

NGfL Pathfinders

Final Report on the roll-out of the NGfL Programme in ten Pathfinder LEAs

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This research on which this report is based was managed by the British Educational Communications and Technology Agency (Becta) on behalf of the Department for Education and Skills (DfES), and conducted by:

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It is the final report from the Pathfinders Evaluation. The Preliminary Report¹ and the Second Report² are available on the Becta Research web site at:

www.becta.org.uk/research/reports/pathfinders

A series of Information Sheets based around issues relating to the study are forthcoming and will be published on the Becta Research web site, where other reports in the ICT in Schools Research and Evaluation Series can also be found.

¹ Becta (2001). *NGfL Pathfinders: Preliminary Report on the roll out of the NGfL Programme in ten Pathfinders LEAs*. (Becta, Coventry: www.becta.org.uk/research/reports/pathfinders)

² Becta (2001). *NGfL Pathfinders: Second Report on the roll out of the NGfL Programme in ten Pathfinders LEAs*. (Becta, Coventry: www.becta.org.uk/research/reports/pathfinders)

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The Pathfinder evaluation

The evaluation of the roll-out of the National Grid for Learning in ten Pathfinder local education authorities (LEAs) is one of a number of projects commissioned by the Department for Education and Skills and managed by Becta with the aim of evaluating the progress of the ICT in Schools Programme.

The Pathfinder evaluation was designed to:

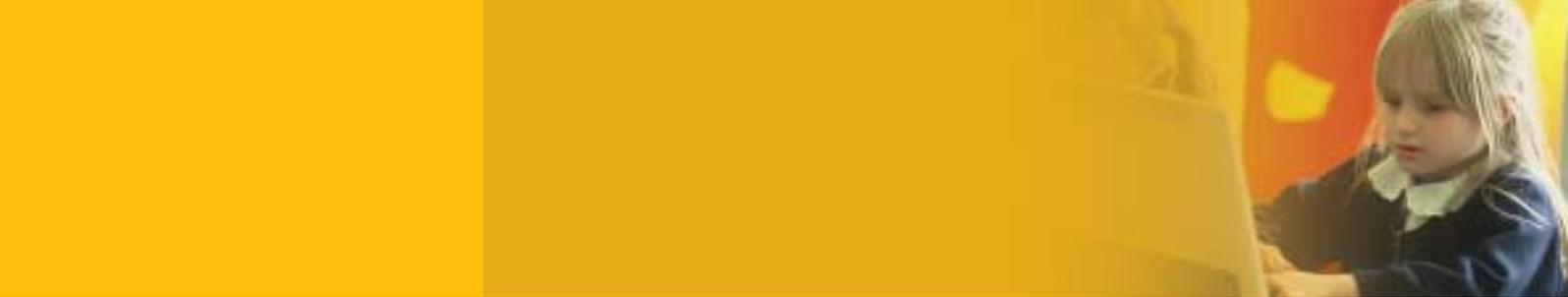
- gather evidence to inform future policy for ICT in schools
- identify and evaluate the range of models of implementation adopted by LEAs in order to disseminate good practice and inform future decision-making in LEAs.

The Pathfinder evaluation was divided into three strands and carried out by three teams of researchers:

- The Implementation and Management evaluation (IM) at the University of Lancaster, carried out by a team led by Don Passey
- The Standards and Effectiveness in Schools evaluation (SES) at the University of Bristol, led by Professor Rosamund Sutherland
- The Technical Evaluation (TE) at the University of Nottingham, led by Professor Colin Harrison.

These were drawn together by a synopter, Professor Bridget Somekh, at the Manchester Metropolitan University.

The Pathfinder LEAs were chosen because they exemplified the range of strategies put forward by LEAs within the bidding process for NGfL funding. The non-pathfinder LEAs worked in comparable ways, and in many cases were working with the same or higher levels of funding.



Summary of key findings

Achievements

- All secondary schools in the Pathfinder LEAs now have high-speed broadband access to the Internet and primary schools have at least the fastest available connection via a telephone line. In line with all other LEAs in the country, schools in Pathfinder LEAs have met targets set by Government for levels of ICT equipment in schools by 2002.
- The Pathfinder LEAs have all established local Grids for Learning, linked to the National Grid for Learning portal. They have also established local networks or intranets, usually based in secondary schools.
- Pupils' skills in using ICT have increased very considerably since 1999. This is due both to the increased use of ICT at home and to a focus on teaching ICT skills in schools. This has been aided by the increased availability of specialist ICT rooms, or suites, installed in primary schools under the NGfL Programme.
- All teachers in primary schools in the Pathfinder LEAs now regard it as an expected and accepted part of their work, to use ICT in their teaching. For many, though, the focus is still on teaching ICT skills. In secondary schools ICT is still regarded as a specialist activity by many teachers, but there is an increasing commitment by other subject teachers to make regular use of ICT in their teaching. Both primary and secondary teachers are making increasing use of interactive whiteboards, data projectors and low-cost digital cameras.

Approaches to the roll-out of the NGfL

- LEAs have adopted different approaches to the roll-out of the NGfL. These can be categorised into four broad types of approach. Type A and B approaches, which gave schools more autonomy over decision-making, had the advantage of increasing teachers' motivation to use ICT by giving them a greater sense of control and responsibility, but the disadvantage of failing to establish a coherent infrastructure and thereby making maintenance and support more difficult and often more expensive. Type C and D approaches, in which the LEA took the majority of decisions centrally, buying into the services of a main provider, had the advantage of negotiating special deals with the provider and

reducing overall costs, but the disadvantage that teachers were often frustrated because the computer network and software were not tailored specifically to their needs.

- Over time, the differences between the four types of approach have become less obvious as steps were taken by LEAs to overcome initial problems. Since the arrival of the Regional Broadband Consortia, all LEAs are moving to more coherent network provision.
- Integration of all local authority provision, including for example libraries and social services, was apparent in only three of the Pathfinder LEAs yet has yielded significant benefit.

Lessons emerging from the work of the Pathfinder LEAs and their schools

- Speed of users' access to the Internet is one of the key factors in making effective use of ICT in schools. There are two components to providing speed: bandwidth (the speed at which information comes from the Internet) and storage of materials on local servers (which makes information available much more quickly after it has been retrieved the first time). The Pathfinder LEAs have developed considerable expertise in establishing and managing servers both for the LEA and individual schools. This means that they have increased the speed of access for users more cost effectively than could have been done simply by increasing bandwidth.
- Now that teachers are making more use of ICT they have become more dependent upon its functionality. Spending on effective technical support has therefore become more important. Technical support also needs to be more fully integrated with curriculum support in order to provide teachers with the assistance they need to use ICT effectively in their teaching.
- Successful use of ICT in schools depends upon the commitment of the senior management team. It usually requires the active involvement of at least one of its members in promoting and supporting the use of ICT in the school. The range of activities involved means that secondary schools in the Pathfinder LEAs have made most effective use of ICT when the role of ICT co-ordinator has been split between two or more teachers working in collaboration with a member of the senior management team and one or more technicians, depending on the size of the school.

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- Teacher training for ICT is most effective when it is provided locally and is related to teachers' motivation to use ICT in their teaching. Newly qualified teachers were found to be a valuable source of expertise.
- When learning to use ICT in the classroom it is essential to have technical support within reach. A culture within the school of shared learning through exploration is also essential and sometimes computer technicians may have to be given additional training in interpersonal skills to help them establish this culture.
- Since they have concentrated mainly upon teaching ICT skills, few schools in the Pathfinder LEAs have as yet embedded the use of ICT in subject teaching. One barrier to doing this is the logistical problem of moving pupils out of subject rooms and into specialist ICT rooms. This is particularly true in secondary schools where the timetable normally gives short time-slots for individual lessons. Experiments with the use of laptops with wireless connectivity in the Pathfinder LEAs have shown that this is one of the best ways of overcoming this problem. In primary schools, the use of ICT in specialist computer suites has also led to a move away from using ICT to support the whole curriculum.



Summary of recommendations

- In both secondary and primary schools, there is a need for more laptop computers and clusters of workstations to be made available to teachers in the vicinity of their normal classrooms. The laptop computers used in schools are still rather heavy, but as the cost of 'ultra-thin' laptops decreases, many more pupils are likely to acquire them and be able to use them both at home and at school with wireless connectivity.
- The provision of wireless connectivity in all schools would greatly facilitate the use of laptops. Wireless technologies present some problems because it is difficult to prevent unauthorised users from gaining access. Their reliability also needs to be improved. However, they provide very important flexibility for teaching and learning when they are used with laptop computers.
- As the use of networked ICT becomes established in schools, it will perhaps signal a time to shift a greater proportion of spending to maintenance of existing resources and reduce the proportion of spending on innovation. To achieve this it would be helpful to move away from the provision of annual budgets and allocate funding to LEAs and schools over periods of 3-5 years.
- There is an urgent need to train more technicians and equip them with a wider range of skills, including curriculum and management skills. Teachers increasingly depend upon ICT to be fully functional, which suggests that there should either be a technician available on site in every school, or computers and networks should be maintained through on-line support via a broadband network.
- Interactive whiteboards are becoming increasingly available, but substantial teacher training is needed if their potential is to be realised.
- Until there is a shift of resources away from specialist rooms into subject teaching areas ICT is unlikely to have a major impact on pupils' attainment in subject learning. This is particularly important in secondary schools where specialist ICT rooms are heavily used for teaching specialist ICT courses to older pupils leading to examinations. Younger pupils, and teachers teaching non-ICT courses, have much less access to ICT facilities.
- The development of more effective grids for learning, and dynamic server capacity, leads to increased need for technical support. This shift in focus to the use of curriculum materials also means that technical staff need to be made more aware of curriculum concerns.
- Teachers in both primary and secondary schools need considerably more encouragement and support to use ICT for administrative purposes. To achieve this, current approaches to the use of information will need to be changed to make use of the facilities made available by computer-based systems, while at the same time paper-based systems will need to be phased out. At present few teachers see the need to change or any potential advantages.

1 Introduction

The National Grid for Learning (NGfL) Programme was the Government's key initiative to improve ICT provision in schools between 1998 and 2002. It aimed to improve ICT provision in schools by stimulating the development of high-quality on-line and off-line digital content, delivering this to schools via the NGfL portal, putting into place the infrastructure for schools to access these resources, and providing teachers with appropriate training to enable them to use ICT in their everyday teaching.

During the four-year period, local education authorities (LEAs) received over £700 million to develop the use of networked technologies in their schools. Planning and implementing the roll-out of the Programme, including decision-making in collaboration with schools, the provision of technical support and teacher training, was one of the most complex exercises that LEAs had ever been asked to undertake.

It was important for both Government and LEAs to learn from the experience of implementing an initiative of this size. The ten LEAs¹ that received funding in 1998 and 1999 were selected as 'Pathfinders' on the grounds that their proposals for funding outlined interesting and innovative approaches to implementing the NGfL Programme. Additionally, they were judged to be broadly representative of other LEAs across the country. In the autumn of 1999 the then Department for Education and Employment commissioned an evaluation of the NGfL Roll-Out to focus specifically upon the Pathfinder LEAs. The evaluation was funded by the DfES and managed by Becta.

The Pathfinder LEAs agreed to take part in an evaluation that had two key aims:

- To gather evidence to inform future policy for ICT in schools
- To identify and evaluate the range of models of implementation adopted by LEAs in order to disseminate good practice and inform future decision-making in LEAs.

The evaluation was divided into three inter-connecting strands:

- The Implementation and Management evaluation (IM) at the University of Lancaster, which looked at the

strategic planning, management, implementation and long-term sustainability of the NGfL Programme in local authorities. This involved observing strategic meetings and interviews with senior LEA personnel, school visits and interviews with school personnel, and documentary analysis.

- The Technical Evaluation (TE) at the University of Nottingham, which concerned the optimum conditions and strategies for implementation of NGfL Programme infrastructure in local authorities. This was carried out by interviewing LEA officers responsible for ICT development and their counterparts in schools. The team also carried out focus group meetings during the project.
- The Standards and Effectiveness in Schools evaluation (SES) at the University of Bristol, which looked at the impact of the NGfL Programme on schools and in classrooms. The research was carried out by initially surveying 1128 Year 6 pupils from 26 primary schools and 6882 pupils from Years 9, 10 and 12 in 27 secondary schools. During the second year, visits were made to 20 case study schools (10 secondary and 10 primary) where lessons were observed and teachers and pupils were interviewed. This was followed up towards the end of the project by surveying 24 primary and 72 secondary teachers drawn from six Pathfinder authorities.

The evaluations were drawn together by a synopter at the Manchester Metropolitan University.

The evaluation findings draw exclusively upon data from the Pathfinder LEAs. However, they were chosen as Pathfinders because they provided examples of the range of strategies put forward by LEAs as a whole within the bidding process. The IM evaluation team is able to confirm from other related work that non-Pathfinder LEAs are working in comparable ways, and in many cases are not working with lower levels of funding.

Two preliminary reports have been published:

- *NGfL Pathfinders: Preliminary report on the roll-out of the NGfL Programme in ten Pathfinder LEAs* was published by the DfES in November 2001
- *NGfL Pathfinders: Second Report on the roll-out of the NGfL Programme in 10 Pathfinder LEAs* was published by the DfES in November 2002.

¹ The Pathfinder LEAs were: Birmingham, Bradford, Cumbria, Dudley, Greenwich, Kent, Somerset, Staffordshire, Stoke-on-Trent and Telford & Wrekin.



The evaluation of the Pathfinder LEAs provides evidence that a considerable amount has been achieved. This report builds upon two previously published reports and presents outcomes from the third and fourth years of the evaluation. It is divided into four sections:

- An overview of the main achievements of the NGfL Programme in the Pathfinder local education authorities and their schools
- An account of the four different approaches to implementation of the NGfL Programme adopted by the Pathfinder LEAs, and an assessment of the implications of these approaches
- Facing challenges at LEA level and an account of what has been learnt
- Facing challenges at school level and an account of what has been learnt.

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2 The main achievements of the NGfL Programme in the Pathfinder LEAs and their schools

2.1 General points

In general terms, the majority of the Pathfinder LEAs have effectively implemented the NGfL Programme in line with their original proposals, although there were variations between the LEAs in terms of areas of strength and weakness. Where there have been problems leading to a reduction in efficiency and effectiveness, lessons can be learned from their experience and these are discussed in sections 3 and 4 of this report.

All secondary schools in the Pathfinder LEAs now have high-speed broadband access to the Internet² and all primary schools have at least the fastest available connection via a telephone line. All ten Pathfinder LEAs are now moving to upgrade Internet access in primary schools to match the speed of connections in secondary schools. For widespread rural authorities in particular this is a major achievement.

Access to ICT resources in all the Pathfinder LEAs has increased very considerably as a result of the NGfL Programme and, in line with all other LEAs in the country, they have met the targets set by Government for levels of ICT equipment in schools by 2002.

The Pathfinder LEAs have all established local Grids for Learning, linked to the National Grid for Learning portal, to enable the easy provision to schools of locally held software and on-line resources for use in teaching and learning. The vast majority have also established local networks or intranets, usually based in secondary schools, which enable a school or group of schools to store local resources and exchange information rapidly. Schools' intranets can access materials from the local Grids for Learning as well as from the NGfL portal and the wider Internet. Achievements in the development of content and its ease of access from schools have not been uniform

across all ten Pathfinder LEAs, but all have made significant progress in line with their original proposals.

There has been a considerable increase in pupils' skills in using ICT. This applies to both primary and secondary pupils and is partly due to the penetration of ICT into society as a whole, which has given many pupils access to the Internet at home (see the Second Pathfinder Report; a brief summary of key findings can be found in Appendix C). To a considerable extent, however, this has been due to ICT teaching in schools. This is particularly true of primary schools, where the installation of specialist ICT rooms, known as suites, has given all teachers and pupils access to high-quality computers and the Internet, normally at least once a week. In secondary schools, where specialist ICT rooms are used extensively for specialist ICT teaching for older pupils leading to examinations, the impact on pupils' ICT skills has been much more uneven. However, in most secondary schools specialist computer rooms are used extensively during the lunch hour and pupils are acquiring skills very rapidly. This all means, of course, that there is a need to continually revise approaches to teaching ICT skills in line with pupils' changing needs.

There has been an impressive shift in primary teachers' attitudes to the use of ICT in their teaching. It is now accepted as a normal and expected part of a primary teacher's role to work with pupils in the specialist ICT room on a regular basis, often with an ICT co-ordinator available nearby to give assistance, although perhaps in another classroom. In secondary schools there has not been the same universal change in expectations because ICT is still regarded as a specialist subject by many secondary teachers. These differences in the context of use were probably a factor in the greater acceptance of NOF training in primary schools compared with secondary schools. However, in primary schools the emphasis is on teaching skills rather than integrating the use of ICT with subject teaching and the new ICT suites may have caused this shift in emphasis away from previously established norms when teachers had one computer in the classroom – although, as many teachers point out, those single computers in the past were frequently not used.

² The Public Switched Telephone Network (PSTN) conveys data along copper wires after they have been converted into analogue form by a modem. It works at a slow rate. ISDN lines transmit digital data and are about twice as fast as PSTN networks. Some telephone exchanges have been upgraded to enable local cables to be used to provide much faster data transfer down copper wires, called ASDN networks. Broadband links usually involve fibre-optic transmission and the current standard for secondary schools is 2 mbps, which is 16 times faster than PSTN links.



2.2 Specific examples

The following examples of achievements show how individual LEAs are developing new ICT strategies and systems.

- One small urban LEA with a highly developed integrated school structure has re-negotiated and changed the way in which software companies license and make available software over educational networks through a new arrangement called 'current user licences'. Software producers are now including facilities in their software to enable the LEAs to make it available in different ways on their networks.
- The same LEA has developed a system for storing and analysing curriculum resources on its local network, known as a 'managed learning environment' (MLE). This is available to all teachers and pupils via the LEA network. Whereas the networks in most LEAs are based on a commercially provided MLE, this LEA chose to build its own to provide a less hierarchical structure and address issues of safety and security in a way that better suited its needs.
- All the LEAs have put in place a system of servers (large capacity computers where resources are stored for use) for delivering content speedily to classrooms. In some cases this development was supported by the RBC. Those LEAs that have chosen to provide substantial resources centrally have established a hierarchy of servers which allow materials to be downloaded from the Internet and stored (cached). By linking these to the local intranet servers in schools, also capable of caching materials, they have significantly speeded up the provision of content to teachers and pupils.
- One large rural Pathfinder LEA has developed a particularly comprehensive Internet Access Policy (IAP) to give clear guidance about what is 'good conduct' on the Internet and what is inappropriate use. This is designed to provide schools with a template policy for use with pupils, parents and staff. This IAP, as an example of the sharing of good practice, has been adopted by a number of other LEAs.
- Three Pathfinder LEAs, two largely urban and one largely rural, have developed close interactive links with local community services and are contributing their experience to improving community ICT resources, linking with libraries and City Learning Centres. One is

planning to experiment with including local homes within its framework through a wireless network, as another means of providing home access to school materials.

3 The four approaches to implementation adopted by the LEAs

Each LEA developed strategies for rolling out the NGfL that were appropriate to local needs and circumstances, including geographical and demographic factors. Each approach was, therefore, unique. However, in order to look at the implications of taking one approach rather than another, and the ways in which decisions on the approach were influenced by local contexts, the approaches were analysed in detail during the first year of the evaluation and each LEA was categorised as one of four types. These approaches are summarised in the table below. A more extended version of the table is presented in Appendix B. Reference will also be made to the substantive character of the LEA. Some are classified as broadly rural, others as urban. These are in both cases, of course, broad classifications, and rural LEAs contain some urban communities while urban LEAs often have some rural areas attached.³

The main focus of this section is to provide a commentary on the reasons for adopting one approach rather than another and the implications of each for the development of the NGfL Programme in the ten LEAs over a four-year period. Although it is often not possible to say that one approach was better than another, there are some interesting lessons to be learnt which should inform future large-scale technological initiatives.

3.1 Reasons for adopting different approaches

When the initiative was launched, the LEAs had to act quickly in making the decisions which led to their strategy for implementing it. During the period 1998-2001, the amount of money they could hold back centrally was limited to 5 per cent, except where they established collaborative agreements with their schools to provide some of the services. Each LEA had a varying level of initial investment that it felt it could provide from its own budget. The 'matched funding' rule meant that NGfL funding from government also varied between them in similar proportions to the LEA's investments. As a consequence, the approach adopted by each LEA was determined by whether or not they had traditions of collaborative partnership with schools and by the overall level of funding available. In some cases traditions of partnership were apparent in LEAs that believed in the importance of empowering schools to make their own decisions. Hence they preferred to choose a decentralised model.

Geographic factors were also influential in determining the approach. A large rural LEA has great difficulty in managing large-scale discussions with all its schools to enable a consensus to be reached. This can lead to rural LEAs being drawn to type A or B arrangements in which schools themselves are responsible for ensuring that the initiative is established and maintained. For a small urban LEA with close collaborative communications with its schools, a consensus can be easier to reach and such LEAs were more likely to adopt type C or D arrangements.

The choice of model was also influenced by the extent to which educational services for ICT were integrated with

	Type A	Type B	Type C	Type D
Characteristics of the approach or model	The LEA takes a very decentralised approach. Schools take responsibility for making choices about connectivity, networking, hardware and software. The LEA maintains a range of choice and low-cost options through framework agreements.	Networking provision (but not connectivity, hardware or software provision) is contracted to a single company by agreement with all schools.	A partnership has been managed between the LEA and a single company, to provide for all networking, hardware, software and content. Elements of technical support are also included, and, as such, this constitutes a form of managed service arrangement.	A public-private financial initiative places a greater emphasis on the company involved to provide technological support, but links schools into a much longer agreement with a single company. Schools have committed their funding to the initiative over a long time period.

³ The Pathfinder LEAs' original designations were: Birmingham (B, urban), Bradford (C, urban), Cumbria (A, rural), Dudley (D, urban), Greenwich (C, urban), Kent (A, rural), Somerset (B, rural), Staffordshire (B, rural), Stoke-on-Trent (B, urban) and Telford & Wrekin (C, urban)



other council services (such as library, police, health and social services) in offering coherent community provision.

This again depended to some extent on the nature of communities within that authority. A small urban authority by definition covers a small number of communities within a limited area, making it easier to adopt a centralised approach for all council services (type C or D). A widespread rural authority, by comparison, covers a number of small local communities that vary considerably in size and needs. This makes it more difficult to integrate council services in a way that meets the needs of all, and a type A or B arrangement is likely to be more appropriate. One rural LEA, however, was greatly aided in its provision of a high-speed link by the decision to provide a network throughout the county covering all council services including libraries, museums, social services and highways as well as schools.

3.2 The implications of adopting different approaches

The initial decision on the extent to which the NGFL Programme should be organised centrally and 'a common solution' rolled out to all the schools, had clear implications for the autonomy of schools. Some LEAs adopted a type A approach because they wanted to empower schools and teachers and believed that they would embrace Internet use with better motivation if they made key decisions about hardware and software themselves. One type A LEA built its approach on the principle of empowering its schools and helping them take responsibility for delivering the required outcomes. This enabled schools to develop their own network systems and technical procedures but it meant that they may have had to focus on technical issues before turning to classroom level development.

It emerged over time that schools might be equally empowered through type C and D approaches because they enabled a more coherent network system, better connections between schools and more appropriate technical support, in some cases delivered on line. One type D LEA, committed to empowering its teachers by developing their confidence and competence in using ICT, adopted an alternative strategy of providing every teacher with a personal laptop. While the LEA itself took responsibility for structures and systems, individual schools were still able to leave development of classroom use more to individual teachers or departments.

The key point here is that the initial decision to centralise infrastructure management or distribute control over the development of the infrastructure led to other decisions

needing to be made. Similar end-points could often be achieved by following different paths. This became particularly clear over time. For example, in one LEA, which developed a type A model in 1999, nine secondary schools were by 2002 planning to become a 'distributed technology college' as a 'rural academy' using their new broadband connectivity to establish 'the community'. This is a clear move towards more collaboration and a voluntary loss of individual decision-making, which the participating schools believe will provide valuable co-operative developmental learning. It is an example of schools using their autonomy to find ways of responding to new opportunities.

3.3 Differences between school phases

Regardless of the approach adopted by the LEA, the way in which it works with its primary and secondary schools is likely to be very different. A primary school forms a single coherent community, whereas in secondary schools there are often a number of smaller communities with different emphases and needs. Resource needs are then different. For example, secondary schools are becoming dependent on broadband to meet their increasing needs, whereas the needs of smaller primary schools can currently be satisfied with access through enhanced narrowband provision (though as usage increases this may eventually prove to be inadequate). The deployment of the computers in the school is likely to be different in that computer suites, and clustered resources, are used in different ways in secondary and primary schools. Type C or D LEAs may provide an excellent service by responding to both their primary and secondary schools. However, the greater number of primary schools makes it difficult to involve them equally in decision making.

3.4 Pros and cons of different approaches

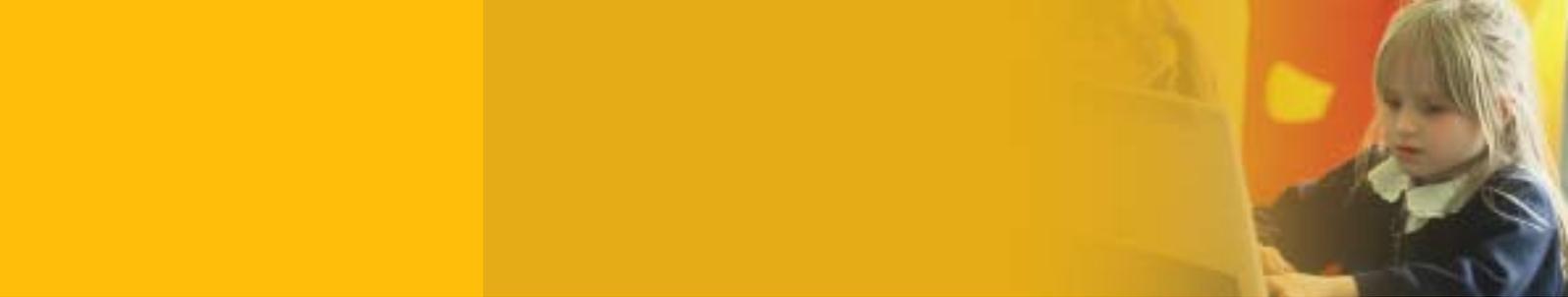
One obvious advantage of adopting a Type C or D approach lay in economies of scale. Providers were prepared to reduce the costs of equipment in return for a bulk sale. It also became worthwhile for providers to adapt their services or equipment to fit the needs of the LEA. It therefore became possible for Type C or D LEAs to influence their managed service providers. One particular LEA has taken a strong lead in negotiating software contracts and licences with commercial providers. This has made the provision of services to its schools much more efficient, and in the process it has brought about changes to some aspects of the commercial marketing procedures for the whole of the UK education sector.

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There are, of course, some drawbacks to a Type C or D approach. For example, there is some evidence of frustration on the part of individual teachers in not having their preferred software available on the network without having to go through significant bureaucratic procedures. What may well appear to be the best choices to an LEA or managed service provider, in relation to either administrative or curriculum software, may not be seen in the same way by the user – the teacher – at the receiving end. It was usually possible to restore access to tried and tested 'legacy software' when teachers protested, but the initial loss of resources could be a significant factor in undermining teachers' motivation to use new software and resources.

Drawbacks with Type A and B approaches typically resulted from a lack of coherence in provision. For example, in one LEA a primary school on the same site as a secondary school maintained its independence and was thereby limited to a relatively slow telephone link to the Internet rather than moving to a high-speed broadband link when this became available to the secondary school. In another LEA, the same site contains a secondary school with a limited broadband (2Mbps) link to the Internet, a primary school with one form of narrowband (ISDN2), an EAZ learning centre with another narrowband link (ADSL) and a housing development office with one of the highest speed broadband links available (1000Mbps). This kind of scenario is clearly inefficient. In another LEA, schools and other bodies adopted 17 different systems for accessing e-mail and this made the introduction of an LEA-wide support structure unnecessarily difficult.

An important feature of the four models is that none of them is static. The improved communication resulting from networked technologies is itself a factor that enables schools in rural areas to work more collaboratively. Advances in technology, which enable the sharing of resources, actively invite the development of partnerships. Whilst the development of shared solutions was initially confined to Type C and D authorities they are now becoming common in Type B and A authorities.



4 Facing challenges at LEA level: what has been learnt

This section focuses on some aspects of the roll-out of the NGfL which were challenging because they were either problematic or complex. In each case, the work of the Pathfinder LEAs can help inform future decision-making in developments of a similar kind.

4.1 State-of-the-art ICT in the LEAs and their schools

The period between 1999 and 2002 has seen some very significant advances in the technologies available. The NGfL Programme equipped schools with the best that was available in 1998-9 and, as it was rolled out to schools over the next three years, there were opportunities for plans to be adapted to take advantage of technologies as they became available. The Pathfinder LEAs demonstrate how this process was carried forward.

4.1.1 Speed of access to the Internet: bandwidths and server storage

Now that all schools are linked to the Internet, the Pathfinder LEAs have turned their attention to issues relating to bandwidth and speed of access to on-line resources. This is in line with the dramatic changes during this period, which have seen the penetration of broadband connections into businesses and homes throughout the UK.

Typically, demand has increased in response to increasing provision. What, at first, seemed likely to be an adequate infrastructure proved not to be so once it was in place. For example, very large numbers of pupils in a secondary school attempting to access the Internet during the lunch hour makes a 2Mbps broadband infrastructure very slow. This has led to a vigorous debate about the level of real demands and what constitutes a satisfactory bandwidth for school needs – for example, whether 2Mbps will be sufficient for future developments in secondary schools.

To increase the bandwidth to all schools would have been a significant additional expense. Over time, however, the Pathfinder LEAs began to adopt a more sophisticated approach to achieving speed of access for users. A very significant advance has been the

development of dynamic servers capable of managing well-structured learning environments. These servers automatically track patterns of Internet use and 'cache', or save, web sites locally ready for quick access the next time a user calls them up. To enable this, one LEA has decided that the cheapest solution for its large number of primary schools is to install media-streaming proxy servers, which enable video and other media to be stored and managed⁴. By doing this it can use existing narrowband connections, and keep installation costs very low while still providing a satisfactory service. This then releases monies for other investment.

At LEA level these servers are capable of caching large quantities of material from the Internet, ready for speedy access by local users. Another strategy is to store the Internet resources that teachers are going to require in sub-servers in the schools during the night, thereby enabling high-speed access to them during lesson time.

Three Pathfinder LEAs are progressing towards an arrangement which offers wide bandwidths to dynamic servers in secondary schools, which in turn store learning materials to be delivered through narrower bandwidths to local primary schools. This has speeded up download times for users considerably.

4.1.2 Wireless networks

Another major development in the provision of ICT infrastructure during the lifetime of the NGfL Programme has been the advent of wireless technology. This promises to meet a need in schools for more flexible provision of ICT resources to enable their use in curriculum teaching. It may be efficient and desirable to move classes to specialist ICT rooms for ICT skills teaching, but inefficient and disruptive to do so when the aim is to use ICT to teach specialist subjects which require access to other resources only available in specialist classrooms.

In all the Pathfinder authorities, some secondary schools have been experimenting with wireless networks, with mixed success to date. Although standards for these networks are expected to improve, some reports suggest that as yet they are not totally reliable and offer only intermittent access. Wireless networks also raise issues of security since wireless connectivity is, at its simplest,

⁴ Slow transfer of video and music is one of the difficulties that result from connections that are not broadband, together with restricting the number of users who can access the Internet at the same time.

open to anyone within a certain radius (regardless of whether they are inside or outside the school) with an appropriate transmitter. The installation of wireless networks also often involves building works with consequent additional costs, particularly if asbestos is found when installing equipment in roof spaces. However, wireless connectivity can reduce problems associated with exposed wiring and reduces the number of additional sockets and connection points, which may reduce some of the overall longer term costs.

If unauthorised access and cost issues can be successfully overcome, wireless networks may be enlarged to give all pupils access to the school intranet from home, and this could lead to some significant changes in the use of ICT for learning at school and at home. One Pathfinder LEA has funding from the Department of Trade and Industry for a project to provide wireless broadband access to its local Grid for Learning for one whole-school population (800 homes) by 2005. It is exploring achieving this through using new web-tablets (keyboard-less, touch-screen, hand-held computers) and wireless links.

4.1.3 Laptop computers and hand-held personal organisers

During 1999-2002 there has been a considerable reduction in the cost of lightweight 'ultra-thin' laptop computers. However, where schools in the Pathfinder LEAs have purchased laptops they have bought traditional ones because they are still significantly cheaper. These have frequently been used with wireless networks, often in clusters stored on movable trolleys, to give teachers and pupils flexible access to Internet resources. The lightweight and small size of ultra-thin laptops makes them more suitable for school bags and as the price reduces further they are likely to be widely used in schools. Some schools in the Pathfinder LEAs have experimented with giving pupils hand-held technologies to carry between home and school, usually as part of a special project sponsored by a commercial company, and these may also be used increasingly frequently in the near future.

4.1.4 Interactive whiteboards and data projection

Another very significant development has been the recent investment of schools in data projectors and interactive whiteboards. In all of the Pathfinder LEAs interactive whiteboards are now established equipment in

some primary and secondary schools, and are in regular use for teaching the curriculum. One Pathfinder LEA has invested in interactive whiteboards for all its nursery schools. This looks to be one of the most significant developments in ICT since it has the potential to support teaching across the whole curriculum and enables whole-class access to video and data. As with all innovative classroom resources, the interactive whiteboard does, however, present a further challenge in teacher training and development. It also puts greater demands on network capacity since they make much use of video and Internet materials. Interactive whiteboards have considerable potential but at present there is a need to explore what are the most appropriate classroom uses.

4.1.5 Digital cameras and video conferencing

The other new technology that has been welcomed with great enthusiasm in many classrooms is the good quality, easy-to-use, low-cost digital camera. This technology has developed very rapidly since 1998 and many primary and secondary schools in the Pathfinder LEAs are using them widely. Both pupils and teachers can create their own images, refine and edit them using relatively low-cost software and integrate them with text in presentations for the classroom or materials to go on the school's web site. On the other hand, the use of scanners has not proved as useful as was once anticipated, and they are reported as being rarely used in schools. One reason given is that documents are now much more likely to be available in digital form through the web, from a digital camera or on disk.

Developments in video conferencing, originally seen as holding significant potential, have been much slower than expected. High-quality video transfer, linked with voice transfer, is still only effective in specialist video-conferencing suites, which are expensive to provide and inflexible in use. It has been used on occasions for specific purposes such as co-ordinated 'A'-level teaching where expertise is scarce. However, although there is still belief in its potential, schools in the Pathfinder LEAs have made relatively little use of video conferencing, though some schools retain long-term interest in developing its use.

4.2 Managing sustainability across the LEA

The evidence from the Pathfinder evaluation indicates that the NGfL programme has been well timed and is clearly now firmly established. Compared with earlier



initiatives, such as the National Development Programme for Computer-Assisted Learning in the 1970s (NDP-CAL) and the Microelectronics in Education Programme in the 1980s (MEP), it can depend upon robust, high-powered computers and an ever-improving international infrastructure through the Internet. In establishing the funding mechanisms, approaches to network infrastructure, and ideas for using networked ICT in the curriculum, policy-makers could also draw upon the lessons learnt from the Education Departments' Superhighways Initiative in the mid 1990s (EDSI). Nationally, the NGfL Programme is clearly sustainable.

4.2.1 Financial issues

At the level of the LEA, however, sustainability is not well assured. Financial planning in most commercial organisations draws a distinction between innovation funding and maintenance funding, and the two are separately evaluated. Whilst in the past commercial innovation funds have often been about 10 per cent of total funding, such is the rate of development that in commercial organisations they now comprise around 40/50 per cent. This pattern has been the opposite of funding in schools and LEAs. Initially all LEAs and schools needed to make very high levels of investment, and in most cases over 90 per cent was committed to innovation. Over the four years of the NGfL Programme, a very large proportion of funding (probably still around 80 per cent) remained in the category of innovation. This needs to change. As teachers utilise technology resources more and more so they become more dependent on their effectiveness. Systems failure is now unacceptable because of the serious consequences that result from disrupting teaching and learning. System maintenance is now critically important.

Although the NGfL funding is targeted at schools, and LEAs only manage its distribution, one of the responsibilities of the LEA is to monitor the effectiveness of schools' use of these resources. This was specifically the purpose for which LEAs were permitted to retain a percentage of funding centrally. The mechanism established for doing this at the time when the NGfL Programme was introduced was the requirement for each school to produce an ICT Development Plan. LEAs need to ensure that these plans incorporate spending on sustainability. There is clearly a need to cover a range of aspects well beyond the realm of equipment maintenance. Security systems are a significant cost for

public buildings such as schools. Technical support is a substantial, continuing and increasing cost.

4.2.2 Managing sustainability

Technical issues and curriculum issues are not often separable, however, and essentially sustainability has to be managed within the framework of curriculum planning and strategic decisions need to be taken. Schools need to monitor problems as they emerge, analysing their frequency and nature, and devise not just immediate action but also training to enable users to avoid or overcome such problems.

The rapid developments in technology also mean that the cost of sustainability is tending to increase. For example, the recent significant increase in schools' acquisition of interactive whiteboards requires proper forward planning for maintenance and training. The problems that teachers are experiencing need to be monitored, and decisions need to be made about who is responsible for dealing with them, what training is needed for technicians, what technical expertise teachers need, how long the equipment will remain functional, and what happens when it fails. These are all questions that need the constant attention of technical managers, with additional skills to those of technicians. There is a severe shortage of people with the right technical skills, and those who combine technical skills with managerial skills are in even shorter supply.

We are, of course, still at an early stage of the implementation of networked technologies in schools. Perhaps understandably, the emphasis is still on strategy and implementation rather than long-term management. The Pathfinder LEAs are not giving sufficient consideration to when implementation has to slow down in order to allow sustainability to be ensured. 'Initiative fatigue' is now a recognised problem and as newer technologies enter the schools, teachers need time to assimilate them and recognise their potential. Instead, schools still tend to see 'maintenance' issues as relating to maintaining innovation rather than maintaining the status quo.

The lack of planning for sustainability can be directly related to the funding system employed for the NGfL. Annual funding rounds encourage short-term planning, and centrally funded initiatives establish a pattern which takes attention away from the need to take local responsibility for sustainability. It is easier for both LEAs

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and schools to plan for sustainability if they have knowledge of likely long-term funding levels. This is particularly true of technical support since this has personnel implications. A secure and sustainable structure cannot be implemented without funding assurance.

4.3 Wider community and authority links

In those Pathfinder LEAs where the NGfL has been developed in collaboration with other council services, economies of scale are achieved in terms of networking infrastructure and user access. This enables the LEA to respond more flexibly to new initiatives involving collaboration with other services, such as anti-truancy programmes and the Connexions service, or to extend educational provision, for example by providing resources for independent learning through community library provision. The latter can also help to counter the problem of supporting the now small minority of pupils without home access to ICT. It opens up the ways in which information can be made available to parents and the wider community.

Whether or not such integrated planning is in place, it is essential that the size, scope and potential of the NGfL are fully understood by the Director of Education. The Director is the conduit through which opportunities for enhanced co-operative development can take place, and involvement at Director level ensures that the local councillors are aware and supportive of the initiative. It is also important to ensure that the whole of the staff of the LEA are knowledgeable about the ICT developments that are taking place. Even where a particular advisor has been vested with responsibility for the NGfL, it is critically important that all the other advisors participate fully.

The management of strategic ICT developments at council level, involving the education department as an integral part of developments in the authority as a whole, appears to be in place at varying levels in only three Pathfinder LEAs (one Type C, one Type B and one Type A). As a result, the potential for NGfL Programme influence and involvement at council levels has been lost in the great majority of cases. Regular meetings and liaison between key county or borough personnel within different departments are often not in place. Similarly, existing patterns of management and communication have often not been adapted to make full use of the range of communication tools made available by ICT.

4.4 The Impact on Pathfinder LEAs of the Regional Broadband Consortia

The Regional Broadband Consortia (RBC) were established up to two years after the NGfL Programme, and they inevitably had an impact on the Pathfinder LEAs. This impact depended, of course, on the nature of the consortium and the state of development of the LEAs involved. Within the Pathfinder LEAs, the Type C and D authorities were generally much further along the line of providing broadband access than the Type A and B authorities, which meant that the former had less to gain from the creation of RBC.

The structure of consortia varies widely. In London a large number of LEAs are involved, and their involvement has been co-ordinated and managed, whereas in the north-west one collaboration is between only two LEAs, and as a consequence, co-ordination is much easier and the organisation can be less formal. Another RBC comprises a larger number of LEAs, all at very different stages in network provision. One already has an effective infrastructure in place and it would be costly and irrelevant to change these in order to participate in the regional structures. Its ICT network is also integrated into the wider borough provision and further integration with the RBC would be problematic.

Within the Pathfinder LEAs, the response to the RBC initiative has been mixed and, apart from the perceived differences in needs between Types A/B and Types C/D LEAs, there is no clear pattern of 'fit' dependent upon the Type of LEA. For example, of the four rural LEAs, one (Type A) has gained great benefits from the RBC; in another (Type A) the RBC has had some impact but the long-term impact is not clear; for a third (Type B) there has been no impact whatever; whilst a fourth (Type B) has tended to lead its RBC.

4.5 Management Information Systems in the Pathfinder LEAs

The NGfL Programme had the potential to revolutionise an LEA's ability to access, manage and make use of information about its schools and their pupils. In practice, however, this is an area where the NGfL has been slow to make an impact. The main problem was lack of appropriate software. Most management information systems (MIS) have traditionally been concerned with collecting and storing information rather than its analysis. The DfES now collects from schools, and provides for



them, a wealth of statistical data. Schools have been encouraged to use this data to predict their likely national test and examination results as a way of setting targets. However, schools find this difficult because the established MIS package that has been in use for many years is SIMS, a DOS-based system, which is difficult to integrate with more recent Windows-based databases and spreadsheets.

In most authorities the need to maintain the integrity and confidentiality of information has meant that the MIS network has been kept strictly separate from the academic curriculum network. Often the MIS data is only available through computers dedicated to administration. Teachers, however, need access to data about pupils and their progress and need to use records as part of their own planning strategies. All the Pathfinder LEAs are now moving towards new MIS that will be integrated with the academic networks, incorporating firewalls and password-protected areas to hide files from unauthorised viewers. This should make record keeping and information flow more efficient and, according to the co-ordinator of the NGfL in one LEA, this will significantly reduce the bureaucratic demands on schools.

The moves to centralise the management of information across all schools in an LEA has clear advantages and the Pathfinder LEAs are to be commended for giving a strong lead in this direction. As with other areas of centralisation, however, the impact on individual teachers in schools is not always immediately beneficial. One school ICT co-ordinator complained that her own MS Excel-based record system was more efficient for tracking pupils' progress and performance than the new system, which the LEA had recently provided. Teachers in another Pathfinder LEA were also sceptical about the usability of the LEA's central system. LEAs need to develop such systems in collaboration with all stakeholders, and the incorporation of the administrative and curriculum networks within one system makes this rather a complex operation, involving at least two main departments of the LEA as well as a large number of schools.

There is also some inherent incompatibility between the nature of MIS networks and curriculum networks. MIS networks have traditionally been closed, with users tending to be highly focused on a small number of activities, whereas in curriculum networks, learning resources are open and users need to be oriented towards creativity. The environment established to meet

the requirements of a traditional LEA/schools MIS inevitably raises issues of surveillance and closes down the opportunity to take more risky options. Curriculum needs and MIS needs are not, however, inherently incompatible. For example, most strategic use of information in national and international companies is for evaluating risks and assessing adventurous actions, and this is the direction in which LEAs and schools should be developing their MIS activities.

4.6 Provision of technical support systems by the LEA

One of the most difficult issues for Pathfinder LEAs is ensuring the provision of technical support for its schools. Technical support was not included as an element of the NGfL funding; rather, LEAs were expected to provide it from their existing resources. However, in the years before the implementation of the NGfL Programme, funding to LEAs for central services had been considerably reduced and, as a result, it was difficult to provide adequate technical support, even before the huge increase in ICT equipment levels in schools greatly exacerbated the need.

However, all the Pathfinder LEAs are committed to ensuring the provision of technical support to schools and see it as an essential component of NGfL provision. They understand that if teachers are to integrate the use of ICT into their teaching on a regular and sustained basis, they need to know that someone is available to sort out technical problems immediately. Even in Type D LEAs, secondary schools have tended to insist on having their technical support on site, although this may mean renegotiating the contractual arrangements with the LEA's commercial partner.

Two Pathfinder LEAs (one urban, the other rural) provide a central ICT support service for their primary schools. In some LEAs, Type B as well as Types C and D, there is growing use of 'pyramid support systems' with technicians based in secondary schools out-servicing the local primary schools. Two largely rural LEAs, whose schools vary widely in terms of their accessibility, have mixed systems in which some primary schools engage local commercial support, some employ part-time technicians, some use the LEA provided service, whilst some may rely upon a mixture of two or three of these.

In Type A LEAs, schools often negotiate reasonable contracts with local firms, though they can only do this

officially if the company is accredited. In some Pathfinder LEAs, schools were initially reluctant to rely upon LEA technical support units, but there is some evidence that schools are now more likely to buy into the LEA technical support service. This is partly because the LEAs have improved their technical service operations significantly and many schools are now satisfied with the level of support provided. However, it is also linked to the rise in the cost of commercial providers who need to ensure profit margins and are pricing themselves outside the market. Where technical support is provided by a large supplier, some schools find it unacceptable that each enquiry can be dealt with by a different contact person. This does not provide a consistent and knowledgeable point of contact, and is another reason for schools returning to the LEA, or the LEA-sponsored servicing agents, as a managed service provider.

One issue that is rarely clear is where the responsibility for monitoring and analysing the technical support services lies. In particular there needs to be forethought in the provision of training for both technicians and users. This is especially true when new technological resources arrive. As we indicated when considering sustainability earlier, this needs management skills as well as technical insight. Similarly the growth of intranets in schools requires not just technical management of the server but the structuring and organising of resources to match the curriculum needs. Technical support requires a demanding mixture of skills and probably the best way of providing this is to establish technical support teams in schools, led by a technically able teacher.

4.7 Strategies for giving ownership of ICT to the whole staff

The Pathfinder LEAs all saw it as their duty to support the ICT training of teachers in their schools. Competence in ICT skills and confidence in their use was seen as essential for all teachers. The biggest improvement in teacher confidence and competence was identified by at least two Pathfinder LEAs as relating to newly qualified teachers entering the profession during the past three years.

Most Pathfinder LEAs reported that the New Opportunities Funding (NOF) training was generally not well received, especially amongst secondary teachers. This was echoed in the schools that were surveyed. One LEA adviser commented that even where it was reasonably successful there remained the problem that NOF planning pre-dated the introduction of broadband.

This led to specific problems of 'schools making narrowband use of broadband networks'.

One Type A LEA had a clear philosophy about empowering schools to deal with their own development needs. As a widespread rural LEA, this strategy may have been partly determined by its context but it was very successful in giving schools a sense of ownership. They also needed to develop their own resource banks and hence understand how caching (local storage of Internet resources) and server structures operate; they needed to establish their own security and protection systems and so became conversant with the needs and structures required. More importantly, where decisions were made within the school the discussion and analysis took place amongst the school staff. They had to reflect on their needs and this was a major stimulus to their use of the new technologies. The only drawback was that this led to schools acting independently and therefore not learning from each other in terms of good practice. Lack of inter-school co-operation in such a structure can lead to difficulties for small schools, especially small primary schools, where teachers may not find a colleague able to help with problems.

The involvement of teachers in the production of content was seen by all LEAs as one strategy for giving them ownership of ICT in their school. In terms of the production of on-line resources, all the Pathfinder LEAs had some form of development team, often referred to as learning consultants. These were usually part-seconded teachers, who could develop content and oversee its development in specific curriculum areas on the local Grid for Learning. Different variations of this approach are possible: two Pathfinder LEAs employed 'expert' developers who produced a small quantity of high-quality resources, whilst in one of these LEAs a wider working group was also organised to advise teachers on the production of web-based resources and help them to evaluate their quality. Looser working groups of teachers were often organised either by the LEA or a group of schools and, whilst they produced a greater variety of resources, these were of more variable quality.

Ultimately the involvement of the whole school staff relies upon the leadership qualities of the ICT managers and co-ordinator. In primary schools the ICT co-ordinator often has to respond quickly to minor technical issues, so as to prevent frustration and loss of enthusiasm. This is a significant burden. In secondary schools, with a



variety of subject interests and a large staff to involve, the co-ordinator has to find time for consultations and must find ways of responding to those consultations effectively and quickly. This requires clear knowledge of the financial and planning parameters within the LEA and access to a budget within the school. The former is particularly important in Type C or D authorities where the ICT co-ordinator/manager is often the only person with a close link to the LEA's central team or managed service provider where many decisions are made.

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5 Facing challenges at school level: what has been learnt

5.1 Management of the NGfL in the Pathfinder schools

In most primary schools in the Pathfinder LEAs, initial leadership for the NGfL was provided by head teachers, who set priorities and encouraged their staff to engage with ICT. Where this did not happen, the initiative was much less likely to be successful. Most head teachers appointed an ICT co-ordinator who needed to liaise with support services, keep abreast of curriculum materials, encourage staff development and handle minor technical problems or train other staff to deal with them. There was usually at least one staff meeting per term devoted to appraising the use of ICT in addition to many day-to-day interactions.

Since 1999 there has been an improvement in general levels of staff competence and confidence in primary schools and this is no doubt due to the quality of leadership from both heads and the ICT co-ordinators. Primary schools generally operate as a single supportive team of teachers and hence the job of co-ordination is different from that in a large secondary school.

Secondary schools in the Pathfinder LEAs work in very different contexts from primary schools. They are usually combinations of co-operating but distinct subject communities, each with different priorities and different ways of working within classrooms. Managerial responsibility for ICT is often held by one of the Deputy Heads working with an ICT co-ordinator and a head of ICT. In the past these roles were often combined but increasingly they are being separated as a result of the increasing workload, and one Pathfinder LEA is advising schools to take this step.

There are a number of distinct roles relating to ICT management in a secondary school:

- Co-ordination/management of activities carried out by a team
- The teaching of ICT skills (recently codified by the QCA Key Stage Three guidelines)
- The co-ordination of curriculum development in ICT (especially in relation to newer technology such as interactive whiteboards)

- Management of curriculum resources (especially in terms of caching and server management)
- Management of hardware and technical support resources (including procurement, installation and monitoring of reliability)
- Training and staff development.

Managing these roles across the varied communities needs the full co-operation of the school's senior management team. Where ICT has been a priority during the implementation of the NGfL this has been generally forthcoming and effective but senior managers will need to sustain their commitment in the future when other priorities emerge.

The different models adopted by the Pathfinder LEAs clearly affected the nature of the managerial tasks. In Type A LEAs, schools needed to take wide responsibility for their ICT development, including purchase of equipment, negotiation of contracts, personnel management and devising a strategy for developing resources to be made available on the school's intranet. This provided schools with a sense of ownership and ensured thorough knowledge of what they were doing and why. It did, however, allow schools to make mistakes.

In Type C or D LEAs, there was more uniformity of provision, but it was bought at the price of less autonomy in the schools to devise their own curriculum network and this did sometimes lead to frustration. There was, however, often a better network of ICT co-ordinators who could share good practice and help plan development, probably aided by the fact that the Type C or D LEAs tended to be smaller urban LEAs.

5.2 In-school ICT support

As teachers use more ICT in their curriculum teaching they become more dependent on it for sustaining pupils' learning activities. Their dependence means that the ICT systems have to be ever more reliable and this needs quality technical support. Secondary schools are recognising this issue and are increasing technical staff to meet demand. The real problem, however, is the absence of suitably qualified technicians. This is especially true where technicians have to interact regularly with teaching staff and need to have good communication skills as well as technical skills. In some secondary schools where technical staffing has been increased there is the opportunity for technicians to focus



on specialised areas, such as laptops, servers or interactive whiteboards.

For primary schools the situation is often very difficult, since they can rarely afford to have technical support on site. The current norm of half a day per week is almost certainly insufficient and places a major burden on ICT co-ordinators, who feel they have to attempt to provide technical support to colleagues themselves. In some Pathfinder LEAs, secondary schools are beginning to provide a technician service for local primary schools. For example, one secondary school with six technicians uses two of them to work in local primary schools. This kind of arrangement depends on good working relationships between the heads and their staff. On some occasions the relationship becomes more strained and one primary school that shares a site with a secondary school prefers to manage part-time technical support itself.

In the Pathfinder LEAs teachers are becoming more expert at managing the ICT systems and resources. Whilst this has the disadvantage of increasing demands on teachers, it is making an important contribution to schools' management of ICT resources. This is particularly true for primary schools, because of the lack of on-site technicians.

As newer technology is obtained so the range of technical support needs increases. Increasingly this technical support interacts with curriculum aspects and part of the technical services role is to be aware of the potential uses of equipment and to make that potential visible to teachers. One primary head spoke about the LEA technician coming into school to solve a technical problem related to their recent broadband installation and leaving with the whole school re-invigorated and better able to solve its own problems in the future.

Giving teachers training in ICT skills is recognised to be problematic, since it often comes before teachers have begun to feel the need to use ICT in their teaching. Ideally, training should be provided at the time when teachers need to use an ICT-based resource, but such one-to-one mentoring is expensive. However, when learning to use new technical resources the support of a technician, an ICT co-ordinator or colleagues who are knowledgeable is essential. This works well where schools have developed a culture of sharing and where trial and error is recognised as being a normal and necessary part of learning. Developing such a culture of shared learning through exploration is part of the role of

the senior management team and the ICT co-ordinator. Sometimes computer experts have grown used to delivering ICT courses, which emphasise the 'right way' of using hardware or software and they need to be given new skills in providing a different kind of interactive, flexible support.

5.3 Deployment of ICT equipment in schools

Space and potential flexibility make the situations in primary schools and secondary schools very different when it comes to the deployment of ICT resources.

In the Pathfinder LEAs, the installation of a computer suite in most primary classrooms was one of the most significant changes introduced by the NGfL Programme. There were many reasons for this radical change from the former dominant pattern of one computer in each classroom in primary schools. In one primary school in a Type B LEA, where a suite of 15 computers had been installed, the ICT co-ordinator felt that these were more effective than stand-alone computers in classrooms that had only been used rarely. Suites made it easy for primary schools to give all children access to computing in a context where skills could be taught easily. The suite also placed a commitment on teachers to use the equipment since they would be timetabled into the suite for periods of time and given at least some support by the ICT co-ordinator. There were other reasons, which were less centrally to do with teaching and learning. Many primary schools were encouraged to move towards suites because they clearly exhibited the schools' commitment to developing ICT. There was the added advantage that they do not count towards the school's classroom space count by which the space available in the school is related to the number of pupils it is expected to accept.

Secondary schools are generally well equipped with computer suites, often as many as five. Some subject groups, notably Design and Technology, have held their own clusters of computers for some time and this pattern of deployment is extending, so that it is now normal for schools to develop clusters in several or all subject areas, in addition to specialist computer rooms. These clusters are sometimes trolley-based laptops, in some cases with wireless networking. One Type A LEA suggested that a school's exploration of wireless provision was in part a consequence of teachers being provided with laptops and in part a result of involvement in specific projects with funding from commercial sponsors.

There is evidence that once primary teachers have gained expertise and experience, primary schools, like secondary schools, are placing additional clusters of computers in classrooms. This trend is being hastened by the tremendous potential of interactive whiteboards. One LEA ICT co-ordinator feels that an interactive whiteboard with two computers in every classroom is more valuable than a suite of ten computers. There is limited evidence of primary schools adopting laptops, but where this happens it provides a movable cluster for curriculum purposes. A small number of particularly innovative primary schools are experimenting with laptops connected to wireless networks.

What happened in one primary school in a Type A LEA is a good example of the impact that interactive whiteboards have had in many schools. Having installed one interactive whiteboard, they received two more as part of a foundation subject pilot scheme, and felt immediately that they needed a fourth to enable all teachers to have the same level of resource. These interactive whiteboards are supplemented by groups of three computers in each classroom together with a mini-suite of five computers in the entrance hall.

The developing models in primary schools are well illustrated by the history in one Type C Pathfinder LEA. It reports that:

- prior to 1998 most primary schools had (at best) one computer per classroom
- during 1998-99 they installed computer suites in order to meet the needs of 'skills-teaching'
- during 1999-2000, as skills improved and access to the outside world through networks became a reality, one hour per week proved insufficient and primary schools wanted the Internet to be available in classrooms on demand
- during 2000-2001, the interactive whiteboard showed that using ICT, information could be easily available to everyone; having installed one interactive whiteboard per school, its value was quickly identified and that created pressure to install one in every classroom
- during 2001-2002, most primary schools moved to interactive whiteboards and a mini-suite of computers in every classroom, with a larger suite somewhere in the school for progressive skills teaching.

This was an emerging, but by no means universal, pattern, so that by 2002 primary schools were at different stages of this development.

5.4 Teachers' perceptions

To find out the views of teachers on the current state of ICT resource provision, a small number of schools in each authority were surveyed by questionnaire in the autumn of 2002. So as not to overburden teachers, the sample was restricted to two primary teachers in each of two primary schools and six secondary teachers in each of two secondary schools, in each authority. Not all responses were available for analysis and a fuller report on this survey will be available in 2003.

The outcomes of this survey cannot be said to be typical of the views of teachers in the Pathfinder LEAs as a whole, since the sample was small, schools vary quite widely even within the same authority, and much depends upon the leadership of the ICT co-ordinator and head teacher. Nevertheless, the survey provides some interesting insights into the current climate of ICT development in a sample of the Pathfinder schools.

It is important to note that questionnaire data, given anonymously, is more likely than interview data to raise problems. Open-ended questions in survey data give informants an opportunity to vent their frustrations. They are by comparison less likely to comment at length when they feel that things are going well. Teachers in the UK are generally tentative about making claims for their own achievements.

5.4.1 Confidence

Almost all the primary teachers reported that they felt reasonably confident about using ICT. However, when they mentioned their ICT training, often it had not been a positive experience. The best training was that provided in response to a request for help. Secondary teachers also reported being confident in the use of word processing, e-mail and Internet searching. ICT teachers, as one would expect, expressed confidence in all aspects of ICT usage. Most secondary teachers claimed to be largely self-taught, but to have gained from the limited training that they had received. Teachers generally say that they are gaining confidence in dealing with minor technical issues, and this is important, since it gives them re-assurance to employ ICT in the classroom. NOF training appears to have been very variable, with many secondary teachers saying it was not very



satisfactory. Primary teachers generally comment upon it more favourably, particularly when it was delivered by a colleague or previously known provider. Almost all teachers reported being less confident with databases and spreadsheets, which they said they only rarely use. The improved levels of general confidence are already helping with the introduction of newer technology such as interactive whiteboards. Teachers are becoming more inclined to experiment, but there is inevitably a problem when access is only occasional (for example, only once per month as some secondary teachers report).

5.4.2 Availability of hardware and software

Problems in gaining access to software appeared to have caused more frustrations to teachers than any other area. Teachers reported variations as to whether the choice of software and hardware made available for teaching and learning had been determined by the staff as a whole, the ICT co-ordinator or the Managed Service Provider. Frustrations were expressed most frequently in LEAs where decisions had been taken centrally. One primary school teacher from a Type D LEA commented, 'The present software which has been approved is barely adequate'. A teacher from this school also reported that 'software was not available several months after training, despite the school having ordered and paid for it'. Similar views were stated in the responses of the secondary teachers in that LEA. The Managed Service Provider (MSP) takes the final decisions in matters of content and support and this appears to have caused frustrations with teachers of some subjects unable to get access to subject-specific software. In all LEAs there was evidence of poor communication in some secondary schools. For example, in one Type B authority, different assessments of the quality of provision were given by the ICT managers (head of ICT and ICT co-ordinator) and other subject staff. This reinforces the finding indicated earlier that the quality of school management and school communications makes a significant difference.

5.4.3 Computer suites

For primary schools, access to the school's computer suite varied from once per week to two or three times per week. There was general approval of this new resource. In about half the schools, teachers reported that they also had access to laptops or a cluster of computers. In addition, most said they had a computer available in their classroom and could use a data projector or interactive whiteboard, though this was often only on a monthly

basis. This level of infrequency caused some problems in that 'every time you get access you start again trying to remember how to use it'.

In secondary schools, access to computing suites was very different for ICT departments and the other departments. ICT teachers usually said they had access to an Internet-connected suite on a daily basis. Teachers from other departments usually said they had to book access well in advance and some only had access once per month. Although some teachers said there was a cluster of computers available for departmental use, they usually complained that there were not enough for a whole class to use. As reported in the First Preliminary Pathfinder Report, access to ICT varied between different subjects with science and geography having moderate access, English, mathematics, modern foreign languages and music much more limited access.

The pattern of access to resources is very likely to affect the nature of the ICT curriculum offered by a school. Where access is focused on ICT as a subject, and only spasmodically available to other departments, there will be a clear tendency to teach computing skills in isolation from the general curriculum. Even when taught within a subject, if access is less than weekly the activity will be an addition to the 'real' curriculum and not integral to the learning process for that subject. With the arrival of the new Curriculum Online initiative this will become a major concern for curriculum managers.

5.4.4 Planning teaching and impact on learning

Nearly all the primary teachers reported using the Internet for lesson planning. Most, but not all, said they use word processing regularly. They also said they used computers for making graphs and charts, with half indicating they use spreadsheets and databases.

Secondary teachers reported using ICT two or three times a week for constructing worksheets, word processing and searching the Internet, but rarely using databases or spreadsheets. Specialist ICT teachers and Design and Technology teachers reported daily usage for these activities as well as frequent use of PowerPoint.

Most primary teachers said they believed that ICT would have an impact on pupils' learning and attainment. In two primary schools teachers wrote about the impact of ICT on encouraging independence and independent research. Primary teachers often talked about the increased confidence created by ICT, for example for pupils with

special educational needs or poor spellers. Many also said that ICT helped with extending the most able.

Secondary teachers had mixed views on the impact of ICT on learning. ICT teachers were very positive. Teachers of other subjects, however, were less sure that ICT had any real effect, and some teachers even thought it had had a negative effect on literacy and numeracy. Several teachers reported on the positive effects of ICT on independent learning, though again some disagreed. In terms of classroom applications, teachers across almost all subjects reported use of word processing and the Internet on a weekly or monthly basis, with little or very occasional use of other applications such as databases, spreadsheets or presentation software. Some subject-specific software was used occasionally. ICT teachers use a much wider variety of applications, and this reinforces the view that in many secondary schools the teaching of ICT skills is much more in evidence than the application of ICT to subject teaching.

5.4.5 Use of ICT for administration

Amongst primary teachers, responses to the questions about using ICT for administration were very polarised. A small number of teachers said they used ICT very often, for e-mails and communication with colleagues, writing reports and accessing pupils' records. About half of the teachers apparently use it rarely for administrative purposes. Overall it would appear that the software available in primary schools is unnecessarily complex and often perceived by teachers to be inappropriate for their needs. This may partly be a matter of providing primary teachers with more and better training in using administrative software.

Secondary teachers reported using ICT for administrative purposes in an equally limited manner. They said they used e-mail and word processing for writing memos, reports and letters. However, teachers in a Type D authority reported usage of the MIS and recording system on a weekly, or more frequent, basis. Most teachers in this LEA said they thought that ICT made administrative tasks easier. Those secondary teachers who did use the administrative systems were generally very positive about their use and about their training.

5.4.6 Home-School links

Primary teachers' estimates of the number of their pupils with out-of-school access to ICT varied from 25 per cent to 75 per cent, whereas secondary teachers felt it was in

the range 50 per cent to 75 per cent. The earlier findings of the Pathfinder project (see the second report) showed that a larger proportion of pupils than that already had access to ICT in June 2000. This would suggest that both primary and secondary teachers are underestimating the actual availability of computers to pupils outside school. It was clear that teachers had little real data on this matter. There were varying views, too, on whether access to ICT from home was an important resource, though a majority felt that pupils without access would be disadvantaged. This disadvantage was seen particularly in terms of the inability to carry out independent research or to achieve better quality of presentation through drafting assignments. Very few of the schools had a formal policy on the use of ICT for home-school links. As a result, a variety of practice was reported. Teachers in one school said that pupils were not allowed to bring floppy disks from home, because of viruses, while teachers in another school said that pupils were allowed to bring in homework on floppy disks. One teacher expressed the view that pupils 'have a tendency to pull information off the Internet which they cannot understand and have not incorporated into their work'. This data confirms the findings already reported that schools are not making good use of ICT to support pupils' learning apart from the learning of ICT skills. Improving the use of ICT to extend pupils' opportunities for learning in the home and to link home and school is an area in which schools need to be encouraged to develop a more proactive policy.

5.4.7 Technical support

There was a mixed response from both primary and secondary teachers to questions about the frequency of technical problems and the availability of support. Some teachers reported regular breakdowns (usually of single computers, log-in failures or very slow Internet connections) whilst others seemed less affected by problems. Some teachers were clearly quite resourceful in dealing with technical problems, whilst others complained that they had to wait two weeks for the technician to come and sort things out. In one Type D authority, which relied on a Managed Service Provider for support, secondary teachers complained at having to wait several weeks for a problem to be solved. However, nearly all secondary teachers said that they normally attempted to solve problems themselves, or with the aid of pupils. In one school every teacher questioned reported that the printers had not worked reliably for



several months. It was put strongly that 'pupils have difficulty accepting that computers make life easier if they appear to break down often', and many teachers said they were resentful of wasted learning time.

5.4.8 Conclusion

The Pathfinder LEAs show clearly that the NGfL Programme has provided an ideal base from which schools can develop to take advantage of opportunities provided by the latest technologies. It is not the technology itself, however, that is the important factor, it is the way it is used by teachers and pupils. Effective use of ICT in schools is no longer dependent merely upon giving teachers skills in its use but also includes the need for teachers to develop expertise in teaching strategies which allow pupils to use these new technologies for creative and independent learning either alone or in groups. These developments are challenging policy-makers and teachers to look again at fundamental features of the education system such as the curriculum, pedagogy, assessment and teacher education.

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Appendix A: The Research Methodology

A1.1 The Implementation and Management evaluation (IM)

Data was collected through:

- interviews with NGfL Programme managers and personnel in the LEAs
- interviews with head teachers and staff in schools
- analysis of documents from LEAs and schools
- observation of meetings in the LEAs
- observation of meetings of Regional Broadband Consortia (RBC).

The data was analysed qualitatively, with an emphasis on exploring issues in depth in relation to the unique context of each LEA. Emerging patterns across LEAs were also of particular interest.

A1.2 The Technical Evaluation (TE)

Following documentary analysis, data in this section of the evaluation was collected by:

- focus groups conducted in the LEAs, involving participants from at least three schools. The focus groups were organised by the LEA ICT team who could have up to two representatives present. The evaluators provided a facilitator and led the meeting. Focus groups lasted for at least an hour and were run as twilight meetings at the end of the school day. Participants were told in advance that the topic would be the implementation of ICT, and particularly networked ICT, in their schools and sessions would be tape-recorded.
- telephone interviews with selected LEA personnel and teachers
- comments obtained from LEA ICT co-ordinators.

Data from the focus groups included a transcript of the tape-recording of the meeting and field notes written by the facilitator. This data was analysed by at least two team members to identify recurring themes in relation to six categories: LEA vision and structure; LEA technical issues; LEA technical support for schools; school-based issues; NGfL Programme funding issues; lessons learned.

Follow-up interviews were carried out with the ICT co-ordinators in six LEAs and with the ICT co-ordinators in one primary and one secondary school in each of these LEAs.

A1.3 The Standards and Effectiveness in Schools evaluation (SES)

The SES evaluation probed the issue of standards and school effectiveness, with a particular focus on teaching and learning, through teacher questionnaires, pupil questionnaires and case studies of schools. At the start of the project questionnaires were sent to all schools in the Pathfinder LEAs. This provided the basis for individual case studies of two schools from each authority comprising questionnaires to all their pupils and some classroom observation. This was completed in June 2001 by:

- 1128 Year 6 pupils from 26 primary schools
- 6882 pupils from Years 9, 10 and 12 in 27 secondary schools.

The quantitative data from the 2001 pupil questionnaire was coded and analysed. Open-ended responses to the 1128 responses from the primary pupils were transcribed into a word processor, transferred to tables, coded and analysed quantitatively to establish patterns. This data also provided illustrative material of pupils' experiences with ICT.

In 2002 a further survey was carried out in six LEAs. Two teachers in each of two primary schools were sent questionnaires, and six teachers in each of two secondary schools were surveyed. This provided evidence of teachers' views as they approached the end of the project.



Appendix B: The management and procurement implications of different models of NGfL implementation

	LEA Type A	LEA Type B	LEA Type C	LEA Type D
Characteristics of model	The LEA takes a very decentralised approach. Schools take responsibility for making choices about connectivity, networking, hardware and software. The LEA maintains a range of choice and low-cost options through framework agreements. The schools need to make decisions about maintenance and upgrading without any long-term involvement or commitment from a provider, which could lead to some compatibility problems or to lack of access to spare parts in the longer-term.	Networking provision (but not connectivity, hardware or software provision) is contracted to a single company by agreement with all schools. This secures a possible greater potential for coherence, but can lead to wide ranging problems if problems do arise. The advantages and disadvantages of individual schools making decisions on hardware and software purchase are maintained in this model.	A partnership has been managed between the LEA and a single company, to provide for all networking, hardware, software and content. Elements of technical support are also included, and, as such, this constitutes a form of managed service arrangement.	A public-private financial initiative places a greater emphasis on the company involved to provide technological support, but links schools into a much longer agreement with a single company. Schools have committed their funding to the initiative over a long time period, and if there are any inflexibilities in terms of what the company provides, or how it provide it, these may be imposed on schools. The problems of long-term commitment versus not being tied to particular technologies needs to be considered carefully, and built into contractual arrangements.
Implications for management at LEA level	The LEA can work with a minimum of personnel, but they need to be highly skilled and experienced in using external expertise to account for specific areas of need or recognised weakness. Because the central team works with a minimal number, building other teams to accommodate particular needs can be more difficult or time consuming. Links with and liaison with schools on the one hand and with key figures in the LEA and wider council on the other are essential in this model.	While limited personnel within the LEA can undertake this form of model, the experience of those personnel in terms of infrastructure is essential. The need for expertise in contractual arrangements and procurement becomes more critical.	The success of the LEA management is more dependent upon the relationship between the company and the LEA. How this has been created, how contractual arrangements are made, and how monitoring of implementation is undertaken is particularly crucial.	Responsibility for technical provision and support lies much more with the company in this model. LEA management can in theory focus much more upon the teaching and learning needs, but ultimately the manager of the partnership can take on high levels of responsibility. Such responsibilities must be shared with others across the LEA and council if the partnership is to succeed in the long-term.
Implications for management at school level	School managers need to be highly aware of all management areas in order to make useful and informed decisions. For this reason, management training is a crucial need.	School managers need to be aware of the contractual arrangements and how they are to monitor implementation and use for certain contractual areas. In other aspects, school managers need high levels of management awareness and understanding.	School managers need high levels of awareness of contracts and of the effective means to monitor these. Management arrangements between the LEA and school need to be well understood.	School managers need to know how to monitor contracts, and who to contact if difficulties arise. School managers are more concerned with implementation requirements over longer periods of time than with strategic reviews.
Implications for a new focus on content development and use of the Internet for teaching and learning	The LEA has a major awareness raising function, and can only support implementation after schools have made choices. Diversification of content types according to choice could create a very wide support need.	The LEA has much the same issues as those in Type A, except that the responsibility for how content or whether content can function across the network lies in the area of responsibility of the LEA to a far greater extent.	The LEA has a major liaison and communication function. Schools may need to be supported in using content, but there is greater uniformity in this respect across the LEA.	The LEA has a deep long-term responsibility with regard to content. The LEA is likely to be in the best position to consider how durable content will be over the period of the contract.

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	LEA Type A	LEA Type B	LEA Type C	LEA Type D
Implications for management and implementation planning	Management and implementation planning is largely the responsibility of the individual school. In this respect school managers all need to have understanding of project and implementation planning, which could be provided through support and training from the LEA.	In some aspects the LEA clearly needs to have project management in place, and for schools to be informed of schedules and plans in advance. In other aspects the issues are similar to those in Type A.	Project planning becomes far more the responsibility of the LEA or company involved in this model. The school is concerned much more with uses and outcomes of uses of the resources available.	Project planning within the initiative is a vital need. Implementation of uses becomes a focus for the school, but the LEA and company need to be responsive to the implementation findings of schools if they are to continue to support them as effectively as possible.
Implications for procurement issues	Procurement is largely the responsibility of schools. Schools need to be fully aware of the financial and procurement issues involved, and the need for their own monitoring of procurement decisions and outcomes.	Whilst procurement issues must lie with schools in many respects, the LEA responsibility in certain areas requires their awareness of issues and their monitoring of how procurement decisions and outcomes have developed.	Procurement is largely an LEA responsibility, but monitoring of procurement outcomes needs to be understood and undertaken by schools, but collated by the LEA.	Procurement is a shared concern, but the LEA is likely to take major responsibility in this respect. External advice in these circumstances is likely to be vital, and the ways in which the LEA will consider this should perhaps be agreed in advance.
Implications for key performance indicators and the transfer of risk in contractual arrangements	Key performance indicators must be understood by schools, and used in appropriate circumstances. School managers may well need support or training in this area, and will need to consider how to set up monitoring, which can be put in place.	Key performance indicators agreed in contracts negotiated by an LEA need to be made known to schools, and the means for schools to monitor and feed back on these indicators also needs to be in place.	School managers need a full understanding of all key performance indicators in contracts. Schools need to know what to monitor, how to monitor it, and how to feed it back. LEAs need mechanisms to collate this feedback and to act on it.	Whilst issues in Type C also relate to this model, the transfer of risk is a particularly important area for the LEA to consider. Schools need to be fully aware of what risk has and can be transferred, and what their needs are as a consequence.
Implications for sustainability	Sustainability is largely a school concern. Schools need to be fully aware of what their options are, and the ways in which they can consider sustainability.	Sustainability of the network is clearly a shared responsibility in this model. The LEA and schools need to work out what this means and how they can address the implications.	Sustainability is a shared responsibility between the LEA, the company, and schools. All parties need to understand and agree their options, and to make these clear to all concerned.	Sustainability is an area which takes on particular meaning in long-term contracts. Schools, the LEA and the initiative partners need to build in sustainability checks at appropriate points, and to couch these within reasonable key performance indicators.

Appendix C: Brief Summary of key findings from the Second NGfL Pathfinder Report

C.1 Issues relating to management, procurement, implementation and sustainability

Management at LEA level

- Most LEAs have been successful in developing a shared vision with their schools.
- LEAs have needed to put together a skilled team and, where not available in either the LEA or the providing partner (in Type C and D LEAs), to buy in specialist expertise.
- Strategic vision is important to link the NGfL Programme with other government initiatives such as Regional Broadband Consortia (RBC). Clear lines of accountability between the LEA and the RBC need to be established.

Management at school level

- Some schools are managing the NGfL Programme very effectively where ICT is seen as a senior management responsibility with devolved responsibility to all staff.
- The job of the school ICT co-ordinator has expanded greatly. In many schools the role of ICT co-ordinator is being split into two or more roles, for example: technical support and learning support.
- LEAs need to develop common standards and provide low cost technical support to all schools.
- In schools strategic planning is often good, but detailed implementation planning is rare.
- Implementation strategies for in-class uses are rare and ad hoc.

Funding and procurement issues

- Problems have been due to inadequate prior experience or training for LEA personnel and headteachers in procurement, financial and contractual arrangements.
- When responsibility for procurement is through managed service providers schools have insufficient expertise to ensure (a) that contracts are properly drawn up and (b) that contractors deliver a good quality service.

- LEAs should engage in detailed analysis of the costs of different procurement decisions.
- Key Performance Indicators (KPIs) are important and effective provided they are contractually sound.
- When the KPIs are missing or unquantifiable, poor quality service is likely.
- All the rural LEAs are experiencing difficulty in implementing broadband because of inflated costs.
- Differential funding between schools, and between LEAs, raises issues of fairness and social justice.

Sustainability

- It is difficult to plan for sustainability when funding is awarded on a year-on-year basis.
- Schools need reliable and resilient high-speed Internet access guaranteed over a period of years. The technical support for this is not currently available in all LEAs.
- Sustainability plans need to cover consumables, as well as maintenance and technical support.

C.2 Technical Issues

Provision of equipment

- Computer suites remain popular with schools.
- More flexible arrangements, such as sets of wireless laptops and clusters located in classrooms are needed to support subject learning.
- Increased use is leading to demand for better quality systems and higher bandwidths.
- School building designs need to take account of the need for installation of cabling.

Technical support

- As teachers integrate the use of ICT into their teaching technical failures become more seriously disruptive and more technical help becomes imperative.
- Some skilled teachers' time is being diverted from teaching to technical support.
- The huge increase in Internet/intranet use is putting pressure on server space and the management of server capacity. Primary schools need support in establishing and managing servers.

Provision of software and resources on the network

- The move from stand-alone machines to school intranets and area networks raises problems of access to software.
- 'Legacy' software cannot be delivered on some networks. On-line resources are not yet sufficiently wide-ranging or high quality to fill the gap when legacy software is lost.

Security

- Pathfinder LEAs and their schools have made good progress in addressing the security issues arising from greatly increased use of the Internet by pupils and staff.
- Teachers are very conscious of the dangers of legislation and significant career damage if they are not sufficiently vigilant in supervising pupils' use of the Internet.
- Guidance to schools is needed on Internet safety, responsive and differentiated filtering across the network and on identifying and dealing with internal and external 'hacking'.

C.3 Curriculum and pupils' use of ICT

Content development and Internet-based teaching

- The focus of attention is now on content development.
- Coherent and comprehensive content provision is an integral part of the approach of Type C and D LEAs.
- In Type A and B LEAs content development is much more patchy.
- There is a need for Internet support personnel to work alongside teachers.

ICT skills and confidence of teachers and pupils

- There has been a significant increase in teachers' confidence and competence with ICT, although there is a continuing need for in-service training.
- The best way to increase teachers' ICT skills is to give them a personal computer.
- Pupils' ICT skills have developed rapidly in all of the LEAs. Schools need to continuously revise their expectations of pupils' skills when planning for ICT in the curriculum, including those developed outside school.

Use of computers in school

- There was an increase in primary pupils' engagement

in all computer activities in school.

- Computer use in both primary and secondary schools tends to be dominated by word processing and looking up information on the Internet.
- In secondary schools there are very significant differences between computer use in different subjects.

Use of computers outside school

- With only 10% of pupils not having out-of-school access to computing there is a difficult issue of equity of access for this increasingly small minority of pupils.
- Pupils reported using the computer outside school in a much broader and more exciting range of activity than they encountered at school.
- The infrastructures for ICT-based links between the schools and home or community have not yet been effectively established.

Appendix D: Glossary

Broadband – enhanced telephone connections allowing multiple access channels and faster data transfer.

Caching – storing pages from the web locally so as to enable faster access and reduce the frequency of downloading regularly accessed web sites.

Chat room – a web address which facilitates instant message exchange.

Fibre-optic cabling – enhanced telephone cabling which enables broadband access.

Firewalls – protection of computers from unauthorised access and some computer viruses.

Intranet – a local web system which allows those belonging to an organisation to access documents and exchange data.

Internet – an *international network* of computers which can exchange information.

ISDN – Integrated Services Digital Network refers to the ‘standard’ telephone network connection, sometimes called a ‘narrowband’ connection.

ISDN2 – a slightly enhanced ISDN connection which provides faster data transfer but much less powerful than a broadband connection.

ISP – Internet Service Provider – the computer through which you can connect your computer to the Internet.

KPI – Key Performance Indicators – targets for quality and time of delivery of elements of a service contract.

Legacy Software – software used previously on a different system which may not be compatible.

Mbps – megabits per second – measures the connection speeds of a network.

MIS – Management Information System – a program which organises data such as financial, personnel, timetabling, attendance and achievement data.

MSP – Managed Service Provider.

NOF funding/training – New Opportunities Funding provided by the income from the National Lottery to fund additional resources and training to support the development of ICT in schools.

On-line content – curriculum materials held centrally in a computer network.

PLASC – Pupil Level Annual School Census is data on individual pupils provided annually by a school in a common format.

RBC – Regional Broadband Consortia are 11 local consortia of LEAs established to provide cost-effective broadband connectivity.

Satellite connections – connection through a satellite transmission link rather than through cabling.

Video streaming – enables faster downloading of video material by displaying a video file whilst it is being received rather than after it has been fully transmitted.

WAN – Wide Area Networks refers to the linking of a number of networks so as to provide greater accessibility.

Wireless networks – networks maintained by wireless transmitters and receivers rather than cabling.

Worldware – software available on the Internet for use when downloaded.

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The ICT in Schools programme (formerly the NGfL programme) is the Government's key initiative for improving ICT provision in schools, developing a wide range of digital resources for teaching and learning and equipping teachers to be effective users of ICT. The programme underpins the Government's vision for transforming education. Evaluation is being undertaken using a variety of techniques, both qualitative and quantitative, and at both national and local level.

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