Index

Symbols

3rd Generation Partnership Project 22, 183, 185

a
A Holistic Approach Towards the Development of the First Responder of the Future xiii
access point 51, 55, 65
additive white Gaussian noise 57, 74, 116, 120, 124, 230–237
address auto-configuration 4, 138, 158–161, 175, 224
address auto-configuration OLSR 162
address duplication 158, 160
Address Resolution Protocol 166
agent system 1, 14, 15, 47, 223
amplify-and-forward 37, 93, 96, 97
angle diversity 53
angular diversity 53
artificial intelligence 25, 26, 29, 77
autonomic behaviour 23, 25, 29, 186, 207
autonomic computing xi, 1, 7–10, 14, 15, 18, 19, 21, 24–26, 29, 30, 34, 38, 47, 223
autonomic computing enabled cooperative networked design xi
autonomic control loop 26, 31, 32
autonomic cooperative networking xi
Autonomic Cooperative Networking Protocol xi, 1, 4, 5, 8, 39, 41–43, 46, 47, 80, 81, 119, 130, 138, 152, 156, 162, 163, 166, 169–176, 179, 180, 191, 192, 197, 201, 203, 205–210, 216, 218, 223–225
Autonomic Cooperative Node xi, xxiii
autonomic cooperative re-routing 194
autonomic cooperative sets 36, 44, 60, 119, 150, 192

Autonomic Cooperative System  
Architectural Model  21, 80
autonomic cooperative transmission  83, 194
autonomic decision-making elements  25
autonomic element  25, 26
autonomic elements  25, 26, 28
autonomic functions  20, 23, 185
autonomic intelligence  xi, 25
Autonomic Intelligence Evolved
Cooperative Networking  xi, 7, 25, 77, 83, 88, 94, 129, 137, 158, 174, 204, 209
autonomic manager  26, 29
autonomic managers  26, 27
autonomic nervous system  9
Autonomic network engineering for the
self-managing Future Internet  xiii, 15, 17, 181–183
autonomic networked computing system  11
autonomic networking  1, 7, 8, 10, 12, 21, 24–26, 29, 47, 181, 182, 186, 190, 191, 201
autonomic node  25, 27, 28, 33, 77, 78, 190
autonomic nodes  22, 24, 33, 186
autonomic overlay  209
Autonomic Routines  35, 37, 42
autonomic system  9, 11, 20, 25, 26, 29–31, 77, 115
autonomous system  14

b
bit error rate  82, 124, 164, 165, 210, 238, 239
Broadband Forum  183, 185
business-to-business  9
business-to-customer  9

central processing unit  10
channel bandwidth  58
channel capacity  58, 60, 61
channel capacity gain  58

channel coefficient  xiii, 1, 68, 82, 223
channel coefficients  xiii, 1, 61, 81, 153
channel gain  xiii, 1, 58
channel matrix  xiii, 1, 57, 59, 61
channel state information  55, 64
characteristic information  24, 28, 29
chief first responder  193–198, 200–205, 210
chief first responders  4, 5, 179, 193, 218, 225
co-channel interference  58
code rate  66, 67
code rates  66, 67
coded cooperation  103
coding advantage  63
coding gain  2, 35, 51, 52, 63, 54, 88, 89, 223
coeherence bandwidth  53
coeherence distance  53
coeherence time  53
collaborative protocols  3, 93, 132, 224
complex adaptive decode-and-forward  104
complex orthogonal design  66
complex orthogonal designs  120
computer-assisted simulation  42, 108, 115
computer-assisted simulations  168
computing process  108
constant bit rate  117
control plane  189, 190
conventional relaying  2, 3, 93–95, 98, 106, 110, 111, 118, 119, 131, 132, 137, 165, 197, 224
covolutional code  116
coopetration diversity  103
cooperation management decision element  2, 4, 8, 46, 47, 82, 88, 120, 123, 130, 131, 138, 163, 166, 167, 174, 175, 214–217, 223, 224
cooperation orchestration decision element  2, 5, 8, 46, 47, 79, 120, 131, 175, 180, 201, 203, 207, 209, 213, 214, 216–218, 223, 225
coopetration awareness  191
coopetration diversity  103
Cooperative Intelligent Transportation Systems 191
cooperative networking xi
cooperative protocol 3, 93, 132, 224
cooperative re-routing 1, 3, 46, 47, 79, 94, 123, 129, 131, 132, 223, 224
cooperative re-routing decision element 1, 3, 8, 46, 47, 79, 94, 120, 123, 125–127, 129–132, 214, 215, 223, 224
cooperative relay nodes 56
cooperative re-routing 1, 3, 8, 35–37, 41, 44, 47, 52, 56, 76, 81, 93–100, 102, 103, 111, 118, 131, 132, 137, 150, 223, 224
cumulative distribution functions 210, 212, 213
cyclic prefix 36
data plane 21, 22, 189, 190
decision element 1, 13, 5, 7, 8, 22, 23, 25–31, 33, 38, 42, 45–47, 78, 79, 82, 98, 123, 130, 131, 180, 185, 186, 192, 213, 214, 216–218, 223
decision plane 21, 22
decision-making element 13, 15, 22, 25
decision-making entities 25
decode-and-forward 37, 93, 96–98
decode-and-reencode 37, 93, 96–98
delayed transmission diversity 55
destination node xxiii, 1, 37, 79, 81, 82, 94–96, 98, 99, 103–105, 116, 120, 124, 130, 147, 149, 151, 152, 153, 165–167, 169, 216
device-to-device 98
digital terrestrial video broadcasting 36
direct transmission 118
discovery plane 21, 22
dissemination plane 21, 22
distributed space-time block coding 1–3, 8, 36, 37, 40, 41, 46, 47, 51, 56, 64–66, 79, 81, 82, 86–89, 93, 95, 103–106, 115, 118, 119, 129, 130, 132, 137, 150, 152, 153, 162, 163, 165, 171, 192, 197, 201, 214, 215, 224
diversity gain 2, 35, 51, 56, 63, 64, 88, 96, 111, 120, 197, 223
diversity order 63
duplicate address 161
duplicate address avoidance 160
duplicate address detection 4, 138, 159–162, 175, 224
dynamic host configuration protocol 159, 160
economic sciences 26
emergency communications network 4, 5, 179, 180, 192–194, 196, 198, 200, 201, 210, 217, 218, 225
emergency communications networks 78, 163, 218
emergency operations centre 195
equal cost multipath protocol 130
equivalent distributed space-time block encoder xxiii, 1, 3, 52, 75, 94, 106, 119–123, 129, 132, 149, 152, 174, 193, 210, 215, 224, 235–237
equivalent virtual multiple-input multiple-output 2, 46, 51, 56, 59–61, 64, 79, 81, 82, 86–88, 103, 119, 120, 130, 171, 223
equivalent virtual multiple-input single-output 82
European telecommunications standards institute xiii, 8, 15, 17, 181–183
European union xiii, 115, 183
evolved messaging structure 4, 138, 150, 154, 155, 163, 164, 167, 170, 171, 175, 224
Exposing the Features in IP version Six protocols that can be exploited/extended for the purposes of designing/building Autonomic Networks and Services xiii
Extended Link Code 155–157, 166, 167, 169
Extended Link Mask 155, 157
extended routing information enhanced algorithm for cooperative transmission 4, 138, 156, 163, 166, 171, 173–175, 179, 201, 208, 216, 224

f
fast re-routing 94, 100, 123, 124, 127, 130, 215
fault management decision element 3, 79, 94, 123, 130, 132
first responder 193–198
first responders 4, 179, 192, 193, 218, 225
fixed deployment concept 3, 93, 106, 107, 132, 137, 224
fixed relay node xxiii, 1, 3, 93, 94, 106–108, 110, 111, 115–119, 132, 201, 224
flooding multi-point relay 145, 146
Framework Programme 183
frequency diversity 53
frequentia! diversity 53
function level 1, 3, 4, 8, 23, 27, 30, 32, 33, 42, 47, 79, 81, 93, 94, 123, 128–132, 137, 138, 174, 175, 184, 185, 190, 215, 216, 223, 224
functional block 22, 185, 216
functional planes 7
future internet 78, 180, 181

g
generalised complex orthogonal design 66, 67, 68
Generalised Hello message 155, 158, 171
generalised virtual antenna array 105
generic receiver xxiii, 1, 2, 51, 59–61, 65, 66, 68, 88, 120, 223
generic transmitter xxiii, 1, 2, 51, 59–61, 65–70, 72, 73, 88, 120, 223
Group Specification 8, 21–23, 25–27, 30, 31, 33, 182, 185

h
Hello message 139, 141–143, 147, 152, 155, 157
hierarchical autonomic control loop 1, 8, 22, 23, 26, 28–34, 38, 42, 47, 81, 82, 98, 120, 185, 186, 190, 192, 223
Horizontal Architectural Extension xi, 1, 8, 35, 38, 39, 42, 43, 47, 85, 223
horizontal reference points 30
human autonomic nervous system 1, 7, 9, 15, 19, 47, 77, 186, 191, 223

i
Industry Specification Group xiii, 15, 17, 181–183
Integrated Project xiii, 115
intelligent transport system 4, 179, 187, 190–192, 218, 225
inter-channel interference 58
International Telecommunication Union – Telecommunications 183
Internet Assigned Number Authority 142
Internet Engineering Task Force 183
Internet of Things 191
Internet Protocol 141, 142, 161, 162, 166
Internet Protocol version 6 158–160

k
knowledge plane 21, 22, 24, 185

l
layer-3 decode-and-forward 95, 96
layered space-time coding 105
least significant bit 140, 141
level of abstraction 1, 4, 8, 9, 22, 23, 24, 27–31, 34, 38, 45, 47, 78, 80, 106, 120, 179, 184, 186, 190, 192, 204, 209, 213–215, 217, 218, 223, 225
line-of-sight 116, 167
<table>
<thead>
<tr>
<th>Term</th>
<th>Page(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Code 155</td>
<td></td>
</tr>
<tr>
<td>link layer 3, 4, 8, 36, 37, 40, 42, 44, 46, 79–82, 85–87, 93, 94, 96, 99–102, 106, 111, 123, 128, 129, 132, 137, 150, 162, 163, 166, 171, 173–175, 191, 224</td>
<td></td>
</tr>
<tr>
<td>Link message 169, 170</td>
<td></td>
</tr>
<tr>
<td>Link Type 154, 155, 169</td>
<td></td>
</tr>
<tr>
<td>link verification 197</td>
<td></td>
</tr>
<tr>
<td>Link-State Routing Protocol 101</td>
<td></td>
</tr>
<tr>
<td>Long Term Evolution 195</td>
<td></td>
</tr>
<tr>
<td>m</td>
<td></td>
</tr>
<tr>
<td>machine-to-machine 4, 179, 187, 190–192, 218, 225</td>
<td></td>
</tr>
<tr>
<td>managed element 23, 26, 29, 98</td>
<td></td>
</tr>
<tr>
<td>managed entity 26, 29, 31, 186, 192</td>
<td></td>
</tr>
<tr>
<td>management plane 19, 22</td>
<td></td>
</tr>
<tr>
<td>massive multiple-input multiple-output 59</td>
<td></td>
</tr>
<tr>
<td>maximal ratio combining 54, 55, 63</td>
<td></td>
</tr>
<tr>
<td>maximal ratio receive combining 54</td>
<td></td>
</tr>
<tr>
<td>maximum likelihood detection 63, 69</td>
<td></td>
</tr>
<tr>
<td>maximum likelihood sequence estimator 86</td>
<td></td>
</tr>
<tr>
<td>medium access control 36, 166</td>
<td></td>
</tr>
<tr>
<td>mobile ad hoc network 3, 33, 37, 137, 139, 152, 154, 155, 158, 160, 162, 168, 170, 175, 190, 192, 193, 198, 207, 210, 216, 217</td>
<td></td>
</tr>
<tr>
<td>mobile deployment concept 3, 93, 94, 132, 137</td>
<td></td>
</tr>
<tr>
<td>mobile emergency operations centre 192, 193, 195–199, 201, 210</td>
<td></td>
</tr>
<tr>
<td>mobile nodes 139</td>
<td></td>
</tr>
<tr>
<td>mobile relay nodes 36, 167</td>
<td></td>
</tr>
<tr>
<td>Modified Hello message 148, 154, 156–158, 166, 169, 171</td>
<td></td>
</tr>
<tr>
<td>modulation and coding scheme 116</td>
<td></td>
</tr>
<tr>
<td>most significant bit 140, 141, 156, 157</td>
<td></td>
</tr>
<tr>
<td>multi-agent system 13–15</td>
<td></td>
</tr>
<tr>
<td>multi-element array 36, 53–56, 59, 64–66, 68, 120</td>
<td></td>
</tr>
<tr>
<td>Multiple Address Declaration 162</td>
<td></td>
</tr>
<tr>
<td>multiple-input multiple-output 2, 51, 55–57, 59, 61, 63, 65, 88, 93, 103, 105, 120, 223</td>
<td></td>
</tr>
<tr>
<td>multiple-input single-output 57, 103, 120, 153, 197</td>
<td></td>
</tr>
<tr>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Neighbour Discovery 158–160, 197</td>
<td></td>
</tr>
<tr>
<td>Neighbour Type 154–156, 169</td>
<td></td>
</tr>
<tr>
<td>network coding 98</td>
<td></td>
</tr>
<tr>
<td>network elements 22</td>
<td></td>
</tr>
<tr>
<td>network function virtualisation 188</td>
<td></td>
</tr>
<tr>
<td>network layer 3, 4, 8, 11, 36, 37, 42, 44, 46, 47, 80–82, 87, 88, 93, 94, 96, 100–102, 106, 108, 110, 111, 123, 128, 129, 132, 137, 150, 162–164, 166, 171, 173–175, 191, 206, 208, 209, 224</td>
<td></td>
</tr>
<tr>
<td>network level 1, 2, 5, 8, 22–25, 27, 30, 32–34, 43, 47, 79, 88, 130, 131, 175, 179, 180, 184, 185, 203, 204, 207, 209, 216–218, 223, 225</td>
<td></td>
</tr>
<tr>
<td>Network of Excellence in Wireless COMmunications xiii</td>
<td></td>
</tr>
<tr>
<td>network operator 190</td>
<td></td>
</tr>
<tr>
<td>networked system 1, 223</td>
<td></td>
</tr>
<tr>
<td>Next Generation Mobile Networks 183</td>
<td></td>
</tr>
<tr>
<td>node level 1–3, 8, 23–25, 28, 30, 32, 33, 42, 47, 94, 123, 128–132, 137, 174, 179, 184, 185, 216, 223, 224</td>
<td></td>
</tr>
<tr>
<td>non line of sight 116</td>
<td></td>
</tr>
<tr>
<td>non-cooperative transmission 46, 123, 127, 130</td>
<td></td>
</tr>
<tr>
<td>on-board unit 192</td>
<td></td>
</tr>
<tr>
<td>Open Shortest Path First 29, 101</td>
<td></td>
</tr>
</tbody>
</table>
Index

Open Systems Interconnection xi, 1, 4, 5, 8, 31, 34, 38, 39, 52, 83, 95, 101, 102, 106, 120, 128, 131, 163, 170, 172–174, 179, 223, 225


orthogonal frequency-division multiple access 36, 86, 87, 116, 129
orthogonal frequency-division multiplexing 36, 87, 117
Overhead Auto-Configuration Optimised Link State Routing 192, 195

p
passive duplicate address detection 162
passive duplicate address detection OLSR 161, 162
path loss xxiii, 1, 116, 167
phase-shift keying 72, 74
physical layer 2, 8, 35, 36, 40, 42, 44, 46, 52, 76, 79–81, 85, 86, 89, 93, 94, 106, 119, 128, 129, 163, 173, 191, 197
polar diversity 53
polarisation diversity 53
Power Level 156–158, 167, 169
probability density function 63, 227–229
process interaction 3, 93, 108, 132
protocol level 1, 2, 8, 23, 27, 30–32, 42, 47, 51, 52, 76, 79–81, 86, 88, 89, 93, 98, 128, 131, 184, 185, 209, 214, 215, 223, 224
public safety networks 195

q
quadrature phase-shift keying 82, 116, 124, 153, 167
quality of service 26, 27, 82, 110, 118, 193, 216
quasi-orthogonal 67

r
radio access point 110, 115, 111, 120
radio frequency 55
receive diversity 54
receiving antenna xxiii, 1, 68, 82
Reference Architecture 217
reception diversity 54–56
reference point 28
Reference Point Architecture 22, 24, 28, 29, 185
relay agent 159, 160
relay-enhanced cell 3, 5, 94, 115, 116, 132, 180, 210, 218, 224, 225
relay node xxiii, 1, 36, 37, 41, 46, 56, 59, 60, 66, 94, 95–99, 103–105, 107, 116, 150, 152, 153, 163–165, 173
relaying techniques 93, 94, 98, 137
repetition-based cooperative diversity 104
resilience and survivability decision element 3, 79, 94, 123, 130, 132
Router Advertisement message 159
Router Solicitation message 159
routing information enhanced algorithm for cooperative transmission 4, 137, 138, 146, 150, 152, 153, 158, 163, 169, 171, 175, 224
routing mechanisms 2, 8, 35, 37, 47, 137, 179, 223
routing multi-point relay 145, 146
routing table 4, 138, 161–163, 166, 175, 224
routing tables 139

s
scanning diversity 54
selection combining 54
self-organising networks 22
Service Based Architecture 28
service-oriented architecture 12, 14, 15
Seventh Framework Programme xiii
signal-to-interference-plus-noise ratio 120, 127
signal-to-noise ratio 54, 55, 58, 59, 63, 164–166
simple adaptive decode-and-forward 104
single-input multiple-output 57, 153
single-input single-output 57, 103, 165
single-agent systems 14
single-path relaying 94, 98, 118, 153, 201–205
singular-value decomposition 2, 51, 59, 88, 223
Sixth Framework Programme xiii, 115
social intelligence 25
software agent 14, 15
software-defined networking 4, 179, 187–192, 218, 225
space diversity 53
space-time block coding xxiii, 1, 2, 35–37, 40, 46, 51, 55, 64–68, 72, 74–76, 81, 86, 87, 89, 99, 104, 119, 120, 129, 166, 223
space-time block decoder 75
space-time block encoder 74
space-time coding 2, 51, 54, 88, 89, 93
space-time trellis coding 2, 35, 52, 72–75, 89, 105, 223
space-time-coded cooperative diversity 104
spatial diversity 53, 54
spatio-temporal processing 2, 35, 39–41, 51, 52, 56, 63, 64, 68, 76, 88, 93, 103, 105, 117, 223
standards development organisation 22, 185, 187
stateful address auto-configuration 159, 160
stateless address auto-configuration 159, 160
sub-decision elements 28
supportive protocol 3, 93, 132, 224
switched combining 54
system orchestration 179
t
Technical Report 223
Technical Specification 28, 182, 190
Telemanagement Forum 183
temporal diversity 53
time diversity 53
time division duplex 116
Time To Live 141, 144
topology control 138, 139, 161
total cost of ownership 11
Transmission Control Protocol 22
Transmission Control Protocol/Internet Protocol 31, 45, 181
transmission diversity 54–57
transmit diversity 54
transmitting antenna xxiii, 1, 68
trellis-coded modulation 72, 74–76
u
User Datagram Protocol 22, 139, 142
utility functions 26
v
vehicular ad hoc network 78, 192
vertical reference points 30
Vertical Technological Pillar xi, 1, 8, 34, 35, 38, 39, 41–44, 47, 85, 223
virtual antenna array 36, 37, 41, 43, 46, 56, 60, 66, 93, 95, 96, 103–106, 111, 115, 118, 119, 132, 137, 146, 149–156, 163, 167, 171, 173, 175, 197, 224
virtual antenna arrays 3, 36, 56, 132, 137, 224
virtual cooperative set 163, 166
virtual multiple-input multiple-output 56, 60, 62, 137, 163, 192, 201
w
weighted round-robin 110
Wireless World Initiative New Radio I xiii, 115
Wireless World Initiative New Radio II xiii, 115
Work Item 182, 183