

Internet Techniques and Web Formats

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1. Internet Techniques and Web Formats

Learning Objectives

- You will be able to distinguish the terms "Internet" and "WWW".
- You will be able to explain the functions of different protocols.
- You will be able to distinguish between raster graphics and vector graphics format.

Introduction

When starting the [cartouche homepage](#) in a browser, you are using Internet, because you can access the homepage only via Internet. You certainly do not only use the Internet for the purpose of studies but also during your spare time. For example when you are reading your e-mails, or googling for an issue, etc.

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In this lesson we will teach you how the Internet works. And since you learned in the first lesson, that there is a difference between the Internet and the WWW, we will resume this subject.

If you could choose between an e-learning lesson featuring only text and one that includes also images, you would definitely choose the one with the images. Webpages as well operate a lot with images to gain customers. Therefore, we introduce the common graphics formats that are used in the Internet.

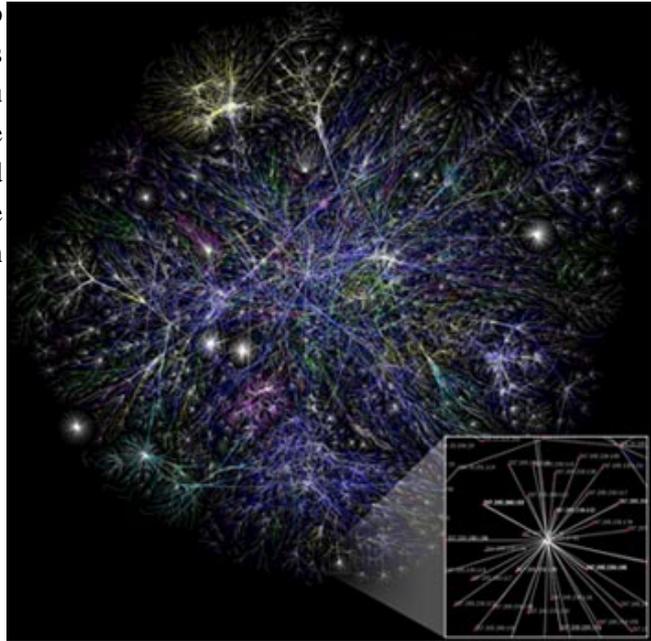
1.1. Internet

Learning Objectives

- You will be able to name the two basic protocols used for the communication in the Internet.
- You will be able to explain the main function of these basic protocols.

Introduction

The terms "Internet" and "World Wide Web (WWW)" are often used synonymously. But there is a significant difference between these terms. As you learned in the first lesson, the WWW is based on the Internet. That means that the Internet was developed before the WWW and therefore is independent of the WWW. The WWW on the other hand is dependent on the Internet, because it uses the Internet.



Visualisation of the various routes through a portion of the Internet (Wikipedia)

We will deepen these statements in the next chapters. First we will concentrate on the term "Internet" and afterwards, [in unit 2](#), we explain the characteristics of the World Wide Web.

1.1.1. Internet

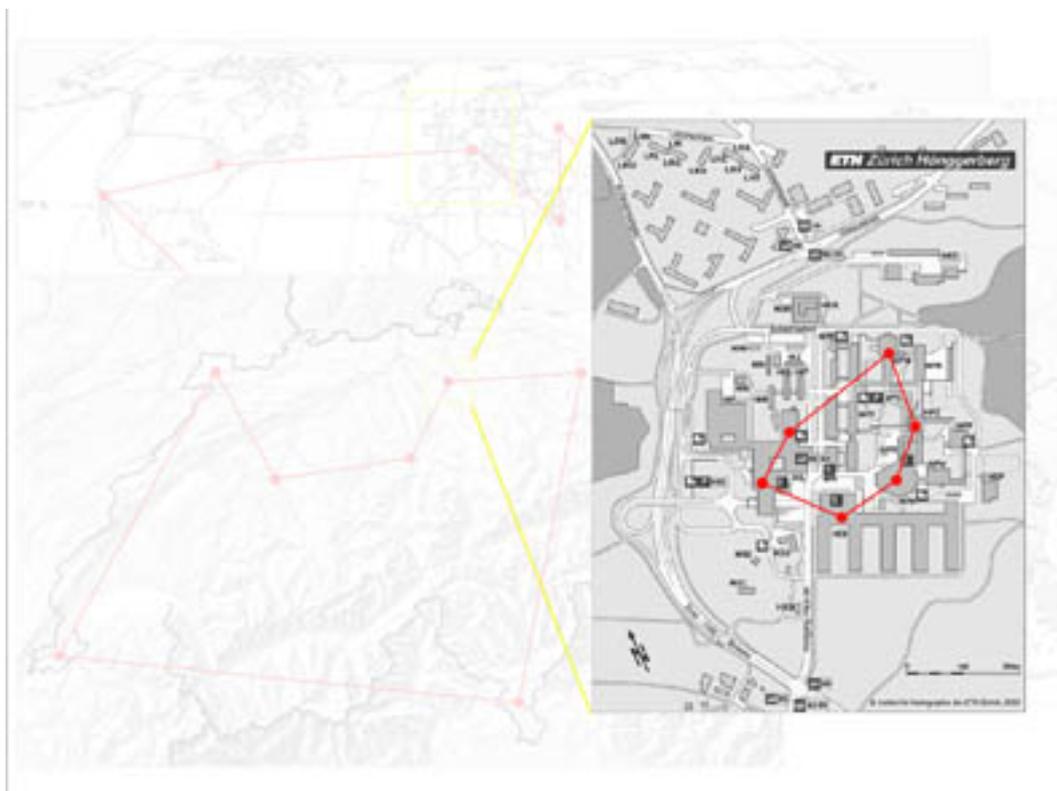
Definition

The Internet is a worldwide system of interconnected computer *networks*¹. That's why the word Internet is a contraction of the phrase inter-network (GOSWAMI 2003, p. 7). It is used for the communication and the exchange of data. Each computer of a network is able to communicate with all other computers.

The Internet consists of the following groups of networks (GOSWAMI 2003, p. 7):

- Large networks which exist primarily to interconnect other networks. They currently consist of the network of several carriers: *MCI*², *Sprint*³, *AT & T*⁴, etc.
- Regional networks connection, for example, universities (e.g. ETH Zurich and University of Zurich) and colleges.
- Local networks, such as campus-wide university networks (e.g. ETH Zurich).

Have a look at the following interaction part (click on the thumbnail). It shows the hierarchy of the different networks. By clicking on the yellow rectangle, you reach the next network level. You can go back to the previous level by clicking in the grey maps.



Groups of Networks

¹ A network is a group of two or more things or people. This notion is often used in terms of "computer network", where computer systems are linked together so that they can exchange data and share resources.

1.1.2. Protocol Hierarchy

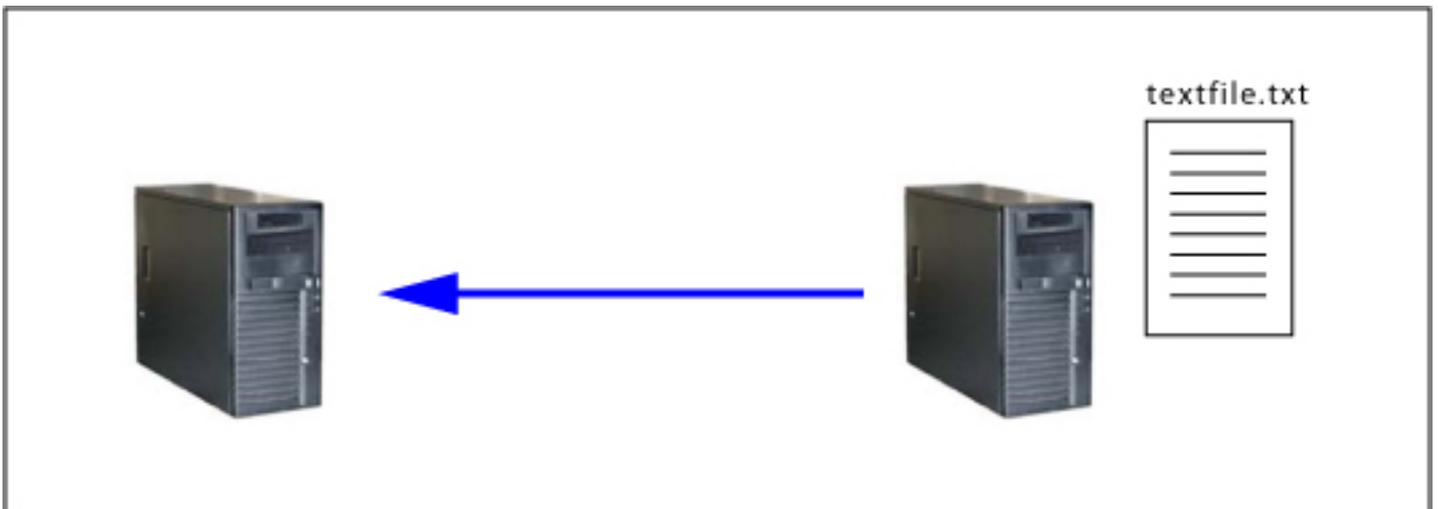
The communication between the computers in the Internet is defined by different protocols. The protocols TCP (Transmission Control Protocol) and IP (Internet Protocol) build the basis of the communication in the Internet. The combination of the TCP and the IP protocol is known as TCP/IP protocol that represents the standard system used in most large networks.

Before describing these and some other protocols, it will be helpful to illustrate the position of each protocol relative to the others in the protocol hierarchy.

By moving the mouse cursor over the abbreviations in the boxes you can see the whole name of the protocol.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

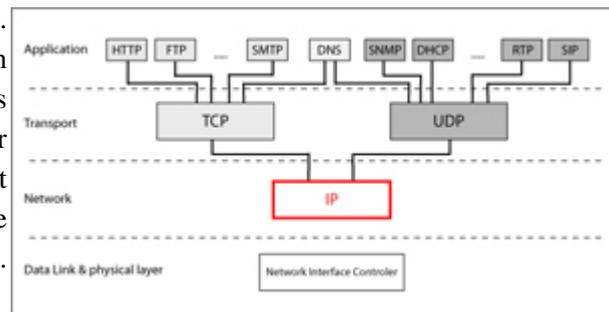
In the next paragraphs we will go into details of some protocols. To understand better the function of the different protocols and their differences we explain you the theory using an example: We will show you how a computer sends the textfile "textfile.txt" to another computer like it is illustrated in the following graphic.



Transferring a file from one computer to another

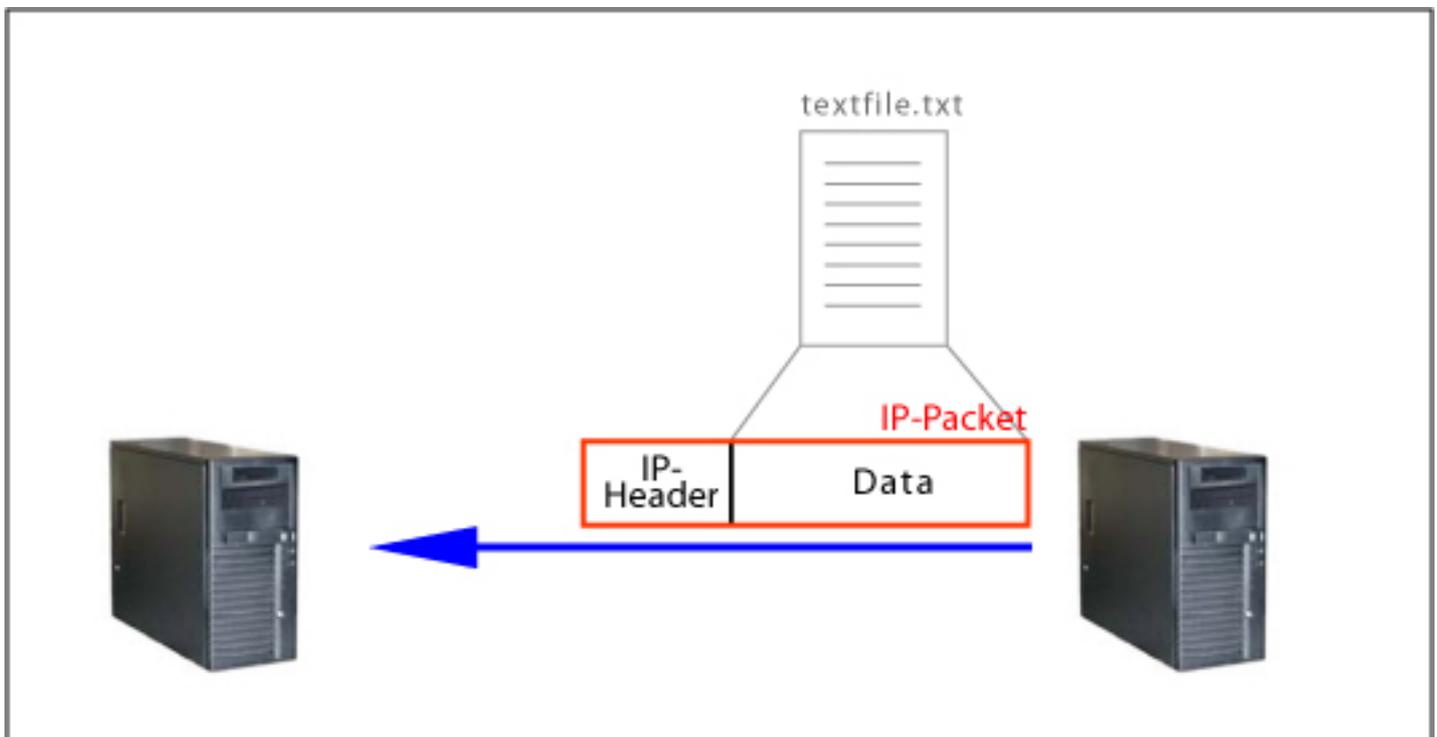
1.1.3. Internet Protocol (IP)

At the heart of the Internet lies the Internet Protocol (IP). IP defines a packet switched network, where information is carried in packets (also known as datagrams) of bits between computers. The IP packet is the atomic transfer unit in the IP. It has a header containing information about the packet, and a data field (see picture below) where the content of the file that has to be transferred is stored. (GOSWAMI 2003, p. 10)



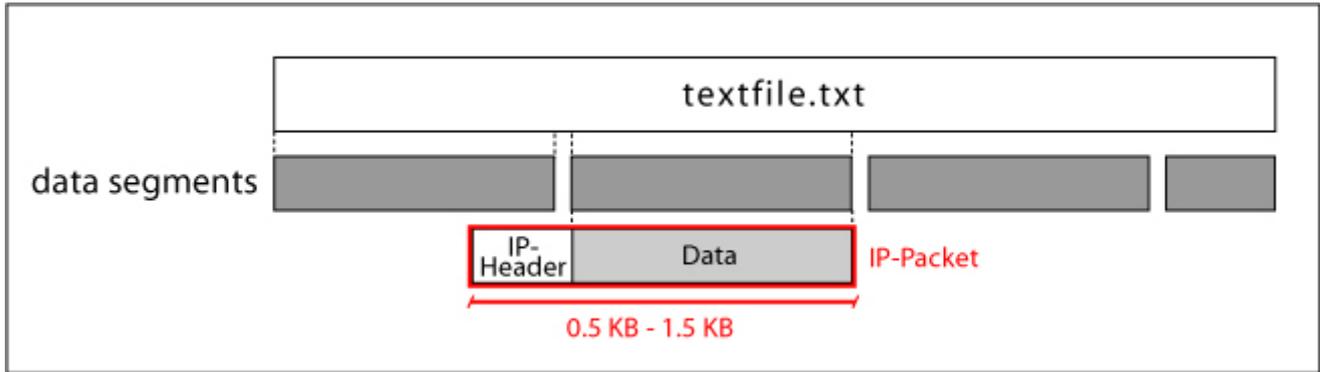
IP in the Protocol Hierarchy

Considering our example the content of the textfile is stored in the data field and an IP-header has to be created. Afterwards, the textfile can be sent in form of an IP-packet to the other computer.



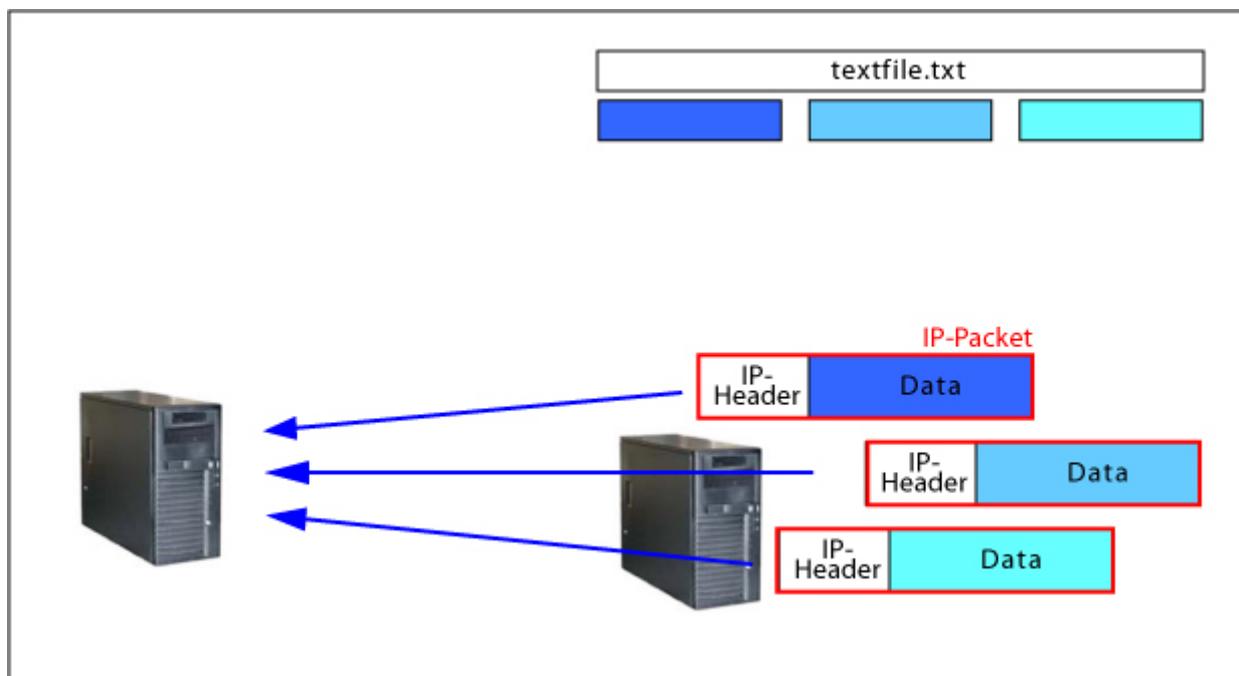
Transferring the textfile using IP.

The IP packet has a maximum size which ranges from 0.5KB to 1.5KB or even higher (depending on the underlying network). Therefore if a filesize exceeds the maximum IP-Packetsize the file has to be splitted into several parts of the maximum IP-packet size. The next image shows this splitting.



Splitting a textfile in several IP-Packets

When a file has to be splitted into several IP-packets the packets are transferred independently.



Transfer of the individual IP-Packets

The Internet Protocol is an unreliable best-effort service; i.e. it does not case guarantee about the IP-packets. The packet may arrive damaged, it may be out of order, it may be duplicated, it may be lost entirely, or not all of the packets may be arrived. If an application needs reliability, it is provided by other means, typically by upper level protocols such as e.g. the TCP. (WIKIPEDIA)

The following animation part uses the term IP Address. If you do not know the meaning of an IP address have a look at this popup window!

IP-Address

An IP address is a unique number, similar in concept to a telephone number. An example IP address is: **129.132.127.191**.

- The first part (129) of the address identifies the network on which the host resides.

- The second part (132) identifies the particular host on the given network. In our case 129.132. is the ETH host.
- The third part (127) identifies the subnetwork of the host. The subnetwork 127 is attached to the Institute of Cartography and the Institute of Geodesy and Photogrammetry of the ETH Zurich.
- The forth part (191) identifies the computer number.

In few words we can say that the first and the second part of the IP address define the global scope and the third and the forth part the local scope.

The following figure shows the IP datagram. The IP datagram header is a minimum of 20 *bytes*⁵ long and contains several components.

Move mouse over the red text to get information about the function of the component.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

In this lesson we discuss only the main components of the IP header. If you are interested in detailed information of all components, have a look at (GOSWAMI 2003, p. 11-16)

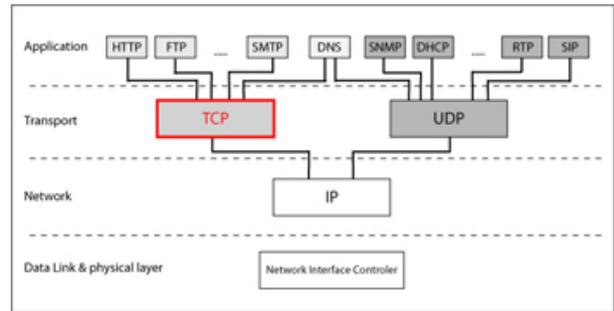
For all programs using the IP protocol, the source IP address and destination IP address are required in order to establish communications and send data.

The Internet can be deemed to be a service for the transmission of information in the form of IP-packages. If we compare this service to the letter service of our post office we can equate an IP-package with a letter and the IP-address to the postal address.

⁵ A byte comprises 8 bits. Since one bit can adopt two states it is possible to describe 256 (2⁸) signs with one byte.

1.1.4. Transmission Control Protocol (TCP)

We saw that the Internet Protocol is an unreliable service. We therefore present you next the Transmission Control Protocol which is responsible for the transport of the datagrams and provides reliability.

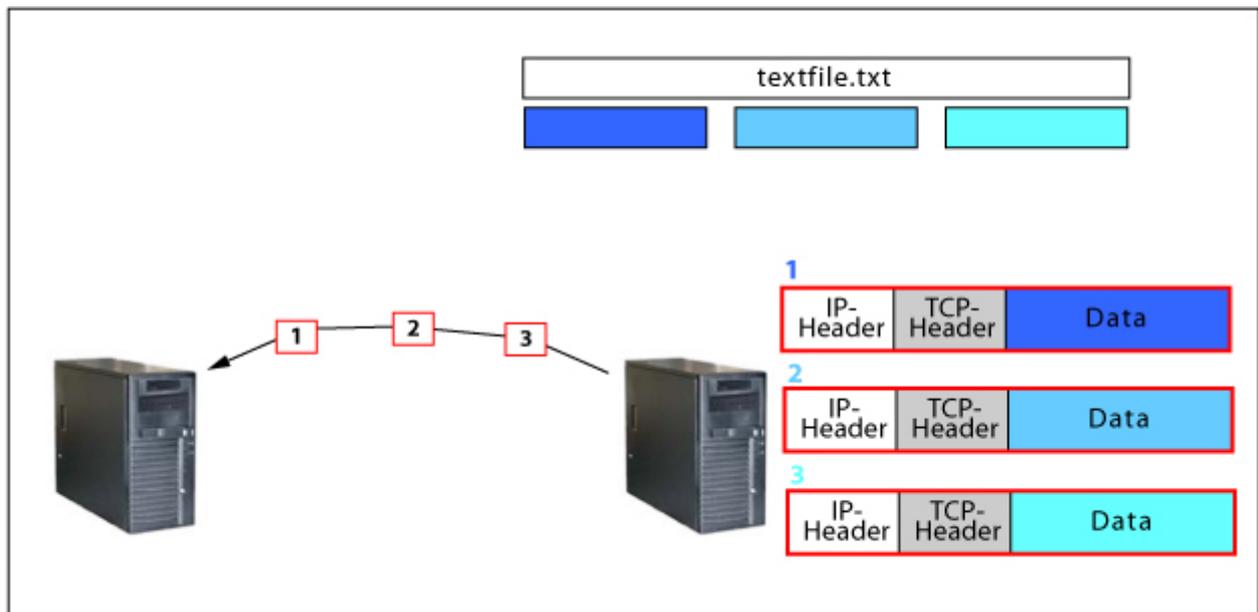


TCP in the Protocol Hierarchy

IP versus TCP

TCP is a protocol used along with the Internet Protocol (IP) to send data in the form of packets between computers over the Internet. Whereas IP handles the actual delivery of the data, TCP keeps track of the packets that a message is divided into for efficient routing through the Internet. (Wireless Telcorp)

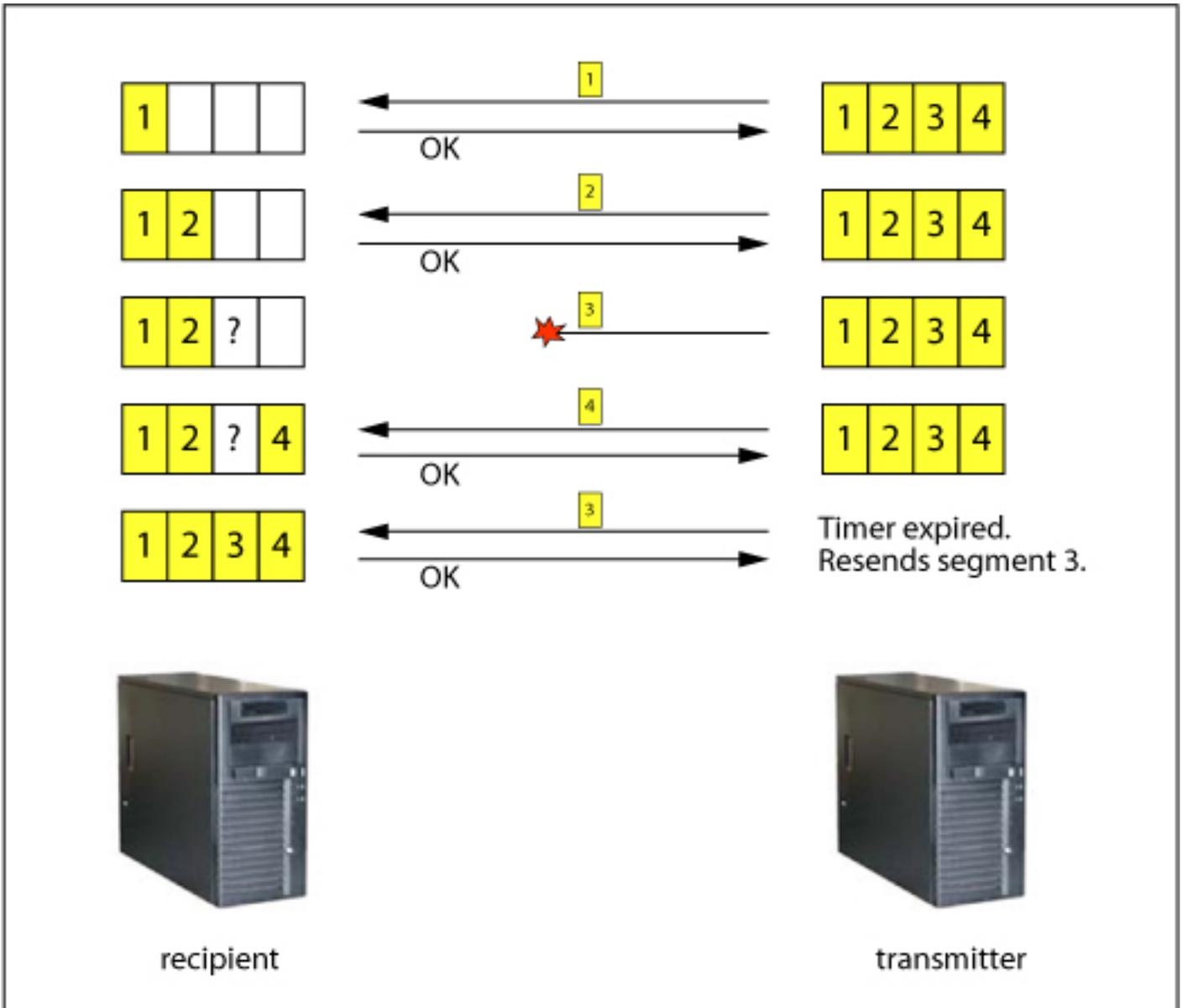
For example, when a web page is downloaded from a Web server⁶, the TCP program layer in that server divides the file into packets, numbers the packets, and then forwards them individually to the IP program layer. Although each packet has the same destination IP address, it may get routed differently through the network. At the other end, TCP reassembles the individual packets and waits until they have all arrived to forward them as a single file. (Wireless Telcorp)



Transferring the textfile using IP and TCP

⁶ A server is a computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries. Servers are often dedicated, meaning that they perform no other tasks besides their server tasks. On multiprocessing operating systems, however, a single computer can execute several programs at once. A server in this case could refer to the program that is managing resources rather than the entire computer.

The Transmission Control Protocol guarantees reliable and in-order delivery of sender to receiver data. To understand better the reliability of TCP have a look at the next graphic.



Reliability of TCP

The header of a TCP looks as following. Move mouse over the red text to get information about the function of the component. The function of "ports" will be explained in the next chapter:

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

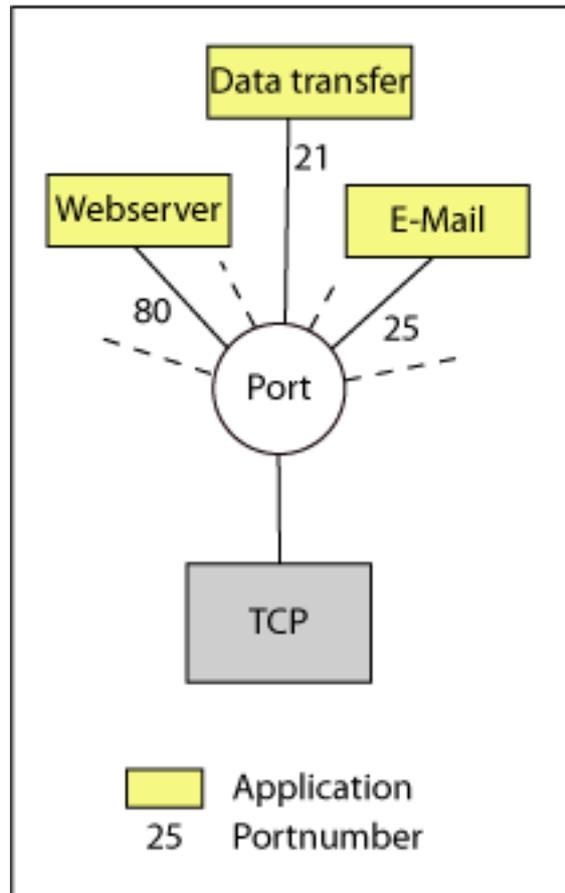
In this lesson we discuss only the main components of the TCP header. If you are interested in detailed information of all components, have a look at (HALSALL 2005, p. 447-450)

As you can see in the graphic [Protocol Hierarchy](#), the "brother" of TCP is UDP (User Datagram Protocol). We won't go into it's details. The following statements should be enough to understand it's principles:

The protocol UDP is is used to transfer streams of audio and / or video data. For example when you listen to the radio over Internet, the data is transferred using the User Datagram Protocol. As IP it is a unreliable service.

1.1.5. Port

Ports are address components used in network protocols to assign the datagrams to the right services (applications). They are expressed as numbers between 0 and 65535. Every number is assigned to a certain service, e.g. port 80 is assigned to the application "Webserver". The next picture illustrates these connections.



Port

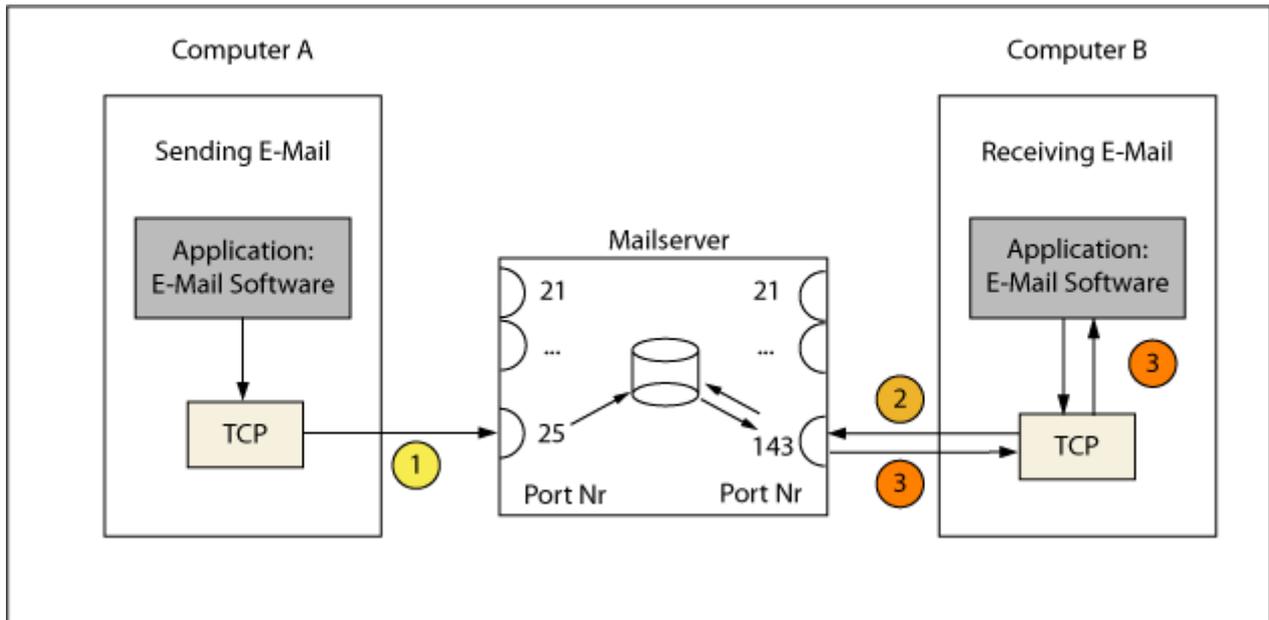
On your computer a file exists with all port numbers and some descriptions at:

- Windows NT: C:/WINDOWS/system32/drivers/etc/services
- Unix and Mac: /etc/services

Example: Sending an E-Mail to a friend

To understand better the function of the port we make an example of sending an e-mail to a friend:

When clicking on the send-button the e-mail is sent by TCP to a Mail-Server using the port 25 and is saved on the Mail-Server until the friend downloads his e-mails. If he does so, his computer sends a request to the Mail-Server with TCP using the port 143. The content of the e-mail is then transferred with TCP to his e-mail program.



Sending an E-Mail

If you still don't understand the function of the port number have a look at the following popup solutions.

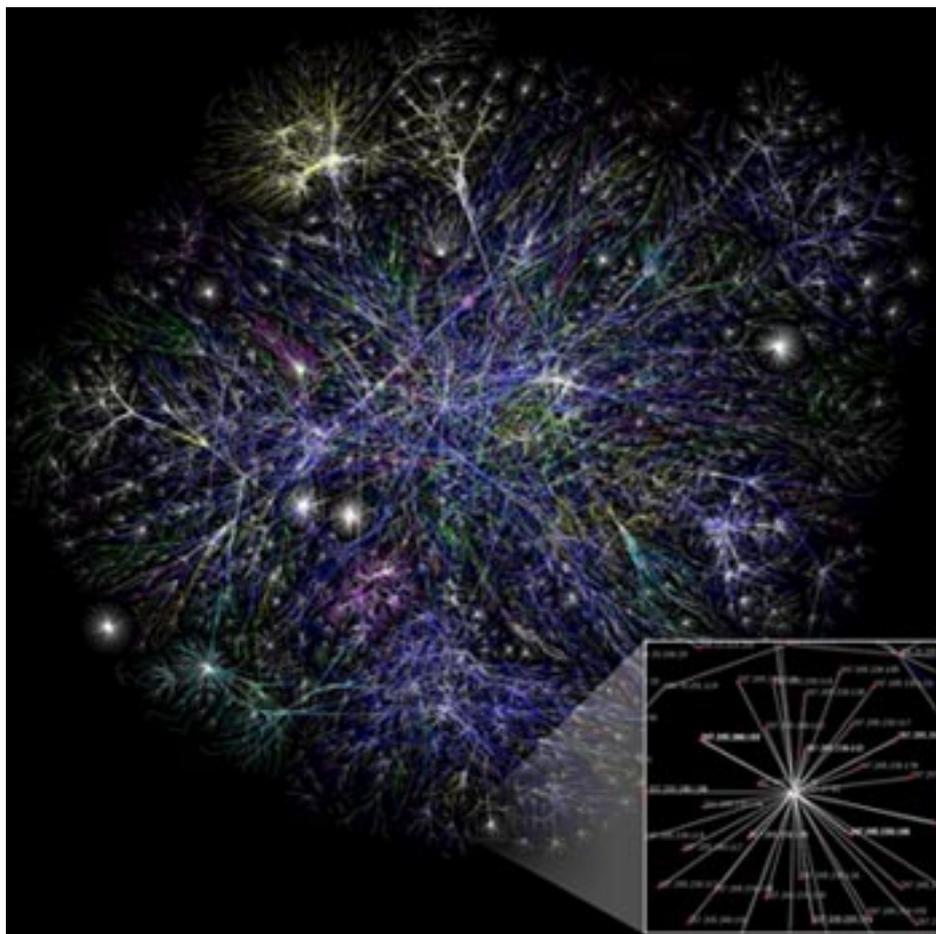
Imagine sending a letter to a friend. You write the letter and then bring it to the post office. At the post office there are several desks: one for letters, one for packets, one for payments, etc. and all desks have different numbers. Since you want to send a letter, you queue up at the letter desk (Nr.1 in the graphic). The postman accepts the letter and keeps it. If your friend wants to get the letter, he has to visit as well the post office. Because he wants to pick up the letter, he has to go to another desk (Nr.2 in the graphic). After speaking to the postman he receives the letter and goes home with it (Nr.3 in the graphic).

1.1.6. Unit-Summary

The Internet is a worldwide system of interconnected computer networks. It is used for the communication and the exchange of data between the interconnected computers. The communication between the computers in the Internet is defined by different protocols. The protocols TCP (Transmission Control Protocol) and IP (Internet Protocol) build the basis of this communication.

TCP is a protocol used along with the Internet Protocol (IP) to send data in the form of packets between computers over the Internet. Whereas IP handles the actual delivery of the data, TCP keeps track of the packets that a message is divided into for efficient routing through the Internet.

The following image visualises the various routes through a portion of the Internet. You can enlarge the image by clicking on the thumbnail. Have a look at the small extract down to the right of the image. You there find a few IP-addresses as examples.



Visualisation of the various routes through a portion of the Internet (Wikipedia)

1.2. World Wide Web

Learning Objectives

- You will be able to explain the differences between the Internet and the World Wide Web.
- You will be able to list at least three components which are necessary for the proper working of the World Wide Web.

Introduction

In [unit 2](#) you learned how the Internet works. You therefore know that the Internet is independent of the World Wide Web. The World Wide Web, on the other hand, is dependent on the Internet. In this unit we will show you how the World Wide Web works and why it depends on the Internet.

In addition we will introduce what Common Gateway Interfaces are and what they are used for.



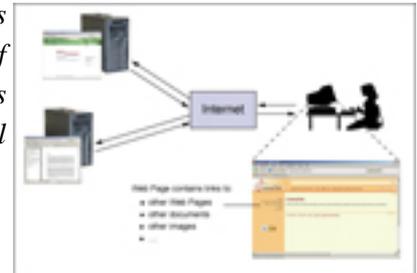
Examples of web browsers

1.2.1. Terms

In the following paragraphs we introduce some terms you have to be aware of when using the World Wide Web. The following terms will be explained: World Wide Web, Web Page, Web Browser, Hypertext Markup Language (HTML), Web Server, Hypertext Transfer Protocol (HTTP), Uniform Resource Locator (URL).

World Wide Web

"The World Wide Web – normally abbreviated to "the Web" or sometimes "the Net" - is a vast collection of electronic documents each composed of a linked set of pages written in HTML. The documents are stored in files on many thousands of computers that are distributed around the global Internet" (HALSALL 2005, p. 568)



World Wide Web

Web Page

"A Web Page is a "page" of the WWW, usually in HTML / XHTML⁷ format and with hypertext⁸ links to enable navigation from one page or section to another." (WIKIPEDIA)

A Web Page contains all the information necessary both to display the contents of the page – text, images, and so on – on the screen of the user machine and also the links that lead to other Web Pages. (HALSALL 2005, p. 570)



Web Page

Web Browser

A Web Browser is a software application that runs on the user machine and enables the user to display and interact with Web Pages hosted by Web Servers. *"A Web browser locates and fetches each requested page and, by interpreting the formatting commands that the page contains, the page contents are displayed."* (HALSALL 2005, p. 570) There are a number of browser programs available such as Mozilla Firefox, Opera, Internet Explorer, etc.



Firefox Browser (Firefox)

Hypertext Markup Language (HTML)

HTML is used to define how the contents of each Web Page are displayed on the screen of the user's machine and to set up the *hyperlinks*⁹ with other pages. (HALSALL 2005, p. 569)

```
<html>
  <head>
    <title>First Homepage</title>
  </head>
  <body>
    This is my first homepage
    <b>This text is bold</b>
  </body>
</html>
```

HTML Code



HTML in Browser

Web Server

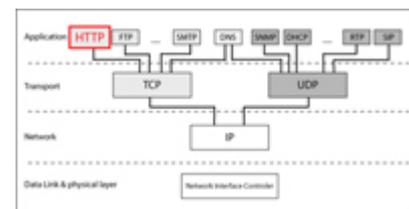
A Web Server is a computer permanently connected to the Internet on which Web sites are stored and accessed. (Kudos Webdesign) The Web Server manages requests from the browser and delivers HTML documents and files in response using HTTP. (PC Magazine)



Web Server

HyperText Transfer Protocol (HTTP)

HTTP is the protocol used by a browser program to communicate with a server program over the Internet and is based on IP and TCP. (HALSALL 2005, p. 569)



HTTP in the Protocol Hierarchy

Uniform Resource Locator (URL)

"A URL comprises the name of the file and the location of the server on the Internet where the file is stored." (HALSALL 2005, p. 569)

<http://www.karto.baug.ethz.ch/index.html>

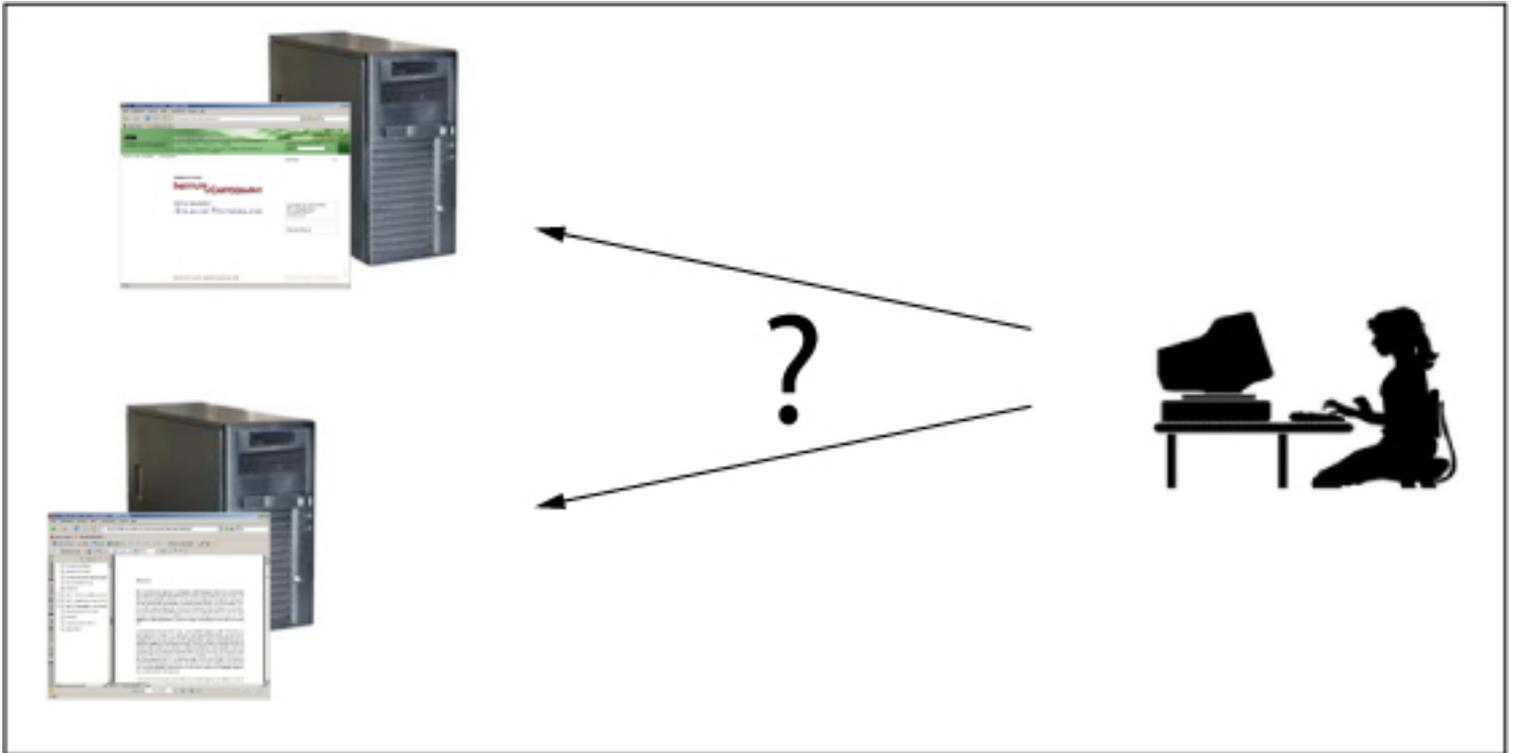
Example of URL

With the understanding of the listed terms we will explain you the principle of the World Wide Web in the next chapter.

⁹ An element in an electronic document that links to another place in the same document or to an entirely different document. Typically, you click on the hyperlink to follow the link. It is most commonly used in the World Wide Web to link various documents (Web Pages, pdf-files, etc.).

1.2.2. URL

You all know very well the World Wide Web. Already by reading this lesson you are using a Web Browser. When starting your Web Browser you do it always with the intention to get some information of the WWW such as e.g. looking up the timetable of your train, looking up the price of the newest computer, etc. This information is stored on various Web Pages, which are stored on different Web Servers.

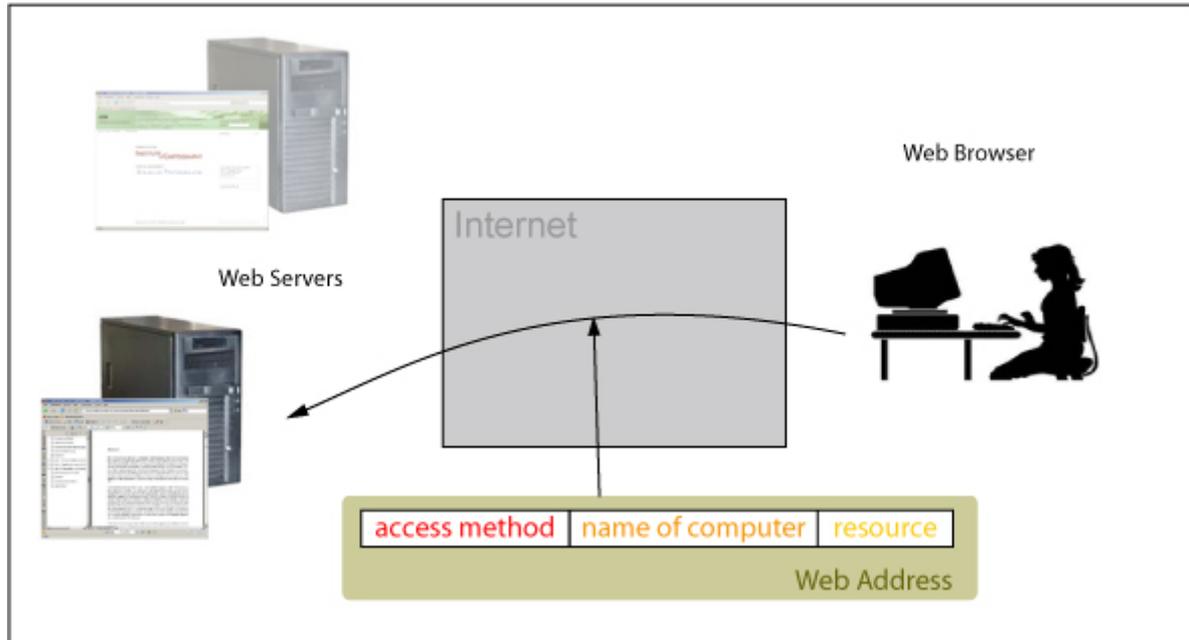


How to access the information which is stored on a Web Server?

To get the wanted information, you have to know the location - the so called **Web-Address** - of the web resource and enter it in the address bar of the browser.

But what is the content of a Web-Address and how does it look like? The following parts have to be defined in the Web-Address when accessing a Web Page :

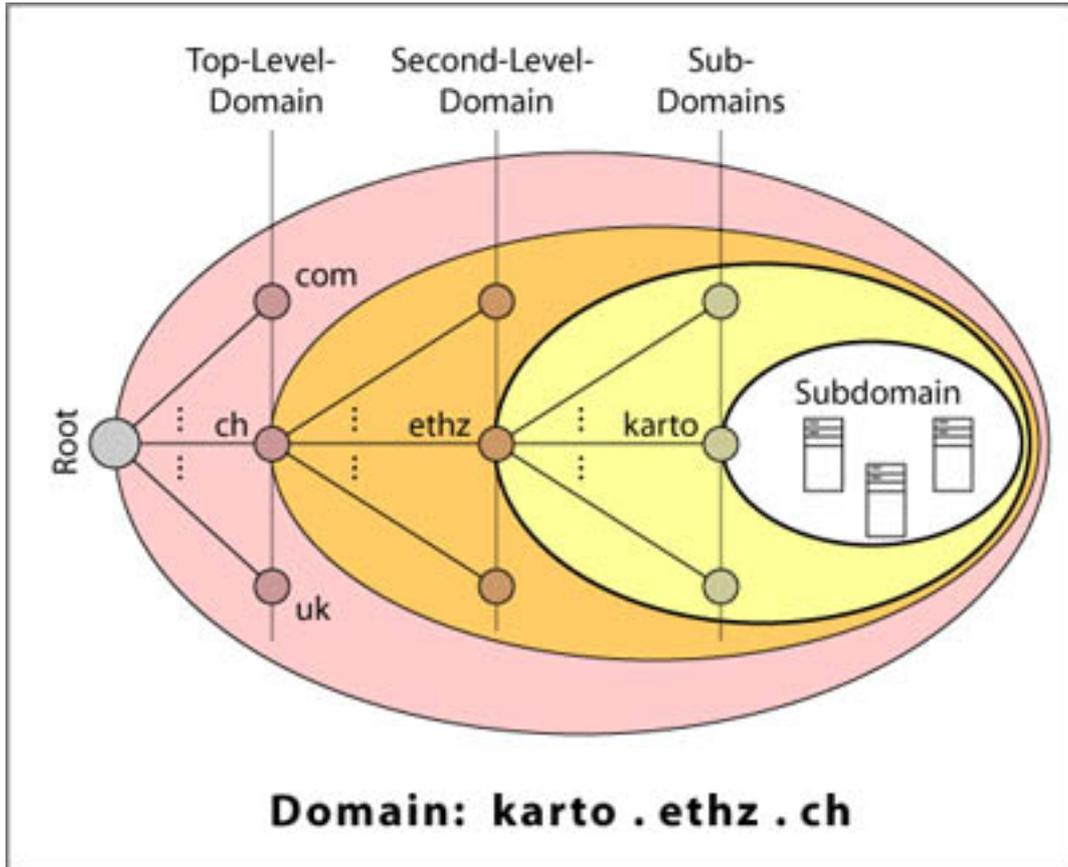
- The method of how to access the Web Server. Therefore, the type of protocol that is used has to be specified.
- The name of the computer where the resource is stored.
- The resource that we are looking for.



A Web Server can be accessed using a Web Address

Domain Name System (DNS)

All computers and all files on the computers are identified by means of names. All names that can be found in the Internet are organised in a worldwide list of names the so called *Domain Name System (DNS)*. The structure of the DNS is like the one of a tree as it is shown below. Each node of the tree represents a Domain and therefore a part of the Internet names. The node "Root" represents the whole Internet. Each Domain can be subdivided into several Sub-Domains. A Web Server is always part of a Domain. A Domain in turn, may contain several Web-Servers. (BADACH et al. 2003, p. 16-17)



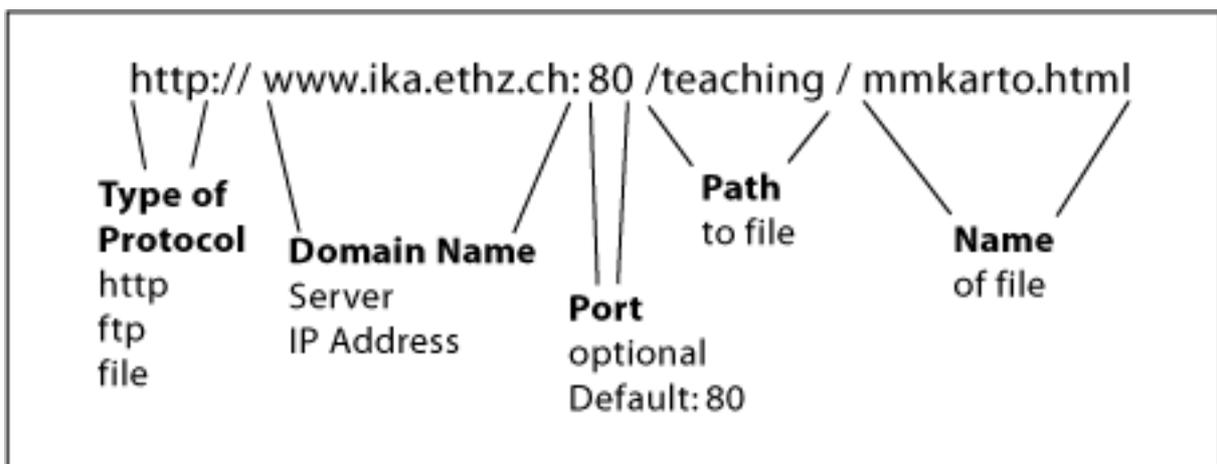
Domain Name System

To identify the resources in the Internet a so called URL (Uniform Resource Locator) was defined that has to be entered in the address bar of the browser.

An URL may look like this:

<http://www.ika.ethz.ch:80/teaching/mmkarto>

The role of all these components are the followings:



URL

- **Type of Protocol:** is used for the communication,

- **Domain Name (Host):** is used to know with whom is communicated,
- **Network Port on the Server:** is the access point on the server for data entry or exit,
- **Path:** gives the path to the resource on the server,
- **Name of file.**

The Domain Name can be replaced by the IP address of the server: the URL would then look like this:

<http://129.132.127.159:80/teaching/mmkarto>

Most Web Browsers do not require the user to enter "http://" to address a Web page, as HTTP is by far the most common protocol used in Web Browsers. Likewise, since 80 is the default port for http it is not usually specified. One usually just enters a partial URL such as www.karto.ethz.ch. (WIKIPEDIA)

Query Strings

In addition to the path where the wanted file is stored, URLs can be extended by query strings. To understand what is meant by this we want you to do a little exercise:

- Open a new browser window and type the following address in the address bar: **<http://www.google.ch/search?q=cartouche&q=e-learning>**
- Press the "Enter key" and look what happens.

Without having started the Google homepage and without having entered the two terms "Cartouche" and "E-Learning" in the search bar we get the corresponding matches. Why this?

We entered the query for these terms already in the URL by using the query string "?q=cartouche&q=e-learning". The query starts with a question mark "?" and is followed of one or a series of parameter=value pairs (in our case this is "q=cartouche" and "q=e-learning"). The series of pairs is separated by the ampersand "&". The presented query can therefore be extended by an arbitrary number of pairs.

Not every web page supports query strings in the URL. Programs that allow the execution of queries within the URL, have to be implemented on the web server.

Exercise

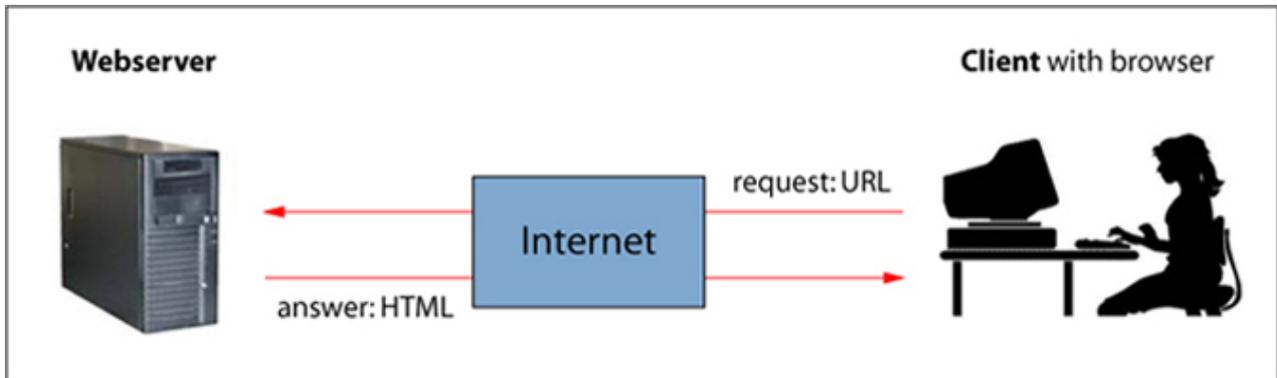
Try to create other queries by changing the values of the parameter q and adding other parameter=value pairs of the above query string "<http://www.google.ch/search?q=cartouche&q=e-learning>". Look at the result you get in your browser.

You can discuss your results on the discussion board "Internet Techniques", if you want.

1.2.3. HTTP

In this unit we show you what happens in the computer when using the Web.

After having entered the URL in the address bar of your browser you have to press the enter key to establish the connection to the server and receiving the answer as a Web Page. You will now get familiar to the steps that happen in the background at the time of pressing the enter key until looking at the wanted Web Page:



Process of entering an URL in the browser and getting an HTML page as answer (SALVINI 2005)

Since the HyperText Transfer Protocol (HTTP) is used for the communication between the browser and the server we next go into detail of the HTTP content.

Have a look at the following interaction part. You get detailed information about the HTTP message content by moving the mouse cursor over the red and blue text. You do not have to understand the meaning of every term. We only want to provide you an insight into the content of the protocol. The most important parts of the protocol will be explained afterwards.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

Details concerning the interaction part

HTTP is a request/response protocol between *clients*¹⁰ and servers. An HTTP client typically initiates a request by entering an URL in his browser window. An HTTP server waits for the client to send a request string, such as "GET / HTTP/1.1", followed by a *MIME*¹¹ message which has a number of informational header strings that describe aspects of the request, followed by an optional body of arbitrary data. Some headers are optional, while others (such as Host) are required by the HTTP/1.1 protocol. Upon receiving the request string, the server sends back a response string, such as "200 OK", and a message of its own, the body of which is perhaps the requested file, an error message, or some other information. (WIKIPEDIA)

If you want to get familiar with all term specifications used in the protocol, have a look at [chapter 1.2 "Terminology" of the W3C Web Page](#).

¹⁰ Typically, a client is an application that runs on a personal computer or workstation and relies on a server to perform some operations. For example, an e-mail client is an application that enables you to send and receive e-mail.

¹¹ MIME (Multipart Internet Mail Extension) is a standard specifying the format of data transferred over the Internet. MIME allows to specify the transferred content (Content-Type). For example when html pages are transmitted the MIME-Type is text/HTML.

Internet Techniques and Web Formats

In this lesson we concentrate only on the different request methods:

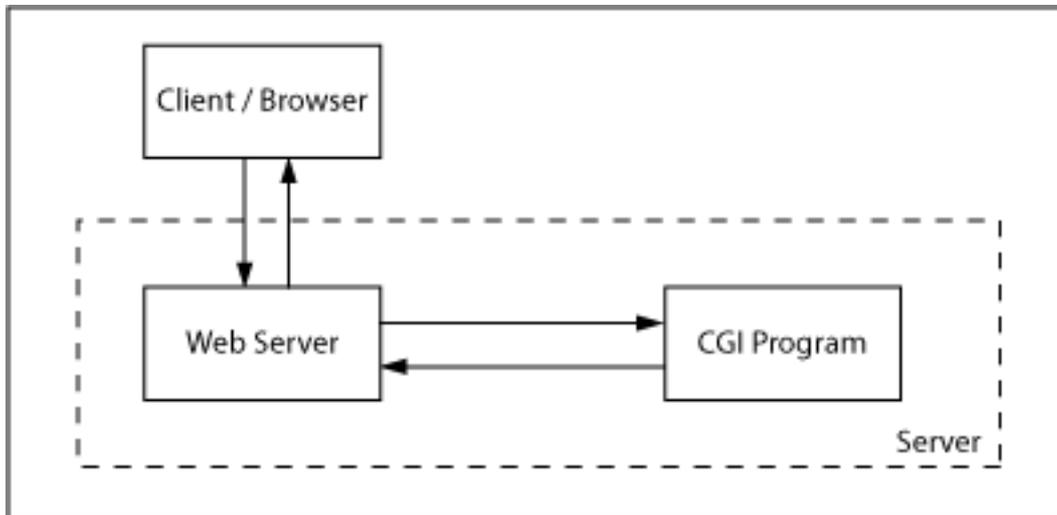
The first term of the request message above is "GET". This term stands for the request method and can vary between the following statements:

Method	Description
GET	Requests the specified document (most common used). (Sun Netscape Alliance)
HEAD	Identical to GET, except that the page content is not returned; just the headers are. Useful for retrieving meta-information. (WIKIPEDIA)
POST	Requests that the server accept some data from the client, such as form input for a CGI program. (Sun Netscape Alliance)
PUT	Used for data transfer from the client to the server (e.g. uploading files to a specified URL on a Web Server).
DELETE	Deletes data on the server (rarely implemented).
TRACE	Echoes back the received request, so that a client can see what intermediate servers are adding or changing in the request. (WIKIPEDIA)

1.2.4. Common Gateway Interface

Definition

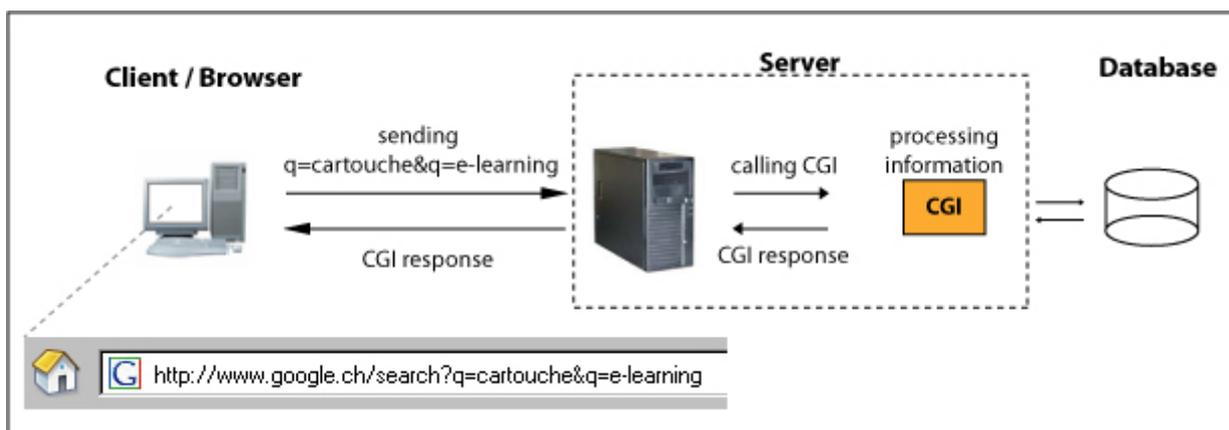
"Common Gateway Interface (CGI) is an important World Wide Web technology that enables a client to request data from a program executed on the Web Server. CGI specifies a standard for passing data between the client and the program." (WIKIPEDIA)



Connection of Client, Server and CGI Program

As you have seen in the unit [URL](#) we are able to execute queries by entering the query-strings (e.g. ?q=cartouche&q=e-learning) directly in the URL. These parameters are sent to the server. Since the Web Server cannot handle these query parameters a Common Gateway Interface is necessary to process the data.

In the unit [URL](#) we used the query-string "?q=cartouche&q=e-learning" with the parameters "q=cartouche" and "q=e-learning" in a searching machine to look for documents (web pages, pdf etc.) that contain these terms. But what happens with these terms? The following graphic gives you the solution.



CGI in connection of a google query

Important is, that the server calls the CGI to process the data. The CGI response is mostly an HTML-code, but it can also be in the form of XML, SVG, JPEG, etc.

Forms

Often, you do not have to enter the query-strings in the URL because the Web Page offers a form where you have to enter some terms. This can be your name, your credit card number, the terms in a searching machine, etc. After having entered all data, you typically have to click on a symbolic submit button to initiate the sending of the entered information back to the server machine.

This process is the same as it is described above. The input of the completed form is automatically transformed into the URL notation with the query-string. Therefore the information is sent to the server which calls the CGI to process the received data.

You find a typical form when using a search machine on the Web. You always have to enter the term you are looking for.

Exercise

Enter some searching terms in the search bar of an arbitrary search machine. After having pressed the "Start-Search-Button" have a look at the URL that will be created automatically. You don't have to understand the meaning of every single parameter but normally the meanings can be guessed.

You can discuss your results on the discussion board "Internet Techniques", if you want.

1.2.5. Unit-Summary

The World Wide Web (WWW) is a vast collection of electronic documents each composed of a linked set of pages. The documents are stored in files on many thousands of computers that are distributed around the global Internet.

Web browsers allow a user to access the Internet easily. Entering an URL in the browser's address bar starts the request for the wanted homepage. Using the Hypertext Transfer Protocol the request is sent to the server which sends back the HTML page also using HTTP.

Common Gateway Interfaces take action on the server side when a Web Page contains a form . The Common Gateway Interface processes the received information and responds the server, which forwards the information to the user.

1.3. Browser, Plugins and Applets

Learning Objectives

- You will be able to list at least three browsers and their capability.
- You will be able to tell which browser runs on which platform.
- You will be able to explain what applets and plugins are.

Introduction

To browse the World Wide Web you need a browser software. There are several browsers available: some of them have to be paid for, some are OpenSource and some are free to download. Not all browsers run on every platform and their capabilities varies as well.



Mozilla Firefox



Internet Explorer

In this chapter we will introduce you the common browsers and go into detail of their capabilities. We will show you as well which browsers run on which platforms.

In addition to browsers we explain you what plugins and applets are.

1.3.1. Browser

As mentioned above a browser is a software application that runs on the user machine and enables the user to display and interact with Web Pages hosted by Web Servers.

Originally, a browser was a software able to send requests with HTTP to a server and interpret the answers in case the answers were in HTML.

In the meantime, various multimedia elements are implemented in some browsers. That's why they are now able to interpret other formats (e.g. XML¹²) and not only HTML.

There are several browser programs available. There are browsers that are named differently but based on the same software (e.g. Netscape and Mozilla Firefox). There are also browsers that feature the same name but are based on different software (e.g. Internet Explorer for Mac and Internet Explorer for Windows).

The presentation of HTML etc. is on different browser programs or system software sometimes different. Particularly font-family and font-size can vary significantly. The following table shows a list of browsers and their capability.

	HTML	XHTML	Raster	SVG	XML (XSL)	Logo	Homepage	Availability
Firefox 3	+	+	+	+	+	 Firefox	Firefox	OpenSource
Opera 9.5	+	+	+	+	+	 OPERA software	Opera	Free Download
Internet Explorer 7	+	+	+		+	 Internet Explorer	Internet Explorer	Free Download
Safari 3.1	+	+	+	+	+	 Safari	Safari	Free Download
Netscape 8.1	+	+	+		+	 Netscape 8.0	Netscape	Free Download (support stopped)
Konqueror 3.5	+	+	+	(+) included in the system	+	 KDE Konqueror	Konqueror	OpenSource
Lynx 2.8	+					 Lynx	Lynx	OpenSource (browses only text)

¹² XML is a text-based markup language for data interchange on the Web. As with HTML, you identify data using tags (identifiers enclosed in angle brackets, like this: <price>12.95</price>). Collectively, the tags are known as "markup". But unlike HTML, XML tags label the structure of the data, rather than specifying how to display it.

The different browsers run on the following platforms:



If you are interested in more information about browsers in general or about particular browsers have a look at the [W3C Schools Homepage](http://www.w3schools.com). There you also find monthly statistics about which browsers are used to call that homepage.

There exist other browser softwares, which are not introduced in this lesson.

1.3.2. Plugin

Generally a PlugIn is a computer program that can interact with another program to provide a certain, usually very specific, function.

In connection with browsers we can say that a PlugIn is a program that allows a Web Browser to display a wider range of content than originally intended. For example: the Adobe Flash Player PlugIn allows Web Browsers to display flash content.

There are Web Pages which test if their plug-in is already installed on the computer of the client. Have a look at the following animation. In the image below you should see an animated flash graphic. If you cannot see it, the Flash-Plugin is not properly installed on your computer and you have to [download](#) and install it.

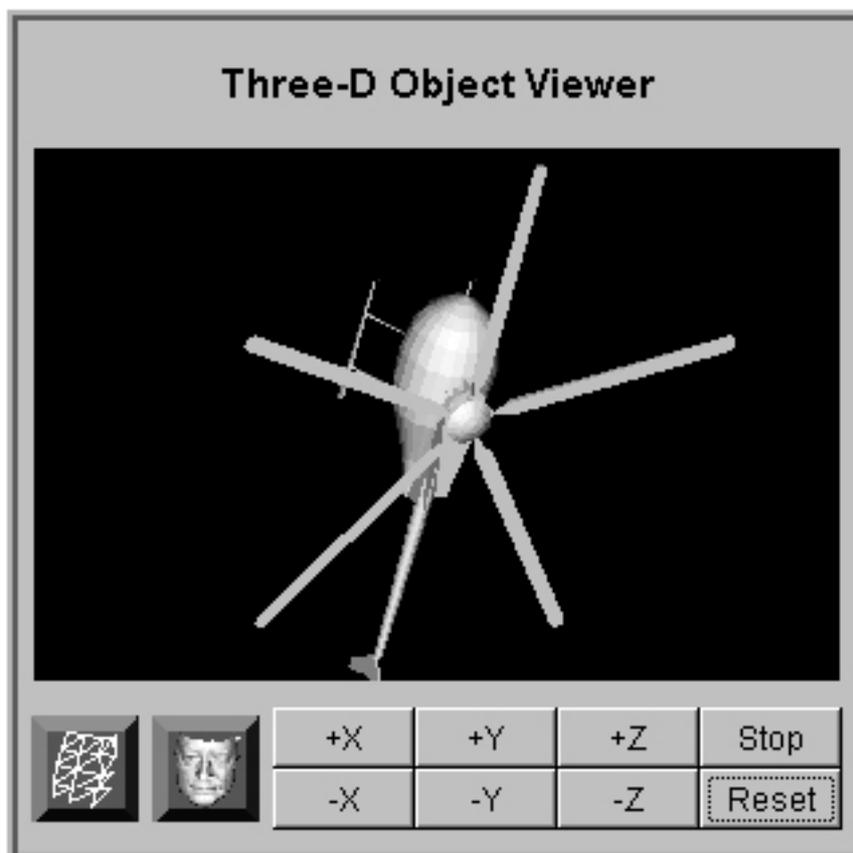
Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

1.3.3. Applet

An applet is a software component that runs in the context of another program, for example a Web Browser. The word applet stands for "little application" and is mostly understood as *Java*¹³-Applet which is a computer program that runs in a Web Browser and is written in the programming language Java.

Applets usually have some form of *user interface*¹⁴ or perform a particular piece of the overall user interface in a Web page.

Click the following thumbnail to see an example of a Java applet. You can rotate the given object around each axis using the buttons.



3D object viewer coded in Java (The J Maker)

¹³ Java is a high-level, object-oriented programming language developed by Sun Microsystems. It is similar to C++, but has been simplified to eliminate language features that cause common programming errors. Java is a general purpose programming language with a number of features that make the language well suited for use on the Web. Small Java applications are called Java applets and can be downloaded from a Web server and run on your computer by a Java-compatible Web Browser such as Mozilla Firefox or Opera.

¹⁴ The system of computer screen images, devices, and software components that allow the user to interact with and control the computer's operating system. Graphical user interfaces (GUI) allow the user to interact with the operating system by manipulating icons or menus. Command-line interfaces allow the user to interact with operating systems by entering commands from the keyboard.

1.3.4. Unit-Summary

Browsers are software applications that run on the user machine and enable the user to display and interact with Web Pages hosted by Web Servers. There exist several browser softwares which differ in their capability. Additionally not all browsers run on every platform and their availability varies as well.

Plugins are computer programs which provide a certain function. An example: To be able to view Flash files in the browser, you need an Adobe Flash Plugin.

An applet is a small program, often written in Java, which usually runs in a web browser, as part of a web page.

1.4. Client-Server-Model

Learning Objectives

- You will be able to list at least two properties of a client and a server.
- You will be able to explain the differences between a thin and a fat client.

Introduction

The Client-Server-Model is an architecture which separates the client from the server. When browsing the World Wide Web on your computer you are always on the client side. The information you are looking for is always on the server side. With the request-respond principle you will get the information on your screen.

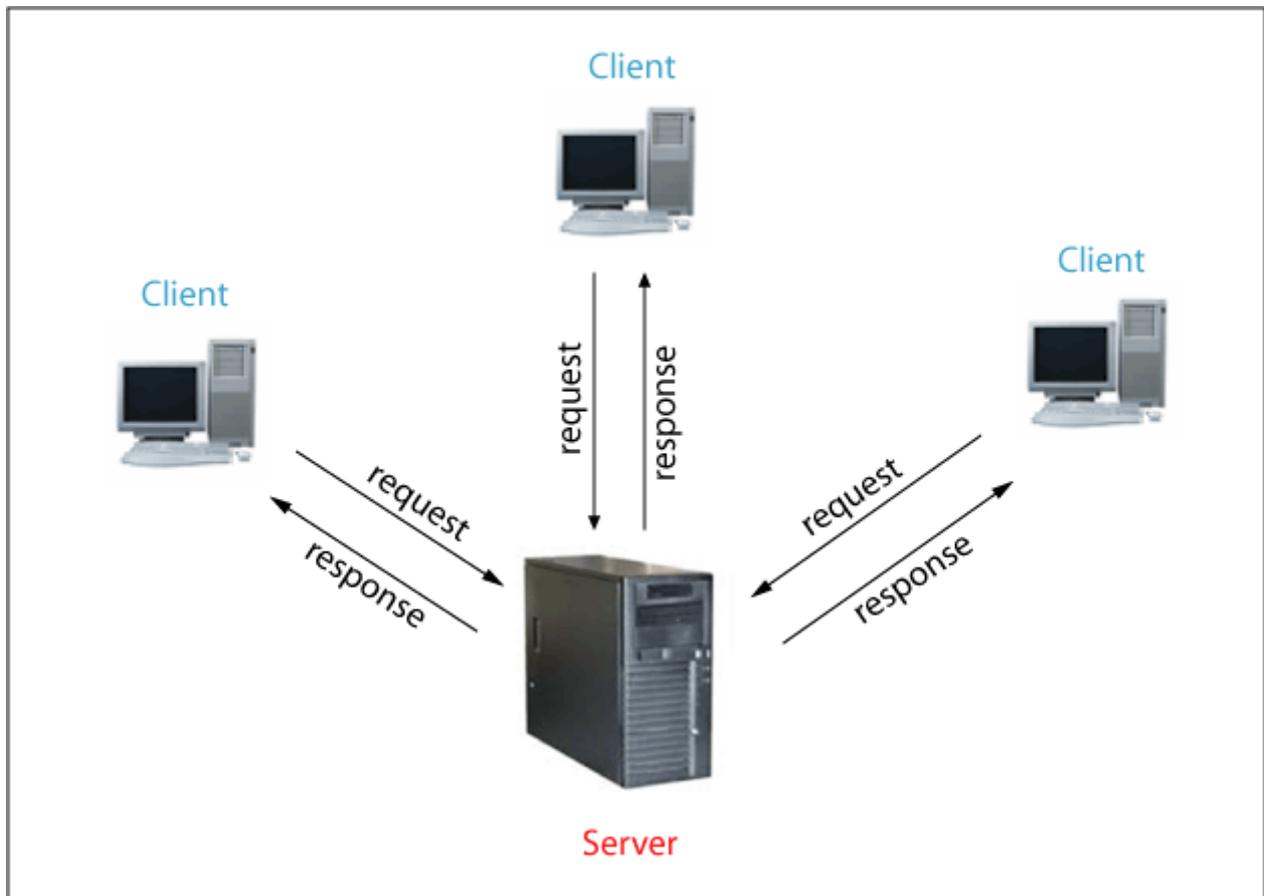


Browser

In this chapter we will explain you the Client-Server-Model and the characteristics of a client and a server. In addition we will illustrate the differences of a thin client and a fat client.

1.4.1. Client and Server

The Client-Server model is a network application architecture which separates the client from the server. Each instance of the client software can send requests.



Client-Server-Model

Client-Server is an architecture whereby each computer on the network is either a client or a server. Server software generally runs on powerful computers. Client software on the other hand generally runs on common PCs or workstations.

Properties of a server:

- Passive
- Waiting for requests
- On requests serves them and sends a reply

Properties of a client:

- Active
- Sending requests
- Waits until reply arrives

1.4.2. Thin and Fat Client

Thin Client

A thin client does most of its processing on a central server with as little software and hardware as possible at the user's location, and as much as possible at some centralized managed site.

A thin client is designed to provide just those functions which are useful for user-interface programs. He has no storage medium and all needed applications are lying on the server.



Thin Client



Thin Client

The client is using special software which allows only the graphical output of the server's application on his screen. The mouse cursor movements and keyboard commands of the client are transmitted by a special protocol to the server. The graphical output of the application is sent back to the client from the server.

Ideally the user will have only a screen, keyboard, a pointing device (if needed) and enough computer to handle display and communications.

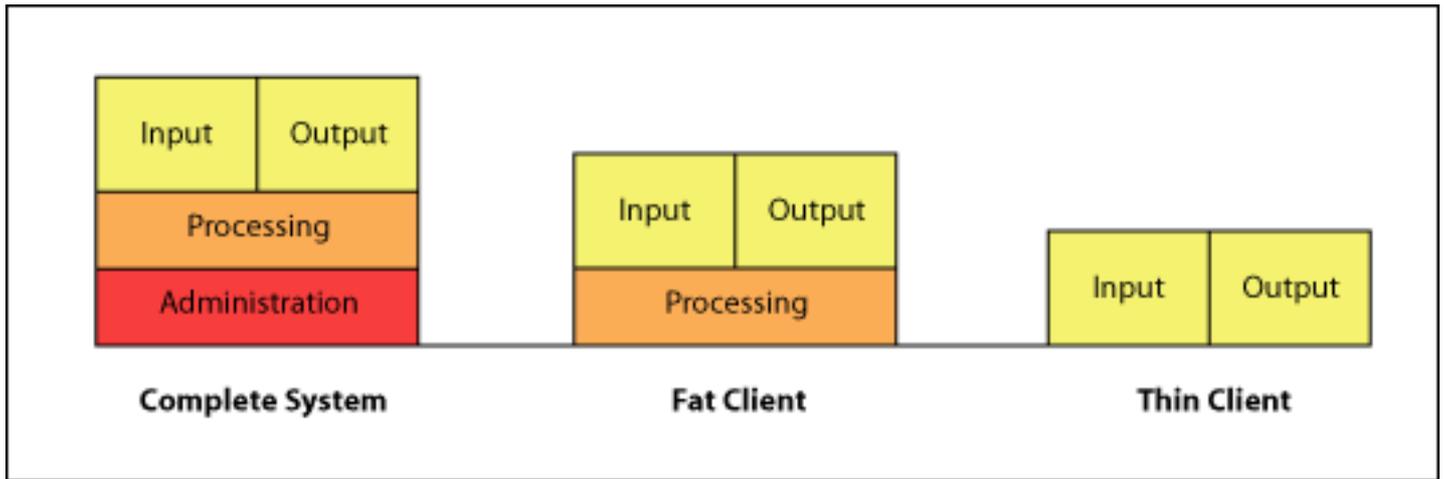
Fat Client

The concept of a fat client is that as much data processing operations as possible are performed on the client's side. All applications are installed on the client's computer. He only passes data required for communication and archival storage to the server. The data itself is stored on the server.



Fat Client

The next picture shows the comparison of a complete system, as you are normally used to, a fat client and a thin client.

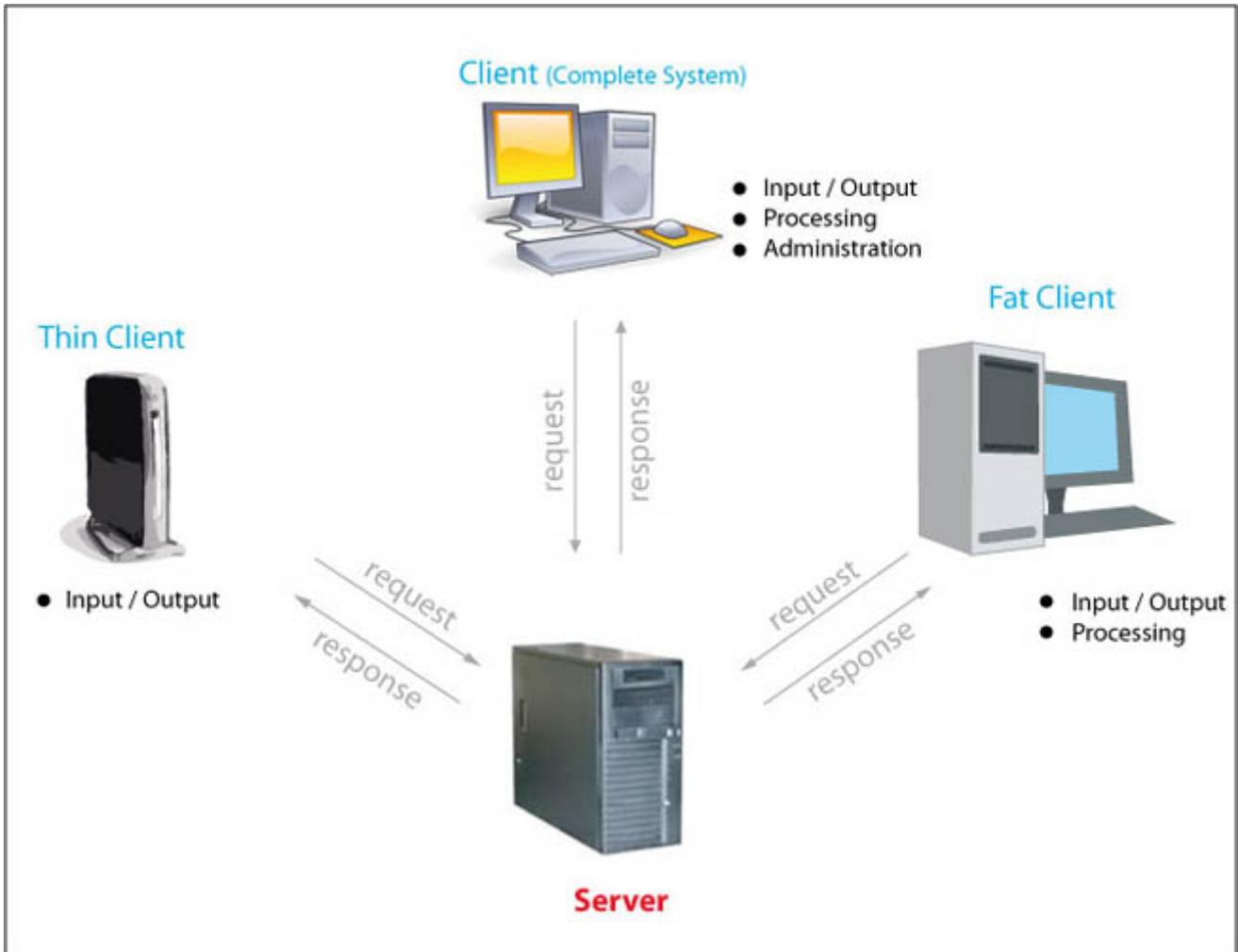


Thin and Fat Client compared to a complete system

The "Thin and Fat Client-Model" can also be placed in the context of web browsers. A browser that includes already some plugins (e.g. supporting flash files, etc.) is a fat client. A browser that does not include any plugins (that means that the plugin has to be installed on the hard disk of the computer) is a thin client.

1.4.3. Unit-Summary

The following graphic includes the most important information of this unit:



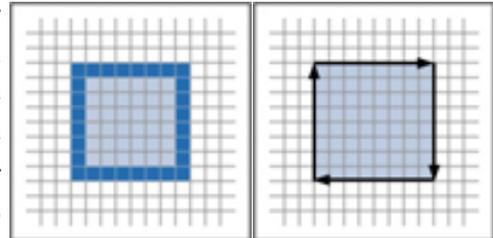
Client-Server-Model

1.5. Web Graphics Formats

Learning Objectives

- You will be able to list at least three differences between raster and vector graphics
- You will be able to list two vector graphics formats
- You will be able to list two raster graphics formats

In computer graphics two format types are distinguished: Raster graphics and vector graphics. In this unit we will introduce you the characteristics of these formats. There are several possible file formats for each format type. We will present you some of those file formats such as gif and jpeg for raster graphics or svg and flash for vector graphics. We provide an example picture for each format, so that you see the differences of them.



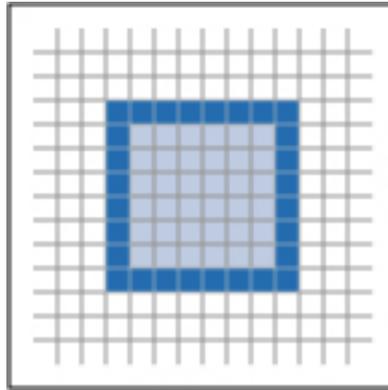
Raster Format

Vector Format

1.5.1. What Raster Graphics are

Definition

Raster Graphics is a type of graphics that stores the images as a collection of pixels. (Minnesota State Archives) In graphics there are no lines, circles, or polygons, only pixels that are grouped to give the appearance of these elements. The colour of each pixel is individually defined. (CADD / GIS Technology Center) This series of pixels is often stored in a compressed format.



Raster Graphics

When zooming a raster graphic the individual pixels get visible. Thus the image quality is reduced:

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

1.5.2. Raster Graphics Formats

The following raster graphics are mostly used in the World Wide Web.

GIF (Graphics Interchange-Format)

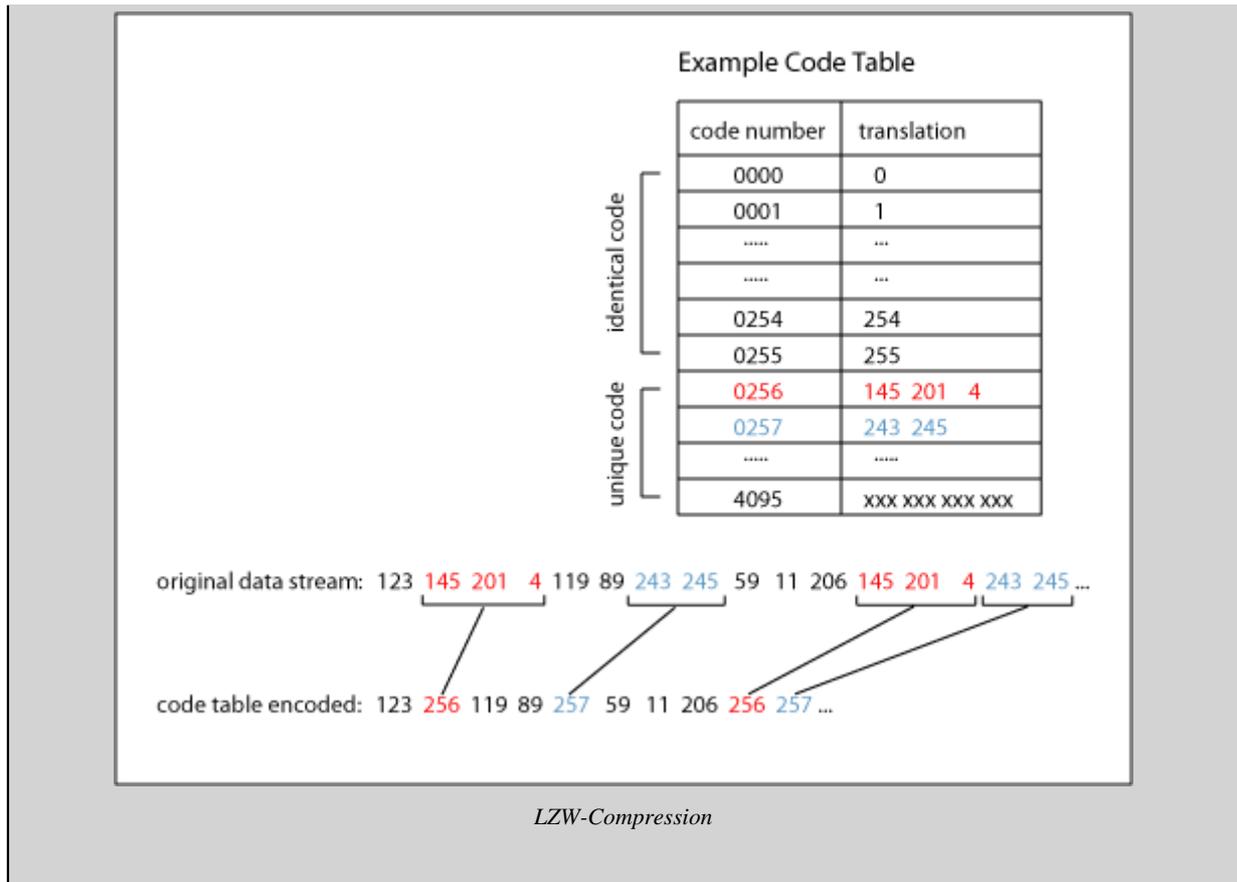
GIF is a raster image format for pictures that use 256 distinct colours. GIFs are compressed files and are employed specially to reduce the amount of time it takes to transfer images over a network connection. A GIF file employs lossless LZW data compression so that the file size of an image may be reduced without degrading the visual quality (provided the image fits into 256 colours). GIF is normally used for diagrams, buttons, etc., that have a small number of colours. It is therefore not suitable for photographs.

With GIF it is possible to store several images in only one GIF-File. This method is mostly used for simple animations.

If you do not know what LZW (Lempel-Ziv-Welch) compression is have a look at the presented popup solutions.

LZW compression is named after its developers, A. Lempel and J. Ziv, with later modifications by Terry A. Welch. LZW is a lossless data compression algorithm. It is used to reduce the size of a file. You can expect LZW to compress text, executable code, and similar data files to about one-half their original size. LZW compression uses a code table. A common choice is to provide 4096 entries in the table. Uncompression is achieved by taking each code from the compressed file, and translating it through the code table to find what character or characters it represents. Codes 0-255 in the code table are always assigned to represent single bytes from the input file.

The codes 256 through 4095 are used to represent sequences of bytes. For example, code 523 may represent the sequence of three bytes: 231 124 234. Each time the compression algorithm encounters this sequence in the input file, code 523 is placed in the encoded file. But how to determine what sequence should be in the code table? The LZW algorithm identifies repeated sequences in the data, and adds them to the code table. The longer the sequence assigned to a single code, and the more often the sequence is repeated, the higher the compression achieved. (Smith)



GIF in few words:

- lossless LZW data compression
- at most 256 colours can be displayed
- able to visualise *transparency* ¹⁵

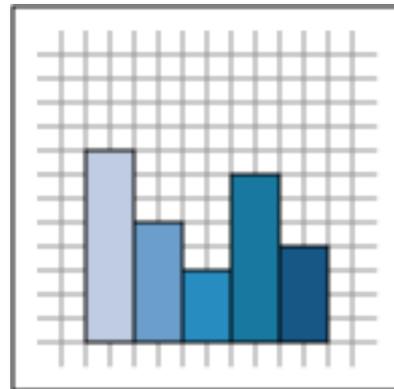


Diagram stored as GIF

JPEG (Joint Photographic Experts Group)

JPEG is a commonly used standard method of lossy compression for photographic images. JPEG is the most common format used for storing and transmitting photographs on the World Wide Web. It is not as well suited for line drawings and other textual graphics because its compression method performs badly on these types of images.

JPEG in few words:

- lossy compression
- 16.7 Mio. colours
- does not support transparency
- adapted for colour gradients and photos



Photograph stored as JPEG (NEUMANN)

PNG (Portable Network Graphics)

The PNG format was designed to replace the GIF format.

PNG is a lossless raster image format. It offers a variety of transparency options. With truecolour and greyscale images either a single pixel value can be declared as transparent or an alpha channel can be added. For *paletted images*¹⁶, alpha values can be added to palette entries.

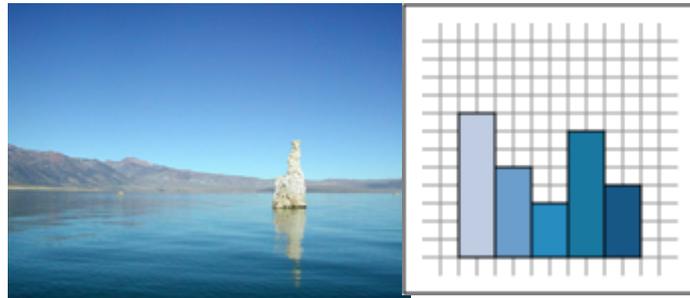
PNG uses a lossless data compression method. To upgrade the compression of the images PNG supports preliminary filters which are applied to the image before the compression is applied. The principle of these preliminary filters is: for each image line, a filter method is chosen that predicts the colour of each pixel based on the colours of previous pixels and subtracts the predicted colour of the pixel from the actual colour. An image line filtered in this way is often more compressible than the raw image line would be, especially if it is similar to the line above. (WIKIPEDIA)

PNG is used for a large spectrum of graphics from little images such as diagrams up to complex images such as photographs.

Versions of Internet Explorer up to 6 do not support native alpha channel transparency.

PNG in few words:

- lossless compression
- full alpha channel and transparency support
- 16.7 Mio. Colours
- W3C¹⁷-Standard



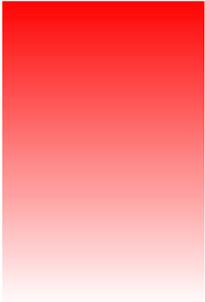
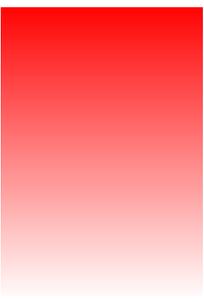
Photograph stored as PNG Diagram stored as PNG
(NEUMANN)

Comparison of GIF, JPEG and PNG

The following table shows the comparison of the three presented raster graphics formats. Considering as example the *colour gradient*¹⁸ of a filling, the differences of these formats are best visualized.

¹⁶ A paletted image is a method to store a raster graphic. If an image has 256 colours or less, a colour palette is used to encode all colours. A code number is assigned to every colour used in the image. The colour palette is stored separated from the pixel image. For each pixel is set the code number of the colour palette instead of the real colour code. Since the code number (e.g. 255) needs less storage space as the real colour code (e.g. 255,255,255) the storage space of the whole image is reduced.

¹⁸ Colour gradient is a smooth blending of shades from light to dark or from one colour to another.

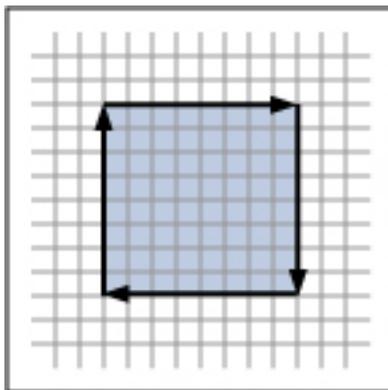
GIF	JPEG	PNG
		

1.5.3. What Vector Graphics are

Definition

Vector graphics are images which are represented by the use of geometrical primitives such as points, lines, curves, and polygons. (WIKIPEDIA) An image is described as a series of geometric shapes. Vector graphics work by describing the grid points at which lines or curves are to be drawn.

Vector graphics "understand" what they are – a square "knows" it is a square and text "knows" that it is text. Because they are objects rather than a series of pixels, vector objects can change their shape and colour, whereas raster graphics cannot. (EISENBERG 2002, p. 2)



Vector Graphics

When zooming vector graphics the quality of the graphic is not getting reduced.

Experience it in the following graphic. Set mouse cursor over graphic, right click and choose "Zoom In" to get a zoomed view of the graphic (This function doesn't exist in Firefox). Do this step several times to zoom in very close and see that the quality of the image is not getting reduced.

To reach the original picture size, right click and choose "Original View".

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

To visualise vector graphics in the World Wide Web plugins are often required. For example, this SVG vector graphic is visualised in the Internet Explorer with the [Adobe SVG Viewer](#) plugin since this browser does not support the vector graphic standard.

1.5.4. Vector Graphics Formats

The following vector graphics are mostly used to visualise 2D vector formats in the browser:

SVG (Scalable Vector Graphics)

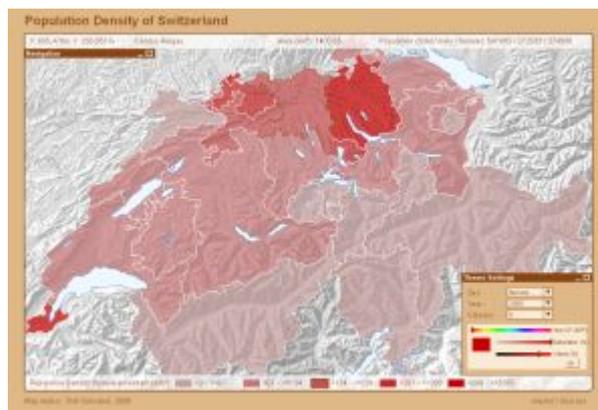
SVG is an XML based markup language for describing two-dimensional vector graphics, both static and animated. It is an open standard created and recommended by the W3C.

SVG allows three types of graphic objects:

- vector graphic shapes (e.g. lines, circles, rectangles, etc.)
- raster graphics images
- text

Graphical objects can be grouped, styled and transformed. The feature set includes i.a. nested transformations, alpha masks and filter effects. SVG drawings can be dynamic and interactive. An SVG file can be written in an arbitrary text editor (e.g. UltraEdit) or created and edited with a vector graphics program such as Adobe Illustrator or the free alternative [Inkscape](#).

Typical browsers such as Firefox, Safari and Opera can render SVG content. However, in Internet Explorer you need the plugin [Adobe SVG Viewer](#) to see the example.



Population Density of Switzerland in a SVG map (Schnabel 2008)

Flash

Flash is a widespread, binary and proprietary vector format, originally designed by the software company Macromedia, now property of the company Adobe.

Flash is not only able to show vector graphics. Video and audio clips may be easily integrated, or generated. Graphics can be exported from the software Macromedia Freehand, Adobe Illustrator or CoreIDRAW, and/or edited with the software Macromedia Flash. There is a wide range of functions for animating and integration of special graphical effects. (NEUMANN et al.)

For the visualisation of the following example in your browser, you need the plugin [Adobe Flash Player](#).



Iceland as Flash (Iceland Tourist Board - North America)

The next example shows you that flash is often used to realize animations.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [link]

XAML (Extensible Application Markup Language)

XAML is Microsoft's XML-based language. It is basically a copy of [SVG](#), mixed with tags for form elements. It differs only in some tag names (e.g. SVG uses the tag <rect> and XAML uses the tag <rectangle>).

Like in *XForms*¹⁹ and *XUL*²⁰, buttons and forms in XAML are easy to implement using the appropriate tags (e.g. <button>clickme</button>).

In typical usage, XAML files will be produced by a visual design tool, such as Visual Studio, to design user interfaces.

To see an example and get more information, please go to [Microsoft's XAML homepage](#). For the visualisation of the XAML files in your browser, you need the [Microsoft Silverlight Plugin](#).

The next two formats are 2D vector formats which are used for printing.

¹⁹ XForms is a W3C specification for the description of forms and form elements in XML. More infos: <http://www.w3.org/MarkUp/Forms/>

²⁰ XUL (XML User Interface Language) is a Mozilla project for the description of forms and form elements in XML. XUL will be mostly used in Mozilla applications, such as the browser Firefox and mail client Thunderbird.

PDF (Portable Document Format)

PDF is a file format developed by Adobe Systems for representing documents in a manner that is independent of the original application software, hardware, and operating system used to create those documents. It therefore does not matter on which platform and with which program you are writing e.g. a text document. When exporting it as a PDF file every other platform (Windows, Mac or Unix) is able to read it anyway. A PDF can describe documents containing any combination of text, graphics, and images. These documents can be one page or thousands of pages, very simple or extremely complex with a rich use of fonts, graphics, colour, and images. PDF files are most appropriate for encoding the exact look of a document in a device-independent way. (WIKIPEDIA)

To read a PDF file you have to install a PDF reader such as Adobe Reader which is free to download. For the visualisation of the following example, you need the [Adobe Acrobat Reader](#).



Iceland as PDF (Scantours)

PS (PostScript)

PostScript is a page description language. When saving graphics and printing pages as PostScript format you are able to open them on various output devices and in variable sizes without loss. Graphical elements and fonts are described as vectors. The PostScript format is optimized for printouts and is not so suited for the output on the screen. (WIKIPEDIA)

Furthermore, PS is not made for the manipulation of the content.

To view PostScript files you have to install a PostScript viewer on your computer, such as e.g. [Ghost View 4.7](#). It is important to know that for printing a different colour space, CMYK (Cyan, Magenta, Yellow, Black), is used as for screen displays. For more information about this colour space have a look at the GITTA lesson [Colour Design](#).

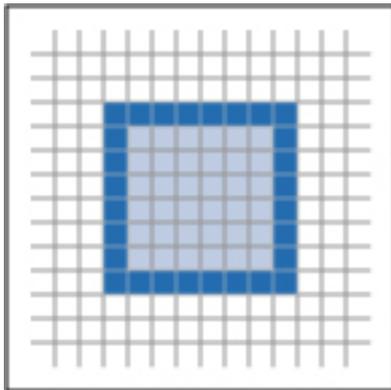
In this lesson we discussed only 2D vector graphics. If you are interested in vector graphics which are used in the 3D space, have a look at the module "3D applications".

1.5.5. Summary

There are two types of Web Graphics Formats:

Raster Graphics:

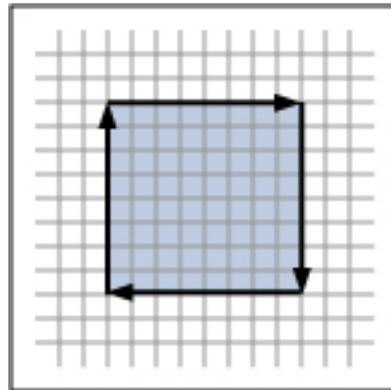
- individual pixels are coloured
- no objects
- zooming reduces image quality
- each pixel can be edited



Raster Graphics

Vector Graphics:

- objects are described with mathematical functions
- each object can be edited
- zooming does not reduce image quality
- often a plugin is used to view vector graphics



Vector Graphics

Raster Graphics Formats:

- GIF
- JPEG
- PNG

Vector Graphics Formats:

- SVG
- Flash
- XAML
- PDF (for printing)
- PS (for printing)

1.6. Self Assessment

Drag the terms in the appropriate theme group. You get feedback about the correctness of your action by clicking the "Show Solutions" button. The button "Reset" resets the whole interaction part.

Only pictures can be viewed in the PDF version! For Flash etc. see online version. Only screenshots of animations will be displayed. [\[link\]](#)

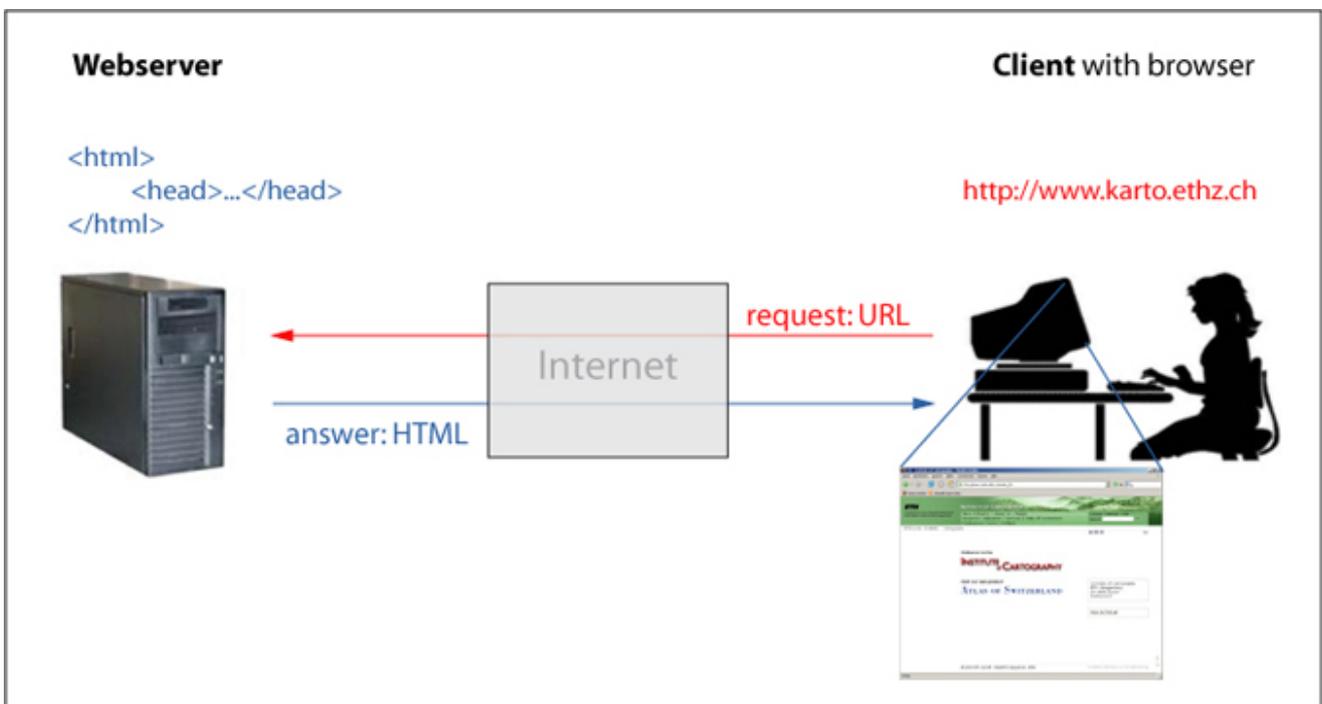
1.7. Summary

The main difference between the Internet and the World Wide Web is that the Internet is the forerunner of the World Wide Web and is a stand-alone system. The World Wide Web, on the other hand, is based on the Internet and opens its advantages to the public.

The Internet is a worldwide system of interconnected computer networks. It is used for the communication and the exchange of data. Each computer of a network is able to communicate with all other computers. In order that the communication between the computers works several protocols are required. The Internet Protocol (IP) and the Transmission Control Protocol (TCP) build the basis of the communication.

The World Wide Web is a vast collection of electronic documents. The documents are stored in files on many thousands of computers, so called servers, that are distributed around the global Internet.

With a browser software (and of course a computer and Internet access in the form of a modem) one is able to access the World Wide Web as well as the Internet. Entering a URL in the browser means requesting a Web Page from a server as it is shown in the next image:

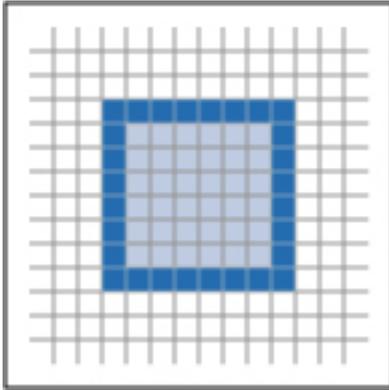


URL request of Client and HTML response of Webserver

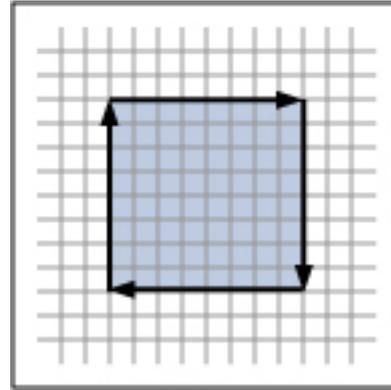
The above model is called Client-Server-Architecture. This network consists of several computers which adopt either the position of a server or a client. Clients and servers are able to communicate with each other. The client sends requests to the server and the server sends back the responses to the client.

Web Pages very often are full of pictures. Their content varies from simple objects like rectangles or diagrams to rich coloured photographs. Since these various contents have different requirements, there exist several graphics formats. They are divided in raster graphic formats and vector graphics formats. For each of these two classes different format types exist.

Raster graphics store images as a collection of pixels whose colour is defined individually. Whereas vector graphics define their content by the use of geometrical primitives (points, lines, etc.). Therefore, a vector image is described as a series of geometric shapes.



Raster Graphics



Vector Graphics

There exist several raster and vector graphics formats which are used in Web pages:

Raster Graphics:

- GIF
- JPEG
- PNG

Vector Graphics:

- SVG
- Flash
- XAML
- PS (for printing)
- PDF (for printing)

1.8. Glossary

AT&T:

"AT&T (formerly an abbreviation for American Telephone and Telegraph) is an American telecommunications company. AT&T provides voice, video, data, and Internet telecommunications and professional services to businesses, consumers, and government agencies." (WIKIPEDIA)

Byte:

A byte comprises 8 bits. Since one bit can adopt two states it is possible to describe 256 (2^8) signs with one byte.

Client:

Typically, a client is an application that runs on a personal computer or workstation and relies on a server to perform some operations. For example, an e-mail client is an application that enables you to send and receive e-mail. (BAER)

Colour Gradient:

Colour gradient is a smooth blending of shades from light to dark or from one colour to another.

**Hyperlink:**

An element in an electronic document that links to another place in the same document or to an entirely different document. Typically, you click on the hyperlink to follow the link. (Panama-Hosting.com) It is most commonly used in the World Wide Web to link various documents (Web Pages, pdf-files, etc.).

Hypertext:

Hypertext is text with links to other text. Documents written as hypertext contain text that when "clicked on" by the user with a mouse, links to other documents. (Texas A & M University)

Java:

Java is a high-level, object-oriented programming language developed by Sun Microsystems. It is similar to C++, but has been simplified to eliminate language features that cause common programming errors. Java is a general purpose programming language with a number of features that make the language well suited for use on the Web. Small Java applications are called Java applets and can be downloaded from a Web server and run on your computer by a Java-compatible Web Browser such as Mozilla Firefox or Opera. (BAER)

MCI:

MCI, Inc. is an American telecommunications company headquartered in Ashburn, Virginia. (WIKIPEDIA)

MIME:

MIME (Multipart Internet Mail Extension) is a standard specifying the format of data transferred over the Internet. (JS-X.com) MIME allows to specify the transferred content (Content-Type). For example when html pages are transmitted the MIME-Type is *text/HTML*.

Network:

A network is a group of two or more things or people. This notion is often used in terms of "computer network", where computer systems are linked together so that they can exchange data and share resources.

Paletted Image:

A paletted image is a method to store a raster graphic. If an image has 256 colours or less, a colour palette is used to encode all colours. A code number is assigned to every colour used in the image. The colour palette is stored separated from the pixel image. For each pixel is set the code number of the colour palette instead of the real colour code. Since the code number (e.g. 255) needs less storage space as the real colour code (e.g. 255,255,255) the storage space of the whole image is reduced. (WIKIPEDIA)

(WIKIPEDIA)

Server:

A server is a computer or device on a network that manages network resources. For example, a file server is a computer and storage device dedicated to storing files. Any user on the network can store files on the server. A print server is a computer that manages one or more printers, and a network server is a computer that manages network traffic. A database server is a computer system that processes database queries. Servers are often dedicated, meaning that they perform no other tasks besides their server tasks. On multiprocessing operating systems, however, a single computer can execute several programs at once. A server in this case could refer to the program that is managing resources rather than the entire computer. (BAER)

Sprint:

Sprint Nextel Corporation is one of the largest telecommunications companies in the United States. It operates the third largest wireless network in the U.S. with nearly 44 million subscribers. (WIKIPEDIA)

Transparency:

Transparency defines the ability of an object to allow light to pass through it. Therefore a transparent object is one that can be seen through.

User Interface:

The system of computer screen images, devices, and software components that allow the user to interact with and control the computer's operating system. Graphical user interfaces (GUI) allow the user to interact with the operating system by manipulating icons or menus. Command-line interfaces allow the user to interact with operating systems by entering commands from the keyboard. (ATC)

W3C (World Wide Web Consortium):

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

XForms:

XForms is a W3C specification for the description of forms and form elements in XML. More infos: <http://www.w3.org/MarkUp/Forms/>

XHTML:

XHTML is the next generation of HTML and is a hybrid between HTML and XML. XML was designed to describe data. HTML was designed to display data. XHTML is much stricter than HTML. Not all browsers support XML so XHTML provides an intermediary solution and can be interpreted by XML and HTML browsers. (DevLib - Devices and Development)

XML:

XML is a text-based markup language for data interchange on the Web. As with HTML, you identify data using tags (identifiers enclosed in angle brackets, like this: `<price>12.95</price>`). Collectively, the tags are known as "markup". But unlike HTML, XML tags label the structure of the data, rather than specifying how to display it. (Data Direct Technologies)

XUL:

XUL (XML User Interface Language) is a Mozilla project for the description of forms and form elements in XML. XUL will be mostly used in Mozilla applications, such as the browser Firefox and mail client Thunderbird.

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