IEEE P802.11

Wireless Access Method and Physical Layer Specification

Primary Protocol for DSM Transfers in an ESS

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Summary

This submission provides the text modifications and additions to enhance the 802.11 standard by defining a rudimentary mechanism for exchanging association information and distributing MSDUs over the DSM of an ESS.

- The proposed mechanism is trivial to support at any 802.11 entity, because the information exchange is based on the management functions and frame formats which must already be supported as part of the interface to the wireless medium.
- This mechanism permits the establishment of ESSes with access, distribution, and integration entities from multiple vendors, connected to a common DSM. However, this mechanism does not mandate a single procedure to be used to provide distribution services, and this mechanism neither specifies nor constrains the manner in which distribution–related information (association state, authentication state, etc.) is stored and managed within any 802.11 entities.
- Instead, this mechanism provides a rudimentary means to communicate association and distribution information over a DSM comprised of 802 type LAN(s), and defines several MIB parameters. There are allowable settings of these parameters which facilitate any of a wide range of distributed and centralized association management techniques, as well as providing communication for either inform-on-association or query-on-reassociation strategies for handling mobility transitions within the ESS.

The mechanism defined herein is most beneficial when used in an ESS where the distribution system media are comprised strictly of one or more segments of 802 type LANs, connected by repeaters or 802.1d MAC Bridges (and/or 802.11 wireless distribution system links, connected by access points). The use of "ESS" in the text below is consistent with the revised definition of this term presented in document 95–188, Clause 1, and proposed as a modification of the standard in several other letter ballot comments by this author (updating sections 1.1, 2.2.x, and 2.3.x). If this revised definition of ESS is not adopted, text will have to be added to some of the updates below, adding the restriction that this mechanism may not function properly in an ESS with a distribution system which operates above the data link layer or which includes non–LAN media. These later two cases are what is defined as a "more extended service set" (MESS) in document 95–188, Clause 1

Justification for Proposing a Change that Includes New Functionality

A basic means by which DS entities at APs (and portals) determine whether a given station is associated anywhere in an ESS, and obtain the address of the AP with which that station is currently associated, need to be defined in the standard, because without such a definition, the benefits of standardization apply only to stations, leaving large organizations (the very ones most likely to want to deploy large ESSes) with nothing in the standard to facilitate mixed-vendor interoperability among APs. Failing to provide at least a minimal form of interoperability over the DSM of an ESS will limit the market acceptance of 802.11-compliant products, especially in the larger sites which constitute some of those in greatest need of wireless mobility solutions.

The early history of 802.11 includes the decision to not specify, nor constrain, the distribution system implementation strategy. This remains both possible and desirable — the mechanism proposed herein provides a parameterized means for interoperable communication over the DSM WITHOUT defining the distribution system implementation strategy, and WITHOUT restricting DSS to be either centralized or distributed.

To focus strictly on establishing mixed–vendor interoperability between wireless stations (APs and remote stations in the infrastructure case) ignores a major portion of the problem being addressed by 802.11. Because the coverage ranges of most of the 802.11 PHYs are substantially shorter than are needed to span spatial extents comparable to wired 802 networks, the "normal" configurations of 802.11 LANs are likely to be ESS networks used for physical coverage extension (the more detailed terminology for the types of ESS usage is defined in document 95–188). Therefore, the 802.11 protocol should provide for standardized, interoperable, exchange of the fundamental association information over the DSM, symmetric with the 802.11 protocol providing standardized, interoperable transfer of that association information between BSSes of the ESS (such as the reassociation mechanism used by stations to achieve BSS–transition mobility).

There is precedent for defining intra–medium coverage extension mechanisms within 802 MAC/PHY standards — 802.3 defines the repeater used to provide physical range extension for their (coaxial cable) medium; and 802.5 defines an inter–MAU interface, which is different from the station–to–MAU interface.

As will become apparent when examining the proposed mechanism for exchange of association information within an ESS, the same mechanism can be applied to data frames to achieve a rudimentary, interoperable mechanism for MSDU distribution within an ESS (new definition, will not work in a MESS). The remainder of this document is organized into two parts, the first defines the mechanism for association information exchange, the second defines the manner in which the same mechanism allows for MSDU distribution exchange.

1. New and Modified Text on Transfer of Association Information in an ESS

{modified text for the third paragraph at the end of clause 2.4.2.2 – Association}

Before a STA is allowed to send a data message via an AP, it must first become associated with the AP. The act of becoming associated invokes the Association service which provides the STA to AP mapping to the DS. The DS uses this information to accomplish it's message distribution service. How the information provided by the Association service is stored / managed within the DS is not specified by 802.11. However, 802.11 does include a rudimentary mechanism that can be used to communicate association information within an ESS. With appropriate parameter settings, this mechanism can be used as part of a wide variety of distributed and centralized association management schemes. This mechanism is further described in 4.5 and 8.3.5.

{text to add as a new paragraph at the end of clause 2.4.2.3 – Reassociation}

The changes of association location due to reassociation can be communicated with an ESS using the rudimentary mechanism for communication of association information defined in 4.5 and 8.3.5.

{text to add as a new paragraph at the end of clause 2.4.2.4 – Disassociation}

The occurrence of disassociations can be communicated with an ESS using the rudimentary mechanism for communication of association information defined in 4.5 and 8.3.5.

{modified text for clause 4.1.2.1.3 – To DS}

The To DS field shall be one bit in length and shall be set to '1' in Data Type frames destined for the Distribution System and in any WDS frames being distributed between APs via the WM. It shall be set to '0' in all other frames.

The permitted To/From DS bit combinations and their meaning are given in table 4.2, below.

{modified text for clause 4.1.2.1.4 – From DS}

The From DS field shall be one bit in length and shall be set to '1' in Data Type frames exiting the Distribution System and in any WDS frames being distributed between APs via the WM. It shall be set to '0' in all other frames.

The permitted To/From DS bit combinations and their meaning are given in table 4.2.

To/From DS Values	Meaning

To DS = '0' From DS = '0'	A Data ~~f~~Frame direct from one STA to another STA within the same BSS. Also any non–Data frames sent within a BSS.
To DS = '1' From DS = '0'	Data ~~f~~Frame entering the DS.
To DS = '0' From DS = '1'	Data ~~f~~Frame exiting the DS.
To DS = '1' From DS = '1'	WDS frame being distributed from one AP to another AP.

Table 4-2: To / From DS Combinations in Data Type frames

{insert new clause 4.5 after clause 4.4, assumes the limited extent of an ESS as defined in 95–188}

4.5. Intra–ESS Communication via the DSM

Intra–ESS communication among access points, portals, and other entities providing distribution system services may take place using a variation of the frame format used by 802.11 for performing distribution of data frames over the wireless medium.

The general approach for modifying an 802.11 MAC frame for transfer on a wired DSM is to place the station addresses of the transmitter and intended recipient (generally TA and RA in the 802.11 frames) in the source and destination address fields of the wired DSM MAC frame, and to omit the 802.11 CRC field, relying instead on the frame check mechanism of the wired DSM. Any frame length, frame type, and/or protocol identifier information required in wired DSM MAC frames shall be used as defined for the wired MAC protocol. The fields from the 802.11 MAC header, as well as the 802.11 frame body, shall constitute the MSDU being transferred over the wired DSM. By retaining the fragmentation capability provided in the 802.11 Frame Control and Sequence Control fields, 802.11 frames of any legal size may be conveyed by any 802 type wired DSM, including those which have a shorter maximum MPDU payload than a full–length 802.11 MAC frame.

The format of the frames used by this mechanism for intra–ESS communication are based on the WDS Data frame format specified in 4.2.2.1. However, frame types other than Data may be used for intra–ESS distribution frames:

1) Control frame types are never used over the DSM.

2) Any Management frame subtype may be sent on the DSM; however, distribution services only generates and interprets certain Management subtypes, as defined in 8.3.5. All Management frames sent on the DSM have the To–DS and From–DS in the Frame Control field set to '1'. This permits unambiguous discrimination between intra–BSS and intra–ESS Management frame transfers when the WM is used as the DSM. When the DSM is another 802 LAN type, the contents of the Management frame DA field is used for the DSM destination address, while the contents of the Management frame SA field is used for the DSM source address.

In some cases, these frame formats can be used for communication within a MESS, but many MESS configurations lack certain addressing and/or connectivity functions required for proper operation this rudimentary distribution mechanism.

{modifications to clause 6.7 (MAC State Machines) — This mechanism requires significant additions to the MAC Management state machine and minor modifications to the Distribution Services state machine. The author of this document will provide these updates if this proposal is adopted.}

{modifications to the last paragraph of clause 8.3.2}

c) The AP shall inform the Distribution System of the association, by means which include those specified in 8.3.5.

{modifications to the last paragraph of clause 8.3.4}

c) The AP shall inform the Distribution~~Disribution~~ System- of the reassociation, by means which include those specified in 8.3.5.

{insert new clause 8.3.5, after clause 8.3.4}

8.3.5. Procedures for Communicating Association Information Within an ESS

The rudimentary mechanism for communication among DSS entities is controlled by two MIB attributes:

1) aAssoc_Report_Addr, which can be set to a group address (or set of individual addresses) for use with a distributed association management scheme that updates the distributed association data upon association and disassociation events, can be set to an individual address for use with a centralized association management scheme, and can be set to null for use with any association management scheme that only transfers association data upon reassociation events (or to disable this mechanism entirely).
2) aAssoc_Query_Addr, which can be set to a group address (or set of individual addresses) for use with a distributed association management scheme that transfers association data upon reassociation events, can be set to an individual address for use with a centralized association management scheme, and can be set to null for use with any association management scheme that only transfers association information upon association and disassociation events (or to disable this mechanism entirely).

The specific instances in which association information may be communicated, and the frames to be used for this communication, are defined below.

8.3.5.1. Association/Reassociation Advisory Report

When a DSS entity within an ESS generates an Association Response or Reassociation Response frame with "successful" status, that entity shall cause the following procedure to be followed at the physically closest point of attachment to the DSM:

a) If the value of aAssoc_Report_Addr is null, no standardized action is taken to report the occurrence of this association.

b) If the value of aAssoc_Report_Addr is non–null an association advisory frame shall be generated. The association advisory frame shall be a WDS–format frame (To–DS and From–DS both '1') with a frame type of Association Response or Reassociation Response, as appropriate; an Address3 field containing the address of the newly associated or reassociated station; an Address4 field containing the address of the access point (BSSID) with which the association or reassociation occurred; and a null frame body.

c) If the value of aAssoc_Report_Addr is a group address, this address is used as the destination address of a single, broadcast/multicast transmission of the association advisory frame onto the DSM.

d) If the value of aAssoc_Report_Addr is one or more individual addresses, these addresses are used as the destination addresses in an equivalent number of directed transmissions of association advisory frames onto the DSM.

e) Distribution service entities which receive the association advisory frame may record the BSSID and station address of the new or changed association. This information is useful to determine the existence of the association, and as a source of the DSM address to which frames addressed to the associated station are to be distributed.

8.3.5.2. Association Status Query

When a DSS entity within an ESS needs to determine the association status of a station for which local information is not available, that entity shall cause the following procedure to be followed at the physically closest point of attachment to the DSM:

a) If the value of aAssoc_Query_Addr is null, no standardized action is taken to determine the association status of this station.

b) If the value of aAssoc_Query_Addr is non–null an association status query frame shall be generated. The association status query frame shall be a WDS–format frame (To–DS and From–DS both '1') with a frame type of Reassociation Request; an Address2 field containing the address of the station to which the reply should be sent; an Address3 field containing the address of the station whose association status is being requested; an Address4 field containing the address of the entity requesting the association status; and a null frame body.

c) If the value of aAssoc_Query_Addr is a group address, this address is used as the destination address of a single, broadcast/multicast transmission of the association status query frame onto the DSM.

d) If the value of aAssoc_Query_Addr is one or more individual addresses, these addresses are used as the destination addresses in an equivalent number of directed transmissions of association status query frames onto the DSM.

8.3.5.3. Association Status Reply

When a DSS entity within an ESS receives an association status query frame from the DSM, that entity shall perform the following procedure:

a) If this entity has no local information about the association status of the station designated by the contents of the Address3 field of the association status request frame, the request frame is discarded without reply.

b) If this entity has local information about the association status of the station designated by the contents of the Address3 field of the association status request frame, an association status reply frame shall be generated. The association status reply frame shall be a WDS–format frame (To–DS and From–DS both '1') with a frame type of Reassociation Response; an Address1 field containing the value obtained from the Address2 field of the association status query frame; an Address2 field containing the address of the station sending this reply; an Address3 field containing the address of the station about which association status is being reported; an Address4 field containing the address of the access point (BSSID) where the station is associated; and a null frame body. If the replying entity has definite information that the subject station of

this query is not associated anywhere in the ESS (generally possible only with a centralized distribution services implementation), the Address4 field shall contain all zeros.

c) The association status reply shall be sent to the source address of the corresponding association status query, using a directed frame on the DSM.

8.3.5.4. Disassociation Advisory Report

When a DSS entity within an ESS generates a frame or receives a Disassociation frame from an associated station, that entity shall cause the following procedure to be followed at the physically closest point of attachment to the DSM:

a) If the value of aAssoc_Report_Addr is null, no standardized action is taken to report the occurrence of this association.

b) If the value of aAssoc_Report_Addr is non–null a disassociation advisory frame shall be generated. The disassociation advisory frame shall be a WDS–format frame (To–DS and From–DS both '1') with a frame type of Disassociation; an Address3 field containing the address of the previously associated station; an Address4 field containing the address of the access point (BSSID) by which the Disassociation frame was generated received; and a null frame body.

c) If the value of aAssoc_Report_Addr is a group address, this address is used as the destination address of a single, broadcast/multicast transmission of the disassociation advisory frame onto the DSM.

d) If the value of aAssoc_Report_Addr is one or more individual addresses, these addresses are used as the destination addresses in an equivalent number of directed transmissions of disassociation advisory frames onto the DSM.

e) Distribution service entities which receive the disassociation advisory frame may expunge their record the association reported therein.

{insert new MI B attribute definitions at appropriate sub-clauses of clause 8.4}

8.4.#.#.#. aAssoc_Report_Addr

```
Assoc_Report_Addr ATTRIBUTE
DERIVED FROM
    Set-of IEEE802CommonDefinitions.MACAddress;
BEHAVIOUR DEFINED AS
    "This attribute shall identify the set of zero or more stations on the DSM to which a distribution services
    entity shall send advisories of association, reassociation, and disassociation events.";
REGISTERED AS
    { iso(1) member-body(2) us(840) ieee802dot11(10036) SMT(0) attribute(7) assoc_report_addr(#) };
```

8.4.#.#.#. aAssoc_Query_Addr

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Assoc_Query_Addr ATTRIBUTE
DERIVED FROM
    Set-of IEEE802CommonDefinitions.MACAddress;
BEHAVIOUR DEFINED AS
    "This attribute shall identify the set of zero or more stations on the DSM to which a distribution services
    entity shall send queries when attempting to determine the association status of a station.";
REGISTERED AS
    { iso(1) member-body(2) us(840) ieee802dot11(10036) SMT(0) attribute(7) assoc_query_addr(#) };
```

2. New and Modified Text on Distribution of MSDUs in an ESS

{modifications to the last paragraph of clause 2.4.1.1 – Distribution}

While 802.11 does not specify DS implementations, it does recognize and support the use of the WM as the DSM. This is specifically supported by the 802.11 frame formats. (Refer to 4 for details). In addition, 802.11 includes a rudimentary mechanism, based on the wireless management functions and frame formats, which is able to perform distribution within an ESS. This mechanism is described in 4.5 and 8.3.5.

{modifications to the last paragraph of clause 2.4.1.2 – Integration}

The details of an Integration service are dependent on a specific DS implementation and are not further specified by 802.11. However, each instance of Integration service shall be able to handle the frames of the rudimentary distribution mechanism defined in 4.5 and 8.3.5.

{insert additional text at the end of the indented, numbered list after the third paragraph of new clause 4.5, the remainder of which appears above}

3) Any Data frame subtype may be sent on the DSM; however, distribution services neither generates, nor interprets, the subtype bits pertaining to contention free polling and acknowledgment. All Data type frames sent on the DSM use the 4–address format, with the To–DS and From–DS bits in the Frame Control field set to '1'. When the DSM is an 802.11 WM, this is the frame format already defined for a "wireless distribution system." When the DSM is another 802 LAN type, the contents of the Data frame Address1 field is used for the DSM destination address, while the contents of the Data frame Address2 field is used for the DSM source address.

{insert new clause 8.3.6, after new clause 8.3.5, which appears above}

8.3.6. Procedure for Distributing MSDUs Within an ESS

The rudimentary mechanism for distribution of MSDUs between APs and portals of an ESS entities is controlled by two MIB attributes:

1) aBasic_Distribution_Enable, which can be set to enable this distribution mechanism.
2) aBasic_Distribution_Addr, which can be set to a group address (or a set of individual addresses) that identify all possible distribution destinations on the DSM for use with an association management scheme that neither maintains local information about the locations of station associations nor uses MAC bridge functionality between the DSM and each BSS, can be set to an individual address for use with a centralized association management scheme, and can be set to null if MSDUs are to be distributed without substitution of the provided recipient address.

When a DSS entity with aBasic_Distribution_Enable set to '1' receives an MSDU from a station in the local BSS (or integrated LAN) with a destination address that is either a non–local individual address or a group address, that DSS entity shall cause one or more distribution frames to be transmitted at the physically closest

point of attachment to the DSM. The distribution frame(s) shall be WDS–format Data type frames, containing the MSDU, as defined in 4.5. The distribution frame(s) shall be addressed as defined below:

a) If the value of aBasic_Distribution_Addr is null, the Address1 field shall contain the DA of the received MSDU, the Address2 field shall contain the station address of the DSS entity sending this frame, the Address3 field shall contain the DA of the received MSDU, and the Address4 field shall contain the SA of the received MSDU.

b) If the value of aBasic_Distribution_Addr is a group address, this address shall be used in the Address1 field, the Address2 field shall contain the station address of the DSS entity sending this frame, the Address3 field shall contain the DA of the received MSDU, and the Address4 field shall contain the SA of the received MSDU.

d) If the value of aBasic_Distribution_Addr is one or more individual addresses, these addresses shall be used as the Address1 field contents in an equivalent number of directed transmissions of each distribution frame. In each of these frames the Address2 field shall contain the station address of the DSS entity sending this frame, the Address3 field shall contain the DA of the received MSDU, and the Address4 field shall contain the SA of the received MSDU.

{insert new MI B attribute definitions at appropriate sub-clauses of clause 8.4}

8.4.#.#.#. aBasic_Distribution_Enable

Basic_Distribution_Enable ATTRIBUTE
WITH APPROPRIATE SYNTAX
    Boolean;
BEHAVIOUR DEFINED AS
    "This attribute shall indicate that the basic distribution mechanism is enabled.";
REGISTERED AS
    { iso(1) member-body(2) us(840) ieee802dot11(10036) SMT(0) attribute(7) basic_distribution_enable(#) };

8.4.#.#.#. aBasic_Distribution_Addr

Basic_Distribution_Addr ATTRIBUTE
DERIVED FROM
    Set-of IEEE802CommonDefinitions.MACAddress;
BEHAVIOUR DEFINED AS
    "This attribute shall identify the set of zero or more MAC addresses on the DSM to be used in Address1 fields of distribution frames generated by the basic distribution mechanism.";
REGISTERED AS
    { iso(1) member-body(2) us(840) ieee802dot11(10036) SMT(0) attribute(7) basic_distribution_addr(#) };