IEEE P802.19
Wireless Coexistence Working Group

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Re:	
Abstract	Full proposal
Purpose	
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Contents

TV White Space Coexistence Methods

1. Overview

1.1 Scope

The standard specifies radio technology independent methods for coexistence among dissimilar or independently operated TV Band Device (TVBD) networks and dissimilar TV Band Devices

1.2 Purpose

The purpose of the standard is to enable the family of IEEE 802 Wireless Standards to most effectively use TV White Space by providing standard coexistence methods among dissimilar or independently operated TVBD networks and dissimilar TVBDs. This standard addresses coexistence for IEEE 802 networks and devices and will also be useful for non IEEE 802 networks and TVBDs.

2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

3. Definitions, Abbreviations and Acronyms

4. System Description

This clause presents the concepts used within this standard. The key architectural components and their interrelations are introduced. System architecture is used to describe functional components of the

coexistence system. The architectural descriptions are not intended to represent any specific physical implementation of the coexistence system.

4.1 System architecture

The coexistence system has three logical entities and five logical interfaces. Each logical entity is defined by its functional roles and interfaces with other logical entities.

Figure 1 shows system architecture of the coexistence system.

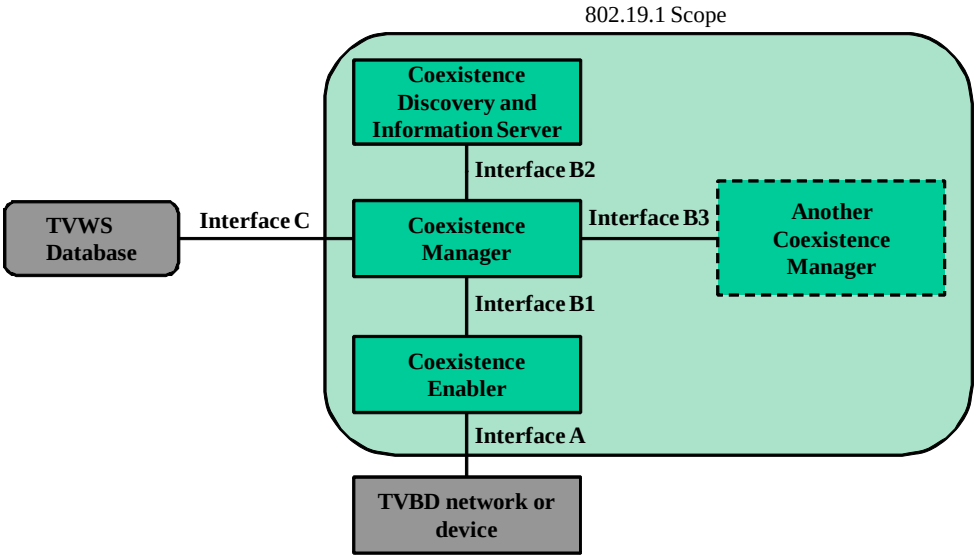

Figure 1—System architecture

Three logical entities of the coexistence system are:

- Coexistence Enabler (CE)
- Coexistence Manager (CM)
- Coexistence Discovery and Information Server (CDIS).

The CE enables all communication between a TVBD network or device and a coexistence manager that serves this TVBD network or device.

The CM is responsible for coexistence decision making related to reconfiguration of TVBD networks or devices to solve coexistence problems between them. The CM obtains all necessary information for this decision making. CM decisions are informed to TVBD networks or devices. Different CMs may communicate with each other.

The CDIS is responsible for calculating neighbor TVBD networks or devices for CMs. Also, the CDIS supports discovery of CMs by each other in order to open interfaces between them.

Five logical interfaces of the coexistence system are:

- Interface A between a CE and a TVBD network or device
- Interface B1 between a CE and a CM
- Interface B2 between a CM and a CDIS

— Interface B3 between different CMs

— Interface C between a CM and a TV bands database.

4.2 Logical entities / Entities

4.2.1 Coexistence enabler

The CE enables all communication between a TVBD network or device and a coexistence manager.

The key functions of the CE are the following:

— Perform registration/deregistration of the TVBD network or device in the coexistence system

— Request and obtain information required for coexistence from the TVBD network or device

— Translate reconfiguration requests/commands and control information received from the CM into TVBD-specific reconfiguration requests/commands and send them to the TVBD network or device

— Translate measurement results or coexistence information from the TVBD network or device into coexistence messages and send them to the CM.

4.2.2 Coexistence manager

The CM is responsible for coexistence decision making related to reconfiguration of TVBD networks or devices to solve coexistence problems between them. The CM obtains all necessary information for this decision making. CM decisions are informed to the TVBD networks or devices. Different CMs may communicate with each other.

The CM has the following main functions:

— Perform registration/deregistration of the TVBD networks and devices in the CDIS

— Exchange information required for coexistence with CEs, CDIS, and other CMs

— Request TVBD networks or devices to perform measurements required for coexistence

— Make coexistence decisions related to TVBD network or device reconfiguration

— Request reconfiguration of the TVBD network or device according to the decisions

— Obtain information from a TVWS database directly or via the TVBD network or device.

4.2.3 Coexistence discovery and information server

The CDIS is responsible for calculating neighbor TVBD networks or devices for CMs. Also, the CDIS supports discovery of CMs by each other in order to open interfaces between them.

The CDIS has the following main functions:

— Store registration information of TVBD networks and device

— Calculate neighbor TVBD networks or devices

— Provide neighbor information.

4.3 Interfaces

4.3.1 Interface A

Interface A between a CE and a TVBD network or device may be used to transmit the following:

- From a TVBD network or device to a CE:
  - TVBD network or device registration information
  - Information required for coexistence
  - Measurement results
  - Reconfiguration results
- From a CE to a TVBD network or device:
  - Neighbor and radio environment information
  - Information requests
  - Measurement requests
  - Reconfiguration requests.

4.3.2 Interface B1

Interface B1 between a CE and a CM may be used to transmit the following:

- From a CE to a CM:
  - TVBD network or device registration information
  - Information required for coexistence
  - Measurement results
  - Reconfiguration results
- From a CM to a CE:
  - Neighbor and radio environment information
  - Information requests
  - Measurement requests
  - Reconfiguration requests.

4.3.3 Interface B2

Interface B2 between a CM and a CDIS may be used to transmit the following:

- From a CM to a CDIS:
  - CM registration information
- From a CDIS to a CM:
  - Neighbor information.

4.3.4 Interface B3

Interface B3 between CMs may be used to transmit the following:

- Information required for coexistence.

4.3.5 Interface C

Interface C between a CM and a TVWS database may be used to transmit the following:

— From a CM to a TVWS database:
  — Available channel list request
— From a TVWS database to a CM:
  — Available channel list.

4.4 Coexistence services

4.4.1 Introduction

Coexistence services are services provided by the coexistence system to dissimilar or independently operated TVBD network or device, as well as, services provided by entities of the coexistence system to other entities of the coexistence system. Correspondingly, there are two categories of the coexistence services:

— Services provided to TVBD devices or networks
— Service provided to CMs.

The coexistence services are summarized in Figure 2.

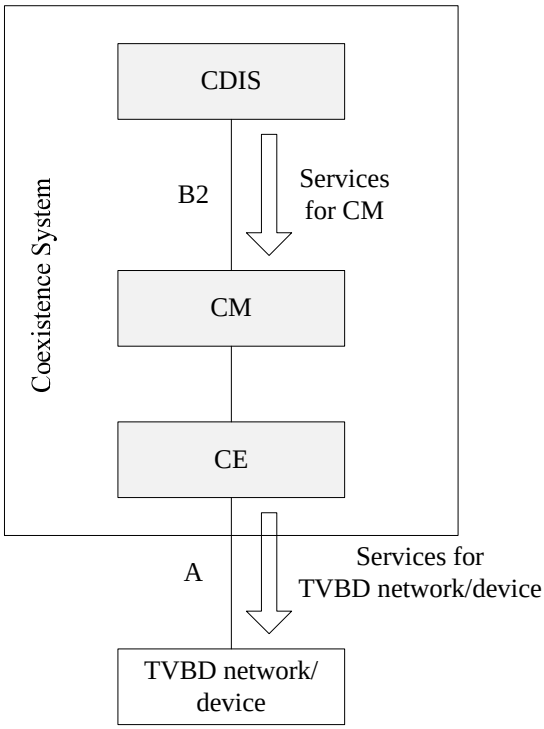

Figure 2—Summary of coexistence services

4.4.2 Services for TVBD network or device

The coexistence system provides coexistence services to a TVBD network or device via interface A. To obtain services from the coexistence system, a TVBD network or device needs to authenticate and register to the system and subscribe to its services.

After the registration, the TVBD network or device can get one of the following coexistence services from the coexistence system:

— Information service

— Management service.

A TVBD device or network can be subscribed to only one service at a time.

Within the information service, the TVBD network or device gets neighbor and radio environment information.

Within the management service, the TVBD network or device gets reconfiguration requests generated by the coexistence system. The TVBD network or device needs to provide information to the coexistence system while using this service. Also, the TVBD network or device needs to perform measurements according to requests from the coexistence system. These information and measurement results are used by the coexistence system to make coexistence decisions.

4.4.3 Service for CM

A CDIS provides coexistence services to CMs via interface B2. A CM can get the following coexistence service from a CDIS:

— Neighbor discovery service.

Within the neighbor discovery service, the CM gets the neighbor lists for all TVBD networks or devices served by this CM.

5. IEEE 802.19.1 reference model

5.1 General description

Figure 3 illustrates reference model of a Coexistence Enabler.

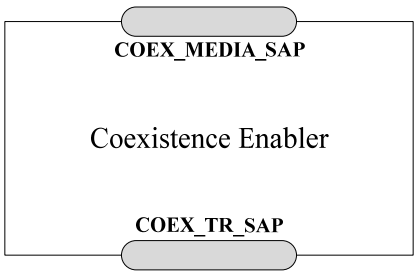

Figure 3—Reference model of a Coexistence Enabler

The Coexistence Enabler has two service access points:

— Coexistence Media SAP (COEX_MEDIA_SAP)

— Coexistence Transport SAP (COEX_TR_SAP).

Figure 4 illustrates reference model of a Coexistence Manager and a Coexistence Discovery and Information Server.

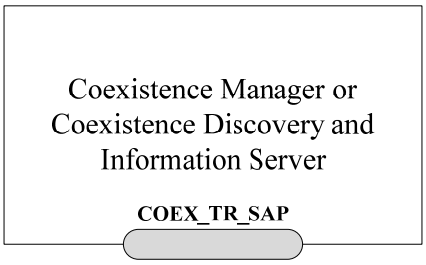

Figure 4— Reference model of a Coexistence Manager and a Coexistence Discovery and Information Server

The Coexistence Manager and the Coexistence Discovery and Information Server have one service access point:

— Coexistence Transport SAP (COEX_TR_SAP).

COEX_MEDIA_SAP defines the interface A between the CE and a TVBD network/device. Example reference model of a CE describing an example implementation of the interface A inside a base station is shown in Figure 5.

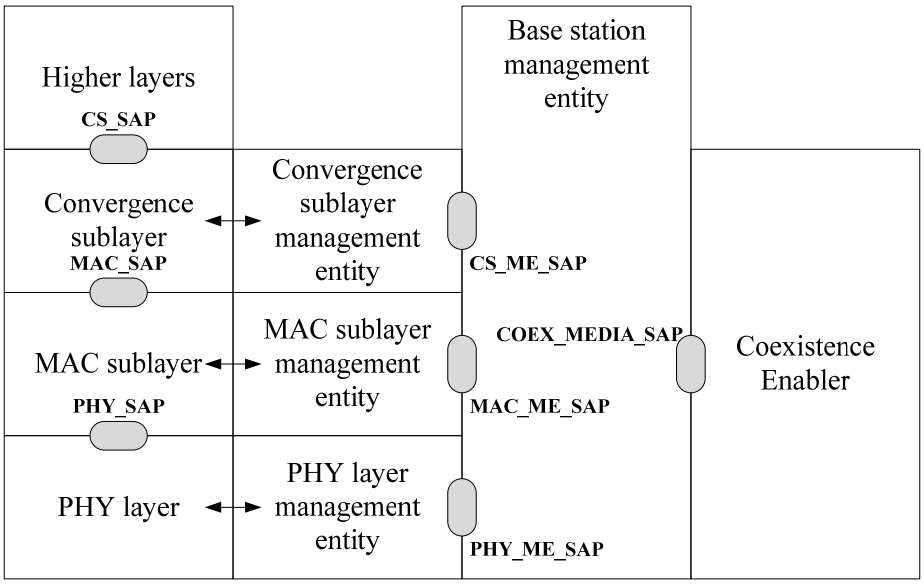

Figure 5— Example reference model for the interface A

The left side of Figure 5 shows a typical reference model of a radio interface including data, control and management planes for physical layer, MAC sublayer, and convergence sublayer. The middle part of the Figure 5 shows the base station management entity. The right part of Figure 5 shows the CE.

Typically, the radio interface is implemented in such a way that it provides a management interface for the base station management entity. In Figure 5, such interface is represented by three service access points PHY_ME_SAP, MAC_ME_SAP, and CS_ME_SAP, corresponding to the physical layer, the MAC sublayer, and the convergence sublayer. These service access points can be used to obtain information from the radio interface and to request reconfiguration of the radio interface. Correspondingly, the CE can use these service access points to implement the interface A. The interface A is defined by the service access point COEX_MEDIA_SAP. Communication between the radio interface management service access points PHY_ME_SAP, MAC_ME_SAP, and CS_ME_SAP and the CE service access point COEX_MEDIA_SAP is done via the base station management entity.

The COEX_TR_SAP provides means for a Coexistence Enabler, a Coexistence Manager, and a Coexistence Discovery and Information Server to communicate with each other and with external entities by using transport services provided by underlying layers. The underlying layers could be application layer, transport layer, network layer, and link layer. Example reference model of a CE and a CM describing example of using COEX_TR_SAP for interface B1 is shown in Figure 6.

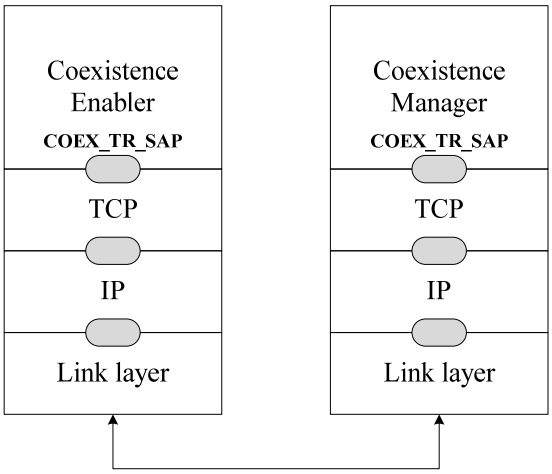

Figure 6— Example of using COEX_TR_SAP for interface B1

Information required for coexistence and reconfiguration commands that are exchanged between a CE and a CM over the interface B1 are forwarded to transport layer, for example, to TCP, for transmission. This is done using the COEX_TR_SAP service access point of the CE and the CM.

5.2 Service access points

5.2.1 COEX_TR_SAP

Coexistence Transport SAP (COEX_TR_SAP) provides means for a Coexistence Enabler, a Coexistence Manager, and a Coexistence Discovery and Information Server to communicate with each other and with external entities by using transport services provided by underlying layers. The Coexistence Transport SAP is defined as a set of primitives that provides the following service:

— Transport service:
  — Used by a CE, a CM, a CDIS or an external entity to send a coexistence protocol data unit to each other and to external entities and to receive an acknowledgement of such operation

— Used by a CE, a CM, and a CDIS or an external entity to receive a coexistence protocol data unit from each other and from external entities.

Primitives described in Table 1 are used to define the Coexistence Transport SAP.

Table 1—Coexistence Transport SAP primitives

Primitive	Service	Description
CP_PACKET_SEND	Transport	Used by a CE, CM, CDIS or external entity to send a coexistence protocol data unit using a transport service provider.
CP_PACKET_RECEIVE	Transport	Used by a transport service provider to deliver a coexistence protocol data unit to a CE, CM, CDIS or external entity.

5.2.1.1 Transport service

5.2.1.1.1 CP_PACKET_SEND.request

Function:
Used by a CE, a CM, a CDIS or an external entity to request the transport service provider to transport a coexistence protocol data unit.
Semantics:
CP_PACKET_SEND.request (

transportPref,

sourceID,

destinationID,

coexProtocolPDU

)

Name	Data Type	Description
transportPref	TransportPref	Transport protocol preference.
sourceID	OCTET_STRING	Address of the entity sending a coexistence protocol data unit.
destinationID	OCTET_STRING	Address of the entity to receive a coexistence protocol data unit.
coexProtocolPDU	OCTET_STRING	Coexistence protocol data unit to be transported.

When generated:
Generated by a CE, a CM, a CDIS or an external entity to request the transport service provider to transport a coexistence protocol data unit.
Effect on receipt:
The specific transport service provider receiving this primitive attempts to transport the coexistence protocol data unit.

5.2.1.1.2 CP_PACKET_SEND.confirm

Function:

Used by a transport service provider to acknowledge transportation of the coexistence protocol data unit if such acknowledgment is supported by the transport service provider.

Semantics:

```
CP_PACKET_SEND.confirm (
    transportPref,
    sourceID,
    destinationID,
    transportStatus
)
```

Name	Data Type	Description
transportPref	TransportPref	Transport protocol used.
sourceID	OCTET_STRING	Address of the entity sending a coexistence protocol data unit.
destinationID	OCTET_STRING	Address of the entity to receive a coexistence protocol data unit.
transportStatus	BOOLEAN	Indicates whether the transfer of a coexistence protocol data unit was successful or not.

When generated:

Generated by the transport service provider to indicate whether the transfer of a coexistence protocol data unit is successful or not if such acknowledgement is supported by the transport service provider.

Effect on receipt:

When a CE, a CM, a CDIS or external entity receives this primitive, it learns about the status of the requested delivery of coexistence protocol data unit.

5.2.1.1.3 CP_PACKET_RECEIVE

Function:

Used by a transport service provider to deliver a coexistence protocol data unit to a CE, a CM, a CDIS or an external entity.

Semantics:

```
CP_PACKET_RECEIVE (
    transportPref,
    sourceID,
    coexProtocolPDU
)
```

Name	Data Type	Description
transportPref	TransportPref	Transport protocol used.
sourceID	OCTET_STRING	Address of the entity from which a coexistence protocol data unit was received.
coexProtocolPDU	OCTET_STRING	The received coexistence protocol data unit.

When generated:

Generated by the transport service provider when it has coexistence protocol data unit for CE, CM, CDIS or external entity

Effect on receipt:

The CE, CM, CDIS or external entity receiving this primitive gets a coexistence protocol data unit.

5.2.2 COEX_MEDIA_SAP

Coexistence Media SAP (COEX_MEDIA_SAP) defines the interface A between a CE and a TVBD network or device. The Coexistence Media SAP is defined as a set of primitives that provides the following services:

- Authentication service
  - Used by the TVBD network or device to provide its authentication information to the coexistence system
- Subscription service
  - Used by the TVBD network or device to provide its subscription information to the coexistence system and to update this subscription information
- Registration service
  - Used by the TVBD network or device to provide its registration information to the coexistence system and to update this registration information
- Information service
  - Used by the CE to send a neighbor report to the TVBD network or device subscribed to the coexistence information service
  - Used by the CE to obtain an available channel list from the TVBD network or device subscribed to the coexistence management service
  - Used by the CE to obtain information required for coexistence from the TVBD network or device subscribed to the coexistence management service
- Measurement service
  - Used by the CE to obtain measurement results required for coexistence from the TVBD network or device subscribed to the coexistence management service
- Reconfiguration service
  - Used by the CE to request the TVBD network or device subscribed to the coexistence management service to perform reconfiguration required for coexistence
- Event service
  - Used by the CE and TVBD network or device to exchange indications of events related to coexistence.

Primitives described in Table 2 are used to define the Coexistence Media SAP.

Table 2—Coexistence Media SAP primitives

Primitive	Service	Description
GetAuthInfo	Authentication	Used by the TVBD network or device for authentication with the coexistence system
GetServiceSubscription	Subscription	Used by the TVBD network or device to provide its subscription information to the coexistence system
NewServiceSubscription		Used by the TVBD network or device to update its subscription information in the coexistence system
GetRegInfo	Registration	Used by the TVBD network or device to provide its registration information to the coexistence system

NewRegInfo		Used by the TVBD network or device to update its registration information in the coexistence system
NeighborReport	Information	Used by the CE to send neighbor report to the TVBD network or device subscribed to the coexistence information service
AvailableChannelList		Used by the CE to obtain available channel list from the TVBD network or device subscribed to the coexistence management service
GetInfo		Used by the CE to obtain information required for coexistence from the TVBD network or device subscribed to the coexistence management service
GetMeasurement	Measurement	Used by the CE to obtain measurement results required for coexistence from the TVBD network or device subscribed to the coexistence management service
PerformReconfiguration	Reconfiguration	Used by the CE to request the TVBD network or device subscribed to the coexistence management service to perform reconfiguration required for coexistence
Event	Event	Used by the CE and TVBD network or device to exchange indications of events related to coexistence

5.2.2.1 Authentication service

5.2.2.1.1 GetAuthInfo

5.2.2.1.1.1 GetAuthInfo.request

Function

Used by a CE to request authentication information from the TVBD network or device.

Semantics

GetAuthInfo.request()

When generated

Generated by the CE to obtain authentication information from the TVBD network or device.

Effect on receipt

When the TVBD network or device receives this primitive, it sends a GetAuthInfo.response back to the CE.

5.2.2.1.1.2 GetAuthInfo.response

Function

Used by the TVBD network or device to provide the authentication information to the CE.

Semantics

GetAuthInfo.response (

User ID

User Password

)

Name	Type	Description
User ID	IA5String (ITU-T X.208)	This parameter contains User ID to be used by a CE to authenticate with the coexistence system.
User Password	IA5String	This parameter contains User Password to be used by a CE to authenticate with the coexistence system.

When generated

Generated by the TVBD network or device in response to a GetAuthInfo.request from the CE.

Effect on receipt

When the CE receives this primitive, it starts authentication of the TVBD network or device with the coexistence system.

5.2.2.1.1.3 GetAuthInfo.confirm

Function

Used by a CE to inform the TVBD network or device about the results of the authentication.

Semantics

GetAuthInfo.confirm(

status

)

Name	Type	Description
status	Boolean	This parameter shows whether the authentication was successful or not.

When generated

Generated by the CE after an attempt to authenticate the TVBD network or device in the coexistence system.

Effect on receipt

If the authentication was not successful, the TVBD network or device re-examines its authentication information provided.

5.2.2.2 Subscription service

5.2.2.2.1 GetServiceSubscription

5.2.2.2.1.1 GetServiceSubscription.request

Function

Used by a CE to obtain subscription information from the TVBD network or device.

Semantics

GetCxServSubscr.request ( )

When generated

Generated by the CE to request the TVBD network or device to indicate the coexistence service which it wants to receive from the coexistence system.

Effect on receipt

When the TVBD network or device receives this primitive, it sends a GetServiceSubscription.response back to the CE.

5.2.2.2.1.2 GetServiceSubscription.response

Function

Used by the TVBD network or device to inform the CE about the coexistence service which it wants to receive from the coexistence system.

Semantics

GetServiceSubscription.response (

subscribedService

)

Name	Type	Description
subscribedService	SubscribedService	This parameter describes coexistence service that the TVBD network or device wishes to receive from the coexistence system.

When generated

Generated by the TVBD network or device in response to a GetServiceSubscription.request from the CE.

Effect on receipt

When CE receives this primitive, it requests a service subscription from a CM.

5.2.2.2.1.3 NewServiceSubscription.indication

Function

Used by the TVBD network or device to inform the CE that it wants to update its subscription to the coexistence services.

Semantics

NewServiceSubscription.indication (

subscribedService

)

Name	Type	Description
subscribedService	SubscribedService	This parameter describes the coexistence service that a TVBD network or device wishes to receive from the coexistence system.

When generated

Generated by the TVBD network or device when it wishes to change its subscription to the coexistence services.

Effect on receipt

When CE receives this primitive, it shall update the information of the subscribed coexistence service of its TVBD network or device in the coexistence system.

5.2.2.3 Registration service

5.2.2.3.1 GetRegInfo

5.2.2.3.1.1 GetRegInfo.request

Function

Used by a CE to request the TVBD network or device to provide registration information.

Semantics

GetRegInfo.request ( )

When generated

Generated by the CE to request the TVBD network or device to provide registration information.

Effect on receipt

When the TVBD network or device receives this primitive, it shall send a GetRegInfo.response back to the CE.

5.2.2.3.1.2 GetRegInfo.response

Function

Used by the TVBD network or device to provide requested registration information to CE.

Semantics

GetRegInfo.response (

networkID,

networkTechnology,

networkType,

discoveryInformation,

listOfSupportedFrequencies,

minTxPower,

txScheduleSupported,

listOfOperatingFrequencies,

radioEnvironmentInformation OPTIONAL

)

Name	Type	Description
networkID	NetworkID	E.g., BSS ID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
networkType	NetworkType	E.g., fixed, mode 2
discoveryInformation	DiscoveryInformation	Information for neighbor discovery, e.g., location information, maximum transmission power, receiver sensitivity, antenna gain, minimum SINR required for system operation, other information needed to calculate coverage and interference areas
listOfSupportedFrequencies	ListOfSupportedFrequencies	List of supported operating frequencies
minTxPower	REAL	Minimum transmission power
txScheduleSupported	BOOLEAN	Indicates whether scheduled transmission is supported or not
listOfOperatingFrequencies	ListOfOperatingFrequencies	List of operating frequencies including occupancy of each operating frequency
radioEnvironmentInformation	RadioEnvironmentInformation	Information on radio environment as observed by this TVBD network or

	OPTIONAL	device

When generated

Generated by the TVBD network or device in response to the GetRegInfo.request from the CE.

Effect on receipt

When the CE receives this primitive it registers the TVBD network or device in the coexistence system.

5.2.2.3.2 NewRegInfo

5.2.2.3.2.1 NewRegInfo.indication

Function

Used by a TVBD network or device to update its registration information in the coexistence system.

Semantics

```
NewRegInfo.indication (
    networkID,
    networkTechnology,
    networkType,
    discoveryInformation,
    listOfSupportedFrequencies,
    minTxPower,
    txScheduleSupported,
    listOfOperatingFrequencies,
    radioEnvironmentInformation OPTIONAL
)
```

Name	Type	Description
networkID	NetworkID	E.g., BSS ID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
networkType	NetworkType	E.g., fixed, mode 2
discoveryInformation	DiscoveryInformation	Information for neighbor discovery, e.g., location information, maximum transmission power, receiver sensitivity, antenna gain, minimum

		SINR required for system operation, other information needed to calculate coverage and interference areas
listOfSupportedFrequencies	ListOfSupportedFrequencies	List of supported operating frequencies
minTxPower	REAL	Minimum transmission power
txScheduleSupported	BOOLEAN	Indicates whether scheduled transmission is supported or not
listOfOperatingFrequencies	ListOfOperatingFrequencies	List of operating frequencies including occupancy of each operating frequency
radioEnvironmentInformation	RadioEnvironmentInformation OPTIONAL	Information on radio environment as observed by this TVBD network or device

When generated

Generated by the TVBD network or device when its registration information is changed.

Effect on receipt

When the CE receives this primitive, it updates the registration information with the most newly received values.

5.2.2.4 Information service

5.2.2.4.1 NeighborReport

5.2.2.4.1.1 NeighborReport.indication

Function

Used by a CE to provide a neighbor report to the TVBD network or device subscribed to the coexistence information service.

Semantics

NeighborReport.indication (

    neighborReport

)

Name	Type	Description
neighborReport	NeighborReport	The list of neighbors of the TVBD network or

		device

When generated

Generated by the CE to provide a neighbor report to the TVBD network or device.

Effect on receipt

When the TVBD network or device receives this primitive, it updates the neighbor information with the new information provided in this primitive.

5.2.2.4.2 AvailableChannelList

5.2.2.4.2.1 AvailableChannelList.request

Function

Used by a CE to obtain an available channel list from the TVBD network or device

Semantics

AvailableChannelList.request()

When generated

Generated by the CE to obtain an available channel list from the TVBD network or device.

Effect on receipt

When the TVBD network or device receives this primitive, it sends an AvailableChannelList.response back to the CE.

5.2.2.4.2.2 AvailableChannelList.response

Function

Used by a TVBD network or device to provide its list of available channels to the CE.

Semantics

AvailableChannelList.response (

availableChannelList

)

Name	Type	Description
availableChannelList	AvailableChannelList	Available channel list to operate in TVWS

When generated

Generated by the TVBD network or device in response to an AvailableChannelList.request from the CE.

Effect on receipt

When the CE receives this primitive, it provides the available channel list to the CM.

5.2.2.4.2.3 AvailableChannelList.indication

Function

Used by the TVBD network or device to update the list of its available channels to the CE.

Semantics

AvailableChannelList.indication (

availableChannelList

)

Name	Type	Description
availableChannelList	AvailableChannelList	Available channel list to operate in TVWS

When generated

Generated by the TVBD network or device if information in the list of available channels has changed.

Effect on receipt

When the CE receives this primitive, it provides the list of available channels to the CM.

5.2.2.4.3 GetInfo

5.2.2.4.3.1 GetInfo.request

Function

Used by a CE to obtain information from the TVBD network or device.

Semantics

GetInfo.request(

reqInfoDescr

)

Name	Type	Description
reqInfoDescr	ReqInfoDescr	Requested information ID.

When generated

Generated by the CE to request the TVBD network or device to provide coexistence information.

Effect on receipt

When the TVBD network or device receives this primitive, it sends a GetInfo.response back to the CE.

5.2.2.4.3.2 GetInfo.response

Function

Used by a TVBD network or device to provide requested information to the CE.

Semantics

GetRegInfo.response (

reqInfoValue

)

Name	Type	Description
reqInfoValue	ReqInfoValue	Requested information

When generated

Generated by the TVBD network or device in response to a GetInfo.request from the CE.

Effect on receipt

When the CE receives this primitive, it examines the received information.

5.2.2.5 Measurement service

5.2.2.5.1 GetMeasurement

5.2.2.5.1.1 GetMeasurement.request

Function

Used by a CE to request the TVBD network or device to perform measurements.

Semantics

GetMeasurement.request(

measurementDescription

)

Name	*Type*	*Description*
measurementDescription	MeasurementDescription	Measurement Description

When generated

Generated by the CE to request the TVBD network or device to perform measurements.

Effect on receipt

When the TVBD network or device receives this primitive, it performs measurements required by the CE and responds back either with a GetMeasurement.response or a GetMeasurement.indication.

5.2.2.5.1.2 GetMeasurement.response

Function

Used by a TVBD network or device to provide one time measurement results to the CE.

Semantics

GetAvailableChannelList.response (

    measurementResult

)

Name	Type	Description
measurementResult	MeasurementResult	Measurement Result

When generated

Generated by the TVBD network or device in response to a GetMeasurement.request from the CE to provide one time measurement results.

Effect on receipt

When the CE receives this primitive, it examines the received measurement results.

5.2.2.5.1.3 GetMeasurement.indication

Function

Used by a TVBD network or device to provide scheduled measurement results to the CE.

Semantics

GetMeasurement.indication (

    measurementResult

)

Name	Type	Description
measurementResult	MeasurementResult	Measurement Result

When generated

Generated by the TVBD network or device in response to a GetMeasurement.request from the CE to provide scheduled measurement results.

Effect on receipt

When the CE receives this primitive, it examines the received measurement results.

5.2.2.6 Reconfiguration service

5.2.2.6.1 PerformReconfiguration

5.2.2.6.1.1 PerformReconfiguration.request

Function

Used by a CE to request reconfiguration of the TVBD network or device required for coexistence.

Semantics

PerformReconfiguration.request(

    reconfigurationRequest

)

Name	Type	Description
reconfigurationRequest	ReconfigurationRequest	Reconfiguration description.

When generated

Generated by the CE to request the TVBD network or device to reconfigure.

Effect on receipt

When the TVBD network or device receives this primitive, it reconfigures according to reconfiguration description and sends a PerformReconfiguration.response to the CE.

5.2.2.6.1.2 PerformReconfiguration.response

Function

Used by a TVBD network or device to report the result of the requested reconfiguration to the CE.

Semantics

PerformReconfiguration.response (

    reconfigurationStatus

)

Name	Type	Description
reconfigurationStatus	Boolean	This parameter shows the status of reconfiguration.

When generated

Generated by the TVBD network or device in response to a PerformReconfiguration.request from the CE.

Effect on receipt

When the CE receives this primitive, it examines the received information.

5.2.2.7 Event service

5.2.2.7.1 Event

5.2.2.7.1.1 Event.indication

Function

Used by a TVBD network or device to inform the CE about events related to coexistence observed or predicted by the TVBD network or device.

Also, used by a CE to inform the TVBD network or device about events related to coexistence observed or predicted by the coexistence system.

Semantics

Event.indication(

    eventParams

)

Name	Type	Description
eventParams	EventParams	This parameter contains a list of event parameters.

When generated

Generated by the TVBD network or device to inform the CE about events related to coexistence observed or predicted by the TVBD network or device.

Generated by the CE to inform the TVBD network or device about events related to coexistence observed or predicted by the coexistence system.

Effect on receipt

When the CE receives this primitive, it examines the received information about events related to coexistence observed or predicted by the TVBD network or device.

When the TVBD network or device receives this primitive, it examines the received information about events related to coexistence observed or predicted by the coexistence system.

5.3 Data type definition

5.3.1 COEX_TR_SAP

```
TransportPref ::= ENUMERATED{
    TCP,
    UDP,
```

```
    HTTP,
    SNMP,
    …
}
```

5.3.2 COEX_MEDIA_SAP

```
SubscribedService::= ENUMERATED{
    information,
    management
}

NetworkID::= ENUMERATED{
    BSSID,
    …
}

NetworkTechnology ::= ENUMERATED{
    IEEE802.11af,
    IEEE802.22,
    ECMA392,
    …
}

NetworkType ::= ENUMERATED{
    fixed,
    mode2,
    …
}
```

```
DiscoveryInformation ::= SEQUENCE{
    coordinateX      REAL,
    coordinateY      REAL,
    coordinateZ      REAL,
    maxTxPower    REAL,
    rxSensitivity     REAL,
    antennaGain     REAL,
    minReqSNR     REAL,
    …
}

ListOfSupportedFrequencies ::= SEQUENCE OF SEQUENCE{
    startFreq    REAL,
    stopFreq    REAL
}

ListOfOperatingFrequencies ::= SEQUENCE OF SEQUENCE{
    startFreq            REAL,
    stopFreq            REAL,
    occupancy          REAL,
    totalOccupancy    REAL OPTIONAL
}

FreqDescription ::= SEQUENCE{
    networkID                NetworkID    OPTIONAL,
    networkTechnology      NetworkTechnology    OPTIONAL,
    coexType                 ENUMERATED{known, unknown},
```

```
    interferenceDirection    ENUMERATED{mutual, source, victim},
    occupancy                REAL OPTIONAL,
    totalOccupancy           REAL OPTIONAL
}

RadioEnvironmentInformation ::= SEQUENCE OF SEQUENCE{
    startFreq            REAL,
    stopFreq             REAL,
    state                ENUMERATED{free, occupiedKnown, occupiedUnknown, notMeasured},
    freqDescription      FreqDescription    OPTIONAL
}

NeighborReport ::= SEQUENCE OF SEQUENCE{
    networkID                       NetworkID,
    networkTechnology               NetworkTechnology,
    interferenceDirection           ENUMERATED{mutual, source, victim},
   interferenceLevelFromNeighbor    REAL,
    interferenceLevelToNeighbor     REAL,
    listOfOperatingFrequencies      ListOfOperatingFrequencies,
    radioEnvironmentInformation     RadioEnvironmentInformation    OPTIONAL
}

AvailableChannelList::= SEQUENCE OF SEQUENCE{
    startFreq          REAL,
    stopFreq           REAL,
    txPowerLimit       REAL
}
```

```
ReqInfoDescr ::= SEQUENCE OF ENUMERATED{
   SINR,
….desiredBandwidth,
   desiredOccupancy,
   …
}

ReqInfoValue ::= SEQUENCE OF SEQUENCE{
   reqInfoDescr    ReqInfoDescr,
   reqInfoValue    CHOICE{SINRValue    REAL, desiredBandwidth    REAL,
                          desiredOccupancy    REAL, otherValue    ANY}
}

MeasSchedule ::= SEQUENCE {
   measStartTime                REAL,
   numberOfMeasurements         INTEGER,
   timeBetweenMeasurements      REAL
}

MeasurementDescription ::= SEQUENCE OF SEQUENCE{
   measDescr    ENUMERATED{SINR, …},
   measSchedule    MeasSchedule
}

MeasurementResult ::= SEQUENCE OF SEQUENCE{
   reqInfoDescr    ReqInfoDescr,
   reqInfoValue    CHOICE{SINRValue    REAL, otherValue    ANY}
}
```

```
TxSchedule ::= SEQUENCE {
    scheduleStartTime                REAL,
    scheduleDuration                 REAL,
    numberOfScheduleRepetitions      INTEGER,
    transmissionStartTime            REAL,
    transmissionDuration             REAL
}

ReconfigurationRequest ::= SEQUENCE OF SEQUENCE {
    operatingFrequency    SEQUENCE{startFeq    REAL, stopFreq    REAL},
    txPowerLimit          REAL OPTIONAL,
    channelIsShared       BOOLEAN,
    txSchedule            SEQUENCE OF TxSchedule OPTIONAL
}

EventParams ::= SEQUENCE OF ENUMERATED{
    SINRThresholdReached,
    …
}
```

6. Procedures and protocols

6.1 Procedures

6.1.1 Authentication and deauthentication procedures

This set includes the following procedures:

— TVBD network or device authentication procedure

— TVBD network or device deauthentication procedure

— CM authentication procedure

— CM deauthenticaiton procedure.

6.1.1.1 TVBD network or device authentication procedure

This procedure is performed when a CE receives a request to start operation. It is shown in Figure 7.

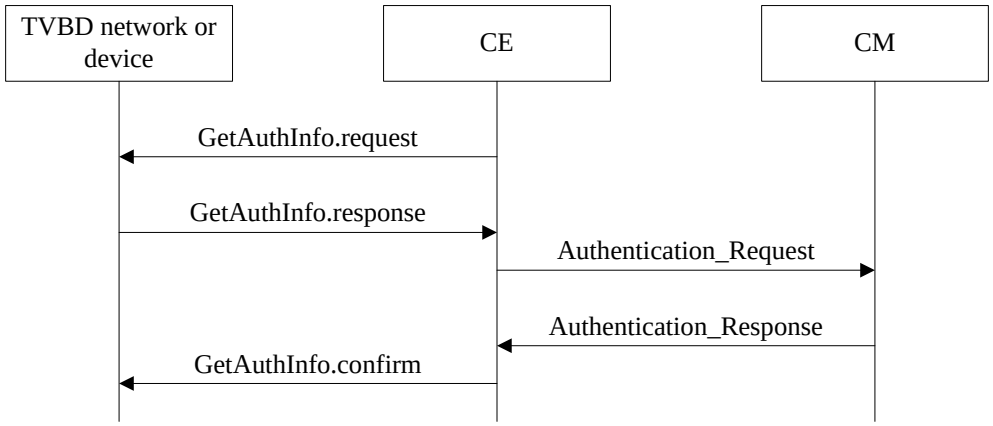

Figure 7—TVBD network or device authentication procedure

6.1.1.2 TVBD network or device deauthentication procedure

This procedure is performed when a CE receives a request to stop operation. It is shown in Figure 8.

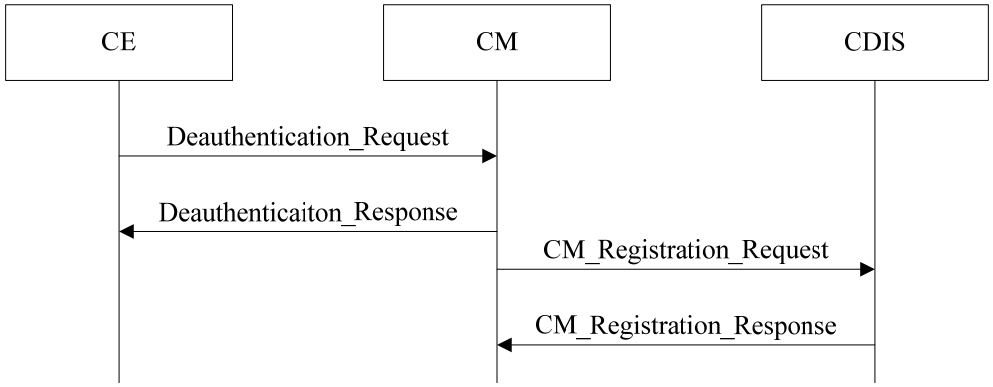

Figure 8—TVBD network or device deauthentication procedure

6.1.1.3 CM authentication procedure

This procedure is performed when a CM receives a request to start operation. It is shown in Figure 9.

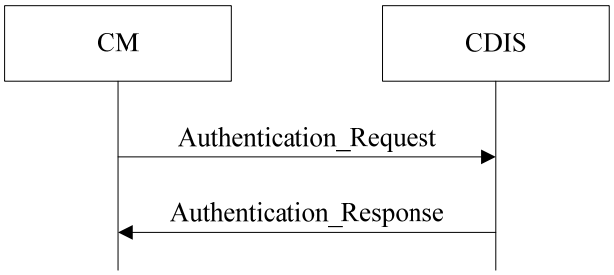

Figure 9—CM authentication procedure

6.1.1.4 CM deauthentication procedure

This procedure is performed when CM receives request to stop operation. It is shown in Figure 10.

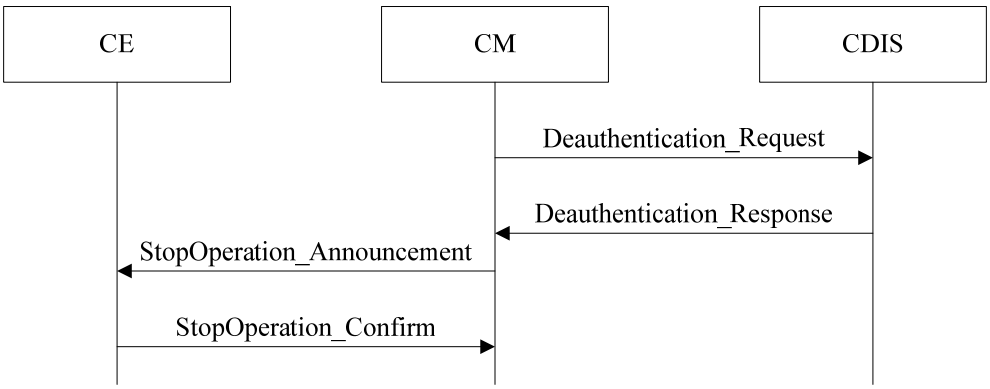

Figure 10—CM deauthentication procedure

6.1.2 Coexistence service subscription procedures

This set includes the following procedures:

— TVBD network or device subscription procedure
— TVBD network or device subscription update procedure.

6.1.2.1 TVBD network or device subscription procedure

This procedure is performed after the TVBD network or device authentication procedure. It is shown in Figure 11.

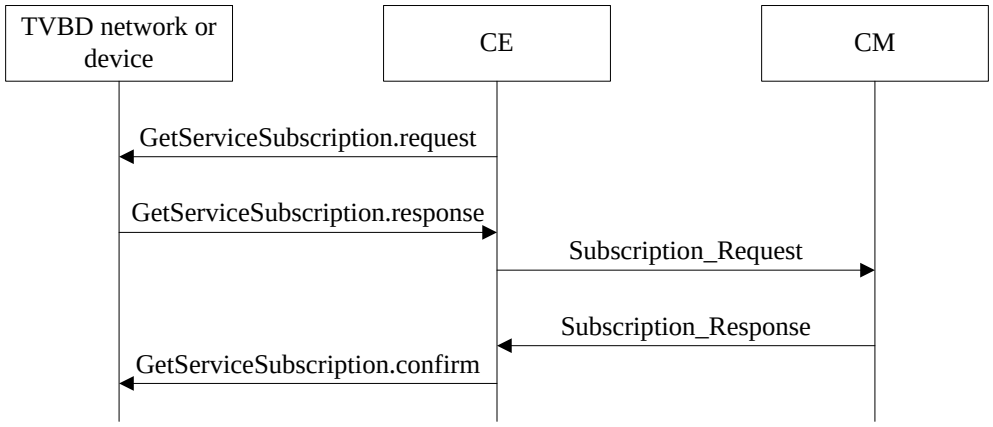

Figure 11—TVBD network or device subscription procedure

6.1.2.2 TVBD network or device subscription update procedure

This procedure is performed when the TVBD network or device wants to change the service it receives from the coexistence system. It is shown in Figure 12.

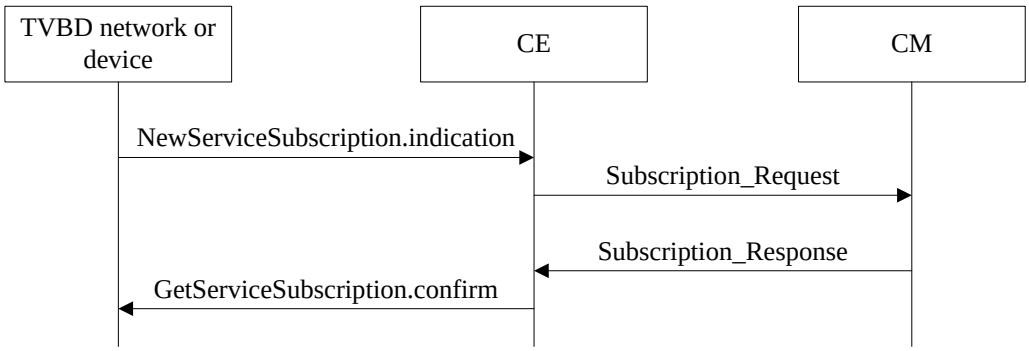

Figure 12—TVBD network or device subscription update procedure

6.1.3 Providing registration information procedures

This set includes the following procedures:

- TVBD network or device registration procedure
- TVBD network or device registration update procedure.

6.1.3.1 TVBD network or device registration procedure

This procedure is performed after the TVBD network or device subscription procedure. It is shown in Figure 13.

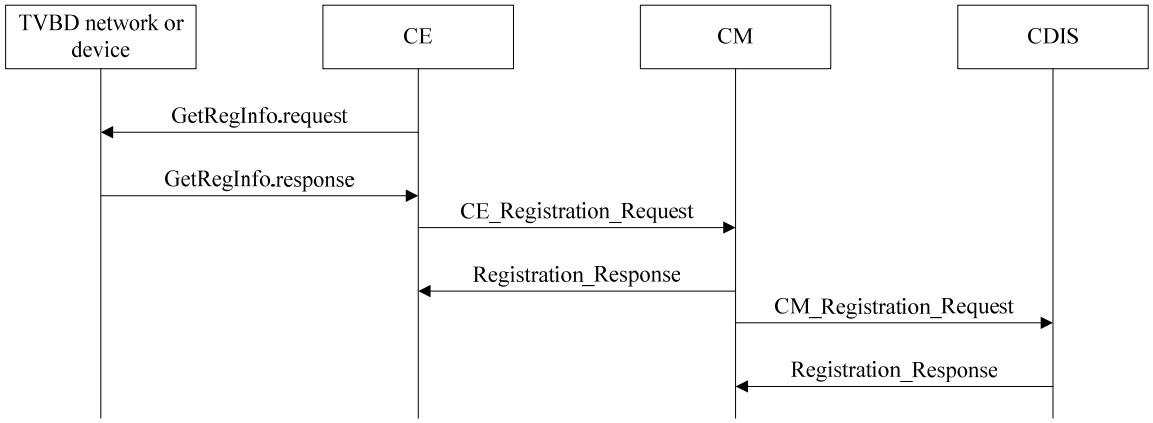

Figure 13—TVBD network or device registration procedure

6.1.3.2 TVBD network or device registration update procedure

This procedure is performed when the TVBD network or device registration information is changed. It is shown in Figure 14.

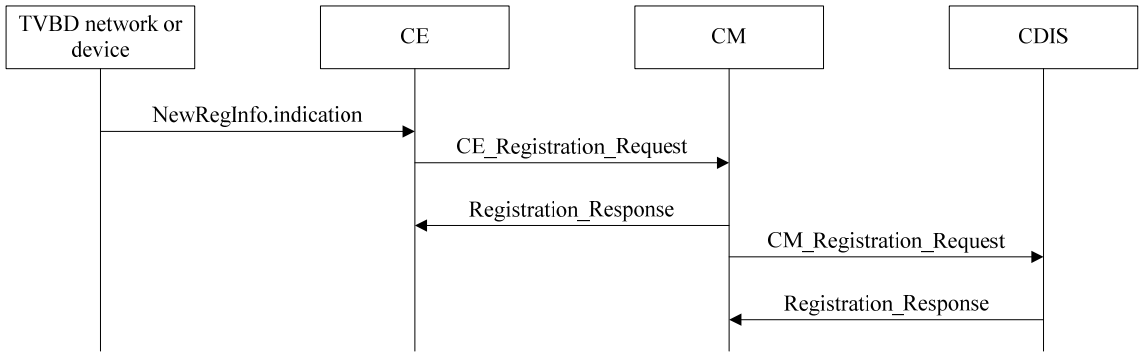

Figure 14—TVBD network or device registration update procedure

6.1.4 Providing neighbor report procedure

This procedure is performed when neighbor information is changed for one or several TVBD networks or devices of a CM. It is shown in Figure 15 with only one CE and TVBD network or device illustrated. The neighbor report is carried over to a CE and a TVBD network or device subsequently only if the TVBD network or device is subscribed to the information service.

Figure 15—Providing neighbor report procedure

6.1.5 Obtaining available channel list procedures

This set includes the following procedures:

- Obtaining an available channel list from a TVBD network or device procedure
- Announcing an available channel list change by a TVBD network or device procedure
- Obtaining an available channel list from a TVWS database procedure
- Announcing an available channel list change by a TVWS database procedure.

6.1.5.1 Obtaining available channel list from TVBD network or device procedure

This procedure is performed when a CM obtains a list of available channels from a TVBD network or device. It is shown in Figure 16.

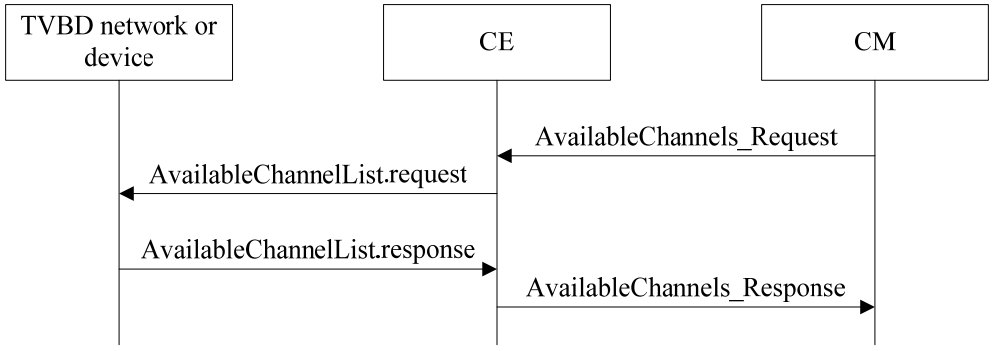

Figure 16—Obtaining available channel list from TVBD network or device procedure

6.1.5.2 Announcing available channel list change by TVBD network or device procedure

This procedure is performed when a CM has previously requested a TVBD network or device to provide a list of available channels and this list is changed. It is shown in Figure 16.

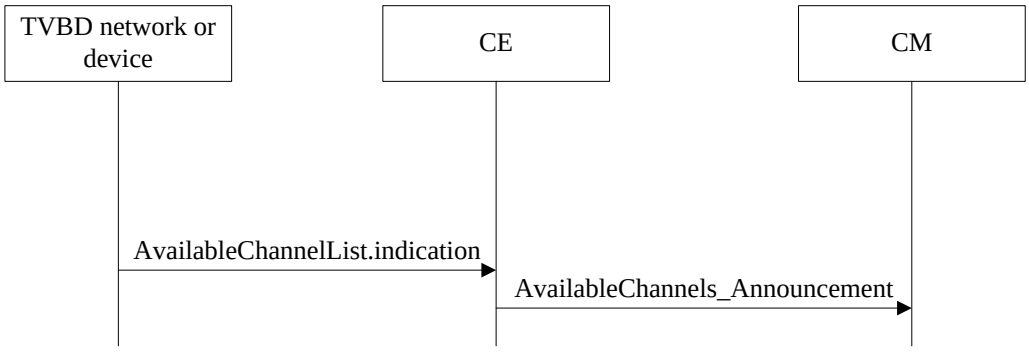

Figure 17—Announcing available channel list change by TVBD network or device procedure

6.1.5.3 Obtaining available channel list from TVWS database procedure

This procedure is performed when a CM obtains a list of available channels from a TVWS database. It is shown in Figure 18.

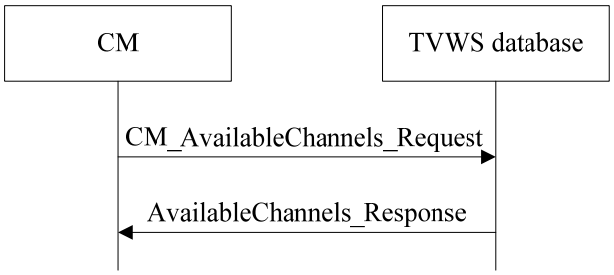

Figure 18—Obtaining available channel list from TVWS database procedure

6.1.5.4 Announcing available channel list change by TVWS database procedure

This procedure is performed when a CM has previously requested a TVWS database to provide list of available channels and this list is changed. It is shown in Figure 19.

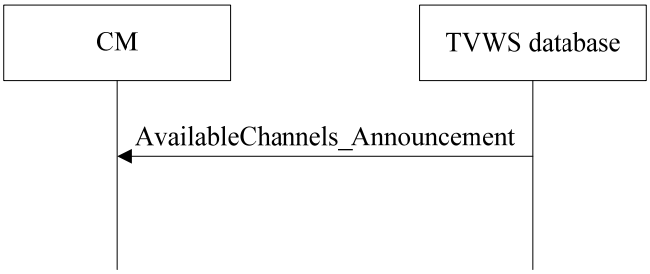

Figure 19—Announcing available channel list change by TVWS database procedure

6.1.6 Obtaining information from TVBD network or device procedure

This procedure is performed when a CM wants to obtain information from a TVBD network or device. It is shown in Figure 20.

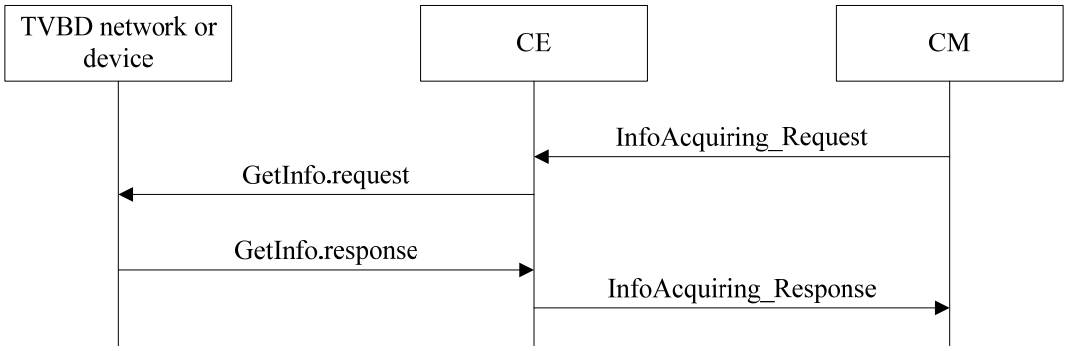

Figure 20—Obtaining information from TVBD network or device procedure

6.1.7 Obtaining information from another CM procedure

This procedure is performed when a CM wants to obtain information from another CM. It is shown in Figure 21.

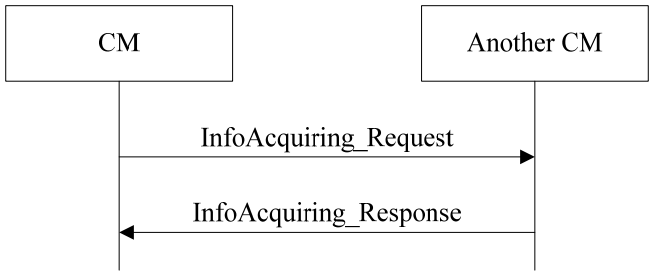

Figure 21—Obtaining information from another CM procedure

6.1.8 Sharing neighbor information procedure

This procedure is performed when a CM needs to share TVBD network or device information with another CM that serves a neighbor TVBD network or device. It is shown in Figure 22.

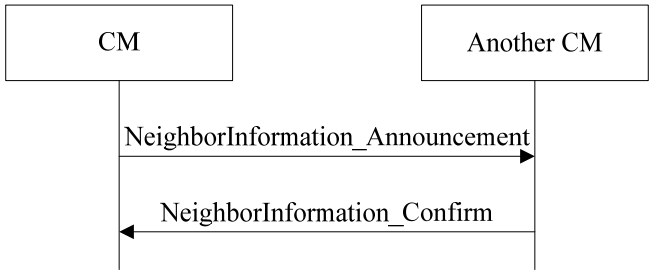

Figure 22—Sharing neighbor information procedure

6.1.9 Requesting and obtaining measurement procedures

This set includes the following procedures:

- Requesting measurement procedure
- Obtaining one-time measurement procedure
- Obtaining scheduled measurement procedure.

6.1.9.1 Requesting measurement procedure

This procedure is performed when a CM wants to obtain measurement results from a TVBD network or device. The CM requests the TVBD to perform measurements and provide measurement reports either once per the request or on schedule basis. The request procedure is shown in Figure 23.

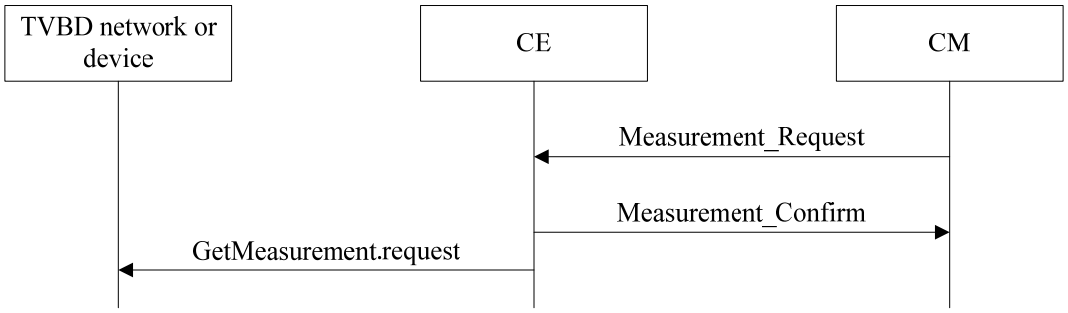

Figure 23—Requesting measurement procedure

6.1.9.2 Obtaining one-time measurement procedure

This procedure is performed when a CM has requested a one-time measurement from a TVBD network or device. It is shown in Figure 24.

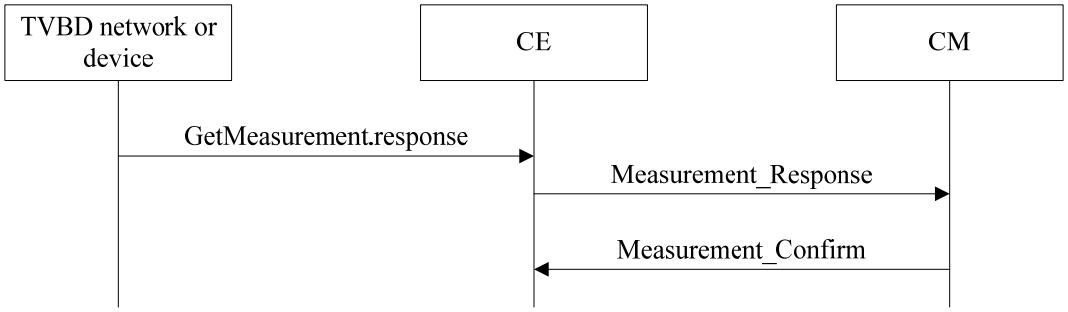

Figure 24—Obtaining one-time measurement procedure

6.1.9.3 Obtaining scheduled measurement procedure

This procedure is performed when a CM has requested scheduled measurements from a TVBD network or device. It is shown in Figure 25.

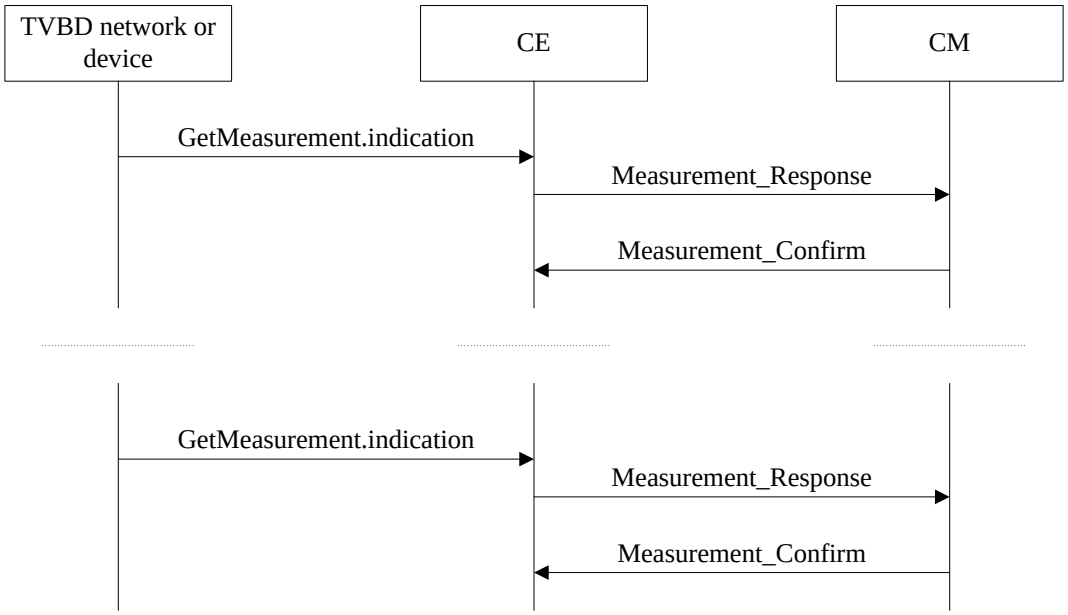

Figure 25—Obtaining scheduled measurement procedure

6.1.10 Reconfiguration procedure

This procedure is performed when a CM has made a coexistence decision that requires reconfiguration of the TVBD network or device. It is shown in Figure 26.

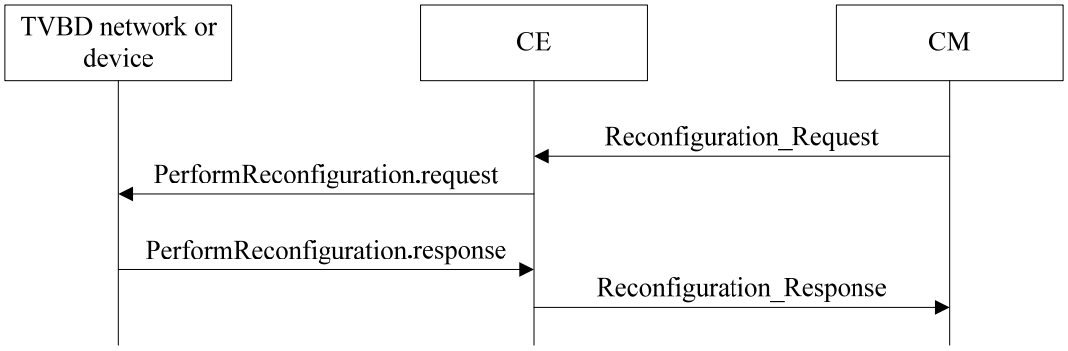

Figure 26—Reconfiguration procedure

6.2 Messages

6.2.1 Authentication and deauthentication procedure messages

6.2.1.1 Authentication_Request

This message is sent from a CE to a CM to login to the CM. Also, this message is sent from a CM to a CDIS to login to the CDIS.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID or CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID or CDIS_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
clientID	IA5String	Client ID (client is a CE or a CM)
clientPassword	IA5String	Client password

6.2.1.2 Authentication_Response

This message is sent from a CM to a CE to confirm or reject a CE authentication. Also, this message is sent from a CDIS to a CM to confirm or reject a CM authentication.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID or CDIS_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID or CM_ID	CX_ID	Destination identifier
ACK Policy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
serverID	IA5String	Server ID (server is a CM or a CDIS)
serverPW	IA5String	Server password (server is a CM or a CDIS)
status	BOOLEAN	Status: successful or not

6.2.1.3 Deauthentication_Request

This message is sent from a CE to a CM to log off from the CM. Also, this message is sent from a CM to a CDIS to log off from the CDIS.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID or CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier

or CDIS_ID		
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
clientID	IA5String	Client ID (client is a CE or a CM)
clientPW	IA5String	Client password (client is a CE or a CM)

6.2.1.4 Deauthentication_Response

This message is sent from a CM to a CE to confirm or reject a CE deauthentication. Also, this message is sent from a CDIS to a CM to confirm or reject a CM deauthentication.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID or CDIS_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID or CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
serverID	IA5String	Server ID (server is a CM or a CDIS)
serverPW	IA5String	Server password (server is a CM or a CDIS)
status	BOOLEAN	Status: successful or not

6.2.1.5 StopOperation_Announcement

This message is sent from a CM to a CE to notify the CE that the CM stops its operation.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.1.6 StopOperation_Confirm

This message is sent from a CE to a CM to confirm reception of the StopOperation_Announcement from the CM.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception

Payload		
Information element	*Data type*	*Description*
None		

6.2.2 Coexistence service subscription procedure messages

6.2.2.1 Subscription_Request

This message is sent from a CE to a CM to subscribe a TVBD network or device to a coexistence service.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
subscribedService	SubscribedService	Subscribed coexistence service (information or management)

6.2.2.2 Subscription_Response

This message is sent from a CM to a CE to confirm or reject a TVBD network's or device's coexistence service subscription.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACK Policy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
status	BOOLEAN	Status: successful or not

6.2.3 Providing registration information procedure messages

6.2.3.1 CE_Registration_Request

This message is sent from a CE to a CM to register information of a TVBD network or device served by this CE to the CM. This message is used for initial registration and for registration update.

Header		
Information element	*Data type*	*Description*
SourceIdentifier = CE_ID	CX_ID	Source identifier
DestinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		

Information element	*Data type*	*Description*
operationCode	OperationCode	Indicates whether this is a new registration or registration update
networkID	NetworkID	E.g., BSS ID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
networkType	NetworkType	E.g., fixed, mode 2
discoveryInformation	DiscoveryInformation	Information for discovery
listOfSupportedFrequencies	ListOfSupportedFrequencies	List of supported frequencies
listOfOperatingFrequencies	ListOfOperatingFrequencies	List of operating frequencies including occupancy information
minTxPower	REAL	Minimum transmission power
txScheduleSupported	BOOLEAN	Indicates whether scheduled transmission is supported or not
radioEnvironmentInformation	RadioEnvironmentInformation OPTIONAL	Information on radio environment as observed by this TVBD network or device

6.2.3.2 Registration_Response

This message is sent from a CM to a CE to confirm the registration.

Header		
Information element	*Data type*	*Description*
SourceIdentifier = CM_ID	CX_ID	Source identifier
DestinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.3.3 CM_Registration_Request

This message is sent from a CM to a CDIS to register information of a TVBD networks or devices served by this CM to the CDIS. This message is used for initial registration, for registration update and to remove a TVBD network or device from the CDIS. This message includes registration information of one or several TVBD networks or devices.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CDIS_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
Note: For each TVBD network or device, the information elements below are repeated.		
operationCode	OperationCode	Indicates whether this is new registration, registration update or deletion of a TVBD network or device
networkID	NetworkID	E.g., BSS ID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
networkType	NetworkType	E.g., fixed, mode 2

discoveryInformation	DiscoveryInformation	Information for discovery
listOfSupportedFrequencies	ListOfSupportedFrequencies	List of supported frequencies

6.2.3.4 CM_Registration_Response

This message is sent from a CDIS to a CM to confirm a registration.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CDIS_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.4 Providing neighbor report procedure messages

6.2.4.1 NeighborList_Announcement

This message is sent from a CDIS to a CM to provide neighbor information regarding a TVBD network or device or multiple of them served by this CM.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CDIS_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
Note: Information elements below are repeated for each neighbour CM.		
neighbourCMID = CM_ID	CX_ID	Neighbour CM ID
Note: Information elements below are repeated for each neighbour TVBD network or device.		
networkID	NetworkID	E.g., BSSID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
interferenceDirection	InterferenceDirection	Mutual, source or victim
interferenceLevelFromNeighbor	REAL	Estimated worst case interference level caused by the neighbor
interferenceLevelToNeighbor	REAL	Estimated worst case interference level caused by the TVBD network or device for which neighbors are reported

6.2.4.2 NeighborReport_Announcement

This message is sent from a CM to a CE to provide a neighbor report.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement

		of reception
Payload		
Information element	*Data type*	*Description*
Note: Information elements below are repeated for each neighbor TVBD network or device.		
networkID	NetworkID	E.g., BSSID
networkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
interferenceDirection	InterferenceDirection	Mutual, source or victim
interferenceLevelFromNeighbor	REAL	Estimated worst case interference level caused by the neighbor
interferenceLevelToNeighbor	REAL	Estimated worst case interference level caused by the TVBD network or device for which neighbors are reported
listOfOperatingFrequencies	ListOfOperatingFrequencies	List of operating frequencies
radioEnvironmentInformation	RadioEnvironmentInformation OPTIONAL	Radio environment information

6.2.5 Obtaining available channel list procedure messages

6.2.5.1 AvailableChannels_Request

This message is sent from a CM to a CE to request an available channel list from the CE.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.5.2 CM_AvailableChannels_Request

This message is sent from a CM to a TVWS DB to request an available channel list for a particular TVBD network or device.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = TVWSDB_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
requestedTimeStamp	TIME	Time of the request
deviceFCCID		FCC ID of the TVBD network or device
deviceSN		Serial number of the TVBD network or device
deviceLocation	DeviceLocation	Location of the TVBD network or device
antennaHeight	REAL	Antenna height of the TVBD network

		or device
networkType	NetworkType	E.g., fixed mode 2
…		

6.2.5.3 GetAvailableChannels_Response

This message is sent from a CE to a CM to provide an available channel list. Also, this message is sent from TVWS DB to a CM to provide an available channel list to the CM.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID or TVWSDB_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
Note: Information elements below are repeated for each available frequency.		
startFreq	REAL	Start frequency
stopFreq	REAL	Stop frequency
txPowerLimit	REAL	Transmit power limit

6.2.5.4 AvailableChannels_Announcement

This message is sent from a CE /TVWS DB to a CM to provide an available channel list.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID or TVWSDB_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
Note: Information elements below are repeated for each available piece of frequency.		
networkID	NetworkID OPTIONAL	E.g., BSSID
startFreq	REAL	Start frequency
stopFreq	REAL	Stop frequency
txPowerLimit	REAL	Transmit power limit

6.2.6 Obtaining information from TVBD network or device and from another CM procedures messages

6.2.6.1 InfoAcquiring_Request

This message is sent from a CM to a CE to request the CE to obtain information from the TVBD network or device. Also, this message is sent from a CM to another CM to request information about neighbor TVBD networks or devices.

Header		
Information element	*Data type*	*Description*

sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID or CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
reqInfoDescr	ReqInfoDescr	ID of the requested information

6.2.6.2 InfoAcquiring_Response

This message is sent from a CE/CM to a CM to provide requested information.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID or CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
reqInfoValue	ReqInfoValue	Requested information

6.2.7 Sharing neighbor information procedure messages

6.2.7.1 NeighborInformation_Announcement

This message is sent from a CM to another CM to share information about neighbor TVBD network or device.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
sourceTVBDIdentifier	CX_ID	CE_ID of the TVBD network or device served by the source CM
sourceNetworkTechnology	NetworkTechnology	E.g., 802.11af, 802.22
sourceListOfSupportedFrequencies	ListOfSupportedFrequencies	List of supported frequencies
sourceListOfOperatingFrequencies	ListOfOperatingFrequencies	List of operating frequencies
sourceNetworkCapabilities	NetworkCapabilities	Device and network capabilities that have an effect on coexistence decision making
sourceSubscribedService	SubscribedService	Coexistence service subscription
managingCM	BOOLEAN	Indicates whether this TVBD network or device shall be managed by source CM or destination CM

6.2.7.2 NeighborInformation_Confirm

This message is sent from a CM to another CM to cofirm reception of the NeighborInformation_Announcement message.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.8 Requesting and obtaining measurement procedure messages

6.2.8.1 Measurement_Request

This message is sent from a CM to a CE to request the CE to request the TVBD network or device to perform measurements.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
measurementDescription	MeasurementDescription	Measurement description

6.2.8.2 Measurement_Response

This message is sent from a CE to a CM to report measurement results.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
measurementResult	MeasurementResult	Measurement results

6.2.8.3 Measurement_Confirm

This message is sent from a CE to a CM to confirm reception of a measurement request. This message is also sent from a CM to a CE to confirm reception of measurement results.

Header		
Information element	*Data type*	*Description*

sourceIdentifier = CE_ID or CM_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID or CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
None		

6.2.9 Reconfiguration procedure messages

6.2.9.1 Reconfiguration_Request

This message is sent from a CM to a CE to request reconfiguration of the TVBD network or device served by this CE.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CM_ID	CX_ID	Source identifier
destinationIdentifier = CE_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
reconfigurationRequest	ReconfigurationRequest	Reconfiguration request description

6.2.9.2 Reconfiguration_Response

This message is sent from a CE to a CM to report the result of the requested reconfiguration of the TVBD network or device served by this CE.

Header		
Information element	*Data type*	*Description*
sourceIdentifier = CE_ID	CX_ID	Source identifier
destinationIdentifier = CM_ID	CX_ID	Destination identifier
ACKPolicy	BOOLEAN	Request to send an acknowledgement of reception
Payload		
Information element	*Data type*	*Description*
status	BOOLEAN	Status: successful or not

6.3 Data types

```
CX_ID ::= ENUMERATED{
    CE_ID,
    CM_ID,
    CDIS_ID,
    TVWSDB_ID
```

```
}
OperationCode ::= ENUMERATED{
    New,
    Add,
    Modify,
    Remove
}

SubscribedService::= ENUMERATED{
    information,
    management
}

NetworkID::= ENUMERATED{
    BSSID,
    …
}

NetworkTechnology ::= ENUMERATED{
    IEEE802.11af,
    IEEE802.22,
    ECMA392,
    …
}

NetworkType ::= ENUMERATED{
    fixed,
    mode2,
```

```
    …
}

DiscoveryInformation ::= SEQUENCE{
    coordinateX      REAL,
    coordinateY      REAL,
    coordinateZ      REAL,
    maxTxPower       REAL,
    rxSensitivity    REAL,
    antennaGain      REAL,
    minReqSNR        REAL,
    …
}

ListOfSupportedFrequencies ::= SEQUENCE OF SEQUENCE{
    startFreq    REAL,
    stopFreq     REAL
}

ListOfOperatingFrequencies ::= SEQUENCE OF SEQUENCE{
    startFreq          REAL,
    stopFreq           REAL,
    occupancy          REAL,
    totalOccupancy     REAL OPTIONAL
}

FreqDescription ::= SEQUENCE{
    networkID              NetworkID    OPTIONAL,
```

```
    networkTechnology     NetworkTechnology    OPTIONAL,
    coexType              ENUMERATED{known, unknown},
    interferenceDirection ENUMERATED{mutual, source, victim},
    occupancy             REAL OPTIONAL,
    totalOccupancy        REAL OPTIONAL
}

RadioEnvironmentInformation ::= SEQUENCE OF SEQUENCE{
    startFreq             REAL,
    stopFreq              REAL,
    state                 ENUMERATED{free, occupiedKnown, occupiedUnknown, notMeasured},
    freqDescription       FreqDescription    OPTIONAL
}

ReqInfoDescr ::= SEQUENCE OF ENUMERATED{
    SINR,
    desiredBandwidth,
    desiredOccupancy,
    …
}

ReqInfoValue ::= SEQUENCE OF SEQUENCE{
    reqInfoDescr    ReqInfoDescr,
    reqInfoValue    CHOICE{SINRValue    REAL, desiredBandwidth    REAL,
                           desiredOccupancy    REAL, otherValue    ANY}
}

MeasSchedule ::= SEQUENCE {
```

```
    measStartTime                REAL,
    numberOfMeasurements         INTEGER,
    timeBetweenMeasurements      REAL
}

MeasurementDescription ::= SEQUENCE OF SEQUENCE{
    measDescr    ENUMERATED{SINR, …},
    measSchedule    MeasSchedule
}

MeasurementResult ::= SEQUENCE OF SEQUENCE{
    reqInfoDescr    ReqInfoDescr,
    reqInfoValue    CHOICE{SINRValue    REAL, otherValue    ANY}
}

TxSchedule ::= SEQUENCE {
    scheduleStartTime                REAL,
    scheduleDuration                 REAL,
    numberOfScheduleRepetitions      INTEGER,
    transmissionStartTime            REAL,
    transmissionDuration             REAL
}

ReconfigurationRequest ::= SEQUENCE OF SEQUENCE {
    operatingFrequency    SEQUENCE{startFeq    REAL, stopFreq    REAL},
    txPowerLimit          REAL,
    channelIsShared       BOOLEAN,
    txSchedule            SEQUENCE OF TxSchedule OPTIONAL
```

}

7. Coexistence mechanisms and algorithms

7.1 CE operation

Figure 27 shows states of CE operation.

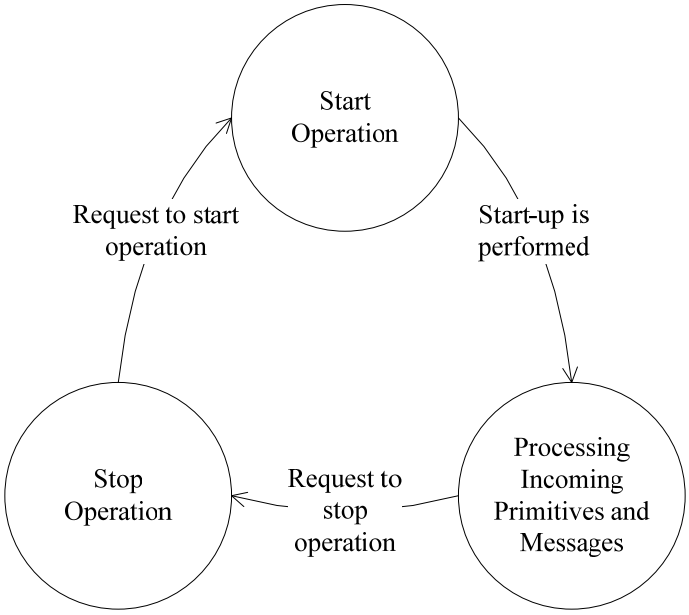

Figure 27 —States of CE operation

The following is assumed for CE operation:

— A CE knows network address of a CM

— The CM is operating

— The CM is connected to a CDIS.

A CE has three states:

— Start Operation

— Processing Incoming Primitives and Messages

— Stop Operation.

A CE switches to the Start Operation state from the Stop Operation state when it receives a request to start operation. Such a request may be received as an example from the TVBD network or device management entity. In the Start Operation state the CE performs start-up and then switches to the Processing Incoming Primitives and Messages state.

In the Processing Incoming Primitives and Messages state the CE processes primitives from the TVBD network or device and messages from the CM. The CE remains in this state until it receives a request to

stop operation. Such a request may be received as an example from the TVBD network or device management entity. When such a request is received, the CE switches to the Stop Operation state.

In the Stop Operation state the CE performs deauthentication of its TVBD network or device in the coexistence system. After this, the CE remains in this state until it receives a request to start operation.

The states are not binding in implementation but they are introduced here merely for illustrative purposes and to make the CE description easy to understand. Only the rules related to processing of received messages and actions upon their reception are binding and normative if so specified.

Error case handling is on default implementation dependent. Unless explicitly mentioned, error handling depends on implementation. The error case handlings described in the sub-clauses of this clause are exemplary and not binding.

7.1.1 CE operation in Start Operation state

Figure 28 shows CE operation in the Start Operation state.

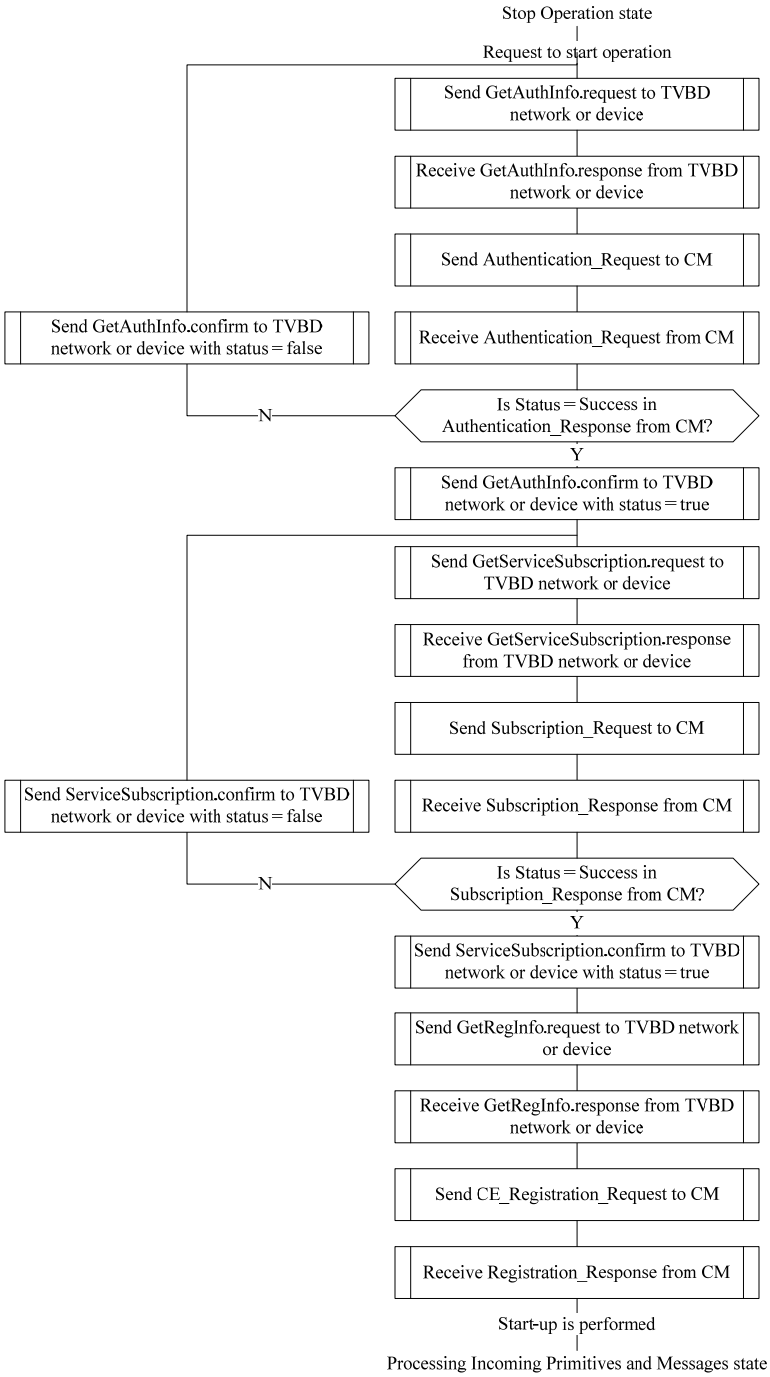

Figure 28 —CE operation in the Start Operation state

After entering this state, the CE performs the following operations:

— Obtains authentication information from the TVBD network or device

— Performs authentication of the TVBD network or device in the coexistence system

— Obtains service subscription information from the TVBD network or device

— Performs service subscription to the CM

- Obtains registration information from the TVBD network or device
- Performs registration of the TVBD network or device in the coexistence system.

After that, the CE switches to the Processing Incoming Primitives and Messages state.

7.1.2 CE operation in the Processing Incoming Messages and Primitives state

7.1.2.1 TVBD network or device is subscribed to the information service

Figure 29 shows CE operation in the Processing Incoming Messages and Primitives state when its TVBD network or device is subscribed to the information service.

The CE expects only the following messages or primitives (no actions are taken if any other messages or primitives are received):

- Primitives from the TVBD network or device
  - NewRegInfo.indication
  - NewServiceSubscription.indication
  - Event.indication
- Messages from the CM
  - Neighbor_Report
  - Event_Indication
  - Registration_Response
  - Subscription_Response
  - Event_Confirm.

Anytime the CE receives a request to stop operation as an example from the TVBD network or device management entity, it switches to the Stop Operation state.

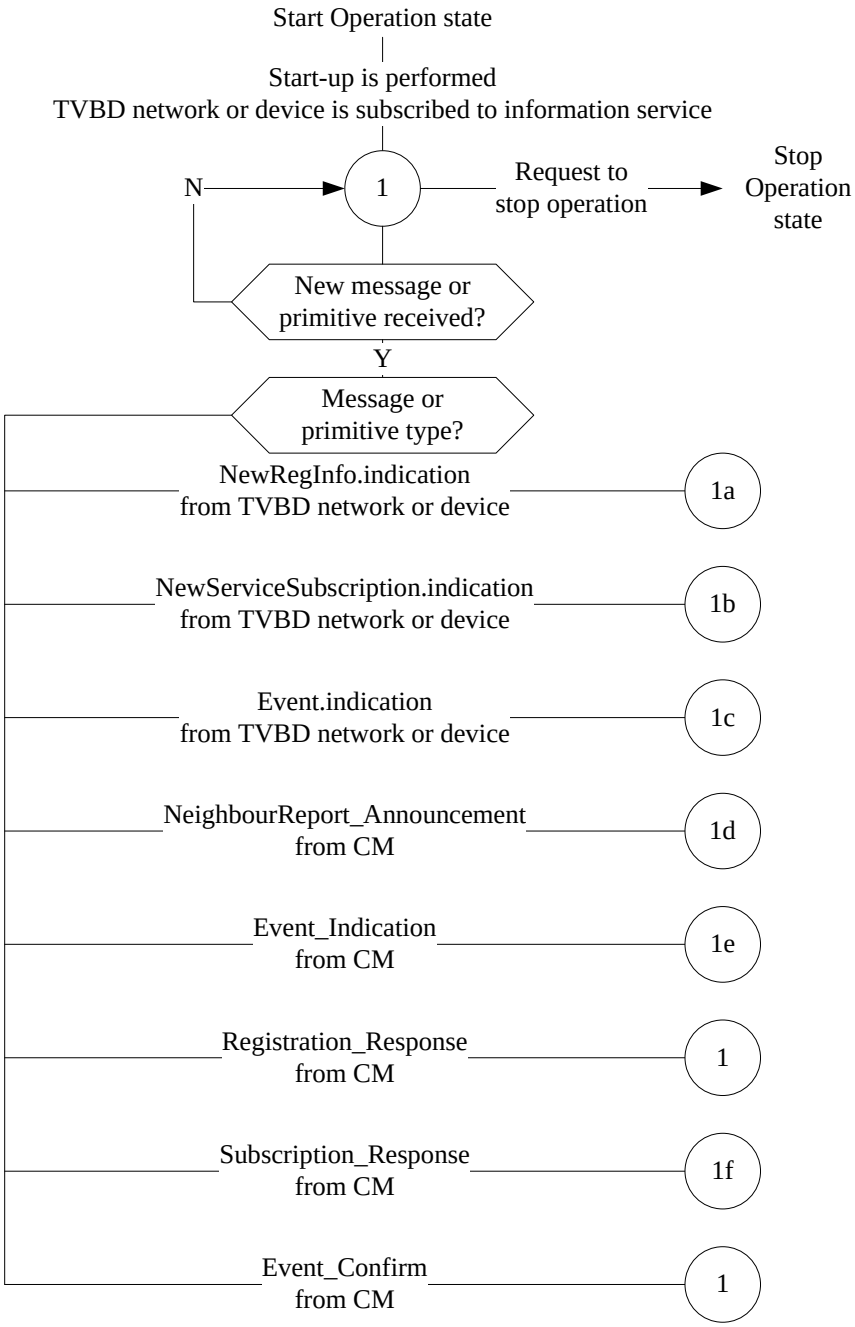

Figure 29 —CE operation in the Processing Incoming Messages and Primitives state when its TVBD network or device is subscribed to the information service

7.1.2.1.1 Processing a NewRegInfo.indication primitive from TVBD network or device

Figure 30 shows CE operation upon reception of a NewRegInfo.indication primitive from the TVBD network or device. Upon receiving a NewRegInfor.indication primitive the CE shall send a CE_Registration_Request message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Registration_Response message from the CM. If a

Registration_Response message from the CM is not received within a certain time, the CE may resend the CE_Registration_Request to the CM.

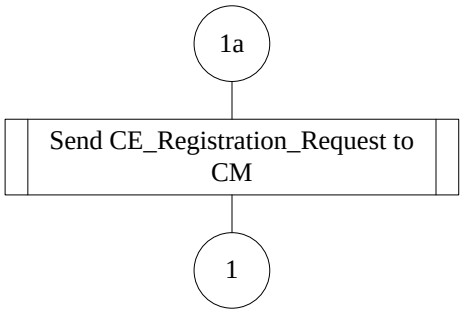

Figure 30 —Processing a NewRegInfo.indication primitive from TVBD network or device

7.1.2.1.2 Processing a NewServiceSubscription.indication primitive from TVBD network or device

Figure 31 shows CE operation upon reception of a NewServiceSubscription.indication primitive from the TVBD network or device. Upon receiving a NewServiceSubscription.indication primitive the CE shall send a Subscription_Request message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Subscription_Response message from the CM. If a Subscription_Response message from the CM is not received within a certain time, the CE may resend the Subscription_Request to the CM.

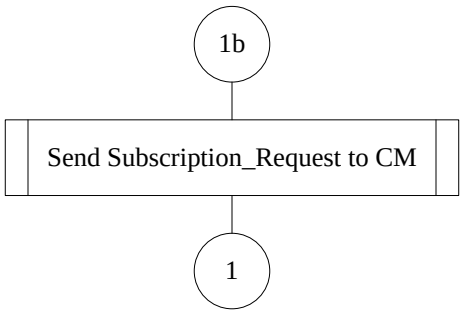

Figure 31 —Processing a NewServiceSubscription.indication primitive from TVBD network or device

7.1.2.1.3 Processing an Event.indication primitive from TVBD network or device

Figure 32 shows CE operation upon reception of an Event.indication primitive from the TVBD network or device. Upon receiving an Event.indication primitive the CE shall send an Event_Indication message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Event_Confirm message from the CM. If an Event_Confirm message from CM is not received within a certain time, the CE may resend the Event_Indication to the CM.

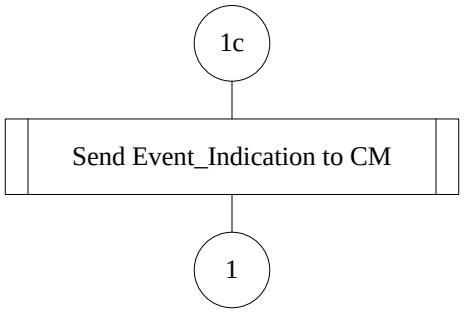

Figure 32 —Processing an Event.indication primitive from TVBD network or device

7.1.2.1.4 Processing a NeighborReport_Announcement message from CM

Figure 33 shows CE operation upon reception of a NeighborReport_Announcement message from the CM. Upon receiving a NeighborReport_Announcement message the CE sends a NeighborReport.indication primitive to the TVBD network or device and continues to check for incoming messages and primitives.

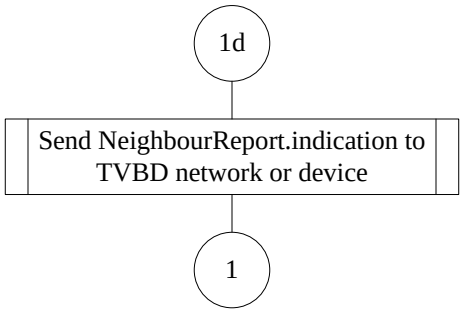

Figure 33 —Processing a NeighborReport_Announcement message from CM

7.1.2.1.5 Processing an Event_Indication message from CM

Figure 34 shows CE operation upon reception of an Event_Indication message from the CM. Upon receiving an Event_Indication message the CE shall first send an Event_Confirm message to the CM in order to confirm the reception of the Event_Indication message. Then the CE shall send an Event.indication primitive to the TVBD network or device and continues to check for incoming messages and primitives.

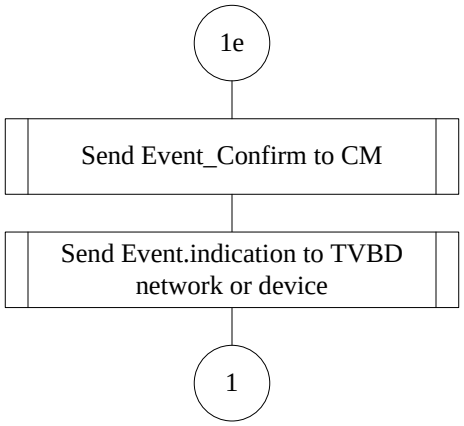

Figure 34 —Processing an Event_Indication message from CM

7.1.2.1.6 Processing a Registration_Response message from CM

A Registration_Response message from the CM serves as a confirmation of a registration update of the TVBD network or device in the coexistence system. This finishes the processing of the corresponding NewRegInfo.indication primitive from the TVBD network or device.

7.1.2.1.7 Processing a Subscription_Response message from CM

Figure 35 shows CE operation upon reception of a Subscription_Response message from the CM. This message serves as a confirmation of the reception of a Subscription_Request by the CM. Upon reception of a Subscription_Response message the CE shall send a ServiceSubscription.confirm primitive to the TVBD network or device. If Status = true in the Subscription_Response message from the CM and the new subscribed service is management service, the CE adopts the management service as the new coexistence service of the TVBD network or device and continues to check for incoming messages and primitives. This finishes the processing of the corresponding NewServiceSubscription.indication primitive from TVBD network or device. Otherwise, the CE continues to check for incoming messages and primitives with the TVBD network or device subscribed to the information service

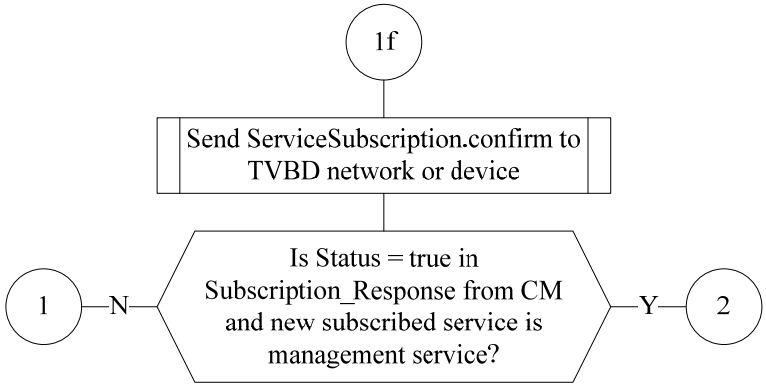

Figure 35 —Processing a Subscription_Response message from CM

7.1.2.1.8 Processing an Event_Confirm message from CM

An Event_Confirm message from the CM serves as a confirmation of reception of an Event_Indication by the CM. This finishes processing of the corresponding Event.indication primitive from the TVBD network or device.

7.1.2.2 TVBD network or device is subscribed to the management service

Figure 36 shows CE operation in the Processing Incoming Messages and Primitives state when its TVBD network or device is subscribed to the management service.

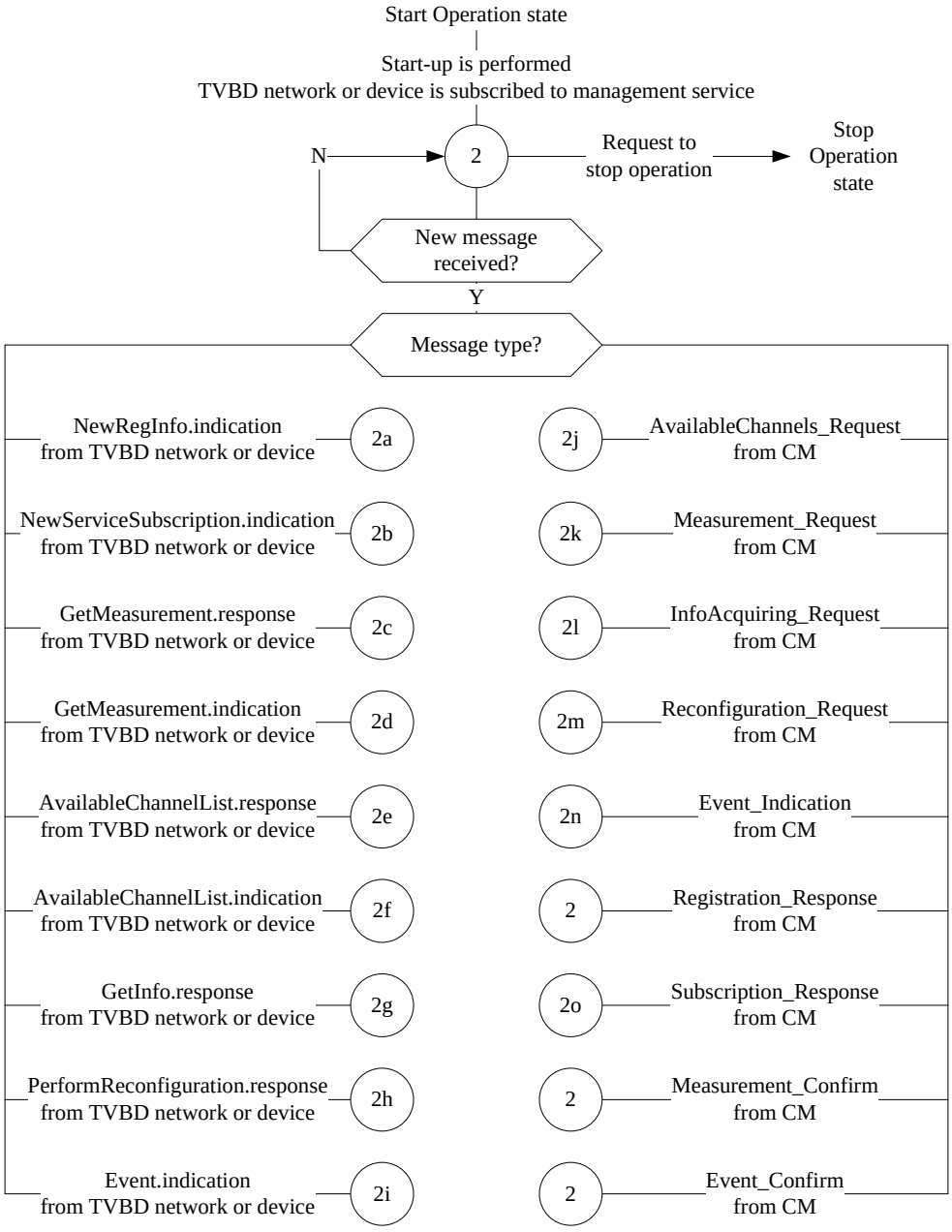

Figure 36 — CE operation in the Processing Incoming Messages and Primitives state when its TVBD network or device is subscribed to the management service

The CE expects only the following messages or primitives (no actions are taken if any other messages or primitives are received):

- Primitives from the TVBD network or device
  - NewRegInfo.indication
  - NewServiceSubscription.indication
  - GetMeasurement.response

- GetMeasurement.indication
- AvailableChannelList.response
- AvailableChannelList.indication
- GetInfo.response
- PerformReconfiguration.response
- Event.indication

— Messages from the CM

- AvailableChannels_Request
- Measurement_Request
- InfoAcquiring_Request
- Reconfiguration_Request
- Event_Indication
- Registration_Response
- Subscription_Response
- Measurement_Confirm
- Event_Confirm.

Anytime the CE receives a request to stop operation as an example from the TVBD network or device management entity, it switches to the Stop Operation state.

7.1.2.2.1 Processing a NewRegInfo.indication primitive from TVBD network or device

Figure 37 shows CE operation upon reception of a NewRegInfo.indication primitive from the TVBD network or device. Upon receiving a NewRegInfor.indication primitive the CE shall send a CE_Registration_Request message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Registration_Response message from the CM. If a Registration_Response message from the CM is not received within a certain time, the CE may resend the CE_Registration_Request to the CM.

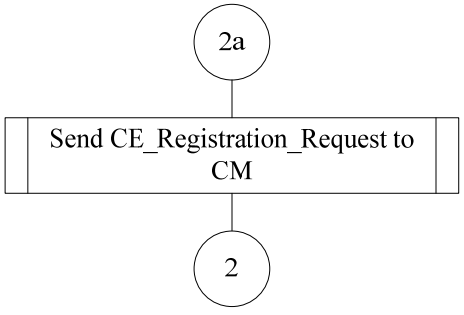

Figure 37 —Processing a NewRegInfo.indication primitive from TVBD network or device

7.1.2.2.2 Processing a NewServiceSubscription.indication primitive from TVBD network or device

Figure 38 shows CE operation upon reception of a NewServiceSubscription.indication primitive from the TVBD network or device. Upon receiving a NewServiceSubscription.indication primitive the CE shall send a Subscription_Request message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Subscription_Response message from the CM. If a Subscription_Response message from the CM is not received within a certain time, the CE may resend the Subscription_Request to the CM.

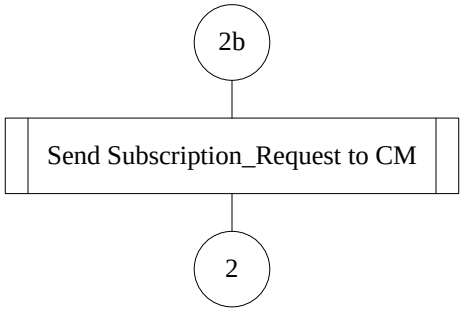

Figure 38 —Processing a NewServiceSubscription.indication primitive from TVBD network or device

7.1.2.2.3 Processing a GetMeasurement.response primitive from TVBD network or device

Figure 39 shows CE operation upon reception of a GetMeasurement.response primitive from the TVBD network or device. Upon receiving a GetMeasurement.response the CE shall send a Measurement_Response message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Measurement_Confirm message from the CM. If a Measurement_Confirm message from the CM is not received within a certain time, the CE may resend the Measurement_Response to the CM.

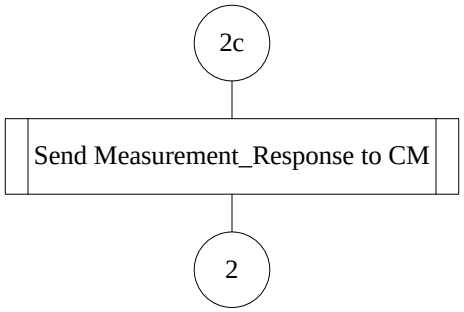

Figure 39 —Processing a GetMeasurement.response primitive from TVBD network or device

7.1.2.2.4 Processing a GetMeasurement.indication primitive from TVBD network or device

Figure 40 shows CE operation upon reception of a GetMeasurement.indication primitive from the TVBD network or device. Upon receiving a GetMeasurement.indication primitive the CE shall send a Measurement_Response message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Measurement_Confirm message from the CM. If a

Measurement_Confirm message from the CM is not received within a certain time, the CE may resend the Measurement_Response to the CM.

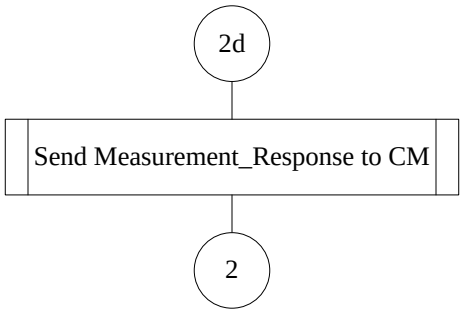

Figure 40 —Processing a GetMeasurement.indication primitive from TVBD network or device

7.1.2.2.5 Processing an AvailableChannelList.response primitive from TVBD network or device

Figure 41 shows CE operation upon reception of an AvailableChannelList.response primitive from the TVBD network or device. Upon receiving an AvailableChannelList.response primitive the CE shall send an AvailableChannels_Response message to the CM and continues to check for incoming messages and primitives.

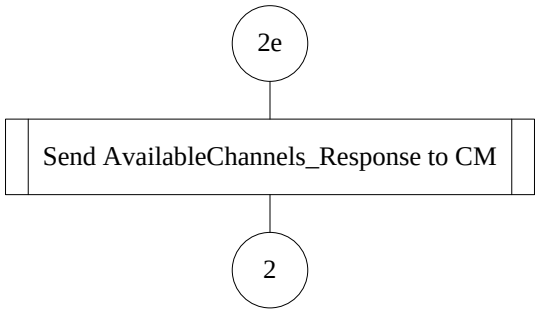

Figure 41 —Processing an AvailableChannelList.response primitive from TVBD network or device

7.1.2.2.6 Processing an AvailableChannelList.indication primitive from TVBD network or device

Figure 42 shows CE operation upon reception of an AvailableChannelList.indication primitive from the TVBD network or device. Upon receiving an AvailableChannelList.indication primitive the CE shall send an AvailableChannels_Announcement message to the CM and continues to check for incoming messages and primitives.

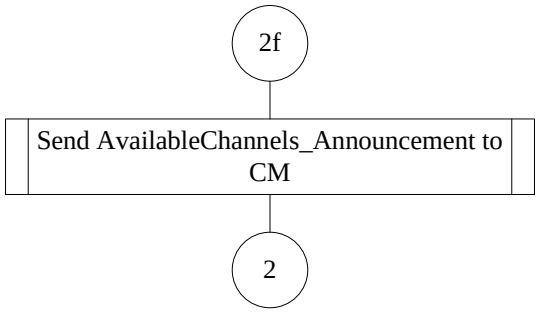

Figure 42 —Processing an AvailableChannelList.indication primitive from TVBD network or device

7.1.2.2.7 Processing a GetInfo.response primitive from TVBD network or device

Figure 43 shows CE operation upon reception of a GetInfo.response primitive from the TVBD network or device. Upon receiving a GetInfor.response the CE shall send an InfoAcquiring_Response message to the CM and continues to check for incoming messages and primitives.

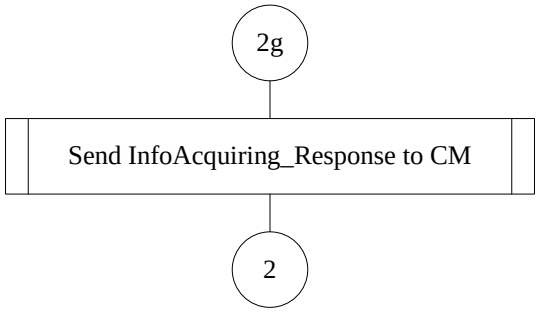

Figure 43 —Processing a GetInfo.response primitive from TVBD network or device

7.1.2.2.8 Processing a PerformReconfiguration.response primitive from TVBD network or device

Figure 44 shows CE operation upon reception of a PerformReconfiguration.response primitive from the TVBD network or device. Upon receiving a PerformReconfiguration.response primitive the CE shall send a Reconfiguration_Response message to the CM and continues to check for incoming messages and primitives.

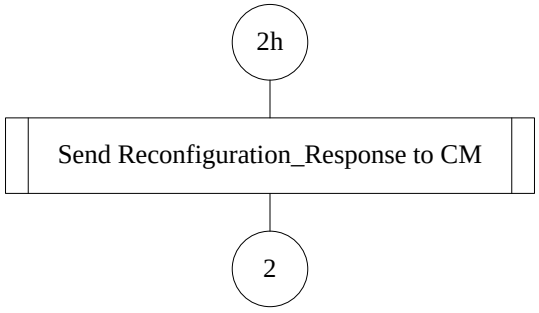

Figure 44 —Processing a PerformReconfiguation.response primitive from TVBD network or device

7.1.2.2.9 Processing an Event.indication primitive from TVBD network or device

Figure 45 shows CE operation upon reception of an Event.indication primitive from the TVBD network or device. Upon receiving an Event.indication primitive the CE shall send an Event_Indication message to the CM and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding Event_Confirm message from the CM. If an Event_Confirm message from the CM is not received within a certain time, the CE may resend the Event_Indication to the CM.

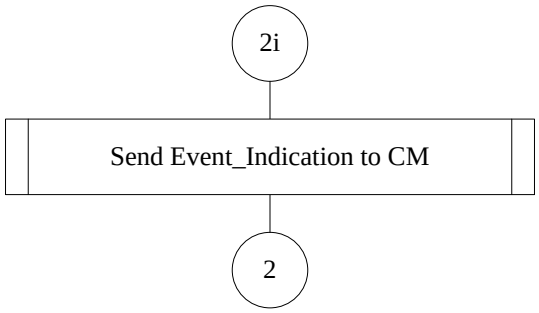

Figure 45 —Processing an Event.indication primitive from TVBD network or device

7.1.2.2.10 Processing an AvailableChannels_Request message from CM

Figure 46 shows CE operation upon reception of an AvailableChannels_Request message from the CM. Upon receiving an AvailableChannels_Request message the CE shall send an AvailableChannelList.request primitive to the TVBD network or device and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding AvailableChannelList.response primitive and AvailableChannelList.indication primitive from the TVBD network or device.

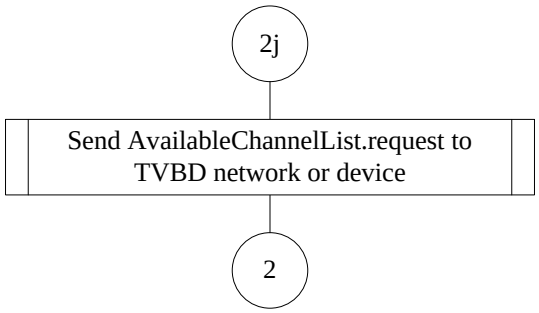

Figure 46 —Processing an AvailableChannels_Request message from CM

7.1.2.2.11 Processing a Measurement_Request message from CM

Figure 47 shows CE operation upon reception of a Measurement_Request message from the CM. Upon receiving a Measurement_Request messaget the CE shall first send a Measurement_Confirm message to the CM. Then the CE shall send a GetMeasurement.request primitive to the TVBD network or device and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding GetMeasurement.response or GetMeasurement.indication primitive from the TVBD network or device.

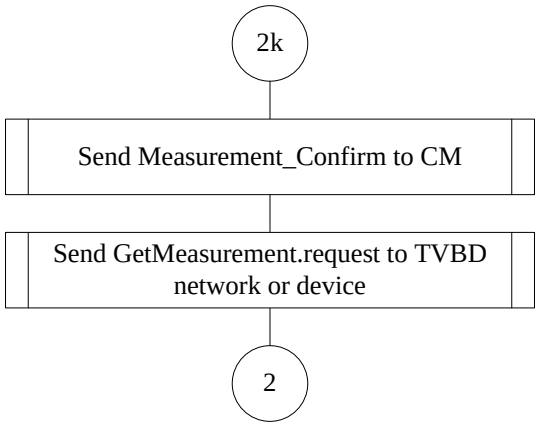

Figure 47 —Processing a Measurement_Request message from CM

7.1.2.2.12 Processing an InfoAcquiring_Request message from CM

Figure 48 shows CE operation upon reception of an InfoAcquiring_Request message from the CM. Upon receiving an InfoAcquiring_Request message the CE shall send a GetInfo.request primitive to the TVBD network or device and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding GetInfo.response primitive from the TVBD network or device.

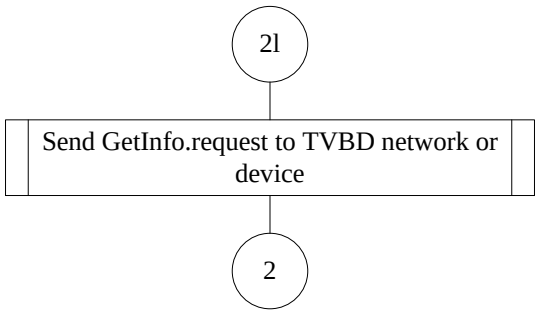

Figure 48 —Processing an InfoAcquiring_Request message from CM

7.1.2.2.13 Processing a Reconfiguration_Request message from CM

Figure 49 shows CE operation upon reception of a Reconfiguration_Request message from the CM. Upon receiving a Reconfiguration_Request message the CE shall send a PerformReconfiguration.request primitive to the TVBD network or device and continues to check for incoming messages and primitives. In parallel the CE waits for the corresponding PerformReconfiguration.response primitive from the TVBD network or device.

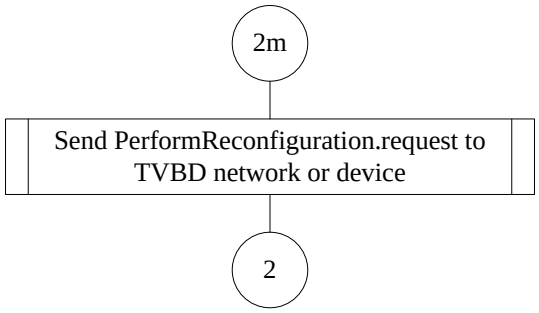

Figure 49 —Processing a Reconfiguation_Request message from CM

7.1.2.2.14 Processing an Event_Indication message from CM

Figure 50 shows CE operation upon reception of an Event_Indication message from the CM. Upon receiving an Event_Indication message the CE shall first sends an Event_Confirm message to the CM. Then the CE shall send an Event.indication primitive to the TVBD network or device and continues to check for incoming messages and primitives.

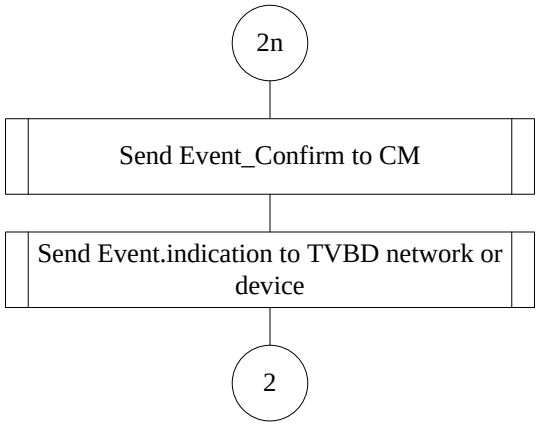

Figure 50 —Processing an Event_Indication message from CM

7.1.2.2.15 Processing a Registration_Response message from CM

A Registration_Response message from the CM serves as a confirmation of a registration update of the TVBD network or device in the coexistence system. This finishes the processing of the corresponding NewRegInfo.indication primitive from the TVBD network or device.

7.1.2.2.16 Processing a Subscription_Response message from CM

Figure 51 shows CE operation upon reception of a Subscription_Response message from the CM. This message serves as a confirmation of reception of the corresponding Subscription_Request by the CM. Upon receiving a Subscription_Response message the CE shall send a ServiceSubscription.confirm primitive to the TVBD network or device. If Status = true in the Subscription_Response message from the CM and the new subscribed service is information service, the CE adopts the information service as the new service of the TVBD network or device and continues to check for incoming messages and primitives. This finishes the processing of the corresponding NewServiceSubscription.indication primitive from TVBD network or

device. Otherwise, the CE continues to check for incoming messages and primitives with the TVBD network or device receiving the information service.

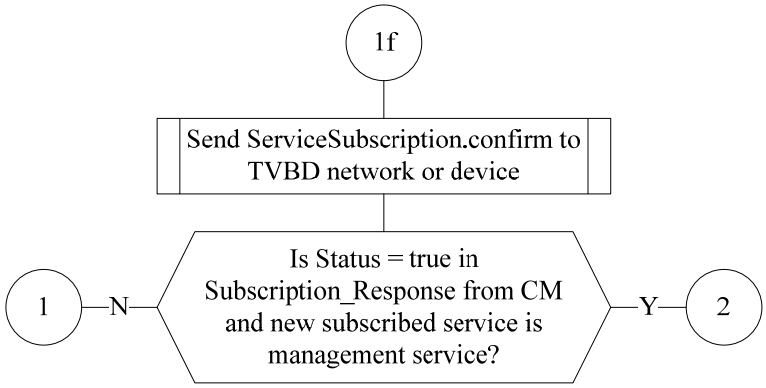

Figure 51 —Processing a Subscription_Response message from CM

7.1.2.2.17 Processing a Measurement_Confirm message from CM

A Measurement_Confirm message from the CM serves as a confirmation of reception of the measurement results from the TVBD network or device by the CM. This finishes the processing of the corresponding GetMeasurement.response or GetMeasurement.indication primitive from the TVBD network or device.

7.1.2.2.18 Processing an Event_Confirm message from CM

An Event_Confirm message from the CM serves as a confirmation of reception of the corresponding Event_Indication by the CM. This finishes the processing of the corresponding Event.indication primitive from the TVBD network or device.

7.1.3 CE operation in the Stop Operation state

Figure 52 shows CE operation in the Stop Operation state.

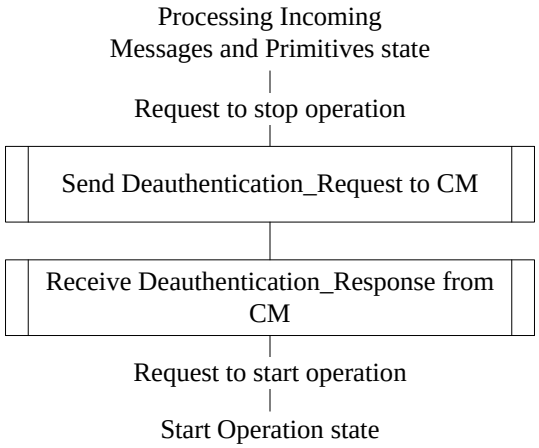

Figure 52 —CE operation in the Stop Operation state

After entering this state, the CE performs deauthentication of the TVBD network or device in the coexistence system. Then the CE waits for request to start operation. Upon reception of the request to start operation from the TVBD network or device management entity, the CE switches to the Start Operation state.

7.1.4 CE operation when StopOperation_Announcement is received from CM

In any state except the stop operation state if a CE receives a StopOperation_Announcement message from a CM, it shall send a StopOperation_Confirm message back to the CM, enter Stop Operation state, skip deauthentication procedure, and wait for the request to start operation.

7.2 CM operation

Figure 53 shows states of CM operation

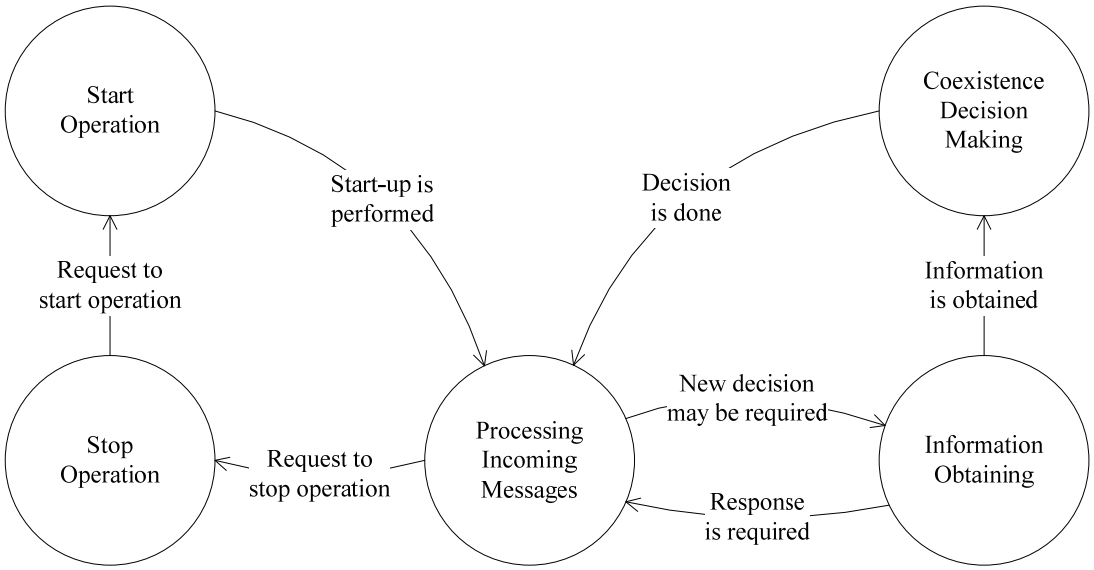

Figure 53 —States of CM operation

The following is assumed for CM operation

- A CM knows network address of a CDIS
- The CDIS is operating
- The CM is connected to the CDIS
- The CM is connected to a TVWS DB and authenticated by the TVWS DB

A CM has five states

- Start Operation
- Processing Incoming Messages
- Information Obtaining
- Coexistence Decision Making

— Stop Operation

A CM switches to the Start Operation state from the Stop Operation state when the CM receives a request to start operation. In the Start Operation state the CM performs start-up and then switches to the Processing Incoming Messages state.

In the Processing Incoming Messages state the CM processes messages from the CE, the other CM or the CDIS. The CM switches to the Information Obtaining state when more information is needed as an example for coexistence decision making and switches to the Stop Operation state when it receives a request to stop operation.

In the Information Obtaining state the CM obtains information required for coexistence decision making. The CM switches back to the Processing Incoming Messages state if a response from an external entity is needed and to the Coexistence Decision Making state if all necessary information is obtained.

In the Coexistence Decision Making state the CM makes coexistence decisions and sends event indications and reconfiguration requests as required. After the decision is done, the CM switches to the Processing Incoming Messages state.

In the Stop Operation state the CM performs deauthentication with the CDIS and sends notification to all its CEs. After this, the CM remains in this state until it receives a request to start operation.

The states are not binding in implementation but they are introduced here merely for illustrative purposes and to make the CM description easy to understand. Only the rules related to processing of received messages and actions upon their reception are binding and normative if so specified.

Error case handling is on default implementation dependent. Unless explicitly mentioned, error handling depends on implementation. The error case handlings described in the sub-clauses of this clause are exemplary and not binding.

7.2.1 CM operation in the Start Operation state

Figure 54 shows CM operation in the Start Operation state.

In the Start Operation state, a CM performs the following operations

— Performs authentication with the CDIS

After that, the CM switches to the Processing Incoming Messages state

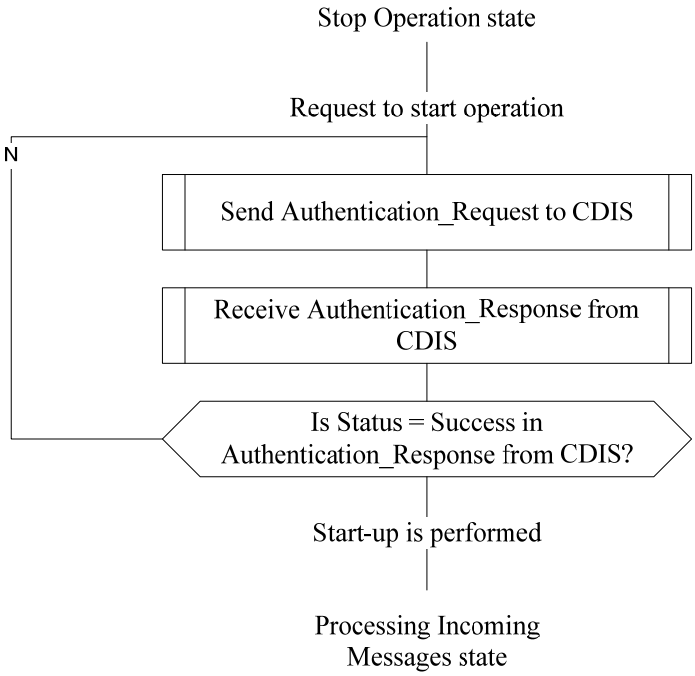

Figure 54—CM operation in the Start Operation State

7.2.2 CM operation in the Processing Incoming Messages state

Figure 55 shows CM operation in the Processing Incoming Messages state.

The CM expects only the following messages (no actions are taken if any other messages are received):

- Messages from the CE over the interface B1
  - Authentication_Request
  - Subscription_Request
  - CE_Registration_Request
  - Deauthentication_Request
  - AvailableChannels_Response
  - AvailableChannels_Announcement
  - Measurement_Confirm
  - Measurement_Reponse
  - InfoAcquiring_Response
  - Reconfiguration_Response
  - Event_Confirm
  - Event_Indication
- Messages from the CDIS over the interface B2

- CM_Registration_Response
- NeighborList_Annoucement

— Message from the other CM over the interface B3

- InfoAcquiring_Response
- Event_Indication
- InfoAcquiring_Request
- NeighborInformation_Announcement
- NeighborInformation_Confirm

— Messages from TVWS database over the interface C

- AvailableChannels_Response
- AvailableChannels_Announcement.

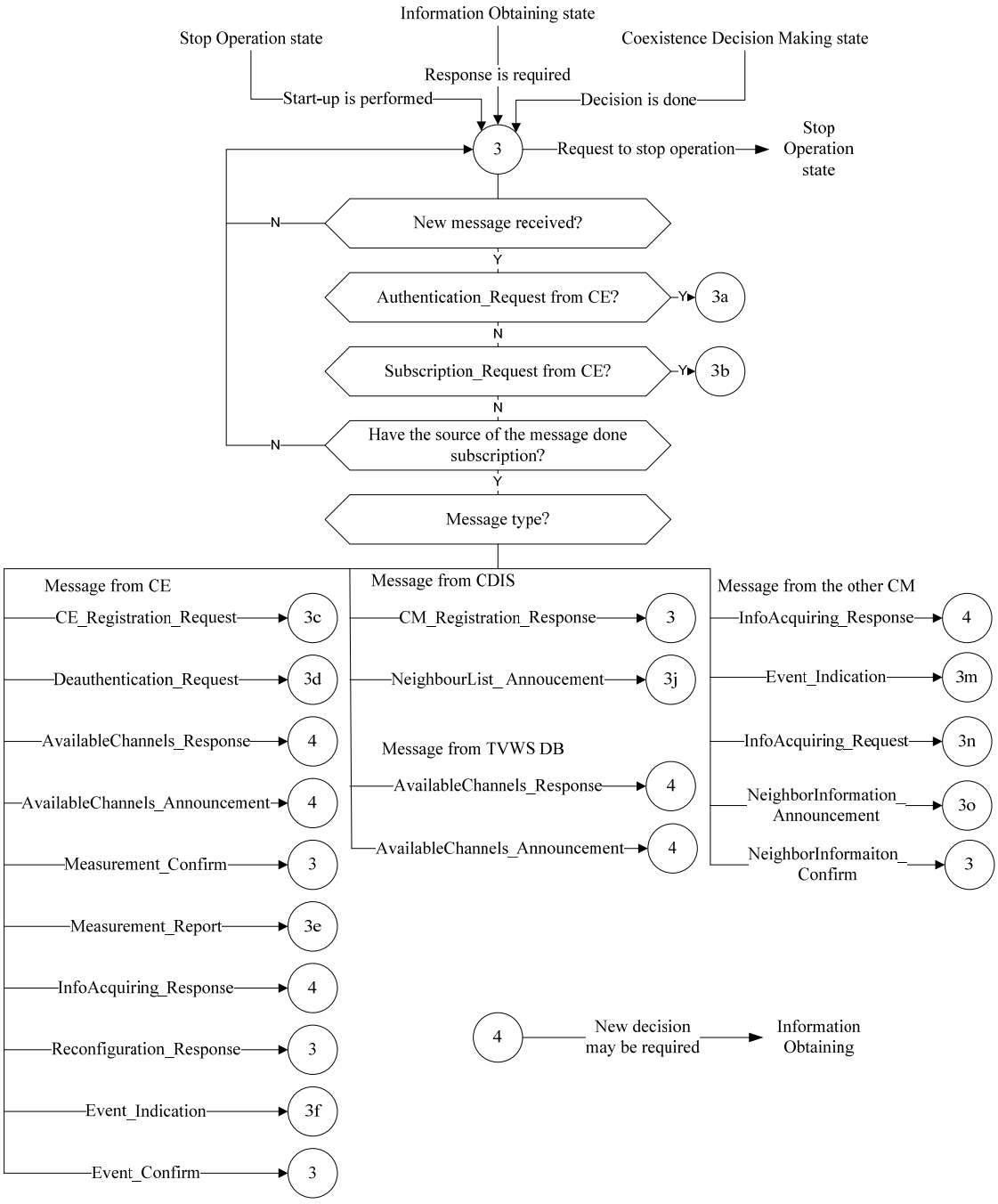

Figure 55—CM operation in the Processing Incoming Messages state

7.2.2.1 Messages from CE

7.2.2.1.1 Processing an Authentication_Request from CE

Figure 56 shows CM operation upon reception of an Authentication_Request message from the CE. Upon receiving an Authentication_Request message the CM shall perform authentication with the information provided in the Authentication_Request message, form an Authentication_Response message and set the

Status field in the Authentication_Response message according to the result of authentication. Then the CM shall send the Authentication_Response message to the CE and continues to check for incoming messages.

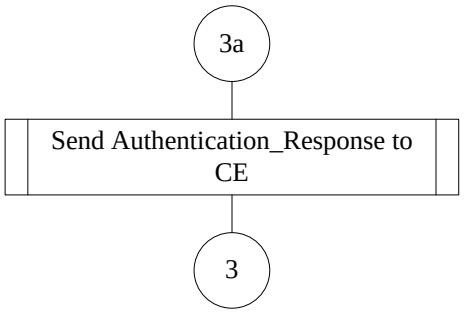

Figure 56—Processing an Authentication_Request from CE

7.2.2.1.2 Processing a Subscription_Request from CE

Figure 57 shows CM operation upon reception of a Subscription_Request message from the CE. Upon receiving a Subscription_Request message the CM shall send a Subscription_Response message to the CE. If the Subscription_Request message was received from a CE that had no service subscription yet, the CM continues to check for incoming messages. Otherwise the CM shall send a NeighborInformation_Announcement message to all CMs that serve a neighbor TVBD network or device. Additionally, the CM switches to the Information Obtaining state.

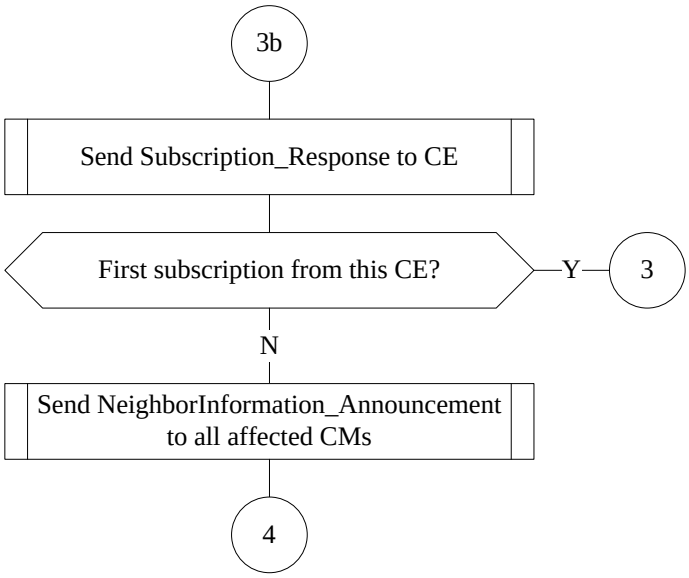

Figure 57 Processing a Subscription_Request from CE

7.2.2.1.3 Processing a CE_Registration_Request from CE

Figure 58 shows CM operation upon reception of a CE_Registration_Request from the CE. Upon receiving a CE_Registration_Request message the CM shall first send a Registration_Response message to the CE to acknowledge reception of the CE_Registration_Request message. Then the CM shall send a CM_Registration_Request message to the CDIS to register or update the information of the TVBD network or device in the CDIS. After that, the CM continues to check for incoming messages. In parallel the CM

waits for the corresponding Registration_Response message from the CDIS. If a Registration_Response message from the CDIS is not received within a certain time, the CM may resend the CM_Registration_Request to the CDIS.

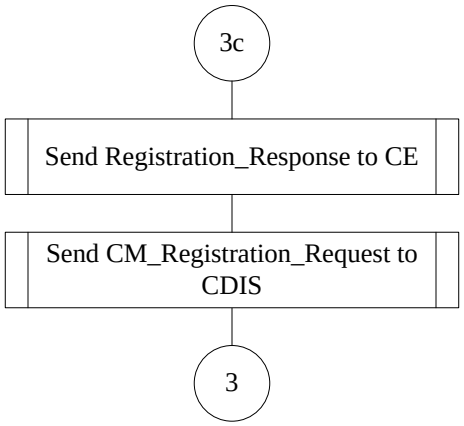

Figure 58— Processing a CE_Registration_Request from CE

7.2.2.1.4 Processing a Deauthentication_Request from CE

Figure 59 shows CM operation upon reception of a CE_Deauthentication_Request message from the CE. Upon receiving a CE_Deauthentication_Request message the CM sall first send a Deauthentication_Response message to the CE to acknowledge reception of the Deauthentication_Request message. Then the CM shall send a CM_Registration_Request to the CDIS to remove the information of the TVBD network or device from the CDIS. After that, the CM continues to check for incoming messages. In parallel the CM waits for the corresponding Registration_Response message from the CDIS. If a Registration_Response message from the CDIS is not received within a certain time, the CM may resend the CM_Registration_Request to the CDIS.

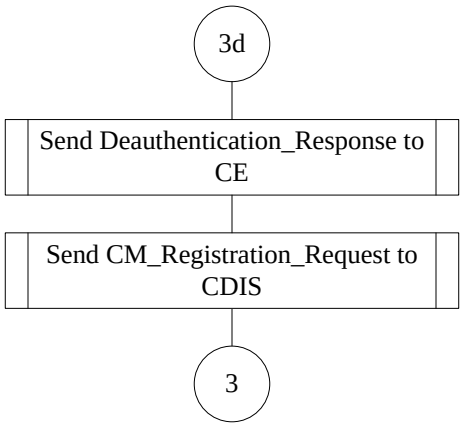

Figure 59— Processing a Deauthentication_Request from CE

7.2.2.1.5 Processing a AvailableChannels_Response from CE

This message serves as a response to an AvailableChannels_Request from the CM, which is sent in the Coexistence Decision Making state. When the CM receives a AvailableChannels_Response message from the CE, the CM switches to the Information Obtaining state.

7.2.2.1.6 Processing an AvailableChannels_Announcement from CE

When the CM receives an AvailableChannels_Announcement message from the CE, the CM switches to the Information Obtaining state.

7.2.2.1.7 Processing a Measurement_Confirm from CE

A Measurement_Confirm message serves as a confirmation of the reception of a Measurement_Request from the CM. Upon receiving a Measurement_Confirm message the CM continues to check for incoming messages. In parallel the CM waits for the corresponding Measurement_Response message from the CE. If a Measurement_Response message from the CE is not received within certain time or a scheduled time period, the CM may resend the Measurement_Request to the CE.

7.2.2.1.8 Processing a Measurement_Report from CE

Figure 60 shows CM operation upon reception of a Measurement_Report from the CE. Upon receiving a Measurement_Report the CM shall send a Measurement_Confrim to the CE to acknowledge reception of the Measurement_Report message. Then the CM switches to Information Obtaining state.

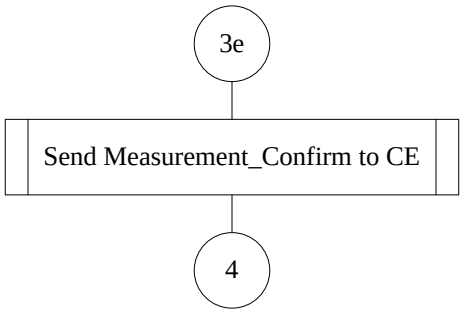

Figure 60— Processing a Measurement_Report from CE

7.2.2.1.9 Processing an InfoAcquiring_Response from CE

This message serves as a response to an InfoAcquiring_Request from the CM.When the CM receives an InfoAcquiring_Response message from the CE, the CM switches to the Information Obtaining state.

7.2.2.1.10 Processing a Reconfiguration_Response from CE

Upon receiving a Reconfiguration_Response message the CM checks the Status in the Reconfiguration_Response message. If the status is successful, the CM continues to check for incoming messages. If status is false, the CM switches to the Information Obtaining state.

7.2.2.1.11 Processing an Event_Indication from CE

Figure 61 shows CM operation upon reception of an Event_Indication message from the CE. Upon receiving an Event_Indication message the CM shall send an Event_Confirm message to the CE. Then the CM switches to the Information Obtaining state.

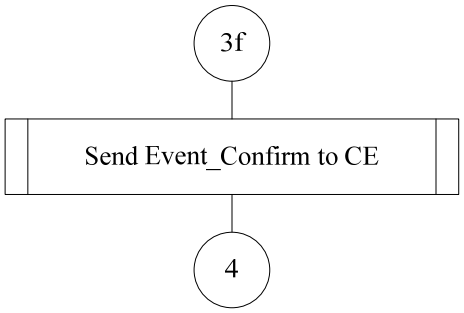

Figure 61— Processing an Event_Indication from CE

7.2.2.1.12 Processing an Event_Confirm from CE

An Event_Confirm message from a CE serves as a confirmation of reception of the corresponding Event_Indication message that was sent by the CM. This finishes the processing of the corresponding Event.indication primitive from the TVBD network or device.

7.2.2.2 Messages from CDIS

7.2.2.2.1 Processing CM_Registration_Response from CDIS

Upon receiving a CM_Registration_Response message, the CM shall check the Status in the CM_Registration_Response message. If the status is successful, the CM continues to check for incoming messages. Otherwise, the CM may resend the CM_Registration_Request to the CDIS.

7.2.2.2.2 Processing a NeighborList_Annoucement from CDIS

Figure 62 shows CM operation upon receiving a NeighborList_Annoucement from the CDIS. The CM uses the information in the NeighborList_Announcement to generate a Neighbor Report that it shall send to each affected CE that is subscribed to the information service. After that the CM shall send a NeighborInformation_Announcement message to all affected CMs that serve a neighbor TVBD network or device. Then the CM switches to the Information Obtaining state.

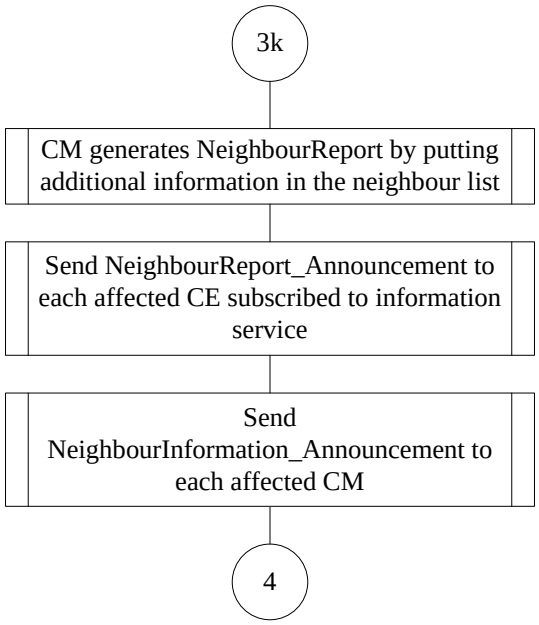

Figure 62—Processing a NeighborList_Annoucement from CDIS

7.2.2.3 Messages from TVWS DB

7.2.2.3.1 Processing a GetavailableChannels_Response from TVWS database

This message serves as a response to a GetAvailableChannels_Request from the CM. When the CM receives a GetAvailableChannels_Response message from TVWS database, the CM switches to the Information Obtaining state.

7.2.2.3.2 Processing AvailableChannels_Announcement from TVWS database

When the CM receives AvailableChannels_Announcement message from the TVWS database, the CM switches to the Information Obtaining state.

7.2.2.4 Messages from another CM

7.2.2.4.1 Processing an InfoAcquiring_Response from another CM

Upon receiving an InfoAcquiring_Response from another CM, the CM switches to the Information Obtaining state.

7.2.2.4.2 Processing an Event_Indication from another CM

Figure 63 shows CM operation upon reception of an Event_Indication message from another CM. Upon receiving an Event_Indication message the CM shall send an Event_Confirm to the other CM Then the CM switches to the Information Obtaining state.

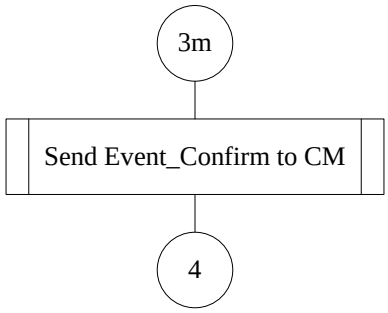

Figure 63—Processing an Event_Indication from another CM

7.2.2.4.3 Processing an InfoAcquiring_Request from another CM

Figure 64 shows CM operation upon reception of an InfoAcquiring_Request message from another CM. Upon receiving an InfoAcquiring_Request message the CM shall send an InfoAcquiring_Response to the other CM and continue to check for incoming messages.

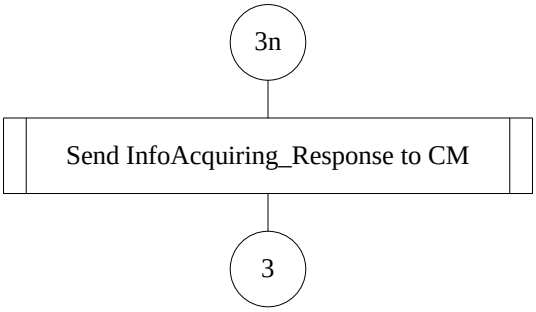

Figure 64—Processing an InfoAcquiring_Request from another CM

7.2.2.4.4 Processing a NeighborInformation_Announcement from another CM

Figure 65 shows CM operation upon reception of a NeighborInformation_announcement message from another CM. Upon receiving a NeighborInformation_Announcement message the CM shall send a NeighborInformation_Confirm to the other CM and switch to the Information Obtaining state.

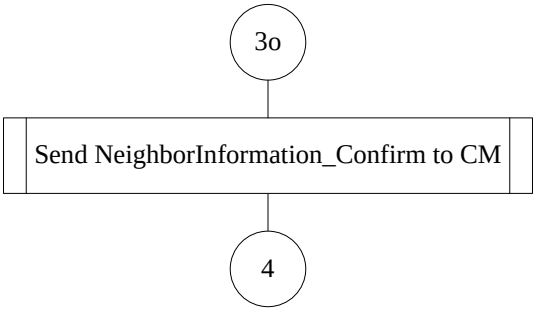

Figure 65—Processing an InfoAcquiring_Request from another CM

7.2.2.4.5 Processing a NeighborInformation_Confirm from another CM

A NeighborInformation_Confirm message serves as a confirmation of the reception of a NeighborInformation_Announcement from the CM. Upon receiving a NeighborInformation_Confirm message the CM continues to check for incoming messages.

7.2.3 CM operation in the Information Obtaining state

Figure 66 shows CM operation in the Information Obtaining state.

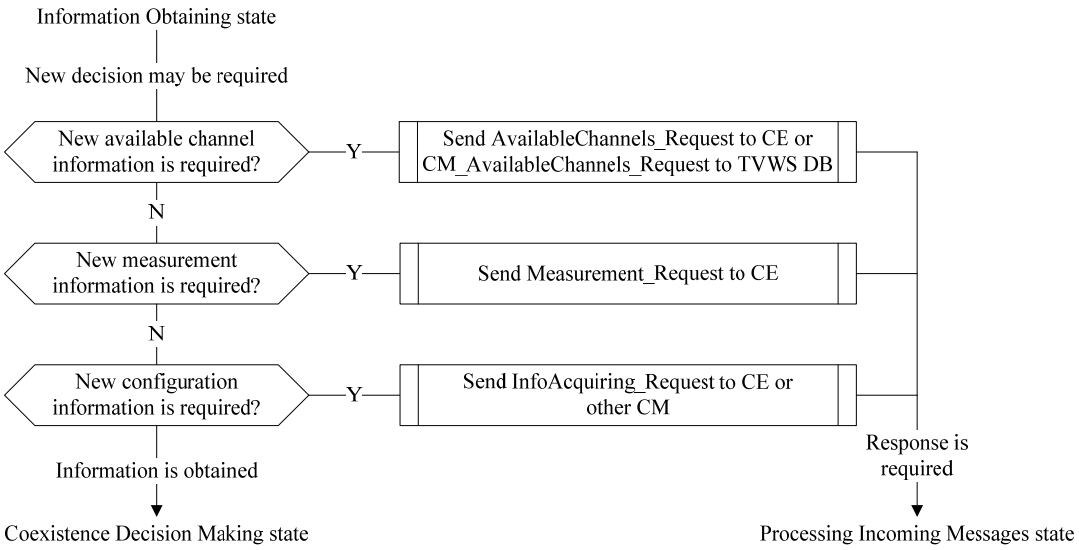

Figure 66—CM operation in the Information Obtaining state

In this state the CM checks whether more information is needed as an example for coexistence decision making and if yes, obtains such information.

The CM obtains the following information by sending corresponding requests:

— Available channels from CE and/or TVWS database

— Measurements from CE

— Configuration informaiton from CE and/or other CM.

If a response is required from the entity to which a request was sent, the CM switches to the Processing Incoming Messages state. If all required information is obtained, the CM switches to the Coexistence Decision making state.

7.2.4 CM operation in the Coexistence Decision Making state

Figure 67 shows CM operation in the Coexistence Decision Making state.

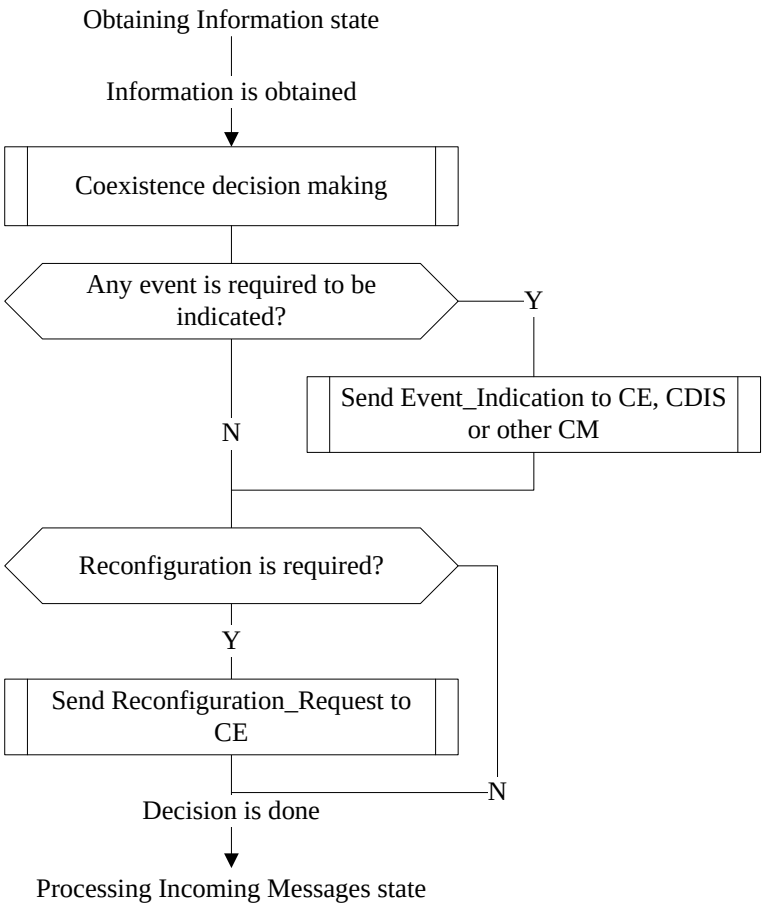

Figure 67—CM operation in the Coexistence Decision Making state

In the Coexistence Decision Making state the CM makes coexistence decision. If there is a need to send an event indication to an external entity, the CM sends such event indication. If there is a need for reconfiguration of a TVBD network or device, the CM sends reconfiguration request to a corresponding CE. Finally, the CM switches to the Processing Incoming Messages state.

7.2.5 CM operation in the Stop Operation state

Figure 68 shows CM operation in the Stop Operation state.

After entering this state, the CM performs deauthentication with the CDIS, notifies all its CEs, and switches to the Stop Operation state.

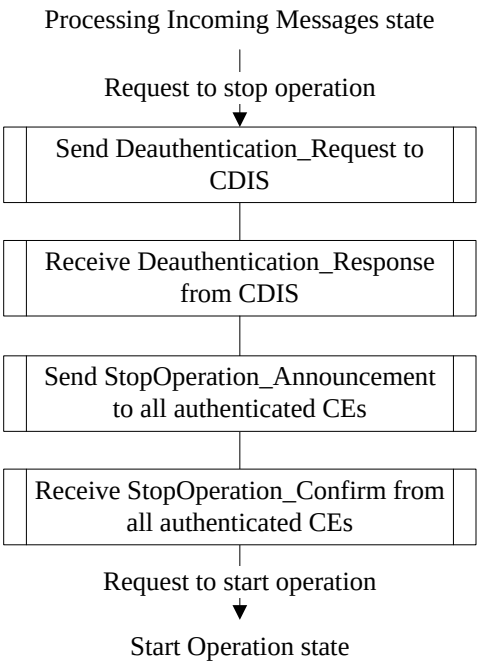

Figure 68—CM operation in the Stop Operation state

7.3 CDIS operation

Figure 69 shows states of CDIS operation

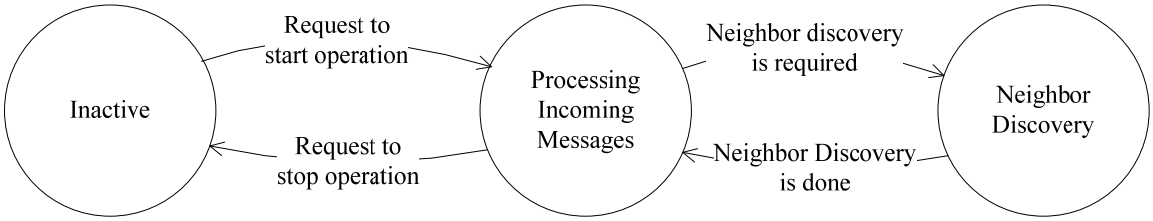

Figure 69 —States of CDIS operation

A CM has three states

- Inactive
- Processing Incoming Messages
- Neighbor Discovery

A CDIS switches from the Inactive state to the Processing Incoming Messages state when the CDIS receives a request to start operation. In the Inactive state, CDIS does nothing but keeps checking the reception of request to start operation.

In the Processing Incoming messages state, the CDIS processes messages from the CM. The CDIS switches to the Neighbor Discovery state when a new neighbor discovery operation is required. The CDIS switches to the Inactive state when it receives a request to stop its operation.

In the Neighbor Discovery state, the CDIS calculates the neighbor list based on the registered information from CMs. The CDIS switches to the Processing Incoming message state, when it completes the neighbor discovery process.

The states are not binding in implementation but they are introduced here merely for illustrative purposes and to make the CDIS description easy to understand. Only the rules related to processing of received messages and actions upon their reception are binding and normative if so specified.

Error case handling is on default implementation dependent. Unless explicitly mentioned, error handling depends on implementation. The error case handlings described in the sub-clauses of this clause are exemplary and not binding.

7.3.1 CDIS operation in the Processing Incoming Messages state

Figure 70 shows CDIS operation in Processing Incoming Messages

The CDIS expects only the following messages (no action are taken if any other messages are received.)

- Messages from CM
  - CM_Registration_Request
  - Event_Indication

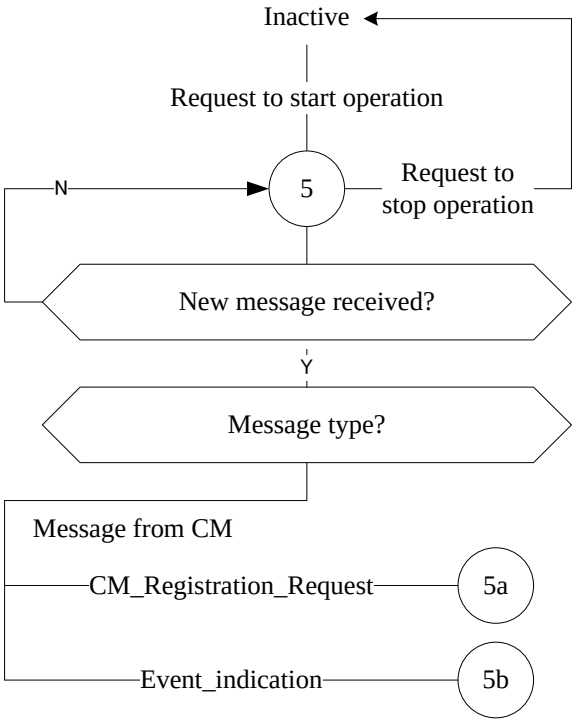

Figure 70 — CDIS operation in the Processing Incoming Messages state

7.3.1.1 Messages from CDIS

7.3.1.1.1 Processing CM_Registration_Request from CDIS

Figure 71 shows CDIS operation upon reception of a CM_Registration_Request message from a CM. Upon receiving a CM_Registration_Request message the CDIS shall send a Registration_Response message to the CM and switches to the Neighbor Discovery state to check whether there are any changes in the neighbor list due to this new registration, registration update or removal of the registration.

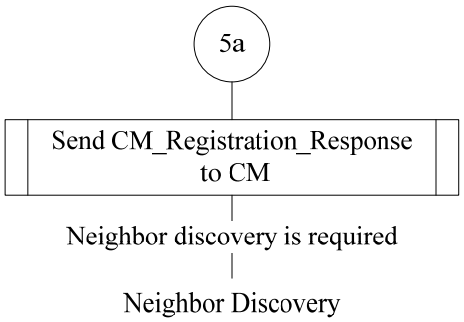

Figure 71 — Processing CM_Registration_Request from CDIS

7.3.1.1.2 Processing Event_Indication from CM

Figure 72 shows CM operation upon reception of an Event_Indication message from a CM. Upon receiving an Event_Indication message the CDIS shall send an Event_Confirm message to CM and switches to Neighbor Discovery state to check whether there are any changes in the neighbor list due to this received message.

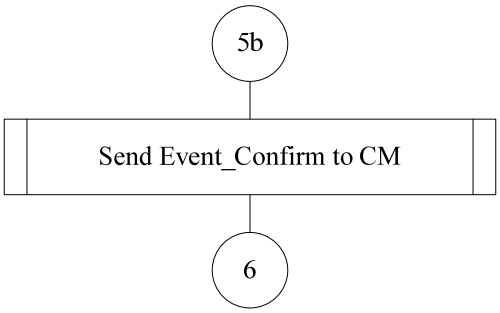

Figure 72 — Processing Event_Indication from CM

7.3.2 CDIS operation in Neighbor Discovery state

Figure 73 shows CDIS operation in Neighbor Discovery state. The CDIS calculates a neighbor list for the subject CM that does new registration, updates a registration or removes a registration, and then the CDIS shall send a NeighborList_Annoucement to the CMs that are impacted. After the neighbor discovery is done, the CDIS switches back to the Processing Incoming Messages state.

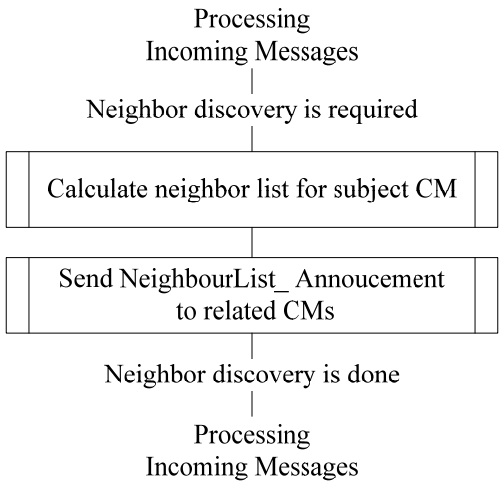

Figure 73 CDIS operation in Neighbor Discovery state

Annex A Algorithm Examples

This annex contains descriptions of exemplary algorithms for coexistence decision making and neighbor discovery.

A.1 Coexistence decision making

TBD

A.2 Neighbor discovery

TBD