INDEX

Adaptation, see also Mapping
Adaptation atomic function, 21
  OTN OCh, 98, 99
  OTN ODUk, 85, 92
  OTN OMSn, 101
  OTN OPS, 104
  OTN OTSn, 102, 103
  OTN OTUk, 95, 96
  PTN, 108, 111
  SDH ES1, 82, 83
  SDH FEC capable, 80
  SDH MSn, 71, 72
  SDH OSn, 81, 82
  SDH RSn, 77, 78
  SDH S3 to MS1, 75
  SDH Sm, 63, 67
  SDH Sm to S3, 63
  SDH Sm to S4, 58–62
  SDH Sn, 55, 57

Administrative Unit AU
  AU, 5
  AU pointer bytes, 74
  AU-n structure, 32, 33
  AU group AUG, 5
  AU group AUG-N structure, 29, 32, 33, 34

ANSI standard, 7–9
ATM cell structure, 49
ATM mapping, 41, 44, 87
Atomic functions, 18–26, 53
Automatic Protection Switching APS, 129, 139
Availability, 127

Bi-directional line switched ring BLSR, 137
Bit a-synchronous mapping, 150
Bit stuffing, 113, 123–124
Bit synchronous mapping, 151
Byte synchronous mapping, 150
Channel layer, packet transport channel
PTC, 105
Concatenated VC-n structure, 39
Concatenation, 161–170
Concatenation
contiguous CCAT, 161–163
virtual VCAT, 163–168
Connection, 25
Connection atomic function, 20
OTN OMSn, 101
OTN OCh, 99
OTN ODUk, 91
OTN OPS, 104
OTN OTSn, 103
OTN OTUk, 96
PTN, 110
SDH ES1, 83
SDH MSn, 71
SDH OSn, 81
SDH RSn, 77
SDH Sm, 66
SDH Sn, 56
Connection
link connection LC, 25
network connection NC, 25
sub-network connection SNC, 25
Constant bit-rate (CBR) mapping, 44,
86, 153
Container
contiguous concatenated, 5
payload C-n, 4, 5, 40
virtual concatenated, 5
virtual container VC, 4, 5, 37
Contiguous concatenated container, 5
Contiguous concatenation CCAT,
161–163
Defects, 172
Digital Cross Connect DXC, 14
E11—(DS1) structure, 45
E12—(E1) structure, 46
E21—(DS2) structure, 46
E22—(E2) structure, 47
E31—(E3) structure, 47
E32—(DS3) structure, 47, 48
E4 structure, 48
Electrical section layer ES1, 82
ES1 adaptation function, 82, 83
ES1 connection function, 83
ES1 layer functional model, 82
ES1 termination function, 83
Ethernet MAC PDU structure, 49, 50
ETSI standard, 7–9
Failures, 172
FC-BBW_SONET PDU structure, 52
Forward Error Correction FEC, 31, 42
FEC capable adaptation function,
80
Four fiber ring protection, 141
Frame mapped GFP GFP-F, 157
Frame structure, see Structure,
Frequency justification, 113–126
Functional model, 11
network, 18–26, 53, 83, 105
OTN, 83–104
OTN OCh layer, 98
OTN ODUk layer, 85
OTN OMSn layer, 100
OTN OPS layer, 104
OTN OTSn layer, 102
OTN OTUk layer, 95
PTN, 105–111
ring protection, 138, 140, 142
SDH ES1 layer, 82
SDH MSn layer, 71, 75
SDH OSn layer, 81
SDH RSn layer, 76, 79
SDH Sm layer, 65
SDH Sn layer, 55
SDH/SONET, 53–83
SNC protection, 144, 145, 146
TCM sub-layer, 64, 92
trail protection, 136
Future OTN mapping, 155
Generic Framing Procedure GFP
frame structure, 156
frame mapped GFP-F, 157
mapping, 41, 44, 155–159
transparent mapped GFP-T, 157
HDLC/PPP PDU structure, 51
Higher order path layer Sn, 54–64
processing, 181–185
see also Path layer
Higher order VCAT overhead, 165
INDEX

History, 2
GFP, 3
LCAS, 3
OTN, 3
SDH, 3
SONET, 2
VCAT, 3

ITU-T recommendation, 7–9

Justification
OTN mapping, 125
OTN multiplexing, 126
positive and negative, 114, 124
SDH mapping, 124

Layer, 53
electrical section ES1, 82
higher order path Sn, 54–64
lower order path Sm, 64–70
multiplex section MSn, 67–75
optical channel data unit ODUk, 84–94
optical channel OCh, 97–100
optical channel transport unit OTUk, 95–97
optical multiplex section OMSn, 100–102
optical physical section OPS, 103–104
optical section Osn, 80–82
optical transmission section OTSn, 102–103
packet transport channel layer PTC, 105
regenerator section RSn, 75–80
SONET MS0, 73, 75
SONET RS0, 78, 79

Layers
below Osn and ES1, 83
OTN, 83–104
PTN, 105–111
SDH/SONET, 53–83

Line, 4
Linear topology, 12
Linear trail protection, 134

Link Capacity Adjustment Scheme
LCAS, 168–170
LCAS + VCAT parameters, 167
Link connection LC, 25

Local area network LAN, 18
Lower order multiframe, 68
Lower order path layer Sm, 64–70
processing, 186–190
see also Path layer
Lower order VCAT overhead, 166

Maintenance entity end point MEP, 106–110
Maintenance entity intermediate point MIP, 106–110
Mapping justification, 124
Mapping methodologies, 149–159

Mapping
ATM, 41, 44, 87
bit a-synchronous, 150
bit synchronous, 151
byte synchronous, 150
constant bit-rate (CBR), 44, 86, 153
future OTN, 155
GFP, 155–159
non-OTN to ODUk, 100
non-SDH to S4, 62
ODU[i][j] to ODUk, 88
OTN payload unit OPUk, 153–155
packet in OTN, 154
packet in SDH, 151
PTN to ODUk, 88
SDH to ODUk, 86
SDH/SONET container Cn, 149–152
Sn client specific, 57
special OTN, 155
special SDH, 152
STM, 153
test signal to ODUk, 88

Mesh topology, 14
Metro area network MAN, 18
Mid-span meet, 2
Model, OSI protocol reference model, 26
MPLS-TP and MPLS PDU structure, 50, 51

Multiframe, lower order, 68
Multiplex section layer MSn, 67–75
MSn adaptation function, 71, 72
MSn connection function, 71
MSn layer functional model, 71, 75
MSn overhead MS-OH, 29, 72–74
MSn section overhead, 72–74
MSn termination function, 71, 72
Multiplexer
- add drop multiplexer ADM, 12, 133
- terminating multiplexer TM, 12

Multi-service platforms, 16
- Multi-service access platform MSAP, 17
- Multi-service provisioning platform MSPP, 17
- Multi-service switching platform MSSP, 17
- Multi-service transport platform MSTP, 16

Network architecture, 11–26
- Network connection NC, 25
- Network functional model, 18–26, 53, 83, 105
- Network topology, 11–17
- Network
  - local area network LAN, 18
  - metro area network MAN, 18
  - storage area network SAN, 18
  - virtual private network VPN, 17
  - wide area network WAN, 18
- NGN topology, 15
- Non-OTN to ODUk adaptation function, 100
- Non-SDH to S4 adaptation function, 62

ODU[ij] to ODUk mapping, 88
- Optical channel data unit ODU, 6
- Optical channel data unit layer ODUk, 84–94
  - ODUk adaptation function, 85, 92
  - ODUk connection function, 91
  - ODUk frame structure, 43
  - ODUk layer functional model, 85
  - ODUk path overhead ODU-OH, 93, 94
  - ODUk termination function, 91
- Optical channel layer OCh, 97–100
  - OCh adaptation function, 98, 99
  - OCh connection function, 99
  - OCh layer functional model, 98
  - OCh section overhead, 100
  - OCh termination function, 98, 99
- Optical channel payload unit OPU, 6
  - OPUk frame structure, 43, 44
  - OPUk path overhead OPU-OH, 93
  - Optical channel transport unit OTU, 6
  - Optical channel transport unit layer OTUk, 95–97
    - OTUk adaptation function, 95, 96
    - OTUk connection function, 96
    - OTUk frame structure, 42
    - OTUk layer functional model, 95
    - OTUk section overhead, 96
    - OTUk termination function, 95, 96
  - Optical multiplex section layer OMSn, 100–102
    - OMSn adaptation function, 101
    - OMSn connection function, 101
    - OMSn layer functional model, 100
    - OMSn termination function, 101
  - Optical physical section layer OPS, 103–104
    - OPS adaptation function, 104
    - OPS connection function, 104
    - OPS layer functional model, 104
    - OPS termination function, 104
  - Optical section layer OSn, 80–82
    - OSn adaptation function, 81, 82
    - OSn connection function, 81
    - OSn layer functional model, 81
    - OSn termination function, 81
  - Optical transmission section layer OTSn, 102–103
    - OTSn adaptation function, 102, 103
    - OTSn connection function, 103
    - OTSn layer functional model, 102
    - OTSn termination function, 102, 103
- Optical transport network OTN functional model, 83–104
  - OTN frames and structures, 41–45
  - OTN layers, 83–104
  - OTN mapping justification, 125
  - OTN multiplex structure, 42
  - OTN multiplexing justification, 126
  - OTN OPUk mapping, 153
  - OTN VCAT overhead, 168
- OSI protocol reference model, 26
- Overhead OH, 4
  - Processing SDH/SONET, 171–190
  - MSn section overhead MS-OH, 72–74
  - ODUk path overhead ODU-OH, 93, 94
  - OPUk path overhead OPU-OH, 93
  - OTN VCAT overhead, 168
OTUk section overhead OUT-OH, 96
RSn section overhead RS-OH, 78–79
Sm path overhead Sm-POH, 67–70
Sn path overhead Sn-POH, 57–59
STM-N overhead, 30, 31
VC-m path overhead, 38
Packet in OTN mapping, 154
Packet in SDH mapping, 151
Packet transport channel layer PTC, 105
Packet transport network PTN
  functional model, 105–111
  PTN adaptation function, 108, 111
  PTN connection function, 110
  PTN frame structures, 48–52
  PTN OAM traffic unit, 109, 111
  PTN termination function, 110, 111
Packet transport path layer PTP, 105
Packet transport section layer PTS, 105
Path, 4
Path layer, higher order path Sn
  functional model, 54–64
  Sn adaptation function, 55, 57
  Sn connection function, 56
  Sn path overhead, 57–59
  Sn termination function, 55, 56
Path layer, lower order path Sm
  functional model, 64–70
  Sm adaptation function, 65, 67
  Sm connection function, 66
  Sm path overhead, 67–70
  Sm termination function, 66
  Sm to S3 adaptation function, 63
  Sm to S4 adaptation function, 59
Path layer, packet transport path PTP, 105
Path overhead, see overhead,
Path protection sub-layer SnP, 63
Payload, 29
Payload container C-n, 40
PDH frame structures, 45–48
PDH hierarchy, 12
Pointer
  byte allocation, 117
  bytes, AU, 74
  bytes, TU, 70
  generation, 119
  interpretation, 120–123
  justification, 119
  processing, 114–117, 179–180
  Positive and negative justification, 114, 124
Processing SDH/SONET overhead,
  171–190
  higher order path layer Sn, 181–185
  lower order path layer Sm, 186–190
  SDH multiplex section MSn, 177–178
  SDH regenerator section RSn, 175–176
  SONET line layer, 177–178
  SONET section layer, 175–176
Protection
  (1:1), 129
  (1:n), 130
  (1+1), 129
  (1+1)n, 132
  (m:n), 131
  architectures, 128–132
  automatic protection switching APS,
    129, 139
  classes, 132–147
  linear trail, 134–136
  mechanisms, 127
  path protection sublayer SnP, 63
  replacement by, 128
  ring, 136–142
  sub-network connection protection
    SNCP, 134, 142–147
  trail, 133, 134–142
  unidirectional path switched ring
    UPSR, 136
PTN to ODUk adaptation, 88
Reference points, 23
Regenerator section layer RSn
  functional model, 75–80
  RSn adaptation function, 77, 78
  RSn adaptation overhead, 78
  RSn connection function, 77
  RSn section overhead, 78
  RSn termination function, 77
  RSn termination overhead, 79
Regenerator section overhead RS-OH, 29
Replacement by protection, 128
Replacement by restoration, 128
Ring protection, 136
four fiber, 141
Ring topology, 13

SDH frames and structures, 27–41
SDH multiplex section processing, 177–178
SDH multiplex structure, 28
SDH regenerator section processing, 175–176
SDH to ODUk adaptation, 86
SDH/SONET container Cn mapping, 149
SDH/SONET functional model, 53–83
Section, 4
Section layer
electrical section ES1, 82
multiplex section MSn, 67, 71
optical section OSn, 80–82
packet transport section PTS, 105
Section overhead
multiplex section MS-OH, 29, 72
regenerator section RS-OH, 29
SONET line layer processing, 177–178
SONET MS0 layer, 73, 75
SONET multiplex structure, 28
SONET RS0 layer, 78, 79
SONET section layer processing, 175–176

Standards
ANSI, 7–9
ETSI, 7–9
ITU-T recommendation, 7–9

Storage area network SAN, 18

Structure
ATM cell, 49
AUG-N, 29, 32, 33, 34
AU-n, 32, 33
E11—(DS1), 45
E12—(E1), 46
E21—(DS2), 46
E22—(E2), 47
E31—(E3), 47
E32—(DS3), 47, 48
E4, 48
Ethernet MAC PDU, 49, 50
FC-BBW_SONET PDU, 52
HDLC/PPP PDU, 51

MPLS-TP and MPLS PDU, 50, 51
ODUk frame, 43
OPUk frame, 43, 44
OTN frames and structures, 41–45
OTN multiplex, 42
OTUk frame, 42
PDH frame structures, 45–48
PTN frame structures, 48–52
SDH frames and structures, 27–41
SDH multiplex, 28
SONET multiplex, 28
STM-N frame, 28–32
TUG-n, 33, 35, 36
TU-n, 35, 37
VC-n, 37–40
virtual concatenated OPUk, 45
virtual concatenated VC-n, 40

Sub-network connection protection
SNCP, 134, 142–147
with inherent monitoring SNC/I, 144
with non-intrusive monitoring SNC/P, 145
with sub-layer trail monitoring SNC/S, 145
with test monitoring SNC/T, 147

Sub-network connection SNC, 25
Synchronous payload envelope SPE, 4, 37

Synchronous transport module STM, 5
STM mapping, 153
STM-N bit-rates, 30
STM-N frame structure, 28–32
STM-N overhead, 31

Tandem connection monitoring TCM
TCM sub-layer functional model
OTN, 92
TCM sub-layer functional model
SDH, 64
Terminating multiplexer TM, 12
Termination function, 22
OTN OCh, 98, 99
OTN ODUk, 91
OTN OMSn, 101
OTN OPS, 104
OTN OTSn, 102, 103
OTN OTUk, 95, 96
PTN, 110, 111
SDH ES1, 83
SDH MSn, 71, 72
SDH OSn, 81
SDH RSn, 77
SDH Sm, 66
SDH Sn, 55, 56

Topology
mesh, 14
network, 11–17
NGN, 15
ring, 13

Trail, 4, 25
Trail protection, 133, 134
Trail termination function, see Termination function,

Transparent mapped GFP GFP-T, 157
Transport entity, 25
Tributary Unit TU, 5
TU pointer bytes, 70
TU-n structure, 35, 37
TU group TUG, 5
TU group TUG-n structure, 33, 35, 36

Unidirectional path switched ring UPSR, 136

VC-n structure, 37–40
Virtual concatenated container, 5
Virtual concatenated OPUk structure, 45
Virtual concatenated VC-n structure, 40
Virtual concatenation VCAT, 163–168
VCAT + LCAS parameters, 167
VCAT overhead, higher order SDH, 165
VCAT overhead, lower order SDH, 166
VCAT overhead, OTN, 168
VCAT payload distribution, 164
VCAT payload reconstruction, 164
Virtual container VC, 4, 5, 37
Virtual private network VPN, 17

Wide area network WAN, 18