Calimera Guidelines

Cultural Applications:
Local Institutions Mediating Electronic Resources

Underlying technologies and infrastructure

The Calimera Project is funded under the European Commission,
IST Programme

Calimera Guidelines
Underlying technologies and infrastructure

SCOPE

The cultural heritage sector aims to provide services which have a measurable social, economic and educational impact on their communities. This guideline describes the key technologies which underlie these services:

- XML (eXtensible Markup Language)
- web services
- Semantic Web
- Semantic Web services
- networks
- Broadband
- fibre optics
- satellite
- wireless
- WiFi

POLICY ISSUES

Back to Scope

Technology has already transformed the way museums, libraries and archives deliver services, and has made possible new services unimagined only a few years ago. Users are becoming used to the electronic delivery of services, for example in the retail and banking sectors. The focus of the EU's IST 6th Framework Programme is "*on the future generation of technologies in which computers and networks will be integrated into the everyday environment*" [1]. Cultural heritage institutions can play a major part in making this happen.

Delivering services electronically has implications for the general infrastructure consisting of buildings, furniture and equipment. Space must be found for computers, interactive displays and activities. Different types of furniture are required. Communications technology connections must be installed. On the other hand many users will access services remotely and for them physical space, furniture and equipment will be less important.

This guideline however focuses on the technological infrastructure, where policy issues for museums, libraries and archives include finding ways to keep up with increasingly sophisticated new technologies which quickly become obsolescent, selecting those technologies most relevant to their domains, satisfying the demanding expectations of users, and meeting European and national targets for e-accessibility.

Technologies and standards are still emerging and will continue to change and develop over time. Museums, libraries and archives need to be aware of the current state of the art so as to avoid the adoption of inappropriate or obsolescent technology and standards.

Museums, libraries and archives need an understanding of these issues in order to plan and prioritise their work and particularly when they are procuring new systems or commissioning development work from outside consultants or contractors.

XML – eXtensible Markup Language

Back to Scope

XML is a mechanism or "metalanguage" for creating special-purpose mark up languages. Its primary purpose is to facilitate the sharing of structured text and information between computers across the Internet. XML is formally defined as a recommendation of the World Wide Web Consortium (W3C). An understanding of mark up helps to understand XML. A mark up language is a set of rules for encoding or tagging structures in a document. The name is derived from the traditional publishing practice of "marking up" a manuscript, that is, adding printer's instructions in the margins of a paper manuscript, as used, for example, by the publishing industry to communicate printed works among authors, editors and printers. The XML specification defines a standard way to describe mark up.

The focus of XML is on the content of the document rather than the format or layout, i.e. the emphasis is on identifying a piece of text as a name and laying down rules for how a name should be structured rather than that the name should be bold, underlined or indented, since these are merely visual devices and do not represent the characteristics of a name, such as first name, last name, title etc.

XML documents can be made to conform to rule sets which are expressed as Document Type Definitions (DTDs) or Schemas. So a DTD or Schema might lay down the characteristics of a name and how it is to be encoded. Once a DTD or Schema (such as MARC-XML [2] or EAD (Encoded Archival Description) [3]) has been defined and published, any XML document may be associated with it. This mechanism allows XML documents to be validated and processed consistently by software applications, for a wide variety of purposes, e.g. search and retrieval, data exchange.

Finally XML is expressed in Unicode [4] which makes it language and computer independent.

For an introduction to the subject see *A Gentle Introduction to XML* by C M Sperberg-McQueen and Lou Burnard [5] on the TEI (Text Encoding Initiative) website. The TEI is an international and interdisciplinary standard that helps libraries, museums, archives, publishers, and individuals represent all kinds of literary and linguistic texts for online research and teaching, using an encoding scheme that is maximally expressive and minimally obsolescent [6]. (See also the 10 point summary produced by W3C [7].) More detailed information can be found on the websites of W3C [8], Wikipedia [9] and XML.COM [10]. There is a great deal of research and development

activity focused around XML. A good source of current information on query facilities and specifications, including tools such as xpath, is the webpage of the W3C XML Query Group [11].

Web Services

Back to Scope

Web Services evolved in response to the need for large organisations to enable a diverse range of software applications written in different languages and running on different hardware systems to share and exchange data. However outside the organisation the Internet is a similar mix of applications and environments. The cultural heritage sector is a good example – in order to discover resources on the Internet a searcher needs a facility that will enable him/her to get the results of a single search from a range of systems held in different databases with different data structures, search conventions and presentation facilities.

So what exactly are Web Services? A service is a piece of program code – usually written in Java, C#, or other object-oriented programming language – which specifies the means by which objects or classes of objects can be accessed and/or manipulated. Web Services use XML to describe services through the Web Services Description Language (WSDL) [12] and through the Simple Object Access Protocol (SOAP) [13] to pass messages between services and the client applications which use (consume) them. SOAP messages are mostly accessed using TCP/IP based protocols, e.g. HTTP, SMTP, FTP over Internet / Networks. Universal Description, Discovery and Integration (UDDI) [14] and Lightweight Directory Access Protocol (LDAP) [15] are directory services which enable available services to be discovered. Web services are language and hardware platform independent.

More detailed information can be found on the websites of W3C [16], OASIS (Organization for the Advancement of Structured Information Standards) [17], Wikipedia [18], and WS-I (Web Services Interoperability Organization) [19]. OASIS also provides a current awareness service [20].

For examples outside the cultural heritage sector and some fun with Web Services try *Xmethods*, a directory of simple services with demonstration capabilities [21].

Web services technology is developing rapidly. See for example WS-Security [22].

Semantic Web

Back to Scope

The Semantic Web is a vision described in a Scientific American magazine cover story in May 2001 [23], in which Tim Berners-Lee, Director of the World Wide Web Consortium (W3C), says "*The Semantic Web is a web of data, in some ways like a global database*". This builds on the idea that "*a goal of the WWW is that it should be useful not only for human-human communication, but also that machines would be able to participate and help*". Important concepts, technologies, protocols and standards for developing the Semantic Web include XML, RDF and unique identification. A good source of current information, and news about research and developments, is the W3C Semantic Web webpages [24]. In the European context, the 6th framework programme has demonstrated the EU's commitment to this technology area and the first European Semantic Web Symposium was held at Heraklion, Greece, in May 2004 [25].

RDF (Resource Description Framework)
RDF enables the encoding, exchange and re-use of structured metadata, using XML as an interchange syntax. In this way it supports the integration of a variety of applications from library catalogues and world-wide directories; to syndication and aggregation of news, software, and content; to personal collections of music, photos, and events.

RDF allows statements to be made about a resource as a set of properties that conform to a named schema. Statements are recorded in rdf:Description XML elements.

The reason it is so powerful is that it imposes structural constraints which support the consistent and unambiguous encoding and exchange of standardized metadata and this provides for the interchangeability of separate packages of metadata defined by different resource description communities. In addition RDF provides a means for publishing both human-readable and machine-processable vocabularies designed to encourage the re-use and extension of metadata semantics among disparate information. Descriptions of RDF sometimes use libraries as an analogy. For information see the W3C RDF webpages [26].

The Web Ontology Language (OWL) [27] builds on RDF and RDF Schema to add a richer vocabulary to describe properties and classes. OWL facilitates the creation of definitions of basic concepts and their relationships that can be processed by machine. OWL is derived from DAML+Oil [28], the latest release of the DAML language, which provided a rich set of constructs with which to create ontologies and to markup information so that it is machine readable and understandable.

Semantic Web Services

Back to Scope

Web services are sites that do not merely provide static information but allow some action, such as the sale of a product. Semantic Web services aim to enable users to locate and use such services automatically. WSMO (Web Service Modeling Ontology) [29] defines ontologies for describing the various aspects of a Web Service. OWL-S [30] (formerly DAML-S [31]) is an ontology of services that aim to make this possible. The importance of ontologies to Semantic Web services has prompted the development of schema extensions to existing Web standard languages: XML has been extended to give XML-Schema (XMLS) [32], while RDF has been extended to give RDF-Schema (RDFS) [33].

Ontologies

Ontologies are crucial to the development of intelligent web services by helping machines to communicate more effectively. An ontology may be described as a formal description of objects and their inter-relationships. In the context of the Semantic Web, the aim is to enable machines to speak to machines with limited or no human intervention (see Wonderweb [34]). There are progressively more semantically rich approaches to modelling ontologies, including:

- term lists with undefined relationships;
- classification schemes;
- thesauri with inheritance and association relations;

- topic maps [35], a new ISO standard for a system describing knowledge structures and associating them with information resources. They should provide powerful ways of navigating large and interconnected corpora. Instead of replicating the features of a book-index the topic map generalises them, extending them in many directions at once.

Ontologies are of growing importance in knowledge management systems and in the development of Semantic Web services. They have applications in knowledge management systems such as e.g. in e-commerce for the description of products and services (see the guideline on Social and economic development), and the description and organisation of digitised museum collections.

Projects may wish to explore the potential for semantic interoperability offered by established ontologies such as the CIDOC Conceptual Reference Model (CRM) [36] or the ABC Ontology/Model [37]. The CRM provides a common and extensible semantic framework that any cultural heritage information can be mapped to, and can provide a model for mediating between different sources of information. The ABC Ontology, developed for the Harmony Project, is a top-level ontology intended to facilitate interoperability between metadata schemas within the digital library domain.

Networks

Back to Scope

Any two or more computers connected together makes a network. A network allows computers to share files, printers, scanners, and Internet connections. There are two main types of networks: Wireless and Ethernet (or “wired”). Both types have two main components: a base station (also known as a gateway or router), and a network adapter for each computer on the network. In a wired network, Ethernet cables connect each computer’s network adapter to the base station, or router. In a wireless network, radio waves are used to communicate between each networked computer’s wireless adapter and the Wireless Base Station. Depending on the range covered, a network can be a PAN (Personal Area Network), a LAN (Local Area Network), or a WAN (Wide Area Network). Wireless technology enables global networking.

Filesharing networks allow users to request and distribute electronic files through their computers, often acting as both a client and a server on the network. Computer and handheld operating systems can integrate Peer-to-Peer (P2P) [38] capabilities to harness the file sharing, distribution and communication aspects of the technology. File sharing services such as Foldershare [39], Groove Networks [40], Skype [41], Gnutella [42] and Kazaa [43] enable all types of digital objects including film, images and software to be shared.

Broadband

Back to Scope

Broadband is a type of data transmission in which a single medium (wire) can carry several channels at once, so users can use the telephone and surf the web at the same time. It has sufficient bandwidth to support sophisticated multi-media applications. A typical speed for a dial-up modem is 56 kilobits per second; a broadband connection can be up to 1,000 times faster. Most larger organisations will use ISDN (Integrated Services Digital Network) modems, or T1 or T3 connections (high-capacity, always-on network connections that directly connect a local area

network (LAN) to the Internet, usually through a telephone company). Digital Subscriber Lines (DSL) and digital cable connections can be used by small institutions or in homes. DSL is a relatively inexpensive always-on connection to the Internet which uses a phone line without interrupting the phone service. Speeds are about 1.5 megabits per second. Digital cable connections are also always-on and are transmitted over copper or fibre optic cables at speeds up to 1 megabit per second.

Fibre optics

Back to Scope

Optical fibres are glass fibres which are used to carry signals in the form of pulses of light over distances of up to 50 kilometres. The signals may be coded voice communications or computer data. As they use much less energy than copper cable and can support a much higher bandwidth, they can carry more channels of information over longer distances. Optical fibre cables are very light and thin and so easier to install in cabling ducts. It is difficult to tap information from them, and they are immune from interference from radio signals etc. and from fire. Optical fibres are coming into common use in Local Area Networks, cable TV, CCTV (Closed Circuit TV), etc.

Satellite

Back to Scope

Satellite Internet access may be worth considering for systems serving largely rural communities. It uses a satellite dish for two-way (upload and download) data communications. Upload speed is about one-tenth of the 500 kilobits per second download speed. Cable and DSL have higher download speeds, but satellite systems are about 10 times faster than a normal modem. Two-way satellite Internet uses Internet Protocol (IP) multicasting technology, which means up to 5,000 channels of communication can simultaneously be served by a single satellite which sends data from one point to many points, simultaneously, in compressed format. Compression reduces the size of the data and the bandwidth. Dial-up land-based terrestrial systems have bandwidth limitations that prevent multicasting of this magnitude.

Satellite Internet represents the best opportunity for remote areas to gain access to worldwide communications. It is not subject to local control over access or content. It has the ability to reach people no other communications medium can at a practical cost.

Wireless

Back to Scope

Wireless technologies enable connectivity without the restrictions of wires and cables. There are several kinds of wireless networks covering ranges from the size of a desk top to whole continents:

- Local wireless (or PAN - Personal Area Network) for use within an office or room. Allows connectivity between cordless mice, keyboards, laptops and printers etc. using radio or infrared technologies.
- Wireless Local Area Network (WLAN) for connecting typically 10 to 15 users over a range of about 100m indoors or 300m outdoors. Could be useful in a museum, library or archive with several rooms or floors, or at an outside heritage site. Most WLANs are built to WiFi standards (see below).
- Wireless Wide Area Network (wWAN) e.g. mobile phone network for connecting worldwide.

For an overview see *Wireless networks* by Deborah Liddle and Stuart Smitton [44].

Wireless standards/protocols include:

- GSM (Groupe Spécial Mobile - Global Systems for Mobile Communications) [45], the dominant second-generation (2G) digital mobile phone standard for Europe. It uses a land-based network of masts and stores information on SIM cards;
- Bluetooth [46], a short range radio technology with a range of about 10 metres which can support labelling devices and barcode scanners etc.;
- WAP (Wireless Application Protocol) [47], designed to connect mobile phones etc. to the Internet. Users view web pages written in WML (Wireless Mark-up Language) [48];
- GPRS (General Packet Radio Service) [49], a 2.5G technology (i.e. it is more advanced than standard 2G digital technology, but does not meet the requirements of a full-fledged 3G technology) that allows information to be sent and received across a mobile telephone network. It has a faster transfer rate than WAP and a higher success rate for connection.
- Universal Mobile Telecommunications System (UMTS) [50], one of the third-generation (3G) mobile phone technologies. Transmission speed can be up to 2 megabits per second per mobile user and global roaming is possible.

WiFi Back to Scope

WiFi (Wireless Fidelity) is a technology for transferring network data between computers without the need for cabling.

A WiFi access point (sometimes called a 'hotspot) will 'broadcast' a wireless signal that can be received by a wireless-enabled device. This can be a laptop, a Personal Digital Assistant (PDA), a 3G mobile telephone or any other device capable of receiving a wireless signal.

The major development in WiFi has been the proliferation of WiFi hotspots. WiFi hotspots are aimed primarily at people on the move who wish to get access to the Internet or other secure networks via the Internet. Typical locations for hotspots are fast food restaurants, coffee houses, railway stations, hotels and libraries. However, supercharged hotspots are now being developed which cover whole city centres. Some WiFi hotspots are available free of charge but most require a payment based on a specific period of time (e.g. per 30 minutes).

The WiFi hotspot enables the user to simply switch on (for instance) their laptop and begin to surf the Internet without having to physically connect or 'plug in' to the host network. This has obvious benefits for the person who is away from the office and needs to check e-mail, the researcher who stores data on his/her own laptop, or anyone that just needs a convenient site to browse the Internet.

WiFi is convenient for the host organisation because it offers a relatively cheap way of providing a public Internet access facility. If a network is already in place, the WiFi kit to extend the reach of the network (usually about 100 metres) is fairly inexpensive. Building a WiFi hotspot from scratch will require the installation of a dedicated (for instance ADSL - Asymmetric Digital Subscriber Line) feed from an Internet Service Provider.

Technical standards for WiFi have been developed by the Institute for Electrical and Electronic Engineers (IEEE) [51]. The standard usually associated with WiFi hotspots is 802.11b but the 802.11 standard has a number of variants for different types of wireless applications. The UK Department of Trade and Industry has published a useful short factsheet on WiFi [52]. Other sources of information include *WiFi Networking News* [53], an online newsletter reporting on developments regarding standards etc., and the *WiFi Alliance* [54], a not-for-profit international association formed in 1999 to certify interoperability of wireless products based on IEEE 802.11 specification. The website contains a guide to creating a wireless network, and lists WiFi hotspots worldwide.

FUTURE AGENDA

Back to Scope

The Semantic Web has a long way to go before the dream of Tim Berners-Lee is realised. It will be built in parts, by people with varied interests. The real power of the Semantic Web will be realised when people create many programs that collect web content from diverse sources, process the information and exchange the results with other programs. In its envisaged next step, the Semantic Web will break out of the virtual realm and extend into the physical world. The vision of the web-enabled microwave oven consulting the frozen-food manufacturer's website for the best cooking instructions can be extended to the services provided by museums, libraries and archives. The virtual picture frame might for example, consult the local museum or art gallery for an ideal picture to display, and the local virtual public library for an ideal e-book biography to download to accompany it, in response to a simple voice request. In this environment, the imagination of cultural heritage people should be encouraged to run wild! The EU IST FP6 is funding new projects in this area [55].

In the future, ontologies may be used to support content-based access and to provide users with much more sophisticated searching and browsing capabilities as well as support from intelligent agents.

In the future it is envisaged that directories of Web Services will be available on the Internet for client programs to seek out and consume. There are however issues of maintenance, persistence, quality, control, security and IPR to be resolved before such a vision is universal. In the meantime closed communities are implementing their own controlled libraries of services.

In the next few years web services may be developed which can be understood and used automatically by the computing devices of users. External Application Services Providers (ASPs) for cultural heritage organisations may also provide such services. The concept of web services is currently being developed under the banner of e-commerce. However, there do appear to be potential applications for public sector service providers. For example, search interfaces could be accessed or provided as web services by public libraries or by Application Service Providers on their behalf. The overwhelming need to develop plug-in modes of technology transfer from industry to local cultural heritage institutions is a key element for the future.

The flexibility of XML is one of the principle reasons for its popularity. But it is also one of its potential weaknesses. New XML-based languages, schemas etc. are defined every day. The long term value of XML will depend to a significant extent on user communities agreeing to focus on adapting and developing a few core standards rather than on proliferation.

The popularity of mobile phones illustrates how people now require access to services while on the move. WiFi technology is likely to develop to meet growing demand. Public libraries are ideal places for WiFi hotspots, given their synonymity with information; indeed some are already and the number is likely to grow. WiFi hotspots have traditionally covered a small area such as a café, but a more powerful version is now being developed which will cover much larger areas with fewer base stations, and this may supersede the need for individual hotspots. Also mobile phones are being made with WiFi technology allowing much faster Internet access, and computers are being built with WiFi chips and access cards as standard features. This is an interesting development which, over time, may well change the Internet delivery infrastructure to wireless, particularly in large cities and other highly populated areas.

Wi-Fi is revolutionizing the way museums and exhibitions use technology to serve their visitors. Many museums are replacing their existing audio head set devices with interactive, context-aware, location based tours powered by Wi-Fi handsets.

Technologies are developing rapidly and delivery channels are getting increasingly smaller and more portable. Keeping up with developments will be important for museums, libraries and archives, and will pose challenges in terms of finance, infrastructure, staff skills and user expectations. Staff and policy makers need to use communications form professional associations, mailing lists, newsletters and other current awareness techniques to keep up-to-date. Projects such as DigiCULT [56], which monitors and assesses existing and emerging technologies specifically for the benefit of the cultural heritage sector and which publishes newsletters and technology watch reports, are invaluable.

REFERENCES

Back to Scope

[1] EU IST 6th Framework Programme
http://europa.eu.int/comm/research/fp6/index_en.html

[2] MARC 21 XML Schema - The Library of Congress' Network Development and MARC Standards Office is developing a framework for working with MARC data in a XML environment. This framework is intended to be flexible and extensible to allow users to work with MARC data in ways specific to their needs. The framework itself includes many components such as schemas, stylesheets, and software tools. http://www.loc.gov/standards/marcxml/

[3] EAD (Encoded Archival Description) http://www.loc.gov/ead/

[4] Unicode http://www.unicode.org/

[5] Sperberg-McQueen, C. M. and Burnard, Lou: A Gentle Introduction to XML. TEI Consortium, 2004. http://www.tei-c.org/P4X/SG.html

[6] Text Encoding Initiative (TEI) - The TEI is an international and interdisciplinary standard that helps libraries, museums, archives, publishers, and individuals represent all kinds of literary and linguistic texts for online research and teaching, using an encoding scheme that is maximally expressive and minimally obsolescent. http://www.tei-c.org

[7] World Wide Web Consortium (W3C): XML in 10 points http://www.w3.org/XML/1999/XML-in-10-points.

[8] World Wide Web Consortium (W3C) - XML site http://www.w3.org/XML

[9] Wikipedia http://en.wikipedia.org/wiki/Xml

[10] XML.COM – a site covering all aspects of XML http://www.xml.com/pub/a/98/10/guide1.html#AEN58

[11] World Wide Web Consortium (W3C) XML Query Group http://www.w3.org/XML/Query

[12] Web Services Description Language (WSDL) http://www.w3.org/TR/wsdl

[13] Simple Object Access Protocol (SOAP) http://www.w3.org/TR/soap12-part1/

[14] Universal Description, Discovery and Integration (UDDI) http://www.uddi.org/

[15] Lightweight Directory Access Protocol (LDAP) http://www.openldap.org/

[16] World Wide Web Consortium (W3C) – The major source of Web standards http://www.w3c.org/2002/ws/

[17] OASIS (Organization for the Advancement of Structured Information Standards) - a not-for-profit, global consortium that drives the development, convergence and adoption of e-business standards. http://www.oasis-open.org/who/

[18] Wikipedia http://en.wikipedia.org/wiki/Web_services

[19] Web Services Interoperability Organization (WS-I) http://www.ws-i.org. See also http://xml.coverpages.org/ws-i.html

[20] OASIS provides *Cover Pages* as a current awareness service http://xml.coverpages.org/

[21] Xmethods http://www.xmethods.net/

[22] Web services technology is developing rapidly. See for example WS-Security http://www-106.ibm.com/developerworks/webservices/library/ws-secure/

[23] Berners-Lee, Tim; Hendler, James and Lassila Ora: The Semantic Web. Scientific American, May 2001. http://www.scientificamerican.com/article.cfm?articleID=00048144-10D2-1C70-84A9809EC588EF21&catID=2

[24] World Wide Web Consortium (W3C) - Semantic Web webpages http://www.w3c.org/2001/sw/

[25] European Semantic Web Symposium, Heraklion, Greece, May 2004. http://www.esws2004.org/

[26] World Wide Web Consortium (W3C) RDF webpages http://www.w3.org/TR/2004/REC-rdf-primer-20040210/

[27] World Wide Web Consortium (W3C) Web-Ontology (WebOnt) Working Group: [Web Ontology Language (OWL)] http://www.w3.org/2001/sw/WebOnt/
OWL Web Ontology Language Overview http://www.w3.org/TR/owl-features/

[28] DAML+OIL http://www.daml.org/about.html

[29] WSMO (Web Service Modeling Ontology) http://www.wsmo.org/

[30] OWL-S http://www.w3.org/Submission/2004/SUBM-OWL-S-20041122/

[31] DAML-S http://www.daml.org/services/

[32] XML-Schema (XMLS) http://www.w3.org/XML/Schema

[33] RDF-Schema (RDFS) http://www.w3.org/TR/rdf-schema/

[34] Wonderweb http://wonderweb.man.ac.uk/

[35] Pepper, Steve: The TAO of Topic Maps: finding the way in the age of infoglut. Paper presented at XML Europe 2000, Graphics Communications Association. http://www.gca.org/papers/xmleurope2000/papers/s11-01.html

[36] CIDOC Conceptual Reference Model (CRM) http://cidoc.ics.forth.gr/

[37] The ABC Ontology and Model
http://jodi.ecs.soton.ac.uk/Articles/v02/i02/Lagoze/

[38] Peer-to-Peer (P2P) http://www.openp2p.com/

[39] Foldershare http://www.foldershare.com/

[40] Groove Networks http://www.groove.net/

[41] Skype http://www.skype.com/

[42] Gnutella http://www.gnutella.com

[43] Kazaa http://www.kazaa.com

[44] Liddle, Deborah and Smitton, Stuart: Wireless networks. An issue paper from the Networked Services Policy Taskgroup.
http://www.ukoln.ac.uk/public/earl/issuepapers/wireless.html

[45] GSM (Groupe Spécial Mobile - Global Systems for Mobile Communications) http://www.gsmworld.com/index.shtml

[46] Bluetooth http://www.bluetooth.com/

[47] WAP (Wireless Application Protocol)
http://www.cordis.lu/ist/99helsinki/finland/wap.html

[48] WAP Wireless Markup Language Specification (WML)
http://xml.coverpages.org/wap-wml.html

[49] GPRS (General Packet Radio Service)
http://www.gsmworld.com/technology/gprs/intro.shtml

[50] Universal Mobile Telecommunications System (UMTS)
http://www.iec.org/online/tutorials/umts/

[51] IEEE (Institute of Electrical and Electronics Engineers) Standards Association http://standards.ieee.org/

[52] UK Department of Trade and Industry: WiFi factsheet.
http://www.dti.gov.uk/bestpractice/assets/wifi.pdf

[53] WiFi Networking News http://www.wifinetnews.com/

[54] WiFi Alliance http://www.wi-fi.org/

[55] EU IST projects helping to weave the Semantic Web [61].
http://istresults.cordis.lu//index.cfm?section=news&tpl=news&ID=65260

[56] DigiCULT project http://www.digicult.info/pages/index.php

Czech Republic

The National Archives (formerly the State Central Archives)
Czech archives use the following technologies in connection with the Internet: XML, web services, Broadband, fibre optic, satellite, wireless, WiFi, a Networks.
http://www.nacr.cz

System Kramerius
This system has a user and administrator interface. It is formed by database PostgreSQL, file system, disc field, server and a back-up system, and is based on open source on GNU GPL licence which will enable all other institutions to use it without any fee. The system is based on standard XML. http://kramerius.nkp.cz/

Finland

Mantsala
The town of Mantsala has an 11 square kilometre WiFi network available to the public and to schools.
http://www.80211gnews.com/publications/page354-880326.asp

MuseumFinland - Finnish Museums on the Semantic Web
A portal which provides the end user with a semantic seamless view of distributed cultural collections. By using semantic web techniques, it is possible to make collections semantically interoperable and provide museum visitors with intelligent content-based search and browsing services to the global collection base.
http://museosuomi.cs.helsinki.fi; http://www.cs.helsinki.fi/group/seco/museums/

Hungary

CodeXML
CodeXML is a frame system developed by Scriptum Inc. with stable database background, designed to store, manage and query objects and descriptive information belonging to the objects. http://codex.scriptum.hu

The Netherlands

HotSpot Amsterdam
In August 2004 HotSpot Amsterdam launched a wireless computer network with a supercharged version of WiFi technology which will cover the whole city with 125 antennae. http://www.hotspotamsterdam.com/ . (For an article about this see http://www.reuters.com/newsArticle.jhtml?type=internetNews&storyID=6104054.)

Norway

Digital Repository of the National Library of Norway (NLN)
The NLN has developed a generalised input/output service for the Digital Repository based on open standards (SOAP communication protocol via HTTP, Software in Java,

based on the SOAP-Library Apache Axis, Linux-server, Tomcat application server, Oracle database). (Still under development so no website.)

Kulturnett Norge / Culture Net Norway
The official gateway to Norwegian culture on the web, Kulturnett Norge represents a new form of portal using Topic Maps and XML to distribute information to personal devices such as PDAs and mobile phones. For more information about Topic Maps see http://www.ontopia.net (in English). The Topic Maps ISO standard, ISO 13250, can be found at http://www.isotopicmaps.org/m4tm/.
http://www.kulturnett.no; http://www.culturenet.no

Russia

ARBICON
This project links libraries from 54 regions and creates an "umbrella" for local library systems on a regional basis. System solutions are based on open standards: Z39.50, ISO ILL, LDAP. http://www.arbicon.ru

United Kingdom

AIM 25, Archives in London and the M25 area.
A major open archive initiative to provide electronic access to collection level descriptions of the archives of over fifty higher education institutions and learned societies within the greater London area. http://www.aim25.ac.uk/

Bristol StreetNet
Started in autumn 2004, this is an outdoor wireless access zone with wireless hotspots installed inside street furniture such as lamp posts.
http://www.cityspace.com/press/level2/releases/040722-PR-Bristol.asp

Cornucopia
A database of collection descriptions funded by MLA in England which utilises Web Services to enable concurrent searching across multiple targets.
http://www.cornucopia.org.uk/search

Natural History Museum
The Natural History Museum's collections and research Data Locator uses ontologies to find information about organisms and material held on the museum's online databases. http://internt.nhm.ac.uk/jdsml/locator/index.dsml

OSS Watch
A web-based clearing-house for up to date information, advice and guidance about free and open source software. It develops best-practice guidelines, investigative reports, and briefing materials for strategic IT decision-makers, software developers, and end-users. http://www.oss-watch.ac.uk/

The People's Network
The remit of the People's Network was to provide all UK public libraries with a broadband connection. This has not been possible in some rural areas, so 10 rural

public libraries are now using WiFi as a pilot. This makes it possible for people to use their own WiFi-enabled devices in the library so increasing the usefulness for small businesses etc. where security is an issue. (See Potts, David: *Libraries Go Wireless - extending broadband to rural communities*. 15 July 2004. http://www.peoplesnetwork.gov.uk/news/article.asp?id=333)