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Presentation of the Research Group of J Fidler on the World Wide Web

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A hypertext version of this document with many internal and external links is available on the World Wide Web:
`http://stud1.tuwien.ac.at/~e9426502/projects/P9712WWW/P9712WWW.html`

1 History of the Internet

The World Wide Web (abbreviated WWW, W3 or simply "the Web") is less than 10 years old but it enjoyed a rapid development. It is based on the infrastructure of the Internet, a world-wide network of computers whose origins date back to the 1960s.

The concept of a global network and its influence on social interactions were first described in a series of memos by J.C.R. Licklider of MIT in August 1962. The vision of his "Galactic Network" resembled already many aspects of today's Internet. In October 1962 Licklider became the first head of the computer research program at the Defense Advanced Research Projects Agency (DARPA). [Lein97, Tapp95]

The technology necessary for computer networking was also developed at MIT by Leonard Kleinrock. He published the first paper on packet switching theory in July 1961. This type of network has no central hub and no central control centre. Packets containing small amounts of data are forwarded from place to place until they arrive at the proper destination.

In 1966 a first concept for ARPANET (Advanced Research Projects Agency NETwork) was developed at DARPA. At the same time research groups at the National Physical Laboratory (NPL) in Teddington, UK, and at the RAND Corporation worked on packet networking. The RAND group had published a paper on packet switching networks for secure voice in the

military in 1964. This might be the source for all rumour claiming that the ARPANET was somehow related to building a network resistant to nuclear war, but this was never the main goal.

In 1969 ARPANET was founded and initially connected four sites: Stanford Research Institute, University of California at Los Angeles, University of California at Santa Barbara and University of Utah. At that time only telnet and ftp services were available. Soon, the network started to grow as NASA, Department of Defense (DoD), National Science Foundation (NSF), and other governmental institutions became interested in this project.

No earlier than 1972 this new network technology was demonstrated to the public. Then the ARPANET developers invented a new tool for coordinating their work: email. It became the largest network application for over a decade.

In 1973 a new communications protocol for the network had to be developed to allow the connection of more computers and overcome resulting reliability problems. Robert E. Kahn and Vinton G. Cerf created the new standard, the Transmission Control Protocol/Internet Protocol (TCP/IP). DARPA supported the University of California Berkeley in incorporating the new protocol in their Unix operating system. These releases proved to be a critical element in dispersion of the protocols to the research community. On January 1, 1983 all hosts connected to ARPANET had to convert to the new protocol simultaneously. This can also be said to be the day when ARPANET ceased to be and the Internet came into being.

In 1981 IBM founded a network of its own, BITNET (Because Its Time NETwork). BITNET was a store and forward network, which is also indicated by its name, designed to allow email and mailing lists. This meant that first users could not get a real time connection over a BITNET link.

The development of Local Area Networks (LANs), PCs and workstations in the 1980s allowed the nascent Internet to flourish. Ethernet technology, which defines physical and electrical standards for small networks, was developed by Bob Metcalfe at Xerox PARC (where also the "mouse" was invented) in 1973. Today it is probably the dominant network technology used by the Internet.

In 1983 Paul Mockapetris of the Information Science Institute (ISI) at the University of Southern California (USC) developed the idea of the Domain Name System. In order to establish communication with another host on the Internet, its host name has to be converted into its IP address which uniquely identifies any computer connected to the Internet. In the early days, the host name to address mappings were maintained by the Network Information Center (NIC, today InterNIC) in a single file which was sent to all hosts. As the Internet grew, this technique became slow and inefficient.

The Domain Name System [RFC1034] specifies the design of a distributed database for converting host names into IP addresses. The mappings are not kept in a single database but the Internet is divided into different zones and for each zone there are at least two authoritative name servers. Within its zone a name server is responsible for an up-to-date host name database. In addition it may save resolved host names of other zones in a local cache. If it receives a request to resolve a host name from outside its zone it can either use information from its cache or it has to return the address of another name server which is closer to the desired zone and can return the required information or the address of a third name server even closer and so on.

In 1984 the National Science Foundation founded five super computer centres, linked them via backbones and also to the Internet and funded connections to these super computer centres. Soon the network had to be upgraded with T1 lines, transferring 1.5 Mbps (Megabits per second) which was twenty-five times faster than the old 56 kbps lines. As a consequence network traffic started to increase by as much as fifteen percent per month as more sites were coming online. They had been attracted by easier access and the new speed.

In 1989 the European Organization for Nuclear Research (CERN) connected to the Internet and by 1990 it had become the largest Internet site in Europe. That was also the year when Tim Berners-Lee [Bern96] launched his "Hypertext Project" which led to the development of the World Wide Web.

In 1991 new T3 lines (45 Mbps) were introduced. There were 4,500 different networks connected to the NSF backbone, as opposed to 170 in 1986.

On October 24, 1995, the Federal Networking Council passed a resolution defining the term Internet.

Resolution: The Federal Networking Council (FNC) agrees that the following language reflects our definition of the term "Internet". "Internet" refers to the global information system that – (i) is logically linked together by a globally unique address space based on the Internet Protocol (IP) or its subsequent extensions/follow-ons; (ii) is able to support communications using the Transmission Control Protocol/Internet Protocol (TCP/IP) suite or its subsequent extensions/follow-ons, and/or other IP-compatible protocols; and (iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein.

The Internet is just over fifteen years old, but growing at an unprecedented speed. It has reached almost all countries in the world and the Internet Domain Survey of January 1998 (Figure 1) counts almost 30 million hosts forming the Internet. This survey uses the Domain Name System to count the number of hosts in each domain. The old survey counted the number

Domain	Abbrev.	Hosts
Commercial	com	8201511
Networks	net	5283568
Educational	edu	3944967
Japan	jp	1168956
US Military	mil	1099186
United States	us	1076583
Germany	de	994926
United Kingdom	uk	987733
Canada	ca	839141
Australia	au	665403
Organizations	org	519862
Government	gov	497646
Finland	fi	450044
Netherlands	nl	381172
France	fr	333306
Sweden	se	319065
Norway	no	286338
Italy	it	243250
Taiwan	tw	176836
New Zealand	nz	169264
Spain	es	168913
Denmark	dk	159358
South Africa	za	122025
South Korea	kr	121932
Brazil	br	117200
Switzerland	ch	114816
Austria	at	109154
rest of the world		1117456
total		29669611

Table 1: Distribution by Top-Level Domain Name by Host Count (Jan. 1998)

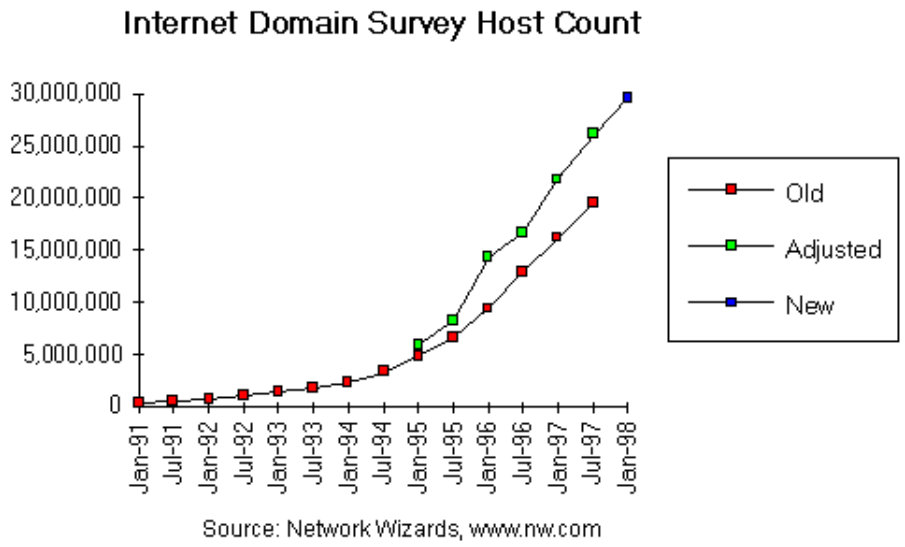

Figure 1: Exponential growth of the Internet

of domain names that had IP addresses assigned to them. Since there are restrictions to the access of domain data, a new technique has been developed. The new domain survey is the reverse of the old survey. It counts the number of IP addresses that have been assigned a name. The results of the latest survey are available at the Network Wizards' [NetWiz] Web site.

2 History of the World Wide Web

The fundamental idea of the World Wide Web is the presentation of hypertext. The origins of hypertext can be traced back to 1945. Then, Vannevar Bush, a science advisor to president Roosevelt, proposed a system called "Memex". It should store vast amounts of information, links of related texts and illustrations, which could be saved and used for future reference. Twenty years later Theodor Holm Nelson coined the word "hypertext" and in 1981 he conceptualized "Xanadu", a central, pay-per-document hypertext database containing "all" written information. In 1988 Autodesk bought the Xanadu project, "finished" it, and dropped the project in 1992.

In 1994 Nelson was invited to Japan and founded the Sapporo HyperLab with the support of Hitachi and Fujitsu. More recently he was given a research appointment by Keio University, where he plans to continue building Xanadu.

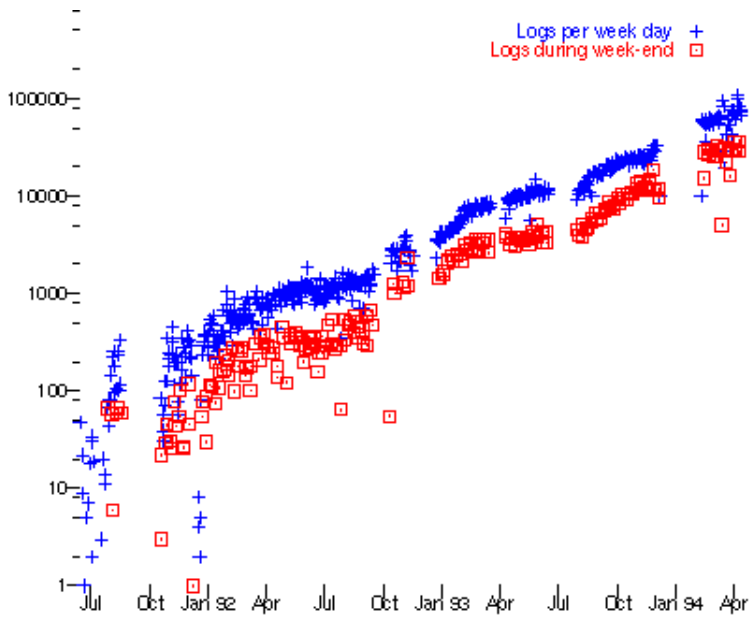

Figure 2: Exponential growth of the nascent Web

In contrast to Xanadu's failure, the World Wide Web encompassed the globe and has proliferated across all computer platforms within few years (cf. figure 2). The remarkable success of the Web is a result of its intuitive, platform independent, yet simple design.

In 1990 Tim Berners-Lee, a researcher at the distributed computing group at CERN, proposed a "Hypertext Project" to provide an intuitive single user-interface to large classes of information (reports, notes, data-bases, computer documentation and on-line help). As a management tool it should facilitate cooperation in large organizations by giving an accurate representation of the state of people's thoughts, interactions, and work patterns.

That was the vision, however, the real world was scattered with incompatible networks, disk formats, data formats, and character encoding schemes, which made any attempt to transfer information between dislike systems a daunting and generally impractical task. Consequently the key points for success of the project were flexibility, interoperability, scalability, ease of use and the ability to provide a path of evolution which allowed the inclusion of existing material as well as the migration to new standards in the future.

Flexibility had to ensure that implementations of all necessary software would become available on a wide variety of computer platforms.

Interoperability, based on the HTTP and HTML standards, was necessary for a broad acceptance in a world of proprietary hardware and operating

systems.

Scalability should allow the Web to grow boundlessly. Typically hypertext systems were built around a database of links which limited their size. However, it did guarantee that links would be consistent, and links to documents would be removed when documents were removed. The renunciation of this feature was the principle compromise made in the architecture of the Web, which then, by allowing references to be made without consultation with the destination, gave rise to the scalability and exponential growth of the Web.

Though, "Hyperwave", a Web server developed at the Technical University Graz and now distributed by "Hyperwave Information Management GmbH." is able to guarantee link consistency. This is achieved by storing documents, links and document attributes in an object oriented database. All Web pages are generated on the fly, i.e. their contents and links are assembled on demand and sent to the client. In addition it includes an integrated search engine and sophisticated user management.

Another feature is worth mentioning: Hyperwave lets publishers attach a price to individual documents on commercial sites. This is also supported by HTTP/1.1 [RFC2068], which defines a client error with status code 402 as "Payment Required". The future of the Web seems to become more expensive. However, it is not only companies which want to make money on the Web, there are also plans considered by the European Union to raise taxes on the amount of data transmitted over the Internet. The president of the United States, Bill Clinton, holds the opinion that the cyberspace should be a free trade zone.

Ease of use was the key to the adoption of the World Wide Web as a new global information system by the whole online community, not only a small group of freaks.

In December 1990 the initial prototype consisting of a line mode Web browser and a simple Web server was written in NeXTStep. However, it was impossible to convince anyone to use the system since it had a small audience and contained information only about itself. The first useful application was an interface to a phone book database at CERN. This made a few people, the first Web surfers, use their browsers to access the phone book.

As there were no more resources available at CERN, the Internet community at large was encouraged to port the World Wide Web program to other platforms. As a result various browsers were developed: "Erwise", "Midas", "Viola-WWW" for X windows and "Cello" for Windows. A research team at the National Center for Supercomputer Applications (NCSA) at the University of Illinois improved the interface of the Web browser and incorporated several different protocols in use on the Internet (e.g. Ftp, Wais, Gopher; the

latter was seen for a long time as a preferable information system). In 1993 they released the first Web browser which was capable of displaying text and inline images, "Mosaic". It suddenly made the Web an interesting place to explore and encouraged businesses to market themselves and their products on the Web.

However, industry needed reliable technology for long term strategies and investments as it feared that a fragmentation of the Web's standards could destroy this promising "universe of information". This lead to the formation of the World Wide Web Consortium (W3C) in 1994. It provides a vendor-neutral forum where competing companies can meet to agree on common specifications for the common good and a fruitful future of the Web.

Just one example of the W3C's effectivity is its reaction to the worries of parents, schools, and governments that children could gain access to indecent, violent or in some other way harmful material on the web. Under threat of government restrictions of Internet use, or even government censorship, the consortium reacted rapidly on behalf of the Internet community in the form of W3C's Platform for Internet Content Selection (PICS) initiative. PICS allows parents to set up filters for the information their children can get access to, where the filters can refer to the parent's choice of independent rating services.

As commerce and money become increasingly important on the Web, the W3 Consortium is also working on protocols to negotiate the security and payment protocols which will ensure safe business transactions.

In the middle of 1994 Marc Andreessen and several other members of the group at NCSA founded Netscape Communications Corporation to commercially develop and improve the Mosaic Web browser. Today Netscape's Communicator still has the upper hand with regard to numbers of users and market share as compared to Microsoft's Internet Explorer but they are fighting for the lead (cf. section 6).

3 Networking

The tasks and relationship of various protocols can best be described using a layer model or protocol stack. [Blieb92, Brun]

The top layer is the **application layer 7**. It includes application programs for electronic mail, browsing the Web, data transfer or remote login.

These applications have to respect a certain standardized syntax and semantics, which are defined in the **presentation layer 6**. Protocols for file transfer (FTP), remote login (telnet), electronic mail (SMTP), gopher, wais, WWW (HTTP) etc. are defined here. In addition, data conversion between

different platforms (e.g. ASCII to EBCDIC) or data encryption may take place.

The World Wide Web uses another protocol to transfer the contents of Web sites from one place to another. It is called HTTP/1.1 (HyperText Transfer Protocol, Version 1.1). Using this protocol a WWW-client (e.g. a Browser) can ask a WWW-server to send a certain Web page. As soon as the client receives the data, he has to interpret them in a sensible way. This process of interpretation is governed by HTML, the HyperText Markup Language (cf. section 5). It is a sort of "programming language" which resembles SGML (Structured Generalized Markup Language), a standardized (ISO 8779) document formatting language.

The **session layer 5** is responsible for communication between processes on different hosts. In practice the real task of this layer is rather obscure and therefore of no major importance. In fact, the Internet does not know any presentation or session layer, which were invented some twenty years after the development of ARPANET. Therefore the tasks described above are all included in the application layer.

The **transport layer 4** provides services for opening network connections, transferring data, and closing connections. On the Internet this is done by the Transfer Control Protocol (TCP). Any data to be transferred have to be split up in small packets. A header containing information about the source and destination port, a sequence number for correct rearrangement of the packets at the destination, and a checksum for detection of data loss is attached to each packet.

The **network layer 3** is the level of the Internet Protocol (IP). Its main task is the routing of datagrams to their destination. Since there is usually no direct connection between source and destination host, the data are sent from one host to the other, each finding for each datagram individually the best way to its destination. This technique makes it possible to by-pass defective or overloaded connections.

The **data link layer 2** has to provide services for flawless data transmission. For this task the data are once again split into small frames which usually carry a checksum at the end. The receiving host checks the incoming frames for data loss and acknowledges correct transmission or asks for retransmission. Another important task of this layer is to control the data flow. This means that the speed at which data are sent and the speed at which the receiver processes the data have to be synchronized.

The **physical layer 1** describes the physical connection between the hosts in a network, basically how single bits (digital) or data units (analog data transfer) can be transmitted. Data transmission can be effected using twisted pair, coaxial or light-wave cables, radio transmission or satellite links.

4 Tools

Browsers

The browser is the key or rather the window to the World Wide Web. It's main task is to display the formatted content of pages from the Web. This has to be done in a standardized way, defined by HTML. However, there are differences in how the content is presented on the computer screen depending on the local configuration. The operating system, screen resolution, available fonts, graphics capabilities and last but not least the browser itself determine how the Web is presented to the user.

That is why during the design and development of a Web site, it should always be viewed with different browsers on different platforms at different screen sizes and resolutions to obtain reliable results in any environment.

The first browser developed by Tim Berners-Lee was written for simple text terminals. At that time there were no fancy graphics or interactive web pages. "lynx" is such a browser. Its main advantage is that it can be used on dumb terminals and displays no images. The latter is an advantage for low bandwidth connections and makes lynx one of the fastest browsers. Nevertheless, it supports even forms, frames, which are displayed separately, and Client-Side-Image-Maps.

Though, its the graphics capabilities and interactivity, which make the Web so attractive. Mosaic and its descendant Netscape Navigator were the first browsers to display text and inline images. Later, almost too late, Microsoft moved in and developed the Internet Explorer. Due to Microsoft's aggressive marketing it became the only serious competitor to the Navigator. All other browsers like Arena, Chimera, Cello, Amaya, or Opera remained niche products.

Arena was developed by the W3 Consortium as an example for the full implementation of the HTML 3.2 standard. It supported new tags for mathematics markup, including subscripts, superscripts and Greek symbols. However, it is not updated any more and maths markup has not proliferated across the Web.

Its successor is Amaya, a test-bed browser/authoring tool for HTML 4.0. Jigsaw is its counterpart on the server side. It is an object-oriented Web server written entirely in Java.

Editors

HTML Documents are simple ASCII files. Thus, they can be created and edited with any text editor. Since HTML is a kind of "programming lan-

guage" there are extensions for many programming editors for HTML syntax. "NEdit", a standard GUI style text editor for Unix, uses syntax highlighting to distinguish different elements in structured files. In HTML documents, for example, all tags are coloured and therefore the code is easier to read and understand.

"asWedit", a special HTML editor, has a built-in parser to check the syntax for HTML 3.2 conformity. In addition text formatting is facilitated by a button bar and automatic insertion of formatting tags.

Finally there a more or less accurate WYSIWYG editors. These editors display HTML documents almost like a browser and include many features of modern text processing applications. Netscape delivers the Gold editions of Navigator and Communicator with this type of editor. Microsoft's pendant is Frontpage, HotMetal is an often recommended editor.

The editor of choice depends on programming experience, frequency of use and personal preferences. WYSIWYG editors hide all HTML coding behind their user friendly interface. However, many editors still have problems with complicated combinations of frames, tables and images, producing undesired results when viewing the pages with a real browser. Therefore users with programming experience often prefer usual programming editors.

Finally, the syntax and HTML conformity can be checked with HTML validators. The "official" HTML checker is the W3C HTML Validation Service. WebTech also provides a validation service. Having validated one's HTML documents ensures that less permissive browsers, which do not excuse forgotten closing tags for instance, will render the document as expected. Nevertheless it is always a good idea to check the results with various browsers also on different hardware and operating systems.

5 HTML Documents

Tags

An HTML Document is a simple ASCII file. Apart from the text to be displayed, it contains links to images, links to other documents and formatting instructions, which are programmed using HTML "tags". Tags are characterized by brackets. Between the opening "<" and closing ">" bracket proper HTML code, consisting of a single keyword and optionally additional commands, is expected. HTML is not case sensitive. Usually there is an opening and a closing tag (e.g. `<h1>HTML Documents</h1>`), the latter being characterized by a slash. Between these two parts the tag takes effect. In our example `h1` is the keyword for a heading of first order (very big) and the text

between the opening and closing tag is used for the heading.

Tags can also be nested like `<h1><i>HTML</i> Documents</h1>`, which prints "*HTML*" in italic letters and the whole expression as a big heading. There are also standalone tags like `<hr>`, which draws a horizontal rule.

There are many books and Web sites providing quick introductions or complete descriptions of the latest HTML standard and extensions like Java, JavaScript, ActiveX or cgi-scripts. At NCSA or at the University of Kansas quick introductions and links to other courses and tutorials can be found. For German speaking Web publishers there is a highly recommended book by Stefan Münz [Münz96], which is also fully available on the Web.

Structure of an HTML Document

Any HTML Document is embraced by `<html>` ... `</html>`. Inside this mandatory tag there are two main parts. First, the head denoted by `<head>` ... `</head>` and secondly the body denoted by `<body>` ... `</body>`. The head usually contains the title (`<title>` ... `</title>`) which appears in the title bar of the browser and some more information about the author, keywords or a short description. Only the text in the body section will be displayed by the browser. Figure 3 shows the HTML code of a simple document and figure 4 how it is rendered by Netscape Navigator 3.01 for Linux.

Umlauts and other special characters have to be encoded with special commands. The reason being that only the first 128 characters of the standard ISO 8859-1 (ISO Latin-1) character set required by HTML are identical with the ASCII character set used on many computer platforms. Moreover all characters, which have a special meaning in HTML (e.g. `<`, `>`, `&`, `&quot;`), have to be replaced by their special commands. Table 2 gives some commonly used examples.

6 Browsers and Business

There is a variety of Web browsers available, but two of them are clearly dominating the market, Netscape's Communicator and Microsoft's Internet Explorer. Microsoft had no interest in the Internet for quite a while, and now they are trying hard to catch up and take the lead.

To reach a big share of the browser market Microsoft distributes its browser for free. They also bundled the browser with their operating system Windows 95, which lead to a law suit in the United States. Furthermore Microsoft forced Internet Service Providers (ISPs) to choose the Internet Explorer as the preferred browser and to distribute it to their customers. As a

HTML Code	Character
À	À
Á	Á
Ã	Ã
Ä	Ä
Å	Å
Ö	Ö
Ü	Ü
ä	ä
à	à
ö	ö
ü	ü
ß	ß
	non-breaking space
<	<
>	>
&	&
"	"

Table 2: Encoding of special characters

```
<HTML>

<HEAD>
  <META
    NAME="keywords"
    CONTENT="magnetism, magnets, micromagnetism, simulation">
  <TITLE> Research Group J Fidler </TITLE>
</HEAD>

<BODY TEXT="#000000" BGCOLOR="#FFFFFF">
<CENTER>
<TABLE CELLSPACING=0 CELLPADDING=0 WIDTH="85%" >
  <TR>
    <TD>
      <CENTER><A HREF="sfl2film.gif"><IMG SRC="m4.gif"></A></CENTER>
    </TD>
    <TD>
      <CENTER><H4>
          Institut f&uuml;r Angewandte und Technische Physik<BR>
          Vienna University of Technology
      </H4></CENTER>
      <CENTER><H1>Research Group J Fidler</H1></CENTER>
      <CENTER><H3>Magnetic Materials and Micromagnetism</H3></CENTER>
    </TD>
    <TD>
      <IMG SRC="mnalc_1.gif" HEIGHT=170 WIDTH=80>
    </TD>
  </TR>
</TABLE>
</CENTER>

<HR WIDTH="100%">
This is the homepage of
<P>
Research Group J Fidler<BR>
email <A HREF="mailto:fidler@email.tuwien.ac.at">fidler@email.tuwien.ac.at</A>

<HR WIDTH="100%">
We are a research group at the <A HREF="http://info.tuwien.ac.at/">Vienna
University of Technology</A> concentrating on the development of new
magnetic materials and to solve micromagnetic problems. Experimental
facilities include powdermetallurgical and electron microscopy laboratories.
</BODY>

</HTML>
```

Figure 3: Basic structure of an HTML document

Figure 4: Rendered sample document

consequence, Netscape, making money with its Web server software and related products, refrained from selling their Communicator as shareware and offers it for free again. There are even plans to distribute not only binaries of the browser but also its source code for free.

For Windows 98 Microsoft plans to merge the Internet Explorer and the Explorer built into Windows 95 to a single multi purpose application. The "desktop" of the Windows environment will become an "Active Desktop", which is capable of displaying Web pages in the background.

No matter what Microsoft does, it eagerly tries to become the market leader. Microsoft uses its quasi-monopoly of the PC operating system market to increase its influence by adding proprietary extensions. For instance, Microsoft left the strict HTML standard and invented new HTML tags such as `<marqee>` for scrolling banners or `<object>` to include ActiveX objects. On the other hand Netscape introduced the `<multicol>` tag to set text in columns or `<blink>` for blinking text. Consequently many Web sites which were optimized for one browser (some point it out by saying "best viewed with ..."), are rendered incompletely or inaccurately by the others. Some extensions were proposed and accepted for a new version of the HTML standard. This lead to the standardization of `<table>` tags for tables and `<font>` to select a certain font. Style sheets and layers were introduced by Netscape with version 4.0 of their browser and will be included in HTML 4.0.

Another Microsoft specific extension is "ActiveX" which makes it easier to develop interactive Web sites. This technology is designed in competition with "Java". Java, developed by Sun Microsystems, is a new object oriented programming language specifically designed for Internet purposes. It is an open standard which is supported by all big players in the software industry. Microsoft's Java Virtual Machine (JVM), which interprets the Java code, is one of the best available. Therefore Netscape considers dropping their own JVM and licensing Microsoft's.

This strategy sped up the development of new HTML standards, however sometimes Microsoft takes unfair measures. In order to visit Microsoft's newly acquired picture gallery "corbis" it was necessary to install the Internet Explorer because all other browsers would not receive any data from the corbis server. If the setup program of the Internet Explorer found the Navigator installed, it disabled it or made it malfunctioning. With version 4.0 of the Internet Explorer it is possible again to run the Navigator and Explorer simultaneously, but it is not advisable to uninstall the Internet Explorer which has already left many Windows 95 partitions corrupted and unable to reboot. Meanwhile corbis proudly declares itself "available on all browsers". For a while access to Microsoft's Web site for developers was granted only to users of the Internet Explorer. After a flood of complaints all browsers were

given access again.

The Web is continuously growing, evolving, developing further. New standards are negotiated and passed at a breathtaking pace. At the beginning of February 1998 the standard for 56 kbps modem connect rates will be passed by the International Telecommunications Union (ITU) and HTML 4.0 is on the way to become an official standard.

References

[Bern96] Tim Berners-Lee, *The World Wide Web: Past, Present and Future.* (1996)
ppf.html

[Blieb92] J. Blieberger, G.-H. Schildt, U. Schmid, S. Stöckler, *Informatik.* Springer, Vienna (1992) 286

[Brun] Angelo Brunero (translated by Andrea Valori), *The TCP/IP Protocol.*
`http://www.cisi.unito.it/radiogw/etcpip.html`

[Chew96] Bob Chew, *A Brief History of the Internet and WWW.* (1996)
`http://www.art.acad.emich.edu/faculty/chew/digital_imaging/history.html`

[Kend97] Jon D. Kendall, *World Wide Web Browsers – Software for the Internet or Internet for the Software?* (1997)
`http://www.ntu.ac.sg/nbs/internet_course/b6533-lect02/b6533-lect02a.htm`

[Lein97] Barry M. Leiner, Vinton G. Cerf, David D. Clark, Robert E. Kahn, Leonard Kleinrock, Daniel C. Lynch, Jon Postel, Larry G. Roberts, Stephen Wolff, *A Brief History of the Internet.* (1997)
`http://www.isoc.org/internet-history/brief.html`

[Münz96] Münz, Nefzger, *HTML-Referenz.* Franzis, Feldkirchen (1996)
`http://www.teamone.de/selfhtml/`.

[NetWiz] Network Wizards
`http://www.nw.com/`

[RFC1034] P. Mockapetris, *RFC1034: Domain names - concepts and facilities.* (1987)

`http://www.globecom.net/(nocl,sv)/ietf/rfc/rfc1034.shtml`

[RFC2068] R. Fielding, J. Gettys, J. Mogul, H. Frystyk, T. Berners-Lee, *RFC2068: Hypertext Transfer Protocol – HTTP/1.1.* (1997) `http://www.globecom.net/(nocl,sv)/ietf/rfc/rfc2068.shtml`

[Tapp95] Sean Tappendorf, *ARPANET and Beyond.* (1995) `http://clavin.music.uiuc.edu/sean/Internet_history.html`