ISO/IEC 11801:2002-09 (E)

Information technology_- Generic cabling for customer premises

CONTENTS

FOREWORD 10
INTRODUCTION 11
1 Scope 13
2 Normative references 13
3 Definitions, abbreviations and symbols 17
3.1 Definitions 17
3.2 Abbreviations 23
3.3 Symbols 24
3.3.1 Variables 24
3.3.2 Indices 25
4 Conformance 25
5 Structure of the generic cabling system 26
5.1 General 26
5.2 Functional elements 26
5.3 Cabling subsystems 27
5.3.1 General 27
5.3.2 Campus backbone cabling subsystem 27
5.3.3 Building backbone cabling subsystem 28
5.3.4 Horizontal cabling subsystem 28
5.3.5 Design objectives 28
5.4 Interconnection of subsystems 29
5.4.1 General 29
5.4.2 Centralised cabling architecture 30
5.5 Accommodation of functional elements 30
5.6 Interfaces 30
5.6.1 Equipment interfaces and test interfaces 30
5.6.2 Channel and permanent link 32
5.6.3 External network interface 32
5.7 Dimensioning and configuring 32
5.7.1 Distributors 32
5.7.2 Cables 34
5.7.3 Work area cords and equipment cords 34
5.7.4 Patch cords and jumpers 34
5.7.5 Telecommunications outlet (TO) 35
5.7.6 Consolidation point 36
5.7.7 Telecommunications rooms and equipment rooms 36
5.7.8 Building entrance facilities 36
5.7.9 External services cabling 36
6 Performance of balanced cabling 37
6.1 General 37
6.2 Layout 38
6.3 Classification of balanced cabling 39
6.4 Balanced cabling performance 39
6.4.1 General 39

6.4.2 Return loss 39
6.4.3 Insertion loss/attenuation 40
6.4.4 NEXT 41
6.4.5 Attenuation to crosstalk ratio (ACR) 44
6.4.6 ELFEXT 45
6.4.7 Direct current (d.c.) loop resistance 47
6.4.8 Direct current (d.c.) resistance unbalance 48
6.4.9 Current carrying capacity 48
6.4.10 Operating voltage 48
6.4.11 Power capacity 48
6.4.12 Propagation delay 48
6.4.13 Delay skew 49
6.4.14 Unbalance attenuation 49
6.4.15 Coupling attenuation 50
7 Reference implementations for balanced cabling 50
7.1 General 50
7.2 Balanced cabling 50
7.2.1 General 50
7.2.2 Horizontal cabling 50
7.2.3 Backbone cabling 54
8 Performance of optical fibre cabling 55
8.1 General 55
8.2 Component choice 55
8.3 Channel attenuation 56
8.4 Channel topology 56
8.5 Propagation delay 58
9 Cable requirements 58
9.1 General 58
9.2 Balanced cables 58
9.2.1 Basic performance requirements 58
9.2.2 Additional requirements 59
9.2.3 Additional performance requirements for flexible cables 60
9.3 Additional crosstalk considerations for cable sharing in balanced cables 60
9.3.1 General 60
9.3.2 Power summation in backbone cables 60
9.3.3 Hybrid, multi-unit and cables connected to more than one TO 60
9.4 Optical fibre cables 61
9.4.1 Optical fibre types 61
9.4.2 Generic performance requirements 61
9.4.3 Multimode optical fibre cable 61
9.4.4 Single-mode optical fibre cables 62
10 Connecting hardware requirements 62
10.1 General requirements 62
10.1.1 Applicability 62
10.1.2 Location 63
10.1.3 Design 63
10.1.4 Operating environment 63
10.1.5 Mounting 63

10.1.6 Installation practices 63
10.1.7 Marking and colour coding 64
10.2 Connecting hardware for balanced cabling 64
10.2.1 General requirements 64
10.2.2 Performance marking 64
10.2.3 Mechanical characteristics 64
10.2.4 Electrical characteristics 66
10.2.5 Telecommunications outlet requirements 72
10.2.6 Design considerations for installation 73
10.3 Optical fibre connecting hardware 74
10.3.1 General requirements 74
10.3.2 Marking and colour coding 74
10.3.3 Mechanical and optical characteristics 74
10.3.4 Telecommunications outlet requirements 75
10.3.5 Connection schemes for optical fibre cabling 75
11 Screening practices 77
11.1 General 77
11.2 Electromagnetic performance 77
11.3 Earthing 78
12 Administration 78
13 Balanced cords 78
13.1 Introduction 78
13.2 Insertion loss 78
13.3 Return loss 79
13.4 NEXT 79
Annex A (normative) Balanced permanent link and CP link performance 82
A.1 General 82
A.2 Performance 82
A.2.1 General 82
A.2.2 Return loss 83
A.2.3 Insertion loss/attenuation 84
A.2.4 NEXT 85
A.2.5 Attenuation to crosstalk ratio (ACR) 88
A.2.6 ELFEXT 89
A.2.7 Direct current (d.c.) loop resistance 92
A.2.8 Direct current (d.c.) resistance unbalance 93
A.2.9 Propagation delay 93
A.2.10 Delay skew 94
Annex B (normative) Test procedures 96
B.1 General 96
B.2 Channel and link performance testing 96
B.2.1 Testing balanced cabling channels, permanent links and CP links 96
B.2.2 Testing optical fibre cabling channels 96
B.2.3 Channel and link test schedules 96
B.3 Transmission testing of cords for balanced cabling 97
B.4 Transmission testing of components for cabling 98
B.4.1 Transmission testing of copper cables for balanced cabling 98

B.4.2 Transmission testing of connecting hardware for balanced cabling 98
B.4.3 Transmission testing of cables for optical cabling 98
B.4.4 Transmission testing of connectors for optical cabling 98
Annex C (normative) Mechanical and environmental performance testing of connecting hardware for balanced cabling 99
C.1 Introduction 99
C.2 Test requirements 99
C.2.1 General 99
C.2.2 Initial test measurements 99
C.2.3 Environmental and mechanical performance 100
Annex D (informative) Electromagnetic characteristics 104
Annex E (informative) Acronyms for balanced cables 105
Annex F (informative) Supported applications 107
F.1 Supported applications for balanced cabling 107
F.2 Supported applications for optical fibre cabling 109
Annex G (informative) Channel and permanent link models for balanced cabling 113
G.1 General 113
G.2 Insertion loss 113
G.2.1 Insertion loss of the channel configuration 113
G.2.2 Insertion loss of the permanent link configurations 114
G.2.3 Assumptions for insertion loss 114
G.3 NEXT 115
G.3.1 NEXT of the channel configuration 115
G.3.2 NEXT of the permanent link configurations 115
G.3.3 Assumptions for NEXT 116
G.4 ELFEXT 119
G.4.1 ELFEXT of the channel configuration 119
G.4.2 ELFEXT for the permanent link configurations 119
G.4.3 Assumptions for ELFEXT 120
G.5 Return loss 120
G.5.1 Return loss of the channel and permanent link configurations 120
G.5.2 Assumptions for the return loss circuit analysis method 121
Annex H (informative) Class F channel and permanent link with two connections 124
Annex I (informative) Significant changes to balanced cabling requirements with respect to earlier editions of this International Standard 125
I.1 General 125
I.2 References 125
I.3 Structural elements 125
I.4 Product designation 125
I.5 Component requirements 125
I.6 Installed cabling requirements 126
Bibliography 132

Figure 1 – Structure of generic cabling 27
Figure 2 – Hierarchical structure of generic cabling 29
Figure 3 – Structures for centralised generic cabling 29
Figure 4 – Accommodation of functional elements 30
Figure 5 – Interconnect models 31
Figure 6 – Cross-connect models 31
Figure 7 – Equipment and test interfaces 31
Figure 8 – Example of a generic cabling system with combined BD and FD 33
Figure 9 – Inter-relationship of functional elements in an installation with redundancy 34
Figure 10 – Channel, permanent link and CP link of a balanced cabling 37
Figure 11 – Example of a system showing the location of cabling interfaces and extent of associated channels 38
Figure 12 – Horizontal cabling models 52
Figure 13 – Backbone cabling model 54
Figure 14 – Combined backbone/horizontal channels 57
Figure 15 – Eight-position outlet pin and pair grouping assignments (front view of connector) 73
Figure 16 – Duplex SC connectivity configuration 76
Figure 17 – Optical fibre patch cord 77
Figure A.1 – Link options 82
Figure E.1 – Cable naming schema 105
Figure E.2 – Cable types 106
Figure G.1 – Example of computation of NEXT with higher precision 116
Figure H.1 – Two connection channel and permanent link 124
Figure I.1 – Horizontal cabling model 127
Figure I.2 – Backbone cabling model 127

Table 1 – Maximum channel lengths 32
Table 2 – Return loss for channel....40
Table 3 – Informative return loss values for channel at key frequencies 40
Table 4 – Insertion loss for channel....41
Table 5 – Informative insertion loss values for channel at key frequencies 41
Table 6 – NEXT for channel 42
Table 7 – Informative NEXT values for channel at key frequencies....42
Table 8 – PS NEXT for channel....43
Table 9 – Informative PS NEXT values for channel at key frequencies 43
Table 10 – Informative ACR values for channel at key frequencies....44
Table 11 – Informative PS ACR values for channel at key frequencies 45
Table 12 – ELFEXT for channel....46
Table 13 – Informative ELFEXT values for channel at key frequencies....46
Table 14 – PS ELFEXT for channel 47
Table 15 – Informative PS ELFEXT values for channel at key frequencies 47
Table 16 – Direct current (d.c.) loop resistance for channel....47
Table 17 – Propagation delay for channel 48
Table 18 – Informative propagation delay values for channel at key frequencies 49
Table 19 – Delay skew for channel....49
Table 20 – Unbalance attenuation for channel....50
Table 21 – Horizontal link length equations 53
Table 22 – Backbone link length equations 55
Table 23 – Channel attenuation....56
Table 24 – Basic requirements of balanced cables 58
Table 25 – Mechanical characteristics of balanced cables....59
Table 26 – Optical fibre cable attenuation 61
Table 27 – Multimode optical fibre modal bandwidth....62
Table 28 – Mechanical characteristics of connecting hardware for use with balanced cabling 65
Table 29 – Electrical characteristics of telecommunications outlets intended for use with balanced cabling 67
Table 30 – Return loss 68
Table 31 – Insertion loss 68
Table 32 – Near end crosstalk (NEXT) 68
Table 33 – Power sum near end crosstalk (PS NEXT) 69
Table 34 – Far end crosstalk (FEXT)....69
Table 35 – Power sum far end crosstalk (PS FEXT 70
Table 36 – Input to output resistance 70
Table 37 – Input to output resistance unbalance 70
Table 38 – Current carrying capacity....71
Table 39 – Propagation delay....71
Table 40 – Delay skew 71

Table 41 – Transverse conversion loss (TCL) f.f.s. 71
Table 42 – Transfer impedance (screened connectors only) 72
Table 43 – Insulation resistance 72
Table 44 – Voltage proof 72
Table 45 – Matrix of backward compatible mated modular connector performance 73
Table 46 – Mechanical and optical characteristics of optical fibre connecting hardware 75
Table 47 – Minimum return loss for balanced cords 79
Table 48 – Informative values of return loss at key frequencies for Category 5, 6 and 7 cords 79
Table 49 – Informative values of NEXT at key frequencies for Category 5, 6 and 7 cords 81
Table A.1 – Return loss for permanent link or CP link 83
Table A.2 – Informative return loss values for permanent link with maximum implementation at key frequencies 83
Table A.3 – Insertion loss for permanent link or CP link 84
Table A.4 – Informative insertion loss values for permanent link with maximum implementation at key frequencies 85
Table A.5 – NEXT for permanent link or CP link 86
Table A.6 – Informative NEXT values for permanent link with maximum implementation at key frequencies 86
Table A.7 – PS NEXT for permanent link or CP link 87
Table A.8 – Informative PS NEXT values for permanent link with maximum implementation at key frequencies 88
Table A.9 – Informative ACR values for permanent link with maximum implementation at key frequencies 89
Table A.10 – Informative PS ACR values for permanent link with maximum implementation at key frequencies 89
Table A.11 – ELFEXT for permanent link or CP link 90
Table A.12 – Informative ELFEXT values for permanent link with maximum implementation at key frequencies 91
Table A.13 – PS ELFEXT for permanent link or CP link 92
Table A.14 – Informative PS ELFEXT values for permanent link with maximum implementation at key frequencies 92
Table A.15 – Direct current (d.c.) loop resistance for permanent link or CP link 93
Table A.16 – Informative d.c. loop resistance for permanent link with maximum implementation 93
Table A.17 – Propagation delay for permanent link or CP link 94
Table A.18 – Informative propagation delay values for permanent link with maximum implementation at key frequencies 94
Table A.19 – Delay skew for permanent link or CP link 95
Table A.20 – Informative delay skew for permanent link with maximum implementation 95
Table B.1 – Cabling characteristics of copper and optical fibre cabling for acceptance, compliance and reference testing 97
Table C.1 – Group P 100
Table C.2 – Group A 101
Table C.3 – Group B 102
Table C.4 – Group C 103

Table C.5 – Group D 103
Table F.1 – Applications using balanced cabling 108
Table F.2 – Modular connector pin assignment for applications 109
Table F.3 – Supported applications using optical fibre cabling 110
Table F.4 – Maximum channel lengths supported by optical fibre applications for multimode fibre 111
Table F.5 – Maximum channel length supported by optical fibre applications for single-mode fibres 112
Table G.1 – Insertion loss deviation. 114
Table H.1 – ACR and PS ACR values for 2 connection class F channels and permanent links at key frequencies 124
Table I.1 – Principal transmission performance requirements of 150 Ω connecting hardware 126
Table I.2 – Minimum return loss limits for links, permanent links and channels for the different cabling classes 128
Table I.3 – Maximum attenuation limits for links, permanent links and channels for the different cabling classes 128
Table I.4 – Minimum NEXT limits for links, permanent links and channels for the different cabling classes 129
Table I.5 – Minimum ACR limits for links, permanent links and channels for the different cabling classes 129
Table I.6 – Maximum propagation delay limits for links, permanent links and channels for the different cabling classes 130
Table I.7 – Maximum d.c. loop resistance limits for links, permanent links and channels for the different cabling classes 130
Table I.8 – Minimum unbalance attenuation (LCL/LCTL) limits for links, permanent links and channels for the different cabling classes 130
Table I.9 – Minimum PS NEXT, PS ACR, ELFEXT and PS ELFEXT limits for permanent links and channels for the different cabling classes 131
Table I.10 – Maximum delay skew limits for permanent links and channels for the different cabling classes 131