Relay Station Assistance in Location Based Services for IEEE 802.16m

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Venue:
    TGm SDD: Relay   IEEE 802.16m-08/040: Call for Comments and Contributions on Project 802.16m System Description Document (SDD)
Purpose:
    For consideration and adoption by TGm group

Introduction

- In accordance with IEEE 802.16m SRD IEEE 802.16m systems shall provide support for high resolution location determination. Location latency and accuracy characteristics should satisfy the following requirements:

Table 15–Location-based service requirements

| Feature	Requirement	Comments
Location determination latency	< 30 s	
Handset-based position accuracy (in meters)	50 meter (67%-tile of the CDF of the position accuracy) 150 meter (95%-tile of the CDF of the position accuracy)	Need to meet E911 Phase II Requirements
Network-based position accuracy (in meters)	100 meter (67%-tile of the CDF of the position accuracy) 300 meter (95%-tile of the CDF of the position accuracy)	

RS Assistance in LBS - Motivation

- Radio-location methods are based on measurements of different signal location parameters (i.e. cell ID, TDOA/TOA, AOA, RTD and etc.).

- Accurate network based positioning of MS is mainly limited by following factors:
  - NLOS propagation induced errors;
  - 'Hear-ability' issue due to severe interference environment (i.e. MS is not able to detect sufficient number of BSs to make reliable estimation of its location);
  - Ambiguity/convergence of different location methods.

- In any radio-location method (TDOA/TOA/AOA or hybrid) the MS positioning accuracy is improved if the number of particular location parameter measurements is increased. The lack of particular location parameter measurements results in significant degradation of location accuracy.

- To increase MS positioning accuracy it is proposed to use 16m RSs in order to assist LBS purposes in serving cell

RS Assistance in LBS - Architecture

- 802.16m RS may assists LBS in both UL/DL:
  - DL: RS transmits SCH channel/pilots that can be used to extract signal location parameters at the MSs (i.e. TDOA, Cell ID, etc.);
  - UL: Distributed wideband signaling transmitted by MSs can be used to estimate TOA/RTD and optionally AOA at RS.
- The similar measurements / mechanisms that are used in the BS-MS location can be exploited for RS assistance in LBS.
- 802.16m RS shall be able to provide its own location coordinates to the network/(BS/RSs/MSs) and transmit the coordinates of its neighborhood stations (BS/RS) to the associated MS.

Application of RSs for TOA/TDOA Location Methods
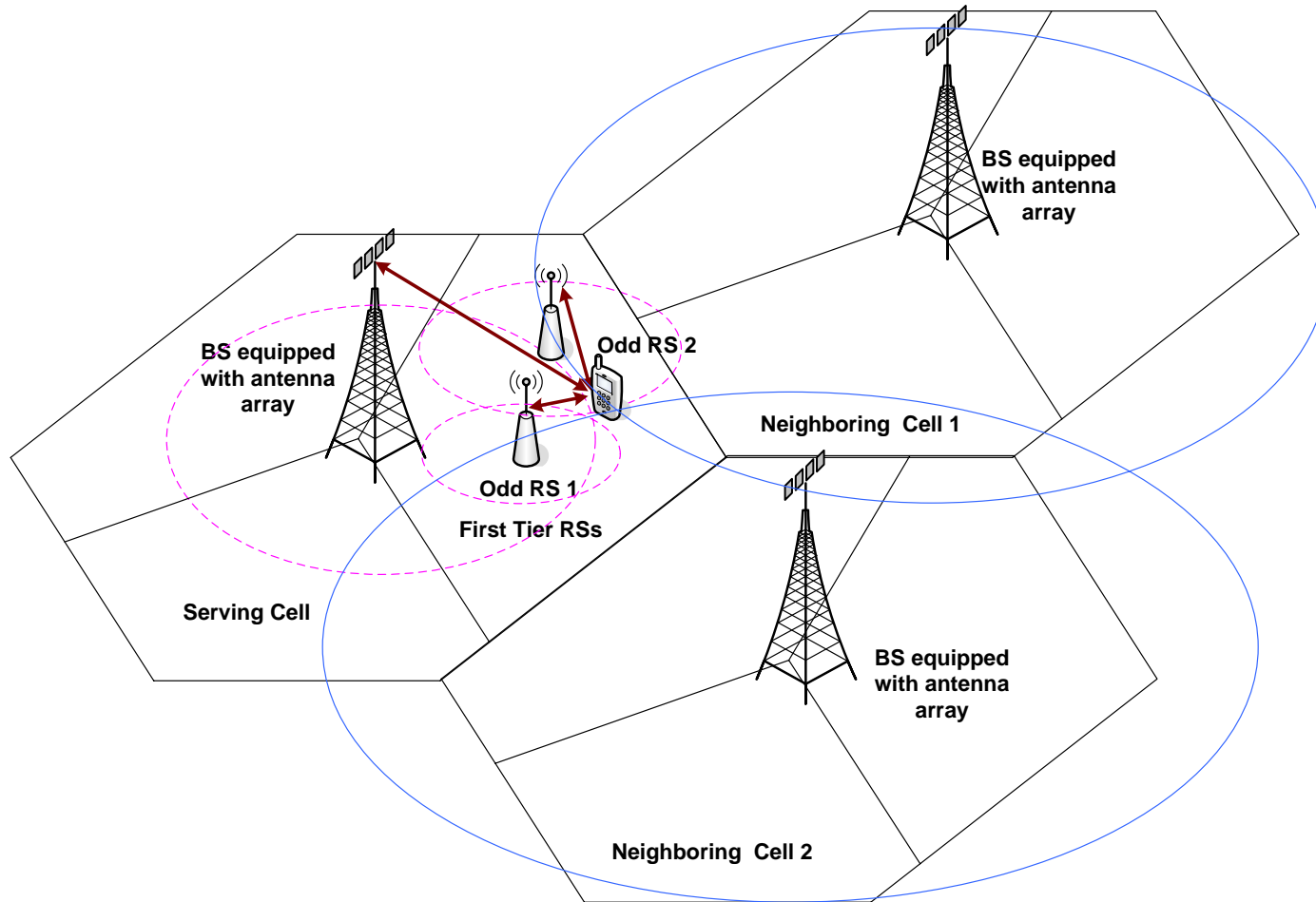
RS assistance in LBS - Benefits

- RS assistance in LBS leads to more accurate estimates of MS location due to several reasons:
  - Additional synchronized reference sources are appeared in the cell network. Signals transmitted in DL / received in UL by RSs can be used for estimation of different location parameters.
  - RS operation is fully controlled by BSs. BS can manage RS transmission/reception to overcome 'hear-ability' problem within the cell. For instance BS may assign some silence periods (reducing interference within the cell) in order to improve estimate accuracy of location parameter.
  - Usage of RSs can simplify TOA/RTD measurements that can be performed within cell only if several RSs are deployed. Using RSs for TDOA/TOA/RTD measurements the BS may not need to coordinate MS UL transmissions with neighboring BSs taking network resources of neighboring cells

Summary and Proposed SDD text

- This contribution proposes to use 802.16m RSs for assisting in network LBS.
- Proposed text to SDD:

[Insert the following text into section 15 of the SDD:]
    15.x.x Relay Station assistance in Location Based Services

  – IEEE 802.16m Relay Stations assist the serving BS in the delivery of LBS and may be used in cooperation with serving BS/RS to make and provide needed measurements of location parameters. In addition to time difference of arrival (TDOA) measurements the 802.16m RSs support Round trip delay (RTD)/TOA measurements using DL and UL frame resources designated to LBS purposes. Uplink measurements of RTD/TOA are performed using MS distributed wideband signaling. Optionally RSs may perform AOA measurements if a sufficient number of antennas is available.