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| AN Setup Procedure over unlicensed Band in IEEE 802.1CF |
| Date: 2015-09-14 |
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Abstract

This document provides the text of access network setup procedure over the unlicensed band in Recommended Practice specification of IEEE 802.1CF.

Dynamic Spectrum Allocation and Access Network Setup Procedure

1. **Overview**
2. **Normative reference**
3. **Definition**
4. **Acronyms and abbreviations**
5. **Conformance**
6. **Network Reference Model**
7. **Functional design and decomposition**
	1. Access network setup
		1. Dynamic spectrum allocation and access network setup over ASA bands
		2. Dynamic spectrum allocation and access network setup over unlicensed bands
			1. Roles and Identifiers
				1. Node of Attachment

Node of attachment (NA) is the physical device at the edge of the access network to communicate to the terminal. Different NAs may have different capabilities. An NA uses its MAC address or BSSID in the 802.11 access network as the identifier.

ID of Node of Attachment could be expressed as {EUI48} or {EUI64}

* + - * 1. Access Network

Access network denotes the infrastructure consisting of one or more Nodes of Attachment and the related backhaul for providing the communication links between the nodes of attachment and one or more interfaces to connected service provider’s network services. In 802.11 networks, the access network uses ESS ID to identify the access service provided the network.

ID of Access Network based on ESS ID could be expressed by ANI {EUI-48} + AN Name {String}.

In addition, if the IP address of the AN controller is unique within the network, the IP address of Access Network controller might also be used to identify the access network from the network management point of view.

* + - 1. Use Cases
				1. AN sharing and Service Provider Discovery

IEEE 802.11 based AN provides an wireless access over unlicensed spectrum. An Access Network could be used in home network, enterprise network or carrier-grade wireless local access network to offload traffic from Cellular networks.

In high dense deployment scenario, like shopping centers, airports, it is possible to have more than one ANs deployed by different service providers. To reduce CapEx and OpEx, some service providers might consider sharing the radio access networks, which means the single AN needs to connect to multiple service provider’s networks through the access router. Therefore the AN is required to discover and establish connection through the access router with each service providers’ network before it can forward the user data packets between the user terminal and the corresponding service provider’s network .

* + - * 1. Virtual AN and Configuration

AN configuration is to provisioning the AN to provide wireless access services with.

* Network Identity
* Service Identity or Session Identity
* Security information
* Radio parameters.
* Service parameters, such as QoS information

AN configuration is performed by the AN controller. When the IP connection is established between the AN and the Service Provider network through the access router, the service provider network through the access router controller could provide the AN controller a set of parameters for configuration of AN.

In the case of AN shared by multiple service providers, each service provider may provide different configuration parameters through the access router. Therefore the shared AN could be formed as virtual access networks over same radio coverage.

* + - * 1. Channel Selection

Channel selection is a part of radio configuration of AN. The unlicensed spectrum is designated as wireless medium to be operated by devices without permission. But as many devices are operating on the same frequency channel in same coverage area, the interference among devices is inevitable. In order to reduce the interference to each other in the unmanaged environment, the access network should select the proper operating frequency channel with less interference during the initial setup. In 2.4GHz unlicensed band, there are three or four non-overlapped 20MHz bandwidth channels depending on the region regulation of ITU. In 5GHz unlicensed band, there are more than 20 20MHz bandwidth channels. The channel selection in the access network provides such mechanism to help the NA operating on the channel with less interference over the available channels. The channel selection may be assisted by the access network controller, or performed by the NA independently.

When the access network powers up, the channel selection function of NA searches every channel in the unlicensed operating band and measure the channel busy level (loads). It selects the channel with the least busy level as the operating channel and enters the initialization procedure.

An NA may report the channel search result to the access network controller. The access network controller stores the collected loading information of each NA. When a new NA powers up, the access network controller would provide some assistance to the NA to speed up the searching procedure.

After the channel selection, the NA receives the initialization parameters from the access network controller and operates on the selected frequency channel, and transmits beacon frames after initialization completes.

* + - * 1. Channel Re-selection

The NA may switch to another operating channel if the current operating channel is overloaded or interfered. Switching the operating channel can be performed via the channel selection, and may cause the service interrupt.

As the access network controller may store the channel operation information of each NA, it may provide assistance or coordination for re-selecting a better operating channel in the coverage area.

Before switching to another channel, the NA may need to de-associate devices under its BSS to trigger them to search for and associate with another available access network. During the network discover and selection (NDS), devices may re-select the same NA on the new operating channel if the NA is available.

* + - 1. Functional Requirements
				1. Support operating on multiple frequency channels

The unlicensed bands include 2.4GHz band, 5GHz band, etc. of license exempt bands. Each band consists of multiple channels. The access network SHOULD be able to operate on one frequency channel in the unlicensed band with at least 20MHz bandwidth.

The access network MAY support multi-band operation over 2.4GHz and 5GHz unlicensed bands

* + - * 1. Support Multiple Technologies

The access network SHOULD be able to multiple access technologies, such as 802.11g, 802.11n, or 802.11ac, integrated in single NA or different NAs.

The access network MAY be able to support interworking function with other technology like LTE-U or LTE-LAA when omniRAN is collocated with LTE-U/LTE-LAA SeNB.

* + - * 1. Support Multiple Service Providers

The access network may be connected to one or more service providers’ networks through the access router, which is the gateway of access network. Therefore the access network SHOULD be able to provide a sharing mechanism amongst different service providers’ networks.

* The access network SHOULD be capable to discover and join a service provider network that is connecting to.
* The access network SHOULD be capable to share with more than one service providers’ networks.
* The access network SHOULD maintain different access network identifier associated to each service provider’s network.
* The access network SHOULD provide fair access to devices associated to different service provider’s network.
* The access network SHOULD be capable to be configured and controlled by the service provider’s network
* The access router SHOULD be able to route the user packet to the service providers’ networks which the user subscribes to.
	+ - 1. Detailed Procedure
				1. Discovery Procedure



The NA of AN should send Discovery Request Message to the service provider’s networks through the access router. The Message may be broadcasted to a list of service providers’ networks stored in the NA or unicast to an address, such as a DNS server. The message should include the following information:

* NA Identity;
* Discovery type, which provides the information that how the NA get the service providers’ networks address, such as manual configuration, DNS server, etc.
* NA attributes, such as release version, etc.

When the service provider’s network receives the Discovery Request through the access router, it should send a Discovery Response Message to the NA through the access router. The message should include the following information:

* Service provider’s network Identity;
* Service provider’s network attributes, such as release version, etc.
* Service provider’s network address list. The list includes multiple ports addresses of the network and the load of each port, which helps NA to choose a proper port for the following communication.
	+ - * 1. Join Procedure

According to the Discovery Response Messages from different service provider networks through the access router, the NA of AN can choose one or multiple service providers’ networks to initiate the Join procedure.



The Join Request Message should include the following information:

* NA Identity;
* NA location information. This helps the service provider’s network to determine whether to accept the join request.
* NA descriptor, such as capability, encryption information, etc.

Service provider’s network through the access router should determine whether to accept the Join Request according the information in the Join Request and other information such as service provider’s network load, etc. And the service provider’s network should send Join Response to the NA to inform the NA the admission control results. The Join Response Message should include the following information:

* Service provider network Identity;
* Result code. Inform the NA whether its Join Request is admitted or not. If not, list the reason of the rejection.
* Service provider network descriptor, such as capability (max NA number, max user number…), security information, etc.
	+ - * 1. Session or Service Configuration Procedure

After the completion of the two procedures above, NA joins the service provider network through the access router successfully. And a service provider’s network is capable to control the joined NAs through the access router by sending them Session or Service Configuration Update Request Messages over the reference point R9 to control the NA for a service or sessions of a service.



The Configuration Update Request Message may include various elements, such as:

* Service provider Network Identity, Service Identity or Session Identity;
* Security configuration;
* Radio configuration, such as service QoS information (Guaranteed Bit Rate, Maximum Bit Rate, Access Class…), etc.
* Load balance information such as traffic steering for R3;

An NA should send Session or Service Configuration Update Response Message to feedback the results. And the NA may also feedback some negotiation results in the response message, such as the rates set, max or min power, user number limits, etc.