

CONTENTS IN ENGLISH

1. TELECOMMUNICATIONS SECTOR	11
1.1 Telecommunications as a business	11
1.2 Development of telecommunications sector	14
1.2.1 History of telecommunications in Finland	16
1.2.2 Economics of telephone companies	16
1.2.3 Automatization comes	17
1.2.4 Government regulation	19
1.3 Liberalization process	22
1.4 Competition for market shares	27
1.5 Milestones	28
2. STANDARDS AND STANDARDIZATION ORGANIZATIONS.....	33
2.1 International standardization	35
2.1.1 ITU	35
2.1.2 ISO/IEC	36
2.2 European standardization	37
2.2.1 ETSI / CEPT	37
2.2.2 CEN/CENELEC	38
2.2.3 CE marking.....	38
2.3 National standardization in Finland.....	38
2.3.1 Finnish Communications Regulatory Authority.....	38
2.3.2 SFS/SESKO	39
2.4 National standardization in other countries.....	39
2.4.1 ANSI – American National Standards Institute	39
2.4.2 IEEE – Institute of Electrical and Electronics Engineers.....	39
2.4.3 EIA – Electronics Industries Alliance	40
2.4.4 DIN – Deutsches Institut für Normung	40
2.4.5 Standardization in Japan.....	40
2.5 <i>De facto</i> standards	40
2.6 Standardization of Internet	42
2.7 Summa summarum	43
3. CHARGING	45
3.1 Charging and cost correlation	45
3.2 Charging principles.....	46
3.3 Implementation of charging	48

3.4	Mathematical aspects	49
3.5	Long time trends in telephone fees	50
3.5.1	In-operator fee	51
3.5.2	Different kinds of "local calls"	51
3.5.3	Finnish telephone fees	52
4.	FUNDAMENTALS OF INFORMATION THEORY	55
4.1	Bandwidth	55
4.2	Noise	56
4.3	Shannon's theorem	57
4.4	Nyquist sampling theorem.....	57
4.5	Quantization	58
5.	FUNDAMENTALS OF DATA TRANSMISSION	61
5.1	Data terminal equipment (DTE) vs. data connecting equipment (DCE)	61
5.2	Connection type	62
5.2.1	Non-switched connection	63
5.2.2	Dial-up connection	64
5.2.3	Circuit switched vs. packet switched connection	65
5.2.4	Cell switched connection.....	65
5.3	Serial transfer vs. parallel transfer.....	66
5.4	Bit, byte and baud	66
5.5	Different kinds of kilos	67
5.6	Synchronization	68
5.7	Error correction.....	70
5.8	Compression	71
5.9	Handshaking and flow control.....	72
5.10	Modulation.....	73
5.10.1	Amplitude modulation.....	73
5.10.2	Frequency modulation.....	74
5.10.3	Phase modulation.....	74
5.11	Line coding	75
5.12	Multiplexing	76
6.	DATA TRANSFER MEDIUM	79
6.1	Open wiring.....	79
6.2	Cables	81
6.2.1	Symmetrical (paired) cable	81
6.2.2	Coaxial cable	84
6.3	Optical fibres	84
6.3.1	Physics of optical fibres	85
6.3.2	Fiber types.....	87
6.3.3	Attenuation	88

6.3.4	Development of fiberoptics	90
6.4	Free space	91
6.4.1	Propagation mechanisms of radiowaves	92
6.4.2	Attenuation of atmosphere	94
6.5	Comparisons of different media	94
7.	TRADITIONAL TELECOMMUNICATION TECHNOLOGIES	99
7.1	Modern telecommunications network	99
7.2	Pulse code modulation – PCM	101
7.3	Telephone	105
7.4	Modem.....	109
7.4.1	Multilevel modulation	110
7.4.2	Serial interface.....	111
7.4.3	Null modem cable and break box.....	114
7.4.4	56k modem	115
7.5	Telex, telefax, teletex etc.....	116
8.	COMPUTER NETWORKS.....	119
8.1	Protocol.....	119
8.1.1	OSI model	119
8.1.2	Connection oriented or connectionless?.....	120
8.2	Network topologies	121
8.3	Bridge, router, switch.....	122
8.4	Contention access method	124
8.4.1	Ethernet (IEEE 802.3).....	129
8.5	Token passing access method.....	130
8.5.1	Token Ring (IEEE 802.5)	132
8.5.2	FDDI	132
8.6	Cell switched network technologies	134
8.6.1	Building an ATM connection.....	135
8.6.2	Statistical multiplexing	137
8.6.3	Strengths and weaknesses of ATM.....	139
9.	INTERNET	143
9.1	Development of the Internet	143
9.2	TCP/IP protocol family.....	144
9.2.1	IP addresses and routing	146
9.2.2	IP datagram.....	147
9.2.3	TCP segment	148
9.3	What is really being transfered in the Internet?	149
9.3.1	Connection.....	149
9.3.2	The actual data transfer.....	150
9.3.3	Payload.....	151

9.4	Backbone network	152
9.5	Shadows of the net.....	152
9.5.1	Hackers vs. crackers.....	153
9.5.2	Fire walls	154
9.5.3	Cryptography.....	155
9.6	Net buying and cybercash.....	156
9.7	Net phone	157
10.	ISDN.....	159
10.1	Digital subscriber line.....	159
10.2	Connecting the customer to the network.....	161
10.2.1	Terminal equipments	161
10.2.2	Interfaces	162
10.3	What does the customer benefit?.....	163
10.3.1	Always On/Dynamic ISDN	164
10.3.2	Small scale data transmission	165
10.4	Standardization has been slow	166
10.5	ISDN in Finland	168
11.	BROADBAND ACCESS.....	171
11.1	xDSL – a fast connection using a normal telephone wiring	171
11.1.1	G.lite (ITU G.922.2)	174
11.1.2	Telephone companies' new hope.....	174
11.2	Cable modem – CATV companies' alternative	175
11.3	Power line communications – power companies' alternative	176
11.4	WLAN.....	177
12.	MOBILE TELEPHONE NETWORKS	181
12.1	Fundamentals of cellular radio networks	181
12.2	First generation: ARP (Finnish car radio system) and NMT	184
12.3	Second generation: GSM	185
12.4	Sound quality (1st vs. 2nd generation)	186
12.5	Safety features	187
12.6	Distribution of different networks in the world.....	189
12.7	Other networks	192
12.7.1	Other second generation networks	192
12.7.2	City networks: PCN	192
12.7.3	Cordless phones: CT2 / DECT	193
12.7.4	Satellite phones	194
12.7.5	Third generation: UMTS / IMT-2000.....	195
12.7.6	WAP.....	196
12.7.7	GPRS.....	197
12.8	Interconnection	199

13. HOW ABOUT THE FUTURE?.....	201
APPENDIX (NOT REQUIRED IN THE EXAM)	205
Abbreviations	205
Source books.....	211
ITU-T recommendations.....	212
IEEE 802 standards.....	213
Mathematical aspects of charging	214
INDEX	216