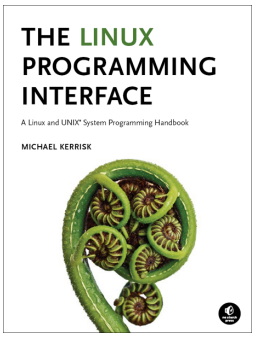
TCP/IP Fundamentals

Course code: M7D-TCPIP01

This course covers the fundamentals of the TCP/IP networking protocols. It is designed particularly for engineers who create and work with network applications, but is also useful for anyone who is more generally trying to understand the TCP/IP protocol suite. Topics covered include: the TCP/IP protocol stack; IP (Internet Protocol); UDP (User Datagram Protocol); and TCP (Transmission Control Protocol), including the TCP state machine. The course also explores the use commands such as *ss*, *tcpdump*, and *wireshark*, used both as tools for understanding the operation of TCP/IP and as tools for monitoring and debugging network applications.



Audience and prerequisites

The course is intended for participants (especially programmers) who are trying to obtain a deeper understanding of the TCP/IP protocols and how they are used by network applications.

Participants should have some familiarity with basic networking concepts and terminology. While programming experience is *not* strictly required, previous experience programming network applications (e.g., using system calls such as *socket()*, *bind()*, *listen()*, *accept()*, and *connect()*) will be helpful.

Course duration and format

One day, with up to 40% devoted to practical sessions.

Course materials

- A course book (written by the trainer) that includes all slides and exercises presented in the course
- An electronic copy of the trainer's book, *The Linux Programming Interface*

Course inquiries and bookings

For inquiries about courses and consulting, you can contact us in the following ways:

- Email: training@man7.org
- Phone: +49 (89) 2488 6180 (German landline)

Prices and further details

For course prices and further information about the course, please visit the course web page, `http://man7.org/training/tcpip/`.

About the trainer

Michael Kerrisk has a unique set of qualifications and experience that ensure that course participants receive training of a very high standard:

- He has been programming on UNIX systems since 1987 and began teaching UNIX system programming courses in 1989.
- He is the author of *The Linux Programming Interface*, a 1550-page book acclaimed as the definitive work on Linux system programming.
- He has been actively involved in Linux development, working with kernel developers on testing, review, and design of new Linux kernel–user-space APIs.
- Since 2000, he has been the involved in the Linux *man-pages* project, which provides the manual pages documenting Linux system calls and C library APIs, and was the project maintainer from 2004 to 2021.

TCP/IP Fundamentals: course contents in detail

Topics marked with an asterisk (*) are optional, and will be covered as necessary or as time permits

1. **Course Introduction**
2. **TCP/IP Overview**
   - The TCP/IP protocol stack
   - The link layer
   - The network layer: IP
   - The transport layer
   - Port numbers
   - User Datagram Protocol (UDP)
   - Displaying sockets and capturing packets
3. **Transmission Control Protocol (TCP)**
   - Overview of TCP
   - Segments
   - Sequence numbers
   - Acknowledgements and retransmissions
   - TCP header
   - TCP state machine
   - TCP connection establishment and termination
4. **Transmission Control Protocol: Further Details (*)**
   - Flow control and congestion control
   - TCP sliding window
5. **Displaying Sockets**
   - *ss*
   - *netstat*
6. **Capturing network packets**
   - *tcpdump*
   - *wireshark*
7. **Capturing network packets**
   - *tcpdump*
   - *wireshark*
   - Packet filtering
8. **Packet filtering: capture filters**
   - Capture filters
   - Capture filters and BPF (*)
9. **Packet filtering: display filters**
   - *wireshark* display filters
10. **Other Networking Tools (*)**
    - Displaying devices and addresses
    - Testing connectivity and routes
11. **Raw Sockets (*)**
    - Overview of creating and using raw sockets
    - Raw sockets example

The following are some of the **other courses taught by Michael Kerrisk**. Custom courses are also available upon request. Further details on these and other courses can be found at `http://man7.org/training/`. For course inquiries please email training@man7.org or phone +49 (89) 2488 6180 (German landline).

Linux Security and Isolation APIs

Course code: M7D-SECISOL02 (4 days)

Covering topics including control cgroups (cgroups), namespaces (with a deep dive into user namespaces), capabilities, and seccomp (secure computing), this course provides a deep understanding of the low-level Linux features used to design, build, and troubleshoot container, virtualization, and sandboxing frameworks.

Linux/UNIX Network Programming

Course code: M7D-NWP03 (3 days)

This course covers sockets programming (both UNIX and Internet domain sockets), and the use of relevant I/O techniques for working with sockets (*poll()*, *epoll*, nonblocking I/O). In addition, we look at the TCP/IP protocol stack (including details of TCP such as the 3-way handshake and the TCP state machine), the use of monitoring and tracing tools (*ss* and *tcpdump*/*wireshark)*, and raw sockets.

Linux/UNIX System Programming

Course code: M7D-LUSP01 (5 days)

This course covers the APIs used to build system-level applications on Linux and UNIX systems ranging from embedded processors to enterprise servers. The presentations and practical exercises provide participants with the knowledge needed to write complex system, network, and multithreaded applications. Topics include: file I/O; signals; process creation and termination; program execution; POSIX threads; interprocess communication, and I/O multiplexing (*poll()*, *epoll*).

Building and Using Shared Libraries on Linux

Course code: M7D-SHLIB04 (2.5 days)

This course describes how to design, build, and use shared libraries on Linux. Topics include: fundamentals of library creation and use; shared library versioning; symbol resolution; library search order; executable and linking format (ELF); dynamically loaded libraries; controlling symbol visibility; and symbol versioning.