Annex 4

Technology aspects of the e-U

Contents

1 Introduction and summary

1. The purpose of this annex is to provide a description of the technology issues that will affect the design, implementation and future operations of the e-U. This annex aims to discuss the technology options open to the e-U and make recommendations where possible. Finally, a section is included giving a background to outside developments in technology.

2. The e-U aims to offer a world class learning programme to many students across the globe. It also intends to assemble learning content, modules and support services from multiple providers predominantly based in UK higher education institutions (HEIs). In order to achieve this, the e-U will be designed to be agile enough to adapt to potentially large changes in demand, market size and technology. The underlying technology to support this type of operation must be responsive, flexible, scalable and secure.

3. The e-U technology platform will need to be accessed by many parties with differing technical skills and access to technology. As a consequence of being a global, multi-party system, the e-U technology platform must be developed using an open architecture which encourages interoperability between parties and is not exclusive.

4. Learning technologies will improve well beyond what is currently available, to offer a highly interactive learning experience. Internet technologies such as broadband (which allows faster connection and transmission of data over the internet) are developing to enable more interactive and content-rich experiences which will feel more like that on TV. In the future we foresee that concerns about technology capabilities will become secondary to actually providing a meaningful experience, to the point where the fact that a service is offered over the internet will, effectively, make little difference.

5. In order to provide an excellent service to learners and to streamline its back office systems, the e-U must make full use of the new e-learning technologies such as Content Asset Management and Learning Management Systems. Technologies such as these will be developing very fast in the next few years, and will provide one of the main differentiators between the e-U and its competitors. The e-U may wish to invest in research and development into niche technologies to keep abreast of, and even initiate, innovations in e-learning technology.

6. To ensure easy and secure transfer of information between the e-U and its partners it is likely that a secure-access extranet will be needed for partner operations. This extranet would allow multiple organisations to access private information either via the public internet, or via the higher education network JANET.

7. Some technology factors, which lie outside the e-U's control, will have a significant impact. Technology trends, such as the advent of the internet via wireless and digital TV channels, will affect the e-U's operations fundamentally. Broadband technology is also being introduced in many parts of the world but at differing speeds. As a consequence of these changes, the e-U will need to keep up by offering the best e-learning content and services in the medium required by the market. It is

not hard to envisage the same content being packaged for access via multiple channels, with different qualities of delivery and at different speeds depending on where the learner is in the world. It will be the e-U's task to ensure that all its services, including administrative services, are excellent and take full advantage of the technology opportunities available.

8. The operations of the e-U will be very complex. It is therefore likely that a bespoke software solutions provider will be needed to create the basic platform to support the e-U. However, the process for determining procurement methods, outlined in section 3 of this annex, should be followed to decide if this is the right course to take. Procurement will involve defining an overall functionality specification (which needs to link with all business functions) and then selecting the right solutions providers and working with them to develop the system. Some off-the-shelf applications may be used for more common e-U functions such as e-commerce or finance.

Objectives

9. The technology options and recommendations in this annex have been based on the business model developed so far in the main report. The following sections illustrate the high-level functionality requirements of the e-U and a suggested physical systems architecture. These have been included at the outset to provide context for the main report and a basic summary of the components of the e-U's technology platform.

e-U functionality diagram

10. Figure 1 below illustrates the role that the e-U organisation will play in dealing both with students and with HEIs and other partners.

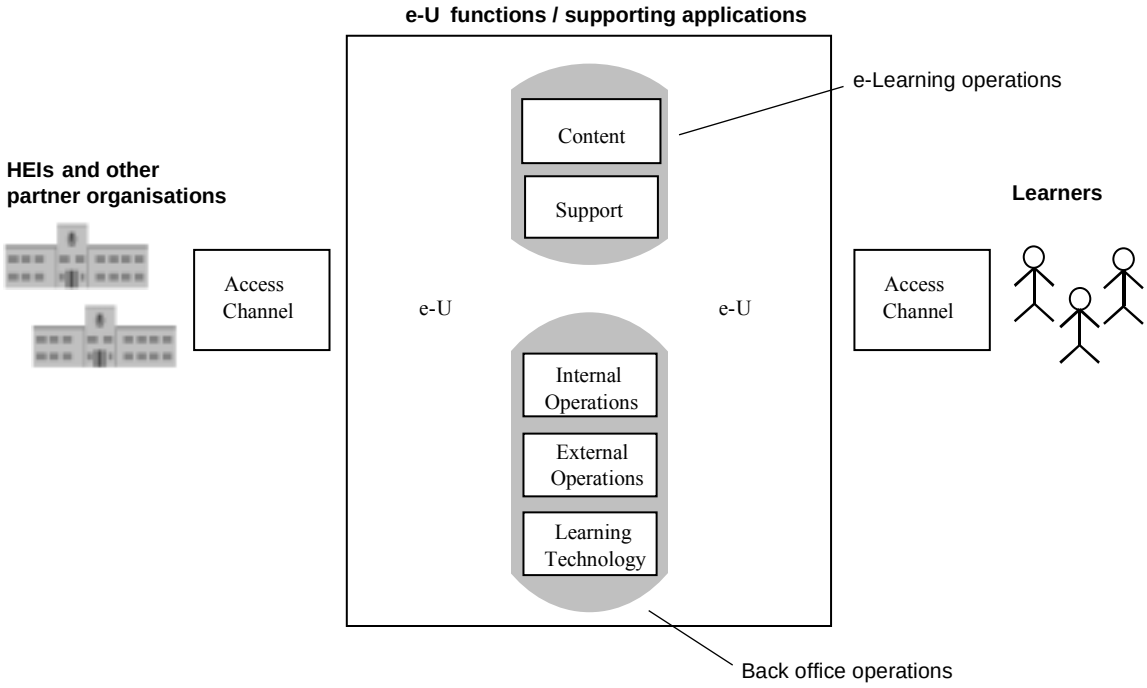


Figure 1 e-U Functionality

11. The e-U would make available to learners the learning materials produced by HEIs and others. In some ways the e-U could be seen to be a facilitator but it is more than that –insofar as it would add value whilst managing the interfaces between learners and content providers. The technology is instrumental in enabling the e-U to add such value.

12. The e-U will also need to perform some administrative functions that are customer facing (such as payment) as well as the back office operations that support the business. Technology which takes full advantage of the internet would play a key part in these operations.

e-U Systems architecture

13. Figure 2 below shows a possible architecture for the hardware and network infrastructure of the e-U.

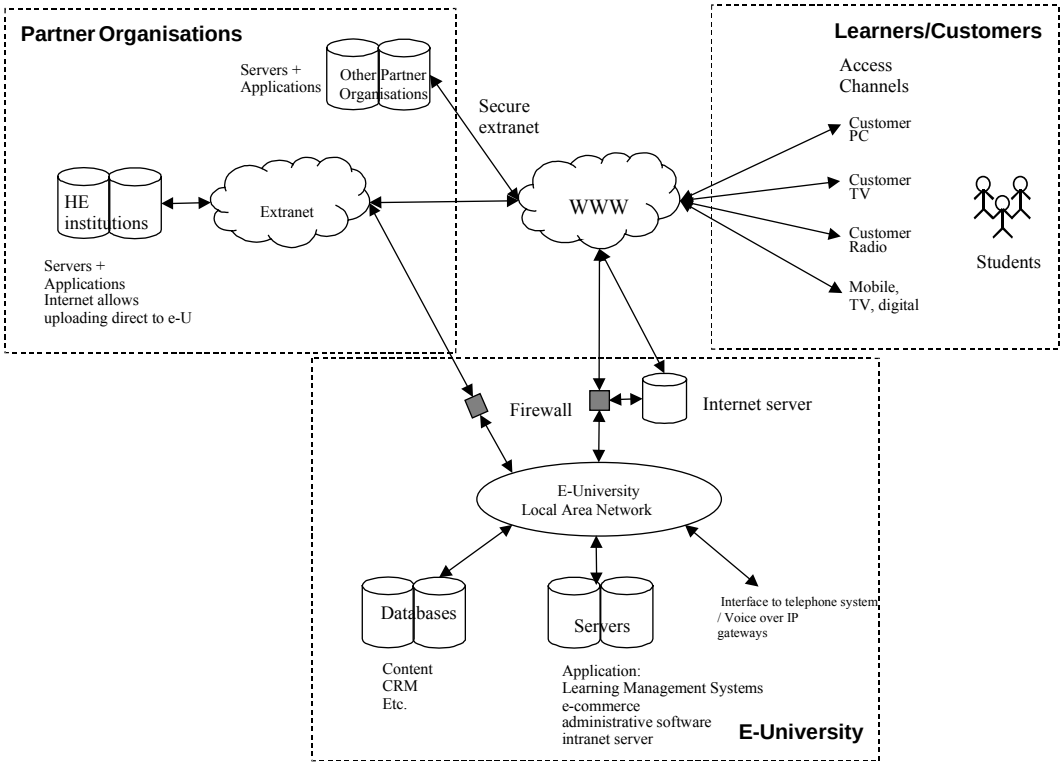


Figure 2 Possible e-U Systems Architecture

14. The e-U network should link all its applications and stored information, and be based on an open architecture. It should have secure connections both to the partner organisation extranet and to the internet. The firewalls indicated would be one of the security measures used to protect the valuable content assets of the e-U.

15. Partner organisations would use applications that can easily exchange information with the e-U over the extranet. In some cases the partner organisations would upload material direct to the internet for access by students.

16. The students would be able to access the learning materials and administrative e-U services via any number of channels. In the future it is likely that students will demand access over wireless and digital TV as well as PC.

2 e-learning technology

17. Advances in the overall capabilities of technology will serve as a catalyst for acceptance of e-learning technologies. Concerns about technology capabilities will become secondary to providing a meaningful experience as, in time, the fact that a service is offered over the internet will, effectively, make little difference. This is sometimes referred to as 'losing the e'.

18. As e-learning technology evolves we would expect the e-U to have the following technical functionality within 10 years:

- full learning on-demand capability
- high quality content at low cost
- wide acceptance of 'object based' content standards
- sophisticated, low cost e-tools to help develop content
- tracked network learning
- correlation of learning to individual and enterprise performance
- easy to use, sophisticated interactive technologies
- thriving e-commerce in learning and training content.

19. This section identifies and describes the main types of application that would be required to support this functionality. It also considers the ways in which the e-U can best achieve this level of technical capability, not only for its central operations but also for its partner HEIs and other organisations.

20. 'Learning objects' and e-tools, which are instrumental in the production of e-learning content, are covered in Annex 3.

21. Standards are being developed for e-learning technology. The US based IMS Global Learning Consortium is the most advanced, and is widely supported by vendors and buyers alike.

Learning Management Systems

22. A Learning Management System (LMS) will be critical to the success of the e-U because it will enable component learning materials to be assembled into a customised learning programme for an individual. The LMS is the system that interfaces with the learner, determines his or her needs, selects the appropriate learning application and content to satisfy those needs, and then delivers it to the learner. Somewhat simplistically, the LMS, supplemented with the navigator as appropriate, is rather like a maitre d' of a restaurant. In the same way that a good maitre d' will first establish where the diner wants to be seated, and whether he wants a meal or just drinks, and then guide him to a suitable table, the LMS will choose and present the appropriate application and content to the learner. Furthermore once the maitre d' has ascertained some of the diner's preferences he

may make menu or wine suggestions based on his knowledge of the restaurant's wine cellar and specials for the day. Similarly the LMS has the 'intelligence' to establish what the learner needs (often the learner may not know), and using its knowledge of the content and learning materials available it is able to suggest what the learner might best do next. In this somewhat clumsy analogy, the LMS is the front-man; rather than the chef who creates the food – the main reason the diners are there.

23. An LMS would help carry out pre-assessments and then manage and assemble an entire course. Most importantly it would also help track and monitor an individual's learning programme taking into account the learner's existing proficiencies, job role, learning objectives, style and preferred delivery. The LMS would be used to monitor an individual's progress over a learning programme, and also over a long period of time (suitable for lifelong learners).

24. In this way the LMS would assist the navigator in offering a more personal and useful service to the student.

25. The other aspect of the LMS functions is those services that would be provided to tutors and to content providers. The LMS could help manage the design and editing of courses by the provider. It would also provide useful feedback (such as learner progress, attendance, etc) to the tutor.

26. Learning Management Systems must have a close interface with the other administrative functions of the e-U. The administrative operations of the e-U are covered in detail in section 3 of this annex, however it is important to note that the LMS will need to exchange data, such as financial and management reporting data, with the administration systems. Based on this information the e-U management will be able to further support both learners and tutors.

27. Some of the typical features of an LMS include:

a. Assessments for learners to test skill and design learning programmes. Some LMSs provide self-testing to assess progress.

b. Available learning programmes with options. The LMS will present suitable learning for the students based on their preferences, skills, etc. The navigator will supplement the LMS (particularly on softer issues) in providing advice on course choices.

c. Course outline. A schedule with an overview of the course structure with timetable, facilities, modules, tutor contact information, etc.

d. Portal front-end/navigator. This is the visual and guiding interface that leads the learner through the learning experience. It is designed in such a way that it presents the right feature at the right time, and with the same look and feel to ensure the student perceives the e-U as a seamless operation.

e. Individual learner record. Information recording the performance of the learner, and records of any transactions between the learner and the e-U.

f. Community tools such as noticeboards, learner group information, introduction to other learners, alumni services, etc.

g. e-learning tools specifically to aid in learning (not administration). These might include conferencing tools for discussion groups, synchronous collaboration tools such as electronic whiteboards, and multimedia resources such as 3-D simulations, which may be live or downloaded.

h. Search and bookmarking tools.

i. Tutor upload areas for coursework. Also facilities for tutors to amend coursework materials.

j. Tutor access to learner records (on progress, attendance and so on).

k. Tutor communication with specific learners: a facility to help tutors communicate direct with their students in groups or individually.

28. There are many providers of LMSs currently offering state of the art solutions. Along with the recommendations regarding procurement below, we suggest that the first step to selecting either a bespoke or off-the-shelf LMS is to determine the full functionality requirements of the e-U. We strongly recommend that the functionality is determined not only for the initial offering, but also, as far as possible, with a view to possible future developments both external and internal to the e-U.

LMS standards

29. It is crucial that the LMS should be able to operate with content and tools from multiple sources. Several standards are being developed in this area which:

- allow material to be moved from one computer managed instruction (CMI) system to another, while maintaining its ease of use and functionality
- make it easier for learning technologies to be implemented on various types of browsers and operating systems
- establish a protocol that aids communication between software tools (such as spreadsheets and text editors) that a learner is using, and the instructional software agents that provide guidance to the learner.

30. The technical standard that is emerging as the format for the exchange of e-learning information over the internet is XML (Extensible Mark-up Language). XML is a standard that is able to identify content (not just formatting) and thus enables a specific piece of content to be identified for use by the LMS when needed for a bespoke learning course.

Content Asset Management

31. The e-U's modular approach should provide the facility for individual courses to be assembled on a basis specific to the individual customer. Starting from the production of modules of learning, the evolution to a granularity of learning objects may take place over time. Either way the e-U should take advantage of sharing learning modules or re-using content; all this information will then need to be managed. Content Asset Management allows vast amounts of valuable data to be stored and accessed very quickly and accurately.

32. It is likely that the content will be stored in central databases and possibly also in dispersed repositories amongst some e-U partners. This will include not just completed content but also content under development. In order to manage the learning materials it will be essential for them to be properly described using standards-based metadata. Metadata is an information tag attached to content material that provides a description of that content. To provide a rich description suited to the anticipated requirements of the e-U, it is likely that the following information will be needed in the metadata:

- subject or topic area
- level and context within different types of programme
- authors and design team
- date of most recent update
- price (which might vary by user, geography, etc)
- style of content (for example, is it suited to users who prefer a very interactive and highly supported type of course)
- language(s)
- type of technology delivery (for example, is it suitable for PC, and/or WAP technology).

33. Content Asset Management Systems contain powerful search facilities to allow the right learning material to be found quickly. The system would support the Learning Management System and its navigator in assembling learning courses.

34. As the degree of personalisation and tailoring of learning programmes increases, so will the number of components from which learning programmes can be assembled. As a result, the role of the Content Asset Management system will become central to the success of the e-U.

Collaboration tools

35. Collaboration tools include internet applications for virtual classrooms, on-line presentations and web meetings. Current technology now allows live collaboration over the internet. The e-U would expect to see material producers use collaboration tools in their content modules, as well as for advanced support such as live, voice-enabled meetings between learners and tutors.

36. In the future the e-U may wish to offer live collaboration tools for some of the provision made under its auspices. Live collaboration tools allow integration of voice, video, interactive tools and shared workspace, eg for one-to-one or one-to-many live events.

Application Service Provider model

37. Application Service Providers (ASPs) host software applications on their own servers for others to access them remotely via a web browser. Using an ASP may be

particularly suitable for educational institutions looking to gain access to a wide variety of e-based learning applications at reasonable cost and maintenance effort. Although ASPs are not yet used widely, especially in the education and training industries, there are a number of vendors now pursuing this strategy.

38. There are several compelling reasons to adopt the ASP model:

a. IT personnel shortage. IT staff are in great demand and are therefore difficult to find and retain. Furthermore, every new member of staff needs to be brought up to speed on the systems to be managed. Outsourcing the day-to-day management and maintenance of learning applications relieves the IT department of that burden.

b. Modernisation and distribution of innovation. As technology is constantly evolving and developing it will be difficult for organisations to keep up with the latest software. An ASP, which represents the IT needs of many different organisations, will be able to keep abreast of the newest technologies and offer them to its clients.

c. Fast, affordable implementation. The customer does not have to buy the software or the equipment used to run it (servers, operating systems, and so on), therefore saving time and effort. Also, an ASP-delivered application is generally much quicker to get up and running compared with the time it would take an organisation to install it itself. This time saving frees up staff.

d. Ubiquitous access. Since the application is delivered via a Web browser, learners would be able to access it not only from their desk at the office, but also from home, their laptop, or an internet café.

39. There are several options open to the e-U with regard to ASPs. The e-U could itself become an ASP and host the most up-to-date software applications on behalf of all its partner institutions. The major benefits of this would be that, by providing a service to partner HEIs the e-U could ensure that the overall offering to students uses the same high standard of specialist software with the same look and feel. It would also help to encourage HEIs to make use of the e-U facilities if they had previously had doubts about meeting its IT requirements.

40. Alternatively, the e-U could decide to outsource its IT requirements to a third party ASP. The advantage of this would be that the e-U itself would spend less effort on IT, although it may be no cheaper. One consideration is that the technology will be a very important facet of the e-U, and as such, the e-U may wish to keep full control of it in-house. A further consideration is that, despite future predictions, the e-learning market is still relatively small and so it is doubtful if an external ASP would be able to provide a cost-effective choice of all the constantly evolving applications that might be required by the e-U. It may be that a subsidiary or partner of the e-U acts as an ASP to serve the e-U's requirements.

3 e-U operations

41. The e-U will be a new internet company starting from nothing and without legacy systems or business processes to affect its development. From a technology

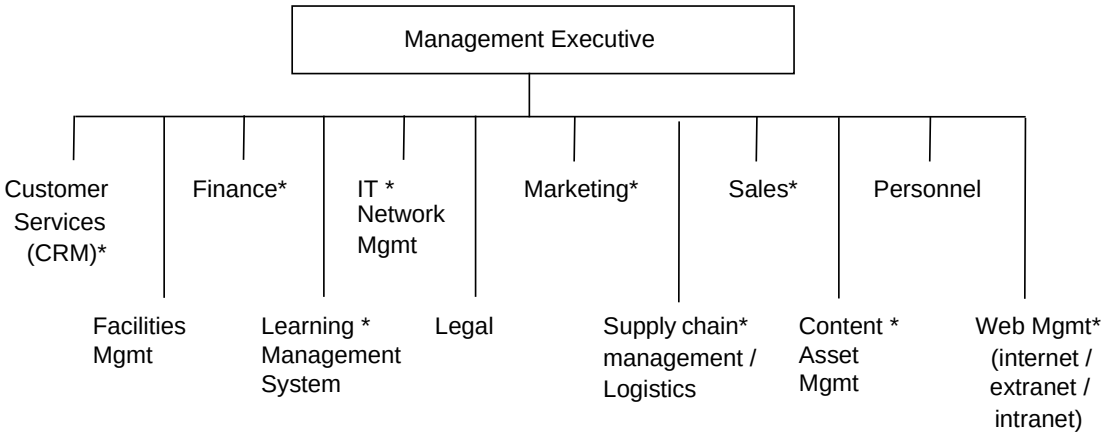
point of view, this will give the e-U a chance to be a truly innovative e-business with its operations based on a wholly web-oriented, open standards model.

Back office and customer facing administration

42. This section describes the main e-U administrative functions. Details are given of the back office operations and support systems, as well as the customer facing administrative functions.

e-U back office operations

43. Figure 3 below shows the main internal operational functions of the e-U. These are the back office operations that make up the e-U administration.



* indicates web-enabled applications available to support these activities

Figure 3 e-U Management Operations

44. It is envisaged that the e-U will employ web-enabled applications to support its management functions where possible (see later for more details). At present the following web-enabled applications are available:

- customer relationship management (CRM)
- finance and electronic billing systems
- IT network management systems
- marketing and sales
- supply chain management /e-procurement
- web management and web publishing.

45. There are also several enterprise software suppliers who would provide an entire suite of web-based applications.

46. The applications developed so far that take full advantage of the opportunities presented by the internet are marketing, sales, CRM and the internet-specific applications such as web publishing. CRM now has an enormous influence on e-business strategies, brought about mainly by the advent of the Web. We discuss it further in the section below.

47. In the near future, technology will develop sufficiently to allow access to the internet via a number of different channels. Today, most access is via a PC but it will not be long before users can access the internet via mobile telephones, interactive TV or even computer games consoles. The development of technology is discussed further in section 4 of this annex, but a point to note here is that the information relayed to the learner may need to be made available via different

channels, including administrative information and transactions with the learner. One could imagine a student in the future picking up his exam results via his mobile telephone. Some administrative services will have to be redesigned, or repackaged, for access via new digital channels.

Customer Relationship Management (CRM)

48. CRM is the process to develop an accurate view of an organisation's customers. The goal of CRM is to know all the points at which customers interact with the organisation. With the use of internet technology and CRM applications it is now possible to build up a clear view of customers which allows strategic marketing or business initiatives to be more accurate. By offering timely incentives and product choices where and when the customer needs them most, an organisation can offer the best possible service to its customers. Excellent customer service helps an organisation to keep its customers happy, and ultimately grow its market, as satisfied customers are more likely to provide recommendations to others.

49. CRM gives clear information on actual customers, but business intelligence is required to analyse it in conjunction with other operational data to spot trends and develop business strategies accordingly.

50. The advent of the internet has brought about an explosion in CRM technologies as it is possible to track and record every transaction a customer, or partner, may have with an organisation. A customer's behaviour whilst visiting an internet site is easily monitored; call centres and other transactions can also now be logged in the central CRM database. This valuable information provides the driver for new business strategies and continuous improvement.

51. The e-U should take full advantage of the opportunity to build up a full picture of its customers, and use that information when making business decisions about investments in new materials and/or services. The e-U should also use CRM to improve its customer service to partner HEIs and others.

Customer facing administrative operations

52. The operations below are some of the administrative functions that involve direct interaction with the customer. The administrative functions of the e-U will need to interact directly with the Learning Management System, particularly for the exchange of data. A very brief description of the main technology aspects is given.

- **Registration** – on-line student enrolment, direct link to back office administrative functions.
- **Central services** – these are services such as the library which would be offered to all students irrespective of course, geographic location, etc (see Annex 3). Central library services are likely to be presented to students via an e-U portal that helps direct users to the information they require. (It is possible that the provision of central services will be outsourced to others and a link provided from the e-U home page.)
- **Payment** – typically on-line payment for learning programmes, with a direct link to back office administrative functions (especially billing and finance).

- **e-commerce** (including associated services) – typically includes on-line sales of books and other courseware, and sale of services such as travel and banking (these services will probably be provided by others but a link will be provided from the e-U web-site to their sites). The internally managed e-commerce facilities will have a direct link to fulfilment functions of the e-U.

53. Administrative systems specifically for learning institutions exist today and are developing rapidly. It is becoming more and more important for these systems to integrate with the LMS as well as other applications needed for the operation of the e-U. To this end, standards are being developed to ensure greater interoperability between systems. Procurement of e-U technology systems is covered generally below. However, we note that further analysis of the functionality requirements of the e-U is required before any systems can be purchased.

Main characteristics of the e-U technical platform

54. The e-U platform will comprise the networks, hardware, software applications and interfaces with external systems that support the e-U operations. The following sections outline the main characteristics we would hope to see associated with the technology platform.

Integrated infrastructure

55. For any e-business to excel, its employees require fast, efficient support systems, and timely and accurate information to inform their decisions. It is important that the applications that underpin the operations of the e-U are able to exchange relevant information automatically and accurately. For instance, when a student registers or buys a learning module on-line, the navigator, sales, marketing and finance functions should have real-time access to that information. In order to do this, the infrastructure and applications themselves need to be well integrated to the point where they can exchange data which can be automatically interpreted without human intervention. Industry providers of software and hardware are currently trying to develop standards that will support a high level of integration. However, at present these standards are not universally applied and generally the interfaces between applications must be integrated using bespoke software solutions.

56. When selecting applications a conflict exists between choosing a single, proprietary supplier, and going with the best-of-breed application for each function. The mammoth Enterprise Resource Management systems able to integrate the entire operations of a company, and widely implemented in global companies throughout the 1990s, are often seen to be unwieldy and difficult to integrate with legacy or new systems. A best-of-breed approach, taking different applications from various suppliers, will generally require heavy integration input to achieve a smooth operation. The market for these applications has been demanding more easily interchangeable products, but so far the industry has gone only some way to achieving this.

57. Web-enabled applications, which employ browser technology and run using Internet Protocol (IP) over the internet, extranet or intranet, go a long way to enabling easy exchange of information, particularly over distributed networks. They

are also able to interpret data which are gathered via the organisation's web-site. It is envisaged that almost all applications will be web-enabled before long and, because of the reasons above, we would suggest that the e-U selects internet-based applications over more conventional offerings. Currently the applications which are web-enabled tend to be those that directly use data gathered on customer web-sites such as marketing and finance. As companies use the internet for more and more of their operations (for example, the personnel department may use the internet for recruitment), more and more web-enabled applications will become available.

Flexibility

58. The e-U will need to demonstrate flexibility in its operations in order to react fast to its changing environment. This is particularly true for an internet start-up operating in a new industry, where external forces may require the business to change on a regular basis. Consequently, the systems architecture which supports the operations will need to be just as agile in its response to change. The adoption of agreed standards by suppliers will make their products inherently more flexible by allowing modularity and the easy interchange of different products.

Scalability and growth

59. It is impossible to predict with any certainty how the e-U will develop once it is up and running. There are many variables which will affect the load on the office systems including numbers of students; number, size and packaging of modules offered; and volume of content available, including archived material. Therefore, just as the e-U will need to be flexible so that it can change its operations easily, it will also need to be readily scalable to cope with potentially rapidly increased demand.

Modernisation/upgrade

60. The e-U will need to be constantly reviewing its operations and associated technology systems in order to stay ahead of the competition. A process of continuous improvement will entail regular modernisation of its systems. So although the e-U will have the advantage of not having legacy systems to incorporate when it starts up, it will very quickly need to consider upgrading or replacing its various IT systems. The systems architecture should be designed to be flexible, so that modernisation can be much easier and cheaper.

Convergence

61. As the devices over which the learner will receive content develop (for example with the advent of wireless and interactive TV), the back office systems will also need to change. The e-U will need to provide services regardless of network type or customer channel.

Security and privacy

62. The e-U will need convincing security arrangements to ensure it has the trust of all the customers, and partners who use its systems. An overall security policy would include:

- an assessment of risk to the systems (including competitors trying to overload the e-U systems, credit card fraud, a hacker breaking into the server and altering customer records, etc)
- planning a proper security architecture
- developing general organisational policies involving employees to protect customer privacy.

63. Measures which can be taken against security risks include firewalls, digital certification and encryption. A firewall is a computer running on a modified operating system that isolates an organisation's internal network from the internet. It allows some connections to pass and blocks others; it is considered the first line of defence for security measures. A digital certificate is an electronic document that has been digitally signed by the issuer, similar to a paper document being signed in ink. Its function is to identify a person or an organisation on the internet. These could be used for learner identification for assessment purposes. Encryption supports secure payment over the internet using SSL (Secure Sockets Layer).

64. A further security issue of growing importance is privacy on the internet. Organisations should encourage a culture of respecting privacy to build the trust of their customers. In addition to using the above tools to ensure privacy of information it will be necessary for the e-U to consider the different legal considerations in different countries.

Availability and reliability

65. To ensure the reliability and availability of the e-U's back office systems, care must be taken in the initial design to ensure sufficient capacity. After initial design, testing and commissioning to get the system up and running it will continue to grow in scale, complexity and basic value as the variety of available equipment and services within it expands. As the e-U network will be distributed, rather than established on a centralised computing platform, it will be more vulnerable to network failures, which could occur on real circuits, software or hardware. Network management systems feature sophisticated tools such as visually-aided fault detection. Their main purpose is to ensure network availability. Network management involves other tasks as well. Many network problems arise not from dramatic strikes of lightning or sudden equipment failure but from gradual erosions of performance that could be detected well in advance if proper procedures had been deployed. Therefore network management must concentrate on monitoring and maintenance, as well as responding to emergency failures.

Standards

66. Existing and new standards are being developed across all components of systems including infrastructure hardware, software and networks. If standards are

designed with the end user in mind they will enable systems to be more easily integrated, more flexible and scalable, and more easily upgraded. They will also allow the customer to select the best product to suit his or her requirements. However, a standard will only be effective if it is accepted both by the users and by suppliers themselves. The e-U should be aware of the development of standards to ensure the platform it chooses is compliant and therefore more adaptable to changing future requirements.

67. One example, the Business and Accounting Software Developers Association (BASDA) developed the electronic Business Interchange Standard (eBIS) in early 1999 to determine the best way for applications to be directly linked. eBIS uses XML messages sent by e-mail to do this. It is intended that eBIS should replace Electronic Data Interchange (EDI) which requires expensive configuration and proprietary delivery mechanisms.

Partner operations based on the extranet

68. For the smooth and efficient administration of the e-U it is vital that content providers, providers of student support services and supporting areas (such as libraries) be linked to the e-U by an 'e-U extranet'. This would be the vehicle for communication between the e-U and its partner institutions and organisations.

69. An extranet is similar to a corporate intranet. However it enables multiple organisations to access private information from each of the organisation's internal networks via the public internet. It supports the same protocols and services as the public internet, including e-mail, news, chat rooms and web pages. The extranet would provide access to internal 'group' information whilst also securing other data from partners on a selective basis (for example, it will not let one partner access billing information about another partner).

70. The extranet should be used for functions such as:

- billing and invoicing
- marketing functions
- on-line tendering
- exchange of student information
- course information
- e-U resources for partners
- knowledge management.

Network

71. We would expect the majority of the information to be shared would be hosted by the e-U regardless of originator. All parties would access this information via their normal method of accessing the internet.

72. The major technology issues for network extranets are security and interoperability. Standards for users of the internet will assist in ensuring security

and interoperability, and to this end the Internet Engineering Task Force (IETF) has been established. The IETF is a large, open international community of network designers, operators, vendors and researchers whose purpose is to co-ordinate the operation, management and evolution of the internet and to resolve short- and mid-range protocol and architectural issues. It is a major source of proposals for protocol standards which are submitted to the Internet Architecture Board (IAB) for final approval.

73. In the case of HEIs, many of these are already linked (to the internet and each other) by JANET, a Virtual Private Network (VPN) which uses carrier-provided networks but which functions as a private network. The primary service already delivered over JANET is IP (Internet Protocol). See later in this section for more information about JANET.

74. Each organisation would require an extranet router at the edge of its network. Routers are the interconnection points between the internal networks and the extranet itself and would provide a point for security and control.

75. Security functions are performed on IP packets by the router, which are then encapsulated, or tunnelled, inside other IP packets for routing across the internet. There are a number of protocols which are used to implement IP VPNs: Point to Point Tunnelling Protocol (PPTP), Layer 2 Forwarding (L2F), L2TP, and IPSec. IPSec has the advantage that it provides security on a packet by packet basis. The limitation is that it only carries IP packets and not other protocols (such as IPX and Appletalk).

Interoperability

76. The interoperability of the various networks which would make up the extranet would be key to its success. Many parts of each of the networks involved must interoperate.

77. Netscape is leading a consortium of companies in the support of a set of extranet standards to create a comprehensive, interoperable infrastructure for the secure transmission of information. The standards cover directory services, encryption and authentication and formats for the exchange of information.

Network security

78. Routers will be required by each organisation as the interconnection points between individual networks. Extranet routers also include security features which would provide all parties with secure links.

79. Access to data can be controlled and managed through strategies including IDs, passwords and encryption.

JANET and SuperJANET4 – the academic network

80. JANET is the Joint Academic Network. It comprises physical infrastructure that connects all higher education institutions, Research Council sites, further education colleges and other bodies with an interest in working with the HE and research community. The JANET network provides a very fast and secure route for

information to be relayed between HE organisations. It does not provide the applications and servers to support the operations of those organisations; these are held on a local area network (LAN) dedicated to the organisation.

81. Currently, the SuperJANET3 network offers high connection data rates between 18 major HE sites in the country. Connection rates for these sites range from 34Mbits/s to 155Mbits/s. The remaining HEIs are also connected into the network although generally at lower speeds.

82. In June 2000 it was announced that the JANET network and infrastructure are to be upgraded to enhance service and increase capacity. The new SuperJANET4 will connect over 700 sites across the UK and provide very fast internet access speeds for all users. Although SuperJANET4 will not be complete for 5 years or so, the interim improvements will be considerable. The minimum link to the main HEI nodes of the network will be 155Mbits/s and the maximum will be 2.5 Gbits/s.

83. As mentioned previously, it is possible that communication and transfer of information between the e-U and the HEIs may be carried out over the SuperJANET network. It is possible that non-HE e-U partners may also be able to link to SuperJANET subject to satisfying membership requirements. It would appear that the network does have sufficient capacity to handle e-U requirements if desired. The advantages of SuperJANET would be that it offers fast and secure connections between parties and also to the internet, and would obviate the need for HEIs to upgrade existing connections to the internet. The alternative would be simply to operate an extranet over the internet. However, use of the public network is likely to be more costly and slow if the same connection speeds are to be achieved.

84. When considering the capacity of the JANET network, the main factors are the type of applications or data to be transmitted, and the maximum demand, or number of simultaneous users. Early e-U traffic will typically comprise documents, images and downloadable video and audio; other material would include live streaming of audio and video material (which requires very high data rates), and interactive whiteboard and other collaboration tools. SuperJANET4 will probably have the capacity even to deliver the live streaming of audio and video at an adequate quality.

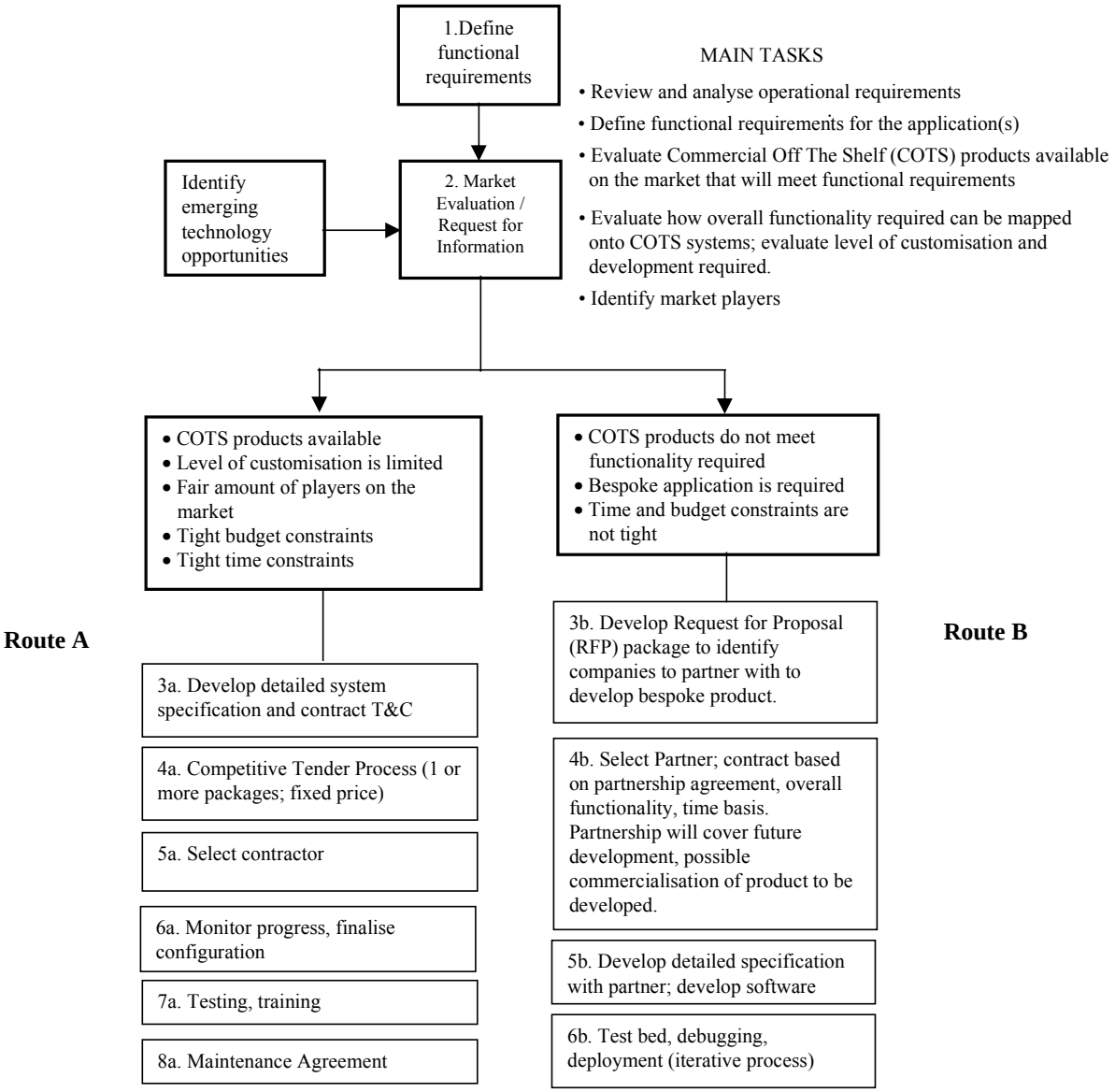
85. The software used in e-learning applications is still developing, and higher data rates or better quality information may be required in the future. However, we would expect the UK's education network to keep up with demand trends and be able to support the evolution of e-learning requirements.

Procurement of technology platform

86. Procurement of software applications requires effective co-ordination of the applications and all other aspects of the communications infrastructure such as networks, LANs and WANs, cabling infrastructure and building IT infrastructure.

87. In this section we outline the two main routes for procurement of the e-U technology platform and the factors to be considered to ensure an effective procurement process and successful implementation. Table 1 shows the main steps.

Table 1 Procurement of the e-U technology platform



88. After the major task of defining the operational and functional requirements of the system, there are two main routes for IT procurement. The first, Route A, would be to base the systems on commercial, off-the-shelf products. This is clearly only possible if they are available. The second, Route B, would be to commission a systems integrator to create a bespoke application. This would be done even if off-the-shelf products were available but did not meet the required functionality. More details about the two options are given below.

Route A

89. Route A generally limits the buyer's risk in terms of cost and time required to implement the solution. Our experience shows that costs can be reduced by more than 50 per cent if Route A can be accepted.

90. Route A would also offer greater flexibility for the e-U in terms of future developments and maintenance. COTS products would typically be updated by the vendor, and new versions offered at no cost as part of the maintenance contract. Future developments would be carried out at less cost for the customer, as these also benefit other customers. As a result development costs and maintenance cost are 'shared'.

91. Route A still allows for a modular approach, whereby different functions could be fulfilled by different COTS software. In this case, integration is required between systems, and middleware may be required to develop electronic interfaces. An advantage of this solution would be to allow the e-U to 'unplug' a sub-system at a later date and replace it with a new system from another supplier as new products become available on the market. However, it would be important to define interface requirements tightly, and ensure that all systems were based on open standards, with each interface documented in detail. As interface standards are becoming more and more advanced, this type of development becomes more cost effective and less risky.

92. The system specification and tender package would need to cover the following issues:

- functional requirements
- technical specification
- resilience, performance requirements
- terms and conditions
- interface specification
- contractors' responsibilities in developing interfaces
- maintenance requirements, service level agreement
- modernisation and adaptability to it and business change
- integration of third party systems through mergers and acquisitions.

Route B

93. Route B would provide the e-U with a bespoke application, which would fulfill its specific requirements. Although this approach can be required for very specific businesses – or to provide a business advantage over the competition – it would require more effort on the part of the e-U and the software developer partner(s) to specify the detailed functional requirements and architecture for the system. Development time and testing of the product would also be longer.

94. In Route B the e-U would be required to work very closely with the developer, and continue the relationship with the developer in the long term, as and when the software has to be maintained and modified.

95. If such a solution were required, the e-U, in order to limit risk and cost, might try to enter a partnership agreement with the developer to commercialise the product at a later date.

E-U technology procurement

96. The e-U technology platform will be a very large, unusual and complex entity. It is unlikely that an off-the-shelf product already exists which would offer all the functionality and capability required. It is more likely that the e-U will require a bespoke solution for its technology platform, although the potential benefits of a tailored solution may be offset by the attendant costs and time for development. However, the e-U may well be able to use off-the-shelf products for some more common functions such as e-commerce, finance, etc. In addition, the e-U will want to use the best-of-breed learning applications for specific operations. All of these off-the-shelf products would still require considerable effort to tailor them for the e-U's particular requirements and to integrate them with the rest of the system.

4 Internet trends

97. In the next few years, access to the internet will be offered via a greater choice of channels and a choice of devices such as mobile handsets, TV boxes or game consoles as well as traditional PCs. This will have significant implications in terms of internet applications. Some of the devices will be more suitable for delivery of certain types of services than others and it is therefore likely that devices will become more application-specific.

98. The use of different devices and the development of networks and applications will give the e-U the opportunity to deliver learning products to students according to their personal preferences, skills and training. In parallel with technological advances, regulatory and infrastructure developments also affect the uptake of the internet as well as public perception of new technologies. The development of some channels for the internet, such as satellite, will allow individuals to access the internet independently, thereby rendering them less dependent on their country's infrastructure.

99. This section includes a review of existing and future technologies for the provision of access to the internet. It also looks at how regulations, standards and infrastructure will affect the development of the internet and advanced technology services world-wide.

Present and future technologies for internet access

Traditional technologies

100. Currently customers commonly access the internet through a PC, using dial-up services over a Public Switched Telephone Network (PSTN). Users access the internet via a dial-up connection or Asynchronous Digital Subscriber Lines (ADSL) at home, or via Integrated Services Digital Network (ISDN) or a leased line at work. The call is conveyed from the customer premises to the Internet Service Provider via the PSTN networks of originating and terminating operators. A diagram showing current dial-up internet access services is given in Figure 4.

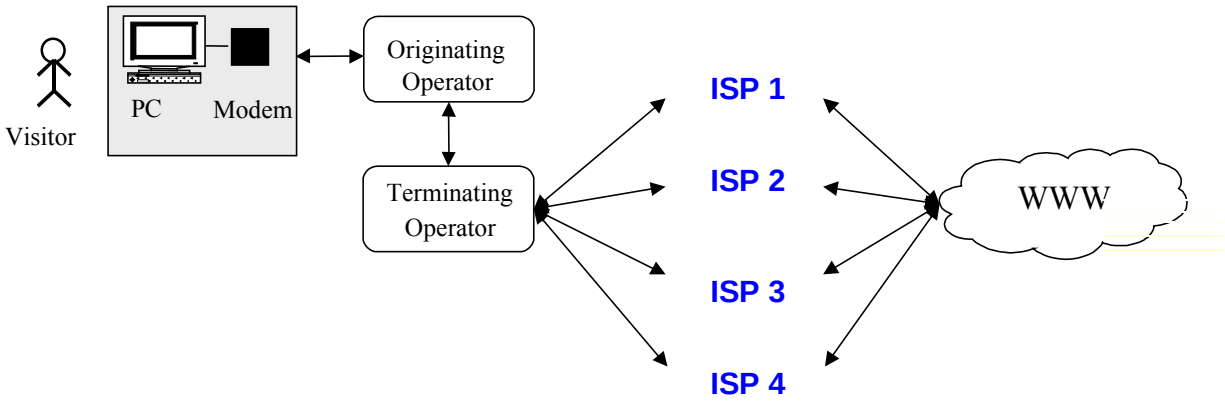


Figure 4 Dial-up connection via the PSTN to multiple ISPs

101. However, PSTN was designed for narrow bandwidth voice services that involve relatively small amounts of transmission data. Consequently PSTN cannot support the high bandwidth data transmission required for the provision of sophisticated internet services. Over the past six years, local access technologies have improved in the UK in terms of the amount of data transmission they can support. In 1995, the modem standard was 14.4Kbits/s, but only a year later it doubled to 28.8 Kbits/second. By 1998 it had reached a rate of 56.7 Kbits/s (43 Kbits/s on average). However local access remains too slow to deliver high speed internet access, video-on-demand or interactive services via PCs or other devices.

Future customer channels and technologies for higher bandwidth services

102. In order to achieve higher bandwidth to access the internet it is necessary to upgrade the final link to the customer, or the 'last mile'; the core networks have adequate capability already. Over the next few years we shall see the introduction of new technologies such as Digital Subscriber Line (DSL), cable modems, third generation mobile (3G), broadband fixed wireless access, and satellite. Coupled with alternative devices (such as Wireless Application Protocol – WAP – enabled mobile handsets), these will be able to provide higher bandwidth and more sophisticated services.

103. Table 2 compares different local access technologies for the provision of internet services in terms of devices, access bit-rate, services delivered and when they are likely to be available in the UK.

Table 2 Alternative access technology for the provision of internet services

	Techno-Logy	Device	Local access bandwidth (actual)	Type of service	When first available in the UK
Tele - phone network ↓	PSTN	PCs	Up to 56 Kbits/s	Internet dial-up e-mails	Currently available
	ISDN-2	PC	128 Kbits/s – 2 Mbits/s	Internet dial-up e-mails	Currently available
Wireless mobile ↓	GSM	GSM mobile	Up to 9.6 Kbits/s	Basic web pages slow speed	Currently available
	GPRS	GPRS mobile	Up to 56 Kbits/s	Wireless internet services, location based applications	Currently available
	EDGE	EDGE compatible mobile	Up to 192Kbit/s	Wireless internet service; download of high quality picture; location based applications	2001
	3G/UMTS	UMTS enabled mobile handset	Min 384 Kbits/s for stationary terminals. Less for moving terminal	High speed access to the internet, interactive services, video – conferences, m-commerce , other services	2001 - 2002
Fixed Wireless ↓	Satellite	Satellite enabled mobile and PCs	Up to 2 Mbits/s	Internet services with lower performance than terrestrial / submarine links, also costly. Suitable for remote areas	Currently available
	Broadband WLL	Telephone, PC, TV set boxes	Around 5 Mbit/s	High speed access to internet and interactive services	Future (already in US)
Fixed ↓	Cable modems	TV set boxes PCs	Up to 27 Mbits/s downstream. 10Mbits/s upstream	Fast, 'always on' connection to internet and high quality on-line services	Currently available
	ADSL	PC	Up to 8Mbits/s downstream and up to 1 Mbits/s upstream.	Internet access, multimedia access, video-on-demand, home shopping	Currently available (recently introduced)

104. Interactive services via TV and mobile phones are already available, although still in a relatively primitive form. For instance, interactive services and e-mail are offered via digital satellite; virtual shopping malls and e-mails are available via digital TV cable.

105. It is anticipated that technology will develop to provide higher speeds and more sophisticated interactive services via a host of different devices such as WAP-enabled mobile phones, interactive TV and specially modified games consoles.

However, the general level of technology currently available would require that, if it were to launch today, almost all e-U activities would be designed for delivery over a PC. Connection to the internet could be by PSTN telephone, GSM wireless, cable or satellite depending on the learner's location.

Wireless

106. WAP is currently one of the leading protocols for wireless connection to the internet. It is a licence-free protocol that enables internet pages to be read from a mobile phone using Wireless Mark-up Language, the mobile equivalent of HTTP (HyperText Transfer Protocol) on the internet. It is predicted that WAP will eventually evolve for use with the future wireless technology, UMTS 3G mobile technology.

107. Wireless technology will evolve in phases. Between WAP mobile and UMTS 3G mobile commercialisation, two intermediate services may operate in the market: the GPRS (General Packet Radio Service), and the EDGE (Enhanced Data Rates for GSM Evolution) services. In parallel, satellite, cable modem, xDSL and broadband WLL technologies will develop to generate operational services with equivalent functionality. These are explained below.

- **GPRS – General Packet Radio Service.** This is the first phase in transforming the GSM network into 3G functionality. The GPRS's packet-switched technology allows more efficient use of the spectrum. It will double the speed of mobile internet access to 115 Kbits/second, and will be an 'always on' technology, that is it will no longer require dial-up calls due to the use of packet technology.

  GPRS is able to provide location-based applications. Mobile phone companies are able to locate roughly where their customers are at any time of the day. They will be able to do this more and more precisely as the geopositioning technology becomes more sophisticated. This may have a significant impact on future businesses, with the creation of new services which have not even been considered so far. However, the major issue surrounding location-based services concerns the general public's privacy and security.

- **EDGE – Enhanced Data-rates for GSM Evolution.** EDGE technology represents a further step towards 3G UMTS mobile. Similar to GPRS, EDGE is a packet switched technology and will enable operators to optimise their use of frequencies. It will offer higher data rates up to 384 Kbits/s, although in practice data rates of 96 Kbits/s and 192 Kbits/s are more likely. The increasing bandwidth will enable EDGE to offer more advanced services than GPRS. In addition to higher speed access to the internet via mobile handsets and location-based applications, EDGE will offer high quality images and video.

- **3G – Third Generation mobile**. Unlike second generation mobile, 3G will be a unique global standard to offer converged services at an international level. The International Telecommunications Union (ITU) is working towards a global standard, offering seamless global roaming (to

receive and make phone calls anywhere in the world without changing either number or handset), and high transmission rates (maximum speed of 2 Mbits/s for a stationary terminal and 348 Kbits/s for a moving one).

The broadband capacity of 3G mobile will enable development of a wide range of services not available today via mobile handsets. 3G mobile will offer internet access and graphical content interactive services. This will include video-conferencing, video telephony, real time video content and mobile commerce. Its technology is sophisticated enough to become a potential platform for e-learning services delivery.

In the next five years, most of Europe, Asia and the US will have access to 3G, but the future of 3G in Central and South America is currently uncertain.

Satellite

108. Satellite systems are mainly used to access the internet in remote areas where no alternative technology is available. A constellation of satellites enables operators to provide services over a large geographical area. Satellite systems are classified according to the orbital altitude they inhabit: geostationary (GEO), low earth orbit (LEO) and medium earth orbit (MEO). GEO systems use satellites situated some 36,000 km above the equator, each of them having a coverage area of 45 per cent of the globe. So far this system has primarily been used to provide voice and data communications, as well as TV, video, and audio broadcast services. Satellite services are being developed to offer internet access, but at present this is still relatively slow and expensive.

109. Mobile satellite services will become a viable solution only through LEO and MEO systems. LEO systems use non-fixed satellites at approximately 450 to 1,000 km above the earth; but unlike MEO, which are at 15,000 km, they require a large number of satellites (a minimum of 48 to 77) to offer global coverage. MEO systems have been specially designed to provide global coverage of communication services and require only 9 to 12 satellites. It is likely that the MEO service will be operable in the near future.

Cable modems

110. In parallel with wireless technology, the development of cable modem and CATV infrastructure provides improved access speeds to the internet. Cable modems are external devices connected to PCs. They convert digital signals to and from a radio frequency channel, which enables internet traffic to be conveyed via CATV infrastructure. Cable modems increase access speeds up to 27 Mbits/s downstream and up to 500 Kbit/s to 10 Mbits/s upstream.

111. Cable modems are shared amongst users through neighbourhood network nodes or a corporate remote LAN network. The performance of the service depends on the number of users that are simultaneously connected: the more simultaneous users the slower the access speed.

112. Two international standards have emerged for cable modems which are not interoperable: DOCSIS (Data Over Cable Service Interface Specification) in North

America and other international networks, and DVB/DAVIC (Digital Audio Video Council) in Europe.

113. The use of cable modem requires CATV networks to be upgraded to enable two-way transmissions. Cable network providers are currently implementing widespread upgrades to their networks. The development of interoperable cable modem standards should boost the use of this technology as an alternative channel for accessing the internet.

Digital Subscriber Line (DSL)

114. xDSL technology involves the upgrading of the existing copper wire telephone line connection to permit the transmission of higher bandwidth at the local end. As part of xDSL technologies, asynchronous (ADSL) is the most sophisticated technology that can be used for internet access, multimedia access, video on demand, and e-commerce. It is an asymmetric technology, which enables transmission of information to and from remote offices at speeds over 60 times faster than ISDN. ADSL offers data transmission rates/of up to 8 Mbits/s downstream and up to 1 Mbit/s upstream.

Broadband Wireless Local Loop (WLL)

115. Wireless Local Loop, also known as Fixed Wireless Access (FWA), is the technology that uses wireless links from the customer's premises to the local exchange for the provision of voice telephony and data transmission services. WLL technology can be broadband or narrowband. Broadband WLL enables access to Internet Protocol (IP) networks and therefore access to the internet. This technology is suitable in areas where the terrain and the telecommunications development make the installation of traditional services less attractive or less cost-effective. Although WLL is not common in the UK, it is proving a popular technology in the US, and will be very suitable in areas such as South America and some parts of Asia where the existing telecommunications infrastructure is undeveloped, particularly over the 'last mile'.

Voice over IP

116. Finally, although standards for voice over IP are still very undeveloped, the current low quality of voice transmission it offers makes it hard to see the benefits for the e-U of this latest technology. Voice over IP transmits voice telephony as packets over an IP network. Although the technology is still in its early stages, voice over IP is unlikely to match the quality of service of voice telephony transmission currently available over circuit switched networks. This is because IP networks are specially designed for data transmission. When packets of data are transmitted over IP networks, some packets can be lost or delayed during the transmission. This does not have significant impact on traditional data transmission, but would definitely be unacceptable for voice telephony services.

Status of local access technology around the world

117. Despite ITU objectives to develop a unique global standard for 3G mobile, the reality is that regulation and competition are not internationally uniform. The time scale for adoption of advanced technologies is likely to vary according to geographical location. The lack of regulatory uniformity may slow the implementation of new technologies in less developed countries unsure of which technology to adopt. This will limit local access bandwidth availability and international connectivity to internet backbone in particular geographical locations.

Europe

118. In Europe, the UK is one of the countries taking the lead in implementing advanced technologies for local access. Basic WAP services, such as a mobile banking service, are already available in the UK and in some other European countries.

119. The upgrading of GSM technology to support 3G networks has already started in the UK. British Telecom (BT Cellnet) announced at the end of June 2000 the launch of the world's first GPRS service and GPRS-based application. The service, initially only available to the corporate market, will enable mobile access to corporate networks. It will allow users to access the web and scheduler information, and to pick up e-mails. It is expected that GPRS services will spread over other market sectors in the coming months, targeting specific groups of workers.

120. In parallel with technology advances, efforts are being made to resolve regulatory issues ahead of the introduction of 3G mobile in Europe. Recommendations from the European Union to finalise licensing of Universal Mobile Telecommunications Systems (UMTS) by the end of 1999 and to launch the service by 1 January 2002, have put pressure on EU members to go ahead with the 3G mobile implementation process. After Finland, the United Kingdom was one of the first countries in the world to license 3G mobile operators. The auction, held in early 2000, allocated five licences authorising the operation of 3G mobile services from 2002. Licensing of UMTS in other European countries is following.

121. Finally, the development of the regulatory environment in Europe should help businesses to develop multi-channel delivery of higher bandwidth services. For example, OFTEL (UK's regulatory telecommunications authority) announced that BT will be required to offer unbundled local loop to third party service providers from 1 July 2001. Access to the local loop will enable BT’s competitors to offer access to the internet via ADSL technology. Similar rulings are expected for cable operators. OFTEL is currently considering whether cable network providers have excessive market power and therefore should be submitted to regulatory access open controls.

United States

122. In the US, ISDN technology is widely used as a means to access the internet; this is expected to continue for the next few years. However, alternative channels are also developing. Fixed broadband wireless services are currently offered at the

24GHz, 28GHz, and 38GHz bandwidth by various companies for the provision of internet access, high speed data transmission and videoconferencing services.

123. Other higher speed services such as Local Multipoint Distribution Service (LMDS) and Multichannel Multipoint Distribution Service (MMDS) are currently available and are becoming more widespread. As of early 1999, MMDS services (for high-speed internet access and wireless TV) were available (either commercially or in trials) in 18 states and accounted for about 1 million wireless cable subscribers.

124. Third generation mobile is expected to be available in North America from 2002.

Asia Pacific

125. In Asia Pacific, the most developed countries are building broadband networks to offer high speed voice, data and video services. These include Australia, Hong Kong, Japan, Singapore, and South Korea. Interactive multimedia services are already provided in most industrialised Asian countries through the use of ADSL and cable modems.

126. Japan is currently competing with European countries to be the first to commercialise 3G mobile services. Japan plans to launch its 3G mobile system in early 2001 (NTT Docomo previously launched its i.mode packet service in February 1999 in Japan).

127. In countries such as China, India and the Philippines, where rural areas are facing bottlenecks over the last mile of connectivity, WLL is expected to provide the solution.

Rest of the world

128. The global adaptation of internet technologies and e-business has further enhanced the availability of public internet access through traditional telecommunications services. As outlined earlier, this has now led to the development of broadband services with the aim to increase speed of access and quality of service. China, India and Brazil are following this trend and will increase the availability of high quality internet access as a response to growing user demand and market pressures. The e-U will act as a smart follower according to local service level available.

129. In Latin America, the current infrastructure remains generally quite poor, although it is better in South than in Central America. International connectivity to the internet predominantly relies on low capacity satellite links. However, with the arrival of foreign investment in the region (a large number of countries have now privatised their incumbent operator), new technologies are likely to be introduced to improve the local infrastructure.

130. Some analysts forecast that Latin America may be one of the regions with the most advanced technology infrastructure in the future. Anticipated changes include increased digitisation of the network, expansion of the fixed wireless access network, development of the data communications infrastructure based on IP protocol, and the introduction of integrated services such as fixed-mobile and cable telephony (based on cable television networks). International and intra-regional capacity is also expected to expand, with the deployment of submarine cables between the US and Mexico and neighbouring countries. Intra-regional networks already exist between Brazil and Argentina.

131. In Africa, network deployment for data transmission services is very limited. Apart from South Africa, African countries currently have very basic data transmission services. At the end of 1999, South Africa, Morocco and Tunisia were the only three African countries with connections to the internet at more than 10 Mbits/s. The chances are that, in the coming years, satellite technology will be deployed in African markets as a means to access the internet.

132. Satellite has been the technology chosen in several African countries for the provision of cellular and broadcast services. In October last year the launch of WorldSpace satellite broadcasting services across almost the entire African continent paved the way for the introduction of satellite systems and enabled the delivery of multimedia applications such as high speed internet, e-commerce, video conferencing and interactive entertainment. Despite the fact that satellite performance lags behind terrestrial links, this is the trend expected in most developing countries under-served by terrestrial or submarine cables. This is because most of the population is rural, and national demand for high bandwidth is not a priority.

133. SkyBridge LP, a company led by Alcatel, is currently developing an 80 LEO satellite constellation system that will offer combined broadband and narrowband services for business and residential users anywhere in the world. The service is due

to be launched in 2002 and is seen as a promising solution for offering a potential universal channel for the delivery of high bandwidth services.

Development of international internet architecture

134. For historical reasons, the internet transmission facilities are concentrated in the US, making it the hub through which all international traffic passes. Intra-regional traffic in Europe for example is mainly routed via the US. The trace route for world internet traffic is not dependent on distance but is based on time efficiency: because long haul cables offer higher transmission capacity, they deliver information packets in a shorter time than low capacity cables on a shorter route.

135. The location of Domain Name System (DNS) databases also explains why the internet has developed according to a US-centric typology. The DNS databases are stored in 13 root servers, only three of which are situated outside the US (in Tokyo, London and Stockholm). DNS database information can be accessed locally as Internet Service Providers store copies of it in their servers. But the information has to be updated on the root servers every two to three days, generating traffic to the US.

136. The US-centric internet backbone architecture is starting to diffuse, thanks to regulatory development in the rest of the world. Western Europe and East Asia are becoming secondary internet hubs as regulatory reforms have helped to drive down the cost of a local internet backbone. Increasing competition in European and Asian telecommunication sectors has reduced the costs of local regional long distance circuits. However, in less developed areas, intra-region links have grown more slowly because of the remaining monopoly environment and poor local infrastructure.

137. Figure 5 shows the availability of inter-regional internet bandwidth in 1999. Domestic backbone routes are not included.

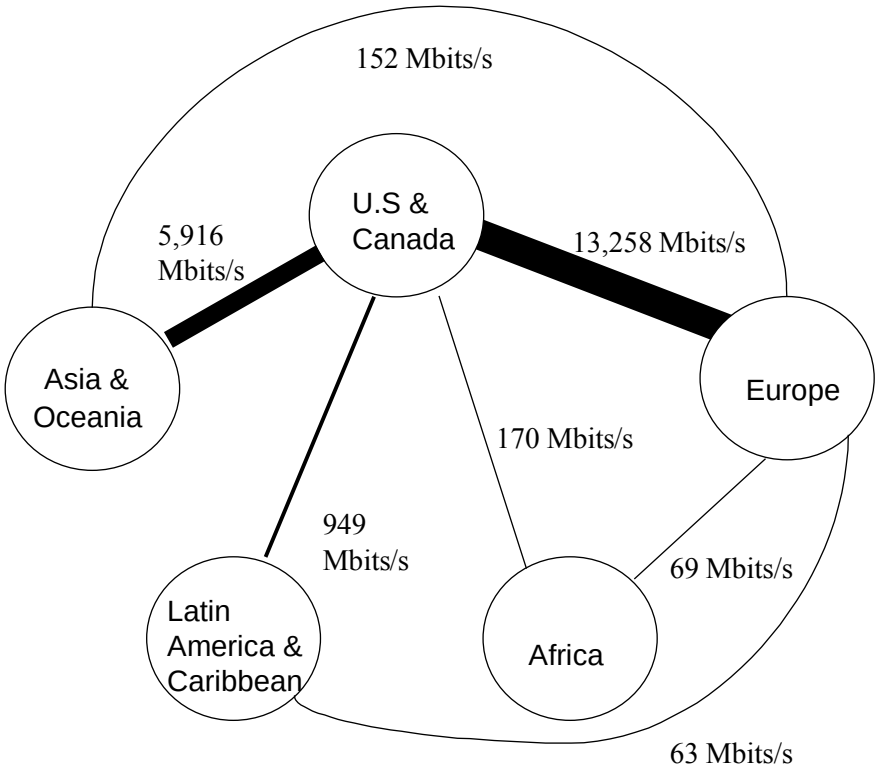


Figure 5 Inter-regional internet bandwidth, 1999

Source: 'Hubs and Spokes', TeleGeography, 2000.

138. Despite low bandwidth international connectivity in Africa and Latin America, whether or not (and how quickly) advanced services are commercialised in these regions depends more on the regulatory development than on technical factors. Indeed, if national governments authorise competition to develop, investment in local networks will increase and new technologies will roll out. In the past, and where regulatory development permitted it, internet backbones have developed in line with demand.

Development of Internet Service Providers (ISP)

139. An Internet Service Provider (ISP) provides its customers with access to the internet, generally via a PC. Customers usually visit the ISP homepage automatically, every time they log on to the internet. Figure 4 shows how individuals typically gain access to the internet.

140. There are currently two models: the first is a pure ISP which owns the technical infrastructure backbone required to offer the service. The second model is a Virtual Internet Service Provider (V-ISP) which leases the use of the technical infrastructure from an ISP but still maintains the direct contact with the customer.

141. Currently in the UK, ISPs and V-ISPs, especially those offering a free service, generate revenues by taking a portion of telephone call charges. ISPs sometimes charge for internet access but they are able to offer superior services which are more

reliable and sophisticated. The main ISP/V-ISPs in the UK are FreeServe, BT, AOL UK, Virgin, Compuserve, Tesco Net and Demon Net.

142. In other countries, particularly the US, there has been a move towards a flat rate subscription model. Currently many European businesses are exerting great pressure on OFTEL, and other telecom regulatory bodies, to move to this model. (Some UK ISPs have already started to introduce flat rate payment, which, unsurprisingly, has proved popular with customers.) ISP/V-ISP revenues generated from the subscription charges, which will probably be lower in total than call charge shares, will now need to be supplemented by e-commerce activities and advertising.

143. It is anticipated that, whilst ISPs will be able to protect their business, V-ISPs will find it much harder to be commercially viable and many will disappear. The only alternative for V-ISPs is to develop and strengthen their customer base by offering more value-adding services. Furthermore, technology trends will almost certainly mean greater demand for bandwidth both from businesses and home users. Because of their reliance on the network operators, a V-ISP's survival will depend on its ability to negotiate good commercial agreements with ISPs offering speedy internet access.

144. The e-U may consider becoming its own V-ISP to provide internet access to its students and partners. It is unlikely that the e-U would become an ISP because of the huge investment required to provide the technology infrastructure – a whole different business. The potential benefits for the e-U would be that it could:

- generate additional revenue
- develop and strengthen relationships with customers (a subscription model would mean having an ongoing billing relationship with customers).

145. However, there would be a risk that the V-ISP would not be able to generate sufficient revenues with a flat rate subscription model. External market forces and technology changes outside the control of the e-U would also have an impact on the success of such a venture. Furthermore, different countries have different requirements from an ISP which may make it a very complex and difficult operation to establish and run across many geographic locations (although the e-U could restrict its offering to certain countries).

146. If the e-U were to establish an ISP service for its target markets (likely to be students and partner organisations) it could offer specific services such as free e-mail or alumni services. Students of the e-U will need internet access anyway and it would be convenient for them to bundle in internet subscription charges with course fees. The e-U V-ISP could offer access to the internet via a number of different channels as the e-learning technology develops. This could differentiate the e-U's offering from other service providers.

147. The business model for an e-U V-ISP would need to be considered carefully before implementation, particularly in view of the predicted technology changes and the difficulties of offering such a service across many different countries. It may be that a subsidiary or partner operation(s) could offer the service in partnership with the e-U. The next steps for the e-U are to investigate ISP current and future predicted markets and technology providers in target e-U countries. If there seems to

be a good business case a business plan should be developed for an e-U V-ISP. However, in our view it is probable that the e-U will either leave the provision of internet access to local providers, or it will partner with others to act as a V-ISP.

Acronyms

3G	Third Generation
ADL	Advanced Distributed Learning
ADSL	Asynchronous Digital Subscriber Line
AICC	Aviation Industry CBT Committee
ASP	Application Service Provider
CMC	Computer Mediated Conference (or Collaboration)
CMI	Computer Managed Instruction
COTS	Commercial Off the Shelf
CPD	Continuing Professional Development
CRM	Customer Relationship Management
CVCP	Committee of Vice-chancellors and Principals
DNS	Domain Name System
DSL	Digital Subscriber Line
eBIS	Electronic Business Interchange Standard
EDGE	Enhanced Data-rates for GSM Evolution
EDI	Electronic Data Interchange
GEO	Geostationary
GPRS	General Packet Radio Service
GSM	Groupe Speciale Mobile
HEI	Higher Education Institution
IEEE	Institution of Electrical and Electronic Engineers
IETF	Internet Engineering Task Force
IMS	Instructional Management Project
IP	Internet Protocol
IPR	Intellectual Property Rights
ISDN	Integrated Services Digital Network
ISP	Internet Service Provider
JANET	Joint Academic Network
LAN	Local Area Network
LEO	Low Earth Orbit
LMS	Learning Management System
LTSC	Learning Technology Standards Committee
LTSN	Learning and Teaching Support Network
MEO	Medium Earth Orbit
MMDS	Multichannel Multipoint Distribution Service
PSTN	Public Switched Telephone Network

SCORM	Shareable Courseware Object Reference Model
UfI	University for Industry
UMTS	Universal Mobile Telecommunications Systems
V-ISP	Virtual Internet Service Provider
VPN	Virtual Private Network
WAN	Wide Area Network
WAP	Wireless Application Protocol
WLL	Wireless Local Loop
XML	Extensible Mark-up Language