

Textbook for  
Fundamental Information Technology Engineers

NO. 4 NETWORK AND DATABASE  
TECHNOLOGIES

Supervised by Japan Information Processing Development Corporation  
Central Academy of Information Technology

9	2	0	0	1	
U	I	O	P		
H	J	K	L		
V	B	N	M		

## Contents

**Part 1 NETWORK TECHNOLOGY****1. Protocols and Transmission Control**

<b>Introduction</b>	<b>2</b>
<b>1.1 Network Architecture</b>	<b>3</b>
1.1.1 The Background of the Birth of Network Architecture	3
1.1.2 Outline and Standards of Network Architecture	3
1.1.3 The Types of Network Architecture	5
1.1.4 De Facto Standards	5
1.1.5 Network Topology and Connection Methods	5
<b>1.2 OSI – Standardization of Communication Protocols</b>	<b>7</b>
1.2.1 Overview of OSI	7
1.2.2 OSI Basic Reference Model	9
1.2.3 Communication Procedures in OSI	12
<b>1.3 TCP/IP – The De Facto Standard of Communication Protocols</b>	<b>13</b>
1.3.1 Overview of TCP/IP	13
1.3.2 Communication Procedures in TCP/IP	16
<b>1.4 Addresses Used for TCP/IP</b>	<b>16</b>
1.4.1 IP Address	16
1.4.2 MAC Addresses	20
<b>1.5 Terminal Interfaces</b>	<b>21</b>
1.5.1 V-series	21
1.5.2 X-series	22
1.5.3 I-series	22
1.5.4 RS-232C	23
<b>1.6 Transmission Control</b>	<b>23</b>
1.6.1 Overview and Flow of Transmission Control	24
1.6.2 Transmission Control Procedures	25
<b>Exercises</b>	<b>30</b>

## 2. Encoding and Transmission

<b>Introduction</b>	<b>33</b>
<b>2.1 Modulation and Encoding</b>	<b>33</b>
2.1.1 Communication Lines	33
2.1.2 Modulation Technique	33
2.1.3 Encoding Technique	34
<b>2.2 Transmission Technology</b>	<b>36</b>
2.2.1 Error Control	36
2.2.2 Synchronous Control	38
2.2.3 Multiplexing Methods	39
2.2.4 Compression and Decompression Methods	42
<b>2.3 Transmission Methods and Communication Lines</b>	<b>45</b>
2.3.1 Classes of Transmission Channel	45
2.3.2 Types of Communication Lines	46
2.3.3 Switching Methods	47
<b>Exercises</b>	<b>54</b>

## 3. Networks (LAN and WAN)

<b>Introduction</b>	<b>58</b>
<b>3.1 LAN</b>	<b>59</b>
3.1.1 Features of LAN	59
3.1.2 Topology of LAN	59
3.1.3 LAN Connection Architecture	60
3.1.4 LAN Components	61
3.1.5 LAN Access Control Methods	65
3.1.6 Inter-LAN Connection Equipment	68
3.1.7 LAN Speed-up Technology	70
<b>3.2 The Internet</b>	<b>72</b>
3.2.1 The Historical Background of the Development of the Internet	72
3.2.2 The Structure of the Internet	73
3.2.3 Internet Technology	75
3.2.4 Types of Servers	76
3.2.5 Internet Services	78
3.2.6 Search Engines	80
3.2.7 Internet Related Knowledge	81
<b>3.3 Network Security</b>	<b>83</b>
3.3.1 Confidentiality Protection and Falsification Prevention	83
3.3.2 Illegal Intrusion and Protection against Computer Viruses	89

3.3.3	Availability Measures	91
3.3.4	Privacy Protection	93
<b>Exercises</b>		<b>95</b>
<b>4. Communication Equipment and Network Software</b>		
<b>4.1 Communication Equipment</b>		<b>99</b>
4.1.1	Transmission Media (Communication Cables)	99
4.1.2	Peripheral Communication Equipment	101
<b>4.2 Network Software</b>		<b>103</b>
4.2.1	Network Management	104
4.2.2	Network OS (NOS)	105
<b>Exercises</b>		<b>107</b>
<b>Answers to Exercises</b>		<b>108</b>
 <b>Part 2 DATABASE TECHNOLOGY</b>		
<b>1. Overview of Database</b>		
<b>1.1 Purpose of Database</b>		<b>110</b>
<b>1.2 Database Model</b>		<b>112</b>
1.2.1	Data Modeling	112
1.2.2	Conceptual Data Model	113
1.2.3	Logical Data Model	113
1.2.4	3-Tier Schema	115
<b>1.3 Data Analysis</b>		<b>117</b>
1.3.1	ERD	117
1.3.2	Normalization	117
<b>1.4 Data Manipulation</b>		<b>127</b>
1.4.1	Set Operation	127
1.4.2	Relational Operation	129
<b>Exercises</b>		<b>131</b>

## 2. Database Language

<b>2.1 What are Database Languages?</b>	<b>138</b>
2.1.1 Data Definition Language	138
2.1.2 Data Manipulation Language	138
2.1.3 End User Language	138
<b>2.2 SQL</b>	<b>139</b>
2.2.1 SQL: Database Language	139
2.2.2 Structure of SQL	139
<b>2.3 Database Definition, Data Access Control and Loading</b>	<b>141</b>
2.3.1 Definition of Database	141
2.3.2 Definition of Schema	141
2.3.3 Definition of Table	142
2.3.4 Characteristics and Definition of View	144
2.3.5 Data Access Control	145
2.3.6 Data Loading	146
<b>2.4 Database Manipulation</b>	<b>147</b>
2.4.1 Query Processing	147
2.4.2 Join Processing	160
2.4.3 Using Subqueries	162
2.4.4 Use of View	166
2.4.5 Change Processing	166
2.4.6 Summary of SQL	168
<b>2.5 Extended Use of SQL</b>	<b>175</b>
2.5.1 Embedded SQL	175
2.5.2 Cursor Operation	175
2.5.3 Non-Cursor Operation	179
<b>Exercises</b>	<b>180</b>

## **3. Database Management**

<b>3.1 Functions and Characteristics of Database Management System (DBMS)</b>	<b>185</b>
3.1.1 Roles of DBMS	185
3.1.2 Functions of DBMS	186
3.1.3 Characteristics of DBMS	188
3.1.4 Types of DBMS	192
<b>3.2 Distributed Database</b>	<b>195</b>
3.2.1 Characteristics of Distributed Database	195
3.2.2 Structure of Distributed Database	196
3.2.3 Client Cache	197
3.2.4 Commitment	197
3.2.5 Replication	200
<b>3.3 Measures for Database Integrity</b>	<b>201</b>
<b>Exercises</b>	<b>202</b>
<b>Answers to Exercises</b>	<b>203</b>
<b>Index</b>	<b>204</b>