CONTENTS

FOREWORD xv
PREFACE xvii
ACKNOWLEDGMENTS xix

PART I INTRODUCTION AND PERIOD BEFORE 1800 1

1 Introduction 3
   1.1 Definition of Telecommunications, 3
   1.2 Telecommunications Tree, 7
   1.3 Major Creators of Telecommunications, 11

2 Evolution of Telecommunications Up to 1800 14
   2.1 Evolution of Telecommunications Prior to 1750, 14
   2.2 Evolution of Telecommunications from 1750 to 1800, 16

3 Optical Telegraphy 18
   3.1 Tachygraphe of Claude Chappe, 18
   3.2 Optical Telegraph of Claude Chappe, 20
   3.3 Beginning of Optical Telegraphy, 24

PART II PERIOD FROM 1800 TO 1850 27

4 Evolution of Telecommunications from 1800 to 1850 29
5 Optical Telegraph Systems Worldwide
5.1 Optical Telegraph Systems in France, 34
  5.1.1 Chappe Systems, 34
  5.1.2 Other Optical Telegraph Systems in France, 37
5.2 Optical Telegraphy Outside France, 45

6 Electrical Telegraphy
6.1 Evolution Leading to Electrical Telegraphy, 48
6.2 Electrical Telegraphy in the United States, 55
  6.2.1 Morse Telegraph, 55
  6.2.2 Washington–Baltimore Electrical Telegraph Line, 59
  6.2.3 Pioneering Telegraph Companies, 61
  6.2.4 House Direct Printing Telegraph Systems, 65
6.3 Electrical Telegraphy in Canada, 66
6.4 Electrical Telegraphy in Great Britain, 66
  6.4.1 Electrical Telegraphs of Cooke and Wheatstone, 66
  6.4.2 Electrochemical Telegraph of Bain, 72
6.5 Electrical Telegraphy in France, 72
6.6 Electrical Telegraphy in Germany, 74
  6.6.1 Railway Telegraph Lines in Germany, 74
  6.6.2 German Electrical Telegraph Equipment for Public Use, 76
6.7 Electrical Telegraphy in Austria, 83

PART III PERIOD FROM 1850 TO 1900

7 Evolution of Telecommunications from 1850 to 1900

8 Electrical Telegraph Systems Worldwide
8.1 Telegraph Transmission Technology, 91
  8.1.1 Open-Wire Lines, 91
  8.1.2 Underground Cable, 94
  8.1.3 Submarine Cable, 95
8.2 Electrical Telegraph Lines in the United States, 98
  8.2.1 Western Union, 98
  8.2.2 The Pony Express, 98
  8.2.3 First Transcontinental Telegraph Line, 99
  8.2.4 Collins Overland Telegraph Line and the Purchase of Alaska, 100
  8.2.5 The Hughes Direct Letter Printing Telegraph, 103
8.3 Electrical Telegraph Lines in Canada, 104
8.4 Electrical Telegraph Lines in Great Britain, 106
8.5 Summary of National Electrical Telegraph Achievements, 107
8.6 Major Terrestrial Telegraph Lines, 119
  8.6.1 Australian Overland Telegraph Line, 119
  8.6.2 Indo-European Telegraph Line, 124
12 Radio Transmission

12.1 Evolution Leading to Radio Transmission, 199
12.2 Experiments of Heinrich Hertz, 201
12.3 Radio Transmission from Theory to Practice, 204
12.4 The Radio Invented by Marconi, 207
12.5 Radios of Marconi's Competitors, 212

13 International Cooperation

PART IV PERIOD FROM 1900 TO 1950

14 Evolution of Telecommunications from 1900 to 1950

15 Worldwide Telephone Penetration

15.1 Worldwide Telephone Statistics, 229
15.2 Telephone Penetration in the United States, 231
15.3 Telephone Penetration Outside the United States, 234

16 Electromechanical Telephone Switching

16.1 Worldwide Introduction of the Strowger System, 237
16.1.1 Strowger System in the United States, 237
16.1.2 Strowger System in Canada, 238
16.1.3 Strowger System in Japan, 240
16.1.4 Strowger System in Germany, 241
16.1.5 Strowger System in Great Britain, 244
16.1.6 Strowger System in Austria, 246
16.1.7 Strowger System in Sweden, 246
16.2 Automatic or Semiautomatic Switching?, 247
16.3 Electromechanical Indirect-Control Systems, 250
16.3.1 Automanual and All-Relay Systems, 251
16.3.2 Lorimer System, 252
16.3.3 Panel System, 255
16.3.4 Rotary System, 258
16.3.5 Uniselector System in France, 260
16.3.6 LME 500-Point System, 261
16.3.7 Hasler Hs 31 System, 262
16.3.8 Automatic Switching Systems in the USSR, 264
16.4 Crossbar Switching, 264
16.5 Private Switching, 266

17 High-Frequency Radio Transmission

17.1 Evolution of Radio Technology, 269
17.1.1 Spark Radio Transmitters, 269
17.1.2 Squeened Spark Radio Transmitter, 271
17.1.3 Poulsen Convertor Arc Radio Transmitter, 274
PART V PERIOD FROM 1950 TO 2000

24 Evolution of Telecommunications from 1950 to 2000
24.1 The Semiconductor Era, 364
24.2 Digitalization, 366
24.3 New Telecommunications Networks, 367

25 Radio-Relay Networks
25.1 Technological Development of Radio-Relay Systems, 369
25.1.1 All-Solid-State Radio-Relay Systems, 370
25.1.2 Digital Radio-Relay Systems, 371
25.1.3 Radio-Relay Systems for the Synchronous Digital Hierarchy, 374
25.1.4 Transhorizon Radio-Relay Systems, 375
25.2 Radio-Relay Systems Worldwide, 376
25.2.1 Radio-Relay Systems in North America, 376
25.2.2 Radio-Relay Systems in Latin America, 376
25.2.3 Radio-Relay Systems in Europe, 379
25.2.4 Radio-Relay Systems in Asia, 381
25.2.5 Radio-Relay Systems in Australia, 382
25.2.6 Radio-Relay Systems in Africa, 383
25.3 Wireless Access Systems, 386
25.4 Radio-Relay Towers and Aesthetics, 391

26 Coaxial Cable Transmission
26.1 Terrestrial Coaxial Cable, 397
26.2 Submarine Coaxial Cable, 399
26.2.1 Transatlantic Coaxial Telephone Cables, 399
26.2.2 Worldwide Submarine Coaxial Telephone Cables, 404

27 Satellite Transmission
27.1 Evolution Leading to Satellite Transmission, 407
27.1.1 Rocketry Pioneers, 408
27.1.2 Passive Satellites, 410
27.1.3 Postwar Rocket Development in the United States, 410
27.1.4 Postwar Rocket Development in the USSR, 411
27.1.5 Sputnik, the First Satellite, 412
27.1.6 First Communication Satellites, 413
27.2 First Synchronous Communication Satellites, 419
27.3 Satellite Launching, 421
27.4 Satellite Transmission Systems, 426
27.4.1 Global Satellite Systems, 427
27.4.2 Regional Satellite Systems, 428
27.4.3 Domestic Satellite Systems, 431
27.4.4 Mobile Satellite Systems, 433
27.4.5 Global Mobile Personal Communication by Satellite, 435
27.4.6 Multimedia Satellite Systems, 439

28 Optical Fiber Transmission 445

28.1 Evolution Leading to Optical Fiber Transmission, 445
28.2 Terrestrial Optical Fiber Cable Systems, 456
28.3 Submarine Optical Fiber Cable Systems, 459
28.3.1 Transatlantic Optical Fiber Cables, 460
28.3.2 SEA–ME–WE Cable System, 461
28.3.3 Caribbean ARCOS Network, 463
28.3.4 Global Submarine Optical Fiber Cable Systems, 463
28.3.5 African Cable Network Africa ONE, 466
28.3.6 Various Submarine Cable Systems, 467
28.3.7 Repeaterless Submarine Cable Systems, 467
28.4 Fiber-in-the-Loop Systems, 471
28.4.1 Worldwide Testing of FITL Solutions, 472
28.4.2 Delay of FITL Deployment, 475

29 Electronic Switching 480

29.1 Continuation of Deployment of the Prewar Switching Systems, 480
29.1.1 Crossbar Switching, 480
29.1.2 Siemens Rotary Switch, 480
29.1.3 End of the Strowger Switch, 482
29.2 Implementation of Automatic Telephone Switching, 483
29.2.1 National Automatic Switching, 483
29.2.2 International Automatic Switching, 484
29.3 Electronic Switching Systems, 485
29.3.1 Evolution toward Electronic Switching, 485
29.3.2 Preliminary Electronic Switching Systems, 489
29.3.3 Commercial Electronic Switching Systems, 494
29.4 Digital Switching Systems, 495
29.5 Data Switching, 500
29.6 Integrated Services Digital Network, 505
29.7 Broadband Switching, 506
29.8 Private Switching, 507

30 Telex 510

30.1 Continuation of Teleprinter Deployment, 510
30.2 Telex Service, 510
30.3 Teletex, 512
30.4 Termination of Telex Services, 512

31 Telefax 515

31.1 Technological Development of Telefax, 515
31.2 Worldwide Telefax Penetration, 517
32 Cellular Radio

32.1 Evolution of Cellular Radio, 519
32.2 Analog Cellular Radio, 521
  32.2.1 Analog Cellular Radio in Japan, 522
  32.2.2 Analog Cellular Radio in Scandinavia, 523
  32.2.3 Analog Cellular Radio in North America, 523
  32.2.4 Analog Cellular Radio in West Europe, 524
32.3 Digital Cellular Radio, 524
  32.3.1 Global System for Mobile Communication, 528
  32.3.2 D-AMPS System, 532
  32.3.3 Personal Digital Cellular System, 534
32.4 Personal Communications Network, 535
  32.4.1 CT1–CT3 Systems, 536
  32.4.2 Japanese Personal Handyphone System, 537
  32.4.3 Digital European Cordless Telecommunications, 537
  32.4.4 Personal Access Communications System, 539
32.5 International Mobile Telecommunication System, 540

33 Telephony and Deregulation

33.1 Telecommunications Deregulation and Liberalization, 546
33.2 Telephony and Deregulation in the Americas, 551
  33.2.1 Telephony and Deregulation in the United States, 551
  33.2.2 Telephony and Deregulation in Canada, 555
  33.2.3 Telephony and Deregulation in Mexico, 556
  33.2.4 Telephony and Deregulation in Central America, 557
  33.2.5 Telephony and Deregulation in the Caribbean, 558
  33.2.6 Telephony and Deregulation in Brazil, 558
  33.2.7 Telephony and Deregulation in Chile, 559
  33.2.8 Telephony and Deregulation in Argentina, 561
  33.2.9 Telephony and Deregulation in Peru, 561
  33.2.10 Telephony and Deregulation in Venezuela, 561
  33.2.11 Telephony and Deregulation in Colombia, 561
  33.2.12 Telephony and Deregulation in Ecuador, 562
  33.2.13 Telephony and Deregulation in Bolivia, 563
  33.2.14 Telephony and Deregulation in Uruguay, 563
  33.2.15 Telephony and Deregulation in Paraguay, 563
33.3 Telephony and Deregulation in Africa, 563
  33.3.1 Telephony and Deregulation in North Africa, 565
  33.3.2 Telephony and Deregulation in South Africa, 566
  33.3.3 Telephony and Deregulation in Sub-Saharan Africa, 566
33.4 Telephony and Deregulation in Asia, 567
  33.4.1 Telephony and Deregulation in India, 568
  33.4.2 Telephony and Deregulation in China, 569
  33.4.3 Telephony and Deregulation in Japan, 571
  33.4.4 Telephony and Deregulation in Other Asian Countries, 573
33.5 Telephony and Deregulation in Europe, 574
33.5.1 Telephony and Deregulation in the European Union, 575
33.5.2 Telephony and Deregulation in Eastern Europe, 575
33.6 Telephony and Deregulation in Oceania, 577

34 Multimedia

34.1 Evolution Leading to Multimedia, 580
34.2 Computers and Communications, 581
34.3 Global Information Infrastructure, 581
34.4 Internet, 583
34.5 Global Village, 589
34.6 Multimedia Services, 590

35 International Cooperation

APPENDICES

A Chronology of the Major Events in the Two Centuries of Telecommunications 601

B Worldwide Statistics of Population, Internet Users, Cellular Phones, and Main Telephones 607

C Glossary 613

INDEX 621