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Abstract

This document provides text amendment proposals to address comment CID-36 of the initial sponsor ballot on P802.1CF-D2.2. The text also incorporates the proposed remedies for CID-34 (as captured in omniran-18-0073-00-CF00-d2-2-comment-resolution-proposals.docx), CID-35, CID-52, CID-37, CID-38, CID-5, and CID-6.

# Text amendment to address i-36 (Brian):

* Access network setup
* Introduction and overview

When being powered up or activated, an access network has to be configured before becoming operational. Assuming that all configuration attributes of the network elements are set to some default value after power-up, initial configuration consists of adjusting the base operational parameters of the network elements and establishing the connections among the network elements of the AN and toward the associated SSs, ARs, NMS, and CIS of the AN. Depending on the implementation of the AN, the configuration may also include adjustments to the radio interfaces, either to comply with regulatory requirements or to optimize radio resource usage. Depending on the regulatory requirements and the intended use of the spectrum, special preparatory steps are required before turning on radio interfaces and operating access networks in unlicensed or authorized spectrum.

The specific details and procedures for setting up and operating an access network using authorized spectrum are described in Annex A.1

* Roles
* Terminal (TE)

The TE does not usually play a role in access network setup.

* Access network (AN)

AN includes all the NAs, the BH, and the ANC, which all have to be configured to enter operation of the AN. An AN usually defines an operational domain; however, spectrum access may vary over the regional area that the AN covers with its NAs. Within one AN, there may be different kinds of NAs, and the NAs with wireless interfaces may operate in different frequency ranges, channel assignments, and spectrum regimes.

* Node of attachment (NA)

The NA provides the interface toward the TE and requires basic configuration enabling the TE to discover the access network and to initiate communication to establish a connection. In radio access networks it is the device accessing the spectrum for radio transmissions to the TE.

* Backhaul (BH)

BH consists of a number of bridges and transmission lines, which provide the means for setting up user connectivity between the NAs and the AR. Initial configuration does not only establish the PHY and MAC parameters of the communication links, but also brings the bridges into a clean state ready for setting up user connections.

* Access network control (ANC)

The ANC performs the initial configurations of access network elements to prepare for connectivity service delivery to terminals through processing and propagation of control and configuration information of TE, SS, AR, NAs, BH, CIS, and NMS. Usually ANC acts as agent for the NMS, both to retrieve the information about the AN infrastructure and to forward the base settings to network elements, which are provided by the NMS.

* Network management system (NMS)

The NMS contains and provides the initial setup of all network entities either directly to the network entities or by way of forwarding the information through the ANC. Initial configuration of the network entities is maintained in a permanent repository either as individual configuration for network entities or as templates for types of network entities. The NMS also provides the parameters for the operation of the ANC.

* Coordination and information service (CIS)

The CIS enables access to common configuration parameters either provided by external means or established and shared across multiple ANs.

* Use cases
* Access network initialization

When the access network is powered up, the network elements receive their configurations from the ANC, which receives infrastructure and basic operational configuration values from the Network Management System and other operational parameters for shared resources from the Coordination and Information Service. As part of the network initialization, connectivity to the associated SSs and ARs is also established.

* Access network reconfiguration (reinitialization)

When major changes are applied to the configuration of the AN, it may be necessary to reinitialize the whole access network infrastructure to bring configurations into a consistent state. In this case, the access network reinitialization procedure is performed when AN is already in an operational state.

* Radio channel adjustments

When the radio systems in the NAs are checking the usage and availability of the used spectrum, the ANC or NA may decide during operation to tune to a different channel. Such reconfigurations do not require a complete reinitialization of the AN, but can be performed during a short service break of the NA for the reconfiguration of the radio parameters. To avoid termination of sessions, the AN may inform connected TEs about the change beforehand, allowing the TE to reconnect to the NA on the new channel while maintaining the session.

* Functional requirements
* Access network configuration

After the AN is powered up, the ANC communicates with the NMS to get its configuration information including the interconnection information about the CIS, and triggers the initial configuration of the network elements of the AN, which is performed through the ANC based on information retrieved from NMS.

* Access network interconnection

After establishing the basic operation of the network entities, the AN needs to establish the connections with the associated SSs and the ARs using the configuration parameters provided by the NMS for the interconnections to external entities.

* Channel selection

Channel selection is part of NA initialization to tune each of its radio to a designated channel on the unlicensed band. Each NA should preferably select a non-overlapping channel either autonomously or following instructions from ANC. Each NA should be able to determine and to report all the channels on which one or more over-lapping NAs or terminals are operating.

The algorithm used by the NA to select the channel is beyond the scope of this specification.

* Channel reselection

The NA may re-select another channel for operation either autonomously or following instructions from ANC. Switching to that channel will cause its connected terminals to lose connectivity temporarily.

The algorithm used by the NA to re-select the channel is beyond the scope of this specification.

* Operation on various channels

Unlicensed bands usually consist of multiple channels. The NA should be able to operate on any of the channels of the band for which the radio interface is designed.

The NA may be equipped with a radio interface allowing operation in multiple unlicensed bands. In this case, the channel selection procedure should be able to operate across all the supported bands and select the least occupied channel of all the supported bands.

* Multi-mode support

The NA should support all the different radio modes specified for compliance of its radio interface, to allow for adaptation of operational parameters to the radio environment in the chosen channel. Such adaptation allows for more efficient use of the available spectrum and benefits the performance of the whole system.

* Access network setup-specific attributes

AN setup covers essentially all base configuration parameters of the IEEE 802 technologies as well as the base attributes describing the network structure.

* Network Management System (NMS)

Note - The notation introduced in this subclause is explained in Clause 4.2.1, Occurrence of information elements.

{1} NMS-ID: FQDN.

 Unique identifier of the default NMS.

* Access Network Control (ANC)

{1} OperationStatus: Indication of the status of the operation of AN.

* Backhaul (BH)

{1} OperationStatus: Indication of the status of the operation of BH.

* Node of Attachment (NA)

{1} OperationStatus: Indication of the status of the operation of NA.

* AN configuration

{1} ANCConfig: Configuration parameters of ANC.

 E.g., to initialize the control functions and establish connection to the service entities such as CIS and SS.

{1+} NAConfig: Configuration parameters of NA to set up ports and initialize operational functions.

{1+} BHConfig: Configuration parameters of BH to initialize VLAN settings.

* Access network setup-specific basic functions

6.1.6.1 Boot-up process of network elements

After turning power on of a network element, the circuitry is first kept at a defined state until all circuits have reached their required voltage levels. With releasing the clocks, the processors start to fetch code from their boot ROMs to establish the operating system and to initialize its I/O system to enable communication with peripherals and other systems. Once the operating system and the peripherals are up and ready for operation, the processes realizing the networking functions are initialized.

* Detailed procedures
* Access network setup procedure

The access network setup procedure includes the initiation of the procedure by the ANC with retrieving its configuration parameters from NMS; the establishment of the communication links of the ANC to CIS, associated SSs, and associated ARs; the dynamic discovery and configuration of NAs; and the configuration of the BH including the links to the associated ARs.



* An example of access network setup procedure

Figure 28 shows an example of access network setup procedure.

* Access network setup procedure starts when the AN is powered up and ANC is booting up.
* When the ANC is booted up, the ANC sends a ANCinit Request message to the NMS which is assigned to the access network. The ANC knows about its assigned NMS through a locally stored address or identifier.
* After receiving the ANCinit Request message, the NMS sends the ANCinit Response message with the information for the ANC to configure itself and its communication with CIS, associated SSs, and ARs.
* Once the ANC retrieves the basic configuration information from the NMS, it accepts Join Request messages from powering-up NAs.
* The ANC registers the NA in its network element database and forwards the information about the NA in an Update Request message to the NMS, to register it and to retrieve its configuration parameters.
* The NMS adds the information about the new NA to its repository of management information and responds to ANC with and Update Response message containing the basic configuration parameters for the NA.
* The ANC amends the configuration information retrieved from NMS with locally generated configuration information and sends the complete basic configuration set to the NA, which activates the configuration and enters its operational state indicating to TEs the availability to connect.

It can happen, during the operation of the NA, that new NAs are connected and powered up. After power-up, the new NAs send Join Requests to the ANC, and the ANC handles the basic configuration during operation the same way as in the initial setup procedure.

* Access network release procedure

There are two ways to release the access network: access network is released by itself or it is released by the access network operator through the NMS. In any case, the ANC terminates the operation of the network elements in an orderly way before shutoff of the AN.



* Example procedure for access network release by ANC



* Example procedure for access network release by NMS

Figure 29 and Figure 30 show examples of access network release procedure for the two cases. The access network could be released by the ANC as shown in Figure 29 or by the access network operator through NMS as in Figure 30.

* In some exceptional cases, such as at certain abnormal conditions, the access network may have to initiate access network release under the control of ANC as shown in Figure 29. In such cases, the ANC will inform the NMS that the access network will be going down through a Release Request message.
* In a normal case, the access network release should be controlled by the access network operator through the NMS. When the access network operator needs to release the access network for maintenance, power saving, or major software/hardware upgrade, it initiates the access network release through the NMS sending a Release Request message to the ANC as shown in Figure 30.
* When AN release is requested by the ANC, the NMS responds with a Release Response message indicating that the NMS is aware of the ongoing teardown of AN operation.
* When AN release is initiated by NMS as shown in Figure 30, the ANC responds with a Release Response message to notify that the request has been received and the AN operation will be terminated shortly.
* The ANC pursues the AN release through sending ShutDown Request messages to each of the NAs of the AN, to achieve an orderly termination of the service.
* After termination of the sessions going over R1 through disassociation of the terminals, the NAs inform the ANC about the end of the service through ShutDown Response messages.
* When all user traffic has stopped and all network elements terminated its operations, the ANC notifies the NMS about the end of the AN operation through a ShutOff message before ending its operation.

The ANC of a released AN may stay in a hibernated state listening to potential messages coming from the NMS. Such hibernated state of the ANC reduces the time to reinvoke an AN.

* + 1. Mapping to IEEE 802 technologies

Power-up and initialization are covered in the specifications of IEEE 802 technologies only where physical interfaces are specified or special care has to be taken to reach a particular state for starting the operation.

ANNEX A

(normative)

Functional enhancements to IEEE 802 access network

A.1 Dynamic spectrum management

A.1.1 Introduction

A.1.2 Roles

A.1.2.1 Terminal (TE)

A.1.2.2 Node of attachment (NA)

The NA

A.1.2.3 Access network control (ANC)

A.1.2.4 Coordination and information service (CIS)

The CIS enables access to common configuration parameters either provided by external means or established and shared across multiple ANs.

* current spectrum usage information

A.1.3 Use cases

A.1.3.1

A.1.4 Functional requirements

A.1.4.1

A.1.4.2

A.1.4.3

A.1.4.4

A.1.4.5

A.1.5 Dynamic spectrum management specific attributes

A.1.5.1

A.1.6 Dynamic spectrum management specific functions

A.1.6.1

A.1.6.2

A.1.7 Detailed procedures

A.1.7.1 AN setup for authorized spectrum access

* Detailed procedure of AN setup for authorized spectrum access

Figure 31 shows the detailed procedure of AN setup for authorized spectrum access. This procedure is also described as follows:

* After AN power-up, the NA should establish a secure connection to the ANC, report its geolocation based on the preconfigured information, and configure the port to the BH.
* The ANC generates an access request message on behalf of the NA containing the geolocation and other related information. The access request message is sent from the ANC over R10 to the valid CIS.
* Upon receipt of an access request message, the CIS starts the EAP message exchange with the ANC.
* If the identifier of ANC is known and requested access can be granted, the CIS informs the ANC with an access accept message of the allowed access. The pairwise master key is delivered in the access accept message from the CIS to the ANC.
* Once the authentication process succeeds, the ANC can query the CIS via sending the SA information request message that allows the ANC to request a list of available channels and maximum allowed EIRP per channel from the CIS. After receipt of an SA information request message, the CIS returns an SA information response notification message to the ANC providing the requested information.
* Based on the retrieved information, NA can be initially switched on and perform a spectrum sensing procedure on the specified channel(s).
* The results of the above sensing should be provided to ANC embedded in an SA use information request message.
* As the spectrum availability information provided by the CIS and spectrum sensing results from the NA is gathered, the ANC should determine the operation channel(s) and indicate the NA through SA use response message to commence operation on the selected channel(s).

NA may hand over radio configuration information used for TVWS to the TEs located in the same area, avoiding interference with the primary services.

A.1.7.2 Primary service protection

* Detailed procedure for primary service protection
for authorized spectrum access

Figure 32 illustrates the detailed procedure for primary service protection for authorized spectrum access. This procedure is also described as follows:

* Independent procedure of spectrum sensing may be performed periodically by TE and NA as the operation of the primary service changes over time. If the activity of the primary service is detected through the distributed sensing technique by both TE and NA, the ANC should be notified immediately.
* If the ANC concludes that the operating channel is under interference and primary service needs to be protected, a channel switch notification message will be generated and sent from the ANC to the NA.
* In this situation, the NA should update the status of the listed backup channels and notify the ANC with a channel switch confirm message.
* Meanwhile, the NA will start a timer to schedule the channel switch, and notify the TE about the action with a channel switch notification message.
* If the backup channel is available when the timer expired, the NA will continue its operation on the backup channel and reestablish communication with the TE. Otherwise, the NA should terminate its operation on current channel and the connectivity service will be shut down.

A.1.7.3 Renewal of spectrum access authorization

* Detailed procedure for spectrum access authorization renewal

Figure 33 illustrates the detailed procedure for spectrum access authorization renewal. This procedure is also described as follows:

* When NA is operating in the authorized spectrum, its ANC needs to set up a timer to track the granted period of operation.
* When the authorized spectrum usage timer expires, the ANC will query the CIS with the updated location of NA to renew the use of authorized spectrum.
* If the operating channel is available, the CIS will grant the renewal request. Otherwise, it will reject the renewal request and trigger the reinitialization of the AN.
* When the renewal request is granted, the ANC will reset the timer to the granted value and prolong the operation on current channel.

A.1.8 Mapping to IEEE 802 technologies

While all IEEE 802 radio technologies contain specifications for operation in unlicensed spectrum, only a few support operations exist in TVWS. IEEE 802.22 is fully aimed for TVWS operations, and IEEE 802.11 TVWS amended the IEEE 802.11 WLAN specification by a special mode fulfilling the requirements for licensed shared access in unused TV bands.