In the Inter-eNB CA, for example, a cell of the macro base station (Macro eNB (MeNB)) and a cell of a low-power base station (Low-Power Node (LPN)) are used simultaneously as a PCell and a SCell, respectively. In this case, bearers are separately configured in the PCell and the SCell. The UE communicates with the MeNB through a bearer in the PCell and communicates with the LPN through the bearer in the SCell.

[0012]

The inventors of this application has conducted various studies on the continuity of communication services when a radio terminal (UE) that is executing Inter-eNB CA moves between cells and has found several problems. For example, a case in which a UE that is executing Inter-eNB CA using a cell of a MeNB as a PCell and using a cell of a first LPN as a SCell changes the SCell to a cell of another second LPN will be considered. When a SCell change procedure (Fig. 17) in normal CA (i.e., Intra-eNB CA) is applied to this change of the SCell, the UE has to release all information regarding the cell of the first LPN and to newly configure information regarding the cell of the second LPN. Thus, a problem occurs in that communication services in the cell of the first LPN cannot be continued in the cell of the second LPN after the SCell is changed.

[0013]

Accordingly, ~~an object~~ embodiments of the present invention ~~is to~~ provide a radio communication system, a radio station, a radio terminal, a communication control method, and a program which contribute to enabling a communication service in a secondary cell to be continued after the secondary cell is changed when a radio terminal which is simultaneously using a plurality of cells served by different radio stations changes the secondary cell from a cell of one radio station to a cell of another radio station.

Solution to Problem

[0014]

~~In a first aspect, a radio communication system includes a radio terminal and a radio network including first to third radio stations.~~

~~The first to third radio stations serve first to third cells, respectively. The radio terminal has a capability of, while using a cell of one radio station as a primary cell, using a cell of another radio station as a secondary cell. Furthermore, the radio network and the radio terminal are configured to, when the radio terminal is using the first cell as the primary cell and the second cell as the secondary cell, change the secondary cell from the second cell to the third cell while keeping communication status information regarding the radio terminal on the second cell.~~

According to a first aspect of the present invention, there is provided a radio communication system comprising: a radio network including a first radio station that serves a first cell, a second radio station that serves a second cell, and a third radio station that serves a third cell; and a radio terminal that has a capability of, while using a cell of one radio station as a primary cell, using a cell of another radio station as a secondary cell, wherein the radio network and the radio terminal are configured to, when the radio terminal is using the first cell as the primary cell and the second cell as the secondary cell, change the secondary cell from the second cell to the third cell while keeping communication status information regarding the radio terminal on the second cell.

[0015]

~~In a second aspect, a first radio station includes a radio communication unit that serves a first cell, and a communication control unit. The communication control unit is configured to, when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using the first cell as a primary cell and using a second cell served by a second radio station as the secondary cell, perform at least one of: (a) sending a request to abort data communication with the radio terminal in the second cell; and (b) receiving or sending communication status information regarding the radio terminal on the second cell.~~

According to a second aspect of the present invention, there is provided a first radio station that serves a first cell, comprising: radio

communication means for serving the first cell; and communication control means for, when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using the first cell as a primary cell and using a second cell served by a second radio station as the secondary cell, performing at least one of: (a) sending a request to abort data communication with the radio terminal in the second cell; and (b) receiving or sending communication status information regarding the radio terminal on the second cell.

[0016]

~~In a third aspect, a second radio station includes a radio communication unit that serves a second cell, and a communication control unit. The communication control unit is configured to, when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using a first cell served by a first radio station as a primary cell and using the second cell as the secondary cell, receive at least one of: (a) a request to abort data communication with the radio terminal in the second cell; and (b) a request to send communication status information regarding the radio terminal on the second cell, and perform at least one of aborting the data communication and sending the communication status information.~~

According to a third aspect of the present invention, there is provided a second radio station that serves a second cell, comprising: radio communication means for serving the second cell; and communication control means for, when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using a first cell served by a first radio station as a primary cell and using the second cell as the secondary cell, receiving at least one of: (a) a request to abort data communication with the radio terminal in the second cell; and (b) a request to send communication status information regarding the radio terminal on the second cell, and for performing at least one of aborting the data communication and sending the communication status information.

[0017]

~~In a fourth aspect, a third radio station includes a radio~~

~~communication unit that serves a third cell, and a communication control unit. The communication control unit is configured to, when changing a secondary cell to the third cell while a radio terminal is using a first cell served by a first radio station as a primary cell and a second cell served by a second radio station as the secondary cell, receive, from the first radio station or the second radio station, communication status information regarding the radio terminal on the second cell.~~

According to a fourth aspect of the present invention, there is provided a third radio station that serves a third cell, comprising: radio communication means for serving the third cell; and communication control means for, when changing a secondary cell to the third cell while a radio terminal is using a first cell served by a first radio station as a primary cell and a second cell served by a second radio station as the secondary cell, receiving, from the first radio station or the second radio station, communication status information regarding the radio terminal on the second cell.

[0018]

~~In a fifth aspect, a radio terminal includes radio communication unit configured to communicate with first to third radio stations, and a communication control unit. The communication control unit is configured to perform control of, while using a first cell of the first radio station as a primary cell, using a second cell served by the second radio station as a secondary cell. The communication control unit is further configured to, when the first cell is being used as the primary cell and the second cell is being used as the secondary cell, change the secondary cell from the second cell to a third cell served by the third radio station while keeping communication status information on the second cell.~~

According to a fifth aspect of the present invention, there is provided a radio terminal comprising: radio communication means for communicating with first to third radio stations; and communication control means for performing control of, while using a first cell served by the first radio station as a primary cell, using a second cell served

by the second radio station as a secondary cell, wherein the communication control means is further configured to, when the first cell is being used as the primary cell and the second cell is being used as the secondary cell, change the secondary cell from the second cell to a third cell served by the third radio station while keeping communication status information on the second cell.

[0019]

~~In a sixth aspect, a communication control method, in a first radio station that serves a first cell, includes when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using the first cell as a primary cell and using a second cell served by a second radio station as the secondary cell, performing at least one of: (a) sending a request to abort data communication with the radio terminal in the second cell; and (b) receiving or sending communication status information regarding the radio terminal on the second cell.~~

According to a sixth aspect of the present invention, there is provided a communication control method in a first radio station that serves a first cell, the method comprising: when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using the first cell as a primary cell and using a second cell served by a second radio station as the secondary cell, performing at least one of: (a) sending a request to abort data communication with the radio terminal in the second cell; and (b) receiving or sending communication status information regarding the radio terminal on the second cell.

[0020]

~~In a seventh aspect, a communication control method, in a second radio station that serves a second cell, includes: when changing a secondary cell to a third cell served by a third radio station while a~~

~~radio terminal is using a first cell served by a first radio station as a primary cell and using the second cell as the secondary cell, receiving at least one of (a) a request to abort data communication with the radio terminal in the second cell and (b) a request to send communication status information regarding the radio terminal on the second cell; and performing at least one of aborting the data communication and sending the communication status information.~~

According to a seventh aspect of the present invention, there is provided a communication control method in a second radio station that serves a second cell, the method comprising: when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using a first cell served by a first radio station as a primary cell and using the second cell as the secondary cell, receiving at least one of (a) a request to abort data communication with the radio terminal in the second cell and (b) a request to send communication status information regarding the radio terminal on the second cell; and performing at least one of aborting the data communication and sending the communication status information.

[0021]

~~In an eighth aspect, a communication control method, in a third radio station that serves a third cell, includes when changing a secondary cell to the third cell while a radio terminal is using a first cell served by a first radio station as a primary cell and a second cell served by a second radio station as the secondary cell, receiving, from the first radio station or the second radio station, communication status information regarding the radio terminal on the second cell.~~

According to an eight aspect of the present invention, there is provided a communication control method in a third radio station that serves a third cell, the method comprising: when changing a secondary cell to the third cell while a radio terminal is using a first cell served by a first radio station as a primary cell and a second cell served by a second radio station as the secondary cell, receiving, from the first radio station or the second radio station, communication status information regarding the radio terminal on the second cell.

[0022]

~~In a ninth aspect, a communication control method, in a radio terminal, includes: (a) while using a first cell of a first radio station as a primary cell, using a second cell served by a second radio station as a secondary cell; and (b) when the first cell is being used as the primary cell and the second cell is being used as the secondary cell, changing the secondary cell from the second cell to a third cell served by a third radio station while keeping communication status information on the second cell.~~

According to a ninth aspect of the present invention, there is provided a communication control method in a radio terminal, the method comprising: while using a first cell served by a first radio station as a primary cell, using a second cell served by a second radio station as a secondary cell; and when the first cell is being used as the primary cell and the second cell is being used as the secondary cell, changing the secondary cell from the second cell to a third cell served by a third radio station while keeping communication status information on the second cell.

[0023]

~~In a tenth aspect, a program includes instructions for causing a computer to perform the communication control method according to the sixth aspect described above.~~

According to a tenth aspect of the present invention, there is provided a non-transitory computer-readable medium storing therein a program for causing a computer to perform a communication control method in a first radio station that serves a first cell, wherein the communication control method comprises: when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using the first cell as a primary cell and using a second cell served by a second radio station as the secondary cell, performing at least one of: (a) sending a request to abort data communication with the radio terminal in the second cell and (b) receiving or sending communication status information regarding the radio terminal on the second cell.

[0024]

~~In an eleventh aspect, a program includes instructions for causing a computer to perform the communication control method according to the seventh aspect described above.~~

According to an eleventh aspect of the present invention, there is provided a non-transitory computer-readable medium storing therein a program for causing a computer to perform a communication control method in a second radio station that serves a second cell, wherein the communication control method comprises: when changing a secondary cell to a third cell served by a third radio station while a radio terminal is using a first cell served by a first radio station as a primary cell and using the second cell as the secondary cell, receiving at least one of (a) a request to abort data communication with a radio terminal in the second cell and (b) a request to send communication status information regarding the radio terminal on the second cell; and performing at least one of aborting the data communication and sending the communication status information.

[0025]

~~In a twelfth aspect, a program includes instructions for causing~~

~~a computer to perform the communication control method according to the eighth aspect described above.~~

According to a twelfth aspect of the present invention, there is provided a non-transitory computer-readable medium storing therein a program for causing a computer to perform a communication control method in a third radio station that serves a third cell, wherein the communication control method comprises, when changing a secondary cell to the third cell while a radio terminal is using a first cell served by a first radio station as a primary cell and a second cell served by a second radio station as the secondary cell, receiving, from the first radio station or the second radio station, communication status information regarding the radio terminal on the second cell.

[0026]

~~In a thirteenth aspect, a program includes instructions for causing a computer to perform the communication control method according to the ninth aspect described above.~~

According to a thirteenth aspect of the present invention, there is provided a non-transitory computer-readable medium storing therein a program for causing a computer to perform a communication control method in a radio terminal, wherein the communication control method comprises: while using a first cell served by a first radio station as a primary cell, using a second cell served by a second radio station as a secondary cell; and when the first cell is being used as the primary cell and the second cell is being used as the secondary cell, changing the secondary cell from the second cell to a third cell served by a third radio station while keeping communication status information on the second cell.

Advantageous Effects of Invention

[0027]

According to the above aspects, it is possible to provide a radio communication system, a radio station, a radio terminal, a communication control method, and a program capable of enabling a communication service in a secondary cell to be continued after the

secondary cell is changed when a radio terminal which is simultaneously using a plurality of cells served by different radio stations changes the secondary cell from a cell of one radio station to a cell of another radio station.

Brief Description of Drawings

[0028]

Fig. 1 is a diagram illustrating a configuration example of a radio communication system according to a first embodiment.

Fig. 2 is a diagram illustrating a configuration example of a first radio station according to the first embodiment.

Fig. 3 is a diagram illustrating a configuration example of a second radio station according to the first embodiment.

Fig. 4 is a diagram illustrating a configuration example of a third radio station according to the first embodiment.

Fig. 5 is a diagram illustrating a configuration example of a radio terminal according to the first embodiment.

Fig. 6 is a flowchart illustrating an operation example of a radio terminal according to the first embodiment (Procedure Example 1).

Fig. 7 is a flowchart illustrating an operation example of a radio network according to the first embodiment (Procedure Example 1).

Fig. 8 is a sequence diagram illustrating an example of a communication control method in the radio communication system