Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**Enhancement of Association using SCAN-REQ/RSP — Harmonization Ad-Hoc Consensus Contribution**
Date Submitted	**2004-08-17**
Source(s)	Sungjin Lee, Yeongmoon Son, Jungje Son, Changhoi Koo Samsung Electronics Voice: +82 31 279 5248 steve.lee@samsung.com Phillip Barber Broadband Mobile Technology Voice: +1 (972) 365-6314 pbarber@BroadbandMobileTech.com Min-Sung Kim, Jeong-Hwi Kim, Seong-Choon Lee KT Voice: +82-2-526-6109 cyberk@kt.co.kr Sang-Yun Han, Jinyong Chung, Jae-Hak(Steve) Lee SOLiD Tech., Inc. Voice: +82-2-2142-3881 syhan@st.co.kr Kisun Ryu, Yongho Kim, Kihyung Cho, Beomjoon Kim, Changjae Lee LG Electronics beom@lge.com
Re:	This contribution is response to call for contribution about IEEE 802.16e-D4, Recirculation 14c
Abstract	This document proposes the scheme enhancing scanning and association operation with SCAN-REQ/RSP
Purpose	Discuss and adapt proposed text and message format.
Notice	This document has been prepared to assist IEEE 802.16. It is offered as a basis for discussion and is not binding on the contributing individual(s) or organization(s). The material in this document is subject to change in form and content after further study. The contributor(s) reserve(s) the right to add, amend or withdraw material contained herein.
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.
Patent Policy and Procedures	The contributor is familiar with the IEEE 802.16 Patent Policy and Procedures <http://ieee802.org/16/ipr/patents/policy.html>, including the statement "IEEE standards may include the known use of patent(s), including patent applications, provided the IEEE receives assurance from the patent holder or applicant with respect to patents essential for compliance with both mandatory and optional portions of the standard." Early disclosure to the Working Group of patent information that might be relevant to the standard is essential to reduce the possibility for delays in the development process and increase the likelihood that the draft publication will be approved for publication. Please notify the Chair <mailto:chair@wirelessman.org> as early as possible, in written or electronic form, if patented technology (or technology under patent application) might be incorporated into a draft standard being developed within the IEEE 802.16 Working Group. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Enhancement of Association using SCAN-REQ/RSP

Sungjin Lee, Yeongmoon Son, Changhoi Koo and Jungje Son

SAMSUNG Electronics

Phillip Barber

Broadband Mobile Technology

Min-Sung Kim, Jeong-Hwi Kim, Seong-Choon Lee

KT

Jinyong Chung, Sangyun Han, JaeHak(Steve) Lee

SOLiD Technologies, Inc.

Kiseon Ryu, Yongho Kim, Kihyung Cho, Beomjoon Kim, Changjae Lee

LGE

1. Problem Statement

Currently, in many ways, MSS can get information about neighbor BS and measure SINR value of neighbor BS. MSS can get informed of neighbor BS with NBR-ADV message or by scanning another frequency directly. And MSS can measure SINR during scan interval or sleep interval without interruption of service with serving BS. According to the measured SINR values, it can decide whether it handover another BS or not. Further, MSS can get advantage expediting handover process using association with neighbor BS. Association is the process of pre-calibrating parameters required for ranging with neighbor BS.

In this contribution, we assume that the MSS have performed scanning operation more than one time before initiate association and already have SINR information of neighbor BS. In most cases, a MSS performs Neighbor BS scanning multiple times until the MSS make final decision to handoff so that the Serving BS and MSS already have knowledge of Neighbor BSs. When a MSS decides to try association before actual handoff, MSS may perform association with Target BS during a time duration assigned by Serving BS. However, the association procedure should be considered as urgent procedure that should be finished in a short time interval in order to minimize service unavailability time between BS and MSS. In addition to this consideration, initial access to Neighbor BS in association should be tried with contention free access, because the association performed within a limited time.

However, there is no detailed association procedure described in current draft 802.16e-D3 only except that association is performed during scan interval. It is expected to access to Neighbor BS through contention-based access without any assistance from serving BS

A MSS may try to make association with one Neighbor BS within the short time duration, it is crucial that the Target BS allows the MSS to access based on contention-free method in order to minimize delay time for association.

Our proposed solution can enhance the association procedure by allowing a MSS to access Neighbor BS based on contention-free method.

Since serving BS can negotiate with Neighbor for assigning fast_ranging_IE, we can get advantage using only redundant

resource of Neighbor to make handoff procedure easy.

2. Proposed Remedy

Association Procedure during scanning interval

We propose fast access scheme for association operation in order to allow MSS to fast access to Association Test during limited duration that is assigned by Serving BS.. Since a MSS in association procedure tries to access to Neighbor BS by initial ranging that takes unexpected time, it sometimes may fail to associate with Neighbor within a limited duration for association. Therefore, we need to allow MSS to use fast-ranging in order to finish association within a limited duration for association.

A modified MOB_SCN-REQ and MOB_SCN-RSP message are proposed to enhance MSS's operation for association. . ASC-Notification and ASC-Notification-RSP backbone messages are also proposed to inform Neighbor BSs of the information of MSS..

A MSS trying association can access to Neighbor BS through fast UL ranging IE provided by Target Association Test . This case is the same as handoff case with above proposed messages and scenario.

- MOB_SCN-REQ
- This message includes Scan type field to indicate whether a MSS requests Scanning or Association. A serving BS may understand what operation the MSS requests referred to the Scan Type field. Neighbor BS list can be included if the MSS have preference list for association based on scanning performed lastly.
- MOB_SCN-RSP

  This message includes also Scan Type filed as MOB_SCN-REQ. The BS can indicate whether the BS orders scanning or association referred to the scan type field in SCN-REQ.

  The BS can also transmit unsolicited MOB_SCN-RSP message to a MSS with scan_type_field.~~,~~ Neighbor BS list can be included in SCN-RSP message to inform MSS of Neighbor BSs that the Serving BS recommends to perform association. The Neighbor BS may contain multiple target BSs that is recommended at Serving BS.
- ASC-Notification

  ASC_Notification is used to inform Neighbor BS of MSSs, which try to make association with Neighbor BS, so that Neighbor BS may assign fast UL ranging IE by receiving ASC-Notification message with 'action=1'. The goal of ASC-Notification is the same as HO_pre-notification message.
- ASC-Notification-RSP

  Neighbor BS may response to ASC-Notification with reserved BW and QoS resources of BS. The purpose of this message is the same as HO_Pre-Notification-RSP

Remedy 1:

[In 6.3.2.3.48 Scanning Interval Allocation Request (MOB-SCN-REQ) message, page 37, line61, Modify section and Table as]:

6.3.2.3.48 Scanning Interval Allocation Request (MOB-SCN-REQ) message

A MOB-SCN-REQ message may be transmitted by an MSS to request a scanning interval for the purpose of seeking ~~neighbor~~ Available BS~~,~~ and determining their suitability as targets for HO. An MSS may request the scanning allocation to perform scanning with Scan type = 0, or non-contention Association ranging with Scan type = 1.

An MSS shall generate MOB-SCN-REQ messages in the format shown in Table 106e:

Table 106e --- MOB-SCN-REQ Message Format

Syntax	Size	Notes
MOB-SCN-REQ_Message_Format() {		
Management message type = 54		
Scan duration	8 bits	in frames
Scan type	1 bit	[0] Scanning [1] Association
reserved	3 bits	Shall be set to zero.
If (Scan type=0){		
Interleaving interval	8bits	Units are frames
Scan iteration	8bits	Units are frames
}		
Else {		
For(j=0; j<N_Recommended_BS; j++) {		N_Recommended_BS can be derived from the known length of the MAC message
Association Test BS ID	48 bits	BS IDs of Available BS for Association
}		
}		
HMAC Tuple	21 bytes	See 11.1.2
}		

The following parameters shall be included in the MOB-SCN-REQ message,

Scan duration

Duration (in units of frames) of the requested scanning period.

Scan type

Operation that a MSS intends during Scanning Interval (0) Scanning (1) Association

HMAC Tuple (see 11.1.2)

The HMAC Tuple Attribute contains a keyed Message digest (to authenticate the sender). HMAC Tuple shall be the last item in the message.

If Scan type is set to '0', the following parameters shall be included in the MOB-SCN-REQ message,

Interleaving interval

The period interleaved between Scanning Intervals when MSS may perform Normal Operation.

Scan iteration

The requested number of iterating scanning interval by an MSS

If Scan type is set to '1', the following parameters may be included in the MOB-SCN-REQ message,

Association Test BS ID

Association Test BS ID field may be included only if a MSS has a candidate Available BS to Associate. Multiple Association Test BS IDs may be included in the MOB-SCN-REQ Message.

Remedy 2:

[In 6.3.2.3.49 Scanning Interval Allocation Response (MOB-SCN-RSP) message, page 38, line39, Modify section and Table as]:

6.3.2.3.49 Scanning Interval Allocation Response (MOB-SCN-RSP) message

A MOB-SCN-RSP message shall be transmitted by the BS either unsolicited or in response to an MOB-SCN-REQ message sent by an MSS. ~~In addition, BS may send an unsolicited MOB-SCN-RSP.~~ A BS may request the scanning allocation for MSS scanning with Scan type = 0, or MSS non-contention Association ranging with Scan type = 1.The message shall be transmitted on the ~~b~~Basic CID.

The format of the MOB-SCN-RSP message is depicted in Table 106f

Table 106f --- MOB-SCN-RSP Message Format

Syntax	Size	Notes
MOB-SCN-REQ_Message_Format() {		
Management message type = 55	8 bits	
Scan duration	8 bits	in frames
Start Frame	4 bits	
Scan_type	1 bit	[0] Scanning [1] Association
reserved	7 bits	Shall be set to zero.
If (Scan type=0){		
Interleaving interval	8 bits	Duration in frames
Scan iteration	8 bits	
Report mode	2bits	0b00 : no report 0b01 : periodic report 0b10 : event triggered report

		0b11 : reserved
Scan report period	8 bits	Available when the value of Scan Report is set to 0b01. Scan report period in frames
reserved	2 bits	Shall be set to zero.
}		
Else {		
For(j=0; j<N_Recommended_BS; j++) {		N_Recommended_BS can be derived from the length field in the MAC header of the message
Association Test BS ID	48 bits	BS IDs of Available BS for Association
} }		
}		
}		

The following parameters shall be included in the MOB-SCN-RSP message:

Scan duration

Duration (in units of frames) where the MSS may ~~scan~~ perform scanning or association for ~~neighbor~~ Available BS.

Start Frame

Measured from the frame in which this message was received. A value of zero means that it will start in the next frame.

If Scan type=1 and multiple Association Test BS IDs are included in MOB-SCN-RSP message. The MSS may perform Association with the first Association Test BS at Start Frame and sequentially perform Association with each following Association Test BS in the message.

Scan type

0 : BS approval of requested/directed Scanning operation

1 : BS approval of requested/directed Association operation

The Scan type field in MOB-SCN-RSP message shall have the same value as Scan type in MOB-SCN-REQ.

If Scan type is set to '0', the following parameters shall be included in the MOB-SCN-REQ message,

Interleaving interval

The period interleaved between Scanning Intervals when MSS may perform Normal Operation.

Scan iteration

The requested number of iterating scanning interval by an MSS

Report mode

Action code for an MSS's report of CINR measurement:

00: The MSS measures channel quality of the ~~neighbor~~ Available BSs without reporting.

01: The MSS reports the result of the measurement to ~~s~~Serving BS periodically. The period of reporting is different from that of scanning.

10: The MSS reports the result of the measurement to ~~s~~Serving BS after each measurement.

11: *reserved*

Scan report period

Available when the value of Scan report is set to 01. Scan report period in frames

If Scan type is set to '1', the following parameters may be included in the MOB-SCN-REQ message,

Association Test BS ID

Recommended Association Test BS list for Association. If multiple Association Test BS IDs are included in the message, the MSS may perform Association in ascending order of the sequence of Association Test BS ID presented in the message. Serving BS may request, over the backbone, Association Test BS allocation of non-contention based initial ranging opportunity for MSS Association activity. When conducting initial ranging to Association Test BS, MSS shall use allocated non-contention based initial ranging opportunity, if available.

Remedy 3:

[In 6.3.20.1.2 MSS Scanning of neighbor BS, page 68, line18, Replace entire section with]:

6.3.20.1.2 MSS Scanning of ~~neighbor~~ Available BS

A BS may allocate time intervals to MSS~~'s~~ for the purpose of MSS seeking and monitoring ~~neighbor~~ Available BS suitability as targets for HO. The time during which the SS scans for ~~neighbor~~ Available BS will be referred to as a ~~s~~Scanning ~~i~~Interval.

An MSS may request an allocation of a ~~s~~Scanning ~~i~~Interval using the MOB-SCN-REQ MAC Management message. The MSS indicates in this message the estimated duration of time it requires for the scan.

The MSS or BS may ~~allocate~~ request group of Scanning ~~i~~Intervals with Interleaving intervals of Normal Operation be allocated through a single exchange of MOB-SCN-REQ/RSP management messages~~, which are composed of Scan duration and Interleaving interval,~~ for the purpose of reducing the number of MOB-SCN-REQ and MOB-SCN-RSP messages required to create multiple scanning opportunities when frequent scanning is required. Scanning Interval and Interleaving interval repeat with the number of Scan iteration.

In the MOB-SCN-REQ MAC management message the MSS, and in the MOB-SCN-RSP MAC management message the BS shall indicate either Scanning, Scan type = 0, or Association, Scan type = 1, as the intended MSS activity during the Scanning Interval. If Scan type = 1, Association, then the MSS and BS may include, in their respective messages, one or more Association Test BS ID. The BS may send over the backbone to the Association Test BS request to allocate non-contention based ranging opportunity, at the appropriate timing interval, for MSS to conduct Association ranging with the Association Test BS. When conducting initial ranging to Association Test BS, MSS shall use allocated non-contention based initial ranging opportunity, if available. Regardless of value of Scan type and the presence of one or more Association Test BS ID, MSS may determine and perform any scanning or ranging or Association activities during Scanning Interval at its own discretion.

Upon reception of ~~this~~ the MOB-SCN-REQ message, the Serving BS shall respond with a MOB-SCN-RSP MAC Management message. The Serving BS may also send MOB-SCN-RSP MAC management message unsolicited. The MOB-SCN-RSP MAC Management message shall either grant the requesting MSS a ~~s~~Scanning ~~i~~Interval that is at least as long as requested by that MSS, or deny the request. A value of zero for Duration in MOB-SCN-RSP shall indicate the request for an allocation of ~~s~~Scanning ~~i~~Interval is denied.

Following reception of a MOB-SCN-RSP MAC Management message granting the request, beginning at Start frame an MSS shall scan for ~~a neighbor~~ one or more BS during the time interval allocated in ~~that~~ the message. When ~~neighbor~~ Available BS are identified through scanning, the MSS ~~shall~~ may attempt to synchronize with their downlink transmissions~~,~~ and estimate the quality of the PHY channel. MSS may also perform contention, or non-contention if available, based initial ranging during the Scanning Interval to one or more Available BS to more completely evaluate PHY channel characteristics with Available BS, obtain Service Level Predictions for MSS Service Flows, and assess for Association.

The Serving BS may buffer incoming data addressed to the MSS during the ~~s~~Scanning ~~period~~Interval~~,~~ and transmit that data after the ~~s~~Scanning ~~period~~Interval during any Interleaving interval or after exit of the Scanning Mode and resumption of Normal Operation.

~~–~~An MSS may terminate scanning and return to Normal Operation anytime by sending a PDU to the Serving BS during any Scanning Interval. If a Serving BS receives a PDU during any Scanning Interval from an MSS that is supposed to be in ~~s~~Scanning ~~m~~Mode, the BS shall assume that the MSS is no longer in ~~s~~Scanning ~~m~~Mode. Any UL message from the MSS to the Serving BS during a Scanning Interval shall interrupt the ~~s~~Scanning ~~i~~Interval~~,~~ ~~–~~ and shall signal the Serving BS that the MSS is still active and has not dropped the connection during ~~its~~the ~~s~~Scanning ~~i~~Interval. The group of intervals is terminated at any time if the MSS sends MOBSCN-REQ message or Serving BS sends MOB-SCN-RSP message during any Interleaving interval with ~~setting the~~ parameters (Scan duration, Interleaving interval, and Scan iteration) set to all zeros.

~~The BS may allocate group of intervals, which are composed of Scan duration and Interleaving interval, for the purpose of reducing the number of MOB_SCN-REQ and MOB_SCN-RSP messages when frequent scanning is required. The MSS scans neighbor BSs, and the BS may buffer incoming data addressed to the MSS during the scan duration. The buffered data is transmitted to the MSS during Interleaving interval. Scan duration and Interleaving interval repeat with the number of Scan iteration. The group of intervals is terminated at any time if the BS sends MOB_SCN-RSP message with setting the parameters (Scan duration, Interleaving interval, and Scan iteration) to all zeros. The MSS may request the periodic scanning. This group of intervals is terminated any time if the MSS sends MOBSCN-REQ message with setting the parameters (Scan duration, Interleaving interval, and Scan iteration) to all zeros.~~

After scanning for ~~neighbor~~ Available BS~~s~~ using the allocated ~~scanning~~ Scanning ~~interval~~Interval, the MSS shall periodically report the scanning results to the Serving BS through MOB-SCAN-REPORT message ~~periodically~~. In ~~A~~addition to the periodic reporting scheme, the MSS may report the scanning results at will to support event or policy driven needs, ~~in case of a specific event which can be that the rank~~for instance a change in threshold level of ~~the~~ received CINR of ~~neighbor~~ Available BS~~s is changed~~. This scanning report may assist Serving BS to recommend suitable BSs for BS initiated ~~handover~~ HO operation.

Remedy 4:

[In 6.3.20.1.3 Association Procedure, page 69, line4, Modify as]:

6.3.20.1.3 Association Procedure

Association is an optional initial ranging parameter negotiation occurring during Initial Ranging of a BS. The function of ~~a~~Association is to enable the MSS to record successful scanning and ranging attempts for the purpose of expediting a potential

future ~~hand-over~~HO of the MSS's active service flows to a ~~t~~Target BS. An MSS may store successful ranging information of an ~~a~~Associated BS for the purpose of setting initial ranging values in future ranging events.

MSS may perform scheduled Association through non-contention based initial ranging opportunity using the method provided in 6.3.20.1.2.

Upon completion of a successful MSS initial-ranging of a BS, if the RNG-RSP message contains a Service Level Prediction parameter set to 2, the MSS may mark the BS as Associated in its MSS local Association table of identities, recording elements of the RNG-RSP to the MSS local Association table, and setting an appropriate aging timer (See Table 269a—Parameters and Constants, ASC-AGING-TIMER). Association state in the MSS local Association table shall be aged-out after ASC-AGING-TIMER timeout and the Association entry removed.

While Association is valid (aging timer has not expired), MSS may use recorded Associated Ranging values to set Initial Ranging values in a new initial Ranging event to the same Associated BS. An MSS may have several Associated BS in its local Association table concurrently and shall use the respective stored Associated Ranging values only with the related Associated BS.

Remedy 5:

[In Annex E, page 225, line5, Add to end of section as]:

E.3 Association during Scan interval by MSS request

The following figures describe the messages flow for scanning of Available BS by the MSS request, BS request and periodic scanning of Available BS during hand-over.

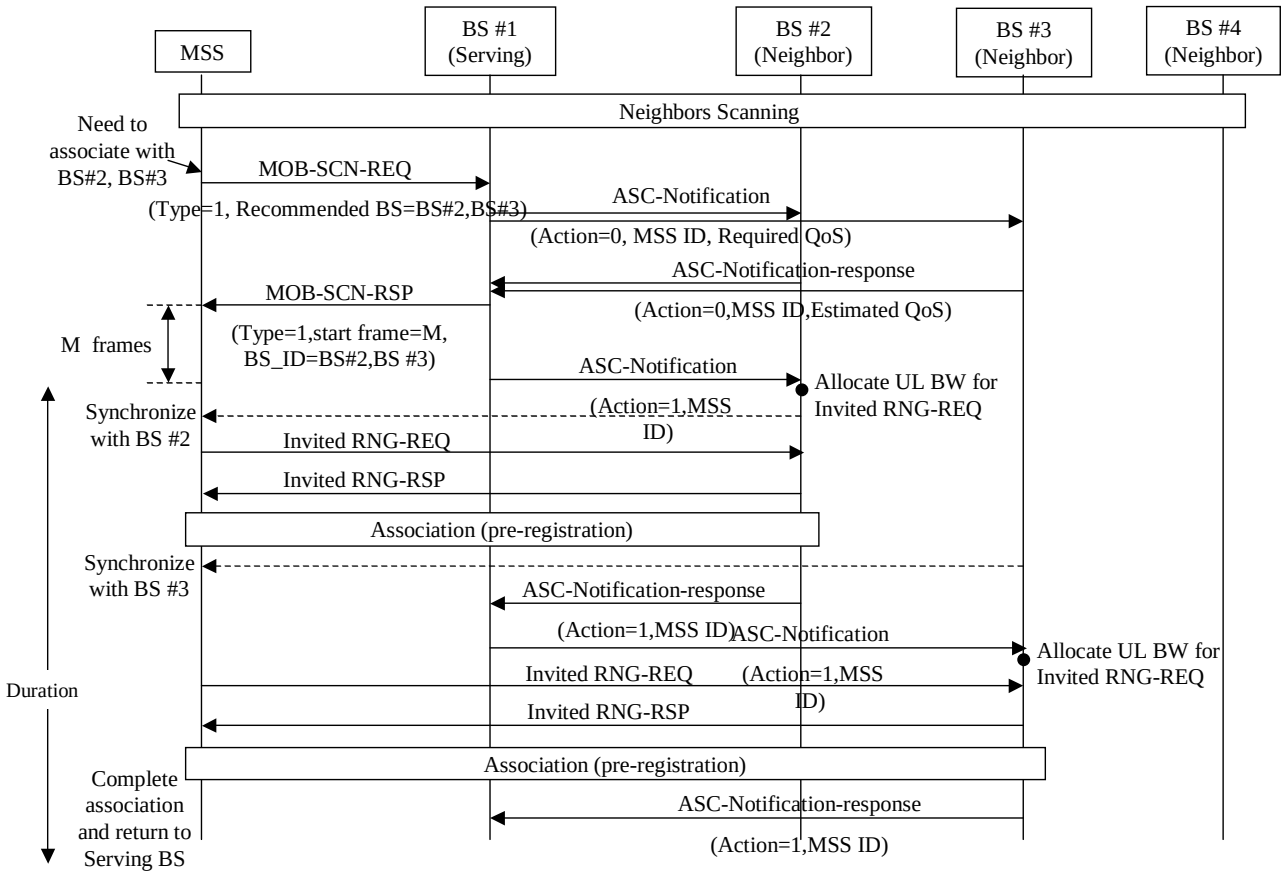

Figure E.3—Example Association during Scan interval by MSS request

Remedy 6:

[In D.2 Inter-base station message formats, page 211, line1, Add to end of section as]:

D.2.19 Association-notification (ASC-NOTIFICATION) message

This message is sent from BS to BS to provide the Association Test BS with information about MSS attempting to perform Association. Typically the message will be sent as a reaction to Serving BS transmittal of a MOB_SCN-RSP message with Scan type=1. This message may be used to notify the Association Test BS to allocate uplink bandwidth for invited ranging of the MSS. The message contains the following information

Field	Size	Notes
Global Header	152 bits	
Num_Records	8 bits	
For (j=0; j<Num_Records;j++){		
MSS unique ID	16 bits	Basic CID of the MSS
Estimated time to start Association	12 bits	Units are frame
Action	2 bits	0: Association request from the specified MSS 1: reserve bandwidth for Association 2: cancel the Association request 3: reserved
If (Action==0) {		
Required BW	4 bits	
Reserved	2 bits	
For (i=0; i<Num_SFID_Records: i++){		Number of SFID records can be derived from the length field in MAC header of message
SFID	32 bits	
Field Length	8 bits	Length in byte
For(u=0;u<Num_QoS_Records;i++) {		
Required QoS	variable	
}		
}		
}		
Else {		
Reserved	7bits	

}		
}		
Security Field	TBD	

D.2.20 Association-notification response (ASC-NOTIFICATION-RSP) message

This message is sent from BS to BS, typically in response to a SCN-NOTIFICATION message. This message is used to notify the Serving BS of the expected level of service when the MSS performs association with the Association Test BS. This message may also be used to notify the Serving BS that the Association Test BS has received a RNG-REQ from the MSS.

The message contains the following information

Field	Size	Notes
Global Header	152 bits	
Num_Records	8 bits	
For (j=0; j<Num_Records;j++){		
MSS unique ID	48bits	MAC Address of the MSS
Action	2 bits	0: Association reply to the specified MSS 1: completion of Association 2: Association failed 3: reserved
Reserved	6 bits	
If (action==0) {		
Field Length	8 bits	
BW estimated	8 bits	
QoS estimated	variable	
}		
}		
Security Field	TBD	