APPARATUS, METHOD, AND COMPUTER PROGRAM

Field of the disclosure

The present disclosure relates to an apparatus, a method, and a computer program and in particular but not exclusively for apparatus, methods and computer programs for use in packet duplication scenarios.

Background

A communication system can be seen as a facility that enables communication sessions between two or more entities such as communication devices, base stations/access points and/or other nodes by providing carriers between the various entities involved in the communications path. A communication system can be provided for example by means of a communication network and one or more compatible communications devices.

Access to the communication system may be via an appropriate communications device or terminal. A communications device is provided with an appropriate signal receiving and transmitting apparatus for enabling communications, for example enabling access to a communication network or communications directly with other communications device. The communications device may access a carrier provided by a station or access point, and transmit and/or receive communications on the carrier.

The communication system and associated devices typically operate in accordance with a given standard or specification which sets out what the various entities associated with the system are permitted to do and how that should be achieved.

Summary

According to an aspect, the present disclosure refers to a communications device comprising at least one processor and at least one memory including computer code

for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the communications device at least to: determine that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and determine an allocation of one or more cells associated with the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.

According to another aspect, the present disclosure refers to a communications device, comprising means for: determining that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and determining an allocation of one or more cells associated with the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.

According to another aspect, the present disclosure refers to a method performed by a communications device, said method comprising: determining that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and determining an allocation of one or more cells associated with the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.

According to another aspect, the present disclosure refers to a non-transitory computer readable medium comprising program instructions stored thereon which when run on at least one processor cause performing of the method of: determining that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and determining an allocation of one or more cells associated with

the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.

According to another aspect, the present disclosure refers to a computer program comprising computer executable code which, when run on at least one processor cause performing of the method of: determining that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and determining an allocation of one or more cells associated with the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.

According to an ~~aspect~~example, there is provided an apparatus provided in a communications device, said apparatus comprising at least one processor and at least one memory including computer code for one or more programs, the at least

The at least one memory and the computer program code may be configured to, with the at least one processor, cause the apparatus at least to receive information indicating that at least one of a plurality of logical channels configured for packet duplication is to be deactivated and in response thereto determine that the respective logical channel is to be deactivated.

A communications device comprising the apparatus as previously described may be provided.

According to an ~~aspect~~example, there is provided an apparatus provided in a communications device, said apparatus comprising means for: determining that at least one of a plurality of logical channels configured for packet duplication is to be deactivated; and determining an allocation of one or more cells associated with the at least one deactivated logical channel to one or more active logical channels of said plurality of logical channels configured for packet duplication.

The active logical channel may be associated with an active radio link control entity.

The active logical channel may be associated with an active leg.

The means may be for determining the allocation using one or more preconfigured rules.

The means may be for receiving the one or more preconfigured rules from a base station.

The means may be for allocating the one or more cells associated with the deactivated logical channel to a primary logical channel of the plurality of logical channels configured for packet duplication.

The means may be for allocating the one or more cells associated with the deactivated logical channel to one or more active logical channels in dependence on a logical channel index of at least one of said plurality of logical channels configured for packet duplication.

The means may for be for allocating the one or more cells associated with the deactivated logical channel to an active logical channel associated with a same cell group as the deactivated logical channel.

The means may be for receiving information indicating that one or more of the deactivated logical channels is to be activated and reallocating the one or more cells previously associated with that respective logical channel to that respective logical channel.

The means may be for receiving information indicating that at least one of a plurality of logical channels configured for packet duplication is to be deactivated and in response thereto determine that the respective logical channel is to be deactivated.

The means may be provided at least partially by circuitry.

A communications device comprising the apparatus as previously described may be provided.

According to an exampleaspect, there is provided an apparatus provided in a communications device, said apparatus comprising: circuitry for determining that at least one of a plurality of logical channels configured for packet duplication is to be deactivated; and circuitry for determining an allocation of one or more cells associated with the at least one deactivated logical channel to one or more active logical channels of said plurality of logical channels configured for packet duplication.

According to an exampleaspect, there is provided a method performed by an apparatus provided in a communications device, said method comprising: determining that at least one of a plurality of logical channels configured for packet duplication is to be deactivated; and determining an allocation of one or more cells associated with the at least one deactivated logical channel to one or more active logical channels of said plurality of logical channels configured for packet duplication.

The active logical channel may be associated with an active radio link control entity.

an active logical channel associated with a lowest number of carriers.

The method may comprise allocating the one or more or more cells associated with the deactivated logical channel to an active logical channel associated with most number of carriers.

The method may comprise allocating the one or more or more cells associated with the deactivated logical channel to an active logical channel associated with a lowest number of carriers.

The method may comprise allocating the one or more or more cells associated with the deactivated logical channel to one or more active logical channels in dependence one or more of the following: the logical channel priority; the prioritized bit rate; and the channel access priority class.

The method may comprise for allocating the one or more cells associated with the deactivated logical channel to an active logical channel associated with a same cell group as the deactivated logical channel.

The method may comprise receiving information indicating that one or more of the deactivated logical channels is to be activated and reallocating the one or more cells previously associated with that respective logical channel to that respective logical channel.

The method may comprise receiving information indicating that at least one of a plurality of logical channels configured for packet duplication is to be deactivated and in response thereto determine that the respective logical channel is to be deactivated.

According to an example, ~~aspect~~ there is provided a computer program comprising computer executable code which when run on at least one processor is configured to cause any of the previously described methods to be performed.

According to an exampleaspect, there is provided a computer readable medium comprising program instructions stored thereon for performing at least one of the above methods.

According to an exampleaspect, there is provided a non-transitory computer readable medium comprising program instructions stored thereon for performing at least one of the above methods.

According to an exampleaspect, there is provided a non-volatile tangible memory medium comprising program instructions stored thereon for performing at least one of the above methods.

In the above, many different aspects have been described. It should be appreciated that further aspects may be provided by the combination of any two or more of the aspects described above.

Various other aspects are also described in the following detailed description and in the attached claims.

Brief Description of the Figures

Embodiments will now be described, by way of example only, with reference to the accompanying Figures in which:

Figure 1 shows a schematic diagram of an example communication system comprising a plurality of base stations and a communication device;

Figure 2 shows a schematic diagram of an example mobile communication device;

Figure 3 shows a schematic diagram of an example apparatus provided in a base station;

WHAT IS CLAIMED IS:

1. A communications device, ~~n apparatus provided in a communications device, said apparatus~~ comprising at least one processor and at least one memory including computer code for one or more programs, the at least one memory and the computer code configured, with the at least one processor, to cause the ~~apparatus~~ communications device at least to:

determine that at least one of a plurality of logical channels ~~configured~~ activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and

determine an allocation of one or more cells associated with the at least one deactivated logical channel for use by~~to~~ one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

2. The communications device ~~apparatus~~ as claimed in claim 1, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus at least~~further to:

determine the allocation using one or more preconfigured rules.

3. The communications device ~~apparatus~~ as claimed in any preceding claim, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus at least~~further to:

receive the one or more preconfigured rules from a base station.

4. The communications device ~~apparatus~~ as claimed in any preceding claim, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel ~~to~~ for use by a primary logical channel of the plurality of logical channels configured for packet duplication.

5. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a logical channel index of at least one of said plurality of logical channels ~~configured for packet duplication~~.

6. The communications device ~~apparatus~~ as claimed in claim in any of claims 1 to 3 or 5, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel for use by~~to~~:

an active logical channel with a highest logical channel index;

an active logical channel with a lowest logical channel index;

an active logical channel with a next highest logical channel index to that of the deactivated logical channel; or

an active logical channel with a next lowest logical channel index to that of the deactivated logical channel.

7. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on activity associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

8. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3 or 7, wherein the at least one memory and the computer program code are configured to,

with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more or more cells associated with the deactivated logical channel for use by~~to~~:

an active logical channel associated with a most queued buffer;

an active logical channel associated with a least queued buffer;

an active logical channel associated with a highest sequence number of a packet; or

an active logical channel associated with a lowest sequence number of a packet.

9. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a predefined mapping between said logical channels.

10. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a number of cells associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

11. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3 or 10, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

~~-~~allocate the one or more or more cells associated with the deactivated logical channel for use by~~to~~:

an active logical channel associated with highest number of allowed cells; or
an active logical channel associated with a lowest number of allowed cells

12. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a number of carriers in a given band associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

13. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3 or 12, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more or more cells associated with the deactivated logical channel for use by~~to~~:

an active logical channel associated with most number of carriers; or
an active logical channel associated with a lowest number of carriers.~~/~~

14. The communications device ~~apparatus~~ as claimed in any of claims 1 to 3, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence one or more of the following: the logical channel priority; the prioritized bit rate; and the channel access priority class.

15. The communications device ~~apparatus~~ as claimed in any preceding claim, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus~~ further ~~at least~~ to:

allocate the one or more cells associated with the deactivated logical channel ~~to~~ for use by an active logical channel associated with a same cell group as the deactivated logical channel.

16. The communications device ~~apparatus~~ as claimed in any preceding claim, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus at least~~further to:

receive information indicating that ~~one~~ a certain logical channel ~~or more~~ of the at least one deactivated logical channel~~s~~ is to be re-activated; ~~and~~

re-allocate the one or more cells for use by the certain logical channel, wherein the re-allocated one or more cells were associated with the certain logical channel before its deactivation; and~~reallocating the one or more cells previously associated with that respective logical channel to that respective logical channel.~~

remove the re-allocated one or more cells from use by the one or more active logical channels for which the re-allocated one or more cells had been allocated upon deactivation of the certain logical channel.

17. The communications device ~~apparatus~~ as claimed in any preceding claim, wherein the at least one memory and the computer program code are configured to, with the at least one processor, cause the communications device ~~apparatus at least~~further to:

receive information indicating that at least one of a plurality of logical channels configured for packet duplication is to be deactivated; and ~~in response thereto~~

determine that the respective logical channel is to be deactivated based on the received information.

18. The communications device as claimed in any preceding claim, wherein the packet duplication comprises a dual connectivity based packet duplication and a carrier aggregation based packet duplication in each of at least two cell groups for the dual connectivity based packet duplication.

19. The communications device as claimed in any preceding claim, wherein the at least one deactivated logical channel is associated with a secondary cell group.

20. The communications device as claimed in any preceding claim, wherein the communications device is a user equipment.

~~18~~21. A~~n apparatus provided in a~~ communications device, ~~said apparatus~~ comprising means for:

determining that at least one of a plurality of logical channels ~~configured~~ activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and

determining an allocation of one or more cells associated with the at least one deactivated logical channel ~~to~~ for use by one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

~~19~~22. A method performed by ~~an apparatus provided in~~ a communications device, said method comprising:

determining that at least one of a plurality of logical channels ~~configured~~ activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and

determining an allocation of one or more cells associated with the at least one deactivated logical channel ~~to~~ for use by one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

~~20~~23. The method as claimed in claim ~~19~~22, comprising receiving the one or more preconfigured rules from a base station.

~~21~~24. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more cells associated with the deactivated logical channel for use by ~~to~~ a primary logical channel of the plurality of logical channels ~~configured for packet duplication~~.

~~22~~25. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more

active logical channels in dependence on a logical channel index of at least one of said plurality of logical channels ~~configured for packet duplication~~.

~~23~~26. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on activity associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

~~24~~27. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a predefined mapping between said logical channels.

28~~25~~. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a number of cells associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

~~26~~29. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence on a number of carriers in a given band associated with one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

~~27~~30. The method as claimed in claim ~~19~~ 22 or ~~20~~23, comprising allocating the one or more or more cells associated with the deactivated logical channel for use by ~~to~~ one or more active logical channels in dependence one or more of the following: the logical channel priority; the prioritized bit rate; and the channel access priority class.

~~28~~31. The method as claimed in any of claims ~~19~~ 22 to ~~27~~30, comprising allocating the one or more cells associated with the deactivated logical channel for use by ~~to~~ an active logical channel associated with a same cell group as the deactivated logical channel.

~~29~~32. The method as claimed in any of claims ~~19~~ 22 to ~~28~~31, comprising receiving information indicating that a certain logical channel ~~one or more~~ of the at least one deactivated logical channel~~s~~ is to be re-activated; ~~and~~ reallocating the one or more cells for use by the certain logical channel, wherein the re-allocated one or more cells were associated with the certain logical channel before its deactivation; and removing the re-allocated one or more cells from use by the one or more active logical channels for which the re-allocated one or more cells had been allocated upon deactivation of the certain logical channel~~previously associated with that respective logical channel to that respective logical channel~~.

~~30~~33. The method as claimed in any of claims ~~19~~ 22 to ~~29~~32, comprising receiving information indicating that at least one of a plurality of logical channels configured for packet duplication is to be deactivated and ~~in response thereto~~ determine that the respective logical channel is to be deactivated based on the received information.

34. The method as claimed in any of claims 22 to 33, wherein the packet duplication comprises a dual connectivity based packet duplication and a carrier aggregation based packet duplication in each of at least two cell groups for the dual connectivity based packet duplication.

35. The method as claimed in any of claims 22 to 34, wherein the at least one deactivated logical channel is associated with a secondary cell group.

~~31~~36. A non-transitory computer readable medium comprising program instructions stored thereon which when run on at least one processor cause performing of the method of:

determining that at least one of a plurality of logical channels ~~configured~~ activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and

determining an allocation of one or more cells associated with the at least one deactivated logical channel for use by ~~to~~ one or more active logical channels of said plurality of logical channels ~~configured for packet duplication~~.

37. A computer program comprising computer executable code which, when run on at least one processor cause performing of the method of:

determining that at least one of a plurality of logical channels activated for packet duplication is to be deactivated, wherein at least two of the plurality of logical channels remain active for the packet duplication after deactivation of the at least one of the plurality of logical channels; and

determining an allocation of one or more cells associated with the at least one deactivated logical channel for use by one or more active logical channels of said plurality of logical channels.