Title: DYNAMIC SUBCARRIER UTILIZATION AND INTELLIGENT TRANSMISSION SCHEDULING

Abstract: In one embodiment, a transmitting device monitors transmission activity of each of a plurality of subcarriers in a communication network, and determines a set of unutilized subcarriers of the plurality of subcarriers. As such, the transmitting device may then transmit a data frame on one or more of the unutilized subcarriers to a receiving device while transmission activity is present on one or more utilized subcarriers within the network. In another embodiment, the transmitting device may also determine timing information associated with the transmission activity, and may correspondingly schedule the transmitting device to optimize network performance based on the timing information.
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(88) Date of publication of the international search report: 9 January 2014
INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/033485

A. CLASSIFICATION OF SUBJECT MATTER

INV. H04L27/00 H04L5/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>paragraph [(00082)] - paragraph [(00084)] paragraph [(00094)] - paragraph [(000100)] figure 9</td>
<td>4,5,16, 17</td>
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<td>paragraph [(0008)] paragraph [(0029)]</td>
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Further documents are listed in the continuation of Box C. X See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"Q" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"W" document member of the same patent family

Date of the actual completion of the international search
13 August 2013

Date of mailing of the international search report
08/11/2013

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Authorized officer
Douglas, Ian
# INTERNATIONAL SEARCH REPORT

**Box No. II**  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. □ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. □ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. □ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

**Box No. III**  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

> see additional sheet

1. □ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. □ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. □ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. □ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

   1, 5, 10, 12-17, 21, 23, 24

**Remark on Protest**

- □ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- □ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- □ No protest accompanied the payment of additional search fees.
This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 10, 12-17, 21, 23, 24

   determining a first finish time associated with transmitting the data frame substantially immediately in response to availability of the one or more of the unutilized subcarriers;
   determining a second finish time associated with transmitting the data frame in response to availability of a sufficient number of unutilized subcarriers to meet a determined transmission timing; and
   selecting whether to transmit the data frame substantially immediately or in response to availability of a sufficient number of unutilized subcarriers based on the quickest finish time of the first and second finish times.

2. claims: 6-8, 18, 19

   Initiating the transmitting only when the transmitting will finish before a current active transmission.

3. claims: 9, 11, 20, 22

   Transmitting a preamble and physical (PHY) header of the data frame on each individual subcarrier with information as to which one or more subcarriers will be used for the transmitting, such that decoding any individual subcarrier allows the receiving device to determine which one or more subcarriers will be used for the transmitting.
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