IEEE P802.11
Wireless LANs

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| Specification Framework for TGac |
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Abstract

This document provides the framework from which the draft TGai amendment will be developed. The document provides an outline of each of the functional blocks that will be a part of the final amendment. The document is intended to reflect the working consensus of the group on the broad outline for the draft specification. As such it is expected to begin with minimal detail reflecting agreement on specific techniques and highlighting areas on which agreement is still required. It may also begin with an incomplete feature list with additional features added as they are justified. The document will evolve over time until it includes sufficient detail on all the functional blocks and their inter-dependencies so that work can begin on the draft amendment itself.

**Revision notes**

***R0:*** *Initial version*

# Definitions

1. **Link Setup**: the process of gaining the ability to send IP traffic with a valid IP address through the AP. Link Setup may involve more than one AP in an ESS. This includes AP/Network discovery and (secure) Association and Authentication. [1]
2. **Link-Attempt Rate** is the number of STAs attempting to establish a link for the first time to an AP within an ESS as measured over a one second time interval.
3. **Media Load** is the “busyness” of the wireless medium of the ESS. It is measured as the percentage of time the medium is in use.
4. **Link Setup Time** is defined as the process of gaining the ability to send IP traffic with a valid IP address through the AP. Link Setup may involve more than one AP in an ESS. This includes AP/Network discovery and (secure) Association and Authentication. Link Setup Time is the amount time required in the use case to establish link setup. Timing starts when the STA elects to perform Link Setup.

# Abbreviations and acronyms

FILS Fast Initial Link Setup

# MAC Service definition(Clause 5)

## AP Discovery

### Beacon Coordination

* The transmission of beacons shall be coordinated among neighboring APs (time when to transmit a beacon) [11-11/1628r1]
* The TGai spec shall include a mechanism electing a single AP (“active responder”) to respond to probe request “as a representative for others”. [11-11/1628r1]
* An AP shall defer the transmission of its beacon under certain circumstances, including: [11-11/1628r1]
	+ Having overheard a beacon from another AP
	+ Other?
* May Pre-emptively stop transmission of (pending) probe requests if probe responses are seen [11-12/124r0]
* A criteria on how often a “short beacon” shall be transmitted has to be specified [11-12/42]

### Scanning

* Scanning primitives shall immediately report back any found AP [11-11/1521r2 & 11-11/1576r3]
* Intermediate results of the scanning procedure shall be reported back using a new, to be defined primitive [11-11/1521r2 & 11-11/1576r3]
* A service primitive allowing to abort / stop any ongoing scanning process shall be defined [11-11/1521r2 & 11-11/1576r3]

## Network Discovery

* Beacons [11-12/13r0] and Probe Responses [11-12/56r0] shall include information on the operating channel of neighboring APs
* Beacons shall carry the IP subnet prefix of the AP in an information element [11-12/27r1]
* Beacons and probe responses shall include information that indicates to a STA that any association attempt will be rejected. [11-12/80r0]

## Link (re-)establishment

* Every FILS AP shall announce its capability to support IP address assignment during link set-up [11-11/32r1]
	+ The announcement shall be included in the beacon and probe response frames
	+ The announcemt shall indicate if IPv4 and/or IPv6 address assignment is supported
	+ The announcemt shall indicate if both, IPv4 and IPv6 addresses can be assigned at the same time (vs. only supporting the assignment of either of the one)
* Association response frame shall not include information that has been received by a STA via a previously received beacon UNLESS the assocation resonse frame is transmitted as a protected management frame [11-11/1170r2 & 11-12/56r0]
	+ The STA shall include the beacon time stamp of the last correctly received beacon in the association request.
	+ The following information of the association response shall only be included in the association response frame if they have changed from the ones transmitted in the beacon identified by the time stamp included in the corresponding association request:
		- LIST TO BE INCLUDED or
		- All duplicate information

## Higher Layer Aspects

### IP Address Assignment

* The draft specification shall have a protocol / mechanism to enable fragment information carried in association response frames containing IP address assignment. [discussion on 11-11/32r1]

# Layer Management (Clause 6)

# Frame Formats (Clause 8)

* Format of the IP subnet prefix of the AP in the information element [11-12/27r1]
	+ NOTE: Discussion on the usefulness if AP operate in a private IP address space;

FORMAT NEEDED

* Beacons and Probe Response Frames shall include the following information: [11-12/11r0]
	+ Number of associated STAs
	+ Air-time occupation
	+ Speed of backhaul link

A value for each information element shall be given for every access catagory

FORMAT NEEDED

* Beacons [11-12/13r0] and Probe Responses [11-12/56r0] format for information on the operating channel of neighboring APs

FORMAT NEEDED

* Beacons and probe responses shall include information that indicate to a STA that any association attempt will be rejected. [11-12/80r0]

FORMAT NEEDED

* Create a new frame (“short beacon”) which can be sent at a high frequency [11-12/13r0 & 11-12/42]

FORMAT NEEDED

* The Associaction Request Frame shall include an information element used to convey the “request to assign IP addresses during link-set up” to the AP [11-11/32r1]

FORMAT NEEDED

* The Association Response Frame shall be used to carry the “assigned IP Addresses” [11-11/32r1]

FORMAT NEEDED

* A new frame shall be used (instead of the existing association response frame) to fulfill the function of the association response frame including IP address assignment. The new frame shall allow for longer payload elements to avoid fragmentation of contained information required for assigning IP Addresses. [discussion on 11-11/32r1]

FORMAT NEEDED

* + NOTE: There was discussion on collision probability of larger packets which might not be desired during link set-up.
* The probe request shall include information specifying which APs [11-12/59r1 & 11-12/124r0 & 11-12/56r0]
	+ A) shall respond the the probe request
	+ B) shall NOT respond to the probe request
	+ The list may include [11-12/63r1]
		- The identification of a dedicated AP
		- A description of capabilities of the AP that have to be fulfilled
* The probe request frame shall include an information element on the “probe response deadline”, i.e. the time after which the STA would no longer process probe responses (Note: the value could for example be obtained from the MaxChannelTime value). [11-12/61r1 & 11-12/56r0
* An AP shall not send probe responses to a probe request containing a “probe response deadline” if the deadline has expired. [11-12/61r1] NOTE: This bullet should rather go to Section 3 or 4.
* Probe Requests may be sent to a unicast address [11-12/13r0]
* Probe Requests shall not be sent using the Wildcard SSID [11-12/13r0]
* TGai APs shall not respond to probe requests having a Wildcard SSID [11-12/13r0]
* The Probe Response Frame shall include MCS feedback if the probe response frame is sent to a unicast address [11-12/70r1]
* If a STA receives a probe response including a MCS feedback, following frames (e.g. authentication related frames) by be sent at a higher MSC according to the feedback. [11-12/70r1]. NOTE: May go into another section (3 or 4 ?).
* Allow probe response frames being sent to the broadcast address [11-12/124r0 & 11-12/56r0]
* APs may respond to several pending probe request with a single probe response being sent to a broadcast address [11-12/124r0 & 11-12/56r0] Note: might have to go in another section of this doc.
* Create a new frame used to “terminate” the active scanning, i.e. to chancel out any pending probe request not being sent by an AP so far. [11-12/56r0]
* Include in every data frame information on [11-12/124r0]
	+ Network ID / roaming consortium ID
	+ Most recent Anonce copied from beacon
* Note: missing a bullet that could go in another section of this doc describing how this information would be used. [relates to 11-12/124]
* Allow GAS request frames being sent to a broadcast address [11-12/46r0]

# MAC sublayer functional description (Clause 9)

# MLME (Clause 10)

# Security (Clause 11)

* The security scheme used shall NOT include a third party for authentication [11-11/1408r9]
* TGai STAs shall support a “certificate-based public key” security scheme. A third party shall only be used to generate the certificates [11-11/1408r9 & 11-12/52r1]
* Authentication shall be using a key shared with a trusted third party [11-11/1429r2]
* Employed security scheme shall be capable of provided perfect forward security [11-11/1429r2]
* TGai STAs shall support a “shared-key based” security scheme. [11-12/55r1]
* TGai STAs shall support a “password-based” authentication protocol. [11-12/54r1]
* Communication with trusted third party shall be realized using existing infrastructure such as Radius, DIAMETER [11-11/1429r2]
* Security scheme must be implementable using 802.1X

# Fast BSS transition (Clause 12)

# New clause for AP functionality

**References:**

[0] IEEE Std 802.11-2012

[1] 11-10/0238: TGai Use Cases

[2] 11-11/0811: TGai Evaluation Methodology

[3] 11-11/0745: TGai Functionl Requirements