initiative)
Photographers Gallery
Publishers Association
Royal College of Psychiatrists
Royal College of Surgeons
Royal Geographical Society
Royal National Institute for the Blind
Science Museum
Scottish Council for Voluntary Organisations
Scottish Engineering
Scottish Library & Information Council
Scottish Museums Council
Scottish Sensory Centre
SOLOTEC
South London Training & Enterprise Council
Sports Council for Wales
Staffordshire Training & Enterprise Council
Wales Youth Agency
Welsh Library Association
West Cumbria Partnership
West London Training & Enterprise Council
Women's Engineering Society
Women's National Commission
Workers' Educational Association

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The Rt Hon Michael Forsyth MP
Secretary of State for Scotland



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The Rt Hon Sir Patrick Mayhew QC MP
Secretary of State for Northern Ireland



[Back](#)

[Prepared 6th November 1995]

The Rt Hon William Hague MP
Secretary of State for Wales



Back

[Prepared 6th November 1995]

The Rt Hon Gillian Shephard MP
Secretary of State for Education and Employment



[Back](#)

[Prepared 6th November 1995]

