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| Updated Text for Dynamic Spectrum Allocation and AN Setup Procedure in IEEE 802.1CFRevised and edited by Max Riegel on May 20th for inclusion in initial .1CF draft |
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Abstract

This document is to update the proposal of omniran-14-0078-00 about the dynamic spectrum allocation and the access network setup procedure in Recommended Practice specification of IEEE 802.1CF based on the latest omniRAN Network Reference Model. The procedure of dynamic spectrum allocation and access network set up could be used in IEEE 802 based technologies like WLAN over un-licensed spectrum or authorized shared access frequency band (TV white space). It could be used for co-existence of IEEE 802 based technologies with LTE operating on unlicensed band (LTE-U) as well.

Dynamic Spectrum Allocation and Access Network Setup Procedure

1. **Introduction and Scope**
2. **Abbreviations, Acronyms, Definitions, and Conventions**

ASA: Authorized Shared Access

CIS: Coordination and Information Service

LSA: Licensed Shared Access.

SA: Shared Access

SS: Subscription Service

1. **References**

[1] IEEE 802.19.1 D3.06 Draft Standard for TV White Space Coexistence Methods

[2] IEEE 802.19

[3] IETF draft-ietf-paws-protocol-12 Protocol to Access White-Space (PAWS) Databases

1. **Roles and Identifiers**

The ASA (or LSA) is a mechanism that allows radio frequency spectrum that is licensed for international mobile telecommunications (IMT) to be used by more than one service entity in the share matter.

According to FCC regulation, the Authorized Shared Access (ASA) spectrum is mainly allocated for the primary users to provide radio services. Only when the primary users are not providing radio services, the secondary users may allow occupying the ASA spectrum and provide radio access services to their customers.

In order to get the operation information of primary service over the ASA spectrum, the ANC in IEEE802 NRM needs to communicate with (ASA) CIS first, and to get authorization before AN (and/or TE) can turn on its radio transmission on authorized shared frequency.

* + 1. ASA enabled Terminal

An ASA TE is operating in the authorized frequency channel(s) such as TV white space, which is shared with primary services over the same authorized spectrum.

* + 1. ASA enabled Access Network

An ASA Access Network contains one or more ASA enabled Nodes of Attachment. In some specifications, the ASA enabled NA is also called the Master Device. An NA provides radio access connectivity to the ASA enabled TEs (or called Slave Devices) in the authorized license frequency channel(s), which is shared with primary services over this authorized spectrum.

* + 1. ASA enabled Access Network Controller

The authorized shared access network controller (ASA-ANC) is a function in the ANC, which is used to manage and control operations of ASA enabled NAs, such as setup, provisioning, and/or tear-down over the authorized spectrum shared with primary services. The ASA-ANC also controls operations of ASA enabled TEs over the authorized shared spectrum through the reference point R8.

The ASA-ANC may support following but not limited to functions for co-existence with primary servers and/or other services over the authorized shared spectrum.

1. Co-existence management: it is responsible to control enabling NA to co-exist with primary wireless device in the authorized shared spectrum.
2. Co-existence discovery and information (local) server is used to store the co-existence information used for determining co-existence of NAs operating in the authorized spectrum shared with primary wireless services.
	* 1. ASA Coordination and Information Service (ASA-CIS)

ASA-CIS is a function in the Coordination and Information Service (CIS) of the network reference model to provide storage of the information used for the access services over the authorized spectrum shared with primary services. It could be implemented as a database server to provide information service for its clients. The information in ASA-CIS could include

1. authorized shared frequency band and channels information
2. shared access spectrum geo-location information
3. allowed maximum transmit power in the authorized shared access spectrum
4. primary service provider and secondary service providers and their operating status
5. potential neighboring services and their interference levels

ASA-CIS could be accessed by the ANC through the reference point R10. The ASA-ANC may have a local copy in the local memory and is periodically synchronized with ASA-CIS.

1. **Use Cases**

Dynamic spectrum allocation and access network setup is a prerequisite for the radio access network operation before providing the services to terminals. The ASA enbabled NA shall initiate the dynamic spectrum allocation procedure to determine the operating frequency.

* 1. Mutual authentication

The mutual authentication is used for ASA-ANC and ASA-CIS to mutual authenticate each other to provide strong security and protection before AN provides the authorized shared access.

* 1. Dynamic spectrum allocation

The dynamic spectrum operation is controlled by ASA-ANC. ASA-ANC queries the ASA-CIS to get the channel usage information, and determine the operating channel for the radio system in the ASA spectrum. If there is an available channel in ASA spectrum, ASA-ANC would setup NA operating on that channel. Otherwise, if there is no available channel in ASA spectrum, the ASA-ANC should not turn on the radio of NA.

* 1. AN Initialization

AN initialization is to bring up AN operating on the given channel in the authorized share access spectrum. When the AN is operating on the authorized shared channel with primary user, it has to notify the ASA-CIS.

* 1. AN Shut-down

During the operation in the authorized shared access spectrum, the ASA-ANC should continue monitoring or be notified the status of shared access spectrum in ASA-CIS. If it detects the information that the primary user of the ASA spectrum would like to operate on the channel that is being used by the NA, the ASA-ANC should disable the services over ASA channel and turn off the radio of NA.

1. **Functional Requirements**

The following requirements apply to dynamic spectrum allocation and access network setup procedure.

* 1. Support for multiple access technologies

The dynamic spectrum allocation and access network setup procedure SHOULD be able to support different access network technologies.

* 1. Support for multiple access networks

The dynamic spectrum allocation and access network setup procedure SHOULD be able to support the access network operating on the same or different channel of ASA spectrum from the neighboring AN’s.

1. **Dynamic Spectrum Allocation and AN Setup Functions**

The dynamic spectrum allocation and access network setup/configuration is to provide the procedure of operating one or multiple NAs in the authorized spectrum environment shared with primary wireless devices. The procedure includes following steps

* ASA-CIS discovery and mutual authentication
* Query the authorized shared spectrum information
* Configuration of radio access network to operate on the authorized shared access spectrum.

* 1. ASA-CIS discovery and mutual authentication

ASA-CIS discovery and mutual authentication is the process of AN to find and authenticate the ASA-CIS which is used to store the authorized shared spectrum usage information at given area, before querying the ASA-CIS to get the information about authorized shared spectrum usage.

The ASA-ANC may be pre-configured with IP address, or URL of the ASA-CIS server.

When ASA-ANC is powered up, it may load the default shared spectrum list and

shall automatically communicate with ASA-CIS using pre-configured ASA-CIS information. If ASA-ANC could not be able to communicate with ASA-CIS server, radio operation over the shared spectrum in the NAs is not allowed. The communication between ASA-ANC and ASA-CIS should follow the protocols specified by R10 reference point.

Once ASA-ANC receives the response from ASA-CIS, it shall start the mutual authentication with the ASA-CIS to make sure that the ASA-CIS being communicated with is the right one.

* 1. Query the authorized shared spectrum information

Query of authorized shared spectrum information is the process to acquire the information about the authorized shared spectrum usage status stored in ASA-CIS.

Before operating on the authorized shared spectrum, The ASA-ANC needs to query the ASA-CIS to get the information about authorized shared spectrum usage status using the protocols specified by the R10 reference point. Once receiving the usage status of authorized shared spectrum, the ASA-ANC can determine whether the AN could be able to operate on a particular channel of the authorized shared spectrum.

During the operation on the authorized shared spectrum, the ASA-ANC needs to constantly get the usage status update about the authorized shared spectrum by querying the ASA-CIS.

* 1. Operating in authorized shared spectrum

Operating in the authorized shared spectrum is the process of enabling the radio transmission of AN and informing the surrounding TEs the operation channel, transmit power and other radio parameters.

Once the AN is operating on the authorized shared spectrum, the ASA-ANC is responsible to control the radio transmission of NAs and TEs over the operating channels to meet the authorized shared access regulation on the given area.

1. **Detailed Procedure**
	1. AN setup

FIG 3 An example of the procedure of IEEE 802 based access network setup.

1. When IP connection is established after boot-up, the NA should discover the URI of ASA-ANC through pre-configured information. NA may update its stored URI information to adapt the deployment change. The NA would send a SA registration request message through the reference point R5 to the ANC to register with the ASA-ANC for the shared access service operation over the authorized shared spectrum. The SA registration request is used to provide the ASA-ANC the information about NA such as subscription information and location information for ASA operation. The ASA-ANC may forward this SA registration request message to the ASA-CIS for authentication and authorization over the reference point R10 using an appropriate protocol.
2. The ASA-CIS authenticates the NA to determine operation on the shared spectrum. The ASA-CIS sends the response message to ASA-ANC about the authentication and authorization result. Then the ASA-ANC sends the SA registration response message to the NA upon receiving the response message from the ASA-CIS.
3. Once the registration for the shared access service succeeds, the NA can query the ASA-CIS via sending the SA information request message to ASA-ANC to get the status of the shared spectrum usage information and status.
4. The ASA-ANC communicates with ASA-CIS over the reference point R10 to get the shared spectrum information and usage status and sends back the NA.
5. Based on received shared spectrum information and status, the NA decides how to operate the wireless services over the shared spectrum. If NA would operate the wireless access services over the shared spectrum, it sends the SA usage notification message to the ASA-ANC for updating the shared spectrum usage status.
6. The ASA-ANC sends an acknowledgement message to the NA after it communicates and updates the shared spectrum usage in ASA-CIS.
7. The NA can now turn on its radio transmission on the authorized shared spectrum to provide access services. NA may provide radio configuration information used for the ASA spectrum to the TEs in the overhead message in order to control the interference to the primary services.
	1. AN Teardown

FIG 4 An example of the procedure of IEEE 802 based access network tear-down.

1. The primary service would be back over the authorized shared spectrum and notifies with ASA-CIS.
2. ASA-ANC could get the authorized shared spectrum usage status update information via registered notification service with ASA-CIS. If the ASA-ANC registers a notification service with ASA-CIS, the ASA-CIS would receive the notification when the primary service status changes, or the time of shared spectrum expires.
3. When ASA-ANC receives the notification about authorized shared spectrum usage notification, it shall send the de-registration notification to the existing registered NAs operating on the authorized shared frequency channels, to force them to tear down existing services.
4. Once the NA receives the de-registration notification, it shall respond with Use Notification to indicate to shut-down the radio service over the authorized shared frequency channels.
5. The ASA-ANC and ASA-CIS updates the record in the data base and notify the NA.
6. NA may start the procedure of de-association with TEs operating on the authorized shared frequency channels, or immediate enter step 7).
7. NA disables its radio transmission
	1. AN Renewal



1. The NA is operating on the shared spectrum and set up a timer to track the granted operation period.
2. When the shared spectrum use timer will expire, the NA send a SA registration message to renew the use of shared spectrum through ASA-ANC.
3. The ASA-ANC forwards the renew registration message to ASA-CIS
4. If no primary service will occupy the shared spectrum for the renew period, the ASA-CIS will grant the renew request. Otherwise, it will reject the renew request.
5. ASA-ANC forwards the CIS renew response to the NA in the SA registration response message.
6. If the renew request is granted, the NA will reset the timer of shared spectrum operation to a new granted period and continues operation on the shared spectrum.