VIRTUALIZED WIRELESS NETWORK

BACKGROUND OF THE INVENTION

[0001] The proliferation of Internet-enabled smart phones and mobile devices have driven wireless subscribers to consume an unprecedented amount of multimedia and multimodal mobile data traffic, such as real-time video streaming, high definition movies downloading, and the like. This explosion has been augmented by machine-to-machine (M2M) type real-time applications, such as utility-meter monitoring, that operate autonomously and independently from user transactions. Such advances have resulted in exponential growth of the demand for mobile data capacity on a global scale, challenging traditional cellular networks. Yet. the supply of mobile data capacity provided by existing radio network solutions may only be growing linearly. Therefore, there may be a need to address the gap between supply and demand for mobile data capacity as the gap is rapidly widening.

SUMMARY OF THE INVENTION

[0002] These and other problems may be addressed by embodiments of the present invention. ~~The~~ Embodiments of the present invention ~~relates~~ relate to wireless communication systems. More particularly, embodiments of the present invention ~~provides~~ provide methods and systems related to a virtualized wireless network.

[0003] According to embodiments of the present invention, the virtualization of a wireless network is provided utilizing software configurable radio-based distributed antenna system (DAS). As described herein, embodiments of the present invention enable wireless network operators to virtualize their base station farms or hotels (allowing the operators to mix-and-match base stations from different OEM vendors) and to provide on demand wireless capacity and coverage in an anywhere / anytime format. As a result, embodiments of the present invention enable increased efficiency and utilization of new and existing assets that fundamentally change the manner in which operators are able to plan and deploy their wireless networks.

~~[0004] According to an embodiment of the present invention, a network is provided. The network may include a first base transceiver station (BTS). The first BTS may be operable to provide a first signal including a plurality of first carriers. The network may also include a~~

~~second BTS operable to provide a second signal including a plurality of second carriers. The network may also include a set of one or more digital access units (DAUs), each of the one or more DAUs being coupled to at least one of the first BTS or the second BTS. A set of one or more digital remote units (DRUs) may be included in the network, each of the DRUs being coupled to one of the one or more DAUs and operable to broadcast the first signal or the second signal.~~

[0004] According to the first aspect of the present invention there is provided a network comprising: a first base transceiver station (BTS) operable to provide a first signal including a plurality of first carriers; a second BTS operable to provide a second signal including a plurality of second carriers; a set of one or more digital access units (DAUs), each of the one or more DAUs being coupled to at least one of the first BTS or the second BTS; and a set of one or more digital remote units (DRUs), each of the DRUs being coupled to one of the one or more DAUs and operable to broadcast the first signal or the second signal.

[0005] In some embodiments, the first BTS may be associated with a first infrastructure supplier and the second BTS may be associated with a second infrastructure supplier. In some embodiments, the first infrastructure supplier and the second infrastructure supplier are a same infrastructure supplier.

[0006] The one or more BTSs may provide the signal including the plurality of carriers using differing broadcast protocols. The different broadcast protocols may include at least one of CDMA, WCDMA, or LTE. The one or more DAUs may include a plurality of DAUs coupled via at least one of Ethernet cable, Optical Fiber, Microwave Line of Sight Link, Wireless Link, or Satellite Link. The one or more DAUs may include a plurality of DAUs coupled to the plurality of DRUs via at least one of Ethernet cable, Optical Fiber, Microwave Line of Sight Link, Wireless Link, or Satellite Link. The one or more DRUs may include a plurality of DRUs connected in a daisy chain configuration and/or a star configuration. Each of the one or more DAUs may be coupled to at least one of the first BTS or the second BTS, e.g., via at least one of a Ethernet cable, Optical Fiber, Microwave Line of Sight Link, Wireless Link, or Satellite Link.

~~[0007] In some embodiments of the invention, a method of operating a virtual DAS network is provided. The method may include: receiving a first signal including a first plurality of carriers from a first BTS; receiving a second signal including a second plurality of carriers from a second~~

~~BTS; routing the first and second signals to a first DRU; and routing the first and second signals to a second DRU.~~

[0007] According to the second aspect of the present invention, there is provided a method of operating a virtual DAS network, the method comprising: receiving a first signal including a first plurality of carriers from a first BTS; receiving a second signal including a second plurality of carriers from a second BTS; routing the first and second signals to a first DRU; and routing the first and second signals to a second DRU.

[0007a] The method may further include: associating the first and second signals with one of a plurality of DRUs based on a geographic usage pattern, the plurality of DRUs comprising the first DRU and the second DRU. Routing the first and second signals to the second DRU may include routing the first a second signals through a plurality of DAUs.

~~[0008] In some embodiments of the invention, a method of operating a virtual DAS network is provided. The method may include: receiving a first signal from a first BTS; receiving a second signal from a second BTS; routing the first signal to a first DRU; routing the second signal to a second DRU; receiving a third signal from the first BTS; and routing the third signal to the second DRU~~

[0008] According to the third aspect of the present invention, there is provided a method of operating a virtual DAS network, the method comprising: receiving a first signal from a first BTS; receiving a second signal from a second BTS; routing the first signal to a first DRU; routing the second signal to a second DRU; receiving a third signal from the first BTS; and routing the third signal to the second DRU.

[0008a] The method may further include: repeatedly assigning the first DRU to one of a plurality of BTSs, the plurality of BTSs including the first BTS and the second BTS. The first DRU may be assigned at least partly in an attempt to evenly distribute combined BTS resources across DRUs in the network. Routing the third signal to the second DRU may include: routing the third signal through a plurality of DAUs.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. 1 illustrates two types of wireless networks: a non-virtualized wireless network and a virtualized wireless network according to an embodiment of the present invention;

[0010] FIG. 2 is a simplified schematic diagram of a virtual DAS network according to an embodiment of the present invention;

[0011] FIG. 3 is a simplified flowchart illustrating a method of operating a virtual DAS network according to an embodiment of the present invention;

[0012] FIG. 4 is a simplified flowchart illustrating a method of operating a virtual DAS network according to an embodiment of the present invention;

[0013] FIG. 5 is a block diagram showing a multi-channel High Power Remote Radio Head Unit according to one embodiment of the present invention;

[0014] FIG. 6 is a block diagram according to one embodiment of the invention showing the basic structure and an example of a Flexible Simulcast downlink transport scenario based on having 2 DAU and 4 DRU;

[0015] FIG. 7 is a block diagram in accordance with an embodiment of the invention showing the basic structure and an example of a Flexible Simulcast uplink transport scenario based on having 2 DAU and 4 DRU;

[0016] FIG. 8 shows an embodiment of an indoor system employing multiple Remote Radio Head Units (RRUs) and a central Digital Access Unit (DAU);