# DIN EN 14908-1:2007-11 (E)

## Open Data Communication in Building Automation, Controls and Building Management - Building Network Protocol - Part 1: Protocol Stack; English version EN 14908-1:2005

## Contents

page


Foreword ..... 7

Introduction ..... 8

1 Scope ..... 9

2 Normative references ..... 9

3 Terms and definitions ..... 9

4 Symbols and abbreviations ..... 11
4.1 Symbols and Graphical Representations ..... 11
4.2 Abbreviations ..... 13

5 Overview of Protocol Layering ..... 13

6 MAC Sublayer ..... 15
6.1 Service Provided ..... 15
6.2 Interface to the Link Layer ..... 15
6.3 Interface to the Physical Layer ..... 16
6.4 MPDU Format ..... 17
6.5 Predictive *p*-persistent CSMA — Overview Description ..... 18
6.6 Idle Channel Detection ..... 19
6.7 Randomising ..... 19
6.8 Backlog Estimation ..... 19
6.9 Optional Priority ..... 20
6.10 Optional Collision Detection ..... 21
6.11 Beta1, Beta2 and Preamble Timings ..... 22

7 Link Layer ..... 24
7.1 Assumptions ..... 24
7.2 Service Provided ..... 24
7.3 CRC ..... 24
7.4 Transmit Algorithm ..... 25

8 Network Layer ..... 25
8.1 Assumptions ..... 25
8.2 Service Provided ..... 27
8.3 Service Interface ..... 27
8.4 Internal Structuring of the Network Layer ..... 28
8.5 NPDU Format ..... 28
8.6 Address Recognition ..... 29
8.7 Routers ..... 29
8.8 Routing Algorithm ..... 30
8.9 Learning Algorithm — Subnets ..... 30

9 Transaction Control Sublayer ..... 30
9.1 Assumptions ..... 30
9.2 Service Provided ..... 31
9.3 Service Interface ..... 31
9.4 State Variables ..... 31
9.5 Transaction Control Algorithm ..... 32

10 Transport Layer ..... 32
10.1 Assumptions ..... 32
10.2 Service Provided ..... 32
10.3 Service Interface ..... 34
10.4 TPDU Types and Formats ..... 34

10.5 Protocol Diagram ..... 35
10.6 Transport Protocol State Variables ..... 36
10.7 Send Algorithm ..... 36
10.8 Receive Algorithm ..... 37
10.9 Receive Transaction Record Pool Size and Configuration Engineering ..... 37
10.9.1 General ..... 37
10.9.2 Number of Retries ..... 37
10.9.3 Transport Layer Timers ..... 39

11 Session Layer ..... 39
11.1 Assumptions ..... 39
11.2 Service Provided ..... 40
11.3 Service Interface ..... 40
11.4 Internal Structure of the Session Layer ..... 41
11.5 SPDU Types and Formats ..... 41
11.6 Protocol Timing Diagrams ..... 43
11.7 Request-Response State Variables ..... 46
11.8 Request-Response Protocol — Client Part ..... 46
11.9 Request-Response Protocol — Server Part ..... 46
11.10 Request-Response Protocol Timers ..... 47
11.11 Authentication Protocol ..... 47
11.12 Encryption Algorithm ..... 47
11.13 Retries and the Role of the Checksum Function ..... 47
11.14 Random Number Generation ..... 49
11.15 Using Authentication ..... 49

12 Presentation/Application Layer ..... 49
12.1 Assumptions ..... 49
12.2 Service Provided ..... 49
12.3 Service Interface ..... 50
12.4 APDU Types and Formats ..... 51
12.5 Protocol Diagrams ..... 52
12.6 Application Protocol State Variables ..... 54
12.7 Request - Response Messaging in Offline State ..... 54
12.8 Network Variables ..... 55
12.8.1 General ..... 55
12.8.2 Network Variable Processing ..... 55
12.9 Error Notification to the Application Program ..... 56
12.9.1 General ..... 56
12.9.2 Error Notification for Messages ..... 56
12.9.3 Error Notification for Network Variables ..... 56

13 Network Management & Diagnostics ..... 56
13.1 Assumptions ..... 56
13.2 Services Provided ..... 57
13.3 Network Management and Diagnostics Application Structure ..... 57
13.4 Node States ..... 57
13.5 Using the Network Management Services ..... 58
13.5.1 General ..... 58
13.5.2 Addressing Considerations ..... 58
13.5.3 Making Network Configuration Changes ..... 58
13.5.4 Downloading an Application Program ..... 59
13.5.5 Error Handling Conditions (Informative) ..... 60
13.6 Using Router Network Management Commands ..... 62
13.7 NMPDU Formats and Types ..... 63
13.7.1 General ..... 63
13.7.2 Query ID ..... 63
13.7.3 Respond to Query ..... 64
13.7.4 Update Domain ..... 64
13.7.5 Leave Domain ..... 64
13.7.6 Update Key ..... 64

10.5 Protocol Diagram ..... 35
10.6 Transport Protocol State Variables ..... 36
10.7 Send Algorithm ..... 36
10.8 Receive Algorithm ..... 37
10.9 Receive Transaction Record Pool Size and Configuration Engineering ..... 37
10.9.1 General ..... 37
10.9.2 Number of Retries ..... 37
10.9.3 Transport Layer Timers ..... 39

11 Session Layer ..... 39
11.1 Assumptions ..... 39
11.2 Service Provided ..... 40
11.3 Service Interface ..... 40
11.4 Internal Structure of the Session Layer ..... 41
11.5 SPDU Types and Formats ..... 41
11.6 Protocol Timing Diagrams ..... 43
11.7 Request-Response State Variables ..... 46
11.8 Request-Response Protocol — Client Part ..... 46
11.9 Request-Response Protocol — Server Part ..... 46
11.10 Request-Response Protocol Timers ..... 47
11.11 Authentication Protocol ..... 47
11.12 Encryption Algorithm ..... 47
11.13 Retries and the Role of the Checksum Function ..... 47
11.14 Random Number Generation ..... 49
11.15 Using Authentication ..... 49

12 Presentation/Application Layer ..... 49
12.1 Assumptions ..... 49
12.2 Service Provided ..... 49
12.3 Service Interface ..... 50
12.4 APDU Types and Formats ..... 51
12.5 Protocol Diagrams ..... 52
12.6 Application Protocol State Variables ..... 54
12.7 Request - Response Messaging in Offline State ..... 54
12.8 Network Variables ..... 55
12.8.1 General ..... 55
12.8.2 Network Variable Processing ..... 55
12.9 Error Notification to the Application Program ..... 56
12.9.1 General ..... 56
12.9.2 Error Notification for Messages ..... 56
12.9.3 Error Notification for Network Variables ..... 56

13 Network Management & Diagnostics ..... 56
13.1 Assumptions ..... 56
13.2 Services Provided ..... 57
13.3 Network Management and Diagnostics Application Structure ..... 57
13.4 Node States ..... 57
13.5 Using the Network Management Services ..... 58
13.5.1 General ..... 58
13.5.2 Addressing Considerations ..... 58
13.5.3 Making Network Configuration Changes ..... 58
13.5.4 Downloading an Application Program ..... 59
13.5.5 Error Handling Conditions (Informative) ..... 60
13.6 Using Router Network Management Commands ..... 62
13.7 NMPDU Formats and Types ..... 63
13.7.1 General ..... 63
13.7.2 Query ID ..... 63
13.7.3 Respond to Query ..... 64
13.7.4 Update Domain ..... 64
13.7.5 Leave Domain ..... 64
13.7.6 Update Key ..... 64

13.7.7 Update Address ..... 64
13.7.8 Query Address ..... 64
13.7.9 Query Network Variable Configuration ..... 65
13.7.10 Update Group Address ..... 65
13.7.11 Query Domain ..... 65
13.7.12 Update Network Variable Configuration ..... 65
13.7.13 Set Node Mode ..... 65
13.7.14 Read Memory ..... 66
13.7.15 Write Memory ..... 66
13.7.16 Checksum Recalculate ..... 66
13.7.17 Install ..... 66
13.7.18 Memory Refresh ..... 82
13.7.19 Query SI ..... 82
13.7.20 Network Variable Value Fetch ..... 82
13.7.21 Manual Service Request Message ..... 82
13.7.22 Network Management Escape Code ..... 82
13.7.23 Router Mode ..... 83
13.7.24 Router Clear Group or Subnet Table ..... 83
13.7.25 Router Group or Subnet Table Download ..... 83
13.7.26 Router Group Forward ..... 83
13.7.27 Router Subnet Forward ..... 84
13.7.28 Router Do Not Forward Group ..... 84
13.7.29 Router Do Not Forward Subnet ..... 84
13.7.30 Router Group or Subnet Table Report ..... 84
13.7.31 Router Status ..... 84
13.7.32 Router Half Escape Code ..... 84
13.8 DPDU Types and Formats ..... 84
13.8.1 General ..... 84
13.8.2 Query Status ..... 84
13.8.3 Proxy Status ..... 88
13.8.4 Clear Status ..... 88
13.8.5 Query Transceiver Status ..... 88

Annex A Reference Implementation (Normative) ..... 89
A.1 General ..... 89
A.2 Predictive CSMA Algorithm ..... 89
A.3 LPDU Transmit Algorithm ..... 148
A.4 LPDU Receive Algorithm ..... 150
A.5 Routing Algorithm ..... 153
A.6 Learning Algorithm ..... 153
A.7 Transaction Control Algorithm ..... 154
A.8 Network Layer Algorithm ..... 161
A.9 TPDU and SPDU Send Algorithm with Authentication ..... 177
A.10 Application Layer ..... 232
A.11 Network Management Commands ..... 287
A.12 Configuration Data Structures ..... 324
A.13 Include Files for the Reference Implementation ..... 343
A.14 Application Protocol State Variables and Address Recognition Structures ..... 373
A.15 Query-id Data Structures ..... 375
A.16 Respond to Query Data Structure ..... 376
A.17 Update Domain Data Structures ..... 376
A.18 Leave Domain Data Structures ..... 376
A.19 Update Key Data Structures ..... 376
A.20 Update Address Data Structures ..... 377
A.21 Query Address Data Structures ..... 378
A.22 Query NV Cnfg Data Structures ..... 378
A.23 Update Group Address Data Structures ..... 378
A.24 Query Domain Data Structures ..... 378
A.25 Update Network Variable Configuration Data Structures ..... 379
A.26 Set Node Mode Data Structures ..... 379

A.27 Read Memory Data Structures ..... 380
A.28 Write Memory Data Structures ..... 380
A.29 Checksum Recalculate Data Structures ..... 380
A.30 Install Command Data Structures ..... 381
A.31 Memory Refresh Data Structures ..... 389
A.32 Query SI Data Structures ..... 389
A.33 NV Fetch Data Structures ..... 390
A.34 Manual Service Request Message Data Structures ..... 390
A.35 Product Query Data Structures ..... 390
A.36 Router Mode Data Structures ..... 390
A.37 Router Table Clear Group or Subnet Table Data Structures ..... 391
A.38 Router Group or Subnet Download Data Structures ..... 391
A.39 Router Group Forward Data Structures ..... 391
A.40 Router Subnet Forward Data Structures ..... 391
A.41 Router Group No-Forward Data Structures ..... 392
A.42 Router Subnet No-Forward Data Structures ..... 392
A.43 Group / Subnet Table Report Data Structures ..... 392
A.44 Router Status Data Structures ..... 392
A.45 Query Status Data Structures ..... 393
A.46 Proxy Status Data Structures ..... 393
A.47 Clear Status Data Structures ..... 394
A.48 Query Transceiver Status Data Structures ..... 394

Annex B Additional Data Structures (Normative) ..... 395
B.1 General ..... 395
B.1.1 The System Image ..... 395
B.1.2 The Application Image ..... 395
B.1.3 The Network Image ..... 396
B.2 Read-Only Structures ..... 396
B.2.1 Fixed Read-Only Data Structures ..... 396
B.2.2 Read-only Structure Field Descriptions ..... 398
B.3 Domain Table ..... 401
B.3.1 Domain Table Field Descriptions ..... 402
B.4 Address Table ..... 402
B.4.1 Declaration of Group Address Format ..... 403
B.4.2 Group Address Field Descriptions ..... 403
B.4.3 Declaration of Subnet/Node Address Format ..... 404
B.4.4 Subnet/Node Address Field Descriptions ..... 404
B.4.5 Declaration of Broadcast Address Format ..... 404
B.4.6 Broadcast Address Field Descriptions ..... 404
B.4.7 Declaration of Turnaround Address Format ..... 405
B.4.8 Turnaround Address Field Descriptions ..... 405
B.4.9 Declaration of Protocol Processor's Address Format ..... 405
B.4.10 Protocol Processor Address Field Descriptions ..... 405
B.4.11 Timer Field Descriptions ..... 406
B.5 Network Variable Tables - Informative ..... 407
B.5.1 Network Variable Configuration Table Field Descriptions - Informative ..... 408
B.5.2 Network Variable Alias Table Field Descriptions - Informative ..... 409
B.5.3 Network Variable Fixed Table Field Descriptions - Informative ..... 409
B.6 Self-Identification Structures ..... 409
B.6.1 SI Structure Field Descriptions ..... 410
B.6.2 NV Descriptor Table Field Descriptions ..... 411
B.6.3 SNVT Table Extension Records ..... 411
B.6.4 SNVT Alias Field Descriptions ..... 412
B.6.5 Version 2 SI Data ..... 412
B.7 Configuration Structure ..... 416
B.7.1 General ..... 416
B.7.2 Configuration Structure Field Descriptions ..... 417
B.8 Statistics Relative Structure ..... 418

Annex C Behavioral Characteristics (Informative) ..... 420

C.1 Channel Capacity and Throughput ..... 420
C.2 Network Metrics ..... 421
C.3 Transaction Metrics ..... 422
C.4 Boundary Conditions — Power-Up ..... 423
C.5 Boundary Conditions — High Load ..... 423

Annex D PDU Summary (Normative) ..... 424

Annex E Naming and Addressing (Normative) ..... 426
E.1 Address Types and Formats ..... 426
E.2 Domains ..... 426
E.3 Subnets and Nodes ..... 427
E.4 Groups ..... 427
E.5 Unique_Node_ID and Node Address Assignment ..... 428
E.6 NPDU Addressing ..... 429

Annex F List of patents that pertain to this European Standard (Normative) ..... 431

Bibliography ..... 434