Project	**IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>**	
Title	**Proposed Enhancement to Framing Structure in OFDM proposal**	
Date Submitted	**2001-03-09**	
Source(s)	Anish Tolia, Yonatan Manor Oren Semiconductor	Voice: 408 330 0300 ext 22 Email: anish@oren.com, yonatan@oren.co.il
	Chet Shirali, Menashe Shahar Vyyo	cshirali@vyyo.com, mshahar@vyyo.com
Re:	Response to call for improvements and mergers.	
Abstract	Proposed additions to the data framing for OFDM and OFDMA systems. The enhancements proposed here enable frame-by-frame dynamic adaptive modulation in a simple, elegant fashion while maintaining the OFDM symbol construction and sub carrier allocations described for OFDM and OFDMA implementations.	
Purpose	For discussion and consideration at Session #12	
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 text 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 (Version 1.0) <http://ieee802.org/16/ipr/patents/policy.html>, including the statement “IEEE standards may include the known use of patent(s), including patent applications, if there is technical justification in the opinion of the standards-developing committee and provided the IEEE receives assurance from the patent holder that it will license applicants under reasonable terms and conditions for the purpose of implementing 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:r.b.marks@ieee.org> as early as possible, in written or electronic form, of any patents (granted or under application) that may cover technology that is under consideration by or has been approved by IEEE 802.16. The Chair will disclose this notification via the IEEE 802.16 web site <http://ieee802.org/16/ipr/patents/notices>.

Proposed Enhancement to Down Stream Framing in OFDM proposal

(IEEE 802.16.3 c-01/33)

Anish Tolia and Yonatan Manor, Oren Semiconductor

Chet Shirali and Menashe Shahar, Vyyo

Overview

This enhancement to the downstream framing is designed to accommodate dynamic adaptive modulation on a frame-by-frame basis. Various modulation schemes varying from QPSK to QAM 64 are supported, as are OFDM and OFDMA modes. Various FEC modes may also be implemented including concatenated RS and convolutional as well as block turbo codes. The frame structure may be implemented in the MAC or the PHY however, implementation in the PHY layer somewhat simplifies the MAC/PHY communication.

The base station organizes the data for transmission according to the channel quality of the targeted CPEs. The data for transmission is divided to blocks, called the Super Frame (Sframe). Contained within the Super Frame are sync pattern, header and data segments of varying modulation rates and FEC structure.

Sframe Structure

The Sframe and the Frames are always cyclic. Each Sframe is made of a whole number of Frames. A Frame is defined as data in an OFDM block. The Sframe consists of the following:

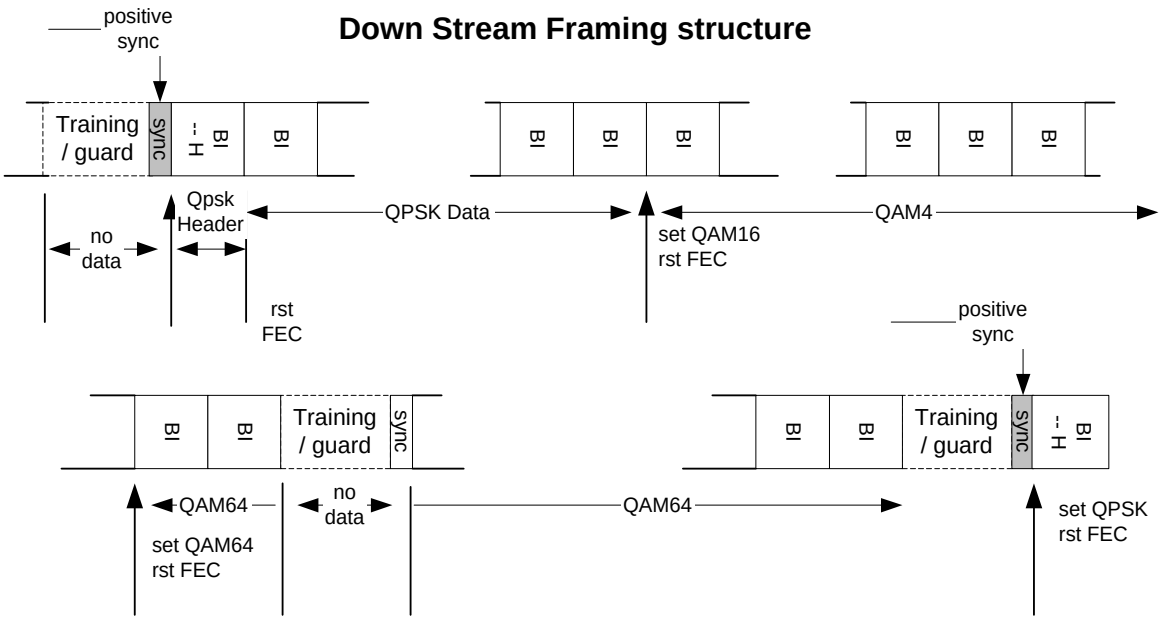
1. Sync pattern: The start of any Frame should include a unique data stream to identify the start of a super frame or frame.
2. QPSK header. The header describes the parameters of the 6 segments to follow in the next Sframe. The QPSK modulation on the header ensures reception by all CPE's.
3. Data segments; each is assigned with a length and a burst profile representing modulation and FEC parameters. The modulation may vary from QPSK up to QAM 64
4. Termination of last Sframe segment. This is done to prevent data packet splitting because of Sframe termination. The modulation parameters of this segment are the same as of the last segment of the previous Sframe.

Each data segment in a Sframe is made of a whole number Bit Interleaved blocks that are processed by the bit interleaver (BI) and the bit deinterleaver (BDI) at the receiver. The length of each segment is thus reported in the header in units of BI blocks. The BI block has a programmable length. A data segment may occupy part of an OFDM symbol or more than one OFDM symbol.

Each data segment constitutes a single transmission burst, excluding the termination segment. The FEC of each segment is initiated and terminated independently of other data segments. This allows adaptive modulation and coding to be applied to each data segment.

Each data segment can have a length of zero symbols. Each data segment can cover the whole length of the Sframe. The last data segment can continue into the next Sframe, where the next Sframe header indicates the continuation.

The packet arrangement is shown in the diagram below.


Down Stream Framing structure
positive sync
Training / guard
sync
BI -- H
BI
BI
BI
BI
BI
BI
BI
Qpsk Header
no data
QPSK Data
QAM4
set QAM16 rst FEC
rst FEC
positive sync
BI
BI
Training / guard
sync
BI
BI
Training / guard
sync
BI -- H
QAM64
no data
QAM64
set QAM64 rst FEC
set QPSK rst FEC