P802.11  
Wireless LANs

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| --- | --- | --- | --- | --- |
| TGaq –Pre-association Service Discovery Protocol | | | | |
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Abstract

This document describes the Pre-association Service Discovery protocol

P™/D  
Draft for for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications – Amendment: Pre-Association Discovery

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Abstract: This amendment defines modifications to the IEEE 802.11 standard, above the physical layer (PHY), to enable delivery of pre-association Service Discovery information by IEEE 802.11 stations (STAs).

Keywords: <Select this text and type or paste keywords>

[[1]](#footnote-1)•

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*{Editor’s note: The revision log table below shall be removed before publication}*

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| --- | --- | --- | --- | --- |
| P802.11aq Draft Revision Log  Last updated: 2014-09-30 | | | | |
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| 0.01 | 2014-06-04 | * 11-13-0299-03-00aq-draft-tgaq-terminology.docx * 11-13-0300-01-00aq-proposed-specification-framework-for-tgaq.docx * 11-14-0657-00-00aq-pre-association-discovery-protocol.doc | Various TGaq members | Initial TG draft |
| 0.02 | 2014-10-01 | * 11-14-0925-00-00aq-editorial-comments-on-d0-01.ppt * 11-14-1277-02-00aq-simplification-of-service-identifiers.doc | Stephen McCann |  |
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Introduction

This introduction is not part of P/D, Draft for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications – Amendment: Pre-Association Discovery

.

This standard defines one medium access control (MAC) and several physical layer (PHY) specifications for wireless connectivity for fixed, portable, and moving stations (STAs) within a local area. It defines modifications to the IEEE 802.11 standard, above the physical layer (PHY), to enable delivery of pre-association Service Discovery information by IEEE 802.11 stations (STAs).

Contents

*<After draft body is complete, select this text and click Insert Special->Add (Table of) Contents>*

Draft for Information technology--Telecommunications and information exchange between systems Local and metropolitan area networks--Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications – Amendment: Pre-Association Discovery

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1. Overview
   1. Scope
   2. Purpose
2. Normative references

The following referenced documents are indispensable for the application of this document (i.e., they must be understood and used, so each referenced document is cited in text and its relationship to this document is explained). For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments or corrigenda) applies.

[1]. P802.11aq PAR: <https://development.standards.ieee.org/get-file/P802.11aq.pdf?t=77398700003>

[2]. P802.11aq Use Cases: <https://mentor.ieee.org/802.11/dcn/12/11-12-1416-00-0pad-use-cases-and-requirements.doc>

[3]. P802.11aq Use Cases Analysis, Rev 6: <https://mentor.ieee.org/802.11/dcn/13/11-13-0125-06-00aq-use-case-analysis.doc>

[4]. IEEE Standards Definition Database online: http:// <http://dictionary.ieee.org/>

[5]. IEEE 802.11 [draft] standard: P802.11mc Rev: \_\_\_\_\_\_\_ Dated: \_\_\_\_\_\_\_\_\_\_

* 1. Definitions

For the purposes of this document, the following terms and definitions apply. The IEEE Standards Dictionary Online [4] should be consulted for terms which not defined in this clause. [[2]](#footnote-2)

**3GPP Access Network Discovery and Selection Function (ANDSF):** An entity within a 3GPP Evolved Packet Core (EPC) of the system architecture evolution (SAE), for 3GPP compliant mobile networks. The purpose of the ANDSF is to assist user equipment (UE) to discover non-3GPP access networks, such as WLAN, that can be used for data communications in addition to 3GPP access networks, such as HSPA or LTE, and to provide the UE with rules policing the connection to these networks.

**Application:** All the software that causes a device to perform a particular useful task beyond the running of the device itself.

**Bonjour:** A popular implementation of Zero configuration networking (Zeroconf), a group of technologies that includes service discovery, address assignment, and hostname resolution. Bonjour locates devices such as printers, other computers, and the services that those devices offer on a local network using multicast Domain Name System (mDNS) service records.

**Pre-Association Discovery Protocol (PADP):** A protocol to enable the discovery of service information for a pre-associated STA.

**Proximity:** Nearness in space, within the reception range of a radio frequency (RF) signal.

**Service:** An independently operable component of a peer unit that processes requests and associated data from clients in other peer units (peer services). Or an action or response initiated by a process (i.e., a server) at the request of some other process (i.e., a client) (peer and client services).

**Service Discovery:** The process of finding services that match the requirements of the service requestor. It includes procedures for querying and browsing for services offered by, or through, another STA.

**Service Discovery Protocols (SDPs**): Network protocols that allow automatic detection of STAs and services offered by these STAs on a computer/wireless network. Service discovery requires a common language to allow software agents to make use of one another's services without the need for continuous user intervention. Examples of service discovery protocols include Bluetooth Service Discovery Protocol (SDP), DNS Service Discovery (DNS-SD) as used in Bonjour, Dynamic Host Configuration Protocol (DHCP), Internet Storage Name Service (iSNS), Service Location Protocol (SLP), Simple Service Discovery Protocol (SSDP) as used in Universal Plug and Play (UPnP), Universal Description Discovery and Integration (UDDI) for web services, Web Proxy Autodiscovery Protocol (WPAD), WS-Discovery (Web Services Dynamic Discovery), and XMPP Service Discovery (XEP-0030).

**Universal Plug and Play (UPnP):** A set of networking protocols that permit networked devices, such as personal computers, printers, Internet gateways, access points and mobile devices to seamlessly discover each other's presence on the network and establish functional network services for data sharing, communications, and entertainment. The UPnP architecture is a distributed open networking architecture that leverages TCP/IP and the Web to enable seamless proximity networking in addition to control and data transfer among networked devices. UPnP technology is independent of any particular operating system, programming language, or network technology.

**Universally Unique Identifier (UUID):**is an identifier that is uniquely identifies a service

**Service Hash**: Hash value formed by using the first 6 octets of the SHA-256 algorithm hashing of the value of the service name or UUID.

**Upper Layer Protocol (ULP):** A protocol which operates at a higher OSI layer than the MAC layer of IEEE 802.11

* 1. Definitions specific to IEEE 802.11

----- {TBD} -----

* 1. Abbreviations and acronyms

ANDSF Access Network Discovery and Selection Function

App Application

SDP Service Discovery Protocol

SLP Service Location Protocol

SSDP Simple Service Discovery Protocol

UPnP Universal Plug and Play

1. { TBD?}

4.5.9 Interworking with external networks

*Change the text as follows*   
{Editor note: need to show the changed text with Track Changes marks}

The interworking service allows non-AP STAs to access services provided by an external network according to the subscription or other characteristics of that external network. An IEEE 802.11 non-AP STA may have a subscription relationship with an external network, e.g., with an SSPN.

An overview of the interworking functions addressed in this standard is provided below:

— Network discovery and selection

— Discovery of suitable networks through the advertisement of access network type, roaming

consortium and venue information, via management frames

— Selection of a suitable IEEE 802.11 infrastructure using advertisement services (e.g., Access Network Query Protocol (ANQP) or an IEEE 802.21 Information Server) in the BSS or in an external network reachable via the BSS.

— Selection of an SSPN or external network with its corresponding IEEE 802.11 infrastructure

— Pre-Association Discovery

— Discovery of services offered by an infrastructure network in prior to association.

— Emergency services

— Emergency Call and Network Alert support at the link level

— QoS Map distribution

— SSPN interface service between the AP and the SSPN

{TBD – add the PAD element to the Beacon and Probe Response management frames}

**8.4.2.1 General**

*Insert the following row (ignoring the header row) in Table 8-1 after <preceding amendment last entry>*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | | Table 8-54 – Element IDs | | |
| Element | | Element ID | | Length of indicated element (in octets) | Extensible |
| Service Hint Information (see 8.4.2.122a) | | <TBD> | | <TBD> |  |
| Service Advertisement Information (see 8.4.2.122b) | | <TBD> | | <TBD> |  |
| Service Hash (see 8.4.2.122c) | | <TBD> | | <TBD> |  |
| Supported ULP (see 8.4.2.122d) | | <TBD> | | <TBD> |  |

**8.4.2.95 Advertisement Protocol element**

*Insert the following row (ignoring the header row) in Table 8-175 after Registered location query protocol (RLQP):*

|  |  |
| --- | --- |
| Table 8-175 - Advertisement protocol ID definitions | |
| Name | Value |
| Pre-Association Discovery Protocol | <ANA> |

*Insert dashed list text after Registered location query protocol (RLQP) as follows:*

—The Pre-association Discovery Protocol (PADP) supports service information retrieval. PADP is a protocol used by a requesting STA to query another STA (i.e., the receiving STA can respond to queries with and without proxying the query to a server in an external network). See 10.24 (WLAN interworking with external networks procedures) for information on PADP procedures.

*{Need some text to explain the two-stage process}*

*PADP consists of the following procedures:*

1. *Unsolicited PAD from an AP to a non-AP STA as described in 10.24.3.4.1*
2. *Solicited PAD from non-AP STA to an AP as described in 10.24.3.4.2*
3. *PADP request/response, typically from a non-AP STA to an AP for a more detailed service discovery query as described in 8.4.6.2.*

*Insert the following new subclause after <TBD> at the end of 8.4.2.*

**8.4.2.122a Service Hint Information Element**

The Service Hint Information element contains information identifying services that are supported by an AP. The Service Information element is transmitted in beacons.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Element ID | | Length | Bloom Filter Information | *m*-bit Service Hint Map |
| Octets | 1 | 2 | | 2 | variable |



Figure 8-401aq – Service Hint Information element format

The Element ID field is set to the value given in Table 8-54*{this table requires a new value added to it}.*

The value of the Length field is 2 plus the variable length *m*-bit Service Hint Map.

The Bloom filter information field is a 2-octet field representing the settings of the Bloom filter. The format of the Bloom filter information is shown in Figure 8-402aq.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Number of services | Number of Hash functions | Reserved |
| Bit: | 0-8 | 9-12 | 13-15 |



Figure 8-402aq – Bloom filter information format

The number of services field is used to indicate the maximum number of services, *n* that can be supported by the AP. The maximum number of services are 512

The number of Hash functions field is used to indicate the number of hash functions, *k* (out of maximum of 16) used by the Bloom filter. For example, 0001 means the first 2 Hash functions (denoted by Hash function index 0x00 and 0x01 as shown in Table 8-xyaq) are used.

The Bloom filter Hash function is as follows. Each Service Hash is hashed to *j* bit positions in the *m*-bit Service hint map using *j* hash functions. A total of 16 Hash functions are defined and are constructed as follows:

Let H(*j*,X,*m*) denotes the Hash function with

1. *j* Bloom filter Hash Function pre-pend parameter used in the computation. *j* ranges from 0x00, 0x0F in hexadecimal notation.
2. X is the Service Hash that is mapped to *j*-bits of the *m*-bits Service Hint Map
3. *m* is the size of Bloom filter to be indicated in bits

*H*(*j*,X,*m*) is computed as follows:

1. Compute A(*j*,X) = [*j* || X] where || denotes an append operation
2. Compute B(*j*,X) = CRC32(A(*j*,X)) & 0x0000FFFF. i.e., obtain the last 2 bytes 32 bit CRC of A(*j*,X) where the CRC operation is seeded with 0xFFFFFFFF.
3. H(*j*,X,*m*) = B(*j*,X) mod *m*

The full set of Hash functions is shown in Table 8-xyaq.

|  |  |
| --- | --- |
| Hash Function Index, *j* (in Hexadecimal) | Hash Function |
| 0x00 | H(0x00,X,*m*) |
| 0x01 | H(0x01,X,*m*) |
| 0x02 | H(0x02,X,*m*) |
| 0x03 | H(0x03,X,*m*) |
| 0x04 | H(0x04,X,*m*) |
| 0x05 | H(0x05,X,*m*) |
| 0x06 | H(0x06,X,*m*) |
| 0x07 | H(0x07,X,*m*) |
| 0x08 | H(0x08,X,*m*) |
| 0x09 | H(0x09,X,*m*) |
| 0x0A | H(0x0A,X,*m*) |
| 0x0B | H(0x0B,X,*m*) |
| 0x0C | H(0x0C,X,*m*) |
| 0x0D | H(0x0D,X,*m*) |
| 0x0E | H(0x0E,X,*m*) |
| 0x0F | H(0x0F,X,*m*) |

Table 8-xyaq – Hash functions for the Bloom filter

**8.4.2.122b Service Advertisement Information (SAI) Element**

The Service Advertisement Information (SAI) element identifies a service advertised by an AP.

The SAI element is included in the Probe Response by the AP, in response to a Probe Request from a non-AP STA that has one or more matching Service Hashes. For each matching Service Hash, the AP includes a corresponding basic service descriptor.

The format of the SAI element is shown in Figure 8-403aq.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | | Length | Basic Service Information Descriptor #1 | Basic Service Information Descriptor #2 | … | Basic Service Information Descriptor #j |
| Octets | 1 | 1 | | variable | variable |  | variable |

**Figure 8-403aq – Service Advertisement Information element format**

The Element ID field is set to the value given in Table 8-54.

The value of the Length field is 2, plus the total length of all the basic service information descriptors. The format of the basic service information descriptor is shown in Figure 8-404aq.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Advertisement ID | Service Name Length | Service Name | Service  Status |
| Octets: | 4 | 1 | Variable | 1 |

**Figure 8-404aq – Basic Service Information Descriptor format**

The service status field is a 1octet field indicating the current status of the service as shown in Table 8-4xxaq.

|  |  |
| --- | --- |
| Service Status Value | Description |
| 0 | Not available |
| 1 | Available |
| 2-255 | Reserved |

**Table 8-4xxaq – Service status value**

The advertisement ID field is a 4-octet unsigned integer assigned by the AP when advertising a service. Service Name is an UTF-8 encoded string with maximum length of 64 bytes. Service Name may be an official IANA registered name as defined in RFC 6335 or developer specified name.

**8.4.2.122c Service Hash Element**

The Service Hash element consists of service Hash values. Service Hash element may be included in the Probe Request.

The format of the Service Hash element is shown in Figure 8-405aq.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Element ID | | Length | Service Hash value #1 | Service Hash value #2 | … | Service Hash #j |
| Octets | 1 | 1 | | 6 | 6 |  | 6 |

**Figure 8-405aq – Service Hash element format**

The Service Hash value field is a field formed from the value of service name by using the first 6 octets of the SHA-256 algorithm hashing of the value of the service name.

**8.4.2.122d Supported ULP Element**

The Supported ULP element is used to indicate the supported ULP by the AP. The Supported ULP may be included in the Beacons and Probe Response.

The format of the Supported ULP element is shown in Table 8-40xaq:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Element ID | | Length | Supported ULP Bitmap |
| Octets | 1 | 1 | | 4 |

**Figure 8-40xaq – Supported ULP element format**

The Supported ULP Bitmap field is a 4-octets field that represents the set of supported ULPs by the AP.

**Table 8-402aq – Supported ULP Bitmap**

|  |  |  |
| --- | --- | --- |
| **ULP name** | **ULP Abbreviation** | **Bits** |
| DNS Service Discovery, part of Apple’s Bonjour technology | DNS-SD, Bonjour | 0 |
| Service Location Protocol | SLP | 1 |
| Simple Service Discovery Protocol as used in Universal Plug and Play | SSDP, UPnP | 2 |
| Universal Description Discovery and Integration for web services | UDDI | 3 |
| Jini for Java objects. | JINI | 4 |
| Bluetooth Service Discovery Protocol | SDP | 5 |
| Salutation | Salutation | 6 |
| XMPP Service Discovery | XEP-0030 | 7 |
| Web Services Dynamic Discovery | WS-Discovery | 8 |
| multicast DHCP | MDHCP | 9 |
| Internet Storage Name Service | iSNS | 10 |
| Web Proxy Autodiscovery Protocol | WPAD | 11 |
| Dynamic Host Configuration Protocol | DHCP | 12 |
| eXtensible Resource Descriptor Sequence | XRDS | 13 |
| e911 (Emergency Service) | e911 | 14 |
| Next Generation 911 (Emergency Service) | NG911 | 15 |
| Location Service | Location | 16 |
| Reserved | - | 17-31 |







*Insert the following new subclause 8.4.6*

**8.4.6 Pre-Association Discovery Protocol elements**

**8.4.6.1 General**

PADP-elements are defined to have a common format consisting of a 2-octet Info ID field, a 2-octet Length field, and a variable-length element-specific Information field. Each element is assigned a unique Info ID as defined on this standard. The PADP-element format is shown in Figure 8-406aq:

|  |  |  |  |
| --- | --- | --- | --- |
|  | Info ID | Length | PADP Protocol-specific Information |
| Octets: | 2 | 2 | variable |

**Figure 8-406aq – PADP-element format**

Each PADP-element in 8.4.6 is assigned a unique 2-octet Info ID value of 276.

The Length field is a 2-octet field that indicates the number of octets in the Information field and is encoded following the conventions given in 8.2.2 (Conventions).

The PADP Protocol-Specific Information field is a variable length field that contains a specific PADP element definition.

**8.4.6.2 PADP Service Information Request/Response**

The PADP Service Information Request/Response is a protocol for exchanging service specific information.

The PADP Protocol-Specific Information fields are defined as follows:

**8.4.6.2.1 Service Information Request PADP-element**

The Service Information Request element is used to request service information between STAs using the PADP Service Information Request/Response protocol. The Service Information Request element is included in a GAS Query Request and is sent by the non-AP STA to the AP.

The format of the Service Information Query Request is shown in Figure 8-407aq.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Service Name Length | Service Name | Service Information Query Request Length | Service Information Query Request |
| Octets: | 1 | variable | 1 | variable |

**Figure 8-407aq – Service Information Request PADP-element format**

The Service Information Query Request field contains service specific query such as key-value query.



**8.4.6.2.2 Service Information Response element**

The Service Information Response element is used to provide detailed service information between STAs using the GAS protocol in response to a Service Information Request element. The Service Information Response element is included in a GAS Query Response sent by the AP to the non-AP STA

|  |  |  |  |
| --- | --- | --- | --- |
|  | Detailed Service Information Descriptor #1 | … | Detailed Service Information Descriptor #j |
| Octets: | variable |  | variable |

**Figure 8-408aq – Detailed Service Information Response element format**

The Service Information Descriptor field is a variable length field. The format of the Detailed Service Information Descriptor is shown in Figure 8-409aq.

|  |  |  |
| --- | --- | --- |
| Basic Service Information Descriptor | Service Information Query Response Length | Service Information Query Response |
| variable | 2 | variable |

**Figure 8-409aq – Detailed Service Information Descriptor element format**

The Service Information Query Response field is a variable length field. The format of the Service Information Query Response is service specific that contains requested service information



















**8.4.6.4 Encapsulation PADP-element**

The Encapsulation element is used to exchange upper layer protocol (ULP) frames between STAs using the GAS protocol. The Encapsulation PADP-element is used as a transaction request included in a GAS Query Request or returned as a transaction response in the GAS Query Response.

|  |  |  |
| --- | --- | --- |
|  | Token | <TBD> |
| Octets: | 2 | variable |

**Figure 8-409aq – Encapsulation PADP-element format**

The Length and Token fields are defined in 8.4.6.1 (General).

The format of the <TBD> sub-field is <TBD>.

**10. MLME**

**10.24 WLAN interworking with external networks procedures**

**10.24.3 Interworking procedures: generic advertisement service (GAS)**

*Insert new subclause 10.24.3.4 after the end of 10.24.3.3 as follows:*

**10.24.3.4 Pre-Association Discovery Protocol (PADP) procedures**

**10.24.3.4.1 General**

PADP provides functionality that enables STAs to discover the availability of services offered by an AP, before they associate with the wireless LAN. While the specification of service specific information is outside the scope of this standard, the AP can act as a proxy to the services offered by an external network or services offered by non-AP STAs associated with the AP.

There are two types of PAD namely unsolicited and solicited.

In the unsolicited PAD, basic service information is included in the Beacons, transmitted by the AP. Upon receiving the Beacons frames, the non-AP STAs can make an informed decision to associate with the AP, or query for more detailed service information using PADP as described in 8.4.6.2 before association.

In the solicited PAD, basic service information is included in the Probe Request transmitted by the non-AP STA. Upon receiving the Probe Request, the AP responds with a Probe Response only if there is a service match between the non-AP STA and the AP. The non-AP STAs can make an informed decision to associate with the AP or query for more detailed service information using PADP as described in 8.4.6.2 before association

**10.24.3.4.1 Unsolicited PAD**

An AP having dot11UnsolictedPADActivated equals to true shall include a Service Hint Information element in Beacon frames.

A non-AP STA having dot11PADActivated equals to true shall listen for at least TBD beacon interval for Beacon frames.

The non-AP STA may associate to the AP based on the received Service Hint Information element or may use PADP Service Information Request to request more detailed information as defined in Table 8-175 (Advertisement protocol ID definitions) prior to association. The receiving AP shall respond to the PADP Service Information Request with PADP Service Information Response.

**10.24.3.4.2 Solicited PAD**

A non-AP STA having dot11PADActivated equals to true may send Probe Request containing Service Hash element

An AP having dot11SolictedPADActivated equals to true shall include Service Advertisement Information element in Probe Response frame, if there is one or more Service Hashes matching with the received Probe Request containing the Service Hash element sent by the non-AP STA.

The non-AP STA may associate to the AP based on the received Service Advertisement Information element or may use PADP Service Information Request to request more detailed information as defined in Table 8-175 (Advertisement protocol ID definitions) prior to association. The receiving AP shall respond to the PADP Service Information Request with PADP Service Information Response.

A STA that encounters an unknown or reserved PADP Info ID value in a GAS frame (see 8-210) received without error shall ignore that PADP Info ID and shall parse any remaining PADP Info IDs.

A STA that encounters an unknown vendor-specific PADP-element field or subfield in a GAS frame (see 8-210) received without error shall ignore that field or subfield respectively, and shall parse any remaining fields or subfields for additional information with recognizable field or subfield values.

**10.24.3.4 PAD Encapsulation Protocol procedures**

<TBD> - Normative description of the protocol here.

**Annex C**

**(normative)**

**ASN.1 encoding of the MAC and PHY MIB**

**C.3 MIB Detail**

***Insert new MIB values as follows:***

dot11PADImplemented OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"This is a capability variable. Its value is determined by device capabilities.

This attribute when true, indicates the STA is capable of pre-association discovery (PAD)

with external networks. A STA setting this to true implements PAD. When this is false, the STA

does not implement PAD.

DEFVAL {false}

::= { dot11StationConfigEntry *<TBD>*}

dot11PADActivated OBJECT-TYPE

SYNTAX TruthValue

MAX-ACCESS read-write

STATUS current

DESCRIPTION

"This is a control variable.

It is written by an external management entity or the SME. Changes take

effect as soon as practical in the implementation.

This attribute when true, indicates the capability of the STA to operate PAD

with external networks is enabled. The capability is disabled otherwise."

DEFVAL {false}

::= { dot11StationConfigEntry *<TBD>*}

**Annex AQ1**

**(normative)**

**AQ1.1 Service Discovery**



.

**Annex AQ2**

**(normative)**

**AQ2.1 Proxy Entity**

{<placeholder> for description of a service directory in the STA}. This is required to pass information up to higher layer applications (e.g. a Service Hash) and for the PADP to work.

It is assumed that there is proxy function in the network that maintains a list of services. The upper layer protocols are not exposed to un-associated STAs. The proxy is used to encapsulate the service identifiers and exchange that information to the STA. Therefore, PADP is opaque to the service definition and is handled by the proxy and the end STA itself.

# (Informative) Bibliography

Bibliographical references are resources that provide additional or helpful material but do not need to be understood or used to implement this standard. Reference to these resources is made for informational use only.

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