

# Computer Networks and Embedded Systems – 3CR

Instructor: Dr. Aleksander Malinowski <http://gdansk.bradley.edu/olekmali/>

## Actual course description

Fundamental concept of computer networks and network programming used to build all distributed computing systems. Various server designs as well as techniques used to build clients and servers are discussed. Main Internet protocols are introduced and exercised. The network programming is introduced using Winsock sockets API and utilization of C language so that the concepts can be easily extrapolated to various embedded systems. About one third of the course is devoted to applying learned knowledge to programming a selected 8-bit or 16-bit embedded system with provided simplified TCP/IP stack library.

## Prerequisites by topics

Proficiency in computer programming in C or C++; Concepts of the data structures; some experience in programming a microprocessor system in assembly or C with use of interrupts; EE221 and EE365 satisfy these requirements.

## Textbooks and/or other required material

1. **MANDATORY TCP/IP Protocol Suite, 3rd Edition** by B. A Forouzan; McGraw Hill; ISBN13: 9780072967722
2. **PDF DATASHEETS for Silicon Lab 8051F120 and Embedded Ethernet Development Kit**  
<https://www.silabs.com/products/mcu/Pages/EmbeddedEthernetDK.aspx>

## Long Distance Education Students

This course heavily utilizes Embedded and Network Laboratory (<http://gdansk.bradley.edu/olekmali/projects/embedded/>). Students who do not live in the area would need to purchase Silicon Labs C8051F120 Ethernet Development Kit (<https://www.silabs.com/products/mcu/Pages/EmbeddedEthernetDK.aspx>) (\$120).

## Course Objectives

1. Understand Internet technology with underlying TCP/IP
2. Learning details of protocols including ARP, RARP, IP, ICMP, IGMP, TCP, UDP, SCTP, RIP, DHCP, OSPF
3. Understanding paradigm of client-server computing and of multicasting
4. Learning TCP/IP API (Application Programming Interface) for Windows and some for Unix
5. Learning details of Internet application protocols including HTTP, SMTP, POP3, and others
6. Learning programming a particular 8- or 16-bit microcontroller in C with use of interrupts, and hardware configuration
7. Learning how to use an example implementation of embedded TCP/IP stack for custom applications

## Topics Covered

1. TCP/IP protocol suite including protocols: ARP, RARP, IP, ICMP, IGMP, TCP, UDP, SCTP, RIP, DHCP, OSPF
2. Introduction to Virtual Private Networks (VPNs) and Network Address Translation (NAT) technologies
3. Fundamental concept of client-server computing used to build all distributed computing systems
4. Windows Sockets API used with the Microsoft Windows operating systems (and some Unix)
5. Case studies of various server designs as well as the tools and techniques used to build clients and servers
6. Application layer protocols including protocols: HTTP, SMTP, POP3, and others
7. Programming Silicon Labs 8051 in Keil C with utilization of hardware configuration and interrupts
8. Custom applications utilizing Silicon Labs TCP/IP stack and embedded Web server

**Note: embedded system programming is introduced in parallel with theory of computer networks, lectures are alternated**