

SYSTEMS AND METHODS FOR NON-CELLULAR WIRELESS ACCESS

5

TECHNICAL FIELD

10 [0002] The present invention relates to a system and method for wireless communications, and, in particular embodiments, to a system and method for non-cellular wireless access in radio access networks.

BACKGROUND

15 [0003] For the past 40 years, the cellular cell has functioned as the atom of the wireless network, as shown in Figure 1. A cellular system 100 includes a plurality of transmit points (TPs) 104 each with an associated coverage area or cell 102. UEs 106 communicate only with the TP 104 in the cell 102 in which the UE 106 is associated using an ID specific for the cell 102. When a UE 106 moves to another cell, a handover between TPs 104 must occur and the UE 106 is associated with a new TP 104 through a new cell ID. However, radio access performance is limited by inter-cell interference. Further, as shown in plot 200 of spectral efficiency in Figure 2, there is non-uniform spectral
20 efficiency across a cell.

SUMMARY

[0004] In an embodiment, a method for non-cell grid based radio access in a radio access network includes determining, by a controller, a group of transmit points (TPs) to assign to a logical entity; assigning, by the controller, a logical entity identifier (ID) to the logical entity, wherein the logical entity ID identifies the logical entity through which a user equipment (UE) communicates with the
25 radio access network; and causing, by the controller, at least one of the TPs in the logical entity to send signals to the UE.

[0005] In an embodiment, a controller for a non-cell grid based radio access in a radio access network includes a processor and a computer readable storage medium storing programming for execution by the processor, the programming including instructions to: determine a group of transmit
30 points (TPs) to assign to a logical entity; assign a logical entity identifier (ID) to the logical entity, wherein the logical entity ID identifies the logical entity through which a user equipment (UE) communicates with the radio access network; and cause at least one of the TPs in the logical entity to send signals to the UE.

5 [0058] One skilled in the art will appreciate that modifications to the membership of a hyper cell may be performed as a result of predicted changes to characteristics of UE connectivity. For example, it may be determined by a network planning routine that a particular TP should be powered down to save energy. When the TP to be powered down is identified as part of a hyper cell serving a particular UE, the hyper cell membership can be modified and the TP can be removed from the logical entity. In
10 doing so, network traffic associated with the UE will no longer be routed to the TP. This can be done prior to the powering down of the TP so that adverse effects on connected UEs can be minimized. Although discussion herein has focused on powering down a TP, any Operations And Maintenance (O&M or O&AM) function. Additionally, where it has been discussed that a hyper cell membership can be changed due to the removal of a TP for service or power savings functions, it should also be
15 noted that hyper cell membership can also be modified in response to a TP being powered on (or in response to advanced notice that a TP is going to be powered on).

[0059] When a UE attaches to the network, the hyper cell created to serve the UE can be assigned an identifier. The UE can be provided an identifier of the hyper cell so that it can include this identifier will all transmissions it sends. It should be recognized that the assigned identifier should be unique
20 across the network (globally unique). The UE may receive either all or part of the hyper cell identifier, but in cases where it only receives a portion of the identifier, the UE should be able to programmatically determine the whole identifier. Those skilled in the art will appreciate that the assigned identifier will be globally unique if it includes a UE identifier which is guaranteed to be unique.

25 [0060] One embodiment provides a method for non-cell grid based radio access in a radio access network, which includes: determining, by a controller, a group of transmit points (TPs) to assign to a logical entity; assigning, by the controller, a logical entity identifier (ID) to the logical entity, wherein the logical entity ID identifies the logical entity through which a UE communicates with the radio access network; and causing, by the controller, at least one of
30 the TPs in the logical entity to send signals to the UE.

One aspect of the embodiment further includes generating, by the controller, a UE-dedicated connection ID according to a UE ID and the logical entity ID; and sending the UE-dedicated connection ID to the UE, wherein the UE-dedicated connection ID enables the UE to access the radio network utilizing the UE-dedicated connection ID through
35 at least one of the TPs in the logical entity.

One aspect of the embodiment further includes the UE-dedicated connection ID remains the same as long as the UE is communicating with a TP within the logical entity.

5 One aspect of the embodiment further includes: generating a UE-TP association table according to uplink (UL) measurements from the UE.

One aspect of the embodiment further includes: assigning the logical entity ID to a group of TPs comprises selecting a group of TPs to serve the UE utilizing a UE-TP association table.

10 One aspect of the embodiment further includes: changing the TPs assigned to the logical entity according to at least one of network attributes and UE attributes.

One aspect of the embodiment further includes: the network attributes comprise at least one of a number of active UEs within the radio access network, network congestion, network power consumption, and type of network traffic.

15 One aspect of the embodiment further includes: the group is a first group and further comprising determining a second group of physical TPs to assign to the logical entity, wherein the at least one of the TPs in the first and second groups do not belong to both groups.

One aspect of the embodiment further includes: removing a TP from the logical entity in response to an indication of the TP being disabled or powered down.

20 One aspect of the embodiment further includes: wherein the logical entity provides wireless access for a coverage area that is larger than the coverage area for a single TP.

One aspect of the embodiment further includes: the logical entity ID is a first logical entity ID, wherein the group comprises a first group, and further comprising sending a second logical entity ID to the UE when the UE travels out of a coverage area for the first logical entity and
25 into a coverage area for the second logical entity, wherein the second logical entity comprises at least one non-overlapping coverage area with the first logical entity.

One aspect of the embodiment further includes: sending control and/or data to the UE through a UE-centric channel.

30 One aspect of the embodiment further includes: assigning at least one of the TPs in the group to provide downlink radio access to the UE.

One aspect of the embodiment further includes: the at least one of the TPs in the group assigned to provide radio access to the UE is determined according to relative signal strength of the UE at each of the TPs in the group.

5 One aspect of the embodiment further includes: the TPs comprise physical TPs.

[0061] One embodiment provides a controller for a non-cell grid based radio access in a radio access network, which includes: a processor; and a computer readable storage medium storing programming for execution by the processor, the programming including instructions to: determine a group of transmit points (TPs) to assign to a logical entity; assign a logical
10 entity identifier (ID) to the logical entity, wherein the logical entity ID identifies the logical entity through which a user equipment (UE) communicates with the radio access network; and cause at least one of the TPs in the logical entity to send signals to the UE.

One aspect of the embodiment further includes instructions to: generate a UE-dedicated connection ID according to a UE ID and the logical entity ID; and send the UE-dedicated
15 connection ID to the UE, wherein the UE-dedicated connection ID enables the UE to access the radio network utilizing the UE-dedicated connection ID through at least one of the TPs in the logical entity.

One aspect of the embodiment further includes the UE-dedicated connection ID remains the same as long as the UE is communicating with a TP within the logical entity.

20 One aspect of the embodiment further includes instructions to generate a UE-TP association table according to uplink (UL) measurements from the UE.

One aspect of the embodiment further includes the instructions to assign the logical entity ID to a group of TPs comprises instructions to select a group of TPs to serve the UE utilizing a UE-TP association table.

25 One aspect of the embodiment further includes instructions to change the TPs assigned to the logical entity according to at least one of network attributes and UE attributes.

One aspect of the embodiment further includes: the network attributes comprise at least one of a number of active UEs within the radio access network, network congestion, network power consumption, and type of network traffic.

30 One aspect of the embodiment further includes: the group is a first group and wherein the programming further comprises instructions to determine a second group of TPs to assign to the logical entity, wherein the at least one of the TPs in the first and second groups do not belong to both groups.

5 One aspect of the embodiment further includes instructions to remove a TP from the logical entity in response to an indication of the TP being disabled or powered down.

One aspect of the embodiment ,the logical entity provides wireless access for a coverage area that is larger than the coverage area for a single TP.

10 One aspect of the embodiment further includes: the logical entity ID is a first logical entity ID, wherein the group comprises a first group, and wherein the programming further comprises instructions to send a second logical entity ID to the UE when the UE travels out of a coverage area for the first logical entity and into a coverage area for the second logical entity, wherein the second logical entity comprises at least one non-overlapping coverage area with the first logical entity.

15 One aspect of the embodiment further includes instructions to send control and/or data to the UE through a UE-centric channel.

One aspect of the embodiment further includes instructions to assign one of the TPs in the group to provide downlink radio access to the UE.

20 One aspect of the embodiment, the one of the TPs in the group assigned to provide radio access to the UE is determined according to relative signal strength of the UE at each of the TPs in the group.

One aspect of the embodiment, the TPs comprise physical TPs.

[0062] One embodiment provides a method in a wireless device for non-cellular wireless access, which includes: receiving a logical entity identifier (ID) from at least one transmit
25 point (TP) in a radio access network, wherein the logical ID identifies a logical entity in the radio access network, wherein the logical entity comprises a plurality of TPs; and determining a dedicated connection ID according to a wireless device ID and the logical entity ID, wherein the wireless device sends signals to and receives signals from the radio access network using the dedicated connection ID regardless of which one or more TPs
30 within the logical entity is serving the wireless device.

One aspect of the embodiment, the logical entity ID is a first logical entity ID, the logical entity is a first logical entity, the plurality of TPs is a first plurality of TPs, and further comprising: receiving a second logical entity ID when the wireless device moves into an area covered by the second logical entity; and determining a second dedicated connection ID

5 according to the wireless device ID and the second logical entity ID, wherein the wireless device sends signals to and receives signals from the radio access network using the second dedicated connection ID.

[0063] One embodiment provides a method of supporting a connection between a user equipment (UE) and a wireless network having a plurality of transmit points (TPs) assigned to membership in a hyper cell associated with the UE for provision of wireless access to the wireless network, which includes: receiving an indication that the membership of the hyper cell should be changed; modifying the membership of the hyper cell in accordance with the received indication; and transmitting a notification of a change in the membership in the hyper cell to a TP associated with the modification.

15 One aspect of the embodiment, the step of modifying includes: identifying a TP that is not associated with the hyper cell; and adding the identified TP to the membership of the hyper cell.

One aspect of the embodiment, the step of transmitting includes transmitting an identifier associated with the hyper cell to the identified TP.

20 One aspect of the embodiment, the step of modifying includes: identifying a TP that is associated with the hyper cell; and removing the identified TP from the membership of the hyper cell.

One aspect of the embodiment, the step of receiving an indication includes receiving an indication that the UE is moving relative to a topology of the wireless network.

25 One aspect of the embodiment, the step of receiving an indication includes receiving an indication that a TP in the plurality of TPs assigned to membership in the hyper cell is scheduled for an operations and maintenance function.

5 One aspect of the embodiment, a subset of the TPs in the plurality of TPs are used to provide the UE access to the wireless network.

[0064] It should also be understood that although the above described methods allow for an elastic hyper cell which can be used to eliminate handovers, it is also possible for a network to make use of the elastic hyper cell, but to also define boundaries that will result in the UE needing to be
10 handed over to a new hyper cell. Such a transfer may require handover processes, and the resulting network would still have a somewhat cellular nature.

[0065] While this invention has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications and combinations of the illustrative embodiments, as well as other embodiments of the invention, will be
15 apparent to persons skilled in the art upon reference to the description. It is therefore intended that the appended claims encompass any such modifications or embodiments.

Claims

1. A method in a wireless device for non-cellular wireless access, comprising:
 - receiving a logical entity identifier (ID) allocated by a controller in a radio access network, wherein the logical entity ID identifies a logical entity covering a group of transmit point (TPs) which are not associated with a cell; and
 - communicating with a TP in the logical entity based on the logical entity ID.
2. The method of claim 1, wherein the logical entity ID is independent with a cell.
3. The method of claim 1, further comprising:
 - obtaining a dedicated connection ID according to a wireless device ID and the logical entity ID; and
 - communicating with the TP in the logical entity based on the dedicated connection ID.
4. The method of claim 3, wherein the dedicated connection ID is unique in the area of the logical entity.
5. The method of claim 3, wherein the obtaining a dedicated connection ID further comprises:
 - receiving the dedicated connection ID from the controller; or
 - generating the dedicated connection ID based on the wireless device ID and the logical entity ID.
6. The method of claim 1, wherein the receiving a logical entity ID allocated by a controller comprises:
 - receiving the logical entity ID from the controller; or
 - receiving the logical entity ID from at least one TP in the group of TPs.
7. The method of claim 1, wherein the logical entity ID is a first logical entity ID, the logical entity is a first logical entity, the group of TPs is a first group of TPs, and further comprising:
 - receiving a second logical entity ID when the wireless device moves into an area covered by a second logical entity, the second logical entity ID identifies the second logical entity covering a second group of TPs which are not associated with a cell; and

communicating with a TP in the second logical entity based on the second logical entity ID.

8. The method of claim 7, further comprising:

obtaining a second dedicated connection ID according to a wireless device ID and the second logical entity ID; and

communicating with the TP in the second logical entity based on the second dedicated connection ID.

9. A method in a wireless device for non-cellular wireless access, comprising:

receiving, by a transit point (TP) in a radio access network, a logical entity identifier (ID), wherein the logical entity ID identifies a logical entity covering a group of transmit point (TPs) which are not associated with a cell; and

communicating with a wireless device in the logical entity based on the logical entity ID.

10. The method of claim 9, wherein the logical entity ID is independent with a cell.

11. The method of claim 9, further comprising:

sending a dedicated connection ID to the wireless device, wherein the dedicated connection ID is related to a wireless device ID and the logical entity ID; and

communicating with the wireless device in the logical entity based on the dedicated connection ID.

12. The method of claim 9, wherein the logical entity ID is a first logical entity ID, the logical entity is a first logical entity, the group of TPs is a first group of TPs, and further comprising:

receiving, by the transit point (TP), a second logical entity ID, wherein the second logical entity ID identifies a second logical entity covering a second group of TPs which are not associated with a cell, wherein at least one of the TPs in the first group does not also belong to the second group or at least one of TPs in the second group does not also belong to the first group.

13. A user equipment (UE) for non-cellular based radio access in a radio access network, comprising:

a processor; and

a non-transitory computer readable storage medium storing programming for execution by the processor, the programming including instructions for:

receiving a logical entity identifier (ID) allocated by a controller in a radio access network, wherein the logical entity ID identifies a logical entity covering a group of transmit point (TPs) which are not associated with a cell; and

communicating with one of the TPs in the logical entity based on the logical entity ID.

14. The UE of claim 13, wherein the logical entity ID is independent with a cell.

15. The UE of claim 13, the programming further comprising:

instructions for obtaining a dedicated connection ID according to a wireless device ID and the logical entity ID; and

instructions for communicating with the TP in the logical entity based on the dedicated connection ID.

16. The UE of claim 15, wherein the dedicated connection ID is unique in the area of the logical entity.

17. A transmit point (TP) in a radio access network for non-cellular wireless access, comprising:

a processor; and

a non-transitory computer readable storage medium storing programming for execution by the processor, the programming including instructions for:

receiving a logical entity identifier (ID), wherein the logical entity ID identifies a logical entity covering a group of transmit point (TPs) which are not associated with a cell; and

communicating with a wireless device in the logical entity based on the logical entity ID.

18. The TP of claim 17, wherein the logical entity ID is independent with a cell.
19. The TP of claim 17, the programming further comprising instructions for:
sending a dedicated connection ID to the wireless device, wherein the dedicated connection ID is related to a wireless device ID and the logical entity ID; and
communicating with the wireless device in the logical entity based on the dedicated connection ID.
20. The TP of claim 17, wherein the logical entity ID is a first logical entity ID, the logical entity is a first logical entity, the group of TPs is a first group of TPs, and the programming further comprising instructions for:
receiving a second logical entity ID, wherein the second logical entity ID identifies a second logical entity covering a second group of TPs which are not associated with a cell, wherein at least one of the TPs in the first group does not also belong to the second group or at least one of TPs in the second group does not a