

Exhibit 4



US010447450B2

(12) **United States Patent**
Li et al.

(10) **Patent No.:** **US 10,447,450 B2**

(45) **Date of Patent:** ***Oct. 15, 2019**

(54) **METHOD AND SYSTEM FOR
MULTI-CARRIER PACKET
COMMUNICATION WITH REDUCED
OVERHEAD**

H04L 1/00 (2006.01)

H04W 72/04 (2009.01)

H04J 11/00 (2006.01)

H04W 52/14 (2009.01)

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(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

This patent is subject to a terminal dis-
claimer.

(52) **U.S. Cl.**

CPC **H04L 5/0053** (2013.01); **H04J 11/005**
(2013.01); **H04L 1/0003** (2013.01); **H04L**
1/0009 (2013.01); **H04L 1/0029** (2013.01);
H04L 5/006 (2013.01); **H04L 5/0007**
(2013.01); **H04L 5/0044** (2013.01); **H04L**
27/2601 (2013.01); **H04W 52/146** (2013.01);
H04W 72/04 (2013.01); **H04W 72/048**
(2013.01); **H04L 5/0094** (2013.01)

(58) **Field of Classification Search**

CPC H04L 5/0053; H04L 1/0003; H04J 11/005
See application file for complete search history.

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(21) Appl. No.: **15/676,421**

(22) Filed: **Aug. 14, 2017**

(65) **Prior Publication Data**

US 2018/0183558 A1 Jun. 28, 2018

Related U.S. Application Data

(63) Continuation of application No. 14/720,554, filed on
May 22, 2015, now Pat. No. 9,735,944, which is a
continuation of application No. 14/248,243, filed on
Apr. 8, 2014, now Pat. No. 9,042,337, which is a
continuation of application No. 13/115,055, filed on
May 24, 2011, now Pat. No. 8,693,430, which is a
continuation of application No. 11/908,257, filed as
(Continued)

(51) **Int. Cl.**

H04L 5/00 (2006.01)

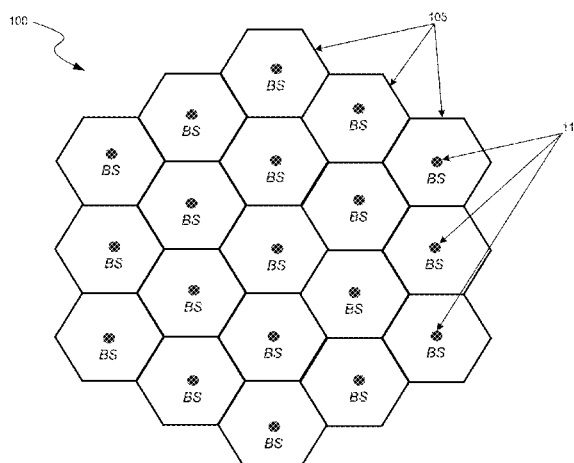
H04L 27/26 (2006.01)

(57)

ABSTRACT

A method and system for minimizing the control overhead
in a multi-carrier wireless communication network that
utilizes a time-frequency resource is disclosed. In some
embodiments, one or more zones in the time-frequency
resource are designated for particular applications, such as a
zone dedicated for voice-over-IP (VoIP) applications. By
grouping applications of a similar type together within a
zone, a reduction in the number of bits necessary for
mapping a packet stream to a portion of the time-frequency
resource can be achieved. In some embodiments, modular
coding schemes associated with the packet streams may be
selected that further reduce the amount of necessary control
information. In some embodiments, packets may be classi-
fied for transmission in accordance with application type,
QoS parameters, and other properties. In some embodi-
ments, improved control messages may be constructed to
facilitate the control process and minimize associated over-
head.

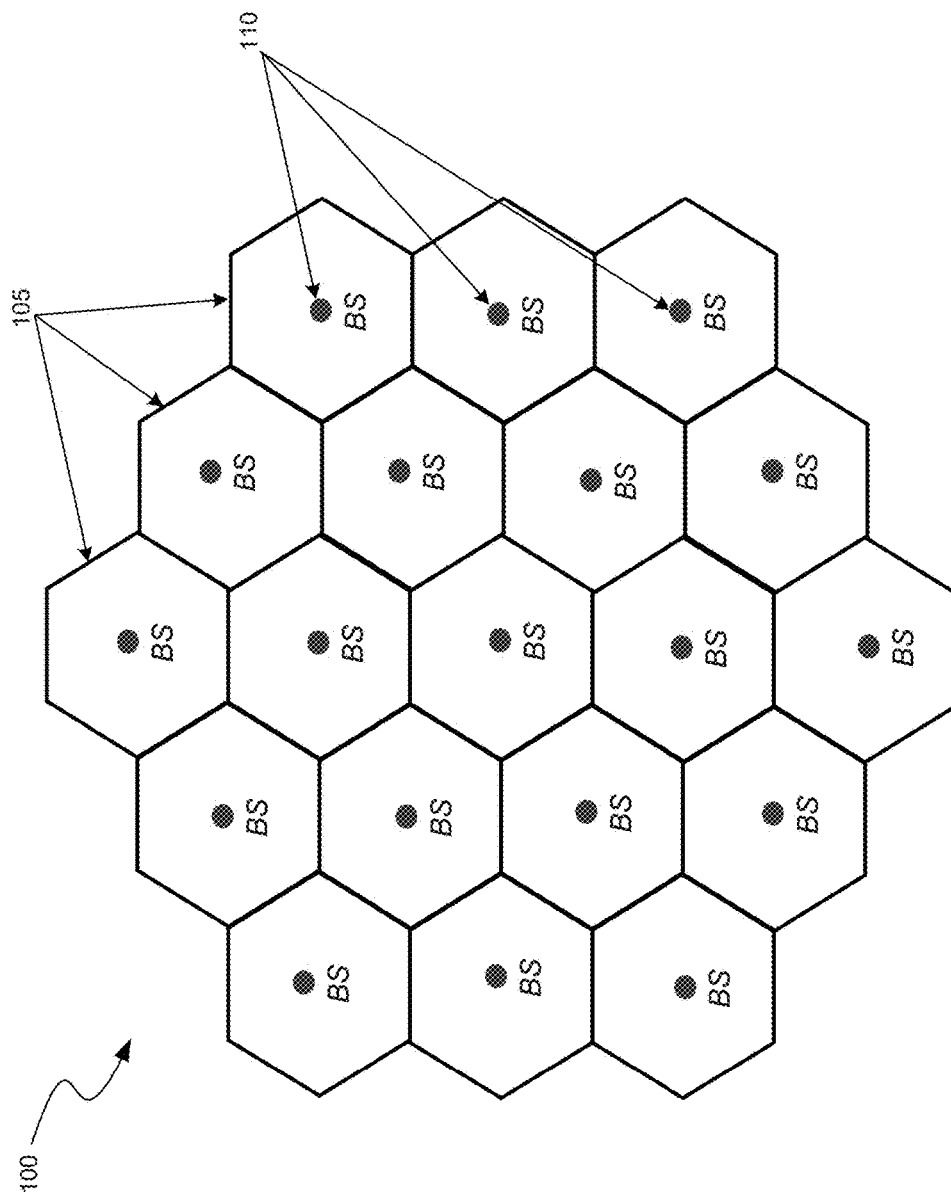
18 Claims, 12 Drawing Sheets

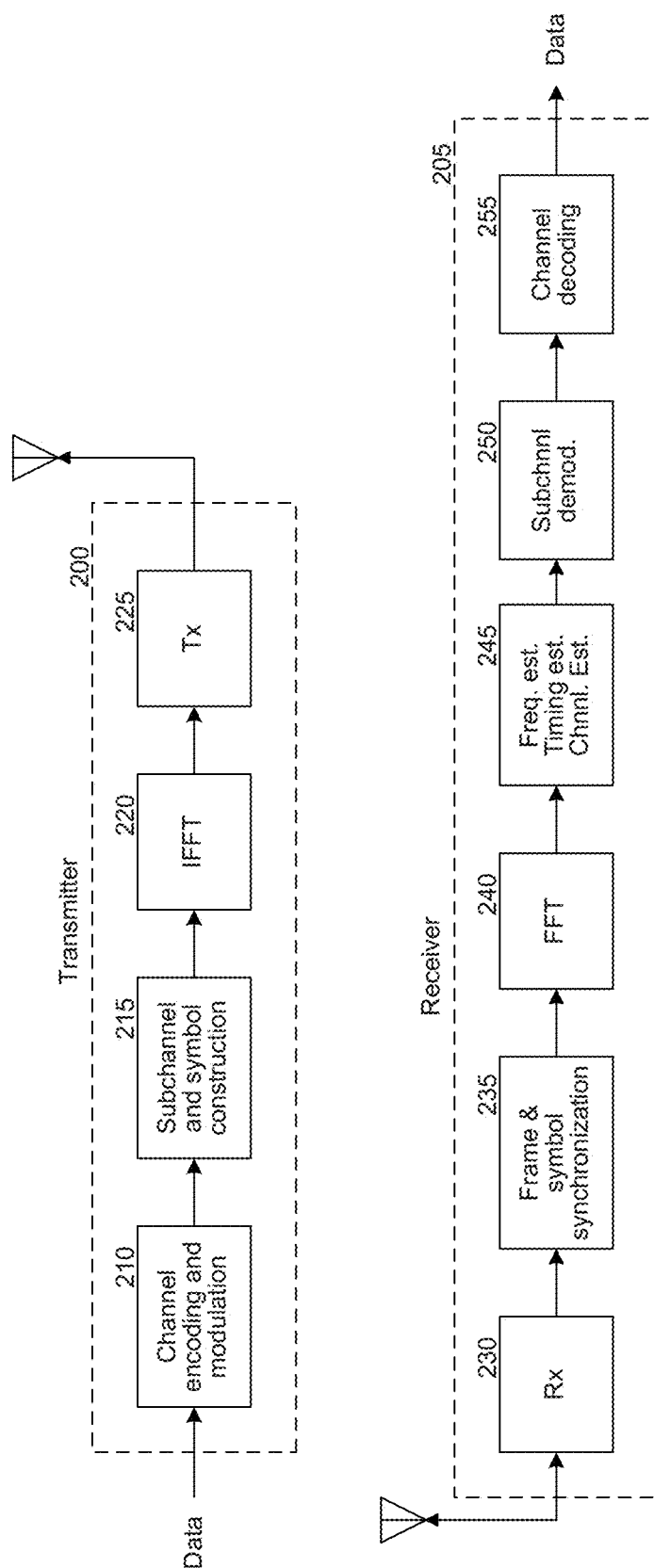


Related U.S. Application Data

application No. PCT/US2006/038149 on Sep. 28, 2006, now Pat. No. 7,948,944.

- (60) Provisional application No. 60/721,451, filed on Sep. 28, 2005.

**FIG. 1**

**FIG. 2**

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