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STANDARDIZATION SECTOR
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G.9961

Amendment 1
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SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
DIGITAL SYSTEMS AND NETWORKS

Access networks – In premises networks

Unified high-speed wire-line based home
networking transceivers – Data link layer
specification

Amendment 1

Recommendation ITU-T G.9961 (2010) – Amendment 1

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999
In premises networks	G.9900–G.9999

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.9961

Unified high-speed wire-line based home networking transceivers – Data link layer specification

Amendment 1

Summary

Amendment 1 to Recommendation ITU-T G.9961 (2010) primarily specifies a procedure for neighbouring network interference mitigation.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.9961	2010-06-11	15
1.1	—ITU-T G.9961 (2010) Cor. 1	2011-12-16	15
1.2	—ITU-T G.9961 (2010) Amd. 1	2012-09-21	15

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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Recommendation ITU-T G.9961

Unified high-speed wire-line based home networking transceivers – Data link layer specification

Amendment 1

1) Clause 4

Add the following abbreviations to clause 4:

CSP Cluster Synchronization Point

IDCC Inter-Domain Communication Channel

IDM Inter-Domain Message

IDSW Inter-Domain Signalling Window

MSID Multicast Stream Identifier

2) Clause 8.1.3.1.1.6

Revise clause 8.1.3.1.1.6 "Originating node" as follows:

8.1.3.1.1.6 OriginatingNode

For intra-domain LLC frames, the OriginatingNode field carries the DEVICE_ID of the node that originated the LLC frame. For inter-domain LLC frames, the OriginatingNode field shall be set to 251. The content of this field shall not be changed when an LLC frame is relayed by another node.

3) Clause 8.1.3.1.1.10

Revise clause 8.1.3.1.1.10 "DestinationNode" as follows:

8.1.3.1.1.10 DestinationNode

The DestinationNode field indicates one or more nodes to which the LLC frame is finally destined. It shall be set to the DEVICE_ID of the final destination node in case of unicast (BRCTI=0, MCSTI=0). It shall be set to the multicast stream identifier (MSID) assigned by the multicast source in case of multicast (BRCTI=0, MCSTI=1). It shall be set to the BROADCAST_ID by the originating node in case of broadcast (BRCTI=1, MCSTI=0). It shall be set to 0 for the LLC frames in which the DA is set to reserved MAC address 01-19-A7-52-76-96.

The content of this field shall not be changed when an LLC frame is relayed by another node. This field shall be used by the relay nodes for routing LLC frames.

4) Clause 8.3.3.4.3

Revise clause 8.3.3.4.3 "CBTS back-off rules" as follows:

8.3.3.4.3 CBTS back-off rules

...

Table 8-7 shows the valid-default values of $DC_{max}(BSC)$ and $NCW_{max}(BSC)$. These valid-default values are used for all MA priorities. ~~BSC_{max} shall be 4.~~

The default values in Table 8-7 can be overridden by using the contention window (CW) information sub-field of the auxiliary information field in the MAP, as described in clause 8.8.5.11.

Table 8-7 – ~~Valid-Default~~ DC_{max}(BSC) and NCW_{max}(BSC) values

BSC	DC _{max} (BSC)	NCW _{max} (BSC)
1	1	8
2	2	16
3	4	32
4	16	64
NOTE – other values of BSC, DC _{max} and NCW _{max} are for further study.		

...

5) Clause 8.5.5

Revise clause 8.5.5 "Reporting of detected neighbouring domains" as follows:

8.5.5 Reporting of detected neighbouring domains

Each node shall send information to the domain master ~~and other nodes of the domain~~ about all detected neighbouring domains using the NDIM_InterferenceReport.ind ~~TM_NodeTopologyChange.ind~~ message, as defined in clause 8.14.9.12 ~~10-xx6.4.3~~.

A node shall send an NDIM_InterferenceReport.ind message with updated interference information whenever a change in the interfering conditions occurs. The criteria for determining whether the interfering conditions have changed are vendor discretionary.

6) Clause 8.6.1.1.4.2

Revise clause 8.6.1.1.4.2 "Registration response message (ADM_DmRegistrResponse.cnf)" as follows:

8.6.1.1.4.2 Registration response message (ADM_DmRegistrResponse.cnf)

The ADM_DmRegistrResponse.cnf message is a unicast management message sent by the domain master to the registering node (directly or via a proxy), and is intended to be used for registration response only. The format of the MMPL of the ADM_DmRegistrResponse.cnf message shall be as shown in Table 8-17.

Table 8-17 – Format of the MMPL of the ADM_DmRegistrResponse.cnf message

Field	Octet	Bits	Description
REGID	0 to 5	[47:0]	REGID of the node that requested the admission in standard format of a MAC address
DEVICE_ID	6	[7:0]	An ID assigned to the node by the domain master; shall be set to 00 ₁₆ in case registration is denied
Registration flag	7	[0]	Set to one for successful registration, set to zero for registration denied
Bandplan		[3:1]	Bandplan used by new registering node represented as described in clause 7.1.2.3.2.2 of [ITU-T G.9960] (BNDPL/GRP_ID field)
Rejection code		[6:4]	As described in Table 8-15
Security mode		[7]	Set to zero for insecure domain, set to one for a secure domain

Table 8-17 – Format of the MMPL of the ADM_DmRegistrResponse.cnf message

Field	Octet	Bits	Description
Attempt	8	[1:0]	00 ₂ for response on the initial attempt, 01 ₂ , 10 ₂ , 11 ₂ for the response on the second, third and fourth attempts, respectively
Reserved		[7:2]	Reserved by ITU-T (Note)
Security	9 to 15	[55:0]	If Security mode is set to zero, this field shall be set to zero. If Security mode is set to one, the eight LSBs of this field represent the DEVICE_ID of the security controller, and the 48 MSBs represent the REGID of the security controller
<u>NumTLVs</u>	<u>16</u>	<u>[7:0]</u>	<u>Number of TLVs (n)</u>
<u>TLV[n]</u>	<u>variable</u>	<u>[7:0]</u>	<u>A list of n TLVs. Each TLV shall be formatted as described in Table 8-17.1</u>
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

Table 8-17.1 – Format of the TLV field

<u>Field</u>	<u>Octet</u>	<u>Bits</u>	<u>Description</u>
<u>TLV type</u>	<u>0</u>	<u>[7:0]</u>	<u>Indicates the TLV type (See Table 8-17.2)</u>
<u>TLV length</u>	<u>1</u>	<u>[7:0]</u>	<u>Indicates the length of the following TLV value field in octets (L). The valid range is from 0 to 255</u>
<u>TLV value</u>	<u>2 to L+1</u>	<u>[7:0]</u>	<u>This field shall be formatted as indicated in Table 8-17.2, for the TLV type. This field exists if and only if L > 0</u>

Table 8-17.2 – TLV Type assignments

<u>TLV Type Value</u>	<u>Description</u>	<u>Clause</u>	<u>TLV value format</u>
<u>1</u>	<u>Non-default CW parameters</u>	<u>8.8.5.11</u>	<u>Table 8-85.2</u>
<u>0 and 2-255</u>	<u>Reserved by ITU-T for future assignments</u>		

7) **Clause 8.6.4.2.1**

Revise clause 8.6.4.2.1 "Endpoint node topology maintenance in CRTM mode" as follows:

8.6.4.2.1 Endpoint node topology maintenance in CRTM mode

A node shall reply with ~~the~~ a TM_NodeTopologyChange.cnf message upon receiving a TM_NodeTopologyChange.req message sent by the domain master or backup domain master requesting ~~for~~ topology information. The message shall be sent within T_{N_RSP} ms (see clause 8.4) after reception of the ~~message~~ TM_NodeTopologyChange.req message from the domain master.

In case one of the events occurs (see clause 8.6.4.2), a TM_NodeTopologyChange.ind message shall be sent to the domain master as soon as possible.

If the DM requests a periodic topology report through the MAP (see clauses 8.6.4.2 and 8.8.5.8.1), every node in the domain shall transmit a TM_NodeTopologyChange.ind message randomly within each interval according to the requested report specified in the RequestReport field included in the topology update interval sub-field. Each node shall start ~~to counting~~ the interval from the first received MAP that contains a request for a periodic topology report. Each new interval starts after the end of the previous interval ~~has ended~~.

At its own discretion, a node may request an acknowledgement via a TM_DomainRoutingChange.ind message, that the domain master received the periodically sent TM_NodeTopologyChange.ind message, by setting the AckType field to 10₂ (see Table 8-46). If a node requests an acknowledgement, then the domain master shall include the DEVICE_ID of this node and the sequence number of the topology change message (see Table 8-50) in the next TM_DomainRoutingChange.ind message.

NOTE – For routine TM_NodeTopologyChange.ind messages sent by a node as "keep-alive messages" it should not request an explicit acknowledgement in order to reduce unnecessary control traffic. If a node suspects that a TM_NodeTopologyChange.ind message that it sent was not received by the domain master, then it should request an explicit acknowledgement via TM_DomainRoutingChange.ind for the TM_NodeTopologyChange.ind message.

Messages TM_NodeTopologyChange.ind and TM_NodeTopologyChange.cnf shall contain the following updated information:

- the DEVICE_ID of each node in its own domain that it can detect. This is called the node's visibility list and it shall be included in the message if there was a change in the detected nodes;
- MAC addresses associated with the AE of the node; namely, the local AAT. (MAC addresses associated with another domain are considered as associated with a node that provides IDB to this domain). This component shall be included in the message if there was a change in the AAT list. Incremental information on added and deleted MAC addresses can also be sent using this message;
- data rates associated with each node in the domain that the reporting node could connect with or detect. This component shall be included in the message if there was a change in the data rate;
- main node capabilities (bandplan, capability to serve as a domain master, as a security controller, or as a relay);
- sequence number of the message (for monitoring purposes).

An endpoint node is not required to maintain complete topological information of the domain, as a domain master does (see clause 8.6.4.1) but only the information it needs for topology reporting and communication with the domain master and other nodes. A node that has been appointed as the domain master's backup shall maintain complete topological information of the domain (see clause 8.6.5). Nodes shall update their topological information using the received TM_DomainRoutingChange.ind message.

A node may also request the domain master for an update of domain topology by sending a message TM_ReturnDomainRouting.req message to the domain master. If a node has received a message TM_DomainRoutingChange.ind from the domain master in the past T_{UPDATE_MIN} ms (see clause 8.4), it is not allowed to request the topology update from the domain master (i.e., to send a TM_ReturnDomainRouting.req message to the domain master).

A node that receives a TM_DomainRoutingChange.ind message shall update its local topology tables and routing table accordingly.

If a node that has a link to a destination node detects that the route to the destination node is broken, it may select an alternative route (if allowed by the Routing Authorization field) towards the destination node based on the current routing table, until a new TM_DomainRoutingChange.ind message is received from the domain master.

A node whose current routing table differs from the last routing table indicated in the MAP, shall request the domain master for an update of the routing information by sending the TM_ReturnDomainRouting.req message to the domain master.

8) Clause 8.6.4.3.1

Revise Table 8-46 "Format of MMPL of the TM_NodeTopologyChange.ind message" in clause 8.6.4.3.1 as follows:

Table 8-46 – Format of MMPL of the TM_NodeTopologyChange.ind message

Field	Octet	Bits	Description
DEVICE_ID	0	[7:0]	DEVICE_ID of the node whose topology information is conveyed in this message
Type	1	[73:0]	Shall be set to: — 00₁₆ if report includes all the topology parameter available to the node (full report) — 01₁₆ if the report includes any fraction of topology parameters available to the node — 02₁₆ if the report includes only parameters that changed relatively to the last report Other values are for further study
AckType		[5:4]	This field shall be set to: • 00₂: Event driven update, ACK requested • 01₂: Periodic update, no ACK requested • 10₂: Periodic update, ACK is requested • 11₂: Reserved by ITU-T ACK in this case means acknowledgement via TM_DomainRoutingChange.ind is requested (see Table 8-50)
Reserved		[7:6]	Reserved by ITU-T (Note 1)
<u>InterferenceInfo</u>	2	[1:0]	<u>Node's estimation of level of interference that it suffers from neighbouring domains.</u> 00₂ – No interference 01₂ – Low interference 10₂ – High interference
Reserved		[7:20]	Reserved by ITU-T (Note 1)
Reserved	3 and 4	[15:0]	Reserved by ITU-T (Note 1)
NodeRec_Size	5 to 7	[23:0]	Size of the node record in bytes (S0) represented as 24-bit unsigned integer
NodeRec_Info	8 to (S0+7)	See Table 8-47	Node record information field, S0-byte long, with a format as defined in Table 8-47. S0 = 8+(4*M)+(6*L)
NumDomRecs (Note 2)	(S0+8)	[7:0]	Number of records (n) on neighbouring domains represented as an unsigned integer in the range from 0 to 255

Table 8-46 – Format of MMPL of the TM_NodeTopologyChange.ind message

Field	Octet	Bits	Description
NeighbDom_ID [0]	(S0+9)	[7:0]	The DOD of the first neighbouring domain
NeighbDom_Size[0]	(S0+10) to (S0+11)	[15:0]	Size of the first neighbouring domain Info field in bytes represented as an unsigned integer. The value of this field shall be set to zero
...	...	...	...
NeighbDom_ID [n-1]	(S0+6+3*n)	[7:0]	The DOD of the last neighbouring domain
NeighbDom_Size[n-1]	(S0+7+3*n) to (S0+8+3*n)	[15:0]	Size of the last neighbouring domain Info field in bytes represented as an unsigned integer. The value of this field shall be set to zero
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver. NOTE 2 – The value of 0 indicates that no information on neighbouring domain is available. The value of 255 indicates that no record on neighbouring domains is attached (while information on neighbouring domains is available).			

9) Clause 8.6.9

Add new clause 8.6.9 "Per-node transmit PSD shaping" as follows:

8.6.9 Per-node transmit PSD shaping

In addition to a domain-wide transmit PSD mask described in clause 8.8.5.5, the domain master may apply a separate transmit PSD mask to an individual node or a group of nodes by sending the node(s) a TP_TransmitPsdChange.req message. This per-node transmit PSD mask shall comply with the domain-wide transmit PSD mask and shall be one of the additional transmit PSD masks indicated in the PSD-related domain info sub-field of the MAP (see clause 8.8.5.5). Up to three additional PSD masks (i.e., a PSD mask different from domain-wide mask) shall be allowed per domain (see Table 8-77).

NOTE – An external management entity may instruct the domain master to set a separate transmit PSD mask for an individual node.

The node shall confirm the reception of this message by sending a TP_TransmitPsdChange.cnf message within 200 ms, and shall apply new settings as soon as possible. The node may need to renew channel estimation with associated receivers. After getting confirmation from the node(s), the domain master shall indicate that the transmit PSD for these node(s) has been changed, to all the nodes in the domain via the PSD related domain info sub-field sent in a MAP (see Table 8-77).

8.6.9.1 Format of TP_TransmitPsdChange.req message

The format of the MMPL of the TP_TransmitPsdChange.req message shall be as shown in Table 8-60.3.

Table 8-60.3 – Format of the MMPL of the TP_TransmitPsdChange.req message

Field	Octet	Bits	Description
PSD shaping descriptor	0 to L-1	[(8L-1):0]	This field indicates the PSD shaping of the node, and shall be coded as shown in Table 8-78 (Note)
NOTE – The value of L is equal to the value of the first octet of the PSD shaping descriptor multiplied by 3 plus 1.			

8.6.9.2 Format of TP_TransmitPsdChange.cnf

The format of the MMPL of the TP_TransmitPsdChange.cnf message shall be as shown in Table 8-60.4.

Table 8-60.4 – Format of the MMPL of the TP_TransmitPsdChange.cnf message

Field	Octet	Bits	Description
Request Status	0	[2:0]	This field indicates the request status: 0 – Request is confirmed;1 to 7 – Reserved by ITU-T (Note)
Reserved		[7:3]	Reserved by ITU-T
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

10) Clause 8.6.10

Add new clause 8.6.10 "Selection of initialization seeds used for generating preamble, PR, INUSE, NACK and IDPS signals" as follows:

8.6.10 Selection of initialization seeds used for generating preamble, PR, INUSE, NACK and IDPS signals

The domain master shall use the 'default' seed (as defined in clause 7.2) for generation of the preamble of MAP-D frame transmission regardless of its medium type. Nodes that relay MAP-D frames shall also use the 'default' seed for generation of the preamble of MAP-D frame transmission.

The 'default' seed (as defined in clause 7.2) shall be used for generation of the preamble, INUSE and PR signals in all transmissions in a TXOP used for communications with neighbouring domains (clause 8.14).

For preamble, INUSE, PR, and NACK signals generation, usage of either the 'default' or the 'domain-specific' seed in a specific TXOP shall be indicated in TXOP attributes extension (clause 8.8.4.1.1) using the 'Seed_usage_indicator' field.

For IDPS, the seed to be used shall be as specified in clause 7.2.2.2.5 of [ITU-T G.9960].

Selection of either the 'default' or the 'domain-specific' seed for a given TXOP, other than the ones mentioned, is described in clause 8.14. For a given TXOP, only a single seed shall be used for generation of the preamble, INUSE, PR, and NACK signals.

11) Clause 8.7.1.2

Revise Table 8-61 "Definition and valid values of node identification parameters" in clause 8.7.1.2 as follows:

Table 8-61 – Definition and valid values of node identification parameters

Parameter	Valid values	Description
DEVICE_ID	0	The ID used by a new node joining the network before it is assigned a unique DEVICE_ID by the domain master. The domain master shall not assign the DEVICE_ID = 0 to any node admitted to the network
	1 to 250	IDs reserved for assignment by the domain master to nodes admitted to the network
	<u>251</u>	<u>The ID used for inter-domain communication</u>
	<u>252</u> to 255	Reserved by ITU-T
MULTICAST_ID	0	Reserved by ITU-T
	1 to 254	IDs reserved for assignment for multicast traffic
BROADCAST_ID	255	A special value of MULTICAST_ID reserved for broadcast traffic

12) Clause 8.8.4.1.1

Revise Table 8-65 "TXOP Attributes Extension Data format" in clause 8.8.4.1.1 as follows:

Table 8-65 – TXOP Attributes Extension Data format

Field	Octet	Bits	Description
Length	0 to 2	[17:0]	Duration allocated to the TXOP in TIME_UNIT units where the size of a TIME_UNIT is equal to the base TICK size (the values of TICK are defined in clause 8.4) multiplied by a constant factor defined in the MAP header (see TICK_Factor in clause 8.8.3)
Traffic Limitation		[19 :18]	Restrictions on the type of traffic that can be sent in the TXOP: 0 – No restriction (default) 1 – Channel estimation only 2-3 – Reserved by ITU-T.
<u>Seed_usage_indicator</u>		[19]	<u>0 – Indicates that, for frames and signals in this TXOP, the 'default' seed shall be used for generation of the preamble, INUSE, PR and NACK signals.</u> <u>1 – Indicates that, for frames and signals in this TXOP, the 'domain-specific' seed shall be used for generation of the preamble, INUSE, PR and NACK signals</u>
Non-Persistent/Persistent		[20]	0 – Non Persistent TXOP (Default) 1 – Persistent TXOP

Table 8-65 – TXOP Attributes Extension Data format

Field	Octet	Bits	Description
Start_Time_Type		[21]	0 –TXOP Start time is at the end of the previous TXOP and shall be computed as the sum of the durations of all preceding TXOPs (default) 1 – TXOP Start time is the same as the start time of the previous TXOP (e.g., spatial reuse) This field shall be ignored if the TXOP Absolute Timing extension is appended to the TXOP descriptor
Header segmentation		[22]	0 – PHY-frame header is segmented into one symbol ($D = 1$) 1 – PHY-frame header is segmented into two symbols ($D = 2$) (see clause 7.1.3.5.2)
Enhanced frame detection (EFD) STXOP Indicator		[23]	0 – Indicates a non EFD STXOP (see clause 8.3.3) 1 – Indicates an EFD STXOP (see clause 8.3.3.5)
TS_Grid_Resync	3	[0]	0 (Default) – A node that inferred loss of synchronization with the TS grid of this STXOP shall attempt to resynchronize with the TS grid (as described in clause 8.3.3.6) 1 – A node that inferred loss of synchronization with the TS grid of this STXOP shall refrain from transmission until the end of the STXOP (as described in clause 8.3.3.6) (Note).
INUSE signal required		[1]	This bit instructs nodes contending for transmission in a CBTS in this TXOP whether to use INUSE signal: 0 – INUSE signal shall not be used 1 – INUSE signal is required
RTS/CTS required		[2]	This bit instructs the transmitter to use RTS/CTS prior to the data: 0 – RTS/CTS shall not be used 1 – RTS/CTS is required
Extension Type and Extension		[7:3]	See Table 8-64
NOTE – This bit does not apply to CBTXOP without INUSE.			

13) Clause 8.8.5

Revise Table 8-73 "Types of auxiliary information sub-fields" in clause 8.8.5 as follows:

Table 8-73 – Types of auxiliary information sub-fields

Type	Value	Description
Reserved	00 ₁₆	Reserved by ITU-T
Domain name	01 ₁₆	A sub-field indicating domain name represented in ASCII characters, as described in clause 8.8.5.2
Long inactivity schedule	02 ₁₆	A sub-field indicating long inactivity schedules, as described in clause 8.8.5.3
Short inactivity schedule	03 ₁₆	A sub-field indicating short inactivity schedules, as described in clause 8.8.5.4
PSD-related domain Info	04 ₁₆	A sub-field carrying PSD-related domain information, as described in clause 8.8.5.5
New domain Master ID	05 ₁₆	A sub-field carrying the DEVICE_ID and the REGID of the node that will take the role of the domain master after the handover is complete, as described in clause 8.8.5.6
Backup domain Master ID	06 ₁₆	A sub-field carrying the DEVICE_ID and the REGID of the node assigned as a backup domain master for the domain, as described in clause 8.8.5.7
Timer-related domain info	07 ₁₆	A sub-field carrying timer-related domain information, as described in clause 8.8.5.8
Reserved	08 ₁₆	Reserved by ITU-T
Registration code	09 ₁₆	A sub-field indicating registration code to register nodes to which Domain Name cannot be provided by the user, as described in clause 8.8.5.9
DOD update	0A ₁₆	The new value of DOD
<u>Contention Window (CW) information</u>	0B ₁₆	<u>A sub-field used to specify CW back-off parameter values other than the values defined in Table 8-7 (see clause 8.3.3.4.3)</u>
<u>NDIM information</u>	0C ₁₆	<u>A sub-field carrying the information related to inter-domain information exchange and MAC cycle alignment</u>
Reserved	0D ₁₆ to 7F ₁₆	Reserved by ITU-T

14) Clause 8.8.5.5

Revise Table 8-77 "Format of PSD-related domain info sub-field" in clause 8.8.5.5 as follows:

Table 8-77 – Format of PSD-related domain info sub-field

Field	Octet	Bits	Description
Type	0	[6:0]	Set to 0304 ₁₆
ModificationFlag		[7]	This flag shall be set to one
Length	1	[7:0]	Length of the field in octets (range 3-255199)

Table 8-77 – Format of PSD-related domain info sub-field

Field	Octet	Bits	Description
DmVersion	2	[7:0]	0 – Domain master supports version 0 of [ITU-T G.9960] and [ITU-T G.9961]. All other values of this field are reserved by ITU-T for indicating support for future versions of the Recommendation (Note 1)
Regional <u>domain-wide</u> PSD shaping mask	3	[0]	0, when PSD shaping <u>descriptor sub-field</u> is not used <u>present</u> 1, when PSD shaping <u>descriptor sub-field</u> is used <u>present</u>
Regional SM		[1]	0, when sub-carrier masking <u>SM descriptor sub-field</u> is not used <u>present</u> 1, when sub-carrier masking <u>SM descriptor sub-field</u> is used <u>present</u>
Regional TX power limit		[2]	0, when standard transmit <u>TX power limit sub-field</u> is used <u>not present</u> (see clause 7.2.6) 1, when TX power limit <u>sub-field</u> is used <u>present</u>
Regional Amateur radio bands		[3]	0, when all international <u>Amateur radio bands are masked descriptor sub-field</u> is not present 1, when one or more bands are not masked <u>Amateur radio band descriptor sub-field</u> is present
<u>Symbol boost indicator</u>		[4]	0, when Symbol boost parameters sub-field is not <u>present</u> 1, when Symbol boost parameters sub-field is <u>present</u>
<u>Num additional PSD shaping masks</u>		[6:5]	<u>Number of additional PSD shaping descriptor sub-fields</u>
Reserved		[7: 5 4]	Reserved by ITU-T (Note 2)
Amateur radio band descriptor	4 and <u>5</u> <u>Variable</u>	[9:0]	Zero octets <u>This field shall only not be present if the regional Amateur radio bands field bit 3 of octet 3 is set to zero, otherwise it represents a bit map representing usage of international amateur bands (0 = masked, 1 = unmasked). The LSB represents the lowest band (1.8-2.0 MHz), the second LSB represents the second lowest band (3.5-4.0 MHz), etc. Masked amateur bands are part of RMSC (see clause 7.1.4.2.1 of [ITU-T G.9960])</u>
Reserved		[15:10]	Reserved by ITU-T (Note 2)
TX power limit	6 <u>Variable</u>	[7:0]	Zero octets <u>This field shall only not be present if the regional TX power limit field bit 2 of octet 3 is set to zero, otherwise it represents the value of maximum transmit power in dBm, represented as 0.1 dBm per unit</u>
<u>Domain-wide PSD shaping descriptor</u>	7 to (6+L) <u>Variable</u>	[(8*L) – 1:0]	Zero octets <u>This field shall only not be present if the regional PSD shaping mask field bit 0 of octet 3 is set to zero, otherwise this descriptor uses the format specified in see Table 8-78 (Note 3)</u>

Table 8-77 – Format of PSD-related domain info sub-field

Field	Octet	Bits	Description
SM descriptor	(7+L) to (6+L+M) Variable	[(8*M) – 1:0]	Zero octets This field shall only not be present if the regional SM field bit 1 of octet 3 is set to zero, otherwise see Table 8-79. Masked bands are part of RMSC (see clause 7.1.4.2.1 of [ITU-T G.9960]) (Note 4)
Symbol boost parameters	Variable	[7:0]	This field shall only not be present if the symbol boost indicator field bit 4 of octet 3 is set to zero, otherwise see Table 8-79.1
Additional PSD shaping descriptor1	Variable	[(8*L) – 1:0]	This field shall be present if and only if the "Num additional PSD shaping masks" field is greater than or equal to 1. This descriptor uses the format specified in Table 8-78 (Note 3)
Num Nodes with PSD 1	Variable	[7:0]	Number of nodes (n_1) for which the PSD shaping mask described by "Additional PSD shaping descriptor1" applies
DEVICE_ID [n_1]	Variable	Variable	An array of size n_1 consisting of the DEVICE_IDs of the nodes for which the PSD shaping mask described by "Additional PSD shaping descriptor1" applies
Additional PSD shaping descriptor2	Variable	[(8*L) – 1:0]	This field shall be present if and only if the "Num additional PSD shaping masks" field is greater than or equal to 2. This descriptor uses the format specified in Table 8-78 (Note 3)
Num Nodes with PSD 2	Variable	[7:0]	Number of nodes (n_2) for which the PSD shaping mask described by "Additional PSD shaping descriptor2" applies
DEVICE_ID [n_2]	Variable	Variable	An array of size n_2 consisting of the DEVICE_IDs of the nodes for which the PSD shaping mask described by "Additional PSD shaping descriptor2" applies
Additional PSD shaping descriptor3	Variable	[(8*L) – 1:0]	This field shall be present if and only if the "Num additional PSD shaping masks" field is equal to 3. This descriptor uses the format specified in Table 8-78 (Note 3)
Num Nodes with PSD 3	Variable	[7:0]	Number of nodes (n_3) for which the PSD shaping mask described by "Additional PSD shaping descriptor3" applies

Table 8-77 – Format of PSD-related domain info sub-field

Field	Octet	Bits	Description
<u>DEVICE_ID</u> [n_3]	<u>Variable</u>	<u>Variable</u>	<u>An array of size n_3 consisting of the DEVICE_IDs of the nodes for which the PSD shaping mask described by "Additional PSD shaping descriptor3" applies</u>
NOTE 1 – A domain master indicating support for a certain version of this Recommendation shall mean that it also supports all the earlier versions of the Recommendation. NOTE 2 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver. NOTE 3 – The value of L equals to the value of the first octet of the PSD shaping descriptor multiplied by 3 plus 1. The value of M equals to the value of the first octet of the SM descriptor multiplied by 3 plus 1. NOTE 4 – The SM is intended to incorporate masked sub-carriers defined by the regional Annex to comply with local regulations and masked sub-carriers defined by the user or service provider to facilitate local deployment practices.			

15) Clause 8.8.5.11

Add new clause 8.8.5.11 "Contention window (CW) information sub-field" as follows:

8.8.5.11 Contention window (CW) information sub-field

A CW information sub-field shall be used to specify CW back-off parameter values other than the default values defined in Table 8-7 (see clause 8.3.3.4.3).

One set of CW parameters may be assigned to one or more MA priorities with a single contention window information sub-field.

When receiving a MAP that contains this sub-field, all nodes shall initialize BSC to 1, DC to the new $DC_{\max}(1)$ and BC to a random value in the range $(0, NCW_{\max}(1)-1)$ using the new $NCW_{\max}$ for the priorities included in the sub-field for all CBTSs starting from the MAC cycle indicated by the validity counter AUX_VALID. Upon receiving an ADM_NodeRegistrRequest.req message from a newly registering node (DEVICE_ID=0), the domain master shall include any non-default CW parameters in the ADM_DmRegistrResponse.cnf message (see Tables 8-17, 8-17.1 and 8-17.2). To indicate the non-default CW parameters, the TLV type shall be set to 01_{16} , TLV value shall be of the format as shown in Table 8-85.2 and TLV length shall be set to the length of the TLV value field in octets.

Table 8-85.1 – Format of "Contention window (CW) info" sub-field

Field	Octet	Bits	Description
Type	0	[6:0]	Set to $0B_{16}$
ModificationFlag		[7]	This flag shall be set to 1
Length	1	[7:0]	Length of the sub-field data in octets (range 3-42)
MA Priority	2	[3:0]	A bit map representing to which MA priorities the following CW parameters apply. Bit 0 represents MA0 and so on. 0 – Not applicable for this MA priority 1 – applicable for this MA priority
Reserved		[6:4]	Reserved by ITU-T (Note 1)

Table 8-85.1 – Format of "Contention window (CW) info" sub-field

Field	Octet	Bits	Description
ResumeDefault		[7]	0 – Use the following CW parameter values for the specified MA priorities 1 – Resume the default CW parameter values for the specified MA priorities
BSC _{max}	3	[2:0]	Value for BSC _{max} , valid values are from 1 to 5. Other values are reserved by ITU-T
Reserved		[7:3]	Reserved by ITU-T (Note 1)
DC _{max} (1)	4	[2:0]	DC _{max} values for BSC=1: 0 – 1 1 – 2 2 – 4 3 – 8 4 – 16 5, 6 – Reserved by ITU-T (Note 1) 7 – 256 See Note 2, Note 3
NCW _{max} (1)		[5:3]	NCW _{max} for BSC=1: 0 – 2 ³ 1 – 2 ⁴ 2 – 2 ⁵ 3 – 2 ⁶ 4 – 2 ⁷ See Note 2
Reserved		[7:6]	Reserved by ITU-T (Note 1)
...			
DC _{max} (BSC _{max})	Var	[2:0]	DC _{max} for BSC _{max}
NCW _{max} (BSC _{max})	Var	[5:3]	NCW _{max} for BSC _{max}
Reserved		[7:6]	Reserved by ITU-T (Note 1)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			
NOTE 2 – For each BSC level of N>1, the value of DC _{max} (N) shall be greater than or equal to the value of DC _{max} (N-1) and the value of NCW _{max} (N) shall be greater than or equal to the value of NCW _{max} (N-1).			
NOTE 3 – Setting DC _{max} (i) to '7' (i.e., assigning the value 256 to DC _{max} for BSC=i) will achieve a scheme that practically does not use the defer counter (DC) mechanism (Due to the high value assigned).			

**Table 8-85.2 – Format of non-default contention window parameters
for all MA priorities**

Field	Octet	Bits	Description
MA Priority0	1	[3:0]	A bit map representing to which MA priorities the non-default CW Params0 apply. Bit 0 represents MA0 and so on. 0 – Not applicable for this MA priority 1 – Applicable for this MA priority
Reserved		[7:4]	Reserved by ITU-T (Note 1)
CW Params0	Variable	Variable	Non-default CW params for MA priorities indicated in MA Priority0 (see Table 8-85.3)
MA Priority1	Variable (Note 2)	[3:0]	A bit map representing to which MA priorities the non-default CW Params1 apply. Bit 0 represents MA0 and so on. 0 – Not applicable for this MA priority 1 – Applicable for this MA priority
Reserved		[7:4]	Reserved by ITU-T (Note 1)
CW Params1	Variable (Note 2)	Variable	Non-default CW params for MA priorities indicated in MA Priority1 (see Table 8-85.3)
MA Priority2	Variable (Note 2)	[3:0]	A bit map representing to which MA priorities the non-default CW Params2 apply. Bit 0 represents MA0 and so on. 0 – Not applicable for this MA priority 1 – Applicable for this MA priority
Reserved		[7:4]	Reserved by ITU-T (Note 1)
CW Params2	Variable (Note 2)	Variable	Non-default CW params for MA priorities indicated in MA Priority2 (see Table 8-85.3)
MA Priority3	Variable (Note 2)	[3:0]	A bit map representing to which MA priorities the non-default CW Params3 apply. Bit 0 represents MA0 and so on. 0 – Not applicable for this MA priority 1 – Applicable for this MA priority
Reserved		[7:4]	Reserved by ITU-T (Note 1)
CW Params3	Variable (Note 2)	Variable	Non-default CW params for MA priorities indicated in MA Priority3 (see Table 8-85.3)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			
NOTE 2 – These fields are only added as needed to indicate additional sets of CW Params corresponding to different MA priorities. For example, if one set of CW Params is needed to indicate the CW parameters for MA0 and MA1 and another set of CW Params is needed to indicate the CW parameters for MA2 and MA3, then first set is indicated by MA Priority0 and CW Params0 fields, and the second set is indicated by adding MA Priority1 and CW Params1 fields in this table.			

**Table 8-85.3 – Format of contention window parameters
for a specific set of MA priorities**

Field	Octet	Bits	Description
BSC _{max}	0	[2:0]	Value for BSC _{max} , valid values are from 1 to 5. Other values are reserved by ITU-T
Reserved		[7:3]	Reserved by ITU-T (Note 1)
DC _{max} (1)	1	[2:0]	DC _{max} values for BSC=1: 0 – 1 1 – 2 2 – 4 3 – 8 4 – 16 5, 6 – Reserved by ITU-T (Note 1) 7 – 256 See Notes 2 and 3
NCW _{max} (1)		[5:3]	NCW _{max} for BSC=1: 0 – 2 ³ 1 – 2 ⁴ 2 – 2 ⁵ 3 – 2 ⁶ 4 – 2 ⁷ See Note 2
Reserved		[7:6]	Reserved by ITU-T (Note 1)
...			
DC _{max} (BSC _{max})	Var	[2:0]	DC _{max} for BSC _{max}
NCW _{max} (BSC _{max})	Var	[5:3]	NCW _{max} for BSC _{max}
Reserved		[7:6]	Reserved by ITU-T (Note 1)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			
NOTE 2 – For each BSC level of N>1, the value of DC _{max} (N) shall be greater than or equal to the value of DC _{max} (N-1) and the value of NCW _{max} (N) shall be greater than or equal to the value of NCW _{max} (N-1).			
NOTE 3 – Setting DC _{max} (i) to '7' (i.e., assigning the value 256 to DC _{max} for BSC=i) will achieve a scheme that practically does not use the defer counter (DC) mechanism (Due to the high value assigned).			

16) Clause 8.8.5.12

Add new clause 8.8.5.12 "NDIM information sub-field" as follows:

The format of the NDIM information sub-field shall be as presented in Table 8-85.4. The length of the sub-field data is variable.

Table 8-85.4 –Format of "NDIM information" sub-field

Field	Octet	Bits	Description
Type	0	[6:0]	Set to 0C ₁₆
ModificationFlag		[7]	This flag may be set to either zero or one
Length	1	[7:0]	Variable

Table 8-85.4 –Format of "NDIM information" sub-field

Field	Octet	Bits	Description
NDIM_CLID	2 to 7	[47:0]	ClusterID of the domain
NDIM_DM_REGID	8 to 13	[47:0]	REGID of the domain master
NDIM_SYNCHRO_COUNTER	14 and 15	[15:0]	Cluster-wide synchronization counter that is used to count the number of MAC cycles in a coordination allocation period
NDIM_SYNCHRO_REF_NDID	16 to 18	[23:0]	NDID of the domain that is used as a reference for synchronization counter
NDIM_NDID	19 to 21	[23:0]	NDID of the domain
SENDING_NODE_MAC	22 to 27	[47:0]	MAC address of the node sending the MAP
ID_PRESENCE	28	[7:0]	0 – Normal MAP or ID_PresenceRequest 1 – ID_PresenceConfirm with alignment proposal being accepted 2 – ID_PresenceConfirm with alignment proposal being rejected due to higher ClusterID 3 – ID_PresenceConfirm with alignment proposal being rejected due to another MAC cycle alignment procedure currently under way All other values are reserved for ITU-T
NumAuthNodes	29	[7:0]	Number of nodes (m) that are authorized to transmit a MAP-D as presence message in the IDCC. If 0, all nodes of the domain except for the domain master shall refrain from sending MAP-D as presence messages in the IDCC
AUTHORIZED_DEVICE [1]	Var	[7:0]	First device in the authorized list that shall contend to send a MAP-D presence message in the IDCC (see clause 8.14.5) in the following MAC cycles
...	...	...	...
AUTHORIZED_DEVICE [m]	Var	[7:0]	m-th device in the authorized list that shall contend to send a MAP-D presence message in the IDCC (see clause 8.14.5) in the following MAC cycles

17) Clause 8.10.1.1

Revise Table 8-88 "OPCODEs of management messages" in clause 8.10.1.1 as follows:

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
Admission (01X)	ADM_NodeRegistr Request.req	010	Registration request	Clause 8.6.1.1.4.1
	ADM_DmRegistr Response.cnf	011	Registration response	Clause 8.6.1.1.4.2
	ADM_NodeResign Request.req	012	Resignation request	Clause 8.6.1.1.4.3

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	ADM_DmResign.cnf	013	Registration announcement	Clause 8.6.1.1.4.4
	ADM_DmForced Resign.req	014	Forced resignation request	Clause 8.6.1.1.4.5
AKM (02X)	AUT_NodeRequest.req	020	Request for authentication	Clause 9.2.5.1.1
	AUT_Prompt.ind	021	Delivers authentication prompt	Clause 9.2.5.1.2
	AUT_Verification.res	022	Authentication prompt verification	Clause 9.2.5.1.3
	AUT_Confirmation.cnf	023	Authentication confirmation message	Clause 9.2.5.1.4
	AKM_KeyRequest.req	024	Request for secure communication with another node(s)	Clause 9.2.5.2.1
	AKM_NewKey.req	025	Message delivers the encryption key to the Supplicant node	Clause 9.2.5.2.2
	AKM_Key Confirmation.req	026	Message delivers the encryption key to the Addressee node(s)	Clause 9.2.5.2.3
	AKM_KeyUpdate.req	027	Request for re-authentication and update the keys	Clause 9.2.5.3.1
	AKM_KeyAck.cnf	028	Addressee confirmation that encryption key was delivered	Clause 9.2.5.2.3
	SC_DMRes.req	029	Request to resign a node from the domain	Clause 9.2.5.2.5
	SC_DMRes.cnf	02A	Confirmation of resignation from the domain master	Clause 9.2.5.2.6
	AKM_KeyAdd Request.req	02B	Request to join a node to a multicast group	Clause 9.2.5.2.1.1
	AKM_DomainKey Update.ind	02C	Indication to update the domain-wide encryption keys	Clause 9.2.5.3.2
	AKM_NewKey.ind	02D	Indication that the new encryption key is available for use	Clause 9.2.5.2.7
Topology maintenance (03X)	TM_NodeTopology Change.ind	030	Topology report from a node	Clause 8.6.4.3.12.1
	TM_NodeTopology Change.req	031	Request sent by the domain master to a particular node	Clause 8.6.4.3.2

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
			requesting its topology report	
	TM_NodeTopologyChange.cnf	032	Topology report from a node in response to the message TM_NodeTopologyChange.req	Clause 8.6.4.3.3
	TM_DomainRoutingChange.ind	033	Optimal routing update from the domain master	Clause 8.6.4.3.5
	TM_ReturnDomainRouting.req	034	Request for routing update from the node to the domain master	Clause 8.6.4.3.6
	TM_ReturnDomainRouting.cnf	035	Reply on routing request by the Domain master	Clause 8.6.4.3.7
	TM_DMBackup.ind	036	Topology report from a node sent by backup domain master to a node	Clause 8.6.4.3.4
Power-line coexistence with alien networks (04X)	Reserved for use by [ITU-T G.9972]			
Multicast Binding (05X)	MC_GrpInfoUpdate.ind	050	Multicast Binding Information update	Clause 8.16.5.1
	MC_GrpInfoUpdate.cnf	051	Multicast binding information update confirmation	Clause 8.16.5.2
	MC_GrpRemove.req	052	Multicast leave request from the transmitter	Clause 8.16.5.3
	MC_GrpRemove.cnf	053	Multicast leave confirmation from the receiver	Clause 8.16.5.4
	DMC_Path.req	054	DLL multicast path establishment request	Clause 8.17.6.1
	DMC_Path.cnf	055	DLL multicast path establishment confirmation	Clause 8.17.6.2
	DMC_PathReject.cnf	056	DLL multicast path establishment rejection	Clause 8.17.6.3
	DMC_EnforcePath.req	057	DLL multicast enforced path establishment request	Clause 8.17.6.4

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	DMC_ReleasePath.req	058	A request to release a DLL multicast client node from its MSID	Clause 8.17.6.5
	DMC_ReleasePath.cnf	059	Confirmation of the release of a DLL multicast client node from its MSID	Clause 8.17.6.6
	DMC_PathAlive.ind	05A	DLL multicast path alive indication	Clause 8.17.6.7
	DMC_BrokenLink.ind	05B	DLL multicast broken link indication	Clause 8.17.6.8
Domain Master Selection and Backup Domain Master (06X)	DM_Handover.req	060	Domain master role handover request	Clause 8.6.6.5.1
	DM_Handover.cnf	061	Domain master role handover confirmation	Clause 8.6.6.5.2
	DM_Handover.ind	062	Domain state update	Clause 8.6.6.5.3
	DM_Handover.rsp	063	Domain state update confirmation	Clause 8.6.6.5.4
	DM_BackupAssign.req	064	Backup domain master assignment request	Clause 8.6.5.2
	DM_BackupAssign.cnf	065	Backup domain master assignment confirmation	Clause 8.6.5.2
	DM_BackupData.ind	066	Domain state update	Clause 8.6.5.2
	DM_BackupRelease.req	067	Release of a backup domain master	Clause 8.6.5.2
	DM_BackupRelease.cnf	068	Backup domain master release confirmation	Clause 8.6.5.2
Channel Estimation (07X)	CE_ProbeSlotAssign.req	070	Channel estimation bandwidth assignment request	Clause 8.11.7.1
	CE_ProbeSlotRelease.req	071	Channel estimation bandwidth release request	Clause 8.11.7.2
	CE_ParamUpdate.req	072	Channel estimation parameters update request	Clause 8.11.7.1
	CE_ParamUpdateRequest.ind	073	Request for channel estimation parameter update	Clause 8.11.7.4
	CE_PartialBatUpdate.req	074	Partial BAT update request	Clause 8.11.7.5
	CE_ACESymbols.ind	075	Request for an ACE symbol attachment	Clause 8.11.7.6

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	CE_ProbeSlot Assign.cnf	076	Channel estimation bandwidth assignment confirmation	Clause 8.11.7.7
	CE_ProbeSlot Release.cnf	077	Channel estimation bandwidth release confirmation	Clause 8.11.7.8
	CE_ParamUpdate.cnf	078	Channel estimation parameters update confirmation	Clause 8.11.7.9
	CE_PartialBat Update.cnf	079	Partial BAT update confirmation	Clause 8.11.7.10
Neighbouring networks coordination (08X)	For further study	For further study	For further study	For further study
Inactivity scheduling (09X)	IAS_LongInactivity.req	090	Long inactivity scheduling request	Clause 8.3.6.1.1
	IAS_LongInactivity.cnf	091	Long inactivity scheduling confirmation	Clause 8.3.6.1.1
	IAS_ShortInactivity.req	092	Short inactivity scheduling request	Clause 8.3.6.2.1
	IAS_ShortInactivity.cnf	093	Short inactivity scheduling confirmation	Clause 8.3.6.2.1
Flow establishment (0AX)	CL_EstablishFlow.req	0A0	Flow establishment request	Clause 8.6.2.3.1
	CL_EstablishFlow.cnf	0A1	Flow establishment confirmation	Clause 8.6.2.3.2
	FL_AdmitFlow.req	0A2	Flow admission request	Clause 8.6.2.3.8
	FL_AdmitFlow.cnf	0A3	Flow admission confirmation	Clause 8.6.2.3.9
	FL_AdmitFlow.ind	0A4	Flow admission indication	Clause 8.6.2.3.10
	FL_AdmitFlow.rsp	0A5	Flow admission acknowledgement	Clause 8.6.2.3.18
	FL_OriginateFlow.req	0A6	Flow origination request	Clause 8.6.2.3.6
	FL_OriginateFlow.cnf	0A7	Flow origination confirmation	Clause 8.6.2.3.7
Flow maintenance (0BX)	FL_ModifyFlow Parameters.req	0B0	Modification of flow parameters and allocation	Clause 8.6.2.3.11
	FL_ModifyFlow Parameters.cnf	0B1		Clause 8.6.2.3.12
	FL_ModifyFlow Parameters.ind	0B2		Clause 8.6.2.3.15

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	FL_ModifyFlow Allocations.req	0B3	Modification of flow allocation	Clause 8.6.2.3.17
	FL_ModifyFlow Allocations.cnf	0B4		Clause 8.6.2.3.18
Flow termination (0CX)	CL_TerminateFlow.req	0C0	Flow termination request and confirmation	Clause 8.6.2.3.3
	CL_TerminateFlow.cnf	0C1		Clause 8.6.2.3.4
	CL_FlowTerminated.ind	0C2		Clause 8.6.2.3.5
	FL_TerminateFlow.req	0C3		Clause 8.6.2.3.13
	FL_TerminateFlow.cnf	0C4		Clause 8.6.2.3.14
	FL_BrokenTunnel.ind	0C5	Indicate broken tunnel	Clause 8.6.2.3.19
	FL_BrokenTunnel.rsp	0C6	Response to indication	Clause 8.6.2.3.20
	FL_ReleaseTunnel.req	0C7	Request Release Tunnel	Clause 8.6.2.3.21
	FL_ReleaseTunnel.cnf	0C8	Confirm Release Tunnel	Clause 8.6.2.3.22
	FL_DM_Renew Tunnel.req	0C9	DM renew tunnel request	Clause 8.6.2.3.23
	FL_DM_Renew Tunnel.cnf	0CA	Confirm DM renew tunnel	Clause 8.6.2.3.24
	FL_RenewTunnel.req	0CB	Renew tunnel request	Clause 8.6.2.3.25
	FL_RenewTunnel.cnf	0CC	Confirm Renew tunnel	Clause 8.6.2.3.26
	FL_DeleteFlow.req	0CD	Delete Flow request	Clause 8.6.2.3.27
	FL_DeleteFlow.cnf	0CE	Confirm Delete Flow	Clause 8.6.2.3.28
Media Access Plan (0DX)	MAP	0D0	MAP message	Clause 8.8
Channel Estimation 2 (0EX)	CE_Request.ind	0E0	Channel estimation trigger	Clause 8.11.7.11
	CE_Initiation.req	0E1	Channel estimation initiation request	Clause 8.11.7.12
	CE_Initiation.cnf	0E2	Channel estimation initiation confirmation	Clause 8.11.7.13
	CE_ProbeRequest.ind	0E3	Request for PROBE frame transmission	Clause 8.11.7.14
	CE_Cancellation.req	0E4	Channel estimation cancellation request	Clause 8.11.7.15

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	CE_BatIdMaintain.ind	0E5	BAT ID maintenance	Clause 8.11.7.16
	CE_Cancellation.cnf	0E6	Channel estimation cancellation confirmation	Clause 8.11.7.17
	Reserved	0E7-0EF	Reserved by ITU-T	
<u>Transmission Profile (0FX)</u>	<u>TP_TransmitPsdChange.req</u>	<u>0F0</u>	<u>Transmit PSD mask change request</u>	<u>Clause 8.6.9.1</u>
	<u>TP_TransmitPsdChange.cnf</u>	<u>0F1</u>	<u>Transmit PSD mask change confirmation</u>	<u>Clause 8.6.9.2</u>
<u>Neighbouring network coordination (10X to 13X)</u>	<u>NDIM_StartAlignmentProcedure.ind</u>	<u>100</u>	<u>Request to start a MAC cycle alignment procedure (DM to proxy node)</u>	<u>Clause 8.14.9.1</u>
	<u>NDIM_IDCCReserve.req</u>	<u>101</u>	<u>Slot reservation request</u>	<u>Clause 8.14.9.2</u>
	<u>NDIM_IDCCReserve.cnf</u>	<u>102</u>	<u>Slot reservation confirmation</u>	<u>Clause 8.14.9.3</u>
	<u>NDIM_ReportAlignment.req</u>	<u>103</u>	<u>Report on MAC cycle alignment</u>	<u>Clause 8.14.9.4</u>
	<u>NDIM_ReportAlignment.cnf</u>	<u>104</u>	<u>Confirm receiving NDIM_ReportAlignment.req</u>	<u>Clause 8.14.9.5</u>
	<u>NDIM_RemotePresence.req</u>	<u>105</u>	<u>Request to respond to ID_PresenceRequest</u>	<u>Clause 8.14.9.6</u>
	<u>NDIM_RemotePresence.cnf</u>	<u>106</u>	<u>Permission to respond to ID_PresenceRequest</u>	<u>Clause 8.14.9.7</u>
	<u>NDIM_Transmit.ind</u>	<u>107</u>	<u>DM to proxy node message to be transmitted to neighbouring domain</u>	<u>Clause 8.14.9.8</u>
	<u>NDIM_Receive.ind</u>	<u>108</u>	<u>Proxy node to DM message received from neighbouring domain</u>	<u>Clause 8.14.9.9</u>
	<u>NDIM_InterferenceReport.ind</u>	<u>109</u>	<u>Indication of interference detected</u>	<u>Clause 8.14.9.12</u>
	<u>NDIM_IDCCRelease.req</u>	<u>10A</u>	<u>Release Slot reservation</u>	<u>Clause 8.14.9.10</u>
	<u>NDIM_IDCCRelease.cnf</u>	<u>10B</u>	<u>Confirm receiving NDIM_IDCCRelease.req</u>	<u>Clause 8.14.9.11</u>
	<u>IDM_ClusterAlignment.req</u>	<u>120</u>	<u>DM informs other DMs about new cluster alignment</u>	<u>Clause 8.14.10.1</u>

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	<u>IDM_ClusterAlignment.cnf</u>	<u>121</u>	DM confirm receiving <u>IDM_ClusterAlignm ent.req</u>	<u>Clause 8.14.10.2</u>
	<u>IDM_InterfNodes Info.ind</u>	<u>122</u>	Proxy node to neighbouring domains indication of interfering nodes	<u>Clause 8.14.10.3</u>
	<u>IDM_CoordDomains Info.ind</u>	<u>123</u>	Proxy node to neighbouring domains indication of coordinating nodes	<u>Clause 8.14.10.5</u>
	<u>IDM_ShareUnalloc Slot.req</u>	<u>124</u>	Request to share unallocated slots	<u>Clause 8.14.10.7</u>
	<u>IDM_ShareUnalloc Slot.cnf</u>	<u>125</u>	Confirmation of request to share unallocated slots	<u>Clause 8.14.10.8</u>
	<u>IDM_ShareUnalloc Slot.ind</u>	<u>126</u>	Indication of status of the request to share unallocated slots	<u>Clause 8.14.10.9</u>
	<u>IDM_Request UnallocSlot.req</u>	<u>127</u>	Request assignment of unallocated slots	<u>Clause 8.14.10.10</u>
	<u>IDM_Request UnallocSlot.cnf</u>	<u>128</u>	Confirmation of request for assignment of unallocated slots	<u>Clause 8.14.10.11</u>
	<u>IDM_Request UnallocSlot.ind</u>	<u>129</u>	Indication of status of the request for assignment of unallocated slots	<u>Clause 8.14.10.12</u>
	<u>IDM_SwapAlloc Slot.req</u>	<u>12A</u>	Request to swap allocated slots	<u>Clause 8.14.10.13</u>
	<u>IDM_SwapAlloc Slot.cnf</u>	<u>12B</u>	Confirmation of the request to swap allocated slots	<u>Clause 8.14.10.14</u>
	<u>IDM_SwapAlloc Slot.ind</u>	<u>12C</u>	Indication of status of the request to swap allocated slots	<u>Clause 8.14.10.15</u>
	<u>IDM_CoordPref.ind</u>	<u>12D</u>	Indication of preferred coordination method	<u>Clause 8.14.10.16</u>
	<u>IDM_DmChange.ind</u>	<u>12E</u>	Indication to neighbouring domain masters that the DM of the domain sending the message has changed	<u>Clause 8.14.10.17</u>

Table 8-88 – OPCODEs of management messages

Category	Message name	OPCODE (hex)	Description	MMPL Reference
	<u>IDM_DniChange.ind</u>	<u>12F</u>	<u>Indication to neighbouring domain masters that the DNI of the domain sending the message has changed</u>	<u>Clause 8.14.10.18</u>
	<u>IDM_InterfNodesInfo.rsp</u>	<u>130</u>	<u>A message sent as a confirmation for a received IDM_InterfNodesInfo.ind</u>	<u>Clause 8.14.10.4</u>
	<u>IDM_CoordDomainsInfo.rsp</u>	<u>131</u>	<u>A message sent as a confirmation for a received IDM_CoordDomainsInfo.ind</u>	<u>Clause 8.14.10.6</u>
<u>Reserved</u>	<u>Reserved</u>	<u>140-7FF</u>	<u>Reserved by ITU-T</u>	
<u>MIMO (8XX-9XX)</u>	<u>Reserved for use by [ITU-T G.9963 [x]]</u>	<u>800-9FF</u>		
Reserved	Reserved	<u>A00-FFF</u>	Reserved by ITU-T	

18) Clause 8.14

Replace clause 8.14 "Operation in the presence of neighbouring domains" with the following:

8.14 Neighbouring domain interference mitigation (NDIM)**8.14.1 General principles**

The NDIM procedure shall be used in power lines. The usage of NDIM for other mediums is for further study.

The originating domain of the inter-domain messages used for NDIM shall be indicated using a 24-bit field called NDID. The NDID of a domain shall be set when the domain is established and shall never be changed during the operation of the domain, even if the domain master changes or the DNI changes. The 16 MSBs of NDID shall be the same as the DNI of the domain originating the inter-domain message and the 8 LSBs of NDID shall be a value randomly chosen by the DM when it generates the DNI (see clause 8.6.8.2) and establishes the domain. The NDIM_SYNCHRO_REF_NDID of the domain is then initialized to the value of the NDID.

NOTE – Since the DNI of two domains that are not directly interfering with each other, but are interfering with a third domain, could be the same, an additional randomly chosen byte is useful in differentiating between the messages originated by those domains and received by a third domain.

8.14.1.1 NDIM procedure

A node should be capable of detecting the presence of other neighbouring domains operating in the same medium, either directly or via information sent by other devices in its own domain, and should take all needed actions as detailed in the NDIM procedure to mitigate interference with the neighbouring domains' nodes including coordinating with them.

The NDIM procedure uses the following mechanisms:

- Inter-domain signalling that assists in detection of neighbouring domains.

- A mechanism to align the MAC cycles of all the domains that are present on the same medium and can detect each other (clause 8.14.4), independent of the level of interference among their nodes. The alignment procedure shall be triggered and executed whenever events specified in clause 8.14.4.1 happen.
- A mechanism allowing nodes to routinely update the information (clause 8.14.5) of the neighbouring domains that they detect.
- A mechanism specifying the usage of a near-orthogonal signal for generating and detecting the preamble, PR, INUSE and NACK signals in specific TXOPs. This mechanism may be applied in cases where the interference from neighbouring domains is low. With this mechanism the transmissions from other neighbouring domains are treated as noise.
- A mechanism allowing coordination between domains of transmissions from and to nodes that may interfere with each other (clause 8.14.7).

8.14.2 NDIM cluster

An NDIM cluster is defined as a group of domains that have their MAC cycles aligned. A cluster shall be uniquely identified by its 48-bit cluster identification (ClusterID).

When a new domain is created, the ClusterID of that domain shall be generated as follows:

1. A bit-reversed version of the REGID of the DM is generated, with the most significant bit masked with zero.
2. The two least significant bytes of this number are then replaced by a randomly generated 16-bit number.
3. If the DM is operating in coexistence mode ([ITU-T G.9972]) and is synchronized with an access system as specified in [ITU-T G.9972], the most significant bit of the resulting number shall then be set to one. This number is assigned as the ClusterID of the domain.

For example, if a DM has a REGID 00-B0-D0-86-BB-F7, and it is the only domain in the cluster, the initial ClusterID of that domain shall be generated as follows:

1. The REGID is bit-reversed and the MSB is masked with zero, resulting in the number 6F-DD-61-0B-0D-00.
2. The two least significant bytes are then replaced by a randomly generated 16-bit number ($xxxx_{16}$), resulting in the number 6F-DD-61-0B-xx-xx.
3. If the DM is not synchronized with an access system as specified in [ITU-T G.9972], this number is assigned as the ClusterID of the domain. If the DM is synchronized with an access system as specified in [ITU-T G.9972], the MSB is set to one and the number assigned as the ClusterID shall be EF-DD-61-0B-xx-xx.

NOTE – This ensures that DMs that are not operating in coexistence mode or those not aligned with an access system will align their MAC cycles with neighbouring domains that are operating in coexistence mode and are synchronized with an access system.

The ClusterID shall only be updated after either a MAC cycle alignment procedure as described in clause 8.14.4 or a routine maintenance procedure as described in clause 8.14.5. The new ClusterID to be used by the cluster results from the application of the rules described in clause 8.14.4.

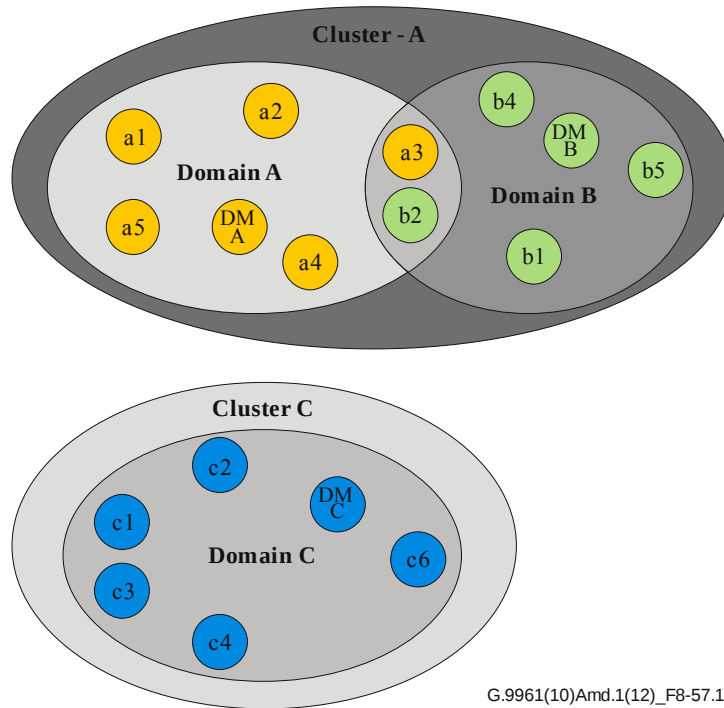


Figure 8-57.1 – Cluster definition

8.14.3 Inter-domain signalling and communication

The domain master shall reserve a fraction of the MAC cycle for an inter-domain signalling window (IDSW) and inter-domain communication channel (IDCC) as shown in Figure 8-57.2.

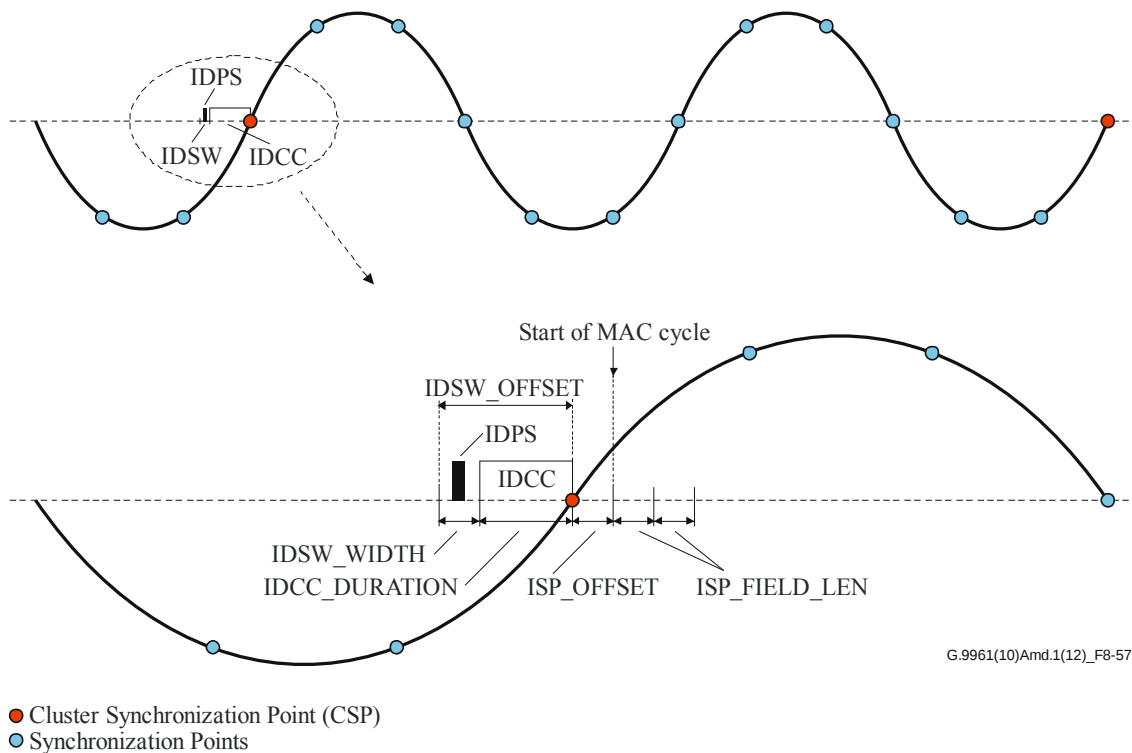


Figure 8-57.2 – Position of signalling information in the MAC cycle

Synchronization points are located at 0°, 60°, 120°, 180°, 240°, or 300° relative to a zero-crossing point of the AC mains.

In order to determine the synchronization point location, each node shall have a zero-crossing detector. The zero-crossing detector of the node shall detect the AC zero-crossing with a tolerance lower than $\pm 25 \mu\text{s}$ in 95% of the cases.

NOTE 1 – Additional filtering of the zero-crossing point detected by the circuit is recommended.

Each cluster shall use one of these synchronization points as a reference for the position of the inter-domain signalling window (IDSW) and the inter-domain communication channel (IDCC). This selected synchronization point is called the cluster synchronization point (CSP). The domain master shall ensure that the MAC cycle starts `ISP_OFFSET` after the CSP where `ISP_OFFSET` is defined in [ITU-T G.9972]. That is, the angular offset Δ defined in clause 8.6.3.1 shall be set to `ISP_OFFSET`.

The IDSW defines a region with width `IDSW_WIDTH` of the MAC cycle that shall be used by all the nodes of a cluster for transmitting their inter-domain presence signal (IDPS, see clause 7.2.2.2.5 of [ITU-T G.9960]). IDSW shall be present once every MAC cycle and shall be always located at a fixed offset `IDSW_OFFSET` before the CSP of that cluster as shown in Figure 8-57.2.

NOTE 2 – The IDSW is placed at the end of the MAC cycle where the start of the MAC cycle is aligned with TDMU defined in [ITU-T G.9972] so that NDIM works seamlessly regardless of whether ISP is enabled or not.

The IDPS shall be transmitted $50 \mu\text{s}$ after the start of the IDSW by all nodes of all domains in the cluster in order to announce their presence to potential neighbouring domains. A node shall transmit IDPS signal as described in clause 7.2.2.2.5 of [ITU-T G.9960] with a periodicity of `IDPS_PERIODICITY` cycles. A node may choose any MAC cycle to transmit IDPS and continue transmitting IDPSs with the periodicity of `IDPS_PERIODICITY`.

Each DM shall set up the inter-domain communication channel (by allocating a CBTXOP containing CBTS with same attributes of minimum duration `IDCC_DURATION`, immediately after the IDSW, in each MAC cycle. Messages for inter-domain communication shall only be sent during the first `IDCC_DURATION` ms of this CBTXOP. This does not restrict this CBTXOP from other use. The DM shall indicate in the MAP that the seed to be used in the CBTXOP containing the IDCC is the "default" seed.

NOTE 3 – The DM should use a CBTXOP of `IDCC_DURATION` whenever possible in order to avoid dividing the CBTXOP into two regions (an IDCC region and a non-IDCC region).

For all inter-domain management messages transmitted within IDCC, the reduced CW parameters shown in Table 8-105.3 shall be used to prioritize over intra-domain management messages that might be transmitted during IDCC. The CW parameters used for all transmissions (except transmissions of inter-domain management messages) in all CBTSs within the CBTXOP containing the IDCC shall be the default CW parameters specified in Table 8-7. INUSE, PR, and RTS/CTS shall not be used within the CBTXOP containing the IDCC.

NOTE 4 – The inter-domain management messages are the management messages starting with "IDM" in Table 8-88.

NOTE 5 – The DM and nodes should prioritize the use of this IDCC for inter-domain communications.

Table 8-105.3 – Valid DC_{max}(BSC) and NCW_{max}(BSC) values

BSC	DC _{max} (BSC)	NCW _{max} (BSC)
1	1	4
2	2	8
3	4	16
4	16	32

8.14.4 NDIM MAC cycle alignment procedures

MAC cycle alignment procedures consist of synchronizing the MAC cycles of two different clusters by:

- Creating a single cluster including all the nodes and domains belonging to the original clusters.
- Choosing a unique cluster synchronization point (CSP) with its associated IDSW and IDCC, to be used by all the nodes belonging to the newly created cluster for inter-domain communication.
- Assigning a unique ClusterID for identification of the resulting cluster.

At the end of the alignment procedures (any of the procedures described in clause 8.14.4) the domain master shall run the post-alignment procedure described in clause 8.14.4.4.

8.14.4.1 Full MAC cycle alignment procedure

A node shall initiate a full NDIM MAC cycle alignment procedure whenever any of the following events occur:

- On start-up, after the node is registered by the DM.
- On request by the DM via the message NDIM_StartAlignmentProcedure.ind
- By its decision, based on vendor discretionary criteria.

When a node launches a MAC cycle alignment procedure, it shall try to detect the presence of a neighbouring domain's node. For this, it shall either try to detect IDPSs in the unaligned IDSWs for NDIM_IDPS_DETECT_CYCLES MAC cycles, or try to infer the position of the neighbouring domain's node in some other way, or both. The unaligned IDSWs are the IDSWs associated with all the synchronization points of the MAC cycle, excluding the one in use by the node's cluster. The exact algorithm, by which the node chooses the synchronization points within the MAC cycle in which to look for IDPSs, is vendor discretionary.

In order to enable searching for IDPSs in unaligned IDSWs, the DM should assign silent TXOPs, overlapping with the unaligned IDSWs, to ensure that no traffic would be transmitted by nodes of its domain.

The node shall select the IDCC associated with one of the unaligned IDSWs, for which the presence of a neighbouring domain's node has been detected, to be used for the rest of the MAC cycle alignment procedure. For the rest of the procedure, this IDSW will be designated "selected IDSW" and the IDCC designated "selected IDCC".

There are two cases of MAC cycle alignment procedure:

1. Local alignment: MAC cycle alignment procedure where the domain of the node that launches the MAC cycle alignment procedure has to be aligned with the neighbouring domain.
2. Remote alignment: MAC cycle alignment procedure where the neighbouring domain of the node that launches the MAC cycle alignment procedure has to be aligned with the local domain.

Figure 8-57.3 shows the local MAC cycle alignment procedure and Figure 8-57.4 shows the remote MAC cycle alignment procedure.

NOTE 1 – In the case that the local node is the local domain master or the remote node is the remote domain master, the message flows between the endpoint node (local or remote node that is the domain master) and the domain master are accomplished via internal communications.

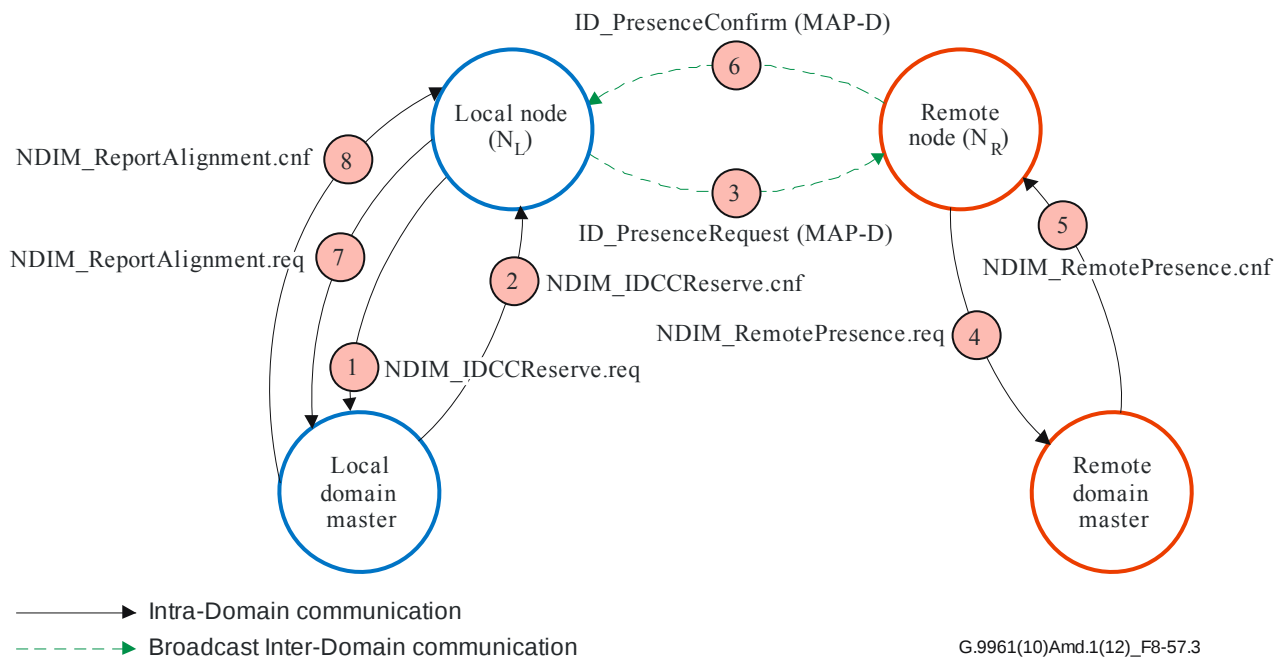


Figure 8-57.3 – Local MAC cycle alignment procedure

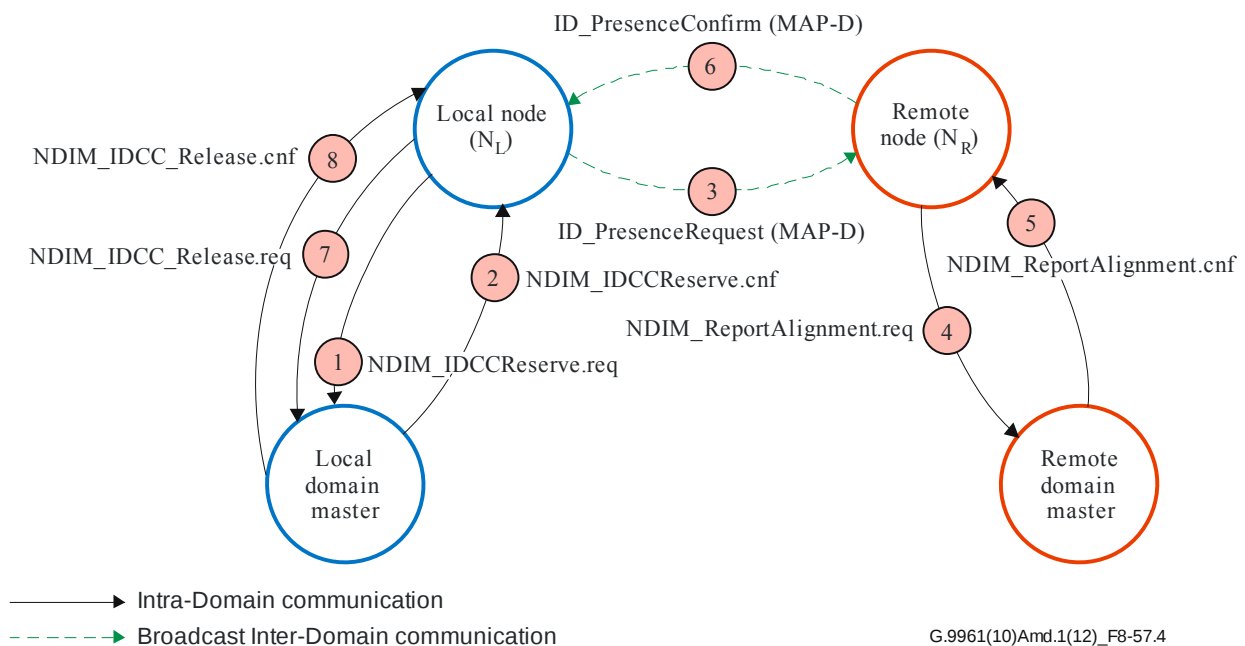


Figure 8-57.4 – Remote MAC cycle alignment procedure

The local node N_L that detected the presence of a neighbouring domain's node with a synchronization point corresponding to the selected IDSW shall start the MAC cycle alignment procedure by indicating its presence to any neighbouring domain's nodes in the selected IDCC. For this, N_L shall follow the procedure described in Figure 8-57.5.

In order to avoid any possible interference from transmissions of other nodes from the local domain during the MAC cycle alignment procedure, the detecting node shall send an NDIM_IDCCReserve.req (1) message to its DM requesting that it reserve time duration corresponding to the unaligned IDCC for the MAC cycle alignment procedure by assigning a CCTXOP to the node.

The DM shall respond with an NDIM_IDCCReserve.cnf (2) message to confirm that the reserved period shall be granted. This period shall only be used for inter-domain communication with the unaligned domain. A DM that granted bandwidth for inter-domain communication through a positive NDIM_IDCCReserve.cnf message shall use the granted node as a proxy for communication with the neighbouring domain the node is reporting, during the remaining MAC cycle alignment procedure, and shall answer any new request for MAC cycle alignment with an NDIM_IDCCReserve.cnf message with failure code 02₁₆ until it receives an NDIM_ReportAlignment.req (7) message in case of local alignment or an NDIM_IDCC_Release.req (7) message in case of remote alignment from the node that launched the MAC cycle alignment procedure. If the DM does not receive one of these messages (7) within 600 ms, it shall terminate the alignment procedure, release the reserved "selected IDCC" slot, and can then accept other requests and allow new requests.

The requesting node shall wait for a positive response from its DM via an NDIM_IDCCReserve.cnf message before continuing further in the procedure. If a node receives a negative response from its DM via an NDIM_IDCCReserve.cnf message, or if no response is received in RESERVE_TIMEOUT ms, the node shall terminate the alignment procedure.

Upon reception of the positive NDIM_IDCCReserve.cnf message, the local node N_L that detected the presence of a neighbouring domain's node with the synchronization point corresponding to the selected IDSW shall indicate its presence to potential interfering nodes by broadcasting an ID_PresenceRequest (3) in the "selected IDCC". ID_PresenceRequest is a MAP-D frame containing the NDIM information sub-field with ID_PRESENCE set to zero.

NOTE 2 – The NDIM information sub-field contains all of the information necessary for MAC cycle alignment assessment (e.g., ClusterID, Domain ID, DeviceID of the local node, REGID of the domain's DM, NDID of the domain, CYCSTART).

After sending the ID_PresenceRequest, the local node N_L shall wait to receive an ID_PresenceConfirm (6) in the "selected IDCC". ID_PresenceConfirm is a MAP-D frame containing the NDIM information sub-field with ID_PRESENCE set to a non-zero value according to Table 8-85.4. If the node does not receive an answer from any neighbouring domain's node during NDIM_IDPS_DETECT_CYCLES MAC cycles, it shall not continue with the process and shall send its DM an NDIM_IDCC_Release.req message (7) with a failure code 01₂.

A node receiving an ID_PresenceRequest in the IDCC corresponding to its cluster shall send an NDIM_RemotePresence.req (4) message to its domain master including the information that the node received in the ID_PresenceRequest.

If the node receives a negative reply (i.e., NDIM_RemotePresence.cnf with StatusCode 02₁₆) from its domain master, it shall terminate the procedure. If the node does not receive any reply (NDIM_RemotePresence.cnf) from its domain master within 200 ms, it shall retransmit the NDIM_RemotePresence.req (4) message.

A domain master receiving an NDIM_RemotePresence.req message from one of the nodes in its domain and accepting to use that node as a proxy, shall respond with an NDIM_RemotePresence.cnf (5) message indicating that the reporting node is allowed to report its

presence to a neighbouring domain that requested to do so through an ID_PresenceConfirm. If the decision is positive, the DM shall reject any new NDIM_IDCCReserve.req or NDIM_RemotePresence.req messages that contain a lower ClusterID than the ClusterID associated with the current alignment procedure until this alignment procedure has finished. If the received NDIM_RemotePresence.req message contains a higher ClusterID than its own ClusterID, the DM shall align its MAC cycle with the neighbour cluster that has the higher ClusterID.

NOTE 3 – The domain master should include the proxy in the list of nodes that are authorized to transmit a MAP-D in the IDCC as soon as possible.

A node receiving an authorization from its DM via an NDIM_RemotePresence.cnf message shall respond to the previously received ID_PresenceRequest with a unicast ID_PresenceConfirm (6) containing the information necessary for MAC cycle alignment (receiving node's ClusterID, DomainID, DeviceID, REGID of the domain master, NDID of the domain) in the IDCC of its own domain to inform the node that launched the alignment procedure of its presence. If the node does not succeed to transmit the ID_PresenceConfirm and meanwhile receives a new MAP from its DM with the new ClusterID, it shall stop trying to transmit the ID_PresenceConfirm.

Upon reception of the first ID_PresenceConfirm through the selected IDCC, the local node that launched the alignment procedure shall extract the necessary information to assess MAC cycle alignment. Any additional ID_PresenceConfirm received from other domains through the IDCC may be stored and used for further detections.

The local node shall use the information from the selected ID_PresenceConfirm and apply the following rules in order to assess if a local alignment (Local Alignment Procedure) or remote alignment (Remote Alignment Procedure) of the MAC cycle is needed:

- If the ClusterID of the local node is lower than the ClusterID of the neighbouring node, the local node shall launch a local alignment procedure as described in Figure 8-57.5, sending an NDIM_ReportAlignment.req message (7) to its DM proposing an alignment with the remote cluster.
- If the ClusterID of the local node is higher than the ClusterID of the remote node, the local node shall release the reserved TXOP of the "selected IDCC" by sending the NDIM_IDCC_Release.req message (7). The DM shall confirm receiving the message by sending a NDIM_IDCC_Release.cnf (8) message"".

The alignment of the MAC cycle shall be based on the CYCSTART field of the ID_PresenceRequest or ID_PresenceConfirm received from the neighbouring domain or the NDID_CYCSTART field of the NDIM_ReportAlignment.req message transmitted by the proxy node.

To generate the NDID_CYCSTART field, NTR and CYCSTART fields received from neighbouring domains shall be converted so as to be in terms of its own domain master's clock.

NOTE 4 – For instance, the domain x's MAC cycle start can be interpreted by the domain y as $RX_Time(y) + CYCSTART(x) - NTR(x)$, taking into account wraparound, where $RX_Time(y)$ is the time according to the domain master y's transmit clock (see clause 7.1.2.3.2.1.2 of [ITU-T G.9960]) of the first received sample of the first OFDM symbol of the preamble of an ID_PresenceRequest or ID_PresenceConfirm transmitted by a node in domain x.

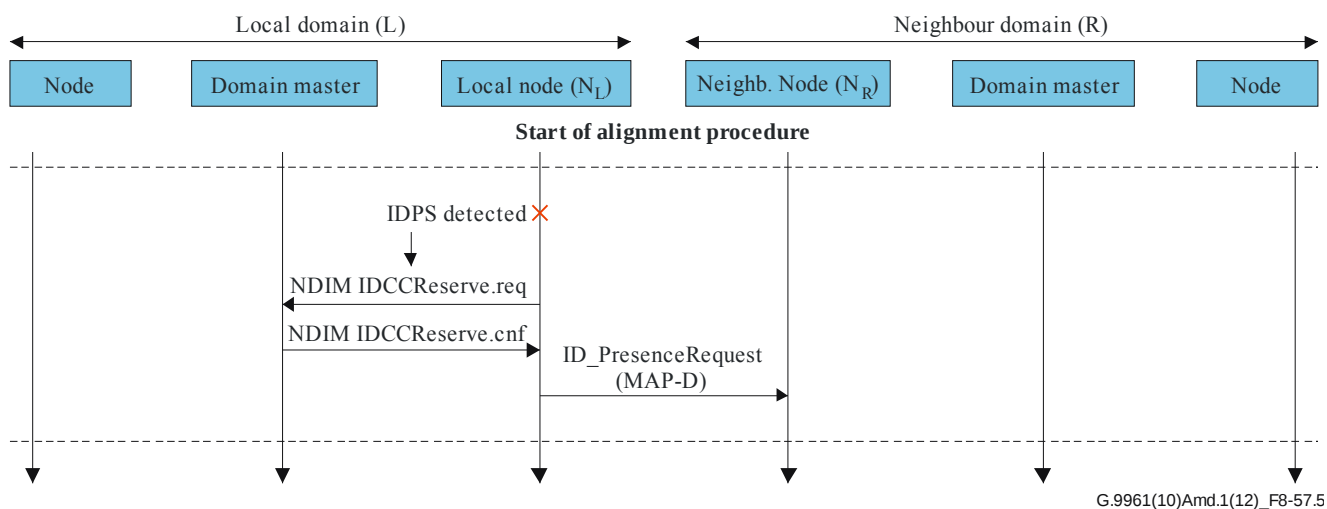


Figure 8-57.5 – Protocol diagram for start of MAC cycle alignment

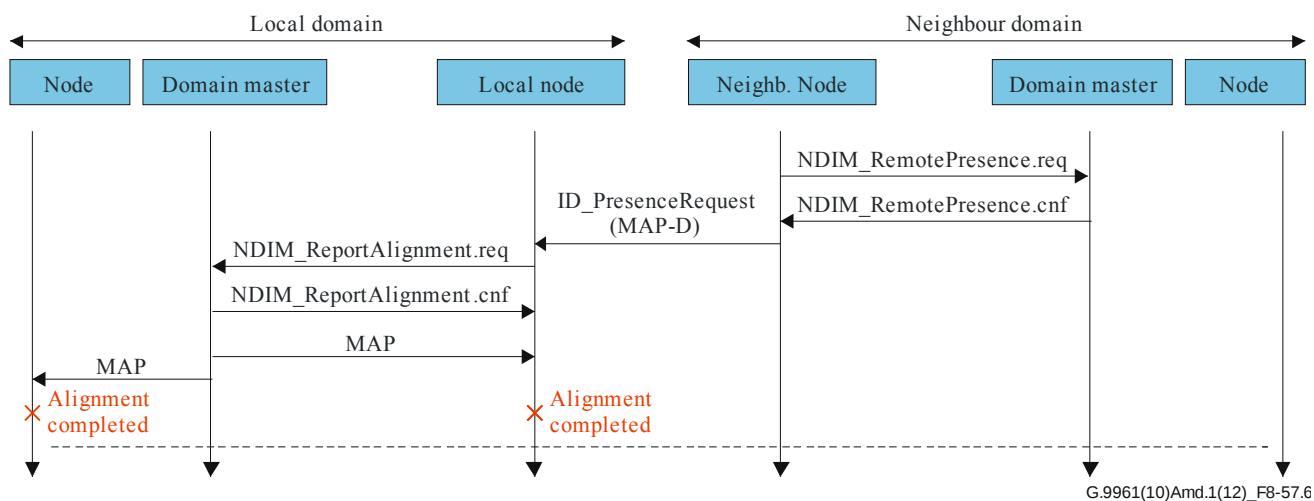


Figure 8-57.6 – Protocol diagram for local MAC cycle alignment

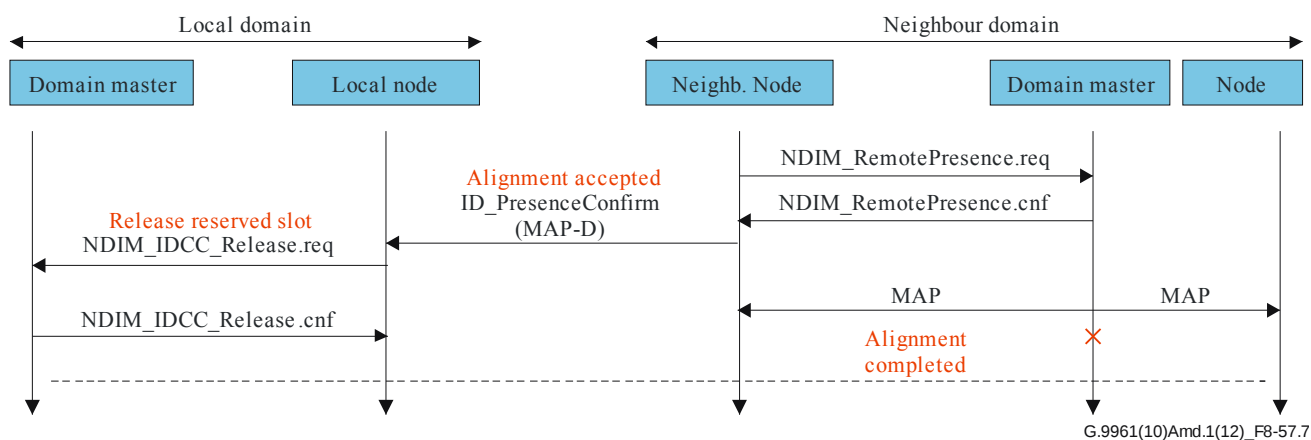


Figure 8-57.7 – Protocol diagram for remote MAC cycle alignment

8.14.4.2 Foreshortened MAC cycle alignment procedure

A node may use the messages collected during normal operation (e.g., MAPs from neighbouring domains, messages from on-going alignment procedures, MAP-D transmitted in IDCC, etc.) to align with neighbouring domains.

A node that decodes a message from a neighbouring domain that contains the ClusterID may use that for MAC cycle alignment. If the ClusterID of the local node is lower than the ClusterID of the neighbouring node, the local node shall send an NDIM_ReportAlignment.req (7) management message to its DM proposing an alignment with the remote cluster.

A node that determines that a remote alignment is necessary (i.e., if its ClusterID is higher than that of the remote node) may start a full MAC alignment procedure.

All MAP-D transmissions including ID_PresenceRequest and ID_PresenceConfirm shall contain NDIM information sub-field in addition to all parameters required for registration as defined in clause 8.8.1.

8.14.4.3 MAC cycle alignment procedure in presence of coexisting access system

The same MAC cycle alignment procedures specified in clause 8.14.4.2 or 8.14.4.3 shall be used in the presence of coexisting systems as specified in [ITU-T G.9972].

If a coexisting access system as specified in [ITU-T G.9972] is detected, the domain master shall set the MSB of its ClusterID to one to indicate the alignment of MAC cycle with a coexisting access system.

8.14.4.4 Post-alignment procedure

After MAC cycle alignment has completed, the domain master shall update NDIM information sub-field defined in Table 8-85.4.

Upon reception of an NDIM_ReportAlignment.req message with the necessary information for the alignment, the DM of the domain the node belongs to shall align its MAC cycle by adopting the received ClusterID and changing its MAP to match the start of the MAC cycle with the one associated with the new CSP. The only exception to this is for the case that the local DM is coexisting with an access system with different alignment, in which case it may decide not to align with the neighbouring cluster. The DM shall reply to the NDIM_ReportAlignment.req message with NDIM_ReportAlignment.cnf message.

A DM that received an NDIM_ReportAlignment.req message from a node of its domain shall select the node that sent the message as the proxy for inter-domain communication (e.g., coordination related messages) with the neighbouring domain reported. The selected proxy may be changed at any time based on updated interference information as described in clause 8.14.6.2.

In the case of a remote alignment procedure, the local DM that receives the NDIM_IDCC_Release.req message from its proxy node or directly receives the ID_PresenceConfirm concludes that the Remote Alignment Procedure is complete.

In the case of a local alignment procedure, the local DM that sends the NDIM_ReportAlignment.cnf message to its proxy node concludes that the local alignment procedure is complete.

A DM that aligns its MAC cycle with a neighbouring domain shall inform the rest of the DMs of the cluster that it has direct link with and that they should align their MAC cycle to the newly specified cluster. This is done by sending an IDM_ClusterAlignment.req message (via its former IDCC) containing the DOD of the domain requesting the alignment, the ClusterID of the new cluster to join, offset of the new CSP relative to the current CSP, and the list of the domains that this message is going to be sent to (i.e., the list of domains in the former cluster to which the domain has a direct link).

If a DM receives an `IDM_ClusterAlignment.req` message from another DM in its cluster while not running an alignment procedure, it shall align its MAC cycle as indicated in the `IDM_ClusterAlignment.req` message and shall forward the message to the other domains in its former cluster that its domain has direct links with. In order to prevent flooding of the message, the message shall be forwarded only to those domains that are not specified in the NDID list that was included in the received `IDM_ClusterAlignment.req` message.

Before forwarding the message, the DM shall update the list of domains included in the NDIDs list in the message by adding the ones that it will send the message to.

If a DM receives an `IDM_ClusterAlignment.req` message from another DM in its cluster while running an alignment procedure, it may abort this procedure in order to align its MAC cycle as indicated in the `IDM_ClusterAlignment.req` message.

A DM that receives an `IDM_ClusterAlignment.req` message shall confirm it by sending an `IDM_ClusterAlignment.cnf` message.

8.14.5 Routine maintenance procedure for a node to follow after MAC cycle alignment

Each node belonging to a cluster shall follow a routine maintenance procedure to keep track of the status of the neighbouring nodes that interfere with it. For this, the DM shall publish in the NDIM information sub field of the MAP the `DEVICE_ID` of the nodes that shall contend to signal their presence in the IDCC in the following MAC cycles until they receive an updated NDIM information sub field. DM shall designate the nodes of the group ensuring that they have direct visibility between them. This guarantees that only one of the nodes will win the contention and transmit a MAP-D.

If a node is designated by the DM to signal its presence in the IDCC, it shall contend for the channel. Upon successful contention, the node shall broadcast a MAP-D containing the neighbouring domains auxiliary field.

NOTE 1 – Nodes may use MAP-D messages sent in IDCC for interference level measurement.

Nodes shall continuously monitor the IDCC channel defined for their cluster for MAP-D or other messages. This procedure allows finding any new nodes in the cluster that may interfere with the monitoring node or to keep track of the neighbouring nodes that disappeared from the medium.

NOTE 2 – This procedure also enables detection of interfering nodes from a domain that is not in the cluster but whose MAC cycle is aligned initially (i.e., the same CSP was selected by both domains).

If the node detects a MAP-D belonging to a neighbouring node that is not in its list of interfering nodes, it shall update the list and notify it to its DM via `NDIM_InterferenceReport.ind`.

If a node does not detect a MAP-D from a neighbouring node for `NDIM_IDLE_NODE` MAC cycles, it shall delete it from its list of detected neighbouring nodes and notify its DM via the `NDIM_InterferenceReport.ind`.

8.14.6 Communication between neighbouring domains

An IDM can be transmitted directly between nodes from different domains through the IDCC or between DMs of different domains.

8.14.6.1 Node to node communication through IDCC

Node to node communication between nodes of different domains through the IDCC can be of two types: unicast node to node communication and broadcast node to multi-node communication. In either of these two cases, the `OriginatingNode` of the inter-domain LLC frames is set to 251 (see clause 8.1.3.1.16).

A node that transmits an MSG PHY frame that contains an IDM to a neighbouring domain's node shall follow these rules:

- It shall transmit the frame in an IDCC.
- It shall transmit the frame using the same transmission parameters as a PHY frame containing a MAP-D as described in clause 8.6.4.
- It shall use an SID 251
- It shall include in the frame a complete IDM message.
- It shall use the MSG PHY frame type with the CNN_MNGMT field set to 1111 (payload does not belong to any connection).

NOTE – This ensures that in case all LPDUs of a PHY frame containing an IDM are received with no error the LCDUs can be extracted completely from the carrying PHY frame.

8.14.6.1.1 Transmitting a unicast IDM to a neighbouring domain

For a unicast IDM, the destination MAC address of the LCDU shall be set to the MAC address of the neighbouring domain's node, while the source MAC address shall be set to the MAC address of the local node that generates the LCDU frame.

The REGID of the neighbouring domain master and NDID of the neighbouring domain shall be retrieved from the received ID_PresenceRequest if the neighbouring node was identified through a MAC cycle alignment procedure as described in clause 8.14.4.2 or from the MAP LCDU of the neighbouring domain's node obtained through the routine maintenance procedure as described in clause 8.14.5.

The DOD in the PHY frame header of a frame that contains a unicast IDM shall be set to the designated neighbouring domain's DOD and the DID shall be set to the DEVICE_ID of the neighbouring domain's node that is intended to receive the message. The DestinationNode of the corresponding LLC frame shall be set to the same value as the DID, and the BRCTI and MCSTI shall be both set to 0.

8.14.6.1.2 Transmitting a broadcast IDM to a neighbouring domain

The purpose of using broadcast transmission of IDMs is to indicate the presence of a node over the medium, maximizing the probability of detection by a neighbouring domain's node. The destination MAC address specified in the LCDU of a broadcast IDM shall be set to the reserved MAC address 01-19-A7-52-76-96, whilst the source MAC address shall be set to the MAC address of the local node that generates the LCDU frame.

The DOD included in the PFH of the PHY frame containing the IDM shall be set to zero and the DID shall be set to the BROADCAST_ID. For the corresponding LLC frame, the DestinationNode, BRCTI and MCSTI shall be all set to 0.

8.14.6.2 Transmitting IDMs from domain master to neighbouring domain master

A DM shall select a proxy to communicate with a given neighbouring domain's DM. The selection of the proxy shall be done during the MAC cycle alignment phase and may be updated after the MAC cycle alignment phase with any interference information the DM gathers from nodes of its domain in order to make use of the best link to reach the neighbouring domain.

A DM that needs to send an LCDU to a neighbouring domain using an IDM shall embed the LCDU in an NDIM_Transmit.ind message EMBEDDED_MESSAGE field and send it to the chosen proxy in the local domain. The local domain proxy shall extract the IDM from the received LCDU and send it through the IDCC to the chosen neighbouring domain using the unicast node to node communication described in clause 8.14.6.1.

A node that receives an inter-domain management message with SID 251 shall forward it to its DM by extracting the payload of the received LCDU (MMH and MMPL) and embedding it in the EMBEDDED_MESSAGE field of an NDIM_Receive.ind message.

The LCDUs that can be exchanged between DMs using this procedure shall be the ones specified in clause 8.14.10 (Inter-domain protocol messages).

Whenever the DM of a domain changes, it shall immediately communicate the REGID of the new DM to all its neighbouring DMs using the unicast IDM_DmChange.ind message (see clause 8.14.10.17).

Whenever the DNI of a domain changes, it shall immediately communicate the new DNI to all its neighbouring DMs using the unicast IDM_DniChange.ind message (see clause 8.14.10.18).

8.14.7 Coordination of transmissions among nodes from neighbouring domains within a cluster

8.14.7.1 General Principles of neighbouring domain coordination

The neighbouring domain coordination mechanism is based on the following general principles:

- Input to the coordination algorithm consists of information on:
 - Nodes causing interference to nodes in neighbouring domains, and
 - Nodes suffering from interference coming from nodes in neighbouring domains.
- For the purpose of coordination, only nodes causing and suffering high interference, based on vendor discretionary criteria, are considered. Nodes with low interference can simply use different seeds for signals like preamble, INUSE and NACK, for interference mitigation, as described in clause 8.6.10.
- For the nodes in the domain that are not interfering, the domain master may allocate transmit opportunities anytime during the MAC cycle.
- All nodes in the domain are allowed to transmit anytime during the assigned (1/16th) of the MAC cycle within the TXOP assigned by the DM, subject to the scheduling constraints described in clause 8.14.7.2.3. This assigned time position in the MAC cycle depends on DOD of the domain.
- Permission for transmission for a node during the rest of the MAC cycle (i.e., (14/16th) of the MAC cycle, since the last (1/16th) of the MAC cycle is available for all of the domains), depends on the number of domains that this node needs to coordinate with and is based on the procedure defined in clause 8.14.7.2 that all domains follow.
- The permissions for transmission for a node that are based on the interference information may be changed by exchange of time resources between coordinating domains.
- Additional constraints to those discussed above may be applicable in some situations to deal with the time allocation corresponding to [ITU-T G.9972].
- Intra-domain receptions for nodes that suffer interference from neighbouring domains can be protected if the transmitting nodes of the domain are aware of the constraints applicable to the receiving nodes of the domain and transmit only during the time duration in which the receiving nodes are protected. This may be enforced by the domain master by using appropriate scheduling policy or by communicating each node's time allocation information to all other nodes in the domain.

8.14.7.2 Neighbouring domain coordination procedure

Once MAC cycles of neighbouring domains are aligned and clusters are formed following the procedure described in clause 8.14.4 or after the routine maintenance procedure described in clause 8.14.5, the procedure for coordination as described below is executed by those domains. The various steps in this procedure are as follows:

- Default MAC cycle time allocation based on DOD.
- Exchange of interference information between neighbouring domains.

- Default MAC cycle time allocation based on interference information.
- Exchange of time slots between neighbouring domains

8.14.7.2.1 Default MAC cycle time allocation based on DOD

The MAC cycle is divided into 16 equal parts. Each of these parts is allocated to the domains with the corresponding DOD. The first part is allocated to domains with DOD 1, second part is allocated to domains with DOD 2 and so on up to the fifteenth part, which is allocated to domains with DOD 15. The sixteenth part is allocated to DOD 0 and it contains the IDSW and IDCC as described in clause 8.14.3. At the end of the coordination process, any node in a coordinated domain can transmit or receive during the time of the MAC cycle allocated to that domain without fear of causing interference to, or suffering interference from nodes of coordinated neighbouring domains. This is called the default time allocation based on DOD. Since DOD 0 is reserved, part of that allocation is used for IDPS and IDCC. The rest of the allocation corresponding to DOD 0 is available for all the domains to share.

8.14.7.2.2 Exchange of interference information between neighbouring domains

The interference information is exchanged between neighbouring domains as follows:

- The domain master shall form lists of nodes that suffer high interference from at least one other node in a neighbouring domain (i.e., list of nodes that requires coordination). The criteria for determining the level of interference requiring coordination is vendor discretionary. It is the node's decision to determine the level of interference (either one of: no interference, possible interference or high interference) and report this to the DM to decide on further action. The node may compare relative power differences between transmissions from nodes in neighbouring domains and transmissions from nodes in its own domain. Each list consists of a node within the domain and all the node(s) in a neighbouring domain that cause high interference to this node. For example, node L_i in local domain (L) can form a list of nodes ($N_1, N_2, N_3, \dots, N_j$) in neighbouring domain (N) that cause high interference.
- This process is repeated for all nodes suffering high interference from nodes in neighbouring domains.
- The lists are then communicated to the neighbouring domains, by unicast transmission where the interfering nodes belong, via an `IDM_InterfNodesInfo.ind` message. For example, the list above is communicated by domain L to domain N. To reduce the size of this message, the nodes that are suffering interference from the same set of interfering nodes in the same set of neighbouring domains shall use a single interference table (see Table 8-105.24). The destination DM for the `IDM_InterfNodesInfo.ind` message shall send a confirmation `IDM_InterfNodesInfo.rsp` message upon receiving the `IDM_InterfNodesInfo.ind` message.
- The same process is executed by all the domains in the cluster.
- Once all the lists are communicated to respective neighbouring domains, each domain master has complete information on its nodes that cause interference to nodes in neighbouring domains (using received `IDM_InterfNodesInfo.ind` messages) and also its nodes that suffer interference from nodes in neighbouring domains (information used to generate the transmitted `IDM_InterfNodesInfo.ind` message).
- Using this information, for each node, the local domain master comes up with the list of DoDs of neighbouring domains that contain at least one node that causes interference or suffers interference or both.
- At the end of the previous step, for each node that needs coordination, the local DM has a list of DoDs that it needs to coordinate with.

- The list of domains that each node needs to coordinate with, are communicated to each one of the domains on that list via an `IDM_CoordDomainsInfo.ind` message. To reduce the size of this message, the nodes that are coordinating with the same set of domains shall use a single coordination table (see Table 8-105.29). The destination DM for the `IDM_CoordDomainsInfo.ind` message shall send a confirmation `IDM_CoordDomainsInfo.rsp` message upon receiving the `IDM_CoordDomainsInfo.ind` message.

NOTE – The `IDM_CoordDomainsInfo.ind` message does not contain list(s) of interfering nodes since that information is already communicated in the `IDM_InterfNodesInfo.ind` messages.

- At the end of the previous step, each node causing or suffering interference has complete knowledge of the allocation table for each one of its interfering nodes, in addition to its own allocation table. The domain master has this information for each node that requires coordination. The domain master can then make scheduling decisions for each node, based on this information.

8.14.7.2.3 Default MAC cycle time allocation based on interference information

After the interference information is exchanged between domains, the rest of the (14/16th) of the MAC cycle that has not been allocated as per clause 8.14.7.2.1, is allocated using the interference information as per the rules described in this clause.

The basic principle of allocating a MAC cycle is to first assign the slot corresponding to the DOD of the local domain and then allocate slots corresponding to the DODs of the neighbouring domains that the node is coordinating with. The remaining unallocated slots are then divided into equal number of slots (with a 1 slot resolution) and allocated to each of the coordinating domains in sequential order. The allocation is done separately for each node that requires coordination with nodes in neighbouring domains.

The various steps in the allocation of time for each node that needs to coordinate with one or more neighbouring domains are as follows:

- First, the allocation table for a given node is generated depending on the number of domains that it needs to coordinate with. At this point each one of the coordinating domain masters has its own default slot allocated, including the local domain master of that node.
- The total number of unallocated slots is $(15-D)$, where D is the number of coordinating domains with unique DODs that are interfering with or being interfered by this node, including the local and remote domains. Remote coordinating domains that have the same DOD can be considered as a single coordinating domain, for the purpose of allocation, without loss of generality. The unallocated slots are equally divided between each of the coordinating domains and assigned sequentially in time in the order of the DODs of the coordinating domains. At this point each of the domains, gets $\text{floor}((15-D)/D)$ additional time slots allocated to its node. The remaining $(15-D) \text{ MODULO } D$, slots are marked as "unallocated".
- The above two steps are repeated for each one of the coordinating nodes in neighbouring domains, i.e., for each node in neighbouring domains that a given node is coordinating with. The allocation table for each one of the coordinating nodes in neighbouring domains is then compared with node's own allocation table and the slots with conflict are also marked as "unallocated".
- The allocated slots can be used by the node as assigned by the domain master in the MAP. The domain master shall consider the allocation table of each individual node, while making its scheduling decisions. The scheduling by the domain master shall ensure that any transmissions by a node associated with the allocated slots shall end at least $T_{\text{IFG_MIN}}$ before the end of the allocated slot if the next slot is not allocated to the node in the allocation table. The mandatory IFG at the end of frames transmitted inside a TXOP can be used to meet this requirement.

NOTE – This ensures that even if there is a skew of up to T_{IFG_MIN} in the MAC cycle alignment between coordinating domains, there is no interference between the coordinating nodes in those domains associated with the same allocation table.

- The usage of unallocated slots is explained in the next clause.

8.14.7.2.4 Static Exchange of time slots between neighbouring domains

The unallocated slots can be shared between nodes of the coordinating domains or can be used by one of the coordinating domains by negotiation using inter-domain messaging between those domains. The exchange of time slots in a given allocation period shall apply to the next allocation period.

The sharing, swapping and allocation requests (i.e., `IDM_ShareUnallocSlot.req`, `IDM_SwapAllocSlot.req` and `IDM_RequestUnallocSlot.req` messages respectively) are associated with a specific coordination table indicated in the corresponding message using the same ordinal number as the one used in the `CoordDomainsInfo.ind` for that coordination table (see Table 8-105.29). For example, for sharing request associated with the second coordination table, the `COORD_TABLE_ID` field is set to 2, indicating that the request is associated with the second coordination table from the `CoordDomainsInfo.ind`. The new transaction ID associated with this coordination table and the transmitting DM shall be generated for each request starting from a value of zero and incrementing for every new request. The status of eight previous consecutive associated transactions (with reference to current transaction) is indicated in each request message. If the status of a previous transaction is not available (for example, at the first transaction), the transaction status shall be set to "no status available" (see Tables 8-105.28, 8-105.31 and 8-105.34).

A domain master may propose sharing of one or more unallocated slots by sending the `IDM_ShareUnallocSlot.req` message to the coordinating domain masters. Sharing means nodes with high interference from neighbouring domains respect each other's signals and use default seeds for signal transmissions during this time. All coordinating domain masters may allocate CBTXOPs with default preamble to enable this kind of sharing. The slots are considered as shared after receiving an `IDM_ShareUnallocSlot.cnf` message with `StatusCode 0016` from all coordinating domain masters. If the confirmation is expected from multiple domain masters, the node that has sent the `IDM_ShareUnallocSlot.req` message shall indicate to the coordinating domain masters that sharing has been successful or failed by sending an `IDM_ShareUnallocSlot.ind` message. All coordinating domain masters associated with the shared slot shall allocate a CBTXOP containing CBTS with same attributes, whenever the nodes associated with the shared slot are allowed to transmit in that CBTXOP. The default CW parameters specified in Table 8-7 shall be used for those CBTXOPs. Also INUSE, PR, and RTS/CTS shall not be used within these CBTXOPs.

Any coordinating domain master that receives the `IDM_ShareUnallocSlot.req` message can indicate in the `IDM_ShareUnallocSlot.cnf` message that it wishes the requesting domain master to refrain from sending it additional `IDM_ShareUnallocSlot.req` messages for `RefrainMultiple` allocation periods.

A domain master may request allocation of one or more unallocated slots by sending the `IDM_RequestUnallocSlot.req` message to coordinating domain masters. The message shall contain an indication of the priority of the request, which is based on DM's vendor discretionary criteria. The slots are considered allocated after receiving an `IDM_RequestUnallocSlot.cnf` message with `StatusCode 0016` from all coordinating domain masters. If the confirmation is expected from multiple domain masters, the node sending the `IDM_RequestUnallocSlot.req` message shall indicate to the coordinating domain masters that the request has been successful or failed by sending an `IDM_RequestUnallocSlot.ind` message.

Any coordinating domain master that receives the `IDM_RequestUnallocSlot.req` message can indicate in the `IDM_RequestUnallocSlot.cnf` message that it wishes the requesting domain master to

refrain from sending it additional IDM_RequestUnallocSlot.req messages for RefrainMultiple allocation periods.

A domain master may request swapping of allocated slots by sending an IDM_SwapAllocSlot.req message to coordinating domain masters. The slots are considered swapped after receiving an IDM_SwapAllocSlot.cnf message with StatusCode 00₁₆ from all coordinating domain masters. If the confirmation is expected from multiple domain masters, the node sending the IDM_SwapAllocSlot.req message shall indicate to the coordinating domain masters that the request has been successful or failed by sending an IDM_SwapAllocSlot.ind message. The swapping of allocated slots may only be done for the slots allocated based on interference information as described in clause 8.14.7.2.3 and not for the slots allocated based on DOD as described in clause 8.14.7.2.1.

Any coordinating domain master that receives the IDM_SwapAllocSlot.req message can indicate in the IDM_SwapAllocSlot.cnf message that it wishes the requesting domain master to refrain from sending it additional IDM_SwapAllocSlot.req messages for a RefrainMultiple allocation periods.

8.14.7.3 Impact of ITU-T G.9972 on neighbouring domain coordination

A node supporting [ITU-T G.9972] follows the allocation table from that Recommendation, which is dependent on its NetworkStatus. Supporting [ITU-T G.9972] may in general result in additional constraints in allocation of time slots to nodes for neighbouring domain coordination as described in this Recommendation. To mitigate the impact of supporting [ITU-T G.9972], a domain master should first try to change its DOD so that the default allocation of the MAC cycle as per clause 8.14.7.2.1 overlaps with the time allocation based on [ITU-T G.9972] for most of its nodes. Furthermore, using the procedure described in clause 8.14.7.2.4, domain masters of coordinating domains can further exchange time slots, taking into account the NetworkStatus of the interfering nodes, to mitigate the impact of supporting [ITU-T G.9972]. Even after executing the above steps, if the domain master ends up with no allowed time allocation for a node, it may allow uncoordinated transmissions from this node within the time allocated as per [ITU-T G.9972] NetworkStatus.

8.14.7.4 Examples of allocation

In these examples the DODs of domains A, B, C, D, and E are assumed to be 1, 2, 3, 4, and 5 respectively, without loss of generality. The nodes shown inside a circle are the nodes that belong to the domain. For example, in Figure 8-57.8 nodes b1, b2 and b3 belong to domain B with DOD 2.

The slots marked with 'X' in orange correspond to unallocated time slots. For example, slot No. 15 in Figure 8-57.9 is unallocated.

8.14.7.4.1 Example of simple neighbouring domain coordination between five domains

Consider five coordinating domains as shown in Figure 8-57.8.

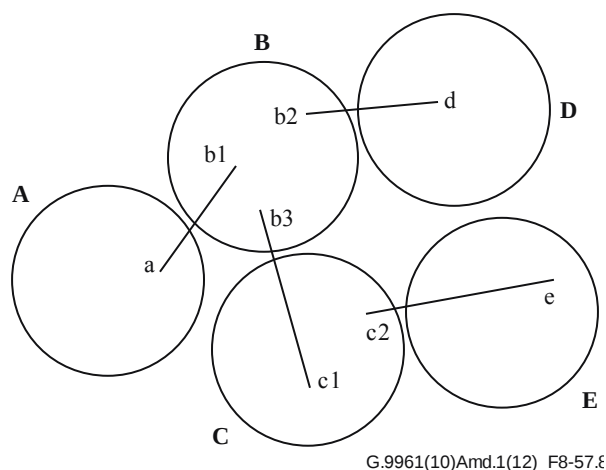


Figure 8-57.8 – Illustration of simple neighbouring domain coordination

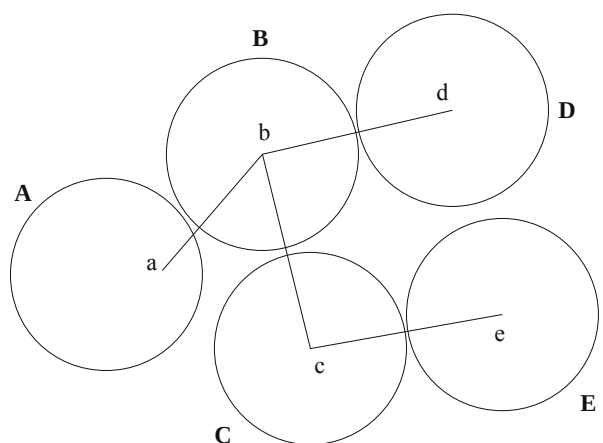
This is a simple example of coordination because each coordinating node requires coordination with a node from just one other domain. The allocation of MAC cycle time slots based on the procedure explained in clause 8.14.7.2 is shown in Figure 8-57.9. The time slots allocated based on clause 8.14.7.2.1 are marked in yellow and those allocated based on clause 8.14.7.2.3 are marked in green.

	Slots		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Nodes		–																
a, b1		–	a	b1	a	a	a	a	a	a	b1	b1	b1	b1	b1	b1	X	IDCC
		–																
b2, d		–	b2	b2	b2	d	b2	b2	b2	b2	d	d	d	d	d	d	X	IDCC
		–																
b3, c1		–	b3	b3	c1	b3	b3	b3	b3	b3	c1	c1	c1	c1	c1	c1	X	IDCC
		–																
c2, e		–	c2	c2	c2	c2	e	c2	c2	c2	e	e	e	e	e	e	X	IDCC

Figure 8-57.9 – Allocation of MAC cycle time slots for example of simple neighbouring domain coordination

8.14.7.4.2 Example of neighbouring domain coordination between five domains with conflicts

Consider five coordinating domains as shown in Figure 8-57.10.



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Figure 8-57.10 – Illustration of neighbouring domain coordination

This is an example of coordination where some coordinating nodes require coordination with nodes from more than one other domain. The allocation of MAC cycle time-slots based on the procedure explained in clause 8.14.7.2 is shown in Figure 8-57.11.

	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Node		—																
a		—	a	b	a	a	a	a	a	a	b	b	b	b	b	b	X	IDCC
b		—	a	b	c	d	a	a	b	b	c	c	d	d	X	X	X	IDCC
c		—	b	b	c	b	e	b	b	c	c	c	c	e	e	e	e	IDCC
d		—	b	b	b	d	b	b	b	b	d	d	d	d	d	d	X	IDCC
e		—	c	c	c	c	e	c	c	c	e	e	e	e	e	e	X	IDCC

	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Node		—																
a		—	a	b	a	a	a	a	X	X	b	b	b	b	b	b	X	IDCC
b		—	a	b	c	d	a	a	X	X	c	c	d	d	X	X	X	IDCC
c		—	b	b	c	b	e	b	b	X	X	X	X	e	e	e	e	IDCC
d		—	b	b	b	d	b	b	b	b	d	d	d	d	d	d	X	IDCC
e		—	c	c	c	c	e	c	c	c	X	X	X	e	e	e	X	IDCC

Figure 8-57.11 –Default allocation table with conflicts

The time slots allocated based on clause 8.14.7.2.1 are marked in yellow and those allocated based on clause 8.14.7.2.3 are marked in green. The slots with conflict are marked with red (see first allocation table in Figure 8-57.11). Some of the time slots are "unallocated" and can be used as per the procedure described in clause 8.14.7.2.4 (see slots marked with X in both tables in Figure 8-57.11). In the final allocation table, the slots with conflict are also considered as "unallocated" (see the second allocation table in Figure 8-57.11).

8.14.7.5 Synchronization of neighbouring domain coordination

The procedure described for neighbouring domain coordination needs to be synchronized so that the time allocations between neighbouring domains are based on the same set of information. Each domain master in a cluster maintains a synchronizing counter of MAC cycles that matches other domain masters in the cluster.

Whenever a new neighbouring domain in the cluster is detected, the domain master shall compare its NDIM_SYNCHRO_REF_NDID to that of the new domain. If it is lower, the domain master shall synchronize its synchronizing counter with that of the newly detected domain's synchronizing counter and set its NDIM_SYNCHRO_REF_NDID to that of the new domain. This procedure ensures that all the domains within a cluster have their synchronizing counter synchronized with that of the domain with the largest NDID.

The MAC cycle time allocation based on the interference information (see clause 8.14.7.2.3) and coordination messages exchanged during an allocation period shall be applied by all coordinating domains within a cluster, in the next allocation period. Additionally, a domain master may update its decision on participating in the coordination procedure every allocation period. It shall indicate its preferred coordination technique for the next period by sending the IDM_CoordPref.ind message to its neighbouring domain masters. If the coordination method indicated is "DM does not coordinate", the IDM_CoordPref.ind messages shall be the only IDM messages related to coordination sent in the allocation period.

During the routine maintenance procedure described in clause 8.14.5, new nodes or domains may be detected requiring re-alignment of the MAC cycle followed by neighbouring domain coordination.

Whenever a new domain joins a cluster:

- It shall first check the NDIM_SYNCHRO_REF_NDID field of its neighbouring domains in the cluster and determine the maximum NDIM_SYNCHRO_REF_NDID among those domains.
- It shall acquire (i.e., match) the synchronizing counter from this domain (see field NDIM_SYNCHRO_COUNTER in Table 8-85.4) whose NDIM_SYNCHRO_REF_NDID is the maximum.
- It shall then set its NDIM_SYNCHRO_REF_NDID to the maximum of its NDID and the maximum NDIM_SYNCHRO_REF_NDID among its neighbouring domains.

For neighbouring domain coordination, the exchange of interference information between neighbouring domains (see clause 8.14.7.2.2) shall be done within ALLOCATION_PERIOD MAC cycles after the previous coordination. The IDM_InterfNodesInfo.ind message transmissions shall be completed within the first (ALLOCATION_PERIOD/2 – ALLOCATION_MARGIN) MAC cycles and the IDM_CoordDomainsInfo.ind message transmissions shall be completed within the first (ALLOCATION_PERIOD/2 – ALLOCATION_MARGIN) MAC cycles of the second half of the allocation period. The ALLOCATION_MARGIN may be used for any retransmissions required due to lost messages, but shall not be used for transmitting new messages. Static exchange of time slots between neighbouring domains (see clause 8.14.7.2.4) may be initiated after the coordination tables for associated nodes are known by the coordinating domain masters.

The default MAC cycle time allocation based on the interference information (see clause 8.14.7.2.3) shall be applied by all coordinating domains within a cluster in the next allocation period. At the end of every allocation period, all DMs should check that the NDIM_SYNCHRO_REF_NDID of neighbouring domains is less than or equal to its own NDIM_SYNCHRO_REF_NDID. If it detects an NDIM_SYNCHRO_REF_NDID that is greater than its own, it shall acquire the synchronizing counter from the domain (see field NDIM_SYNCHRO_COUNTER in Table 8-85.4) whose NDIM_SYNCHRO_REF_NDID is the maximum among its neighbouring domains in the cluster and set its NDIM_SYNCHRO_REF_NDID to that of this domain.

8.14.8 NDIM parameters

The parameters needed in the neighbouring domains interference mitigation process are presented in Table 8-105.4.

Table 8-105.4 – Neighbouring domains coordination parameters

Notation	Parameter	Valid values or range
IDSW_OFFSET	Offset of IDSW window with respect to the cluster synchronization point	IDSW_WIDTH + IDCC_DURATION (Note)
IDSW_WIDTH	Width of the IDSW window	150 μ s
IDCC_DURATION	Duration of the IDCC channel	1 ms
NDIM_IDPS_DETECT_CYCLES	Number of MAC cycles during which a node has to look for IDPS signals during a MAC cycle alignment procedure	2
NDIM_PRESENCE_DETECT_CYCLES	Number of MAC cycles during which a node has to look for an ID_PresenceConfirm received in response to a transmitted ID_PresenceRequest in the IDCC	10
IDPS_PERIODICITY	Periodicity of transmission of IDPS by a node in units of MAC cycles	2
RESERVE_TIMEOUT	Timeout in ms for the reservation of resources for inter-domain communication	100
NDIM_IDLE_NODE	Number of MAC cycles without detecting a neighbouring node before inferring that the node has disappeared	100
ALLOCATION_PERIOD	Number of MAC cycles that an allocation table generated by coordinating domains in a cluster is valid. The allocation table generated in one allocation period applies to the next allocation period	100

Table 8-105.4 – Neighbouring domains coordination parameters

Notation	Parameter	Valid values or range
ALLOCATION_MARGIN	Number of MAC cycles towards the end of the allocation period where exchange of new information between coordinating domains is disallowed and only retransmissions are allowed	10
NOTE – IDSW and IDCC are placed before the CSP. In coexistence mode [ITU-T G.9972], the CSP shall be aligned with the [ITU-T G.9972] synchronization point so that IDSW and IDCC are located in the last TDMS to ensure that the IDCC is guaranteed an allocation.		

8.14.9 NDIM protocol messages

8.14.9.1 NDIM Start alignment procedure request

NDIM_StartAlignmentProcedure.ind is a management message that shall be sent by a DM to a node of its domain to instruct it to trigger a MAC cycle alignment procedure. The MMPL of this message is empty.

8.14.9.2 NDIM IDCC slot reserve request

NDIM_IDCCReserve.req is a management message that shall be sent by a node that intends to launch an NDIM MAC cycle alignment procedure to its DM in order to request a CFTXOP during the duration of the IDCC corresponding to a particular CSP.

The format of the MMPL of the NDIM_IDCCReserve.req message shall be as shown in Table 8-105.5.

Table 8-105.5 – Format of the MMPL of the NDIM_IDCCReserve.req message

Field	Octet	Bits	Description
OFFSET_DIR	0	[0]	This field contains the direction of the offset to be applied to the CSP to identify the required synchronization point to be protected. 0 if the CSP has to be delayed, 1 if the CSP has to be moved forward
OFFSET		[4:1]	Offset to be applied to CSP to obtain the synchronization point to be protected in increments of 60 degrees, where the value 0000 ₂ represents 0 degrees (see Figure 8-57.2). Valid values are from 0 to 11
Reserved		[7:5]	Reserved by ITU-T (Note)
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.9.3 NDIM IDCC slot reserve confirmation

NDIM_IDCCReserve.cnf is a management message that shall be sent by the DM in response to an NDIM_IDCCReserve.req message.

The format of the MMPL of the NDIM_IDCCReserve.cnf message shall be as shown in Table 8-105.6.

Table 8-105.6 – Format of the MMPL of the NDIM_IDCCReserve.cnf message

Field	Octet	Bits	Description
StatusCode	0	[7:0]	Status of the request to reserve a CCTXOP: • 00₁₆ = Success. • 01₁₆ = Failure – Lack of resources. • 02₁₆ = Alignment process already started with another node • 03₁₆ = Failure due to other reason. • 04₁₆ – FF₁₆ = Reserved.
AlignmentclusterID	1 to 6	[47:0]	If StatusCode is 02 ₁₆ this field contains the ClusterID corresponding to the alignment process the domain is already involved in and that caused the failure of the request. In all other cases, this field shall not be present

8.14.9.4 NDIM_ReportAlignment.req format

NDIM_ReportAlignment.req is a management message that shall be sent by a node to inform its DM on the necessity to align the MAC cycle with a neighbouring domain.

The format of the MMPL of the NDIM_ReportAlignment.req message shall be as shown in Table 8-105.7.

Table 8-105.7 – Format of the MMPL of the NDIM_ReportAlignment.req message

Field	Octet	Bits	Description
NEW_CLID	0 to 5	[47:0]	This field contains the new cluster ID that has to be applied to the cluster after completion of MAC cycle alignment indicated by this message
Type of Alignment	6	[0]	This field contains: 0 for a local alignment, or 1 for a remote alignment (see clause 8.14.4.1
OFFSET_DIR		[1]	This field contains: 0 if the CSP has to be delayed, or 1 if the CSP has to be moved forward
OFFSET		[5:2]	This field contains the offset in increments of 60 degrees, where the value 0000 ₂ represents 0 degrees (see Figure 8-57.2), to be applied to the CSP of the cluster to align the MAC cycle. Valid values are from 0 to 11
Reserved		[7:6]	Reserved by ITU-T (Note 1)

Table 8-105.7 – Format of the MMPL of the NDIM_ReportAlignment.req message

Field	Octet	Bits	Description
DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node has requested to align
NDID	14 to 16	[23:0]	The NDID of the domain to which the node has requested to align
NDID_CYCSTART	17 to 20	[31:0]	The start of the MAC cycle of the neighbouring domain indicated in the MAP-D received by a proxy node (Note 2)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver. NOTE 2 – It represents the CYCSTART field of the MAP-D received from neighbouring domain in terms of its own domain master's clock count.			

8.14.9.5 NDIM_ReportAlignment.cnf format

NDIM_ReportAlignment.cnf is a management message that shall be sent by a DM as a respond to a received NDIM_ReportAlignment.req message.

The format of the MMPL of the NDIM_ReportAlignment.cnf message shall be as shown in Table 8-105.8.

Table 8-105.8 – Format of the MMPL of the NDIM_ReportAlignment.cnf message

Field	Octet	Bits	Description
StatusCode	0	[7:0]	0 – MAC cycle alignment request is accepted 1 – MAC cycle alignment request is rejected 2-255: Reserved by ITU-T

8.14.9.6 NDIM Remote presence request

NDIM_RemotePresence.req is a management message that shall be sent by a node that received an ID_PresenceRequest in its cluster's IDCC to its DM in order to ask for permission to answer the request.

The format of the MMPL of the NDIM_RemotePresence.req message shall be as shown in Table 8-105.9.

Table 8-105.9 – Format of the MMPL of the NDIM_RemotePresence.req message

Field	Octet	Bits	Description
RemoteNode_DOD	0	[7:0]	The domain ID of the remote node
RemoteNode_CLID	1 to 6	[47:0]	The cluster ID of the remote node
RemoteNode	7	[7:0]	The DeviceID of the remote node
RemoteNode_NDID	8 to 10	[23:0]	The NDID of the remote node's domain

8.14.9.7 NDIM Remote presence confirmation

NDIM_RemotePresence.cnf is a management message that shall be sent by a DM in response to a node that sent an NDIM_RemotePresence.req message.

The format of the MMPL of the NDIM_RemotePresence.cnf message shall be as shown in Table 8-105.10.

Table 8-105.10 – Format of the MMPL of the NDIM_RemotePresence.cnf message

Field	Octet	Bits	Description
StatusCode	0	[7:0]	Status of the request: • 00₁₆ = Success. The node is allowed to answer the ID_PresenceRequest and the domain shall align with the neighbouring domain • 01₁₆ = Success. The node is allowed to answer the ID_PresenceRequest and the neighbouring domain shall align with this domain • 02₁₆ = Failure. The node is not allowed to respond to the ID_PresenceRequest • 03₁₆ – FF₁₆ = Reserved

8.14.9.8 NDIM Transmit indication

NDIM_Transmit.ind is a management message that shall be sent by a DM to a node of its domain used as a proxy for DM to DM communication between different domains.

The format of the MMPL of the NDIM_Transmit.ind message shall be as shown in Table 8-105.11.

Table 8-105.11 – Format of the MMPL of the NDIM_Transmit.ind message

Field	Octet	Bits	Description
DM_REGID	0 to 5	[47:0]	The REGID of the DM corresponding to the domain to which the inter-domain message is destined
NDID	6 to 8	[23:0]	The NDID of the domain to which the inter-domain message is destined
EMBEDDED_MESSAGE	Variable		LCDU to be transmitted through the IDCC. Only IDM may be embedded

8.14.9.9 NDIM Receive indication

NDIM_Receive.ind is a management message that shall be sent by a node used as a proxy for DM to DM communication between different domains to its DM.

The format of the MMPL of the NDIM_Receive.ind message shall be as shown in Table 8-105.12.

Table 8-105.12 – Format of the MMPL of the NDIM_Receive.ind message

Field	Octet	Bits	Description
DM_REGID	0 to 5	[47:0]	The REGID of the DM corresponding to the domain that originated the inter-domain message
NDID	6 to 8	[23:0]	The NDID of the domain that originated the inter-domain message
EMBEDDED_MESSAGE	Variable		LCDU transmitted through the IDCC. Only IDM may be embedded

8.14.9.10 NDIM IDCC_Release message format

NDIM_IDCC_Release.req is a management message that shall be sent by a node that has received a positive NDIM_IDCCReserve.cnf and it completed using this reserved allocation.

The format of the MMPL of the NDIM_IDCC_Release.req message shall be as shown in Table 8-105.13.

Table 8-105.13 – Format of the MMPL of the NDIM_IDCC_Release.req message

Field	Octet	Bits	Description
RemoteNode_DOD	0	[7:0]	The domain ID of the remote node
RemoteNode_CLID	1 to 6	[47:0]	The cluster ID of the remote node
RemoteNode	7	[7:0]	The DeviceID of the remote node
StatusCode	8	[7:0]	0 – The reserved slot can be released because a neighbouring node has replied with an ID_PresenceConfirm 1 – The reserved slot can be released because no neighbouring node has replied with an ID_PresenceConfirm 2-255 is reserved by ITU-T (Note 1)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.9.11 NDIM IDCC_Release confirmation

The NDIM_IDCC_Release.cnf is a management message that shall be sent by the DM to confirm receiving an NDIM_IDCC_Release.req message.

The format of the MMPL of the NDIM_IDCC_Release.cnf message shall be as shown in Table 8-105.14.

Table 8-105.14 – Format of the MMPL of the NDIM_IDCC_Release.cnf message

Field	Octet	Bits	Description
StatusCode	0	[7:0]	0 – The reserved slot is released 1-255 is reserved by ITU-T (Note)
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.9.12 NDIM interference report indication

NDIM_InterferenceReport.ind is a management message that shall be sent by a node that detected a new interfering source, or a change in an already existing interfering source, to indicate to its DM the level of the interference.

The format of the MMPL of the NDIM_InterferenceReport.ind message shall be as shown in Table 8-105.15.

Table 8-105.15 – Format of the MMPL of the NDIM_InterferenceReport.ind message

Field	Octet	Bits	Description
DEVICE_ID	0	[7:0]	DEVICE_ID of the node whose interference information is conveyed in this message
Type	1	[7:0]	Shall be set to: – 00₁₆ if report includes a record for every neighbouring domain the reporting node detects – 01₁₆ if the report is an update about the neighbouring domain the reporting node detects (Note 8) Other values are reserved by ITU-T
InterferenceInfo	2	[1:0]	Node's estimation of level of interference that it suffers from neighbouring domains. 00₂ – No interference 01₂ – Low interference 10₂ – High interference Other values are reserved by ITU-T
Reserved		[7:2]	Reserved by ITU-T (Note 1)
Reserved	3 and 4	[15:0]	Reserved by ITU-T (Note 1)
NumDomRecs (Note 2, Note 5)	5	[7:0]	Number of records (n) on neighbouring domains represented as an unsigned integer in the range from 0 to 255
NeighbDom_Size[0] (Note 5)	6	[15:0]	Size of the first neighbouring domain information field in bytes represented as an unsigned integer
NeighbDom_Rec[0] (Note 5)	Var	See Table 8-17	First reported neighbouring domain information field, with a format as defined in Table 8-17
...	...	...	...
NeighbDom_Size[n-1] (Note 5)	Var	[15:0]	Size of the nth neighbouring domain information field in bytes represented as an unsigned integer
NeighbDom_Rec[n-1] (Note 5)	Var	See Table 8-17	nth reported neighbouring domain information field, with a format as defined in Table 8-17

**Table 8-105.15 – Format of the MMPL of the
NDIM_InterferenceReport.ind message**

Field	Octet	Bits	Description
NumRemovedDomains (Note 4)	Var	[7:0]	Number of domains that the reporting node has stopped to detect (r)
RemovedDomain_NDID [0] (Note 4)	Var	[23:0]	NDID of the first Domain that does not interfere anymore
...	...	...	...
RemovedDomain_NDID [r-1] (Note 4)	Var	[23:0]	NDID of the rth Domain that does not interfere anymore
LinkPowerReportType	Var	[1:0]	Type of link power report – 00₂: No report is included – 01₂: Report by bands: The received power level is divided in bands of 512 subcarriers. – 10₂: The value indicated in the report represents the received power level for the full band Other values are for further study
NumReportedLinkPower Bands (Note 6)	Var	[4:2]	Number of reported bands minus one included in the link power bands report (p)
Reserved	Var	[7:5]	Reserved by ITU-T (Note 1)
LinkPowerLevel[0] (Note 6)	Var	[7:0]	Received power level in the worst link for this reporting node in the first reported band (lowest band), excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit (Note 3)
LinkPowerLevel[2] (Note 7)	Var	[7:0]	Received power level in the worst link for this reporting node in the 2nd reported band, excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit (Note 3)
...	...	...	

**Table 8-105.15 – Format of the MMPL of the
NDIM_InterferenceReport.ind message**

Field	Octet	Bits	Description
LinkPowerLevel[7] (Note 7)	Var	[7:0]	Received power level in the worst link for this reporting node in the 7th reported band (highest band), excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit (Note 3)
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver. NOTE 2 – The value of 0 indicates that no information on neighbouring domains is available. The value of 255 indicates that no record on neighbouring domains is attached (while information on neighbouring domains is available). NOTE 3 – The criteria for selecting the worst link (less power received for a transmission within a domain) power level is vendor discretionary. NOTE 4 – This field only exists if Type is 01₁₆. NOTE 5 – If Type = 01₁₆ this field represents additional information to be taken into account by the DM. NOTE 6 – This field only exists if LinkPowerReportType = 01₂ or 10₂. NOTE 7 – This field only exist if LinkPowerReportType = 10₂. NOTE 8 – The update refers only to the presence or not of a record for a given neighbouring domain. The type of update within the record is specified in the field NeighDomRecType in Table 8-105.16.			

**Table 8-105.16 – Format of a NeighbDomRec field of the NDIM_InterferenceReport.ind
message**

Field	Octet	Bits	Description
NeighDomRecType	0	[7:0]	Shall be set to: – 00₁₆ if the record includes full information for this node – 01₁₆ if the record includes an update on the information relative to the neighbouring node's characteristics (Note 4) Other values are for further study
NeighbNode_NDID	1 to 3	[23:0]	NDID of the neighbouring domain reported in this record
NeighbNode_CLID	4 to 9	[47:0]	ClusterId of the neighbouring domain reported in this record
NeighbNode_DOD	10	[3:0]	DOD of the neighbouring domain reported in this record
Reserved	10	[7:4]	Reserved by ITU-T (Note 1)

Table 8-105.16 – Format of a NeighbDomRec field of the NDIM_InterferenceReport.ind message

Field	Octet	Bits	Description
NumNodeRecs (Note 2)	11	[7:0]	Number of neighbouring domain's nodes (m) reported in this record for this reported neighbouring domain represented as an unsigned integer in the range from 0 to 255
NeighbNode_Size[0]	12 and 13	[15:0]	Size of the first neighbouring domain's node information field in bytes represented as an unsigned integer
NeighbNode_Rec[0]	Var	See Table 8-18	First neighbouring domain's node information field, with a format as defined in Table 8-105.17
...	...	...	...
NeighbNode_Size[m-1]	Var	[16:0]	Size of the m-th neighbouring domain's node information field in bytes represented as an unsigned integer
NeighbNode_Rec[m-1]	Var	See Table 8-18	Neighbouring domain's node information field, with a format as defined in Table 8-18
NumRemovedNeighbNodes (Note 3)	Var	[7:0]	Number of nodes that the reporting node has stopped to detect (s)
RemovedNeighbNodes[0] (Note 3)	Var	[7:0]	First node that is not detected anymore
...	...	...	...
RemovedNeighbNodes[s-1] (Note 3)	Var	[7:0]	s-th node that is not detected anymore
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver. NOTE 2 – If NeighbDomRecType = 01₁₆ or 02₁₆ this field represents additional information to be taken into account by the DM. NOTE 3 – This field only exists if NeighbDomRecType is 02₁₆. NOTE 4 – If the information relative to a neighbouring domain's node record is indicated as updated, the full information for this node record shall be reported, replacing (if it existed) the previous record about this node.			

Table 8-105.17 – Format of a NeighbNode_Rec field of the NDIM_InterferenceReport.ind message

Field	Octet	Bits	Description
NeighbNode_DeviceID	0	[7:0]	DeviceID of the interfering node this record is reporting
NeighbNode_MAC	1 to 6	[47:0]	MAC Address of the interfering node this record is reporting

Table 8-105.17 – Format of a NeighbNode_Rec field of the NDIM_InterferenceReport.ind message

Field	Octet	Bits	Description
NeighbNode_InterfEstim	7	[1:0]	Node's estimation of level of interference that it suffers from this neighbouring node. 00 ₂ – No interference 01 ₂ – Low interference 10 ₂ – High interference
Reserved	7	[7:2]	Reserved by ITU-T (Note 1)
InterfLevelReportType	8	[1:0]	Type of interference level report – 00 ₂ : No report is included – 01 ₂ : Report by bands: The received power level is divided in bands of 512 subcarriers. – 10 ₂ : The value indicated in the report represents the received power level for the full band Other values are for further study
NumReportedBands (Note 2)	8	[4:2]	Number of reported interference level bands minus one included in this report (q)
Reserved	8	[7:5]	Reserved by ITU-T (Note 1)
InterfLevel[0] (Note 2)	9	[7:0]	Average Power level received as interference from this node in the first reported band (lowest band), excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit
InterfLevel[1] (Note 2)	10	[7:0]	Average Power level received as interference from this node in the second reported band, excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit
...	...	...	...
InterfLevel[7] (Note 3)	Var	[7:0]	Average Power level received as interference from this node in the 7th reported band (highest band), excluding masked sub-carriers, in dBm, represented as 0.1 dBm per unit
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			
NOTE 2 – This field only exist if InterfLevelReportType = 01 ₂ or 10 ₂ .			
NOTE 3 – This field only exist if InterfLevelReportType = 10 ₂ .			

8.14.10 Inter-domain protocol messages

8.14.10.1 IDM_ClusterAlignment.req format

IDM_ClusterAlignment.req is a management message that is sent by a DM that has just completed MAC cycle alignment to a new cluster, to all the domains in its previous cluster that its domain has a direct link with, to inform them of the necessity of performing a MAC cycle alignment to the new

cluster. This message shall include a list of NDIDs of the domains to whom the DM is going to send this message.

Each DM that receives this message sends an IDM_ClusterAlignment.req message to all the domains in its cluster that its domain has direct link with, and that are not included in the NDID list in the received message. Each DM that sends this message adds to the NDID list the NDIDs of the domains that to whom it will send this message.

The format of the MMPL of the IDM_ClusterAlignment.req message shall be as shown in Table 8-105.18.

**Table 8-105.18 – Format of the MMPL of the
IDM_ClusterAlignment.req message**

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
OFFSET_DIR	17	[0]	This field contains the direction of the offset to be applied to the CSP of the cluster of the node receiving the message. 0 if the CSP has to be delayed, 1 if the CSP has to be moved forward
OFFSET		[4:1]	This field contains the offset in increments of 60 degrees, where the value 0000 ₂ represents 0 degrees (see Figure 8-57.2), to be applied to the CSP of the cluster of the node receiving the message. Valid values are from 0 to 11
Reserved		[7:5]	Reserved by ITU-T (Note 1)
Num_Domains	18	[7:0]	Number (n) of domains to whom this message will be sent
NDID_LIST[0]	19 to 21	[23:0]	Contains the NDID of the first domain in the list of domains to whom this message will be sent
...	...	...	
NDID_LIST[n-1]	Variable	[23:0]	Contains the NDID of the last domain in the list of domains to whom this message will be sent
NOTE 1 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.10.2 IDM ClusterAlignment.cnf message format

IDM_ClusterAlignment.cnf is a management message that is sent to confirm receiving the IDM_ClusterAlignment.req message.

The format of the MMPL of the IDM_ClusterAlignment.cnf message shall be as shown in Table 8-105.19.

Table 8-105.19 – Format of the MMPL of the IDM_ClusterAlignment.cnf message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
Status	17	[7:0]	Status of the alignment request: 0 – The domain will align to the new cluster 1 – The domain will not align to the new cluster 2-255: Reserved by ITU-T (Note)
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.10.3 IDM interfering nodes information

IDM_InterfNodesInfo.ind is a management message that is sent by a node in its IDCC to indicate the nodes suffering interference in its domain to the neighbouring domains that contain the nodes causing interference.

The format of the MMPL of the IDM_InterfNodesInfo.ind message shall be as shown in Table 8-105.20.

Table 8-105.20 – Format of the MMPL of the IDM_InterfNodesInfo.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs

Table 8-105.20 – Format of the MMPL of the IDM_InterfNodesInfo.ind message

Field	Octet	Bits	Description
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs.
NUM_INTERF_TABLES	17	[7:0]	Number of interference tables (n) in the domain associated with nodes suffering interference from the nodes in the destination domain for this message, and therefore requiring coordination
NODE_INTF_TABLE_LEN ₁	18 and 19	[15:0]	Length of the first interference table in octets
NODE_INTF_TABLE ₁	Var	[7:0]	First interference table as per Table 8-105.21
NODE_INTF_TABLE_LEN ₂	Var	[15:0]	Length of the second interference table in octets
NODE_INTF_TABLE ₂	Var	[7:0]	Second interference table as per Table 8-105.21
...	...	...	...
NODE_INTF_TABLE_LEN _{n}	Var	[15:0]	Length of the n th interference table in octets
NODE_INTF_TABLE _{n}	Var	[7:0]	n th interference table as per Table 8-105.21

Table 8-105.21 – Format of interference table for a group of nodes

Field	Octet	Bits	Description
NUM_NODES	0	[7:0]	This field contains the number (m) of nodes that are suffering interference from the same set of interfering nodes in the same set of neighbouring domains (i.e., they have the same interference table)
NODE_ID ₁	1	[7:0]	This field contains the DEVICE_ID of the first node for which this interference table applies
...	...	...	...
NODE_ID _{m}	m	[7:0]	This field contains the DEVICE_ID of the last node for which this interference table applies

Table 8-105.21 – Format of interference table for a group of nodes

Field	Octet	Bits	Description
INTERFERENCE_TABLE	variable	[7:0]	Table that contains the list of domains and their nodes that cause interference to the nodes listed above. The format of this table is as specified in Table 8-105.22

Table 8-105.22 – Format of the interference table

Field	Octet	Bits	Description
NUM_INTF_DOMAINS	0	[7:0]	Number of interfering domains (k)
INTF_DOMAIN_TABLE ₁	Variable	[7:0]	The interference table entry corresponding to interfering nodes from the first interfering domain. The format of this field is as specified in Table 8-105.23
INTF_DOMAIN_TABLE ₂	Variable	[7:0]	The interference table entry corresponding to interfering nodes from the second interfering domain. The format of this field is as specified in Table 8-105.23
...	...	...	...
INTF_DOMAIN_TABLE _{k}	Variable	[7:0]	The interference table entry corresponding to interfering nodes from the last interfering domain. The format of this field is as specified in Table 8-105.23

Table 8-105.23 – Format of the interference table entry corresponding to interfering nodes from a specific domain

Field	Octet	Bits	Description
INTF_DOMAIN_NDID	0 to 2	[23:0]	The NDID of the interfering domain D
INTF_DOMAIN_DOD	3	[7:0]	The DOD of the interfering domain D
NUM_INTF_NODES	4	[7:0]	Number of interfering nodes (n) in the interfering domain D
INTF_NODE_ID ₁	5	[7:0]	DEVICE_ID of first interfering node in D
INTF_NODE_ID ₂	6	[7:0]	DEVICE_ID of second interfering node in D
...	...	...	...
INTF_NODE_ID _{n}	4+ n	[7:0]	DEVICE_ID of last interfering node in D

8.14.10.4 IDM interference information response

IDM_InterfNodesInfo.rsp is a management message that shall be sent to confirm that an IDM_InterfNodesInfo.ind has been received.

The format of the MMPL of the IDM_InterfNodesInfo.rsp message shall be as shown in Table 8-105.24.

Table 8-105.24 – Format of the MMPL of the IDM_InterfNodesInfo.rsp message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
StatusCode	17	[7:0]	Status of the request: • 00₁₆ = Success • 01₁₆ – FF₁₆ = Reserved

8.14.10.5 IDM coordinating domains information

IDM_CoordDomainsInfo.ind is a management message that is sent by a node in its IDCC to indicate the nodes in its domain that are coordinating with other domain masters and also contains the DODs of the coordinating domains for each node.

The format of the MMPL of the IDM_CoordDomainsInfo.ind message shall be as shown in Table 8-105.25.

Table 8-105.25 – Format of the MMPL of the IDM_CoordDomainsInfo.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain the node sending this message belongs to
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to

Table 8-105.25 – Format of the MMPL of the IDM_CoordDomainsInfo.ind message

Field	Octet	Bits	Description
			which the node sending the message belongs
NUM_COORD_TABLES	17	[7:0]	Number of coordination tables (<i>n</i>) included in the message
COORD_TABLE ₁	Var	[7:0]	First coordination table as per Table 8-105.26
COORD_TABLE ₂	Var	[7:0]	Second coordination table as per Table 8-105.26
...	...	...	...
COORD_TABLE _{<i>n</i>}	Var	[7:0]	Last coordination table as per Table 8-105.26

Table 8-105.26 – Format of the coordination table for a group of nodes

Field	Octet	Bits	Description
NUM_NODES_COORD	0	[7:0]	Number of nodes (<i>k</i>) for which this coordination table applies
NODE_ID ₁	1	[7:0]	DEVICE_ID of the first node for which this coordination table applies
NODE_ID ₂	2	[7:0]	DEVICE_ID of the second node for which this coordination table applies
...	...	...	...
NODE_ID _{<i>k</i>}	<i>k</i>	[7:0]	DEVICE_ID of the last node for which this coordination table applies
NUM_COORD_DOMAINS	<i>k</i> + 1	[7:0]	Number of unique DODs (<i>n</i>) this group of nodes coordinates with
DOD ₁	<i>k</i> + 2	[3:0]	First unique DOD – DOD ₁
DOD ₂		[7:4]	Second unique DOD – DOD ₂
...	...	...	...
DOD _{<i>n</i>}	<i>k</i> + 1 + ROUNDUP(<i>n</i> /2)	[3:0]/[7:4]	Last unique DOD – DOD _{<i>n</i>}
Reserved	<i>k</i> + 1 + ROUNDUP(<i>n</i> /2)	[7:4]	Padding set to 0, if required to end on a byte boundary

8.14.10.6 IDM coordination information response

IDM_CoordDomainsInfo.rsp is a management message that shall be sent to confirm that an IDM_CoordDomainsInfo.ind has been received.

The format of the MMPL of the IDM_CoordDomainsInfo.rsp message shall be as shown in Table 8-105.27.

**Table 8-105.27 – Format of the MMPL of the
IDM_CoordDomainsInfo.rsp message**

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
StatusCode	17	[7:0]	Status of the request: • 00₁₆ = Success • 01₁₆ – FF₁₆ = Reserved

8.14.10.7 IDM share unallocated slot request

IDM_ShareUnallocSlot.req is a management message that is sent by a node in its IDCC to request sharing of unallocated slots with coordinating domain masters.

The format of the MMPL of the IDM_ShareUnallocSlot.req message shall be as shown in Table 8-105.28.

Table 8-105.28 – Format of the MMPL of the IDM_ShareUnallocSlot.req message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain the node sending the message belongs to
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this request
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this request

Table 8-105.28 – Format of the MMPL of the IDM_ShareUnallocSlot.req message

Field	Octet	Bits	Description
TRANSACTION_STATUS	19 and 20	[15:0]	This field indicates the status of eight previous transactions. The LSB corresponds to the oldest and MSB corresponds to the newest transaction prior to the transaction proposed in this message. The status of each transaction is indicated by a two bit field as follows: 00 ₂ – no status available 01 ₂ – transaction in progress 10 ₂ – transaction succeeded 11 ₂ – transaction failed
NUM_SLOTS_REQ	21	[3:0]	Number of MAC cycle slots requested for sharing minus 1. Valid values are 0 to 14
Reserved		[7:4]	Reserved by ITU-T (Note)
SLOT_ID0	22	[3:0]	Identification of first unallocated slot requested for sharing. Valid values are 1 to 15
SLOT_ID1		[7:4]	Identification of second unallocated slot requested for sharing. Valid values are 1 to 15
SLOT_IDn	21+ ROUNDUP(n/2)	..	Identification of nth unallocated slot requested for sharing. Valid values are 1 to 15
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.10.8 IDM share unallocated Slot confirmation

IDM_ShareUnallocSlot.cnf is a management message that shall be sent as a confirmation of IDM_ShareUnallocSlot.req.

The format of the MMPL of the IDM_ShareUnallocSlot.cnf message shall be as shown in Table 8-105.29.

Table 8-105.29 – Format of the MMPL of the IDM_ShareUnallocSlot.cnf message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this confirmation
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this confirmation
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure • 02₁₆ = Failure and request to refrain from sending additional requests for RefrainMultiple allocation periods • 03₁₆ – FF₁₆ = Reserved
RefrainMultiple	20	[7:0]	Number of allocation periods for which the requesting domain master is asked to refrain from sending additional requests starting from the next allocation period (Note)
NOTE – This field exists only if the StatusCode field is set to 02 ₁₆ .			

8.14.10.9 IDM share unallocated Slot indication

IDM_ShareUnallocSlot.ind is a management message that shall be sent as an indication of the status of the share unallocated slots request.

The format of the MMPL of the IDM_ShareUnallocSlot.ind message shall be as shown in Table 8-105.30.

Table 8-105.30 – Format of the MMPL of the IDM_ShareUnallocSlot.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this indication
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this indication
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure • 02₁₆ – FF₁₆ = Reserved.

8.14.10.10 IDM request unallocated slot request

IDM_RequestUnallocSlot.req is a management message that is sent by a node in its IDCC to request assignment of unallocated slots with coordinating domain masters. The request shall include an indication of the priority of the request for the requested slot, which is based on DM's vendor discretionary criteria.

The format of the MMPL of the IDM_RequestUnallocSlot.req message shall be as shown in Table 8-105.31.

Table 8-105.31 – Format of the MMPL of the IDM_RequestUnallocSlot.req message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs

Table 8-105.31 – Format of the MMPL of the IDM_RequestUnallocSlot.req message

Field	Octet	Bits	Description
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this request
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this request
TRANSACTION_STATUS	19 and 20	[15:0]	This field indicates the status of eight previous transactions. The LSB corresponds to the oldest and MSB corresponds to the newest transaction prior to the transaction proposed in this message. The status of each transaction is indicated by a two bit field as follows: 00₂ – no status available 01₂ – transaction in progress 10₂ – transaction succeeded 11₂ – transaction failed
NUM_SLOTS_REQ	21	[3:0]	Number of MAC cycle slots requested for assignment minus 1 (<i>n</i>). Valid values are 0 to 14
Reserved		[7:4]	Reserved by ITU-T (Note)
SLOT_ID1	22	[3:0]	Identification of first unallocated slot requested for assignment. Valid values are 1 to 15
PRIORITY_SLOT_ID1		[7:4]	Priority of the first unallocated slot requested for assignment. Valid values are 0 to 7
SLOT_ID2	23	[3:0]	Identification of second unallocated slot requested for assignment. Valid values are 1 to 15
PRIORITY_SLOT_ID2		[7:4]	Priority of the second unallocated slot requested for assignment. Valid values are 0 to 7
...	...	...	...

Table 8-105.31 – Format of the MMPL of the IDM_RequestUnallocSlot.req message

Field	Octet	Bits	Description
SLOT_ID n	22 + n	[3:0]	Identification of the n th unallocated slot requested for assignment. Valid values are 1 to 15
PRIORITY_SLOT_ID n		[7:4]	Priority of the n th unallocated slot requested for assignment. Valid values are 0 to 7
NOTE – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.10.11 IDM request unallocated slot confirmation

IDM_RequestUnallocSlot.cnf is a management message that shall be sent as a confirmation of IDM_RequestUnallocSlot.req.

The format of the MMPL of the IDM_RequestUnallocSlot.cnf message shall be as shown in Table 8-105.32.

Table 8-105.32 – Format of the MMPL of the IDM_RequestUnallocSlot.cnf message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this confirmation
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this confirmation

Table 8-105.32 – Format of the MMPL of the IDM_RequestUnallocSlot.cnf message

Field	Octet	Bits	Description
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure • 02₁₆ = Failure and request to refrain from sending additional requests for RefrainMultiple allocation periods 03 ₁₆ – FF ₁₆ = Reserved
RefrainMultiple	20	[7:0]	Number of allocation periods for which the requesting domain master is asked to refrain from sending additional requests starting from the next allocation period (Note 1)
NOTE 1 – This field exists only if the StatusCode field is set to 02 ₁₆ .			

8.14.10.12 IDM request unallocated slot indication

IDM_RequestUnallocSlot.ind is a management message that shall be sent as an indication of the status of the unallocated slots request.

The format of the MMPL of the IDM_RequestUnallocSlot.ind message shall be as shown in Table 8-105.33.

Table 8-105.33 – Format of the MMPL of the IDM_RequestUnallocSlot.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this indication
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this indication
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure 02 ₁₆ – FF ₁₆ = Reserved

8.14.10.13 IDM swap allocated slot request

IDM_SwapAllocSlot.req is a management message that is sent by a node in its IDCC to request swapping of allocated slots with coordinating domain masters.

The format of the MMPL of the IDM_SwapAllocSlot.req message shall be as shown in Table 8-105.34.

Table 8-105.34 – Format of the MMPL of the IDM_SwapAllocSlot.req message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this request
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this request
TRANSACTION_STATUS	19 and 20	[15:0]	This field indicates the status of eight previous transactions. The LSB corresponds to the oldest and MSB corresponds to the newest transaction prior to the transaction proposed in this message. The status of each transaction is indicated by a two bit field as follows: 00 ₂ – no status available 01 ₂ – transaction in progress 10 ₂ – transaction succeeded 11 ₂ – transaction failed
NUM_SLOTS_REQ	21	[3:0]	Number of MAC cycle slots requested for assignment minus 1 (<i>n</i>). Valid values are 0 to 14 (Note 1)
Reserved		[7:4]	Reserved by ITU-T (Note 2)
SLOT_ID1	22	[3:0]	Identification of first slot requested for assignment. Valid values are 1 to 15
SLOT_ID2		[7:4]	Identification of second slot requested for assignment. Valid values are 1 to 15
SLOT_ID _{<i>n</i>}	..	..	Identification of <i>n</i> th slot requested for assignment. Valid values are 1 to 15
NUM_SLOTS_OFFERED	Var	[3:0]	Number of MAC cycle slots offered for assignment minus 1 (<i>k</i>). Valid values are 0 to 15
Reserved		[7:4]	Reserved by ITU-T (Note 2)

Table 8-105.34 – Format of the MMPL of the IDM_SwapAllocSlot.req message

Field	Octet	Bits	Description
SLOT_ID1	Var+1	[3:0]	Identification of first slot offered for assignment. Valid values are 1 to 15
SLOT_ID2		[7:4]	Identification of second slot offered for assignment. Valid values are 1 to 15
SLOT_ID k	Variable	..	Identification of k -th slot offered for assignment. Valid values are 1 to 15
NOTE 1 – The number of requested slots need not be the same as the number of offered slots.			
NOTE 2 – Bits that are reserved by ITU-T shall be set to zero by the transmitter and ignored by the receiver.			

8.14.10.14IDM swap allocated slot confirmation

IDM_SwapAllocSlot.cnf is a management message that shall be sent to confirm that an IDM_SwapAllocSlot.req has been received.

The format of the MMPL of the IDM_SwapAllocSlot.cnf message shall be as shown in Table 8-105.35.

Table 8-105.35 – Format of the MMPL of the IDM_SwapAllocSlot.cnf message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this confirmation
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this confirmation
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure • 02₁₆ = Failure and request to refrain from sending additional requests for RefrainMultiple allocation periods 03 ₁₆ – FF ₁₆ = Reserved

Table 8-105.35 – Format of the MMPL of the IDM_SwapAllocSlot.cnf message

Field	Octet	Bits	Description
RefrainMultiple	20	[7:0]	Number of allocation periods for which the requesting domain master is asked to refrain from sending additional requests starting from the next allocation period (Note)
NOTE – This field exists only if the StatusCode field is set to 02 ₁₆ .			

8.14.10.15IDM swap allocated slot indication

IDM_SwapAllocSlot.ind is a management message that shall be sent as an indication of the status of the proposed swap of allocated slots.

The format of the MMPL of the IDM_SwapAllocSlot.ind message shall be as shown in Table 8-105.36.

Table 8-105.36 – Format of the MMPL of the IDM_SwapAllocSlot.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
COORD_TABLE_ID	17	[7:0]	The coordination table associated with this indication
TRANSACTION_ID	18	[7:0]	The transaction ID associated with this indication
StatusCode	19	[7:0]	Status of the request: • 00₁₆ = Success. • 01₁₆ = Failure 02₁₆ – FF₁₆ = Reserved

8.14.10.16IDM coordination preference indication

IDM_CoordPref.ind is a management message that shall be sent as an indication of a DM's preference of coordination method to its neighbouring domains.

The format of the MMPL of the IDM_CoordPref.ind message shall be as shown in Table 8-105.37.

Table 8-105.37 – Format of the MMPL of the IDM_CoordPref.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CLID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
CoordinationMethod	17	[7:0]	Coordination method: • 00₁₆ = method specified in clause 8.14.7 • FF₁₆ = DM does not coordinate 01₁₆ – FE₁₆ = Reserved

8.14.10.17IDM domain master change indication

IDM_DmChange.ind is a management message that shall be sent as an indication to the neighbouring domains that the DM of a domain has changed.

The format of the MMPL of the IDM_DmChange.ind message shall be as shown in Table 8-105.38.

Table 8-105.38 – Format of the MMPL of the IDM_DmChange.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
IDM_OLD_DM_REGID	17 to 22	[47:0]	The REGID of the earlier DM corresponding to the domain to which the node sending the message belongs

8.14.10.18IDM DNI change indication

IDM_DniChange.ind is a management message that shall be sent as an indication to the neighbouring domains that the DNI of a domain has changed.

The format of the MMPL of the IDM_DniChange.ind message shall be as shown in Table 8-105.39.

Table 8-105.39 – Format of the MMPL of the IDM_DniChange.ind message

Field	Octet	Bits	Description
IDM_DEVICE_ID	0	[7:0]	The 8-bit DEVICE_ID of the node sending this message
IDM_DOD	1	[7:0]	The DOD of the domain to which the node sending this message belongs
IDM_CID	2 to 7	[47:0]	The Cluster ID of the sending node
IDM_DM_REGID	8 to 13	[47:0]	The REGID of the DM corresponding to the domain to which the node sending the message belongs
IDM_NDID	14 to 16	[23:0]	The NDID of the domain to which the node sending the message belongs
IDM_DNI	17 and 18	[15:0]	The current DNI of the domain to which the node sending the message belongs
IDM_OLD_DNI	19 and 20	[15:0]	The previous DNI of the domain to which the node sending the message belongs

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