

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

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(45) **Date of Patent:** ***Jan. 2, 2018**

(54) **PUCCH RESOURCE ALLOCATION FOR CARRIER AGGREGATION IN LTE-ADVANCED**

(58) **Field of Classification Search**
CPC .. H04B 1/3833; H04M 1/0247; H04M 1/0237
(Continued)

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(73) Assignee: **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)**, Stockholm (SE)

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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.

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This patent is subject to a terminal disclaimer.

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Primary Examiner — Md Talukder

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(74) *Attorney, Agent, or Firm* — Coats & Bennett, PLLC

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Related U.S. Application Data

(63) Continuation of application No. 12/896,993, filed on Oct. 14, 2010, now Pat. No. 9,497,004.
(Continued)

(57) **ABSTRACT**

Systems and methods of signaling uplink control information in a mobile communication network using carrier aggregation are provided. In one exemplary embodiment, a method may include scheduling downlink transmissions to a first user terminal on a single downlink component carrier (CC) associated with a primary cell and scheduling downlink transmissions to a second user terminal on multiple downlink CCs or on a downlink CC associated with a non-primary cell. Further, the method may include receiving, on a first set of radio resources, control information associated with the downlink transmissions to the first user terminal. In addition, the method may include receiving, on

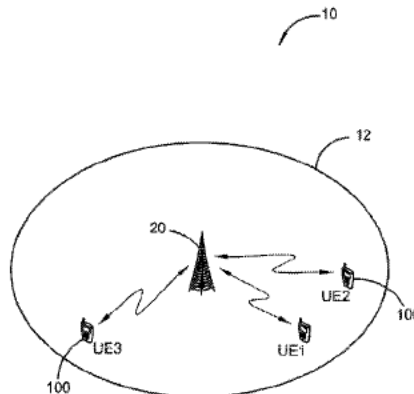
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(51) **Int. Cl.**
H04M 1/00 (2006.01)
H04L 5/00 (2006.01)

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(52) **U.S. Cl.**
CPC **H04L 5/0053** (2013.01); **H04L 5/001** (2013.01); **H04L 5/0094** (2013.01); **H04W 28/26** (2013.01);

(Continued)



a second set of radio resources, control information associated with the downlink transmissions to the second user terminal.

41 Claims, 12 Drawing Sheets

Related U.S. Application Data

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H04W 72/04 (2009.01)
H04W 72/12 (2009.01)
H04W 8/24 (2009.01)
H04W 48/16 (2009.01)
H04W 88/02 (2009.01)
H04W 88/08 (2009.01)
- (52) **U.S. Cl.**
 CPC ... *H04W 72/0453* (2013.01); *H04W 72/1273* (2013.01); *H04L 5/0005* (2013.01); *H04W 8/24* (2013.01); *H04W 48/16* (2013.01); *H04W 88/02* (2013.01); *H04W 88/08* (2013.01)
- (58) **Field of Classification Search**
 USPC 455/451, 452.1, 509, 456.1, 522, 137, 455/103, 575, 456.6
 See application file for complete search history.

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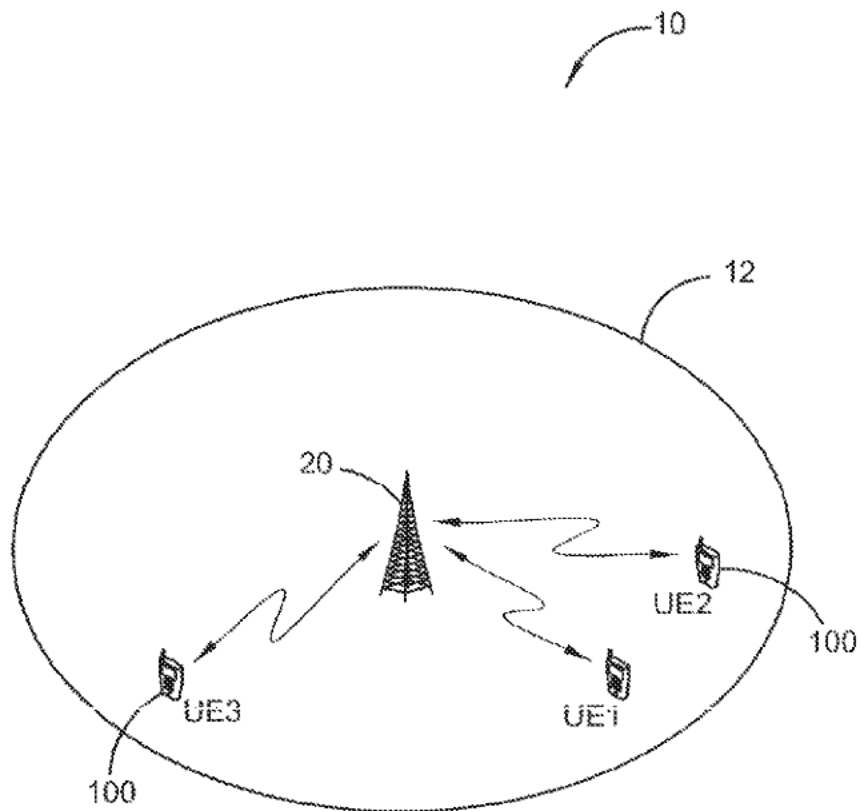


FIG. 1

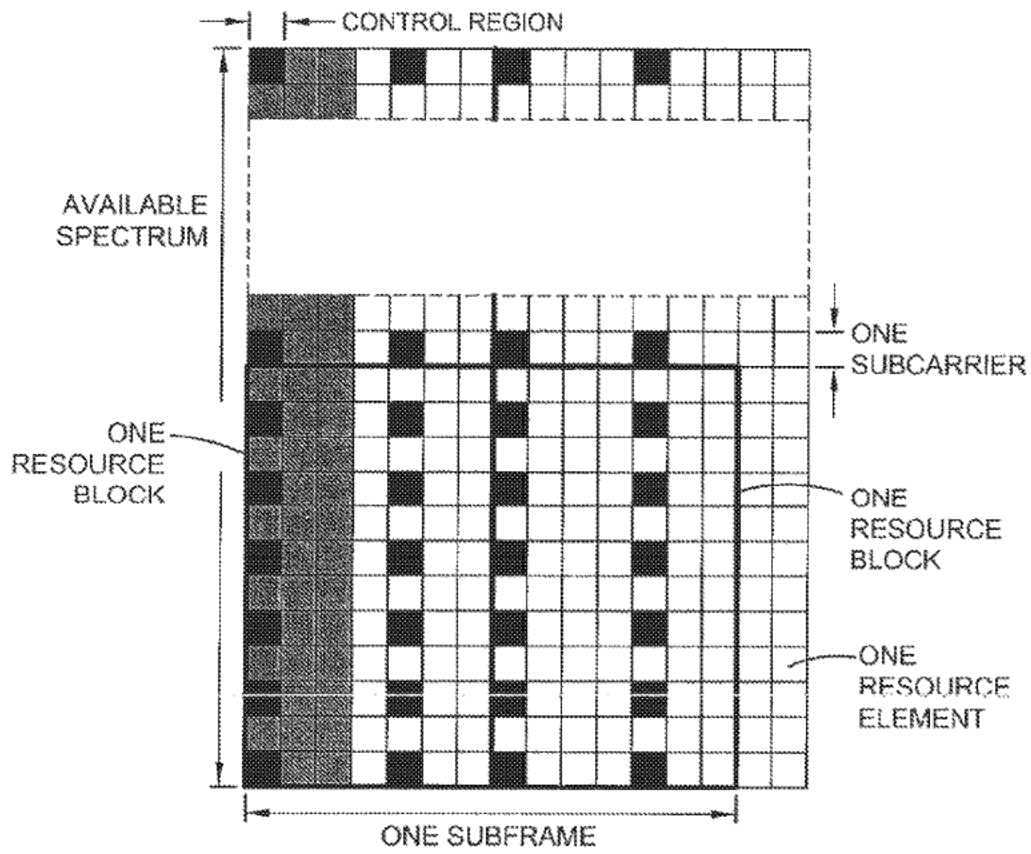


FIG. 2

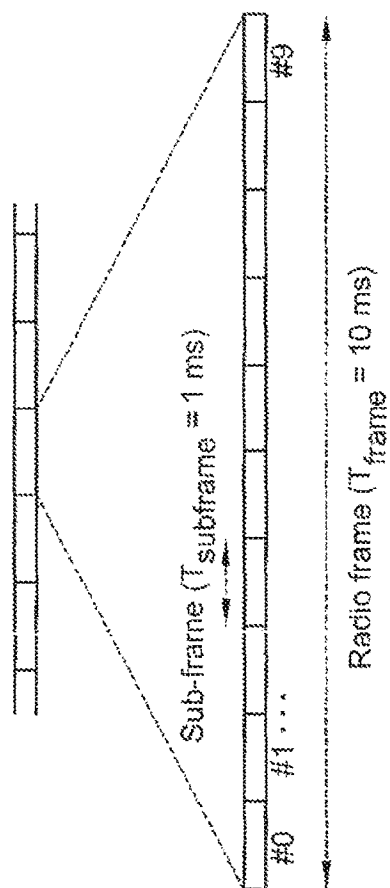


FIG. 3

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