Author index

Andrews, J.G., 33, 38, 41, 48, 57, 65, 132, 154

Baccelli, F., 33, 42, 48, 65
Błaszczyszyn, B., 3, 32, 33, 36, 42, 57, 58

Calka, P., 131

Dhillon, H., 33, 57, 65, 132

Foschini, G.J., 139
Foss, S., 132

Ganti, R.K., 33, 48, 65, 132
Gloaguen, C., 133
Gulati, K., 38

Haenggi, M., 34, 36
Heath, R.W., 3
Hunter, A.M., 38, 41

Jacquet, P., 38
Jo, H.S., 99, 132

Kingman, J.F.C., 23, 26–29
Kountouris, M., 3

Madhusudhanan, P., 36, 56, 58, 98, 115, 132
Mallik, R., 3

Pinto, P.C., 38, 142

Thummler, A., 19

Weber, S., 38, 41, 154
Win, M.Z., 38, 142

Xia, P., 99, 132

Yu, B., 133

Zuyev, S., 44, 132

Subject index

almost-blank subframe (ABS), 121, 123, 126, 147, 151, 164

Bernoulli distribution, 147, 159
Bernoulli trials, 159, 160
binomial distribution, 29, 30, 159

Campbell's theorem, 60
camping, x, 78, 82
canonical SINR calculation problem, 12, 14, 15, 21, 66, 71, 109, 116, 151
capacity, viii, ix, 1, 32, 97, 141, 157
capital expenditure (CapEx), 2
carbon footprint, 153
carrier-sensed multiple access (CSMA), 156
cell range expansion (CRE), 120
circularly symmetric complex Gaussian distribution, 142, 161
code division multiple access (CDMA), 163
cognitive radio, xi, 155
coloring theorem, 29–31
  constant retention probability, 28
  location-dependent retention probability, 29
complementary cumulative distribution function (CCDF), 3
complete spatial randomness (CSR), 24
coverage, ix, x, 1, 2, 7, 11, 32, 65, 80, 92, 94–98, 121, 122, 142, 157
cumulative distribution function (CDF), 10

device-to-device (D2D) communication, xi, 154, 155

eigen-beamforming, 44
energy efficiency, xi, 141, 153, 157
enhanced ICIC (eICIC), xi, 121, 126, 147, 164
equivalent complex baseband signal, 3, 4, 144, 161
  in-phase component, 39, 161
  quadrature component, 39, 161
Erlang distribution, 3, 5, 17, 19, 44, 162
  hyper-Erlang, 17, 19, 74
expectation-maximization (EM) algorithm, 19
exponential distribution, 4, 5, 43, 161, 162
extended Slivnyak–Mecke theorem, 59, 60, 86

Farkas's lemma, 20
Fourier transform, 58
frequency division duplexing (FDD), 155
further enhanced ICIC (feICIC), 126, 164

gamma distribution, 3, 162
  hyper-gamma, 19
Gaussian distribution, 39, 144, 161
greenfield deployment, 32, 151

handoff, 156
HeNB, 163
heterogeneous cellular network (HCN), viii, xi, 120, 147, 157
hexagonal lattice of BSs, x, 6, 32, 33
hotspot, 156

independent identically distributed (i.i.d.), 3, 159
inter-cell interference coordination (ICIC), 164
inter-site distance (ISD), 32
interference-limited system, 79, 97, 122, 139

Jacobian, 69

Laplace transform, 5, 8, 18, 21, 37, 38, 40, 42, 43, 45, 47, 56–58, 60, 88, 130, 136
lognormal distribution, 32, 38, 162
long-term evolution (LTE), xi, 163
LTE-Advanced (LTE-A), 164

M-matrix, 16–19, 21
machine-type communication (MTC), 155
marking theorem, 31, 123
Matérn hard-core process (MHP), 34
Matlab®, 50
minimum mean squared error (MMSE), 44
mixture distribution, 3, 17
  mixture of Erlang distributions, 3, 4, 17, 44, 49, 51, 75, 76, 101, 106
    approximation of arbitrary distribution by, 3, 19
  mixture of gamma distributions, 3
Monte Carlo methods, 6

multiple-input multiple-output (MIMO) transmission, 38, 44

Nakagami distribution, 3, 5, 38, 44, 162
negative binomial distribution, 160
19-cell wraparound region, 6

offloading, viii, 93, 98, 120, 147, 156
operating expenditure (OpEx), 2
orthogonal frequency division multiple access (OFDMA), 156, 163

Pólya distribution, 135, 160
path-loss model, 2
  intercept, 3
  slope (path-loss exponent), 3
peer-to-peer (P2P) communication, 154
phase shift keying (PSK), 39
phase type distribution, 19
point pattern, (spatial), 23, 29, 32, 42, 131
Poisson point process (PPP), ix, 3, 7, 21, 23
  density (of a homogeneous PPP), 24
  homogeneous, 24
  inhomogeneous, 25
  intensity, 25
  thinned, 29, 30, 40, 46, 140
power control, x, 107, 120, 122, 125
  closed-loop (CLPC), xi, 139
  non-adaptive, xi, 125, 126
  open-loop (OLPC), xi, 123, 128, 129, 135, 137–139, 146
probability density function (PDF), 3
probability mass function (PMF), 31
proportional-fair scheduler (PFS), 145, 151

range expansion bias (REB), 120
Rayleigh distribution, 3, 5, 21, 33, 36, 38, 40, 43, 44, 50, 57, 58, 66, 79, 84, 90, 143, 147, 149, 161, 162
reference symbol received power (RSRP), 79
reference symbol received quality (RSRQ), 79
remote radio head (RRH), 157
rings of interfering BSs, 6
round robin scheduler (RRS), xi, 141, 145

Shannon formula, 141, 142, 144
Sherman–Morrison formula, 20
signal to interference plus noise ratio (SINR), viii, 1, 4, 7, 8, 10
signal to interference ratio (SIR), 2–4
Slivnyak's theorem, 42, 60
spectral efficiency, viii, xi, 11, 127, 142, 154, 157
  as area-averaged rate, 143
  of a BS, 145
  on the link from an arbitrary BS to a served user, 144
  on the link to an arbitrarily located user, 143
  of a multi-tier HCN, 146
  relation to ergodic rate, 144
  of a tier, 144, 146
superposition theorem, 28
Suzuki distribution, 38
symmetric alpha-stable distribution, 144

tessellation, 132
  Poisson–Voronoi, 132, 133
  Voronoi, 131, 132
Third Generation Partnership Project (3GPP), viii, 163
3GPP Releases, 163
3GPP-LTE, xi, 163
time division duplexing, 155
time synchronization, 126, 155
transmit time interval (TTI), 78

uniform distribution
  continuous, 160
  discrete, 159
user equipment (UE), 79, 92, 120, 122, 127, 147, 149, 164
utility function, 2, 7, 144

Voronoi cell, 128, 131–133, 146

WiFi (IEEE 802.11), viii, xi, 154, 156

Z-matrix, 15, 16, 20, 21, 68, 105, 110, 117, 152