

Book Reviews

Alex van Someren and Carol Atack

The ARM RISC Chip A Programmer's Guide

Addison-Wesley Publishing Company, Inc., Wokingham, 1994, pp. xiii, 346, ISBN 0-201-62410-9.

This book covers the genesis and early history of the Acorn's RISC machine (ARM), the core architecture, the fundamental hardware and software building blocks for RISC computer systems, and the ARM development environment.

This book, as the authors have stated, is aimed at a wide range of people who share an interest in microprocessor technology and ARM devices in particular: programmers writing for ARM-based hardware systems, hardware designers and anyone interested in the commercial application of RISC technology. I would like to add that this book can be used as an excellent handbook which should be applied as a basic text for a case study in intermediate and advanced undergraduate courses in computer science and engineering.

The text has nine chapters, three appendices, a rather poor bibliography (only 14 references) and an index.

The introductory chapter is followed by the chapter on *The history of the ARM CPU*. In this chapter the history of the ARM processors (from ARM1 through ARM6) including the context within which the ARM processors were developed are described. Also, the ARM design objectives such as high performance for low price, high performance for low power consumption, short design time and easily customized designers are described in detail.

The second chapter *The ARM6 CPU core architecture* describes the architecture of the 32-bit RISC macrocell, the ARM6 CPU core, upon

which the current generation of ARM processors is based. The architectural components: the ARM6 data path, pipelining stages, the core functional blocks (the read and write data register blocks, the instruction decoder and control logic, multi-port register bank, Booth's multiplier, the barrel shifter, the arithmetic-logical unit, address register and address incremter) are described. This chapter, also, introduces the programming model: the ARM CPU registers (31 general-purpose 32-bit registers, 6 status registers), the data types directly supported by the processor (byte and 32-bit word), CPU modes and exception handling, and instruction execution and timing.

Chapter 3 is devoted to the ARM development environment called *The ARM Software Development Toolkit*. It consists of the assembler, the C compiler, the linker and the debugger.

The ARM integer instruction set containing 10 instruction formats, plus an undefined instruction is described in Chapter 4. This chapter gives the syntax and the meaning of each of the instructions understood by the ARM6 CPU core.

Chapter 5 deals with unusual events which occur during program execution, known as *exceptions*. Each of different types of exception is outlined in this Chapter. In order to illustrate the process of despatching interrupts, the IRQ handler is included at the end of the Chapter.

Chapter 6 focuses on the data cache, write buffer and memory management unit which are defined as architectural extensions enabling modular ARM processor variants to be constructed using the ARM QuickDesign Service.

The possibilities for interfacing ARM processors with other devices are depicted in Chapter 7. The bus interface and multi-processor support are examined in detail.

Chapter 8 lists variants of the ARM processor and support chips which have been developed. The ARM Floating-point Accelerator, and the second-generation video and audio controller are such support devices.

Chapter 9 looks at the ARM floating-point instruction set which includes the most traditional monadic and dyadic arithmetic, and transcendental functions. The IEEE arithmetic fundamentals are also given in this Chapter.

The appendices provide a page-per-instruction guide to the ARM integer instructions (Appendix A), the floating-point instructions (Appendix B) and the assembler directives (Appendix C). This is a well-written text (in the form of a good processor's handbook) that proceeds in a logical and orderly manner. Although the book is mainly aimed at "programmers writing for ARM-based hardware systems" and "hardware designers looking for an overview of the ARM world", I would gladly recommend it to engineers and students of computer science and engineering which enjoy reading good books in the field of the processor architecture and organization.

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H. Hegering, A. Läßle:

Ethernet. Building a Communications Infrastructure

Addison-Wesley Publishing Company, Inc., Wokingham, 1993, pp. vii, 389, ISBN 0-201-62405-2; original German language edition: **Ethernet. Basis für Kommunikationsstrukturen**, Datacom-Verlag, 1993.

Both authors of this book have extensive experience in creating Ethernet based communication systems. Heinz-Gerd Hegering is at the University of Munich where he is doing his research in communication systems planning and design,

and Alfred Läßle is the head of the communication networks department at the Leibniz Computing Centre.

As the authors claim, they have more than a decade of experience and responsibility for large production networks based on Ethernet. This experience obviously influenced the structure of the book. In every chapter, the initial description of underlying theory and standards is followed by a discussion of their practical relevance, with practical examples and typical applications.

The book is divided into eight chapters, the eighth one being followed by the list of abbreviations, bibliography and index.

The introductory first chapter describes the classification of Ethernet local area networks as in-house communication systems. Ethernet LANs are local area networks in the narrow sense, the most important representatives being those which comply with IEEE LAN standards. It is described how Ethernet LANs fit in with this family of standards. Typical access procedures are outlined and compared, while the detailed specification is withheld until the next chapter. Some possible uses of Ethernet LANs are described as well.

Chapter 2 is devoted to the Ethernet standard in its entirety. First, there is a brief overview of existing standards of relevance to Ethernet. These are then described didactically on the basis of the layered LAN model. Data Link Layer (IEEE 802.2, LLC) is presented first, with outlines of the tasks, services and protocols of this layer as well as its interface to the medium access control (MAC) layer. The MAC layer (IEEE 802.3) is described with detailed discussion of Ethernet CSMA/CD procedure. A section of this chapter that deals with physical layer (IEEE 802.3, PLS, AUI, MAU) gives good overview of various physical platforms on which Ethernet LANs are being implemented. Attention has been given also to building more complicated Ethernet LANs by connecting multiple segments through repeaters. The remainder of the chapter contains a description of the specifications of other Ethernet LAN types such as Ethernet based on broadband technology and fibre optic cables.

In the third chapter attempt has been made to give both didactic and pragmatic approaches in

explaining the principles and components of the original standard Ethernet and its extensions. The importance of various new techniques, introduced in the last few years, has also been explained here. Many questions and problems that are connected with practical implementation of Ethernet networks are discussed first. The main part of this chapter describes the extended Ethernet technologies such as Cheaper-net, fibre optic and twisted pair Ethernet. Operational experiences are described and advice is given on the installation of the associated components. Some room is also given to the more recent developments like wireless systems and multimedia access centres, which have already led to products, but for which no standards have been released yet.

The most complicated LAN structures described in chapter 3 were multisegment LANs constructed from individual segments using repeaters, so that the whole network is built up from layer-1 coupling elements. Interconnecting LANs at the higher layers is the main concern in chapter 4. This chapter first gives a general introduction to the gateway problem and classifies the coupling elements of the various layers. Bridges, routers and brouters are thoroughly discussed, with the emphasis on choice and the use of real products. LAN-WAN coupling in layer 4 and backbone or transit networks are also described at the end of this chapter.

A network consisting exclusively of data transmission equipment makes no sense for data exchange. It requires the attachment of data terminals that are able to use it as a transport system. Chapter 5 is devoted to techniques and products for connecting various types of data terminals to Ethernet LANs. The term *data terminal* is here related to all devices that can generate or use data. This includes "dumb" terminals, personal computers, workstations, minicomputers and mainframes. Products such as terminal servers, network interface cards and host channel adapters are described here.

Chapter 6 describes the higher layer protocols for Ethernet LANs, that are protocols of the application system. They lie above the functionality of the layers 1 to 4 that provide for the secure end-to-end transport over the network. Description of the general tasks of the higher protocols exposes these protocols as providers

of environment for development of network services and also applications systems. Three families of protocols are described: OSI protocols, protocols of the TCP/IP stack and Xerox's XNS protocol family. The seventh chapter first separately discusses the application programming interfaces for DOS and UNIX worlds, as important prerequisites for the implementation of integrated networks of PCs and workstations. Next, there is an introduction to the most important representatives of PC networks (Novell NetWare, Microsoft LAN Manager, Banyan Vines) followed by a number of general criteria for choosing such systems. The next important world after PC world, which is the world of distributed systems composed of networked workstations, is dealt with in continuation. The NFS (network file system), RFS (remote file sharing system) and AFS (Andrew file system) applications are used to show how distributed applications may be implemented in the UNIX world.

Chapter 8 has a completely pragmatic orientation, dealing with operational aspects and network management. Those are aspects that concern the network provider: network planning, product selection, implementation and operation of the network. Many of the questions considered are in no way specific to Ethernet. Most of the topics covered are relevant to a larger class of networks. The chapter ends with a description of the very extensive communication structures of the Leibniz Computer Centre, which is the environment in which the authors gained their experience of LANs.

The casual reader will appreciate a very good collection of abbreviations that are listed after the eighth chapter. It is handy to have them all explained at the one place, especially in the field of communications where they spawn with great virulence.

As for the criticism, I have but very few objections. Bibliography is extensive (more than 100 entries) and grouped in chapters. The casual reader would, meanwhile, appreciate also to find some annotations in it. Index is not very elaborate, and should contain much more entries if the book is to be considered both a textbook and a reference book, as the authors claim.

Myself, I see this book more as an excellent tutorial, although it indisputably contains valu-

able reference data and is equally recommendable to students, network managers and network users. Communications professionals will find it a well-structured collection of tutorial texts accompanied by many practical tips from the authors' rich experience.

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K. Washburn, J. T. Evans

TCP/IP. Running a Successful Network

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According to the authors' statement in the preface, this is a book "about the practical problems of installing, configuring and maintaining information systems based on the TCP/IP set of standards, from initial installation to on-going maintenance." The book is strongly based on their wide experience gained over many years of work in a series of practical-based training activities on TCP/IP systems.

As it is already well-known, TCP/IP stands for Transmission Control Protocol, resp. Internet Protocol, the two protocols governing the communication in the transport and network layers within the Internet community of globally interconnected (mostly) academic and research networks. However, the acronym also denotes the whole 5-layer Internet network architecture and the respective protocol suite. In relation to the internationally standardized OSI (Open Systems Interconnection) initiative and its 7-layer RM (Reference Model), TCP/IP is comparable in the four lower layers, while the functionality of OSI RM three upper layers resides in TCP/IP fifth-application layer.

TCP/IP model is by far the most popular networking architecture. It is more popular than OSI in spite of OSI international standardization

status and the fact that both were introduced in the same year (in 1983). This is due to several reasons. The first, Internet people chose simplicity as the paramount guideline for achieving solutions. The resultant implementations are thus efficient, and there already exist protocol implementations for a wide range of important applications. Moreover, they have been incorporated in the popular UNIX operating system. Furthermore, documents describing protocols are less formal than the usual international standards, the process of their preparation is shorter, and the purchase very simple: in fact, all of this can be made using Internet itself. Finally, TCP/IP is extensively used in local area networks (LANs).

The above mentioned facts are also the reasons for recommending a book treating this topic. As there exists a large number of TCP/IP systems already installed, and that mostly in a LAN domain, these systems usually configured and managed by non-professionals, such a text is most welcome.

The book is organized in three parts, the first two parts make the classical introduction-corroboration scheme. Part I overviews in 8 chapters (which roughly amounts to a quarter of the book) without too deep a technological detail relevant TCP/IP features and options. Part II, making for the bulk of the book (respectively two thirds of it), offers in 11 chapters a quite thorough description of technical standards behind TCP/IP systems, striving to achieve a good understanding of them. Finally, Part III comprehends 10 appendices on diverse reference material, usefully complementing the previous exposition.

Chapter 1 introduces TCP/IP providing the historical background both of TCP/IP and of its counterpart OSI, as well as an outline of the respective communication architectures. Chapter 2 presents some basic notions on network planning like cable laying, link layer options, and splitting the network. It emphasizes bridging as the technique supporting the latter and exposes its very fundamentals.

Following three chapters are concerned with networking functionality. Chapter 3 shallowly delves into the network layer and addresses the all-important issue of IP addresses. After initially explaining the characteristics of IP addressing, here including the address format, its

classes and the resulting IP network organizations, the chapter concludes with a suggested procedure for IP address selection. The next chapter elaborates on subnetting as an efficient solution for obtaining an adequately structured network configuration. In the short Chapter 5 routing is outlined as the principal function of the network layer (IP), the possible routing protocols and criteria for their selection being just mentioned.

Chapter 6 reviews the transport and application layers with an inventory of application services available with TCP/IP. The specific services here mentioned include support for resource sharing NFS, advance graphical windowed interface X Window System, remote terminal Telnet, file transfer FTP and TFTP, and SMTP for exchange of mail messages.

Chapter 7 deals with performance issues in TCP/IP networks, informally commenting on topics such as tuning software parameters and configuring hardware layout. Some examples are chosen to corroborate the matter, like that on configuring NFS systems for performance.

Chapter 8 explains the particular electronic documents standardizing TCP/IP systems — Request for Comments (RFC), and comprehends their categorization and organization as well as practical hints for obtaining them on-line.

Part II encompassing the biggest portion of the book (roughly some 320 pages of text) is devoted to "a detailed technical discussion of the components and protocols that make up a TCP/IP implementation". It starts with a coarse-grained account of TCP/IP protocol suite layering and its comparison with the standard OSI model, laying down the way to the more detailed approach to particular layers in the chapters to follow, particularly Chapters 10 to 13. The chapter on physical and datalink layers provides an overview of the common alternatives for LANs like DIX Ethernet (Ethernet Ver.2) and IEEE 802.3, IEEE 802.5, and IS 9314 FDDI, as well as of IEEE 802.2 and SNAP used for harmonization purposes. The "internetworking" at the datalink layer, here to be interpreted as LAN interconnection methodology, spans techniques such as bridging and protocols such as SLIP and PPP, while at the lower network sublayer the use of X.25 is described. The chapter ends with a discussion of fast packet services: frame relay, cell relay (ATM) and SMDS.

The Internet Protocol (IP) receives an in-depth description in the subsequent Chapter 11, with an emphasis on the IP datagram, its format and handling (fragmentation and reassembly). The chapter also encompasses special network layer protocols like ARP, RARP and ICMP. The operation of all of these protocols is corroborated with traces from operational networks. The transport layer protocols have a chapter of their own, too. Standard UDP (User Datagram Protocol) providing connectionless unreliable service and TCP providing connection-oriented service are worked out, the more important TCP in a much greater extent. A discussion of TCP message format, the phases of TCP operation, and particular mechanisms such as error correction and retransmission, and sliding window, are furnished. Pertinent TCP traces are included in the chapter. Quite a number of pages (over 50) is dedicated to application layer services in an appropriate chapter. Again completeness was of paramount interest. After a short introduction of the client-server paradigm, detailed descriptions are given for Telnet, FTP, SMTP, *r*-commands, TFTP, BOOTP, LPS, NetBIOS and the X protocol. The use of sockets and socket libraries is explained through a complete example.

A separate chapter — Chapter 14 — considers addressing issues related to the Domain Naming System (DNS). The structure it enforces, the protocol and service provided, along with configuration tips, are explained.

Another chapter is dedicated to the most popular TCP/IP based network operating system — Network File System (NFS) — providing transparent disk/file system sharing. NFS architecture is explained, as well as its components — RPC, XDR, and NFS proper. The explanation is supported by examples of operation, testing and configuration.

Chapter 16 elaborates on routing within IP. A more technical description of the very principles of routing as well as its implementation in TCP/IP networks is given, followed by issues such as routing at end nodes and routing between routers, respectively. All the main leading routing protocols used within IP are presented: the interior ones such as RIP, Hello, OSPF, integrated IS-IS and IGRP, and the exterior ones such as EGP and BGP.

Management issues are described in Chapter 17, where TCP/IP simple means for monitoring and controlling networks — SNMP — is outlined. The concept and structure of Management Information Bases (MIBs) are explained and its information representation and coding produced. Configuration requirements and testing procedures are brought out in Chapter 18, along with the usual debugging and measurements tools.

Chapter 19 concludes the book with a glance to possible future developments of TCP/IP, particularly related to the expected migration to OSI on a worldwide level.

Part III appendices contain among other useful additional information on RFCs and official Internet standards, a list of main TCP/UDP port addresses, and protocol traces for Telnet and FTP.

The book is attentively structured. Not only a global structure, as already noted, is enforced but also every chapter follows a unified style proper of good tutorial materials: it starts with a list of topics to be worked out, and ends with a summary of the exposition. The real bonus of the book is its Part II with the comprehensive treatment of TCP/IP technology and standards. Almost every chapter in Part II is supplemented by a thorough list of relevant RFC documents to serve as references, and where appropriate by explanatory protocol traces. *TCP/IP. Running a Successful Network* by K. Washburn and J.T. Evans is a good choice as a referent text which will be of great help to practicing engineers and TCP/IP network managers and as such it is to be recommended.

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W. Stallings

SNMP, SNMPv2 and CMIP. The Practical Guide to Network-Management Standards

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As technical field of data communications grows to be the one of the most important technology in world economy and everyday life, the need for techniques and international standards of managing data communication networks has become more and more important. This area is covered by two sets of standards, one from ISO OSI (International Organization for Standardization Open System Interconnection), and the other from the Internet community. It should be noted that, although ISO OSI's CMIP (Common Management Information Protocol) could be denoted as the basis indicating the direction for future network management, it is still making slow progress in the marketplace in comparison to the presently widely used and simpler to implement SNMP (Simple Network Management Protocol) from the TCP/IP environment.

The well-known author of computer communication texts William Stallings, elaborates in his book the fundamental differences between the above mentioned two standard sets for network management. The book is structured into three parts and totals 14 chapters and 4 appendices, here including a list of references and a well-compiled index. Every chapter comprises a summary and possibly its own appendix.

After Chapter 1 giving an overview of the area of network management, the two following chapters constituting Part one of the book describe such fundamentals of network management like network, performance, fault and accounting monitoring, with a good introduction to queueing theory and statistical analysis concepts given as appendices. They are followed by a description of control functions of the network management architecture, as well as of configuration and security control.

Part two is an in-depth explanation of the SNMP family. It encompasses Chapters 4 to 10. Chapter 4 introduces the SNMP framework with its very important representation of management information and the Structure of Management

Information (SMI). The format of management information as well as the Management Information Base (MIB-II) is described in Chapter 5. Chapter 6 gives an overview of SNMP itself, while Chapter 7 pays special attention to the most complex and most important function within network management which is remote monitoring. Secure SNMP and SNMPv2 are introduced and elaborated in Chapters 8 through 10 by means of problems concerning security threats, arising from early SNMP applications in the otherwise rapidly growing Internet network.

The management concepts of OSI systems are explained in Part three of the book, otherwise structured in a similar way as Part two. The OSI management standards are shortly outlined in Chapter 11, followed by the description of the OSI management information base in Chapter 12. The complex and sophisticated area of system management functions, covered by the Common Management Information Service (CMIS) and the respective protocol CMIP, are explained in detail in Chapter 13. Ends Part three Chapter 14 exposing the framework and functional areas of system management functions.

Several valuable appendices placed at the end of the book contribute to its overall value. Appendix A introduces the OSI Reference Model with a short description of its layers supported by brief references to standard documents issued. Appendix B presents the TCP/IP protocol suite, here including its historical background based on the ARPAnet; its layered architecture is presented along with the most popular applications as e.g. SMTP, FTP and TELNET. In Appendix C the Abstract Syntax Notation One (ASN.1) is described, which is used in specifications throughout the book. Appendix D offers a short introduction to object oriented design which is thought to be of help in understanding and analyzing the subject matter.

Let me conclude this review with few sentences from the book, which in my opinion illustrate the present situation in the application of network management standards:

“The ultimate success of SNMPv2 versus OSI systems management is impossible to assess at this point. It seems clear that the telecommunications carriers will provide a major impetus to OSI development, since they are all in the process of developing network-management systems based on the OSI standard. In addition, government support for OSI in the United States, the European Community, and Japan is forcing vendors to develop OSI management products for their government customers. On the other hand, computer and network users already have a large installed SNMP base”.

Answering the urgent need for widespread use of international standards, books like this one are of valuable help to develop a critical attitude when defining solutions to real problems. As an active professional in the field of computer networks, I strongly recommend William Stalling's book *SNMP, SNMPv2 and CMIP. The Practical Guide to Network Management Standards* both to my fellow datacom professionals and to students of advanced courses on computer networks. The book also can function as a reference to these standard documents for those who need to implement them.

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