

Tik-110.350 Computer Networks

Sanna Liimatainen, M.Sc.
Teaching Researcher, TML, HUT

Sanna Liimatainen
email: verkot@tml.hut.fi

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Very Brief English Summary

- Lectures are in Finnish, slides and all other material will be in English
- All students must pass the pre-examination
- <http://www.tml.hut.fi/Studies/Tik-110.350>
- Web pages are not ready yet – sorry!
- More help in exercises
 - Wednesdays at 8-10 in Maari-a
 - No exercise 17.1.2001!
- First two exams and midterm exams will be in English – other are only in Finnish.

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email: verkot@tml.hut.fi

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Contents of This Lecture

- 1st lecture:
 - This course
- 2nd lecture:
 - Client-server model (chapter 21)
 - Socket interface (chapter 22)
 - WWW&HTTP (chapter 28)

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email: verkot@tml.hut.fi

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Information

- <http://www.tml.hut.fi/Studies/Tik-110.350/>
- <http://www.tml.hut.fi/Opinnot/Tik-110.350/>
- [news://news.tky.hut.fi/
opinnot.tik.tietokoneverkot](news://news.tky.hut.fi/opinnot.tik.tietokoneverkot)
- #verkot, Thursdays 14-16
- verkot@tml.hut.fi

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email: verkot@tml.hut.fi

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Signing on the Course

- Pre-examinations
 - Signing on the exam through course web page
 - 50 min, five multiple-choice questions
 - Compulsory for all students
 - Results are published after the last pre-exam
- Signing on the course
 - Through course web page.
 - Deadline 26th January 2001 at 16:00

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email: verkot@tml.hut.fi

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Requirements to Pass the Course

- Compulsory
 - PGP authentication
 - Exam or two midterm exams
 - Homework assignments
 - Programming assignment
- Voluntary
 - Lectures & exercises

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Lectures & Exercises

- Lectures: Tuesdays at 14-16 in T1
 - Schedule in the course web page (may change)
 - Lectures are in Finnish, slides in English
 - Lecturers: visiting lecturers and Sanna Liimatainen
- Exercises: Wednesdays at 8-10 in maari-a
 - Help for homework and programming assignments

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Material

- Douglas E. Comer: Internetworking with TCP/IP (4th edition, 2000, Prentice-Hall)
- Slides and possible other material will be delivered as “prujut”
- Slides will be in course web pages in unprintable format

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PGP Authentication

- If you have authenticated your key (on course Tik-110.250/300/401)
 - no need to do authentication again.
- If you have not authenticated your key
 - Check instruction from course web page
 - Any assistant of our courses (Tik-110.250/300/350) can receive authentications

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Exam or Midterm Exams

- Two possibilities (recheck from exam schedule!)
 - 1st midterm exam: 2.4.2001 at 12-15
 - 2nd midterm exam: 7.5.2001 at 9-12
- Or
 - Exam 16.5.2001 at 9-12
- All these are offered as paper and computer exams
- NOTE: Only two first exams (May and September) are in English (other only in Finnish)

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Homework Assignments

- Course offers nine homework assignments
 - Alone:
 - To pass: three
 - To get +1: six
 - Pair
 - To pass: five
 - To get +1: eight
- Deadlines are on Tuesdays at 16:30 (check schedule)
- Returning by email (encrypted and signed)
- Working in pairs must be informed when signing on the course
 - If your pair quits -> you get half of homework points

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Programming Assignment

- WWW client or server or both
- Planning (program and schedule)
 - Deadline 16.2.2001 at 16.00
- Demo (program, documentation)
 - Deadlines: week 12, demos are 10 minutes long.
- Pairs can do together also the program
- Possibility to get +1
- More details in course web page or end of this lecture

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Questions about arrangements?

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Client-Server Model

Comer's
chapter 21 (4th ed.)
chapter 19 (3rd ed.)

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Client-Server Model

- Client
 - Sends a query to a server and waits
 - Works in temporary port
 - Terminates after reply
- Server
 - Waits for a query in well-known port
 - Responds by sending packet to client's port
 - Does not terminate but waits more queries
 - Works in the application layer

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Functionality of Server

- Must handle several concurrent requests
- Operating systems offer a queue
- Five steps
 - open port (well-known port)
 - wait for requests
 - choose port (if necessary)
 - start slave
 - continue from wait step

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Functionality of Server (2)

- Authorization and access control
- Protection of information
- Protection against misuse and errors

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Alternatives / Improvements

- Caching
 - saves results of queries for reuse
 - improves performance
- Collecting information beforehand
 - fast
 - information available even when server is down

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Socket Interface

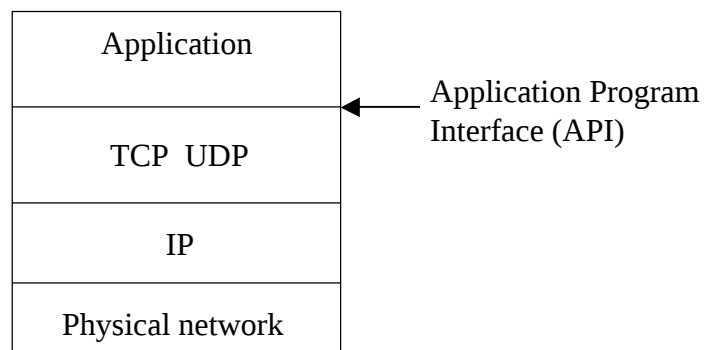
Comer's
chapter 22 (4th ed.)
chapter 20 (3rd ed.)

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Model



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Socket

- Provides an endpoint for communication
- Operating system creates sockets
 - almost like file descriptor
 - "read" = reserve
 - "write" = send

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Structure of Socket

- Protocol family
- Type
- Protocol

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Local Address

- Sockets do not have local or destination addresses
- Clients usually do not care about local address
- Server must be attached to a well-known port
- TCP/IP socket address contains address family, protocol port and IP address

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Destination Address

- Socket is in unconnected state after creation
- connectionless datagrams do not need connected sockets
- Connection-oriented delivery needs connected sockets
- Semantics depends on underlying protocols
 - TCP socket: builds TCP connection to destination

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Sending Data

- Connection-oriented sending of data
 - Send
 - write
 - writev
- Connectionless sending of data
 - Sendto
 - sendmsg

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Receiving Data

- Conventional input operations
 - read
 - readv
- Additional functions
 - recv
 - recvfrom
 - recvmsg

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Local and Remote Socket Addresses

- `getpeername`
 - Address of the peer
 - Connected sockets
- `getsockname`
 - Local address associated with socket

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Socket Options

- Timeout parameters
- Retransmission
- Buffer space
- Out-of-band data...
- `getsockopt` and `setsockopt`

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Queue for Server

- One of the options
- Request are put in a queue until server has time to process them
- listen tells to operating system that connection to this socket must be enqueued
- If queue is full, the connection will be refused

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Connections to Server

- Server's socket waits for request
- When request arrives
 - New socket is created and connected to client
 - Iterative and concurrent way to handle requests
- Server can be connected to multiple sockets

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Summary of Sockets

- Socket is an interface to underlying network and an endpoint of communication
- Originally in BSD Unix but has become a de facto standard
- Creating and connecting sockets, and sending and receiving data

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World Wide Web (WWW) and HyperText Transfer Protocol (HTTP)

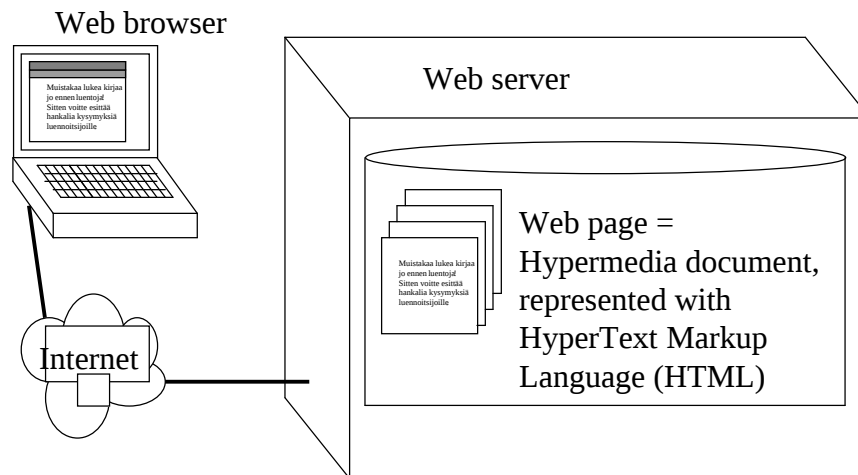
Comer's
chapter 28 (4th ed.)

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email: verkot@tml.hut.fi

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Architecture

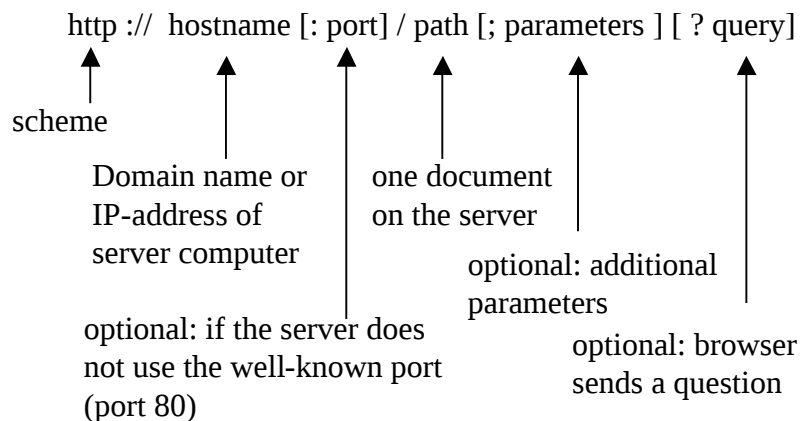


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email: verkkot@tml.hut.fi

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Uniform Resource Locator (URL)



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HyperText Transfer Protocol (HTTP)

- Comer:
 - Application level protocol
 - Request/Response
 - Stateless
 - Bi-Directional Transfer
 - Capability Negotiation
 - Support for Caching
 - Support for Intermediaries

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HTTP get

- Browser contacts a server
 - URL -> hostname -> DNS -> IP-address
 - TCP connection -> HTTP session
 - HTTP get is used to request a web page
- First uses absolute form of URL
- After TCP connection is established, it is possible to use relative form of URL

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email: verkot@tml.hut.fi

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HTTP Connection

- Persistent connection
 - Advantage: not much overhead
 - Disadvantage: when does an item end?
- Length of item
 - MIME Extension and 822 format
 - Structure: header, blank line and item

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email: verkot@tml.hut.fi

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Negotiation in HTTP

- Server-driven and agent-driven
- Negotiable capabilities
 - Characteristics about connection
 - Representation
 - Content
 - Control
 - Request may be conditional

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email: verkot@tml.hut.fi

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Proxy servers

- Saves web pages in a cache
- Browser must be configured to seek from proxy
- Strict rules for proxies

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email: verkot@tml.hut.fi

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Caching

- Improves efficiency
- How long the item is in a cache?
- How to handle situations where the original page has been changed?

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email: verkot@tml.hut.fi

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Summary of WWW&HTTP

- WWW contains
 - hypermedia documents
 - servers and browsers
- HTML describes the hypermedia documents
- HTTP is a communication protocol used between servers and browsers

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email: verkot@tml.hut.fi

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Programming Assignment

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Programming Assignment (1)

- Work load about one credit (about 40 hours)
- For single student:
- Either: Web browser
 - that can get and present a text page fetched from a server
- Or: Web server
 - that can offer web pages to a browser

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email: verkot@tml.hut.fi

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Programming Assignment (2)

- Single student to get +1 for exam grade must do
 - both server and browser
 - or SSL
 - or other useful protocol that is presented to and agreed on with course staff.

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Programming Assignment (3)

- Students that do pair work in homeworks may do also this assignment as a pair
- In order
 - to pass the programming assignment, a pair of students must implement both the server and the browser
 - to get +1, a pair must implement SSL or
 - other useful protocol agreed on with course staff

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email: verkot@tml.hut.fi

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Programming Assignment (4)

- Non-suitable extension:
 - more items like pictures, frames etc.
- The purpose of the programming assignment is that students know how to implement network programs

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email: verkot@tml.hut.fi

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Phase 1

- Plans for the assignment (dl 16.2.2001@16.00)
 - What you are doing
 - Schedule for phase one and two
 - Chosen programming language and justifications
 - Model of communication (interference model) e.g. how the client and server communicate
 - Object model or main functions
 - Risks (shortly)
 - More details in course web page in few days

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email: verkot@tml.hut.fi

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Phase 2

- Demonstrations (week 12)
 - Ready program
 - Code must be commented
 - Document
 - Feedback

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email: verkot@tml.hut.fi

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Languages and Environments

- Supported languages: Java, Perl
- Allowed languages: Java, C, C++, Python, Perl, Scheme (and other lisps),
- Not allowed: visual-xxx, delphi, fortran
- Not allowed to use libraries specified on course web page
- Environments: possible to demonstrate in computer center's machines

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email: verkot@tml.hut.fi

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More info

- Course book (4th edition)
- RFC 2616 (HTTP 1.1)
- RFC 793, 761 (TCP)
- socket programming in programming language books

Sanna Liimatainen
email: verkot@tml.hut.fi

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