IEEE P802.11 Wireless LANs

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| Proposed 802.11ai Specification Text for FILS Discovery Frame Definition |
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| Author(s): |
| Name | Affiliation | Address | Phone | email |
| Lei Wang | InterDigital Communications | 781 Third Ave., King of Prussia, PA 19406 | 1 858 205 7286 | leiw@billeigean.com |
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Abstract

This submission proposes the 802.11ai specification text for the FILS Discovery Frame definition as a part of the passive scanning enhancements, based on the accepted features and functionalities in the 802.11ai Specification Framework Document (SFD), i.e., Section 6.3.1, in 12/0151r13[Ref-1], and also based on the relevant discussions in previous TGai meetings [Ref-9][Ref-10] .

The numbering of the clauses is taken from 2012 revision of IEEE802.11 standard [Ref-2].

# Introduction

To facilitate a fast initial link setup, high-level descriptions about passive scanning enhancement related features/functionalities have been accepted in 802.11ai Specification Framework Document (SFD), 12/0151r13 .

In 2012-September meeting, some initial text for the passive scanning enhancement related features / functionalities has been accepted to the 802.11ai draft specification document, 802.11ai/D0.1 [Ref-3], based on the proposals in Contribution 12/1028r3 [Ref-4] and 12/1168 [Ref-5] .

The 802.11Task Group (TGai) has issued a new call for contributions for Specification Tex for the TGai detailed Draft Text, 12/0992r1 [Ref-6].

As a response to the TGai Call-for-Contributions, this document proposes further detailed text for TGai Specification Document, to provide additional descriptions / specifications for the passive scanning enhancement related features / functionalities, particularly, the definition of the FILS Discovery frame.

# Conventions

In this contribution, the proposed 802.11ai Specification Document text will be presented as an amendment text based on the baseline 802.11 standard, 802.11-2012 [Ref-2]. The following format conventions are used:

1. The new added text is marked as blue underline text;
2. The deleted text is marked as ~~red strikethrough text~~;
3. The unchanged baseline standard text stays in black text in the context of proposed TGai specification text;
4. The editorial instruction is marked as *italic text highlighted by Yellow*;
5. The quoted TGai SFD text is marked as *green italic text*; and
6. Any other text, e.g., discussions, proposed motions, etc., is in black text, but not in the context of proposed TGai specification text.

# Background

Based on Section 6.3 in TGai Specification Framework Document (SFD) [Ref-1], the FILS Discovery frame is introduced as part of the passive scanning enhancements. However, a detailed description and definition of the FD frame has not been included in the initial text accepted into the 802.11ai draft specification doc, due to some open issues in its format and contents design.

There are two options about the FD frame format design that have been discussed and considered: new Extension frame vs. new public action frame. Based on a straw poll conducted in TGai 2012-September meeting, the option of new Extension frame is the preference. However, a concern has been identified regarding the associated implementation complexity for a new Extension frame. Therefore, in this contribution, two options with the detailed TGai Spec text proposals are provided: one is to define the FD frame as a new Extension frame, the other is to define the FD frame as a new Public Action frame.

In order to facilitate the group discussions and decision-making on this FD frame format issue, a comparison study is presented in a separate contribution, 12/1237r1 . Based on the discussions in TGai Monday PM-1 session and Tuesday AM-2, a group decision has been made that the FD frame uses the public action frame format.

Regarding the FD frame contents design, the following text is in the TGai SFD (12/0151r13 [Ref-1]):

*The following information items shall be included in the FILS Discovery Frame body:*

* *SSID*

 *The FILS Discovery frame may include the information item of Access Network Options, encoded as 1-byte information as defined in Figure 8-352 in 802.11-2012 specification*

*The FILS Discovery frame may include the following information items:*

* *Capability*
* *Access network options*
* *Security*
* *AP Configuration change count*
* *AP’s next TBTT*
* *Neighbor AP’s next TBTT*

Based on discussions in TGai 2012-September meeting, a good consensus has been reached regarding the detailed encoding design of the above content items, except for three items, capability, security, and neighbour AP’s next TBTT. In this contribution, a detailed text proposal is provided to specify the FD frame contents, based on the previous consensus and also based on another separate contribution, 12/1238 [Ref-12], with the proposals for those three open items.

# Proposed 802.11ai Specification Text

Based on the discussions in TGai Monday PM-1 session and Tuesday AM-2, a group decision has been made that the FD frame uses the public action frame format.

This Section provides a detailed description for defining the FD frame as a new Public Action frame.

*Instructions to Editor: modify the last raw of Table 8-210 in the 802.11-2012 standard as marked by the change tracking marks:*

**Table 8-210 – Public Action field values**

|  |  |
| --- | --- |
| **Public Action field value** | **Description** |
| 16 ~~– 255~~  | ~~Reserved~~  FILS Discovery |
| 17 – 255  | Reserved |

*Instructions to Editor: insert the following subsection under Section 8.5.8 in the 802.11-2012 standard:*

**8.5.8.ai1 FILS Discovery (FD) Frame Format**

The FILS Discovery frame (FD) uses the Action Frame format. The format of its Action field is shown in Table 8-ai-1.

**Table 8-ai-1 FILS Discovery Frame Action Field Format**

|  |  |  |
| --- | --- | --- |
| **Order** | **Information** | **Notes** |
| 1 | Category | It is an1-byte field, and it is set to the value indicating the Public Category, as specified in Table 8-38 in Section 8.4.1.11. |
| 2 | Public Action | It is an 1-byte field, and it is set to the value indicating FILS Discovery frame, as specified in Table 8-210 in Section 8.5.8.1. |
| 3 | FD Frame Control | It is a 2-byte field, and it consists of a number of subfields, as specified in Figure 8-ai-1. |
| 4 | Service Set Identifier (SSID) | It is a variable length field, and its length is between 1 and 32 octets, as specified by the 5-bit SSID Length field in the FD Frame Control of the FD frame. A SSID field of length 32 bytes is indicated by the SSID Length field with the value 0b00000. |
| 5 | FD Capability | The format of the 3-byte FD Capability field is shown in Figure 8-ai-2. It is an optional field in the FD frame. Its presence is indicated by an 1-bit Capability Presence Indicator in the FD Frame Control. |
| 6 | AP’s Next TBTT (ANT) | The 1-byte AP’s Next TBTT (ANT) field is set to the offset value, in unit of Transmission Unit (TU), between the transmission time of the FD frame and the transmission time of next Beacon frame. It is an optional field in the FD frame, and its presence is indicated by an 1-bit ANT Presence Indicator in the FD Frame Control. |
| 7 | AP Configuration Change Count (AP-CCC) | The 1-byte AP Configuration Change Count (AP-CCC) field is set to the version number of AP configuration parameter setting values. It is an optional field in the FD frame, and its presence is indicated by an 1-bit AP-CCC Presence indicator in the FD Frame Control. |
| 8 | Access Network Options (ANO) | The 1-byte field of Access Network Options (ANO) is of the format as specified in Figure 8-352 in 8.4.2.94. It is an optional field in the FD frame, and its presence is indicated by an 1-bit ANO Presence indicator in the FD Frame Control. |
| 9 | FD Security | The format of the 4-byte FD Security field is shown in Figure 8-ai-3. It is an optional field in the FD frame. Its presence is indicated by an 1-bit Security Presence Indicator in the FD Frame Control. |
| 10 | Neighbour AP’s TBTT information | The format of the variable length Neighbour AP’s TBTT information field is shown in Figure 8-ai-4. It is an optional field in the FD frame. Its presence is indicated by an 1-bit Neighbour AP’s TBTT Information (NAPI) Presence Indicator in the FD Frame Control. |
| Last – n  | Optional Elements | One or more elements can optionally appear in this frame, each consisting of a 1-octet Element ID field as defined in Table 8-54, 1-octet Length field, and a variable-length Data field. The optional elements are ordered by nondecreasing element ID. These elements follow all other content items that are not vendor-specific and precede all other elements that are vendor-specific elements that are part of the Last field in the frame.  |
| Last | Vendor-specific | One or more vendor-specific elements are optionally present. These elements follow all other elements.  |

The format of the 2-byte FD Frame Control field is shown in Figure 8-ai-1.



**Figure 8-ai-1 FD Frame Control Field Format**

The 5-bit SSID Length field indicates the length of the SSID field in the FD frame body, in unit of bytes. The value 0 indicates 32 bytes.

The 1-bit Capability presence indicator is set to 1 if the FD Capability field is present in the FD frame body, otherwise it is set to 0.

The 1-bit ANT presence indicator is set to 1 if the AP’s Next TBTT (ANT) field is present in the FD frame body, otherwise it is set to 0.

The 1-bit AP-CCC presence indicator is set to 1 if the AP Configuration Change Count (AP-CCC) field is present in the FD frame body, otherwise it is set to 0.

The 1-bit ANO presence indicator is set to 1 if the FD Access Network Options (ANO) field is present in the FD frame body, otherwise it is set to 0.

The 1-bit Security presence indicator is set to 1 if the FD Security field is present in the FD frame body, otherwise it is set to 0.

The 1-bit Neighbour AP’s TBTT Information (NAPI) presence indicator is set to 1 if the Neighbour AP’s TBTT Information field is present in the FD frame body, otherwise it is set to 0.

The FD Capability field contains the information that advertises the optional capabilities of the STA transmitting the FD frame. Its length is 2 bytes. The format of the FD Capability field is shown in Figure 8-ai-2.



**Figure 8-ai-2 Format of the FD Capability Field**

The sub-fields of the FD Capability field, except for IPv4 Support, IPv6 support, PHY type, and Supported Minimum Rate, are interpreted the same as specified in Section 8.4.1.4.

The two 1-bit capability indicators, IPv4 support and IPv6 support, are used to indicate the support for IPv4 and IPv6, respectively. When set to 1, it means supported, otherwise, not-supported.

The 4-bit PHY type subfield indicates the PHY type. It is an integer value of the LSB 4 bits of dot11PHYType parameter.

The 4-bit Supported Minimum Rate subfield specifies the minimum rate, as coded in Table 8-ai-2.

**Table 8-ai-2 Supported Minimum Rate in FD Frame**

|  |  |
| --- | --- |
| **Supported Minimum Rate Subfield (4 bits)** | **Supported Minimum Rate** |
| 0b0000 | 1 Mbps |
| 0b0001 | 2 Mbps |
| 0b0010 | 6.5 Mbps |
| 0b0011 | 13 Mbps |
| 0b0100 – 0b1111 | Reserved |

The FD Security field contains the security information required for the data communications within the BSS of the AP STA transmitting the FD frame. Its length is 4 bytes. Its format is defined in Figure 8-ai-3.



**Figure 8-ai-3 Format of the FD Security Field**

The FD Security field contains four 4-bit Cipher Suite Selectors, including, one 4-bit Group Data Cipher Suite selector, one 4-bit Group Management Cipher Suite selector, and two 4-bit Pairwise Cipher Suite Selectors. Each 4-bit Cipher Suite selector is a 4-bit code identifying a Cipher Suite Type as specified in Table 8-99. The definition of the 4-bit Cipher Suite Selectors is shown in Table 8-ai-3.

**Table 8-ai-3 Cipher Suite Selector Definitions**

|  |  |
| --- | --- |
| **Cipher Suite Selector (4 bits)** | **Cipher Suite Type** |
| 0b0000 – 0b0111 | Cipher Suite Type 0 to 7, in Table 8-99 |
| 0b1000 – 1101  | Reserved |
| 0b1110 | Vendor Specific |
| 0b1111 | no cipher suite selected |

The FD Security field contains two 4-bit AKM Suite Selectors. Each 4-bit Cipher Suite selector is a 4-bit code identifying a AKM Suite Type as specified in Table 8-101. The definition of the 4-bit AKM Suite Selectors is shown in Table 8-ai-4.

**Table 8-ai-4 AKM Suite Selector Definitions**

|  |  |
| --- | --- |
| **AKM Suite Selector (4 bits)** | **AKM Suite Type** |
| 0b0000 – 0b1001 | Cipher Suite Type 0 to 9, in Table 8-101. |
| 0b1010 – 1101  | Reserved |
| 0b1110 | Vendor Specific |
| 0b1111 | no AKM suite selected |

The FD Security field contains eight 1-bit security capability subfields, from bit 24 to bit 31. The subfields, Pre-Authentication (bit 24), Management Frame Protection required (bit 25), and Management Frame Protection Capable (bit 30), have the same meaning and set to equivalent bits as in the RSN capabilities field as specified in Section 8.4.2.27.4.

The subfield FILS Fast EAP (bit 26) is set to 1 if the FILS Fast EAP is supported, otherwise, set to 0.

The subfield FILS EAP-RP (bit 27) is set to 1 if the FILS EAP-RP is supported, otherwise, set to 0.

The subfield FILS Non-EAP (bit 28) is set to 1 if the FILS Non-EAP is supported, otherwise, set to 0.

The subfield FILS Authentication Without Third Party (bit 29) is set to 1 if the FILS Authentication Without Third Party is supported, otherwise, set to 0.

The subfield FILS Perfect Forward Secrecy (bit 31) is set to 1 if the FILS FILS Perfect Forward Secrecy is supported, otherwise, set to 0.

The Neighbour AP’s TBTT Information field in the FD frame contains a list channels and the next TBTT information on each channel in the list, where a STA receiving this FD frame is likely to find another AP. The format of the Neighbour AP’s Next TBTT information field in the FD frame is shown in Figure 8-ai-4.



**Figure 8-ai-4 Format of the Neighbour AP’s TBTT Information Field**

The length of the Neighbour AP’s TBTT Information field in the FD frame is variable, which is determined by the information contained in the NAPI control sub-field, including the number of channels and the number of AP/TBTTs for each channel. For n channels that have k1, k2, ..., kn AP/TBTTs, respectively, then the length of the Neighbour AP’s TBTT information field is:

Ceiling((4+2\*n)/8) + 2\*n + k1 + k2 + ... + kn (bytes)

In the NAPI control sub-field, the 4-bit Number of Channels (n) subfield is set to the number of channels contained in the Neighbour AP’s TBTT Information field, where value 0 indicates 16 channels. For each channel, a 2-bit Number of AP/TBTTs sub-field is set to the number of AP/TBTTs that are included, where value 0 indicates 4 AP/TBTTs. A Pad subfield with 0 to 6 bits is included, when needed, so that the length of the NAPI control sub-field is a multiple of 8 bits.

Each channel contained in the Neighbour AP’s TBTT information field in the FD frame is identified by an 1-byte operating class and an 1-byte operating channel number in the class. The Operating Class contains an enumerated value from Annex E, specifying the operating class in which the operating Channel number is valid.

For each channel listed in the Neighbour AP’s TBTT information field in the FD frame, one or more 1-byte offset values is provided, each corresponding to an AP operating on the channel, where the offset value is the time offset, in unit of Transmission Unit (TU), between the FD frame transmission time and the AP’s next TBTT (Target Beacon Transmission Time).

# Straw-Polls and Motions

The following lists the draft straw-polls and motions that are intended to present to the TGai Group in the Face-to-Face meeting.

**Motion-1:** Include the text proposed in Section 4 this contribution (12/1236r1), i.e., defining FD frame as a new Public Action frame, into the TGai Draft Specification Document (D0.1).

Yes: \_\_\_\_\_\_\_\_\_\_\_\_; No: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; Abstain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Move:

Second:

# References:

1. 11-12-0151-13-00ai-Proposed-Specification-Framework-Document.docx
2. IEEE Std 802.11 – 2012
3. IEEE Std 802.11ai/D0.1
4. 11-12-1028-03-00ai-tgai-spec-text-proposal-for-passive-scanning-enhancement
5. 11-12-1168-00-00ai-tgai-spec-text-proposal-for-FD-frame-processing
6. 11-12-0992-01-00ai-call-for-specification-text-contributions-for-the-tgai-detailed-draft-text
7. 11-12-1029-01-00ai-FILS-Discovery-Frame-Format-Discussions
8. 11-12-1030-00-00ai-FILS-Discovery-Frame-Content-Discussions
9. 11-12-1130-03-00ai-paasive-scanning-ad-hoc-report
10. 11-12-1148-01-00ai-further-discussions-about-fd-frame-format-design
11. 12/1237r1: FD frame format comparison study
12. 12/1238: detailed design for FD capability, security, and neighbour AP information