Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**
Title	**A Proposal for the Enhancement of the 802.16.1 MAC: MAC Header Optimization**
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Re:	This document is a response to the following calls for contributions: Call for Contributions for Proposed Modifications of 802.16 MAC and 802.11a-HYPERLAN/2 PHY for the WirelessHuman" Standard 802.16.4-00/01. IEEE 802.16 Task Group 3 Call For Contributions: Proposed MAC Enhancements, Key Characteristics, and Evaluation Criteria: Session #11 , 802.16.4-00/25.
Abstract	This contribution provides a flexible header mechanism that will permit tailoring of the MAC header to optimize link efficiency and improve the performance of higher layer protocols.
Purpose	For Consideration for inclusion in the proposed 802.16.3 and 802.16.4 MAC standards
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A Proposal for the Enhancement of the 802.16.1 MAC

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Introduction

One of the objectives of the BWA systems is to support IP traffic in business, home and multi-tenant environments. While the IP traffic will include many real-time applications such as Voice over IP (VoIP) and Video Conferencing, a significant portion of the traffic will be generated by Internet access and other bursty applications. Various measurements and studies [1, 2, 3] show the nature of such traffic, it consists of variable size IP packets. While the traffic mix is likely to change new applications emerge, as has happened with the WWW, many recent studies show that the predominant traffic on the backbone and access networks will continue to be TCP. It has been shown that between 55% (ADSL access device [1]) and 90% (backbone [2] and [3]) of *packets,* and between 75 % [1] and 85% [2] of all *bytes* transported are TCP. It has also been shown that although the average TCP packet size is between 400 and 500 [1, 2] bytes, between 50% and 60% [1, 2] of these TCP packets are of size 44 bytes or less. The smallest IP packets of size 40 byte not only include TCP ACKs, but also TCP Control packets such as SYN, FIN and RST.

VoIP traffic is typically carried by RTP over UDP. The sizes of audio packets depend on the type of CODEC and other factors. However, most of the commonly used CODECs generate voice packets of sizes in the range of the smallest TCP packets, as described above.

Given the high percentage of small packets and the bursty nature of IP traffic, it is important that BWA systems support these types of traffic efficiently in addition to supporting periodic and other types of traffic support described in the current 802.16.1 MAC draft. Thus the BWA MAC has to efficiently support both small and large IP packets over the air with minimal MAC overhead.To this effect, this contribution proposes a modification to the current 802.16.1 MAC draft that permits the BS and SS to remove optional fields in the packet headers and thereby improve the transport efficiency of the wireless link. In order to permit use of the flexible header, some of the fields in the header have been relocated.

Header Field Selection

The header field selection mechanism is incorporated into the Dynamic Service Addition and Change messages. The current design employs a three-way handshake for adding or changing a service flow. The packet sequence is as follows:
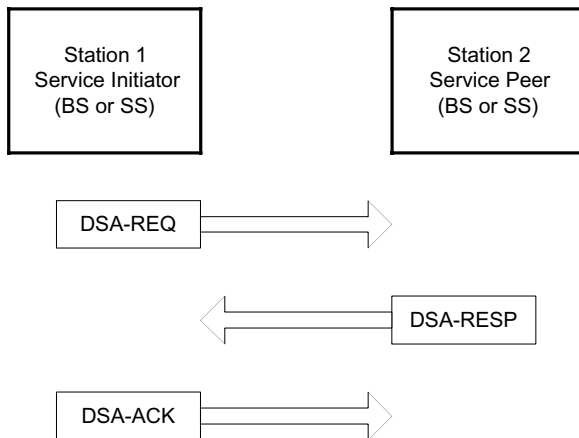
Figure 1 DSA three-way handshake

The DSA-ACK message has a section called the Service Flow Parameters. This section consists of a group of TLVs. The proposed selection mechanism is built around the use of the TLVs.

When one station (Station 1) desires to use a header field, it includes a TLV for that field as a Service Flow Parameter in the outgoing DSA-REQ message. If the peer (Station 2) does not want to use the field, it returns a DSA-RESP within a Service Flow Error Set (SFES). The SFES contains the unwanted field s TLV exactly as it was received from Station 1. If the field is accepted by Station 2, the field s TLV will not be placed in the FSES section.

General Service Flow Encodings – New TLVs

It is important to note that the default configuration, where none of the proposed TLVs are included in an SFP, results in the full header use as is done in the proposed draft.

The following subtypes will be added to the this section:

Remove Signalling and Sequencing

The operational parameter file that is held by each station will include information whether or not to use the signaling and sequencing field. This field allows upper layer protocol packets, such as IP, to be carried in multiple MAC data messages when the MTU of the upper layer protocol is larger than that of a MAC layer PDU data message. It also permits the use of ARQ as well as Convergence Sublayer and early discard eligibility signaling. Agreement to eliminate this field results in the removal of bytes 5 and 6 in the upstream or downstream Generic Headers.

Name	Subtype (1 byte)	Length in bytes (1 byte)	Value (Variable Length)
Remove Signaling Sequencing	24/25.TBD	0	Inclusion of this parameter indicates that the station does not wish to use fragmentation, signalling or ARQ.

Header Check Sequence

The operational parameter file that is held by each station will include information whether or not to request the use of the HCS field. This field provides a method for verifying the integrity of the Generic header following its reception. Agreement to remove the HCS results in the removal of the HCS field in the upstream and downstream Generic Headers. Removing this byte field would be desirable for systems that employ FEC.

Name	Subtype (1 byte)	Length (1 byte)	Value (Variable Length)
Remove Header Check Sequence	24/25.TBD	0	Inclusion of this parameter indicates that the station does not wish to include the HCS field in the Generic Header.

Remove Grant Management

The operational parameter file that is held by each station will include information whether or not to request the use of the GM byte field.

Name	Subtype (1 byte)	Length (1 byte)	Value (Variable Length)
Remove Grant Management	24/25.TBD	0	Inclusion of this parameter indicates that the station does not wish to use the GM field.

Modified Header Format

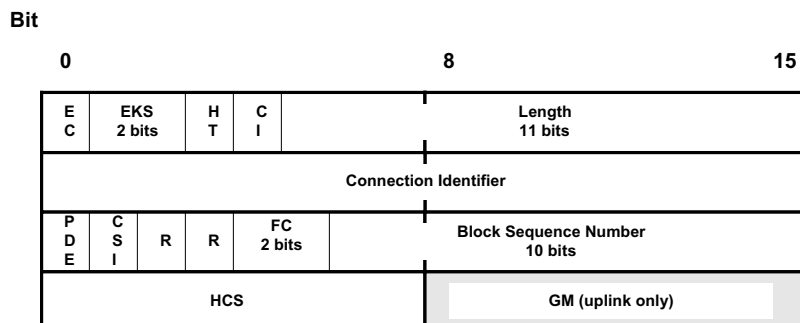The following diagram depicts improved layouts for the Generic Headers.

Figure 2 Generic Header Format

The modified Generic Header in figure 2 shows the first four bytes unchanged except that the Header Type and CRC presence indicators have been swapped with two previously reserved bits. Byte 5 and 6 are the first of the optional fields and carries all of the additional subfields needed to use convergence sublayer signalling, packet discard eligibility, fragmentation and ARQ.

The new format allows systems that don t need fragmentation, Grant Management, ARQ, convergence sublayer signalling or packet discard eligibility to incur only 4 bytes of overhead per data PDU. The rearranged full GH also eliminates the need for a sixteen bit ARQ sequence counter by combining the FSN and ARQ sequence number counters.
Fields that are not employed have their position occupied by the field in the next least significant byte position.

References

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