Table of Contents

1 Introduction ........................................................................................................................................................................................................... 1
   1.1 Scope .................................................................................................................................................................................................................. 1
   1.2 References .................................................................................................................................................................................................... 1
   1.3 Definitions ....................................................................................................................................................................................................... 1
      1.3.1 Annunciation UDP Port Number.................................................................................................................................................................................. 1
      1.3.2 Application Relationship ........................................................................................................................................................................... 1
      1.3.3 Configuration .................................................................................................................................................................................................. 1
      1.3.4 FDA Session .................................................................................................................................................................................................. 1
      1.3.5 Field Device .................................................................................................................................................................................................. 1
      1.3.6 Field Device Access Agent ........................................................................................................................................................................... 1
      1.3.7 FMS Port Number .............................................................................................................................................................................. 2
      1.3.8 Generic Server VCR Endpoint ................................................................................................................................................................. 2
      1.3.9 H1 ....................................................................................................................................................................................................... 2
      1.3.10 High Speed Ethernet (HSE) ........................................................................................................................................................................... 2
      1.3.11 HSE Device .................................................................................................................................................................................................. 2
      1.3.12 HSE Field Device .............................................................................................................................................................................. 2
      1.3.13 HSE Presence .................................................................................................................................................................................................. 2
      1.3.14 HSE Presence Interface ........................................................................................................................................................................... 2
      1.3.15 HSE Subnet .................................................................................................................................................................................................. 2
      1.3.16 I/O Gateway Device ........................................................................................................................................................................... 2
      1.3.17 IP6 Address .................................................................................................................................................................................................. 2
      1.3.18 LAN Redundancy Entity ........................................................................................................................................................................... 2
      1.3.19 Linking Device .................................................................................................................................................................................................. 2
      1.3.20 NMA Configuration Session ..................................................................................................................................................................... 2
      1.3.21 Operational IP Address ........................................................................................................................................................................... 2
      1.3.22 Republishing .................................................................................................................................................................................................. 2
      1.3.23 Session .................................................................................................................................................................................................... 3
      1.3.24 SM Multicast IP Address ........................................................................................................................................................................... 3
      1.3.25 SM Port Number .................................................................................................................................................................................................. 3
      1.3.26 Socket .................................................................................................................................................................................................... 3
   1.4 Acronyms and Abbreviations ........................................................................................................................................................................ 3
   1.5 Conventions Used in this Specification ......................................................................................................................................................... 4
      1.5.1 Class Definition Conventions ................................................................................................................................................................. 4

2 Technical Overview ................................................................................................................................................................................................... 5
   2.1 Key Features of the Field Device Access Agent Architecture .............................................................................................................................................................................. 5
      2.1.1 Objectives of the FDA Agent ......................................................................................................................................................................... 5
      2.1.2 Key Components .............................................................................................................................................................................. 5
      2.1.3 Key Operations .................................................................................................................................................................................. 7
      2.1.4 Open Interfaces .................................................................................................................................................................................. 9

3 Field Device Access Agent Architecture ....................................................................................................................................................... 10
   3.1 Hosts and HSE Device Types ........................................................................................................................................................................ 10
   3.2 FDA Agent External Interactions ................................................................................................................................................................. 11
   3.3 FDA Agent Internal Interactions ......................................................................................................................................................................... 12
      3.3.1 Local Interface 1: UDP/TCP ....................................................................................................................................................................... 12
      3.3.2 Local Interface 2: HSE SMK ....................................................................................................................................................................... 12
      3.3.3 Local Interface 3: Local NMIB (3a), SMIB (3b), and FBAP (3c) VFDs ............................................................................................... 13
      3.3.4 Local Interface 4: Local Ethernet Presence Manager ......................................................................................................................... 13
      3.3.5 Local Interface 5: H1 Stack ................................................................................................................................................................. 13
      3.3.6 Local Interface 6: LAN Redundancy Entity ............................................................................................................................................... 13

4 Field Device Access Agent Operation .............................................................................................................................................................. 14
   4.1 Sessionless Transfers .............................................................................................................................................................................. 14
   4.2 FDA Sessions and HSE VCRs ......................................................................................................................................................................... 14
      4.2.1 Client / Server .................................................................................................................................................................................................. 14
      4.2.1.1 Keeping Client / Server VCRs and their Sessions Open ......................................................................................................................... 16
      4.2.1.2 Linking Device Support for NMA Access and FBAP Access to H1 Devices .......................................................................................... 16
      4.2.2 Publisher / Subscriber ........................................................................................................................................................................... 17
      4.2.2.1 Session and HSE VCR Establishment .................................................................................................................................................. 18
      4.2.2.2 Timeliness .................................................................................................................................................................................................. 18
4.2.3 Report Distribution ........................................................................................................................................................................... 18
4.2.4 Terminating Sessions ......................................................................................................................................................................... 18
4.3 FDA Agent Initialization .......................................................................................................................................................................... 18
4.4 Configuring Sessions and HSE VCRs .................................................................................................................................................... 18
4.5 Configuring FBAP VFDs ....................................................................................................................................................................... 19
4.6 Conveying Services ............................................................................................................................................................................. 19
4.6.1 Buffered Transfers ............................................................................................................................................................................ 19
4.6.2 Matching Requests and Responses ............................................................................................................................................ 19
4.6.3 Misordered Messages ................................................................................................................................................................. 20
4.6.4 Converting Messages to Service Primitives ................................................................................................................................ 22
4.6.5 Converting Service Primitives to Messages .................................................................................................................................. 22
4.6.6 Receiving Messages .................................................................................................................................................................. 22
4.6.7 Starting and Stopping Timers ....................................................................................................................................................... 24
4.6.7.1 HSE VCR Idle Timer ............................................................................................................................................................... 24
4.6.7.2 Inactivity Close Timer ........................................................................................................................................................... 24
4.6.7.3 Transmit Delay Timer ........................................................................................................................................................... 24
4.6.8 Message Padding ............................................................................................................................................................................ 24
4.7 Identifying HSE and H1 Applications ................................................................................................................................................ 25
4.7.1 IP Addresses and HSE Subnet Addresses .................................................................................................................................. 25
4.7.2 Link IDs ............................................................................................................................................................................................ 26
4.7.2.1 Scope ......................................................................................................................................................................................... 26
4.7.2.2 Use .......................................................................................................................................................................................... 26
4.7.3 The Selector .................................................................................................................................................................................. 26
4.7.3.1 Server Selectors .................................................................................................................................................................. 26
4.7.3.2 Publisher / Subscriber Selectors ........................................................................................................................................ 26
4.7.3.3 Report Distribution Selectors ........................................................................................................................................... 26
4.8 Using UDP and TCP ........................................................................................................................................................................... 27
4.8.1 UDP ................................................................................................................................................................................................. 27
4.8.2 TCP ................................................................................................................................................................................................. 27
4.8.3 Concatenating Messages ............................................................................................................................................................. 27
4.8.4 UDP/TCP Ports ................................................................................................................................................................................. 27
4.8.4.1 Scope ....................................................................................................................................................................................... 28
4.8.4.2 Use .......................................................................................................................................................................................... 28
5 FDA Agent Formal Models .................................................................................................................................................................. 30
5.1 The FDA Agent Session Endpoint Object ........................................................................................................................................ 30
5.1.1 Class Definition ............................................................................................................................................................................. 30
5.1.2 Attributes ...................................................................................................................................................................................... 30
5.1.2.1 NMIB OD Index ...................................................................................................................................................................... 30
5.1.2.2 Local IP Address ................................................................................................................................................................. 30
5.1.2.3 Remote IP Address .............................................................................................................................................................. 30
5.1.2.4 Endpoint Type .................................................................................................................................................................... 31
5.1.2.5 Message Header Options ................................................................................................................................................... 31
5.1.2.6 State ....................................................................................................................................................................................... 31
5.1.2.7 Buffer Size .............................................................................................................................................................................. 31
5.1.2.8 Transmit Delay Time ............................................................................................................................................................ 31
5.1.2.9 Transport Protocol ............................................................................................................................................................... 31
5.1.2.10 NMA Configuration Session Use .................................................................................................................................... 31
5.1.2.11 Inactivity Close Time ....................................................................................................................................................... 31
5.1.2.12 Max Outstanding .......................................................................................................................................................... 31
5.1.2.13 UDP Port Number ........................................................................................................................................................... 31
5.1.2.14 Max Message Length ..................................................................................................................................................... 32
5.1.2.15 Remote PD Tag ............................................................................................................................................................... 32
5.2 The Client HSE VCR Object ............................................................................................................................................................. 32
5.2.1 Class Definition ............................................................................................................................................................................. 32
5.2.2 Attributes ...................................................................................................................................................................................... 32
5.2.2.1 HSE VCR Index ...................................................................................................................................................................... 32
5.2.2.2 Related Session Endpoint Id ................................................................................................................................................ 32
5.2.2.3 HSE VCR Type .................................................................................................................................................................... 32
5.2.2.4 FDA Address ...................................................................................................................................................................... 32
5.2.2.5 VCR User Id ..................................................................................................................................................................... 32
5.2.2.6 Inactivity Close Time ....................................................................................................................................................... 32
5.2.3 Client HSE VCR Use ................................................................................................................................................................. 33
Field Device Access Agent

5.3 The Server HSE VCR Object ......................................................................................................................................................... 33
  5.3.1 Class Definition ........................................................................................................................................................................ 33
  5.3.2 Attributes ................................................................................................................................................................................ 33
    5.3.2.1 HSE VCR Index ................................................................................................................................................................. 33
    5.3.2.2 Related Session Endpoint Id ........................................................................................................................................... 33
    5.3.2.3 HSE VCR Type .................................................................................................................................................................. 34
    5.3.2.4 VCR User Id .................................................................................................................................................................... 34
    5.3.2.5 Inactivity Close Time ..................................................................................................................................................... 34
  5.3.3 Server HSE VCR Use .............................................................................................................................................................. 34

5.4 The Multicast HSE VCR Object ..................................................................................................................................................... 37
  5.4.1 Class Definition ........................................................................................................................................................................ 37
  5.4.2 Attributes ................................................................................................................................................................................ 37
    5.4.2.1 HSE VCR Index ................................................................................................................................................................. 37
    5.4.2.2 Related Session Endpoint Id ........................................................................................................................................... 37
    5.4.2.3 HSE VCR Type .................................................................................................................................................................. 37
    5.4.2.4 VCR User Id .................................................................................................................................................................... 37
    5.4.2.5 FIA Address .................................................................................................................................................................... 37
    5.4.2.6 HSE Subnet Mask ........................................................................................................................................................... 37
    5.4.2.7 On Change Threshold ..................................................................................................................................................... 37
  5.4.3 Multicast HSE VCR Object Use ........................................................................................................................................... 37

5.5 H1 to H1 Republishing ................................................................................................................................................................. 39

5.6 Formal State Machines .................................................................................................................................................................. 40
  5.6.1 State Table Transition Processing ......................................................................................................................................... 40
  5.6.2 HSE Client/Server VCR State Machine ...................................................................................................................................... 40
  5.6.3 FDA Service Protocol Machine (FSPM) .................................................................................................................................. 40
  5.6.4 Application Relationship Protocol Machines (ARPMs) ...................................................................................................... 41
    5.6.4.1 ARPM Services ................................................................................................................................................................. 41
    5.6.4.2 Client/Server ARPM ......................................................................................................................................................... 41
    5.6.4.3 Multicast ARPM .................................................................................................................................................. 42
    5.6.4.4 ARPM Functions ............................................................................................................................................................ 42
  5.6.5 Socket Mapping Protocol Machine (SMPM) .................................................................................................................................. 52
    5.6.5.1 SMPM Services ................................................................................................................................................................. 52
    5.6.5.2 SMPM State Machine ..................................................................................................................................................... 52
    5.6.5.3 SMPM Functions ........................................................................................................................................................... 52

6 Field Device Access Agent Interface ........................................................................................................................................... 57
  6.1 Data Types .................................................................................................................................................................................. 57
  6.2 Message Format .......................................................................................................................................................................... 57
  6.3 Message Header ......................................................................................................................................................................... 58
  6.4 Message Trailer ........................................................................................................................................................................ 60
  6.5 Service-Specific Parameters .................................................................................................................................................... 60
    6.5.1 FDA Session Management Services ...................................................................................................................................... 60
      6.5.1.1 FDA Open Session (Confirmed Service Id = 1) ................................................................................................................................. 60
      6.5.1.2 FDA Idle (Confirmed Service Id = 3) ............................................................................................................................................... 60
    6.5.2 SM Services ................................................................................................................................................................. 63
      6.5.2.1 SM Find Tag Query (Unconfirmed Service Id = 1) ................................................................................................................... 63
      6.5.2.2 SM Find Tag Reply (Unconfirmed Service Id = 2) ................................................................................................................. 63
      6.5.2.3 SM Identify (Confirmed Service Id = 3) ........................................................................................................................................... 63
      6.5.2.4 SM Clear Address (Confirmed Service Id = 12) .................................................................................................................. 63
      6.5.2.5 SM Set Assignment Info (Confirmed Service Id = 14) ......................................................................................................... 63
      6.5.2.6 SM Clear Assignment Info (Confirmed Service Id = 15) .................................................................................................. 63
      6.5.2.7 SM Device Annunciation (Unconfirmed Service Id = 16) ................................................................................................ 63
    6.5.3 FMS Services ............................................................................................................................................................... 69
      6.5.3.1 FMS Reject ........................................................................................................................................................................... 69
      6.5.3.2 FMS Initiate (Confirmed Service Id = 96) .............................................................................................................................. 69
      6.5.3.3 FMS Abort (Unconfirmed Service Id = 112) ........................................................................................................................... 69
      6.5.3.4 FMS Status (Confirmed Service Id = 0) ............................................................................................................................... 69
      6.5.3.5 FMS Unsolicited Status (Unconfirmed Service Id = 1) ...................................................................................................... 69
      6.5.3.6 FMS Identify (Confirmed Service Id = 1) .................................................................................................................................... 69
      6.5.3.7 FMS Get OD (Confirmed Service Id = 4) ............................................................................................................................ 69
      6.5.3.8 FMS Initialize Put OD (Confirmed Service Id = 28) ............................................................................................................ 69
      6.5.3.9 FMS Initiate Put OD (Confirmed Service Id = 29) ............................................................................................................. 69
      6.5.3.10 FMS Terminate Put OD (Confirmed Service Id = 30) .................................................................................................. 69

© Fieldbus Foundation 1994-2007
| 6.5.3.11 | FMS Generic Initiate Download Sequence (Confirmed Service Id = 31) | 75 |
| 6.5.3.12 | FMS Generic Download Segment (Confirmed Service Id = 32) | 75 |
| 6.5.3.13 | FMS Generic Terminate Download Sequence (Confirmed Service Id = 33) | 76 |
| 6.5.3.14 | FMS Initiate Download Sequence (Confirmed Service Id = 9) | 76 |
| 6.5.3.15 | FMS Download Segment (Confirmed Service Id = 10) | 76 |
| 6.5.3.16 | FMS Terminate Download Sequence (Confirmed Service Id = 11) | 77 |
| 6.5.3.17 | FMS Initiate Upload Sequence (Confirmed Service Id = 12) | 77 |
| 6.5.3.18 | FMS Upload Segment (Confirmed Service Id = 13) | 77 |
| 6.5.3.19 | FMS Terminate Upload Sequence (Confirmed Service Id = 14) | 77 |
| 6.5.3.20 | FMS Request Domain Download (Confirmed Service Id = 15) | 78 |
| 6.5.3.21 | FMS Request Domain Upload (Confirmed Service Id = 16) | 78 |
| 6.5.3.22 | FMS Create Program Invocation (Confirmed Service Id = 17) | 78 |
| 6.5.3.23 | FMS Delete Program Invocation (Confirmed Service Id = 18) | 78 |
| 6.5.3.24 | FMS Start (Confirmed Service Id = 19) | 79 |
| 6.5.3.25 | FMS Stop (Confirmed Service Id = 20) | 79 |
| 6.5.3.26 | FMS Resume (Confirmed Service Id = 21) | 79 |
| 6.5.3.27 | FMS Reset (Confirmed Service Id = 22) | 79 |
| 6.5.3.28 | FMS Kill (Confirmed Service Id = 23) | 79 |
| 6.5.3.29 | FMS Read (Confirmed Service Id = 2) | 80 |
| 6.5.3.30 | FMS Read with Subindex (Confirmed Service Id = 62) | 80 |
| 6.5.3.31 | FMS Write (Confirmed Service Id = 3) | 80 |
| 6.5.3.32 | FMS Write with Subindex (Confirmed Service Id = 63) | 80 |
| 6.5.3.33 | FMS Define Variable List (Confirmed Service Id = 7) | 81 |
| 6.5.3.34 | FMS Delete Variable List (Confirmed Service Id = 8) | 81 |
| 6.5.3.35 | FMS Information Report (Unconfirmed Service Id = 0) | 81 |
| 6.5.3.36 | FMS Information Report with Subindex (Unconfirmed Service Id = 16) | 81 |
| 6.5.3.37 | FMS Information Report On Change (Unconfirmed Service Id = 17) | 81 |
| 6.5.3.38 | FMS Information Report On Change with Subindex (Unconfirmed Service Id = 18) | 82 |
| 6.5.3.39 | FMS Event Notification (Unconfirmed Service Id = 2) | 82 |
| 6.5.3.40 | FMS Alter Event Condition Monitoring (Confirmed Service Id = 24) | 82 |
| 6.5.3.41 | FMS Acknowledge Event Notification (Confirmed Service Id = 25) | 82 |

### 6.5.4 LAN Redundancy Services

| 6.5.4.1 | LAN Redundancy Get Information (Confirmed Service Id = 1) | 83 |
| 6.5.4.2 | LAN Redundancy Put Information (Confirmed Service Id = 2) | 84 |
| 6.5.4.3 | LAN Redundancy Get Statistics (Confirmed Service Id = 3) | 84 |
| 6.5.4.4 | Diagnostic Message (Unconfirmed Service Id = 1) | 85 |

### 6.6 Error Parameters

| 6.6.1 | Common Error Parameters | 87 |
| 6.6.2 | PI Error Parameters | 87 |
| 6.6.3 | OD Error Parameters | 87 |
| 6.6.4 | Error Classes and Codes | 88 |

### 6.7 Service Data

| 6.7.1 | Device Specific FDA Agent Internal Interfaces (Informative) | 90 |

#### 6.7.1 Device Specific FDA Agent Internal Interfaces (Informative)

| A.1 | Device Specific FDA Agent Internal Interfaces for HSE Field Devices | 90 |
| A.2 | Device Specific FDA Agent Internal Interfaces for Linking Devices | 91 |
| A.3 | Device Specific FDA Agent Internal Interfaces for I/O Gateways | 91 |

### Annex B. FDA Access Use (Normative)

| B.1 | Messages Sent by a Client HSE VCR Endpoint | 92 |
| B.2 | Messages Sent by a Server HSE VCR Endpoint | 93 |
| B.3 | Messages Sent by a Publisher HSE VCR Endpoint | 93 |
| B.4 | Messages Sent by a Report Source HSE VCR Endpoint | 93 |

### Annex C. OD Object Descriptions (Normative)

<p>| C.1 | Structure of the OD Object Description | 94 |
| C.2 | Object Description of Domain in the S-OD | 95 |
| C.3 | Object Description of Program Invocation in the DP-OD | 96 |
| C.4 | Object Description of Event in the S-OD | 96 |
| C.5 | Object Description of Data Type in the ST-OD | 97 |
| C.6 | Object Description of Data Type Structure Description in the ST-OD | 97 |
| C.7 | Object Description of Simple Variable in the S-OD | 97 |
| C.8 | Object Description of Array in the S-OD | 98 |
| C.9 | Object Description of Record in the S-OD | 98 |</p>
<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.10</td>
<td>Object Description of Variable List in the DV-OD</td>
</tr>
<tr>
<td>Annex D.</td>
<td>NMA Update Messages (Normative)</td>
</tr>
</tbody>
</table>

© Fieldbus Foundation 1994-2007