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3GPP Draft; R1-2007525, vol. RAN WG1, no. e-Meeting; 20201026 - 20201113, 2020, RAN2, "LS on cell-grouping UE capability for synchronous NR-DC".
3GPP Draft; R2-2010029, vol. RAN WG2, no. Electronic meeting; 20201102 - 20201113, 2020, Ericsson, "Cell group filtering for NR-DC".

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(54) Title of the Invention: **Improvements in and relating to dual connectivity in a telecommunication network**
Abstract Title: **Managing capability reporting by a User Equipment in a network configured for Dual Connectivity**

(57) Capability filtering for capability reporting by a UE in response to a capability enquiry from a base station of a network configured for Dual Connectivity, DC. Network controls the cell grouping information the UE includes in its capability report. Network controls the cell grouping by including in its enquiry: a) field indicating the UE shall include cell grouping for asynchronous DC, b) field indicating the UE is allowed to include cell grouping for asynchronous DC other than 'R15' grouping and 'any grouping', c) field indicating the UE shall include cell grouping for synchronous DC, or d) field indicating the UE is allowed to include cell grouping for synchronous DC other than 'R15' grouping and 'any grouping'. Also disclosed is a BS sending to the UE a capability enquiry comprising a first set of bands, the UE replying to indicate it supports more than a predefined number of bands. Further disclosure includes a network including in a UE capability enquiry a band list comprising more than a predefined number of bands and the UE replying with one of the predefined messages. Also, the UE is arranged to report its capability to the network in a Release format (RN).

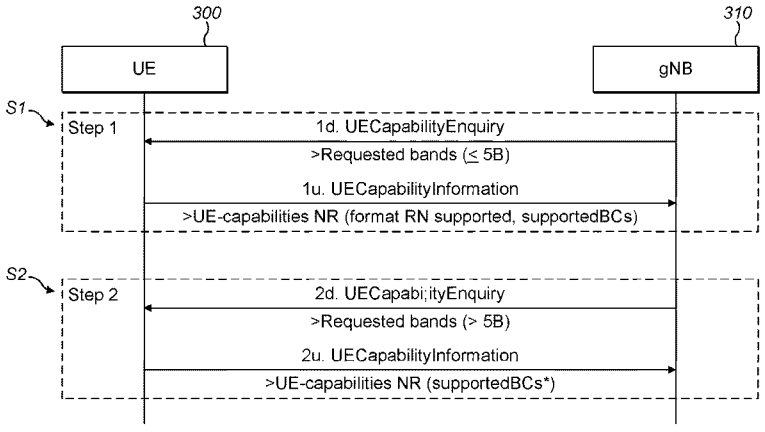

FIG. 4

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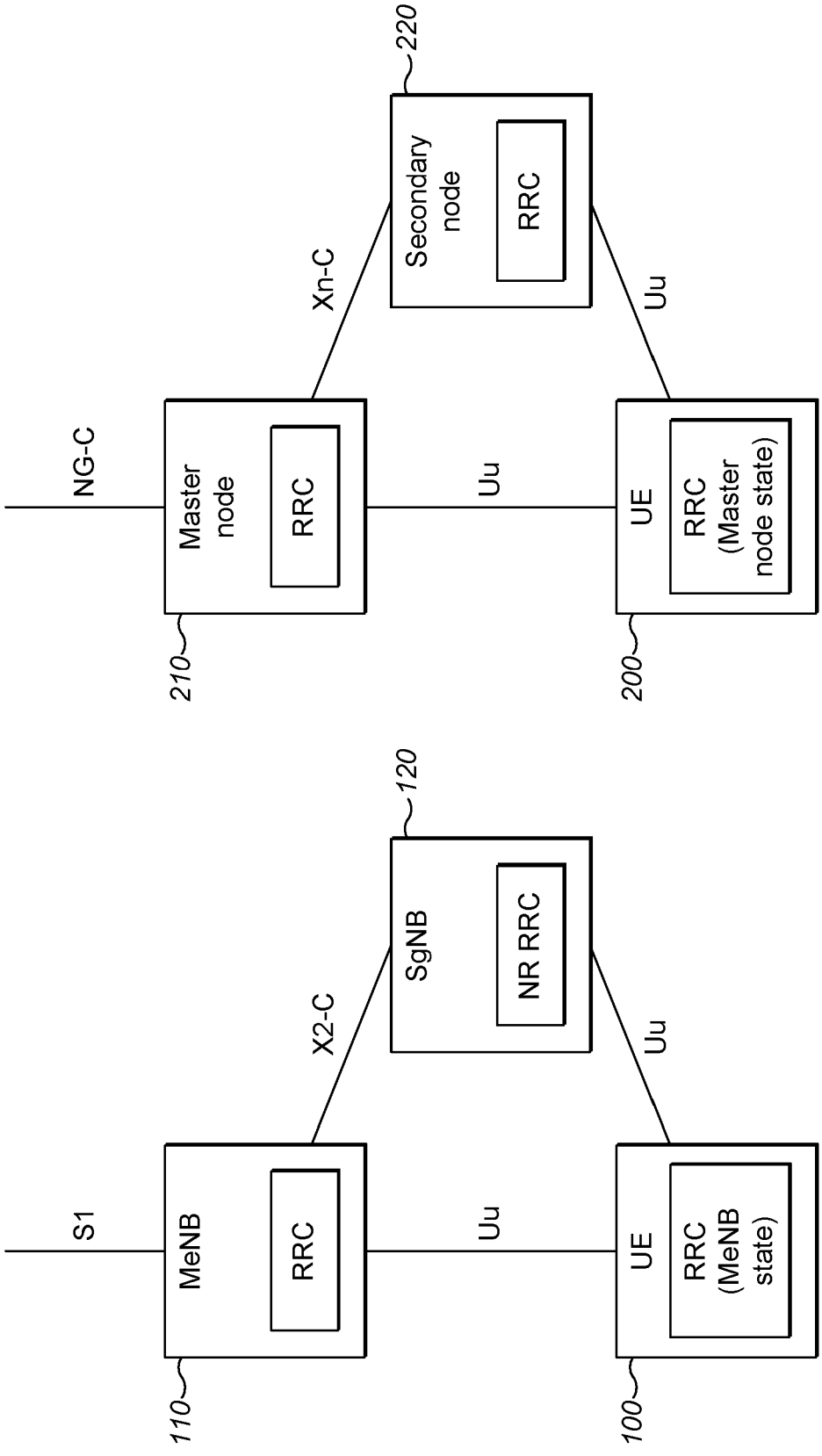
S1
MeNB
RRC
110
X2-C
SgNB
NR RRC
120
Uu
UE
RRC (MeNB state)
100
NG-C
Master node
RRC
210
Xn-C
Secondary node
RRC
220
Uu
UE
RRC (Master node state)
200

FIG. 1

```
CA-ParametersNRDC-v16xy ::= SEQUENCE {
    cellGroupingSync-r16            CHOICE {
          anyGrouping                    NULL,
          twoBands-r16                   BIT STRING (SIZE(2)),
          threeBands-r16                 BIT STRING (SIZE (6)),
          fourBands-r16                  BIT STRING (SIZE (14)),
          fiveBands-r16                  BIT STRING (SIZE (30))
    }                                                              OPTIONAL,
    cellGroupingASync-r16           CHOICE {
          sameAsSync                     NULL,
          twoBands-r16                   BIT STRING (SIZE(2)),
          threeBands-r16                 BIT STRING (SIZE (6)),
          fourBands-r16                  BIT STRING (SIZE (14)),
          fiveBands-r16                  BIT STRING (SIZE (30))
    }                                                              OPTIONAL
}
```

FIG. 2

Nr of Frequency Bands:	5	4	3	2
Length of Bit-String:	30	14	6	2
Bit String Position	Cell grouping option (0=MCG,1=SCG)			
1	00001	0001	001	01
2	00010	0010	010	10
3	00011	0011	011	
4	00100	0100	100	
5	00101	0101	101	
6	00110	0110	110	
7	00111	0111		
8	01000	1000		
9	01001	1001		
10	01010	1010		
11	01011	1011		
12	01100	1100		
13	01101	1101		
14	01110	1110		
15	01111			
16	10000			
17	10001			
18	10010			
19	10011			
20	10100			
21	10101			
22	10110			
23	10111			
24	11000			
25	11001			
26	11010			
27	11011			
28	11100			
29	11101			
30	11110			

FIG. 3

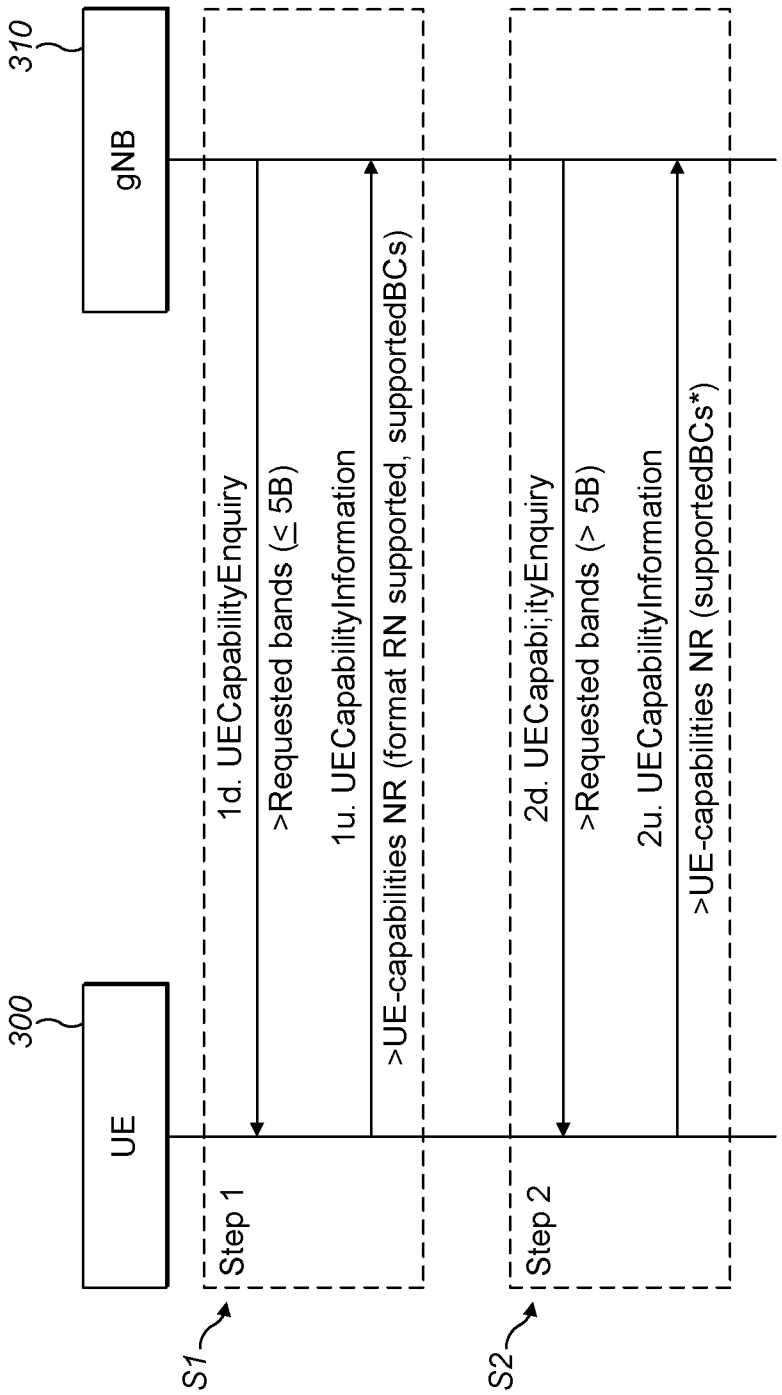
310
gNB
300
UE
1d. UECapabilityEnquiry
>Requested bands (≤ 5B)
1u. UECapabilityInformation
>UE-capabilities NR (format RN supported, supportedBCs)
2d. UECapabi;ityEnquiry
>Requested bands (> 5B)
2u. UECapabilityInformation
>UE-capabilities NR (supportedBCs*)
Step 1
Step 2
S1
S2

FIG. 4

```
UE-CapabilityRequestFilterCommon ::=  SEQUENCE {
    mrdc-Request                      SEQUENCE {
        omitEN-DC                     ENUMERATED {true} OPTIONAL, -- Need N

-- Irrelevant parts omitted
    ...,

    [[
    codebookTypeRequest-r16           SEQUENCE {

-- Irrelevant parts omitted

        type1-SinglePanel-r16         ENUMERATED {true} OPTIONAL,
    }                                                   OPTIONAL, -- Need N

    uplinkTxSwitchRequest-r16         ENUMERATED {true} OPTIONAL  -- Need N
    [[
    dc-CellGroupingRequestAsync-r16   ENUMERATED {true} OPTIONAL  -- Need N
    ]],
    ]]
}
```

FIG. 5

Improvements in and relating to Dual Connectivity in a telecommunication network

The present invention relates to dual connectivity in a telecommunication network. Dual Connectivity, DC, can take different forms, but it typically involves a User Equipment, UE, being simultaneously connected to at least two different nodes in a network. Such an arrangement poses certain difficulties in terms of network configuration and planning.

In cases where a UE is configured with Dual Connectivity, the UE is connected via a Master Cell Group (MCG) to a Master Node (MN) and a Secondary Cell Group (SCG) to a Secondary node (SN). Each node sets the parameters of the cell group it controls, but the nodes interact to ensure that UE capabilities are respected. This is needed, as what the UE can support for the SCG may depend on what is configured for the MCG. As an example, such coordination is needed to ensure that the nodes, together, configure a Band Combination, BC, in accordance with UE capabilities.

There are several different cases of Dual Connectivity, including cases in which the MCG and the SCG use a different Radio Access Technology, RAT. For instance, the UE can be configured with an MCG using Long Term Evolution, LTE, known as 4G, and an SCG using New Radio, NR' known as 5G. This invention in particular addresses DC cases for which one of the cell groups uses NR. The general term Multi RAT Dual Connectivity, MR-DC, is herein used to refer to these DC cases. This is meant to include the case of NR DC i.e. with both MCG and SCG using NR. 3GPP specification TS 37.340 provides a general description of this and Figure 1 shows the control plane architecture for EN-DC (left) and MR-DC with a 5G core (right). In each case, it shows a UE 100, 200 connected to a Master eNB 110 or Master Node 210, as well as a Secondary gNB 120 or Secondary Node 220. The various interface names are also shown.

The UE signals its capabilities to the network. In case of MR-DC, with the MCG using LTE and the SCG using NR (referred to as EN-DC) or vice versa (i.e. the MCG using NR and the SCG using LTE, referred to as NE-DC), the UE signals its capabilities by 3 different parts:

a) LTE capabilities, that are used by the LTE eNB
b) NR capabilities, that are used by the NR gNB
c) MR-DC capabilities, that are used by both LTE eNB and NR gNB

As the signalling associated with UE capabilities can be quite large i.e. require a substantial amount of data, methods have been defined to reduce the size. One such option is that the UE omits band combinations that are fallbacks from another band combination that is included in the UE capabilities. A fallback BC is defined in 3GPP TS 38.306:

"Fallback band combination: A band combination that would result from another band combination by releasing at least one SCell or uplink configuration of SCell, or SCG. An intra-band non-contiguous band combination is not considered to be a fallback band combination of an intra-band contiguous band combination."

One of the UE capabilities relevant for operation in MR-DC concerns the grouping of cells i.e. which cells part of the BC the UE can support in a particular cell group. For the case of NR DC, it has been agreed to introduce signalling similar to what is defined in LTE, although there are some differences:

- A UE only supporting Release 15, R15, of the applicable standard, will not signal any cell group capabilities. It will only support synchronous DC, and for each supported BC, the UE supports the MCG comprising any cell using a band of the BC that is in Frequency Range 1, FR1, and the SCG comprising any cell using a band of the BC that is in Frequency Range 2, FR2.

- A UE supporting Release 16, R16, of the applicable standard, can indicate the additional cell grouping options it supports for synchronous DC, as follows:

    - o the UE can indicate it supports any grouping
    - o the UE can signal a bitmap, similar to the one used in LTE, but with some differences:
        - a) A bit of the bitmap corresponds to a band rather than a band-entry, with a maximum of 5 bands
        - b) the UE can separately indicate which grouping it supports for MCG and SCG

- An R16 UE that supports asynchronous DC can, for each BC, indicate whether it supports:

    - o Cell groupings as defined for synchronous DC in R15 (MCG in FR1 and SCG in FR2) i.e. by absence of cell grouping signalling
    - o The same cell grouping as for synchronous DC

- o Cell grouping as indicated by a bitmap, the same as for synchronous DC (see above)

The solution adopted by RAN2 involves changes that are covered by the following Change Requests, CRs:

- R2-2102210: 38.331 CR#2472 Introduction of Cell Grouping UE capability for NR-DC
- R2-2102211: 38.306 CR#0540 Introduction of Cell Grouping UE capability for NR-DC

The main change introduced by CR#2472 concerns an extension of CA-ParametersNRDC, as shown in Figure 2, which shows an ASN.1 extract which introduces cell grouping signalling. This illustrates the changes required in order to implement an embodiment of the invention.

The main change introduced by CR#0540 concerns specification of the use of the bit strings as shown in Figure 3, which shows an extract for the referenced CR which relates to cell grouping and bit string usage. Note that the mapping of serving cells to cell groups (i.e. MCG or SCG), as indicated by cellGroupingSync-r16 and cellGroupingAsync-r16, is shown in this table.

A cell grouping option is represented by a number of bits, where the left-most bit corresponds to the frequency band listed first in the band combination, etc.

Value 0 indicates that the carriers of the corresponding frequency band are mapped to MCG, while value 1 indicates that the carriers of the corresponding frequency band are mapped to SCG.

The leading/leftmost bit of cellGroupingSync-r16 and cellGroupingAsync-r16 respectively corresponds to the Bit String Position 1.

At present, the aforementioned CRs are not yet fully agreed but have been endorsed by the standards body in question.

Before the above described solution was adopted, there was some debate, as the cell grouping signalling could result in some appreciable additional signalling overhead, in particular for BCs involving a larger number of cells. These concerns were at least partly addressed by restricting implementation such that all cells in the same band are part of same cell group, so that a bit of the bitmap can represent a band rather than a band entry. Nevertheless, suggestions were made of other options with less granularity (e.g. re-using the PUCCH cell grouping) that would particularly be needed for BCs involving a large number of bands e.g. beyond 5 bands (referred to as >5B BCs in the following).

Given the ongoing discussions, it may be expected that other cell grouping signalling options may be introduced in a future release, RN, of the specification. Herein, this will be referred to as the RN format.

So far, only NR DC BCs comprising of at most 4 bands are defined. However, further BCs involving a higher number of bands may be introduced in the future. Moreover, these may be introduced in a release independent manner.

It is currently not clear whether in such case the UE capability reporting operations will be modified or not. It seems preferable if the UE capability reporting procedures introduced in R16 are defined, considering that BCs involving more than 5 bands will be introduced in the future.

The cell group signalling introduced in R16 can be used for >5B BCs, but the grouping options that the UE can indicate are limited (as the bitmap format does not support >5B BCs):

- For synchronous DC, the UE can indicate that it supports
  a) R15 grouping (i.e. by absence of per BC signalling) and
  b) Any grouping

- For asynchronous DC, the UE can similarly indicate it supports
  a) R15 grouping (i.e. by absence of per BC signalling) and
  b) Any grouping (i.e. by indicating same as synchronous DC, while indicating support of any grouping for synchronous DC)

It is currently however unclear whether R16 UE is allowed to indicate it supports >5B BCs using the above options.

It is an aim of embodiments of the present invention to address shortcomings and problems in the prior art, whether mentioned herein or not.

According to the present invention there is provided an apparatus and method as set forth in the appended claims. Other features of the invention will be apparent from the dependent claims, and the description which follows.

According to a first aspect of the present invention, there is provided a method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein a base station of the network sends to the UE a capability enquiry comprising a first set of bands, the UE replies, with a first reply to the base station to

indicate that it supports more than a predefined number of bands if it is capable of doing so and the base stations sends a further request to the UE with a second set of bands, including details of the more than the predefined number of bands and the UE replies with a second reply including the requested information.

According to a second aspect of the present invention, there is provided a method of capability filtering for capability reporting by a UE in response to a capability enquiry from a base station of a telecommunication network, in a telecommunication network configured for Dual Connectivity, DC, ,wherein the telecommunication network controls cell grouping information that the UE includes in its capability report, wherein the network controls the cell grouping information by including in its enquiry one or more of:

a) a field indicating whether the UE shall include cell grouping for asynchronous DC;

b) a field indicating whether the UE is allowed to include cell grouping for asynchronous DC other than 'R15 grouping' and 'any grouping';

c) a field indicating whether the UE shall include cell grouping for synchronous DC; and

d) a field indicating whether the UE is allowed to include cell grouping for synchronous DC other than 'R15 grouping' and 'any grouping'.

According to a third aspect of the present invention, there is provided a method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein the telecommunication network includes in a UE capability enquiry, a band list comprising more than a predefined number of band and the UE replies to the capability enquiry with one of the following messages:

a) the UE reply does not include any BCs with more than the predefined number of bands;

b) the UE reply only includes BCs with more than the predefined number of bands, for which it supports R15 grouping (MCG in FR1 and SCG in FR2);

c) the UE reply only includes BCs with more than the predefined number of bands, for which cell grouping can be indicated by R16 UE capability signalling, including:

i) BCs for which the supports R15 grouping (MCG in FR1 and SCG in FR2); and

ii) BCs for which the UE supports any cell grouping.

According to a fourth aspect of the present invention, there is provided a method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for

Dual Connectivity, DC, wherein the UE is arranged to report its capability in RN format, supporting cell grouping, whereby the UE reports BCs using RN format for one of:

1) BCs with more than the predefined number of bands;
2) Any BC; and
3) Specific BCs, in accordance with network control.

According to a fifth aspect of the present invention, there is provided a method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein the telecommunication network includes in a capability enquiry to the UE one of:

a) a field indicating that the UE is allowed or requested to use RN format;

b) a field indicating that the UE is allowed or requested to use RN format for BCs having more than a predefined number of bands;

c) a field indicating that the UE is allowed or requested to use RN format for BCs having the predefined number of bands or less; and

d) a field indicating that the UE is allowed or requested to use RN format for specific BCs, including an indication of a particular criterion the the BC should meet in order to use RN format.

In an embodiment, for option d), the particular criterion includes one or more of:

a) the BC comprises specific bands as indicated by the network;

b) the BC comprises at least a certain number of bands; and

c) the BC comprises bands with specific properties, such as being a part of a particular frequency range.

According to a sixth aspect of the present invention, there is provided apparatus arranged to perform any one of the preceding aspects.

In an embodiment, the apparatus comprises at least one of a base station of a telecommunication network and a User Equipment.

Although a few preferred embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that various changes and modifications might be made without departing from the scope of the invention, as defined in the appended claims.

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example only, to the accompanying diagrammatic drawings in which:

Figure 1 shows a control plane architecture known in the prior art;

Figure 2 shows a modified ASN.1 extract related to an embodiment of the invention;

Figure 3 shows details of cell grouping bit string usage related to an embodiment of the invention;

Figure 4 shows a 2 step capability enquiry according to an embodiment of the present invention; and

Figure 5 shows an ASN.1 extract related to a UE capability filter related to an embodiment of the invention.

The following relates to capability reporting by R16 UE for >5B BCs. As indicated previously, it is not entirely clear what cell grouping capabilities a R16 UE would report when the network requests >5B BCs. A first option may be that network avoids this as follows.

In a first option, the network ensures that only UEs supporting the new RN format will report >5B BCs e.g. by setting a band filter including at most 5 bands.

The network option according to the previous implies that network can only request a UE to report >5B BCs when it knows that the UE supports the new format (RN format). In other words, a network interested to have UE capabilities for >5B BCs will have to use 2 steps:

1) A first UE capability enquiry, with limited number of bands listed, merely to find out whether the UE supports the new format

2) A second UE capability enquiry, in which network can set the band list to include the >5B BCs that it would like to know about

This is illustrated in Figure 4, which shows message exchanges between UE 300 and gNB 310. The two messages referred to above are designated S1 and S2, respectively.

Avoiding such a 2-step approach seems possible, but it requires that UE behaviour is defined as by the following second option.

The second option specifies UE capability reporting for a UE that supports:

- The cell grouping format as introduced in R16, referred to as R16 format, but not any further format as may be introduced in a future release RN of the specification (referred to as RN format) and

- Band combinations involving more than 5 bands (i.e. referred to as >5B BCs)

There are options for the UE capability reporting by a UE according to the second option when the network includes in the UE capability enquiry a band list including more than 5 bands:

a) the UE does not include any >5B BCs

b) the UE only includes >5B BCs for which it supports R15 grouping (MCG in FR1 and SCG in FR2)

c) the UE only includes >5B BCs for which cell grouping can be indicated by R16 UE capability signalling i.e. both

1. BCs for which it supports R15 grouping (MCG in FR1 and SCG in FR2)
2. BCs for which UE supports any cell grouping

The above may be reflected in the applicable standards in different ways, including the following options:

i) Adding statements in field description

ii) Adding procedural specification

An example of option i) for case c, immediately above, is shown below.

***CA-ParametersNRDC* field descriptions**
ca-ParametersNR-forDC (with and without suffix)   If this field is present for a band combination, it reports the UE capabilities when NR-DC is configured with the band combination. If no version of this field (i.e., with and without suffix) is present for a band combination, the *ca-ParametersNR* field versions (with and without suffix) in *BandCombination* are applicable to the UE configured with NR-DC for the band combination. UEs may include BCs comprising more than 5 bands for which it either supports all MCG cells in FR1 and all SCG cells in FR2 or any cell grouping.
featureSetCombinationDC   If this field is present for a band combination, it reports the feature set combination supported for the band combination when NR-DC is configured. If this field is absent for a band combination, the *featureSetCombination* in *BandCombination* (without suffix) is applicable to the UE configured with NR-DC for the band combination.

The statement above"UEs may include BCs comprising more than 5 bands for which it either supports all MCG cells in FR1 and all SCG cells in FR2 or any cell grouping" differentiates this from the known prior art definition.

The following relates to capability filtering for reporting by R16 UE. Even if the UE applies the R16 format for ≤5B BCs, this will introduce possibly significant additional signalling. Some of the cell grouping information may however not be relevant for network. It is therefore beneficial to introduce some form of network control.

An embodiment introduces means for the network to control the cell grouping information that the UE includes in the UE capabilities.

In this regard, there are various options for the network to control which cell grouping information the UE shall include, comprising the following:

a) a field indicating whether the UE shall include cell grouping for asynchronous DC

b) a field indicating whether the UE is allowed to include cell grouping for asynchronous DC other than 'R15 grouping' and 'any grouping'

c) a field indicating whether the UE shall include cell grouping for synchronous DC

d) a field indicating whether the UE is allowed to include cell grouping for synchronous DC other than 'R15 grouping' and 'any grouping'

The introduction of new filter option(s) as above involves an extension of the UECapabilityEnquiry message. There are 2 different filters that might be used:

a) UE-CapabilityRequestFilterCommon

b) UE-CapabilityRequestFilterNR

The filter affects for which NR DC BCs the UE provides the cell grouping information. At first glance, it does not seem to affect which BCs the UE actually includes in the list of supported BCs. However, it may be that the grouping filter will actually affect which supported BCs a UE reports e.g. because cell grouping options are different for a fallback BC, meaning that the UE may report a fallback BC when cell grouping info is requested. In any event, the filter may be added to either of the filters listed immediately above.

Figure 5 shows an example of how to reflect the aforementioned embodiment by extension of a common UE capability filter. The underlined portion indicates the adaptation.

The following relates to further enhancements regarding capability reporting by UE supporting RN format. In an embodiment, UE capability reporting is specified for a UE that supports the cell grouping format as introduced in RN, referred to as RN format. The UE will also support formats introduced in earlier releases).

There can be different options regarding how UE should use the new format.

In a first embodiment, options are provided regarding for which BCs a UE applies the RN format:

1) Option 1: >5B BCs

2) Option 2: Any BC

3) Option 3: Specific BCs, in accordance with network control

Options 1 and 2, above, can be reflected in standard specifications in a manner similar to what is shown in the table related to CA-ParametersNRDC field descriptions, shown previously.

As described previously, the R16 specification may allow a UE not supporting RN format to include >5B BCs although such a UE can only indicate limited options. The RN format supports indication of additional grouping options, but this comes at the cost of additional signalling overhead. Hence, network control would be appropriate.

A further question is whether UE should use the new format for ≤5B BCs i.e. instead of the R16 format. This may be desirable to reduce signalling overhead but comes at the cost of reduced granularity. Moreover, if not all RAN nodes support the RN format, this option may

require legacy nodes to again retrieve the UE capabilities. Hence, separate network control seems desirable.

A further option may be that the network provides further details regarding for which BCs the UE shall apply the RN format. For instance, it may be used for particular bands, for BCs involving more than N bands.

In a further embodiment, options for the network to control which cell grouping format the UE shall apply include the following:

a) Field indicating that UE is allowed/requested to use RN format

b) Field indicating that UE is allowed/requested to use RN format for >5B BCs

c) Field indicating that UE is allowed/requested to use RN format for ≤5B BCs

d) Field indicating that UE is allowed/requested to use RN format for specific BCs i.e. indicating some particular further detailed criteria the BC should meet in order to use RN format

Options for more detailed network control of which cell grouping format that the UE shall apply include the following:

a) BC comprises specific bands as indicated by network

b) BC comprises at least a certain number of bands

c) BC comprises bands with specific properties e.g. part of a particular frequency range

With regard to how to reflect the aforementioned in applicable standards, this may either be done by the NR or the common filter and if the latter option is adopted, it may be done in a similar manner as shown by the example in Figure 5.

Embodiments of the present invention provide advantages over the cited art. For instance, Capability reporting by R16 UE for 5B BCs has the benefit of clarifying UE operations regarding cell grouping capabilities, facilitating extensions in the future while avoiding any interoperability problems. Capability filtering for reporting by R16 UE has the benefit of reducing signalling overhead by avoiding transfer of capability info not relevant for network at

the cost of some limited additional complexity. Enhancements regarding capability reporting by a UE supporting RN format has the benefit of introducing UE operations regarding use of different formats for cell grouping capabilities, with network control in order to avoid any interoperability problems.

At least some of the example embodiments described herein may be constructed, partially or wholly, using dedicated special-purpose hardware. Terms such as 'component', 'module' or 'unit' used herein may include, but are not limited to, a hardware device, such as circuitry in the form of discrete or integrated components, a Field Programmable Gate Array (FPGA) or Application Specific Integrated Circuit (ASIC), which performs certain tasks or provides the associated functionality. In some embodiments, the described elements may be configured to reside on a tangible, persistent, addressable storage medium and may be configured to execute on one or more processors. These functional elements may in some embodiments include, by way of example, components, such as software components, object-oriented software components, class components and task components, processes, functions, attributes, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuitry, data, databases, data structures, tables, arrays, and variables. Although the example embodiments have been described with reference to the components, modules and units discussed herein, such functional elements may be combined into fewer elements or separated into additional elements. Various combinations of optional features have been described herein, and it will be appreciated that described features may be combined in any suitable combination. In particular, the features of any one example embodiment may be combined with features of any other embodiment, as appropriate, except where such combinations are mutually exclusive. Throughout this specification, the term "comprising" or "comprises" means including the component(s) specified but not to the exclusion of the presence of others.

Attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings) may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. A method of capability filtering for capability reporting by a UE in response to a capability enquiry from a base station of a telecommunication network, in a telecommunication network configured for Dual Connectivity, DC, ,wherein the telecommunication network controls cell grouping information that the UE includes in its capability report, wherein the network controls the cell grouping information by including in its enquiry one or more of:

a) a field indicating whether the UE shall include cell grouping for asynchronous DC;

b) a field indicating whether the UE is allowed to include cell grouping for asynchronous DC other than 'R15 grouping' and 'any grouping';

c) a field indicating whether the UE shall include cell grouping for synchronous DC; and

d) a field indicating whether the UE is allowed to include cell grouping for synchronous DC other than 'R15 grouping' and 'any grouping'.

2. A method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein a base station of the network sends to the UE a capability enquiry comprising a first set of bands, the UE replies, with a first reply to the base station to indicate that it supports more than a predefined number of bands if it is capable of doing so and the base stations sends a further request to the UE with a second set of bands, including details of the more than the predefined number of bands and the UE replies with a second reply including the requested information.

3. A method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein the telecommunication network includes in a UE capability enquiry, a band list comprising more than a predefined number of band and the UE replies to the capability enquiry with one of the following messages:

a) the UE reply does not include any BCs with more than the predefined number of bands;

b) the UE reply only includes BCs with more than the predefined number of bands, for which it supports R15 grouping (MCG in FR1 and SCG in FR2);

c) the UE reply only includes BCs with more than the predefined number of bands, for which cell grouping can be indicated by R16 UE capability signalling, including:

i) BCs for which the supports R15 grouping (MCG in FR1 and SCG in FR2); and

ii) BCs for which the UE supports any cell grouping.

4. A method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein the UE is arranged to report its capability in RN format, supporting cell grouping, whereby the UE reports BCs using RN format for one of:

1) BCs with more than the predefined number of bands;
2) Any BC; and
3) Specific BCs, in accordance with network control.

5. A method of managing capability reporting by a User Equipment, UE, in a telecommunication network configured for Dual Connectivity, DC, wherein the telecommunication network includes in a capability enquiry to the UE one of:

a) a field indicating that the UE is allowed or requested to use RN format;

b) a field indicating that the UE is allowed or requested to use RN format for BCs having more than a predefined number of bands;

c) a field indicating that the UE is allowed or requested to use RN format for BCs having the predefined number of bands or less; and

d) a field indicating that the UE is allowed or requested to use RN format for specific BCs, including an indication of a particular criterion the the BC should meet in order to use RN format.

6. The method of claim 5 wherein for option d), the particular criterion includes one or more of:

a) the BC comprises specific bands as indicated by the network;

b) the BC comprises at least a certain number of bands; and

c) the BC comprises bands with specific properties, such as being a part of a particular frequency range.

7. Apparatus arranged to perform any one of the preceding methods.

8. Apparatus as claimed in claim 7 comprising at least one of a base station of a telecommunication network and a User Equipment.

Intellectual Property Office

Application No:	GB2309588.8	**Examiner:**	Harry Davies
Claims searched:	1	**Date of search:**	4 December 2023

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1	US 10757566 B2 (HE et al.) - see col.3 ln.38-44 and col.6 ln.8-32.
X,P	1	WO 2021/242159 A1 (ERICSSON TELEFON AB L M) - see pg.10 ln.21-31 and pg.16 ln.16-29.
X,E	1	WO 2022/081060 A1 (ERICSSON TELEFON AB L M) - see pg.16-20.
X	1	3GPP Draft; R2-2010029, vol. RAN WG2, no. Electronic meeting; 20201102 - 20201113, 2020, Ericsson, "Cell group filtering for NR-DC". - see introduction and s2.2 cell group filtering.
X	1	US 2017/0339555 A1 (HENTTONEN et al.) - see paragraphs [0032] and [0035].
A	-	3GPP Draft; R1-2007525, vol. RAN WG1, no. e-Meeting; 20201026 - 20201113, 2020, RAN2, "LS on cell-grouping UE capability for synchronous NR-DC".
A	-	EP 3986045 A1 (HUAWEI TECH CO LTD)
A	-	GB 2562598 A (SAMSUNG ELECTRONICS CO LTD)
A	-	WO 2019/066547 A1 (LG ELECTRONICS INC)

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC[X] :

Worldwide search of patent documents classified in the following areas of the IPC

H04W

The following online and other databases have been used in the preparation of this search report

SEARCH-PATENT, XP3GPP

International Classification:

Subclass	Subgroup	Valid From
H04W	0028/06	01/01/2009
H04W	0036/00	01/01/2009
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