027607

mGBL

mobile Game Based Learning

Specific Targeted Research Project

Information Society Technologies

D 4.1 – Standards and technology monitoring report [revised version]

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University of Maribor

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Project co-funded by the European Community within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other program participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

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1 General Deliverable information

This section provides general information about the deliverable.
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1.1 General Deliverable Description

WP number:	**WP 4**
WP name:	**System specification, Web and Mobile Interfaces for Applications**
Deliverable number:	**D 4.1**
Deliverable name:	**Standards and technology monitoring report**
Responsible work package leader: **name:** address: email: phone: mobile: fax:	 **Gregor Lenart** Faculty of Organizational Sciences Kidriceva cesta 55a 4000 Kranj Slovenia Gregor.Lenart@fov.uni-mb.si +386 4 2374 292 +386 51 380 188 +386 4 2374 365
Involved project partners:	**UM, evolaris, ARC-sr, Trieste, PFRI**

Table 1: General Deliverable Description

1.2 Revision history of this document

Date	Version	Description	Author
09-02-2006	0.1	Standards and technology monitoring report – content structure	Gregor Lenart, University of Maribor
22-02-2006	0.2	Technology overview – First draft	Kristina Bogataj, University of Maribor
09-02-2006	0.3	Technology selection – First draft	Richard Hable, evolaris
10-02-2006	0.4	Technology selection - First complete version	Richard Hable, evolaris

13-02-2006	0.5	Technology selection - Tomcat added, Browser requirements changed	Richard Hable, evolaris
26-03-2006	0.6	New learning approaches- First draft	Prof. Dragan Cisic, University of Rijeka
31-03-2006	0.7	New learning approaches- First complete version	Prof. Dragan Cisic, University of Rijeka
29-03-2006	0.8	Standards overview - First draft	Anna Vatta, University of Trieste
31-03-2006	0.9	Standards overview - Final version	Anna Vatta, University of Trieste
31-03-2006	0.95	Technology overview – emerging technologies added	Uros Hribar, Kristina Bogataj, University of Maribor
2-04-2006	1.0	Standards and technology monitoring report – content structure – Write up first complete version of the D 4.1 report	Gregor Lenart, University of Maribor
6.4.2006	1.1	Web technologies edited	Kristina Bogataj, University of Maribor
6.4.2006	1.2	Standards and technology monitoring report – editing full report	Uroš Hribar, University of Maribor
7.4.2006	1.3	Technology selection updated – opensource database	Thomas Ebner, evolaris
11.4.2006	1.4	Final version	Gregor Lenart, Uros Hribar, Kristina Bogataj, University of Maribor
29.3.2007	1.5	eLearning standards	Steffano Mininel. University of Trieste
31.3.2007	1.6	Final version for externally reviewed for resubmission	Gregor Lenart, University of Maribor
23.4.2007	1.7.	Final reviewed version for resubmission	Gregor Lenart, University of Maribor Reviewer: Andreja Pucihar, University of Maribor

1.3 External peer-review (internal chapter, not part of the public deliverable)

This section contains a description and an overview of the results of the external peer-review of the deliverable. This is an internal chapter (consortium, Project Officer and reviewers) and will be removed within the final public version of the deliverable.

1.3.1 General description of the review process

Review process description

- Work package leader have to send final version of deliverable to the reviewer 2 weeks before deliverable due date as defined in Annex1.
- Work package leader coordinates the external review (date, time, availability of the reviewer, payment, …) with the selected external reviewer
- The reviewer provides his report within an extra chapter within the deliverable. The report has to be submitted within 1 week and returned to the work package leader. This chapter is not part of the final version of the deliverable to be published. This chapter will only used internally - only for consortium members, Project Officer and Reviewer.
- The work package leader has to implement all recommendations into the deliverable and put his\her feedback to the recommendations also within an extra chapter within the deliverable. This chapter will only used internally - only for consortium members, Project Officer and Reviewer.
- The work package leader has to send the final version of the deliverable to Hans Joerg Peyha at the due date of the deliverable the latest.

Reviewer CV

Andreja Pucihar is assistant professor at the Faculty of Organizational Sciences, University of Maribor. She is a head of eMarkets Laboratory (http://ecenter.fov.uni-mb.si/ecomENG/Labs/eMarkets.htm) and head of eMarkets LivingLab (http://elivinglab.org/Markets/) and eGovernment LivingLab (http://elivinglab.org/Government).

Through both laboratories, she is involved into the several EU projects and intensively cooperates with industry. She is serving as a National Contact point of the eMarketServices initiative(http://www.emarketservice.som), which was funded by European Commission.She is involved in 3 EU funded projects (eGOVRTD2020 http://www.egovrtd2020.org , SEAMLESS http://www.seamless-eu.org, RURAL eGOV http://rural-egov.eu).

She cooperates with centres involved in eCommerce research at various universities as for example University Colleague Dublin, Ireland; Technical University Košice. Slovakia; Utrecht University, The Netherlands.

Since 1995, she has been involved in eCommerce Center and its several research and e-commerce activities, as for example annual international Bled eConference, where she is serving as a Conference Chair Assistant.

Her current research includes: e-marketplaces, business-to-business e-commerce, e-learning, supply chain management, business process reengineering, e-government and new e-commerce business models.

1.3.2 Comments and Recommendations of the External Reviewers

The Standards and technology monitoring report provides comprehensive high level overview off standards and information technology development. The report is structured into 4 main chapters:

- Chapter *"Review of existing and emerging web and mobile technologies with focus to web and mobile services"* describes web, mobile current and emerging technologies given by examples and lists standards related to web and mobile application development.
- Chapter *"Standards overview"* provides description of Internet and mobile protocol suite of standards and describes also organizations for standards and interoperability. This chapter includes also extensive review of elearning standards and its applicability to mGBL project which was also requested by EC reviewers during yearly mGBL project review.
- Chapter "*Technology selection*" provides list of selected technology to be used for development of mGBL platform. The usage of open source technology is preferred for the development of mGBL platform.
- Chapter "*New Learning Approaches and Scenarios Evaluation"* provides description of new learning approaches by research of usage of games for learning.

Recommendations for improvements:

1. The *"Standards and technology monitoring report"* covers very dynamic and fast developing field of Information technology. Therefore there is a need for constant updating on latest development in this field. I would recommend to updated the content with latest developments for final "*D4.3 Final report on monitoring and specification"* in order to reflect the real current state in this fast developing field.
2. I would recommend that in final deliverable "*D4.3 Final report on monitoring and specification"* the content is focused only on technologies and standards, which will be used or explored in mGBL project. As the D4.1 reports on the state of play at the beginning of the project this might only be possible for final report "*D4.3 Final report on monitoring and specification".*

Overall impression is that the content of deliverable "*D4.1: Standards and technology monitoring report"* contains content that is defined by Annex 1 - Description of Work.

1.3.3 Justification and actions/corrections taken regarding the external peer-review

We acknowledge reviewers recommendations for further improvements on reporting of standards and technology development which will be incorporated into “D4.3 Final report on monitoring and specification”.

To comply with reviewer recommendations we are planning in “D4.3 Final report on monitoring and specification” to focus on standards and technology trends which are more directly linked or influenced to mGBL project and as such provide a final report which more focused to domain of mGBL project.

1.4 Research Background

Standards and technology monitoring report presents finding of initial research on standards and technologies which are examined for development of envisioned mGBL platform. Thus this report contains findings which are based on literature review of information technology research, elearning standards and web/mobile services.

D 4.1 Standards and technology monitoring report provides a direct input into deliverable “D4.2 Systems specification” in form of technology selection and into “D4.3 Final report on monitoring and specifications” as base for final report on standards and technology related to the mGBL platform.

D 4.1 Standards and technology monitoring report also provides an in-direct input (informs) into deliverables “D3.3 Mobile Learning Game Models” by informing it on new learning approaches and scenarios evaluation.

1.5 Executive Summary of the Deliverable

Standards and technology monitoring report presents an overview of standards and technologies which are examined for development of envisioned mGBL platform. Special focus is given to the review of learning standards. Objective of this report is also to present an overview of emerging technologies in the field of web and mobile services to enable technology selection for mGBL platform. mGBL platform technology selection is based on analysis of standards, technologies and emerging web as well as mobile services. At the end of report new learning approaches and scenarios are presented with special focus on use of games for learning purposes.

2 Review of existing and emerging web and mobile technologies with focus to web and mobile services

The objective of standards and technology monitoring report is to present an overview of standards and technologies which relates to development of mGBL platform. Furthermore the objective of this report is also to present an overview of emerging technologies in the field of web and mobile services in order to provide direction setting for technology selection of the mGBL platform.

Information and communication technologies (ICT) has a vital role to play in achieving the ambitious objectives set by Lisbon strategy which was adopted by Heads of States and Government of the European Union during Lisbon European Council in March 2000. Latest report "Use of the Internet among individuals and enterprises" issued by Eurostat (Ottens ,2006a) shows that almost half of European households 48% had internet access in 2005 and 91% of enterprises with 10 or more employees had internet access in the January 2005. These two figures show a growth in usage of internet among households and enterprises over the last years.

Similar growth trend can be also observed in field of usage of mobile services. The report "Telecommunications in Europe" published by Eurostat (Ottens, 2006b) shows that there were in 2004 in Europe 25 altogether 409 millions mobile subscriptions which also shows 36.2% an average growth over last 8 years period. The mGBL project builds on widespread usage and development of web and mobile services in Europe.

2.1 Web technologies

For the past years, the Web has become the platform of choice for delivery of educational content. Web browsers have expanded dramatically their capabilities, adding the ability to incorporate seamlessly audio/video or "plug-in" applications, to display content in sophisticated layouts, and to interact with the user through client-side script ability. A big change has also been made: support for Web browsing on different devices (cell phones, palmtop computers, TV sets). For developers of Web-based language learning materials, new access pathways and encoding systems will further provide significant opportunities as well as technical challenges (Godwin Jones 2000).

2.1.1 Web Servers

Web server can be defined as a computer that is accepting HTTP requests from clients, which are known as Web browsers, serving them Web pages.

Basic common web server features (Wikipedia):

- **HTTP responses to HTTP requests**: every Web server program operates by accepting HTTP requests from the network, and providing an HTTP response to the requester. The HTTP response typically consists of an HTML document, but can also be a raw text file, an image, or some other type of document; if something bad is found in client request or while trying to serve the request, a Web server has to send an error response which may include some custom HTML or text messages to better explain the problem to human people (people trying to fetch a web page, etc.).
- **Logging:** usually Web servers have also the capability of logging some detailed information, about client requests and server responses, to log files; this allows the Webmaster to collect statistics by running log analyzers on log files.

In practice many Web servers implement the following features too:

- **Configurability** of available features by configuration files or even by an external user interface.
- **Authentication**, optional authorization request (request of user name and password) before allowing access to some or all kind of resources.
- Handling of not only static content (file content recorded in server's filesystem(s)) but of dynamic content too by supporting one or more related interfaces (SSI, CGI, SCGI, FastCGI, PHP, ASP, ASP .NET, Server API such as NSAPI, ISAPI, etc.).
- **Module support**, in order to allow the extension of server capabilities by adding or modifying software modules which are linked to the server software or that are dynamically loaded (on demand) by the core server.

- **HTTPS** support (by SSL or TLS) in order to allow secure (encrypted) connections to the server on the standard port 443 instead of usual port 80.
- **Content compression** (i.e. by gzip encoding) to reduce the size of the responses (to lower bandwidth usage, etc.).
- **Virtual Host** to serve many web sites using one IP address.
- **Large file support** to be able to serve files whose size is greater than 2 GB on 32 bit OS.
- **Bandwidth throttling** to limit the speed of responses in order to not saturate the network and to be able to serve more clients.

The four top most common Web or HTTP server programs are (Wikipedia):

- Apache HTTP Server from the Apache Software Foundation.
- Internet Information Services (IIS) from Microsoft.
- Sun Java System Web Server from Sun Microsystems, formerly Sun ONE Web Server, iPlanet - Web Server, and Netscape Enterprise Server
- Zeus Web Server from Zeus Technology.

Apache

Apache is primarily used to serve static and dynamic content on the World Wide Web. It is free software/open source HTTP web server for Unix-like systems (BSD, Linux, and UNIX systems), Microsoft Windows, Novell NetWare and other platforms.

Apache supports a variety of features, many implemented as compiled modules which extend the core functionality. These can range from server-side programming language support to authentication schemes. Some common language interfaces support Perl, Python, Tcl, and PHP. Main positive characteristic of Apache web server would be that the software is free.

Apache constraints: Apache's developers do not provide any type of support for their product. There are third-party companies that provide Apache support, but you have to pay for it. It runs best on Linux. This means that that maximum performance will be provided on Linux.

Microsoft Internet Information Server (IIS)

It is a set of Internet-based services for servers using Microsoft Windows. The main IIS positive characteristic would be integration into the Microsoft OS. IIS has the ability to limit how much bandwidth your web pages have available. It also enables crash protection (if one application running on the server crashes, the web server and other applications continue to run, and the failed application restarts the next time a user requests it. IIS constraint: IIS is not available for use on non-NT system, e.g. Unix. Also The source code is closed.

Sun Java System Web Server
It is a web server designed for medium and large business applications. It is available on all major operating systems and provides provides a single deployment platform for Web services, JavaServer Pages (JSP) and Java Servlet technologies, Microsoft Active Server Pages, PHP, and CGI.

Zeus Web Server
It is a high-performance web server, developed for Unix and Unix-like platforms. It is developed by software company Zeus Technology.

Servlet container
It comprises essentially the component of an application server that hosts and interacts with Java servlets. It controls the servlets that are deployed within the Web Server and is responsible for forwarding the requests and responses for them. It has the functionality of mapping a URL to a particular servlet and of ensuring that the process requesting the URL has the correct access rights. There are some non-commercial Servlet Containers in the market: Apache Tomcat, Enhydra. Java Mini Daemon contains a slightly higher abstraction than servlets, Jetty, jo!, Winstone, tjws.

The November 2005 Netcraft Web Server Survey found that more than 70% of the Web sites on the Internet are using Apache (Netcraft 2005)

2.1.2 Web browser

Is a software application used to locate and display Web pages. Popular browsers available for personal computers are Microsoft Internet Explorer, Mozilla Firefox, Opera, Netscape, and Apple Safari. Different browsers can be distinguished from each other by the features they support: Standards support, Fundamental features, Usability and accessibility features, Fundamental features, Annoyances removers, External links. Internet Explorer 6 is the dominating browser (w3schools 2006).

2.1.3 Clients

A web client is computer that's utilizing a Web server. Whenever you're using your browser at home or work to surf the Internet, your computer is acting as a Web client. The most known computer manufacturers are: Apple, Dell, Fujitsu, IBM, Hewlett Packard, Toshiba.

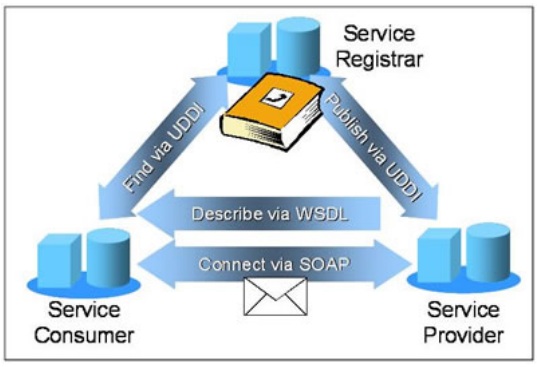
2.1.4 Web Services

The emergence of Web technologies enables a variety of Web-based service applications, which can be examined from business process integration, supply chain management, and knowledge management perspectives (Lin, Shaw, Chuang 2005).

Web services can be characterizes as “self-contained, self-describing, modular applications that clients can publish, locate, and dynamically invoke across the Web” (Fenton & Heavin 2005). Web services allow access to software components through standard Web technologies, regardless of platforms, implementation languages, etc. (Tian, Voigt, Naumwicz, Ritter, Schiller 2004)

Base Web service protocols are:

- Simple Object Access Protocol (SOAP) - defines the runtime message that contains the service request and response. SOAP is independent of any particular transport and implementation technology.
- Web Services Description Language (WSDL) - describes a Web Service and the SOAP Message. It provides a programmatic way to describe what a service does, paving the way for automation.
- Universal Discovery, Description, Integration (UDDI) - UDDI is a cross industry initiative to create a standard for service discovery together with a registry facility that facilitates the publishing and discovery processes.



Base Web Service Protocols (Wilkers 2005)

Web services are components that communicate with SOAP protocol. SOAP uses XML and formats the messages in a textual way. The interfaces, designed by web services, base on message interchange. The most important part of web service development is the definition what kind of messages the web service will receive and what kinds of messages will it shape in answer. Web services are described with WDSL. The WSDL is a language for describing web services and expressing their characteristics. It describes the basic format of web services, demanded across different protocols. It describes them from a technical perspective; however it contains only little about its context and even less about its potential collaborations of more web services with each other. The key success of e-business however lies in collaboration of more than one web services.

Web services can be divided into following categories (Smith 2005):

- Consumer oriented web services
- Business oriented web services
- Programmic access
- Device oriented web services

- System oriented web services

2.2 Mobile technologies

Technologies, used for m-business can be devided into: mobile information technology (hardware and software) and mobile communication technology (hardware and software). It is very hard to define limitation between mobile information and mobile communication technology. Mobile information technology: web servers and other servers, specialized for mobile services such as WAP gateway, SMS gateway, laptops etc. Mobile communication technology: mobile networks, mobile phones, PDAs.

2.2.1 Terminals

As developers explore ways in which they can become more than communication devices, mobile technology (whether phone or handheld PC) is now becoming seen as a potential games platform. As a result, many simple text-based multi-player games are available on many mobile phones. Also the connectivity of handheld games devices is shifting the focus away from the individual player to the connected player. (Facer, Joiner Stanton, ReidHull, Kirk 2004)

Mobile terminal OS
The most common development platform operating systems are Palm, Windows CE, Windows Mobile, and EPOC/Psion, Symbian. On the top of operating systems, there are also application software platforms. Those platforms run on a variety of mobile devices and provide advanced sets of development tools and features. Examples of such platforms include WAP microbrowsers, Java, and Microsoft .NET Compact Framework. (Juntao Yuan 2003)

Mobile phones
The mobile phone has now moved beyond being a mere technical device to becoming a key 'social object' present in every aspect of a user's life. (Srivastava 2005). Today, modern phones let enable not just talking, but also let you send and receive e-mail and text messages, and even surf the Web. Key Phone Features (PC World):
Wireless standard: World travellers are more affected by wireless standards.
Wireless mode: Dual-mode phones, which send and receive both, digital and analog signals or single-mode models. In rural areas where digital service is often spotty or nonexistent, a dual-mode phone can fall back on an analog signal to allow service, though roaming fees may apply. In the cities, where digital service is widespread, can be used a single-mode model phone (often cheaper than a dual-mode phone).
Band support: The more radio bands a phone supports, the more frequencies it picks up. Quad-band phones operate across four frequency bands.

Theoretically, they provide better coverage than triple-, dual-, or single-band phones. These so-called world phones are compatible with four GSM frequencies--850 MHz (prevalent in the United States), 900 MHz (prevalent in Europe), 1800 MHz (prevalent in Asia), and 1900 MHz (also available in the U.S.). As a result, they function around the globe. You can also find tri-mode phones that work on two digital frequency bands in addition to an analogue network, a particularly handy feature for travelling to rural areas

Design: There are flip-open style phones and no flip style phones. Flip phones can be more difficult to use with one hand because the cover may be heavier than the base, and a few low-end models lack a separate caller ID screen on the cover. Many new phones sport dual screens--a small, external LCD on the cover plus an internal display. When choosing the phone design it is recommended to check its ergonomics.

Size and weight: Part of what makes a phone easy to use is its portability. A typical no flip phone weighs about 4 ounces and is about the size of an energy bar--5 inches long, 2 inches wide, and 1 inch thick. Anything above that is considered large. An exception is a PDA phone, which more closely resembles a PDA on steroids than a cell phone

Battery life: Most new phones allow at least three hours of talk time and two to six days on standby. Some phones can last up to 14 days on standby.

Screen: Some handsets enable adjusting the font size to fit more text on the screen. For people send lots of messages and go online it is recommended to choose PDA phone, with a large LCD.

LCD's contrast and backlight strengths are also important. These days most phones offer colour screens, which are easy on the eyes.

Keypad: The keypad layout and menu system should be intuitive. The buttons should be responsive and easy to press. Navigation buttons on the keypad are also important. Many PDA phones and a few cell phones come with a small QWERTY keyboard. The tiny keys may not suit everyone, but for those who need them, they're easier to use than a software-based keyboard on a touch-sensitive screen.

Wireless data: Nearly all new cell phones are capable of doing tasks such as sending and receiving e-mail and IM, downloading custom ring tones and simple games, or connecting to the Internet. Such features, however, are heavily dependent on provider and service plan. Most phones connect at slow speeds: only up to 115 kbps on a GPRS network and up to 384 kbps on EDGE; 3G networks, such as EvDO, provide faster connections at up to 2 Mbps.

There are many J2ME-compatible devices available. Below, there are some Nokia, Sony Ericsson, and Motorola mobile clients presented:

Nokia (GSM/GPRS/EDGE/ CDMA2000 1X/AMPS/ TDMA/ EDGE/ W-CDMA)

- Nokia Series 30 - devices are limited with the lack of capabilities especially with regard to JAR
- Nokia Series 40 - they are the most widely supported and targeted phone class for J2ME developers
- Series 60 – Standard screen size is bigger; the average JAR size is 4MB

- Series 80 - Very high-end PDA phones, with a large screen and keyboard. JAR size is a massive 1416.
- Series 90 – also PDA-come-phones with high-end capabilities, without keyboard

Sony Ericsson (GSM/GPRS/ EDGE, PDC / CDMA2000 1X, W-CDMA)

- Sony Ericsson devices J2ME support starts with T6xx and Z600 Series and follows to P800 and P900.

Motorola

- Motorola J2ME support is within Motorola General Phones (GSM, GPRS; AMPS, CDMA2000 1X, TDMA, W-CDMA) and iDEN Phones.

Handheld game consoles

These lightweight, portable devices include in-built screens, games controls and speakers. The dominant manufacturers include Nintendo (Game Boy Advance), Sony PSP and Nokia N-Gage:

- Game Boy Advance by Nintendo, available from 2001
- Nintendo DS by Nintendo (in Europe from March 2005). Its new features was the incorporation of two screens, as well as a touch screen and wireless connectivity with other devices, The console also features online capabilities with the Nintendo Wi-Fi Connection, the Local Wireless network can support 16 players
- Sony PSP available from 2005. Sony PSP handheld game console provides game play, music, photo, movie and web browser functionalities. It supports either UMD discs for games or movies and memory stick for storing personal content like movies, photos and music. It offers considerably superior processing power and screen quality, but inferior in battery life, price, and durability.

Sony PSP Handhels game console
(http://www.us.playstation.com/psp.aspx?id=aboutInteractive)

- Nokia N-Gage QD, available from 2004 It is successor to the N-Gage. It revises the device's physical design, being smaller and rounder, with a more convenient cartridge slot on the bottom of the device and the

speaker and microphone on the flat side of the device so that calls may be made like a traditional phone
- Nokia N-Gage, available from 2003. It was designed as a combination mp3 player, cell phone, PDA, radio, and gaming device. The system received a lot of criticism on its physical design and layout, including its vertically oriented screen and requirement of removing the battery to change game cartridges. It is a mobile telephone and handheld game system based on the Nokia Series 60 platform
- GP32, available from 2001-2005. Launched by Korean company Gampark a few months after the launch of the Game Boy Advance.
- Game Boy Advance, available from 2001-2003Bandai WonderSwam Colour, available from 2000-2003
- Tiger Telematics Gizmondo is designed to play music, movies, and games, have a camera for taking and storing photos, and have GPS functions. It also has Internet capabilities. It will have a phone for sending text, multimedia, and email and voice calls will come via a Bluetooth headset
- Tapwave Zodiac was designed to be a PDA-handheld game console hybrid. It supported photos, movies, music, Internet, and documents
- Gamepark Holdings GP2X uses the Linux operating system and is designed to support videos, music, photos, and games in an open architecture allowing any user to develop software for the device Personal digital assistants (also called PDA, palmtops, hand-held computers, pocket computers)

Handheld devices

Handheld devices were originally designed as personal organizers, but became much more versatile over the years. A basic PDA usually includes date book, address book, task list, memo pad, clock, and calculator software. Newer PDAs also have both colour screens and audio capabilities, enabling them to be used as mobile phones, web browsers or media players. Most PDAs began as pen-based, using a stylus rather than a keyboard for input. PDAs can also react to voice input by using voice recognition technologies. Many PDAs can access the Internet, intranets or extranets via Wi-Fi, or Wireless Wide-Area Networks (WWANs). Currently major PDA operating systems are: Palm OS, Windows Mobile (Pocket PC), RIM for the BlackBerry. Many operating systems based on the Linux kernel - free (not owned by any company), Symbian OS. PDAs have got some further functions: Audio recording, Camera functionality, Map functionality, with a GPS receiver for localization, Cell Phone functionality. PDAs range from simple devices with limited memory to powerful machines high-resolution colour screens and tons of memory. Especially in the last five years, PDA's have been developed with faster processors, larger memory, colour displays, and multiple functions including Internet access, additional software, and multiple operating systems. Advancements in PDA technology continue to occur monthly. Popular PDAs are:
BlackBerry, hp iPAQ Pocket PC, Palm Pilot, Fujitsu Siemens Loox, GMate Yopy...

Smart Phones

A smartphone is any electronic handheld device that integrates the functionality of a mobile phone, personal digital assistant or other information appliance. Most common operating systems are Symbian, Palm OS Windows Mobile (formerly known as Windows CE, BREW and Linux:

- Symbian OS (FOMA, Nokia Series 60, Nokia Series 80, Nokia Series 90, UIQ...)
- Palm OS (Handspring Treo, Kyocera, Samsung, Palm One...)
- Windows CE / Windows Mobile (Qtek 9xx, Siemens, Motorola, Samsung, i-mate smartphones…)
- Linux (Motorola, Nec, Panasonic…)
- Other (Blackberry 7100 Series)

Internet access, e-mail access, scheduling software, built-in camera, contact management, GPS navigation software and occasionally the ability to read business documents in a variety of formats are possible functionalities of smart phones. Furthermore, building television into the smart phone would be very prosperous topics.

Examples:

Palm Treo 650 smart phone (The gold award in the PDA and Smart phone category for 2005, by SearchMobileComputing.com)

The device is combining features of a cell phone, e-mail, an organizer, messaging and Web access. Each of the Treo's features is accessible by a QWERTY keyboard and the device supports Bluetooth technology, which enables it to connect wirelessly to other Bluetooth-compatible devices such as headsets and GPS navigation systems. Other phone features include speakerphone, speed dialing, conference calling, call history and caller ID.

Motorola A780 (silver award for 2005, by SearchMobileComputing.com)

The device enables internal GPS and synchronization of e-mail, contacts and calendar with a Microsoft Exchange 2003 Server. Also multitasking is available: for example, the A780 lets users simultaneously listen to MP3 tunes while composing SMS messages. The device also has got touch screen user interface.

Sony Ericsson P910a (bronze award for 2005, by SearchMobileComputing.com)

The device offers voice capabilities, e-mail, a personal information management suite (calendar, contacts and notes and it can sync with Microsoft Outlook), camera with video, and multimedia messaging. can run a variety of applications, such as those that provide traffic pattern updates, calculate currency, check weather, provide news updates, provide stock updates and trades, and print pictures. It also includes non-business features such as an MP3 player and games. a digital and video VGA camera, keyboard inside the

flip, and a 262K color screen. The device also offers a flip QWERTY keyboard for thumb typing, or users can rely on the device's handwriting recognition.

Qtek 9000 – the 3G device is combining a smart phone and a PDA. The 520 MHz processor, full QWERTY keyboard and WiFi means that the 9000 is build for performance! Qtek 9000 supports Tri-band GSM/GPRS worldwide, it also features in-built Bluetoot and it is designed to work on the high speed WLAN and UMTS networks. The device can be folded out to give access to the keyboard, or folded back for touchscreen-only PDA use. The touch-screen display measures a full 480 x 640 pixel (VGA) with 65k colours gives bright and clear image. A 1.3 megapixel camera is included, which can take both still pictures and video clips. On the front side there is another camera used for videotelephony. The Qtek 9000 runs the latest Windows Mobile 5.0 Pocket PC Phone Edition Operating System. It supports email, Internet browsing and getting access to corporate LAN resourcess.

QTek 9000

Nokia N70

The Nokia N70 is an imaging smart phone. It is 3G technology for video calling and high speed internet access (WCDMA and EDGE). It supports also Bluetooth technology (version 2.0.), HTML and WAP 2.0 browser, Java™ application, Synchronisation of contacts, calendar, to-do items, and notes to a compatible PC using PC Suite, Push-to-Talk. The display is 262k color TFT.

Nokia N70 mobile phone

TV phones

Examples: Samsung's Satellite TV Phone, CES 2006: The LG SB130 TV Phone... Quality and speed of network is very important that such services are available. Very important is also Cell phones' memory and their battery life.
Abertis Telecom, Nokia and Telefónica Móviles unveiled the results of the first digital mobile TV (DVB-H) pilot in Spain at the 3GSM World Congress.

Highlights from the markets study include the fact that 75% of users would recommend the service while 55% would be willing to pay to watch digital TV on their mobile phones. The results of the study clearly point to a viable commercial launch of the service in the future, confirming that customers are looking for TV on their mobile phone and not a portable TV (Nokia 2005).

Cingular Wireless announced the immediate availability of Cingular Video on-demand streaming video service with a large selection of popular mobile content. Consumers can now watch video clips of their favorite television shows, sports, news and weather, entertainment and premium content on their high-speed 3G capable Cingular phones (3G.co.uk 2006)

There are also first results from pilots on broadcast (DVB-H) mobile TV services amongst consumers in Finland, the UK, Spain and France, which have revealed clear consumer demand for such services as well as important indications over future business models for commercial mobile TV services (3G.co.uk 2006). 83% of participants were satisfied with the service and over three quarters (76%) said they would take up the service within 12 months. The potential commercial benefits of mobile TV for the industry are made clear by these pilots with such a high proportion willing to pay for the service. The most popular pricing model to emerge is a monthly subscription for a package of channels. The most popular types of content were news, sports, music, soaps and documentaries. Interactivity was also an important functionality with over half of Spanish users (58%) saying they wanted specific, interactive content adapted to shorter viewing times. DVB-H technology allows TV channels to be distributed effectively to mobile devices. Nokia will bring the Nokia N92 device together with Nokia's Mobile Broadcast Solution 3.0 network elements to the market in summer 2006 to provide the most complete implementation of existing broadcast mobile TV standards on the market. According to Informa, there will be 50.97 million DVB-H devices sold globally by 2010 (Nokia 2005).

2.2.2 Wireless Networks

First Generation (1G)

First Generation (1G) = analogue networks (beginning in 1979)
In Europe was implemented NMT. It only enabled users to make voice phone calls. In most of the countries it is not operational any more.

Second Generation (2G)

Second Generation (2G) = digital networks (beginning in 1991).
GSM – Global System for Mobile Communication
GSM in Europe operates in 900MHz and 1800MHz (in US it is working in 1900MHz). GSM enables from 9,6bps to 14,4Kbps data processing speed. Unfortunately, there are still spaces and pauses in speech. It enables also fax services, “paging”, SMS…

GSM does not support constantly network connection (users can not be "always on").

CSD (Circuit switched Data)
Allows users to use their wireless handset as a modem for laptops, PDAs and other electronic devices via infrared ports or designated data cables. CSD also allows a user to access Wireless Internet via their wireless handset (handset must be WAP compatible).

HSCSD (High Speed Circuit switched Data)
is a circuit switched protocol based on GSM. It is able to transmit data up to 4 times the speed of the typical theoretical wireless transmission rate of 14,4 Kbps up to 57.6 Kbps.

CDMA (Code Division Multiple Access)
is technology for digital transmission of radio signals between, for example, a mobile telephone and a radio base station. In CDMA, a frequency is divided into a number of codes. It enables calls to be carried over a single 1.25 MHz channel. The technology has been widely adopted by major cellular and PCS carriers in the United States and also internationally.

TDMA (Time Division Multiple Access)
It is one of several digital wireless transmission methods that allows a large number of users to share access (in a time ordered sequence) to a single radio frequency channel without interference by assigning unique time slots to each user within the channel.

iDEN (Integrated Digital Enhanced Network)
It is a wireless network system developed by Motorola. Specialized mobile radio network (TDMA) technology that combines two-way radio, telephone, text messaging and data transmission into one network.

Second and half Generation (2,5)
GPRS (General Packet Radio Service)
The enhancement of GSM and is often referred to 2,5G. GPRs utilizes packet switching technology where information is transmitted in short bursts of data over an IP-based network. GPRS provides a quick session set up. It enables also constantly network connection ("always on"). With throughput rates up to 40 kbit/s, users have a similar access speed to a dial-up modem. GPRS made packet based data transfer possible, which is an important service provision; users do not need to stay connected all the time to use services and they only pay for downloaded data in- stead of connection time. (Carlsson, C., Carlsson, J., Hyvönen, Puhakainen, Walden 2006)

EDGE (Enhanced Data Rates for Global Evolution)

Further advantages of GPRS offers Enhanced Data Rates for Global Evolution (EDGE), which enables data transfer up to 384 Kbps. EDGE also enables multi-user connections. Using EDGE, operators can handle three times more subscribers than GPRS; triple their data rate per subscriber, or add extra capacity to their voice communications. EDGE uses the same TDMA (Time Division Multiple Access) frame structure, logic channel and 200kHz carrier bandwidth as today's GSM networks, which allows it to be overlaid directly onto an existing GSM network. For many existing GSM/GPRS networks, EDGE is a simple software-upgrade. EDGE allows the delivery of advanced mobile services such as the downloading of video and music clips, full multimedia messaging, high-speed colour Internet access and e-mail on the move.

Third Generation (3G)

UMTS - Universal Mobile Telecommunications System

Universal Mobile Telecommunications System (UMTS) is 3G mobile communication systems (beginning in Japan, 2001). It enables packet data transfer to 2Mbit/s, advanced services, advanced hosting, speech, video, multimedia transfer. Using 3G services, mobile phone becomes a multi-purpose device. UMTS offers new opportunities for service provision (Ule 2003): fast mobile multimedia capabilities, location, service portability, personalised and ubiquitous communication capabilities. Streamed low bit rate coded video can be transported over UMTS in real time, whereas higher bit rate coded video would need to be downloaded into a local storage device for later playback. Video/multimedia transport will most likely use the MPEG-4 family of compression and presentation coding (UMTS World)

IMT-2000 International Mobile Telecommunications

Is global standard of 3G wireless communications, defined by a set of interdependent ITU recommendations. Provides a framework for worldwide wireless access by linking the diverse systems of terrestrial and/or satellite based networks.

- IMT-2000 Radio Technology: CDMA2000, Spectrum: 800/900/1800/1900 MHz Bands (in Europe from 2001)
- IMT-2000 Radio Technology: WCDMA, Spectrum: 2 GHz Bands

3G worldwide standard for the creation, delivery, and playback of multimedia over Global GSM networks are 3GPP and 3GPP2 (worldwide standard mobile multimedia over CDMAA networks).

1xRTT (1xEV-DO) is technology based on CDMA. It doubles the voice capacity of current CDMA mobile systems, and adds packet data capability, with a peak downlink speed of 153 kbps.

CDMA2000 1xEV-DO Rev A

It is a broadband wireless packet data technology, which enables IP-based, broadband wireless voice and data networks. It enables speeds up to 3.1 Mbps and providing the technology to support real-time voice, video and multimedia applications

Other Wireless Networks

IR wireless (Infrared radiation)

It is wireless technology in devices or systems that convey data through infrared (IR) radiation. It is used for short- and medium-range communications.

IRDA – Infrared Data Association

A suite of protocols for infrared (IR) exchange of data between two devices, up to 1 or 2 meters apart (20 to 30 cm for low-power devices). IrDA devices typically have throughput of up to either 115.2 Kbps or 4 Mbps. IrDA protocols are implemented in Symbian OS phones, many PDAs, printers and laptop computers.

Bluetooth – Short Range radio technology

Bluetoothe technology enables wireless communication between electronic devices up to 10m. It works on 2,4GHz and enables 1Mbps data transfer (Hribar 2003). The technology specifies how mobile phones, computers and PDAs interconnect with each other, with computers, and with office or home phones. The technology enables data connections between electronic devices in the 2.4 GHz range. Bluetooth would replace cable or infrared connections for such devices.

WLAN – Wireless Local Area Network

Is a way of linking computers (laptops) together, using radio signals or infrared light instead of cables (up to 30m inside buildings and up to 300m in the open). It allows you to connect to the Internet and enables computers to send and receive data indoors and out; anywhere within the range of a base station.

Wi-Fi is a set of product compatibility standards for WLAN based on the IEEE 802.11 specifications. It enables a person with a wireless-enabled computer or PDA to connect to the Internet when in proximity of an access point. 1Mbps is the lowest rate of Wi-Fi. Soon, Wi-Fi networks will be found in urban areas providing coverage throughout the central city, or even lining major highways, enabling travelers access anywhere they can pull over and stop (http://www.etherstack.com/product.php?id=15). It operates on 2.4GHz frequency and enables data transfer up to 11Mps. It is being also considered a replacement for wide-area wireless networks. It is quickly becoming a standard interface in laptop PCs and is also beginning to emerge in PDAs, broadband routers and even TVs. Integration is happening also with mobile handsets

WMAN - Wireless Metropolitan Area Network
It enables greater distance than WLANs, connecting buildings to one another over a broader geographic area.

Ultra-Wide Band (UWB)
It is technology that enables wireless connection of multiple devices for transmission of video, audio and other high-bandwidth data. It is a short-range radio technology (for Personal Area Networks), which complements other longer range radio technologies such as Wi-Fi, WiMAX and cellular wide area communications. It is used to relay data from a host device to other devices in up to 10 meters. We can say that it is very similar to Bluetooth but around 100x faster; used to transmit data at high speeds over very short distances (Steinke)

DECT – Digital Enchanced Cordless Telecommunications
DECT is ISDN digital wireless cellular telephone system, which works from 1,88GHz to 1,9 GHz. The technology is very similar to other mobile networks. The signals can be reached from 50m to 200 m. DECT enables wireless speech communication, fax transfer, data transfer, and multimedia transfer. It is very often used in companies and other organizations.

TETRA – Terrestrial Trunked RAdio
TETRA is open digital telecommunication standard, developed by European Telecommunications Standardization Institute, for the most professional users (fireman, police, rescuer). The system is used also at some airports…
TETRA enables (Toikkanen 2001): group communication, file transfer, safe speech and data transfer, fax transfer, image transfer, video transfer (slow). The system operates on special mobile network, which enables high security.

2.2.3 Services

Services offer the possibility to overcome the limitations of individual mobile devices by making functionality offered by others available to them on an "as-needed" basis. Mobile services can be grouped into three main groups (Hribar 2003):

- Basic mobile services (e-mail, mobile internet access, mobile voice services…)
- User oriented mobile services (mobile games, mobile shopping, mobile payment, mobile banking…)
- Business oriented mobile services (mobile shops, mobile broking, mobile auctions…)
- Add-on: tv, radio, mp3 player, video, GPS…

3G networks allow users to send and receive bandwidth-intensive information such as video conferencing, audio, and web data on demand. Operators are offering consumers many mobile services, including video messaging, news, weather, sports, movie trailers, music and games.

It is predicted that evolution of 4G mobile technologies will be driven by services that offer better quality (e.g. video, sound). Always-on connection will be required. Perceived ease of use and perceived usefulness explain the adoption of mobile services (Carlsson, Hyvönen, Repo, Walden 2005). It is expected that users will require high data rates, similar to fixed networks.

Messaging

SMS (Short Message Service)

Short Message Service (SMS) is a service available on most digital mobile phones that permits the sending of short messages (also known as , messages, or more colloquially SMSes, texts or even txts) between mobile phones, other handheld devices and even landline telephones.

The Short Message Service - Point to Point (SMS-PP) is defined in GSM recommendation 03.40. This is separate from GSM 03.41 which defines the Short Message Service - Cell Broadcast (SMS-CB) which allows messages (advertising, public information, etc.) to be broadcast to all mobile users in a specified geographical area.

Messages are sent via a store-and-forward mechanism to a Short Message Service Centre (SMSC), which will attempt to send the message to the recipient and possibly retry if the user is not reachable at a given moment. Both, Mobile Terminated (MT), for messages sent to a mobile handset, and Mobile Originating (MO), for those that are sent from the mobile handset, operations are supported. Message delivery is best effort, so there are no guarantees that a message will actually be delivered to its recipient and delay or complete loss of a message is not uncommon, particularly when sending between networks. Users may choose to request delivery reports, which can provide positive confirmation that the message has reached the intended recipient, but notifications for failed deliveries are unreliable at best.

Transmission of the short messages between SMSC and phone is via SS7 within the standard GSM MAP framework. Messages are sent with the additional MAP operation forward_short_message, whose payload length is limited by the constraints of the signalling protocol to precisely 140 bytes. In practice, this translates to either 160 7-bit characters, 140 8-bit characters, or 70 2-byte characters in languages such as Arabic, Chinese, Korean, Japanese or Slavonic languages (e.g. Russian) when encoded using 2-byte UTF-16 character encoding (see Unicode). This does not include routing data and other metadata, which is additional to the payload size.

Larger content (known as long SMS or concatenated SMS) can be sent segmented over multiple messages, in which case each message will start with a user data header (UDH) containing segmentation information. Since UDH is inside the payload, the number of characters per segment is lower: 153 for 7 bit encoding, 134 for 8 bit encoding and 67 for 16 bit encoding. The receiving phone is then responsible for reassembling the message and presenting it to the user as one long message. While the standard theoretically permits up to

255 segments, 3 to 4 segment messages are the practical maximum, and long messages are billed as equivalent to multiple SMS messages.

Short messages can also be used to send binary content such as ringtones or logos, as well as OTA programming or configuration data. Such uses are a vendor-specific extension of the GSM specification and there are multiple competing standards, although Nokia's Smart Messaging is by far the most common.

Some service providers offer the ability to send messages to land line telephones regardless of their capability of receiving text messages by automatically phoning the recipient and reading the message aloud using a speech synthesizer along with the number of the sender.
http://en.wikipedia.org/wiki/Short_message_service (wikipedia)
References:
http://www.3gpp.org/ftp/Specs/2000-09/Ph1/03_serie/0340-370.PDF (3GPP - Recommendation GSM 03.40)
http://www.3gpp.org/ftp/Specs/html-info/23040.htm (3GPP - Technical realization of Short Message Service (SMS)

Picture Messaging
It allows users to send and receive picture messages along with text. Users can choose from several presets and/or received pictures stored in their phones. Some phones also contain a picture editor.

USSD – Unstructured Supplementary Services Data (USSD) is a means of transmitting information via to GSM network. In contrast to SMS, which is basically a store and forward service, USSD offers a real-time connection during a session. It is also called Chat Messaging lets users "talk" using SMS messages.

CB - Cell Broadcast
It is the technology, designed for simultaneous delivery of short messages to multiple mobile users within a specified region or nation-wide. It is similar to SMS, but it is a one-to-many service. Usually, cell broadcast services are distributed to the consumer on a no cost basis.

MMS (Multimedia Messaging Service)
Multimedia Messaging Service (MMS) is a technology for transmitting not only text messages, but also various kinds of multimedia content (e.g. images, audio, and/or video clips) over wireless telecommunications networks using the Wireless Application Protocol (WAP). It is the evolution of Short Message Service (SMS), designed to work with mobile packet data services such as GPRS and CDMA2000 1x.

MMS was originally developed within the Third-Generation Partnership Program (3GPP), a standards organization focused on standards for the UMTS/GSM networks. Since then, MMS has been deployed world-wide and across both GSM/GPRS and CDMA networks. MMS has also been standardized within the Third-Generation Partnership Program 2 (3GPP2), a standards organization focused on specifications for the CDMA networks.
As with most 3GPP standards, the MMS standards have three stages:

- Stage 1 - Requirements
- Stage 2 - System Functions
- Stage 3 - Technical Realizations

Both 3GPP and 3GPP2 have delegated the development of the Stage 3 Technical Realizations to the OMA, a standards organization focused on specifications for the mobile wireless networks.

The MMS data flow starts with a subscriber using an MMS client on the mobile phone to compose, address, and send an MMS message to one or more recipients. MMS addresses can be either E.164 phone numbers (e.g., "+18005551212") or RFC 2822 e-mail addresses (e.g., "you@yourdomain.com").

The initial submission by an MMS client to the home MMS Center (MMSC) is accomplished using HTTP with specialized commands and encodings (which are defined in a technical standard specified by the Open Mobile Alliance). Upon reception of the MMS message, the recipient MMSC (MMS Center) sends a notification to the recipient's mobile phone using either an SMS notification, HTTP Push or WAP Push.
There are two modes of delivery in MMS: immediate or deferred:

- Immediate delivery: When the MMS client on the mobile phone receives the MMS notification, it then immediately (without user intervention or knowledge) retrieves the MMS message from the MMSC that sent the notification. After retrieval, the subscriber is alerted to the presence of a newly arrived MMS message.
- Deferred delivery: The MMS client alerts the subscriber that an MMS message is available, and allows the subscriber to choose if and when to retrieve the MMS message.

As with the MMS submission, the MMS retrieval request, whether immediate or deferred, occurs with an HTTP request. The MMSC responds by transmitting the MMS message in an HTTP response to the MMS client, after which the subscriber is finally alerted that the MMS message is available.
The essential difference between immediate and deferred delivery is that former hides the network latencies from the subscriber, while the latter does not.
http://en.wikipedia.org/wiki/Multimedia_Messaging_Service (wikipedia)
References:

http://www.3gpp.org/ftp/Specs/html-info/22140.htm (3GPP TS 22.140 MMS Stage 1)
http://www.3gpp.org/ftp/Specs/html-info/23140.htm (3GPP TS 23.140 MMS Stage 2)
http://member.openmobilealliance.org/ftp/public_documents/mwg/MMS/Permanent_documents/OMA-MMS-ARCH-V1_2_1-20031217-C.zip (OMA MMS Architecture)

SIM Application Toolkit
It is a technology that allows network operators to send applications over the air as SMEs or as Cell Broadcast message in order to update SIM cards with changed or new services. SIM Toolkit applications are built in Java for a client server environment (Hribar 2003)
Web Clipping is technology that enables downloading (saving) the content to the mobile terminals (usually laptops, handhelds) and its offline browsing. The user connects to internet only for content synchronization and saving.

Push to talk (PTT)
It is also function, also expected to integrate on mobile phones in the near future. Push to talk is not like making a phone call. Users will not have to dial to get connected. It is similar to the idea of a walkie-talkie, but can get connected to another user in another side of the world. The size and outlook of mobile phones are also plays an important role for the mobile phone. Thus, many concept mobile phones brought out by the manufacturers now are all very fashionable and colourful. As for the size of mobile phones, concepts such as whist phones and mini sized.

DVB - H Digital Video Broadcasting Handy-TV
DVB-H (Digital Video Broadcast Handheld) technology is the version of DVB-T (digital terrestrial television) adapted for mobile devices. It is the latest development from the DVB Project targeting handheld, battery powered devices such as mobile telephones, PDAs. The DVB-H specification was developed in June 2004 for accessing DVB services on handheld devices. User watches a program on a mobile phone, there will be two types of content on the mobile phone screen -- a broadcast program, by a broadcast service provider, and custom data relevant to the program, prepared by a telecom (http://www.cellular.co.za/technologies/dvb-h/dvb-h.htm) Commercial launches of DVB-H services are expected in 2006 in Italy and the USA

MBMS - Multimedia Broadcast Multicast Service
It is a technology for high capacity distribution of Mobile TV over cellular networks to small form-factor terminals. It is part of the WCDMA evolution standardized by 3GPP. It can be offered via GSM and UMTS cellular networks.

2.3 Emerging technologies

2.3.1 IPv6

IPv6 is short for "Internet Protocol Version 6". IPv6 is the "next generation" protocol designed, to replace the current version Internet Protocol, IP Version 4 ("IPv4"). IPv6 is designed to run well on high performance networks (e.g. Gigabit Ethernet, OC-12, ATM, etc.) and at the same time still be efficient for low bandwidth networks (e.g. wireless). IPv6 fixes a number of problems in IPv4, such as the limited number of available IPv4 addresses. It also adds many improvements to IPv4 in areas such as routing and network autoconfiguration. IPv6 is intended to provide more addresses for networked devices, allowing, for example, each cell phone and mobile electronic device to have its own address. (Hinden 2003)

2.3.2 Mobile IPv6

Mobile IP is to provide the mobility for IP terminals. It specifies routing support to permit an IPv6 host to continue using its "permanent" home address as it moves around the Internet. Mobile IPv6 supports transparency above the IP layer, including maintenance of active TCP connections and UDP port bindings. Mobile IPv6 can handle the mobility management in multi-access networks - e.g. a network with WCDMA and WLAN coverage using multi-mode mobile terminals (Nokia Newtork 2001)

2.3.3 Semantic Web

The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries. It is a collaborative effort led by W3C with participation from a large number of researchers and industrial partners. It is based on the Resource Description Framework (RDF), which integrates a variety of applications using XML for syntax and URIs for naming.
http://www.w3.org/2001/sw/, (W3C)

The Semantic Web is a mesh of information linked up in such a way as to be easily processable by machines, on a global scale. The Semantic Web was thought up by Tim Berners-Lee, inventor of the WWW, URIs, HTTP, and HTML. There is a dedicated team of people at the World Wide Web consortium (W3C) working to improve, extend and standardize the system, and many languages, publications, tools and so on have already been developed. However, Semantic Web technologies are still very much in their infancies, and although the future of the project in general appears to be bright, there seems to be little consensus about the likely direction and characteristics of the early Semantic Web.

Data that is geneally hidden away in HTML files is often useful in some contexts, but not in others. The problem with the majority of data on the Web

that is in this form at the moment is that it is difficult to use on a large scale, because there is no global system for publishing data in such a way as it can be easily processed by anyone. For example, just think of information about local sports events, weather information, plane times, and television guides. All of this information is presented by numerous sites, but all in HTML. The problem with that is that, is some contexts, it is difficult to use this data in the ways that one might want to do so.

So the Semantic Web can be seen as a huge engineering solution, but it is more than that. We will find that as it becomes easier to publish data in a repurposable form, so more people will want to pubish data, and there will be a knock-on or domino effect. We may find that a large number of Semantic Web applications can be used for a variety of different tasks, increasing the modularity of applications on the Web. The Semantic Web is generally built on syntaxes which use URIs to represent data, usually in triples based structures: i.e. many triples of URI data that can be held in databases, or interchanged on the World Wide Web using a set of particular syntaxes developed especially for the task. These syntaxes are called "Resource Description Framework" syntaxes.
http://infomesh.net/2001/swintro/, (Infomesh)

2.3.4 RSS

RSS is a format for syndicating news and the content of news-like sites, including major news sites, news-oriented community sites, and personal weblogs. But it's not just for news. Pretty much anything that can be broken down into discrete items can be syndicated via RSS. Once information about each item is in RSS format, an RSS-aware program can check the feed for changes and react to the changes in an appropriate way.

RSS-aware programs called news aggregators are popular in the weblogging community. Many weblogs make content available in RSS. A news aggregator can help you keep up with all your favorite weblogs by checking their RSS feeds and displaying new items from each of them.
http://www.xml.com/pub/a/2002/12/18/dive-into-xml.html, (XML.COM)

Web feeds are widely used by the weblog community to share the latest entries' headlines or their full text, and even attached multimedia files. The use of RSS has spread to many of the major news organizations, including Reuters, CNN, PR Newswire, and the BBC. These providers allow other websites to incorporate their "syndicated" headline or headline-and-short-summary feeds under various usage agreements. RSS is now used for many purposes, including marketing, bug-reports, or any other activity involving periodic updates or publications. Many corporations are turning to RSS for delivery of their news, replacing email and fax distribution.

As the mainstream media attempts to realize the full potential of RSS, the new media is utilizing RSS by bypassing traditional news sources. Consumers and journalists are now able to have news constantly fed to them instead of searching for it. A program known as a feed reader or aggregator can check a list of feeds on behalf of a user and display any updated articles that it finds. It is common to find web feeds on major websites and many smaller ones. Some websites let people choose between RSS or Atom formatted web feeds; others offer only RSS or only Atom. RSS-aware programs are available for various operating systems (see list of news aggregators). Client-side readers and aggregators are typically constructed as standalone programs or extensions to existing programs such as web browsers. Browsers such as Opera browser and Mozilla Firefox are moving toward integrated feed reader functions.

Web-based feed readers and news aggregators require no software installation and make the user's "feeds" available on any computer with Web access. Some aggregators combine existing web feeds into new feeds, e.g., taking all football related items from several sports feeds and providing a new football feed. There are also search engines for content published via web feeds like Feedster or Blogdigger.
http://en.wikipedia.org/wiki/RSS_(protocol), wikipedia

2.3.5 Emerging Wireless Networks

The world of wireless telecommunications is rapidly evolving. Technologies under research and development promise to deliver more services to more users in less time. Through PANs (personal area networks), users will interface with household and office devices; through advanced WLANs (wireless LANs), users will interface with other users and the devices connected to internet; through 4G wireless, users will talk, see, and send data to one another at blazing speeds. In the future wireless and mobility services will be characterized by global mobile access, high quality of services, and easy and simple access to multimedia services for voice, data, message, video, world-wide web, GPS, etc. via single user terminal. This vision can be implemented by integration of different evolving and emerging wireless technologies in a common flexible and expandable environment enabling future services and applications to users in a single terminal. Future wireless communications will mainly be characterized by a vertical communication model, where different access technologies as cellular, cordless, WLAN type systems, short range wireless connectivity and wired systems will be combined on a common platform to complement each other in an optimum way for different service requirements and radio environments. The terminals will instantly connect to the most appropriate network depending on location, bandwidth needs and other user preferences. Mobile terminals are getting more and more sophisticated. Mobile phone, the piece of communication device itself is also becoming a multi functioned device. Smartphones and PDA phones are already launched in the market. From the new models of mobile phones released in the

market recently, we can see that mobile phone manufacturers now are all heading to this market. Mobile phone incorporating with computing functions will be able to replace other devices such as laptop, PDA and even entertainment devices tool. Mobile terminals will support many wireless connections from short-range Bluetooth to Wi-Max and 4G. They will have strong processing power and large data memory enabling users to use multimedia services. Mobile TV is one of the new emerging services, which will allow users to watch digital TV on their mobile phones. Following this short introduction some ideas and concepts of the future technology and services are presented.

The wireless communication is becoming standardized and in the future it is expected that different wireless networks will supplement each other. The ability to roam across different network systems with single device will become reality. WLAN and Wi-Max technologies are offering wideband internet connection, which enables users to use audio and video services wirelessly. More and more internet services are becoming also available to mobile users on mobile devices. The mobile users will use smart phones, to access services through various wireless communications (Bluetooth, WLAN, 4G…).

HSPDA - High Speed Downlink Packet Access (3,5G)
is a packet-based data service in W-CDMA downlink with data transmission up to 8-10 Mbps. Today, HSPDA is included in the latest version of WCDMA and can provide peak data rates of up to 14 Mbps. (Latest 4G Wireless News 2005)

HSUPA - High-Speed Uplink Packet Access (3,75G)
is a data access protocol for mobile phone networks with extremely high upload speeds up to 5.8 Mbit/s. For, video conferencing is becoming important requirement for the operators. The need for not only fast download speeds, but also fast upload speeds is arising.

4G
4G is short for fourth-generation mobile the successor of 3G and is a wireless access technology. 4G technology stands to be the future standard of wireless devices. This new generation of wireless is intended to complement and replace the 3G systems, perhaps in 5 to 10 years. Accessing information anywhere, anytime, with a seamless connection to a wide range of information and services, and receiving a large volume of information, data, pictures, video, and so on, are the keys of the 4G infrastructures. The future 4G infrastructures will consist of a set of various networks using IP (Internet protocol) as a common protocol so that users are in control because they will be able to choose every application and environment available. Based on the developing trends of mobile communication, 4G will have broader bandwidth, higher data rate, and smoother and quicker handoff and will focus on ensuring seamless service across a multitude of wireless systems and networks. Figures of 100Mbps have been tossed around, but a more reasonable figure to expect

is about 20Mbps. The key concept is integrating the 4G capabilities with all of the existing mobile technologies. Application adaptability and being highly dynamic are the main features of 4G services of interest to users. These features mean services can be delivered and be available to the personal preference of different users and support the users' traffic, air interfaces, radio environment, and quality of service. Connection with the network applications can be transferred into various forms and levels correctly and efficiently. The dominant methods of access to this pool of information will be the mobile telephone, PDA, and laptop to seamlessly access the voice communication, high-speed information services, and entertainment broadcast services (Rouffet, Kerboeuf, Cai, Capdevielle).

The fourth generation will encompass all systems from various networks, public to private; operator-driven broadband networks to personal areas; and ad hoc networks. The 4G systems will interoperate with 2G and 3G systems, as well as with digital (broadband) broadcasting systems. In addition, 4G systems will be fully IP-based wireless Internet. This all-encompassing integrated perspective shows the broad range of systems that the fourth generation intends to integrate, from satellite broadband to high altitude platform to cellular 3G and 3G systems to WLL (wireless local loop) and FWA (fixed wireless access) to WLAN (wireless local area network) and PAN (personal area network), all with IP as the integrating mechanism. With 4G, a range of new services and models will be available. These services and models need to be further examined for their interface with the design of 4G systems. (Javad 2002)

WiMAX

WiMAX is an acronym that stands for Worldwide Interoperability for Microwave Access. WiMAX is a standards-based wireless technology that provides high-throughput broadband connections over long distances. WiMAX can be used for a number of applications, including "last mile" broadband connections, hotspots and cellular backhaul, and high-speed enterprise connectivity for business as an alternative to cable and DSL. WiMAX will provide fixed, nomadic, and portable and, eventually, mobile wireless broadband connectivity without the need for direct line-of-sight with a base station. It is expected that WiMAX technology will be incorporated in notebook computers and PDAs by 2007, allowing for urban areas and cities to become “metro zones” for portable outdoor broadband wireless access.

Products that pass the conformity tests for WiMAX are capable of forming wireless connections between them to permit the carrying of internet packet data. It is similar to WiFi in concept, but has certain improvements that are aimed at improving performance and should permit usage over much greater distances.

More technically speaking WiMAX is a wireless metropolitan area network (MAN) technology that can connect IEEE 802.11 (Wi-Fi) hotspots with each

other and to other parts of the Internet. IEEE 802.16 provides up to 50 km (31 miles) of linear service area range and allows connectivity between users without a direct line of sight. Note that this should not be taken to mean that users 50 km (31 miles) away without line of sight will have connectivity. Practical limits from real world tests seem to be around "3 to 5 miles" (5 to 8 kilometers). The technology has been claimed to provide shared data rates up to 70 Mbit/s, which, according to WiMAX proponents, is enough bandwidth to simultaneously support more than 60 businesses with T1-type connectivity and well over a thousand homes at 1Mbit/s DSL-level connectivity. Real world tests, however, show practical maximum data rates between 500kbit/s and 2 Mbit/s, depending on conditions at a given site.

It is also anticipated that WiMAX will allow interpenetration for broadband service provision of VoIP, video, and Internet access—simultaneously. Most cable and traditional telephone companies are closely examining or actively trial-testing the potential of WiMAX for "last mile" connectivity. This should result in better price points for both home and business customers as competition results from the elimination of the "captive" customer bases both telephone and cable networks traditionally enjoyed. Even in areas without pre-existing physical cable or telephone networks, WiMAX could allow access between anyone within range of each other. Home units the size of a paperback book that provide both phone and network connection points are already available and easy to install (WiMax.com Broadband Solutions 2005)

Pervasive Ultra-wideband Low Spectral Energy Radio Systems (UWB-RT)

Pervasive Ultra-wideband Low Spectral Energy Radio Systems, is an industry led European Commission funded Integrated Project of 30 key industrial and academic organisations. The project's strategic, scientific and technological objectives are defined to strengthen Europe's knowledge base and readiness to successfully exploit the benefits of UWB-RT.

The PULSERS project aims at advancing the state of the art of research on Ultra wide band radio, by gathering expertise from partners all over Europe and abroad. The key objective of the project is to provide new concepts and architectures for Physical (PHY), Medium Access Control (MAC) and higher layers, up to definition of user scenarios, and to validate such concepts and architectures by developing hardware and software platforms. Research will investigate two basic classes of UWB radio systems, Single Antenna Systems (SAS) and Multiple Antenna Systems (MAS).
For both classes, PHY concepts for two major modes, HDR and LDR-LT, will be considered. For both HDR and LBR-LT modes, very innovative medium access control (MAC) features will be studied, modelled and designed. Optimized concepts will be developed up to implementation for efficient management of very high data rate (possibly beyond 1 Gbit/s) for the HDR systems, while completely new lightweight protocols will be studied in order to cope with the

stringent constraints of very low cost, very low power (including processing power) LDR-LT systems. (Ercim News 2006)

Multiple Input/Multiple Output (MIMO) WLAN

Multiple Input/Multiple Output (MIMO) is an area of intense development in the wireless industry because it delivers profound gains in range, throughput and reliability. As a result, manufacturers of wireless local area network (WLAN), wireless metropolitan area network (WMAN), and mobile phone equipment are embracing MIMO technology.

Misuse of "MIMO" is a disservice to consumers facing an urgent problem: wireless LAN products based on existing Wi-Fi standards don't always have sufficient range to cover entire homes. Wireless LAN products incorporating genuine MIMO technology often solve this problem, while products claiming "MIMO" based on the use of multiple antennas or channels may not. MIMO and pseudo-MIMO "MIMO," as understood by engineers and academics, refers to the use of multiple, simultaneous signals (two or more radio waveforms) in a single frequency channel to exploit multipath propagation and thereby multiply spectral efficiency. Numerous conference presentations and refereed research papers support this understanding of the term.
Prior to the development of MIMO, wireless communication systems treated multipath propagation as a problem to be mitigated. MIMO is the first wireless communications technology that treats multipath propagation as an opportunity—an inherent feature of wireless communication environments that may be harnessed to multiply link capacity. Multiplying link capacity greatly increases throughput, range, and reliability. For example, wireless LAN products implementing MIMO have demonstrated in laboratory tests, field tests and commercial applications the ability to cover areas at least twice as large as conventional wireless LAN products at comparable or better data rates with comparable or better reliability. Some vendors claim wireless products that use smart antennas and/or multiple channels employ "MIMO" or deliver MIMO benefits. The proposed IEEE 802.11n standard strives to draft technical specifications for the next generation of high throughput WLAN technology. Supporters of the two leading 802.11n proposals—firms such as Broadcom, Intel, Qualcomm, and Texas Instruments—are promoting genuine MIMO solutions.
(ICT Centre)

Non-invasive Wireless Body Area Networks

The principle research goal is the design, optimization and demonstration of a non-invasive wireless body area network (BAN) with unprecedented energy efficiency, unobtrusiveness, and scalability and cost structure.

A BAN connects independent nodes (e.g. sensors) dispersed in the clothing. It is an indispensable element of Wearable Computing and has rich applications in home/health care, sports, defence, ambient intelligence, pervasive

computing and many other areas. Major characteristics/challenges of our design are:

- An extremely low transmits power per node (non-invasive) to minimize interference and cope with health concerns. The targeted transmit power is below the spurious emission level of electronic equipment like personal computers and portable CD players. This is key for the user acceptance of a wireless network so close to the body.
- An efficient support of a high density of heterogeneous nodes (about 50 per body) with data rates ranging from several hundred to several million bits per second.
- An optimal network energy efficiency (node autonomy). We target an energy consumption which is an order of magnitude below the current state of the art.

To provide wireless multimedia applications future generation wireless local area networks (WLAN) have to support much higher data rates (200 MBit/s up to 1 GBit/s) at high link reliability. Furthermore, the gap between ''wired'' and ''wireless'' LANs should be decreased. Recent research results show that the use of multiple antennas at the wireless nodes (multiple-input multiple-output, MIMO) in combination with and space-time signal processing allows to incerase the data rate and/or to improve the link reliability without additional costs in bandwidth or power. Moreover, multiple antennas allow enhancements to the existing IEEE 802.11 technology which are standard compliant and improve coverage and link quality.

Today existing wireless local area networks (WLAN) support data rates from 11 MBit/s (IEEE 802.11b) to 54 MBit/s (IEEE 802.11a/g). The focus of this project is to enhance the IEEE 802.11.a technology especially by the use of multiple antenna arrays and to develop new concepts for future high-speed wireless LANs.
http://www.nari.ee.ethz.ch/wireless/research/projects/ban.html,
(Communication Technology Laboratory)

2.3.6 Future Mobile Terminals

Thanks to the development of ubiquitous technology, hardware is becoming smaller, thinner, and less visible than ever before. On the other hand, the volume of information we handle is expanding at an accelerated rate. For some time now, the mobile phones are not used only for making phone calls, but they can offer information, games, audio-video players etc. In the near future, IT devices will go beyond the conventional framework of efficiency and convenience. In near future we can expect devices with ambient intelligence that judge situations to meet user's needs and interfaces that let users access unlimited information as naturally as breathing. A personal mobile communication device that lets you be free and have fun. Yet it has many of the features we come to expect from mobile devices as standard, including an

alarm clock, a digital wallet, all the standard phone features, a push email receiver, video-calling, GPS and an integrated PDA, multimedia player, and digital camera.

Smartphones

By observing the trends in the mobile terminal development it is possible to notice that devices are merging into one single device with all features and functionalities. The future mobile phone will probably be something between PDA and mobile phone and it will integrate mobile phone, organizer, multimedia player, GPS module, multi-megapixel digital camera, internet browser, office assistant, game console, fast data transfer (4G, WLAN, WiMax). Yes, the future mobile phones will support all sorts of wireless communication from Bluetooth, 3G, 4G, WLAN, WiMax…

Multimedia support is a piece of cake with dual speakers and both MP3 and AAC audio support. Load up on the 512MB of internal memory, or expand by way of MicroSD cards. If high speed data transfer is more your cup of tea, look no further than GPRS, UMTS, Bluetooth and WLAN found on one handset.

Future smartphone examples

The Ultra-Mobile PC

The Ultra-Mobile PC is portable, lightweight, and configured to connect on the go. It's the device that you'll always want with you. Featuring full Microsoft Windows XP functionality and the ability to touch, write, or type, the Ultra-Mobile PC is a powerful companion that lets you communicate, accomplish your tasks, and stay entertained and informed wherever life takes you.

Ultra mobile PC by Microsoft (www.microsoft.com)

Designer accessories and wearable devices

There will also be some terminals which will be more a designer accessories like bracelets, watches, pendants or even devices integrated into clothes. The mobile device will be totally integrated into the clothes, so it will be representative of so called wearable devices. They will be powered by static electricity generated by clothes movement. Some will support voice control and in combination with glasses they could also provide image projection right in front of user's eyes.

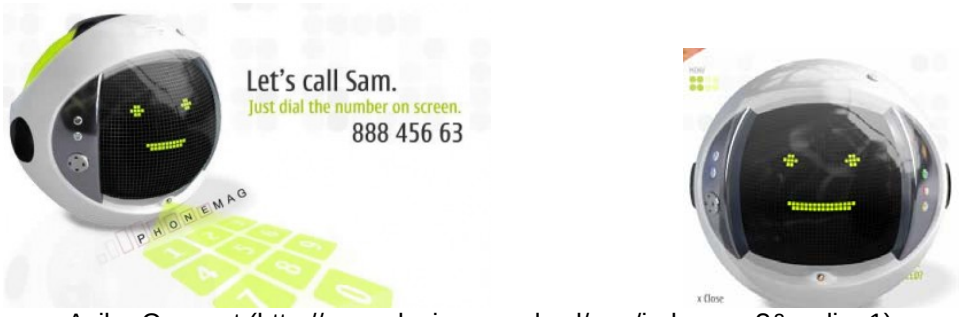
The bracelet-like phone is based on a liquid battery and has a flexible touch screen and touch-sensitive body cover. Featuring speech recognition allowing it to understand and adapt to the environment.

Nokia wearable mobile phone by Nokia (www.nokia.com)

You don't have to carry it in your pocket or on your wrist. You can carry it anywhere, in any form. You can roll it, bend it and put on your clothes like a clip. It also makes some form changes that make it more ergonomically: i.e. when you want to talk on the phone, the body form turns into the form of the

good old telephone. You can personalize these forms and record them. So it fits you the best in the way that you have chosen."

Smart mobile companion
The Acibo concept adds human intelligence to your cell phone and hands you a buddy that can make your life much more productive.
The coveted Acibo concept has taken surpassed conventional wisdom and created a new buddy device that not only understands and delivers on your communication needs, but offers a unique level of personalization. The device features all standard phone functionality, multimedia capabilities, a shadow based projected keypad, an integrated voice recorder and personal organizer features.



Acibo Concept (http://www.designawards.nl/eng/index.asp?&audio=1)

2.3.7 Future Mobile Services

Mobile TV
Mobile TV is a signal of a new era of mobile business. As everyone enjoys watching TV, seeing one's favorite TV programs on mobile phones will be as natural as watching TV in the living room. Europe-wide mobile TV markets are set to develop for terminals, consumer devices and network equipment. Digital content is also expected to become increasingly 'mobile' across regional and national borders. The proliferation of partnerships between content producers and the mobile industry is a clear indication of this trend.

Even software giant Microsoft is making substantial steps into this market, with demonstrations at 3GSM thanks to partnerships with Virgin Mobile and BT Movio. They say that mobile TV will be a driving force behind growing the mobile phone industry, making cell phones even more "necessary" than they are today.
There are a handful of major standards currently available, all vying for supremacy. Korea seems to be heading toward the T-DMB and S-DMB road, whereas the United States seems to prefer MediaFLO. However, Europe's DVB-H appears to be the most popular, according to Telecoms Korea.

The European Commission is supporting the development of mobile TV technology through a series of actions to promote international co-operation in

research, development and standardization for digital television. All in all, the Commission is funding research - directly or indirectly connected to mobile TV - amounting to some euro 40 million under the EU's 6th Research Framework Programme (2002- 2006). (Kwan 2006)

Location based services (LBS)

Location Based Services provide personalized services to the subscriber based on their current position. This position can be known by user entry or a GPS receiver that she carries with her, but most often the term implies the use of a function built into the cell network that uses triangulation between the known geographic coordinates of the base stations through which the communication takes place. There are many technologies related to Locatin based services. (GSM Word)

Positioning

One of the most obvious technologies behind LBS is positioning, with the most widely recognized system being the Global Positioning System (GPS). There are however, other means of positioning in addition to GPS. These other technologies are network based positioning and typically rely on various means of triangulation of the signal from cell sites serving a mobile phone. In addition, the serving cell site can be used as a fix for location of the user.

Geographic Information Systems

Geographic data is an important aspect of any location system. Geographic Information Systems (GIS) provide the tools to provision and administer base map data such as man made structures (streets, buildings) and terrain (mountains, rivers). GIS is also used to manage point-of-interest data such as location of gas stations, restaurants, nightclubs, etc. Finally, GIS information also includes information about the radio frequency characteristics of the mobile network. This allows the system to determine the serving cell site of the user.

Location Management Function

It is not enough to be able to position the mobile user and know the map data around that position. There must be a location management function to process positioning and GIS data on behalf of LBS applications. The location management function acts as a gateway and mediator between positioning equipment and LBS infrastructure.

Location based information

Many people are familiar with wireless Internet, but many don't realize the value and potential to make information services highly personalized. One of the best ways to personalize information services is to enable them to be location based. An example would be someone using their Wireless Application Protocol (WAP) based phone to search for a restaurant. The LBS application would interact with other location technology components to determine the

user's location and provide a list of restaurants within a certain proximity to the mobile user.

Location based billing

The ability to have preferential billing is provided by this type of application. Through location based billing, the user can establish personal zones such as a home zone or work zone. Through arrangements with the serving wireless carrier, the user could perhaps enjoy flat-rate calling while in the home area and special rates while in other defined zones. This type of application can be especially useful when use in conjunction with other mobile applications such as prepaid wireless.

Tracking

This is a rather large category that contains everything from the difficult fleet applications to enabling mobile commerce. Fleet applications typically entail tracking vehicles for purposes of the owning company knowing the whereabouts of the vehicle and/or operator. Tracking is also an enable of mobile commerce services. A mobile user could be tracking and provided information that he has predetermined he desires, such as notification of a sale on men's suits at a store close to the user's current proximity.

Navigation

GPS navigation becomes a perspective direction on the mobile device market. This relates not only to PDA, but also communicators and smartphones. Satellite receivers are installed even to multimedia combines and portable game consoles or they use Bluetooth to communicate with mobile terminals. Mobile services providers enable customers to turn their cell phones or palmtops into a satellite navigator, offering continuously updated maps, voice and visual instructions, real-time traffic info and an enormous database with places of interest. The service is capable of locating the user's position via the Bluetooth GPS receiver, which can be placed, for example, on the dashboard of one's car, and, by sending information to the cell phone via a Bluetooth link; guide the user along the selected route.

GPS Add-on for mobile phone navigation services (www.simobil.si)

There are two main models of navigation services. In the first model all maps, points of interest and other data are stored in the mobile phone memory or memory extension card. The other model uses the GPRS and UMTS networks to rapidly consult the most up-to-date, online version of road maps, without taking up the phone's memory. The system also provides information on traffic

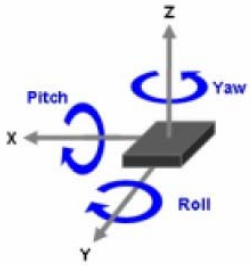
conditions along the route, any blocked roads and work in progress, allowing the user to choose from alternative routes.

GPS Device by Garmin (www.garmin.com)

One of the most innovative options is the possibility to integrate the cell phone's or palmtop's address book with the navigator. The destination can be chosen simply from among the contacts in the address book.
(PC World)

Motion control sensor

The Motion Control Sensor senses handset movements and posture in all directions in 3D, plus directional acceleration. The new Motion Control Sensor introduced in mobile phone is the world's smallest 6-axis sensor on a single semiconductor chip and offers greater functionality without a significant increase in size. The previous sensor used an electric compass (3-axis) and 2D directional acceleration sensor (2-axis) on one chip, while the new sensor has been improved to add a 3D directional acceleration sensor (3-axis), an A/D converter for converting detected data into digital data for output, a controlling microcomputer, and an internal sensor for temperature compensation, all on one unified chip.



To showcase the applications of the new Motion Control Sensor, the mobile phone Vodafone 904SH comes with a pre-installed trial version of "Seiza o Sagaso" (Let's look for constellations, provided by Vodafone K.K.), an application that displays constellations in real time depending on which way a mobile handset is pointed towards the sky. "Seiza o Sagaso" lets customers transform their handset into a plan sphere to scan the night sky for constellations, creating a completely new and unprecedented mobile experience.

(http://www.vodafone.jp/english/release/2006/20060228_4e.pdf)

Natural interfaces

With natural speech and handwriting technology embedded on the device, handsets and other mobile devices become easier to use, safer, and more accessible. Productivity rises as people rely on their phones, networks, and services more frequently and with greater satisfaction. Speech technologies provide a solution to the constraints of small keyboards requiring multiple keystrokes and tiny screens with long scroll bars. Speech enables hands-free (keyboard replaced by speech recognition) and eyes-free (screen complemented by speech output) operations. The most important user benefits are:

- A Safer Way to Call and Drive
- SMS and e-mail Dictation
- More Convenient Control of Handset Features
- Entertainment and Multimedia Modes
- Enhanced Access to Handset Features for Blind and Low-Vision Users
- Significantly more user-friendly and intuitive interface
- Simpler retrieval and visualization of information (voice in > visual out).
- Improved access to existing speech-activated applications and services (e.g. directory assistance, navigation guides).

Speech recognition (speech to text)

Speech recognition engines- are the software drivers that convert the acoustical signal to a digital signal and deliver recognized speech as text to your application. Most recognizers support continuous speech, meaning you can speak naturally into a microphone at the speed of most conversations.

The speech-to-text voice mode capability, available on new mobile phones, will allow users to speak into the phone and have the phone convert those words directly into text. This new technology will significantly change how people interact with their wireless phones. Dictation mode allows users to dictate memos, letters, and e-mail messages, as well as to enter data using a speech recognition dictation engine. The possibilities for what can be recognized are limited by the size of the recognizer's "grammar" or dictionary of words. Most recognizers that support dictation mode are speaker-dependent, meaning that accuracy varies on the basis of the user's speaking patterns and accent. To ensure accurate recognition, the application must create or access a "speaker profile" that includes a detailed map of the user's speech patterns used in the matching process during recognition. (Nuance Communications 2006)

Text to speech

Text to speech is a technology that converts text into remarkably high quality speech, in both male and female voices. Whether you want to speech-enable an in-car navigation system, provide a screen reader for the blind or partially sighted, or enhance your call centre service, RealSpeak is the natural solution, with its friendly, expressive, highly intelligible speech interface.

Biometric technology

Face Recognition

Feature for enhanced security and privacy protection. This feature authenticates customers by scanning their facial features.

Mobile terminal utilizes the sub-camera located close to the main display to recognize customers by sensing the position of their eyes, eyebrows, mouth and other facial features. By pre-registering a customer's face and a secret question and answer, the camera will automatically activate when the handset is opened and authenticate a customer in less than a second. When the Face Recognition function is enabled the keypad will be locked until the handset is opened and the pre-registered customer's facial features matched. Also, if facial features cannot be properly sensed due to dark or backlight conditions, the face and secret question of the person who opens the handset will be displayed and the handset can be unlocked by entering the appropriate answer.

Face recognition on mobile phone(http://www.akihabaranews.com/news-9481-X.html)

Mobile phone with RFID (Radio Frequency Identification)

A SIM card with embedded RFID capabilities was developed by Telenor The idea was to bring all the benefits of contact-less cards into the mobile phone using the SIM card as a storage device. The mobile phone will be able to function as an electronic ticket, ID, key or credit card.

Merging RFID and GSM services One of the main purposes of including the RFID technology into the SIM card was to be able to offer an alternative for the contact-less card infrastructure being installed in different parts of the world (with the first beneficiary being contact-less ticketing). Including RFID into the mobile phone gives contact-less cards the advantage of being able to be installed, updated and cancelled over the air through the services offered by GSM. (Lopez Calvet 2005)

Memory cards and mobile hard drives

Memory cards like MultiMedi Card or Secure Digital cards, which are used to extend the mobile phone or PDA memory, are enlarging their capacity. The biggest cards already offer 1GB of storage for pictures, music, video and applications. Very fast development of the storage promises even larger capacities of memory cards. On the other hand there are also mobile devices with integrated micro hard drives with capacities to 10GB. So, mobile phones are turning into powerful storage devices for documents, applications and multimedia. The micro hard drives, available in 8- and 10-gigabytes, will allow OEMs to offer thinner and higher-capacity consumer electronics (CE) devices while featuring industry-leading robustness, durability, and low power requirements for everyday consumer use.

(http://www.corniceco.com/products/dragon-series.html)

MegaSIM

Multimedia content and the need for high density memory are getting huge in the mobile phone business these days, but I never would have thought that the solution may come from the tiny card that maintains your phone's identity. Microelectronica, along with its parent company M-Systems, are the on cusp of releasing a range of new 2G and 3G SIM cards.

The 512 megabyte M-SIM MegaSIM series will be available to "pilots with mobile network operators" in the second quarter, and in the third quarter to commercial outlets. But why stop at 512 megabytes, when you can roll out one with one gig? That's right, by the end of this year, the company plans on releasing 1 gigabyte versions of its M-SIM MegaSIM series SIM cards. This MegaSIM platform combines the M.MAR SIM software and operating system from Microelectronica, with the flash management technology of M-Systems, which purchased the former just last November. This unique combination is said to provide "advanced capabilities, enabling smarter mobile services."

2.4 Web and mobile application development

2.4.1 Web languages

The most frequent languages used on the web are JavaScript, JScript, VBScript, and Java on the client side, and Perl, Python, Rexx, C, and C++ on the server side. The client side languages all have counterparts on the server

side as well, but we will consider only their client side implementations. The main division lines among languages can be (Zschokke 2001):

- Compiled languages: C, C++, Pascal, Delphi. Compiled languages are programming languages whose implementations are typically compilers (translators which generate machine code from source code), and not interpreters (step-by-step executors of source code, where no translation takes place). Compiled languages are usually much faster in execution. They also provide very powerful syntax checking capabilities which let you detect many errors at compile time which can be easier to debug than runtime errors.
- Interpreted languages: JavaScript, JScript, VBscript, Perl, Rexx, Python, PHP, Python etc. These languages are (at least in principle) executed line by line as the data flow in. Their programs may be executed from source form, by an interpreter. Interpreted languages are often easier to write. They are slower and don't provide the powerful syntax checking capabilities of compiler languages and so are better suited to small programs created by one person where runtime errors are easier to find.
- Object Oriented Languages: The best known Object Oriented Languages are Java, C++, Cecil, Smalltalk, Pascal. Object Oriented languages are particularly important for the WWW because its very structure lends itself well to that approach.

2.4.2 HTML (HyperText Markup Language)

HyperText Markup Language (HTML) is a markup language designed for the creation of web pages with hypertext and other information to be displayed in a web browser. HTML is used to structure information — denoting certain text as headings, paragraphs, lists and so on — and can be used to describe, to some degree, the appearance and semantics of a document.

HTML is an international standard (ISO/IEC 15445:2000) and a formal Recommendation by the World Wide Web Consortium (W3C); it is generally adhered to by the major browsers (Microsoft's Internet Explorer and Netscape's Navigator), which also provide some additional non-standard codes. The current version of HTML is HTML 4.0. However, both Internet Explorer and Netscape implement some features differently and provide non-standard extensions. Web developers using the more advanced features of HTML 4 may have to design pages for both browsers and send out the appropriate version to a user. Significant features in HTML 4 are sometimes described in general as dynamic HTML.

XHTML, which applies the stricter rules of XML to HTML to make it easier to process and maintain, is the W3C's successor to HTML. As such, many consider XHTML to be the "current version" of HTML, but it is a separate, parallel standard; the W3C continues to recommend the use of either XHTML 1.1, XHTML 1.0, or HTML 4.01 for web publishing.

http://en.wikipedia.org/wiki/Html (wikipedia)
http://searchwebservices.techtarget.com (searchWebServices)
References:
http://www.w3.org/TR/html401 (W3C - HTML 4.01 Recommendation)
http://www.purl.org/NET/ISO+IEC.15445/15445.html (ISO/IEC 15445:2000)
http://www.w3.org/TR/xhtml11/ (W3C - XHTML 1.1)
http://www.w3.org/TR/xhtml1/ (W3C - XHTML 1.0 Recommendation)

2.4.3 XHTML Mobile - Extensible Hypertext Markup Language Mobile

It is a new language for building Web pages that can be displayed in a mobile Web browser. The advantage of using XHTML Basic over WML relates to the fact that one can create a single version of an application that can be viewed by either a PC-based browser (e.g. Internet Explorer, Netscape) or the microbrowser on a handheld device. (Developing Mobile Applications)

2.4.4 cHTLML - Compact HTML

A subset of HTML for small information devices, such as smart phones and PDAs. cHTML is a scaled down version of regular HTML. cHTML does not support JPEG images, tables, image maps, multiple fonts and styles of fonts, background colors and images, frames, style sheets and more than two colors, typically black and white. In many environments, XHTML is replacing cHTML

2.4.5 XML (Extensible Markup Language)

The Extensible Markup Language (XML) is a W3C-recommended general-purpose markup language for creating special-purpose markup languages, capable of describing many different kinds of data. It is a simplified subset of Standard Generalized Markup Language (SGML). Its primary purpose is to facilitate the sharing of data across different systems, particularly systems connected via the Internet. Languages based on XML (for example, Geography Markup Language (GML), RDF/XML, RSS, MathML, Physical Markup Language (PML), XHTML, SVG, MusicXML and cXML) are defined in a formal way, allowing programs to modify and validate documents in these languages without prior knowledge of their form (Wikipedia)

2.4.6 SCORM (Sharable Content Object Reference Model)

SCORM (Sharable Content Object Reference Model) is a collection of standards and specifications adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content.
http://www.adlnet.gov/scorm/index.cfm (ADL)

It defines communications between client side content and a host system called the run-time environment (commonly a function of a learning

management system). SCORM also defines how content may be packaged into a transferable ZIP file.
SCORM is a specification of the Advanced Distributed Learning Initiative (ADL), which comes out of the Office of the Secretary of the Defence. SCORM 2004 (the last released version) introduces a complex idea called sequencing, which are rules that specify the order that a learner may experience content objects. The standard uses XML, and it is based on the results of work done by AICC, IMS, IEEE, and Ariadne.
http://en.wikipedia.org/wiki/SCORM (wikipedia)

2.4.7 VXML – Voice eXtensible Mark-up Language

VXML is aimed at enabling voice recognition for accessing the internet via phone, wired or wireless. It is a mark up language that, just like HTML, aims to create interaction between a computer and a person. VXML presents the content as an automated telephone conversation.

2.4.8 WML (Wireless Markup Language)

Wireless Markup Language is the primary language of the WAE in the WAP protocol suite. It is an XML-compliant format. However, since XML documents can take up a lot of room, a specific compression technique for XML documents was developed (wireless binary XML, or WBXML).

WML pages are stored on a web server. They are accessed by a WAP gateway, which sits between mobile devices and the World Wide Web, passing pages from one to the other much like a proxy. This translates pages into a form suitable for mobiles. This process is hidden from the phone, so it may access the page in the same way as a browser accesses html, using a URL (for example http://example.com/foo.wml), if the mobile phone operator has not specifically prevented this.

Wireless Markup Language is very similar to HTML, because it provides navigational support, data input, hyperlinks, text and image presentation, and forms. A WML document is known as a “deck”. Data in the deck is structured into one or more “cards” (pages) – each which represents a single interaction with the user. WML has a scaled down set of procedural elements which can be used by the author to control navigation to other cards.

Future?
Mobile devices are moving towards support for greater amounts of XHTML and even standard HTML as processing power in handsets increases. It is likely WML will be phased out in the future.
http://en.wikipedia.org/wiki/Wireless_Markup_Language (wikipedia)
References:

http://www.openmobilealliance.org/tech/affiliates/wap/wap-238-wml-20010911-a.pdf (OMA - WML 2.0 Specifications)
http://www.openmobilealliance.org/tech/affiliates/wap/wapindex.html (OMA - WAP Forum)

2.4.9 HDML – Handheld device markup language

It is a language used to create content for small display, handheld devices, e.g. phones. HDML allows Internet access from wireless devices and is derived from HTML. It was created before WAP and uses Openwave's Handheld Device Transport Protocol (HDTP), instead of WAP. It is the only language that older phones understand.

2.4.10 SMIL 2.1 - Synchronized Multimedia Integration Language 2.1

It enables multimedia presentations for the mobile Web. It is based on SMIL experiences and includes screen transitions, enhanced visual layout capabilities such as background image tiling, and enhanced audio layout capabilities, including fade-in and fade-out …

2.4.11 WBMP - Wireless Bitmap

It is WAP graphic format optimized for mobile computing devices. A WBMP image is identified using a TypeField value, which describes encoding information (such as pixel and palette organization, compression, and animation) and determines image characteristics according to WAP documentation.

2.4.12 SQL (Structured Query Language)

SQL is an ANSI/ISO standard and is the most popular computer language used to create, modify and retrieve data from relational database management systems. The language has evolved beyond its original purpose to support object-relational database management systems.
The SQL standard is not freely available. SQL: 2003 may be purchased from ISO or ANSI.
http://en.wikipedia.org/wiki/Sql (wikipedia)
ISO/IEC 9075 defines the SQL language. The scope of the SQL language is the definition of data structure and the operations on data stored in that structure. Parts 1, 2 and 11 encompass the minimum requirements of the language. Other parts define extensions.

- ISO/IEC 9075-1:2003 describes the conceptual framework used in other parts of ISO/IEC 9075 to specify the grammar of SQL and the result of processing statements in that language by an SQL-implementation.

- ISO/IEC 9075-2:2003 defines the data structures and basic operations on SQL-data. It provides functional capabilities for creating, accessing, maintaining, controlling, and protecting SQL-data. Both static and dynamic variants of the language are proved. In addition to direct invocation, bindings are provided for the programming languages Ada, C, COBOL, Fortran, M, Pascal and PL/I.
- ISO/IEC 9075-11:2003 specifies an Information Schema and a Definition Schema that describes the structure and integrity constraints of SQL-data, the security and authorization specifications relating to SQL-data and the features supported by an SQL-implementation together with other sizing information.

http://www.iso.org/ (ISO)

Although SQL is defined by both ANSI and ISO, there are many extensions to and variations on the version of the language defined by these standards bodies. Many of these extensions are of a proprietary nature, such as Oracle Corporation's PL/SQL or Sybase, IBM's SQL PL(SQL Procedural Language) and Microsoft's Transact-SQL. It is also not uncommon for commercial implementations to omit support for basic features of the standard, such as the DATE or TIME data types, preferring some variant of their own.

Alternatives to SQL

The list below are proposed alternatives to SQL, still (nominally) relational:

- IBM BS12
- Tutorial D
- TQL Proposal.
- Hibernate Query Language (HQL) - A Java-based tool that uses modified SQL (from http://www.hibernate.org/hib_docs/v3/reference/en/html/queryhql.html: "an extremely powerful query language that (quite intentionally) looks very much like SQL")
- OSQL - A PHP-based object-oriented tool for constructing and manipulating SQL queries
- Quel introduced in 1974 by the U.C. Berkeley Ingres project.
- the Object Data Standard of the ODMG (Object Data Management Group).

http://en.wikipedia.org/wiki/Sql (wikipedia)

2.4.13 Java EE (Java Platform, Enterprise Edition)

Java Platform, Enterprise Edition or Java EE (formerly known as Java 2 Platform, Enterprise Edition or J2EE up to version 1.4), is a programming platform—part of the Java platform—for developing and running distributed multi-tier architecture Java applications, based largely on modular software components running on an application server. The Java EE platform is defined

by a specification. Java EE is also considered informally to be a standard because providers must agree to certain conformance requirements in order to declare their products as Java EE compliant; albeit with no ISO or ECMA standard.

Java EE includes several API specifications, such as JDBC, client-side applets, RPC, CORBA, and defines how to coordinate them. Java EE also features some specifications unique to Java EE for components. These include Enterprise Java Beans, servlets, portlets (following the Java Portlet specification), JavaServer Pages and several web service technologies. This allows the developer to create an enterprise application that is portable between platforms and scalable, while integrating with legacy technologies.
http://en.wikipedia.org/wiki/J2ee (wikipedia)

The Java 2 platform, Enterprise Edition reduces the cost and complexity of developing multi-tier services, resulting in services that can be rapidly deployed and easily enhanced as the enterprise responds to competitive pressures.
The Java 2 platform, Enterprise Edition (J2EE) achieves these benefits by defining a standard architecture that is delivered as the following elements:

- *J2EE Application Programming Model* - A standard programming model for developing multi-tier, thin-client applications.
- *J2EE Platform* - A standard platform for hosting J2EE applications, specified as a set of required APIs and policies.
- *J2EE Compatibility Test Suite* - A suite of compatibility tests for verifying that a J2EE platform product is compatible with the J2EE platform standard.
- *J2EE Reference Implementation* - A reference implementation for demonstrating the capabilities of J2EE and for providing an operational definition of the J2EE platform.

http://java.sun.com/j2ee/reference/whitepapers/j2ee_guide.pdf (sun-java J2EE guide)

2.4.14 Java ME (Java Platform, Micro Edition)

Java Platform, Micro Edition or Java ME (formerly referred to as Java 2 Platform, Micro Edition or J2ME), is a collection of Java APIs for the development of software for resource constrained devices such as PDAs, cell phones and other consumer appliances. Java ME is formally a specification, although the term is frequently used to also refer to the runtime implementations of the specification. Java ME was developed under the Java Community Process as JSR 68. The evolution of the platform has abandoned the umbrella Java Specification Request in favor of separate JSRs for the different flavors of Java ME.

The Java 2 Micro Edition (J2ME): J2ME is a Java platform that is designed for small devices. J2ME is the ideal mobile client platform for wireless PDAs and enhanced mobile phones. (Juntao Yuan 2003):

Java ME was designed by Sun Microsystems and is a replacement for a similar technology, PersonalJava. Java ME has become a popular option for creating games for cell phones, as they can be emulated on a PC during the development stage and easily uploaded to the phone. This contrasts with the difficulty of developing, testing, and loading games for other special gaming platforms such as those made by Nintendo, Sony, and others, as expensive system-specific hardware and kits are required.

Sun Microsystems has tended not to provide free binary implementations of its Java ME runtime environment for mobile devices, rather relying on third parties to provide their own, in stark contrast to the numerous binary implementations it provides for the full Java platform standard on server and workstation machines. One of the notable omissions is for Microsoft Windows Mobile (Pocket PC) based devices, despite an open letter campaign to Sun to release a rumoured complete project "Captain America" which is such an implementation.
http://en.wikipedia.org/wiki/J2me
References:
http://java.sun.com/j2me/index.jsp (Sun Java - Java Platform, Micro Edition)

2.4.15 BREW - Qualcomm's Binary Runtime Environment for Wireless

It has been developed by Qualcomm and is an open source application development platform for wireless devices. BREW developers can create portable applications that work on any CDMA handset. Applications include SMS, e-mail, location positioning, games and Internet radio. When first introduced, BREW was solely for CDMA handsets. BREW has since been enabled for GSM handsets and expects to add TDMA handsets. BREW and J2ME are competing head-to-head for the wireless application development market. J2ME applications could run on BREW devices through a J2ME runtime for BREW.

2.4.16 .NET Compact Framework (.NET CF)

It is the closest competition to the J2ME. Like J2ME, it targets smart-managed mobile client's development. It has a strong focus on enterprise applications. However, the .NET CF runs only on high-end Windows CE and PocketPC devices (Juntao Yuan 2003). With .NET we can program for a mobile device as a normal web page and the Common Language Runtime and .NET framework

will take care of rendering the data in the appropriate format, i.e. as HTML for browsers, as WML for mobile phones.

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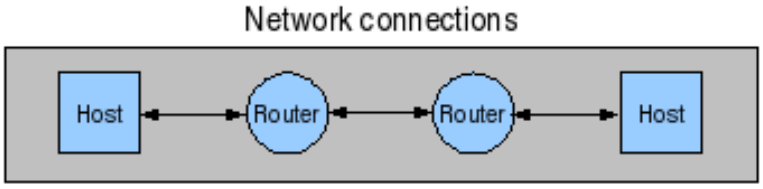
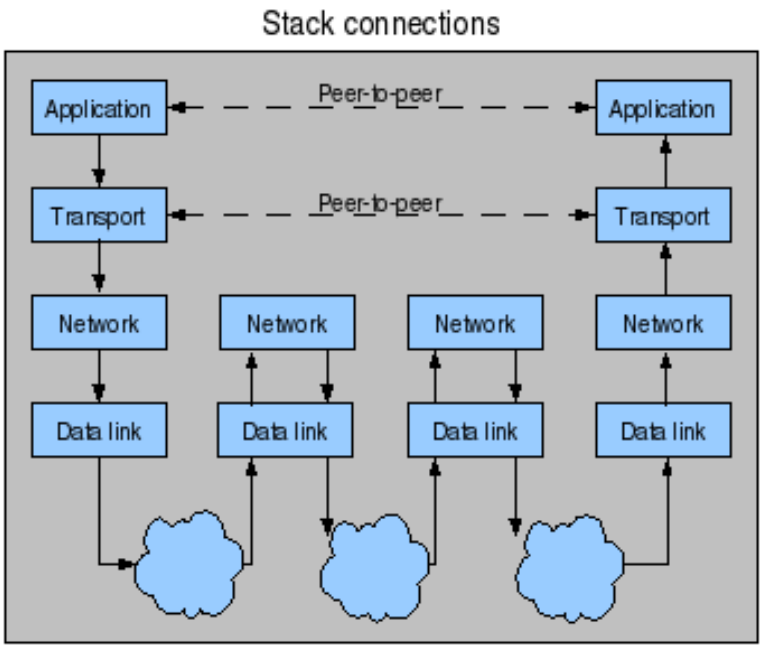
3 Standards overview

3.1 Internet protocol suite (TCP/IP protocol suite)

The internet protocol suite is the set of communications protocols that implements the protocol stack on which the Internet and most commercial networks run. It is sometimes called the TCP/IP protocol suite, after the two most important protocols in it: the Transmission Control Protocol (TCP) and the Internet Protocol (IP), which were also the first two defined.

The internet protocol suite — like many protocol suites — can be viewed as a set of layers; each layer solves a set of problems involving the transmission of data, and provides a well-defined service to the upper layer protocols based on using services from some lower layers. Upper layers are logically closer to the user and deal with more abstract data, relying on lower layer protocols to translate data into forms that can eventually be physically transmitted.





Layer	Protocols
Application	DNS, TLS/SSL, TFTP, FTP, HTTP, IMAP, IRC, NNTP, POP3, SIP, SMTP, SNMP, SSH, TELNET, BitTorrent, RTP, rlogin, ENRP, ...
Transport	TCP, UDP, DCCP, SCTP, IL, RUDP, ...
Network	IP (IPv4, IPv6), ICMP, IGMP, ARP, RARP, ...

Link	Ethernet, Wi-Fi, Token ring, PPP, SLIP, FDDI, ATM, Frame Relay, SMDS, …

The OSI model describes a fixed set of seven layers that some vendors prefer and that can be roughly compared to the IP suite.

Layer	**Protocols**
(7) Application	HTTP, SMTP, SNMP, FTP, Telnet, ECHO, SIP, SSH, NFS, RTSP, XMPP, Whois, ENRP
(6) Presentation	XDR, ASN.1, SMB, AFP, NCP
(5) Session	ASAP, TLS, SSH, ISO 8327 / CCITT X.225, RPC, NetBIOS, ASP, Winsock, BSD sockets
(4) Transport	TCP, UDP, RTP, SCTP, SPX, ATP, IL
(3) Network	IP, ICMP, IGMP, IPX, BGP, OSPF, RIP, IGRP, EIGRP, ARP, RARP, X.25
(2) Data Link	Ethernet, Token ring, HDLC, Frame relay, ISDN, ATM, 802.11 WiFi, FDDI, PPP
(1) Physical	wire, radio, fiber optic, Carrier pigeon

http://en.wikipedia.org/wiki/Internet_protocol_suite (wikipedia)
References:
http://www.ietf.org/rfc/rfc1180.txt (IETF - RFC 1180: A TCP/IP Tutorial)

3.1.1 IP (Internet Protocol, version 4)

The Internet Protocol (IP) is a data-oriented protocol used for communicating data across a packet-switched internetwork: it contains addressing information and some control information that enables packets to be routed. IP is documented in RFC 791 and is the primary network-layer protocol in the Internet protocol suite. Along with the Transmission Control Protocol (TCP), IP represents the heart of the Internet protocols.

IP has two primary responsibilities: providing connectionless, best-effort delivery of datagrams through an internetwork; and providing fragmentation and reassembly of datagrams to support data links with different maximum-transmission unit (MTU) sizes.

Each host on a TCP/IP network is assigned a unique 32-bit logical address that is divided into two main parts: the network number and the host number. The network number identifies a network and must be assigned by the Internet Network Information Center (InterNIC) if the network is to be part of the Internet. An Internet Service Provider (ISP) can obtain blocks of network addresses from the InterNIC and can itself assign address space as necessary. The host number identifies a host on a network and is assigned by the local network administrator.
http://www.cisco.com/univercd/cc/td/doc/cisintwk/ito_doc/ip.htm (Cisco, Internet Protocols)
http://en.wikipedia.org/wiki/Internet_Protocol (wikipedia)
References:
http://www.ietf.org/rfc/rfc791.txt (IETF)

3.1.2 IPv6 (Internet Protocol version 6)

Internet Protocol version 6 (IPv6) is the network layer standard that follows IPv4 as the second version of the Internet Protocol. It is intended to provide more addresses for networked devices, allowing, for example, each cell phone and mobile electronic device to have its own address. IPv4 supports 4.3×10^{9} (4.3 billion) addresses, which is inadequate to give one (or more if they possess more than one device) to every living person. IPv6 supports 3.4×10^{38} addresses (128-bit addresses), or 5×10^{28}(50 octillion) for each of the roughly 6.5 billion people alive today.

As of December 2005, IPv6 accounts for a tiny percentage of the live addresses in the publicly-accessible Internet, which is still dominated by IPv4. The adoption of IPv6 has been slowed by the introduction of network address translation (NAT), which partially alleviates address exhaustion. The U.S. Government has specified that all federal agencies must deploy IPv6 by 2008. In European Union, IPv6 is one of the main key of eEurope2005, as stated in

the conclusion of the Presidency from the Barcelona European Summit (2004): ensuring affordable broadband access and the deployment of IPv6 in Europe.
It is expected that IPv4 will be supported alongside IPv6 for the foreseeable future.

The main feature of IPv6 is the larger address space: addresses in IPv6 are 128 bits long. The larger address space allows avoiding the potential exhaustion of the IPv4 address space without the need for NAT and other devices that break the end-to-end nature of Internet traffic. Pv6 addresses are typically composed of two logical parts: a 64-bit network prefix, and a 64-bit host part, which is either automatically generated from the interface's MAC address or assigned sequentially.

IPv6 hosts can configure automatically when connected to a routed IPv6 network. If IPv6 auto configuration is not suitable, a host can use stateful auto configuration (DHCPv6) or be configured manually. Multicast (both on the local link and across routers) is part of the base protocol suite in IPv6. This is in opposition to IPv4, where multicast is optional and only rarely deployed across routers.

In IPv4, packets are limited to 64KB of payload. When used over suitable link layers, IPv6 has support for packets over this limit, affectionately known as jumbograms. Use of jumbograms might improve performance over high-throughput networks.
http://en.wikipedia.org/wiki/IPv6 (wikipedia)
References:

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- http://www.ietf.org/rfc/rfc2374.txt: (IETF - RFC 2374: An IPv6 Aggregatable Global Unicast Address Format)
- http://www.ietf.org/rfc/rfc2460.txt: (IETF - RFC 2460: Internet Protocol, Version 6 (IPv6) Specification (obsoletes RFC 1883))
- http://www.ietf.org/rfc/rfc2463.txt: (IETF - RFC 2463: Internet Control Message Protocol (ICMPv6) for the IPv6 Specification)
- http://www.ietf.org/rfc/rfc2464.txt: (IETF - RFC 2464: Transmission of IPv6 Packets over Ethernet Networks)
- http://www.ietf.org/rfc/rfc3513.txt: (IETF - RFC 3513: Internet Protocol Version 6 (IPv6) Addressing Architecture (obsoletes RFC 2373))

3.1.3 TCP (Transmission Control Protocol)

The Transmission Control Protocol (TCP) is one of the core protocols of the Internet protocol suite. Using TCP, applications on networked hosts can create connections to one another, over which they can exchange data or packets. The protocol guarantees reliable and in-order delivery of sender to receiver data. TCP also distinguishes data for multiple, concurrent applications (e.g. Web server and email server) running on the same host.

TCP supports many of the Internet's most popular application protocols and resulting applications, including the World Wide Web, email and Secure Shell.
In the Internet protocol suite, TCP is the intermediate layer between the Internet Protocol below it, and an application above it. Applications often need reliable pipe-like connections to each other, whereas the Internet Protocol does not provide such streams, but rather only unreliable packets. TCP does the task of the transport layer in the simplified OSI model of computer networks.
Applications send streams of 8-bit bytes to TCP for delivery through the network, and TCP divides the byte stream into appropriately sized segments (usually delineated by the maximum transmission unit (MTU) size of the data link layer of the network the computer is attached to). TCP then passes the resulting packets to the Internet Protocol, for delivery through the internet to the TCP module of the entity at the other end. TCP checks to make sure that no packets are lost by giving each packet a sequence number, which is also used to make sure that the data are delivered to the entity at the other end in the correct order. The TCP module at the far end sends back an acknowledgement for packets which have been successfully received; a timer at the sending TCP will cause a timeout if an acknowledgement is not received within a reasonable round-trip time (or RTT), and the (presumably lost) data will then be re-transmitted. The TCP checks that no bytes are damaged by using a checksum; one is computed at the sender for each block of data before it is sent, and checked at the receiver.

TCP has been optimized for wired networks. Any packet loss is considered as congestion and hence the window size is reduced dramatically as a precaution, however wireless links are known to experience sporadic and usually temporary losses due to fading, shadowing, handoff etc. which cannot be considered as congestion. Erroneous back-off of the window size due to wireless packet loss is followed by a congestion avoidance phase with a conservative decrease in window size which causes the radio link to be underutilized. Extensive research has been done on this subject on how to combat these harmful effects. Suggested solutions can be categorized as end-to-end solutions (which require modifications at the client and/or server), link layer solutions (such as RLP in CDMA2000), or proxy based solutions (which require some changes in the network without modifying end nodes).

http://en.wikipedia.org/wiki/Transmission_Control_Protocol (wikipedia)

References:
http://www.ietf.org/rfc/rfc793.txt (IETF - RFC 793: Transmission Control Protocol)
http://www.ietf.org/rfc/rfc1122.txt (IETF - RFC 1122: Requirements for Internet Hosts - Communication Layers)
http://www.ietf.org/rfc/rfc1323.txt (IETF - RFC 1323: TCP Extensions)

3.1.4 SSL (Secure Sockets Layer) and TLS (Transport Layer Security)

Secure Sockets Layer (SSL) and Transport Layer Security (TLS), its successor, are cryptographic protocols which provide secure communications on the Internet.
Developed by Netscape, SSL version 3.0 was released in 1996, which later served as a basis to develop TLS version 1.0, an IETF standard protocol first defined in RFC 2246. Visa, MasterCard, American Express and many leading financial institutions have endorsed SSL for commerce over the Internet.
There are slight differences between SSL 3.0 and TLS 1.0, but the protocol remains substantially the same. The term "SSL" as used here applies to both protocols unless clarified by context.
SSL provides endpoint authentication and communications privacy over the Internet using cryptography. In typical use, only the server is authenticated (i.e. its identity is ensured) while the client remains unauthenticated; mutual authentication requires public key infrastructure (or PKI) deployment to clients. The protocols allow client/server applications to communicate in a way designed to prevent eavesdropping, tampering, and message forgery.
SSL involves a number of basic phases:

- Peer negotiation for algorithm support
- Public key encryption-based key exchange and certificate-based authentication
- Symmetric cipher-based traffic encryption

During the first phase, the client and server negotiate which cryptographic algorithms will be used. Current implementations support the following choices:

- for public-key cryptography: RSA, Diffie-Hellman, DSA or Fortezza;
- for symmetric ciphers: RC2, RC4, IDEA, DES, Triple DES or AES;
- for one-way hash functions: MD5 or SHA.

SSL runs on layers beneath application protocols such as HTTP, SMTP and NNTP and above the TCP transport protocol.
SSL operates in modular fashion: its authors designed it for extendability, with support for forwards and backwards compatibility and negotiation between peers.
http://en.wikipedia.org/wiki/Transport_Layer_Security (wikipedia)
References:

http://www.ietf.org/rfc/rfc2246.txt (IETF -RFC 2246: TLS 1.0)
http://www.ietf.org/rfc/rfc3546.txt (IETF - RFC 3546: TLS Extensions)

3.1.5 SSH (Secure Shell)

In computing, Secure Shell or SSH is both a computer program and an associated network protocol designed for logging into and executing commands on a networked computer. The designers of SSH aimed to replace the earlier rlogin, TELNET and rsh protocols, and the resultant protocol provides secure encrypted communications between two untrusted hosts over an insecure network. Users of SSH can also use it for tunnelling, forwarding arbitrary TCP ports and X11 connections over the resultant secure channel; and can transfer files using the associated SFTP or SCP protocols. An ssh server, by default, listens on the standard TCP port 22.
First version of SSH (now called SSH-1) was developed in 1995. In 1996, a revised version of the protocol, SSH-2, was designed, incompatible with SSH-1. In 2006, this protocol became a proposed Internet standard with the publication by the IETF "secsh" working group of RFCs (see references). SSH-2 features both security and feature improvements over SSH-1. Better security, for example, comes through Diffie-Hellman key exchange and strong integrity checking via MACs. New features of SSH-2 include the ability to run any number of shell sessions over a single SSH connection.
Since SSH-1 has inherent design flaws which make it vulnerable to e.g. man in the middle attacks, it is now generally considered obsolete and should no longer be used. In practice most modern servers and clients support SSH-2, which should be used exclusively (by explicitly disabling fallback to SSH-1). However, software not supporting SSH-2 is still used by many organizations, which can make it hard to avoid the use of SSH-1.
The SSH-2 protocol has a clean internal architecture (defined in RFC 4251) with well-separated layers. These are:

- The *transport* layer (RFC 4253)
- The *user authentication* layer (RFC 4252)
- The *connection* layer (RFC 4254)

http://en.wikipedia.org/wiki/Secure_Shell (wikipedia)
References:
http://www.ietf.org/rfc/rfc4251.txt (IETF - RFC 4251 SSH-2 Architecture)
http://www.ietf.org/rfc/rfc4252.txt (IETF - RFC 4252 SSH User Authentication Layer)
http://www.ietf.org/rfc/rfc4253.txt (IETF - RFC 4253 SSH Transport Layer)
http://www.ietf.org/rfc/rfc4254.txt (IETF - RFC 4252 SSH Connection Layer)

3.1.6 SIP (Session Initiation Protocol)

Session Initiation Protocol (SIP) is a protocol developed by the IETF MMUSIC Working Group and proposed standard for initiating, modifying, and

terminating an interactive user session that involves multimedia elements such as video, voice, instant messaging, online games, and virtual reality. In November 2000, SIP was accepted as a 3GPP signaling protocol and permanent element of the IMS architecture. It is one of the leading signalling protocols for Voice over IP, along with H.323.
http://en.wikipedia.org/wiki/Session_Initiation_Protocol (wikipedia)
http://www.masternewmedia.org/2003/12/26/standards_do_we_really_need.htm

3.1.7 FTP (File Transfer Protocol)

FTP or File Transfer Protocol is a commonly used protocol for exchanging files over any network that supports the TCP/IP protocol. The protocol is standardized in RFC 0959 by the IETF.
There are two computers involved in an FTP transfer: a server and a client. The FTP server, running FTP server software, listens on the network for connection requests from other computers. The client computer, running FTP client software, initiates a connection to the server. Once connected, the client can do a number of file manipulation operations such as uploading files to the server, download files from the server, rename or delete files on the server and so on.
FTP is commonly run on two ports, 20 and 21, and runs exclusively over TCP. The FTP server listens on port 21 for incoming connection from FTP clients. A connection on this port forms the control stream, on which commands are passed to the FTP server. For the actual file transfer to take place, a different connection is required. Depending on the transfer mode, the client (active mode) or the server (passive mode) can listen for the incoming data connection. Before file transfer begins, the client and server also negotiate the port of the data connection. In case of active connections (where the server connects to the client to transfer data), the server binds on port 20 before connecting to the client. For passive connections, there is no such restriction.
While data is being transferred via the data stream, the control stream sits idle. This can cause problems with large data transfers through firewalls which time out sessions after lengthy periods of idleness. While the file may well be successfully transferred, the control session can be disconnected by the firewall, causing an error to be generated.

FTP is an inherently insecure method of transferring files because there is no way for the original FTP specification to transfer data in an encrypted fashion. What this means is that under most network configurations, user names, passwords, FTP commands and transferred files can be "sniffed" or viewed by someone else on the same network using a protocol analyzer (or "sniffer"). It should be noted that this is a problem common to many Internet protocols written prior to the creation of SSL such as HTTP, SMTP and Telnet. The common solution to this problem is to use SFTP (SSH File Transfer Protocol)

which is based on SSH, or FTPS (FTP over SSL), which adds SSL or TLS encryption to FTP.
http://en.wikipedia.org/wiki/Ftp (wikipedia)
References:
http://www.ietf.org/rfc/rfc0959.txt (IETF - RFC 959: File Transfer Protocol)
http://www.ietf.org/rfc/rfc1579.txt (IETF - RFC 1579: Firewall-Friendly FTP)

3.1.8 SFTP (SSH File Transfer Protocol)

The SSH File Transfer Protocol provides secure file transfer functionality over any reliable data stream. It is the standard file transfer protocol for use with the SSH2 protocol.
http://www.ietf.org/internet-drafts/draft-ietf-secsh-filexfer-12.txt (IETF - ID on SSH File Transfer Protocol)

The protocol is not yet an Internet standard. The latest specification is an Internet Draft, which defines version 6 of the protocol. Currently the most widely used version is 3, implemented by the popular OpenSSH SFTP server. Many Microsoft Windows-based SFTP implementations use version 4 of the protocol, which lessened its ties with the Unix platform.
A common misconception is that SFTP is simply FTP run over SSH (FTP over SSH: the practice of tunnelling a normal FTP session over an SSH connection); in fact it is a new protocol designed from the ground up by the IETF SECSH working group. The protocol itself does not provide authentication and security; it expects the underlying protocol to secure this. SFTP is most often used as subsystem of SSH protocol version 2 implementations, having been designed by the same working group. However, it is possible to run it over SSH-1 (and some implementations support this) or other data streams. Running SFTP server over SSH-1 is not platform independent as SSH-1 does not support the concept of subsystems. An SFTP client willing to connect to an SSH-1 server needs to know the path to the SFTP server binary on the server side.
http://en.wikipedia.org/wiki/SSH_file_transfer_protocol (wikipedia)

References:
http://www.ietf.org/internet-drafts/draft-ietf-secsh-filexfer-12.txt (IETF - ID on SSH File Transfer Protocol)

3.1.9 FTPS (FTP over SSL)

FTPS is a name used to encompass a number of ways in which FTP software can perform secure file transfers. Each way involves the use of a SSL/TLS layer below the standard FTP protocol to encrypt the control and/or data channels. It should not be confused with SSH file transfer protocol (SFTP).
The most common uses of FTP and SSL are:

- *AUTH TLS or Explicit FTPS*, named for the command issued to indicate that TLS security should be used. This is the preferred method according

to the RFC defining FTP over TLS. The client connects to the server port 21 and starts an unencrypted FTP session as normal, but requests that TLS security be used and performs the appropriate handshake before sending any sensitive data (see RFC 4217: "Securing FTP with TLS").
- *AUTH* as defined in RFC 2228 ("FTP Security Extensions") extensions to the FTP specification - RFC 959 - providing strong authentication, integrity, and confidentiality on both the control and data channels with the introduction of new optional commands, replies, and file transfer encodings)
- *Implicit FTPS* is an older style in which the client connects to a different port (usually 990), and an SSL handshake is performed before any FTP commands are sent.

If you are trying to deploy a secure FTP client or server, you may get badly bitten by a poorly designed or configured Firewall. [1] has a link to an Internet Draft that might help.
http://en.wikipedia.org/wiki/FTPS (wikipedia)

RFC 2228: FTP Security Extensions
This document defines extensions to the FTP specification STD 9, RFC 959, "FILE TRANSFER PROTOCOL (FTP)" (October 1985). These extensions provide strong authentication, integrity, and confidentiality on both the control and data channels with the introduction of new optional commands, replies, and file transfer encodings.
http://www.ietf.org/rfc/rfc2228.txt (IETF - RFC 2228)

RFC 4217: Securing FTP with TLS
This document describes a mechanism that can be used by FTP clients and servers to implement security and authentication using the TLS protocol defined by RFC 2246, "The TLS Protocol Version 1.0.", and the extensions to the FTP protocol defined by RFC 2228, "FTP Security Extensions". It describes the subset of the extensions that are required and the parameters to be used, discusses some of the policy issues that clients and servers will need to take, considers some of the implications of those policies, and discusses some expected behaviours of implementations to allow interoperation.
In summary, an FTP session is established on the normal control port. A client requests TLS with the AUTH command and then decides if it wishes to secure the data connections by use of the PBSZ and PROT commands. Should a client wish to make the control connection revert back into plaintext (for example, once the authentication phase is completed), then the CCC command can be used.
Implementation of this protocol extension does not ensure that each and every session and data transfer is secure, it merely provides the tools that allow a client and/or server to negotiate an acceptable or required level of security for that given session or data transfer. However, it is possible to have a server implementation that is capable of refusing to operate in an insecure fashion.
http://www.ietf.org/rfc/rfc4217.txt (IETF - RFC 4217)

3.1.10 HTTP (HyperText Transfer Protocol)

HyperText Transfer Protocol (HTTP) is the protocol used to transfer or convey information on the World Wide Web. The original purpose was to provide a way to publish and receive HTML pages.
Development of HTTP was coordinated by the World Wide Web Consortium and working groups of the Internet Engineering Task Force, culminating in the publication of a series of RFCs, most notably RFC 2616, which defines HTTP/1.1, the version of HTTP in common use today.
HTTP is a request/response protocol between clients and servers. The originating client, such as a web browser, spider, or other end-user tool, is referred to as the user agent. The destination server, which stores or creates resources such as HTML files and images, is called the origin server. Between the user agent and the origin server there may be several intermediaries, such as proxies, gateways, and tunnels.
A HTTP client initiates a request by establishing a Transmission Control Protocol (TCP) connection to a particular port on a remote host (port 80 by default). A HTTP server listening on that port waits for the client to send a Request Message.
Upon receiving the request, the server sends back a status line, such as "HTTP/1.1 200 OK", and a message of its own, the body of which is perhaps the requested file, an error message, or some other information.
Resources to be accessed by HTTP are identified using Uniform Resource Locators (URLs) using the http: URL scheme.
http://en.wikipedia.org/wiki/HyperText_Transfer_Protocol (wikipedia)
References:
http://www.ietf.org/rfc/rfc2616.txt (IETF - RFC 2616: HTTP/1.1 Specification)

3.1.11 HTTPS (HyperText Transfer Protocol over SSL)

HTTPS is not, strictly, a separate protocol, as the data is still transferred using HTTP; however, instead of using plain text socket communication, the session data is encrypted using a version of the Secure Socket Layer (SSL) or Transport Layer Security (TLS) protocols, thus ensuring reasonable protection from eavesdroppers and man in the middle attacks. The default TCP port of an https: URI is 443 (for unsecured HTTP, the default is 80).

To prepare a web-server for accepting https connections the administrator must create a public key certificate for the web-server. This certificate must be signed by a certificate authority of one form or another, who certifies that the certificate holder is who they say they are. Web browsers are generally distributed with the signing certificates of major certificate authorities such as VeriSign, so that they can verify certificates signed by them.

Organizations may also run their own certificate authority, particularly if they are responsible for setting up browsers to access their own sites (for example, sites on a company intranet), as they can trivially add their own signing certificate to the defaults shipped with the browser.

Finally, for a single site, self-signed certificates can be the ideal solution. It is important to understand though, that unless the certificate can be verified in some way (for example, phoning the certificate owner to verify its checksum), there is a risk of a man in the middle attack.

The system can also be used for client authentication, in order to restrict access to a web-server to only authorized users. For this, typically the site administrator creates certificates for each user, which are loaded into their browser, although certificates signed by any certificate authority the server trusts, should work. These normally contain the name and e-mail of the authorized user, and are automatically checked by the server on each reconnect to verify the user's identity, potentially without ever entering a password.
The level of protection depends on the correctness of the implementation by the web browser and the server software and the actual cryptographic algorithms supported.
http://en.wikipedia.org/wiki/Https (wikipedia)

The Informational RFC 2818 describes how to use TLS to secure HTTP connections over the Internet, distinguishing secured traffic from insecure traffic by the use of a different server port.
http://www.ietf.org/rfc/rfc2818.txt (IETF - RFC 2818)

3.1.12 Telnet

The purpose of the TELNET Protocol is to provide a fairly general, bi-directional, eight-bit byte oriented communications facility.
http://www.ietf.org/rfc/rfc854.txt (IETF - RFC 854: Telnet protocol)

It is typically used to provide user oriented command line login sessions between hosts on the Internet.

TELNET is a client-server protocol, based on TCP, and clients generally connect to port 23 on the host providing the service (though like many protocols in use on the Internet, which port to use is fairly easy to change). Partly because of the design of the protocol and partly because of the flexibility typically provided by TELNET client programs, it is also possible to use a TELNET program to establish an interactive TCP connection to some other service on an Internet host.

The TELNET protocol can be divided into a core and a set of extensions. The core protocol is described by IETF documents RFC 854 and RFC 855 which are also collected together in STD 8, which defines fairly basic operating characteristics of the protocol and a means of defining and implementing extensions. There are many extensions, some of which have been adopted as Internet Standards. IETF STD document numbers from 27 through to 32 define various TELNET extensions (most of which are extremely common). Of the remaining extensions the most useful ones are probably those that are on the IETF standards track as proposed standards; details can be found in STD 1.
There are three main problems with TELNET, making it a bad choice for modern systems from the point of view of computer security:

- Commonly used TELNET daemons have several vulnerabilities discovered over the years, and probably several more still exist.
- TELNET, by default, does not encrypt any data sent over the connection (including passwords), and so it is trivial to eavesdrop on the communications and use the password later for malicious purposes.
- TELNET lacks an authentication scheme that makes it possible to ensure that communication is carried out between the two desired hosts, and not intercepted in the middle.

In environments where security is important, such as on the public Internet, TELNET should not be used. TELNET sessions are unencrypted. This means that anybody who has access to any router, switch, or gateway located on the network between the two hosts where telnet is being used can intercept the TELNET packets passing by and easily obtain login and password information (and whatever else is typed) with any of several common utilities like tcpdump and Ethereal.

These flaws have seen the usage of the TELNET protocol drop rapidly in favor of the more secure and functional protocol SSH. SSH provides all functionality present in telnet, with the addition of strong encryption to prevent sensitive data such as passwords from being intercepted, and public key authentication, to ensure that the remote computer is actually who it claims to be.
http://en.wikipedia.org/wiki/Telnet (wikipedia)
References:
http://www.ietf.org/rfc/rfc854.txt (IETF - RFC 854: Telnet protocol)
http://www.ietf.org/rfc/rfc855.txt (IETF - RFC 855: Telnet option)

3.2 Mobile protocol suites

3.2.1 WAP (WAP protocol suite)

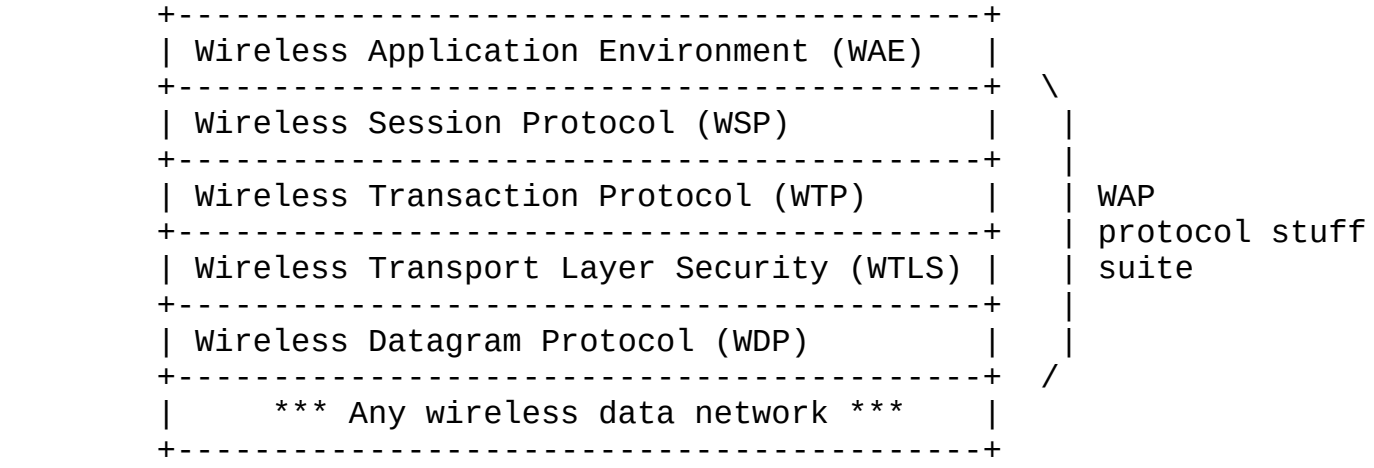
WAP – Wireless Application Protocol is a worldwide protocol for Internet and Intranet applications to be used in wireless devices. It enables time and place independent access to internet. WAP utilizes Internet standards such as XML, user datagram protocol (UDP) and Internet protocol (IP). Many of the protocols

are based on Internet standards such as hypertext transfer protocol (HTTP) and TLS but have been optimized for the unique constraints of the wireless environment: low bandwidth, high latency, and less connection stability (International Engineering Consortium 2005).

The lightweight WAP protocol stack is designed to minimize the required bandwidth and maximize the number of wireless network types that can deliver WAP content. Multiple networks will be targeted, with the additional aim of targeting multiple networks. These include global system for mobile communications (GSM) 900, 1,800, and 1,900 MHz; interim standard (IS)–136; digital European cordless communication (DECT); time-division multiple access (TDMA), personal communications service (PCS), FLEX, and code division multiple access (CDMA). All network technologies and bearers will also be supported, including short message service (SMS), USSD, circuit-switched cellular data (CSD), cellular digital packet data (CDPD), and general packet radio service (GPRS)

WAP protocol suite

The WAP Forum (a join of wireless industry for building a common standard for wireless data applications) proposed a protocol suite that would allow the interoperability of WAP equipment and software with many different network technologies; the rationale for this was to build a single platform for competing network technologies such as GSM and IS-95 (also known as CDMA) networks.



- The bottom-most protocol in the suite is the WAP Datagram Protocol (WDP), which is an adaptation layer that makes every data network look a bit like UDP to the upper layers by providing unreliable transport of data with two 16-bit port numbers (origin and destination). WDP is considered by all the upper layers as one and same protocol, which has several "technical realizations" on top of other "data bearers" such as SMS, USSD, etc. On native IP bearers such as GPRS, UMTS packet-radio service, or PPP on top of a circuit-switched data connection, WDP is in fact exactly UDP.

- WTLS provides a public-key cryptography-based security mechanism similar to TLS. Its use is optional.
- WTP provides transaction support (reliable request / response) that is adapted to the wireless world. WTP supports more effectively than TCP the problem of packet loss, which is common in 2G wireless technologies in most radio conditions, but is misinterpreted by TCP as network congestion.
- Finally, WSP is best thought of on first approach as a compressed version of HTTP.

This protocol suite allows a terminal to emit requests that have an HTTP or HTTPS equivalent to a WAP "gateway"; the gateway translates requests into plain HTTP.

WAP vs. IP

Wireless Application Protocol (WAP) vs. Internet Protocol

Internet	WAP
HTTP	Wireless Session Protocol (WSP)
	Wireless Transaction Protocol (WTP)
TLS-SSL	Wireless Transport Layer Security (WTSL)
TCP/IP	Wireless Datagram Protocol (WDP)
UDP/IP	User Datagram Protocol (UDP)
HTML	Wireless Application Environment (WAE)

Maintenance

The official body developing WAP used to be the WAP Forum. The WAP Forum has consolidated (along with many other forums of the industry) into OMA (Open Mobile Alliance), which covers virtually everything in future development of wireless data services.

WAP 2.0

The new version of WAP, WAP 2.0, is a re-engineering of WAP using a cut-down version of XHTML with end-to-end HTTP (i.e., dropping the gateway and custom protocol suite used to communicate with it).
XHTML MP (XHTML Mobile Profile), the markup language defined in WAP 2.0, is made to work in mobile devices. It is a subset of XHTML and a superset of XHTML Basic. A version of cascading style sheets (CSS) called WAP CSS is supported by XHTML MP.

Failure?

In terms of speed, ease of use, appearance, and interoperability, WAP early failed. Here are some criticisms explaining the failure: use of an idiosyncratic WML language (which cut users off from the true HTML web), under-specification of terminal requirements (difficult interoperability), constrained user interface capabilities, lack of good authoring tools, neglect of content providers, lack of openness by wireless carriers.
http://en.wikipedia.org/wiki/Wap (wikipedia)

References:
http://www.openmobilealliance.org/tech/affiliates/wap/wapindex.html (OMA - WAP Forum)
http://www.wapforum.org/what/WAPWhite_Paper1.pdf (WAP Forum - White Paper WAP 2.0)

3.2.2 WAE - Wireless Application Environment

WAE is a part of WAP. It specifies application environment based fundamentally on World Wide Web technologies. WAE specifies an environment that allows operators and service providers to build applications and services that can reach a wide variety of different platforms.

3.2.3 Mobile IP

Mobile IP is proposed standard solution for handling terminal mobility among IP subnets and was designed to allow a host to change its point of attachment transparently to an IP network. Mobile IP solves the mobility problem by managing the correlation between a changing IP address (core-of address) and the static home address. It enables connection to the visited network, using home address (regardless of location).

3.2.4 Mobile IPv4

Mobile IP was originally defined for IPv4 (Nokia networks 2001), which support transparency above the IP layer, including maintenance of active TCP connections and UDP port bindings. Currently is being deployed on a wide basis (e.g., in CDMA2000 networks).

3.3 Recommendations for multimedia delivery

3.3.1 H.320

H.320 is a umbrella recommendation by the ITU-T for running Multimedia (Audio/Video/Data) over ISDN based networks. The main protocols in this suite are H.221, H.230, H.242, audio codecs such as G.711 and G.723, and video codecs such as H.261 and H.263.
http://en.wikipedia.org/wiki/H320 (wikipedia)
References:
http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=T-REC-H.320 (ITU-T H.320 Recommendation)

3.3.2 H.323

H.323 is an umbrella recommendation from the ITU-T, that defines the protocols to provide audio-visual communication sessions on any packet network.

It is commonly used in Voice over IP (VoIP, Internet Telephony, or IP Telephony) and IP-based videoconferencing.
H.323 defines the different multimedia entities that make up a multimedia system - Endpoints, Gateways, Multipoint Conferencing Units (MCUs), and Gatekeepers -- and their interaction.
H.323 references many other ITU-T protocols like:

- H.225.0 protocol is used to describe call signaling, the media (audio and video), the stream packetization, media stream synchronization and control message formats.
- H.245 control protocol for multimedia communication, describes the messages and procedures used for opening and closing logical channels for audio, video and data, capability exchange, control and indications.
- H.450 describes the Supplementary Services
- H.235 describes security in H.323
- H.239 describes dual stream use in videoconferencing, usually one for live video, the other for presentation

http://en.wikipedia.org/wiki/H323 (wikipedia)
References:
http://www.itu.int/rec/T-REC-H.323 (ITU-T H.323 Recommendation)

3.3.3 T.120

T.120 is an ITU-T standard (International Telecommunications Union) for document conferencing. Document conferencing allows two or more people to concurrently view and edit a document across a network.
T.120 is the commonly used name to refer to a family of distinct standards. Many videoconferencing companies were developing their own implementations of this until Microsoft released its free NetMeeting software. Now, many companies are using NetMeeting, while perhaps enhancing it in some way.
http://www.ecu.edu/itcs/vc/glossary.htm (ecu)
References:
http://www.itu.int/rec/T-REC-T.120/en (ITU-T T.120 Recommendation)

3.4 Organizations for standards and interoperability

3.4.1 ETSI (European Telecommunications Standards Institute)

The European Telecommunications Standards Institute (ETSI) is an independent, non-profit organization, whose mission is to produce telecommunications standards for today and for the future.

Based in Sophia Antipolis (France), the European Telecommunications Standards Institute (ETSI) is officially responsible for standardization of Information and Communication Technologies (ICT) within Europe. These

technologies include telecommunications, broadcasting and related areas such as intelligent transportation and medical electronics.

ETSI unites 688 members from 55 countries inside and outside Europe, including manufacturers, network operators, administrations, service providers, research bodies and users - in fact, all the key players in the ICT arena.

ETSI plays a major role in developing a wide range of standards and other technical documentation as Europe's contribution to world-wide ICT standardization. This activity is supplemented by interoperability testing services and other specialisms. ETSI's prime objective is to support global harmonization by providing a forum in which all the key players can contribute actively. ETSI is officially recognized by the European Commission and the EFTA secretariat.

ETSI's Members determine the Institute's work programme, allocate resources and approve its deliverables. As a result, ETSI's activities are closely aligned with market needs and there is wide acceptance of its products.
ETSI's standards are built on consensus.

Standardization in a changing world
The Information Society offers huge potential to enrich everyone's lives. We can communicate with the other side of the world almost as easily as we speak to our next-door neighbour. Our children take for granted what their PC or mobile phone will do. New technology is affecting our work, our rest and our play.
But with new opportunities come challenges. Technology makes things quicker, easier, better. But it is also more complex.
Achieving the Information Society involves practical action by a wide range of players. Data exchange around the world, using different platforms, with different practices, different languages and character sets, requires a neutral tool for all parties to communicate. Standardization carves a path through this complexity.

The Benefits of Standardization
Standardization:
- enables interoperability
- encourages innovation, fosters enterprise and opens up new markets
- creates trust and confidence in products
- expands the market, brings down costs and increases competition
- helps prevent the duplication of effort

Standardization is an essential requirement for the open exchange of information; without it, the network simply will not work.

There are two major caveats, however, without which standardization could impede rather than accelerate progress:

- standards must be produced at a speed that is consistent with market demand,
- standards must consider all interested parties, or they will not be widely acceptable.

http://www.etsi.org/about_etsi/5_minutes/home.htm (ETSI)
References:
http://www.etsi.org/ (ETSI)

3.4.2 GSM Association

The GSM Association is dedicated to turn that vision into reality by promoting and driving the global platform for GSM mobile communications.
The GSM Association is a global trade association serving the world's GSM mobile operator member community by promoting, protecting and enhancing their interests and investments. The GSM world has exceeded the one billion-customer milestone, with one in seven people on the planet already connected today. GSM has already become one of the technological success stories of our age, ranking proudly alongside other wonders of the modern era such as mass air travel, television and the Internet – and in fact, more people now have GSM mobile phones than are online globally.
But it's not just about numbers. GSM ranks alongside them, because of its power to change our lives. For those of us privileged to work in this wireless industry, we can be proud of what we have already achieved, and excited by the opportunities and challenges ahead.
We are already enabling people to cut loose and communicate easily and quickly on one number, almost anywhere in the world. Now, as the GSM family develops and evolves to offer high-speed digital data services such as GPRS, EDGE & 3GSM, we are driving forward our vision of the seamless, limitless, wireless world of communications.(http://www.gsmworld.com/index.shtml)

3.4.3 3GPP (3rd Generation Partnership Project)

The 3rd Generation Partnership Project (3GPP) is a collaboration agreement that was established in December 1998. The collaboration agreement brings together a number of telecommunications standards bodies which are known as "Organizational Partners". The current Organizational Partners are ARIB, CCSA, ETSI, ATIS, TTA, and TTC.
The establishment of 3GPP was formalized in December 1998 by the signing of the "The 3rd Generation Partnership Project Agreement".
The original scope of 3GPP was to produce globally applicable Technical Specifications and Technical Reports for a 3rd Generation Mobile System based on evolved GSM core networks and the radio access technologies that they support (i.e., Universal Terrestrial Radio Access (UTRA) both Frequency

Division Duplex (FDD) and Time Division Duplex (TDD) modes). The scope was subsequently amended to include the maintenance and development of the Global System for Mobile communication (GSM) Technical Specifications and Technical Reports including evolved radio access technologies (e.g. General Packet Radio Service (GPRS) and Enhanced Data rates for GSM Evolution (EDGE)).

The discussions that led to the signing of the 3GPP Agreement were recorded in a series of slides called the “Partnership Project Description” that describes the basic principles and ideas on which the project is based. The Partnership Project Description has not been maintained since it’s first creation but the principles of operation of the project still remain valid.
In order to obtain a consolidated view of market requirements a second category of partnership was created within the project called “Market Representation Partners”.

“Observer” status is also possible within 3GPP for those telecommunication standards bodies which have the potential to become Organizational Partners but which, for various reasons, have not yet done so.
A permanent project support group called the “Mobile Competence Centre (MCC)“ has been established to ensure the efficient day to day running of 3GPP. The MCC is based at the ETSI headquarters in Sophia Antipolis, France.
http://www.3gpp.org/About/about.htm
References:
http://www.3gpp.org/ (3GPP)

3.4.4 IEEE Standards Association

The IEEE is the world's largest technical professional association, connecting more than 360,000 members in approximately 150 countries. Through its members, the IEEE is a leading authority in technical areas ranging from computer engineering, biomedical technology and telecommunications, to electric power, aerospace and consumer electronics, among others..
Founded in 1884 by electrical engineering innovators who understood the value of shared information, the IEEE vision is to advance global prosperity by fostering technological innovation, enabling members' careers, and promoting community worldwide. (http://standards.ieee.org/)

3.4.5 IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes international standards for all electrical, electronic and related technologies. These serve as a basis for national standardization and as references when drafting international tenders and contracts.

Through its members, the IEC promotes international cooperation on all questions of electrotechnical standardization and related matters, such as the assessment of conformity to standards, in the fields of electricity, electronics and related technologies.

The IEC charter embraces all electrotechnologies including electronics, magnetics and electromagnetics, electroacoustics, multimedia, telecommunication, and energy production and distribution, as well as associated general disciplines such as terminology and symbols, electromagnetic compatibility, measurement and performance, dependability, design and development, safety and the environment.

The Commission's objectives are to:

- meet the requirements of the global market efficiently
- ensure primacy and maximum world-wide use of its standards and conformity assessment schemes
- assess and improve the quality of products and services covered by its standards
- establish the conditions for the interoperability of complex systems
- increase the efficiency of industrial processes
- contribute to the improvement of human health and safety
- contribute to the protection of the environment.

3.4.6 ISO (International Organization for Standardization)

ISO is a network of the national standards institutes of 156 countries, on the basis of one member per country, with a Central Secretariat in Geneva, Switzerland, that coordinates the system.
ISO is a non-governmental organization: its members are not, as is the case in the United Nations system, delegations of national governments. Nevertheless, ISO occupies a special position between the public and private sectors. This is because, on the one hand, many of its member institutes are part of the governmental structure of their countries, or are mandated by their government. On the other hand, other members have their roots uniquely in the private sector, having been set up by national partnerships of industry associations.
Therefore, ISO is able to act as a bridging organization in which a consensus can be reached on solutions that meet both the requirements of business and the broader needs of society, such as the needs of stakeholder groups like consumers and users.
http://www.iso.org/iso/en/aboutiso/introduction/index.html#two
References:
http://www.iso.org/ (ISO)

3.4.7 OMA (Open Mobile Alliance)

The mission of the Open Mobile Alliance is to facilitate global user adoption of mobile data services by specifying market driven mobile service enablers that ensure service interoperability across devices, geographies, service providers, operators, and networks, while allowing businesses to compete through innovation and differentiation.

Maintaining an open organization (actively collaborating with other organizations, developing industry solutions in a transparent manner, etc.) is key to OMA's vision for broad industry participation and adoption.

The OMA Technical Plenary is responsible for the delivery of technical specifications for application and service frameworks, with certifiable interoperability, enabling deployment of rich mobile applications and services. In addition, it oversees the technical specification drafting activities, approval and maintenance of technical specifications, as well as the resolution of technical issues within the OMA organization.

The Technical Plenary is organized around a collection of technical working groups, each focusing on a particular technology area. Currently, there are 15 Technical Working Groups and 2 Committees of the Technical Plenary. Some of these technical working groups are particularly interesting for mGBL purposes:

- Games Services Working Group: It continues the work originated in the former Mobile Games Interoperability Forum (MGIF). Its goal is to define interoperability specifications, application programming interfaces (API's) and protocols for network enabled gaming. The GS specifications will allow game developers to develop and deploy mobile games that can interoperate more efficiently with platforms and networks based on the OMA specifications. The intent is to produce significant cost reduction for game developers, game platform owners and service providers.
- Developer's Interest Working Group: OMA is organized around a collection of technical working groups, each focusing on a particular technology area. Many of these working groups define OMA specifications and best practices that eventually will be utilized by software developers to create and deploy applications. Such applications may reside in the operator space, the infrastructure space or the terminal space. The OMA Developers Interest Group allows software developers to express their requirements into OMA and will facilitate the creation of innovative mobile applications and services.
- Interoperability Working Group: It acts as a center of excellence to identify, specify and maintain the required processes, policies and test programs for ensuring interoperability for OMA specified enablers and end-to-end services. It will continuously consolidate all present and future interoperability groups from organizations consolidated, or to be consolidating into OMA, to secure a common understanding of the ongoing IOP activities, study and understand best practices in the IOP area. The OMA IOP group is responsible for providing interoperability of

the enablers included in OMA's scope, as well as to provide end-to-end interoperability test cases at a service level as defined by OMA. This will be handled over the interfaces specified by the OMA architecture.

- Mobile Web Service: As evidenced by the industry developments and the work of other standards bodies and consortia, there is a growing need to provide consistent, standard, federated access to services and service enablers that exist within the wireless network and clients, based on gathering and analysis of market requirements in this area. In addition, the OMA itself, via the current WAP Framework, provides for access to various services or service enablers such as Push, Client Identity, and location information, among others. However, the OMA provides no consistent, coherent method to publish or discover the presence of, or the methods used to access these services.
  The goal of the Mobile Web Services Working (MWS) Group is to develop specifications that define the application of web services within the OMA architecture. The goal of the group will be to ensure the specifications provide for the application of web services that is converged with the work of external activities. This includes the generation of a recommendation and/or specification and a set of best practices that describe how to apply web services with the OMA Architecture. The Mobile Web Services Group does not intend to develop new competing specifications where recognized standards exist, but to leverage existing standards where applicable to achieve the OMA goal of convergence.

The OMA interoperability process (IOP) has been established around the concept of regularly held TestFestivals (OMA TestFests) hosted by OMA, where member companies can bring their implementation to test in multiple cross-vendor combinations.

The WAP Forum (the official body developing WAP) has also consolidated into OMA.

References:
http://www.openmobilealliance.org

3.4.8 W3C (World Wide Web Consortium)

The World Wide Web Consortium (W3C) develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential. W3C is a forum for information, commerce, communication, and collective understanding.

3.5 Overview on e-Learning standards

The goal of the e-learning standards, as in all the other fields, is to provide fixed data structures and communication protocols for e-learning objects and

cross-system workflows. They facilitate, although not assuring, interoperability between applications, such as an LMS (Learning Management System) and third-party or in-house developed content, by providing uniform communication guidelines that can be used throughout the design, development, and delivery of learning objects. When these standards are incorporated into off-the-shelf products, developers can base their purchasing decisions on quality and appropriateness rather than compatibility.

Unfortunately, the typical components within a learning environment are supported by multiple products with different vendors' solutions. Not surprising, if all the points of interoperability among e-learning components vary from vendor to vendor, then it is very difficult and costly to implement an integrated learning environment.

Currently, most e-learning standards can be organized into some general categories:

Metadata. Many developers argue that metadata content is the heart of e-learning. Learning content and catalog offerings must be labeled in a consistent way to support the indexing, storage, discovery (search), and retrieval of learning objects by multiple tools across multiple repositories.

Content packaging. The goal of content packaging specifications and standards is to enable organizations to transfer courses and content from one learning system to another. This is crucial because content can potentially be created by one tool, modified by another tool, stored in a repository maintained by one vendor, and used in a delivery environment produced by a different supplier.

Content packages include both learning objects and information about how they are to be put together to form larger learning units. They can also specify the rules for delivering content to a learner.

Learner profiles. These standards allow different system components to share information about learners across multiple system components. Learner profile information can include personal data, learning plans, learning history, accessibility requirements, certifications and degrees, assessments of knowledge (skills/competencies). In addition, systems need to communicate learner data to the content, such as scores or completion status.

Standards are and continue to be a part of all aspects of learning. To be successful with standards, we must keep in mind that, although standards are helpful, there is not always need to use every aspect of each standard. No one standard is perfect for every use, so we must be ready to pick and choose. Most important, because e-learning standards are constantly evolving, we must keep updated about developments among the standards organizations that create the guidelines.

3.6 IEEE Learning Technology Standards Committee

The IEEE Learning Technology Standards Committee (LTSC) is chartered by the IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning

technology.
The LTSC coordinates formally and informally with other organizations that produce specifications and standards for similar purposes. Standards development is done in working groups via a combination of face-to-face meetings, teleconferences, and exchanges on discussion groups. The LTSC is governed by a Sponsor Executive Committee (SEC) consisting of working group chairs and elected officers.

3.7 Digital Rights Expression Lang. WG4

The Digital Rights Expression Languages (DREL) workgroup within the IEEE Learning Technology Standards Committee is gathering requirements that a standardized DREL must meet to support learning, education, and training.

3.8 Computer Managed Instruction, WG11

Today Computer Based Training (CBT) is being written by a diverse number of parties using very diverse tools or authoring systems. Many of the CBT lessons being developed can complement and work well with other lessons developed in different locations with different tools by different people. There is a need to allow these complementary lessons to be brought together and used in a single course. However, this cannot be done without defining a standard set of CMI (Computer Managed Instruction) functions and a matching set of CBT functions.

3.8.1 RAMLET (1484.11.4)

The Resource Aggregation Model for Learning Education and Training is a new activity within the IEEE Learning Technology Standards Committee (LTSC). This activity is defining a nomenclature and a conceptual model for digital aggregates of resources for learning, education, and training applications.

3.8.2 CMI Data Model (1484.11.1)

This Standard describes a data model to support the interchange of agreed upon data elements and their values between a learning-related content object and a runtime service (RTS) used to support learning management.

3.8.3 ECMAScript API (1484.11.2)

This Standard describes an ECMAScript application-programming interface (API) for content-to-runtime-services communication.

3.8.4 XML Binding of Data Model (1484.11.3)

The purpose of IEEE project P1484.11.3 is to define an XML Schema for the data model defined in IEEE 1484.11.1-2004, "Standard for Learning Technology - Data Model for Content Object Communication." This data model is already used in SCORM 2004, but with a different binding. One potential application for the XML binding is to facilitate the communication of data from

SCORM learner sessions within LMS implementations and between related services such as tracking data aggregation, reporting and analysis. The 1484.11.3 draft has been approved in balloting by IEEE members. It has been submitted for final approval by the IEEE-SA Standards Board Standards Review Committee (RevCom). Upon approval by RevCom, it will become an official standard. It takes several weeks after RevCom approbal before a final standard publication becomes available in the IEEE store.

Purpose
The purpose of this Standard is to allow the creation of IEEE 1418.11.1–2004 data-model in-stances in XML. This Standard uses the W3C XML Schema definition language to specify the encoding of these data-model instances (see XML Schema Parts 1 and 2). This allows for inter-operability and the exchange of data-model instances between various systems.

Normative References
The following referenced documents are indispensable for the application of this Standard. For dated references, only the edition cited applies. For undated references, the latest edition f the referenced document (including any amendments) applies.
IEEE 1484.11.1–2004, IEEE Standard for Learning Technology-Data Model for Content Ob-ject Communication.
W3C Recommendation (28 October 2004), XML Schema Part 1: Structures, Second Edition.
W3C Recommendation (28 October 2004), XML Schema Part 2: Datatypes, Second Edition.

Definitions
For purposes of this Standard, the following terms and definitions apply. IEEE 100, The Authori-tative Dictionary of IEEE Standards Terms, Seventh Edition [B1]2, should be referenced for terms not defined in this Clause.

content object*:* A collection of digital content that is intended for presentation to a learner by a learning technology system. A content object may include learning material and processing code. Example: A content object might be an interactive HTML page with an embedded video clip and an ECMAScript.

content object communication data Extensible Markup Language instance (COCD XML instance): A particular XML representation of the data model defined in IEEE 1484.11.1–2004 that adheres to the requirements and constraints of an XML binding of the data model.

Extensible Markup Language binding (XML binding): In this Standard, the method of encoding the behaviors, attributes, and value spaces of data-model elements in W3C Extensible Markup Language. This method is specified using the W3C XML Schema definition language.

Conformance

This Standard defines conforming IEEE 1481.11.1–2004 content object communication data (COCD) instances in an XML binding. Hereafter, such instances are referred to as "COCD XML instances."

In this Standard, "shall" is to be interpreted as a requirement on an implementation; "shall not" is to be interpreted as a prohibition.

A conforming COCD XML instance

- Shall conform to the data-model requirements of IEEE 1484.11.1–2004;
- Shall not contain any extensions to the data model defined in IEEE 1484.11.1–2004;
- Shall be valid according to the XML Schema definition (XSD) specified in this Standard;
- Shall not contain any elements or attributes not defined in the XSD specified in this Standard; and
- Shall consist of a single element and its descendants. The single element shall have the name "cocd" as defined in the XSD specified in this Standard. The single element shall reside within the scope of a namespace declaration using the namespace specified in this Standard.

XML binding

The namespace for the XML binding is defined by the conforming XSD and shall be:

http://ltsc.ieee.org/xsd/1484_11_3

The XSD conforms to XML Schema Parts 1 and 2, October, 2004.

Acronyms and abbreviations

COCD: content object communication data
SPM: smallest permitted maximum
W3C: World Wide Web Consortium
XML: Extensible Markup Language
XSD: XML Schema definition

3.9 Learning Object Metadata, WG12

This multi-part standard will specify the syntax and semantics of Learning Object Metadata, defined as the attributes required to fully/adequately describing a Learning Object.

3.9.1 The Learning Object Metadata standard

This standard will specify the syntax and semantics of Learning Object Metadata, defined as the attributes required to fully/adequately describing a Learning Object. Learning Objects are defined here as any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning.

3.9.2 LOM Data Model Standard (1484.12.1)

This part of the LOM specifies a conceptual data schema that defines the structure of a metadata instance for a learning object.

3.9.3 LOM XML Binding (1484.12.3)

This part of the LOM standard describes an XML binding to enable the exchange of LOM instances between conforming systems that implement the 1484.12.1 data model.

3.10 The Dublin Core Metadata Initiative

3.10.1 About the Initiative

The Dublin Core Metadata Initiative (DCMI) is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems.
Mission and Scope
The Dublin Core Metadata Initiative provides simple standards to facilitate the finding, sharing and management of information.
DCMI does this by:

- Developing and maintaining international standards for describing resources
- Supporting a worldwide community of users and developers
- Promoting widespread use of Dublin Core solutions

The major characteristics of DCMI as an organization are (the three 'I's):
Independent: DCMI is not controlled by specific commercial or other interests and is not biased towards specific domains nor does it mandate specific technical solutions
International: DCMI encourages participation from organizations anywhere in the world, respecting linguistic and cultural differences
Influenceable: DCMI is an open organization aiming at building consensus among the participating organizations; there are no prerequisites for participation
The development and maintenance of a core set of metadata terms (the DCMI Metadata Terms) continues to be one of the main activities of DCMI. In addition, DCMI is developing guidelines and procedures to help implementers define and describe their usage of Dublin Core metadata in the form of Application Profiles. This work is done in a work structure that provide discussion and cooperation platforms for specific communities (e.g. education, government information, corporate knowledge management) or specific interests (e.g. technical architecture, accessibility).

3.10.2 Dublin Core Metadata Element Set, Version 1.1

The Dublin Core Metadata Element Set is a vocabulary of fifteen properties for use in resource description. The name "Dublin" is due to its origin at a 1995

invitational workshop in Dublin, Ohio; "core" because its elements are broad and generic, usable for describing a wide range of resources.
The fifteen element "Dublin Core" described in this standard is part of a larger set of metadata vocabularies and technical specifications maintained by the Dublin Core Metadata Initiative (DCMI). The full set of vocabularies, DCMI Metadata Terms [DCMI-TERMS], also includes a set of resource classes, the DCMI Type Vocabulary [DCMI-TYPE]. The terms in DCMI vocabularies are intended to be used in combination with terms from other, compatible vocabularies in the context of application profiles and on the basis of the DCMI Abstract Model [DCAM].

Each term is specified with the following minimal set of attributes:

- Name: The unique token assigned to the term.
- URI: The Uniform Resource Identifier used to uniquely identify a term.
- Label: The human-readable label assigned to the term.
- Definition: A statement that represents the concept and essential nature of the term.
- Comment: Additional information about the term or its application.

3.10.3 The Dublin Core Metadata Element Set

Term Name: contributor

URI:	http://purl.org/dc/elements/1.1/contributor
Label:	Contributor
Definition:	An entity responsible for making contributions to the resource.
Comment:	Examples of a Contributor include a person, an organization, or a service. Typically, the name of a Contributor should be used to indicate the entity.

Term Name: coverage

URI:	http://purl.org/dc/elements/1.1/coverage
Label:	Coverage
Definition:	The spatial or temporal topic of the resource, the spatial applicability of the resource, or the jurisdiction under which the resource is relevant.
Comment:	Spatial topic may be a named place or a location specified by its geographic coordinates. Temporal period may be a named period, date, or date range. A jurisdiction may be a named administrative entity or a geographic place to which the resource applies. Recommended best practice is to use a controlled vocabulary such as the Thesaurus of Geographic Names [TGN]). Where appropriate, named places or time periods can be used in preference to numeric identifiers such as sets of coordinates or date ranges.
References:	[TGN] http://www.getty.edu/research/tools/vocabulary/tgn/index.html

Term Name: creator

URI:	http://purl.org/dc/elements/1.1/creator
Label:	Creator
Definition:	An entity primarily responsible for making the resource.
Comment:	Examples of a Creator include a person, an organization, or a service. Typically, the name of a Creator should be used to indicate the entity.

Term Name: date

URI:	http://purl.org/dc/elements/1.1/date

Label: Date
Definition: A point or period of time associated with an event in the lifecycle of the resource.
Comment: Date may be used to express temporal information at any level of granularity. Recommended best practice is to use an encoding scheme, such as the W3CDTF profile of ISO 8601 [W3CDTF].
References: [W3CDTF] http://www.w3.org/TR/NOTE-datetime

Term Name: description

URI: http://purl.org/dc/elements/1.1/description
Label: Description
Definition: An account of the resource.
Comment: Description may include but is not limited to: an abstract, a table of contents, a graphical representation, or a free-text account of the resource.

Term Name: format

URI: http://purl.org/dc/elements/1.1/format
Label: Format
Definition: The file format, physical medium, or dimensions of the resource.
Comment: Examples of dimensions include size and duration. Recommended best practice is to use a controlled vocabulary such as the list of Internet Media Types [MIME].
References: [MIME] http://www.iana.org/assignments/media-types/

Term Name: identifier

URI: http://purl.org/dc/elements/1.1/identifier
Label: Identifier
Definition: An unambiguous reference to the resource within a given context.
Comment: Recommended best practice is to identify the resource by means of a string conforming to a formal identification system.

Term Name: language

URI: http://purl.org/dc/elements/1.1/language
Label: Language
Definition: A language of the resource.
Comment: Recommended best practice is to use a controlled vocabulary such as RFC 3066 [RFC3066].
References: [RFC3066] http://www.ietf.org/rfc/rfc3066.txt

Term Name: publisher

URI: http://purl.org/dc/elements/1.1/publisher
Label: Publisher
Definition: An entity responsible for making the resource available.
Comment: Examples of a Publisher include a person, an organization, or a service. Typically, the name of a Publisher should be used to indicate the entity.

Term Name: relation

URI: http://purl.org/dc/elements/1.1/relation
Label: Relation
Definition: A related resource.
Comment: Recommended best practice is to identify the related resource by means of a string conforming to a formal identification system.

Term Name: rights

URI: http://purl.org/dc/elements/1.1/rights
Label: Rights
Definition: Information about rights held in and over the resource.
Comment: Typically, rights information includes a statement about various property rights associated with the resource, including intellectual property rights.

Term Name: source

URI: http://purl.org/dc/elements/1.1/source

Label: Source
Definition: The resource from which the described resource is derived.
Comment: The described resource may be derived from the related resource in whole or in part. Recommended best practice is to identify the related resource by means of a string conforming to a formal identification system.

Term Name: subject
URI: http://purl.org/dc/elements/1.1/subject
Label: Subject
Definition: The topic of the resource.
Comment: Typically, the topic will be represented using keywords, key phrases, or classification codes. Recommended best practice is to use a controlled vocabulary. To describe the spatial or temporal topic of the resource, use the Coverage element.

Term Name: title
URI: http://purl.org/dc/elements/1.1/title
Label: Title
Definition: A name given to the resource.
Comment: Typically, a Title will be a name by which the resource is formally known.

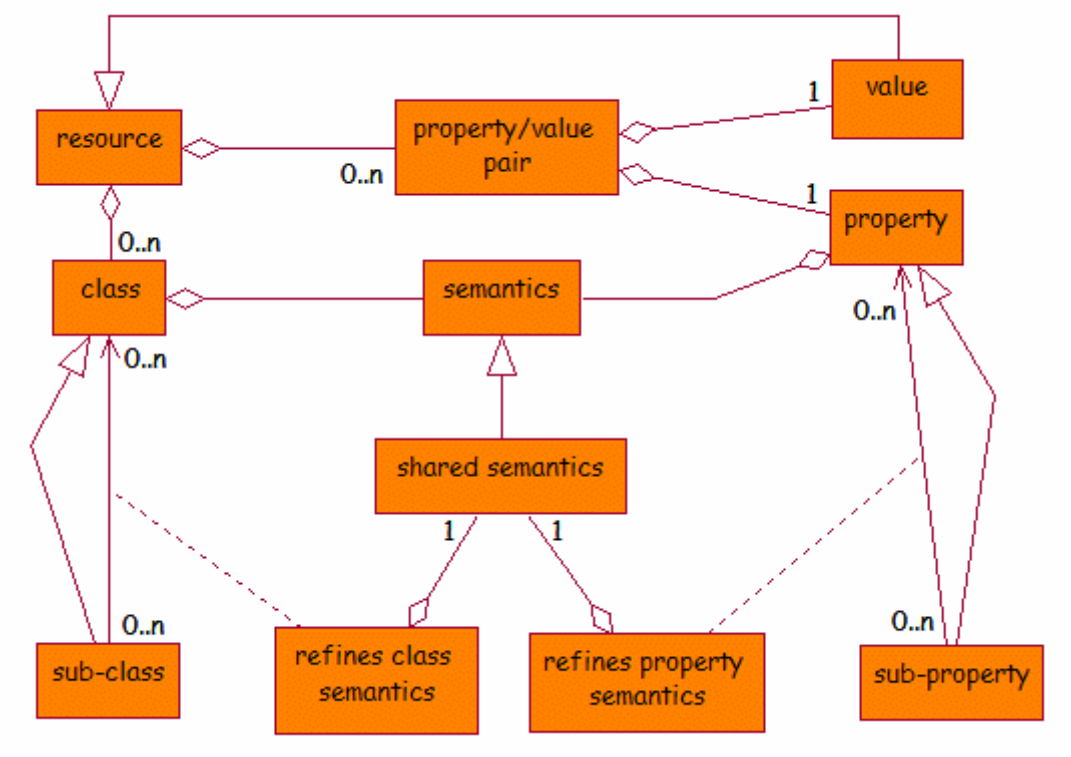
Term Name: type
URI: http://purl.org/dc/elements/1.1/type
Label: Type
Definition: The nature or genre of the resource.
Comment: Recommended best practice is to use a controlled vocabulary such as the DCMI Type Vocabulary [DCMITYPE]. To describe the file format, physical medium, or dimensions of the resource, use the Format element.
References: [DCMITYPE] http://dublincore.org/documents/dcmi-type-vocabulary/

3.10.4 DCMI Abstract Model

This document specifies an abstract model for Dublin Core metadata. It defines the nature of the components used and describes how those components are combined to create information structures. It provides a reference model which is independent of any particular encoding syntax. Such a reference model allows us to gain a better understanding of the kinds of descriptions that we are trying to encode and facilitates the development of better mappings and cross-syntax translations. The DCMI Abstract Model builds on work undertaken by the World Wide Web Consortium (W3C) on the Resource Description Framework (RDF) [RDF[1], RDFS[2]].

[1] Klyne, Graham and Jeremy Carroll, editors. Resource Description Framework: Concepts and Abstract Syntax. W3C Recommendation. 10 February 2004. <http://www.w3.org/TR/rdf-concepts/>

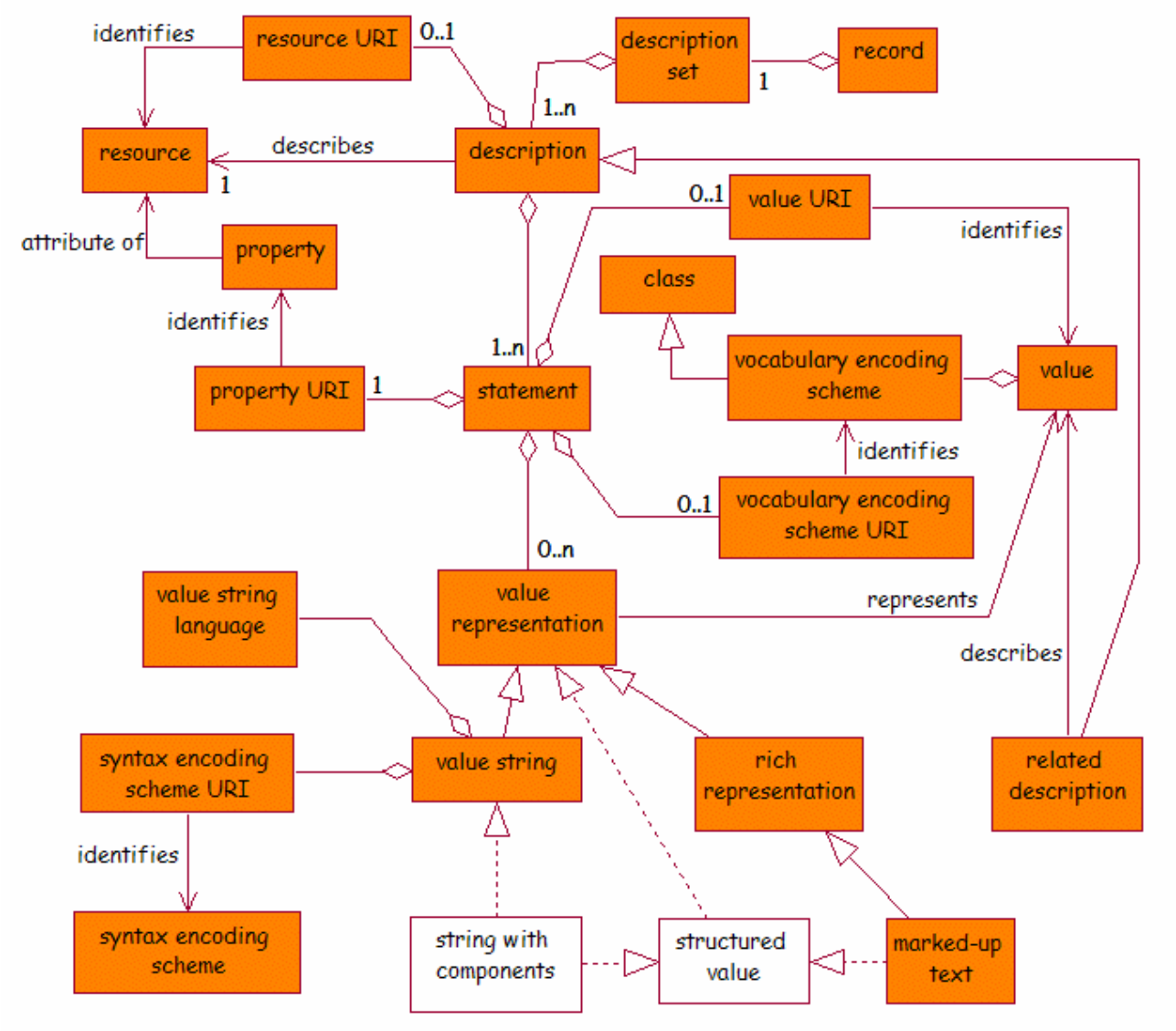
The DCMI Abstract Model is represented using UML[3] class diagrams. Lines ending in a block-arrow should be read as 'is' or 'is a' (for example, "a *value* is a *resource*") and that lines starting with a block-diamond should be read as 'contains a' or 'has a' (for example, "a *statement* contains a *property URI*"). Other relationships are labeled appropriately. Note that the UML modeling used shows the abstract model but is not intended to form a suitable basis for the development of software applications.



the DCMI resource model

[2] Brickley, Dan and R.V. Guha, editors. RDF Vocabulary Description Language 1.0: RDF Schema. W3C Recommendation. 10 February 2004. <http://www.w3.org/TR/rdf-schema/>

[3] Booch, Grady, James Rumbaugh and Ivar Jacobson. The Unified Modeling Language User Guide. Addison-Wesley, 1998.



the DCMI description model

The abstract model of the *resources* described by *descriptions* is as follows:

- Each *described resource* may be described using one or more *property-value pairs*.
- Each *property-value pair* is made up of one *property* and one *value*.
- Each *value* is a *resource* - the physical or conceptual entity that is associated with a *property* when a *property-value pair* is used to describe a *resource*.

The abstract model of DC metadata *descriptions* is as follows:

- A *description set* is a set of one or more *descriptions*, each of which describes a single *resource*.
- A *description* is made up of one or more *statements* (about one, and only one, *described resource*) and zero or one *resource URI* (a *URI* that identifies the *described resource*).
- Each *statement* instantiates a *property-value pair* and is made up of a *property URI* (a *URI* that identifies a *property*), zero or one *value URI* (a

URI that identifies the *value* associated with the *property*), zero or one *vocabulary encoding scheme URI* (a *URI* that identifies the *vocabulary encoding scheme* of which the *value* is a member), and zero or more *value representations*.

- The *value representation* may take the form of a *value string* or a *rich representation*.
- Each *value string* is a string which represents the *resource*. *Value strings* are intended to be human-readable.
- Each *value string* may have either an associated *syntax encoding scheme URI* that identifies a *syntax encoding scheme* or an associated *value string language* that is an ISO language tag (for example en-GB) but not both.
- Each *rich representation* is a sequence of octets that represents the *value* (a *resource*) - for example, some marked-up text, an image, a video, some audio, or some combination thereof.
- Each *rich representation* must have an associated *media type* (a MIME Media Type).

The abstract model of the vocabularies used in DC metadata *descriptions* is as follows:

- Each *property* may be related to one or more *classes* by a *has domain* relationship. Where it is stated that a *property* has such a relationship with a *class* and a *described resource* is related to a *value* by that *property*, it follows that the *described resource* is an instance of that *class*.
- Each *property* may be related to one or more *classes* by a *has range* relationship. Where it is stated that a *property* has such a relationship with a *class* and a *described resource* is related to a *value* by that *property*, it follows that the *value* is an instance of that *class*.
- Each *resource* may be an *instance of* one or more *classes*.
- Each *resource* may be a *member of* one or more *vocabulary encoding schemes*.
- Each *class* may be related to one or more other *classes* by a *sub-class of* relationship (where the two *classes* are defined such that all *resources* that are instances of the sub-class are also instances of the related *class*).
- Each *property* may be related to one or more other *properties* by a *sub-property of* relationship. Where it is stated that such a relationship exists, the two *properties* are defined such that whenever a *resource* is related to a *value* by the sub-property, it follows that the *resource* is also related to that same *value* by the *property*.
- Each *syntax encoding scheme* is a *class* (of strings).
- A *vocabulary* is a set of one or more *terms*. Each *term* is a member of one or more *vocabularies*.

A number of things about the model are worth noting:

- Each *value* may be the *described resource* in a separate *description* within the same description set - for example, a separate *description*

may provide metadata about the person that is the creator of the *described resource*.

- The description model does not provide an explicit mechanism for indicating the *classes* of the *described resource* or the *classes* of any given *value. Classes* of the *described resource* can either be indicated explicitly using one or more *statements* in the *description* or be inferred from the *domains* of the *properties* used in the *description. Classes* of any given *value* can either be indicated explicitly using one or more *statements* in a separate *description* about that *value* or be inferred from the *range* of the *property*.

The abstract model presented above indicates that each DC metadata *description* describes one, and only one, *described resource*. This is commonly referred to as the one-to-one principle.
However, real-world metadata applications tend to be based on loosely grouped sets of *descriptions* (where the *described resources* are typically related in some way), known here as *description sets*. For example, a *description set* might comprise *descriptions* of both a painting and the artist. Furthermore, it is often the case that a *description set* will also contain a *description* about the *description set* itself (sometimes referred to as 'admin metadata' or 'meta-metadata').
Description sets are instantiated, for the purposes of exchange between software applications, in the form of metadata *records*, according to one of the DCMI encoding guidelines (for example, XHTML meta tags, XML and RDF/XML) [DCMI-ENCODINGS[4]].
A DC metadata *value* is the physical or conceptual entity that is associated with a *property* when a *property-value pair* is used to describe a *resource*. For example, a *value* associated with the Dublin Core Creator *property* is a person, organization or service - a physical entity. A *value* associated with the Dublin Core Date *property* is a point (or range) in time - a conceptual entity. A *value* associated with the Dublin Core Coverage *property* is a geographic region or country - a physical entity. A *value* associated with the Dublin Core Subject *property* is a concept (a conceptual entity) or a physical object or person (a physical entity). Each of these entities is a *resource*.

[4]Encoding Guidelines
Expressing Simple Dublin Core in RDF/XML
http://dublincore.org/documents/2002/07/31/dcmes-xml/ Recommendation
Guidelines for implementing Dublin Core in XML
http://dublincore.org/documents/2003/04/02/dc-xml-guidelines/ Recommendation
Expressing Qualified Dublin Core in RDF/XML
http://dublincore.org/documents/2002/05/15/dcq-rdf-xml/ Proposed Recommendation
Expressing Qualified Dublin Core in HTML/XHTML meta and link elements
http://dublincore.org/documents/dcq-html/ Recommendation

The *value* may be identified using a *value URI*. The *value* may be represented by one or more *value strings* and/or *rich representations*. The *value* may described by a separate *description*. In each case, the *value* is a *resource*.
Some of the concepts in the DCMI Abstract Model are taken from the Resource Description Framework (RDF) and RDF Schema (RDFS) as follows:

DCMI Abstract Model	**RDF/RDFS**
resource	Class: http://www.w3.org/2000/01/rdf-schema#Resource
property or *element*	Class: http://www.w3.org/1999/02/22-rdf-syntax-ns#Property
class	Class: http://www.w3.org/2000/01/rdf-schema#Class
syntax encoding scheme	Class: http://www.w3.org/2000/01/rdf-schema#Datatype
has domain relationship	Property: http://www.w3.org/2000/01/rdf-schema#domain
has range relationship	Property: http://www.w3.org/2000/01/rdf-schema#range
sub-property of relationship	Property: http://www.w3.org/2000/01/rdf-schema#subPropertyOf
sub-class of relationship	Property: http://www.w3.org/2000/01/rdf-schema#subClassOf

Particular encoding guidelines (HTML meta tags, XML, RDF/XML, etc.) [DCMI-ENCODINGS] do not need to encode all aspects of the abstract model described above. However, they should refer to the DCMI Abstract Model and indicate which parts of the model are encoded and which are not.
Encoding guidelines should indicate how a *value* can be treated as a *described resource* in a separate *description* in those cases where there is no *value URI*.

3.11 SCORM

The work done by the US Federal Government ADL (Advanced Distributed Learning) initiative and their recently released Shareable Courseware Object Reference Model (SCORM) provides one of the best and most recent examples of the application and integration of learning standards. These guidelines provide a foundation for how the Department of Defense will use learning technologies to build, and operate in, the learning environment of the future. The US military (be it Navy, Air Force, Army, or Marines) can all use, exchange, manage, track, and reuse all of their learning content and data no matter its source or application. Moreover, the Federal Government can choose multiple vendors, if they comply with the IEEE LTSC standards and the SCORM specifications, for various projects and know that all of the products and services will interoperate.

3.11.1 "What is SCORM?"

The Sharable Content Object Reference Model defines a specific way of constructing Learning Management Systems and training content so that they work well with other SCORM conformant systems. Basically, the different versions of SCORM all govern the same two things: packaging content and exchanging data at runtime.

Packaging content determines how a piece of content should be delivered in a physical sense. At the core of SCORM packaging is a document titled the "imsmanifest". This file contains every piece of information required by the LMS[5] to import and launch content without human intervention. This manifest file contains XML that describes the structure of a course both from a learner's perspective and from a physical file system perspective. Questions like, "Which document should be launched?" and "What is the name of this content?" are answered by this document.

Runtime communication, or data exchange, specifies how the content "talks" to the LMS while the content is actually playing. This is the part of the equation we describe as delivery and tracking. There are two major components to this communication. First, the content has to "find" the LMS. Once the content has found it, it can then communicate through a series of "get" and "set" calls and an associated vocabulary. Conceptually, these are things like "request the learner's name" and "tell the LMS that the learner scored 95% on this test." Based on the available SCORM vocabulary, many rich interactive experiences can be communicated to the LMS.

3.11.2 Why should I use SCORM?

SCORM is a really powerful tool for anyone involved in online training. Content can be created one time and used in many different systems and situations without modification. This plug-and-play functionality can be powerful *within* an organization but even more so *across* organizations. Content can be sold and delivered to the user more quickly, more robustly, and at a lower price.

SCORM is widely adopted by some huge organizations. It has the critical momentum and is the de facto industry standard. The US Department of Defense has specified that all of its content must be delivered via SCORM. *All of it*. Industry is following suit, and the standard appears in a vast majority of RFPs to procure both training content and Learning Management Systems.

[5] Learning Management System, A Learning Management System (or LMS) is a software package that enables the management and delivery of online content to learners. Most LMSs are web-based to facilitate "anytime, any place, any pace" access to learning content and administration.

3.11.3 What's a SCO?

A Sharable Content Object is the most granular piece of training in a SCORM world. Some would call it a module, a chapter, a page… the point is that it varies wildly. A SCORM purist would tell you that it should be the smallest piece of content that is both reusable and independent. In terms of how the LMS treats it, this is the item shown separately in the table of contents and tracked separately from other items. It can contain its own bookmark, score, and completion status.

3.11.4 How does SCORM relate to AICC[6]?

SCORM is a reference model, which means that it is built on top of existing specifications. From the beginning, SCORM has been described as a "best of breed" solution, culling the best pieces of prior specifications. AICC, a standard from the aviation industry, was used as a basis for the runtime communication portion of the SCORM specification. Conforming to one standard does not mean that you automatically conform to the other.

3.11.5 Which version of SCORM is relevant?

The answer is all of them. The primary goal of adopting SCORM is generally to create an interoperable system that will work well with other systems. Support for all of the SCORM versions and AICC is essential to fulfilling that goal. To date, there are three released versions of SCORM, each building on top of the prior one.

- **SCORM 1.0** The original version. Proof of concept only. Introduced the notion of Shareable Content Object (SCO) and the API model in which the burden of managing communication latency across the Internet is handled by the runtime environment, not by the content objects.
- **SCORM 1.1** The first production version. Used a Course Structure Format XML file based on the AICC specifications to describe content structure, but lacked a robust packaging manifest and support for metadata. Quickly abandoned in favor of SCORM 1.2.
- **SCORM 1.2** The first version with a real conformance test in the form of a test suite. Uses IMS Content Packaging specification with full content manifest and support for metadata describing the course. Also allows optional detailed metadata tagging of the content objects and assets

[6] The **Aviation (All Emcompassing) Industry CBT** (Computer-Based Training) **Committee** (AICC) is an international association of technology-based training professionals. The AICC develops guidelines for aviation industry in the development, delivery, and evaluation of CBT, WBT and related training technologies.
CBT: **Computer-based training (CBT)**, also called **computer-assisted instruction (CAI)** is a type of education in which the student learns by executing special training programs on a computer
WBT: **Web-based training** (WBT) is a type of training that is similar to computer-based training (CBT); however, it is delivered over the Internet using a web browser.

described in the manifest. Usually works well; both the delivery system and content pass the test suite without cheating, but lacks sequencing and some other desirable features. No longer maintained or supported by ADL.

- **SCORM 2004** (formerly known as SCORM 1.3) is the most recent release. It extends and formalizes the packaging and runtime portions of the 1.2 standard, but its key addition is the sequencing and navigation (S&N) specification. S&N allows the content vendor to specify both the behavior within the SCO *and* the behavior *between* the SCOs. This allows for substantially richer content interactions and huge increases in the reuse of SCOs. Adoption has been slow, to this point, but the number of LMS's and content vendors supporting SCORM 2004 is increasing greatly.

3.11.6 SCORM 2004 3rd Edition

SCORM 2004 3rd Edition continues to build upon a common Web-based "Content Aggregation Model" and a "Run-Time Environment" for learning content. SCORM continues to solidify its collection of specifications and standards adapted from multiple sources to provide a comprehensive suite of e-learning capabilities that enable interoperability, accessibility and reusability of Web-based learning content.
The SCORM 2004 3rd Edition Documentation Suite is a ZIP file[7] that contains all the SCORM components: the SCORM 2004 3rd Edition Overview, SCORM 2004 3rd Edition Content Aggregation Model (CAM) book, SCORM 2004 3rd Edition Run-Time Environment (RTE) book and the SCORM 2004 3rd Edition Sequencing and Navigation (SN) book.

- **SCORM 2004 3rd Edition Overview** The SCORM Overview book provides an overview of the SCORM 2004 3rd Edition documentation suite, the SCORM 2004 3rd Edition Conformance Test Suite and SCORM 2004 3rd Edition Sample Run-Time Environment. It is written at an intentionally high level. The technical details of SCORM can be found in three stand-alone documents, or books that cover the Content Aggregation Model (CAM), the Run-Time Environment (RTE) and Sequencing and Navigation (SN).

- **SCORM 2004 3rd Edition Content Aggregation Model (CAM) Version 1.0** The SCORM Content Aggregation Model (CAM) book describes components used in a learning experience, how to package those components for exchange from system to system, how to describe those components to enable search and discovery, and how to define the sequencing rules for the components.

[7] http://www.adlnet.gov/downloads/files/311.cfm

- **SCORM 2004 3rd Edition Run-Time Environment (RTE) Version 1.0** The SCORM RTE book describes the Learning Management System (LMS) requirements for managing the run-time environment (i.e., content launch process, communication between content and LMSs and standardized data model elements used for passing information about the learner). The RTE covers the requirements of SCOs and their use of the API and the SCORM Run-Time Environment Data Model.

- **SCORM 2004 3rd Edition Sequencing and Navigation (SN) Version 1.0** The SCORM SN book describes how SCORM conformant content may be sequenced through a set of learner-initiated or system-initiated navigation events. The branching and flow of that content may be described by a predefined set of activities, typically defined at design time. The SCORM SN book also describes how a SCORM conformant LMS interprets the sequencing rules expressed by a content developer along with the set of learner-initiated or system-initiated navigation events and their effects on the run-time environment.

3.12 IMS Global Learning Consortium

IMS GLC is a global, nonprofit, member association that provides leadership in shaping and growing the learning and educational technology industries through collaborative support of Standards, Innovation, Best Practice and Recognition of Superior Learning Impact. IMS includes more than 50 Contributing Members and affiliates. These members come from every sector of the global learning community. They include hardware and software vendors, educational institutions, publishers, government agencies, systems integrators, multimedia content providers, and other consortia. IMS provides a neutral forum in which members work together to advocate the use of technology to support and transform education and learning.

3.12.1 Specification

IMS AccessForAll Meta-data Specification

The AccessForAll Meta-data specification is intended to make it possible to identify resources that match a user's stated preferences or needs. These preferences or needs would be declared using the IMS Learner Information Package Accessibility for LIP specification. The needs and preferences addressed include the need or preference for alternative presentations of resources, alternative methods of controlling resources, alternative equivalents to the resources themselves and enhancements or supports required by the user. The specification provides a common language for identifying and describing the primary or default resource and equivalent alternatives for that resource.

This work represents open collaboration between working group members from IMS, Dublin Core, IEEE, CEN-ISSS, Eduspecs as well as other groups. The

AccessForAll Meta-data specification is a proposed unified approach to matching user needs and preferences with the resources that address those needs and preferences across the participating specifications bodies.

IMS Learner Information Package Accessibility for LIP

The Accessibility for LIP defines two new sub-schemas for the IMS Learning Information Package that define a means to specify accessibility preferences and learner accommodations. These preferences go beyond support for disabled people to include kinds of accessibility needs such as mobile computing, noisy environments, etc. The <accessForAll> element defines accessibility preferences that were left for future work in the IMS Learner Information Package (LIP) specification version 1.0. The "accessibility" data structure includes the following elements: <language>, <preference>, <eligibility>, and <disability> in the LIP. This specification adds the <accessForAll> element under <accessibility> because it is intended to address the needs of learners beyond those with disabilities. The <disability> element is deprecated henceforth.

IMS Guidelines for Developing Accessible Learning Applications

The following set of guidelines developed by the IMS Accessibility Working Group will provide a framework for the distributed learning community. This framework will set the stage for what solutions currently exist, what the opportunities and possibilities are for implementing them, and the areas where more development and innovation are still needed in educational technologies to ensure education that is truly accessible to anyone, anytime, anywhere.

3.12.2 Competency Definitions - IMS Reusable Definition of Competency or Educational Objective

IEEE will adopt IMS RDCEO

The IEEE/LTSC has requested and received permission to use the RDCEO[8] specification as the basis for an IEEE competency definition standard. Producing the standard will involve converting RDCEO to the IEEE format and conducting the IEEE process for approving a standard. This memo explains how LTSC and IMS will cooperate and provides information about how interested parties can join the IEEE Standards Association and the Ballot Group for this standard.

The RDCEO specification provides a means to create common understandings of competencies that appear as part of a learning or career plan, as learning pre-requisites, or as learning outcomes. The information model in this specification can be used to exchange these definitions between learning systems, human resource systems, learning content, competency or skills repositories, and other relevant systems. RDCEO provides unique references to

[8] Reusable Definition of Competency or Educational Objective

descriptions of competencies or objectives for inclusion in other information models.

Digital Repositories Specification

The IMS Digital Repositories v1.0 Final specification, released January 30, 2003, purpose is to provide recommendations for the interoperation of the most common repository functions. These recommendations should be implementable across services to enable them to present a common interface.
On the broadest level, this specification defines digital repositories as being any collection of resources that are accessible via a network without prior knowledge of the structure of the collection. Repositories may hold actual assets or the meta-data that describe assets. The assets and their meta-data do not need to be held in the same repository.
This specification is intended to utilize schemas already defined elsewhere (e.g., IMS Meta-Data and Content Packaging), rather than attempt to introduce any new schema.

3.12.3 General Web Services

IMS General Web Services Final Specification

The General Web Services Base Profile promotes interoperability for web service based specification implementations on different software and vendor platforms. The Base Profile focuses on a core set of web service specifications and the most common problems experienced implementing the identified web service specifications. It is not a goal of the General Web Services Base Profile to create a plug-and-play architecture for web services or to guarantee complete interoperability. The General Web Services Base Profile addresses interoperability in the application layer, in particular, the description of behaviors exposed via Web Services.
The General Web Service Base Profile is derived from the Web Services Interoperability Basic Profile v1.1 and the Web Services Interoperability Simple SOAP Binding Profile v1.0. The IMS Global Learning Consortium (IMS/GLC) recommendations for the General Web Service Base Profile are to adopt:

- XML Schema V1.0 - all data models in IMS specifications will be defined in terms of XML Schema (XSD);
- HTTP V1.1 - the Hypertext Transfer Protocol (HTTP) is the mandated protocol binding for the SOAP messages;
- SOAP V1.1 - SOAP is the mandated messaging protocol;
- WSDL V1.1 - an instance of the service is defined using Web Services Description Language (WSDL) v1.1. WSDL is used to enable the description of services as sets of endpoints operating on messages.

3.12.4 Core Specification

XML

XML 1.0 (Third Edition) is the core data representation technology adopted for the binding of IMS specifications [XML, 04]. An IMS data-model oriented information model can be defined as a hierarchy. Hierarchical models are convenient for representing data consisting of many elements and sub-elements. XML is perfectly suited for representing hierarchical models.

XML Schemas

XML Schema Definition (XSD) is the primary XML binding control document format of IMS (at present these bindings are working to the May 2001 version of XML Schema) [XSD, 01]. The XSD defines elements, their content models, and attributes. It also defines the standard IMS vocabularies. The XSD defines the element types and attribute groups separately from the elements. The key recommendations for XML Schema with respect to the Base Profile are:

- When used in the context of SOAP messages all data constructs should be defined as elements. Attributes should not be used. This follows the recommendation of the WS-I;
- All data types should be defined as 'Global'. The usage of 'Local' data types causes problems for some of the WSDL import tools, e.g., Axis;
- All data types should have the character string ".Type" at the end of their name. This avoids naming conflicts between instances and their types.

SOAP

SOAP is a messaging protocol for XML documents which can be used for exchanging structured and typed information between peers in a decentralized, distributed environment [SOAP, 03a], [SOAP, 03b]. It is a stateless, one-way message exchange mechanism, but applications can create more complex interaction patterns (e.g., request/response, request/multiple responses, etc.) by combining such one-way exchanges with features provided by an underlying transport protocol and/or application-specific information. SOAP provides the framework by which application-specific information may be conveyed in an extensible manner. Also, SOAP provides a full description of the expected actions taken by a SOAP processor on receiving a SOAP message.

A SOAP message contains two SOAP-specific sub-elements within the overall Envelope: the 'Header' and 'Body'. The contents of these elements are application defined and not a part of the SOAP specifications, although the latter does have something to say about how such elements must be handled. The 'Header' is optional. Headers have been designed in anticipation of various uses for SOAP, many of which will involve the participation of other SOAP processing nodes along a message's path from a sender to an ultimate receiver, to allow SOAP processors to exchange information to provide value-added services. These form the mechanism by which SOAP messages may be extended in an application-specific manner. The 'Body' is the mandatory element within an Envelope and this is where the main information conveyed in a SOAP message must be carried. The immediate child elements of a 'Header' are called header blocks, and represent some logical grouping of data

that can be targeted at SOAP nodes encountered in the path of a message from a sender to a receiver.
The SOAP envelope is the container for the messages to be exchanged between the systems. These messages need to be physically transmitted across the communications system using an appropriate transport mechanism. In many cases the Hypertext Transport Protocol (HTTP) is used as this transport mechanism. The key recommendations for XML Schema with respect to the Base Profiles are:

- Only bindings based upon SOAPv1.1 across HTTPv1.1 are supported;
- The SOAP message body contains all of the parameters defined in the corresponding operation;
- The status information is to be placed in the SOAP message header.

WS-Addressing

Web Services Addressing (WS-Addressing) defines two interoperable constructs that convey information that is typically provided by transport protocols and messaging systems. These constructs normalize this underlying information into a uniform format that can be processed independently of transport or application. The two constructs are 'endpoint references' and 'message information' headers. Both of these constructs are designed to be extensible and re-usable so that other specifications can build on and leverage endpoint references and message information headers.
A Web service endpoint is a (referenceable) entity, processor, or resource where Web service messages can be targeted. Endpoint references convey the information needed to identify/reference a Web service endpoint, and may be used in several different ways: endpoint references are suitable for conveying the information needed to access a Web service endpoint, but are also used to provide addresses for individual messages sent to and from Web services. To deal with this last usage case this specification defines a family of message information headers that allows uniform addressing of messages independent of underlying transport. These message information headers convey end-to-end message characteristics including addressing for source and destination endpoints as well as message identity.

Attachments for SOAP Messages

Attachments for SOAP messages are available in several forms:

- SOAP with Attachments (SOAPwA) - SOAP With Attachments (SOAPwA) extends SOAPv1.1 by providing a MIME binding to support multiple message payloads, while ignoring the convention by which Remote Procedure Call (RPC) arguments may be marshalled and unmarshalled in XML. SOAPwA is especially suited for use cases where the two communicating parties are NOT located within the same organization, and the exchange paradigm is therefore more one of asynchronous Document Exchange across the Internet, than synchronous Remote Procedure Call within a single business (or University) enterprise;
- WS-Attachments - this specification defines an abstract model for SOAP attachments and based on this model defines a mechanism for encapsulating a SOAP message and zero or more attachments in a DIME

message. SOAP attachments are described using the notion of a compound document structure consisting of a primary SOAP message and zero or more related documents known as attachments;
- Message Transmission Optimization Mechanism (MTOM) - MTOM is one of the W3C message attachment approaches to enable SOAP messages to contain non-XML objects. MTOM is a development of SOAPwA and is proposed as a replacement for the original SOAPwA specification.

The equivalent attachments recommendations for IMS GWS are defined in the IMS GWS Attachments Profile document.

WSDL

A WSDL document defines services as collections of network endpoints, or ports. In WSDL, the abstract definition of endpoints and messages is separated from their concrete network deployment or data format bindings. This allows the reuse of abstract definitions: messages, which are abstract descriptions of the data being exchanged, and port types that are abstract collections of operations. The concrete protocol and data format specifications for a particular port type constitute a reusable binding. A port is defined by associating a network address with a reusable binding and a collection of ports defines a service. Hence, a WSDL document uses the following elements in the definition of network services:

- Types - a container for data type definitions using some type system (such as XSD);
- Message -an abstract, typed definition of the data being communicated;
- Operation - an abstract description of an action supported by the service;
- Port Type -an abstract set of operations supported by one or more endpoints;
- Binding - a concrete protocol and data format specification for a particular port type;
- Port - a single endpoint defined as a combination of a binding and a network address;
- Service - a collection of related endpoints.

The key recommendations for WSDL with respect to the Base Profile are:

- A separate set of WSDL files are defined for each type of communication mode being supported by the binding and there will be one form of the WSDL binding will be contained within a single physical file;
- Alternatively there will be a split file binding in which the XSD information is defined in a separate file from that which contains the rest of the WSDL definition. The WSDL file imports the XSD definitions using the <xsd:import> construct;
- The second alternative is to have the WSDL definition split into the service specific and abstract files plus the XSD, i.e., to create three separate but linked files. The service-specific file imports the abstract definitions using the <wsdl:import> construct and the abstract definitions file imports the XSD definitions using the <xsd:import> construct;

- The final alternative is to have the two separate WSDL files plus several XSD files. The data schema and the message structure schema will be defined in separate files. The message structure XSD will contain all of the messages required for the different communication modes to be supported.

WS-Security

WS-Security defines a standard way to incorporate security information into a SOAP message using existing security standards for confidentiality, integrity, non-repudiation, authentication and authorization. WS-Security provides a method for representing security information in a SOAP message. WS-Security defines a way to pass security tokens, such as a simple username, SAML, X.509 certificates and Kerberos tickets, a mechanism using XML Signature to digitally sign all or part of a SOAP message, a mechanism using XML Encryption to encrypt part of a SOAP message and a method for attaching signature and encryption headers to a SOAP message. The equivalent security profile for IMS GWS is defined in the IMS GWS Security Profile.

Choreography

IMS plans to adopt the appropriate message and service choreography specifications, as opposed to creating its own. The underlying message choreography support in the GWS bindings are detailed in Section 5 of this document. Reliable messaging is only supported as a feature of the underlying communications infrastructure, e.g., through the usage of the Transmission Control Protocol (TCP). When stable, the following specifications will be adopted:

- Web Services Reliable Messaging Framework (WS-Reliability) [WSR, 03] - the purpose of WS-Reliability is to address reliable messaging requirements, which become critical, for example, when using Web Services in B2B applications. SOAP [SOAP1.1] over HTTP [RFC2616] is not sufficient when an application-level messaging protocol must also address reliability and security. While security is getting traction in the development of Web Services standards, reliability is not. This specification is intended as an initial proposal for defining reliability in the context of current Web Services standards. The specification borrows from previous work in messaging an transport protocols, e.g., SOAP, and the ebXML Message Service. It proposes appropriate modifications to apply this work to Web Services;
- Web Services Choreography Description Language Version 1.0 (W3C Working Draft 27 April 2004) - Web Services Choreography Description Language (WS-CDL) is an XML-based language that describes peer-to-peer collaborations of Web Services participants by defining, from a global viewpoint, their common and complementary observable behavior; where ordered message exchanges result in accomplishing a common business goal. The Web Services specifications offer a communication bridge between the heterogeneous computational environments used to develop and host applications. The Web Services Choreography specification is targeted for composing interoperable peer-

to-peer collaborations between any type of Web Service participant regardless of the supporting platform or programming model used by the implementation of the hosting environment;

- Business Process Execution Language for Web Services (BPEL4WS - BPEL4WS (or BPEL for short) is an XML-based standard for defining Web services can be combined to implement business processes [BPEL, 03]. It builds WSDL and XSD. BPEL provides an XML notation and semantics for specifying business process behavior based on Web Services. A BPEL4WS process is defined in terms of its interactions with partners. A partner may provide services to the process, require services from the process, or participate in a two-way interaction with the process. Thus BPEL orchestrates Web Services by specifying the order in which it is meaningful to call a collection of services, and assigns responsibilities for each of the services to partners. It can be used to specify both the public interfaces for the partners and the description of the executable process.

The General Web Service Base Profile can be extended by the adoption of one or more support General Web Service profiles. Other IMS General Web Service documents describe profiles for Addressing (transport-neutral web service addressing), Attachments (sending non-XML documents with the SOAP messages) and Security (secure data exchange).
In principle, the SOAP-based binding for the web services supports many communications messaging models (the Information Model for an IMS/GLC specification is defined independently of the messaging nature, i.e., this is determined by the form of the Web Services Description Language binding). At the current time only one messaging model is supported:

- Synchronous - this is a request/response message exchange in which the service initiator is blocked until the response message is received

Further messaging models will be added as and when required, i.e., asynchronous, polled, and publish and subscribe. There are three methods by which the functional capability of the base profile can be extended:

- Addition of new SOAP messages - the addition of new business transactions and the usage of new messaging models requires the creation of new SOAP messages;
- Extensions to the SOAP header - the current IMS General Web Service Base Profile makes use of the SOAP header to contain the application-to-application transaction status information. It is recommended that proprietary extensions to the SOAP header maintain the current usage patterns;
- Extensions in the data contained within the SOAP body - the SOAP body contains the XML instance that is used to represent the parameters defined for the transaction operations in the specification. There may be a need to add new parameters or to extend the XML structures of the current parameters.

3.12.5 IMS Learner Information Package Specification

Learner Information is a collection of information about a Learner (individual or group learners) or a Producer of learning content (creators, providers or vendors). The IMS Learner Information Package (IMS LIP) specification addresses the interoperability of internet-based Learner Information systems with other systems that support the Internet learning environment. The intent of the specification is to define a set of packages that can be used to import data into and extract data from an IMS compliant Learner Information server. A Learner Information server may exchange data with Learner Delivery systems or with other Learner Information servers. It is the responsibility of the Learner Information server to allow the owner of the learner information to define what part of the learner information can be shared with other systems. The core structures of the IMS LIP are based upon: accessibilities; activities; affiliations; competencies; goals; identifications; interests; qualifications, certifications and licences; relationship; security keys; and transcripts.

3.12.6 Learning Design Specification

The IMS Learning Design specification supports the use of a wide range of pedagogies in online learning. Rather than attempting to capture the specifics of many pedagogies, it does this by providing a generic and flexible language. This language is designed to enable many different pedagogies to be expressed. The approach has the advantage over alternatives in that only one set of learning design and runtime tools then need to be implemented in order to support the desired wide range of pedagogies. The language was originally developed at the Open University of the Netherlands (OUNL), after extensive examination and comparison of a wide range of pedagogical approaches and their associated learning activities, and several iterations of the developing language to obtain a good balance between generality and pedagogic expressiveness.
Katy Campbell from the University of Alberta is currently moderating the Learning Design Forum.
Learning Design can be considered as an integrative layer to many existing specifications. The IMS Learning Design Specification makes use of, includes, or is extendable with the following specifications:

- **IMS Content Packaging.** The IMS Learning Design is preferably integrated into an IMS Content Package to create a so called 'Unit of Learning'. This is explained later in the text [LD2].
- **IMS Simple Sequencing.** The IMS Simple Sequencing Specification can be used to (a) sequence the resources within a learning-object and (b) sequence the different learning-objects and services within an environment. This works in a similar way as the integration of Simple Sequencing in the organization of items in an IMS Content Package. The Simple Sequencing elements can be namespaced into the 'any' place

holders of the elements learning-object and environment. These place holders are specified in the binding of IMS LD [LD4].

- **IMS/LOM Meta-Data.** Placeholders for meta-data are on various structures within the IMS Learning Design. IMS/LOM Meta-Data can be included at these places [LD3].
- **IMS Question and Test Interoperability.** The IMS QTI can be integrated in two ways. The first way is to integrate QTI elements into the element context environment/learning-object as a separate schema. This is semantically seen as the correct place for tests. Test can than be connected to learning-activities which provide the instruction to complete the test that is present in the environment. Also, the currently used methods, integrating them into IMS Content Packaging as specific Resource types or as separate files are still supported [LD6].
- **IMS Reusable Definition of Competency or Educational Objective (RDCEO).** Learning Objectives and Prerequisites can refer to resources that are defined according to this specification. This is seen as a further refinement when needed. Also supported are simple resources (e.g., textual descriptions) of the learning objectives through the standard 'item' mechanism as can be found in IMS Content Packaging [LD7].
- **IMS Learner Information Package.** The structure of IMS Learning Design properties can be mapped fully to the IMS LIP [LD8].
- **IMS Enterprise** can be used for mapping learners and support staff to roles when instantiating a learning design [LD9].
- With the IMS Learning Design Specification it is possible to include **SCORM** content within a learning design. It would be necessary to have its type set and the runtime system would have to be able to deliver and manage SCORM content [LD10].

3.12.7 IMS Question & Test Interoperability

The IMS Question & Test Interoperability (QTI) specification describes a data model for the representation of question (assessmentItem) and test (assessmentTest) data and their corresponding results reports. Therefore, the specification enables the exchange of this item, test and results data between authoring tools, item banks, test constructional tools, learning systems and assessment delivery systems. The data model is described abstractly, using [UML] to facilitate binding to a wide range of data-modelling tools and programming languages, however, for interchange between systems a binding is provided to the industry standard eXtensible Markup Language [XML] and use of this binding is strongly recommended. The IMS QTI specification has been designed to support both interoperability and innovation through the provision of well-defined extension points. These extension points can be used to wrap specialized or proprietary data in ways that allows it to be used alongside items that can be represented directly.

History of IMS QTI Specification

An initial V0.5 specification was released for discussion in March 1999 and in November it was agreed to develop IMS Question & Test Interoperability v1.0 which was released as a public draft in February 2000 and as a final specification in May that year. The specification was extended and updated twice, in March 2001 and January 2002. By February of that year in excess of 6000 copies of the IMS QTI **1.x** specifications had been downloaded from the IMS website.

Since then, a number of issues of have been raised by implementers and reviewed by the QTI project team. Many of them were dealt with in an addendum, which defined version 1.2.1 of the specification and was released in March 2003. Some of the issues could not be dealt with this way as they required changes to the specification that would not be backwardly compatible or because they uncovered more fundamental issues that would require extensive clarification or significant extension of the specification to resolve.

Since the QTI specification was first conceived, the breadth of IMS specifications has grown and works on Content Packaging, Simple Sequencing, and most recently Learning Design created the need for a cross-specification review. This review took place during 2003 and a number of harmonization issues affecting QTI were identified. In September that year a project charter was agreed to address both the collected issues from **1.x** and the harmonization issues and to draft QTI V2.0. In order to make the work manageable and ensure that results were returned to the community at the earliest opportunity some restrictions were placed on the scope of the recommended work. Therefore, the QTI V2.0 release of the specification concentrated only on the individual assessmentItem and did not update those parts of the specification that dealt with the aggregation of items into sections and tests or the reporting of results. This QTI **2.1** release completes the update from **1.x** to **2.x** by replacing those remaining parts of the QTI specification.

Scope

The IMS QTI work specifically relates to content providers (that is, question and test authors and publishers), developers of authoring and content management tools, assessment delivery systems, and learning systems. The data model for representing question-based content is suitable for targeting users in learning, education, and training across all age ranges and national contexts.

Specification Use Cases

QTI is designed to facilitate interoperability between a number of systems that are described here in relation to the actors that use them.

Specifically, QTI is designed to:

- Provide a well documented content format for storing and exchanging **items** independent of the authoring tool used to create them.

- Support the deployment of item banks across a wide range of learning and assessment delivery systems.
- Provide a well documented content format for storing and exchanging **tests** independent of the test construction tool used to create them.
- Support the deployment of items, item banks, and tests from diverse sources in a single learning or assessment delivery system.
- Provide systems with the ability to report test results in a consistent manner.

Structure of this Specification

The specification is spread over a number of documents:

- Implementation Guide: A document that takes you through the data models by example. The best starting point for readers who are new to QTI and want to get an idea of what it can do.
- Assessment Test, Section, and Item Information Model: The reference guide to the main data model for assessment tests and items. The document provides detailed information about the model and specifies the requirements of delivery engines and authoring systems.
- Meta-data and Usage Data: A document that describes a profile of the IEEE Standard for Learning Object Metadata [LOM] data model suitable for use with assessment tests and items and a separate data model for representing usage data (i.e., item statistics). This document will be of particular interest to developers and managers of item banks and other content repositories, and to those who construct assessments from item banks.
- Results Reporting: A reference guide to the data model for result reporting. The document provides detailed information about the model and specifies the associated requirements on delivery engines.
- Integration Guide: A document that describes the relationship between this specification and other related specifications such as IMS Content Packaging [IMS_CP], IMS Simple Sequencing [IMS_SS], and IMS Learning Design [IMS_LD].
- XML Binding: A document describing the way the data models have been bound to [XML].
- Conformance Guide: A document that describes conformance requirements and provides a data model for the construction of QTI profiles including a predefined profile that replaces the QTI Lite specification [QTI_LITE] released as part of version 1. This document is currently unchanged but an updated version will be published with the final release of the specification.
- Migration Guide: A document aimed at people familiar with version **1.x**. It takes you through the main changes that have been made to the data model and includes an alphabetical listing of version 1 elements providing detailed information about how the same information is represented in version 2.

3.13 ISO/IEC 19796-1:2005

Introduction

The new quality standard ISO/IEC 19796-1 has been published in October 2005. It is a first step to harmonize the variety of quality approaches used in the field of learning, education, and training. It helps decision makers, quality representatives, system developers, and users to develop their own quality system. It is not a standard developed for certification – it is a tool which provides a common quality language, a format to make quality interoperable, and a template for the implementation, development, and improvement of quality development in organizations.

Background

Quality in the field of E-Learning has become an issue of increasing importance in both researchers' and practitioners' communities. A variety of approaches has been developed and implemented successfully: Generic standards, such as EFQM or ISO 900x:2000 have been used also in the educational community. Secondly, specific quality guidelines for distance education or E-Learning (such as the ASTD criteria for E-Learning or the BLA Quality Mark) have been developed and used. It has become clear that Quality Management can contribute to improve the performance of organizations in the field of learning, education, and training (LET).
However, the high number of approaches and their different scopes and objectives lead to confusion in the users' and decision makers' communities. Therefore, a harmonized quality standard has been developed and consensually approved in the standardization committee ISO/IEC JTC1 SC36 (International Organization for Standardization / International Electrotechnical Commission, Joint Technical Committee 1, Subcommittee 36: Information Technology for Learning, Education, and Training).

3.13.1 The Quality Standard for Learning, Education, and Training: ISO/IEC 19796-1

The Quality Standard ISO/IEC 19796-1 is the basic framework for quality development in organizations in the field of learning, education, and training (LET). It has been developed by experts in the international standardization group ISO/IEC JTC1 SC36. It consists of a framework for quality development and the description of quality approaches and it serves for different purposes:

Harmonizing Quality Approaches: A common vocabulary

Many successful quality approaches are successfully used in LET. However, those approaches differ in scope, objectives, and methods. In the future, all quality management and assurance systems should use ISO/IEC 19796-1 to show 1) for which context they are intended to be used, 2) for which processes they can be used, 3) which methods they use in order to assure quality. We

recommend that the providers of quality systems use ISO/IEC 19796-1 to make their approaches transparent and interoperable.

Developing Quality Systems
Developing a new quality system in an organization means that quality objectives and instruments are implemented for the core processes (in the field of LET for example: analyzing learner needs, design of learning systems, providing tutor support, performing assessments). The process model serves as a guide to specify those objectives. An organization should go through the processes of the model and should answer the following questions for each process:

- What is the main quality objective for a process?
- Who are the responsible actors?
- Which methods or instruments can be used to assure quality?
- How can we measure the success of the quality objective?
- The processes therefore just serve as a guideline to discuss quality and to set specific objectives in order to reach the best outcome.

Extending existing quality approaches
Many organizations already have quality management systems (such as ISO 900x) or their own quality guidelines in place. However, generic quality management approaches do not consider the specifics of LET. For these organizations, ISO/IEC 19796-1 can also be used as a guideline to specify the specific aspects of LET. For organizations who have developed own quality guidelines, ISO/IEC 19796-1 can be used to structure, evaluate, and improve their own systems.

Combining Quality Approaches
The model serves as a guide to describe quality approaches in an interoperable way based on a common vocabulary. The model provides a clear terminology and description formats to assemble individual quality concepts from existing approaches. In the future, organizations should be able to combine quality approaches based on their needs. As an example: take design guidelines from ISO 9241, take tutoring guidelines from Tutor Quality Mark, take accreditation guidelines from your National Accreditation Agency. Combine and assemble them into your own quality system.

Developing ICT support for quality development
Based on the information models for processes and quality management, an interoperable format is given which can serve as a base for applications, such as quality information systems or quality support systems. Those systems should support users to document their activities, to apply quality assurance methods to their products and services, to measure the quality, and to exchange experiences.

3.13.2 Description of ISO/IEC 19796-1

The new standard ISO/IEC 19796-1 provides a "reference framework for the description of quality approaches" (RFDQ). A reference framework gives an orientation which aspects should be covered and how solutions for these aspects can found. The standard is an instrument to develop quality in the field of E-Learning. It consists of mainly two parts:
A description scheme for quality approaches
A process model as a reference classification
It supports the development quality profiles for organizations (such as objectives, methods, relations, people involved). Quality profiles means that the standard is adapted to the needs and requirements of an organization. It does not provide specific requirements or rules – it is a framework to guide actors through the process of quality development in the field of LET, specifically E-Learning.

The **Description Model** is just a scheme to interoperably describe quality approaches (such as guidelines, design guides, requirements). It documents all quality concepts in a transparent way. Each process can be described by this scheme:

Table 2: Description Model for Quality Approaches of ISO/IEC 19796-1

Attribute	Description	Example
ID	Unique Identifier	ID1234
Category	Main Process	Course Development
Process Name	Process name	Method selection
Description	Description of the process	"Within this process the didactic concept and methods are evaluated and selected"
Relations	Relation to other processes	"Before the method selection a target group analysis must be performed"; [Process 1.6]
Sub-processes / sub-aspects	Sub-processes / sub-aspects / tasks	Method identification Method alternatives Method priorization
Objective	Objective of a Process	Adequate selection of one or more didactic concepts according to learner preferences and learning styles
Method	Methodology for this process	Method selection shall be based on the target group

		taking into account their competencies and learning styles. Methods are selected based on the teachers' experience.
Result	Expected result of a process	Method specification Documents
Actors	Responsible / participating actors	Team Didactical Design, Project leader
Metrics / Criteria	Evaluation and Metrics for this process	Criteria catalogue 3.2.2-3.2.6
Standards	Standards used	DIN EN ISO 9241, LOM See Method Guidelines Handbook
Annotation / Example	Further Information, Examples of usage	

This model serves only as a base to provide a harmonized scheme to describe quality approaches.

The **Process Model** is a guide through the different processes when developing learning scenarios. The process model includes the relevant processes within the life-cycle of information and communication systems for learning, education, and training. The process model is divided in seven parts. Sub-processes are included referencing to a classification of processes.

Table 3: Process Model of ISO / IEC 19796-1

ID	Category	Description / Sub-Processes
NA	**Needs Analysis**	**Identification and description of requirements, demands, and constraints of an educational project**
		NA.1 Initiation NA.2 Stakeholder Identification NA.3 Definition of objectives NA.4 Demand analysis
FA	**Framework Analysis**	**Identification of the framework and the context of an educational process**
		FA.1 Analysis of the external context FA.2 Analysis of staff resources FA.3 Analysis of target groups

		FA.4 Analysis of the institutional and organizational context FA.5 Time and budget planning FA.6 Environment analysis
CD	**Conception / Design**	**Conception and Design of an educational process**
		CD.1 Learning objectives CD.2 Concept for contents CD.3 Didactical concept / methods CD.4 Roles and activities CD.5 Organizational concept CD.6 Technical concept CD.7 Concept for media and interaction design CD.8 Media concept CD.9 Communication concept CD.10 Concept for tests and evaluation CD.11 Concept for maintenance
DP	**Development / Production**	**Realization of concepts**
		DP.1 Content realization DP.2 Design realization DP.3 Media realization DP.4 Technical realization DP.5 Maintenance
IM	**Implementation**	**Description of the implementation of technological components**
		IM.1 Testing of learning resources IM.2 Adaptation of learning resources IM.3 Activation of learning resources IM.4 Organization of use IM.5 Technical infrastructure
LP	**Learning Process**	**Realization and use of the learning process**
		LP.1 Administration LP.2 Activities LP.3 Review of competency levels
EO	**Evaluation / Optimization**	**Description of the evaluation methods, principles, and procedures**
		EO.1 Planning

		EO.2 Realization EO.3 Analysis EO.4 Optimization / Improvement

3.14 Elaboration on applicability of described learning standards to mGBL project.

Of the above described learning standards many are not really applicable to the mGBL project, since they are oriented to the more “standard” means of e-learning aiming at distributed lessons by videoconference.
The standards that may be relevant and/or useful to mGBL project are:

- **XML Binding of Data Model (3.8.4):** can be used to integrate the elaborated games into learning platforms conformant to SCORM, for aims of tracking data aggregation, reporting and analysis.
- **Learning Object Metadata, WG12 (3.9):** may be used to add “tags” to the different game templates, in order to facilitate creation of an organized database in the platform, according to game categories and pedagogical contents.
- **Dublin Core Metadata Element Set (3.10.3):** an alternative standard set of tags that may be used to describe the resources in the platform.
- **SCORM 2004 3rd Edition Content Aggregation Model (3.11.6):** may offer a way to package mGBL games and components so that they may be integrated into other LMS.
- **IMS Question & Test Interoperability (3.12.7):** this data model for the representation of question and test data and their corresponding results reports may be used to integrate easily into the mGBL games tests or questionnaires developed according to this standard and for other LMS. Although the limited dimension allowed for java jar files on mobile preclude the direct use of XML-based questionnaires in the games, authoring tools may be developed to reach automatic “translation” from IMS-QTI XML structure to mGBL games content structure.
- **The Quality Standard for Learning, Education, and Training: ISO/IEC 19796-1 (3.13.3):** may give to the WP7 (Evaluation) precious tools and a framework to evaluate the quality of the whole mGBL project.

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4 Technology selection

The technology selection was made base on analysis of technologies and envisioned mGBL platform requirements. This chapter describes the technology used for the implementation of the mGBL system. In order to achieve seamless integration and a consistent software system it is necessary that all modules are based on equal versions of uniform technology. The collaborative software development process also requires a definition of the development tools to be used. All software artefacts must be easy to create, deploy and test independently of their origin.

4.1 Base implementation technology

Java technology is used wherever applicable in order to achieve

- device independence
- operating system independence
- industry-standard compliance
- modern object-oriented software development
- availability of powerful open-source tools
- widespread developer know-how
- extensive community support

Toolkit

The following Java 2 Platform, Standard Edition development kits are used:

- Windows Platform - J2SE(TM) Development Kit 5.0
- Linux Platform - J2SE(TM) Development Kit 5.0

It is recommended to always use the latest update from the Sun Developer Network.

4.2 Server

Base Technology

Server technology according to the Java Platform, Enterprise Edition specification is used. This is the industry middleware standard for large, reliable server applications. It offers support for the following aspects critical to the success of the mGBL software system:

- web container infrastructure
- distributed communication
- transaction management
- relational database access

Middleware

The following web server is used as a servlet/JSP container:

- Apache Tomcat 5.5.15

Business components, which require advanced features like message-driven communication, are deployed on the following J2EE application server:

- JBoss Application Server Version 4.0.4 with EJB 3.0 module (Platform independent)

Both servers are widely-used open source software; nevertheless, professional commercial support is available.

Tomcat can be integrated into JBoss with a managed bean (embedded Tomcat service mbean).

Container Framework

Developing, testing and configuring J2EE server applications is a difficult and time-consuming task. Therefore, the Spring framework with its light-weight container support and high programming flexibility is used:

- Spring Framework 1.2.6

Note, that only parts of the framework are utilized. The Spring MVC web application framework is not used all; the XML configuration options are only used, when directly justified by the project requirements.

4.3 Database

We use the widespread open source database MySQL as the main implementation and testing database.

- MySQL 5.0

O/R Mapping Tool

The powerful object/relational mapping tool Hibernate is used for all database access. Hibernate supports automatic creation of Java data access objects and high-performance on-demand querying and data-access with caching. Thus,

direct dependency of the business layer on the database system is avoided and object-oriented persistent data structures can be used.

- Hibernate 3.1.2

4.4 Clients

Stationary Clients

Because a large number of users shall be supported, users of personal computers should have to install as little additional software as possible. Thus, most of the interaction with the server should be possible via a standard internet browser. Applications, which require long and complicated user interaction, like complex game authoring tools, may nevertheless choose to create special downloadable client software.

Web Browser

Since most users have access to a Microsoft Windows personal computer with the Internet Explorer Browser installed, the mGBL web interfaces have to be designed for this browser. In order to ensure standard compliance and take advantage of better debugging support, the web pages also have to be usable with the Firefox browser from the Mozilla project.

The following browser versions are used:

- Microsoft Internet Explorer 6.0
- Mozilla Firefox 1.5.0.1

Framework

If complex authoring tools are developed, they shall be based on the open-source framework Eclipse, which is an extensible development platform. This way, development effort is only necessary to create game-specific software like custom editors. Menues, toolbars, screen layout and common development application components like the management of multiple source documents within projects are already taken care of the framework.

Applications have to be based on the following Eclipse versions:

- Eclipse SDK 3.1.2 Win32
- Eclipse SDK 3.1.2 Linux x86 / GTK 2

Mobile Clients

A large variety of mobile devices shall be supported with as little adaptation as possible required. Nevertheless, because of hardware restrictions it is not feasible that all games are usable on all mobile devices. Display, memory and processor limitations may prevent complex games from execution on lesser powerful devices. Also, devices without online data connection can not be used with distributed interactive games.

Toolkit
If the game concept can be realized with reasonable effort, the Java 2 Micro Edition (J2ME) shall be used for games. The following technologies are available for devices with different capabilities:

- Connected Limited Device Configuration (CLDC)
- Connected Device Configuration (CDC)
-

The actually implementations used on a mobile device depend upon the current tool availability.

4.5 Development Tools

Build Tool
For comprehensive automatic quality assurance including regular nightly builds and regression testing it is necessary that all modules can be built and tested with a common build tool. Therefore, for each module a script has to be created, which supports all required check-out, compilation and deployment tasks for the Ant build tool:

- Apache Ant 1.6.5

Web Application Framework
The proven Struts framework is used for all web applications in order to achieve a unified user interface structure with clear model-view-controller (MVC) separation.

- Apache Struts 1.2.8

Integrated Development Environment (IDE)
Base
The open-source development environment Eclipse is used for all Java projects. In order to allow trouble-free exchange of software projects, the same version has to be used for every module of the mGBL system:

- Eclipse SDK 3.1.2

Extensions
Depending on the requirements of the module, additional Eclipse plug-ins can be used to simplify development:

- Web Tools Platform 1.0

Creation of authoring tools may also require the following plug-ins:

- Plugin Development Environment 3.1.2
- Eclipse Modeling Framework 2.2.0
- Graphical Editor Framework 3.1.1
- Visual Editor 1.1

For mobile game development also the following plug-in might be helpful:

- Mobile Tools for Java (no release yet)

- Target Management (no release yet)
- Device Debugging (no release yet)
- Source Control System

All source files, build scripts, libraries and other files created for the project have to be kept in a source control system. The following open-source successor of the concurrent version system (CVS) is used:

- Subversion 1.3.0

It is recommended to use an Eclipse plug-in for comfortable source control within the integrated development environment.

Modelling Tools

Diagrams are used wherever they help to improve comprehension. In order to adhere to the de-facto standard in software modelling, UML diagram types shall be chosen wherever adequate. We use the following modelling tool:

- Enterprise Architect 6.1

For all other diagrams – usually those required to represent imprecise overview information – a general drawing tool is used.

Bug Tracking Tool

A bug tracking system is used to manage a list of issues and their resolving process.

5 New Learning Approaches and Scenarios Evaluation

5.1 Review of learning games

Computer games are today an important part of most children's leisure lives and increasingly an important part of our culture as a whole. In the past, computer games have been dismissed as a distraction from more 'worthy' activities, such as homework or playing outside.

Computer and video games are increasingly popular. In 2002, the world market for 'games and edutainment/ reference software' realized 16.9 billion US dollars, with 3.3 million games consoles being sold in the UK alone (ELSPA 2003). People of all ages, but most visibly children, play these games, often dedicating long periods of time in total concentration.

Nowadays, however, researchers, and teachers are beginning to ask how this powerful new medium might be used to support student's learning. Rather than shutting the door of the new technology, professors ask how this powerful tool can be adopted in learning environment

Computer games are a growing part of new culture; the global market is worth billions of dollars, related activities range from published magazines to spontaneous internet communities, and the impact of games play on young people has attracted significant interest from the popular media.

5.1.1 Taxonomy of computer games

As games have become more complex in terms of graphics, complexity, interaction and narrative, so a variety of genres have increasingly come to dominate the market. There is, however, no standard categorisation of such games; different stakeholders in the games industry, developers, academics, web review sites, use taxonomy appropriate to their own audience.
Herz 1997 presented system with these major categories:

- action games - these can be subcategorised into shooting games, 'platform' games (so called because the players' characters move between onscreen platforms) and other types of games that are reaction-based
- adventure games - in most adventure games, the player solves a number of logic puzzles (with no time constraints) in order to progress through some described virtual world
- fighting games - these involve fighting computer-controlled characters, or those controlled by other players
- puzzle games - such as Tetris
- role-playing games - where the human players assume the characteristics of some person or creature type, eg elf or wizard

- simulations - where the player has to succeed within some simplified recreation of a place or situation eg mayor of a city, controlling financial outlay and building works • sports games
- strategy games - such as commanding armies within recreations of historical battles and wars.

Playing habits and preferences are continuously studied. The importance of accurate measurements is obviously great for both industry and research. The existing figures, however, are not entirely up-to-date and often describe different regions with very different playing patterns.
The table below show daily time spent with computers by youngsters aged 9 through 16.

Table 1: Daily time spent with computers (aged 9-16)

	PC (NOT GAMES)	COMPUTER GAMES	INTERNET
Belgium	14 min	20 min	8 min
Denmark	26 min	57 min	16 min
Germany	20 min	34 min	7 min
Great Britain	30 min	44 min	10 min
Finland	18 min	46	9 min
Israel	40 min	65 min	31 min
Italy	40 min	45 min	10 min
Netherlands	18 min	28 min	4 min
Switzerland	21 min	34 min	9 min
Spain	35 min	36 min	17 min
Sweden	35 min	43 min	19 min

Source: Drotner, Kirsten (2001). The data was collected in 1998.

5.1.2 The Promise of Digital Game-Based Learning [9]

In his book "Digital Game Based learning Marc Prensky defines basic possibilities of game learning:

- That motivation can finally be found for learning the subjects and content that are the most difficult to teach or train — either because they are extremely dull and dry or extremely complicated, or both, and to get people to train themselves.
- That small groups of trainers, teachers, content experts and game designers working together can create experiences that will radically improve the learning, and ultimately the competence and behavior of thousands, and potentially millions of learners — not only whole companies, but whole industries, whole grade-levels, even whole countries and populations, and that this will ultimately affect the market value of companies, and perhaps even nations.

[9] From Digital Game-Based Learning by Marc Prensky ©2001 Marc Prensky

- That the free market will create — through a user-evaluated process of marrying the engagement-driven, experience-centered, "fun" approach of the interactive entertainment and games world with effective techniques for teaching the
- material, facts, concepts, skills, reasoning and behaviors that students and workers are required to learn — a phenomenon of highly effective learning "hits," that move through target populations at the epidemic speeds of best-selling novels, movies or games, leaving a lasting educational impact.
- That eventually any individual trainer, teacher or educator will have at his or her disposal the tools and colleagues to work with to create such phenomena, and that "talent will out," with successful, effective instruction no longer being confined to those a single fantastic teacher or trainer can reach in person, but to all the learners in his or her entire potential target market, worldwide. Such target markets could be all sales people, all managers, all third graders, all elementary school students, all math students, all college-level chemistry students etc.
- That, consequently, there will be training and learning brands based not just on publishers, but also on authors and designers, subjects and styles, as there are in books, movies, and games.
- That this user-driven learning phenomenon will be not only move from company to company and school to school nationally, but will be worldwide, like movies and videogames.
- That the Web, the Internet and Intranets and its successors, will not just be the conduit for boring education and training courses that people are forced to take or force themselves to suffer through, but a competitive forum — much like the games and movie businesses — where talent, creativity and the ability to hold the audience and deliver a compelling experience is what wins, where the best combination of game play, learning methodology and "eye candy" is what is being sought.

That we will have a learning world, like the games and movies worlds of today, where there are both "classic" learning hits and exciting newcomers; where a plethora of magazines and reviewers cover what's in development and help learners choose the very best; where makers create their experiences with the goal of holding their audience and being successful in learning, and thereby making money and attracting capital; and where learners look forward to the next release as eagerly as they wait for an upcoming game, console or movie.

5.1.3 Advantages of Games Software[10]

[10] This part is take from Becta web site (British Educational Communication and Technology Agency) "What aspects of Games may contribute to education?" (page 2) Computer Games in Education Project
http://www.becta.org.uk/technology/software/curriculum/computergames/aspects.html

A striking feature of games software is its power to motivate. Motivation, or the will to continue to use the software, is the end product of a mixture of psychological effects. However, the action is not simply to carry on with the game because it has novelty value or through interest in operating a highly sophisticated machine.

The software induces conditions within the player which encourage them to continue their involvement with their role as game player. Such conditions include satisfaction, desire, anger, absorption, interest, excitement, enjoyment, pride in achievement, and the (dis)approbation of peers and of others. It is in provoking and harnessing some of these emotions and their consequences that games software might benefit education. Put another way, people like games which are fun to play. Different people define 'fun' in a range of ways, so for now it seems most useful to consider fun and motivation as part of the same effect. For many games players the ultimate motivation is mastery – the promise that with enough energy and concentration you might 'master the machine', or at least the software.
A clear advantage of games is the 'play' environment created. Play during childhood has an important role in psychological, social and intellectual development, and computer games may offer opportunities that complement 'real' play. For example, games have rules which permit the player to choose what to do within limits. With no limits, or with limits which are too severe, there is no game. Playing computer games with their defined rules can help learners to understand why rules are necessary and what rules are sensible. However, the prevalence of information about 'cheats' for games within the community of games players suggests that there is a belief that rules are to be side-stepped or are only for other people, especially novices. There is, however, a danger in interpreting the word 'cheat' in its traditional sense of 'breaking rules'.

The meaning used in the computer context is quite different, perhaps more akin to 'inside knowledge' that an expert may possess. It seems that knowing how to find and use cheats is embedded in the culture of the games player, therefore collecting information about cheats is actually part of the game – another challenge. Games allow the player to act in role. In this safe environment, where action ultimately has no consequence, role play can increase the comprehension of what it is that a specific role actually entails. Role play may also increase the ability to judge the effectiveness of action taken and provide an indication of its likely outcomes. A final characteristic of effective games software is that it is often very good in terms of the sophistication of the user interface and/or content. This is expected by games players – they will not, as a rule, tolerate games which are 'second rate'. This has an important implication, as the best software tends to be expensive to

produce. The high cost can only be justified commercially when the likely returns on investment are also high – ie, if many copies will be sold. So, to attain quality in educational (or any other) software to match that of the bestselling games, it may be important to ensure a wide appeal and the potential of selling many copies.

Perhaps only then will developers be able to involve the range of talent for the required amount of time to produce 'blockbuster educational software'. Games require the use of logic, memory, problem solving and critical thinking skills, visualisation and discovery. Their use requires that players manipulate objects using electronic tools and develop an understanding of the game as a complex system. Collaborative game playing necessitates the development of social skills, for example in order to decide on, define and agree goals. All of these features could be usefully incorporated into educational software.

5.1.4 Digital Game Learning Types [11]

Digital Game-base learning works primarily for three reasons:

- the first is the added engagement that comes from putting the learning into a game context. This can be considerable, especially for material people are loath to learn.
- the second is the interactive learning process employed. This can, and should, take many different forms depending on the learning goals.
- the third is the way the two are put together in the whole package. There are many ways to do this, and the best solution is highly contextual.

Table 2: Types of learning

"CONTENT"	EXAMPLES	LEARNING ACTIVITIES	POSSIBLE GAME STYLES
Facts	Laws, policies, product specifications	Questions, Memorisation, Association, Drill	Game show, competitions flashcard type games, mnemonic, action, sports games
Skills	Interviewing, teaching, selling, running a machine, project management	Imitation, Feedback coaching, Continuous practice, Increasing challenge	Persistent state games, Role-play games, Adventure games, Detective games
Judgement	Management decisions, timing, ethics, hiring	Reviewing cases, asking questions, making choices (practice), feedback,	Role-.play games, detective games, multiplayer interaction, Adventure

[11] This part is taken from Marc Prensky, "Digital Games -Based learning", 2001 Mc-Grow-Hill, paragraphs: Why digital game. Base learning works (pag. 147) and Types of learning (page 156)

		coaching	Games, Strategy games
Behaviours	Supervising, exercising self-control setting examples	Imitation, Feedback Coaching, Practice	Role playing games
Theories	Market how rationales, people learn	Logic, Experimentation Questioning	Open ended simulation games, Building games, Construction games, Reality testing games
Reasoning	Strategic and tactical thinking, quality analysis	Problems, Examples	Puzzles
Process	Auditing, strategy creation	System analysis and deconstruction, Practice	Strategy games, Adventure games, Simulation games
Procedures	Assembly, bank teller legal procedures	Imitation, Practice	Timed games, Reflex games
Creativity	Invention, Product design	Play, Memorisation	Puzzles Invention games
Language	Acronyms, foreign languages, business or professional jargon	Imitation, Continuous practice, Immersion	Role playing games, reflex games, Flashcard games
Systems	Health care, markets, refineries	Understanding principles, Graduating tasks, Playing in microworlds	Simulation games
Observation	Moods, morale, inefficiencies, problems	Observing, Feedback	Concentration games Adventure games
Communication	Appropriate language, timing, involvement	Imitation, Practice	Role playing games, Reflex games

Among the interactive learning techniques that have already been used in Digital Game-based learning are:

- practice and feedback
- learning by doing
- learning from mistakes
- goal-oriented learning
- discovery learning and “guided discovery”
- task-based learning
- question-led learning
- role playing
- coaching
- constructivist learning
- “Accelerated” (multisense” learning)

- Selecting from learning objects
- Intelligent tutoring

5.1.5 The Future of Games In Education[12]

In the 1980s, there was great enthusiasm for harnessing the design knowledge embedded in video games to improve instruction. Educators learned some guidelines about designing engaging environments, most of which have become incorporated into student centered learning environments (Jonassen & Land 2000). Since then, gaming technology has improved dramatically, but very little has been done to study how these improvements might be incorporated into learning environments.

First, many teachers and educators have begun using commercially available "edutainment" products, but there has been very little empirical research into how these environments work. Design experiments (Brown 1992), which examine how instructional programs which employ video games could be useful for instructional technologists. Through such design experiments, instructional technologists might be able to empirically ground the work on instructional-design theory for simulations and games initiated by Reigeluth and Schwartz (1989). Taking a design approach to researching games might provide a useful framework for studying games, which thus far, have lacked a coherent research paradigm (Gredler 1996).

As designers of interactive learning environments, instructional technologists can also learn from current developments in gaming. Interactive fiction and online games are two areas of gaming that have not been studied much at all, and can inform the design of learning environments. Developments in interactive games can produce guidelines on developing socially based micro-worlds, and character development in interactive environments. Online games offer instructional technologists opportunities to understand how online environments are designed to support community development.

Last, video games, as one of the first, best developed, and most popular truly digital mediums embody a wealth of knowledge about interface, aesthetic, and interactivity issues. Historically, video games have been on the technological cutting edge of technically of what is possible, whether it is building online communities on the Internet, creating rich worlds using 3D graphics cards, or allowing dynamic synchronous interaction play by streaming information over the Internet. Indeed, even a cursory glance at the latest games can leave the designer blown away by what is currently possible with technology and inspired by the sleek interface or production values games contain. In fact, the greatest benefit of studying games may not be as much in generating

[12] This part is take from Kurt Squire Video Games in Education

theoretical understandings of human experience in technology or guidelines for instructional design, but rather, in inspiring us to create new designs.

5.2 E-learning

5.2.1 Definitions

The goal of e-learning systems is to improve the teaching and learning process using information and communication technologies. Distance learning includes technologies used in education where there is no contact between the instructor and student. E-learning is performing educational process using information and communication technologies. E-learning is an interactive process between instructors and students, aided by computer technologies. Reasons for using e-learning are:

- sharing of resources,
- sharing of instructors,
- improvement of curriculum quality,
- better quality of education.

Advantages of e-learning are:

- students located far from education centres have more chance for education,
- access to learning materials at any moment from any place,
- individual approach in education,
- less load of professors in classic education,
- achieved acknowledge is better then in classic education,
- choosing between education curriculum in abroad or student's country,
- learning materials are better designed for individual work,
- additional expense are minimal (professor's visiting to other places for lecturing),
- multimedia presentation of learning materials,
- more active role of students in education,
- students acquire more communication's skills,
- multicultural education,
- individualisation – students choose their own style of learning.

Disadvantages of e-learning:

- less of student's self discipline,
- great cost at start,
- instructors in learning have to cooperate with other specialists (pedagogic, didactical, psychological and others),
- learning materials are a result of work of expert's team,
- high level of information and telecommunications infrastructure is required.

5.2.2 Current Applications

Current e-learning applications are based on the web technologies. The learning process can be simulated by dynamic web applications, which are supported by learning material stored in databases. Additionally a learning

management system (LMS) enables evaluation of learning success. Instructors can develop teaching courseware and apply them in the learning process. Examinations and evaluations of the acquired knowledge are also enabled. Student's progress in the learning process can be monitored by the instructors. Better design of teaching materials is achieved using the Content management system (CMS).

In Croatia WebCT is widely used in academic institutions. An adaptive e-learning system has been developed and used at the University of Zagreb, AHyCo, which enables adaptations of the learning process for students. Wide use of these systems confirms the thesis that e-learning technologies will be used more intensively in the future.

5.2.3 E-learning and Mobile Technologies

Video games can be used in e-learning. Video games presents user with numerous decisions and then provide immediate feedback from those decisions. Simulation technology can be effectively used in business application. Video games and simulations can be used in e-learning. They can be implemented by playing console, wireless laptops, handhelds and finally by mobile phones.
The barriers to using handhelds

- The cost – cost of handheld computers is now falling and those that are used mainly as telecommunication devices may be available free, or at a reduced cost, if the customer signs up to a network package.
- Limited functionality – this again is not such an issue on newer handheld devices and many now come with software that is fully functional and compatible with desk/laptop computers. The introduction of ultraportables will deliver full functionality equivalent to desk/laptop computers.
- Cost of connectivity – this is still a limiting factor and the individual or organisational costs involved can be considerable. The costs can be exaggerated when 'pay to use' tariffs are employed as the user is unaware of the total cost until the invoice arrives and by this time it is too late to do anything. Set cost packages enable the users, and organisation, to manage their finances and give some comfort to organisations that have a number of these devices being used by a range of individuals.
- Limited keyboard – again this can normally be overcome by using an additional keyboard and a number of portable solutions are now available. This limitation does not appear to affect the 'younger' user, in particular those frequent users of mobile telephones.
- Small screen size – Due to their compactness the screen size of handheld computers is limited. However,
- Advances made recently regarding flexible LCD screens (even spray on LCD screens) may overcome this limitation in the very near future.

- Future proofing – Updating the software on handheld computers is difficult and expensive, they can become out-of-date very quickly. However, the ultraportable, by virtue of its full operating system and the
- Fact that it uses full versions of commercial software can be updated as you would any desk/laptop computer as required.

The opportunities of using handhelds

- Portability – the ability to have a sophisticated computer with instant access to commercial software, Internet/e-mail access and a range of other useful features including video recording, photographs and diary entry make the use of handheld computers attractive within education/training environments.
- Space saving – handheld computers are small and lightweight, they therefore take up little desk space and can easily be moved from one room to another. The long battery life means that they do not have to be connected to the mains supply and can therefore be used for days between charging.
- Connectivity – instant access to the Internet, e-mail and electronic diary are all highly rated facilities by learners, tutors and managers.
- Functionality – modern handheld devices offer nearly all of the functionality of traditional desk/laptop computers plus the option of instant connectivity to e-mail and the Internet as standard. Ultraportables will
- Offer full functionality plus the additional applications normally associated with mobile communication devices.
- Instant on – most handhelds are operational instantly, unlike desk/laptop computers.
- Long battery life – within learning/working environments it is advantageous to have computers that do not
- Require mains connection. The battery life of the handheld far exceeds that of laptop computers.
- Cost – the majority of handheld computers cost less than desk/laptop computers. However, other charges are incurred and this could make them significantly more expensive if connectivity is included. The cost of
- ultraportables is equivalent to that of desk/laptop computers but offer additional functionality and could replace the desk/laptop computer.
- Recording and processing information – the use of desk/laptop computers within a classroom environment requires them to be either connected to the mains supply or charged up. Handheld computers give learners the flexibility to move round the environment and still continue to use the available resources.
- If the handheld devices are connected to the network via wireless technology they can also send and receive information and feedback instantly.
- Inputting data and automated data gathering – handheld computers can be used indoors or outdoors during the learning session. Data can be

gathered, analysed, evaluated and presented as the session takes place. Feedback from the tutor, learning materials and other research information can also be received as the learning session is taking place.
- Manipulating and interpreting text and shared writing – files and information can be transferred between learners and tutors quickly and learners can produce individual/team work easily and effectively.
- Inclusiveness – learners who are unable to attend a learning session could still take part via handheld computers connected to the network. Learners who also need special support, or are not able to attend due to illness or physical disability could be involved in the learning session.
- Group/teamwork – The handheld computer enables learners to interact with each other more effectively as they do not have to sit in front of a monitor at a desk.

What are the advantages of using handheld computers in education and training?

- They are small and lightweight
- can be used anywhere
- take up little space in the learning environment
- long battery life
- instant access (no boot up time)
- automatic saving of work
- most handheld computers cost less than desk/laptop computers

Limitations of handhelds

- Small screen (new models can be linked to full size)
- Small keyboard (new models can be linked to full size)
- Some have limited functionality (not new models)
- Not a replacement for desk/laptop computers (not new models)
- Not very robust
- Easy to lose
- Hard to expand and upgrade (not the software on new models)
- Connectivity can be expensive and costs are not always known upfront

The future of ‘Mobile Computing’

- It would be ambitious, if not foolhardy, to try and predict what specific technology or manufacturer will develop the leading handheld computers of the future. However, there are a few general assumptions that can be made with regard to the future of mobile computing.
- Handhelds – will be as common as the mobile telephone is today and, to the majority of people, be the only ‘computer’ they own rather than an addition to a desk/laptop computer.
- Cost – as with all electronic devices the cost will fall as demand rises, handheld computers that cost £200 today will probably be available for between £20 to £100 in the very near future.

- Battery life – battery technology is becoming increasingly sophisticated and significant improvements have already been made. In the future handhelds will be able to function for significant periods of time between conventional charging. New methods of charging will be developed and incorporate solar, 'wind up' and piso-electric technology
- Memory – the memory storage capability of handhelds in the future will be equal to that of desk/ laptop computers. As the cost of memory falls and technology improves the memory capability will become significantly greater, whilst the physical size of the memory will be significantly reduced. Additional 'plug in' memory sticks will also be available so that data can be easily stored and transferred. Remote memory storage will also be available via the Internet and large amounts of data will be able to be transferred from the handheld to individual, or centrally managed, storage facilities.
- Connectivity – either by using local or national networks handhelds will be constantly connected to the
- Internet and telecommunications network. The initial cost of this 'always on' connection may be high at first
- but will fall as take-up increases. Some form of 'global' charging system will need to be devised to avoid customer confusion over the charges being levied by individual service providers.
- Functionality – as with all computer devises manufacturers will increase the functionality of handheld devices as the cost for basic unit falls. High definition TV, on-line films, digital radio and global tracking systems are already being developed for future models.
- Video – some mobile devices already have the capability of storing over 60 minutes of video information.
- Due to additional memory and sophisticated software the recording and distribution of large amounts of video information will be commonplace.
- High definition TV – anywhere, anytime high definition TV, that could include education/training materials, is already being piloted and will be available shortly
- Digital radio – the addition of digital radio opens up the possibility of learning in remote locations and would include text as well as audio information.
- Software – the software used on modern handheld computers is exactly the same as that used on desk/laptop computers. This will eliminate the need to have a desk/laptop as well as a handheld computer and with the addition of a larger screen and keyboard the handheld will equal the functionality of its larger counterparts.
- Spray on screens – advances have been made with screen technology and 'roll out' or spray on screens have been tested and will be available shortly. The addition of light weight, flexible screens will overcome one of the barriers identified when using handheld computers.
- Voice recognition – voice recognition software could be used to overcome some of the barriers associated with the small keyboard or

point input devices. ‘Roll out’ keyboards are already available for many handheld devices but the addition of voice operation would significantly improve the effective input of data.

- Global tracking systems – global tracking and mapping systems can be added to all handhelds and this will significantly increase their use by mobile learners.
- Size – it is clear from other technologies that the size of handheld could be reduced significantly. However, there will be an optimum size accepted by the majority of users that fulfils the portability criteria whilst still retaining usability with regard to the input of data and screen size.
- Scientific calculation – using handheld computers within education and training will enable on the spot analysis of scientific and other data as part of the learning process.
- Evidence and assessment – the recording of evidence, photographic, video, audio interviews etc plus the ability to take ‘on demand’ on-line assessment will enable the learner to develop their individual e-learning portfolio as the experiences occur rather than try to get paper based evidence at a later date.

5.3 New learning approaches

Learning is described in terms of knowledge acquisition when it is associated with mental performances or cognition. Learning is described in terms of the acquisition of skills when emphasis is put on the performance of practical activity.

Learning is meaningful construction and creative use of intelligent cognitive tools, therefore, both internal (mental) models and external instruments come into play in a learning process. (Engeström, 1994)
When considering learning in high schools, the theory of expansive learning extends this position on learning by highlighting and emphasizing the fact that the learner should be able to criticise facts given (by the teacher) as well as being able to create new ideas, artefacts and innovative forms of practice (i.e. transform the culture of the teaching and learning process). Therefore, learning does not entail just memorizing and stocking up ready-made facts presented by the teacher or available in textbooks, i.e. both teacher and student can potentially learn more than what is already known (i.e. learning what is not yet known).

New technology approaches are conditioned by three things:

1. New technologies
2. How professors use the technology and
3. How students use technology

There is a bulky problem between new technologies and professors using this technology, as Mark Prensky in "*Adopt and Adapt 21st-Century Schools Need 21st-Century Technology*" states: When a new technology appears, our first instinct is always to continue doing things within the technology the way we've always done it. People still illuminated the first printed Gutenberg Bibles by hand. Television pioneers set up single cameras in "great" theatre seats. The result was pretty much like what came before; some elements may have been lost, but the results were certainly cheaper, and far more efficient.
Big problem grows between technology knowledge discrepancy between professors and students. Nowadays students are more computer literate then their professors, actually some of them have grown side by side with computes
New learning approaches have to take in account knowledge already adapted by students. Some new technologies, for new generation students, are in fact, is only changed technology they have used before. IP- telephony, for example, is only telephoning over the Net, and the same thing they have used to do with their WEB cameras and communicating on Messenger

5.3.1 Technology Usage [13]

The technology usage survey made 2004 in US, on the sample of 4374 students. Fully 93.4 percent of the students who participated in the study own a computer. Desktop computers are owned by 70.7 percent of the senior respondents and 57.1 percent of the freshmen respondents. Laptop computers are owned by 38.5 percent of the senior respondents and 52.7 percent of the freshmen respondents. Personal digital assistants (PDAs) are owned by just 11.9 percent overall.

Internet Access

Freshmen students, who often reside on campus, most often access the Internet through university resources (82.2 percent). Seniors most often use commercial access (56.4 percent). More than 81 percent of students have access to broadband service. In the qualitative interviews, students reported that their satisfaction with access is partially shaped by the institution's IT environment, and they are often frustrated with overcrowded computer labs.

Patterns of Technology Use

Students were asked about the applications they use on their electronic devices. They reported that they use technology primarily for educational purposes, secondarily for communication, and lastly for presentation. They use computers for writing documents (99.5 percent) and sending e-mail (99.5 percent), followed by surfing the Internet for pleasure (97.2 percent) and for classroom activities (96.4 percent). They do many of these activities simultaneously.

Hours of Technology Use

The quantitative survey asked students how many hours each week they used a computer and for what applications. Results show that students primarily use information technology for academic applications, communications, and entertainment. Academic usage is strongly related to the student's academic major and class status (senior versus freshman).

[13] *Judith Borreson Caruso* ECAR Study of Students and Information Technology, 2004 Convenience, Connection, and Control

Table 3: Activities and Hours Spent per Week

Application	N	Mean*	Std. Deviation
Classroom activities and studying using an electronic device	4.367	4.01	1.241
Writing documents (word processing)	4.352	3.76	0.955
Surfing the internet for pleasure	4.359	3.47	1.213
Creating, reading, sending e-mail	4.359	3.47	0.979
Chatting with friends or acquaintances using instant messaging	4.347	3.45	1.620
Using an electronic devise (computer, Palm device, etc.) at your place of employment	4.337	3.31	2.306
Downloading or listening to music or videos/DVDs	4.336	3.15	1.563
Completing a learning activity or accessing information for a course using course management systems	4.344	2.48	1.152
Using a university library resources to complete a class assignment	4.349	2.46	1.010
Playing computer games	4.337	2.39	1.312
Creating spreadsheets or charts (Excel, etc.)	4.342	2.07	1.060
Online shopping	4.353	2.06	0.960
Creating presentations (PowerPoint, etc.)	4.342	1.82	0.896
Creating graphics (Photoshop, Flash, etc.)	4.335	1.79	1.077
Creating Web pages (Dreamweaver, FrontPage, etc.)	4.315	1.39	0.898
Creating and editing video/audio (Director, iMovie, etc.)	4.338	1.34	0.793

*Scale = 1 (do not use), 2 (less than an hour), 3 (1-2 hours), 4 (3-5 hours), 5 (6-10 hours), 6 (11 or more hours)

Level of Skill

When asked about the level of skill they felt they had attained with respect to each application, students rated themselves highly skilled in the use of communications, word processing, and the Internet. Table below shows that the means for e-mail, instant messenger, word processing, and Web surfing were all greater than 3.0.

Table 4: Skill levels Attained

Application	Mean*	Std. Deviation
E-mail	3.60	0.525
Instant messenger	3.54	0.652
Word processing	3.53	0.553
Web surfing	3.47	0.578
Presentation software (PowerPoint, etc.)	2.90	0.762
Online library resources	2.88	0.687
Spreadsheets (Excel, etc.)	2.86	0.763
Course management systems	2.83	0.744
Graphics (Photoshop, Flash, etc.)	2.45	0.846
Creating Web pages (Dreamweaver, FrontPage, etc.)	2.17	0.910
Creating and editing video/audio (Director, iMovie, etc.)	2.07	0.848

* Scale = 1 (strongly disagree) to 5 (strongly agree)

These interviews also indicate that students are skilled with basic office suite applications but tend to know just enough technology to accomplish their work. They do not have in-depth application knowledge or problem-solving skills.

Impact of Technology in the Classroom

Students were asked about the impact of technology on various classroom activities. The activity receiving the highest impact was “helped me to better communicate with the instructor,” with a mean of 3.85.

The benefits that students perceived from the use of information technology in the classroom are:

- convenience (the greatest benefit)
- improved learning (most valuable)
- convenience (the primary benefits of using information technology in classes).

Table 5: Perceived Impact of Classroom Technology, by Activity

Application	N	Mean*	Std. Deviation
The use of IT in classes has helped me to better communicate with the instructor	4.358	3.85	0.845
The use of IT in courses has resulted in prompt feedback from the instructor	4.351	3.84	0.813
The use of IT in courses has helped me communicate and collaborate with my classmates	4.343	3.64	0.893
I primarily use IT in courses to improve the presentation of my work	4.353	3.61	0.872
The use of IT in courses provides more opportunities to practice and reinforcement	4.345	3.58	0.803
The use of technology in my classes meet my expectations	4.358	3.54	0.747
Classes that use IT allow me to take greater control of my class activities	4.346	3.45	0.923
The use of IT in classes has helped me better understand complex or abstracts concepts	4.358	3.38	0.854
the instructor's use of technology in my classes has increased my interest in the subject matter	4.347	3.25	0.906
Classes that use IT are more likely to focus real world tasks and examples	4.347	3.23	0.884
I spend more time engaged in course activities in those courses that require me to use technology	4.362	3.22	0.928
I get better grades in courses that use IT	4.356	3.19	0.925
Faculty members need to give us more in-class training for IT used in the class	4.361	3.04	0.976

* Scale = 1 (strongly disagree) to 5 (strongly agree)

Even though students strongly emphasized the convenience factor of information technology use in the classroom, they also consistently stated that good use of technology helps them learn.

Data from ESA (Entertainment Software Association) 2004 essential facts about computer and video game industry:

Figure 1:Best – selling VIDEO GAME genres

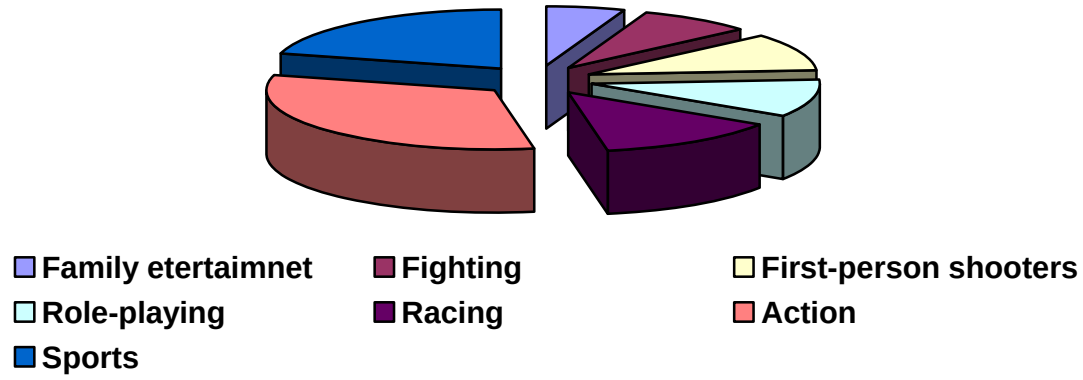


Figure 2: Best – selling COMPUTER GAME genres

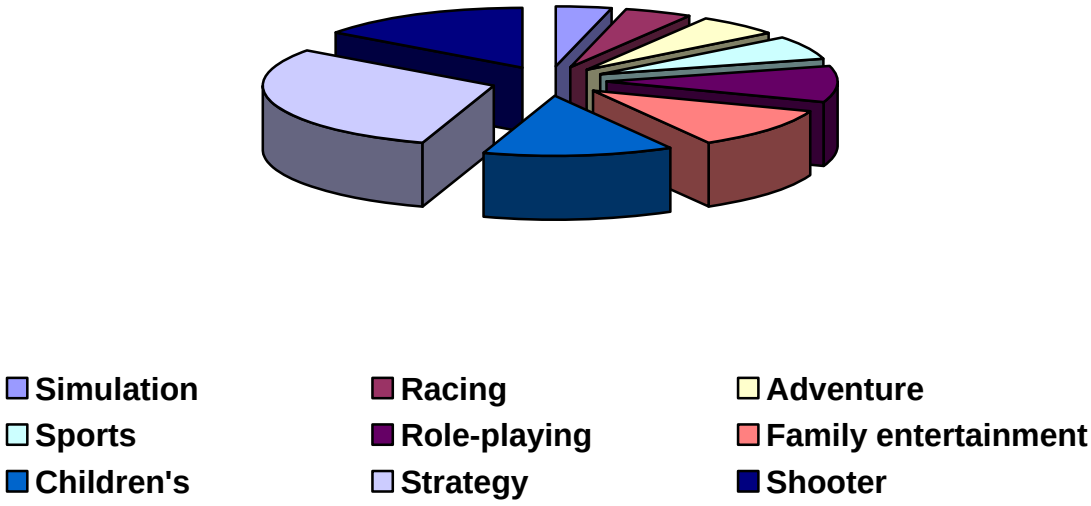


Figure 3: The average game player age

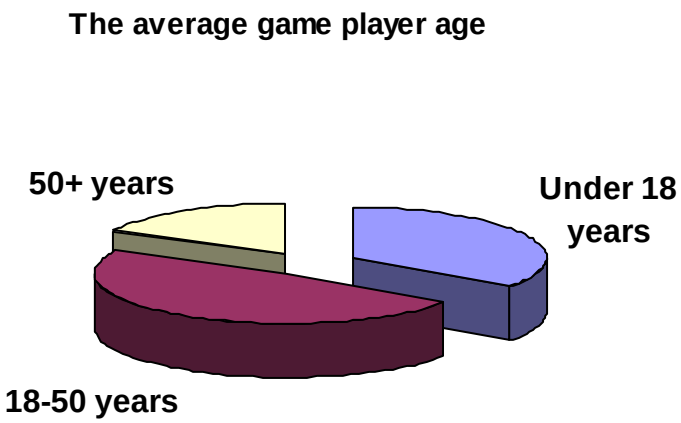
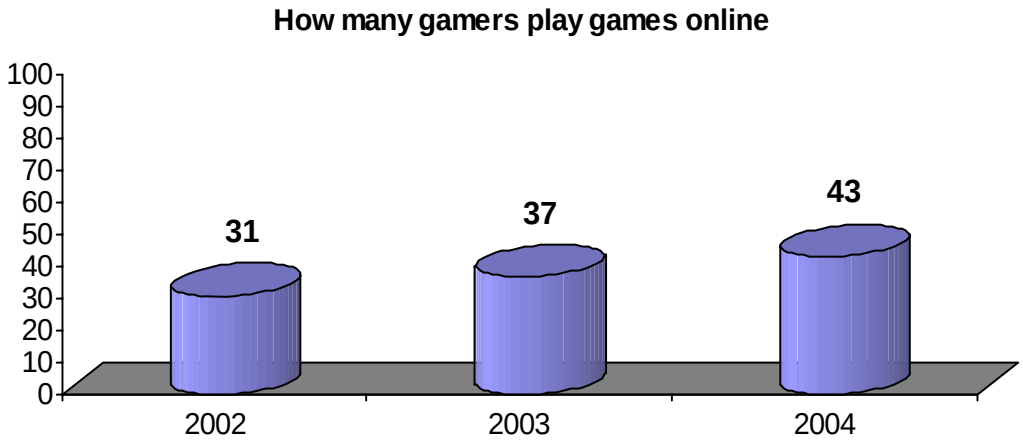


Figure 4: How many gamers play games online



5.3.2 Computer Influence on New Generation of Student

The computer environment not only influences the people who use it, but also has a bearing on the whole of the social context. There are ten aspects of computer influence on new generation of students (based on Tapscott)

Speed
The digital generation has far more experience in processing information rapidly than its predecessors. The amount of information received and the number of channels available for exchanging information are greater today than they have ever been. Information is processed at high speed, and there is some doubt as to whether this high-speed processing is an aid or an obstacle to knowledge construction. Nonetheless, this is the aspect that to large extent depends on the educational measures implemented at school and at home.

Parallel processing versus linear processing
Many parents are surprised that their children are able to do their homework watching television or listening to a walkman at the same time. The digital generation has an ever increasing capacity for parallel processing which involves a more diversified form of concentration — probably less intense, and less centred on a single aspect. For some authors, this is the result of a process of adaptation to an environment in which we are likely to be carrying out several tasks at once — driving and talking on a cell phone, writing a letter, speaking on the phone and checking our e-mail messages.

The text illustrates the image
For many years, images and graphics were used to accompany and illustrate text. Today, in technological media it is often the text that is complementary: It is used to expand on something that has already been presented in image form. Greenfield (1996) speaks of the importance of "visual intelligence" and its intense development since the advent of television, cinema and, of course, multimedia.

The challenge for educators is to design ways to use this shift to enhance comprehension, while still maintaining the same richness of information in the new visual context. According to Prensky (2001), "computers and video games designers are specialist in this area, which is a great advantage of digital game-based learning"

The end of linear access to information
The digital generation is the first that has experienced a non-linear means of learning. They are comfortable using hypertexts and accessing different parts of the screen in educational games and multimedia, and they regularly surf the Internet. These activities have introduced children and adolescents to a form of organizing information that is totally different from that used in writing.

Connectivity
Digital generation is growing in a world connected synchronically and asynchronically. Both types of connection offer access to information and to social relations in highly varied ways. For this reason, the new generation tends to approach problems from a different angle; their searches for information and communication are carried out via ICT.

Active versus passive
There is a big different between reading and interacting with computers. Reading need concentration, silence, working alone. The use of computers introduces more active experiences such as chat, posting, surfing for information. Children and adolescents expect immediate results and become more active. According to Prensky (2001), "we now see much less tolerance n the workplace among the games generations for passive situations such as lectures, corporate classrooms, and even traditional meetings"

Orientation towards problem solving
The increasing emphasis on problem-based teaching is no surprise. The digital generation has an approach to things that is similar in many ways to a computer game: performance and constant revision of the action, without any planning of the processes. "Trial and error" is used a great deal, and possibly the task of the educator is to counterbalance this type of action in order to encourage thinking, and strategies for planning and problem-solving.

Immediate reward
For Prensky, "the challenge for teachers is to understand the great importance of immediate reward for the young and to find ways of offering significant rewards instead of advising things that will be rewarded in the long term"
This is a very important point, since on occasion we may find the responses of students rather confusing. It is often said that pupils ask about the utility of what they are learning. Adults assume that they are asking about its utility in the long term. But what the student wants to know is its immediate applicability — not necessarily in a utilitarian sense, but because she needs an immediate contextualization of what has been learnt. They need to work with "authentic" tasks.

The importance of fantasy
Tapscott (1998), a review of many of the most successful computer games and of the films and novels read by adolescents today, states that fantasy is a key element for today's adolescents. This phenomenon probably has been encouraged by technology but it is not clear if this affect in the same way to both genders.

A positive view of technology
The new generations grow up using ICT and are highly familiar with them. Unlike adults, their attitude to them is positive.

The differences among between children and adolescents can be seen in the types of technology they use. In this regard, studies of gender are particularly relevant. Though research results have not been entirely consistent in recent years, certain major differences appear to persist between the genders. In the domain of video games, there is a greater preference for adventures and simulation among girls and little interest in action and sports games, which are the ones that most motivate the boys.

5.3.3 New Learning Approaches

Clark Aldrich in his paper A Field Guide to Educational Simulations argues that there are six different types of e-learning content which need, in their own right, to be procured, created, valued, and managed differently.

1. Extended books. Most asynchronous courses are basically workbooks delivered over the Web. The material is trustworthy and up-to-date, at least to the same standard as a magazine.
2. Extended lectures. Also called virtual classrooms or synchronous and live eLearning, extended lectures are modelled after the traditional lecture model, but enable teachers and learners to connect from different locations In addition to simulations, there are three new types of content emerging that will ultimately dwarf the use of traditional e-learning types.
3. Extended community. People are learning from organized and ad hoc communities, such as Internet chat rooms, blogs, and some knowledge management implementations. The material is often very current, but it's the user's task to separate among information, misinformation, and disinformation.
4. Extended access to experts. Soon, it will be easier to find the person—
5. Internal or external—who has the answers to your problems, and get them to help you. From a practical perspective, today's call center workers and IT help desk staff are early pioneers.
6. Embedded help. The vision of embedded help is to give a user just enough help on how to use the program exactly when they need it. Today, an example of embedded help is an online dictionary. In embedded help, part of the system figures out when a user seems lost and tries to suggest a solution. Although all this new learning approaches are interesting, in this report only few suitable for m-learning will be presented.

5.3.4 Learning Approaches Taxonomy

In the Brandon Hall report named *Emerging E-Learning: New Approaches to Delivering Engaging Online Learning Content* (2005) author Gary Woodill, Ed.D. has defined following 50 new learning approaches :

1. Adapted Content
2. Advising and Counseling
3. Agent-Generated Content
4. Animations
5. Assessments
6. Audio
7. Brain-Based Learning
8. Business-Based Learning
9. Collaborative Content
10. Competency-Based Learning
11. Conferences and Workshops
12. Creative Activities
13. Cybercartography
14. Discussions Online
15. E-Books
16. E-Drama

17. E-Portfolios
18. Exhibits: Galleries, Museums, and Science Centers
19. Experiential Learning
20. Games and Puzzles
21. Immersive Environments
22. Inquiry-Based Learning
23. Interactive Activities
24. Journals, Magazines, Newsletters, and Newspapers
25. Laboratories
26. Language Learning
27. Learning Objects
28. Libraries
29. Live Presentations and Webinars
30. Metacognitive Learning
31. Metaphorical Learning
32. Narrative Learning
33. Open and Free Content
34. Podcasting
35. Polls, Questionnaires, and Surveys
36. Problem-Based Learning
37. Project-Based Learning
38. Remote Sensing
39. Resource Sites
40. Scenario-Based Learning
41. Simulations
42. Situated Learning
43. Social Networking
44. Tours
45. Tutoring and Mentoring
46. Video-Enhanced Learning
47. Visualization
48. WebQuests
49. Wikis
50. Workflow Learning

Adapted content

The content of the material is adapted to the skill level or preferences of the learner.

Animations

The popularity of using animations to help learners understand and remember information has greatly increased since the advent of powerful graphics-oriented computers. This technology allows animations to be produced much more easily and cheaply than in former years. Previously, traditional animation required specialised labour-intensive techniques that were both time-consuming and expensive. In contrast, software is now available that makes it possible for individual educators to author their own animations without the need for specialist expertise. Teachers are no longer limited to relying on static graphics but can readily convert them into educational animations.

Assessments

These are the sessions where experts analyze the characteristics, skills, prior knowledge or attitudes of people by using different methodologies like testing, cases, interviews, et cetera.

Audio

Integrating audio elements in multi-media Web based and computer based training products has direct implications to various components of the cognitive load theory. According to Sweller, 1999 cognitive load is the amount of mental energy required to process a given amount of information. He states that the the overall goal of cognitive load is to improve the quality of instructional design by considering the role and limitations of the working memory.

Brain-Based Learning

Brain-based learning is derived from the physiological studies of how the brain best learns. When the brain is challenged learning is enhanced. As an example, creative acts, that include thought, feeling, and physical energy, engage many parts of the brain simultaneously.

Collaborative Content

Collaborative learning is an umbrella term for a variety of approaches in education that involve joint intellectual effort by students or students and teachers. Groups of students work together in searching for understanding, meaning or solutions or in creating a product. The approach is closely related to cooperative learning, but is considered to be more radical because of its reliance on youth voice. Collaborative learning activities can include collaborative writing, group projects, and other activities.

Competency-Based Learning

A structured list of knowledge, skills and attitudes those are required for job performance. Competencies are used as the foundation to guide needs analyses and evaluations. Unfortunately most competencies end up in a filing

cabinet to be referenced only when updating job descriptions. Used properly, they are powerful drivers of assessment and training.

Discussions Online

One mode of a online discussions is a discussion board. A discussion board is a general term for any online "bulletin board" where you can leave and expect to see responses to messages you have left. On the Internet, Usenet provides thousands of discussion boards.

E-Books

An ebook is an electronic (or digital) version of a book. The term is used ambiguously to refer to either an individual work in a digital format, or a hardware device used to read books in digital format. Some users deprecate the second meaning in favour of the more precise "ebook device."

E-Portfolios

Creating a professional portfolio is essential in today's employment marketplace. A portfolio is a medium to sell yourself to a potential employer by showcasing your skills and experiences. It can be either electronic or paper based. A well-designed portfolio can give you an edge over other candidates in the job market. It allows you to prepare for an interview by organizing your thoughts about your successes and challenges to show evidence of your accomplishments (Burnett, 2001).

Exhibits: Galleries, Museums, and Science Centres

Experiential Learning

Active learning, as the name suggests, is a process whereby learners are actively engaged in the learning process, rather than "passively" absorbing lectures. Active learning involves reading, writing, discussion, and engagement in solving problems, analysis, synthesis, and evaluation. Active learning is also known as cooperative learning.

Games and Puzzles

Games and puzzles have become the very important learning resource in e-learning circles, suggested as the solution to a wide range of learning objectives. Games and puzzles are often referred to as experimental exercises because they provide unique opportunities for students to interact with a knowledge domain.

Immersive Environments

Immersive learning is a system of complete immersion in a new subject in order to gain skills in the subject. The most extreme, perhaps, is immersive learning of a new language, in which the learner subjects himself to non-stop bombardment of the language by native speakers.

Inquiry-Based Learning

Learning is an active process, rather than assimilation of information. Students benefit from working on complex problems, which can be approached from many angles.

Interactive Activities

Interactive activities require the learner to do something. It should help to maintain learners' interest, to provide a means of practice and reinforcement.

Journals, Magazines, Newsletters, and Newspapers

Language Learning

Language acquisition is the process by which language develops in humans. First language acquisition concerns the development of language in children, while second language acquisition focuses on language development in adults as well. Historically, theories and theorists may have emphasized either nature or nurture as the most important explanatory factor for acquisition. The term "language acquisition" became commonly used after Stephen Krashen contrasted it with formal and non-constructive "learning." Today, most scholars use "language learning" and "language acquisition" interchangeably, unless they are directly addressing Krashen's work.

Learning Objects

A learning object is a reusable unit of instruction for teaching, typically in e-learning. In order to use a learning object in different contexts or different virtual learning environments, the presentation of the instruction is usually to be separated from the other non-visual content or course metadata.

Live Presentations and Webinars

A Webinar is a seminar which is conducted over the World Wide Web. It is a type of web conferencing. In contrast to a Webcast, which is transmission of information in one direction only, a webinar is designed to be interactive between the presenter and audience. A webinar is 'live' in the sense that information is conveyed according to an agenda, with a starting and ending time. In most cases, the presenter may speak over a standard telephone line, pointing out information being presented on screen, and the audience can respond over their own telephones, preferably a speakerphone.

Metacognitive Learning

Metacognitive thought is an essential skill for learning. It ensures that the learner will be able to construct meaning from information. To accomplish this, the learner must be able to think about their own thought process, identify the learning strategies that work best for them and consciously manage how they learn.

Metaphorical Learning

Metaphors are important graphic tools that relate objects in cyberspace to objects that are familiar in the physical world such as desktops, file-folders, and trash-cans. Using a metaphor correctly will help users navigate by providing a sense of place, setting expectations about what is possible, and how to go about getting things done. he right metaphor should help viewers understand what to do, be appropriate for the content, not have content that does not fit the metaphor, and is able to meet the expectations of the audience (Kristof & Satran, 1995).

Podcasting

The term podcasting is a combination of iPod (Apple Computer's portable media player) and broadcasting. Anyone with access to the internet and the capability of playing audio files on a computer or any portable media device can listen to podcasts. These podcasts are audio and video recordings that are made available through an online subscription for use on a computer or portable media player. These subscriptions are normally free of charge and the variety of content is growing at a rapid pace.

Problem-Based Learning

PBL is a concept borrowed from the medical field. It is an instructional strategy in which students, working in groups, take responsibility for solving real world problems. The instructor, instead of lecturing or leading a discussion, creates a hypothetical situation (problem) for the students and then takes a back seat as an observer and an advisor while the students work out a solution. Pertinent problems could be the creation of a energy conservation program or even the process of hiring a teacher (Bridges, 1992).

Project-Based Learning

Project-Based Learning is an instructional strategy that helps students apply academic content to authentic problems that require critical thinking and increase student responsibility for learning. Students are presented with an authentic problem and introduced to a wide range of tools whereby a solution is achieved via an actual project. The project therefore is the culmination of the learning process where a solution to an authentic situation or question was solved.

Remote Sensing

Obtaining information about a subject without being in contact with it. This term is commonly used in conjunction with electromagnetic techniques for acquiring information; that is, techniques which image part of the electromagnetic spectrum (ie, visible light, infrared energy (heat), X-rays, ultraviolet light, etc.). ..."Remote sensing is the science of deriving information about the earth's land and water areas from images acquired at a distance. It usually relies upon measurement of electromagnetic energy reflected or emitted from the features of interest (Campbell 1987)."

Simulations

Simulation has been used to explore and test new ideas by professional organizations for years. Utilizing simulation technologies for education has many advantages, and there is great potential to further develop simulation as a tool for education, research, development and training. Simulation technologies allow education research and development teams the opportunity to model, explore, and try out a variety of strategies in a safe environment. There are at least four forms of simulation technologies: gaming, role-playing, simulators, and modelling.

Situated Learning

Situated learning is education that takes place in a setting functionally identical to that where the learning will be applied. Often it is "just in time learning", but not always - music, sports and military training usually begin very early and continue for the whole career of the learner. And classrooms designed for situated learning are usually in use long before there is any "need" to learn the material at hand.

Social Networking

A social network is a map of the relationships between individuals, indicating the ways in which they are connected through various social familiarities ranging from casual acquaintance to close familial bonds. The term was first coined in 1954 by J. A. Barnes (in: Class and Committees in a Norwegian Island Parish, "Human Relations").

Visualization

Visual perception is an awareness of seeing. Learners derive meaning from what they see based on their frame of reference (Barry, 1994). The meaning of what is seen is subject to individual interpretation. Designers can influence a viewer's perception.

WebQuests

Webquests are an alternative to traditional text based instruction. They are constructivist based activities delivered via the Internet. Webquests feature cooperative learning and the creation of an authentic product. Webquests allow users to explore a large body of information within a content area. Social Studies, the Sciences, and the Humanities are often appropriate areas for a webquest. Webquests however, may be used in any subject at any level, from first grade through college.

Wikis

Wikis provide unique collaborative opportunities for education. Combining freely accessible information, rapid feedback, simplified HTML, and access by multiple editors, wikis are being rapidly adopted as an innovative way of constructing knowledge. he name comes from the Hawaiian word for "quick," and the term is generally attributed to Ward Cunningham, who, in 1995 set out to create "the simplest database that would work." Devoted to the search for

useful and reusable patterns in software development, Cunningham's WikiWikiWeb still remains today a benchmark in wiki development.

Workflow Learning

Workflow at its simplest is the movement of documents and/or tasks through a work process. More specifically, workflow is the operational aspect of a work procedure: how tasks are structured, who performs them, what their relative order is, how they are synchronized, how information flows to support the tasks and how tasks are being tracked. As the dimension of time is considered in Workflow, Workflow considers "throughput" as a distinct measure. Workflow problems can be modelled and analyzed using Petri nets.

5.3.5 Emerging learning technologies14

The next generation's enthusiasm for instant messaging, videogames, and peer-to-peer file swapping is likely to be dismissed by their elders as so many ways to waste time and avoid the real worlds of work or school. But these activities may not be quite as vapid as they may seem from the perspective of outsiders or educators. Researchers point not only to such obvious by-products as computer literacy, communicative skills, and community building, but to less immediately evident benefits like identity creation (avatars in games/chat), collaborative learning (networking to develop game playing strategies), or even mentoring (helping others in game strategies or game-related fiction writing). Clearly these are aspects of the net generation's created "third space" (neither home nor school/work) which are central to many of their lives and which could prove instructive for educators seeking ways to connect to their students. While none of these technologies was developed to support learning, they are being used for that purpose, sometimes directly, sometimes as a side benefit. Given the wide-spread acceptance and use by students of these technologies, it may be of interest to examine some of the ways in which they are being adapted for use in formal and informal learning.

Instant messaging and mobile communication

The use of pen pals for practice and intercultural learning has a long history. Today email exchanges and tandem partners continue that tradition. Services such as *ePals or eTandem* facilitate the process of finding partners. The *eTandem* best practices document points to a variety of ways partners can communicate: e-mail, fax, telephone, video conferencing. Not highlighted (but mentioned in other contexts) is a means of communication that has become as ubiquitous to many young people as e-mail: **instant messaging (IM)**. Despite continued issues with interoperability among different IM networks and programs, this has become a very widely used form of communication. In the

[14] From Godwin – Jones, B.: Emerging Technologies, Language Learning & Technology, Vol. 9. January 2005, pp. 17-22.

United States, *AIM (from AOL)* continues to be the most popular system; in the rest of the world, *MSN (from Microsoft)* and *ICQ* are widely used.

More and more IM is recognized by students as a tool which they know and like to use. IM is often used in conjunction with other means of communication, its spontaneity being balanced by the more deliberate writing of e-mail or blogs. Many IM programs also now support audio exchanges in addition to text-based communication. These programs support video as well, if digital video cameras are being used by the participants. Most IM tools allow the capture of IM sessions, which may be of interest in learning environment. IM is not just a stand-alone activity, but rather a function that is incorporated into many on-line environments such as Learning Management Systems or multiplayer games. The multitasking prowess needed for IMing while gaming or engaged in other online tasks points to the one of the new kinds of literacies evolving among and through the Digital Natives.

Of great popularity among young adults as well is messaging on mobile phones, by way of **SMS (short message service)**. SMS has been used for years in Europe and Asia and is beginning to be more widely known in the USA. While it is considerably more difficult to enter text on a mobile phone than it is on a computer, mobile text messaging has begun to be used in support of learning. In Europe, the EU has funded a major initiative called **m-learning** which uses mobile phones to reach young adults who have not done well in traditional learning environments. The idea is that through the use of the ubiquitous mobile phone one may be more likely to engage young learners in a time (of their choosing) and a place (away from formal institutional settings) more conducive to their learning preferences. The m-learning infrastructure is quite sophisticated, incorporating its own Learning Management System and speech/text tools. More and more Java-enabled phones are being sold, although they vary in memory and screen display size. *Nokia,* the leading mobile phone vendor, currently has some 20 models which support Java. Java support is of interest since it enables interactivity and could be used to create learning games playable on mobile phones.

One of the more interesting new uses of mobile devices is **moblogging or mobile blogging.** Moblogging can be defined as any activity that occurs away from your normal blog-writing place whose purpose is to create content for your blog. The idea is that new posts to a blog can come from a digital camera, PDA, or cell phone, with text and/or pictures sent through wireless networks to update a blog. This becomes particularly compelling now that so many mobile phones also sport digital cameras, and some include the ability to shoot short videos. Blogging software, such as *TypePad*, have made it relatively easy to moblog. *Kablog* is a tool for use with the popular *Movable Type* blog software. As opposed to other services which send the new entry by e-mail or text messaging, *Kablog* allows users to log on directly to their sites for updating. Nokia has developed new software *(Lifeblog)* to enable blog posting from Nokia phones. The possibilities for moblogging in on-line journals (study abroad!) or field trips are compelling.

Peer-to-peer (p2p) networking and the ipod phenomenon

The surprising standout commercial success among small electronic devices recently has been the *iPod,* Apple's digital music player. While Apple has had success in selling digital music (with its own proprietary digital rights management) through its *iTunes* music store, the initial popularity of the *iPod* was built on the wide-spread sharing of music files through the original Napster and subsequent **peer-to-peer (P2P) networks** *(FastTrack, Gnutella, Bittorrent)*. Despite law suits and crackdowns on file swapping at many universities, P2P network file swapping remains wide-spread, with free downloads of music still at many times the rate of sales of digital music through *iTunes* and other on-line music services, according to most estimates. Although some educators have recommended use of P2P for sharing of teaching resources, it has not been widely used for that purpose, due perhaps to the discrediting of the P2P process (through copyright infringements) and of P2P software (through intrusive adware and spyware).

Gaming

Parents of teenagers who spend inordinate amounts of time finding treasure, zapping evildoers, and exploring imaginary worlds may take a dim view of **electronic games** and be sceptical about any potential benefit to their children. Nevertheless gaming is attracting the interest of educators and researchers, in part because it does consume so much of the time of young people today, at least in the industrial world. Researchers are studying this phenomenon, often by participating themselves in multiplayer online games, and are arriving at some surprising findings, such as:

- Multiplayer online games are "sites for socially and materially distributed cognition, complex problem solving, identity work, individual and collaborative learning across multiple multimedia, multimodality “attentional spaces”, and rich meaning-making and, as such, ought to be part of the educational research agenda". Given the time young people spend in such environments and their importance for socialization, enculturation and learning; at the least they should be studied.
- As is the case with many videogaming and fan sites, there is a good deal of reading and writing throughout this site. For example, participants create "fanfiction," extending the stories of the animé characters. Although the stories have Japanese or Chinese backgrounds, the fan contributions are written in English, often by non-natives.

Table 6: Differences between Different Technologies in Learning Approaches

	Timeshift	Replication	Amplification	Interaction	Collaboration	Media	Portability
Writing	⊕						⊕
Press	⊕	⊕					⊕
Radio			⊕				⊕
TV			⊕			⊕	
Audio Video	⊕	⊕					⊕
CD Rom	⊕	⊕		⊕		⊕	⊕
Game consoles	⊕	⊕		⊕	⊕	⊕	⊕
Interactive TV	⊕	⊕	⊕	⊕	⊕	⊕	⊕
PC	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Internet	⊕	⊕	⊕	⊕	⊕	⊕	⊕
Mobile device	⊕	⊕	⊕	⊕	⊕	⊕	⊕

5.4 Learning scenario evaluation

Assessment is central to educational practice. High-stakes assessments exemplify curriculum ambitions, define what is worth knowing, and drive classroom practices. It is essential to develop systems for assessment which reflect our core educational goals, and which reward students for developing skills and attributes which will be of long-term benefit to them and to society.

5.4.1 Taxonomy of Learning Domains

Bloom's Taxonomy, (in full: 'Bloom's Taxonomy of Learning Domains', or strictly speaking: Bloom's 'Taxonomy of Educational Objectives') was initially published in 1956 under the leadership of American academic and educational expert Dr Benjamin S Bloom. 'Bloom's Taxonomy' was originally created in and for an academic context, when Benjamin Bloom chaired a committee of educational psychologists, based in American education, whose aim was to develop a system of categories of learning behaviour to assist in the design and assessment of educational learning. Bloom's Taxonomy of Learning Domains remains the most widely used system of its kind in education particularly and also industry and corporate training. It's easy to see why, because it is such a simple, clear and effective model, both for explanation and application of learning objectives, teaching and training methods, and measurement of learning outcomes.
Bloom's Taxonomy model is in three parts, or 'overlapping domains':

- Cognitive domain (intellectual capability, ie., knowledge, or 'think')
- Affective domain (feelings, emotions and behaviour, ie., attitude, or 'feel')
- Psychomotor domain (manual and physical skills, ie., skills, or 'do')

In the Cognitive Domain, levels 5 and 6, Synthesis and Evaluation, were subsequently inverted by Anderson and Krathwhol in 2001. Anderson and Krathwhol also developed a complex two-dimensional extension of the Bloom Taxonomy.
Bloom's Taxonomy 1956 Cognitive Domain is as follows. An adjusted model was produced by Anderson and Krathwhol in 2001 in which the levels five and six (synthesis and evaluation) were inverted.

Knowledge
Knowledge is defined as the remembering of previously learned material. This may involve the recall of a wide range of material, from specific facts to complete theories, but all that is required is the bringing to mind of the appropriate information. Knowledge represents the lowest level of learning outcomes in the cognitive domain.
Examples of learning objectives at this level are: know common terms, know specific facts, know methods and procedures, know basic concepts, know principles.

Comprehension
Comprehension is defined as the ability to grasp the meaning of material. This may be shown by translating material from one form to another (words to numbers), by interpreting material (explaining or summarizing), and by estimating future trends (predicting consequences or effects). These learning outcomes go one step beyond the simple remembering of material, and represent the lowest level of understanding.
Examples of learning objectives at this level are: understand facts and principles, interpret verbal material, interpret charts and graphs, translate verbal material to mathematical formulae, estimate the future consequences implied in data, justify methods and procedures.

Application
Application refers to the ability to use learned material in new and concrete situations. This may include the application of such things as rules, methods, concepts, principles, laws, and theories. Learning outcomes in this area require a higher level of understanding than those under comprehension.
Examples of learning objectives at this level are: apply concepts and principles to new situations, apply laws and theories to practical situations, solve mathematical problems, construct graphs and charts, and demonstrate the correct usage of a method or procedure.

Analysis
Analysis refers to the ability to break down material into its component parts so that its organizational structure may be understood. This may include the identification of parts, analysis of the relationship between parts, and recognition of the organizational principles involved. Learning outcomes here represent a higher intellectual level than comprehension and application because they require an understanding of both the content and the structural form of the material.
Examples of learning objectives at this level are: recognize unstated assumptions, recognises logical fallacies in reasoning, distinguish between facts and inferences, evaluate the relevancy of data, analyse the organizational structure of a work (art, music, writing).

Synthesis
Synthesis refers to the ability to put parts together to form a new whole. This may involve the production of a unique communication (theme or speech), a plan of operations (research proposal), or a set of abstract relations (scheme for classifying information). Learning outcomes in this area stress creative behaviours, with major emphasis on the formulation of new patterns or structure.
Examples of learning objectives at this level are: write a well organized theme, gives a well organized speech writes a creative short story (or poem or music), propose a plan for an experiment, integrate learning from different areas into a

plan for solving a problem, formulates a new scheme for classifying objects (or events, or ideas).

Evaluation

Evaluation is concerned with the ability to judge the value of material (statement, novel, poem, research report) for a given purpose. The judgments are to be based on definite criteria. These may be internal criteria (organization) or external criteria (relevance to the purpose) and the student may determine the criteria or be given them. Learning outcomes in this area are highest in the cognitive hierarchy because they contain elements of all the other categories, plus conscious value judgments based on clearly defined criteria.

Examples of learning objectives at this level are: judge the logical consistency of written material, judge the adequacy with which conclusions are supported by data, judge the value of a work (art, music, writing) by the use of internal criteria, judge the value of a work (art, music, writing) by use of external standards of excellence.

Table 7: Learning objectives

Cognitive	**Affective**	**Psychomotor**
knowledge	**attitude**	**skills**
1. Recall data	1. Receive (awareness)	1. Imitation (copy)
2. Understand	2. Respond (react)	2. Manipulation (follow instructions)
3. Apply (use)	3. Value (understand and act)	3. Develop Precision
4. Analyse (structure/elements)	4. Organise personal value system	4. Articulation (combine, integrate related skills)
5. Synthesize (create/build)	5. Internalize value system (adopt behaviour)	5. Naturalization (automate, become expert)
6. Evaluate (assess, judge in relational terms)		

The Cognitive Domain

The Cognitive Learning Domain is exhibited by a person's intellectual abilities. Cognitive learning behaviours are characterized by observable and unobservable skills such as comprehending information, organizing ideas, and evaluating information and actions.

Table 8: Cognitive Learning Domain

level	category or 'level'	behaviour descriptions	examples of activity to be trained, or demonstration and evidence to be measured
1	**Knowledge**	recall or recognise information	multiple-choice test, recount facts or statistics, recall a process, rules, definitions; quote law or procedure
2	**Comprehension**	understand meaning, re-state data in one's own words, interpret, extrapolate, translate	explain or interpret meaning from a given scenario or statement, suggest treatment, reaction or solution to given problem, create examples or metaphors
3	**Application**	use or apply knowledge, put theory into practice, use knowledge in response to real circumstances	put a theory into practical effect, demonstrate, solve a problem, manage an activity
4	**Analysis**	interpret elements, organizational principles, structure, construction, internal relationships; quality, reliability of individual components	identify constituent parts and functions of a process or concept, or de-construct a methodology or process, making qualitative assessment of elements, relationships, values and effects; measure requirements or needs
5	**Synthesis (create / build)**	develop new unique structures, systems, models, approaches, ideas; creative thinking, operations	develop plans or procedures, design solutions, integrate methods, resources, ideas, parts; create teams or new approaches, write protocols or contingencies
6	**Evaluation**	assess effectiveness of	review strategic options or plans in terms of efficacy,

whole concepts, in relation to values, outputs, efficacy, viability; critical thinking, strategic comparison and review; judgement relating to external criteria	return on investment or cost-effectiveness, practicability; assess sustainability; perform a SWOT analysis in relation to alternatives; produce a financial justification for a proposition or venture, calculate the effects of a plan or strategy; perform a detailed and costed risk analysis with recommendations and justifications

Based on the 'Taxonomy Of Educational Objectives: Handbook 1, The Cognitive Domain' (Bloom, Engelhart, Furst, Hill, Krathwohl) 1956. Note that levels 5 and 6, Synthesis and Evaluation, were subsequently inverted by Anderson and Krathwhol in 2001.

5.4.2 Project Evaluation Methodology

Evaluation is usually designed around a set of general principles or building blocks that guide the essential decisions in putting together an evaluation plan and keeping it under review.

We can identify six design principles for project evaluation:

- Define the evaluation aims
- Users analysis
- Individuate the objects and define the evaluation actors of the evaluation
- Matching the project life-cycle
- Selecting appropriate methods and tools
- Individuate the main evaluation activities

Different users are interested in different things relevant to the kind of decisions they have to make. In some cases, they have different or competing views about what is important, what constitutes success and how success might be measured.

In particular, it is necessary to define:

- who the different users are
- what kinds of questions they are asking,
- how they will be involved in the project, and
- what kind of data or information needs to be provided at different stages in the project life-cycle to inform their decision-making?

The project evaluation methodology should be based on

- Initial review of project users
- periodic review of project overall functioning and benefits of participation,

- user trial evaluation aimed at the supporting the development of the different phases and of the outputs foresees in the project development, and
- summary evaluation examining the outcomes and impact of the project at regional, national and European level.

INITIAL REVIEW

Initial review will focus on bias users have in using and understanding technology. Evaluation in all countries should be carried defining the students usage and skills in computer and information technology, previous experiences in e-learning, mobile phones usage and experiences. This data should be compared with national mobile phones usage data.

PERIODIC REVIEW

The periodic reviews will focus on the overall functioning of the trans-national partnership and on what, if any, benefits partners are deriving from participation. The reviews will take place in the course of the lifetime of the project during the project meetings. The review will be conducted on the basis of open discussion and problem solving session.

USER TRIAL EVALUATION

Formative evaluation will focus on the development and implementation of project outputs, that is, on gathering systematic, structured feedback from potential and actual users as part of an iterative development cycle. The approach to undertaking formative evaluation will be based on:

1) Collecting and assessing formative user feedback in a structured and systematic way (questionnaires, structured interviews, focus group) in order to test games adapted, the game platform and to collect feedback on game-based learning methods and ideas on possible future actions.

2) The involvement of the experts and professionals (which will be met during the dissemination events) in order to collect feedback and comments on the game platform and perceptions on the usage of game-based learning in education and life-long learning

SUMMARY EVALUATION

Summary evaluation will be carried out at the end of the project in order to assess if the project objectives had been achieved and suggest future actions.
When doing evaluation special care should be considered to:

- Usability
- User behaviour and interaction
- Learning aspects
- Organizational aspects

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