Symbols

3rd generation (B3G) 531
3rd Generation Partnership Project Long Term Evolution (3GPP-LTE) 400
4th generation (4G) 531, 536
(RSs - Relay Stations) 105
(term succeeds interference cancellation - SIC) 108

A

access point (AP) 210, 523
active nodes 229
active user strategy (AUS) 321, 332, 333
Active user strategy (AUS) 330
adaptive algorithm 189
adaptive bit/power loading 382, 384
adaptive DF relaying 306, 307
Adaptive modulation 384, 398
adaptive network-coded cooperation (ANCC) 189, 424
adaptive-network-coded-cooperation (ANCC) 187
Adaptive resource allocation 383
additive white Gaussian noise (AWGN) 1, 4, 136, 332, 403
ad hoc configuration 39, 42, 49
ad hoc networks 523, 524, 526, 532, 541, 542, 543, 544, 545
AF-based cooperative configurations 29
AF cooperative concept 31
AF/DF cooperative framework 50
mentioned asymptotic approaches 112
AF protocol 13
AF protocols 29, 30, 36, 45, 58
AF relay-router 52
AF scheme 30, 33, 41, 44
AF schemes 30, 31
Alamouti’s orthogonal structure 414
algorithm design 58
allocation policy 64, 66, 75, 80, 81, 82, 83, 87, 88, 89, 94, 95, 96
amplification factor 262, 265
amplify-and-forward 321, 324, 331, 336, 337, 341, 342, 343, 344, 347, 350
Amplify-and-Forward (AAF) 322
amplify-and-forward (AF) 262, 302, 431
Amplify-and-Forward (AF) 29, 30
amplify-and-forward approach 529
Amplify and Forward protocol (AF) 354
amplify-and-forward schemes 281
amplify-forward (AF) 13
analogue domain 29, 30, 43
analytical correlation models 111
APP log-likelihood ratios (LLRs) 141
a priori 413, 416, 418, 422
asymptote 516
asymptotic analysis 112
asymptotic eigenvalue distribution 112, 118, 121
asymptotic eigenvalue distribution analysis 112
asymptotic properties 282
asymptotic relay 45, 46
authentication 522, 523, 533, 536, 538, 539, 540, 542, 544
AWGN channel 138, 139, 156

B

backhaul system 107
Bahl-Cocke-Jelinek-Raviv (BCJR) 138
Index

Bahl-Cocke-Jelinek-Raviv (BCJR) algorithm 138
bandwidth 103, 117, 307, 309, 526, 531, 53 9, 540, 541
bandwidth inefficiency 472
based transmission 346
base station (BS) 102, 523, 525
Base Station (BS) 103, 104
base stations 117, 130, 131
B-block compression protocol 7
beacon messages 293
beamforming 207, 208, 209, 210, 212, 213 , 215, 221, 225, 229, 230, 231, 232, 234, 235, 236
beam pattern 207, 208, 214, 215, 219
best-select protocol (BSP) 532
BFNAF protocol 31, 34, 37
bidirectional relay channel 453, 456
Bidirectional Systems 432
binary-input AWGN channel 139
bit error rate (BER) 323, 330, 383, 411
Bit Error Rate (BER) 41
bits per channel use (bpcu) 373
block-fading channels 29, 30, 60
Block-Fading NAF (BFNAF) 30
Block-Fading NAF (BFNAF) scheme 30
Block-Fading Non-Orthogonal Amplify-and-Forward (BFNAF) 31
BPSK constellation 323, 330, 333, 338, 339, 343
broadcast advantage 2
broadcast capacity 498, 500, 501, 514, 516, 517, 519
broadcast channel 454, 455, 468, 470
broadcasting 497, 498, 499, 500, 501, 510, 514, 516, 517, 518, 519, 520, 532
BS cooperation system 106

C

capacity 429, 430, 448, 450, 451, 453, 454, 455, 457, 461, 463, 465, 466, 468, 469
Capacity Analysis 500
capacity region boundary 65, 66, 100
carrier offsets knowledge (COK) 342
carrier sensing multiple access (CSMA) 530
case of point-to-point MIMO channels 118
cell-splitting 522
cellular channel model 104, 113, 131
Central Limit Theorem (CLT) 109
central unit (CU) 272
CF strategy 68
channel asymmetries 39
channel conditions 260, 261, 262, 266, 272
channel conditions (CSI) 125
channel frequency responses (CFRs) 406
channel impulse response 502, 504, 505
channel impulse responses (CIRs) 403
channel matrix 387, 388, 389, 392
channel model 65, 70, 75
Channel models 527
channel state information (CSI) 62, 261, 282, 302, 342, 382, 383, 408
Channel State Information (CSI) 356
channel variances 445, 446, 447
circulant channel matrix 403
Circulant matrices 367
cluster 107
cluster head (CH) 210
co-channel interference (CCI) 383
code division multiple access (CDMA) 235, 327, 530
code-division multiple-access (CDMA) 192
code-division multiple-access (CDMA) 150
code-division multipleaccess (CDMA) 3
Codeword Error Rate (CER) 373
collaborative system 282
communication networks 1
complex circularly symmetric (c.c.s.) 109
complex field network coding (CFNC) 424
Complex Orthogonal Designs (CODs) 369
compress-and-forward approach 529
compress and forward (CF) 68, 69
compress-and-forward (CF) 3, 431
concentration theorem 198
Conjugation 405
Connectivity in Discrete, Time-Invariant Trellis 195
Constellation size 472
continuum model 499, 503, 507, 508, 516
cooperating nodes 471, 472, 473, 474, 476, 477, 478, 479, 482, 483, 484, 486, 487, 488, 489, 490, 492
cooperation frame 32
cooperation link 80, 89
cooperation strategies 107
cooperative 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 536, 537, 538, 539, 541, 542, 543, 544, 545
cooperative architectures 522
Cooperative beamforming (CB) 207
cooperative broadcasting 497, 498, 499, 500, 510, 514, 516, 517
cooperative cellular systems 103
cooperative communication 280, 281, 282, 283, 284, 285, 291, 292, 293, 296, 297, 299, 300, 352, 353, 354, 360, 377, 497, 499, 519
cooperaive communication applications 1
Cooperative communication protocols 1
coopeative communications 301, 302, 304, 317, 319, 320, 323, 327, 348, 349, 350, 429, 430, 431, 467
cooperative communication scenarios 135, 136
cooperative diversity 260, 261, 262, 263, 268, 270, 278, 279, 353, 376, 378, 399, 400, 401, 426, 427
Cooperator diversity 399, 400, 424
cooperative MRC (C-MRC) 307
cooperative multiple-access channel (CMAC), 137
cooperative network 322, 323, 326, 339, 346, 347
cooperative networks 522, 542, 543
cooperaive protocol 382
cooperaive protocols 15, 18, 25
coopeative relayed system 382, 389
Co-Phasing Weights 225
correlated channel matrix 116, 124
correlated sensor networks 475, 492
correlation coefficient 471, 473, 482, 483, 486, 487, 488, 489, 490, 492
covariance 480, 481, 490
covariance matrix 414, 418, 419, 422
Coverage Analysis 500
coverage behavior 497
coverage extension 301
CRC (Cyclic Redundancy Check) 499
Credit-based schemes 533
cross-layer 207, 209, 234, 235, 236
cross-layer coordination 29
cross-layer design 29, 31, 48, 54, 58
cross-layer Multiple Access Control (MAC) decision 49
cross-layer nature 48
Cross-layer techniques 31
cumulative distribution function (CDF) 40
cut-set mutual information 19, 22
cyclic group 366, 367
Cyclic Redundancy Check (CRC) 354
cyclic redundancy code (CRC) 322
D
decay rate 16
decode-and-forward approach 529
decode-and-forward (DF) 3, 262, 302
decode-and-forward schemes 281, 282
decoder 7, 27
decoder complexity 138
decoding algorithm 139, 198
decoding set 307, 308
Degree distribution 199
delicate distributed power control strategies 285
dependency channel 148
destination-driven 270
destination nodes 443, 446, 447, 448
DF achievable rate 10, 11, 13
DF cooperative schemes 45
DF Opportunistic Cooperation 267
DF protocol 5, 6, 7, 8, 10, 15, 16, 17, 21, 25, 28
DF strategy 68
differential coding 352, 355, 358, 363, 366, 368, 371, 376
differential modulation 321, 322, 323, 324, 325, 326, 327, 328, 338, 339, 342, 343, 344, 347, 348, 349, 351
direct link gains 80, 87, 91
Dirty Paper Coding 105, 108, 109, 122
dirty paper coding (DPC) 155
Dirty-Paper Coding (DPC) 58
discrete Fourier transform (DFT) 402
Discrete Time-Varying Network Graph 194
Discrete Time-Varying Trellis 194
distance separation 198
distributed antenna arrays 301, 317
distributed antenna system 106
distributed ascent algorithm 209
distributed diversity schemes 301, 302
distributed diversity techniques 302, 305
Distributed Selection Combining (SC) 307
distributed source coding (DSC) 471, 472, 475
distributed space-frequency block coded single
carrier transmission 399
Distributed Space-Time Block code (DSTBC) 361
Distributed Space Time Block Codes (DSTBC) 354
distributed space time block codes [DSTBCs)] 352
distributed space time block coding (DSTBC) 283
distributed space-time codes (DSTC) 261
distributed space time coding 352, 365, 377, 380
Distributed Space-Time Coding 354
distributed space-time coding (DSTC) 37
distribution of nodes 277
diversity 188, 190, 191, 193
diversity gain 399, 400, 401, 419, 422, 424
Diversity Multiplexing Trade-off 275
diversity-multiplexing tradeoff (DMT) 1, 3, 18
diversity-multiplexing-tradeoff (DMT) 33, 375
diversity-relays 51
diversity-routing protocol 532
DMT metrics 4
DMT perspective 4, 18
double-differential (DD 321, 323
double-differentially modulated signal 343
double-differential modulation 321, 324,
325, 326, 339, 343, 344, 347, 348, 349
doubly-stochastic matrix 434
downlink channels 321, 326, 330, 347
dynamic behavior 22
E
Efficiency of LDPC Network Codes 200
egoistic 524, 537
ergetic fading 81
ergetic per-cell sum-rate capacity 102, 103
ergetic sum capacity 65
ergetic sum rate 443, 445, 446, 447, 448, 449
error-control code 148
error performance 512, 513, 514
error propagation 431, 497, 498, 500, 512, 514
Error Propagation Analysis 500
exact analysis 112
explicit cooperation 472
exponential-based approximation 41
extended Clifford algebras 370
Extended Clifford Algebras (ECA) 373
F
fading 525, 527, 528, 546
fast fading environments 409, 419
fast Fourier transformation (FFT) 326
final destination 42, 43, 49, 51, 52
flow conservation constraint 481
Forward error correction (FEC) 151
frame error rate (FER) 270
Free Probability approach 127
frequency division duplex (FDD) 530
frequency division multiple access (FDMA) 235, 327, 530
frequency division multiple access (SC-FDMA) 400
frequency division multiplexing (FDM) 383
frequency domain 402, 404, 405, 406, 407, 408, 409, 410, 411, 413, 414, 416, 417, 418, 422, 425
Index

frequency domain multiplexed (FDM) 408
frequency domain superimposed pilot technique (FDSPT) 408
frequency expanding technique (FET) 408
frequency selective fading 400
full duplex communication protocols 69
full-duplex operation 11
function 471, 472, 473, 478, 484, 485, 486, 488, 489, 490, 492

G
Gaussian channels 14, 25
Gaussian distributions 75
Gaussian matrix 109, 111, 115, 118
Gaussian noise channel 65
generalized feedback (GMAC) 3
general random distributed networks 285
generic correlation model 104, 109
geo-localized virtual infrastructure (GVI) 532
Gossip Mechanism 196
Grassmann manifolds 358

H
half-duplex 1, 3, 4, 11, 12, 13, 18, 22, 23, 24, 25, 26, 400, 401, 412, 423, 424, 425, 426
half-duplex mode 400, 412, 424
half-duplex single-relay channel 33
half-duplex systems 3
Hamming code 191
Hamming Network Code 190
hard decision 7, 21
harmonic mean 41, 45
Hermitian matrix 115
heterogeneous MAC 530, 531
high-density random networks 505
high-dimensional vector-quantized symbols 157
high spatial diversity 527
homogenous MAC cooperation 530
hybrid cellular 526
hypersphere shape 157
Hyper-Transmitter 105

I
identity matrix 34
implicit cooperation 472
independent and identically distributed (i.i.d.) 211
independent channels 190
independent identically distributed (i.i.d.) 109
information flow 431, 432, 523, 524
Information-Sharing in a TDMA Fashion 212
information-sharing overhead 209
information-theoretic capacity limits 103, 104
information theory 136, 172, 174
infrastructure 523
Initial slot 419
instantaneous channel 65
Inter-cluster cooperative transmission 287
Inter-cluster interference 210
interference 437, 438, 439, 440, 441, 445, 455, 460, 461, 467
interference cancellation system (ICS) 423
interference channel 137, 172, 174, 175, 177, 179
intermediate router 49, 50, 51, 52, 53
inter-symbol-interference (ISI) 383
inter-user channels 192
interval fraction 11
In the superposition coding scheme (SPC) 460
Intra-cluster broadcasting 287
intra-cluster communication 287
iterative multiuser detection 399, 412, 413
Iterative Multiuser Detection with Frequency-Domain Equalization 412
Iterative processing 141, 151

J
Joint Decoding of Signals 108
joint source-channel coding 148, 160, 169, 176, 185

K
Karush-Kuhn-Tucker (KKT) 457
Kronecker correlation model 104, 109, 110, 112, 117, 118, 121
### Index

**L**
- large-scale networks 497, 499, 500, 509
- lattice codes 148, 158, 162, 171, 185
- LDPC codes 139, 140, 143, 144, 145, 148, 150, 161, 162, 176, 179, 184
- LDPC-Like Network Coding 197
- linear Gauss-Markov state and observation model 490
- linear precoding strategies 432
- Linear-Process and Forward (LPF) 354
- linear programming tools 498
- link reliability 301
- local channel 307
- log likelihood ratios (LLRs) 413
- low-density generator-matrix (LDGM) 193
- low-density parity-check (LDPC)
  - 135, 136, 137, 187, 189, 191
- low-density parity-check (LDPC) codes 135, 136, 137
- Lower bound on sum degree 200
- low-rate channel coding 413, 419
- Luby-Transform (LT) 197

**M**
- majorization 429, 433, 434, 435, 437, 445, 467, 468
- Majorization theory 429, 430, 431, 467
- MAP decoder 141, 143, 144
- Marcenko-Pastur law 116, 120, 121
- Marcum Q function 336
- Markov superposition coding 62, 63, 73, 98
- M-ary quadrature amplitude modulation (M-QAM) 477
- Matérn 475
- maximal ratio combining (MRC)
  - 260, 261, 341, 407
- Maximal Ratio Combining (MRC) 305, 317
- Maximal-Ratio Combining (MRC) 512
- maximum a posteriori (MAP) 413
- maximum communication rate 497
- maximum likelihood decoder (MLD) 324
- maximum-likelihood decoding (MLD) 326
- maximum-likelihood (ML) 323
- Maximum-likelihood (ML) 141
- Maximum Ratio Combining (MRC) 50
- max-min criterion 45
- mean 403, 406, 407, 413, 416, 418, 421
- mean square error (MSE) 451, 472, 492
- medium access control (MAC)
  - 209, 280, 281, 530
- mesh networks 261, 277
- micro-cell capacity 522
- MIMO correlated channel 104
- MIMO (multiple input multiple output) 429
- minimizing the mean square error (MSE) 330
- minimum cost network flow (MCNF) 482
- Minimum Energy Data Gathering (MEDG) 477, 481
- minimum mean square error (MMSE) 407
- minimum mean-square error (MMSE) 389
- mobile station (MS) 534
- mobile terminal (MT) 525
- Moment Generating Function (MGF) 306
- monotone comparative statics
  - 473, 474, 484, 492
- monotonic 435, 436, 437
- monotonically decreasing 443, 453
- Monte-Carlo simulations 37
- M terminals 525
- MUD-decoder 151, 152, 153
- Multi-access relay channel (MARC) 57
- multicast 497, 518
- multi-cell joint processing 103, 107
- multicell processing 102, 103, 104, 105, 108
- 112, 113, 117, 122, 127, 128, 131
- multi-hop 187, 188, 194, 202, 283, 299
- multihop 303, 304, 318, 400, 426
- multihop broadcasting 497
- multihop cellular networks (MCNs) 523
- multi-hop configurations 51
- multihop strategy 465
- multi-hop transmission 511, 517
- multi-input multi-output (MIMO) 281
- multi-input multi-output (MIMO) broadcast channel 155
- multi-node cooperative schemes 291, 292
- multipath component (MPC) 527
- multiple access channel (MAC) 150, 433, 454
- multiple access channel (MAC). 108
- Multiple Access Control (MAC) 49
- multiple access interference (MAI) 150, 412

603
Index

multiple access protocol 530
multiple access protocols 525
multiple input and multiple output (MIMO) 471, 472, 473
multiple-input multiple output (MIMO) 529
multiple-input multiple-output (MIMO) 3, 260, 322, 323
multiple-input-multiple-output (MIMO) 383
multiple-input multiple-output (MIMO) systems 3
multiple-input-multiple-output/orthogonal frequency division multiplexing (MIMO-OFDM) 382
multiple-input single-output (MISO) 35
multiple-input single-output (MISO) systems 35
multiple relay scenarios 317
Multiple Simultaneous Beams 224
multistage cooperative broadcasting 497, 498, 499, 500, 510, 516, 517
multi-stage decoding 108
multi-terminal cooperative communication systems 70
multiuser detection 105, 106, 130, 132
multiuser detectors (MUDs) 151
mutual cooperation 3, 9, 10, 25
mutual information 11, 12, 14, 15, 19, 22
mutual information (MI) 471, 490
Mutual Information (MI) 472

N

NAF-based protocols 32, 36
NAF protocol 13, 24, 33, 34
NAF scheme 34
Nakagami-m channels 323, 343, 349, 351
Nakagami-m fading 306, 318, 320
network behavior 500, 505, 506
network capacity 62
network coding 187, 188, 189, 190, 191, 192, 193, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205
Network (NET) layers 49
node broadcasts 1
node distributions 429
nodes 471, 472, 473, 474, 475, 476, 477, 478, 479, 482, 483, 484, 486, 487, 488, 489, 490, 491, 492
non-coherent communication 352, 355, 358
non-coherent DSTC 355, 362, 363
non-coherent signaling schemes 353
Non-convex functions 467
non-fading channels 15, 25
Non Line-Of-Sight (NLOS) 111
non-negative convex-function 463
Non-orthogonal AF scheme (NAF) 30
non-orthogonal channel model 499, 501, 509, 513, 514, 517
Non-orthogonal Channel Model 504
non-orthogonal mode 530
non-regeneratively 322
non-scalable 522
non-systematic 139
non-zero communication 2
normalized cell radius 122, 125
NP-complete problem 51
Nulling Weights 226, 227

O

OAF protocol 36, 39, 41, 50
one-user-at-a-time policy 89
opportunistic large arrays 498
opportunistic relaying 260, 264, 279, 308, 310
Opportunistic Relaying 260, 263, 264, 267, 268, 269, 270
optimal relay choice 272
Optimal Transmit Strategies 456
optimization 431, 451, 454, 455, 456, 457, 458, 463, 469, 476, 481, 482, 485, 487, 488, 489, 491, 492, 493, 494, 468
Orthogonal Amplify-and-Forward (OAF) 33
orthogonal channel model 499, 501, 509, 513, 514, 517
Orthogonal Channel Model 501, 502, 504, 512, 513, 515
orthogonal fading channels 499, 502
orthogonal frequency division multiple access (OFDMA) 530
orthogonal frequency division multiplexing (OFDM) 383, 400
orthogonality 409
orthogonally polarized electromagnetic waves 384
orthogonal mode 530
orthogonal transmissions
  321, 323, 326, 335, 339
outage 188, 189, 191, 192, 194, 196
outage probability 306, 308, 309, 310, 311,
  312, 315, 318, 437, 438, 439, 440, 4
  42, 443
Outage Probability 218

P

packet 190, 197
packet data unit (PDU) 531
pair-wise error performance (PEP) 324
pairwise error probability (PEP) 330
pairwise error probability [PEP] 352
Pairwise Error Probability (PEP) 357, 362
Parallel interference cancellation 108
parity-check matrix 139, 145
Parity Check Network Code 190
parity-symbol 192, 193, 197, 199, 200, 201
partially ordered set 484
passive users relaying strategy (PURS) 321, 332
pathloss 527
path-loss attenuation model 511
PDF (Probability Density Function) 356
peak-to-average power ratio (PAPR) 400
per-cell sum-rate capacity 102, 103, 117, 122
performance analysis 301, 317
phase shift keying (PSK) 479
physical layer 280, 281, 283, 285, 286, 296,
  297, 500, 512, 513
physical-layer network coding (PNC) 424
physical layer (PHY-layer) 309
Physical (PHY) 49
pilot overhead ratio 408
point-to-multipoint (PMP) 526
point-to-point connection 429
Poisson 209, 229, 230, 234, 235
polynomial time 498
posteriori probability 138, 141
power allocation 429, 432, 447, 455, 458, 4
  98, 500, 510, 519
power control 62, 63, 64, 65, 66, 69, 73,
  79, 81, 82, 83, 89, 90, 91, 92, 94,
  95, 96, 98, 99, 100, 280, 281, 282,
  285, 286, 292, 294, 295, 296, 297,
  300
power efficiency 497, 498, 500, 510, 519
Power Expenditure Analysis 500
power Exponential 475, 491
practical channel coded systems 108
practical coding schemes 135, 136, 140,
  147, 150, 155, 163, 170, 171, 172
practical cooperative coding schemes 135, 136
Practical Results 124
pre-cancellation 420, 421, 422, 424
pre-defined coding schemes 189
probability of error
  321, 330, 335, 336, 345, 347
problem formulation 390
procedural algorithm 385, 390
propagation algorithm 106
propagation theory 111

Q

Quadrature Amplitude Modulation (QAM) 374
quality of service (QoS) 531
quantization 480, 482
Quasi-Orthogonal Designs (QODs) 369

R

Random Access Cooperative Beamforming
  (RA-CB) 215
random cooperative communication
  280, 283, 284, 285, 296
random cooperative systems
  281, 285, 286, 291, 296, 297
random-mixing 199, 201
random node cooperation 280, 281
rate admissibility constraint 479
rate performance 80
Rate Region for the Second Phase 455
rational quadratic 475
Rayleigh fading
  382, 394, 429, 498, 499, 501
Received SINR 217
Received SNR 213
regenerative 524, 527
regenerative relays 323, 324
relay-assisted 399, 401, 403, 412, 413,
  414, 417, 419, 420
|-------------|--------------|---------------------|---------------|-----------------|---------------------------|-----------------|-----------------------|-------------|-----------------|---------|----------------|-----------------|-------------------|-----------------|-----------------|

**Index**

<table>
<thead>
<tr>
<th>Relay Selection</th>
<th>Relay Selection Schemes</th>
<th>Relay Transmission</th>
<th>Repeat-Accumulate (RA)</th>
<th>Reputation-Based Schemes</th>
<th>Routing</th>
<th>Routing Layer</th>
<th>RR Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>292</td>
<td>270, 271, 272, 278</td>
<td>293</td>
<td>270</td>
<td>533</td>
<td>285, 296, 297</td>
<td>53</td>
<td></td>
</tr>
</tbody>
</table>

**S**

|------------------|-----------------------------|--------------|-------------|----------|-------------------------|----------------------|----------------------|-------------------------------|

**SNR**

<table>
<thead>
<tr>
<th>SNR</th>
<th>SNR Analysis</th>
<th>SNR Regime</th>
<th>Soft-Input Soft-Output (SISO)</th>
<th>Soliton Distribution</th>
<th>Soliton Distribution</th>
<th>Source Encoder</th>
<th>Source Transmission</th>
</tr>
</thead>
</table>

**Space-Division Multiple Access (SDMA)**

<table>
<thead>
<tr>
<th>Space-Division Multiple Access (SDMA)</th>
<th>Source Transmission</th>
<th>Soliton Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>208</td>
<td>293</td>
<td>200, 201</td>
</tr>
</tbody>
</table>
space-time block codes (STBC) 472
space-time block code (STBC) 323, 352
Space-Time Block Code (STBC) 354
Space-Time Codes (STC) 58
space-time coding (STC) 352
sparse-graph codes 203, 204
spatial correlation 472, 494, 495
spatial diversity 190, 399, 400
spatial rate 472, 479, 483, 484
spectral efficiency 207, 209, 222, 223, 224, 225, 226, 228, 229, 230, 234, 430
Spectral Efficient Cooperative Diversity Protocols 412
spherical 475
stage 474, 475, 476, 477, 478, 479, 480, 481, 482, 486, 487, 490, 491
static half-duplex channels 22
sub-channel division 383, 384, 393, 394, 395, 396, 397
sub-channel division protocol 383, 384, 395
sub-gradient methods 73
sub modularity 471
sub-optimal algorithm 273
suboptimality 465
successive interference cancellation (SIC) 455
successive multiuser interference cancellation (SMIC) 416
super-linear convergence 458
superposition block Markov encoding 71, 72, 75
supportive 524
switch and stay combining (SSC 311
Switch and Stay Combining (SSC) 317
switch diversity 316, 317
symbol 188, 190, 191, 192, 193, 196, 197, 199, 200, 201, 202
symbol error rate (SER) 282, 322, 345
symbol-error rate (SER) 408
Symbol error rate (SER) 305, 324
symbol interval 65
system diversities 382

T

TDD (time division duplex) 393
TDMA cooperative beamforming 212
theory of cooperative communications 1
three-terminal network 2
time division duplex (TDD) 530
time division multiple access (TDMA) 327, 530
time division multiplexing (TDM) 346
time intervals 323, 325, 326, 330, 331, 332, 333, 334, 335, 338, 339, 340, 342
Tomlinson-Harashima precoding (THP) 155
topology 189, 191, 192, 193, 194, 203, 204
Topology-Adaptive LDPC Network Codes 192
Topology-Adaptive Network Coding for General Networks 196
tradeoff 1, 3, 18, 26, 27, 28
traditional MAC 72, 75, 78, 82, 90
transmission range 533
transmit policy 65
transmitter 1, 11, 21
transmitter block diagram 413
transparent 524, 527, 528, 529, 538
transport layer 296
trellis-coded quantization (TCQ) 157, 158
trellis-coded vector quantization (TCQ) 150
trellis network 187, 189
Trellis Representation 194
turbo-coded CDMA system 151, 152
Turbo codes 138
two-hop system 443
two-Relay DSSC 311
two-user cooperative communication system 321, 348
two user cooperative networks 347

U

UMTS networks 526, 534
unidirectional system 432
uniformly distributed user terminals (UTs) 102
unitary matrices 356, 357, 358, 363, 365, 366, 367, 368, 369, 370, 371, 374
unitary space-time matrix 339
unlicensed mobile access (UMA) 531
uplink channels 323
uplink communications 400
Uplink Numerical Results 120, 121
user cooperation 188, 204
user-specific interleaver 412, 413, 419
Index

User Terminal (UT) 103, 104

V

variance 403, 406, 407, 413, 418
virtual antenna array 399, 424
virtual channel 148
Voronoi region 157

W

Weights of TDMA-CB 213
WINNER interface 526
wireless broadcast advantage 2
wireless channel 14
wireless communication channel 136
wireless communications
  29, 61, 103, 105, 129, 132
wireless communication system 383, 385
Wireless Local Area Networks (WLAN) 534
wireless medium 29, 51, 52

Wireless Metropolitan Area Networks (WMAN) 534
wireless network 188, 189, 192, 194, 195, 196, 201, 202, 203, 204, 205, 207, 209, 210, 280, 286, 296
wireless relay networks 498, 518
wireless sensor network (WSN) 472
wireless systems 103, 128
Wishart matrices 112
Wyner-Ziv technique 7
Wyner-Ziv type 5, 7, 8, 12
Wyner-Ziv type compression 7, 8, 12

Z

zero-forcing (ZF) 384, 389