DISTRIBUTED ANTENNA SYSTEM NETWORK ANALYTICS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/189,113, filed on July 6, 2015, entitled "Distributed Antenna Network Analytics," the disclosure of which is hereby incorporated by reference in its entirety for all purposes.

BACKGROUND

[0002] Wireless network operators face a continuing challenge in building networks that effectively manage high data-traffic growth rates. To support the mobility and an increased level of multimedia content for end users, communication networks typically employ end-to-end network adaptations that support new services and the increased demand for broadband and flat-rate Internet access.

[0003] One of the most difficult challenges faced by network operators is determining the performance of a DAS network. Remote units used in a DAS network may have limited functionality and may not have the capability of a base station for extracting all Key Performance Indicators (KPIs) available for each user. These KPIs determine the quality of service provided to each user. Users' quality of service may inform network operators how to optimize their networks and may assist in determining problems as they arise. The separation of the base stations from remote units, which occurs in a DAS network, poses a problem in monitoring the network performance. In addition, identifying the location of a user in a DAS network – especially indoors – is a challenge.

SUMMARY

[0003a] According to a first aspect of the present invention, there is provided a Distributed Antenna System (DAS) including: a first digital remote unit (DRU) in communication with a mobile device, the first DRU including a first antenna; a second DRU in communication with the mobile device, the second DRU including a second antenna; a third DRU in communication with the mobile device, the third DRU including a third antenna; a digital access unit (DAU) configured to route signals to and from the first DRU, the second DRU, and the third DRU via optical connections; and a server computer communicatively coupled to the DAU, the server computer including: a processor; and a memory coupled to the processor, the memory storing instructions, executable by the processor, to perform: collecting, at each DRU, a timed snapshot of traffic data, the timed snapshot including a block of traffic data and a timestamp indicating a time at which the timed snapshot was taken; collecting, from the DAU, a first key performance indicator (KPI) data for the mobile device relative to the first DRU, wherein the first KPI data comprises at least one of a first power level or a first transmission time and the first KPI data is extracted from control channel information in the timed snapshot, obtaining, from the DAU, a first location of the first DRU,

collecting, from the DAU, a second KPI data for the mobile device relative to the second DRU, wherein the second KPI data comprises at least one of a second power level or a second transmission time and the second KPI data is extracted from control channel information in the timed snapshot, obtaining, from the DAU, a second location of the second DRU, collecting, from the DAU, a third KPI data for the mobile device relative to the third DRU, wherein the third KPI data comprises at least one of a third power level or a third transmission time and the third KPI data is extracted from control channel information in the timed snapshot, obtaining, from the DAU, a third location of the third DRU, and determining a geolocation of the mobile device using the first location and at least one of the first power level or the first transmission time, the second location and at least one of the second power level or the second transmission time, and the third location and at least one of the third power level or the third transmission time.

[0003b] According to a second aspect of the present invention, there is provided a method for determining a geolocation of a mobile device in a Distributed Antenna System (DAS), the method including: collecting, at each Digital Remote Unit (DRU), a timed snapshot of traffic data, the timed snapshot including a block of traffic data and a timestamp indicating a time at which the timed snapshot was taken; collecting, from a digital access unit (DAU), a first key performance indicator (KPI) data for the mobile device relative to a first digital remote unit (DRU), wherein the first DRU includes a first antenna and is in communication with the DAU via a first optical connection, and wherein the first KPI data comprises at least one of a first power level or a first transmission time and the first KPI data is extracted from control channel information in the timed snapshot; obtaining, from the DAU, a first location of the first DRU; collecting, from the DAU, a second KPI data for the mobile device relative to a second DRU, wherein the second DRU includes a second antenna and is in communication with the DAU via a second optical connection, and wherein the second KPI data comprises at least one of a second power level or a second transmission time and the second KPI data is extracted from control channel information in the timed snapshot; obtaining, from the DAU, a second location of the second DRU; collecting, from the DAU, a third KPI data for the mobile device relative to a third DRU, wherein the third DRU includes a third antenna and is in communication with the DAU via a third optical connection, and wherein the third KPI data comprises at least one of a third power level or a third transmission time and the third KPI data is extracted from control channel information in the timed snapshot; obtaining, from the DAU, a third location of the third DRU; and determining the geolocation of the mobile device using the first location and at least one of the first power level or the first transmission time, the second location and at least one of the second power level or the second transmission time, and the third location and at least one of the third power level or the third transmission time.

[0004] The present disclosure generally relates to wireless communication systems employing Distributed Antenna Systems (DAS) as part of a distributed wireless network. More specifically, the present disclosure relates to a DAS network that utilizes traffic monitoring of mobile devices of a distributed wireless network. Traffic monitoring may be used to monitor the DAS network performance and generate analytics of individual mobile devices.

[0005] According to one embodiment of the invention, a method for determining a geolocation of a mobile device in a DAS system is provided. The method comprises collecting first key performance indicator (KPI) data for the mobile device from a first digital remote unit (DRU). The first KPI data comprises at least one of a first power level and a first transmission time. The method further comprises obtaining a first location of the first DRU. The method further comprises collecting second KPI data for the mobile device from a second DRU. The second KPI data comprises at least one of a second power level and a second transmission time. The method further comprises obtaining a second location of the second DRU. The method further comprises collecting third KPI data for the mobile device from a third DRU. The third KPI data comprises at least one of a third power level and a third transmission time. The method further comprises obtaining a third location of the third DRU. The method further comprises determining the geolocation of the mobile device using (i) the first location and at least one of the first power level and the first transmission time, (ii) the second location and at least one of the second power level and the second transmission time, and (iii) the third location and at least one of the third power level and the third transmission time.

[0006] Systems for performing the methods described herein are also provided. The system comprises a server computer comprising a processor and memory storing instructions, executable by the processor, the instructions comprising the steps of the methods described herein. The system may further comprise a mobile device, at least one DRU, at least one digital access unit (DAU), and/or at least one base transceiver station (BTS).

[0007] These and other embodiments are described in further detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Further embodiments and advantages of the present invention can be more fully understood from the following detailed description taken in conjunction with the accompanying drawings in which:

[0009] FIG. 1 illustrates an example of a basic DAS network architecture, and also illustrates an example of a data transport network, KPI traffic monitoring, use KPI data and position information storage;

[0010] FIG. 2 illustrates another example of DAS network architecture, in which a single base station is used to provide network coverage for a large geographic area when a frequency reuse pattern of N=1 is used;