

Index

- μ -law, 153–154
Abbreviated dialling, 116–117, 120–122, 531
Abramson, A. N., 446
Absorption coefficient, 250, 254
loss, 266
region, 245
Abstract syntax notation.1 (ASN.1), 438–439
Acceptance cone (angle), 263–265
Access control (AC), 459, 461
Activity management, 437
Adaptive delta modulator, 160
Adaptive differential PCM (ADPCM), 158, 160–161, 517
Address resolution protocol (ARP), 482
Address translation, 64
Administrative programs, 112, 119
Advanced data communication control procedure (ADCCP), 428
Alarm circuit, 44, 46
 A -law, 153–154
Aliasing, 144, 146
Allotter, 42–43, 54–55
ALOHA protocols, 446–450, 454, 458
Alternate mark inversion (AMI) (*see codes*)
American National Standards Institute (ANSI), 23, 477
Amplitude shift keying (ASK), 400
Angular misalignment, 266
Antenna(s), 333–335, 341–343, 390
APPLE, 348
Application layer, 442
Arc contact, 37
Area code, 360, 363
ARPANET, 22, 414, 434, 483
Artificial intelligence (AI), 544
Association control service element, 442
Association Francaise de Normalisation (AFNOR), 23
Asynchronous transmission, 167–169, 473
Atmospheric layers, 331–333
Attenuation, 70–73, 164, 262, 266, 269, 316, 319, 326–327, 330
Attitude and orbit control system, 348
AT&T (*see also Bell System*), 87
Authentication, 441–442
Authority and format identifier (AFI), 420–421
Automatic alarm, 126, 494
Automatic message accounting, 367
Automatic redialling, 123, 322
Automatic repeat request (ARQ), 425–432
Automatic toll ticketing, 367
Availability, 92–94
Avalanche photodiode (APD), 252, 258–262
- Backward sequence number, 385–386
Backward signalling paths, 378
Balanced connections, 321
Band gap, 241–242
Band separation, 69–71
Bandwidth electrical, 245–246
optical, 246
spreading factor, 353
Bandwidth-distance product, 229, 233–234
Bank contacts, 37–38, 41

- Base station, 389
 Baseband transmission, 451
 Baseline networks, 130
 Basic rate access, 516
 Battery testing, 45
 Baud rate(s), 398–399
 Bearer service, 528, 532
 attributes, 530
 functions, 512
 Bell, Alexander Graham, 1
 Bell System(s), 376–377, 380
 D1 24-channel, 380
 D2 24-channel, 380–381
 Bernoulli traffic, 300
 Betulander, 62
 Binary exponential back-off, 458
 Binary N zero substitution, 173
 Binary synchronous communication (BISYNC), 428
 Binomial formula, 300
 Birth-death (B-D) process, 284–287, 292, 294, 297, 307
 Bit oriented protocols, 428
 Bit stuffing, 169, 385–386, 428
 Bit vector, 190
 BITNET, 23, 497
 Blocking models, 278
 Blocking network (switch), 12, 77–79, 306
 Blocking probability, 12, 48, 50, 54, 57, 129–134, 217–219, 221, 223, 225, 273, 278–280
 Boltzmann equation, 248
 BORSCHT, 321
 British Standards Institution (BSI), 23
 British Telecom, 177
 Broadcast connection, 205, 213
 Broadcast services, 547
 Bureau of Indian Standards (BIS), 23
 Busy hour, 274
 call attempts (BHCA), 275
 calling rate, 275
 traffic, 14, 389
 Busy tone, 34–35
 Byte oriented protocol, 428
 Byte stuffing, 428
 Cable hierarchy, 315
 Call(s)
 arrival rate, 277
 barring, 66, 531
 charging, 66
 completion rate, 275
 congestion, 279–280, 297
 distribution, 304
 faults, 46
 forwarding, 120, 123
 messages, 521
 priority, 66
 processing, 64–65, 83, 94, 101, 103, 112, 119, 122, 304
 reference, 522
 release signals, 64
 request, 64
 setup time, 48
 supervision, 523
 waiting, 121, 124, 531
 Call back when free, 120, 123
 Call minutes, 276–277
 Call seconds, 276
 Called subscriber, 1
 Calling line data, 115–116
 Calling line directory, 125
 Calling number record, 121, 123
 Calling subscriber, 1
 Call-in-progress tone, 35
 Carbon microphone, 8
 Carried traffic, 278–279, 297
 Carrier(s), 379
 diffusion, 244, 254, 256–257
 drift, 256–257, 261
 lifetime, 242–243
 mobility, 254
 multiplication, 258, 260, 262
 recombination, 241–243, 246, 332
 transit time, 256, 261

- Carrier sense multiple access
 (CSMA), 454–458
 CSMA/CA, 463
 CSMA/CD 457, 477
 CASNET, 541
 Cattermole, K. W., 152
 CATV (*see* community antenna television)
 CCIR, 347
 CCITT, 22–25, 107, 110–111, 120,
 153, 173, 274, 317, 323, 324,
 325, 327, 329, 358, 360, 374,
 376, 380, 402, 414, 420, 428,
 473–474, 478, 483, 490, 503,
 518, 520, 525–526, 530, 535
 hierarchical structure, 324
 man-machine language (MML),
 111
 multiplexing standard, 178–179
 Plenary Assembly, 110, 497
 CCITT recommendation(s), 540
 E.160, 358
 E.163, 358, 525
 G.702, 490,
 G.705, 535
 Q.23, 73
 R1, 374
 R2, 374–377
 X.20 (bis), 474
 X.21 (bis), 474
 X.25, 474, 482, 483, 484, 515, 522
 X.200, 414
 X.3, X.28, X.29, 474
 X3T9.5, 477
 X.4 xx series, 497–501
 X.75, 482
 Zxxx series, 107, 110
 Ceiling function, 130, 185
 Cellular communication(s), 388–390
 Central battery (CB) exchange, 16
 Central hub, 446
 Central trunk switching centres, 362
 Centum call second (CCS), 276
 CEPT, 380, 381
 Characteristic impedance, 164–165,
 334
 Charging, 64–67, 364–365
 Check bits (sum), 382, 426
 Check-out program, 90
 Chromatic distortion, 239
 Circuit switching, 404, 408
 City-wide centrex, 531
 Classes, protocols (*see* Transport protocols)
 Class of service, 66, 117
 Clos, C., 134
 Closed numbering scheme, 358, 360
 Coaxial cable(s), 326, 354–357,
 452–453
 Coaxial cable system(s), 331,
 356–357
 Code(s)
 AMI, 171–174
 bipolar, 170–171
 Hamming, 425–426
 Huffman, 440, 503–504
 Manchester, 171
 polynomial, 426
 READ, 503–504
 run length, 503
 ternary, 175
 unipolar, 169–170, 239
 violation, 172–174
 Code division multiple access (CDMA), 353
 Coherent source, 239
 Coin operated boxes, 115, 368
 Collision, 446–450, 454–457
 Combination switch(ing), 4, 210
 Command frame, 432
 Command syntax, 121
 Commercial and operational attributes, 530
 Commitment, concurrency and recovery, 442
 Common carriers, 21
 Common channel signalling (CCS),
 86, 369, 370–374, 382–384, 514

- channel associated, 371, 383
 quasiassociated, 371
- Common communication format (CCF), 438
- Common control, 15, 47, 62, 64–65, 67, 86
- Commoned, 49
- Common signalling network, 387
- Commonwealth of Independent States(CIS), 360
- Community antenna television (CATV), 269–270, 451, 453, 465, 466
- Companding, 149, 152–155
- Computerised branch exchange (CBX), 452
- Computer-controlled signalling networks, 325
- COMSAT, 352
- Concurrency control, 443–444
- Concurrent computation, 110–111
- Conduction band, 248, 259
- Conference call(s), 121, 125
- Congestion control, 432
- Connection oriented service(s), 422–424, 477
- Connectionless service(s), 422–424, 477
- Connector loss, 262–263
- Consultation hold, 121, 124
- Contention, 454
- Context switching, 103
- Contiguous allocation, 551–552
- Continuous, RQ, 431
- Continuously variable slope delta (CVSD) modulators, 157
- Control functions, 3, 64, 88–89, 94, 96
 centralised, 88–89, 96
 decomposition of, 96
 hard-wired 3, 96–97
 microprogrammed, 96–98
- Control memory, 185–215
- Conversational service(s), 547
- Coordinate switching, 74
- Cordless phones, 390
- Corning Glass Works (UK), 230
- Cost capacity index, 48, 76, 189
- Country code, 360
- Coupling efficiency(ies), 239, 263–264
- Critical angle, 236–238, 244–245, 263
- Critical frequency, 333
- Critical region (section), 105
- Crossbar, 3, 4, 62, 67, 74–83
 No. 1 crossbar, 62
 No. 4 crossbar, 223
- Crosspoint(s), 74–81, 127, 183, 225
- Crosstalk performance, 356
- CSNET, 23, 496
- Cyclic control, 184–189
- Cyclic redundancy code (CRC), 386, 426
- Cyclic services, 547
- Daisy chain polling, 465
- Dark current, 252, 258
- Data circuit terminating equipment (DCE), 402
- Database access, 494, 506
- Data communication architecture, 413
- Data compression, 438, 440
- Data encryption standard (DES), 441
- Datagram service, 412, 423, 475
- Data in voice answer (DIVA), 73, 364
- Data link layer, 424, 513
- Data memory, 193–197, 209–215
- Data network standards (*see also* CCITT recommendations), 471
- Data network(s), 7, 22–23, 304, 325, 384, 394, 424, 492
- Data scramblers, 169

- Data terminal equipment (DTE),
 473
 Data transmission (communication)
 (see also pulse transmission),
 73, 394, 403–404, 408–409,
 413, 425–426
 Date and time stamp, 506
 Day-to-busy hour traffic ratio, 275
 Deadlock, 105
 Declarative techniques, 542
 Decorrelator, 223–224
 Decryption, 440, 442
 Delay
 bounded, 460, 462
 characteristics, 72
 distortion, 70
 equalisers, 357
 lines, 357
 probability, 279
 systems, 278, 304–310
 variation, 408, 413
 Delta modulation(DM), 156
 Demand assigned multiple
 access(DAMA), 352, 446, 454
 Department of Defence, USA, 414
 Department of Posts, India 22
 Department of Telecommunications, India 22, 402
 Depletion region, 255, 257–258
 Design parameters, 46–48, 50–51,
 53–54, 58–59, 76
 Detector, 71
 Deterministic service time, 306–307
 Deutsches Institut fur Normalisiche
 (DIN), 23
 Diagonal connection matrix, 77
 Dial tone, 33–34
 Dialling procedure(s), 361–362
 Dialling (pulse) rate, 29, 73
 Differential pulse code modulation
 (DPCM), 156–158
 Digit processing, 362
 Digit receiver, 65, 304
 Digital network architecture
 (DNA), 23, 414
 Digital signal processing (DSP), 160
 Digital signature, 442
 Digital speech interpolation (DSI),
 376
 Digitalisation, 8
 Direct control, 15, 40
 Direct distance dialling (DDD), 358
 Direct inward dialling (DID), 16,
 363, 527
 Direct memory access (DMA), 99,
 195
 Direct outward dialling (DOD), 363
 Directive gain, 336
 Director system, 62–64, 358
 Directory number, 66, 115–117
 Directory service(s), 442, 480
 Direct-to-user (DTU) terminal, 350
 Discrimination, 387
 Distortion
 delay, 70
 phase, 164
 Distributed computing, 450
 Distributed parameters, 164
 Distributed queue dual bus
 (DQDB), 479
 Distributed SPC, 88, 96–101
 Distribution cable(s), 315
 Distribution point, 315
 Distribution services, 547
 Diversity, 344
 Documentation distribution, 450
 Domain specific part (DSP), 420
 Double heterostructure, 242–243
 Double-ring pattern, 35
 DTE-DCE interfaces, 474
 Dual bus LAN, 464
 Dual port memory, 197
 Dual processor architecture, 89
 Dual tone multifrequency (DTMF)
 signalling, 70, 99, 115, 119, 364
 Dumb terminals, 445

- Earphone**, 8–9
Earth testing, 45
Echo, 326
 cancellors, 327, 329
 checking, 425
 listener, 329
 suppressors, 327
 talker, 329
Effective isotropically radiated power (EIRP), 336, 349, 353
Einstein relation, 254
Electromagnetic frequency spectrum, 331
Electromechanical switching, 3–4, 79, 86–87, 114, 378
Electronic access of information, 507
Electronic banking, 492
Electronic fund transfer, 494
Electronic mail (Email), 442, 495–499
Electronic switching, 3–4, 79, 87–88,
 108, 119, 125, 365
Electronic switching systems (ESS), 88, 111, 226
 No. 1 ESS, 87
 No. 4 ESS, 222–225
Electronic telephone, 322
Electrostatic discharge, 229
Emission response time, 240, 244
Encoding/Decoding, 424
Encryption, 438, 440–441
End delimiter (ED), 459
End-to-end connectivity, 24, 491
End-to-end layer(s), 421, 434
End-to-end signalling, 67, 73, 374, 378, 523
Energy band, 241–242
Engest traffic, 296–297, 301
Enhanced services, 115, 120
Ensemble statistical parameters, 282–283
Entity, 1, 415, 417, 419–420
Equalisation, 356–357
Equivalent circuit, 164–166, 256
Equivalent noise temperature, 354
Ergodic processes, 283
Ergonomicity, 531
Erlang, 14, 222, 276, 389
 B formula, 296, 309, 389
 C formula, 309
 delay formula, 309
 first formula, 309
 loss formula, 296
 second formula, 309
 traffic, 294, 296, 301
Erlang, A.K., 276, 293
Erlang-*k* distribution, 307
Error(s)
 bursty, 425–426
 control, 425
 correction, 401, 425–426
 detection, 401, 425–426, 436
 recovery, 424, 435–436
Etched well, 243
Ethernet, 457
European Academic Research Network (EARN), 23
Event monitoring, 64–65, 94, 97
Exchange code(s), 64, 117, 359–360
Expanding switch, 131, 209, 217, 221–222
Expert system(s), 540, 542–544, 546
Exponential distribution, 284, 289, 292, 307
Exponential power law, 254

Facsimile, 501–505, 516–517, 528, 532, 535
Factory automation, 450
Fading, 336, 344, 346–347
Failure management, 436
FASNET, 469
Fault alarms, 103
Fault tolerance, 87, 99, 325
Feeder point, 315

- Fibre distributed data interface (FDDI), 469, 478
 Fibre optic cable (*see* Optical fibre),
 Fibre optic communication system, 229, 265, 267, 270, 331
 Fibre optic networks (FON), 466–470
 Figure of merit, 354
 File transfer, access and management (FTAM), 442–443
 File transfer protocol (FTP), 483
 Fill-in signal unit, 385–386
 Final selector(s), 41, 45, 56, 58–59
 Final translator, 65–67
 Finger plate, 30–31
 Finite state machine (FSM), 108–109
 First choice routing, 323
 First selector, 42–43
 First-come-first-served (FCFS), 198, 306, 412, 551
 Five-stage network, 136–137
 Fixed boundary scheme, 551
 Flat rate tariff, 366
 Flow control, 280, 423–425, 432, 436
 Folded network(s), 12–13, 188, 208
 Foldover distortion, 144
 Formal description technique, 106
 Forward drive, 37
 Forward error correction (FEC), 425
 Forward sequence number (FSN), 386
 Forward signalling path, 378
 Fourier transform, 160
 Frame synchronisation, 177, 380–381
 Frame time, 447
 Frame(s), 424, 432, 542
 Frequency diversity, 344–347
 Frequency division multiple access (FDMA), 352
 Frequency division multiplexing (FDM), 378–379
 Frequency shift keying (FSK), 400
 Fresnel phenomenon, 339
 Friis, H. T., 342
 Full availability, 128
 Full duplex, 10, 424
 Fully connected network, 2, 128, 323
 Game playing, 540
 Gap loss, 266
 General attributes, 528, 531
 General Motors (GM), 479–480
 General problem solving, 540
 General switched telephone network (GSTN) (*see also* PSTN), 22, 473–474
 Geometric distribution, 284
 Global database, 544
 Global titles, 420
 Grade of service (GOS), 278–280, 294, 297, 301–302, 389
 Grading, 58
 Groundwave communication, 333
 Group selector, 41, 43, 56–59, 83
 Guarding, 44–45
 Guided mode, 237
 Half duplex, 10, 424
 Handing over, 390
 Hierarchical network(s), 323, 325
 Hierarchical routing, 434
 High band frequency, 71
 High definition television (HDTV), 548
 High layer attributes, 532
 High level data link control (HDLC), 428, 514
 High level languages, 110
 High usage routes, 323
 Holding circuit, 45
 Holding times, 277, 292, 389
 HomeNet, 465
 Homing, 37, 44–45

- Hops, 410, 433
 Hub polling, 465
 Huffman coding, 440, 503
 Human-machine interface, 86
 Hunting circuit, 45
 Hybrid, 322, 326
 Hyperboloidal subreflector, 343
 Hyperexponential distribution, 307
- IBM, 314, 438
 Idle RQ protocol, 429
 IEEE, 471, 483
 IEEE standards, 480
 - 802.3 CSMA/CD, 480
 - 802.3 LAN, 483
 - 802.5, 477, 481
 - 802.6, 477
 Impact ionisation, 259
 Implicit token, 463
 Impulse ratio, 32
 Impulse train, 38
 Impulsing cam, 30
 Impulsing circuit, 44
 Impulsing contacts, 30
 Initial domain identifier, 420
 Initial translator, 65–66
 Injection laser diodes, 239
 Input-controlled switch, 185–186,
 - 191, 202, 204, 212
 INSAT, 348
 Integrated digital network (IDN),
 - 490–491, 508, 533
 Integrated services digital network

 (ISDN) (*see* ISDN)
 Intelligent networks, 25
 INTELSAT, 349, 352, 354
 Interactive services, 547–548
 Interactive video, 270
 Interarrival time, 305, 307
 Intercontinental dialling, 376
 Interdigit gap, 29, 32, 73
 Interface control information (ICI),
- Interface data units (IDUs),
 - 417–418
 Interlibrary loan (ILL), 482
 International gateway exchange, 362
 International number, 363
 International standardisation

 organisation (ISO) (*see also*
 ISO), 414
 International subscriber dialling

 (ISD), 358
 International Telecommunications

 Union (ITU), 22
 Internet control message protocol

 (ICMP), 483
 Internet protocol (IP), 434, 483
 Internetworking (*see also*
 interworking), 421, 434
 Interpersonal messaging service(s),
 - 501
 Interprocessor communication, 103
 Interrupt contact, 37
 Interrupt(s)
 - priority, 103
 - vector, 95
 Intersymbol interference, 164, 239,
 - 357
 Interworking (*see also*
 internetworking), 432, 530, 532
 In-call modification, 523
 Ionisation, 261, 332
 Ionospheric communication,
 - 331–333, 344
 Isarithmic control, 434
 ISDN, 369, 385, 387, 473, 490–491,
 - 494, 504–505, 508, 512–518,
 - 524, 547, 549
 addressing, 527
 architecture, 491
 broadband, 547–548
 channels, 514–516, 548
 conceptual principles, 490–491
 numbering, 421, 524, 534–535
 services, 527–528
 ISDN recommendations, 536

- G.702, 490, 535
- G.705, 535
- I.100–I.200, 535
- I.300, 536–538
- I.400, 537, 539
- I.500, 537, 539
- I.600, 539
- ISDN signalling message(s), 522
- ISDN user part (ISUP), 385, 387, 521, 523, 524
- ISO, 420, 428, 472, 478, 482, 534
- ISO-OSI reference model, 388, 415, 422, 432, 434, 442, 445, 453, 471, 473, 477, 478, 512, 514, 516, 527, 534
- ISO standards, 471–472
 - DP 10162, 507
 - DP 10163, 507
 - IS 7498, 414
- Isochronous channel, 477
- Isotropic radiator (source), 265, 335
- Jacobaeus, C., 132, 139
- Jammer signal, 457
- Joint Academic Network (JANET), 23, 497
- Jitter, 169
- Kendall, D. G., 306
- Key distribution, 441
- Knowledge gateways, 506
- Knowledge representation (engineering), 541, 542
- Lambertian source, 265
- L~N (see Local area network)
- Laser diode(s), 247–251, 265
- Lasing action, 240
- Last mile problem, 408
- Last-come-first-served (stack), 198
- Layering principles, 417
- Lee, C. Y., 132
- Lee's graph, 133, 138, 220
- Legal qualifications, 444
- Library automation protocol (LAP), 478, 481
- Light emitting diodes (LEDs), 242–246, 248, 265
- Limiter, 70–71
- Line(s)
 - category, 66
 - coding, 169–175, 357
 - equipment, 40
 - equipment number, 115
 - finders, 40, 42–44, 53
 - parameters, 67
 - quality, 408
 - selection, 83
 - signalling, 369
 - unit(s), 64–65, 82
- Line build-out (LBO) networks, 357
- Linear predictive coders (LPC), 159–160
- Link access procedure (LAP), 428
- Link access procedure-balanced (LAP-B), 428, 475
- Link frames, 82
- Link power budget, 262
- Link status signal unit, 385
- Linked numbering scheme, 358
- Link-to(by)-link, 379, 383, 421
- List management operations, 198
- Listen-before-talk scheme, 454
- Listen-while-talking, 456
- Little's result, 511
- Load sharing, 89, 91–92
- Loading coil(s), 167, 319–320
- Local area network, (LAN),
 - 394–396, 425, 450–453, 484
 - bus, 452–458
 - fibre optic ring, 451–453
 - ring, 462
 - topologies, 452, 461
- Local battery (LB) exchange, 16
- Lock tone, 377

- Logarithmic law, 152
 Logatoms, 317
 Loop gain, 329
 Loop resistance, 316
 Loss
 estimates, 292
 probability, 279–280
 Loss system(s), 278, 292, 306–307
 lost call delayed (LCD) systems, 304
 lost calls cleared (LCC) systems, 293–301
 lost calls held (LCH) systems, 293, 302–303
 lost calls returned (LCR) system, 293, 301–302
 Lost traffic, 278–279
 Low band frequency, 71
 Low layer attributes, 532
 Low-loss regions, 231, 239
 Low pass filter, 143, 378–379
- Made-up code part, 503
 Magneto exchange, 16
 Main distribution frame (MDF), 315
 Main exchange, 358
 Maintainability, 226
 Maintenance, 67, 100–101, 112, 120
 Make-before-break, 44
 Malicious call, 121, 125
 MAN (*see* Metropolitan area networks)
 Manual exchanges, 28
 Manufacturing automation protocol (MAP), 450, 479–481
 Map-in-memory, 67
 Map-in-network, 67
 Marker(s), 65–66, 82–83, 99
 Markov chain, 284
 Markov process(es), 283, 289–290, 292
 Markov, A.A., 284
- Master earth station (MES), 350
 Master station, 389
 Mean time between failure (MTBF), 93–94
 Mean time to repair (MTTR), 93–94
 Memory-controlled switch, 190
 Mesh network, 323
 Message handling system(s) (*see also* Electronic mail), 442
 Message services, 547
 Message signal unit, 386
 Message switching, 304, 410
 Message transfer agent entity (MTAE), 497
 Message transfer part (MTP), 384–385
 Message transfer service(s), 501
 Message transfer system (MTS), 498
 Message type, 522, 524
 Metering circuit, 44–45
 Metropolitan area network(s) (MAN), 394–395, 425, 465–466
 Microcom networking protocol (MNP), 402
 Microwave communication, 326, 331, 337, 407
 Mid-riser quantisation, 150–151
 Mid-tread quantisation, 150–151
 Military radio, 388
 Miniswitches, 79
 Mobile telephone, 388
 Modal dispersion, 238
 Modelling, 284, 292
 Modems, 382, 396, 399–400, 402
 Modulation bandwidth, 245–246, 248
 Module chaining, 112–113
 Movable boundary scheme, 551–552
 Multidrop lines, 428
 Multiexchange area, 62, 358
 Multiframe, 380–381

- Multifrequency (MF) dialling, 29, 66
 Multifrequency key pulsing (MFKP), 69
 Multihop transmission, 332–333
 Multimetering, 365
 Multipath fading, 336
 Multiple access bus LAN, 454
 Multiplied, 49
 Multiplexing, 357, 436, 515
 Multistage network, 77, 127
 Multitermination, 18
 Multiunit message, 383
 Mutual exclusion, 104
- Narrow band ISDN (NISDN), 547
 Narrow band frequency modulation, 389
 National Bureau of Standards, (US), 347
 National numbering plan, 360, 362–363
 Natural language understanding, 540
 nBmT codes, 175
 Nearest neighbour principle, 426
 Netnews, 23
 Network addressable unit (NAU), 483
 Network intelligence, 384
 Network layer, 432, 513
 Network management, 387, 491
 Network service part (NSP), 385, 387
 Network termination 1 (NT1), 518
 Network termination 2 (NT2), 519
 NICNET, 351, 353
 No dialling calls, 66, 122
 Nonblocking, 12, 50, 55, 76–77, 79, 131, 134–135, 196, 206, 209, 217–218, 221
 Nonfolded, 1, 3–14, 189, 209
 Nonradiative recombination, 244
 Nonvoice services, 142, 491
 NOSFER (Nouveau système fundamental des équivalents de référence), 317
- Number space, 364
 Number unobtainable tone, 35
 Numbering and addressing, 524
 Numbering area, 361
 Numbering interworking, 533
 Numbering, 73, 358
 uniform, 62, 64, 35
 Numerical aperture (NA), 263–264
 Numerical selector, 43, 55
 Nyquist's theorem, 397–398
 N-stage combination switching, 223
- Offered traffic, 278–279, 297, 301
 Office code translation, 118
 Off-hook, 46, 119–120, 123, 316
 Off-normal, 30–32
 Open captioning, 495
 Open numbering plan, 358
 Open system interconnection (OSI)
 (see ISO-OSI reference model), 387, 497,
 Open-channel teletext, 494
 Operating region, 251
 Operations of the OSI virtual filestore, 443
 Operations, administration and maintenance (OA & M), 95, 97, 100–101, 385–387
 Operator answer service, 121, 123
 Optical amplification, 249
 Optical communication system, 6, 262
 Optical detector, 251
 Optical fibre(s) (see also fibre optic), 230, 453, 466
 attenuation, 262–263
 pigtail, 243
 types of, 232–233
 Optical horizon, 338
 Optical power, 239, 245, 250, 254, 256
 Optical radiation, 253–254
 Optical sources, 239

- OSI reference model (*see* ISO-OSI reference model)
- Output-controlled switch, 187–190, 202, 204, 212
- Overlapped operation, 195, 198, 212
- PABX** (*see* Private automatic branch exchange)
- Packet assembler/Disassembler (PAD), 445
- Packet loss, 436
- Packet switching, 304, 384, 410
- Packet transmission, 410, 412, 474
- Packetised voice transmission, 550
- Page mode display, 444
- Pair selected ternary (PST), 176
- Palmgren, 62
- Parallel-in/Parallel-out switch, 211, 214–215
- Parallel-in/Serial-out switch, 211, 213
- Parameterised design, 112–113
- Parasitic diode, 244
- Party lines, 320
- Pass-along service, 524
- Path finding, 67
- Pawl, 30, 36
- P-code, 438
- Peak-hour load, 52
- Peer entities, 417, 424, 435
- Peer protocols, 417, 424
- Periodic pulse metering, 366
- Permanent identification number, 492
- Permanent virtual circuit (PVC), 412, 475
- Petri nets, 107
- Phase locked loop (PLL), 168
- Phase modulation, 399
- Phase shift keying (PSK), 400
- Phase velocity, 164
- Phone point, 390
- Phonon(s), 242
- Photocurrent, 253, 260
- Photodetector, 251
- Photodiode(s), 252, 255, 258
- Photomultipliers, 252
- Photon absorption, 247
- Photon lifetime, 251
- Photon-generated carrier(s), 258, 262
- Phototransistors, 252
- Physical layer, 424, 512
- Physical symbol system, 541
- Piggyback, 386, 429–431
- Pilot tones, 357
- Ping-pong effect, 123
- Pinion, 30
- p-i-n photodiode(s), 255–256, 258, 262
- Pipelined ARQ protocols, 431
- Pitch interval, 156
- Plain old telephone system (POTS), 21, 314
- Planck's law, 247
- Plug-ended cord pair, 16
- Point-to-multipoint, 446, 548
- Point-to-point, 425, 446, 548
- Poisson, 293
- arrival, 288, 303, 306–307
 - equation, 296
 - process, 288, 290–293, 295
 - traffic, 296
- Polarisation, 336,
- diversity, 344–346
- Population inversion, 248–249
- Post dialling delay, 377
- Posts and Telegraphs (P&T), 22, 404
- Post, Telegraph and Telephone (PTT), 21
- P-out-of-N code, 69
- Power
- budget, 262
 - feed, 356
 - gain, 335–336

- loss, 266
 spectral density, 249
Power-bandwidth product, 246
Pre-emptive scheduling, 551
Prefix digits, 362
Prefix signal, 375
Preselector(s), 40, 59
Presentation layer, 438
Primary centres, 323
Primary rate access, 516
Primitive data types, 438
Private automatic branch exchange(s) (PABX or PBX), 16, 81, 87, 99, 123, 363–364, 395, 452, 520, 524
Private key cryptography, 441
Process, 102
 interactions, 107
 operations, 111
 priority, 111
 states, 102
 transitions, 111
Process control, 450
Process control block (PCB), 103
Processing delay, 412
Processing gain, 353
Production rules, 543
Protocol
 control information (PCI), 418
 data units (PDUs), 417, 500
 discriminator, 522
 stack(s), 479
 structure of, 418
 suite(s), 479
PROWAY, 480–481
Pseudo random number, 388
Pseudo ternary codes (*see* codes)
Public data networks (PDNs), 394
Public key cryptography, 441–442
Public switched telephone network (PSTN) (*see also* GSTN), 21–22, 315, 395–398, 402, 404, 420, 504
Pulse amplitude modulation (PAM), 142, 144, 183–184, 191, 268
Pulse code modulation (PCM), 268
Pulse
 dialling, 29, 66–67, 159, 177, 191, 374, 490, 493, 517
 frequency modulation, 268
 position modulation, 268
 shaping units, 358
 signalling, 379
 spreading, 238
 transmission, 160–169
 width modulation, 268
Pulsing circuits, 46
Pumping, 248–249
Pure birth process, 287, 290
Pure chance traffic
 type 1, 294
 type 2, 297
Pure death process, 291
Push button, 68, 73
P-wire, 44–45
Pyramidal table structures, 117–118
Pyroelectric detectors, 252

Quadrature amplitude modulation (QAM), 400–401
Quality of service, 273, 280, 435–436, 530
 parameters, 435
Quantisation, 144
 error, 147, 149–150
 level, 150–151
 noise, 147
 nonuniform, 150
 steps, 154
Quantised PAM, 146
Quantiser, 147
Quantum efficiency, 243, 246, 248, 253, 260
 external, 244–245, 250
 internal, 244, 250

- Queue length(s), 305–306
 Queue parameters, 307
 Queued packet and synchronous exchange switch (QPSX), 478
 Queuing, 278, 304–307, 412
 capacity, 306
 delay, 412
 models, 278
 notation, 306
 theory, 304
- RABMN, 352–353, 357
 Radiance, 240
 Radiation
 efficiency, 335
 loss(es), 266–267
 Radio
 communication, 452
 horizon, 338
 networks, 395, 446
 spectrum, 331
 Random allocation, 551
 Random input/Random output, 193, 196–197
 Random process(es), 280, 283
 Random write/Sequential read, 193, 195–196
 Ratchet, 30
 Rate adaptation, 514
 Ray optics, 234–237, 244, 263
 Rayleigh scattering, 267
 Reach-through avalanche photodiode (RAPD), 259
 Reasoning strategies, 544
 Recorded number calls, 120, 122
 Recorrelator, 225
 Redundancy, 156, 444
 Reed relays, 79, 81
 Reference equivalent (RE), 317–318, 326
 Reflected ray, 235
 Reflection, 249, 329–330, 332
 Reflectivity, 255
- Refraction, 332
 angle of, 235
 Refractive index (es), 231, 235, 238, 251, 263
 Register, 14, 82
 finder, 65
 sender, 65–66
 Register insertion ring, 462
 Relative element address designate (READ), 503
 Release magnet, 38
 Reliability, 96, 106, 226, 531
 Remote computing, 394
 Remote control, 73
 Remote diagnosis, 100
 Remote file access, 442
 Remote procedure call (RPC), 438
 Renewal process(es), 287, 290–291
 Repeater(s), 356
 Replication, 443–444
 Residual error, 435
 Resonating oscillator, 249
 Responsivity, 253, 260
 Retransmission, 410
 Retrieval services, 547
 Return loss, 329
 Reverse drive, 37
 Reynolds, J. N., 62
 Ring interface unit(s) (RIUs), 453, 461, 462, 467–468
 Ring lead (line), 33, 453
 Ringing circuit, 17
 Ringing current, 34
 Ringing tone, 34
 Ring-trip circuit, 44, 46
 Roll back, 111, 437
 Rotary dial, 29, 67–68, 115, 119
 Rotary switch, 36
 Round robin access, 460
 Round trip delay, 330, 351
 Route diversity, 268
 Routing, 322–325, 387, 410, 432–434
 computer controlled, 323
 digits, 64

- tone, 33, 35
- Rule base, 543

- Sampling, 147, 156, 191
- Satellite, 326
 - channel, 447
 - communication(s), 331, 347, 350–352
 - exchange, 358, 363
 - frequency band, 349
 - geostationary, 347–348, 395, 446
 - geosynchronous, 348, 351, 395
 - links, 384, 404, 407
 - spacing, 349
- Satellite based data networks (SBDNs), 395, 445
- Scanners, 99
- Scattering loss, 230, 266
- Scrambling/Descrambling, 358
- Scripts, 542
- Scroll mode, 445
- Search and retrieve (SR) protocol, 482
- Secondary attributes, 530
- Seizure circuit, 41
- Selective repeat retransmission, 431
- Selector circuit(s), 46, 70–72
- Selector hunter, 40, 42–44, 53
- Self-stepping mode, 51
- Semaphore, 105
- Semi-intelligent terminals, 445
- Semiopen plan, 359
- Semipermanent data, 113–114, 117
- Sequence number, 430, 432
- Sequential write/Random read, 193, 196, 206
- Serial-in/Parallel-out switch, 211–212
- Serial-in/Serial-out switch, 211
- Server(s), 275–276, 295, 303
- Service access points (SAPs), 417, 419–420
- Service activation/deactivation, 122

- Service attributes, 528
- Service data unit (SDU), 417–418
- Service discipline, 306
- Service provider, 73, 416
- Service request number, 117
- Service time
 - characterisation, 287
 - distribution, 306–307
- Session layer, 436
- Session protocol machine (SPM), 483
- Shannon, C.E., 398
- Side lobes, 335
- Sidetone, 10
- Signal distributor, 88
- Signal to quantisation noise ratio (SQNR), 148–149
- Signalling, 2–3, 73, 86, 325, 520
 - a.c., 370
 - bunched, 382
 - channel, 514
 - common channel (*see* Common channel signalling)
 - d.c., 370, 377–379
 - DTMF (*see* Dual tone multifrequency signalling)
 - duration, 69
 - E & M, 377–378
 - equipment, 378
 - frames, 381
 - inband, 370, 374
 - interoffice, 292
 - interregister, 369, 376–377
 - inslot, 378, 380
 - limits, 316
 - link, 385
 - message based, 521
 - MF, 378
 - mode, 389
 - network level, 523
 - outband, 370, 378–379
 - outslot, 380
 - per trunk, 370
 - rate, 371, 384

- repertoire, 381–382
 stimulus, 521–522
 techniques, 369
 tones, 33
 units, 382
 user level, 521–522
 voice frequency, 374
Signalling access protocol, 530
Signalling connection control part (SCCP), 385, 387, 524
Signalling points (SPs), 371
Signalling system(s), 314, 378
 SS1, 374
 SS2, 374
 SS3, 374
 SS4, 374, 379
 SS5 (*bis*), 373, 375–377, 379
 SS6, 373
 SS7, 386, 521
Signalling transfer points (STPs), 371
Signal-to-noise ratio, 141, 258, 398
Singing, 225, 326, 329
Single hop transmission, 332
Single stage networks, 77, 127, 209
Single-channel-per-carrier (SCPC), 352
Single stage dialling, 534–535
Skin effect, 165, 229
Skip zone(s), 333
Skywave communication, 332–333
Sliding window, 431
Slope overload, 158
Simple mail transfer protocol (SMTP), 483
Snell's law, 235, 264
Software engineering, 106–107
SONET (*see* Synchronous optical network)
Source multiplexing, 204
Space array, 206
Space diversity, 344
Space division, 3
 networks, 126, 184, 186, 189, 225,
 297, 345
Space-time (ST) switch(es), 216,
 218
Space-time space (STS), 219,
 221–223
SPADE, 352
Special study group D, 490
Specialised domain problem solving, 541
Spectral range, 250
Spectral width, 240
Speech
 circuit, 46
 clipping, 303
 detector hangover time, 377
 digitisation, 142
 encoding, 381
 pauses, 141
 traffic, 404
 transmission, 141
Splice loss(es), 262–263, 266
Splicing, 234
Splitting, 435
Spontaneous emission, 249
Spot beams, 349
Spread spectrum technique, 353
SS1–SS7 (*see* Signalling systems), 374, 379
Star networks, 322–324
Start circuit, 41–43, 55
Starting delimiter (SD), 459
Start-stop transmission, 167–168
State description tables, 119
State transition diagrams, 107
Stationary processes, 283
Statistical multiplexing, 177
STD (*see* Subscriber trunk dialling)
Step-by-step switching, 40, 67
Stimulated emission, 239, 247–248
Stochastic processes, 280–281, 283
Stop-and-go strategy, 432
Stop-and-wait protocol, 429–430
Store and forward (S & F), 382,
 404, 408–410, 412–414, 495,
 512

- Stored program control (SPC), 3, 67, 86–87, 114, 125, 128, 384
 processor, 125, 191
 software architecture, 101
 Strowger Almon, B., 3, 28
 Strowger system(s), 3, 28, 67
 Study group (SG) XVIII, 490
 Sub committee 16 (SC 16), 421
 Submission and delivery entity (SDE), 499
Subscriber
 end instruments, 314
 line number, 360
 line state table, 104, 119
 line(s), 5, 319
 loop, 14, 270, 314, 319, 322
 number, 360
 specifications line, 316
Subscriber trunk dialling (STD), 45, 358, 361, 366–368, 415
 barring, 121
Substitution algorithm, 441
Super radiant diode (SRD), 239
Supervision and fault location, 356
Supplementary services in ISDN, 530–531
Suppressor cam, 30
Switch advantage ratio, 136
Switchboard, 17
Switching
 capacity, 47, 76, 127–128, 189, 191, 196–197
 hierarchy, 323
 matrix, 12
 office, 2
 processor, 98
 software, 108
Symbol interval, 400
Symbol rate, 398
Symmetric network, 12
Synchronisation, 105, 107, 385, 436
Synchronisation points, 437
Synchronising pattern, 380
Synchronous data link control (SDLC), 427, 483
 data transmission, 402
FSM, 109
 model, 445
 operation, 89–90, 108
TDM, 177
 transmission, 167–169, 402
Synchronous optical network(s) (SONET), 395
Syntax definitions, 111
Syntax of user commands, 121
System margin, 263
System Networks Architecture (SNA), 23, 413

T1 channel (system), 178, 380
Take-off angle, 336
Talk-off, 69, 72–73
Tandem exchange, 323
Tariff structures, 67, 273–274, 365–368
Technical and office protocol (TOP), 450, 479, 481
Technical committee 97 (TC 97), 421
Telecommunication
 administration(s), 21
 network(s), 7, 21, 25, 284, 319, 358
 traffic, 287
Teleconferencing, 270
Telephone network(s), 7, 21, 72, 394, 403–404, 422
Telephone user part (TUP), 385, 387
Teleservices, 528, 532
Teletex, 494, 505, 528, 536
Teletext, 494–495, 548
Teletraffic theory, 273
Telnet virtual terminal protocol, 483
Terminal adapter (TA), 519

- Terminal circuit state table, 119
 Terminal equipment
 type 1 (TE1), 518
 type 2 (TE2), 519
 Terrestrial communication, 352, 384
 Terrestrial data networks (TDNs),
 395, 424
 Three-party service, 531
 Three-stage network(s), 131,
 219–220
 Threshold
 current, 250
 gain, 249
 wavelength, 252
 Throughput, 449
 Time assigned speech interpolation
 (TASI), 302–303, 376–377
 Time congestion, 279–280
 Time consistent busy hour, 274
 Time division multiple access
 (TDMA), 352
 Time division multiplexing (TDM),
 175–179, 352
 Time division switching, 3, 87–88,
 119, 183, 191
 analog, 185
 phased operation, 193
 slotted operation, 193
 space switching, 187
 time switching, 4, 192–193,
 209–210
 Time domain redundancies, 159
 Time multiplexed switch(es),
 200–201, 203–206, 210, 216
 Time slot interchange (TSI), 206,
 208, 216–217, 220
 Time statistical parameters,
 282–283
 Time-space (TS) switch, 215, 218
 Tip lead (line), 33, 188
 Time-space-time (TST) switch 219,
 221–223
 Token passing
 bus, 463
 ring, 459–460
 Toll, 21, 67, 141
 Tone duration, 73
 Top-down design, 106–107
 Total internal reflection, 236, 245
 Touch tone dial telephone, 67–68
 Touch tone receiver, 70
 Traffic
 engineering, 5, 273
 handling capability (capacity), 47
 99, 189
 intensity, 217, 221–222, 225,
 275–277, 305
 load, 120, 273
 pattern, 273–274
 Transfer syntax, 438
 Transit exchange, 14
 Transmission
 line, 403
 plan, 325
 system, 314, 330
 time, 504
 unit, 390
 Transmission control protocol
 (TCP), 434, 483
 Transport layer, 435–436
 Transport protocol(s), (TP),
 435–436, 483
 Transposition algorithms, 441
 Triplex protocol, 474
 Tropospheric scatter
 communication, 331, 346
 Trunk(s), 5
 capturing, 124
 code, 360
 groups, 323
 junctors, 64
 link frame, 82
 traffic, 277
 Trunking diagrams, 41, 48, 56–57
 Tunnelling, 236
 Turing, A., 544–545
 Two dimensional addressing, 211
 Two-motion selector(s), 35, 38–39,
 51, 53, 56, 58–59

- Two-stage network(s), 82, 92, 126, 129
 Two-stage dialling method, 534
 Two-wire to four-wire, 321, 326
 TYMNET, 23
- UK post office, 177, 380
 Undersea cable systems, 268
 Unigauge design, 319
 Uniselector(s), 35–38, 45, 50, 58–59
 University of Hawaii, 447
 UNIX, 526
 Unvoiced sounds, 159
 USENET, 23
 User agent entity (UAE), 497
 User-network interfaces, 491, 516
 UUNET, 23, 497
- Valence band, 241, 253
 Value added networks (VANs), 533
 Very small aperture terminals (VSATs), 350
 Video conferencing, 547
 Video surveillance, 547
 Video switch, 270
 Videophone, 270
 Videotex, 442, 494–495, 528, 536
- View data, 494
 Virtual circuit (VC), 410, 422, 476
 Virtual file store, 443
 Virtual memory, 112
 Virtual terminal, 445–446
 Vocoders (voice coders), 159–160
 Voice data integration, 549
 Voice frequency signalling, 370
 Voiced sounds, 159
 Voice activated dialling, 390
 V-series recommendations, 402–403
- Waiting line, (*see* Delay systems)
 Wake-up call, 125
 Walsh function (codes), 171–172
 Wave concepts, 234
 Waveguide(s), 229, 343–344
 Wavelength dispersion, 239
 Wide area networks (WANs), 394
 Window size, 431
 Wipers, 37
 Wired logic, 96
 World numbering plan, 359
- X-series standards (*see* CCITT recommendations)