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| Functional design of association and disassociation | | | |
| Date: 2016-07-27 | | | |
| **Authors:** | | | |
| Name | Affiliation | Phone | Email |
| Max Riegel | Nokia | +491732938240 | maximilian.riegel@nokia.com |
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# Abstract

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# Functional Decomposition and Design

## Association and disassociation

### Introduction

After completion of the network discovery and selection procedure the terminal initiates the connection establishment with the Node of Attachment of choice. The initial process of establishing a data connection between is called Association. It is part of the MAC service and pursues the establishment of an MAC layer connection in order to enable exchanges of Ethernet frames between the peers. Technically it is a registration process of the own MAC address with the peer MAC entity to open the port to allow for the transfer of the MAC service data units.

However, it is not only the registration of the MAC addresses at the peers, but it comprises as well the arbitration of the MAC and PHY configuration parameters of the connections. To conclude to an agreed set of configuration values the association starts with the exchange of the available capabilities and preferences and negotiates the final values. At the NA, which can serve multiple terminals in parallel, a MAC instance is created and initialized for each ‘associated’ terminal during association. Authentication is usually directly following association, as association provides the prerequisites of the controlled and uncontrolled port for each terminal.

As association allocates resources in MAC layer, it is important to orderly release associations to free up allocated resources. The process of tearing down an MAC layer connection, clearing the state dynamically created ports, and releasing the allocated resources is called disassociation. It is usually the end of a session together with the termination of the accounting process.

Some IEEE 802 technologies support further variations of the association messages to enhance the association process for particular cases. E.g., re-association denotes a special form of association when the terminal likes to indicate to the access network that it is moving over its connection from another NA of the same access network, enabling fast session transfers with all the session context moved over from the previous NA to the target NA without lengthy re-negotiations.

Association happens in every IEEE 802 access technology, even it is not always denoted association in the specification. In section 7.3.8 at the end of this chapter, further details about the implementation of association by the particular IEEE 802 technologies are provided.

### Roles and identifiers

#### TEI

The terminal interface is the entity sending and receiving the messages of the association and disassociation process. The implementation and base configuration of the TEI defines the range of capabilities, which can be negotiated during association.

The identity of the TEI is given through its MAC address.

#### TEC

The terminal control provides the target configuration for the connection set-up towards the NA, potentially derived and adjusted from messaging during the network discovery and selection phase.

For association, TEC only communicates through its TEI and can be identified by the MAC address of the TEI

#### NA

The node of attachment is the peer entity to the TEI, to which the TEI seeks to associate with. NA provides the interface for sending and receiving the association messages over R1. Similar to TEI, the capabilities of the NA define the range of the negotiable options of the association.

The identity of the NA is given through its MAC address.

#### ANC

The access network control provides the NA the requirements and constraints for setting up associations to the NA. The ANC may be actively involved in the association process by dynamically checking the negotiated parameters of the association, and it may instruct the NA to deny an association when the capabilities of the TEI do not fit to the requirements stated by the ANC.

In case of re-association of a terminal moving from one NA to another NA, the ANC may provide session context from the previous NA to the target NA to avoid lengthy renegotiations of session parameters.

ANC also contains the agent, which informs the subscription service about the termination of a session after disassociation. Usually the disassociation of a terminal is signaled to the SS through an accounting-stop message.

The identifier of the ANC is defined in section 6.9

### Use Cases

The following use cases of association are examples with further variations possible

#### Connection set-up as part of network entry

After network discovery and selection of an initial attach to an access network the MAC layer connection of the TE to the NA is performed as part of network entry.

The TE associates with the target NA selected through the preceding NDS procedures.

#### Connection relocation within the same AN

In the case that a TE has an active session with an access network and that the TE desires to move its connection from on NA of the AN to another NA of the same AN, the process can be speeded up by allowing the AN to move over the session context to the new NA. The TE can indicate the possibility of the context transfer by using re-association as a special form of the association messaging, or by inclusion of the information about the serving NA into the initial association message to the target NA. In this case the access network can relocate the MAC layer connection from serving NA to target NA together with moving over the existing session context to the target NA.

#### Connection tear-down

Connections may terminate for various reasons. To orderly free up resources allocated with a connection, it is desirable that the upcoming termination is signaled to the peer MAC entity at the point of disconnection.

The MAC entity desiring to terminate the session can send a disassociate message to its peer entity to inform about the termination. It allows the peer entity to timely release all related resources to enable new associations and to avoid that the session context is maliciously reused.

As failures and disruptions can happen both in the wireless and the wired media, neither the TE nor the NA can rely on the receipt of a disassociate message prior to connection teardown. All systems must be aware that the MAC connectivity may disappear without prior notice. Usually TE and NA both have means to declare that a connection terminated after a number of failed transmission attempts. With termination the session context is completely released, and a new connection set-up has to be performed before sending user data frames.

### Functional Requirements

The following are a list of requirements, the association and disassociation process has to provide:

* Association should allow for capabilities discovery
* Association should support extensible parameter sets for signaling capabilities
* Association should allow for orderly negotiation of an agreed capabilities set
* Association should support prioritization with the lists of capabilities sets
* Association as well as disassociation should support MAC addresses for identifying the peer entities
* Association should support that TEs are changing their MAC addresses from session to session
* Association as well as disassociation should support extensible list of reason codes for acknowledgements messages
* Association should support dynamic selection of the subsequent authentication procedure
* Disassociation should support orderly teardown of MAC connections
* Association may support fast relocation of established connections either by special information elements in the associate message or by a dedicated re-associate message. When such capabilities are offered, the system should be actually able to transfer session contexts between the NAs supporting such capabilities.
* Association should support vendor specific extensions of the attribute sets.

### Association specific attributes

#### Protocol configuration

* + E.g. Time-out values, attribute sets, protocol-version, fast-handover support

#### Link Capability Information

* + E.g. Supported PHY and MAC modes, supported channels

#### Preferred and requested link capabilities

* + E.g. broadcast modes, minimum/maximum MCS, power-save

#### Security and QoS capabilities

* + E.g. authentication and encryption modes, QoS models

#### Support of particular services

* + E.g. emergency services, regulatory requirements

#### Result codes

* + E.g. success, time-out, loss-of-carrier

### Association specific basic functions

#### Association

Association performs the establishment of a MAC layer connection between peers allowing the exchange of MSDUs over the medium. Once the association is established the peers can start to exchange higher layer protocol data to further configure the communication link and finally to allow for transfer of user dataframes.

In IEEE 802 association is initiated by the terminal seeking connectivity to an access network. The TE starts the association process by an ASSOCIATE\_request message containing capabilities and proposed connection parameters. The NA responds with an ASSOCIATE\_response message containing selected connection parameters or asking for further negotiations.

#### Re-association

Re-association is a special form of the association function for the case that a TE desires to relocate an established connection from a serving NA to a target NA. The REASSOCOATE\_request message is send to the target NA containing information about the serving NA. When the target NA is able to continue the connection with the session context established with the serving NA, the target NA retrieves the session context from the serving NA over the access network infrastructure, indicates the completion of the relocation to the TE with a REASSOCIATE\_response message and finally informs over the access network infrastructure the serving NA that the session has been successfully taken over.

When re-association is not possible, the association procedures continues with an initial association process establishing a completely fresh session context.

#### Disassociation

Disassociation is the orderly form of discontinuing a session. The procedure can be initiated from either side of the R1 interface, and should be always used if possible. There is only a DISASSOCIATE message send from the initiator of the disassociation to the peer entity. The transmitting entity assumes the termination of the connection directly after the transmission of the message. The receiver of the DISASSOCIATE message immediately tears down the session context and does not accept any further message from the peer.

In many cases sessions are terminated without an explicit disassociation procedure. This happens in particular when the termination of the link is caused by weak radio conditions, e.g. when a terminal is moving out of the coverage area of an NA. In such cases the termination of a connection is determined through the inability to send any further transmission frames to the peer entity.

### Detailed procedures

#### Successful connection setup with negotiation of connection parameters

After successful network discovery and selection, the TE sends an ASSOCIATE\_request message with the capabilities information and the desired connection parameters to the selected NA.

The NA responds with an ASSOCIATE\_response messages with success indication and the selected association parameters.

TE

NA

ASSOCIATE\_request

ASSOCIATE\_response

After successful association both the TE as well as the NA can start exchanging MAC service data units.

#### Orderly session teardown initiated by TE

To terminate an ongoing association with an NA, the TE sends a DISASSOCIATE message to the serving NA. The TE does not send any further message to the NA after sending the DISASSOCIATE message.

TE

NA

DISASSOCIATE

The NA instantly tears down the connection and releases the session context for the TE, which send the DISASSOCIATE message. All queued messages for the TE are deleted from the transmission queue.

#### Session termination enforced by NA

When a NA has to terminate the connection to a particular TE due to expired service period or shortage of resources, the NA sends a DISASSOCIATE message to the TE. After transmission of the DISASSOCIATE message the NA removes the session context of the TE and releases all resources allocated for the TE.

TE

NA

DISASSOCIATE

Upon reception of the DISASSOCIATE message the TE instantly stops sending messages to the NA, removes the session context, and restarts the network discovery and selection process to determine another NA to connect to.

#### Session relocation with support of fast transition schemes

In the case that a TE determines another NA of the same AN providing better service than the serving NA it is currently connected to, the TE can initiate a connection relocation when fast session transfer in the service area was signaled by the NA in the preceding association. The TE does not have to inform the serving NA about the desire to relocate the connection to another NA, as the serving NA will be informed by the target NA about the relocation of the association.

The TE sends a REASSOCIATE\_request message to the target NA. Based on the information about the serving NA contained in the REASSOCIATE\_request message, the target NA informs the serving NA about the desire of the TE to move over and requests the session context information.

TE

NA

REASSOCIATE\_request

REASSOCIATE\_response

serving

target

NA

The serving NA confirms the relocation of the session by forwarding the session context to the target NA and tears down the session of the TE at its location.

The target NA responds to the TE with a REASSOCIATE\_response message indicating successful relocation of the session to its location. Upon receipt of the REASSOCIATE\_response message the TE resumes sending transmission frames within the same connection, however addressed to the target NA instead of the previously serving NA.

### Mapping to IEEE 802 Technologies

#### Overview

The following table provides the terminology used by the various IEEE 802 technologies for the association, as well as references to the related sections of the specifications.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 802.3 | 802.11 | 802.16 | 802.22 |
| Terminology | Arbitration | Association | Registration | Registration |
| Functional description | 37 | 4.5.3.3- 4.5.3.5 | 6.3.20.1.3 | 7.14 |
| Frame formats |  | 8.3.3.4- 8.3.3.9 | 6.3.2.3.7- 6.3.2.3.8 | 7.7.7.1-  7.7.7.2 |

The following subsections contain further technology specific information.

#### IEEE 802.3 specifics

#### IEEE 802.11 specifics

#### IEEE 802.16 specifics

#### IEEE 802.22 specifics