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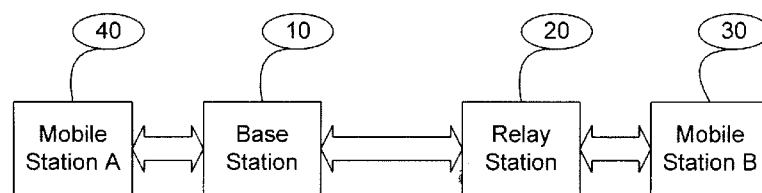


Figure 1

(57) **Abstract:** A method for allocating resources to a plurality of telecommunication nodes in a telecommunication network, said telecommunication network comprising radio cells, each of said radio cells comprising at least one Base Station defining at least one centre area and at least one edge area using different frequency sub-carriers, wherein said telecommunication nodes may either be Relay Stations and/or a Mobile Stations, said method comprising, for each Base Station, the acts of allocating resources to the telecommunication nodes that are directly linked to said Base Station according to a first set of priorities, said first set of priorities allowing the selection of pre-defined frequency sub-carriers according to the type of telecommunication node and its location in the centre or edge areas; allocating resources to the Relay Stations according to a second set of priorities, said second set of priorities allowing the selection of pre-defined frequency sub-carriers according to the type of telecommunication node which is connected to a given Relay Station and its location in the centre or edge areas.



RESOURCE ALLOCATION METHOD AND SYSTEM

Field of the Invention

5 The present invention relates in general to wireless telecommunications and more particularly to resource allocation in wireless telecommunication networks.

Background of the Invention

10 Third generation (3G) of wireless telecommunication systems has been standardized and is currently implemented in telecommunication networks. These 3G wireless telecommunication networks comprise Base Stations (BS) that emit to exchange data with telecommunication nodes such as e.g. Mobile Stations (MS). This is done through communication channel on one or more given frequencies or bands of frequencies or frequency sub-carriers on an area defining a radio cell.

15 Today, fourth generation systems are being tested and standardized. As these systems use higher frequency carriers and larger bandwidth, this implies coverage and spectrum efficiency problems, especially on the edges of the radio cells. One solution to reduce these drawbacks is to integrate into the telecommunication networks an entity called Relay Station (RS). The RS mainly forwards the signal

20 between the BS and the MS. This enhances the performance of the wireless telecommunication system when the MS is far away from the BS. A RS may also further define itself a RS cell. Relay Stations and Mobile Stations are telecommunication nodes for the Base Station. Moreover, a RS may allow some Mobile Stations to connect to it using different frequencies (or different frequency

25 sub-carriers) than the one(s) that is/are used to communicate directly with the BS, helping thus reducing inter-cell interferences near the edges of radio cells.

Interferences remain one of the main concerns of wireless telecommunication systems today as they reduce significantly their efficiency.

30 In existing wireless telecommunication systems, such as e.g. conventional 3G wireless telecommunication systems, inter-cell interferences may be reduce

using for example an interference matrix. An interference matrix may be used to generate a cancellation operator that, when applied to a radio signal, may substantially remove interferences. Similarly the Base Station knows the channel condition of every Mobile Station since the Mobile Stations reports their Received
5 Signal Strength Indicator (RSSI) and Signal to Interference and Noise Ratio (SINR) periodically to the BS. Similarly, resources including frequency, time, radiated power and space isolation may be coordinated among neighbouring BS cells or RS cells to avoid inter-cell interferences. For frequency, close Relay Stations may allocate different frequency bands to avoid interferences. For time resources, slot
10 transmission coordination between MS and RS and RS and BS of neighbouring radio cells may help avoiding inter-cell interferences. Space isolation of the Relay Stations may be detected using RSSI or SINR measurements. Frequency-time resources may be reused among Relay Stations far away enough from each other. Resource allocation may be coordinated between the telecommunication nodes
15 only when interferences are easily predictable because the telecommunication nodes are fixed or close from the BS or not directly subject to interferences of adjacent radio cells. Existing solutions do not satisfactory apply in the case of mobile telecommunication nodes, in particular mobile Relay Stations, and in the case of telecommunication nodes that are on the edge of a radio cell.

20 Relay-aided solutions are being developed, but they mainly concentrate on the Physical (PHY) and Medium Access (MAC) layers and not the network layer. Existing resource allocationschemes for wireless relay-aided telecommunication systems do not propose to reduce interferences and in particular inter-cell interferences. For example, patent application EP1940185 discloses a method and
25 system for bandwidth allocation and scheduling management based on a Relay Station, but does not give any lead on how to reduce interferences, in particular inter-cell interferences, especially for mobile telecommunication nodes, in particular mobile Relay Stations, and in the case of telecommunication nodes that are on the edge of a radio cell.

Today there is no solution to efficiently allocate resources that allow reducing interferences and thus improving efficiency of such wireless telecommunication systems.

Today there is a need for an image prediction solution that can be easily
5 implemented on the existing communication infrastructures, overcoming the drawbacks of the prior art.

Summary of Invention

It is an object of the present system to overcome disadvantages and/or make
10 improvement over the prior art.

To that extend, the invention proposes a method for allocating resources to a plurality of telecommunication nodes in a telecommunication network according to claim 1.

The invention also proposes a system according to claim 8.

15 The invention also proposes a Base Station according to claim 9.

The invention also proposes a readable computer program according to claim
16.

The method according to the invention proposes to efficiently allocate resources for reducing interferences and thus improving efficiency of wireless
20 telecommunication systems.

An advantage of the method according to the invention is that it allows reducing interferences (in particular inter-cell interferences), especially for mobile telecommunication nodes (in particular mobile Relay Stations), and in the case of telecommunication nodes that are located on the edge of a radio cell. Indeed, as
25 some of the telecommunication nodes are located in locations where there are more interferences than others, as some of the telecommunication nodes are either Relay Stations or Mobile Stations with different resource requirements and as some telecommunication nodes are fixed and some other mobile, the method according to the invention takes all these parameters into account to prioritize the resource
30 allocation. This allows in particular allocating the most efficient resources (e.g.

orthogonal frequency sub-carriers in priority for telecommunication nodes in edge areas of different radio cells as opposed to telecommunication nodes in the centre area of a radio cell) to avoid interferences.

By allocating resources to different telecommunication nodes located in specific places, the method according to the invention allows dynamically targeting the telecommunication nodes for allocating the resources.

Another advantage of the method according to the invention is that frequency sub-carrier may be re-used by different groups of Relay Stations, in particular fixed Relay Stations.

Brief Description of the Drawings

Embodiments of the present invention will now be described solely by way of example and only with reference to the accompanying drawings, where like parts are provided with corresponding reference numerals, and in which:

Figure 1 schematically illustrates the system according to an embodiment of the present invention;

Figure 2A schematically illustrates an example of distribution of fixed and mobile Relay Stations in a radio cell according to an embodiment of the present invention;

Figure 2B schematically illustrates the structure of a frame according to an embodiment of the present invention;

Figure 3 schematically illustrates a frequency sub-carriers distribution according to an embodiment of the present invention;

Figure 4 schematically illustrates the method according to an embodiment of the present invention;

Figure 5 schematically illustrates an example of frame defining the resource allocation according to an embodiment of the present invention;

Figure 6 schematically illustrates an example of frame defining the resource allocation according to an embodiment of the present invention.

Description of Preferred Embodiments

The following are descriptions of exemplary embodiments that when taken in conjunction with the drawings will demonstrate the above noted features and advantages, and introduce further ones.

5 In the following description, for purposes of explanation rather than limitation, specific details are set forth such as architecture, interfaces, techniques, devices etc..., for illustration. However, it will be apparent to those of ordinary skill in the art that other embodiments that depart from these details would still be understood to be within the scope of the appended claims.

10 Moreover, for the purpose of clarity, detailed descriptions of well-known devices, systems, and methods are omitted so as not to obscure the description of the present system. Furthermore, routers, servers, nodes, gateways or other entities in a telecommunication network are not detailed as their implementation is beyond the scope of the present system and method.

15 Unless specified otherwise, the exemplary embodiment will be described hereafter in its application to a base station of a wireless telecommunication network.

In addition, it should be expressly understood that the drawings are included for illustrative purposes and do not represent the scope of the present
20 system.

The system according to the invention allows a Base Station (BS) to allocate resources to telecommunication nodes such as Relay Stations (RS) and Mobile Stations (MS) in a wireless telecommunication network, and more particularly in on Orthogonal Frequency Division Multiple Access (OFDMA) wireless
25 telecommunication network.

In such an OFDMA network, subsets of sub-carriers (of frequencies) are assigned to telecommunication nodes.

Figure 1 describes the system according to the invention wherein a BS
30 communicates through a communication channel with a RS and through another

communication channel to a first MS (Mobile Station A) and wherein said RS communicates through a communication channel with a second MS (Mobile Station B).

Mobile Stations and Relay Stations are telecommunication nodes for the
5 Base Station.

According to an exemplary embodiment of the present system, each radio cell of the wireless telecommunication network has a Base Station (BS). In a radio cell, there are:

- at least one Mobile Station connected to the BS,
- 10- at least one Relay Station,
- at least one (other) Mobile Station connected to the RS.

Relay Stations are suitable for locations where the coverage of the BS is attenuated or inexistent as they allow improving the spectrum efficiency for these areas. Relay Stations may be fixed (RS_F) and/or mobile Relay Stations (RS_M).
15 For example, a RS_F may be built at a bus station, a restaurant, a building etc... whereas a RS_M may be e.g. on a bus, a metro, a train etc...

Figure 2A describes an exemplary embodiment of the system according to the present invention wherein a BS cell comprises three fixed Relay Station
20 respectively RS_F1, RS_F2 and RS_F3 and one RS_M. One may notice that for example, RS_F3 covers partially a part of the BS cell, but is still in the radio coverage of the BS.

According to an embodiment of the present invention, Relay Stations work in transparent mode. A RS works in transparent mode when it does not allocate itself
25 resources to the MS. When the RS allocates resources to the MS (i.e. non-transparent mode), the MS considers the RS like a BS. In embodiments described hereunder, Relay Stations in transparent mode exchange data with the BS and the MS according to an allocation scheme defined by the BS.

According to an exemplary embodiment of the present system, frames are
30 used to exchange data on the communication channels between the different

entities (Base Station, Relay Stations and Mobile Stations). Frames allow defining the frequency sub-carriers distribution during pre-defined intervals of time or sub-frames. The data are exchanged in the form of bursts of data, a burst being a packet or block of data sent or received by the BS or by a telecommunication node.

5

Figure 2B describe the structure of a frame according to an exemplary embodiment of the invention. A frame is defined in the frequency domain and in the time domain. In the frequency domain, a frame is defined by the frequency sub-carriers. In the time domain, a frame is defined by symbols. In wireless communication, a symbol is a state or significant condition of the communication channel that persists for a fixed period of time. A symbol represents or conveys one or several bit of data. In the time domain, a frame is divided into four main time intervals or sub-frames wherein:

- a first sub-frame 210, called DL (Down Link) Access Zone, allows the exchange of data downlink between the BS and Mobile Stations directly (direct transmission without a Relay Station in between) and/or downlink between the BS and Relay Stations,
- a second sub-frame 220, called DL Transparent (or Relay) Zone, allows the exchange of data downlink between Relay Stations and the Mobile Stations that are connected to them,
- a third sub-frame 230, called UL (Up Link) Access Zone, allows the exchange of data uplink between Mobile Stations and either the BS or the Relay Stations they are connected to directly,
- a fourth sub-frame 240, called UL Relay Zone, allows the exchange of data downlink between Relay Stations and the BS directly.

The frequency sub-carriers may be allocated independently from one time interval to another by the BS. Relay Stations are able to exchange data on the frequency sub-carriers selected (i.e. allocated) by the BS for each interval of time. This resource allocation is made using some control information contained in a control field called Mobile Application Part (MAP) field 203. The control

information describes time and frequency sub-carriers allocated for each burst of data. In transparent mode, this control information is only sent by the BS (i.e. in a Down Link-MAP field (DL-MAP)) in the first sub-frame 210, but more generally, it can be emphasized that each sub-frame may comprise a MAP field downlink
5 and/or uplink if needed within the scope of the present invention. Furthermore, two other fields are traditionally associated with the MAP field: the preamble 201 and the Frame Control Header (FCH) field 202. The preamble 201 allows a small interval of time for the receiver electronics in each of the nodes to settle after completion of the previous frame in order to correctly process the next frame. The
10 FCH field 202 specifies the burst profile and the length of one or more down link bursts that immediately follow the FCH.

The length of each sub-frame is determined by the downlink and uplink traffic loads. As the traffic varies with time, the length of the sub-frame may be adjusted accordingly periodically. In general, the interval of time of the sub-frame
15 is long enough to avoid too much overhead signalling.

According to an exemplary embodiment of the present invention, the frequency sub-carriers are divided at least two sets of frequency sub-carriers. These sets of frequency sub-carriers are prioritized so as to define level of Quality of Service, i.e. for less interference. Indeed, the set of highest priority is characterized
20 by a better efficiency on the edge of the radio cell and/or for mobile telecommunication nodes (as opposed to fixed one). In other words, the efficiency implies that less interference exist, and in particular less inter-cell interference, in comparison with lower priorities sets of frequency sub-carriers. For example, orthogonal frequency sub-carriers may be defined as the set with the highest
25 priority as they are less to none subject to interferences between each other. Non-orthogonal frequency sub-carriers may, on the opposite, define sets of lower priority.

According to an exemplary embodiment of the system according to the present invention, two sets of frequency sub-carriers are used: reserved sub-carriers
30 and common sub-carriers. Reserved sub-carriers are sub-carriers that are orthogonal

among adjacent radio cells. The rest of the frequency sub-carriers are called the common sub-carriers.

Figure 3 illustrates an example of frequency sub-carrier distribution wherein adjacent cells use orthogonal or reserved frequency sub-carriers on their edges to prevent inter-cell interferences. In this example, four sets of frequency sub-carriers respectively 300, 310, 320 and 330 are used by non-adjacent cells to prevent inter-cell interferences. The other frequency sub-carriers that may be common to adjacent cells being used mainly in the centre of each cell away from the edges to prevent inter-cell interferences.

Figure 4 describes the method according to the invention for allocating resources to a plurality of telecommunication nodes in a telecommunication network. In the method according to the invention, telecommunication nodes may either be Relay Stations or Mobile Stations. The telecommunication network comprises radio cells and is a multi-carrier telecommunication network using a plurality of frequency sub-carriers, such as typically for example an OFDMA telecommunication network. Each radio cell comprises at least one Base Station, which defines at least one centre area and at least one edge area using different frequency sub-carriers. This means that sets of frequency sub-carriers are used by different telecommunication nodes in different location of the radio cell. For example, as described here above, reserved or orthogonal frequency sub-carriers are allocated by the Base Station to communicate with telecommunication nodes that are in a pre-defined edge area and common frequency sub-carriers are allocated by the Base Station to communicate with telecommunication nodes that are on a pre-defined centre area. Frames are broadcasted to the telecommunication nodes that know when and using which resources they may be able to communicate. Communication involves four time intervals or sub-frames, as previously described, during which each entity (BS, RS, MS) may receive or send information (i.e. data):

- one time-interval or sub-frame allows the BS to send data to Relay Stations and Mobile Stations that are directly connected to it (i.e. downlink);
- a second time interval allows Relay Stations to send data to other Relay Stations and Mobile Stations that are directly connected to them (i.e. downlink);
- 5- a third time interval allows Mobile Stations to send data to the Relay Station they are directly connected to (i.e. uplink);
- a fourth time interval allows Relay Stations to send data to the BS they are connected to (i.e. uplink).

However, the resource allocation itself is done by the Base Station which
10 sends the associated information in each frame (as described further in reference to Figure 5) to let telecommunication nodes know how the resource allocation of the radio cell has been defined for them (i.e. when they may send or receive data, using which frequency sub-carriers etc..). The resource allocation is performed by each Base Station of the network according to the number and types of
15 telecommunication nodes that are in the radio cell covered by said Base Station.

The centre and edge areas may be pre-defined using for instance the Signal to Interference Ratio (SIR) which allows the Base Station to know the distance to the telecommunication node (and thus if it is in the centre or edge area). A threshold SIR may be set (SIR_{TH}) in order to determine whether a telecommunication node is
20 in the centre area ($SIR > SIR_{TH}$) or in the edge area ($SIR < SIR_{TH}$). As centre areas in each radio cell is relatively far away enough from each other and as the transmit power of the radio signal from the Base Station to the centre area does not need to be very high (because it is close from the BS), interferences on common sub-carriers are thus negligible or insignificant. Having one centre and one edge
25 areas should not limit the scope of the present invention as they may be more than two areas. Indeed, in a further embodiment according to the invention, for example, several edge areas and several threshold of SIR may be used, wherein each edge area would correspond to a range of SIR limited by two threshold SIR. In another further embodiment, it could be also possible to define non-radial areas within a
30 radio cell and using another parameter than SIR to distribute frequency sub-carriers

between areas. For instance, the radio cell might be sliced in rectangular areas, elliptical or any other shape of area wherein adjacent areas would be associated with different frequency sub-carriers. As before, there may be more than two areas.

The method according to the invention comprises a preliminary act 400 of
5 initialisation, wherein the Base Station gathers or receives data from or on telecommunication node allowing further classification. Said data may be either sent directly by the telecommunication node, measured by the BS or another entity, received from the telecommunication network etc... The classification may for example be to determine the type of telecommunication node, its location, whether
10 it is a mobile or a fixed telecommunication etc... For example, in order to get the location of a telecommunication node, a piece of information on its location may be:

- inserted in a message exchanged with the BS, -
- obtained from a Global Positioning System (GPS) that would be linked with
15 the telecommunication node,
- coming from the telecommunication network,
- measured by the BS,
- or obtained any mean for getting such information...

The aforementioned classification allows the BS the set priorities between
20 the telecommunication nodes to further allocate resource to them as described here under.

The method according to the invention comprises an act 410 for allocating resources to the telecommunication nodes that are directly linked to the Base Station according to a first set of priorities. Telecommunication nodes are directly
25 linked to the Base Station when they exchange data through one common air interface (i.e. one common set of frequency sub-carrier) directly. For example, the BS may exchange data directly with either a Relay Station or a Mobile Station.

The first set of priorities allows selecting pre-defined frequency sub-carriers according to the type of telecommunication node and its location in the edge or
30 centre areas. Indeed, in an exemplary embodiment according to the invention, the

priorities are made upon the type of telecommunication node (either a Relay Station or a Mobile Station) and the location of the telecommunication node (for example in the edge or centre area). This improves the efficiency of the resource allocation and reduces interferences as, as previously described, priorities are based on several
5 areas. The edge area uses frequency sub-carriers orthogonal to the ones that are used in the edge areas of the adjacent cells, reducing thus inter-cell interferences. In parallel, telecommunication nodes that are in a centre area will be further away from telecommunication nodes in a centre area of an adjacent cell using the same frequency sub-carriers and will be thus less (to none) subject to inter-cell
10 interferences. Telecommunication nodes that are in the edge area of a radio cell will therefore be given a higher priority to obtain these edge frequency sub-carriers than the ones that are in the centre area.

When a fixed Relay Station and a Mobile Station are in the edge area, the priority may be given to the RS as several Mobile Stations may possibly be linked
15 directly to it, implying thus a priority need of more efficient resources with less interference than a single Mobile Station.

Similarly, when a fixed Relay Station and a Mobile Station are in the centre area, the priority may be given to the RS as several Mobile Stations may possibly be linked directly to it, implying thus a priority need of more efficient resources
20 with less interference than a single Mobile Station.

Furthermore, mobile Relay Stations may be given the highest priority whatever the area as they combine mobility and aggregation of Mobile Stations as several Mobile Stations may possibly be linked directly to each RS for example, implying thus a priority need of the most efficient resources with the least
25 interferences. When a mobile Relay Station covers a small area, which is usually the case if it is on a bus or on a train, then interferences received by the Mobile Stations directly connected to said mobile Relay Station are very similar. In this case, it may not be necessary to distinguish between edge mobile Relay Stations and centre mobile Relay Stations when defining the priorities in the method
30 according to the invention.

The resource allocation concerns frequency sub-carriers, but also other types of resources such as e.g. time, space isolation or transmitted power. For example, edge Relay Stations and edge Mobile Stations, as they are further away, may be given higher transmitted power than centre Relay Stations and centre Mobile Stations to reduce interferences to adjacent cells.

According to an exemplary embodiment of the present method, the first and second sets of priorities may take into account the location of telecommunication nodes (for example if they are in the centre or in the edge area).

According to an exemplary embodiment of the present method, the first and second sets of priorities may further take into account if telecommunications nodes are fixed or mobile.

According to an exemplary embodiment of the present method, the first and second sets of priorities may further take into account the fact that a mobile Relay Station may have a higher priority than any other type of telecommunications node.

According to an exemplary embodiment of the present method, priorities of the first set may be thus as follows: Mobile Relay Stations are given priority over Edge fixed Relay Stations which are given priority over Edge Mobile Stations which are given priority over Centre fixed Relay Stations which are given priority over Centre Mobile Stations.

The method according to the invention comprises also an act for allocating resources to the Relay Stations according to a second set of priorities. The second set of priorities allows selecting pre-defined frequency sub-carriers according to the type of telecommunication node which is connected to a given Relay Station and its location in the edge or centre areas.

For example, according to an exemplary embodiment of the present invention, said second set of priorities may define that mobile Relay Stations may be given higher priority over fixed Relay Stations whatever the area as they are mobile and are thus more subject (i.e. more sensitive) to interferences than fixed Relay Stations and need thus more efficient resources (orthogonal frequency sub-carriers, higher transmitted power).

According to an exemplary embodiment of the method according to the present invention, priorities of the second set may be thus as follows: Mobile Relay Stations have priority over Edge fixed Relay Stations which have priorities over Centre fixed Relay Stations.

5

Figure 5 describes a frame defined using an exemplary embodiment of resource allocation according to the present invention.

The frame described in Figure 5 comprises two sub-frames: one downlink access zone sub-frame and one downlink relay zone sub-frame. The downlink access zone sub-frame comprises a preamble field, a MAP field and a FCH field as previously described. The priorities defined in the method according to the invention allow burst of time and frequency sub-carriers to be allocated to different types of telecommunication nodes which are at different locations. In this example, reserved frequency sub-carriers are allocated first respecting the priorities between telecommunication. For telecommunication nodes that are allocated reserved frequency sub-carriers, the order of allocation in time depends also on the priorities between telecommunication nodes. Then, when all reserved frequency sub-carriers have been allocated, non-reserved or common frequency sub-carriers are allocated. For telecommunication nodes that are allocated non-reserved frequency sub-carriers, the order of allocation in time depends also on the priorities between telecommunication nodes.

In this exemplary embodiment of the method according to invention, the first sub-frame, wherein the resources allocated by the Base Station are used by the Base Station to communicate downlink with telecommunication nodes that are directly connected to it, is the downlink access zone sub-frame. The downlink access zone sub-frame is the time interval wherein Base Stations may use the frequency sub-carriers of the telecommunication network to communicate with the telecommunication nodes that are connected directly to them downlink (i.e. Relay Stations and/or Mobile Stations). As previously described, the resource allocation is made by the Base Station: the Base Station decides for every sub-frame which

telecommunication nodes may use which resource at what time and/or in which time interval (i.e. sub-frame).

From the example of Figure 5, in this first sub-frame, the RS_M has the highest priority and is thus allocated first. It gets hence a burst at the start of the resource part (in time) of the downlink access zone sub-frame with the reserved frequency sub-carriers that are the most efficient ones to reduce interferences. The next priority for frequency sub-carriers allocation is given to edge fixed Relay Stations. Edge RS_F1 is thus allocated some of the reserved frequency sub-carriers in the earliest in time. Then, edge RS_F3 is allocated some of the remaining reserved frequency sub-carriers. Here edge RS_F1 is allocated first before edge RS_F3, but, as they both have the same priority in the exemplary embodiment, it may have been allocated in the reverse order. When all the edge fixed Relay Stations have been allocated with reserved frequency sub-carriers (providing, as in this example of Figure 5, that there are some left at this stage), then edge MS are allocated some of the remaining reserved frequency sub-carriers (providing, as in this example of Figure 5, that there are some left at this stage). In this example of Figure 5, the edge MS needs more resources than just the ones provided by the remaining reserved frequency sub-carriers. In this case, the edge MS is further allocated some of the non-reserved frequency sub-carriers to fulfil its resource requirement. Then, in order of priority, the centre RS_F2 is allocated some of the remaining non-reserved frequency sub-carriers according to its resource requirements. Finally, the centre MS is allocated some or all of the remaining non-reserved frequency sub-carriers.

In this exemplary embodiment of the method according to invention, the next sub-frame wherein the allocated resources are used by Relay Stations to communicate downlink with telecommunication nodes that are directly connected to them is the downlink relay zone sub-frame. The downlink relay zone sub-frame is the time interval wherein Relay Stations may use the frequency sub-carriers of the telecommunication network to communicate with the telecommunication nodes

that are connected directly to them downlink. Said telecommunication nodes are mainly Mobile Stations, but might also be other Relay Stations.

From the example of Figure 5, in the downlink relay zone sub-frame, the second set of priorities is defined as follows: $RS_M > \text{Edge } RS_F > \text{Centre } RS_F$.

5 The first allocated burst allows the mobile Relay Station RS_M to use some of the reserved frequency sub-carriers to send data to the Mobile Stations that are connected to them. The second allocated burst allows the edge RS_F1 to use some of the reserved frequency sub-carriers and some of the non-reserved frequency sub-carriers to send data to the Mobile Stations that are connected to them. The
10 third allocated burst allows the edge RS_F3 to use some of the non-reserved frequency sub-carriers to send data to the Mobile Stations that are connected to them. The fourth allocated burst allows the centre RS_F2 to use some of the non-reserved frequency sub-carriers to send data to the Mobile Stations that are connected to them.

15

In a further embodiment of the method according to the invention, Relay Stations may be grouped together when they are in a pre-defined neighbourhood. Distinct groups of Relay Stations are considered as being far enough from each other to use e.g. the same groups of frequency sub-carriers, providing the distance
20 between said distinct groups prevents interferences between said distinct groups. In order to group Relay Stations together, the Base Station may use any information, such as in particular for example the location of Relay Stations, in order to decide which Relay Station should belong to which group. For instance, for location information, the Base Station may use the signal strength of the Relay Stations
25 when said Relay Station emits toward the Base Station, or a piece of information on the location of the Relay Station that would be inserted in a protocol, or location from a Global Positioning System (GPS) that would be embedded on the Relay Station, triangulation or any mean for getting such information...

Figure 6 describes an exemplary embodiment of the system according to the
30 invention, wherein there are two groups of distinct Relay Stations.

Using the Figure 2A as a reference for this example, the first group comprises the mobile Relay Station RS_M, the edge RS_F3 and the centre RS_F2. The second group comprises the edge RS_F1. The resource allocation for the downlink access zone sub-frame is the same as the one previously described in Figure 5.

- 5 However, this time, as there distant groups of Relay Stations, each group may use the same whole range of frequency sub-carriers. In Figure 6, RS_F1 may use the whole range of frequency sub-carriers to send data to the Mobile Stations that are connected directly to it. The mobile Relay Station RS_M, the edge RS_F3 and the centre RS_F2 may use different allocated bursts to communicate downlink:
- 10- the RS_M has the priority and uses reserved frequency sub-carriers as shown on Figure 6;
- the edge RS_F3 has not the priority over the RS_M, but has the priority over the centre RS_F2 and may thus use reserved frequency sub-carriers and non-reserved frequency sub-carriers as shown on Figure 6;
- 15- the centre RS_F2 has the least priority of all the Relay Stations and may use non-reserved frequency sub-carriers as shown on Figure 6.

In the example described in Figure 6, the mobile Relay Station is considered of being part of the

- Embodiments presented here above describe the system and method
- 20 according to the invention in the case of Relay Stations working in transparent mode. However, this does not limit the system and method according to the invention to said transparent mode as it may be transposed mutatis mutandis to the non-transparent mode.

A method according to the invention, wherein:

- 25 - in the first set of priorities, Edge fixed Relay Stations which are given priority over Edge Mobile Stations which are given priority over Centre fixed Relay Stations which are given priority over Centre Mobile Stations,
- in the second set of priorities, Mobile Relay Stations have priority over Edge fixed Relay Stations which have priorities over Centre fixed Relay Stations.

Claims

1. A method for allocating resources to a plurality of telecommunication nodes in a telecommunication network, said telecommunication network comprising radio cells, each of said radio cells comprising at least one Base Station defining at least one centre area and at least one edge area using different frequency sub-carriers for said areas, wherein said telecommunication nodes may either be Relay Stations and/or a Mobile Stations, a Mobile Station being either connected to the Base Station or a Relay Station, said method comprising, for each Base Station, the acts of:

- allocating resources to the telecommunication nodes that are directly linked to said Base Station according to a first set of priorities, said first set of priorities allowing the selection of first pre-defined frequency sub-carriers according to the type of telecommunication node and its location in the centre or edge areas,
- allocating resources to the Relay Stations according to a second set of priorities, said second set of priorities allowing the selection of second pre-defined frequency sub-carriers, distinct than the first pre-defined frequency carriers, for each Mobile Station which is connected to a given Relay Station according to its location in the centre or edge areas.

2. A method according to claim 1, wherein frequency sub-carriers are divided into at least two groups of frequency sub-carriers, the first and second pre-defined frequency sub-carriers corresponding to distinct groups, said groups being prioritized according to the level of radio interference they create.

3. A method according to claim 2, wherein a first group of frequency sub-carriers comprises reserved frequency sub-carriers and a second group of frequency sub-carriers comprises non-reserved frequency sub-carriers, said reserved frequency sub-carriers creating less interference than non-reserved frequency sub-carriers, and wherein telecommunication nodes in the edge area are allocated reserved frequency sub-carriers in priority.

4. A method according to claim 3, wherein mobile telecommunication nodes have higher priority than fixed telecommunication nodes and wherein a mobile Relay Station has the highest priority over the other types of telecommunication nodes.

5 5. A method according to any of the preceding claims, wherein:

- in the first set of priorities, Mobile Relay Stations are given priority over Edge fixed Relay Stations which are given priority over Edge Mobile Stations which are given priority over Centre fixed Relay Stations which are given priority over Centre Mobile Stations,

10 - in the second set of priorities, Mobile Relay Stations have priority over Edge fixed Relay Stations which have priorities over Centre fixed Relay Stations.

6. A method according to any of the preceding claims, wherein a plurality of Relay Stations may be grouped together according to their locations, the act of allocating resources to at least one Relay Station allowing allocating resources
15 among the Relay Stations of the same group.

7. A method according to claim 6, wherein two groups of Relay Stations in distinct locations may use the same resources.

8. A telecommunication system for allocating resources to a plurality of telecommunication nodes in a telecommunication network, said telecommunication
20 network comprising radio cells, each of said radio cells comprising at least one Base Station defining at least one centre area and at least one edge area using different frequency sub-carriers for said areas, said telecommunication system comprising:

- a telecommunication network connecting said telecommunication nodes and
25 said Base Station,

- telecommunication nodes which may either be Relay Stations and/or a Mobile Stations, a Mobile Station being either connected to the Base Station or a Relay Station,

- a Base Station further operable to:

- allocate resources to the telecommunication nodes that are directly linked to said Base Station according to a first set of priorities, said first set of priorities allowing the selection of first pre-defined frequency sub-carriers according to the type of telecommunication node and its location in the centre or edge areas,

5 - allocate resources to the Relay Stations according to a second set of priorities, said second set of priorities allowing the selection of second pre-defined frequency sub-carriers for each Mobile Station which is connected to a given Relay Station according to its location in the centre or edge areas.

10 9. A Base Station for allocating resources to a plurality of telecommunication nodes in a telecommunication network, said telecommunication network comprising radio cells, each of said radio cells comprising at least one Base Station defining at least one centre area and at least one edge area using different frequency sub-carriers for said areas, wherein said telecommunication nodes may either be Relay Stations and/or a Mobile Stations, a Mobile Station being either connected to
15 the Base Station or a Relay Station, said Base Station being operable to:

- allocate resources to the telecommunication nodes that are directly linked to said Base Station according to a first set of priorities, said first set of priorities allowing the selection of first pre-defined frequency sub-carriers according to the type of telecommunication node and its location in the centre or edge areas,

20 - allocate resources to the Relay Stations according to a second set of priorities, said second set of priorities allowing the selection of second pre-defined frequency sub-carriers, distinct than the first pre-defined frequency carriers, for each Mobile Station which is connected to a given Relay Station and its location in the centre or edge areas.

25 10. A Base Station according to claim 9, wherein frequency sub-carriers are divided into at least two groups of frequency sub-carriers, the first and second pre-defined frequency sub-carriers corresponding to distinct groups, said groups being prioritized according to the level of radio interference they create.

30 11. A Base Station according to claim 10, wherein a first group of frequency sub-carriers comprises reserved frequency sub-carriers and a second group of

frequency sub-carriers comprises non-reserved frequency sub-carriers, said reserved frequency sub-carriers creating less interference than non-reserved frequency sub-carriers, and wherein telecommunication nodes in the edge area are allocated reserved frequency sub-carriers in priority.

5 12. A Base Station according to claim 11, wherein mobile telecommunication nodes have higher priority than fixed telecommunication nodes and wherein a mobile Relay Station has the highest priority over the other types of telecommunication nodes.

13. A Base Station according to any of the preceding claims 9 to 12, wherein:

10 - in the first set of priorities, Mobile Relay Stations are given priority over Edge fixed Relay Stations which are given priority over Edge Mobile Stations which are given priority over Centre fixed Relay Stations which are given priority over Centre Mobile Stations,

15 - in the second set of priorities, Mobile Relay Stations have priority over Edge fixed Relay Stations which have priorities over Centre fixed Relay Stations.

14. A Base Station according to any of the preceding claims 9 to 13, wherein a plurality of Relay Stations may be grouped together according to their location, the act of allocating resources to at least one Relay Station allowing allocating resources among the Relay Stations of the same group.

20 15. A method according to claim 14, wherein two groups of Relay Stations in distinct locations may use the same resources.

25 16. A computer program providing computer executable instructions stored on a computer readable medium, which when loaded on to a data processor causes the data processor to perform a method for interacting with a call according to claims 1 to 7.

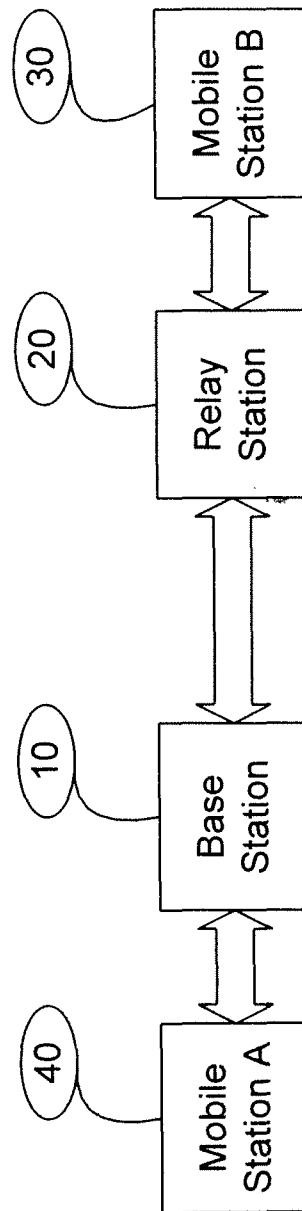


Figure 1

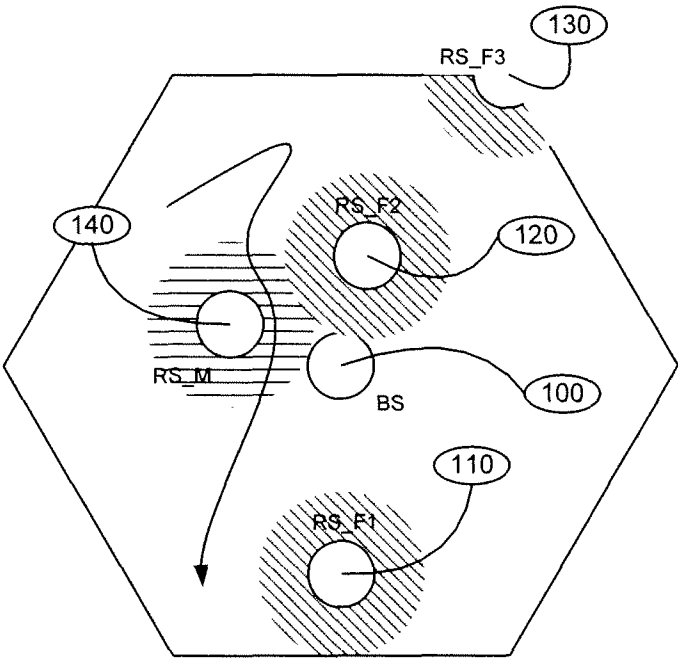


Figure 2A

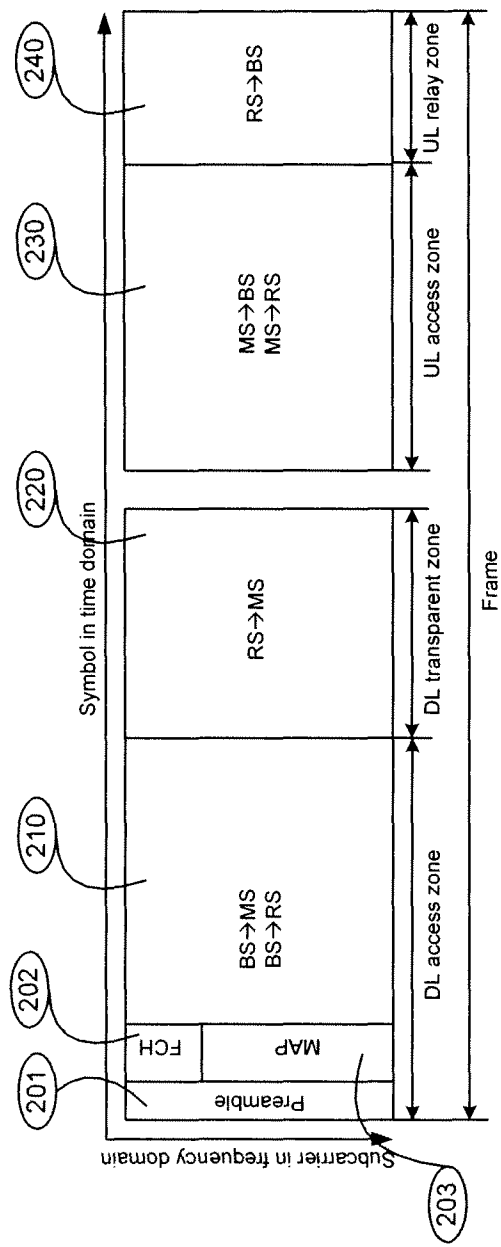


Figure 2B

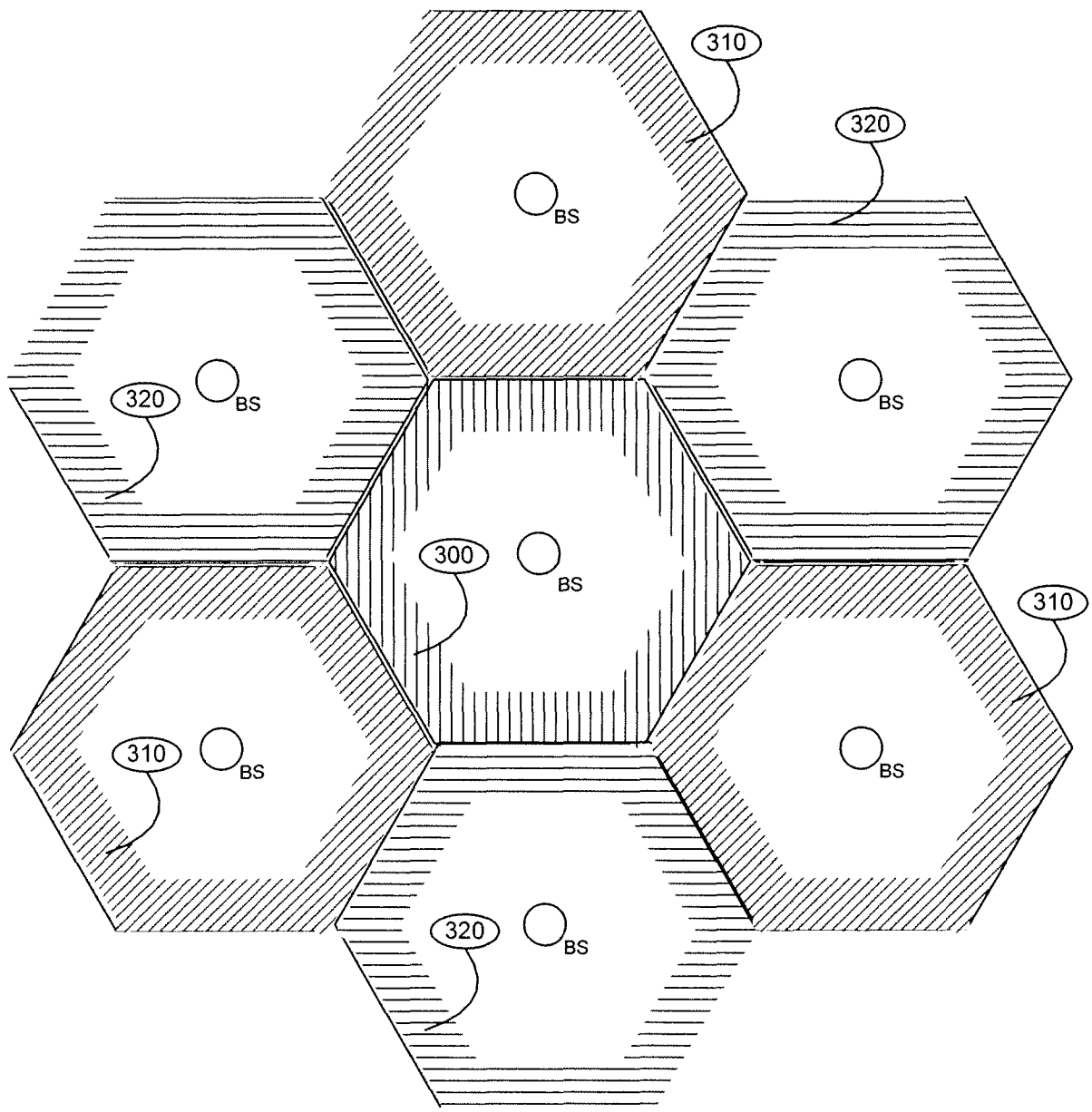


Figure 3

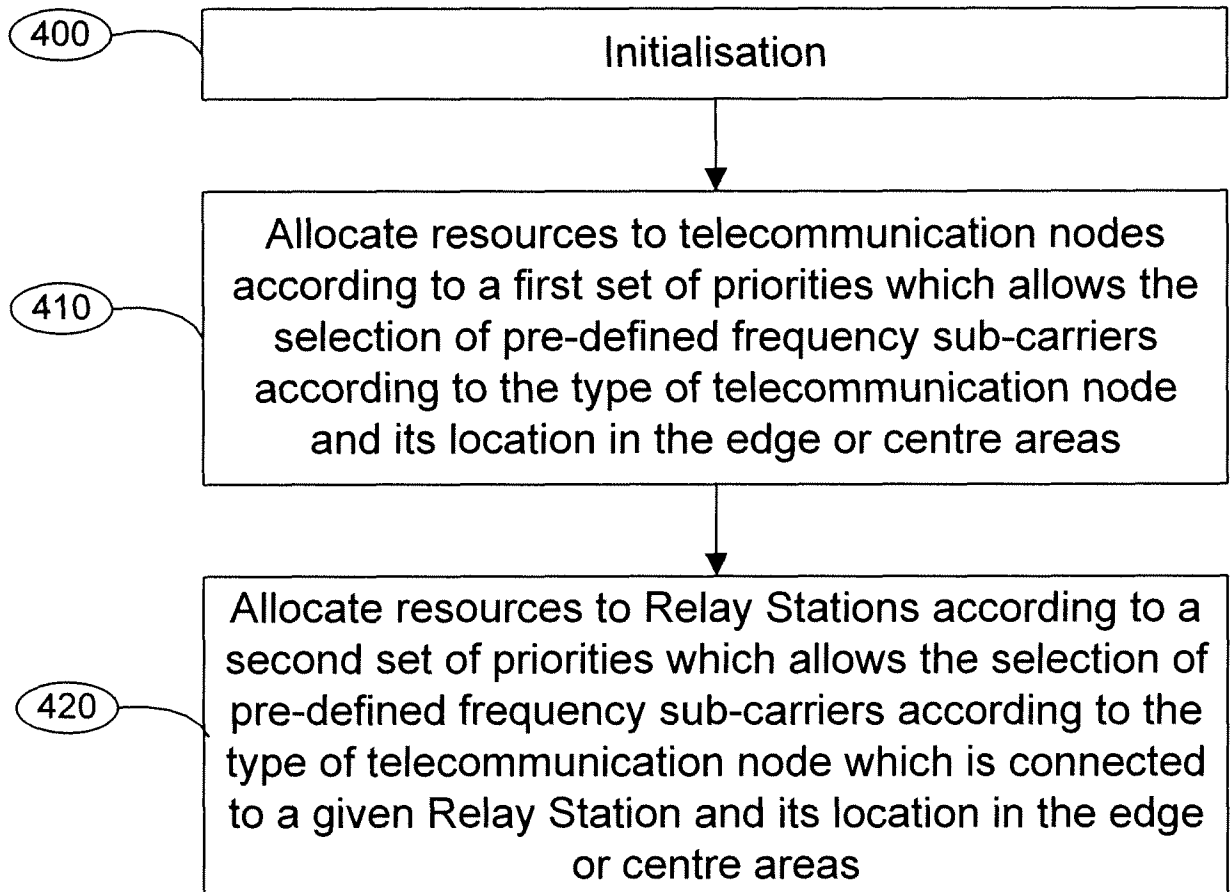


Figure 4

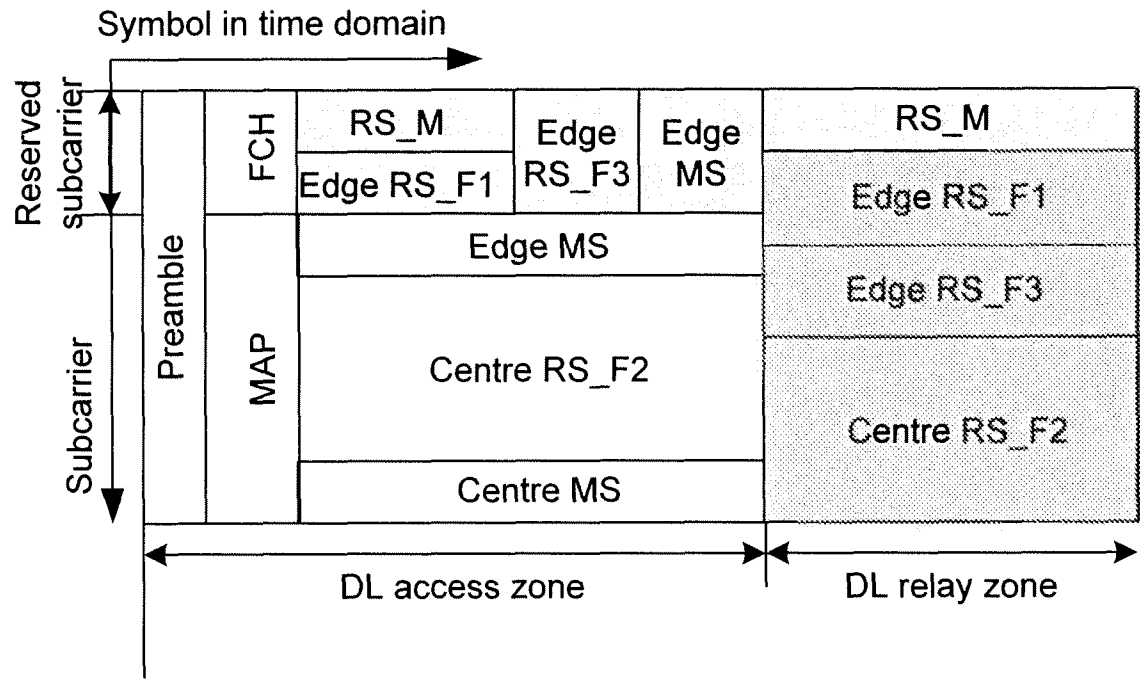


Figure 5

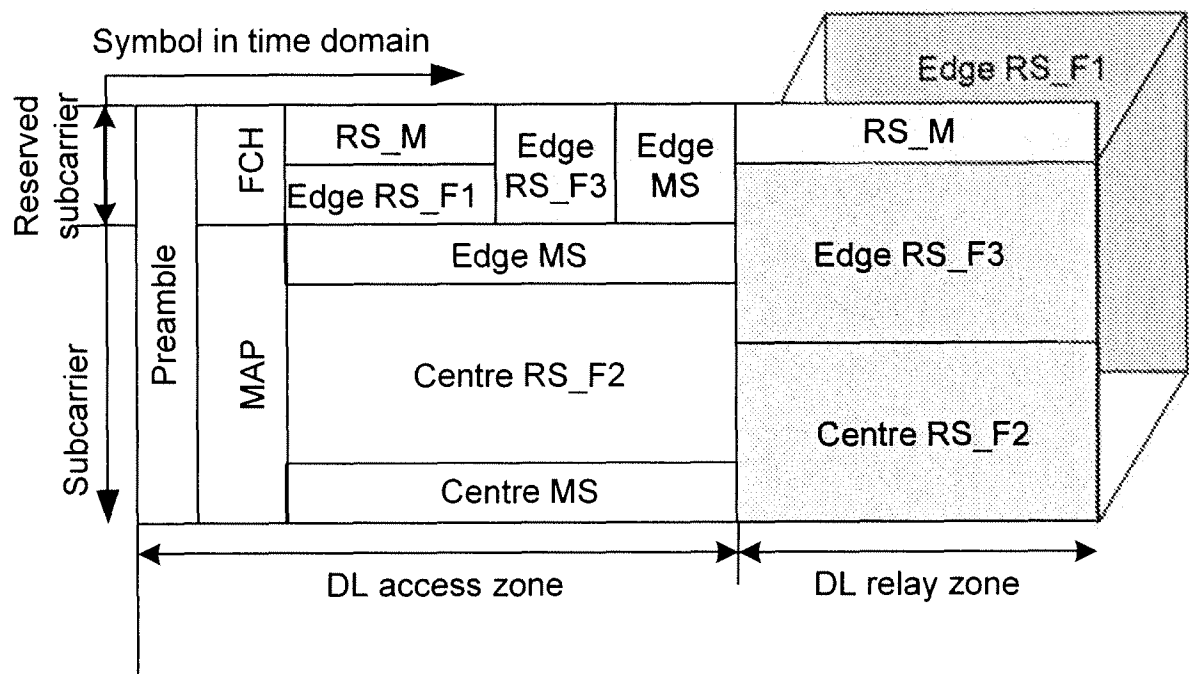


Figure 6