



IEEE Standard for Medium Frequency (less than 12 MHz) Power Line Communications (PLC) with a Hybrid PLC/Radio Frequency Physical Layer (PHY)

IEEE Communications Society

Developed by the
Power Line Communication Standards Committee

IEEE Std 1901.3-2025

STANDARDS

IEEE Standard for Medium Frequency (less than 12 MHz) Power Line Communications (PLC) with a Hybrid PLC/Radio Frequency Physical Layer (PHY)

Developed by the

Power Line Communication Standards Committee
of the
IEEE Communications Society

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Abstract: Abstract: Physical (PHY) and media access control (MAC) layers of the medium frequency band (less than 12 MHz) broadband power line and wireless communication technology for smart grid applications based on orthogonal frequency division multiplexing (OFDM) are specified in this standard. The necessary security requirements that assure communication privacy and allow use for mission-critical and security-sensitive services and applications are addressed in this standard. The coexistence with other technologies based on IEEE Std 1901™-2010 is also addressed. The approach that is geared toward achieving an extended communication range with medium speeds in comparison with the existing power line and wireless communication technologies operating in similar frequency bands is defined in this standard.

Keywords: Keywords: BPL, broadband power line and wireless, coexistence, fast Fourier transformation, FFT, IEEE 1901™, IEEE 1901.1™, IEEE 1901.2™, IEEE 1901.3™, MAC, media access control, medium frequency, OFDM, orthogonal frequency division multiplexing, PHY, PLC, power line and wireless communication, security, smart grid

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Liheng Chen	Jing Li	Mengyu Wang
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Qayumov Bobirmirzo	Yupeng Liu	Liyun Wu
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Qiuyue Chang	Xiongchuan Han	Kunhe Li
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Jinlei Chen	Werner Hoelzl	Ran Li
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Diyorbek Nishonov
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Introduction

This introduction is not part of IEEE Std 1901.3-2025, IEEE Standard for Medium Frequency (less than 12 MHz) Power Line Communications (PLC) with a Hybrid PLC/Radio Frequency Physical Layer (PHY).

This standard establishes a comprehensive framework for assessing the maturity of digital twin implementations within industrial settings. As digital twins become increasingly integral to optimizing operations, enhancing decision-making, and driving innovation across industries, there is a need for standardized guidance on evaluating the progression and effectiveness of these technologies. This standard provides a digital twin maturity model that defines capability domains and corresponding subdomains essential for the development, deployment, and management of digital twins. Additionally, it outlines assessment methodologies, including assessment content, processes, and criteria for determining maturity levels.

The maturity model described in this standard serves as a roadmap for organizations to assess their current digital twin capabilities, identify gaps, and develop targeted strategies for advancement. The model is structured across five distinct maturity levels—mirror, descriptive, diagnostic, predictive, and autonomous—each representing a progressive enhancement in the sophistication and functionality of digital twin technologies. These levels range from basic visual representations and descriptive insights to fully autonomous systems capable of real-time decision-making and self-optimization.

By adhering to the requirements and recommendations outlined in this standard, organizations can help ensure that their digital twin implementations are aligned with industry best practices, effectively integrated across the entire lifecycle of their target entities, and capable of delivering significant value in terms of performance, efficiency, and adaptability. The assessment methodologies provided offer a structured approach to evaluating digital twin maturity, supporting continuous improvement and helping organizations achieve their strategic digital transformation objectives.

This standard is intended for use by a wide range of stakeholders, including industry professionals, technology providers, consultants, and auditors involved in the development, implementation, and evaluation of digital twins. It aims to provide a clear and consistent framework for understanding and measuring digital twin maturity, promoting the widespread adoption of these technologies, and facilitating their integration into industrial processes.

Contents

1. Overview	17
1.1 Scope	17
1.2 Word usage	17
2. Normative references	18
3. Definitions, acronyms, and abbreviations	18
3.1 Definitions	18
3.2 Acronyms and abbreviations	19
4. General description	21
4.1 Introduction	21
4.2 Device roles	21
4.3 Network topology	21
4.4 Reference model	23
4.5 General description of interfaces to PHY layers	24
5. Network management sub-layer	24
5.1 General	24
5.2 Management packet format	25
5.3 Single network	43
5.4 Multi-network	43
5.5 Network maintenance	43
6. MAC sub-layer	65
6.1 Frame format	65
6.2 MAC sub-layer functions	90
7. Data link layer service	99
7.1 Overview	99
7.2 Data transmission service at the data link layer	99
7.3 Data management service at the data link layer	100
8. General PHY requirements	106
8.1 Carrier PHY requirements	106
8.2 RF PHY requirements	106
Annex A (informative) Carrier sense multiple access with collision avoidance (CSMA/CA) process	108
Annex B (informative) Bibliography	111

List of Figures

Figure 1—Example of broadband carrier and wireless communication network topology	22
Figure 2—Example of a topology for multiple broadband carrier and wireless communication networks	23
Figure 3—Protocol stack for a broadband carrier and wireless communication network.....	24
Figure 4—Example 1: timeslot scheduling datagram.....	47
Figure 5—Example 2: timeslot scheduling datagram.....	48
Figure 6—Example 3: timeslot scheduling datagram.....	49
Figure 7—Example 4: timeslot scheduling datagram.....	49
Figure 8—Example 5: timeslot scheduling datagram.....	50
Figure 9—Example 6: timeslot scheduling datagram.....	51
Figure 10—Example 7: timeslot scheduling datagram.....	51
Figure 11—Diagram of carrier communication rate statistics	52
Figure 12—Calculation of weighted carrier communication rate.....	53
Figure 13—Example of weighted carrier communication rate calculation	53
Figure 14—Diagram of route change	54
Figure 15—Update diagram in case of continuous reception	55
Figure 16—Update diagram in case of loss	55
Figure 17—Update diagram in case of transmission delay.....	56
Figure 18—Update diagram in case of out of order (Scenario I)	56
Figure 19—Update diagram in case of out of order (Scenario II).....	56
Figure 20—Unweighted Reception Rate window	57
Figure 21—Weighted Reception Rate window	57
Figure 22—Example of Downlink Reception Rate Aging	58
Figure 23—Example 1 of Uplink Reception Rate Aging.....	59
Figure 24—Example 2 of Uplink Reception Rate Aging.....	60
Figure 25—Diagram of Wireless Reception Rate	61
Figure 26—Reception rate calculation in Wireless Discovery List	61
Figure 27—Normal wireless proxy change.....	62
Figure 28—Proxy evaluation failure	63
Figure 29—Proxy change failure	63

Figure 30—Unsatisfied change interval	64
Figure 31—Optimal route selection change	64
Figure 32—Format of a carrier MAC frame.....	66
Figure 33—Format of a wireless MAC frame	66
Figure 34—Format of a carrier MPDU	70
Figure 35—Format of a wireless MPDU.....	70
Figure 36—RCG	72
Figure 37—RTS/CTS with SOF but no SACK.....	73
Figure 38—RTS/CTS with SOF and SACK.....	73
Figure 39—Single-frame transmission with no SACK frame	76
Figure 40—Single-frame transmission with a SACK frame	76
Figure 41—Wireless PB format for a MPDU	80
Figure 42—PB format for a carrier beacon MPDU	81
Figure 43—PB format for a wireless beacon MPDU.....	83
Figure 44—Timeslot allocation.....	90
Figure 45—Carrier CSMA timeslot allocation.....	92
Figure 46—Carrier Binding CSMA timeslot allocation	93
Figure 47—Wireless timeslot allocation	93
Figure 48—Format of a carrier MAC frame.....	96
Figure 49—Format of a wireless MAC frame	97
Figure 50—Data link layer services	99
Figure A.1—Recommended CSMA/CA Process	109

List of Tables

Table 1—Fields in the management packet header	25
Table 2—Management packet types (MMTYPE)	25
Table 3—Fields in MMeAssocReq packets	26
Table 4—Values of Link Type field	27
Table 5—Values of Module Type field	27
Table 6—Fields in MMeAssocCnf packets	27
Table 7—Values of the Result field	28
Table 8—Values of carrier frequency band	29
Table 9—Subfields in the Route Info field	29
Table 10—Subordinate STA list	29
Table 11—Fields in MMeAssocGatherInd packets	31
Table 12—Fields in MMeChangeProxyReq packets	31
Table 13—Fields in MMeChangeProxyCnf packets	32
Table 14—Fields in MMeChangeProxyBitMapCnf packets	33
Table 15—Fields in the MMeZeroCrossNTBReport packet	34
Table 16—Values of Edge Type field	34
Table 17—Fields of MMeSetKeyRequest packet	34
Table 18—Fields of MMeGetKeyConfirm packet	35
Table 19—Fields of MMeAuthrzConfirm packet	35
Table 20—Fields in the MMeRFChannelConflictReport packet	36
Table 21—Fields in Neighbor Network Entries	36
Table 22—Fields in MMeRFDdiscoverNodeList packets	36
Table 23—Values of Information Unit Type field	37
Table 24—Values of Information Unit Length Type field	37
Table 25—Fields in the Station Attribute Information	38
Table 26—Fields in Station Route Information Format	38
Table 27—Fields in non-bitmap format of neighbor node channel information	38
Table 28—Values of Channel Information Combination Type	39
Table 29—Values of Reception Rate Length	39

Table 30—Values of Average SNR Length.....	39
Table 31—Bit-time average signal-to-noise ratio mapping.....	39
Table 32—Values of Signal Strength Length.....	40
Table 33—4-bit Signal Strength Length mapping.....	40
Table 34—6-bit Signal Strength Length mapping.....	41
Table 35—Neighbor Node Channel Information Bitmap format	42
Table 36—Bitmap type of Channel Information Combination type.....	42
Table 37—Period parameters	45
Table 38—Example 1: values of the beacon list	48
Table 39—Example 2: values of the beacon list	48
Table 40—Example 3: values of the beacon list	49
Table 41—Example 4: values of the beacon list	49
Table 42—Example 5: values of the beacon list	50
Table 43—Example 6: values of the beacon list	51
Table 44—Example 7: values of the beacon list	51
Table 45—Fields in neighbor carrier node entry	52
Table 46—Fields in wireless neighbor node information entry	54
Table 47—Uplink reception rate exchange aging table in example 1	59
Table 48—Uplink reception rate aging table in example 2	60
Table 49—Fixed field in the MAC frame header.....	66
Table 50—Version.....	66
Table 51—Mapping between versions and channels.....	67
Table 52—Fields in a Standard MAC frame header	67
Table 53—Subfields in the Relay variant field	68
Table 54—Values of the Broadcast Direction field.....	68
Table 55—Values of MAC Exist Flag field	68
Table 56—Subfields in the MAC variant field.....	69
Table 57—Single-hop MAC frame header format	69
Table 58—Message type	69
Table 59—Subfields in the FC field.....	71
Table 60—Variant fields in an inter-network coordinate frame	71

Table 61—Variant fields in an RTS/CTS frame	72
Table 62—Variant fields in a beacon frame	74
Table 63—MCS Value.....	74
Table 64—Values of Payload PB size.....	75
Table 65—Variant fields in an SOF	75
Table 66—Values of the LID field	76
Table 67—Payload PB size	76
Table 68—Values of the Broadcast Flag field.....	77
Table 69—Values of the Resend Flag field	77
Table 70—Values of the Encryption Key Select field.....	77
Table 71—Variant fields in a SACK frame.....	78
Table 72—PBH format.....	81
Table 73—Subfields in the Beacon Frame Payload Field.....	84
Table 74—Values of the Smart Beacon Flag	85
Table 75—Subfields in the BMI field	85
Table 76—Values of the NBE field.....	85
Table 77—Values of the BEHDR field	86
Table 78—Value of the BELEN field	86
Table 79—Timeslot allocation list.....	86
Table 80—Subfields in the Non-central beacon information field.....	88
Table 81—Wireless route parameter list.....	88
Table 82—Wireless channel change list	88
Table 83—Subfields in the Smart Beacon Frame Payload field.....	89
Table 84—Subfields in the Smart beacon station info and timeslot entry field	89
Table 85—VCS timer value and channel status transition.....	94
Table 86—Carrier inter frame space values.....	95
Table 87—Wireless inter frame space values	96
Table 88—Data transmission service primitives at the data link layer.....	100
Table 89—MSDU transmit primitive	100
Table 90—Data management service primitives at the data link layer	101
Table 91—Network topology report primitive	101

Table 92—Single network topology entry report primitive	102
Table 93—Wireless channel group query primitive	102
Table 94—Wireless channel group reporting primitive.....	103
Table 95—Wireless channel group setup primitive	104
Table 96—Wireless channel query primitive	104
Table 97—Wireless channel reporting primitive.....	105
Table 98—Wireless channel setup primitive	105
Table 99—Requirements of modulation mode.....	106
Table 100—Requirements of receiver sensitivity.....	107

IEEE Standard for Medium Frequency (less than 12 MHz) Power Line Communications (PLC) with a Hybrid PLC/Radio Frequency Physical Layer (PHY)

1. Overview

1.1 Scope

This standard specifies data link layer for a hybrid physical (PHY) layer composed of PHY defined in the IEEE 1901.1-2018, Standard for Medium Frequency (less than 12 MHz) Power Line Communications for Smart Grid Applications and a PHY based on radio frequency (RF) communication technology based on orthogonal frequency division multiplexing (OFDM) for smart grid, photovoltaic energy system, vehicle-to-grid (V2G) applications, smart home/building, and other data distribution applications. This standard defines an interface to the PHY layers and a mechanism to switch data traffic between PLC and RF PHYs. The standard addresses the necessary security requirements that enable the use of this technology for mission-critical and security-sensitive services and applications.

1.2 Word usage

The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted (*shall* equals *is required to*).^{6,7}

The word *should* indicates that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others; or that a certain course of action is preferred but not necessarily required (*should* equals *is recommended that*).

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⁶ The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

⁷ The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

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FIPS 197, Federal Information Processing Standard, Advanced Encryption Standard (AES), U.S. Department of Commerce/National Institute of Standards and Technology, 26 Nov. 2001.⁸

IEEE Std 1901.1™-2018, IEEE Standard for Medium Frequency (less than 12 MHz) Power Line Communications for Smart Grid Applications, pp. 109–121.^{9,10}

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The IEEE Standards Dictionary Online should be consulted for terms not defined in this clause.¹¹

allowlist: A list of MAC addresses of stations (STAs) allowed to connect to the communication network.

amplitude map: A table of amplitude scaling values assigned to each carrier.

association: A service used to create subordinate relationships among members on a communication network.

beacon: A management packet that is sent by the central coordinator (CCO), proxy coordinator (PCO), or station (STA). The beacon carries information about network management and maintenance, and is used for a specified purpose.

beacon period: The interval at which the central coordinator (CCO) sends a central beacon based on the network scale.

broadband carrier and wireless communication network: The broadband carrier and wireless communication network support the transmission of digital data over electrical power lines and wireless.

direct route: Routes of one hop.

host: Computing system with an integrated IEEE 1901.3 communications module.

indirect route: Routes of more than one hop.

MAC address: A media access control address. The MAC addresses and organizationally unique identifiers (OUIs) in this standard are represented as described in IEEE Std 802™-2001.

multi-network coordination: The process in which the central coordinators (CCOs) on different networks perform negotiation to help ensure that the networks can mutually coexist.

⁸ FIPS publications are available from the National Technical Information Service, U.S. Department of Commerce (<http://www.ntis.org/>).

⁹ The IEEE standards or products referred to in [Clause 2](#) are trademarks owned by The Institute of Electrical and Electronics Engineers, Incorporated.

¹⁰ IEEE publications are available from The Institute of Electrical and Electronics Engineers (<http://standards.ieee.org/>).

¹¹ IEEE Standards Dictionary Online is available at: <http://dictionary.ieee.org>. An IEEE account is required for access to the dictionary, and one can be created at no charge on the dictionary sign-in page.

network identifier (NID): Uniquely identifies a broadband carrier and wireless communication network.

3.2 Acronyms and abbreviations

AES	Advanced Encryption Standard
BEHDR	beacon entry header
BIFS	burst inter frame space
BMI	beacon management information
BPC	beacon period count
BPCS	beacon payload check sequence
BPSK	binary phase shift keying
BT	beacon type
BTS	beacon time stamp
CCO	central coordinator
CIFS	contention inter frame space
CRC	cyclic redundancy check
CSMA/CA	carrier sense multiple access with collision avoidance
CTS	clear to send
DAK	device access key
DTEI	destination terminal equipment identifier
EIFS	extended inter frame space
EKS	encryption key select
EOF	end of frame
FC	frame control
FCCS	frame control check sequence
FEC	forward error correction
FFT	fast Fourier transformation
FL	frame length
ICV	integrity check value
IP	internet protocol
LID	link identifier
MAC	media access control
MM	management message
MME	management message entry
MNBF	multi-network broadcast flag
MPDU	media access control (MAC) protocol data unit
MSDU	media access control (MAC) service data unit

MCS	modulation and coding scheme
NBE	number of beacon entries
NEK	network encryption key
NID	network identifier
NMK	network membership key
NTB	network time base
ODA	original destination address
ODTEI	original destination terminal equipment identifier
OFDM	orthogonal frequency division multiplexing
OSA	original source address
OSI	open systems interconnection
OSTEI	original source terminal equipment identifier
OUI	organizationally unique identifier
PB	physical layer (PHY) block
PBB	physical layer (PHY) block body
PBCS	physical layer (PHY) block check sequence
PBH	physical layer (PHY) block header
PCO	proxy coordinator
PHY	physical layer
PLC	power line communication
PSD	power spectral density
QPSK	quadrature phase shift keying
RCG	request to send (RTS)/clear to send (CTS) gap
RIFS	response inter frame space
RSSI	received signal strength indication
RSVD	reserved
RTS	request to send
RTSF	request to send (RTS) flag
SACK	selective acknowledgement
SNR	signal-to-noise ratio
SOF	start of frame
SSN	segment sequence number
STA	station
STEI	source terminal equipment identifier
TCP	transmission control protocol
TDMA	time division multiple access

TEI	terminal equipment identifier
TLV	Tag-Length-Value
TMI	tone map index
VCS	virtual carrier sensing

4. General description

4.1 Introduction

This clause describes device roles, network topologies, and the reference model for broadband power line and wireless dual-mode communication technology. The information is delivered between the devices described in 4.2 on a network with a tree topology described in 4.3.

4.2 Device roles

On a broadband carrier and wireless dual-mode communication network, three device roles are defined: central coordinator (CCO), proxy coordinator (PCO), and station (STA).

A CCO is responsible for implementing functions such as networking control and network maintenance and management.

An STA is a communication unit installed on an electrical meter. An STA should act as a PCO as well as an STA.

4.3 Network topology

A broadband carrier and wireless dual-mode communication network usually uses a tree topology in which the CCO is the root and the PCOs act as relay proxies to connect all STAs. Figure 1 shows a typical broadband carrier and wireless communication network topology.

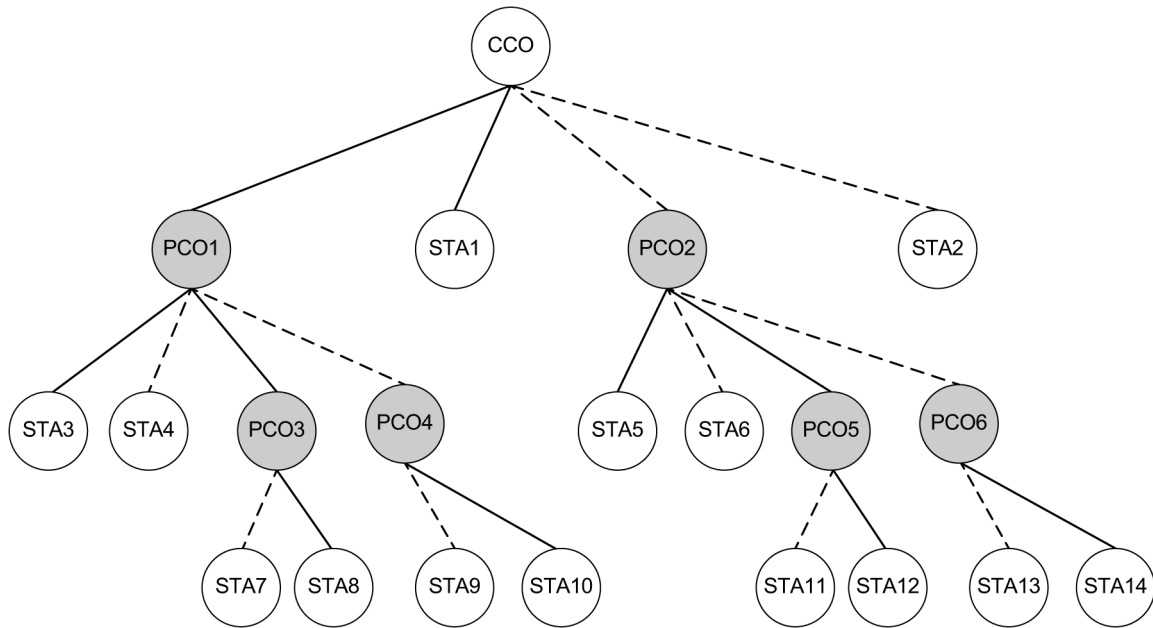


Figure 1—Example of broadband carrier and wireless communication network topology

Figure 2 shows the topology for co-existence of multiple networks.

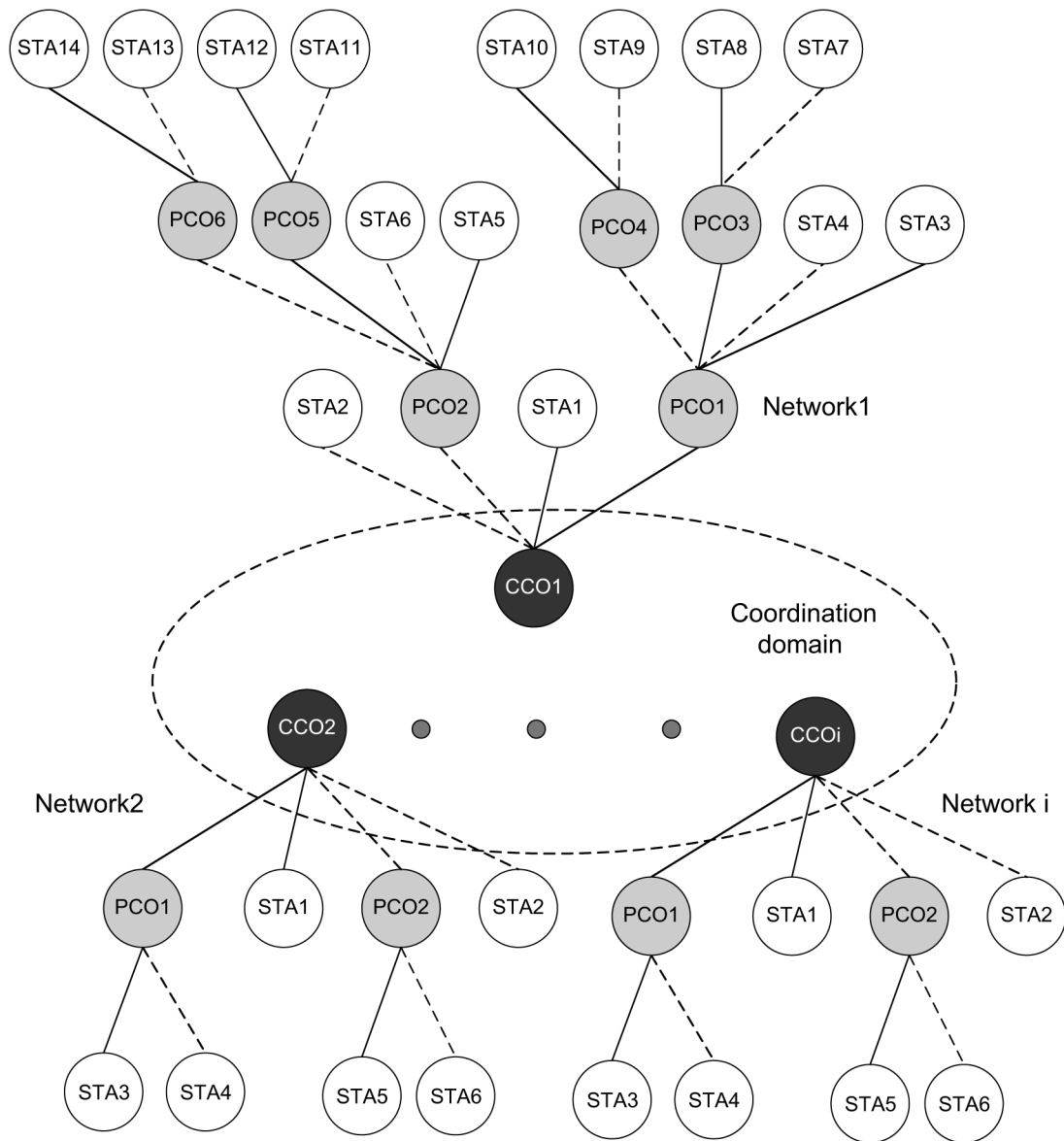


Figure 2—Example of a topology for multiple broadband carrier and wireless communication networks

4.4 Reference model

The reference model for broadband carrier and wireless dual-mode communication networks consists of five layers: physical layer, data link layer, network layer, transport layer, and application layer. Figure 3 shows the basic protocol reference model. The network and transport layers reflect the network and transport layers of the open systems interconnection (OSI) model. The data link layer provides transmission services for the application layer. The data link layer can interoperate with the transmission control protocol/internet protocol (TCP/IP) model to provide IP communications. The adaptation of IPv4/IPv6 is described in IEEE Std 1901.1-2018.

This standard describes interfaces between data link layers and physical layers. The data link layer consists of media access control (MAC) and network management sub-layers.

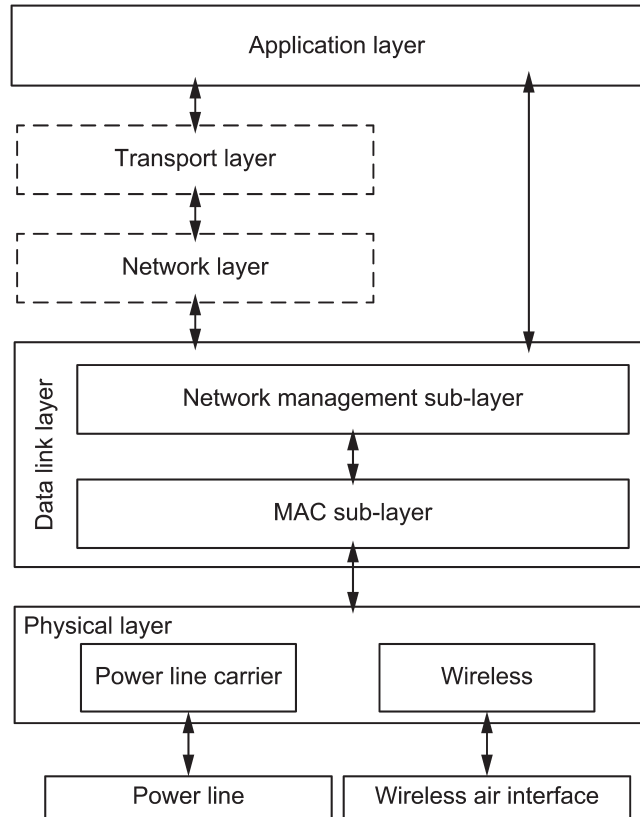


Figure 3—Protocol stack for a broadband carrier and wireless communication network

The functions of these layers are defined as follows:

- For definitions of application layer, data link layer, network management sub-layer, and MAC sub-layer, refer to 4.4 of IEEE Std 1901.1-2018.
- Physical layer: encodes and modulates MAC sub-layer packets to broadband carrier or wireless signals and sends them to power lines or wireless air interface and receives broadband carrier or wireless signals from power lines or wireless air interface, demodulates them, and then sends them to the MAC sub-layer.

4.5 General description of interfaces to PHY layers

The data link layer is specified for a hybrid physical layer. The MAC sub-layer provides an interface between the application layer and both the carrier and RF PHY layers. Messages that interact between the data link layer and PHY layers are defined as primitives, for example, media access control (MAC) service data unit (MSDU) transmit primitive, and MSDU receive primitive. Refer to [Clause 7](#) for more details.

5. Network management sub-layer

5.1 General

The network management sub-layer manages coordination between multiple broadband carriers and wireless communication networks, single network establishment, and network maintenance, including generation and maintenance of relay routes, proxy change, and STA offline.

5.2 Management packet format

5.2.1 General

Table 1 describes the fields in the management packet header.

Table 1—Fields in the management packet header

Field	Octet number	Field size (bytes)
MMTYPE	0 through 1	2
Reserved	2 through 3	2

Table 2 lists the management packet types (MMTYPE).

Table 2—Management packet types (MMTYPE)

Management packet	ID
Association Request (MMeAssocReq)	0x0000
Association Response (MMeAssocCnf)	0x0001
Association Gathering Indication (MMeAssocGatherInd)	0x0002
Proxy Change Request (MMeChangeProxyReq)	0x0003
Proxy Change Response (MMeChangeProxyCnf)	0x0004
Proxy Change Response (MMeChangeProxyBitMapCnf)	0x0005
Offline Indication (MMeLeaveInd)	0x0006
Heartbeat Detection (MMeHeartBeatCheck)	0x0007
Discovery List (MMeDiscoverNodeList)	0x0008
Communication Success Rate Report (MMeSuccessRateReport)	0x0009
Network Conflict (MMeNetworkConflictReport)	0x000A
Zero Cross Network Time Base (NTB) Collect (MMeZeroCrossNTBCollectionReq)	0x000B
Zero Cross NTB (MMeZeroCrossNTBReport)	0x000C
Local Bridge Destination Address Table Request (MMeLBDAtReq)	0x000D
Local Bridge Destination Address Table Confirm (MMeLBDAtCnf)	0x000E
Set Key Request (MMeSetKeyRequest)	0x000F
Set Key Confirm (MMeSetKeyConfirm)	0x0010
Get Key Request (MMeGetKeyRequest)	0x0011
Get Key Confirm (MMeGetKeyConfirm)	0x0012
Authorize Request (MMeAuthrzRequest)	0x0013
Authorize Confirm (MMeAuthrzConfirm)	0x0014
Encrypted Payload Indication (MMeEncryptedPIInd)	0x0015
Set Amplitude Map Request (MMeSetAmpMapReq)	0x0016
Set Amplitude Map Response (MMeSetAmpMapCnf)	0x0017
Reserved	0x0018 through 0x004E
Network Diagnosis (MMeNetworkDiagnosisReport)	0x004F
Reserved	0x0050 through 0x007F
Wireless Channel Conflict Report (MMeRFChannelConflictReport)	0x0080
Reserved	0x0081 through 0xFFFF

For the definitions of the format of MMeLeaveInd, MMeHeartBeatCheck, MMeDiscoverNodeList, MMeNetworkConflictReport, MMeZeroCrossNTBCollectionReq, MMeLBDAReq, MMeLBDAReqCnf, MMeSetKeyConfirm, MMeGetKeyRequest, MMeAuthzRequest, MMeEncryptedPlInd, MMeSetAmpMapReq, MMeSetAmpMapCnf, and MMeNetworkDiagnosisReport, refer to 5.1 of IEEE Std 1901.1-2018.

5.2.2 MMeAssocReq

5.2.2.1 General

Table 3 describes the fields in MMeAssocReq packets.

Table 3—Fields in MMeAssocReq packets

Field	Octet number	Bit number	Field size (bits)
STA MAC Address	0 through 5	0 through 7	48
Candidate Proxy TEI0	6	0 through 7	12
	7	0 through 3	
Link Type	7	4	1
Reserved	7	5 through 7	3
Candidate Proxy TEI1	8	0 through 7	12
	9	0 through 3	
Link Type	9	4	1
Reserved	9	5 through 7	3
Candidate Proxy TEI2	10	0 through 7	12
	11	0 through 3	
Link Type	11	4	1
Reserved	11	5 through 7	3
Candidate Proxy TEI3	12	0 through 7	12
	13	0 through 3	
Link Type	13	4	1
Reserved	13	5 through 7	3
Candidate Proxy TEI4	14	0 through 7	12
	15	0 through 3	
Link Type	15	4	1
Reserved	15	5 through 7	3
Phase	16	0 through 1	2
		2 through 3	2
		4 through 5	2
Reserved	16	6 through 7	2
Product Type	17	0 through 7	8
MAC Type	18	0 through 7	8
Module Type	19	0 through 1	2
Reserved	19	2 through 7	6
STA Association Random	20 through 23	0 through 7	32
Manufacturer Information	24 through 41	0 through 7	144
STA Version	42 through 51	0 through 7	80
Hardware Reset Count	52 through 53	0 through 7	16
Mac Software Reset Count	54 through 55	0 through 7	16

Table continues



Documents
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Table 3—Fields in MMeAssocReq packets (continued)

Field	Octet number	Bit number	Field size (bits)
Proxy Type	56	0 through 7	8
Reserved	57 through 59	0 through 7	24
End Sequence	60 through 63	0 through 7	32

For the definition of fields other than link type, module type, and end sequence, refer to 5.1.1 of IEEE Std 1901.1-2018.

5.2.2.2 Link Type

Indicates the type of communication link between the station that sends the association request and the candidate proxy. The definition of the link type value is shown in Table 4.

Table 4—Values of Link Type field

Value	Description
0	High-speed carrier link
1	Wireless link

5.2.2.3 Module Type

Indicates the type of communication module for sending association request stations, as defined in Table 5.

Table 5—Values of Module Type field

Value	Definition
0	High-speed carrier single-mode module
1	Dual-mode high-speed carrier and wireless module
2	Wireless single-mode module

5.2.2.4 End Sequence

The End Sequence field indicates the sequence number of management packets. When the STA that joins the network generates an association request packet, the STA shall generate a sequence number that starts at zero and is incremented each time it requires an association request. When the CCO determines the association request, the CCO shall use the sequence number of the association request packet in the association request acknowledgement packet.

5.2.3 MMeAssocCnf

5.2.3.1 General

Table 6 describes the fields in MMeAssocCnf packets.

Table 6—Fields in MMeAssocCnf packets

Field	Octet number	Bit number	Field size (bits)
STA MAC Address	0 through 5	0 through 7	48
CCO MAC Address	6 through 11	0 through 7	48
Result	12	0 through 7	8
Level	13	0 through 7	8

Table continues

Table 6—Fields in MMeAssocCnf packets (continued)

Field	Octet number	Bit number	Field size (bits)
Terminal Equipment Identifier (TEI)	14	0 through 7	12
	15	0 through 3	
Link Type	15	4	1
Carrier Frequency Band	15	5 through 6	2
Reserved	15	7	1
Proxy TEI	16	0 through 7	12
	17	0 through 3	
Reserved	17	4 through 7	4
Total Packet Number	18	0 through 7	8
Packet Index	19	0 through 7	8
STA Association Random	20 through 23	0 through 7	32
STA Re-association Time	24 through 27	0 through 7	32
End Sequence	28 through 31	0 through 7	32
Path Sequence	32 through 35	0 through 7	32
Reserved	36 through 39	0 through 7	32
Route Info	Variable	0 through 7	Variable

For the definition of fields except Result, Link Type, Carrier Frequency Band, and Route Info, refer to 5.1.2 of IEEE Std 1901.1-2018.

5.2.3.2 Result

The Result field indicates the association request confirmation result. [Table 7](#) describes the values of the Result field.

Table 7—Values of the Result field

Value	Description
0x00	The association request succeeded
0x01	The STA is not in the allowlist
0x02	The number of associated STAs exceeded the upper limit (refer to Table 13 of IEEE Std 1901.1-2018)
0x03	The allowlist is not configured
0x04	The number of PCOs exceeded the upper limit (refer to Table 13 of IEEE Std 1901.1-2018)
0x05	The number of subordinate STAs exceeded the upper limit (refer to Table 13 of IEEE Std 901.1-2018)
0x06	Duplicate MAC address
0x07	The network topology levels exceeded the upper limit (refer to Table 13 of IEEE Std 1901.1-2018)
0x08	The re-association request succeeded
0x09	A new STA attempted to use its subordinate STA as the proxy to access the network
0x0a	Loops exist in the network topology
0x0b	An unknown error occurs on the CCO
0x0c	Indicates that the wireless proxy has reached the upper limit
0x0c through 0xFF	Reserved

For the thresholds of the values used in the Result field, refer to 5.1.2.3 of IEEE Std 1901.1-2018.

5.2.3.3 Link type

Indicates the type of communication link between the proxy and the associated confirmation target station. The definition of the link type value is shown in [Table 4](#).

5.2.3.4 Carrier frequency band

Indicates the carrier frequency band used by the network. [Table 8](#) lists the carrier frequency band values.

Table 8—Values of carrier frequency band

Value	Definition
0	1.953 through 11.96 Unit: MHz
1	2.441 through 5.615 Unit: MHz
2 through 3	Reserved

5.2.3.5 Route Info

The Route Info field specifies routing information about the STAs contained in the MMeAssocCnf packet. The STAs include directly connected STAs, PCOs, and all the subordinate STAs of the PCOs. [Table 9](#) describes subfields in the Route Info field.

Table 9—Subfields in the Route Info field

Subfield	Octet number	Field size (bytes)	Description
Straight STA Sum	0 through 1	2	Number of STAs directly connected to the new STA
Straight PCO Sum	2 through 3	2	Number of PCOs directly connected to the new STA
Table Size	4 through 5	2	Size of the routing table
Reserved	6 through 7	2	Reserved
Table	Variable	Variable	Information about directly connected subordinate STAs; the total length is variable; for details, see Table 10 .

[Table 10](#) describes the subordinate STA list.

Table 10—Subordinate STA list

Field	Octet number	Bit number	Field size (bits)	Description
Straight STA[0]	0	0 through 7	12	TEI of the directly connected STA
	1	0 through 3		
Link Type	1	4	1	Type of the link to the directly connected station
Reserved	1	5 through 7	3	Reserved
...	...	...	...	TEI of the directly connected STA
Straight STA[N-1]	...	...	...	TEI of the directly connected STA; N = Straight STA Sum

Table continues

Table 10—Subordinate STA list (continued)

Field	Octet number	Bit number	Field size (bits)	Description
Straight PCO[0]	0	0 through 7	12	TEI of the directly connected PCO
	1	0 through 3		
Link Type	1	4	1	Type of the link to the directly connected proxy
Reserved	1	5 through 7	3	Reserved
Child Sum	2 through 3	0 through 7	16	Number of subordinate STAs connected to the Straight PCO[0]
Child Entry[0]	4	0 through 7	12	TEI of the STA connected to the PCO
	5	0 through 3	4	
Reserved	5	4 through 7	4	Reserved
...	...	...	...	TEI of the STA connected to the PCO
Child Entry[M0-1]	...	...	...	TEI of the STA connected to the PCO; M0 is the number of direct STA of PCO
Straight PCO[1]	0	0 through 7	12	TEI of the directly connected PCO
	1	0 through 3		
Link Type	1	4	1	Type of the link to the directly connected proxy
Reserved	1	5 through 7	3	Reserved
STA number	2 through 3	0 through 7	16	Number of subordinate STAs connected to the Straight PCO[1]
Child STA[0]	4	0 through 7	12	TEI of the STA connected to the PCO
	5	0 through 3	4	
Reserved	5	4 through 7	4	Reserved
...	...	...	...	TEI of the STA connected to the PCO
Child STA[M1-1]	...	...	...	TEI of the STA connected to the PCO; M1 is the number of direct STA of PCO S
...	...	...	...	...
Straight PCO[S]	0	0 through 7	12	TEI of the directly connected PCO
	1	0 through 3	4	
Link Type	1	4	1	Type of the link to the directly connected proxy
Reserved	1	5 through 7	3	Reserved
Child Sum	2 through 3	0 through 7	16	Number of subordinate STAs connected to the Straight PCO[S]
Child STA[0]	4	0 through 7	12	TEI of the STA connected to the PCO
	5	0 through 3	4	
Reserved	5	4 through 7	4	Reserved
...	...	...	...	TEI of the STA connected to the PCO
Child STA[MS-1]	...	...	...	TEI of the STA connected to the PCO; MS is the number of direct STA of PCO S

If a routing table is too large and cannot be transmitted in one packet, the routing table needs to be fragmented into several packets. For the definition of fragmentation rules, refer to 5.1.2.13 of IEEE Std 1901.1-2018.

5.2.4 MMeAssocGatherInd

5.2.4.1 General

Table 11 describes the fields in MMeAssocGatherInd packets.

Table 11—Fields in MMeAssocGatherInd packets

Field	Octet number	Bit number	Field size (bits)
Result	0	0 through 7	8
Level	1	0 through 7	8
CCO MAC Address	2 through 7	0 through 7	48
Proxy TEI	8	0 through 7	12
	9	0 through 3	
Carrier Frequency Band	9	4 through 5	2
Reserved	9	6 through 7	2
Reserved	10	0 through 7	8
STA Number	11	0 through 7	8
Reserved	12 through 15	0 through 7	32
STA Information	Variable	0 through 7	Variable

For the definition of fields except Carrier Frequency Band, refer to 5.1.3 of IEEE Std 1901.1-2018.

5.2.4.2 Carrier Frequency Band

Indicates the carrier frequency band used by the network. Table 8 lists the carrier frequency band values.

5.2.5 MMeChangeProxyReq

5.2.5.1 General

Table 12 describes the fields in MMeChangeProxyReq packets.

Table 12—Fields in MMeChangeProxyReq packets

Field	Octet number	Bit number	Field size (bits)
STA TEI	0	0 through 7	12
	1	0 through 3	
Reserved	1	4 through 7	4
New Proxy TEI0	2	0 through 7	12
	3	0 through 3	
Link Type	3	4	1
Reserved	3	5 through 7	3
New Proxy TEI1	4	0 through 7	12
	5	0 through 3	
Link Type	5	4	1
Reserved	5	5 through 7	3
New Proxy TEI2	6	0 through 7	12
	7	0 through 3	
Link Type	7	4	1
Reserved	7	5 through 7	3

Table continues

Table 12—Fields in MMeChangeProxyReq packets (continued)

Field	Octet number	Bit number	Field size (bits)
New Proxy TEI3	8	0 through 7	12
	9	0 through 3	
Link Type	9	4	1
Reserved	9	5 through 7	3
New Proxy TEI4	10	0 through 7	12
	11	0 through 3	
Link Type	11	4	1
Reserved	11	5 through 7	3
Old Proxy TEI	12	0 through 7	12
	13	0 through 3	
Reserved	13	4 through 7	4
Original Proxy Type	14	0 through 7	8
Reason	15	0 through 7	8
End Sequence	16 through 19	0 through 7	32
Phase	20	0 through 1	6
		2 through 3	
		4 through 5	
Reserved	20	6 through 7	2
Reserved	21 through 23	0 through 7	24

For the definition of fields other than Link Type, refer to 5.1.4 of IEEE Std 1901.1-2018.

5.2.5.2 Link Type

Indicates the type of the communication link between the station that initiates the proxy change and the candidate proxy. The definition of the link type is shown in [Table 4](#).

5.2.6 MMeChangeProxyCnf

5.2.6.1 General

[Table 13](#) describes the fields in MMeChangeProxyCnf packets.

Table 13—Fields in MMeChangeProxyCnf packets

Field	Octet number	Bit number	Field size (bits)
Result	0	0 through 7	8
Total Packet Number	1	0 through 7	8
Packet Index	2	0 through 7	8
Reserved	3	0 through 7	8
TEI	4	0 through 7	12
	5	0 through 3	
Link Type	5	4	1
Reserved	5	5 through 7	3
Proxy TEI	6	0 through 7	12
	7	0 through 3	

Table continues

Table 13—Fields in MMeChangeProxyCnf packets (continued)

Field	Octet number	Bit number	Field size (bits)
Reserved	7	4 through 7	4
End Sequence	8 through 11	0 through 7	32
Path Sequence	12 through 15	0 through 7	32
Child Sum	16 through 17	0 through 7	16
Reserved	18 through 19	0 through 7	16
Child Entry	Variable	0 through 7	Variable

For the definition of fields other than Link Type, refer to 5.1.5 of IEEE Std 1901.1-2018.

5.2.6.2 Link Type

Indicates the type of communication link between the station that initiates the proxy change and the candidate proxy. The definition of the link type is shown in [Table 4](#).

5.2.7 MMeChangeProxyBitMapCnf

5.2.7.1 General

If the number of subordinate STAs of a PCO exceeds the maximum capacity of MMeChangeProxyCnf, MMeChangeProxyBitMapCnf shall be used in order to avoid segmenting MMeChangeProxyCnf.

[Table 14](#) describes the fields in MMeChangeProxyBitMapCnf packets.

Table 14—Fields in MMeChangeProxyBitMapCnf packets

Field	Octet number	Bit number	Field size (bits)
Result	0	0 through 7	8
Reserved	1	0 through 7	8
TEI	2	0 through 7	12
	3	0 through 3	
Link Type	3	4	1
Reserved	3	5 through 7	3
Proxy TEI	4	0 through 7	12
	5	0 through 3	
Reserved	5	4 through 7	4
Reserved	6 through 7	0 through 7	16
End Sequence	8 through 11	0 through 7	32
Path Sequence	12 through 15	0 through 7	32
Reserved	16 through 17	0 through 7	16
Bitmap Size	18 through 19	0 through 7	16
Child Bitmap	Variable	0 through 7	Variable

For the definition of fields other than Link Type, refer to 5.1.6 of IEEE Std 1901.1-2018.

5.2.7.2 Link Type

Indicates the type of communication link between the station that initiates the proxy change and the new proxy. The definition of the link type is shown in [Table 4](#).