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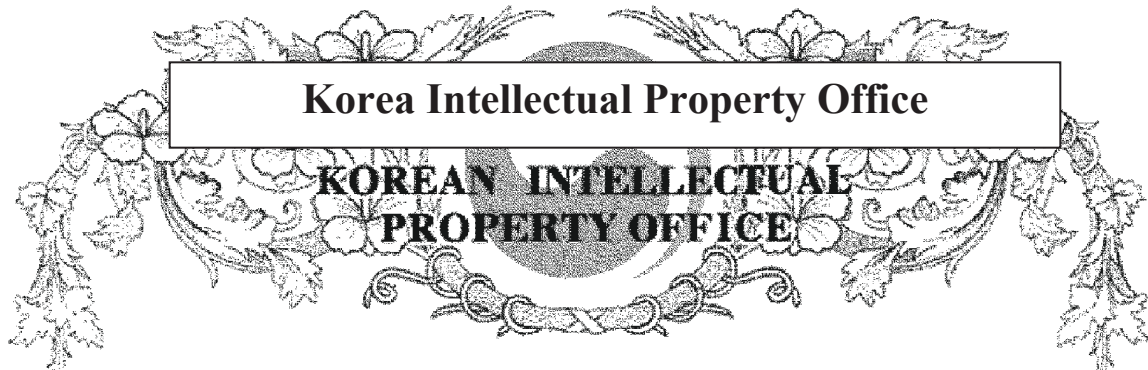
April 12, 2025

Date

**DOCUMENT MADE AVAILABLE UNDER THE
PATENT COOPERATION TREATY (PCT)**

International application number:	PCT/KR2017/009170
International filing date:	22 August 2017 (22.08.2017)
Document type:	Certified copy of priority document
Document details:	Country/Office: KR
	Number: 10-2016-0106427
	Filing date: 22 August 2016 (22.08.2016)
Date of receipt at the International Bureau:	30 August 2017 (30.08.2017)

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-bis)



This is to certify that the following application annexed hereto is a true copy from the records of the Korean Intellectual Property Office

Application Number: 10-2016-0106427

Filing Date: August 22, 2016

Applicant(s): SAMSUNG ELECTRONICS CO., LTD.

August 29, 2017



Commissioner, Korean Intellectual Property Office [seal]

[Bibliography]

[Document name]	Patent application
[Application Category]	Patent application
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[Name]	Samsung Electronics Co., Ltd.
[Patent Customer Number]	1-1998-104271-3
[Mandating Registration Number]	2008-039968-0
[Title of Invention in Korean Script]	무선 셀룰라 통신 시스템에서 코드블록 인덱스 삽입 방법 및 장치
[Title of Invention in English Script]	METHOD AND APPARATUS FOR INSERTION OF CODE BLOCK INDEX IN WIRELESS CELLULAR COMMUNICATION SYSTEM
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Office as above.
Agent: YOON, Dongyeol (Signature or Stamp)
[Fees]
[Application fee] 0 pages 46,000 won
[Additional Application Fee] 231 pages 0 won
[Priority Claim Fee] 0 items 0 won
[Examination request fee] 0 items 0 won
[Total] 46,000 won

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[Title of the invention]

Method and apparatus for insertion of code block index in wireless cellular communication system

[Technical field]

[0001] The present invention relates to a wireless communication system, and more specifically, to a method and apparatus for inserting an index into a code block, which is a unit in which a channel code is performed, and transmitting the same.

[Prior Art]

[0002] To meet a demand for radio data traffic that is on an increasing trend since commercialization of a 4G communication system, efforts to develop an improved 5G communication system or a pre-5G communication system have been conducted. For this reason, the 5G communication system or the pre-5G communication system is called a beyond 4G network communication system or a post LTE system. To achieve a high data transmission rate, the 5G communication system is considered to be implemented in a very high frequency (mm Wave) band (e.g., like 60 GHz band). To relieve a path loss of a radio wave and increase a transfer distance of the radio wave in the very high frequency band, in the 5G communication system, beamforming, massive MIMO, full dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, and large scale antenna technologies have been discussed.

Further, to improve a network of the system, in the 5G communication system, technologies such as an evolved small cell, an advanced small cell, a cloud radio access network (cloud RAN), an ultra-dense network, a device to device communication (D2D), a wireless backhaul, a moving network, cooperative communication, coordinated multi-points (CoMP), and reception interference cancellation have been developed. In addition to this, in the 5G system, hybrid FSK and QAM modulation (FQAM) and sliding window superposition coding (SWSC) that are an advanced coding modulation (ACM) scheme and a filter bank multi carrier (FBMC), a non orthogonal multiple access (NOMA), and a sparse code multiple access (SCMA) that are an advanced access technology, and so on have been developed.

[0003] Meanwhile, the Internet has evolved from a human-centered connection network through which a human being generates and consumes information to the Internet of Things (IoT) network that transmits/receives information between distributed components such as things and processes the information. The Internet of Everything (IoE) technology in which the big data processing technology, etc., is combined with the IoT technology by connection with a cloud server, etc. has also emerged. To implement the IoT, technology elements, such as a sensing technology, wired and wireless communication and network infrastructure, a service interface technology, and a security technology, have been in demand; recently, technologies such as a sensor network, machine to machine (M2M), and machine type communication (MTC) for connecting between things have been researched.

In the IoT environment, an intelligent Internet technology (IT) service that creates a new value in human life by collecting and analyzing data generated in the connected things may be provided. The IoT may be applied to fields, such as a smart home, a smart building, a smart city, a smart car or a connected car, a smart grid, health care, smart appliances, and an advanced healthcare service, by fusing and combining the existing information technology (IT) with various industries.

[0004] Therefore, various tries to apply the 5G communication system to the IoT network have been conducted. For example, the 5G communication technologies, such as the sensor network, the machine to machine (M2M), and the machine type communication (MTC), have been implemented by techniques such as beamforming, MIMO, and the array antenna. The application of the cloud radio access network (cloud RAN) as the big data processing technology described above may also be considered as an example of the fusing of the 5G communication technology with the IoT technology.

[0005] Meanwhile, recently, there is a need for a method and apparatus for inserting an index into a code block as a unit in which a channel code is executed and transmitting the same, in accordance with the development of a next generation mobile communication system.

[Details of the Invention]

[Problem to be Solved by the Invention]

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[0006] A primary object of the present is to provide a method of inserting a code block (CB) index, a method of operating a system by applying a CB index to retransmission, and the like. In a wireless communication system, in particular, the existing LTE system, a data transmission is performed in a transport block (TB) unit. The TB is divided into a plurality of code blocks (CB), and channel coding is performed in a CB unit. The retransmission after an initial transmission is performed in a TB unit, and the TBs need to be retransmitted even when only one CB fails to decode. Therefore, it may be a case in which the retransmission needs to be made in a CB unit. For the case, there is a need for a method of inserting and operating a CB index notifying a CB of the order of CBs.

[0007] In addition, another object of the present invention is to provide a method for selecting a method for mapping the frequency domain first and a method for mapping the time domain first, a method for performing frequency-time hybrid mapping, etc., and to provide a method for selecting each mapping method and transmitting mapping method information. In a wireless communication system, especially in the conventional LTE downlink, when mapping data, the frequency domain is first mapped in an OFDM symbol of an allocated frequency domain and TTI (1ms subframe), and then mapping is performed in the next OFDM symbol. In other words, the method of mapping to the frequency domain first and then to the time domain is followed. In 5G wireless communication, the method of mapping to the frequency domain first and the method of mapping to the time domain first can be set to be performed differently depending on a specific situation. This is because the method of mapping to the frequency domain first and the method of mapping to the time domain first each have their own advantages.

[0008]

[0008] Another object of the present invention is to provide a method for transmitting and receiving data in a mobile communication system.

[0009] In addition, another object of the present invention is that, in a 5th Generation Wireless Cellular Communication System (hereinafter referred to as the 5G communication system), in order to satisfy various user requirements and services, a single system should be able to provide various services with different transmission/reception techniques and transmission/reception parameters, and considering forward compatibility, it aims to design so that additional services in the future do not have restrictions that are limited by the design of the existing system. As an example of a method for supporting various services, the 5G communication system should be able to operate efficiently in various frequency bands compared to the existing communication system. Another object of the present disclosure is directed to provision of various services having different transmission/ reception techniques and transmission/reception parameters in one system in order to satisfy various requirements and services of users in the 5th generation wireless cellular communication system (hereinafter, referred to as 5G communication system) and to realize a design so that services to be added in future in consideration of forward compatibility are not restricted by the current system. As an example of a method for supporting various services, the 5G communication system should be able to operate efficiently in various frequency bands compared to the existing communication system. In other words, it should be able to operate efficiently in frequency bands below 1 GHz to above 70 GHz. While the frequency band below 1 GHz has the advantage of being able to secure wide coverage, it has the disadvantage of being difficult to secure a wide frequency band. On the other hand, the high-frequency band above 70 GHz is suitable for ultra-high-speed data transmission because it is easy to secure a wide frequency band, but has the disadvantage of narrow coverage. Low-frequency bands and high-frequency bands can have different frequency characteristics depending on the frequency band, so this needs to be taken into consideration when designing a communication system. In the low-frequency band below 6 GHz, the path loss attenuation due to the distance between the **transmitter** and **receiver** is relatively small. On the other hand, in the high-frequency band above 6 GHz, the path loss due to the distance between the **transmitter** and **receiver** is very large. Therefore, in the case of a cellular system operating in a high-frequency band, the coverage may be very small compared to a system operating in a low-frequency band.

In order to secure coverage in the high-frequency band, it is desirable to apply transmission based on directional beam using a multi-antenna array in the high-frequency band. Transmission based on directional beam can expand coverage in a specific direction, but it is difficult to transmit signals in all directions simultaneously. On the other hand, in the case of low-frequency bands below 6 GHz, since there is relatively little path loss between the same transmitter and receiver, it is possible to secure full coverage using an omnidirectional beam without a directional beam.

[0010] In designing the initial access process of a communication system supporting various frequency bands, the difference between the low frequency band below 6 GHz and the high frequency band above 6 GHz must be considered. Initial access refers to the method and procedure for an idle terminal to access a base station, and for the initial access of the terminal, the base station broadcasts a synchronization signal and system information to the terminal. The synchronization signal is a signal transmitted by the base station for the terminal to perform time and frequency synchronization and detect the unique number of the base station or network. Here, the unique number of the base station or network refers to the conventional cell number, or the beam number, or it is assumed that the base station includes information necessary for the terminal to obtain system information. In addition, the system information is information necessary for the terminal to access the network, and an idle terminal can detect the unique number of the base station or network using the synchronization signal and then receive it based on the unique number. A base station operating a low frequency band can transmit a synchronization signal using a relatively wide omnidirectional beam (Omni-Beam).

That is, through one transmission of a synchronization signal, terminals in a wide range can acquire synchronization signals and system information regardless of their locations within the cell. On the other hand, a base station operating a high-frequency band must transmit synchronization signals using a directional beam to secure coverage. In the case of a synchronization signal transmitted using a directional beam, unlike a low-frequency band, coverage cannot be secured in all directions, so a method of transmitting beams in multiple directions can be considered to transmit synchronization signals in all directions. For the above reasons, it can be considered in different initial access processes depending on the frequency band. However, providing different initial access methods depending on the frequency band in one communication system may not be desirable in terms of terminal complexity, implementation, and system efficiency. Therefore, it is necessary to provide an initial access method and procedure that is optimized for each frequency band and is as unified as possible.

[0011] Another object of the present disclosure is to provide various services having different transmission/reception techniques and transmission/reception parameters in one system in order to satisfy various requirements and services of users in the 5th generation wireless cellular communication system (hereinafter, referred to as 5G communication system) and to realize a design so that services to be added in future in consideration of forward compatibility are not restricted by the current system. As an example of a method for supporting various services in a 5G communication system, the present invention can consider a system that supports multiple subcarrier spacings within one system.

[0012] Meanwhile, in the wireless communication system, a terminal performs the following initial connection step for the purpose of establishing a radio link with a base station. First, synchronization with a cell in a network is acquired, and a master information block (MIB) is acquired by physical broadcast channel (PBCH) decoding. The MIB contains the most basic information for connection to the system. Based on the information, a physical downlink control channel (PDCCH) and a physical downlink shared channel (PDSCH) are decoded to obtain a system information block (SIB). Thereafter, it exchanges identity with the base station through a random access step and then performs an initial connection to a network through steps such as registration and authentication. At this time, since the 5G communication system supports various numerologies, for example, various parameters for the subcarrier spacing, the numerologies for the physical layer channel in which each information is transmitted in the initial connection step may be different from each other. However, since the terminal can not know the subcarrier spacing used by the system during the initial connection process, the initial connection may not be efficiently performed.

[0013] In addition, a terminal in an RRC_IDLE state undergoes a paging process to start data transmission/reception. In order to observe the paging information, the terminal wakes up for a little while at a predetermined time interval to observe control signaling. For the terminal in the RRC_IDLE state, the network knows a location of the terminal in a tracking area (TA) unit, not in a cell unit, in which the TA is defined by grouping several neighboring eNBs. The paging message may be transmitted across a plurality of cells within the TA. The paging message is transmitted through the PDSCH, and scheduling information on the PDSCH can be acquired from the PDCCH configured as P-RNTI. In this case, if various numerologies are used in the

5G communication system, each cell can transmit the paging message through a physical layer channel set at different subcarrier spacing's. In particular, if an initial connection to a certain cell is performed and then a reselection to another cell is performed, the corresponding cell does not have any information on the terminal in the RRC_IDLE state, such that an operation procedure for efficiently transmitting the paging message is used.

[0014] Therefore, the present disclosure proposes an effective method and operation procedure for cell initial connection and paging suitable for the 5G communication system. The cell initial connection and paging method proposed by the present disclosure can support the efficient services for various numerologies to more flexibly operate the 5G communication system capable of simultaneously providing different requirements.

[Means for Solving the Problems]

[0015]

In order to solve the above problems, the present invention is a method for processing a control signal in a wireless communication system, the method comprising: a step of receiving a first control signal transmitted from a base station, a step of processing the received first control signal, and a step of transmitting a second control signal generated based on the processing to the base station.

[Effect of the Invention]

[0016] According to one embodiment of the present invention, an operation method for inserting and transmitting a CB index is provided, thereby efficiently performing base station and terminal transmission to reduce unnecessary data transmission.

[0017] In addition, according to another embodiment of the present invention, by defining a transmission and reception method for a terminal in a mobile communication system, wireless resources are efficiently utilized and transmission delay is reduced.

[0018] Further, according to another embodiment of the present invention, a base station method and device for efficiently supporting a unified initial access method in designing a system operating in various frequency bands to satisfy various user requirements and services are provided, and an initial access method of a terminal using the same is provided.

[0019] Moreover, according to another embodiment of the present invention, by providing an effective cell initial access and paging method in a 5G communication system supporting various numerologies, a 5G wireless communication system supporting various services with different requirements at the same time can be efficiently operated.

[Brief Description of the Drawings]

FIG. 1A illustrates a diagram of a transport structure of a time-frequency domain of the LTE or LTE-A system.

FIG. 1B illustrates a diagram of a transport structure of an uplink time-frequency domain of the LTE or LTE-A system.

FIG. 1C illustrates a diagram of a state in which data for eMBB, URLLC, and mMTC are allocated in frequency-time resources in a communication system.

FIG. 1D illustrates a diagram of a state in which the data for eMBB, URLLC, and mMTC are allocated in the frequency-time resources in the communication system.

FIG. 1E illustrates a diagram of a structure in which one transport block according to embodiments of the present disclosure is divided into several code blocks and a CRC is added.

FIG. 1F illustrates a diagram of a structure in which an outer code according to embodiments of the present disclosure is applied and coded.

FIG. 1G illustrates a block diagram depending on whether to apply the outer code according to embodiments of the present invention.

FIG. 1H illustrates a diagram of an example of a structure for inserting code block index information according to the present invention.

FIG. 1I illustrates a diagram of an example of the structure for inserting code block index information according to the present invention.

FIG. 1J illustrates a diagram of an example of the structure for inserting code block index information according to the present invention.

FIG. 1K illustrates a diagram of a procedure of a base station and a terminal according to embodiments of the present invention.

FIG. 1M illustrates a diagram of the procedure of the base station and the terminal according to embodiments of the present invention.

FIG. 1S illustrates a diagram of the internal structure of a terminal according to embodiments of the present invention.

FIG. 2a is a diagram showing a downlink time-frequency domain transmission structure of an LTE or LTE-A system.

FIG. 2b is a diagram showing an uplink time-frequency domain transmission structure of an LTE or LTE-A system.

FIG. 2c is a diagram showing how data for eMBB, URLLC, and mMTC are allocated from frequency-time resources in a communication system.

FIG. 2d is a diagram showing how data for eMBB, URLLC, and mMTC are allocated from frequency-time resources in a communication system.

FIG. 2e is a diagram showing a structure in which one transport block is divided into several code blocks and a CRC is added according to an embodiment.

FIG. 2f is a diagram showing a structure in which an outer code is applied and coded according to an embodiment.

FIG. 2g is a diagram showing a block diagram according to whether an outer code is applied according to an embodiment.

FIG. 2h is a diagram showing an example of signal mapping described in the 2-1 embodiment of the present invention.

FIG. 2i is a drawing showing another example of signal mapping described in the second embodiment of the present invention.

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FIG. 2j is a drawing showing another example of signal mapping described in the 2-1 embodiment of the present invention.

FIG. 2k is a drawing showing another example of signal mapping described in the 2-1 embodiment of the present invention.

FIG. 2m is a drawing showing another example of signal mapping described in the 2-1 embodiment of the present invention.

FIG. 2n is a drawing showing another example of signal mapping described in the 2-1 embodiment of the present invention.

FIG. 2o is a drawing showing a procedure of a base station and a terminal according to the 2-1 embodiment.

FIG. 2p is a drawing showing a procedure of a base station and a terminal according to the 2-1 embodiment.

FIG. 2s is a drawing showing an internal structure of a terminal according to embodiments of the present invention.

FIG. 2t is a drawing showing an internal structure of a base station according to embodiments of the present invention. FIG. 3a is a diagram showing the basic structure of the time-frequency resource domain, which is a radio resource domain where data or control channels of existing LTE and LTE-A systems are transmitted.

FIGS. 3b, 3c, and 3d show examples of extended frame structures.

FIG. 3e shows frame structure types A, B, and C in comparison with the LTE frame structure in the time domain.

FIG. 3f shows an example of multiplexing the above frame structure types A, B, and C in one system.

FIG. 3g shows an example of a measurement gap in an LTE system.

FIG. 3h shows that a terminal supports a combination of LTE and NR with frame structure type B, and that the LTE system and the NR system are time-synchronized between subframes or radio frames by a specific offset.

FIGS. 3i, 3j, and 3k show the A1 and A2 sections, respectively, for each frame structure type of the NR system.

FIG. 3l shows an operation method of a terminal and a base station according to an embodiment of the present invention.

FIG. 3m shows a procedure in which a terminal acquires measurement gap control information and performs measurement.

FIG. 3n shows a flexible scheduling timing in an NR system.

FIG. 3o shows a flexible HARQ timing in an NR system.

FIGS. 3p and 3q explain the operation of a terminal according to an embodiment of the present invention.

FIG. 3r shows the terminal procedure when the measurement gap and the uplink data or control information transmission time overlap according to the above method.

FIG. 3s shows that the terminal supports the combination of LTE and NR with frame structure type C, and the LTE system and the NR system are out of time synchronization between subframes or radio frames by a certain offset.

FIG. 3t describes a method for measuring channel status information (CSI; Channel Status Information) of a terminal in a partial subframe.

FIG. 3u shows a procedure for a terminal to measure CSI according to the above method.

FIG. 3v shows a terminal transceiver according to the present invention.

FIG. 4a is a diagram showing a transmission based on a directional beam considered in a high-frequency band of 6 GHz or higher.

FIG. 4b is a diagram showing a method for transmitting a synchronization signal and system information based on beam sweeping.

FIG. 4c is a diagram showing a structure for transmitting a physical channel through which a synchronization signal and system information are transmitted when transmitting a synchronization signal and system information using an omnidirectional beam.

FIG. 4d is a diagram showing a structure for transmitting a physical channel through which a synchronization signal and system information are transmitted when transmitting a synchronization signal and system information using a directional beam.

FIG. 4e is a flowchart showing an initial connection process according to the 4-1 embodiment of the present invention.

FIG. 4f is a drawing illustrating a method of multiplexing synchronization signals and system information in a system using a directional beam according to the 4-2 embodiment of the present invention.

FIG. 5a is a drawing illustrating an example of 5G services being multiplexed and transmitted in one system.

FIG. 5b is a diagram illustrating the basic structure of the time-frequency domain in LTE.

FIG. 5c is a diagram illustrating resource elements having different subcarrier spacings.

FIG. 5d is a diagram illustrating a downlink physical layer channel used for cell initial access in LTE.

FIG. 5e is a diagram illustrating a contention-based random access procedure in LTE.

FIG. 5f is a diagram illustrating an uplink physical layer channel for random access in LTE.

FIG. 5g is a diagram illustrating a first embodiment of a communication system to which the present invention is applied.

FIG. 5h is a diagram illustrating a base station and terminal procedure according to the 5-1 embodiment of the present invention.

FIG. 5i is a diagram illustrating a paging procedure in LTE.

FIG. 5j is a diagram illustrating a second embodiment of a communication system to which the present invention is applied.

FIG. 5k is a drawing illustrating a base station and terminal procedure according to the 5-2nd embodiment of the present invention.

FIG. 5l is a drawing illustrating a base station and terminal procedure according to the 5-2nd embodiment of the present invention.

FIG. 5m is a block diagram showing a terminal transceiver structure according to an embodiment of the present invention.

FIG. 5n is a block diagram showing a base station transceiver structure according to an embodiment of the present invention.

[Specific Details for Carrying Out the Invention]

[0021] Hereinafter, embodiments of the present invention will be described in detail with the attached drawings. In addition, if it is judged that a specific description of a related known function or configuration may unnecessarily obscure the gist of the present invention when explaining the present invention, the detailed description will be omitted. In addition, the terms described below are terms defined in consideration of the functions in the present invention, and this may vary depending on the intention or custom of the user or operator. Therefore, the definition should be made based on the contents throughout this specification.

[0022] The advantages and features of the present invention, and the method of achieving them will become clear with reference to the embodiments described in detail below with the attached drawings. However, the present invention is not limited to the embodiments disclosed below, but can be implemented in various different forms, and these embodiments are provided only to make the disclosure of the present invention complete and to fully inform a person having ordinary skill in the art to which the present invention belongs of the scope of the invention, and the present invention is defined only by the scope of the claims. The same reference numerals refer to the same components throughout the specification.

[0023][First Embodiment]

[0024]In order to meet the increasing demand for wireless data traffic since the commercialization of the 4G communication system, efforts are being made to develop an improved 5G communication system or pre-5G communication system. For this reason, the 5G communication system or pre-5G communication system is called a communication system after the 4G network (Beyond 4G Network) or a system after the LTE system (Post LTE). In order to achieve a high data transmission rate, the 5G communication system is being considered for implementation in an ultra-high frequency (mmWave) band (e.g., a 60 gigabit (60 GHz) band). To mitigate the path loss of radio waves in ultra-high frequency bands and increase the transmission distance of radio waves, beamforming, massive MIMO, full-dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, and large-scale antenna technologies are being discussed in 5G communication systems. In addition, for the network improvement of the system, the 5G communication system is developing technologies such as evolved small cell, advanced small cell, cloud radio access network (cloud RAN), ultra-dense network, device to device communication (D2D), wireless backhaul, moving network, cooperative communication, CoMP (Coordinated Multi-Points), and interference cancellation. Further, in the 5G system, the same reference symbol refers to the same component throughout the FQAM, which is an advanced coding modulation (ACM) method. (Hybrid FSK and QAM Modulation) and SWSC (Sliding Window Superposition

Coding), and advanced access technologies such as FBMC (Filter Bank Multi Carrier), NOMA (non-orthogonal multi access), and SCMA (sparse code multi access) are being developed.

[0025] Meanwhile, the Internet is evolving from a human-centered network where humans create and consume information to an IoT (Internet of Things) network where information is exchanged and processed between distributed components such as objects. IoE (Internet of Everything) technology, which combines IoT technology with big data processing technology through connection to cloud servers, etc., is also emerging. In order to implement IoT, technological elements such as sensing technology, wired/wireless communication and network infrastructure, service interface technology, and security technology are required, and recently, sensor networks for connecting objects, machine-to-machine (M2M), and machine-type communication (MTC) are being studied. In the IoT environment, intelligent IT (Internet Technology) services can be provided that collect and analyze data generated from connected objects to create new values for human life. IoT can be applied to fields such as smart homes, smart buildings, smart cities, smart cars or connected cars, smart grids, healthcare, smart home appliances, and advanced medical services through the convergence and combination of existing IT (information technology) technologies and various industries.

[0026] Accordingly, various attempts are being made to apply 5G communication systems to IoT networks. For example, technologies such as sensor networks, machine-to-machine (M2M), and machine-type communication (MTC) are being implemented by techniques such as beam forming, MIMO, and array antennas, which are 5G communication technologies.

The application of cloud RAN as a big data processing technology described above can also be considered an example of the convergence of 5G and IoT technologies.

[0027] Meanwhile, the new 5G communication, NR (New Radio access technology), is designed to allow various services to be freely multiplexed in time and frequency resources, and accordingly, waveform/numerology, etc. and reference signals can be dynamically or freely allocated according to the needs of the corresponding service. In order to provide the optimal service to the terminal in wireless communication, optimized data transmission through measurement of channel quality and interference amount is important, and therefore accurate channel status measurement is essential. However, unlike 4G communication where channel and interference characteristics do not change significantly depending on frequency resources, in the case of 5G channels, channel and interference characteristics change significantly depending on the service, so support for subsets at the FRG (Frequency Resource Group) level is required to allow for dividing and measuring them. Meanwhile, in the NR system, the types of services supported can be divided into categories such as eMBB (Enhanced mobile broadband), mMTC (massive Machine Type Communications) (mMTC), and URLLC (Ultra-Reliable and low-latency Communications). eMBB can be seen as a service that aims for high-speed transmission of high-capacity data, mMTC as a service that aims for minimizing terminal power and connecting multiple terminals, and URLLC as a service that aims for high reliability and low latency. Different requirements can be applied depending on the type of service applied to the terminal.

[0028] In this way, multiple services can be provided to users in a communication system, and in order to provide such multiple services to users, a method and a device using the method that can provide each service within the same time period according to the characteristics are required.

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[0029] Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

[0030] In describing embodiments, descriptions of technical contents that are well known in the technical field to which the present invention belongs and are not directly related to the present invention will be omitted. This is to convey the gist of the present invention more clearly without obscuring unnecessary explanations.

[0031] For the same reason, some components in the attached drawings are exaggerated, omitted, or schematically illustrated. In addition, the size of each component does not fully reflect the actual size. The same or similar components in each drawing are given the same reference numbers.

[0032] The advantages and features of the present invention, and the methods for achieving them will become clear with reference to the embodiments described in detail below together with the attached drawings. However, the present invention is not limited to the embodiments disclosed below, but can be implemented in various different forms, and these embodiments are provided only to make the disclosure of the present invention complete and to fully inform a person having ordinary skill in the art to which the present invention belongs of the scope of the invention, The present invention is defined only by the scope of the claims. The same reference numerals refer to the same components throughout the specification.

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[0033] At this time, it will be understood that each block of the processing flow diagrams and the combination of the flow diagrams can be performed by computer program instructions. Since these computer program instructions can be loaded onto a processor of a general-purpose computer, a special-purpose computer, or other programmable data processing equipment, the instructions executed through the processor of the computer or other programmable data processing equipment create a means for performing the functions described in the flow diagram block(s). Further, since these computer program instructions can also be stored in a computer-available or computer-readable memory that can be directed to a computer or other programmable data processing equipment to implement the functions in a specific manner, the instructions stored in the computer-available or computer-readable memory can also produce a manufactured item that includes an instruction means for performing the functions described in the flow diagram block(s). Since the computer program instructions can be installed on a computer or other programmable data processing device, the instructions that perform a series of operational steps on the computer or other programmable data processing device to create a computer-executable process, and that perform the computer or other programmable data processing device, can also provide steps for performing the functions described in the flowchart block(s).

[0034] In addition, each block can represent a module, segment, or part of code that includes one or more executable instructions for performing a specific logical function(s). It should also be noted that in some alternative implementation examples, the functions mentioned in the blocks can occur out of order.

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For example, two blocks shown in succession may actually be executed substantially simultaneously, or the blocks may sometimes be executed in reverse order depending on the corresponding function.

[0035] At this time, the term 'part' used in the present embodiment means a software or hardware component such as an FPGA or ASIC, and '-part' performs certain roles. However, '-part' is not limited to software or hardware. '-part' may be configured to be in an addressable storage medium and may be configured to reproduce one or more processors. Therefore, as an example, '-part' includes components such as software components, object-oriented software components, class components, and task components, and processes, functions, properties, procedures, subroutines, segments of program code, drivers, firmware, microcode, memory, data, databases, data structures, tables, arrays, and variables. The functions provided in the components and '-parts' may be combined into a smaller number of components and '-parts' or further separated into additional components and '-parts'. In addition, the components and '-parts' may be implemented to play one or more CPUs in the device or the secure multimedia card. In addition, in an embodiment, the '-parts' may include one or more processors.

[0036] Wireless communication systems are evolving from providing initial voice-oriented services to broadband wireless communication systems that provide high-speed, high-quality packet data services, such as 3GPP's HSPA (High Speed Packet Access), LTE (Long Term Evolution or E-UTRA (Evolved

Universal Terrestrial Radio Access)), LTE-Advanced (LTE-A), 3GPP2's HRPD (High Rate Packet Data), UMB (Ultra Mobile Broadband), and IEEE's 802.16e. In addition, the 5G or NR (new radio) communication standard is being created as a 5th generation wireless communication system.

[0037] As a representative example of the above broadband wireless communication system, the LTE system adopts the OFDM (Orthogonal Frequency Division Multiplexing) method in the downlink (DL) and the SC-FDMA (Single Carrier Frequency Division Multiple Access) method in the uplink (UL). Uplink refers to a wireless link in which a terminal (UE (User Equipment) or MS (Mobile Station)) transmits data or control signals to a base station (eNode B or base station (BS)), and downlink refers to a wireless link in which a base station transmits data or control signals to a terminal. The above multiple access method typically allocates and operates the time-frequency resources for transmitting data or control information to each user so that they do not overlap with each other, that is, so that orthogonality is established, thereby distinguishing the data or control information of each user.

[0038] The LTE system adopts the HARQ (Hybrid Automatic Repeat reQuest) method in which the physical layer retransmits the corresponding data when a decoding failure occurs in the initial transmission. The HARQ method is a method in which the receiver notifies the transmitter of the decoding failure when the receiver fails to correctly decode the data (NACK; Negative Acknowledgement) to allow the transmitter to retransmit the data at the physical layer. The receiver combines the data retransmitted by the transmitter with the data that was previously decoded unsuccessfully to improve data reception performance.

If the receiver correctly decodes the data, it can transmit information (ACK; Acknowledgement) to the transmitter to notify the transmitter of the decoding success, so that the transmitter can transmit new data.

[0039] FIG. 1a is a diagram showing the basic structure of the time-frequency domain, which is a radio resource domain in which the data or control channel is transmitted in the downlink in the LTE system.

[0040] In FIG. 1a, the horizontal axis represents the time domain, and the vertical axis represents the frequency domain. The minimum transmitter in the time domain is an OFDM symbol, and N_{symb} (1a-02) OFDM symbols are combined to form one slot (1a-06), and two slots are combined to form one subframe (1a-05). The length of the slot is 0.5ms, and the length of the subframe is 1.0ms. Further, the radio frame (1a-14) is a time domain unit consisting of 10 subframes. The minimum transmitter in the frequency domain is a subcarrier, and the bandwidth of the entire system transmission bandwidth consists of a total of N_{BW} (1a-04) subcarriers.

[0041] The basic unit of resources in the time-frequency domain is a resource element (1a-12, Resource Element; RE), which can be expressed by an OFDM symbol index and a subcarrier index. A resource block (1a-08, Resource Block; RB or Physical Resource Block; PRB) is defined as N_{symb} (1a-02) consecutive OFDM symbols in the time domain and N_{RB} (1a-10) consecutive subcarriers in the frequency domain. Therefore, one RB (1a-08) consists of $N_{\text{symb}} \times N_{\text{RB}}$ REs (1a-12). In general, the minimum transmitter of data is the above RB unit. In LTE systems, $N_{\text{symb}} = 7$, $N_{\text{RB}} = 12$, and N_{BW} and N_{RB} are proportional to the bandwidth of the system transmission band, but other values may be used in systems other than LTE systems.

The data rate increases in proportion to the number of RBs scheduled to the terminal. The LTE system operates by defining 6 transmission bandwidths. In the case of an FDD system that operates by dividing the downlink and uplink by frequency, the downlink transmission bandwidth and the uplink transmission bandwidth may be different. The channel bandwidth indicates the RF bandwidth corresponding to the system transmission bandwidth. Table 1a-01 shows the correspondence between the system transmission bandwidth and the channel bandwidth defined in the LTE system. For example, an LTE system with a 10MHz channel bandwidth consists of 50 RBs in the transmission bandwidth.

[0042] [Table 1a]

Channel bandwidth BW _{channel} [MHz]	1.4	3	5	10	15	20
Transmission bandwidth configuration N _{RB}	6	15	25	50	75	100

[0043]

[0044] In the case of downlink control information, it can be transmitted within the first N OFDM symbols within the subframe. In the embodiment, N is generally {1, 2, 3}. Therefore, the N value can be applied variably for each subframe depending on the amount of control information to be transmitted in the current subframe. The transmitted control information can include a control channel transmission interval indicator indicating how many OFDM symbols the control information is transmitted over, scheduling information for downlink data or uplink data, and information regarding HARQ ACK/NACK.

[0045] In the LTE system, scheduling information for downlink data or uplink data is transmitted from the base station to the terminal through downlink control information (DCI). DCI is defined according to various formats, and each format can indicate whether it is scheduling information for uplink data (UL grant) or scheduling information for downlink data (DL grant), whether it is compact DCI with small control information size, whether spatial multiplexing using multiple antennas is applied, and whether it is DCI for power control. For example, DCI format 1, which is scheduling control information (DL grant) for downlink data, can include at least one of the following control information.

[0046] - Resource allocation type 0/1 flag: Indicates whether the resource allocation method is type 0 or type 1. Type 0 allocates resources in RBG (resource block group) units using the bitmap method. In the LTE system, the basic unit of scheduling is RB, which is expressed as a time and frequency domain resource, and RBG consists of multiple RBs, which becomes the basic unit of scheduling in the Type 0 method. Type 1 allocates a specific RB within the RBG.

[0047] - Resource block assignment: Indicates the RB allocated to data transmission. The resource to be expressed is determined according to the system bandwidth and resource allocation method.

[0048] - Modulation and coding scheme (MCS): Indicates the modulation method used for data transmission and the size of the transport block, which are the data to be transmitted.

[0049] - HARQ process number: Indicates the process number of HARQ.

[0050] - New data indicator: Indicates whether it is HARQ initial transmission or retransmission.

[0051] - Redundancy version: Indicates the redundancy version of HARQ.

[0052] - Transmit Power Control (TPC) command for PUCCH (Physical Uplink Control CHannel):

Indicates the transmit power control command for PUCCH (Physical Uplink Control CHannel).

[0053] The above DCI can be transmitted on a downlink physical control channel, PDCCH (Physical downlink control channel) (or control information, hereinafter referred to as “control information”) or EPDCCH (Enhanced PDCCH) (or enhanced control information, hereinafter referred to as “enhanced control information”) after going through a channel coding and modulation process.

[0054] Generally, the above DCI is scrambled independently for each terminal with a specific RNTI (Radio Network Temporary Identifier) (or terminal identifier), a CRC (cyclic redundancy check) is added, channel coded, and then configured as an independent PDCCH and transmitted. In the time domain, the PDCCH is mapped and transmitted during the control channel transmission period.

The frequency domain mapping position of the PDCCH is determined by the identifier (ID) of each terminal, and can be transmitted by spreading over the entire system transmission band.

[0055] Downlink data can be transmitted on the PDSCH (Physical Downlink Shared Channel), which is a physical channel for downlink data transmission. The PDSCH can be transmitted after the control channel transmission section, and scheduling information such as the specific mapping position in the frequency domain and the modulation method are determined based on the DCI transmitted through the PDCCH.

[0056] Among the control information constituting the DCI, the base station notifies the terminal of the modulation method applied to the PDSCH to be transmitted and the size of the data to be transmitted (transport block size; TBS) through the MCS. In an embodiment, the MCS can be composed of 5 bits or more or less bits. The above TBS corresponds to the size before channel coding for error correction is applied to the data (transport block, TB) that the base station wants to transmit.

[0057] The modulation methods supported by the LTE system are QPSK (Quadrature Phase Shift Keying), 16QAM (Quadrature Amplitude Modulation), and 64QAM, and the modulation order (Q_m) corresponds to 2, 4, and 6, respectively. That is, in the case of QPSK modulation, 2 bits per symbol can be transmitted, in the case of 16QAM modulation, 4 bits per symbol can be transmitted, and in the case of 64QAM modulation, 6 bits per symbol can be transmitted. In addition, modulation methods higher than 256QAM can also be used depending on system modification.

[0058] FIG. 1b is a diagram showing the basic structure of the time-frequency domain, which is a radio resource area where data or control channels are transmitted in the uplink in the LTE-A system.

[0059] Referring to lb, the horizontal axis represents the time domain and the vertical axis represents the frequency domain. The minimum transmitter in the time domain is an SC-FDMA symbol (lb-02), and NsymbUL SC-FDMA symbols can be combined to form one slot (lb-06). Further, two slots are combined to form one subframe (lb-05). The minimum transmitter in the frequency domain is a subcarrier, and the entire system transmission bandwidth (lb-04) consists of a total of NBW subcarriers. NBW can have a value proportional to the system transmission bandwidth.

[0060] The basic unit of resources in the time-frequency domain is a resource element (RE, lb-12), which can be defined by an SC-FDMA symbol index and a subcarrier index. A Resource Block Pair (LB-08; RB pair) can be defined as NsymbUL consecutive SC-FDMA symbols in the time domain and NscRB consecutive subcarriers in the frequency domain. Therefore, one RB consists of NsymbUL x NscRB REs. Generally, the minimum transmitter of data or control information is an RB unit. In the case of PUCCH, it is mapped to a frequency domain corresponding to 1 RB and transmitted during 1 subframe.

[0061] In the LTE system, the timing relationship of PUCCH or PUSCH, which is an uplink physical channel that transmits HARQ ACK/NACK corresponding to PDSCH, which is a physical channel for downlink data transmission, or PDCCH/EPDCCH including semi-persistent scheduling release (SPS release), is defined. For example, in an LTE system operating in FDD (frequency division duplex), the HARQ ACK/NACK corresponding to the PDCCH/EPDCCH containing the PDSCH or SPS release transmitted in the n-4th subframe is transmitted as the PUCCH or PUSCH in the nth subframe.

[0062] In the LTE system, downlink HARQ adopts an asynchronous HARQ method in which the data retransmission time is not fixed. That is, when the base station receives HARQ NACK feedback from the terminal for the initial transmission data transmitted, the base station freely determines the transmission time of the retransmission data by scheduling operation. For the HARQ operation, the terminal performs decoding of the received data, buffers the data determined to be an error, and then performs combining with the next retransmission data.

[0063] When the terminal receives a PDSCH including downlink data transmitted from the base station in subframe n , it transmits uplink control information including HARQ ACK or NACK of the downlink data to the base station in subframe $n+k$ via PUCCH or PUSCH. In this case, k is defined differently depending on the FDD or TDD (time division duplex) of the LTE system and its subframe settings. For example, in the case of the FDD LTE system, the above k is fixed to 4. On the other hand, in the case of the TDD LTE system, the above k can change according to the subframe setting and the subframe number.

[0064] Unlike the downlink HARQ in the LTE system, the uplink HARQ adopts a synchronous HARQ method with a fixed data transmission time. That is, the uplink/downlink timing relationship of the PUSCH (Physical Uplink Shared Channel), which is a physical channel for uplink data transmission, the PDCCH (Physical Uplink Control Channel) preceding it, and the PHICH (Physical Hybrid Indicator Channel), which is a physical channel for transmitting downlink HARQACK/NACK corresponding to the PUSCH, is fixed by the following rules.

[0065] When the terminal receives a PDCCH including uplink scheduling control information transmitted from a base station in subframe n or a PDCCH transmitting downlink HARQ ACK/NACK, the terminal transmits uplink data corresponding to the control information through a PUSCH in subframe $n+k$. At this time, the k is defined differently depending on the FDD or TDD (time division duplex) of the LTE system and its settings. For example, in the case of an FDD LTE system, the k is fixed to 4. On the other hand, in the case of a TDD LTE system, the k can change depending on the subframe settings and subframe number. In the FDD LTE system, when the base station transmits uplink scheduling approval or downlink control signal and data to the terminal in subframe n , the terminal receives the uplink scheduling approval or downlink control signal and data in subframe n . First, if uplink scheduling approval is received in subframe n , the terminal transmits uplink data in subframe $n+4$. If a downlink control signal and data are received in subframe n , the terminal transmits HARQ ACK or NACK for the downlink data in subframe $n+4$. Therefore, the time that the terminal can receive uplink scheduling approval and transmit uplink data or receive downlink data and prepare to transmit HARQ ACK or NACK is 3 ms corresponding to 3 subframes. Then, when the terminal receives a PDCCH carrying a downlink HARQ ACK/NACK from the base station in subframe i , the PDCCH corresponds to the PUSCH transmitted by the terminal in subframe $i-k$. In this case, the k is defined differently depending on the FDD or TDD of the LTE system and its settings. For example, in the case of an FDD LTE system, the k is fixed to 4.

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Meanwhile, in the case of TDD LTE system, the above k can be changed according to the subframe setting and subframe number.

[0066] FIG. 1e and FIG. 1d illustrate how data for eMBB, URLLC, and mMTC, which are services considered in 5G or NR systems, are allocated from frequency-time resources.

[0067] Referring to FIG. 1e and FIG. 1d, we can see how frequency and time resources are allocated for information transmission in each system.

[0068] First, FIG. 1e illustrates how data for eMBB, URLLC, and mMTC are allocated from the premise system frequency band (1c-00). When URLLC data (1c-03, 1c-05, 1c-07) is generated and needs to be transmitted while eMBB (1c-01) and mMTC (1c-09) are being allocated and transmitted in a specific frequency band, the portion where eMBB (1c-01) and mMTC (1c-09) are already allocated can be emptied, or URLLC data (1c-03, 1c-05, 1c-07) can be transmitted without transmission. Among the above services, since URLLC needs to reduce delay time, URLLC data (1c-03, 1c-05, 1c-07) can be allocated and transmitted to a portion of the resource (1c-01) to which eMBB is allocated. Of course, if URLLC is additionally allocated and transmitted in the resource to which eMBB is allocated, eMBB data may not be transmitted in the overlapping frequency-time resource, and thus the transmission performance of eMBB data may be reduced. That is, in the above case, eMBB data transmission failure may occur due to URLLC allocation.

[0069] In the 1d, the entire system frequency band (1d-00) can be divided and used for transmitting services and data in each subband (1d-02, 1d-04, 1d-06). Information related to the above subband setting can be determined in advance, and this information can be transmitted from the base station to the terminal through upper signaling.

Alternatively, the information related to the above sub-bands may be arbitrarily divided by the base station or network node and services may be provided to the terminal without separate sub-band configuration information transmission. In FIG. 1d-, sub-band 1d-02 is used for eMBB data transmission, sub-band 404 is used for URLLC data transmission, and sub-band 1d-06 is used for mMTC data transmission.

[0070] In the entire embodiment, the length of the transmission time interval (TTI) used for URLLC transmission may be shorter than the length of the TTI used for eMBB or mMTC transmission. In addition, the response to information related to URLLC can be transmitted faster than eMBB or mMTC, and thus, information can be transmitted and received with low delay.

[0071] FIG. 1e is a diagram illustrating the process in which one transport block is divided into multiple code blocks and CRCs are added.

[0072] Referring to the diagram 1e, a transport block (1e-01, transport block; TB) to be transmitted in uplink or downlink may have a CRC (1e-03) added to the last or the very beginning. The CRC may have 16 bits or 24 bits or a fixed number of bits or a variable number of bits depending on channel conditions, and may be used to determine whether channel coding is successful. The F lo-mo-key (1e-01, 1e-03) with TB and CRC added may be divided into several code blocks (codeblock; CB) (1e-07, 1e-09, 1e-11, 1e-13) (1e-05). The above code block can be divided into blocks with a predetermined maximum size, in which case the last code block (1e-13) can be smaller than other code blocks, or can be adjusted to have the same length as other code blocks by inserting 0, a random value, or 1.

CRCs (le-17, le-19, le-21, le-23) may be added to each of the above divided code blocks (le-15). The above CRC may have 16 bits or 24 bits or a fixed number of bits, and may be used to determine whether channel coding is successful or not. However, the CRC (le-03) added to the above TB and the CRCs (le-17, le-19, le-21, le-23) added to the code block may be omitted depending on the type of channel code to be applied to the code block. For example, if an LDPC code, not a turbo code, is applied to the code block, the CRCs (le-17, le-19, le-21, le-23) inserted into each code block may be omitted. However, even when LDPC is applied, CRCs (le-17, le-19, le-21, le-23) can be added to the code block as it is. Also, when polar code is used, CRC can be added or omitted.

[0073] FIG. 1f is a drawing showing a method of transmitting using an outer code, and FIG. 1g is a block diagram showing the structure of a communication system using the outer code.

[0074] Referring to FIG. 1f and FIG. 1g, a method of transmitting a signal using an outer code can be examined.

[0075] FIG. 1f shows that after one transport block is divided into several code blocks, bits or symbols (1f-04) in the same position in each code block are encoded with a second channel code to generate parity bits or symbols (1f-06) (1f-02). After this, CRCs can be added to each code block and parity code blocks generated by the second channel code encoding (1f-08, 1f-10). The addition of the above CRC may vary depending on the type of channel code. For example, when a turbo code is used as the first channel code, the above CRC (1f-08, 1f-10) is added, but after this, each code block and parity code block can be encoded by the first channel code encoding.

[0076] When the outer code is used, the data to be transmitted passes through the second channel coding encoder (lg-09). The channel code used for the second channel coding may be, for example, Reedsolomon code, BCH code, Raptor code, parity bit generation code, etc. The bits or symbols that pass through the second channel coding encoder (lg-09) in this way pass through the first channel coding encoder (lg-11). The channel codes used for the first channel coding include Convolutional code, LDPC code, Turbo code, Polar code, etc. When the channel-coded symbols pass through the channel (lg-13) and are received by the receiver, the receiver side can sequentially operate the first channel coding decoder (lg-15) and the second channel coding decoder (lg-17) based on the received signal. The first channel coding decoder (lg-15) and the second channel coding decoder (lg-17) can perform operations corresponding to the first channel coding encoder (lg-11) and the second channel coding encoder (lg-09), respectively.

[0077] On the other hand, in the channel coding block diagram where the outer code is not used, only the first channel coding encoder (lg-11) and the first channel coding decoder (lg-05) are used in the transmitter and receiver, respectively, and the second channel coding encoder and the second channel coding decoder are not used. Even when the outer code is not used, the first channel coding encoder (lg-11) and the first channel coding decoder (lg-05) can be configured in the same manner as when the outer code is used.

[0078] The eMBB service described below is called Type 1 service, and data for eMBB is called Type 1 data. The Type 1 service or Type 1 data is not limited to eMBB, and may also be applied when high-speed data transmission is required or when wideband transmission is performed.

Also, URLLC service is called type 2 service, and data for URLLC is called type 2 data. The type 2 service or type 2 data is not limited to URLLC, and may be applied to other systems that require low latency or high reliability transmission, or that require both low latency and high reliability. Also, mMTC service is called type 3 service, and data for mMTC is called type 3 data. The above type 3 service or type 3 data is not limited to mMTC, and may be applied to cases that require low speed, wide coverage, or low power. Also, when explaining an embodiment, type 1 service may be understood as including or not including type 3 service.

[0079] The structure of the physical layer channel used for each type to transmit the above three services or data may be different. For example, at least one of the length of the transmission time interval (TTI), the allocation unit of the frequency resource, the structure of the control channel, and the mapping method of the data may be different.

[0080] Although the above description is made with three services and three types of data, there may be more types of services and corresponding data, and the contents of the present invention may be applied in this case as well.

[0081] To describe the method and device proposed in the embodiment, the terms physical channel and signal in the conventional LTE or LTE-A system may be used. However, the contents of the present invention can be applied to a wireless communication system other than the LTE and LTE-A systems.

[0082] The embodiment defines the transmission and reception operations of the terminal and the base station for the first type, second type, and third type service or data transmission as described above, and proposes a specific method for operating terminals receiving different types of service or data scheduling together within the same system. In the present invention, the first type, second type, and third type terminals refer to terminals receiving the first type, second type, and third type service or data scheduling, respectively. In the embodiment, the first type terminal, the second type terminal, and the third type terminal may be the same terminal or may be different terminals.

[0083] Hereinafter, an embodiment of the present invention will be described in detail with accompanying drawings. In addition, when it is determined that a specific description of a related function or configuration may unnecessarily obscure the gist of the present invention in explaining the present invention, the detailed description thereof will be omitted. Further, the terms described below are terms defined in consideration of the functions in the present invention, and may vary depending on the intention or custom of the user or operator. Therefore, the definition should be made based on the contents throughout this specification. Hereinafter, the base station is a subject that performs resource allocation of the terminal, and may be at least one of an eNode B, a Node B, a BS (Base Station), a wireless access unit, a base station controller, or a node on a network. The terminal may include a UE (User Equipment), an MS (Mobile Station), a cellular phone, a smartphone, a computer, or a multimedia system capable of performing a communication function. In the present invention, the downlink (DL) refers to a wireless transmission path of a signal transmitted from a base station to a terminal, and the uplink (UL) refers to a wireless transmission path of a signal transmitted from a terminal to a base station.

In addition, although the embodiments of the present invention are described below using LTE or LTE-A systems as examples, the embodiments of the present invention may be applied to other communication systems having similar technical backgrounds or channel types. For example, the fifth generation mobile communication technology (5G, new radio, NR) developed after LTE-A may be included here. In addition, the embodiments of the present invention may be applied to other communication systems through some modifications within a scope that does not significantly deviate from the scope of the present invention at the discretion of a person with skilled technical knowledge.

[0084] In the present invention, the transmission time interval (TTI) refers to a unit in which a control signal and a data signal are transmitted, or may refer to a unit in which a data signal is transmitted. For example, in the downlink of an existing LTE system, the transmission time interval is a subframe, which is a time unit of 1 ms. Meanwhile, in the uplink of the present invention, the transmission time interval refers to a unit in which a control signal or a data signal is sent, or may refer to a unit in which a data signal is transmitted. The transmission time interval in the existing LTE system uplink is a subframe, which is the same 1 ms time unit as the downlink.

[0085] Unless otherwise specified, the shortened-TTI described herein may include a terminal capable of transmitting control information, or data, or control information and data in a transmission time interval shorter than 1ms or 1ms, and the normal-TTI terminal may include a terminal capable of transmitting control information, or data, or control information and data in a transmission time interval of 1ms. Meanwhile, in the present invention, the terms shortened- TTI, shortened- TTI, shortened TTI, shorter TTI, short TTI, and s TTI have the same meaning and are used interchangeably.

In addition, in the present invention, normal-TTI, normal TTI, subframe TTI, and legacy TTI have the same meaning and are used interchangeably. In the above, the 1ms , which is the standard for distinguishing between shortened-TTI and normal-TTI, may vary depending on the system. That is, in a specific NR system, if the TTI is shorter than 0.2ms based on 0.2ms , it is shortened-TTI, and a TTI of 0.2ms can be called normal-TTI.

[0086] Meanwhile, one of the important standards for the performance of a cellular wireless communication system is packet data latency. For this purpose, in the LTE system, signal transmission and reception are performed in subframe units having a transmission time interval (TTI) of 1ms . In the LTE system operating as described above, it may be possible to support a terminal (short-TTI UE) having a transmission time interval shorter than 1ms . Meanwhile, in the 5th generation mobile communication system, NR, the transmission time interval can be shorter than 1ms . Short-TTI terminals are expected to be suitable for services such as Voice over LTE (VoLTE) services and remote control, where latency is important. In addition, short-TTI terminals are expected to be a means to realize the Internet of Things (IoT), which is mission critical on a cellular basis.

[0087] In addition, in the present invention, shortened-TTI data means data transmitted on a PDSCH or PUSCH that is transmitted and received in shortened TTI units, and normal-TTI data means data transmitted on a PDSCH or PUSCH that is transmitted and received in subframe units. In the present invention, the control signal for shortened-TTI means a control signal for shortened-TTI mode operation and is referred to as sPDCCH, and the control signal for normal-TTI means a control signal for normal-TTI mode operation.

For example, the control signal for normal-TTI may be PCFICH, PRICH, PDCCH, EPDCCH, PUCCH, etc. in the existing LTE system.

[0088] In the present invention, the terms physical channel and signal in the existing LTE or LTE-A system may be used interchangeably with data or control signals. For example, PDSCH is a physical channel through which normal-TTI data are transmitted, but in the present invention, PDSCH may be referred to as normal-TTI data, and sPDSCH is a physical channel through which shortened-TTI data are transmitted, but in the present invention, sPDSCH may be referred to as shortened-TTI data. Similarly, shortened-TTI data transmitted in downlink and uplink in the present invention may be referred to as sPDSCH and sPUSCH.

[0089] Hereinafter, in the present invention, the uplink scheduling approval signal and the downlink data signal are referred to as the first signal. In addition, in the present invention, the uplink data signal for the uplink scheduling approval and the HARQ ACK/NACK for the downlink data signal are referred to as the second signal. In the present invention, among the signals transmitted by the base station to the terminal, a signal that expects a response from the terminal can be the first signal, and the terminal's response signal corresponding to the first signal can be the second signal. In addition, in the present invention, the service type of the first signal can belong to categories such as eMBB, mMTC, and URLLC.

[0090] Hereinafter, in the present invention, the TTI length of the first signal means the length of time during which the first signal is transmitted. In addition, in the present invention, the TTI length of the second signal means the length of time during which the second signal is transmitted. Additionally, in the present invention, the second signal transmission timing refers to information about when the terminal transmits the second signal and when the base station receives the second signal, and may be referred to as second signal transmission/reception timing.

[0091] If there is no mention of a TDD system in the present invention, the FDD system will be generally described. However, the method and device of the present invention in the FDD system can be applied to the TDD system with a simple modification.

[0092] Hereinafter, the upper signaling in the present invention is a signal transmission method that is transmitted from a base station to a terminal using a downlink data channel of a physical layer, or from a terminal to a base station using an uplink data channel of a physical layer, and may be referred to as RRC signaling or a MAC control element (CE).

[0093]

[0094] [Embodiment 1-1] .

[0095] Embodiment 1-1 describes a method of transmitting a code block by adding a code block index when transmitting a code block with reference to FIG. 1h, FIG. 1i, FIG. 1j, FIG. 1k, and FIG. 1m.

[0096] The diagram shows a TB divided into several code blocks, and then a CRC and a code block index are added. A TB (1h-01) to be transmitted in the uplink or downlink can have a CRC (1h-03) added to the last or the very beginning. The CRC can have 16 bits or 24 bits or a fixed number of bits or a variable number of bits depending on the channel conditions, and can be used to determine whether the entire TB has been successfully received. A block (1h-01, 1h-03) to which a TB and a CRC are added can be divided into several code blocks (1h-07, 1h-09, 1h-11, 1h-13) (1h-05).

The above code block can be divided by pre-determining the maximum size, and in this case, the last code block (lh-13) can be smaller than other code blocks, or can be adjusted to have the same length as other code blocks by inserting 0, a random value, or 1. CRCs (lh-17, lh-19, lh-21, lh-23) can be added to each of the above divided code blocks (lh-15). The above CRC can have 16 bits, 24 bits, or a fixed number of bits, and can be used to determine whether channel coding is successful. However, the CRC (lh-03) added to the above TB and the CRCs (lh-17, lh-19, lh-21, lh-23) added to the code block can be omitted depending on the type of channel code to be applied to the code block. For example, if LDPC codes, not turbo codes, are applied to the code blocks, the CRCs (lh-17, lh-19, lh-21, lh-23) inserted into each code block may be omitted. However, even when LDPC is applied, the CRCs (lh-17, lh-19, lh-21, lh-23) can be added to the code blocks as they are. Also, when a polar code is used, the CRCs can be added or omitted.

[0097] Afterwards, the code block index (lh-27, lh-29, lh-31, lh-33) is inserted into each code block so that transmission is possible. The code block index may be information consisting of bits of a predetermined length, such as which order the corresponding code block is transmitted in one TB, or the location order of the corresponding code block. For example, if the code block index consists of 8 bits, the code block index of lh-27 will be 00000000, the code block index of lh-29 will be 00000001, and lh-31 and lh-33 can be the values of N-1 and N converted to 8-digit binary numbers, respectively. The length of the above code block index can be determined by at least one of the upper signaling, a specific value indicated by DCI, the MCS value, and the TB size (TBS).

[0098] After the above code block index and CRC are added to the code block, channel codes such as turbo code, LDPC code, and polar code can be applied.

[0099] FIG. li is a drawing showing the location of the code block index being added to the back of the code block or in front of the CRC (li-27, li-29, li-31, li-33). Unlike the example presented in FIG. lh, you can see that the code block index is added right in front of the CRC.

[0100] In the above FIGS. lh and li, only examples of the code block index being inserted at the very front of the code block or in front of the CRC are described, but it is not necessarily limited thereto. It should be noted that the modified example of the first embodiment may be implemented by being modified to an example in which the code block and CRC are inserted in the middle, etc.

[0101] FIG. lj is a diagram showing an example in which a code block index is masked by an XOR operation on the CRC. After the code block index (lj-27, lj-29, lj-31, lj-33) is generated to have the same length as the CRC length, each CRC (lj-17, lj-19, lj-21, lj-23) is XOR-operated and can be added to the end of the code block. According to the above method, when the terminal decodes each channel-coded code block and checks the CRC, it can determine whether the channel coding is successful by performing an XOR operation on various code block indices.

[0102] FIG. lk is a flowchart showing the procedures of a base station and a terminal for a method of determining whether to insert a code block index according to a higher signaling or DCI specific bit and transmitting it.

The base station transmits to the terminal whether the code block index is inserted using the bits of the upper signaling or the specific position of the DCI (1k02). The terminal checks the bits of the upper signaling or the specific position of the DCI and checks whether the code block index is inserted (1k06). Thereafter, when transmitting data, the base station inserts the code block index, performs channel coding, and transmits (1k04), and the terminal checks the order of the code blocks or determines the location of the data by considering the inserted code block index when performing channel coding and checking the data (1k08).

[0103] FIG. 1m is a drawing showing the procedures of the base station and the terminal in the method of transmitting and receiving by determining whether the code block index is inserted. In the present invention, the method of inserting and transmitting the code block index can be called A-type transmission. The above A-type transmission case may be the initial transmission in which data is first transmitted, or the case where a specific transmission mode is set as upper signaling, or the case where TBS is greater than a specific value, the case where it is the 1st type transmission, the 2nd type transmission, or the 3rd type transmission, or the case where it is transmitted with a specific TTI length, etc. The base station prepares data to be transmitted (1m02), and determines whether it is the A-type transmission in order to determine whether to insert a code block (1m06). In the case of the A-type transmission. It inserts the code block index information, performs channel code encoding, and transmits (1m06), and in the case where it is not the A-type transmission, it does not insert the code block index information, and transmits the code block by channel code encoding (1m08). When the terminal prepares to receive data, it checks C1m12) and whether it is the A-type transmission (1m16). If it is an A-type transmission, the success or failure of decoding is determined by considering the code block index when decoding the channel code of the code block (1m16), and if it is not an A-type transmission, the success or failure of decoding is determined by assuming that there is no code block index when decoding the channel code of the code block (1m18).

1) When providing artificial intelligence or a product or service utilizing artificial intelligence, an artificial intelligence business operator must review in advance whether the artificial intelligence is considered high-impact artificial intelligence, and, if necessary, may request the Minister of Science and ICT to confirm whether the artificial intelligence is considered high-impact artificial intelligence. In the present invention, the initial transmission and retransmission may refer to the initial transmission and retransmission in the HARQ operation.

[0104] In the first embodiment, at least one or more of the methods presented in FIG. 1h, FIG. 1i, FIG. 1j, FIG. 1k, and FIG. 1m may be combined and used. Also, although the present embodiment describes that the code block index information is inserted and then channel code encoded and transmitted, it is not necessarily limited to this, and it may be modified and implemented so that the code block index information is inserted after the channel code encoding. Meanwhile, since the present embodiment assumes and describes the case of downlink data transmission, the base station transmits data and the terminal receives data, but it is not necessarily limited to this. As a modified example of the first embodiment, the present embodiment may be applied in the part where the code block index information is inserted in uplink data transmission, where the terminal transmits data and the base station receives data.

[0105] [Embodiment 1-2]

[0106] Embodiment 1-2 describes a method for providing feedback on whether decoding of a code block is successful or not when a receiver decodes a TB and feeds back whether reception is successful or not, and performing the same for a code block for which retransmission has failed. The above-mentioned receiver may be a terminal in the downlink and a base station in the uplink.

[0107] In this embodiment, the code block index information may be a method presented in FIG. 1h, FIG. 1i, and FIG. 1j, or may be information indicating the location of the code block in the TB in a modified manner without being limited thereto. For example, the code block index information may be arbitrarily checked according to the order of the code blocks included in one TB. That is, if the initial transmission is transmitted without including the code block index, and 10 code blocks are transmitted in one TB when the initial transmission is performed, the code block index may be assigned in ascending order from the code block located from the front, even though the code block index is not included.

[0108] In this embodiment, the method in which the code block index is inserted and transmitted may be called A-type transmission. The above A-type transmission case may be the initial transmission in which data is first transmitted, or the upper signaling is set to a specific transmission mode, or the TBS has a specific value or more, the 1st type transmission, the 2nd type transmission, or the 3rd type transmission, or the transmission is performed with a specific TTI length, etc.

[0109] The receiver may perform channel code decoding on the code blocks in the TB and feed back failed code blocks to the transmitter. For example, when there are 10 code blocks in one transmitted TB, the code blocks that were successfully transmitted may be mapped to 1 and the failed code blocks may be mapped to 0, and the channel code decoding success or failure of each code block may be transmitted as 10-bit information. In the above example, if the 2nd and 5th code blocks among the 10 code blocks failed to be decoded and the remaining code blocks were all successfully decoded, it may be possible to feed back the value 1011011111 to the transmitter. The above feedback may be transmitted to the base station on the uplink control channel or data channel.

Or, it may be possible to set up a code block group consisting of M code blocks and transmit whether the decoding is successful or not for each code block group. The above code block group M may be signaled from the base station to the terminal, or the information of the M value may be transmitted as DCI, or it may be automatically determined according to the number of code blocks included in the TBS or TB or the system frequency band. For example, as follows, the number M of code blocks included in the code block group according to the TBS may be determined according to the TBS value of the scheduled data.

TBS Value	M
$TBS < 61,440$	1
$61,440 < TBS < 122,880$	2
$122,880 < TBS < 184,320$	3
$184,320 < TBS < 245,760$	4

[0110]

[0111] The above table describes cases where the TBS value is less than 245,760, but it is not limited thereto, and the M value may be defined by similar rules for large TBS values. As another example, it may be determined according to the system frequency band. Let the unit of frequency resources be a resource block. The above resource block corresponds to 180 kHz and 12 subcarriers in the LTE system, but it may be determined differently in the NR or 5G system. For example, one resource block may correspond to a frequency band corresponding to 375 kHz. The M value may vary as follows depending on the total number of resource blocks in the system frequency band.

Total number of resource blocks of the system frequency band	M
≤ 10	1
11 - 26	2
27 - 63	3
64 - 110	4

[0112]

[0113] Meanwhile, in the above example, when the receiver checks the code block index of the code block that failed to be decoded, in the case of A-type transmission, it can be obtained by checking the code block index information included in the code block, and in the case of non-A-type transmission, the code block index information can be checked arbitrarily according to the order of the code blocks included in one TB. For example, if the initial transmission is transmitted without including the code block index, and if 10 code blocks are transmitted in one TB when the initial transmission is performed, the code block index from 0 or 1 can be assigned sequentially from the code block located from the front, although the code block index is not included.

[0114] If the transmitter fails to transmit several code blocks after the initial transmission of one TB, it can transmit only the failed code blocks when retransmission is performed. In the above retransmission, it is possible for the code block index information to be included and transmitted when the code block is transmitted. Therefore, when the receiver receives data corresponding to retransmission, it determines that it is a type A transmission, checks the code block index information, and performs decoding by combining it with the initial transmission in decoding the corresponding code block.

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[0115] This embodiment describes a method in which a receiver provides feedback on whether a code block has been transmitted or not, and a transmitter retransmits partial code blocks, but it is not necessary to always use them in combination, and each may be used separately.

[0116] In the present invention, the initial transmission and retransmission may refer to the initial transmission and retransmission in the HARQ operation.

[0117] In order to perform the above embodiments of the present invention, a transmitter, a receiver, and a processor of a terminal and a base station are illustrated in FIGS. 1s and 1t, respectively. From the above-mentioned embodiments 1-1 to 1-2, a transmission/reception method of a base station and a terminal is shown to determine whether to insert code block index information and perform an operation according to the above-mentioned embodiments, and in order to perform this, the receiver, processor, and transmitter of the base station and the terminal must operate according to the embodiments.

[0118] Specifically, FIG. 1s is a block diagram illustrating the internal structure of a terminal according to an embodiment of the present invention. As illustrated in FIG. 1s, the terminal of the present invention may include a terminal receiver (1s-00), a terminal transmitter (1s-04), and a terminal processor (1s-02). The terminal receiver (1s-00) and the terminal transmitter (1s-04) may be collectively referred to as a transceiver unit in the embodiment of the present invention. The transceiver unit may transmit and receive signals with a base station. The signals may include control information and data. To this end, the transceiver unit may be composed of an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, an RF receiver that low-noise amplifies a received signal, and down-converts the frequency. In addition, the transceiver can receive a signal through a wireless channel and output it to the terminal processor (1s-02), and transmit a signal output from the terminal processor (1s-02) through the wireless channel.

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The terminal processor (1s-02) can control a series of processes so that the terminal can operate according to the embodiment of the present invention described above. For example, when the terminal receiver (1s-00) receives a data signal from the base station, it decodes it depending on whether code block index information is inserted, and the terminal processor (1s-02) can be controlled to interpret the code block index information. Thereafter, the terminal transmitter (1s-04) performs signal transmission and reception depending on whether code block index information is inserted.

[0119] FIG. 1t is a block diagram showing the internal structure of a base station according to an embodiment of the present invention. As shown in FIG. 1t, the base station of the present invention can include a base station receiver (1t-01), a base station transmitter (1t-05), and a base station processor (1t-03). The base station receiver (1t-01) and the base station transmitter (1t-05) may be collectively referred to as a transceiver unit in the embodiment of the present invention. The transceiver unit can transmit and receive signals with the terminal. The signals may include control information and data. To this end, the transceiver unit may be configured with an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, an RF receiver that low-noise amplifies the received signal, and down-converts the frequency. In addition, the transceiver unit may receive a signal through a wireless channel and output it to the base station processor (1t-03), and transmit the signal output from the terminal processor (1t-03) through the wireless channel. The base station processor (1t-03) may control a series of processes so that the base station can operate according to the embodiment of the present invention described above. For example, the base station processor (1t-03) may determine whether to insert code block index information and control to generate code block index information to be transmitted to the terminal.

After that, the base station transmitter (It-05) inserts and transmits the code block index, and the base station receiver (It-01) checks the code block index or receives the code block index feedback information that has been successfully transmitted.

[0120] In addition, according to one embodiment of the present invention, the base station processor (It-03) can control to generate downlink control information (DCI) or an upper signaling signal including the code block index information. In this case, the DCI or the upper signaling can indicate whether the scheduled signal includes the code block index information.

[0121] Meanwhile, the embodiments of the present invention disclosed in this specification and drawings are only specific examples presented to easily explain the technical content of the present invention and help in understanding the present invention, and are not intended to limit the scope of the present invention. That is, it is obvious to a person having ordinary skill in the art to which the present invention belongs that other modified examples based on the technical idea of the present invention can be implemented. In addition, the above embodiments may be combined and operated as needed. For example, parts of the first and second embodiments of the present invention may be combined and operated as a base station and a terminal. In addition, although the above embodiments have been presented based on the LTE system, other modifications based on the technical ideas of the above embodiments may be implemented in other systems such as 5G or NR systems.

[0122] [Second embodiment]

[0123] Efforts are being made to develop improved 5G communication systems or pre-5G communication systems to meet the increasing demand for wireless data traffic since the commercialization of 4G communication systems. For this reason, 5G communication systems or pre-5G communication systems are called Beyond 4G Network communication systems or Post LTE systems. In order to achieve high data transmission rates, 5G communication systems are being considered for implementation in ultra-high frequency (mmWave) bands (e.g., 60 gigahertz (60 GHz) bands). To mitigate the path loss of radio waves in ultra-high frequency bands and increase the transmission distance of radio waves, beamforming, massive MIMO, full-dimensional MIMO (FD-MIMO), array antenna, analog beam-forming, and large-scale antenna technologies are being discussed in 5G communication systems. In addition, for improving the network of the system, the 5G communication system is developing technologies such as advanced small cells, advanced small cells, cloud radio access networks (cloud RAN), ultra-dense networks, device to device communication (D2D), wireless backhaul, moving networks, cooperative communication, CoMP (Coordinated Multi-Points), and interference cancellation. In addition, advanced coding modulation (ACM) methods such as FQAM (Hybrid FSK and QAM Modulation) and SWSC (Sliding Window Superposition Coding), as well as advanced access technologies such as FBMC (Filter Bank Multi Carrier), NOMA (non-orthogonal multiple access), and SCMA (sparse code multiple access) are being developed in 5G systems.

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[0124] Meanwhile, the Internet is evolving from a human-centered network where humans create and consume information to an Internet of Things (IoT) network where information is exchanged and processed between distributed components such as objects. IoE (Internet of Everything) technology, which combines IoT technology with big data processing technology through connection to cloud servers, is also emerging. To implement IoT, technological elements such as sensing technology, wireless communication and network infrastructure, service interface technology, and security technology are required, and recently, sensor networks for connecting objects, machine-to-machine (M2M), and machine-type communication (MTC) technologies are being studied. In the IoT environment, intelligent IT (Internet Technology) services can be provided that collect and analyze data generated from connected objects to create new value for human life. IoT can be applied to smart homes, smart buildings, smart cities, smart cars or connected cars, smart grids, healthcare, smart home appliances, and advanced medical services through the convergence and combination of existing IT (information technology) technologies and various industries.

[0125] Accordingly, various attempts are being made to apply 5G communication systems to IoT networks. For example, technologies such as sensor networks, machine-to-machine (M2M), and machine-type communication (MTC) are being implemented by techniques such as beam forming, MIMO, and array antennas, which are 5G communication technologies. The application of cloud wireless access networks (cloud RAN) as a big data processing technology described above can also be said to be an example of the convergence of 5G and IoT technologies.

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[0126] Meanwhile, the new 5G communication, NR (New Radio access technology), is designed to allow various services to be freely multiplexed in time and frequency resources, and accordingly, waveform/numerology, etc., and reference signals, etc. can be dynamically or freely allocated according to the needs of the corresponding service. In order to provide the optimal service to the terminal in wireless communication, optimized data transmission through measurement of channel quality and interference amount is important, and therefore accurate channel status measurement is essential. However, unlike 4G communication where channel and interference characteristics do not change significantly depending on frequency resources, in the case of 5G channels, channel and interference characteristics change significantly depending on the service, so support for a subset at the FRG (Frequency Resource Group) level is required to allow for dividing and measuring them. Meanwhile, in the NR system, the types of services supported can be divided into categories such as eMBB (Enhanced mobile broadband), mMTC (massive Machine Type Communications) (mMTC), and URLLC (Ultra-Reliable and low-latency Communications). eMBB can be seen as a service that aims for high-speed transmission of large amounts of data, mMTC as a service that aims for minimizing terminal power and connecting multiple terminals, and URLLC as a service that aims for high reliability and low latency. Different requirements can be applied depending on the type of service applied to the terminal.

[0127] In this way, multiple services can be provided to users in a communication system, and in order to provide such multiple services to users, a method and a device that can provide each service within the same time period according to its characteristics are required.

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[0128] Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

[0129] In describing the embodiments, descriptions of technical contents that are well known in the technical field to which the present invention belongs and are not directly related to the present invention will be omitted. This is to convey the gist of the present invention more clearly without obscuring unnecessary explanations.

[0130] For the same reason, some components in the attached drawings are exaggerated, omitted, or schematically illustrated. In addition, the size of each component does not entirely reflect the actual size. The same reference numbers are assigned to the same or corresponding components in each drawing.

[0131] The advantages and features of the present invention, and the methods for achieving them, will become clear with reference to the embodiments described in detail below together with the attached drawings. However, the present invention is not limited to the embodiments disclosed below, but can be implemented in various different forms, and these embodiments are provided only to make the disclosure of the present invention complete and to fully inform a person having ordinary skill in the art to which the present invention belongs of the scope of the invention, and the present invention is defined only by the scope of the claims. The same reference numerals refer to the same components throughout the specification.

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[0132] At this time, it will be understood that each block of the processing flow diagrams and the combination of the flow diagrams can be performed by computer program instructions. These computer program instructions can be loaded onto a processor of a general-purpose computer, a special-purpose computer, or other programmable data processing equipment, so that the instructions executed through the processor of the computer or other programmable data processing equipment create a means for performing the functions described in the flow diagram block(s). These computer program instructions can also be stored in a computer-available or computer-readable memory that can be directed to a computer or other programmable data processing equipment to implement the functions in a specific manner, so that the instructions stored in the computer-available or computer-readable memory can also produce a manufactured item that includes an instruction means for performing the functions described in the flow diagram block(s). Computer program instructions may also be installed on a computer or other programmable data processing equipment, so that a series of operational steps are performed on the computer or other programmable data processing equipment to produce a computer-executable process, and the instructions that perform the computer or other programmable data processing equipment may also provide steps for performing the functions described in the flowchart block(s).

[0133] In addition, each block may represent a module, segment, or part of code that includes one or more executable instructions for performing a specific logical function(s). It should also be noted that in some alternative implementation examples, the functions mentioned in the blocks may occur out of order.

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For example, two blocks shown in succession may actually be executed substantially simultaneously, or the blocks may sometimes be executed in reverse order depending on the corresponding function.

[0134] At this time, the term '~ part' used in the present embodiment means a software or hardware component such as an FPGA or an ASIC, and the '~ part' performs certain roles. However, the '~ part' is not limited to software or hardware. The 'part' may be configured to be in an addressable storage medium and may be configured to reproduce one or more processors. Accordingly, as an example, the '~ part' includes components such as software components, object-oriented software components, class components, and task components, and processes, functions, properties, procedures, subroutines, segments of program code, drivers, firmware, microcode, circuits, data, databases, data structures, tables, arrays, and variables. The functionality provided within the components and 'parts' may be combined into a smaller number of components and 'parts' or further separated into additional components and 'parts'. In addition, the components and 'parts' may be implemented to play one or more CPUs within the device or secure multimedia card. Also, in the embodiment, the 'part' may include one or more processors.

[0135] Wireless communication systems have evolved from providing voice-oriented services in the early days to broadband wireless communication systems that provide high-speed, high-quality packet data services, such as 3GPP's HSPA (High Speed Packet Access), LTE (Long Term Evolution or E-UTRA (Evolved Universal Terrestrial Radio Access)), LTE-Advanced (LTE-A), 3GPP2's HRPD (High Rate Packet Data), UMB (Ultra Mobile Broadband), and IEEE's 802.16e.

Also, the 5G or NR (new radio) communication standard is being created as a 5th generation wireless communication system.

[0136] As a representative example of the above broadband wireless communication system, the LTE system adopts OFDM (Orthogonal Frequency Division Multiplexing) method in the downlink (DL) and SC-FDMA (Single Carrier Frequency Division Multiple Access) method in the uplink (UL). Uplink refers to a wireless link in which a terminal (UE (User Equipment) or MS (Mobile Station)) transmits data or control signals to a base station (eNode B or base station (BS)), and downlink refers to a wireless link in which a base station transmits data or control signals to a terminal. The above multiple access method usually distinguishes data or control information of each user by allocating and operating the time-frequency resources for transmitting data or control information to each user so that they do not overlap each other, that is, so that orthogonality is established.

[0137] The LTE system adopts the HARQ (Hybrid Automatic Repeat reQuest) method in which the physical layer retransmits the corresponding data when a decoding failure occurs in the initial transmission. The HARQ method is information that the receiver notifies the transmitter of the decoding failure when the receiver fails to decode the data correctly. (NACK; Negative Acknowledgement) to allow the transmitter to retransmit the data at the physical layer. The receiver combines the data retransmitted by the transmitter with the data that failed to be decoded previously to improve data reception performance.

In addition, if the receiver correctly decodes the data, it can transmit information (ACK; Acknowledgement) to the transmitter to notify the transmitter of the decoding success, so that the transmitter can transmit new data.

[0138] FIG. 2a is a diagram showing the basic structure of the time-frequency domain, which is a radio resource domain in which the data or control channel is transmitted in the downlink in the LTE system.

[0139] In FIG. 2a, the horizontal axis represents the time domain, and the vertical axis represents the frequency domain. The minimum transmitter in the time domain is an OFDM symbol, and N_{symb} (2a-02) OFDM symbols are combined to form one slot (2a-06), and two slots are combined to form one subframe (2a-05). The length of the slot is 0.5 ms, and the length of the subframe is 1.0 ms. Further, the radio frame (2a-14) is a time domain unit consisting of 10 subframes. The minimum transmitter in the frequency domain is a subcarrier, and the bandwidth of the entire system transmission bandwidth consists of a total of N_{BW} (2a-04) subcarriers.

[0140] The basic unit of resources in the time-frequency domain is a resource element (2a-12, Resource Element; RE), which can be expressed by an OFDM symbol index and a subcarrier index. A resource block (2a-08, Resource Block; RB or Physical Resource Block; PRB) is defined as N_{symb} (2a-02) consecutive OFDM symbols in the time domain and N_{RB} (2a-10) consecutive subcarriers in the frequency domain. Therefore, one RB (2a-08) consists of $N_{\text{symb}} \times N_{\text{RB}}$ REs (2a-12). In general, the minimum transmitter of data is the above RB unit. In LTE system, $N_{\text{symb}} = 7$, $N_{\text{RB}} = 12$, and N_{BW} and N_{RB} are proportional to the bandwidth of the system transmission band, but other systems other than LTE system may use different values.

The data rate increases in proportion to the number of RBs scheduled to the terminal. The LTE system operates by defining 6 transmission bandwidths. In the case of an FDD system that operates by dividing the downlink and uplink by frequency, the downlink transmission bandwidth and the uplink transmission bandwidth may be different. The channel bandwidth indicates the RF bandwidth corresponding to the system transmission bandwidth. Table 2a-OI shows the correspondence between the system transmission bandwidth defined in the LTE system and the channel bandwidth. For example, an LTE system with a 10MHz channel bandwidth consists of 50 RBs in the transmission bandwidth.

[0141] [Table 2a]

Channel bandwidth BW _{Channel} [MHz]	1.4	3	5	10	15	20
Transmission bandwidth configuration N _{RB}	6	15	25	50	75	100

[0142]

[0143] In the case of downlink control information, it can be transmitted within the first N OFDM symbols within the subframe. In the embodiment, N is generally {1, 2, 3}. Therefore, the N value can be applied variably for each subframe depending on the amount of control information to be transmitted in the current subframe. The transmitted control information can include a control channel transmission interval indicator indicating how many OFDM symbols the control information is transmitted over, scheduling information for downlink data or uplink data, and information about HARQ ACK/NACK.

[0144] In the LTE system, scheduling information for downlink data or uplink data is transmitted from the base station to the terminal through downlink control information (DCI). DCI is defined according to various formats, and each format can indicate whether it is scheduling information for uplink data (UL grant) or scheduling information for downlink data (DL grant), whether it is compact DCI with small control information size, whether it applies spatial multiplexing using multiple antennas, and whether it is DCI for power control. For example, DCI format 1, which is scheduling control information (DL grant) for downlink data, can include at least one of the following control information.

[0145] - Resource allocation type 0/1 flag: Indicates whether the resource allocation method is type 0 or type 1. Type 0 allocates resources in RBG (resource block group) units by applying the bitmap method. In the LTE system, the basic unit of scheduling is RB, which is expressed as a time and frequency domain resource, and RBG is composed of multiple RBs and becomes the basic unit of scheduling in the Type 0 method. Type 1 allocates a specific RB within the RBG.

[0146] - Resource block assignment: Indicates the RB allocated for data transmission. The resource to be expressed is determined according to the system bandwidth and resource allocation method.

[0147] - Modulation and coding scheme (MCS): Indicates the modulation scheme used for data transmission and the size of the transport block, which is the data to be transmitted.

[0148] - HARQ process number: Indicates the HARQ process number.

[0149] - New data indicator: Indicates whether it is HARQ initial transmission or retransmission.

[0150] - Redundancy version: Indicates the redundancy version of HARQ.

[0151] - Transmit Power Control (TPC) command for PUCCH (Physical Uplink Control CHannel): Indicates the transmit power control command for PUCCH (Physical Uplink Control CHannel).

[0152] The above DCI can be transmitted on a downlink physical control channel, PDCCH (Physical downlink control channel) (or control information, hereinafter referred to as “control information”) or EPDCCH (Enhanced PDCCH) (or enhanced control information, hereinafter referred to as “enhanced control information”) after going through a channel coding and modulation process.

[0153] Generally, the above DCI is scrambled independently for each terminal with a specific RNTI (Radio Network Temporary Identifier) (or terminal identifier), a CRC (cyclic redundancy check) is added, channel coded, and then configured as an independent PDCCH for each terminal and transmitted.

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In the time domain, PDCCH is mapped and transmitted during the control channel transmission period. The frequency domain mapping position of PDCCH is determined by the identifier (ID) of each terminal, and can be transmitted by spreading over the entire system transmission band.

[0154] Downlink data can be transmitted on the PDSCH (Physical Downlink Shared Channel), which is a physical channel for downlink data transmission. PDSCH can be transmitted after the control channel transmission period, and scheduling information such as specific mapping position and modulation method in the frequency domain is determined based on the DCI transmitted through the PDCCH.

[0155] Among the control information constituting the DCI, the base station notifies the terminal of the modulation method applied to the PDSCH to be transmitted and the size of the data to be transmitted (transport block size; TBS) through MCS. In an embodiment, the MCS can be composed of 5 bits or more or less bits. The above TBS corresponds to the size before channel coding for error correction is applied to the data (transport block, TB) that the base station wants to transmit.

[0156] The modulation methods supported by the LTE system are QPSK (Quadrature Phase Shift Keying), 16QAM (Quadrature Amplitude Modulation), and 64QAM, and each modulation order (Modulation order) (Q_m) corresponds to 2, 4, and 6, respectively. That is, in the case of QPSK modulation, 2 bits per symbol can be transmitted, in the case of 16QAM modulation, 4 bits per symbol, and in the case of 64QAM modulation, 6 bits per symbol can be transmitted. In addition, modulation methods higher than 256QAM can also be used depending on system modification.

[0157] FIG. 2b is a diagram showing the basic structure of the time-frequency domain, which is a radio resource domain where data or control channels are transmitted in the uplink in the LTE-A system.

[0158] Referring to FIG. 2b, the horizontal axis represents the time domain and the vertical axis represents the frequency domain. The minimum transmitter in the time domain is an SC-FDMA symbol (2b-02), and N_{symbUL} SC-FDMA symbols can be combined to form one slot (2b-06). Further, two slots are combined to form one subframe (2b-05). The minimum transmitter in the frequency domain is a subcarrier, and the entire system transmission bandwidth (transmission bandwidth; 2b-04) consists of a total of N_{BW} subcarriers. N_{BW} can have a value proportional to the system transmission bandwidth.

[0159] The basic unit of resources in the time-frequency domain is the Resource Element (RE, 2b-12), which can be defined by the SC-FDMA symbol index and subcarrier index. A Resource Block Pair (2b-08, Resource Block Pair; RB pair) can be defined as N_{symbUL} consecutive SC-FDMA symbols in the time domain and N_{scRB} consecutive subcarriers in the frequency domain. Therefore, one RB consists of $N_{\text{symbUL}} \times N_{\text{scRB}}$ REs. Generally, the minimum transmitter of data or control information is the RB unit. In the case of PUCCH, it is mapped to the frequency domain corresponding to 1 RB and transmitted for 1 subframe.

[0160] In the LTE system, the timing relationship of the PUCCH or PUSCH, which is an uplink physical channel that transmits HARQ ACK/NACK corresponding to the PDSCH, which is a physical channel for downlink data transmission, or the PDCCH/EPDCCH including a semi-persistent scheduling release (SPS release), is defined. For example, in an LTE system that operates in FDD (frequency division duplex), the HARQ ACK/NACK corresponding to the PDSCH transmitted in the n -4th subframe or the PDCCH/EPDCCH including an SPS release is transmitted in the n th subframe as the PUCCH or PUSCH.

[0161] In the LTE system, downlink HARQ adopts an asynchronous HARQ method in which the data retransmission time is not fixed. That is, when the base station receives HARQ NACK feedback from the terminal for the initial transmission data transmitted, the base station freely determines the transmission time of the retransmission data through the scheduling operation. For the HARQ operation, the terminal performs decoding of the received data, buffers the data determined to be an error, and then performs combining with the next retransmission data.

[0162] When the terminal receives a PDSCH including downlink data transmitted from the base station in subframe n , it transmits uplink control information including the HARQ ACK or NACK of the downlink data to the base station in subframe $n+k$ via PUCCH or PUSCH. In this case, k is defined differently depending on the FDD or TDD (time division duplex) of the LTE system and its subframe settings. For example, in the case of the FDD LTE system, the above k is fixed to 4. On the other hand, in the case of the TDD LTE system, the above k can change according to the subframe setting and the subframe number.

[0163] Unlike the downlink HARQ in the LTE system, the uplink HARQ adopts a synchronous HARQ method with a fixed data transmission time. That is, the uplink/downlink timing relationship of the PUSCH (Physical Uplink Shared Channel), which is a physical channel for uplink data transmission, the PDCCH (Physical Uplink Control Channel) preceding it, and the PHICH (Physical Hybrid Indicator Channel), which is a physical channel for transmitting downlink HARQACK/NACK corresponding to the PUSCH, is fixed by the following rules.

[0164] When the terminal receives a PDCCH including uplink scheduling control information transmitted from a base station in subframe n or a PDCCH transmitting downlink HARQ ACK/NACK, the terminal transmits uplink data corresponding to the control information through a PUSCH in subframe $n+k$. At this time, the k is defined differently depending on the FDD or TDD (time division duplex) of the LTE system and its settings. For example, in the case of an FDD LTE system, the k is fixed to 4. On the other hand, in the case of a TDD LTE system, the k can change depending on the subframe settings and subframe number. In the FDD LTE system, when the base station transmits uplink scheduling approval or downlink control signal and data to the terminal in subframe n , the terminal receives the uplink scheduling approval or downlink control signal and data in subframe n . First, if uplink scheduling approval is received in subframe n , the terminal transmits uplink data in subframe $n+4$. If a downlink control signal and data are received in subframe n , the terminal transmits HARQ ACK or NACK for the downlink data in subframe $n+4$. Therefore, the time that the terminal can receive uplink scheduling approval and transmit uplink data or receive downlink data and prepare to transmit HARQ ACK or NACK is 3 ms corresponding to 3 subframes. Then, when the terminal receives a PDCCH carrying downlink HARQ ACK/NACK from the base station in subframe i , the PDCCH corresponds to the PUSCH transmitted by the terminal in subframe $i-k$. In this case, k is defined differently depending on the FDD or TDD of the LTE system and its settings.

For example, in the case of the FDD LTE system, the above k is fixed to 4. On the other hand, in the case of the TDD LTE system, the above k can be changed according to the subframe setting and the subframe number.

[0165] FIG. 2c and FIG. 2d illustrate how data for eMBB, URLLC, and mMTC, which are services considered in the 5G or NR system, are allocated in frequency-time resources.

[0166] Referring to FIG. 2c and FIG. 2d, we can see how frequency and time resources are allocated for information transmission in each system.

[0167] First, FIG. 2c illustrates how data for eMBB, URLLC, and mMTC are allocated in the premise system frequency band (2c-00). When URLLC data (2c-03, 2c-05, 2c-07) is generated and needs to be transmitted while eMBB (2c-01) and mMTC (2c-09) are being allocated and transmitted in a specific frequency band, the already allocated portion of eMBB (2c-01) and mMTC (2c-09) can be emptied or URLLC data (2c-03, 2c-05, 2c-07) can be transmitted without transmission. Among the above services, since URLLC needs to reduce delay time, URLLC data (2c-03, 2c-05, 2c-07) can be allocated and transmitted to a portion of the resource (2c-01) to which eMBB is allocated. Of course, if URLLC is additionally allocated and transmitted on resources to which eMBB is allocated, eMBB data may not be transmitted on the overlapping frequency-time resources, and thus the transmission performance of eMBB data may be reduced. That is, in the above case, eMBB data transmission failure due to URLLC allocation may occur.

[0168] In FIG. 2d, the entire system frequency band (2d-00) can be divided and used for transmitting services and data in each subband (2d-02, 2d-04, 2d-06). The information related to the subband configuration can be determined in advance, and this information can be transmitted from the base station to the terminal through upper signaling. Alternatively, the information related to the subband can be arbitrarily divided by the base station or network node to provide services to the terminal without transmitting separate subband configuration information. In FIG. 2d-, subband 2d-02 is used for eMBB data transmission, subband 404 is used for URLLC data transmission, and subband 2d-06 is used for mMTC data transmission.

[0169] In the overall embodiment, the length of the transmission time interval (TTI) used for URLLC transmission can be shorter than the length of the TTI used for eMBB or mMTC transmission. In addition, the response of information related to URLLC can be transmitted faster than eMBB or mMTC, and thus, information can be transmitted and received with low delay.

[0170] FIG. 2e is a diagram illustrating a process in which one transport block is divided into several code blocks and a CRC is added.

[0171] Referring to FIG. 2e, one transport block (2e-01, transport block; TB) to be transmitted in uplink or downlink can have a CRC (2e-03) added to the last or first part. The CRC can have 16 bits or 24 bits or a fixed number of bits in advance or a variable number of bits depending on channel conditions, and can be used to determine whether channel coding is successful. The appendix (2e-01, 2e-03) with TB and CRC can be divided into several code blocks (CB) (2e-07, 2e-09, 2e-11, 2e-13) (2e-05).

The above code block can be divided by pre-determining the maximum size; in this case, the last code block (2e-13) can be smaller than other code blocks, or can be adjusted to have the same length as other code blocks by inserting 0, a random value, or 1. CRCs (2e-17, 2e-19, 2e-21, 2e-23) can be added to each of the above divided code blocks (2e-15). The above CRC can have 16 bits, 24 bits, or a fixed number of bits, and can be used to determine whether channel coding is successful. However, the CRC (2e-03) added to the above TB and the CRCs (2e-17, 2e-19, 2e-21, 2e-23) added to the code block can be omitted depending on the type of channel code to be applied to the code block. For example, if LDPC codes, not turbo codes, are applied to the code blocks, the CRCs (2e-17, 2e-19, 2e-21, 2e-23) inserted into each code block may be omitted. However, even if LDPC is applied, the CRCs (2e-17, 2e-19, 2e-21, 2e-23) may be added to the code blocks as they are. Further, if a polar code is used, the CRC may be added or omitted.

[0172] FIG. 2f is a drawing illustrating a method of transmitting using an outer code, and FIG. 2g is a block diagram illustrating the structure of a communication system using the outer code.

[0173] Referring to FIGS. 2f and 2g, a method of transmitting a signal using an outer code can be examined.

[0174] FIG. 2f shows that after one transport block is divided into several code blocks, bits or symbols (2f-04) at the same position in each code block are encoded with a second channel code to generate parity bits or symbols (2f-06) (2f-02). After this, CRCs can be added to each code block and the parity code blocks generated by the second channel code encoding (2f-08, 2f-10).

The addition of the above CRC may vary depending on the type of channel code. For example, if a turbo code is used as the first channel code, the above CRC (2f-08, 2f-10) is added, but after that, each code block and parity code block can be encoded with the first channel code encoding.

[0175] If an outer code is used, the data to be transmitted passes through the second channel coding encoder (2g-09). The channel code used for the second channel coding may be, for example, a Reed solomon code, a BCH code, a Raptor code, a parity bit generation code, etc. The bits or symbols that pass through the second channel coding encoder (2g-09) in this way pass through the first channel coding encoder (2g-11). The channel code used for the first channel coding may be a convolutional code, an LDPC code, a Turbo code, a Polar code, etc. When the channel-coded symbols are received by the receiver through the channel (2g-13), the receiver can sequentially operate the first channel coding decoder (2g-15) and the second channel coding decoder (2g-17) based on the received signal. The first channel coding decoder (2g-15) and the second channel coding decoder (2g-17) can perform operations corresponding to the first channel coding encoder (2g-11) and the second channel coding encoder (2g-09), respectively.

[0176] On the other hand, in the channel coding block diagram where the outer code is not used, only the first channel coding encoder (2g-11) and the first channel coding decoder (2g-05) are used in the transmitter and receiver, respectively, and the second channel coding encoder and the second channel coding decoder are not used. Even when the outer code is not used, the first channel coding encoder (2g-11) and the first channel coding decoder (2g-05) can be configured in the same way as when the outer code is used.

[0177] The eMBB service described below is called Type 1 service, and data for eMBB is called Type 1 data. The Type 1 service or Type 1 data is not limited to eMBB, and may also be applied when high-speed data transmission is required or wide-band transmission is performed. In addition, URLLC service is called Type 2 service, and data for URLLC is called Type 2 data. The Type 2 service or Type 2 data is not limited to URLLC, and may also be applied when low-latency time is required or high-reliability transmission is required, or when low-latency time and high-reliability are required simultaneously in other systems. In addition, mMTC service is called Type 3 service, and data for mMTC is called Type 3 data. The Type 3 service or Type 3 data is not limited to mMTC, and may be applied when low-speed or wide coverage or low-power is required. Also, when explaining an embodiment, the first type service may be understood as including or not including the third type service.

[0178] The structure of the physical layer channel used for each type to transmit the above three services or data may be different. For example, at least one of the length of the transmission time interval (TTI), the allocation unit of the frequency resource, the structure of the control channel, and the mapping method of the data may be different.

[0179] Although the above description is given with three services and three data, there may be more types of services and corresponding data, and in this case, the contents of the present invention may be applied.

[0180] In order to explain the method and device proposed in the embodiment, the terms physical channel and signal in the conventional LTE or LTE-A system may be used. However, the content of the present invention can be applied to a wireless communication system other than the LTE and LTE-A system.

[0181] As described above, the embodiment defines the transmission and reception operations of the terminal and the base station for the first type, the second type, and the third type service or data transmission, and proposes a specific method for operating terminals receiving different types of service or data scheduling together in the same system. In the present invention, the first type, the second type, and the third type terminals refer to terminals receiving the first type, the second type, and the third type service or data scheduling, respectively. In the embodiment, the first type terminal, the second type terminal, and the third type terminal may be the same terminal or may be different terminals.

[0182] Hereinafter, an embodiment of the present invention will be described in detail with accompanying drawings. In addition, when describing the present invention, if it is judged that a specific description of a related function or configuration may unnecessarily obscure the gist of the present invention, the detailed description will be omitted. In addition, the terms described below are terms defined in consideration of the functions in the present invention, and these may vary depending on the intention or custom of the user or operator. Therefore, the definition should be made based on the contents throughout this specification. Hereinafter, the base station is an entity that performs resource allocation of a terminal, and may be at least one of an eNode B, a Node B, a BS (Base Station), a wireless access unit, a base station controller, or a node on a network.

The terminal may include a UE (User Equipment), an MS (Mobile Station), a cellular phone, a smart phone, a computer, or a multimedia system capable of performing a communication function. In the present invention, the downlink (DL) is a wireless transmission path of a signal transmitted from a base station to a terminal, and the uplink (UL) means a wireless transmission path of a signal transmitted from a terminal to a base station. In addition, although the embodiments of the present invention are described below using an LTE or LTE-A system as an example, the embodiments of the present invention may be applied to other communication systems having similar technical backgrounds or channel types. For example, the fifth generation mobile communication technology (5G, new radio, NR) developed after LTE-A may be included here. In addition, the embodiments of the present invention may be applied to other communication systems through some modifications within a scope that does not significantly deviate from the scope of the present invention at the discretion of a person skilled in the art.

[0183] In the present invention, the transmission time interval (TTI) refers to a unit in which a control signal and a data signal are transmitted, or may refer to a unit in which a data signal is transmitted. For example, in the downlink of an existing LTE system, the transmission time interval is a subframe, which is a time unit of 1 ms. Meanwhile, in the uplink of the present invention, the transmission time interval refers to a unit in which a control signal or a data signal is sent, or may refer to a unit in which a data signal is transmitted. In the uplink of an existing LTE system, the transmission time interval is a subframe, which is a time unit of 1 ms, the same as that of the downlink.

[0184] Unless otherwise specified, the shortened-TTI terminal described may include a terminal capable of transmitting control information, or data, or control information and data in a transmission time interval shorter than 1 ms or 1 ms, and the normal-TTI terminal may include a terminal capable of

transmitting control information, or data, or control information and data in a transmission time interval of 1ms. Meanwhile, in the present invention, shortened-TTI, shorter TTI, shortened TTI, shorter TTI, short TTI, and sTTI have the same meaning and are used interchangeably. In addition, in the present invention, normal-TTI, normal TTI, subframe TTI, and legacy TTI have the same meaning and are used interchangeably. In the above, the criterion 1ms for distinguishing between shortened-TTI and normal-TTI may vary depending on the system. That is, in a specific NR system, if TTI is shorter than 0.2 ms based on 0.2 ms, it is shortened-TTI, and TTI of 0.2 ms can be called normal-TTI.

[0185] Meanwhile, one of the important criteria for the performance of a cellular wireless communication system is packet data latency. To this end, in the LTE system, signal transmission and reception are performed in subframe units with a transmission time interval (TTI) of 1ms. In the LTE system operating as described above, it may be possible to support a terminal (short-TTI UE) with a transmission time interval shorter than 1ms. Meanwhile, in the 5th generation mobile communication system, NR, the transmission time interval can be shorter than 1 ms. Short-TTI terminals are expected to be suitable for services such as Voice over LTE (VoLTE) services and remote control, where latency is important. In addition, short-TTI terminals are expected to be a means to realize the mission-critical Internet of Things (IoT) based on cellular.

[0186] Also, in the present invention, shortened-TTI data means data transmitted on PDSCH or PUSCH transmitted and received in shortened TTI units, and normal-TTI data means data transmitted on PDSCH or PUSCH transmitted and received in subframe units. In the present invention, the control signal for shortened-TTI means a control signal for shortened-TTI mode operation and is referred to as sPDCCH, and the control signal for normal-TTI means a control signal for normal-TTI mode operation. For example, the control signal for normal-TTI can be PCFICH, PRICH, PDCCH, EPDCCH, PUCCH, etc. in the existing LTE system.

[0187] In the present invention, the terms physical channel and signal in the existing LTE or LTE-A system can be used interchangeably with data or control signal. For example, PDSCH is normal-TTI. Although it is a physical channel through which data is transmitted, in the present invention, PDSCH can be called normal-TTI data, and sPDSCH is a physical channel through which shortened-TTI data is transmitted, but in the present invention, sPDSCH can be called shortened-TTI data. Similarly, in the present invention, shortened-TTI data transmitted in downlink and uplink are called sPDSCH and sPUSCH.

[0188] Hereinafter, in the present invention, an uplink scheduling approval signal and a downlink data signal are called the first signal. In addition, in the present invention, an uplink data signal for uplink scheduling approval and HARQ ACK/NACK for a downlink data signal are called the second signal. In the present invention, among the signals transmitted by a base station to a terminal, a signal expecting a response from the terminal can be the first signal, and a response signal of the terminal corresponding to the first signal can be the second signal. Additionally, in the present invention, the service type of the first signal may belong to a category such as eMBB, mMTC, URLLC, etc.

[0189] Hereinafter, in the present invention, the TTI length of the first signal means the length of time during which the first signal is transmitted. Also, in the present invention, the TTI length of the second signal means the length of time during which the second signal is transmitted. Also, in the present invention, the second signal transmission timing refers to information about when the terminal transmits the second signal and when the base station receives the second signal, and may be referred to as the second signal transmission/reception timing.

[0190] If there is no mention of a TDD system in the present invention, the FDD system will be generally described. However, the method and device of the present invention in the FDD system may be applied to the TDD system with a simple modification.

[0191] Hereinafter, the upper signaling in the present invention refers to a signal transmission method that is transmitted from the base station to the terminal using a downlink data channel of the physical layer, or from the terminal to the base station using an uplink data channel of the physical layer, and may also be referred to as RRC signaling or a MAC control element (CE).

[0192]

[0193] [Embodiment 2-1].

[0194] Embodiment 2-1 describes a method in which a base station sets and determines a signal resource mapping method, and transmits and receives using the signal resource mapping method when transmitting uplink or downlink data, with reference to FIGS. 2h, 2i, 2j', 2k, 2m, 2n, 2o, 2p, 2s, and 2t.

[0195] FIG. 2h is a drawing showing the appearance and an example of frequency domain priority resource allocation in the allocated frequency-time resources (2h-02, 2h-12). In (a) of FIG. 2h, the arrow (2h-04) shows the order in which the signals to be transmitted are mapped. That is, the mapping is first performed in the frequency domain from the given resource, and then mapping is started from the resource located in the next time. For example, in (b) of FIG. 2h, when 36 signal resources need to be mapped and sent, the order in which the signals are mapped is shown as a number (2h-14). That is, signal symbols from 1 to 36 are first mapped in the frequency domain direction, and then mapping is started by moving to the next time. In the present invention, the signal mapping method shown in FIG. 2h is called the F-type mapping method.

[0196] FIG. 2i is a drawing showing the appearance and an example of time domain priority resource allocation in the allocated frequency-time resources (2i-02, 2i-12). In (a) of FIG. 2i, the arrow (2i-04) shows the order in which the signals to be transmitted are mapped. That is, the mapping is first performed in the time domain from the given resource, and then mapping is started from the resource located in the frequency. For example, in (b) of FIG. 2i, when 36 signal resources need to be mapped and sent, the order in which the signals are mapped is shown as a number (2i-14). That is, signal symbols from 1 to 36 are first mapped in the time domain direction, and then mapping is started by moving to the next time. In the present invention, the signal mapping method illustrated in FIG. 2i is called the T-type mapping method.

[0197] FIG. 2j is a diagram showing an example of time domain priority resource allocation in one area after dividing a time interval (2j-00) in which transmission is performed in an allocated frequency-time resource (2j-02, 2j-12) into a set number of areas (2j-06, 2j-07, 2j-08). The time interval (2j-00) in which the above transmission is performed may be a TTI scheduled at one time.

In addition, when dividing the time interval (2j-00) in which the above transmission is performed into areas, the number of divided areas can be transmitted from the base station to the terminal as a physical layer signal such as upper signaling or DCI, or can be determined according to the TTI length. For example, if the unit of the above transmission, TTI, is 1ms, and the length of the shortened-TTI supported by the base station is 2 OFDM symbols, the above one area can be an area consisting of 2 OFDM symbols. In (a) of FIG. 2j, the arrow (2j-04) shows the order in which the signal to be transmitted is mapped. That is, after dividing the time interval in which the above transmission is performed in a given resource into several areas, the first area (2j-06) is first mapped to the time domain, and then the mapping is performed in the resource located at the frequency, and when the first area mapping is completed, the mapping is moved to the next areas (2j-07, 2j-08) and started. For example, in (b) of FIG. 2j, when 36 signal resources need to be mapped and sent, the order in which the signals are mapped is shown as a number (2j-14). An example of (b) of FIG. 2j is an example in which the time interval during which transmission is performed is divided into three areas. That is, signal symbols from 1 to 36 are first mapped in the time domain direction within the divided areas, and then move to the next frequency to begin mapping. Afterwards, when mapping is completed in the above areas, it moves to the next area and begins mapping again in the time domain first. In the present invention, the signal mapping method illustrated in FIG. 2j is referred to as the TDT type mapping method.

[0198] FIG. 2k is a diagram showing an example of frequency domain priority resource allocation in one area after dividing the frequency interval (2k-00) allocated for transmission in the allocated frequency-time resources (2k-02, 2k-12) into a set number of areas (2k-06, 2k-07, 2k-08).

The allocated frequency section (2k-00) in which the above transmission is performed may be a frequency resource scheduled at one time. In addition, when dividing the frequency section (2k-00) in which the above transmission is performed into regions, the number of regions divided may be transmitted from the base station to the terminal as a physical layer signal such as an upper signaling or DCI, or may be determined according to the allocated frequency bandwidth. For example, if 24 PRBs are allocated based on the LTE terminal for the above transmission, one region may be composed of 8 PRBs. In (a) of FIG. 2k, the arrow (2k-04) shows the order in which the signals to be transmitted are mapped. That is, after dividing the frequency section where transmission is performed in a given resource into several sections, the first section (2k-06) is first mapped to the frequency domain, and then the resource located in the next time is mapped, and when the first section mapping is completed, the mapping is moved to the next sections (2k-07, 2k-08) and started. For example, in (b) of FIG. 2k, when 36 signal resources need to be mapped and sent, the order in which the signals are mapped is shown as a number (2k-14). In the example of (b) of FIG. 2k, the frequency section allocated for transmission is divided into three sections. That is, signal symbols from 1 to 36 are first mapped in the frequency domain direction within the divided section, and then the mapping is started in the next time. Afterwards, when the mapping is completed in the above section, the mapping is moved to the next section and the mapping is started in the frequency domain again. In the present invention, the signal mapping method illustrated in FIG. 2k is referred to as the FDF type mapping method.

[0199] FIG. 2m is a drawing illustrating an example of frequency domain priority resource allocation in one frequency-time domain after dividing a frequency section (2m-10) allocated for transmission in an allocated frequency-time resource (2m-02, 2m-12) into a fixed number of regions (2m-16, 2m-17, 2m-

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18), and dividing a time section (2m-00) in which transmission is performed into a fixed number of regions (2m-06, 2m-07, 2m-08). The allocated frequency section (2m-10) in which the above transmission is performed may be a frequency resource scheduled at one time. The time section (2m-00) in which the above transmission is performed may be a TTI scheduled at one time. In addition, when dividing the frequency section (2m10) in which the above transmission is performed into regions, the number of divided regions may be transmitted from the base station to the terminal as a physical layer signal such as upper signaling or DCI, or may be determined according to the allocated frequency band. For example, if 24 PRBs are allocated based on the LTE terminal for the above transmission, one region may be composed of 8 PRBs. In addition, when dividing the time section (2m-00) in which the above transmission is performed into regions, the number of divided regions may be transmitted from the base station to the terminal as a physical layer signal such as upper signaling or DCI, or may be determined according to the TTI length. For example, when the unit of the above transmission, TTI, is 1ms, and the length of the shortened-TTI supported by the base station is 2 OFDM symbols, the above one area may be a section consisting of 2 OFDM symbols. In (a) of FIG. 2m, the arrow (2m-04) shows the order in which the signals to be transmitted are mapped. For example, in (b) of FIG. 2m, when 36 signal resources need to be mapped and transmitted, the order in which the signals are mapped is shown as a number (2m-14). In the present invention, the signal mapping method illustrated in FIG. 2m is referred to as the TFDF type mapping method.

[0200] FIG. 2n is a diagram showing an example of time domain priority resource allocation in one frequency-time domain, after dividing the frequency interval (2n-10) allocated for transmission in the allocated frequency-time resources (2n-02, 2n-12) into a fixed number of regions (2n-16, 2n-17, 2n-18),

and dividing the time interval (2n-00) where transmission is performed into a fixed number of regions (2n-06, 2n-07, 2n-08). The allocated frequency section (2n-10) in which the above transmission is performed may be a frequency resource scheduled at one time. The time section (2n-00) in which the above transmission is performed may be a TTI scheduled at one time. In addition, when dividing the frequency section (2n-10) in which the above transmission is performed into regions, the number of divided regions may be transmitted from the base station to the terminal as a physical layer signal such as upper signaling or DCI, or may be determined according to the allocated frequency band. For example, if 24 PRBs are allocated based on the LTE terminal for the above transmission, one region may be composed of 8 PRBs. In addition, when dividing the time section (2n-00) in which the above transmission is performed into regions, the number of divided regions may be transmitted from the base station to the terminal as a physical layer signal such as upper signaling or DCI, or may be determined according to the TTI length. For example, when the unit of the above transmission, TTI, is lms, and the length of the shortened-TTI supported by the base station is 2 OFDM symbols, the above one area may be a section consisting of 2 OFDM symbols. In (a) of FIG. 2n, the arrow (2n-04) shows the order in which the signal to be transmitted is mapped. For example, in (b) of FIG. 2n, when 36 signal resources need to be mapped and sent, the order in which the signal is mapped is shown as the number (2n-14). In the present invention, the signal mapping method illustrated in FIG. 2n is called the FTDT type mapping method. [0201] In the signal mapping method described with FIG. 2h, FIG. 2i, FIG. 2j', FIG. 2k, FIG. 2m, and FIG. 2n, if there is a resource dimension that cannot be used for data transmission, it is possible to omit the mapping of the resource dimension and map it to the next order of resource dimensions.

In the above, the resource dimensions that cannot be used for data transmission may be those that are already in use, such as reference signals, synchronization signals, control signals (control channels or control signals), broadcast signals, and channel measurement signals.

[0202] Although the above-described methods for mapping data to resource dimensions in the frequency-time domain are presented in FIGS. 2h, 2i, 2j', 2k, 2m, and 2n, they are not necessarily limited thereto. It should be noted that, as a modified example of the second embodiment, the part where the control channel is inserted may be excluded from the domain, and the like.

[0203] FIG. 2o is a diagram showing the procedure of a transmitter when a base station sets a mapping method to a terminal among signal mapping methods and uses the set mapping method for uplink or downlink transmission. The transmitter may be a terminal in uplink and a base station in downlink. The base station sets the method of mapping the signal to the resource dimension for the terminal (2o-02). The above setting can be set by the upper signaling RRC signaling, or it can be transmitted as a specific bit of the control signal of the physical layer during transmission scheduling such as DCI. Alternatively, the above mapping information setting can be when the data is the first transmitted initial transmission, or when it is set by the upper signaling in a specific transmission mode, or when TBS has a specific value or more, when it is the first type transmission, the second type transmission, or the third type transmission, or when it is transmitted with a specific TTI length, etc. For example, in the case of the first type transmission for eMBB having a setting where the second type data such as URLLC is not transmitted in the transmission, the F type mapping illustrated in FIG. 2h can be used, and in the case of the first type

transmission for eMBB having a setting where the second type data such as URLLC can be transmitted, the T type mapping illustrated in FIG. 2i can be used. According to the above-determined mapping settings, data prepared for transmission is mapped to resource dimension (2o-06). The signal generated by the above-determined mapping is transmitted (2o-08).

[0204] FIG. 2p is a diagram showing the procedure of the receiving end when the base station sets a mapping method to the terminal among the signal mapping methods and uses the set mapping method for uplink or downlink transmission. The receiving end may be the base station in the uplink and the terminal in the downlink. The base station sets a method for mapping signals to resource dimension for the terminal (2p-02). The above-described setting may be set by the upper signaling, RRC signaling, or may be transmitted as a specific bit of the physical layer control signal during transmission scheduling, such as DCI. Alternatively, the above-described mapping information setting may be the case where the data is the initial transmission that is transmitted first, or is set by the upper signaling in a specific transmission mode, or when TBS has a specific value or more, or is the first type transmission, the second type transmission, or the third type transmission, or is transmitted with a specific TTI length, etc. For example, in the case of a first-type transmission for eMBB having a setting in which a second-type data such as URLLC is not transmitted in the transmission, the F-type mapping illustrated in FIG. 2h may be used, and

in the case of a first-type transmission for eMBB having a setting in which a second-type data such as URLLC can be transmitted, the T-type mapping illustrated in FIG. 2i may be used.

[0205] In order to perform the above embodiment of the present invention, the transmitter, receiver, and processor of the terminal and the base station are respectively illustrated in FIG. 2s and FIG. 2t. In order to perform the operation described in the above-mentioned embodiment 2-1, the transmission and reception method of the base station and the terminal is shown, and in order to perform this, the receiver, processor, and transmitter of the base station and the terminal must each operate according to the embodiment.

[0206] Specifically, FIG. 2s is a block diagram illustrating the internal structure of a terminal according to an embodiment of the present invention. As illustrated in FIG. 2s, the terminal of the present invention may include a terminal receiver (2s-00), a terminal transmitter (2s-04), and a terminal processor (2s-02). The terminal receiver (2s-00) and the terminal transmitter (2s-04) may be collectively referred to as a transmitting and receiver in the embodiment of the present invention. The transmitting and receiver may transmit and receive signals with the base station. The above signal may include control information and data. To this end, the transceiver may be configured with an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, an RF receiver that low-noise amplifies the received signal, and down-converts the frequency. In addition, the transceiver may receive a signal through a wireless channel and output it to the terminal processor (2s-02), and transmit the signal output from the terminal processor (2s-02) through the wireless channel. The terminal processor (2s-02) may control a series of processes so that the terminal can operate according to the above-described embodiment of the present invention. For example, the terminal receiver (2s-00) may extract and decode data from a resource dimension according to a signal mapping method set, and the terminal processor (2s-02) may be controlled to interpret the mapping

method setting information. After that, the terminal transmitter (2s-04) performs signal mapping according to the set mapping method.

[0207] FIG. 2t is a block diagram showing the internal structure of a base station according to an embodiment of the present invention. As shown in FIG. 2t, the base station of the present invention may include a base station receiver (2t-01), a base station transmitter (2t-05), and a base station processor (2t-03). The base station receiver (2t-01) and the base station transmitter (2t-05) may be collectively referred to as a transceiver in the embodiment of the present invention. The transceiver may transmit and receive signals with the terminal. The signals may include control information and data. To this end, the transceiver may be composed of an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, an RF receiver that low-noise amplifies a received signal, and down-converts the frequency. In addition, the transceiver can receive a signal through a wireless channel and output it to the base station processor (2t-03), and transmit the signal output from the terminal processor (2t03) through the wireless channel. The base station processor (2t03) can control a series of processes so that the base station can operate according to the embodiment of the present invention described above. For example, the base station processor (2t-03) can control to determine the signal mapping method setting and generate mapping method setting information to be transmitted to the terminal. Thereafter, when the base station transmitter (2t-05) transmits a downlink, the signal is mapped and transmitted according to the mapping method, and the base station receiver (2t-01) can extract and decode a signal from the resource according to the mapping method during uplink transmission.

[0208] Meanwhile, the embodiments of the present invention disclosed in this specification and drawings are only specific examples presented to easily explain the technical contents of the present invention and help understand the present invention, and are not intended to limit the scope of the present invention. That is, it is obvious to those with ordinary skill in the art pertaining to the present invention that other modified examples based on the technical idea of the present invention can be implemented. In addition, some of the above embodiments can be combined and operated as needed. In addition, although the above embodiments were presented based on the LTE system, other modified examples based on the technical idea of the above embodiments can be implemented in other systems such as 5G or NR systems.

[0209] [Third Embodiment]

[0210] Hereinafter, embodiments of the present invention will be described in detail with accompanying drawings. In addition, when it is determined that a specific description of a related known function or configuration may unnecessarily obscure the gist of the present invention in explaining the present invention, the detailed description thereof will be omitted. And the terms described below are terms defined in consideration of the functions in the present invention, and may vary depending on the intention or custom of the user or operator. Therefore, the definition should be made based on the contents throughout this specification. Hereinafter, the base station is a subject that performs resource allocation of the terminal, and may be at least one of an eNode B, a Node B, a BS (Base Station), a wireless access unit, a base station controller, or a node on a network. The terminal may include a UE (User Equipment), an MS (Mobile Station), a cellular phone, a smartphone, a computer, or a multimedia system capable of performing a communication function. In the present invention, the downlink (DL)

refers to a wireless transmission path of a signal transmitted from a base station to a terminal, and the uplink (UL) refers to a wireless transmission path of a signal transmitted from a terminal to a base station. In addition, the embodiments of the present invention can be applied to other communication systems having similar technical backgrounds or channel types to the embodiments of the present invention described below. In addition, the embodiments of the present invention can be applied to other communication systems through some modifications within a range that does not significantly deviate from the scope of the present invention as judged by a person having skilled technical knowledge. [0211] Recently, discussions are actively underway on the 5G (5th Generation) system or New Radio access technology (NR), which is the next-generation communication system after LTE (Long Term Evolution or E-UTRA (Evolved Universal Terrestrial Radio Access)) and LTE-A (LTE-Advanced or E-UTRA Evolution) to handle the explosively increasing mobile data traffic. While existing mobile communication systems have focused on conventional voice/data communications, the 5G system aims to satisfy various services and requirements, such as enhanced Mobile BroadBand (eMBB) services for improving existing voice/data communications, Ultra Reliable and Low Latency Communication (URLLC) services, and massive Machine Type Communication (MTC) services that support massive machine-type communications.

[0212] While the bandwidth of the system transmission bandwidth per single carrier of existing LTE and

LTE-A is limited to a maximum of 20 MHz, the 5G system aims to provide ultra-high-speed data services reaching several Gbps by utilizing ultra-wideband, which is much wider than this. Accordingly, the 5G system is considering ultra-high frequency bands from several GHz to up to 100 GHz, where it is relatively easy to secure ultra-wideband frequencies, as candidate frequencies. In addition, it is considering securing wideband frequencies for the 5G system through frequency reallocation or allocation among frequency bands from hundreds of MHz to several GHz used in existing mobile communication systems.

[0213] The radio waves in the above ultra-high frequency band have wavelengths of several mm and are also called millimeter waves (mmWave). However, in the ultra-high frequency band, the path loss of radio waves increases in proportion to the frequency band, reducing the coverage of the mobile communication system. [0214] In order to overcome the disadvantage of reduced coverage in the above ultra-high frequency band, beamforming technology, which focuses the radiated energy of radio waves to a specific target point using multiple antennas to increase the reach of radio waves, is gaining importance. The above beamforming technology can be applied to each of the transmitter and receiver. In addition to the effect of increasing coverage, the beamforming technology has the effect of reducing interference in areas other than the beamforming direction. In order for the above beamforming technology to operate properly, accurate measurement and feedback methods of the transmission/reception beams are required. [0215] Another requirement of the 5G system is an ultra-low latency service in which the transmission delay between the transmitter and receiver is approximately lms. As one way to reduce the transmission delay, a frame structure design based on a short TTI (Transmission Time Interval) is required compared to LTE and LTE-A.

TTI is the basic unit for performing scheduling, and the TTI of the existing LTE and LTE-A systems is 1ms corresponding to the length of one subframe. For example, a short TTI of 0.5ms, 0.2ms, 0.1ms, etc., shorter than the existing LTE and LTE-A systems, is possible to satisfy the requirements for the ultra-low delay service of the above 5G system. In the following description, unless otherwise stated, TTI and subframe are used interchangeably to mean a predetermined fixed time interval as the basic unit of scheduling.

[0216] Hereinafter, the frame structure of the LTE and LTE-A systems will be described with reference to the drawings, and the design direction of the 5G system will be described.

[0217] FIG. 3a is a drawing showing the basic structure of the time-frequency resource area, which is a radio resource area where data or control channels of the existing LTE and LTE-A systems are transmitted.

[0218] In FIG. 3a, the horizontal axis represents the time domain and the vertical axis represents the frequency domain. Uplink (UL) refers to a wireless link in which a terminal transmits data or control signals to a base station, and downlink (DL) refers to a wireless link in which a base station transmits data or control signals to a terminal. The minimum transmitter in the time domain of the existing LTE and LTE-A systems is an OFDM (Orthogonal Frequency Division Multiplexing) symbol in the downlink and an SC-FDMA (Single Carrier-Frequency Division Multiple Access) symbol in the uplink. N_{symb} (3a-02) symbols are combined to form one slot (3a-06), and two slots are combined to form one subframe (3a-05). The length of the above slot is 0.5 ms, and the length of the subframe is 1.0 ms. And a radio frame (3a-14) is a time domain unit consisting of 10 subframes.

The minimum transmitter in the frequency domain is a 15kHz subcarrier (subcarrier spacing = 15kHz), and the bandwidth of the entire system transmission bandwidth consists of a total of NBW (3a04) subcarriers.

[0219] The basic unit of resources in the time-frequency domain is a resource element (3a-12, Resource Element; RE), which can be expressed as an OFDM symbol or SC-FDMA symbol index and a subcarrier index. A resource block (3a-08, Resource Block; RB or Physical Resource Block; PRB) is defined as N_{symb} (3a-02) consecutive OFDM symbols or SC-FDMA symbols in the time domain and N_{RB} (3a-10) consecutive subcarriers in the frequency domain. Therefore, one RB (3a-08) consists of N_{symb} x N_{RB} REs (3a-12). In LTE and LTE A systems, data is mapped in RB units, and the base station performs scheduling in RB-pair units that constitute one subframe for a given terminal. The number of SC-FDMA symbols or OFDM symbols, N_{symb}, is determined by the length of the cyclic prefix (CP) added to each symbol to prevent interference between symbols. For example, if the general CP is applied, N_{symb} = 7, and if the extended CP is applied, N_{symb} = 6. The extended CP is applied to systems with relatively longer transmission distances than the general CP, so that orthogonality between symbols can be maintained.

[0220] The above subcarrier spacing, CP length, etc. are essential information for OFDM transmission and reception, and the base station and terminal must recognize them as common values to enable smooth transmission and reception.

[0221] NBW and NRB are proportional to the bandwidth of the system transmission band. The data rate increases in proportion to the number of RBs scheduled to the terminal.

[0222] The frame structure of the LTE and LTE-A systems described above is designed for conventional voice/data communication, and thus has limitations in scalability in satisfying various services and requirements such as 5G systems. Therefore, in the 5G system, it is necessary to flexibly define and operate the frame structure by considering various services and requirements.

[0223] FIGS. 3b, 3c, and 3d show examples of extended frame structures. In the examples of FIGS. 3b, 3c, and 3d, the essential parameter set defining the extended frame structure includes subcarrier spacing, CP length, and subframe length.

[0224] In the early stages of the introduction of the 5G system in the future, at least coexistence or dual mode operation with the existing LTE/LTE-A system is expected. Through this, the existing LTE/LTE-A can provide stable system operation, and the 5G system can play a role in providing improved services. Therefore, the extended frame structure of the 5G system needs to include at least the frame structure or essential parameter set of LTE/LTE-A. FIG. 3b shows the 5G frame structure or essential parameter set, which is the same as the frame structure of LTE/LTE-A. Referring to FIG. 3b, frame structure type A shows that the subcarrier spacing is 15 kHz, 14 symbols constitute an lms subframe, and 12 subcarriers (=180 kHz = 12 x 15 kHz) constitute a PRB.

[0225] Figure 3c shows frame structure type B, where the subcarrier spacing is 30 kHz, 14 symbols form a 0.5 ms subframe, and 12 subcarriers ($=360 \text{ kHz} = 12 \times 30 \text{ kHz}$) form a PRB. That is, compared to frame structure type A, the subcarrier spacing and PRB size are twice as large, and the subframe length and symbol length are twice as small.

[0226] Figure 3d shows frame structure type C, where the subcarrier spacing is 60 kHz, 14 symbols form a 0.25 ms subframe, and 12 subcarriers ($=720 \text{ kHz} = 12 \times 60 \text{ kHz}$) form a PRB. That is, compared to frame structure type A, the subcarrier spacing and PRB size are four times larger, and the subframe length and symbol length are four times smaller.

[0227] That is, if the above frame structure type is generalized, the essential parameter sets, such as subcarrier spacing, CP length, and subframe length, have an integer multiple relationship for each type, thereby providing high scalability. If the above frame structure types A, B, and C are compared with the LTE frame structure in the time domain, it is as shown in FIG. 3e.

[0228] The above-mentioned frame structure types can be applied to various scenarios. In terms of cell size, the longer the CP length, the larger the cell can be supported, so frame structure type A can support relatively larger cells than frame structure types B and C. In terms of operating frequency band, the larger the subcarrier spacing, the more advantageous it is for phase noise recovery in the high-frequency band, so frame structure type C can support relatively higher operating frequencies than frame structure types A and B.

From a service perspective, since a shorter subframe length is advantageous for supporting ultra-low latency services such as URLLC, frame structure type C is relatively suitable for URLLC services compared to frame structure types A and B.

[0229] In addition, a scenario in which the above frame structure types are multiplexed and operated in a single system can be considered. Figure 3f shows an example in which the above frame structure types A, B, and C are multiplexed in a single system. That is, by maintaining an integer multiple relationship between the essential parameter sets defining the above frame structure types, resource mapping within a subframe or within a PRB is smoothly performed even in a multiplexed case such as Figure 3f.

[0230] [[Embodiment 3-1] Measurement gap

[0231] In order to support the mobility of the terminal, the terminal needs to measure the radio link quality (radio link quality) of not only the cell (hereinafter referred to as serving cell) to which it is currently connected and performing signal transmission and reception, but also other surrounding cells. The terminal reports the measured radio link quality to the base station, and the base station refers to the radio link quality report of the terminal to determine whether to handover the terminal to another cell with better radio link quality. The radio link quality measurement can be classified into intra-frequency measurement, inter-frequency measurement, and inter-RAT (Radio Access Technology) measurement methods depending on the measurement target:

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[0232] 1) Intra-frequency measurement method is applicable when the frequency of the serving cell of the terminal and the cell for which the radio link quality is to be measured are the same.

[0233] 2) Inter-frequency measurement method is applicable when the frequency of the serving cell of the terminal and the cell for which the radio link quality is to be measured are different.

[0234] 3) Inter-RAT measurement method is applicable when the RAT (Radio Access Technology) of the serving cell of the terminal and the cell for which the radio link quality is to be measured are different.

RAT refers to a wireless access technology, such as communication methods such as 4G and 5G.

[0235] In the case of intra-frequency measurement, the terminal does not need additional RF frequency change (RF tuning) operation to measure the radio link quality of the cell for which it is to be measured.

In contrast, in the case of inter-frequency measurement or inter-RAT measurement, depending on the terminal, it is necessary to change the RF frequency of the terminal to the frequency of the cell to be measured (RF tuning) or to change the RAT to the RAT of the cell to be measured.

[0236] Measurement gap is the time period required for the terminal to change the frequency or RAT and measure the radio link quality during the inter-frequency measurement and inter RAT measurement.

During the measurement gap, the terminal stops the uplink transmission operation and does not receive the downlink signal from the serving cell. In other words, a service interruption occurs between the terminal and the serving cell due to the measurement gap.

That is, a service interruption occurs between the terminal and the serving cell due to the measurement gap. FIG. 3g illustrates the measurement gap of the LTE system. In FIG. 3g, the length of the measurement gap is 6 subframes (=6ms) from subframe (i+1) to subframe (i+6). Therefore, the service interruption time of the terminal lasts from the subframe (i+1) to the subframe (i+6).

[0237] In the case of a terminal capable of transmitting and receiving only one RF or one RAT signal at any moment, interfrequency/inter-RAT measurement is performed by changing the RF or RAT during the measurement gap time period. In addition, even if a terminal capable of simultaneously transmitting and receiving multiple RF or multiple RAT signals at any moment is capable, a measurement gap is required for interference control. For example, if there is no measurement gap, the uplink signal transmitted by the terminal to the serving cell at any moment and the signal of the surrounding cell that the terminal wants to measure may interfere with each other, which may reduce the reliability of the radio link quality measurement. The effect of the interference may vary depending on the gap between the frequency of the serving cell and the frequency of the cell to be measured, and the RF implementation method of the terminal.

[0238] As described above, in the early stage when the 5G system is introduced in the future, the terminal is expected to operate in LTE-NR coexistence or LTE-NR dual mode at least through the combination of existing LTE/LTE-A and NR (LTE-NR aggregation). Through this, the existing LTE/LTE-A can provide stable system operation, and the 5G system can play a role in providing improved services. The present invention proposes a method of setting and applying a measurement gap for a terminal that supports LTE-NR aggregation to support mobility to an LTE or NR system.

The present invention proposes a method for setting and applying a measurement gap for a terminal supporting LTE-NR combination to support mobility to an LTE or NR system. Basically, it is assumed that the LTE system and the NR system are independent systems and that the time synchronization between subframes or radio frames between the two systems does not match. The system where the time synchronization does not match is called an asynchronous system.

[0239] Referring to FIG. 3h, the terminal supports the combination of LTE (3h-01) and NR (3h-02) which is a frame structure type B, and the LTE system and the NR system indicate that the time synchronization between the subframes or radio frames is misaligned by "offset A" (3h-03). In addition, the base station sets a measurement gap (3h-04) corresponding to 6 subframes based on LTE to the terminal, indicating that it corresponds to LTE subframe (i+1) to LTE subframe (i+6). However, due to the above "offset A", the above measurement gap does not coincide with the NR subframe boundary. That is, the NR subframe affected by the above measurement gap is from NR subframe (j+2) to NR subframe (j+14). Among them, the L11 (3h-06) section, which is part of NR subframe (j+2), and the L12 (3h-07) section, which is part of NR subframe (j+14), do not actually overlap with the above measurement gap time section, but from the NR system perspective, they are inevitably included in the interruption time (=measurement gap + L11 + L12) (3h-05), resulting in inefficiency in radio resource utilization.

[0240] In the 3-1 embodiment, in order to resolve the inefficiency of the above wireless resource utilization, a method is proposed in which the A1 and A2 sections are utilized to perform signal transmission and reception of the terminal when only a part of the measurement gap and the subframe overlap. FIGS. 3i, 3j, and 3k illustrate the A1 and A2 sections, respectively, by frame structure type of the NR system.

[0241] In Figure 3i, the terminal supports a combination of LTE (3i-01) and NR (3i02), which is frame structure type A, and the LTE system and the NR system show that the time synchronization between the subframes or radio frames is misaligned by "offset A" (3i-03). In addition, the base station sets a measurement gap (3i04) corresponding to 6 subframes based on the LTE standard to the terminal, indicating that it corresponds to LTE subframe (i+1) to LTE subframe (i+6). And from the NR subframe perspective, it shows that from a part of NR subframe (j+1) to a part of NR subframe (j+7) overlaps with the above measurement gap. That is, the L11 (3i-06) part of NR subframe (j+1) and the i'.12 (3i-07) part of NR subframe (j+7) can perform transmission and reception operations with the NR system without interruption. Therefore, from the NR system perspective, the interruption time (3i-05) = measurement gap (3i -04).

[0242] FIG. 3j shows that the terminal supports the combination of LTE (3j-01) and NR (3j02) with frame structure type B, and the LTE system and the NR system are out of time synchronization between subframes or radio frames by "offset A" (3j-03). And the base station sets a measurement gap (3j04) corresponding to 6 subframes based on LTE to the terminal, indicating that it corresponds to LTE subframe (i+1) to LTE subframe (i+6).

And from the NR subframe perspective, it shows that from a part of NR subframe (j+2) to a part of NR subframe (j+14) overlaps with the above measurement gap. That is, the L11 (3j-06) part of NR subframe (j+2) and the L12 (3j-07) part of NR subframe (j+14) can perform transmission and reception operations without interruption with the NR system. Therefore, from the NR system perspective, interruption time (3j-05) = measurement gap (3j-04).

[0243] FIG. 3k shows that the terminal supports a combination of LTE (3k-01) and NR (3k02) with frame structure type C, and the LTE system and the NR system are out of time synchronization between subframes or radio frames by "offset A" (3k-03). And the base station sets a measurement gap (3k04) corresponding to 6 subframes based on LTE to the terminal, indicating that it corresponds to LTE subframe (i+1) to LTE subframe (i+6). And from the NR subframe perspective, it indicates that a portion of NR subframe (j+4) overlaps with the measurement gap from a portion of NR subframe (j+28). That is, the L11 (3k-06) section, which is a portion of NR subframe (j+4), and the L12 (3k-07) section, which is a portion of NR subframe (j+28), allow the terminal to perform transmission and reception operations without interruption with the NR system. Therefore, from the NR system perspective, the interruption time (3k-05) = measurement gap (3k-04).

[0244] For convenience of explanation below, the subframe that overlaps the beginning of the measurement gap and some sections is called partial subframe 1, and the subframe that overlaps the end of the measurement gap and some sections is called partial subframe 2.

[0245] The terminal receives a downlink signal in the A1 section of the partial subframe 1 and transmits an uplink signal in the A2 section of the partial subframe 2, thereby minimizing waste of radio resources.

[0246] Whether the terminal transmits or receives a signal in the partial subframe is determined based on whether the following condition is satisfied when comparing the "offset A" with the symbol or subframe length of the NR system. As described above, the symbol length and subframe length of the NR system vary depending on the frame structure type of the NR system.

[0247]- Condition 1: "offset A" .C::: 0.5 symbol

[0248]- Condition 2: "offset A" .C::: 0.5 subframe

[0249] If condition 1 is satisfied, the terminal determines that the LTE system and the NR system are in time synchronization, and does not perform transmission and reception operations in the partial subframe. (Hereinafter referred to as synchronous mode.) If condition 1 is not satisfied and condition 2 is satisfied, the terminal determines that the LTE system and the NR system are not in time synchronization, and performs signal transmission and reception in the partial subframe. (Hereinafter referred to as asynchronous mode.) As a variation of the above conditions 1 and 2, the base station can set a predetermined threshold value 1 instead of 0.5 symbols in condition 1 and inform the terminal of this through signaling, and can set a predetermined threshold value 2 instead of 0.5 subframes in condition 2

and inform the terminal of this through signaling.

[0250] The above "offset A" can be measured by the terminal, or determined at the base station installation stage and notified by the base station to the terminal through signaling. If the terminal measures "offset A", the terminal reports the measurement result to the base station so that the base station and the terminal can recognize the same operation.

[0251] Alternatively, the operation in the partial subframe can be determined according to the terminal's capability and the base station settings. Since the asynchronous mode requires additional terminal operation more than the synchronous mode, the synchronous mode can be defined as the basic operation of the terminal, and the terminal capability that additionally supports the asynchronous mode can be defined. Referring to FIG. 31 below, in step 31-01, the terminal reports the terminal capability to the base station. The terminal capability includes information on whether the terminal supports the asynchronous mode. In step 31-02, the terminal obtains configuration information from the base station regarding whether to operate in synchronous mode or asynchronous mode through base station signaling. In step 31-03, the terminal compares the configuration information obtained in step 31-02 with the terminal capability and determines the operation in the partial subframe according to the following decision method.

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[0252] - Decision method 1: (Terminal capability = asynchronous mode not supported or only synchronous mode supported) & (Base station setting = asynchronous mode) -] Determine as synchronous mode and report to the base station that the base station setting error is

[0253] - Decision method 2: (Terminal capability = asynchronous mode not supported or only synchronous mode supported) & (Base station setting = synchronous mode) -] Determine as synchronous mode

[0254] - Decision method 3: (Terminal capability = asynchronous mode supported) & (Base station setting = synchronous mode) -] Determine as synchronous mode

[0255] - Decision method 4: (Terminal capability = asynchronous mode supported) & (Base station setting = asynchronous mode) -] Determine as asynchronous mode

[0256] Additionally, in the above step 31-01, the terminal includes whether a measurement gap is required in the terminal's capability information and reports it to the base station. can be reported. If the terminal does not require a measurement gap, the procedures of steps 31-02 and 31-03 above can be omitted, and the terminal can perform radio link quality measurement of the surrounding cell without a measurement gap.

[0257] Next, the method by which the base station sets a measurement gap to the terminal is described. The length L of the measurement gap is to include the processing time required for cell identification from the signal received by the terminal during the measurement gap period, and the processing time required for RF or RAT change of the terminal.

And in order for the terminal to periodically measure the radio link quality of the surrounding cell, the measurement gap is repeated at a predetermined period P compared to the reference system. And the measurement gap is started at a point in time that is separated by the "measurement offset" within the measurement gap period. The "measurement offset" can prevent the phenomenon in which terminals in the system simultaneously focus on measuring the radio link quality at a limited time by setting different values for each terminal. The reference system can be an LTE system or an NR system.

[0258] The length of the measurement gap, the period, the "measurement offset" information, and the information about the reference system are defined as fixed values and used, or the base station sets some or all of the measurement gap-related control information and notifies the terminal through signaling.

[0259] The terminal obtains the measurement gap-related control information from the base station, and then attempts to measure the radio link quality of the surrounding cell in the radio frame and subframe that satisfy the following condition A.

[0260]- Condition A:

[0261] $\text{SFN mod } T = \text{FLOOR}(\text{"measurement offset"} / N);$

[0262] $\text{Subframe} = \text{"measurement offset"} \bmod N;$

[0263] $T = P/10$

[0264] In the above condition A, SFN is a counter of the radio frame unit of the reference system, FLOOR (x) is the largest integer not greater than x, $x \bmod y$ is the remainder of dividing x by y, and N represents the number of subframes constituting one radio frame of the reference system.

[0265] For example, if the measurement gap-related control information acquired by the terminal from the base station is $P = 40\text{ms}$, "measurement offset" = 25 subframes, and the SFN of the reference system is 2, $N = 10$, when calculating the above condition A,

[0266] $T = 40/10 = 4$;

[0267] $\text{SFN} \bmod T = 2 \bmod 4 = 2$

[0268] $\text{FLOOR}(25/10) = 2$;

[0269] $\text{Subframe} = 25 \bmod 10 = 5$;

[0270] therefore, condition A is satisfied. That is, the terminal starts a measurement gap of length L at $\text{SFN} = 2$ and $\text{subframe} = 5$ of the reference system, and repeats it with a 40ms cycle.

[0271] Figure 3m shows the procedure for the terminal to acquire measurement gap control information and perform measurement. In step 3m-01, the terminal acquires measurement gap control information from the base station.

In step 3m-02, the terminal determines whether the measurement gap control information received from the base station satisfies the above condition A, and if so, performs radio link quality measurement for the surrounding cells in step 3m-03. If condition A is not satisfied, the terminal performs step 3m-02 again at the next time.

[0272] The operation in asynchronous mode or synchronous mode in the above partial subframe has been described in relation to the measurement gap of the terminal, but the above technology can be generalized and applied before and after a certain radio resource area where transmission or reception of the terminal is restricted, similar to the measurement gap. For example, the above-mentioned certain radio resource area can be defined and allocated in advance by the base station so that a terminal supporting an ultra-low latency service within a cell can transmit and receive signals for a time shorter than the subframe length.

[0273] [[Embodiment 3-2] PUSCH/PDSCH transmission/reception

[0274] Example 3-2 describes a flexible data transmission/reception method in an NR system. In the existing LTE/LTE-A system, the time interval between the transmission time of the base station control information that schedules the uplink data transmission of the terminal and the transmission time of the uplink data (hereinafter referred to as scheduling timing) is applied to all terminals as the same fixed value. Similarly, in the LTE/LTE-A system, the time interval between the transmission time of the downlink data of the base station and the transmission time of the HARQ-ACK control information of the

terminal for the downlink data (hereinafter referred to as HARQ timing) is applied to all terminals as the same fixed value.

[0275] However, in the NR system, by flexibly adjusting the scheduling timing and HARQ timing, it is possible to support terminals requiring low-latency (Clow latency) service and efficiently use radio resources. For the flexible timing adjustment, a timing indicator k is defined, and the scheduling timing and HARQ timing are determined as follows.

[0276]- Scheduling timing:

[0277] Uplink data transmission time = $j + T_{MIN1} + k$

[0278]- HARQ timing:

[0279] Uplink HARQ-ACK control information transmission time = $j + T_{MIN2} + k$

[0280] In the scheduling timing, j indicates a subframe in which the base station transmits control information for scheduling the uplink data transmission of the terminal. T_{MIN1} is the minimum time required for a terminal to process and acquire scheduling control information received from a base station.

[0281] In HARQ timing, j represents a subframe in which downlink data of a base station is transmitted. T_{MIN2} is the minimum time required for a terminal to process and acquire data received from a base station.

[0282] And the timing indicator k can be included in the scheduling control information of the base station to the terminal through dynamic signaling or semi-statically through upper layer signaling. [0283]

Figure 3n shows flexible scheduling timing in an NR system. Figure 3n exemplifies the case where $T_{MIN1} = 4$ (3n-01) and the base station transmits scheduling information in subframe j (3n-02). The terminal applies the timing indicator k that the base station signals, and if $k=0$, transmits uplink data in subframe $j+4$ ($=j+4+0$), and if $k=1$, transmits uplink data in subframe $j+5$ ($=j+4+1$). FIG. 3n defines the timing indicator k as 0 or 1, but it can be defined as various values depending on the system design.

[0284] FIG. 3o shows flexible HARQ timing in an NR system. FIG. 3o exemplifies the case (3o-02) where $T_{MIN1} = 4$ (3o-01) and the base station transmits downlink data in subframe j . The terminal applies the timing indicator k that the base station signals, and if $k=0$, transmits the uplink HARQ-ACK in subframe $j+4$ ($=j+4+0$), and if $k=1$, transmits the uplink HARQ-ACK control information in subframe $j+5$ ($=j+4+1$). FIG. 3o defines the timing indicator k as 0 or 1, but it can be defined to various values depending on the system design.

[0285] In addition, it is necessary to define the operation when the time point at which the terminal wants to transmit uplink data or HARQ-ACK control information overlaps with the measurement gap period according to the scheduling timing and HARQ timing. The operation of the terminal is described below with reference to FIGS. 3p and 3q.

[0286] FIG. 3p shows an example where the uplink data transmission time point calculated according to the scheduling timing overlaps with the measurement gap period (3p-06) when the base station transmits scheduling information in subframe j (3p02). In this case, the terminal adjusts the uplink data transmission time point so that it does not overlap with the measurement gap period (3p-05) by the following method.

[0287] - Method A: Transmit immediately after the measurement gap period ends (transmit in subframe j+m in the example of FIG. 3p)

[0288] - Method B: Transmit at the point in time when the measurement gap period ends and additionally applies the timing indicator k (transmit in subframe j+m if k=0 in the example of FIG. 3p, and transmit in subframe j+m+1 if k=1)

[0289] Method A can minimize the uplink transmission delay of the terminal, and Method B can adjust the timing additionally. If it is a TDD system, the terminal transmits in the first uplink subframe that

arrives after the point in time calculated according to the above methods A and B.

[0290] Figure 3q shows an example where, in the case where the base station transmits downlink data in subframe j (3q-02), the uplink data transmission time calculated according to the scheduling timing overlaps with the measurement gap period (3q-06) (3q-04). In this case, similar to the case of the above Figure 3p, the terminal adjusts the uplink HARQ-ACK control information transmission time so that it does not overlap with the measurement gap period according to the above Method A or Method B (3q-05).

[0291] Figure 3r shows the terminal procedure when the measurement gap and the uplink data or control information transmission time overlap according to the above method. In step 3r-01, the terminal receives scheduling information or downlink data from the base station. In step 3r-02, the terminal determines the transmission time of uplink data or uplink HARQ-ACK control information according to the scheduling timing or HARQ timing. In step 3r-03, the terminal determines whether the transmission time determined above overlaps with the measurement gap period. If it does not overlap with the measurement gap period, in step 3r-04, the terminal maintains the transmission time determined in step 3r-02 as is, and transmits uplink data or uplink HARQ-ACK control information to the base station in step 3r-06. If the uplink transmission time determined in step 3r-02 overlaps with the measurement gap period, in step 3r-05, the terminal adjusts the transmission time of uplink data or uplink HARQ-ACK control information according to method A or method B, and transmits it to the base station in step 3r-06.

[0292] And, the transmission/reception timing of the terminal can be defined by combining the above scheduling timing and the partial subframe of the above 3-1 embodiment. The following is described with reference to FIG. 3s. FIG. 3s shows that, like the case of FIG. 3k, the terminal supports the combination of LTE (3s-01) and NR (3s-02) with frame structure type C, and the LTE system and the NR system are out of time synchronization between subframes or radio frames by "offset A" (3k-03). And the base station sets a measurement gap (3s-04) corresponding to 6 subframes based on LTE to the terminal, indicating that it corresponds to LTE subframe (i+1) to LTE subframe (i+6). And from the NR subframe perspective, it indicates that a portion of NR subframe (j+4) to a portion of NR subframe (j+28) overlaps with the measurement gap. That is, it indicates that NR subframe (j+4) is applied as partial subframe 1 and NR subframe (j+28) is applied as partial subframe 2. As described in the description of FIG. 3k above, the terminal can perform transmission and reception operations without interruption with the NR system in the portion of partial subframes 1 and 2 that does not overlap with the measurement gap.

[0293] Under these conditions, FIG. 3s illustrates a case where a terminal transmits uplink data in subframe j according to base station scheduling (3s-05), and the base station wants to transmit retransmission scheduling control information for the uplink data to the terminal in subframe j+4, as the minimum processing time required for receiving and processing the uplink data of the terminal is 4 subframes. The subframe j+4 is partial subframe 1, and since the terminal can receive a downlink signal,

the base station transmits retransmission scheduling control information to the terminal in subframe $j+4$ as initially calculated. After that, the terminal stops transmitting and receiving operations to the NR cell during the measurement gap period, and then performs uplink data transmission according to the retransmission scheduling of the base station at the end of the measurement gap. In the example of FIG. 3s, the terminal transmits uplink data in partial subframe 2 (3s-08). Therefore, the HARQ RTI (Round Trip Time) between the initial uplink data transmission time (3s-05) of the terminal and the retransmission uplink data transmission time is 28 subframes (3s-10). If the terminal does not support the transmission and reception operations in the partial subframe, the terminal cannot receive the retransmission scheduling control information transmitted by the base station in subframe $j+4$, and can receive the retransmission scheduling control information in subframe $j+29$, which is the time at which the downlink signal can be received from the base station the fastest after the measurement gap. Assuming that the above retransmission scheduling control information processing time of the terminal is 4 subframes, the terminal can transmit the uplink data scheduled for retransmission in subframe $j+33$. Therefore, the HARQ RTI increases to 33 subframes, causing transmission delay.

[0294] [Embodiment 3-3] Valid subframe for CSI measurement

[0295] Embodiment 3-3 explains a method for measuring channel status information (CSI; Channel Status Information) of the terminal in the partial subframe. The terminal measures CSI indicating a

downlink channel status from the CSI-RS (CSI Reference Signal) transmitted by the base station, and reports it to the base station to support the scheduling operation of the base station. The above CSI-RS is mapped to a fixed location with a predetermined promised pattern, and the accuracy of the terminal CSI measurement depends on the mapping of the CSI-RS in the partial subframe. The following is explained with reference to FIG. 3t.

[0296] In the example of FIG. 3t (a), it shows that subframe (n) (3s-01) is a partial subframe, and a part of subframe (3s-04) and subframe (n+1) of subframe (n) are included in the measurement gap (3s-02). In the case of FIG. 3t (a), it shows that the mapping of CSI-RS (3s-03) within the partial subframe (3s-01) does not overlap with the measurement gap (3s-02). Therefore, the terminal can receive the CSI-RS without loss and maintain the reliability of the CSI measurement. That is, if the mapping of the CSI-RS that the terminal wants to measure does not overlap with the measurement gap section of the partial subframe, the terminal determines that the partial subframe is valid for CSI measurement and performs CSI measurement in the partial subframe. In contrast, in the case of FIG. 3t (b), the mapping of the CSI-RS (3s-07) in the partial subframe (3s-09) overlaps with the measurement gap (3s-06). Therefore, the terminal determines that the partial subframe is invalid for CSI measurement and does not perform CSI measurement in the partial subframe.

[0297] FIG. 3u shows the procedure for the terminal to measure CSI according to the above method. In step 3u-01, the terminal obtains CSI configuration information and measurement gap configuration information from the base station through signaling.

CSI configuration information includes control information for CSI measurement of the terminal, such as mapping pattern of CSI-RS, transmission period, and transmission time. Measurement gap configuration information includes measurement gap-related control information, such as measurement gap length, period, and time. In step 3u-02, the terminal determines the CSI measurement time. The terminal can determine the CSI measurement time by referring to the CSI configuration information acquired in step 3u-01 and additionally the CSI report command indicated by the base station. In step 3u-03, the terminal determines whether the subframe n for which CSI is to be measured is a partial subframe, and if it is not a partial subframe, proceeds to step 3u-04 and performs CSI measurement in the subframe n. If the determination result of step 3u-03 is a partial subframe, in step 3u-05, the terminal determines whether the CSI-RS overlaps with the measurement gap. If the CSI-RS does not overlap with the measurement gap, the terminal proceeds to step 3u-04 and performs CSI measurement in the subframe n. If the judgment result in step 3u-05 is that the CSI-RS overlaps with the measurement gap, the terminal proceeds to step 3u-06 and does not perform CSI measurement in the subframe n.

[0298] As a modified example of the 3-3 embodiment, the base station can inform the terminal of whether CSI measurement is performed in the partial subframe through signaling.

[0299] FIG. 3v shows a terminal transceiver according to the present invention. For the convenience of explanation, the drawings and descriptions of devices not directly related to the present invention are omitted.

[0300] Referring to FIG. 3v, the terminal is composed of a transmitter (3v-04) comprising an uplink transmission processing block (3v-01), a multiplexer (3v-02), and a transmission RF block (3v-03), a

receiver (3v-08) comprising a downlink reception processing block (3v-05), a demultiplexer (3v-06), and a reception RF block (3v-07), and a control unit (3v-09). The control unit (3v-09) determines how to apply the measurement gap and how to apply the partial subframe from the measurement gap control information acquired by the terminal through the base station signaling, and controls each of the configuration blocks of the receiver (3v-08) for receiving the downlink signal of the terminal and each of the configuration blocks of the transmitter (3v-04) for transmitting the uplink signal. [0301] In the transmitter (3v-04) of the terminal, the uplink transmission processing block (3v-01) performs processes such as channel coding and modulation to generate a signal to be transmitted. The signal generated in the uplink transmission processing block (3v-01) is multiplexed with another uplink signal by the multiplexer (3v-02), and then is signal processed in the transmitting RF block (3v-03) and then transmitted to the base station.

[0302] The terminal receiver (3v-08) demultiplexes the signal received from the base station and distributes it to each downlink receiving processing block. The downlink receiving processing block (3v-05) performs processes such as demodulation and channel decoding on the downlink signal of the base station to obtain control information or data transmitted by the base station. The terminal receiver (3v-08) applies the output result of the downlink receiving processing block to the control unit (3v-09) to support the operation of the control unit (3v09).

[0303] Meanwhile, the embodiments of the present invention disclosed in this specification and drawings are only specific examples presented to easily explain the technical contents of the present invention and help in understanding the present invention, and are not intended to limit the scope of the present invention.

That is, it is obvious to those skilled in the art that other modified examples based on the technical idea of the present invention are possible. In addition, each of the above embodiments can be combined and operated as needed.

[0304] [Fourth Embodiment]

[0305] Wireless communication systems have evolved from providing initial voice-oriented services to broadband wireless communication systems that provide high-speed, high-quality packet data services, such as, for example, 3GPP's HSPA (High Speed Packet Access), LTE (Long Term Evolution or E-UTRA (Evolved Universal Terrestrial Radio Access)), LTE Advanced (LTE-A), LTE-Pro, 3GPP2's HRPD (High Rate Packet Data), UMB (Ultra Mobile Broadband), and IEEE's 802.16e.

[0306] As a representative example of the above broadband wireless communication system, the LTE system adopts the OFDM (Orthogonal Frequency Division Multiplexing) method in the downlink (DL) and the SC-FDMA (Single Carrier Frequency Division Multiple Access) method in the uplink (UL). The uplink refers to a wireless link in which a terminal (UE (User Equipment) or MS (Mobile Station)) transmits data or control signals to a base station (eNode B or base station (BS)), and the downlink refers to a wireless link in which a base station transmits data or control signals to a terminal. The above multiple access method usually distinguishes data or control information of each user by allocating and

operating the time-frequency resources for transmitting data or control information to each user so that they do not overlap each other, that is, so that orthogonality is established.

[0307] As a future communication system after LTE, that is, the 5G communication system must be able to freely reflect various requirements of users and service providers, so services that simultaneously satisfy various requirements must be supported. Services considered for the 5G communication system include enhanced Mobile Broadband (eMBB), massive machine type communication (mMTC), and Ultra Reliability Low Latency Communication (URLLC).

[0308] eMBB aims to provide a data transmission rate that is even higher than the data transmission rate supported by existing LTE, LTE-A, or LTE-Pro. For example, in a 5G communication system, eMBB must be able to provide a peak data rate of 20Gbps in the downlink and a peak data rate of 10Gbps in the uplink from the perspective of a single base station. In addition, 5G communication systems must provide the maximum transmission speed while providing the increased user perceived data rate. To meet these requirements, improvements in various transmission and reception technologies, including more advanced Multi Input Multi Output (MIMO) transmission technology, are required. In addition, while the current LTE transmits signals using a maximum transmission bandwidth of 20 MHz in the 2 GHz band, 5G communication systems can satisfy the data transmission speed required by 5G communication systems by using a wider frequency bandwidth than 20 MHz in the 3-6 GHz or 6 GHz or higher frequency bands.

[0309] At the same time, mMTC is being considered to support application services such as the Internet of Things (IoT) in 5G communication systems. mMTC requires support for large-scale terminal connection within a cell, improved terminal coverage, improved battery life, and reduced terminal costs to efficiently provide the Internet of Things. Since the Internet of Things provides communication functions by attaching various sensors and various devices, it must be able to support a large number of terminals (e.g., 1,000,000 terminals/km²) within a cell. In addition, terminals supporting mMTC are likely to be located in shadow areas that cells do not cover, such as basements of buildings, due to the nature of the service, and therefore require wider coverage compared to other services provided by 5G communication systems. Terminals supporting mMTC must be composed of low-cost terminals, and since it is difficult to frequently replace the terminal batteries, a very long battery life time, such as 10 to 15 years, is required.

[0310] Finally, URLLC is a cellular-based wireless communication service used for a specific purpose (mission-critical). For example, services such as remote control of robots or machinery, industrial automation, unmanaged aerial vehicles, remote health care, and emergency alert can be considered. Therefore, the communication provided by URLLC must provide very low latency and very high reliability. For example, a service supporting URLLC must satisfy an air interface latency of less than 0.5 milliseconds and have a packet error rate requirement of less than 10⁻⁵.

Therefore, for the service supporting URLLC, the 5G system must provide a smaller Transmit Time Interval (TTI) than other services, and at the same time, a design requirement is required to allocate a wide resource in the frequency band to secure the reliability of the communication link.

[0311] The above describes the services that the 5G communication system must provide. As described above, in the case of eMBB, a wider frequency band than the existing one must be used in the high frequency band above 6 GHz to satisfy the requirements that the next-generation communication system must provide. At the same time, various services must be provided in the low frequency band below 6 GHz. The high frequency band above 6 GHz has a very large path attenuation depending on the distance between the transmitter and receiver due to its frequency characteristics. In other words, when the base station transmits a signal with the same power, even if the terminal is located in the same location, the reception power received by the terminal in the high frequency band is very small compared to the reception power in the low frequency band. In addition, the penetration loss of the high-frequency band is much greater than that of the low-frequency band due to its frequency characteristics. This means that when a high-frequency band signal passes through a wall or object, it experiences much greater signal attenuation compared to the low-frequency band. Therefore, in the case of a cellular system operating in the high-frequency band, the coverage may be much smaller than that of a system operating in the low-frequency band. In order to fully secure system coverage in the high-frequency band, the base station and terminal of the high-frequency band must apply transmission based on a directional beam using a multi-antenna-array. However, when the base station and terminal apply transmission based on a directional beam, the coverage can be expanded in a specific direction, but it is difficult to transmit signals in all directions simultaneously.

[0312] Drawing 4a is a drawing showing a directional beam-based transmission considered in a high-frequency band of 6 GHz or higher.

[0313] In Drawing 4a, a base station (4a-001) that manages one cell can communicate with terminals 4a-002, 4a-003, and 4a-004 within the cell. The area 4a-005 covered by the base station (4a-001) indicates the maximum coverage that the base station (4a-001) can communicate with terminals when using an omni-directional beam. As shown in Drawing 4a, when the base station (4a001) transmits a signal using a directional beam, the coverage can be further increased. In the case of high frequency bands, since the target coverage cannot be achieved by using an omnidirectional beam, a directional beam must be used. In the drawing 4a, terminals 4a-002 and 4a-003 can communicate with the base station (4a-001) using an omnidirectional beam, but in the case of terminal 4a-004, the path attenuation is relatively large, so communication with the base station (4a-001) using an omnidirectional beam is impossible. Therefore, a directional beam (4a-006) must be used in the high frequency band. However, although a directional beam can improve coverage in the direction that the beam is directed, it has a narrow beam width compared to an omnidirectional beam, so there is a problem that communication is difficult when the beam direction between the terminal and the base station does not exactly match. For example, since

beam 4a-006 formed toward terminal 4a-004 in drawing 4a does not face terminals 4a-002 and 4a-003, terminals 4a-002 and 4a-003 cannot communicate with the base station (4a-001) using beam 4a-006.

[0314] When a base station performs data transmission to a specific terminal, it can form a beam for the specific terminal before performing the data transmission. The terminal can report channel status information or a preferred beam index to the base station, and the base station can use the information reported by the terminal to form a beam when transmitting data. In addition, since uplink and downlink are communicated using the same frequency resources in time-division duplexing, the base station can measure the channel status information of the terminal by using the sounding reference signal transmitted by the terminal by assuming the reciprocity of the wireless channel between the terminal and the base station, and form a beam to be used when transmitting data to the terminal.

[0315] However, additional consideration is required when transmitting a signal transmitted for initial connection of an idle terminal as a directional beam. During the initial connection process, the synchronization signal and system information transmitted by the terminal also need to be transmitted based on a directional beam to secure full coverage. However, since the base station cannot know the existence of an idle terminal, it cannot form a beam based on the channel status report and measurement of the terminal and transmit a signal for initial connection. Here, the signals transmitted by the base station for the initial connection of an idle terminal include a synchronization signal and a physical channel for system information. The synchronization signal is a signal transmitted by the base station to allow the terminal to synchronize time and frequency with the base station and acquire a unique number transmitted by the cell or network (e.g., cell number (Cell IDentification)). In addition, system

information is information necessary for the terminal to connect to the network and can be transmitted to the terminal through a broadcast channel. In addition, system information is information required for a terminal to access the network, and can be transmitted to the terminal through a broadcast channel. As described above, since the base station cannot know the presence of an idle terminal, it cannot transmit a synchronization signal using a directional beam based on the status report and measurement of the terminal. Therefore, a beam sweeping technique is being considered, which forms a directional beam in a different direction at regular time intervals and transmits it.

[0316] Drawing 4b is a drawing illustrating a method for transmitting a synchronization signal and system information based on beam sweeping.

[0317] In Drawing 4b, a physical channel (4b-002-4b-005) for transmitting a synchronization signal and system information transmitted during one synchronization signal transmission period (4b-001) is mapped one-to-one with one directional beam (4b007-4b-010). The physical channel (4b-002-4b-005) for transmitting the synchronization signal and system information can be transmitted to the terminal through the same signal repeated multiple times and different directional beams (4b007-4b-010). That is, the synchronization signal and system information (4b002-4b-005) can be transmitted through the directional beams (4b-007-4b-010) in which the same signal has different directions. For example, the synchronization signal and system information (4b-002) can be transmitted in the direction directed by the directional beam (4b007), and the synchronization signal and system information (4b-003) can be transmitted in the direction directed by the directional beam (4b-008). As described above, by transmitting the synchronization signal by changing the direction of the directional beam over time, the base station has the advantage of securing coverage in all directions.

However, when using beam swimming based on directional beams for transmitting synchronization signals and system information in high-frequency bands, there is a problem that the beam can only be formed in one direction for the entire band. In other words, during one synchronization signal transmission cycle (4b-001), all frequency resources can only be transmitted in the same direction. In high-frequency bands above 6 GHz, it is difficult to apply digital beamforming for generating directional beams due to the complexity of RF chains and ADCs/DACs, so analog beamforming must be applied. Analog beamforming is a method of implementing a multi-antenna array and phase shifter in the analog stage and controlling the direction of the directional beam by controlling the phase shifter. In the case of directional beam transmission based on analog beamforming, a directional beam is formed in the same direction for the entire frequency band during one transmission time unit. For this reason, it is advantageous to multiplex the synchronization signal and system information in the frequency domain in the frequency band above 6 GHz. That is, if the synchronization signal and system information to be transmitted in the same direction are multiplexed in the frequency domain in one time resource and transmitted, there is an advantage of more efficiently utilizing the time frequency resource. However, in the frequency band below 6 GHz, since the synchronization signal and system information can be transmitted using an omnidirectional beam to secure full coverage, there is no need to consider the method of multiplexing the synchronization signal and system information in the frequency domain like 6 GHz. That is, in the low-frequency band below 6 GHz, if the synchronization signal and system information are multiplexed in the frequency domain, the minimum frequency band that the terminal must

support must increase, which is not desirable, and therefore, the method of multiplexing the synchronization signal and system information in the time domain is more appropriate.

[0318] [[Embodiment 4-1]

[0319] Drawing 4c is a drawing showing a structure of a physical channel in which a synchronization signal and system information are transmitted when transmitting a synchronization signal and system information using an omnidirectional beam.

[0320] In Drawing 4c, the synchronization signal and system information are transmitted at a certain periodic interval (4c-001). The synchronization signal may be composed of a first synchronization signal (4c-002) and a second synchronization signal (4c-003), but the present invention does not exclude including more synchronization signals. Both the first synchronization signal (4c-002) and the second synchronization signal (4c-003) may include a unique number of a cell or network. In this case, the terminal can perform time synchronization based on the first synchronization signal (4c-002) and then acquire the cell number or network number, etc. from the first synchronization signal (4c-002) and the second synchronization signal (4c003). Alternatively, the first synchronization signal (4c-002) may be transmitted to all cells as the same signal regardless of the base station or network unique number. In this case, the terminal must detect the base station timing through the first synchronization signal (4c-002) and attempt to detect the base station or network unique number from the second synchronization signal (4c-003) based thereon.

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When a base station transmits a synchronization signal and system information using an omnidirectional beam, the first synchronization signal (4c-002) and the second synchronization signal (4c-003) are multiplexed in the time domain. The physical channel (4c004) transmitting the system information is also multiplexed in the time domain with the first synchronization signal (4c-002) and the second synchronization signal. The first synchronization signal (4c-002), the second synchronization signal (4c-002), and the physical channel (4c-004) transmitting the system information are transmitted by sharing at least the same frequency band.

[0321] Drawing 4d is a drawing showing a structure in which a physical channel transmitting a synchronization signal and system information is transmitted when transmitting a synchronization signal and system information using a directional beam.

[0322] In Drawing 4d, the synchronization signal and the system information are transmitted at a constant periodic interval (4d-001). Depending on the number of directional beams used by the cell or network within the periodic interval (4d-001) in which the synchronization signal and system information are transmitted, the synchronization signal and system information may be transmitted continuously through directional beams having different directions. The synchronization signal may be composed of a first synchronization signal (4d-002) and a second synchronization signal (4d-003), but the present invention does not exclude including more synchronization signals. Both the first synchronization signal (4d-002) and the second synchronization signal (4d-003) may include a unique number of the cell or network. In this case, the terminal performs time synchronization based on the first synchronization signal (4d-002) and then acquires a cell number or network number, etc. from the first synchronization signal (4d-002) and the second synchronization signal (4d-003). Alternatively, the first synchronization signal (4d-002) may be transmitted to all cells as the same signal regardless of the base station or network unique number.

In this case, the terminal must detect the base station timing through the first synchronization signal (4d-002) and attempt to detect the unique number of the base station or network from the second synchronization signal (4d-003) based thereon. The first synchronization signal (4d-002) and the second synchronization signal (4d-003) are multiplexed in the frequency domain. In addition, the physical channel (4d-004) transmitting the system information is also multiplexed in the time domain with the first synchronization signal (4d-002) and the second synchronization signal (4d-003). In addition, the first synchronization signal (4d-002), the second synchronization signal (4d-003) and the physical channel (4d-004) transmitting the system information are transmitted at the same time.

[0323] As described above, it is desirable that the synchronization signal transmission structure according to the omnidirectional beam according to Drawing 4c multiple synchronization signals and system information are multiplexed in the time domain. On the other hand, it is desirable that the synchronization signal transmission structure according to the directional beam according to Drawing 4d be multiplexed in the frequency domain with multiple synchronization signals and system information. It is desirable that the synchronization signal transmission structure according to the omnidirectional beam and the synchronization signal transmission structure according to the directional beam use different multiplexing methods, but it is desirable to have a structure that is as unified as possible from the system perspective.

[0324] In addition, although the above description assumes that the directional beam is suitable for the high-frequency band, when considering compatibility in the future, initial access signal transmission based on the directional beam is possible even in the low-frequency band, and at the same time, initial access signal transmission based on the omnidirectional beam may be possible even in the high-frequency band. Therefore, it is not desirable to decide which beam-based transmission to use for the measurement frequency band.

Therefore, a method is needed for the base station to inform the terminal of which beam-based synchronization signal is transmitted when the terminal receives the synchronization signal. The present invention aims to solve this problem.

[0325] According to the purpose of the present invention, the first embodiment of the present invention proposes that the first synchronization signal that the terminal must detect first has the same structure regardless of whether the base station transmits the synchronization signal using the forward beam or the directional beam.

[0326] If the same structure is described in detail above,

[0327] the first synchronization signal has the same values for the following design items regardless of whether the base station uses the omnidirectional beam or the directional beam.

[0328]- Frequency band for synchronous signal transmission

[0329]- Frequency resource for synchronous signal transmission

[0330]- Sequence length of synchronous signal

[0331]- Subcarrier spacing

[0332]- Transmission period of synchronous signal

[0333] That is, the first synchronous signal (4c002) transmitted on the omnidirectional beam basis of Drawing 4c and the second synchronous signal (4d-002) transmitted on the directional beam basis of Drawing 4d have the same signal, and the terminal can detect the first synchronous signal to find out whether the base station to be connected transmits an initial access signal based on the omnidirectional beam or the initial access signal based on the directional beam.

[0334] In order for a terminal to find out which beam the initial access signal is transmitted through using the first synchronization signal, the first embodiment of the present invention proposes the following method.

[0335] 1. A method of using the index of the sequence used to transmit the first synchronization signal differently depending on the transmission based on the directional beam and the transmission based on the omnidirectional beam. At this time, the sequence index constituting the first synchronization signal is based only on the beam information used by the base station. For example, if the signal transmitted for the initial access is transmitted using the omnidirectional beam, the first synchronization signal can be transmitted with the sequence index constituting the first synchronization signal set to 0. On the other hand, if the signal transmitted for the initial access is transmitted using the directional beam, the first synchronization signal can be transmitted with the sequence index constituting the first synchronization signal set to 1. This means that if a Zadoff-Chu sequence is used as a sequence constituting the first synchronization signal, the above sequence index can be mapped to the root index of the Zadoff-Chu sequence. Or, if a Zadoff-Chu sequence is used as a sequence constituting the first synchronization signal, the above sequence index can be mapped to a specific cyclic delay of Zadoff-Chu for the same root index.

[0336] 2. A method of using the index of the sequence used to transmit the first synchronization signal differently depending on the directional beam-based transmission and the omnidirectional beam-based transmission. At this time, the sequence index constituting the first synchronization signal may include not only the beam information used by the base station, but also the base station unique number or network unique value. For example, assuming that the values that can be transmitted in the first synchronization signal are 0 to 5, in the case of transmission using the omnidirectional beam, the sequence index constituting the first synchronization signal may be transmitted as 0 to 2. Here, one of the values 0 to 2 may be determined according to the base station unique number or network unique value. In the case of transmission using the directional beam, the sequence index constituting the first synchronization signal may be transmitted as 3 to 5. Here, one of the values 0 to 2 may be determined according to the base station unique number or network unique value. This means that if a Zadoff-Chu sequence is used as a sequence composing the first synchronization signal, the above sequence index can be mapped to the root index of the Zadoff-Chu sequence, or can be mapped to a specific cyclic delay of Zadoff-Chu at the same root index.

[0337] If the terminal finds out which beam the initial access signal is transmitted through using the first synchronization signal, it can operate differently in the case of an omnidirectional beam and in the case of a directional beam.

[0338] Figure 4e is a flowchart showing the initial access process according to the 4-1 embodiment of the present invention.

[0338] Figure 4e is a flowchart showing an initial connection process according to the 4-1 embodiment of the present invention.

[0339] In Figure 4e, the terminal cannot know the beam-based initial information of the base station or network to be connected in the start step (4e-001). That is, the terminal does not have information on whether the base station transmits the initial connection signal, the first synchronization signal, the second synchronization signal, and the system information using an omnidirectional beam.

[0340] The terminal attempts to acquire the first synchronization signal in step (4e-002). Since the base station has the same first synchronization signal structure regardless of the omnidirectional beam or the directional beam, the terminal can receive the first synchronization signal. In this step, the terminal performs cross-correlation on the received signal with multiple sequences that can be transmitted as the first synchronization signal. The sequence with the highest correlation as a result of the cross-correlation can be determined as the sequence transmitted by the base station. In step (4e-003), the unique number of the base station or network is acquired based on the sequence detected in the previous step, and at the same time, it is possible to determine whether the base station or network uses an omnidirectional beam or a directional beam. If the terminal determines that the base station uses a directional beam in step (4e-003), it moves to step (4e-004). In step (4e-004), the terminal assumes that the second synchronization signal and system information are frequency-domain multiplexed in the same time resource as the first synchronization signal when acquiring the second synchronization signal and system information thereafter, and receives the signal. In order to receive a second synchronization signal and system information that are frequency-domain multiplexed on the same time resource as the first synchronization signal, the terminal may need to change its RF settings to receive signals in a wider frequency band than

when receiving the first synchronization signal, or may need to shift its RF frequency to the frequency resource transmitting the second synchronization signal and system information. On the other hand, if it is determined in step (4e-003) that the base station used an omnidirectional beam, the terminal moves to step (4e-006). In step (4e006), the terminal receives a signal assuming that the second synchronization signal and system information are time-domain multiplexed in the same frequency resource as the first synchronization signal when acquiring the second synchronization signal and system information thereafter. In order to receive the second synchronization signal and system information that are time-domain multiplexed in the same frequency resource as the first synchronization signal, the terminal does not need to change the RF frequency band or move the RF frequency, unlike in the case of a directional beam, and can attempt to detect the second synchronization signal at a time determined based on the first synchronization signal and acquire the system information.

[0341] [[Embodiment 4-2]

[0342] In the first embodiment, when using an omnidirectional beam, it is proposed that the first synchronization signal, the second synchronization signal, and the system information are transmitted on the same frequency resource and are multiplexed in the time domain. Therefore, since the first synchronization signal and the second synchronization signal are transmitted on the same frequency resource as the system information, the first synchronization signal and the second synchronization signal can be used as a demodulation reference signal for receiving the system information. That is, it is possible to measure the channel with the first synchronization signal and the second synchronization signal, and demodulate the system information based on the measured channel. On the other hand, when using a directional beam, the first synchronization signal, the second synchronization signal, and the system information are transmitted on the same time resource, but can be multiplexed in the frequency domain.

In this case, unlike the omnidirectional beam-based transmission, the first synchronization signal and the second synchronization signal need to be considered in order to become the reference signals for demodulating system information. Therefore, in the 4-2 embodiment of the present invention, a method is proposed for using the first synchronization signal and the second synchronization signal as reference signals for demodulating system information when the directional beam is used and the first synchronization signal, the second synchronization signal, and the system information are multiplexed in the frequency domain.

[0343] FIG. 4f is a drawing illustrating a method for multiplexing a synchronization signal and system information in a system using a directional beam according to the second embodiment of the present invention.

[0344] In FIG. 4f, it is assumed that the synchronization signal and the system information are transmitted within the synchronization signal transmission frequency bandwidth (4f-001). The synchronization signal transmission frequency bandwidth (4f-001) can be determined to be the same as the minimum bandwidth that the terminal can support. In a system using a directional beam according to the second embodiment of the present invention, the first synchronization signal (4f-002) can be configured by allocating continuous subcarriers (4f-003) in the middle within the transmission bandwidth. As shown in FIG. 4f, there is an advantage in that filtering for cross-correlation performed in the time domain can be facilitated by allocating the first synchronization signal (4f-002) to continuous subcarriers (4f-003). The second synchronization signal (4f-005) can be allocated to have equal intervals according to the second synchronization signal interval (4f-005) among the subcarriers (4f-003) on which the first synchronization signal (4f-002) is not transmitted within the maximum synchronization signal transmission bandwidth. Here, the synchronization signal interval (4f-005) can be designed in consideration of requirements for transmitting channel status or system information.

For example, when the multipath delay of the channel increases, the coherence frequency in the frequency domain decreases, so the frequency domain spacing of the second synchronization signal should be further reduced. At the same time, when the multipath delay of the channel decreases, the coherence frequency in the frequency domain increases, so the frequency domain spacing of the second synchronization signal can be further increased.

[0345] The method of mapping the second synchronization signal to the subcarrier can be described as follows:

[0346] [Mathematical Formula 1]

[0347] Subcarrier number of the second synchronization signal = Second synchronization signal spacing * k + Second synchronization signal offset

[0348] The subcarrier number of the second synchronization signal has a value between 0 and N-1. Here, N is the number of valid subcarriers used for data transmission in the system. k is a natural number greater than 0, and has a value from 0 to K-1. Here, K is the length of the sequence used in the second synchronization signal. The offset of the second synchronization signal has a value from 0 to (the second synchronization signal interval - 1).

[0349] It is proposed that the offset of the second synchronization signal is generated based on the base station or network unique number transmitted by the first synchronization signal, if the first synchronization signal includes the unique number of the base station or network. For example, if the base station unique number is x, the offset of the second synchronization signal can be determined as (x mod second synchronization signal interval).

In this way, when determining the offset of the second synchronization signal, since the subcarrier for transmitting the second synchronization signal is different for each base station or network, blind detection is required to detect the second synchronization signal, but there is an advantage in that interference of the second synchronization signal between base stations can be avoided when demodulating data.

[0350] In the system information transmission considered in the present invention, when using a transmitter multi-antenna technique such as a space-frequency block code to secure coverage and reliability, the channel corresponding to each transmitter antenna port must be estimated. Therefore, the second synchronization signal must be transmitted from multiple antenna ports. To this end, the second synchronization signal generated according to mathematical expression 1 can be alternately assigned to each antenna port. That is, when considering two transmitter antenna ports, the method of mapping the second synchronization signal to the subcarrier can be described as follows:

[0351] [Mathematical Formula 2]

[0352] Subcarrier number of the second synchronization signal for the transmitter antenna port 1 =
Second synchronization signal interval * $k * 2$ + Second synchronization signal offset

[0353] Subcarrier number of the second synchronization signal for the transmitter antenna port 2 =
Second synchronization signal interval * $(k * 2 + 1)$ + Second synchronization signal offset

[0354] The subcarrier number of the second synchronization signal has a value from 0 to N-1. Here, N is the number of valid subcarriers used for data transmission in the system. K is a natural number greater than 0 and has a value from 0 to K-1. Here, K is (the length of the sequence used in the second synchronization signal/2). The offset of the second synchronization signal has a value from 0 to (the second synchronization signal interval - 1).

[0355] If four transmitter antenna ports are considered, the method of mapping the second synchronization signal to the subcarrier can be described by the following equation

[0356] [Mathematical Formula 2]

[0357] Subcarrier number of the second synchronization signal for the transmitter antenna port 1 =
Second synchronization signal interval * k * 4 + Second synchronization signal offset

[0358] Subcarrier number of the second synchronization signal for the transmitter antenna port 2 =
Second synchronization signal interval * (k * 4 + 1) + Second synchronization signal offset

[0359] Subcarrier number of the second synchronization signal for the transmitter antenna port 3 =
Second synchronization signal interval * (k * 4 + 2) + Second synchronization signal offset [0360]

Second synchronization signal for the transmitter antenna port 4 Subcarrier number of the
synchronization signal = Second synchronization signal interval * (k * 4 + 3) + Second synchronization
signal offset [0361] The subcarrier number of the second synchronization signal has a value from 0 to N-
1. Here, N is the number of valid subcarriers used for data transmission in the system. k is a natural
number greater than 0 and has a value from 0 to K-1. Here, K is (the length of the sequence used in the
second synchronization signal / 4).

The offset of the second synchronization signal has a value from 0 to (second synchronization signal interval - 1).

[0362] Meanwhile, the embodiments of the present invention disclosed in this specification and drawings are merely specific examples presented to easily explain the technical content of the present invention and help understand the present invention, and are not intended to limit the scope of the present invention. That is, it is obvious to those with ordinary skill in the art to which the present invention belongs that other modified examples based on the technical idea of the present invention are possible. In addition, each of the above embodiments can be combined and operated as needed. For example, parts of Embodiment 1, Embodiment 2, and Embodiment 6 of the present invention can be combined and operated as a base station and a terminal.

[0363] [Fifth Embodiment]

[0364] Wireless communication systems are evolving from providing voice-oriented services in the early days to broadband wireless communication systems that provide high-speed, high-quality packet data services, such as 3GPP's HSPA (High Speed Packet Access), LTE (Long Term Evolution or E-UTRA (Evolved Universal Terrestrial Radio Access)), LTE Advanced (LTE-A), LTE-Pro, 3GPP2's HRPD (High Rate Packet Data), UMB (Ultra Mobile Broadband), and IEEE's 802.16e.

[0365] As a representative example of the above broadband wireless communication system, the LTE system adopts the OFDM (Orthogonal Frequency Division Multiplexing) method in the downlink (DL) and the SC-FDMA (Single Carrier Frequency Division Multiple Access) method in the uplink (UL). Uplink refers to a wireless link in which a terminal (UE (User Equipment) or MS (Mobile Station)) transmits data or control signals to a base station (eNode B or base station (BS)), and downlink refers to a wireless link in which a base station transmits data or control signals to a terminal. The above multiple access method typically allocates and operates the time-frequency resources for transmitting data or control information to each user so that they do not overlap with each other, that is, so that orthogonality is established, thereby distinguishing the data or control information of each user.

[0366] As a future communication system after LTE, that is, the 5G communication system must be able to freely reflect various requirements of users and service providers, so that services that satisfy various requirements simultaneously must be supported. Services considered for the 5G communication system include enhanced Mobile Broadband (eMBB), massive machine type communication (mMTC), There are Ultra Reliability Low Latency Communication (URLLC), etc.

[0367] eMBB aims to provide a data transmission rate that is higher than the data transmission rate supported by existing LTE, LTE-A, or LTE-Pro. For example, in a 5G communication system, eMBB should be able to provide a maximum transmission rate (peak data rate) of 20Gbps in the downlink and a maximum transmission rate of 10Gbps in the uplink from the perspective of a single base station.

In addition, the 5G communication system must provide the maximum transmission speed while providing the increased user perceived data rate. To meet these requirements, improvements in various transmission and reception technologies, including more advanced Multi Input Multi Output (MIMO) transmission technology, are required. In addition, while the current LTE transmits signals using a maximum transmission bandwidth of 20MHz in the 2GHz band, the 5G communication system can satisfy the data transmission speed required by the 5G communication system by using a wider frequency bandwidth than 20MHz in the 3-6GHz or 6GHz or higher frequency band.

[0368] At the same time, mMTC is being considered to support application services such as the Internet of Things (IoT) in the 5G communication system. mMTC requires support for large-scale terminal connection within a cell, improved terminal coverage, improved battery life, and reduced terminal costs to efficiently provide the Internet of Things. The Internet of Things must be able to support a large number of terminals (e.g., 1,000,000 terminals/km²) within a cell, as it provides communication functions by attaching to various sensors and various devices. In addition, terminals supporting mMTC are likely to be located in shadow areas that cells do not cover, such as underground areas of buildings, due to the nature of the service, and therefore require wider coverage than other services provided by 5G communication systems. Terminals supporting mMTC must be composed of low-cost terminals, and since it is difficult to frequently replace the terminal's battery, a very long battery life time, such as 10 to 15 years, is required.

[0369] Finally, URLLC is a cellular-based wireless communication service used for a specific purpose (mission-critical). For example, it can be considered as a service used for remote control of robots or machinery, industrial automation, unmanaged aerial vehicles, remote health care, emergency alert, etc. Therefore, the communication provided by URLLC must provide very low latency and very high reliability. For example, a service supporting URLLC must satisfy an air interface latency of less than 0.5 milliseconds, and at the same time, it has a requirement of a packet error rate of less than 10^{-5} . Therefore, for a service supporting URLLC, the 5G system must provide a smaller transmission time interval (TTI) than other services, and at the same time, a design requirement is required to allocate a wide resource in the frequency band to secure the reliability of the communication link.

[0370] Figure 5a is a diagram illustrating an example in which three 5G services, namely eMBB (5a-01), URLLC (5a-02), and mMTC (5a-03), are multiplexed and transmitted in one system. According to the example illustrated in Figure 5a, in a 5G communication system, different transmission/reception techniques and transmission/reception parameters can be used between services to satisfy different requirements of each service.

[0371] Hereinafter, the frame structure of the LTE and LTE-A systems will be described in more detail with reference to the drawings.

[0372] Figure 5b is a diagram showing the basic structure of the time-frequency domain, which is a radio resource domain in which the data or control channel is transmitted in the downlink in the LTE system. [0373] In Figure 5b, the horizontal axis represents the time domain and the vertical axis represents the frequency domain. The minimum transmitter in the time domain is an OFDM symbol, and N_{symb} (5b-02) OFDM symbols are combined to form one slot (5b-06), and two slots are combined to form one subframe (5b-05). The length of the slot is 0.5 ms, and the length of the subframe is 1.0 ms. And the radio frame (5b-14) is a time domain unit consisting of 10 subframes. The minimum transmitter in the frequency domain is a subcarrier, and the bandwidth of the entire system transmission bandwidth consists of a total of N_{BW} (1a-04) subcarriers.

[0374] The basic unit of resources in the time-frequency domain is a resource element (5b-12, Resource Element; RE), which can be expressed by an OFDM symbol index and a subcarrier index. A resource block (5b-08, Resource Block; RB or Physical Resource Block; PRB) is defined as N_{symb} (5b-02) consecutive OFDM symbols in the time domain and N_{RB} (5b-10) consecutive subcarriers in the frequency domain. Therefore, one RB (5b-08) consists of $N_{\text{symb}} \times N_{\text{RB}}$ REs (5b-12). In general, the minimum transmitter of data is the above RB unit. In LTE systems, $N_{\text{symb}} = 7$, $N_{\text{RB}} = 12$, and N_{BW} and N_{RB} are proportional to the bandwidth of the system transmission band.

[0375] The frame structure of the LTE and LTE-A systems as described above is designed for typical voice/data communications, and thus has limitations in scalability in satisfying various services and requirements, such as 5G systems.

Therefore, in the 5G system, it is necessary to flexibly define and operate the frame structure by considering various services and requirements. For example, each service can consider having different subcarrier spacing according to requirements. Currently, two methods are being considered to support multiple subcarriers in the 5G communication system. As the first method to support multiple subcarriers in the 5G communication system, the subcarrier spacing set that the 5G communication system can have can be determined using the following mathematical formula 1.

[0376] [Mathematical formula 1]

[0377] $\Delta f = f_0 M$

[0378] Here, f_0 represents the basic subcarrier spacing of the system, and M represents the scaling factor. For example, if f_0 is 15kHz, the subcarrier spacing set that the 5G communication system can have can be composed of 7.5kHz, 15kHz, 30kHz, 45kHz, 60kHz, 75kHz, etc., and the system can be configured using all or part of the set.

[0379] Also, as a second method for supporting multiple subcarriers in the 5G communication system, the subcarrier spacing set that the 5G communication system can have can be determined using the following mathematical expression 2.

[0380] [Mathematical formula 2] [0381] $\Delta f = f_0 2^m$

[0382] Here, f_0 represents the basic subcarrier spacing of the system, and m represents an integer scaling factor. For example, if f_0 is 15 kHz, the set of subcarrier spacings that a 5G communication system can have can be composed of 7.5 kHz, 15 kHz, 30 kHz, 60 kHz, 120 kHz, etc. The system can be configured using all or part of the set, as in mathematical expression 1. In the present invention, according to the two methods described above, the present invention is described assuming that a 5G communication system uses a set of 15 kHz, 30 kHz, and 60 kHz subcarrier spacings with f_0 of 15 kHz. However, the technique proposed in the present invention can be applied without limitation to other subcarrier spacing sets (e.g., f_0 is 17.5KHz, and the subcarrier spacing sets are 17.5KHz, 35KHz, and 70KHz). If the subcarrier spacing sets 17.5KHz, 35KHz, and 70KHz are considered in the present invention, the technique described based on f_0 of 15kHz can be mapped. Similarly, 35kHz, 70kHz, and 140kHz can be mapped one-to-one with 30kHz, 60kHz, and 120kHz, respectively, and the present invention can be described.

[0383] Figure 5c is a diagram illustrating resource elements (5c-00) when the subcarrier spacing is $\Delta f_1(5c-01)$, $\Delta f_2(5c-02)$, and $\Delta f_3(5c-03)$, respectively. In the example of Figure 5c, the values of the subcarrier spacing of each resource element, i.e., $\Delta f_1(5c-01)$, $\Delta f_2(5c-02)$, and $\Delta f_3(5c-03)$, correspond to 15kHz, 30kHz, and 60kHz, respectively. In addition, each resource element has an OFDM symbol length of $T_s(5c-04)$, $T_s'(5c-05)$, and $T_s''(5c-06)$. As a characteristic of OFDM symbols, since the subcarrier spacing and the length of the OFDM symbol have an inverse relationship, it can be confirmed that the symbol length becomes shorter as the subcarrier spacing increases. Therefore, $T_s(5c-04)$ is twice as long as $T_s'(5c-05)$ and four times as long as $T_s''(5c-06)$. In addition, as a second method to support multiple subcarriers in a 5G communication system, the subcarrier spacing set that the 5G communication system can have can be determined using the following mathematical expression 2.

[0384] The various subcarrier spacing sets described above can be used for various purposes within a single system. For example, in a low carrier frequency band such as 2GHz to 4GHz, it may be appropriate to use a low subcarrier spacing considering the channel conditions (multi-path delay spread or coherence bandwidth) of the band. For example, in a center frequency band of 2GHz to 4GHz, the path delay spread is relatively large and therefore the coherence bandwidth is small, so it is advantageous to use a low subcarrier spacing. At the same time, in a band with a high center frequency of 6GHz or higher, the effects of channel conditions, Doppler shift, and frequency offset are more serious, so it may be advantageous to use a wide subcarrier spacing. At the same time, even in a band that uses a low center frequency, the 5G communication system can use a high subcarrier spacing for systems that require very low transmission delay times such as URLLC.

[0385] Hereinafter, the cell initial access operation procedure of LTE and LTE-A systems will be described in more detail with reference to the drawings.

[0386] Figure 5d is a drawing showing the downlink physical layer channel structure used in the cell initial access stage in LTE. An LTE terminal must perform the following processes before communicating with the network.

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[0387]- Acquiring synchronization with cells in the network

[0388]- Receiving and decoding system information

[0389] First, let's explain the procedure for acquiring synchronization with cells. In order for a terminal to acquire synchronization with a cell, two synchronization signals are transmitted in LTE, such as PSS (Primary Synchronization Signal, 5d01) and SSS (Secondary Synchronization Signal). PSS (5d-01) consists of three different ZC (Zadoff-Chu) sequences according to the physical layer cell ID (Identity) of the cell. More specifically, three cell IDs in one cell ID group correspond to different PSS (5d-01), respectively. When the terminal detects and confirms the PSS(5d-01), it obtains information about the 5ms timing of the cell, the location of the SSS(5d-02), and the cell ID within the cell ID group. The SSS(5d-02) has 168 different values corresponding to different cell ID groups. For this purpose, the SSS(5d-02) is designed based on the frequency interleaving of two m-sequences X and Y of 31. By detecting the SSS(5d-02), the frame timing and the cell ID group are known. As a result, the synchronization with the network is obtained through the PSS(5d01) and SSS(5d-02), and one of the total 504 physical layer cell IDs is obtained. Depending on the obtained physical layer ID, the corresponding CRS(Cell-specific Reference Signal) is known. At this time, in the case of initial cell search, i.e., in RRC_IDLE mode, CRS is used for decoding PBCH (5d-03) for channel estimation and system information acquisition. On the other hand, in the case of mobility measurement, i.e., in RRC_CONNECTED mode, the reception power of CRS is measured, and if the measurement value satisfies the set condition, an RSRP (Reference Signal Received Power) measurement report is transmitted to the network. Based on this measurement report, the network decides whether to perform a handover.

[0390] Next, we will specifically explain the reception and decoding of system information in the cell initial access stage. As described above, in the RRC_IDLE mode where cell selection or re-selection is performed, cell system information must be acquired in order to access the cell after obtaining synchronization with the cell through the cell search procedure. In LTE, system information is transmitted in two ways through two different transmission channels.

[0391] - MIB (Master Information Block): Transmitted using PBCH (5d-03)

[0392] - SIB (System Information Block): Transmitted using PDSCH (5d-04)

[0393] The MIB transmitted through PBCH (5d-03) contains the following information:

[0394]- Information on downlink cell bandwidth

[0395]- Cell PHICH (Physical Hybrid ARQ Indicator Channel) setting information

[0396]- SFN (System Frame Number)

[0397] PBCH (5d-03) is decoded using CRS scrambled with cell ID obtained through PSS (5d-01)/SSS (5d-02) as described above. Unlike other downlink transmission channels, PBCH (5d-03) is not mapped based on RB and is transmitted through 72 subcarriers in the middle regardless of cell bandwidth.

[0398] SIB transmitted through PDSCH (5d-05) is defined differently as SIB_x (where x is a number such as 1, 2, 3, etc.) depending on the type of information it contains. To simplify the explanation, we will focus on SIB1 and SIB2, which are related to the initial connection of the cell.

SIB1 mainly includes information related to whether a terminal can access the cell and use the service, and scheduling information in the time domain for the remaining SIBx ($x=2,3,\dots$). Some of them are as follows:

[0399]- PLMN(Public Land Mobile Network)-Identity: Business

[0400]- trackingAreaCode

[0401]- schedulingInfoList

[0402]- si_Periodicity

[0403]- si_WindowLength

[0404]- systemInfoValueTag

[0405]- etc.

[0406] PDSCH(5d-04) on which SIB1 is transmitted is transmitted at a cycle of 80ms from the 0th subframe in the time domain. PDSCH(5d-04) on which SIB1 is transmitted in the frequency domain Scheduling information can be obtained from DCI (Downlink Control Information) transmitted in the common search space of PDCCH (5d-05) set to SI-RNTI (System Information Radio Network Temporary Identifier).

Meanwhile, SIB2 includes information required for a terminal to access a cell. This includes uplink cell bandwidth, random access parameters, paging parameters, and parameters related to uplink power control. Some of them are as follows.

[0407]- ac-BarringInfor

[0408]- radioResourceConfig

[0409]- ra_SupervisionInfo

[0410]- pcch_Config

[0411]- prach_Config

[0412]- uplinkPowerControl

[0413]- etc.

[0414] The time domain scheduling information of the PDSCH (5d-04) where SIB2 is transmitted can be obtained through the above-mentioned SIB1. The frequency domain scheduling information for the PDSCH (5d-04) where SIB2 is transmitted can be obtained from the DCI transmitted to the common search space of the PDCCH (5d-05) set to SI-RNTI, similar to SIB1.

[0415] In LTE, the terminal can form a wireless link with the network through the random access process after obtaining synchronization with the network and system information in the initial access phase of the cell.

Random access can be either contention-based or contention-free. When performing cell selection and reselection during the initial access phase of a cell, or when moving from RRC_IDLE to RRC_CONNECTED, contention-based random access can be used. Non-contention-based random access can be used when resetting uplink synchronization when downlink data arrives, in the case of handover, or in the case of position measurement.

[0416] Figure 5e is a diagram illustrating a contention-based random access process in LTE. According to the diagram illustrated in Figure 5e, the random access process consists of four steps. The first step is a step (5e-01) in which a terminal transmits a random access preamble so that an eNB can estimate the transmission timing of the terminal. The random access preamble is transmitted through an uplink physical layer channel corresponding to the PRACH (Physical Random Access Channel), and the details of this will be described later. Through the step (5e-01) of transmitting the random access preamble, the base station recognizes that there is a random access attempt and estimates the delay time between the terminal and the base station to adjust the uplink timing.

[0417] The second step is the step (5e-02) where the eNB sends a response (Random Access Response, RAR) to the UE for the detected random access attempt. The RAR is transmitted via PDSCH (5d-04) and includes the following messages:

[0418]- Index of the random access preamble sequence detected by the network

[0419]- Temporary Cell Radio Network Temporary Identifier (TC-RNTI)

[0420]- Uplink scheduling grant

[0421]- Timing advance

[0422] The UE that transmitted the preamble observes the PDCCH for the RAR within the configured time window. Frequency domain control information for PDSCH (5d-04) on which RAR is transmitted can be obtained from DCI transmitted to the common search space of PDCCH (5d05) set to RA-RNTI (Random Access Radio Network Temporary Identifier).

The terminal that receives the RAR adjusts its uplink transmission timing and proceeds to the next step. [0423] The third step is the step (5e-03) in which the terminal transmits an L2/L3 message for an RRC connection request to the eNB. The terminal uses the uplink physical layer resources allocated in the random access response in the second step (5e-02) to send necessary messages, such as the terminal's identity and HARQ, to the eNB. At this time, the message is transmitted through the PUSCH (Physical Uplink Shared Channel), which is an uplink physical channel set to TC-RNTI.

[0424] In the fourth step (5e-04), the terminal receives a downlink message for contention resolution and RRC connection setup from the eNB. The contention-resolution message is transmitted through PDSCH (5d-04), and the scheduling information for the corresponding PDSCH (5d-04) can be obtained from the DCI transmitted through PDCCH (5d-05) set to C-RNTI.

[0425] Since contention-resolution is not required in the non-contention-based random access process, only the first step (5e-01) and the second step (5e-02) in FIG. 5e are used.

[0426] FIG. 5f is a diagram illustrating an uplink physical layer channel used in the random access process in LTE. As described above, in the first step (5e-01) of the random access process, the terminal can transmit a random access preamble using PRACH (5e-01). The network can broadcast to all UEs using SIB2 which time-frequency resources are available for PRACH (5e-01). Each cell has 64 available preamble sequences, which are defined into two subsets, and the sequences in each subset are signaled as part of the system information. When performing a random access attempt, the UE randomly selects a sequence from one of the two subsets.

In the third stage (5e-04) of random access, transmission of L2/L3 messages for RRC connection request is performed using PUSCH (5e02).

[0427] As described above, messages required in the initial cell access process in conventional LTE are transmitted using various physical layer transmission channels. At this time, the physical layer transmission channel in LTE is set to a parameter of a common numerology. For example, OFDM modulated symbols set to a subcarrier interval of 15 kHz are transmitted. However, since the 5G communication system supports various parameters for various subcarrier intervals, the numerology of the physical layer channel through which each piece of information is transmitted in the initial access stage may be different. For example, the subcarrier intervals of PBCH and PDCCH or PDSCH may be different. This can be set to different subcarrier spacings because the required constraints may be different depending on the transmission purpose, message size, and broadcasting status of each physical layer channel. Or, physical layer channels with different subcarrier spacings can be multiplexed with each other to simultaneously support various services with different requirements of eMBB, URLLC, and mMTC. Therefore, additional base station and terminal operations are required to efficiently perform initial access in a 5G system supporting various subcarrier spacings.

[0428] [Embodiment 5-1]

[0429] Figure 5g is a drawing illustrating a first embodiment of a communication system to which the present invention is applied.

In FIG. 5g, a terminal (5g-01) supporting various subcarrier intervals and a 5G cell (5g-02) transmitting and receiving data are illustrated. In the example of FIG. 5g, the terminal (5g01) is illustrated to support the subcarrier interval sets of Δf_1 , $L.f_2$, and $L.f_3$ (5g-03), and the base station also supports the subcarrier interval sets of Δf_1 , $L.f_2$, and $L.f_3$ (5g-04). However, the present invention does not exclude the case where the terminal (5g-01) and the 5G base station (5g-02) support not only all subcarrier interval sets, but also support only one or some subcarrier intervals. For example, the terminal (5g-01) may support only Δf_1 , or the base station (5g-02) may support only Δf_2 , $L.f_3$. In the case where only one or some subcarrier spacings are supported among the entire subcarrier spacing set, the service is possible only when the terminal (5g-01) and the cell (5g-02) support the same subcarrier spacing. Therefore, in FIG. 5g, it is assumed that the terminal (5g-01) and the cell (5g-02) support at least one identical subcarrier spacing.

[0430] The following describes the specific contents of the present invention for efficiently dealing with the situation where different subcarrier spacings can be used for the physical layer channels (FIGS. 5d and 5f) used in each stage of the cell initial access described above.

[0431] First, the operation for detecting the synchronization signal of the present invention will be described.

[0432] In the synchronization acquisition stage, which is the very first stage of the cell initial access, the terminal (5g01) and the cell (5g-02) do not have any information. Therefore, in the step of obtaining cell synchronization using a synchronization signal such as PSS/SSS, the terminal (5g-01) can detect a

synchronization signal from a 5G cell (5g02) by performing blind detection for all subcarrier intervals that it can use.

[0433] Next, the operation for PBCH decoding of the present invention will be described.

[0434] For the PBCH (5d-03) where the MIB is transmitted, the base station (5g-02) may consider using a subcarrier spacing different from the subcarrier spacing used for transmitting the synchronization signal. In this case, it may be considered to implicitly indicate through mapping between the sequence of PSS/SSS and the subcarrier spacing. The base station (5g-02) may map a specific sequence of the synchronization signal to one of the subcarrier spacings, and when the terminal (5g-01) obtains synchronization with the sequence, it may utilize this as information on the subcarrier spacing for the PBCH transmitted next. Or, it may be considered that the base station (5g-02) uses the same subcarrier spacing as the subcarrier spacing used for transmitting the synchronization signal for PBCH transmission. In this case, the terminal can perform decoding on the PBCH by assuming the subcarrier spacing for the synchronization signal acquired through blind detection as the subcarrier spacing of the PBCH (5d-03).

[0435] Next, the operation for decoding the PDCCH (5d-05) set to SI-RNTI of the present invention will be described.

[0436] As described above, SIBx is transmitted to the PDSCH (5d-04), and at this time, the control information for decoding the PDSCH (5d-04) can be acquired through the PDCCH (5d-05) set to SI-RNTI. The subcarrier spacing of PDCCH (5d-04) set to SI-RNTI can also use a subcarrier spacing different from that of the synchronization signal (5d-01, 02) or PBCH (5d-03), and the base station (5g-02) can provide information about this through MIB.

The terminal (5g-01) can perform decoding based on the subcarrier spacing information for the PDCCH (5d-05) set to SI-RNTI acquired through the MIB. Or, the base station (5g-02) can use the same subcarrier spacing used for the PBCH (5d-03) for transmitting the PDCCH (5d-05) set to SI-RNTI, and in this case, the terminal (5g-01) can perform decoding by assuming the subcarrier spacing used for decoding the PBCH (5d-03) as the subcarrier spacing of the PDCCH (5d-05) set to SI-RNTI.

[0437] Next, the operation for decoding the PDSCH in which the SIBx of the present invention is transmitted will be described.

[0438] PDSCH (5d-04) on which SIBx is transmitted can be transmitted using a different subcarrier interval from the synchronization signal (5d-01, 02), PBCH (5d-03), and PDCCH (5d-05) set to SI-RNTI. In this case, SIB1 and SIBx(x=2,3, ...) are explained separately. As described above, SIB1 contains the operator information of the cell required for initial access and scheduling information in the time domain for other SIBs. Therefore, SIB1 is acquired before all other SIBx(x=2, 3, ...) . The base station (5g-02) can inform the information about the subcarrier spacing of the PDSCH(5d-04) where SIB1 is transmitted through the MIB. However, since the PBCH(5g-03) that transmits the MIB can be transmitted with a very narrow bandwidth, there may be restrictions on the transmission capacity. Therefore, a method of indicating information about the subcarrier spacing of the PDSCH(5d-04) where SIB1 is transmitted using the DCI acquired from the PDCCH(5d-05) set to SI-RNTI can also be considered. The terminal (5g-01) can perform decoding on PDSCH (5d-04) for SIB1 based on subcarrier spacing information obtained through MIB or DCI.

Information about the subcarrier spacing for PDSCH (5d-04) for SIB_x (x=2,3, ...) transmission can also be indicated via MIB or DCI. Additionally, since the acquisition of SIB1 precedes SIB_x (x=2,3, ...), it may be considered to indicate the subcarrier spacing through SIB1. Meanwhile, the base station (5g-02) may use the same subcarrier spacing used for the PDCCH (5d-05) set to SI-RNTI for the PDSCH (5d-04) transmission for SIB_x transmission, and in this case, the terminal (5g-01) may perform decoding by assuming the subcarrier spacing used for the decoding of the PDCCH (5d-05) set to SI-RNTI as the subcarrier spacing of the PDSCH (5d-04) where SIB_x is transmitted.

[0439] Next, the operation for the PRACH (5e-01) transmission of the present invention will be described.

[0440] As described above, the terminal (5g-01) randomly Obtains configuration information for the physical layer PRACH (5e-01) transmitting the access preamble. Therefore, the base station (5g-02) can add information on the subcarrier spacing to be used for PRACH (5e-01) transmission to SIB2 and instruct the terminal (5g-01). It is also possible to consider implicitly indicating the subcarrier spacing of the PRACH (5e-01) by the terminal (5g-01) determining the subcarrier spacing of the PRACH (5e-01) by itself and transmitting the PRACH (5e-01) without transmitting an additional indicator for the subcarrier spacing of the PRACH (5e-01) from the base station (5g-02). By mapping a specific random access preamble sequence to a specific subcarrier spacing, the base station (5g-02) can obtain information on the subcarrier spacing used for the PRACH (5e-01) through the received random access preamble sequence number or set number. Can be obtained implicitly.

Or, a situation where PRACH (5e-01) uses the same subcarrier spacing as the downlink physical layer transmission channel of the previous stage can also be considered.

[0441] Next, the operation for decoding PDCCH (5d-05) set to RA-RNTI of the present invention will be described.

[0442] As described above, the RAR message is transmitted to PDSCH (5d-04), and at this time, control information for decoding PDSCH (5d-04) can be obtained through PDCCH (5d05) set to RA-RNTI. The subcarrier spacing of the PDCCH (5d-05) set to RA-RNTI can also use a different subcarrier spacing from the synchronization signal (5d-01, 02), PBCH (5d-03), PDCCH (5d-05) set to SI-RNTI, or PDSCH (5d-04) received in the previous step. Therefore, the base station (5g-02) can inform the information about the subcarrier spacing for the PDCCH (5d-05) set to RA-RNTI through MIB or SIB_x (x=1, 2). The terminal (5g-01) can perform decoding based on the subcarrier spacing information for the PDCCH (5d-05) set to RA-RNTI acquired. Or, the base station (5g-02) can use the same subcarrier spacing of another downlink physical layer channel for PDCCH (5d-05) transmission set to RA-RNTI, and in this case, the terminal (5g-01) can perform decoding by assuming the subcarrier spacing of the downlink physical layer channel on which decoding was previously performed as the subcarrier spacing of the PDCCH (5d-05) set to RA-RNTI.

[0443] Next, the operation for decoding the PDSCH (5d-04) on which the RAR of the present invention is transmitted will be described.

[0444] The PDSCH (5d-04) on which RAR is transmitted can also be transmitted using a different subcarrier spacing from other downlink physical layer transmission channels. The base station (5g-02) can inform the information on the subcarrier spacing for the PDSCH (5d-04) on which RAR is transmitted through MIB or SIB_x ($x=1,2$). Or, it can be indicated through DCI transmitted to the PDCCH (5d-05) set to RA-RNTI. The terminal (5g-01) can obtain the RAR message by performing decoding based on the information on the subcarrier spacing for the PDSCH (5d-04) on which the acquired RAR is transmitted. Or, the base station (5g-02) can use the same subcarrier spacing of another downlink physical layer channel for the PDCCH (5d-05) transmission on which RAR is transmitted, and in this case, the terminal (5g-01) can perform decoding by assuming the subcarrier spacing of the downlink physical layer channel on which decoding was previously performed as the subcarrier spacing of the PDSCH (5d-04) on which RAR is transmitted.

[0445] Next, the operation for the PUSCH (5e-02) transmission on which the L2/L3 message of the present invention is transmitted will be described.

[0446] As described above, the control information for the PUSCH (5e02) transmission on which the L2/L3 message is transmitted can be obtained from the RAR message transmitted from the base station (5g-02). Therefore, the base station (5g-02) can instruct the terminal (5g-01) by adding information about the subcarrier spacing to be used for the PUSCH (5e-02) on which the L2/L3 message is transmitted to the RAR message. The terminal (5g-01) can transmit the PUSCH (5e-02) on which the L2/L3 message is transmitted using the acquired subcarrier spacing. Alternatively, it may be considered to transmit the PUSCH (5e-02) using the same subcarrier spacing as the subcarrier spacing of the downlink physical layer transmission channel or the uplink

physical layer transmission channel used in the initial access procedure before.

[0447] Next, the operation for decoding PDCCH (5d-05) set to C-RNTI of the present invention will be described.

[0448] The subcarrier spacing of PDCCH (5d-05) set to C-RNTI may be different from the subcarrier spacing of other physical layer channels. Since TC-RNTI is promoted to C-RNTI in the case of a terminal that succeeds in the random access process, the C-RNTI mentioned here may include TC-RNTI. PDCCH (5d-05) set to SI-RNTI or RA-RNTI is transmitted through a common search space, but C-RNTI can be transmitted through a common search space or a user-specific search space, so it can be transmitted by considering a more user-specific subcarrier spacing. At this time, since C-RNTI is a terminal-specific unique identifier assigned when a terminal succeeds in random access, terminal-specific transmission, not cell-common, becomes possible in subsequent steps. The subcarrier spacing of PDCCH (5d-05) set to C-RNTI can be instructed through MIB, SIBx, RAR, or can follow the subcarrier spacing of a downlink or uplink physical layer transmission channel that was previously successfully transmitted and received. For example, the same subcarrier spacing as PUSCH (5e-02) that transmits L2/L3 messages can be used.

[0449] Next, the operation for decoding PDSCH (5d-04) on which the contention-resolution message of the present invention is transmitted will be described.

[0450] The subcarrier spacing of the PDSCH (5d-04) on which the contention-resolution message is transmitted may be different from the subcarrier spacing of other physical layer channels. Control information for the PDSCH (5d-04) on which the contention-resolution message is transmitted may be obtained from the PDCCH (5d-05) set to C-RNTI. Therefore, the base station (5g-02) may include information about the subcarrier spacing for the PDSCH (5d-04) on which the contention-resolution message is transmitted in the DCI transmitted to the PDCCH (5d-05) set to C-RNTI. Alternatively, it may be considered to decode the PDSCH (5d-04) using the same subcarrier spacing as the subcarrier spacing of the previously used downlink physical layer transmission channel or uplink physical layer transmission channel.

[0451] FIG. 5h is a diagram illustrating a base station and terminal procedure according to the first embodiment of the present invention.

[0452] First, the base station procedure of the present invention will be described. In step 5h-01, the base station transmits configuration information for a downlink or uplink physical layer transmission channel used in the cell initial access stage. The configuration information for the physical layer transmission channel can be a numerology defined by various system parameters, and the subcarrier spacing used in OFDM modulation is described above as an example. The method for transmitting the configuration information for the physical layer transmission channel can be an implicit instruction or an instruction using MIB, SIBx, DCI, etc., and this is specifically described above. The method for transmitting the configuration information for the physical layer transmission channel can be different for each stage of the cell initial access procedure as specifically described above. In step 5h-02, the base station transmits control information and data using the corresponding physical layer channel configuration information.

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Next, the terminal procedure of the present invention will be described. In step 5h-03, the terminal receives physical layer channel configuration information from the base station, and in step 5h-04, decodes the corresponding control information and data.

[0453] The above describes the first embodiment of the present invention in detail. Before describing the second embodiment of the present invention, the paging operation procedure of the LTE and LTE-A systems will be described in detail below.

[0454] FIG. 5i is a diagram illustrating a paging procedure in LTE. The paging procedure can be used to notify a terminal in an RRC_IDLE state when an incoming call occurs and initiate network access for the terminals, or to notify terminals in an RRC_CONNECTED state that system information has changed. Paging is controlled by an MME (Mobile Management Entity), and a paging message can be transmitted across multiple cells within a TA (Tracking Area). According to 5i, paging starts from MME (5i-03) and is delivered to eNB (5i-02) and then to terminal (5i-01). To be more specific, paging starts from MME (5i-03) and is delivered to eNB (5i-02) by SLAP signaling (5i-04) and then to terminal (5i-01) by RRC signaling (5i-06). At this time, terminal (5i-01) can detect the presence of paging message by observing PDCCH (5i-05) set as PRNTI.

[0455] An efficient paging procedure should allow terminal (5i-01) to rest most of the time without performing receiving operation and wake up only briefly at fixed time intervals to observe paging information from the network.

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For this purpose, LTE defines PO (Paging Occasion) and PF (Paging Frame). PO is defined as a subframe in which a PDCCH set to P-RNTI for receiving a paging message exists. PF is defined as one radio frame containing one or more POs. According to FIG. 5i, the terminal (5i-01) can observe one PO per DRX (Discontinuous Reception) cycle (5i-08). PF is given by the following mathematical expression 3.

[0456] [Mathematical Formula 3] [0457] $SFN \bmod T = (T \div N) * (UE_ID \bmod N)$

[0458] T: DRX cycle

[0459] nB: 4T, 2T, T, T/2, T/4, T/8, T/16, T/32, T/64, T/128, T/256

[0460] N: $\min(T, nB)$ [0461] UE_ID: IMSI mod 1024, if P-RNTI is monitored on PDCCH [0462] The T value corresponding to the DRX cycle can be set through upper layer signaling. If there is no upper layer signaling for T, the default paging cycle (defaultPagingCycle) indicated by SIB2 is set to T. Also, in rare cases, a terminal can directly request a terminal-specific DRX cycle, which is possible via an Attach Request or a TAU (Tracking Area Update) Request. In the above mathematical expression 3, the UE_ID is calculated from the IMSI (International Mobile Subscriber Identity). The IMSI is transmitted to the MME in the form of an Attach Request message via upper layer signaling (here, NAS (Non-access stratum) signaling) during the initial access phase.

For this purpose, LTE defines PO (Paging Occasion) and PF (Paging Frame). PO is defined as a subframe in which a PDCCH set to P-RNTI for receiving a paging message exists. PF is defined as one radio frame containing one or more POs. According to FIG. 5i, the terminal (5i-01) can observe one PO per DRX (Discontinuous Reception) cycle (5i-08). PF is given by the following mathematical expression 3.

[0456] [Mathematical Formula 3]

[0457]
$$\text{SFN mod } T = (T \text{ div } N) * (\text{UE_ID mod } N)$$

[0458] T: DRX cycle

[0459] nB: 4T, 2T, T, T/2, T/4, T/8, T/16, T/32, T/64, T/128, T/256

[0460] N: $\min(T, nB)$

[0461] UE_ID: IMSI mod 1024, if P-RNTI is monitored on PDCCH

[0462] The T value corresponding to the DRX cycle can be set through upper layer signaling. If there is no upper layer signaling for T, the default paging cycle (defaultPagingCycle) indicated by SIB2 is set to T. Also, in rare cases, a terminal can directly request a terminal-specific DRX cycle, which is possible via an Attach Request or a TAU (Tracking Area Update) Request. In the above mathematical expression 3, the UE_ID is calculated from the IMSI (International Mobile Subscriber Identity). The IMSI is transmitted to the MME in

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the form of an Attach Request message via upper layer signaling (here, NAS (Non-access stratum) signaling) during the initial access phase.

[0463] Meanwhile, when the terminal is in RRC_IDLE state, the LTE network knows the location of the terminal by TA unit, not cell unit. When connecting to the LTE network, the terminal is allocated a TAI (Tracking Area Identity) list from the MME. The terminal can move freely within the cells in the TAI list without MME update. When an incoming call to the terminal occurs, the MME transmits the same paging message to all cells within the TA currently set for the terminal, and each cell transmits the paging message to the terminal. When the terminal (re)selects a cell, it obtains the TAC (Tracking Area Code) of the cell through SIB1 and can check whether the cell is a cell in its TAI list. If the TAC of the selected cell is an ID that is not in the TAI list, the terminal sends a TAU message to the MME. And when the MME gives the terminal a response (TAU Accept) to the TAU message, it can provide the TAI list together, so that the terminal can update the TAI list according to the change in the location of the terminal.

[0464] The physical layer transmission channel for paging follows the downlink transmission channel structure of FIG. 5d described above. The paging message is transmitted through the PDSCH (5d-04), and the control information for the PDSCH (5d-04) on which the paging message is transmitted is transmitted through the DCI of the PDCCH (5d-05) set to P-RNTI. The terminal can observe the PDCCH (5d-05) set to P-RNTI, and when a paging message is found, it can receive the paging message.

the form of an Attach Request message via upper layer signaling (here, NAS (Non-access stratum) signaling) during the initial access phase.

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[0464] The physical layer transmission channel for paging follows the downlink transmission channel structure of FIG. 5d described above. The paging message is transmitted through the PDSCH (5d-04), and the control information for the PDSCH (5d-04) on which the paging message is transmitted is transmitted through the DCI of the PDCCH (5d-05) set to P-RNTI. The terminal can observe the PDCCH (5d-05) set to P-RNTI, and when a paging message is found, it can receive the paging message.

[0465] As described above, the paging procedure in conventional LTE is characterized by multiple cells in a TA area transmitting the same paging message to a specific terminal. In addition, each cell cannot know whether the corresponding terminal is camped on it, and only the terminal can check the system information about the cell to which it has accessed. In a 5G communication system, various parameters for various subcarrier intervals can be supported, and therefore, different cells belonging to the same TA can transmit paging messages through physical layer transmission channels set to different subcarrier intervals. In other words, depending on whether the terminal supports the corresponding subcarrier interval, there may be cases where paging messages from different cells in the TA area are not properly received. Therefore, additional base station and terminal operations are required to efficiently perform the paging procedure in a 5G system supporting various subcarrier intervals.

[0466] [[Embodiment 5-2]

[0467] Figure 5j is a drawing showing a second embodiment of a communication system to which the present invention is applied. Figure 5j shows one terminal (5j-01), three 5G TRPs (Transmission Reception Points), TRP1 (5j-02), TRP2 (5j-03), TRP3 (5j-04), and one 5G MME (5j05). In Figure 5j, TRP1 (5j-02), TRP2 (5j-03), and TRP3 (5j-04) exist within the same TA area, and the terminal (5j-01) can be allocated information about the TA from the MME (5j-05). It is exemplified that each terminal (5j-01) and TRPs (5j-02, 5j-03, 5j-04) support (5j-06) the subcarrier spacing sets of Δf_1 , Δf_2 , Δf_3 . In the second embodiment of the present

invention, it is not excluded that the terminal (5j-01) and the 5G TRPs (5j-02, 5j-03, 5j-04) support not only all subcarrier spacing sets, but also support only one or some subcarrier spacings. For example, the terminal (5j-01) may support only Δf_1 , or TRP1 (5j-02) may support Δf_1 , $L.f_2$, TRP2 (5j-03) may support Δf_2 , $L.f_3$, and TRP3 (5j-04) may support Δf_1 , Δf_3 . In the case where only one or some subcarrier intervals among the entire subcarrier interval set are supported, the service is possible only when the terminal (5j-01) and the 5G TRPs (5j-02, 5j-03, 5j-04) support at least one identical subcarrier interval.

[0468] First, the operation for decoding the PDCCH (5d-05) set with the P-RNTI of the present invention will be described. The terminal (5j-01) in the RRC_IDLE state goes through the process of obtaining synchronization with the cell and receiving system information when selecting or reselecting a cell. The subcarrier spacing of the PDCCH (5d-05) set to P-RNTI may be different from the subcarrier spacing of the physical layer transmission channels received during the cell selection process, i.e., the synchronization signal, PBCH, PDCCH set to SI-RNTI, and PDSCH. Therefore, the base station (5j-02, 5j-03, 5j-04) can transmit the subcarrier spacing used for the PDCCH (5d-05) set to P-RNTI to the terminal (5j-01) in the form of system information (MIB or SIBx). However, as described above, each base station (5j-02, 5j-03, 5j-04) within the TA cannot know whether the terminal (5j-01) has camped on it, and also cannot know whether the terminal (5j-01) supports the corresponding subcarrier spacing. Therefore, when the subcarrier spacing of the PDCCH (5d-05) set to PRNTI is transmitted as system information, a process for the terminal to reselect a cell may be additionally required depending on whether the received subcarrier spacing can be supported.

For example, in FIG. 5j, let's assume that TRP1(5j-02), TRP2(5j-03), and TRP3(5j-04) support all subcarrier spacing sets of Δf_1 , Δf_2 , and Δf_3 , and the terminal (5j-01) supports only the subcarrier spacing of Δf_1 . We can consider the case where the physical layer channels transmitting synchronization signals and system information in TRP1(5j-02), TRP2(5j-03), and TRP3(5j-04) are transmitted with the subcarrier spacing Δf_1 .

Also, let's assume that the subcarrier spacing for the PDCCH(5d-05) set to PRNTI uses Δf_1 , Δf_2 , and Δf_1 in TRP1(5j-02), TRP2(5j-03), and TRP3(5j-04), respectively. In this environment, the terminal (5j-01) can camp on all of TRP1 (5j-02), TRP2 (5j-03), and TRP3 (5j-04) and thus obtain system information. However, if the terminal camps on TRP2 (5j-03), the terminal can determine that it cannot receive a paging message through the system information. In this case, the terminal can perform reselection to another cell in the TA, TRP1 (5j-02) or TRP3 (5j-04). At the same time, it can send a request message for TAU to the MME to exclude TRP2 (5j-03) from its TA. After that, the terminal (5j-01) can successfully receive a paging message based on the newly updated TA.

[0469] Another way to determine the subcarrier spacing of PDCCH (5d-05) set to P-RNTI is to consider that the terminal (5j-01) transmits capability information on whether it supports its own subcarrier spacing to the MME (5j-05). The terminal (5j-01) can transmit capability information on whether it supports its own subcarrier spacing to the MME (5j-05) through an Attach Request message during the initial access phase, and this can be done through upper layer signaling (e.g. NAS signaling). The MME (5j-05) can inform all cells (TRP1 (5j-02), TRP2 (5j-03), TRP3 (5j-04)) connected to it of the capability for the subcarrier spacing of the

terminal (5j-01), and allow each base station to select the subcarrier spacing of the PDCCH (5d-05) set to P-RNTI based thereon. Alternatively, the base station can reset the TA by considering the selection of the subcarrier spacing of the PDCCH (5d-05) set to PRNTI. For example, in FIG. 5j, let's assume that TRP1 (5j-02), TRP2 (5j-03), and TRP3 (5j-04) support all subcarrier spacing sets of Δf_1 , Δf_2 , and $L \cdot \Delta f_3$, and the terminal (5j-01) supports only the subcarrier spacing of Δf_1 . Also, let's assume that the subcarrier spacing for the PDCCH (5d-05) set to P-RNTI uses Δf_1 , $L \cdot \Delta f_2$, and $L \cdot \Delta f_1$ in TRP1 (5j-02), TRP2 (5j-03), and TRP3 (5j-04), respectively. Consider that the TA of the terminal (5j-01) is initially set to TRP1 (5j-02), TRP2 (5j-03), and TRP3 (5j-04). The MME (5j-05) that has received the capability of the terminal (5j-01) can confirm that TRP2 (5j-03) uses Δf_2 as the subcarrier interval for the PDCCH (5d-05) set to P-RNTI, exclude TRP2 (5j-03) from the TA, and inform the terminal of the updated TA information. Therefore, the terminal (5j-01) can successfully receive the paging message based on the newly updated TA.

[0470] Next, the operation for PDSCH decoding on which the paging message of the present invention is transmitted will be described. Control information for the PDSCH (5d-04) on which the paging message is transmitted can be obtained from the DCI of the PDCCH (5d-05) set to P-RNTI. Therefore, the base station (5j02, 5j-03, 5j-04) can include information about the subcarrier spacing for the PDSCH (5d-04) on which the paging message is transmitted in the DCI transmitted to the PDCCH (5d-05) set to P-RNTI. Alternatively, it can also be considered to decode the PDSCH (5d-04) using the same subcarrier spacing as the subcarrier spacing of the PDCCH (5d-05) set to P-RNTI.

[0471] Figure 5k is a drawing illustrating a base station and terminal procedure according to the first embodiment of the present invention.

[0472] First, the base station procedure of the present invention will be described. In step 5k-01, the base station transmits information on the numerology (e.g., subcarrier spacing, etc.) for the physical layer channel used for paging as system information (MIB or SIBx). In step 5k-02, the base station can transmit control and data for paging. Next, the terminal procedure of the present invention will be described. In step 5k-03, the terminal obtains information on the physical layer numerology (e.g., subcarrier spacing, etc.) used for paging from the base station in the TA. In step 5k-04, the terminal determines whether it supports the corresponding numerology, and if it does, completes the reception of control information and data for paging using the numerology in step 5k-07. On the other hand, if the corresponding numerology is not supported, cell reselection is performed in step 5k-05. Then, a TAU request message is transmitted to the MME in step 5k-06.

[0473] FIG. 51 is a diagram illustrating an MME, a base station, and a terminal procedure according to the first embodiment of the present invention.

[0474] First, the MME procedure of the present invention will be described. In step 51-01, the MME receives information on supportable numerologies from the terminal. In step 51-02, the MME determines whether a base station in the TA supports the corresponding numerology for paging transmission, and if there is a base station that does not support it, it updates the TA by excluding the base station from the TA (step 51-03). If the base station in the TA supports the numerology requested by the terminal for paging transmission, the TA

update is no longer performed and a paging message is transmitted to the base station (step 51-04). Next, we will explain the base station procedure. In step 51-05, the base station receives capability information on the numerology of the terminal from the MME. In step 51-06, the base station selects one or some of the numerologies that the terminal can support as a numerology for transmitting a paging message and transmits this information to the terminal. In step 51-07, the base station transmits control information and data for paging using the configured numerology. Next, the terminal procedure of the present invention will be described. In step 51-08, the terminal obtains information on the physical layer numerology used for paging from the base station in the TA. In step 51-09, the terminal determines whether it supports the corresponding numerology and completes reception of control information and data for paging using the corresponding numerology in step 51-10.

[0475] To perform the above embodiments of the present invention, the transmitter, receiver, and control units of the terminal and the base station are respectively illustrated in FIG. 5m and FIG. 5n. The transmission and reception methods of the base station and the terminal for cell initial access and paging in the 5G communication system corresponding to the above embodiments 1 and 2 are shown, and in order to perform the above, the transmitter, receiver, and processors of the base station and the terminal must each operate according to the embodiments.

[0476] Specifically, FIG. 5m is a block diagram illustrating the internal structure of the terminal according to the embodiment of the present invention. As illustrated in FIG. 5m, the terminal of the present invention may include a terminal processor (5m-01), a receiver (5m-02), and a transmitter (5m-03).

[0477] The terminal processor (5m-01) can control a series of processes that the terminal can operate according to the above-described embodiment of the present invention. For example, the terminal operation can be controlled differently according to the settings for different numerologies, such as subcarrier intervals, according to the embodiment of the present invention. In addition, the control signal and data signal can be transmitted and received according to the cell initial access and paging procedures of the present invention. The terminal receiver (5m-02) and the terminal transmitter (5m-03) can be collectively referred to as the transceiver unit in the embodiment of the present invention. The transceiver unit can transmit and receive signals with the base station. The signals can include control information and data. To this end, the transceiver unit can be composed of an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, and an RF receiver that low-noise amplifies and down-converts the frequency of a received signal. In addition, the transceiver can receive a signal through a wireless channel and output it to the terminal processor (5m-01), and transmit the signal output from the terminal processor (5m-01) through the wireless channel.

[0478] FIG. 5n is a block diagram showing the internal structure of a base station according to an embodiment of the present invention. As shown in FIG. 5n, the base station of the present invention can include a base station processor (5n01), a receiver (5n-02), and a transmitter (5n-03).

[0479] The base station processor (5n-01) can control a series of processes so that the base station can operate according to the embodiment of the present invention described above. For example, the base station operation can be controlled differently according to the setting items for different numerologies, such as subcarrier intervals, according to the embodiment of the present invention. In addition, according to the cell

initial access and paging procedures of the present invention, scheduling for control channels and data channels of uplink/downlink can be performed and setting information can be instructed to a terminal.

[0480] The base station receiver (5n-02) and the base station transmitter (5n-03) may be collectively referred to as a transceiver in the embodiment of the present invention. The transceiver unit can transmit and receive signals with the terminal. The signal may include control information and data. To this end, the transceiver unit may be configured with an RF transmitter that up-converts and amplifies the frequency of a transmitted signal, an RF receiver that low-noise amplifies the received signal, and down-converts the frequency. In addition, the transceiver unit may receive a signal through a wireless channel and output it to the base station processor (5n-01), and transmit the signal output from the base station processor (5n-01) through the wireless channel.

[0481] Meanwhile, the embodiments of the present invention disclosed in this specification and drawings are only specific examples presented to easily explain the technical contents of the present invention and help in understanding the present invention, and are not intended to limit the scope of the present invention. That is, it is obvious to those with ordinary skill in the art pertaining to the present invention that other modified examples based on the technical idea of the present invention are feasible. In addition, each of the above embodiments can be combined and operated as needed.

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[Claims]

[Claim 1]

A method for processing a control signal in a wireless communication system, the method comprising:
a step of receiving a first control signal transmitted from a base station,
a step of processing the received first control signal, and
a step of transmitting a second control signal generated based on the processing to the base station.

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[Abstract]

[Abstract]

The present disclosure relates to a communication technique and system thereof that fuses a 5G communication system to support a higher data transmission rate than a 4G system with IoT technology. The present disclosure can be applied to intelligent services (e.g., smart home, smart building, smart city, smart car or connected car, healthcare, digital education, retail, security and safety-related services, etc.) based on 5G communication technology and IoT-related technology. The present invention discloses a method and device for inserting an index into a code block, which is a unit in which a channel code is performed, and transmitting it.

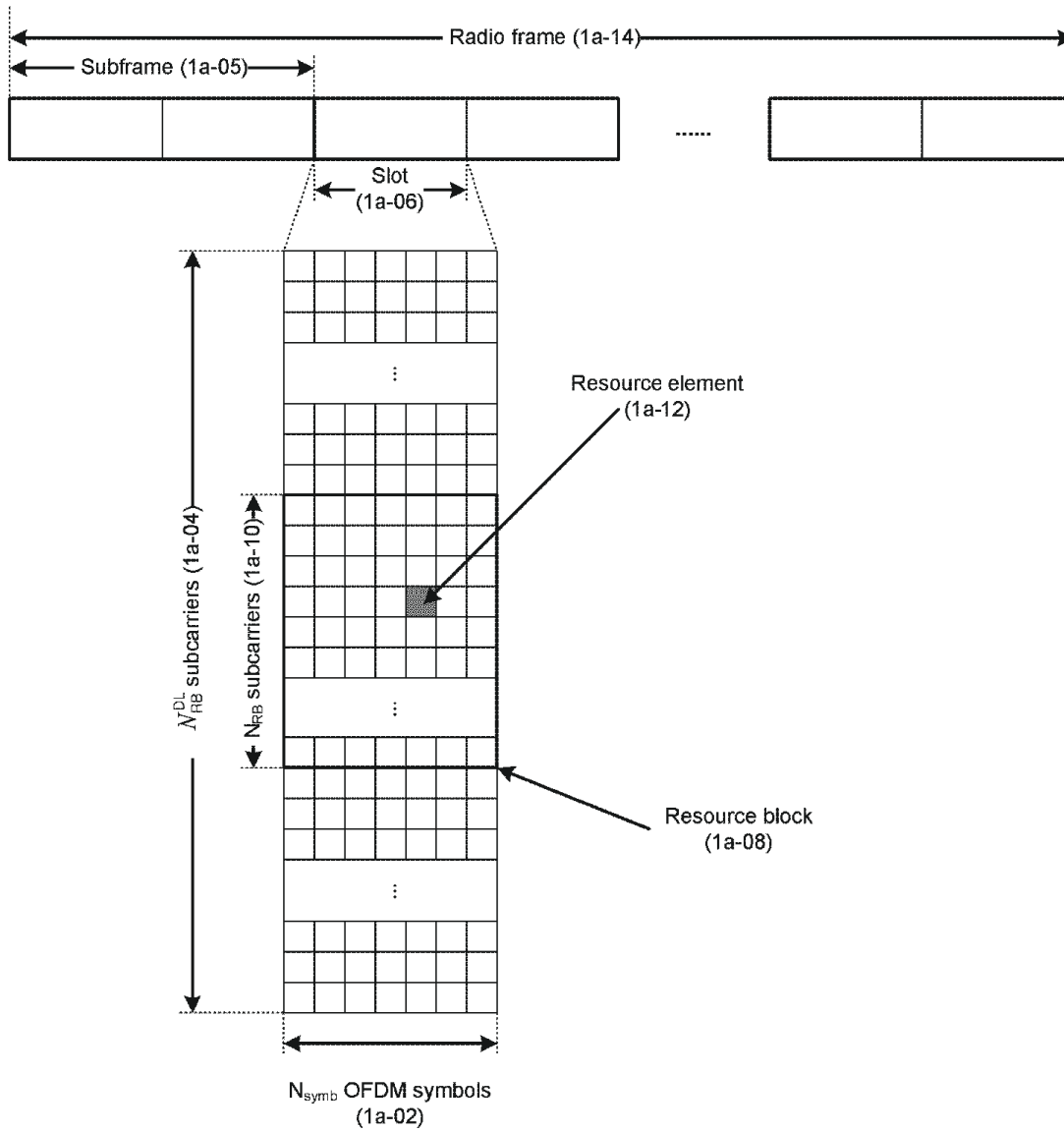
[Representative Drawing]

FIG. 1h

231-175

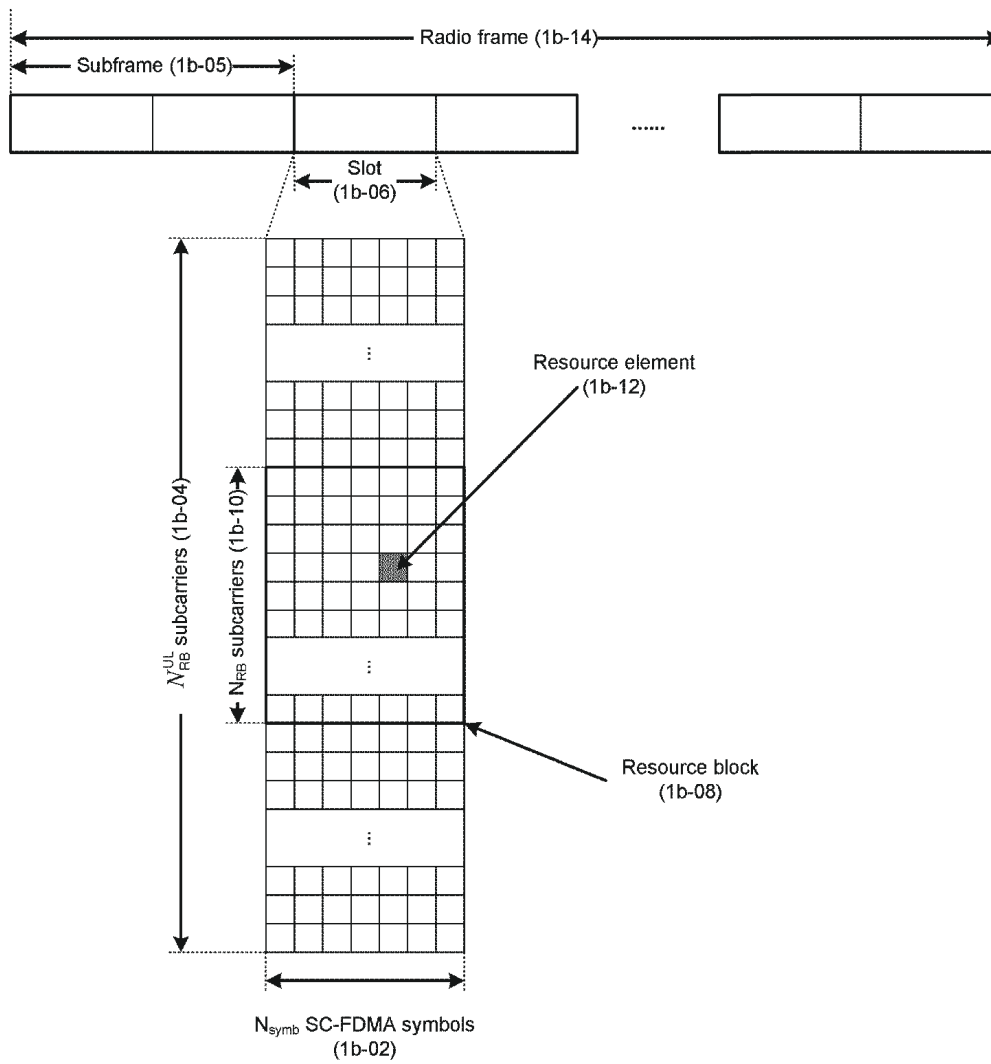
[Drawings]

[FIG. 1a]

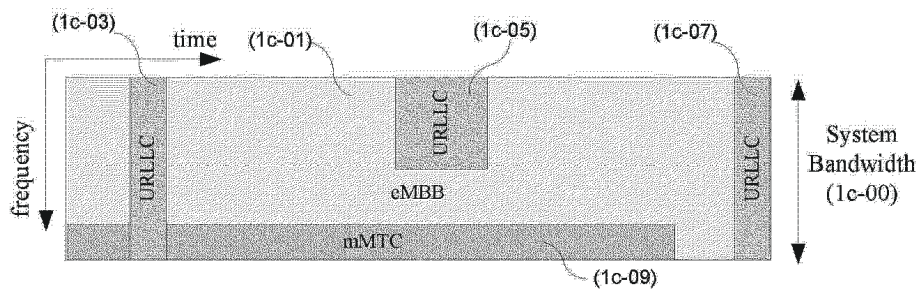


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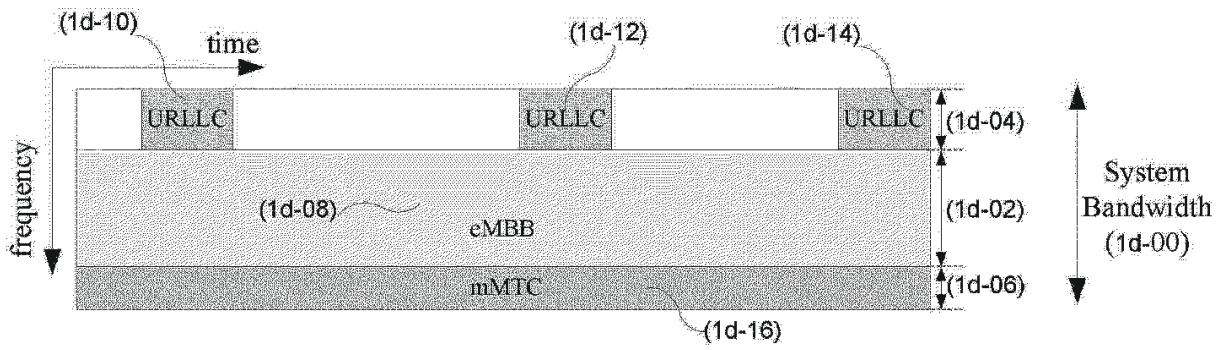
[FIG. 1b]



[FIG. 1c]

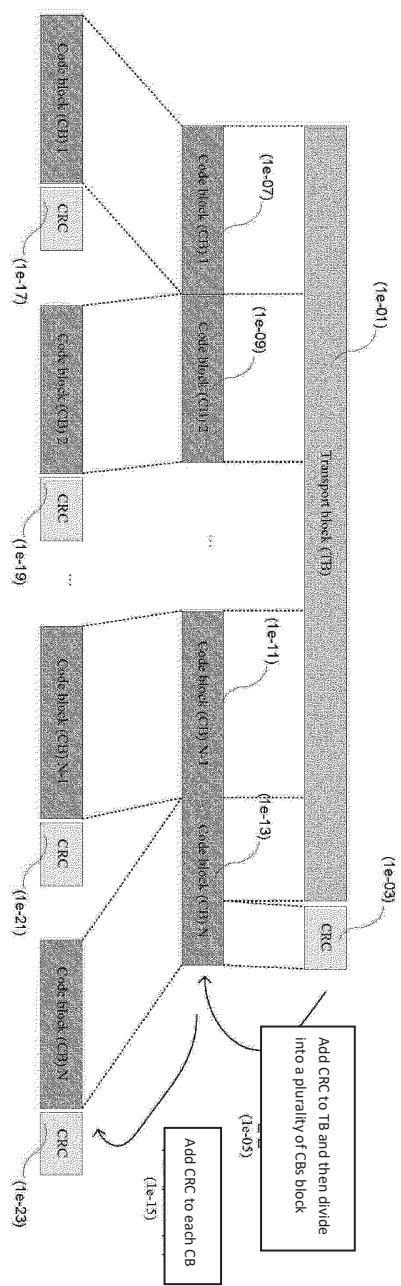


[FIG. 1d]

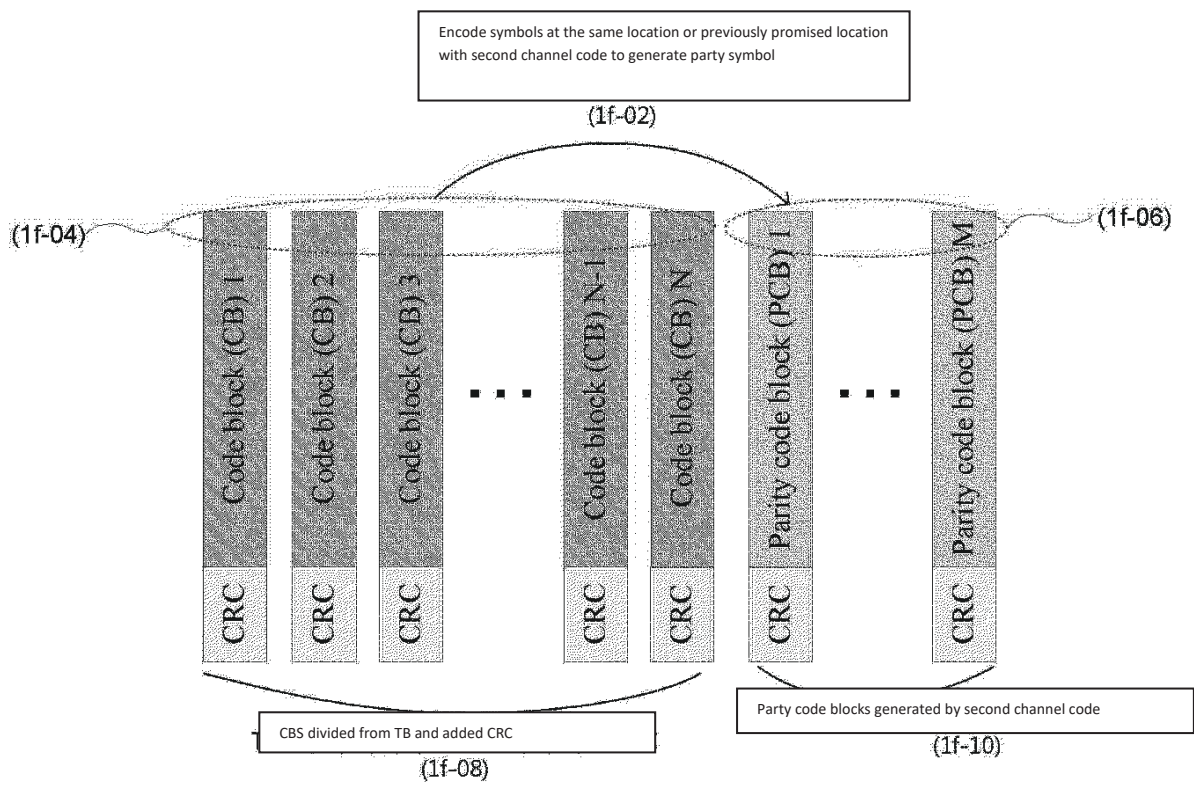


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[FIG. 1e]

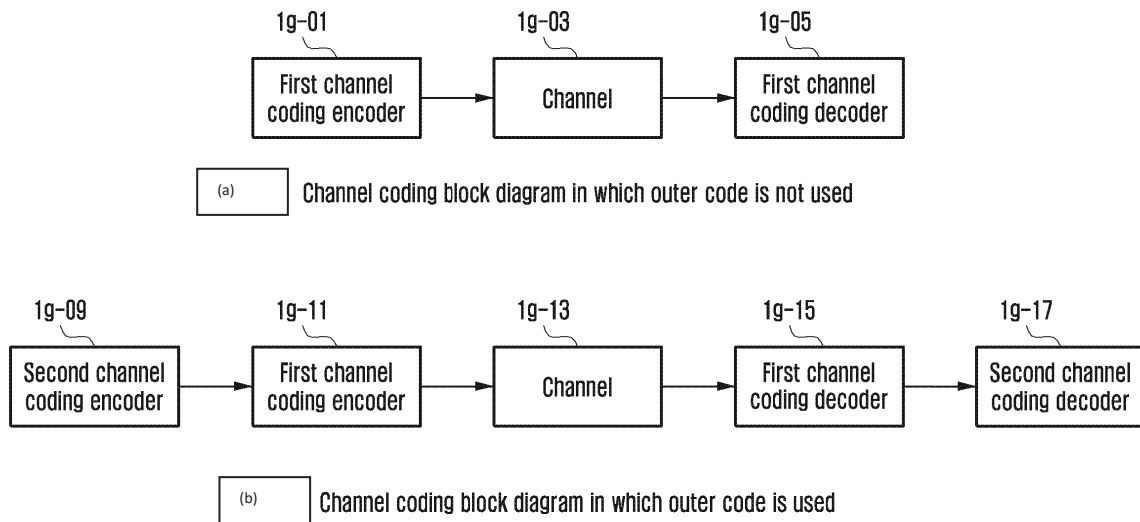


[FIG. 1f]



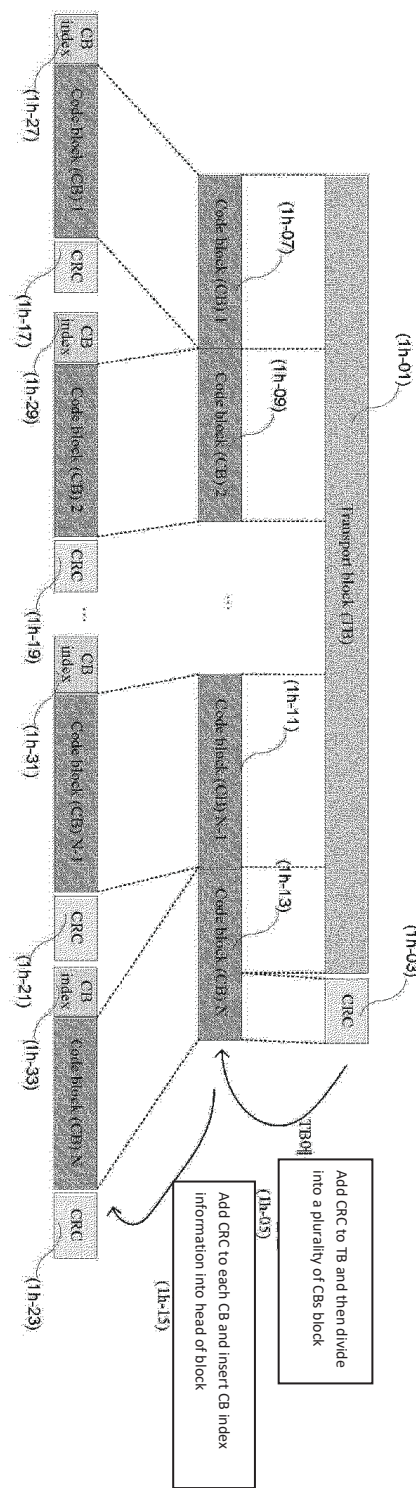
231-180

[FIG. 1g]



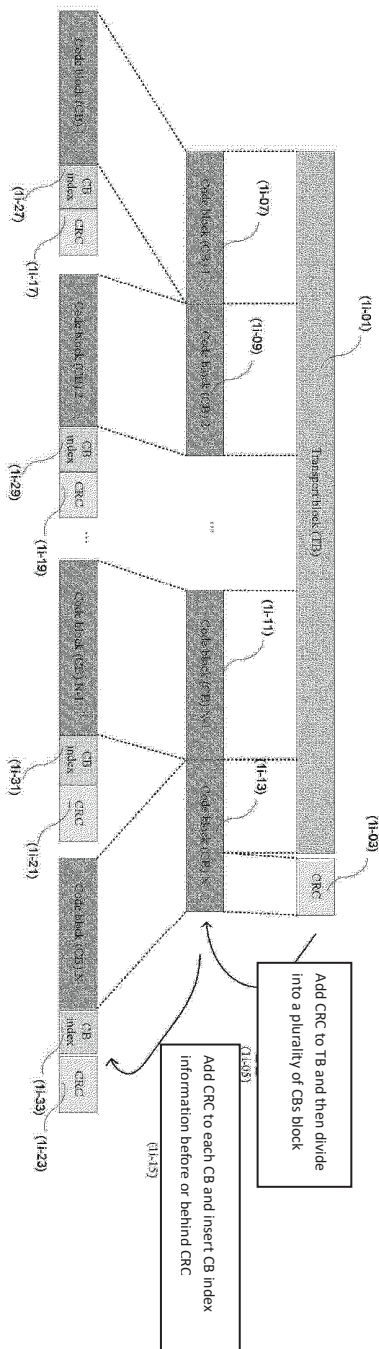
231-181

[FIG. 1h]



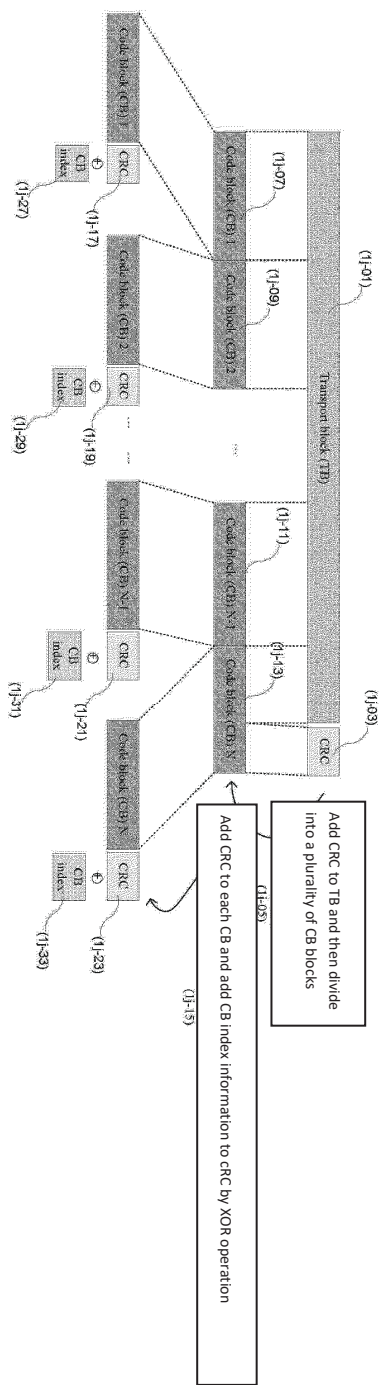
231-182

[FIG. 1i]



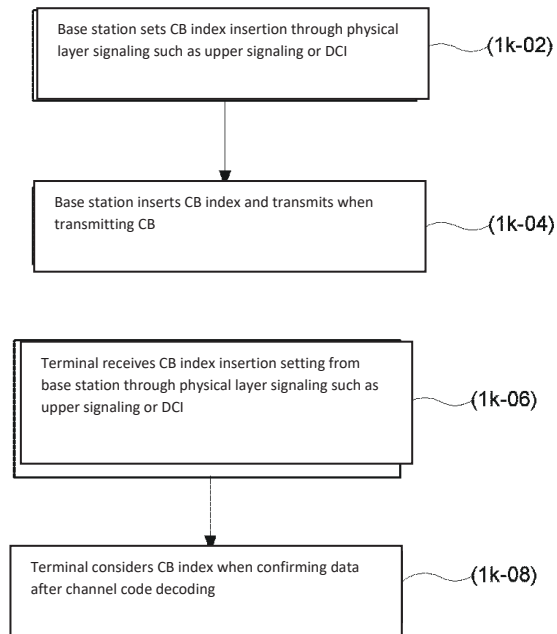
231-183

[FIG. 1j]



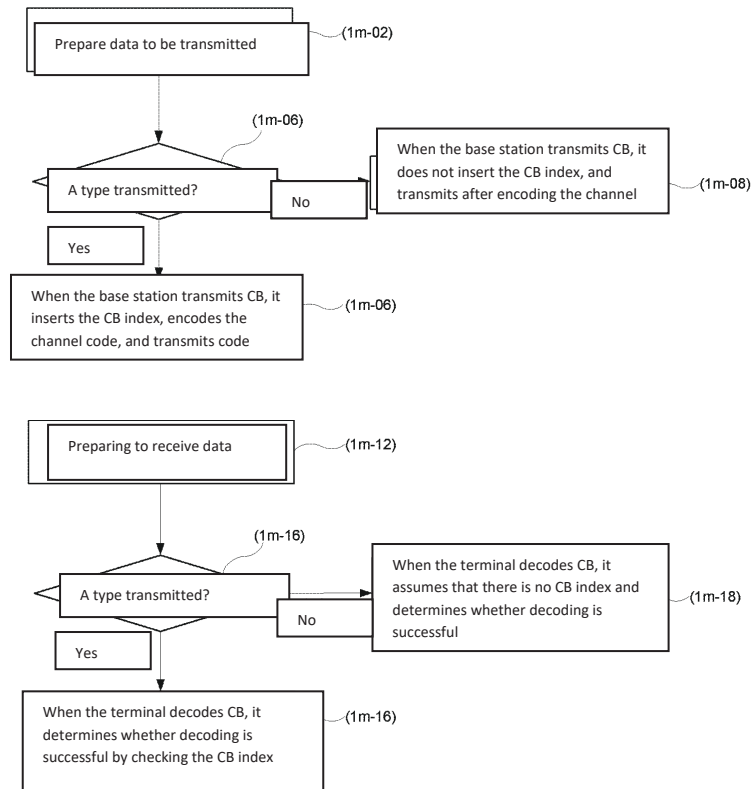
231-184

[FIG. 1k]

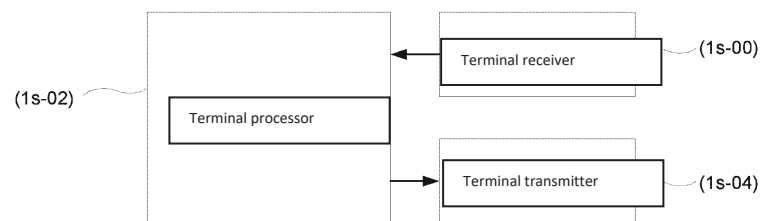


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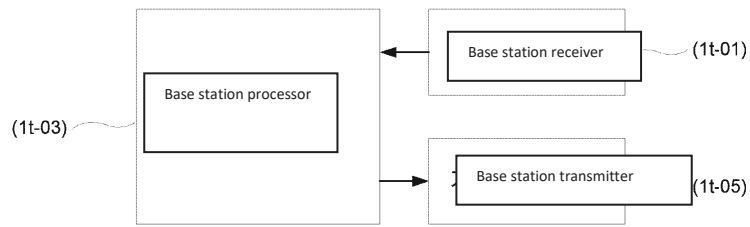
[FIG. 1m]



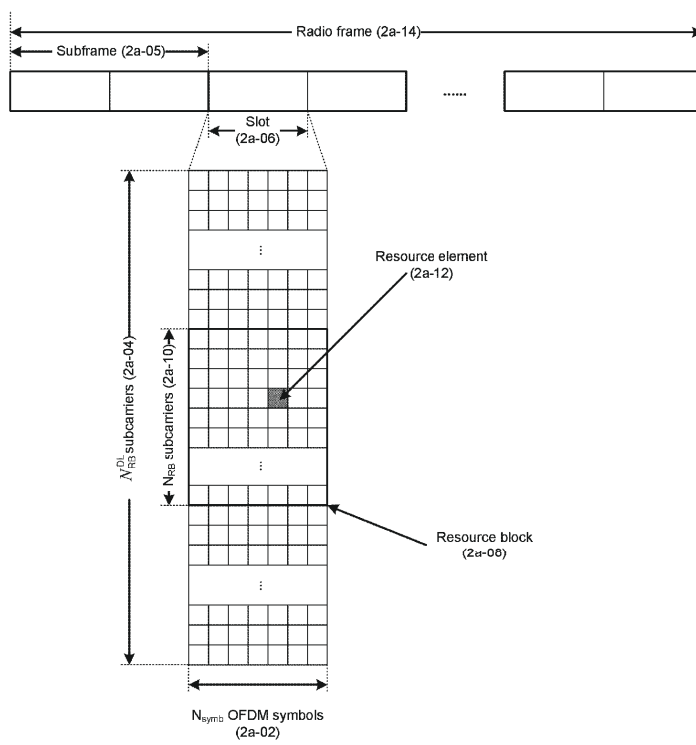
[FIG. 1s]



[FIG. 1t]

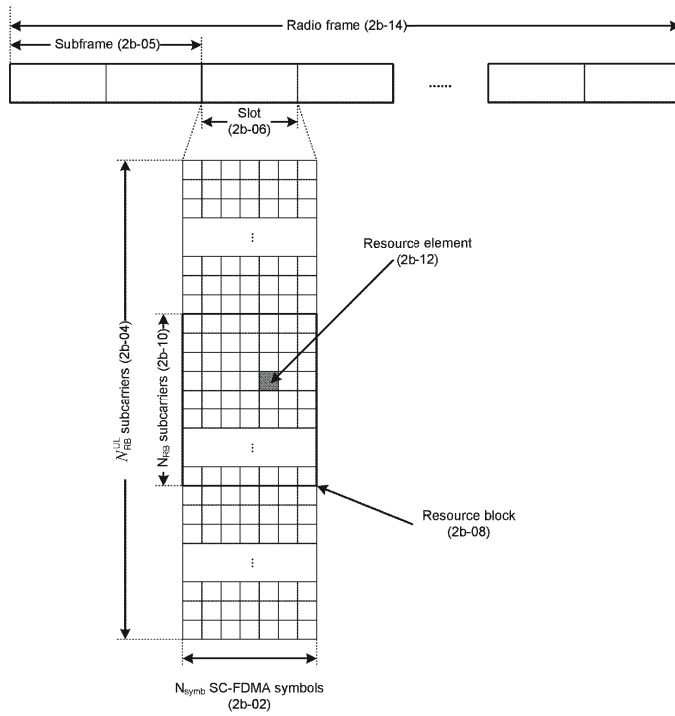


[FIG. 2a]

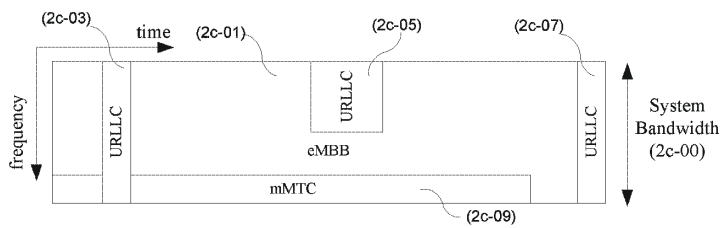


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[FIG. 2b]

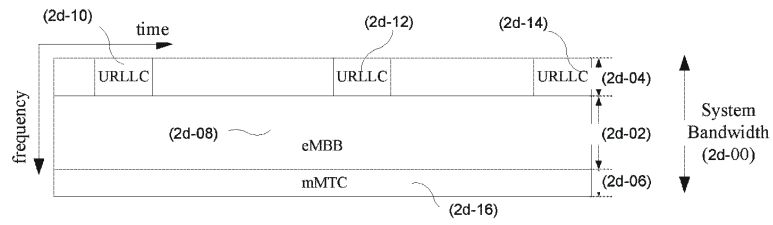


[FIG. 2c]



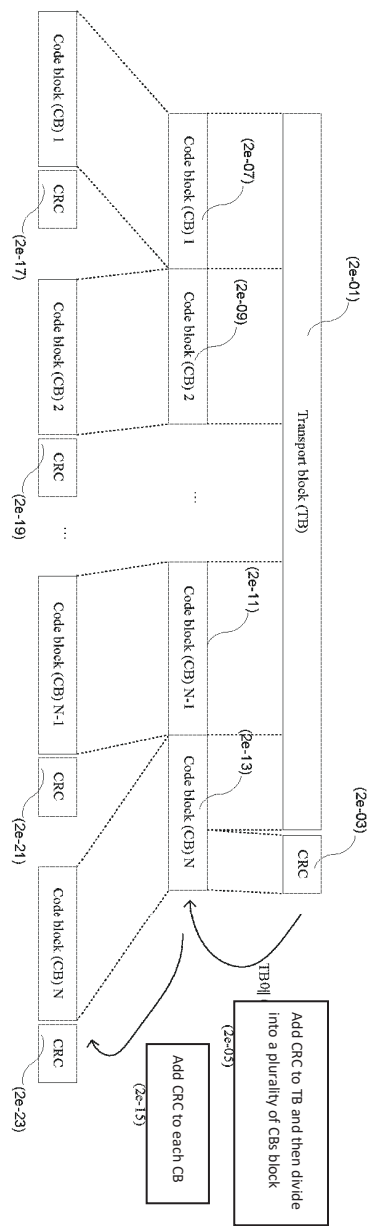
231-188

[FIG. 2d]



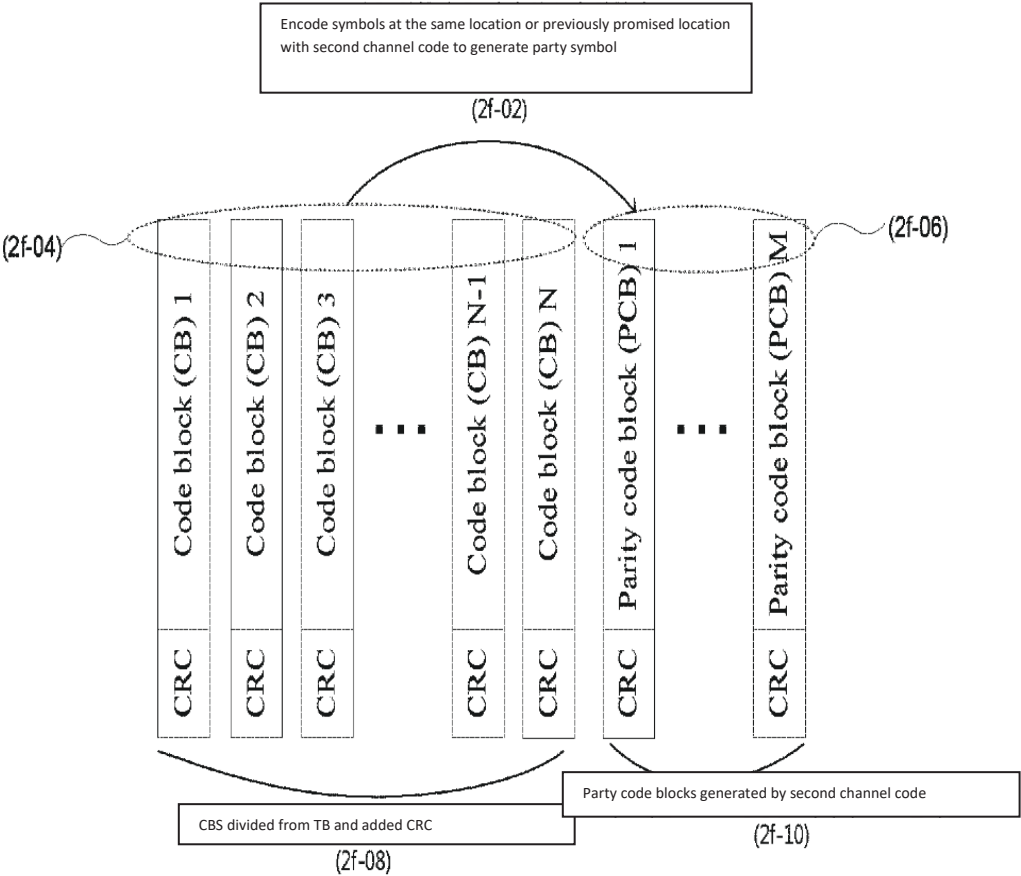
231-189

[FIG. 2e]

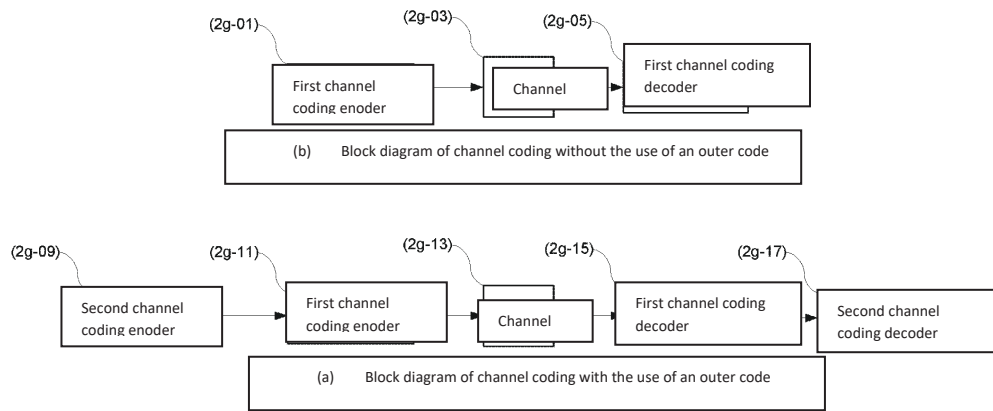


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[FIG. 2f]

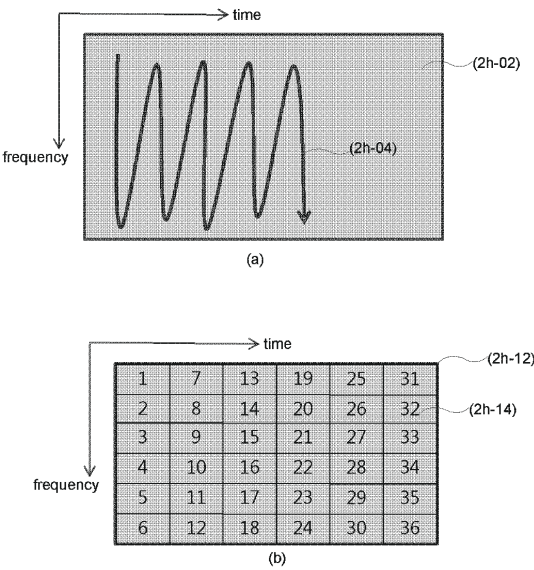


[FIG. 2g]

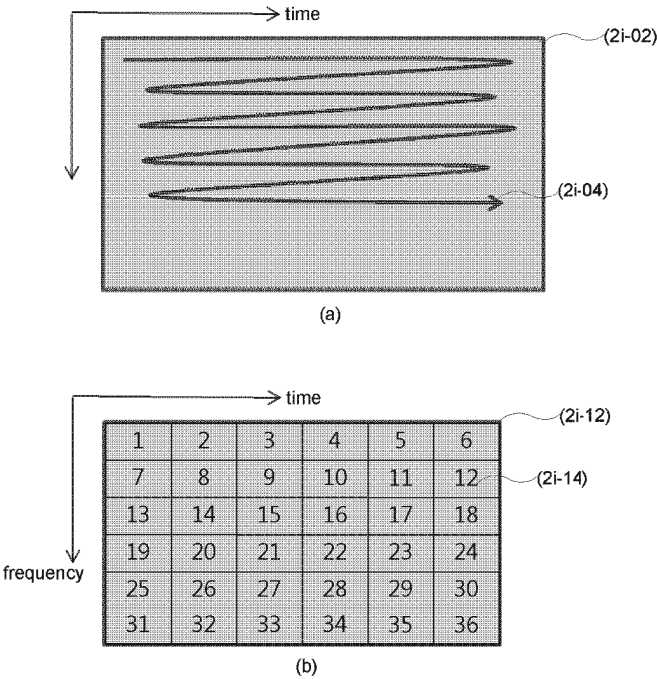


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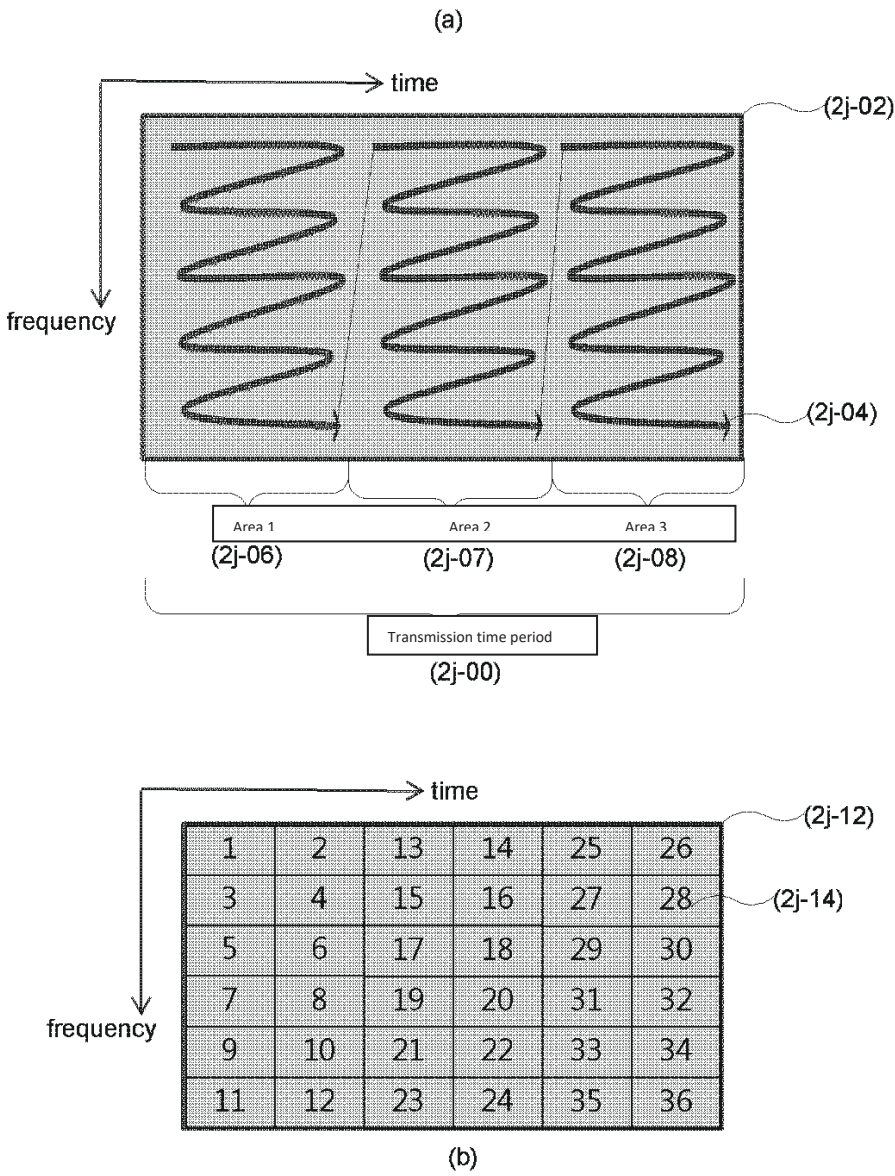
[FIG. 2h]



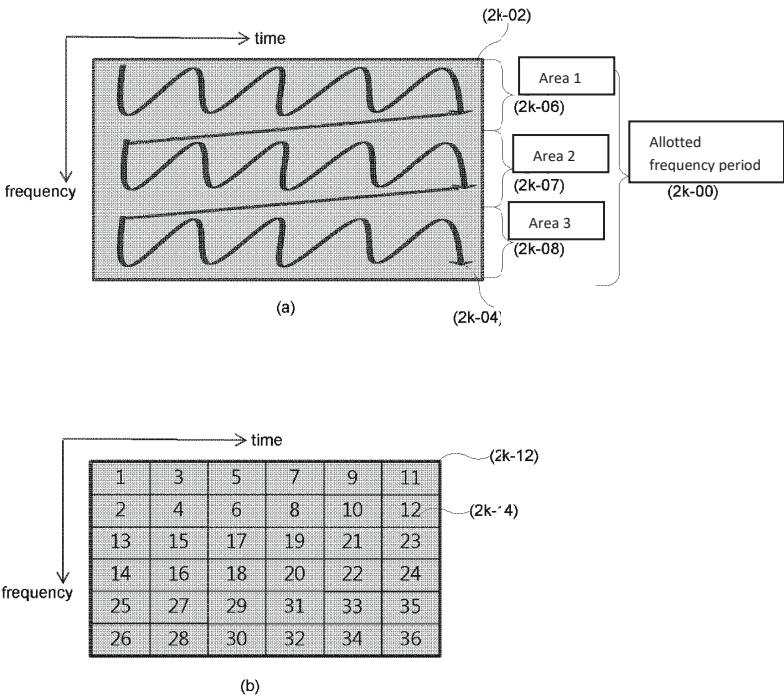
[FIG. 2i]



[FIG. 2j]

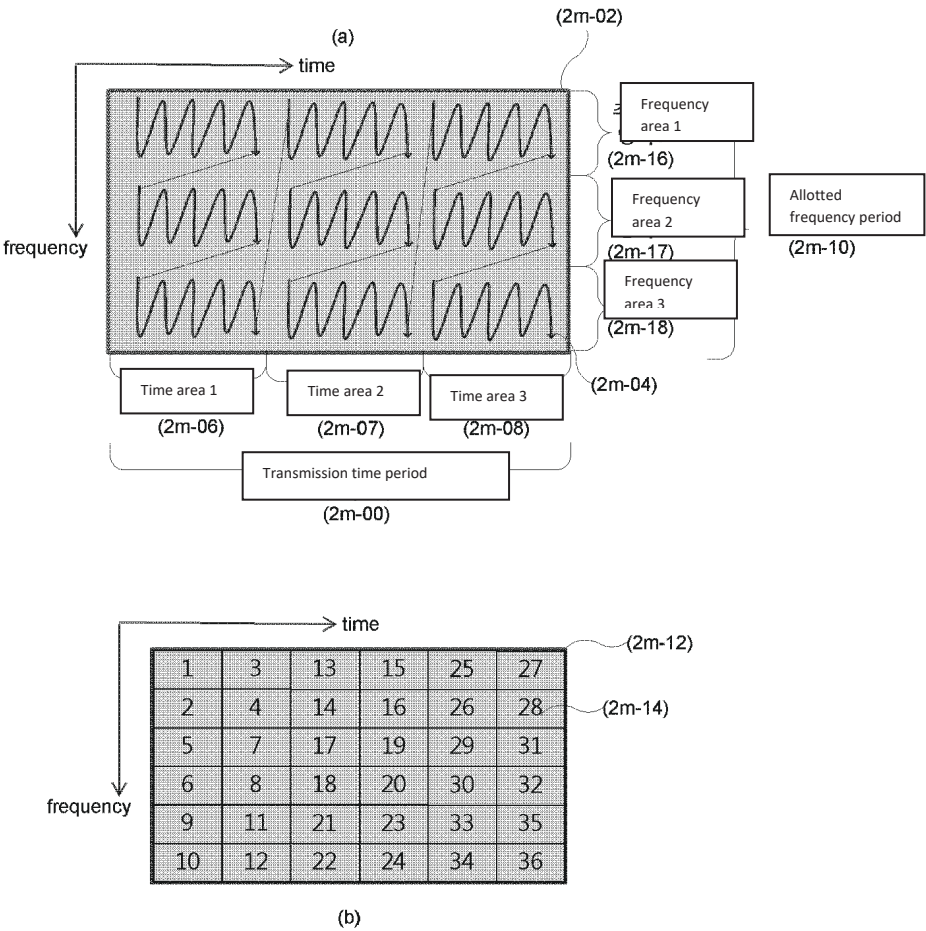


[FIG. 2k]

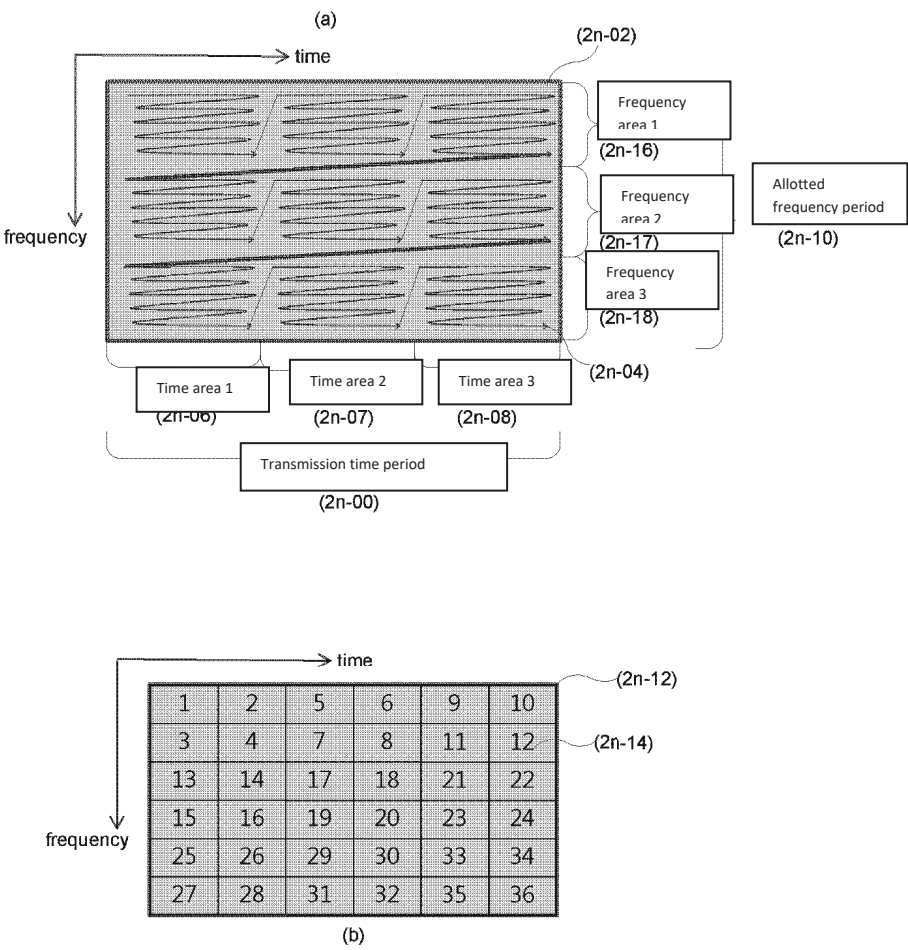


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[FIG. 2m]

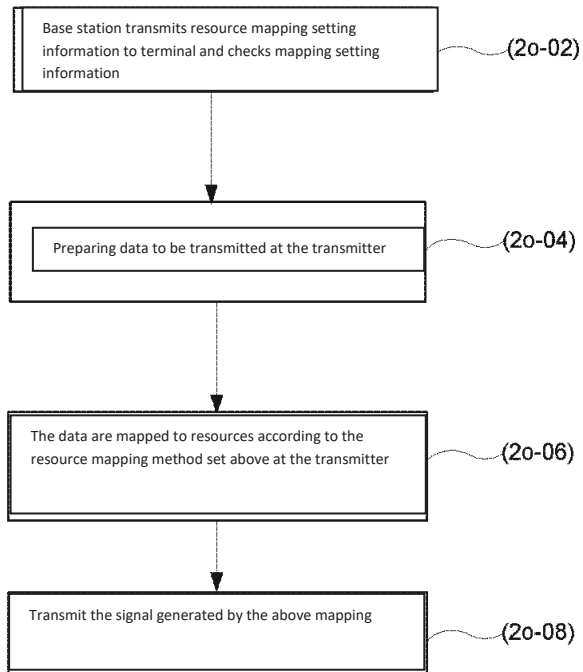


[FIG. 2n]

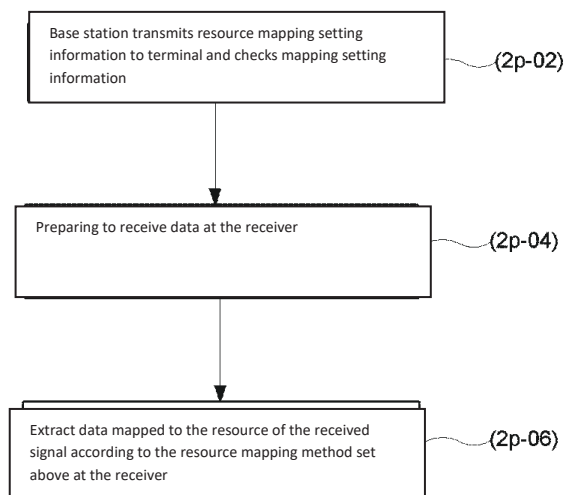


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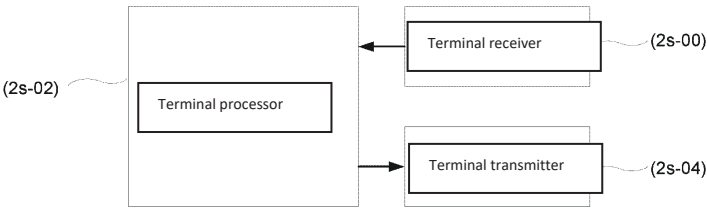
[FIG. 2o]



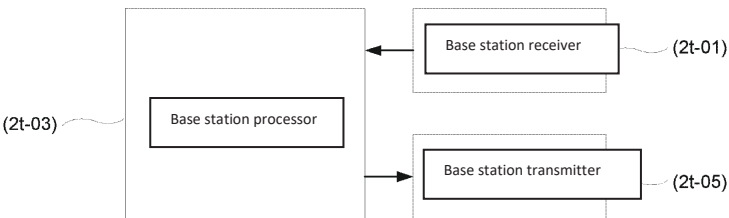
[FIG. 2p]



[FIG. 2s]

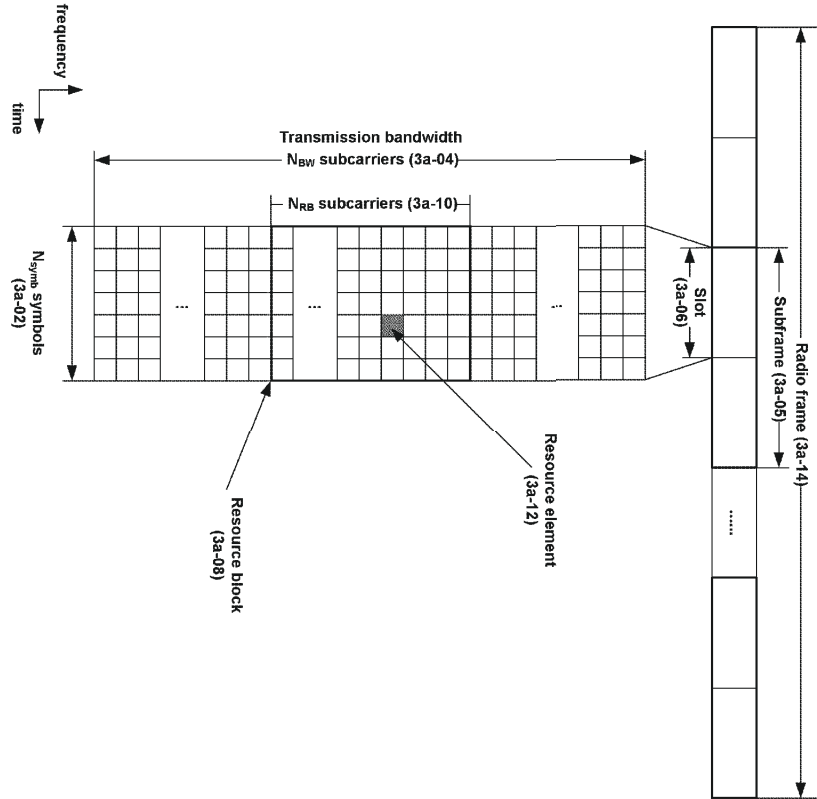


[FIG. 2t]



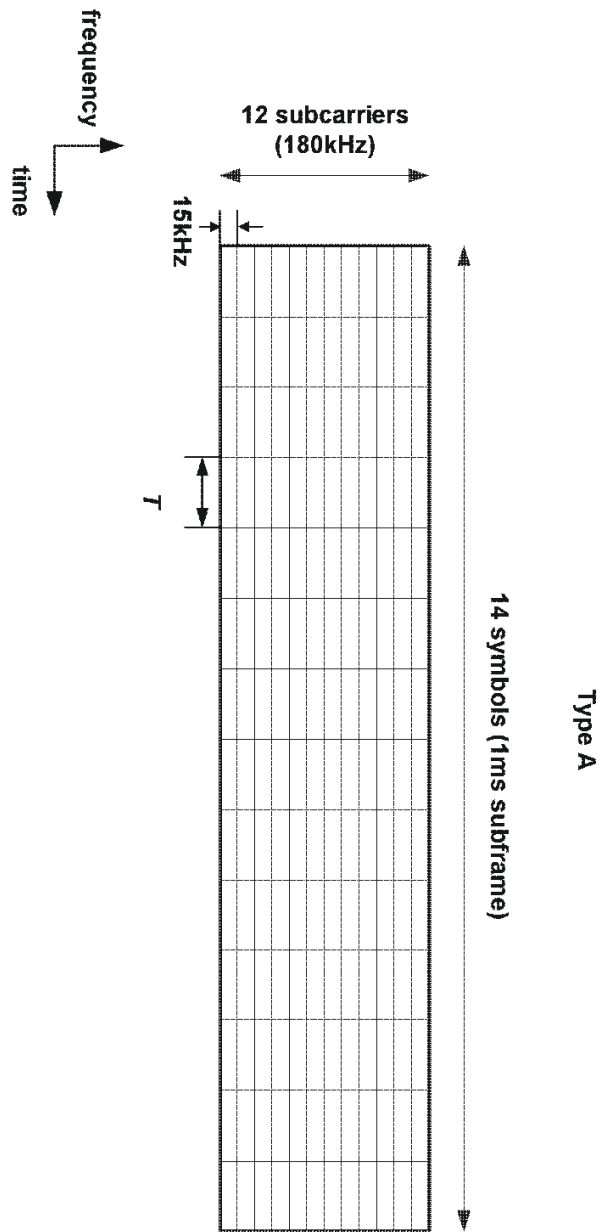
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[FIG. 3a]



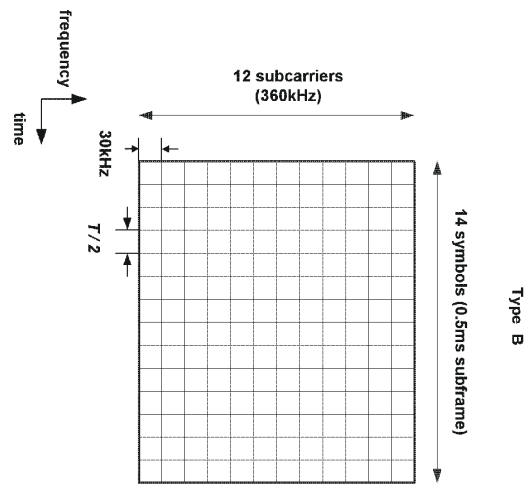
231-178

[FIG. 3b]

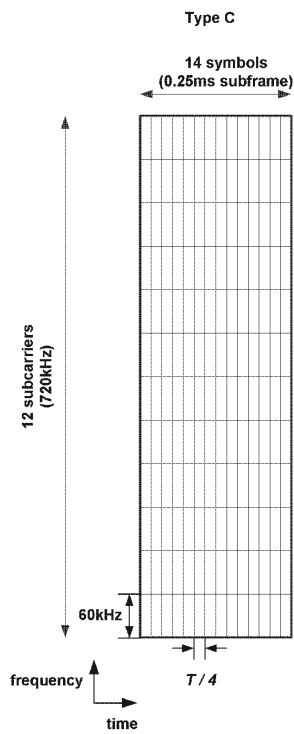


231-201

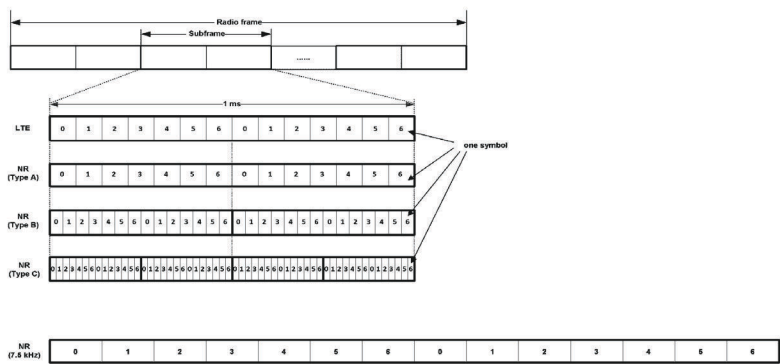
[FIG. 3c]



[FIG. 3d]

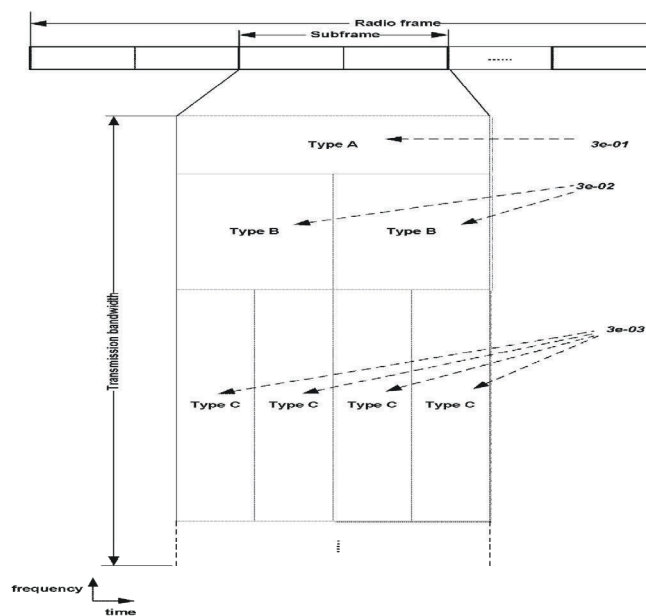


[FIG. 3e]



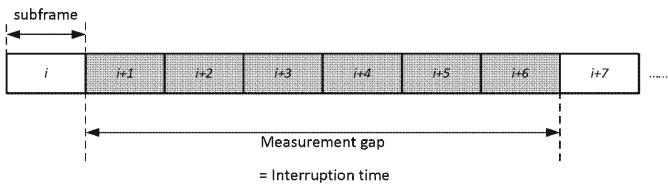
231-203

[FIG. 3f]

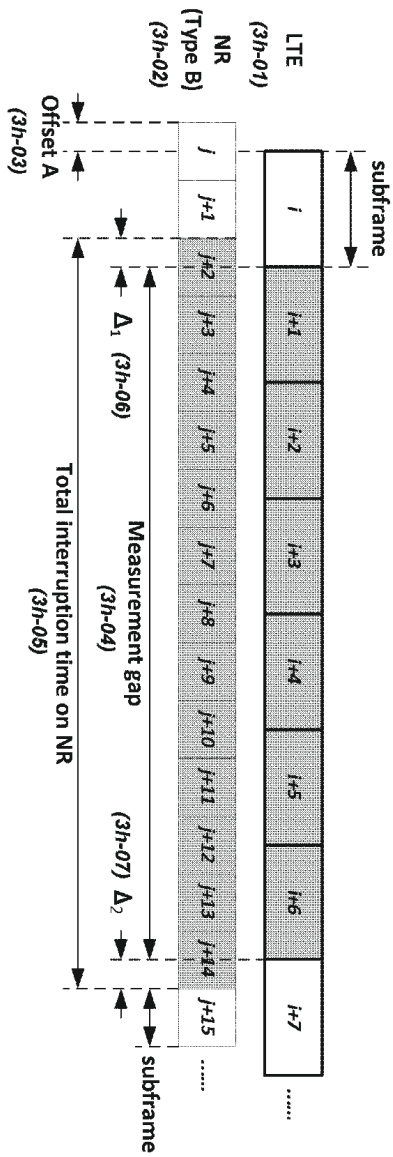


231-204

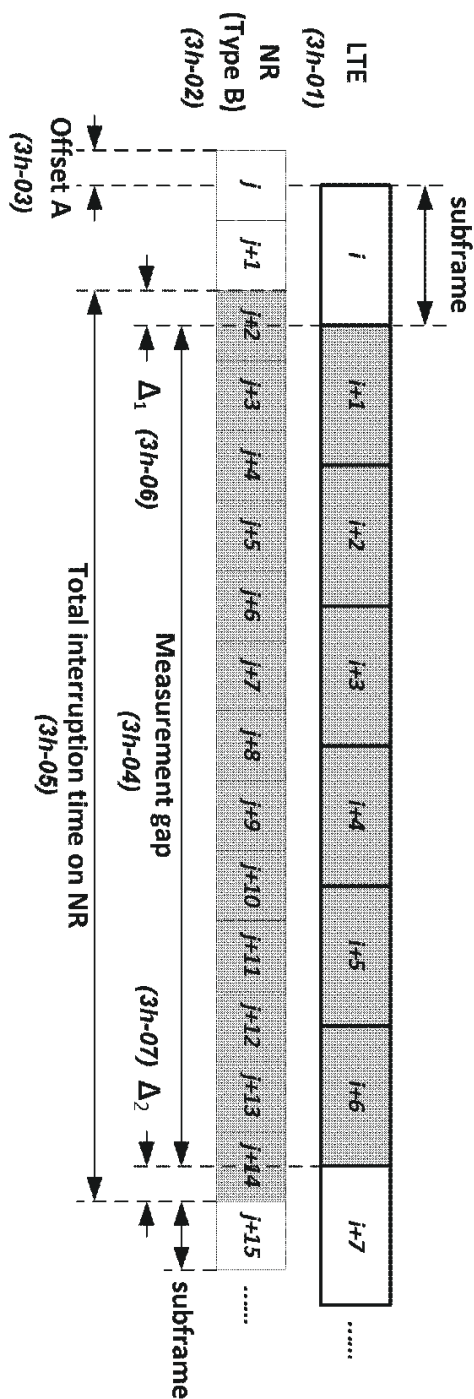
[FIG. 3g]



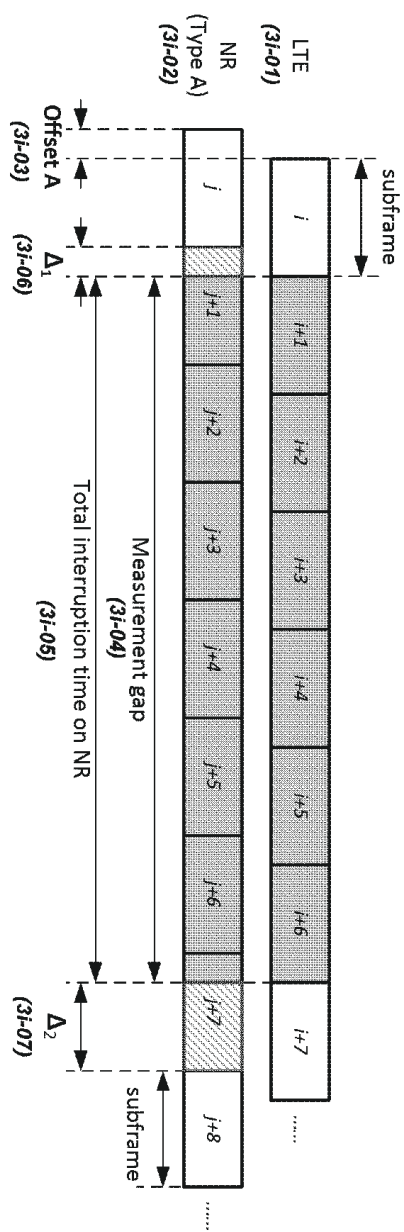
[FIG. 3h]



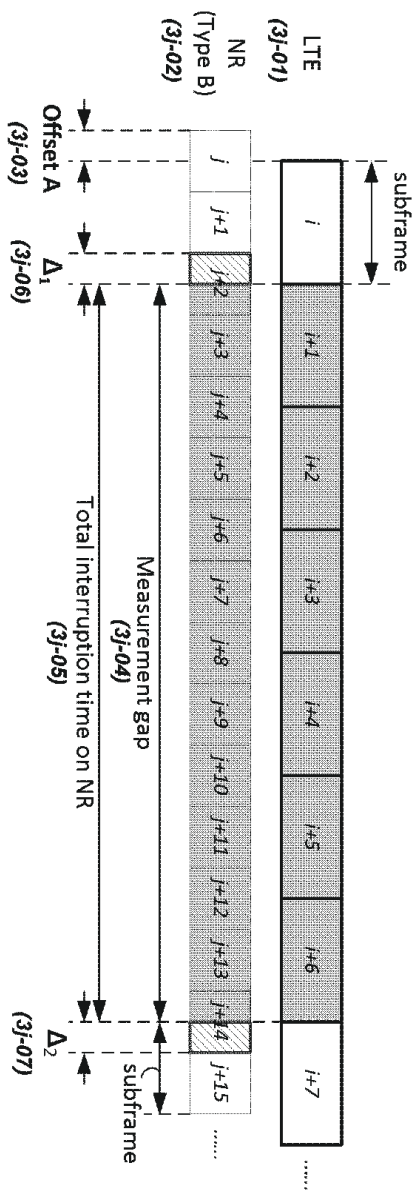
[FIG. 3h]



[FIG. 3i]

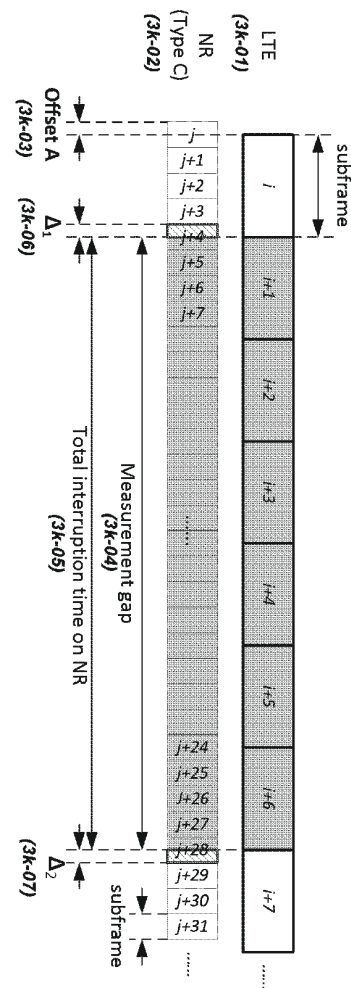


[FIG. 3j]

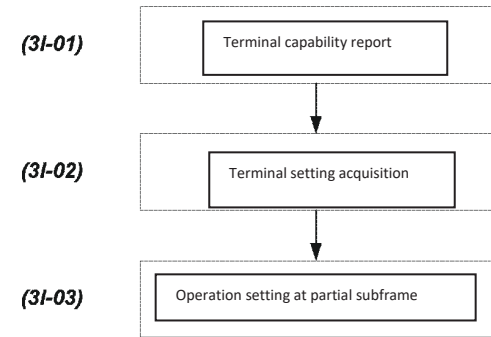


231-178

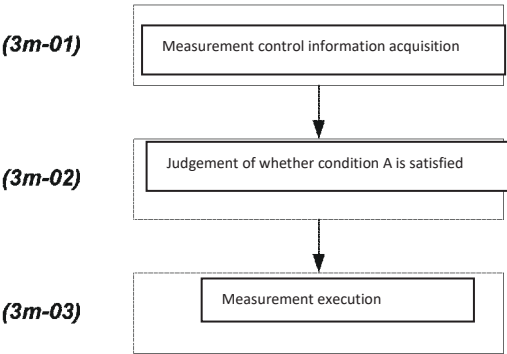
[FIG. 3k]



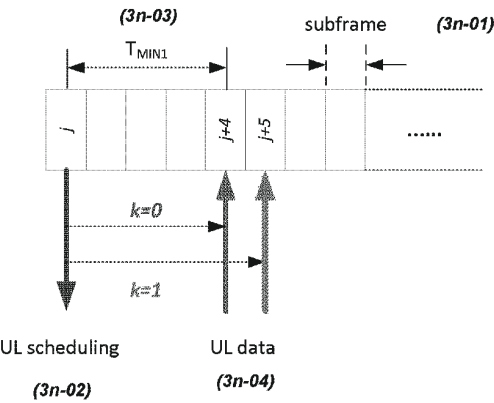
[FIG. 3l]



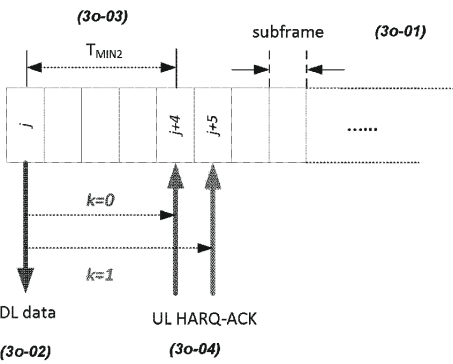
[FIG. 3m]



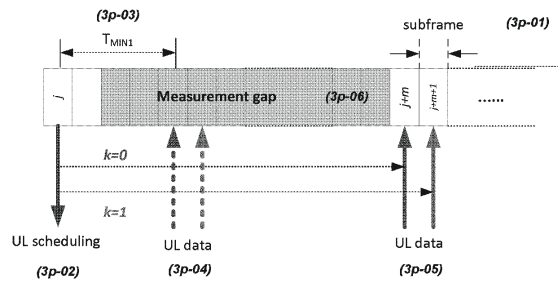
[FIG. 3n]



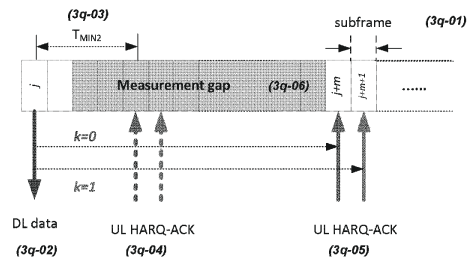
[FIG. 3o]



[FIG. 3p]

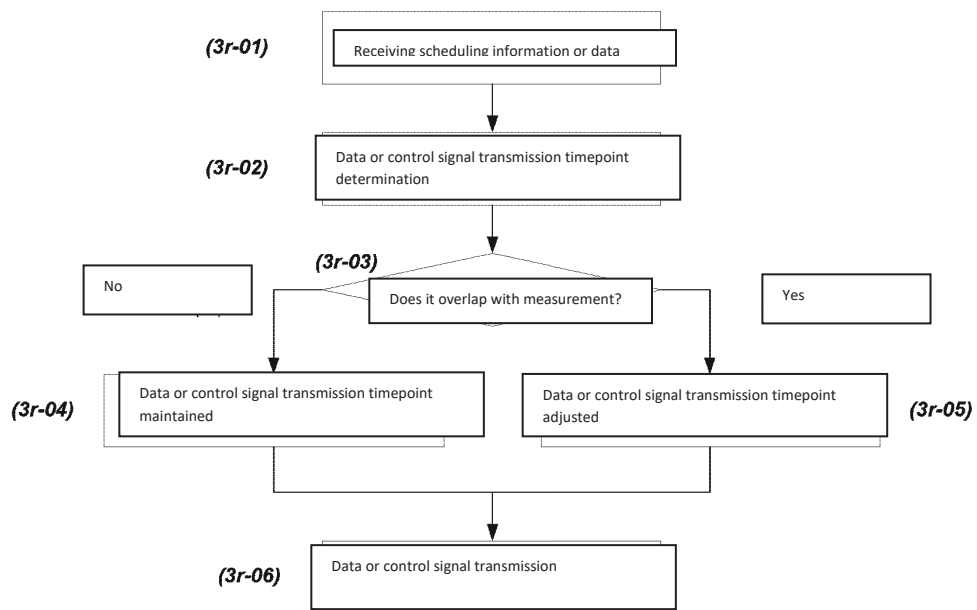


[FIG. 3q]



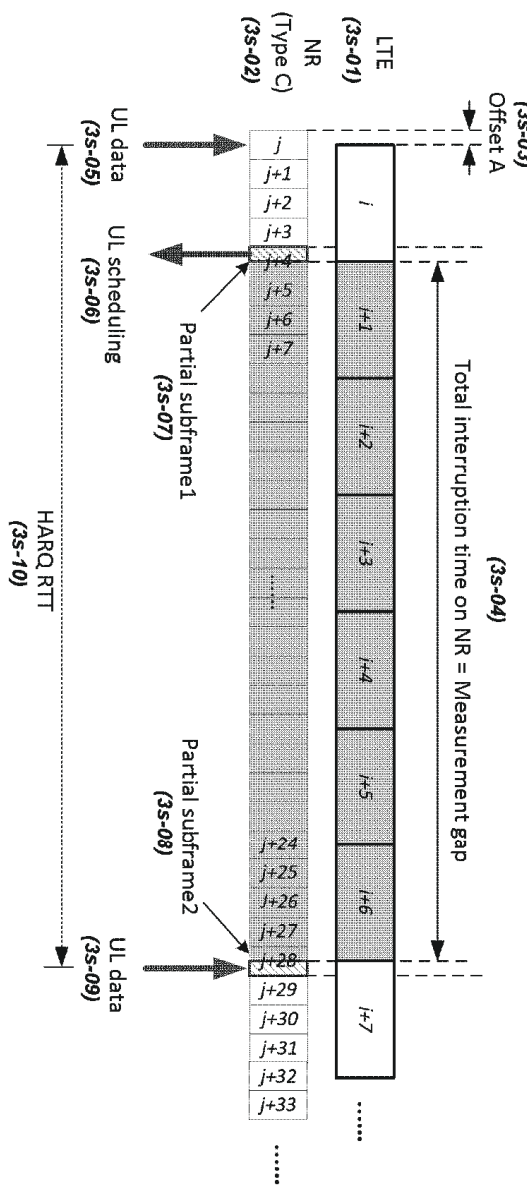
231-210

[FIG. 3r]



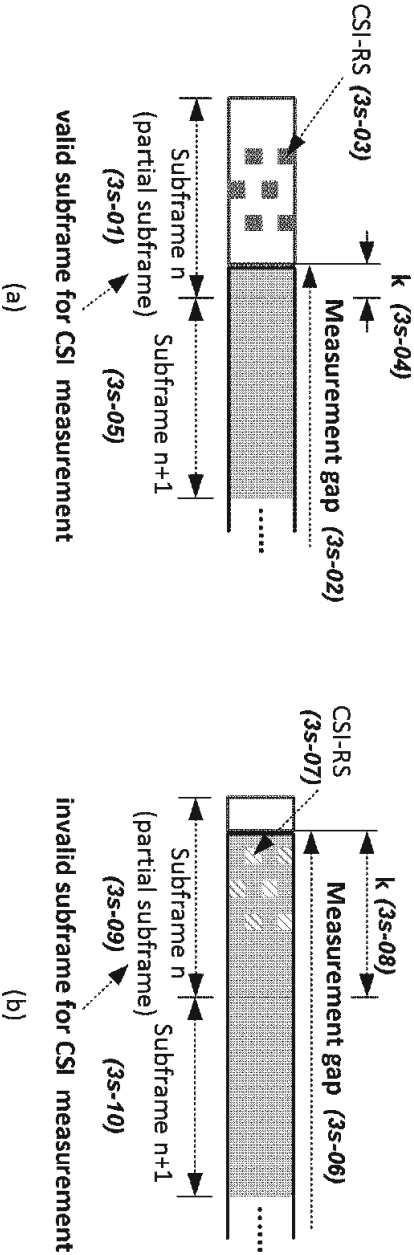
231-211

[FIG. 3s]

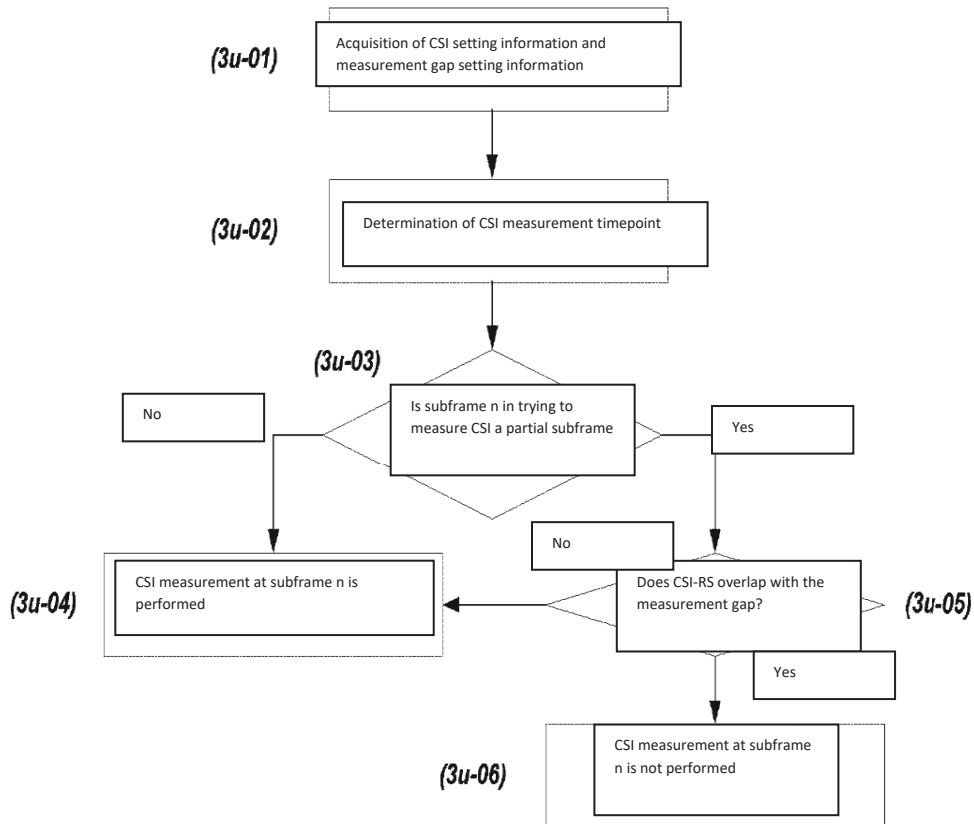


231-212

[FIG. 3t]

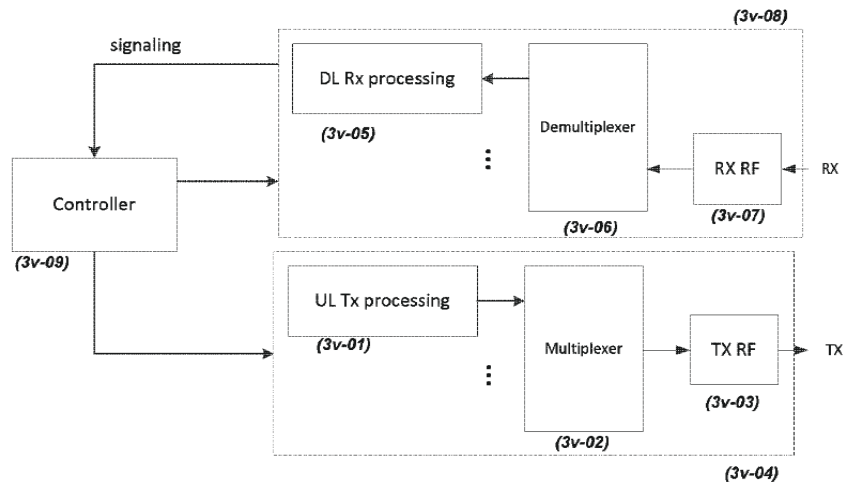


[FIG. 3u]

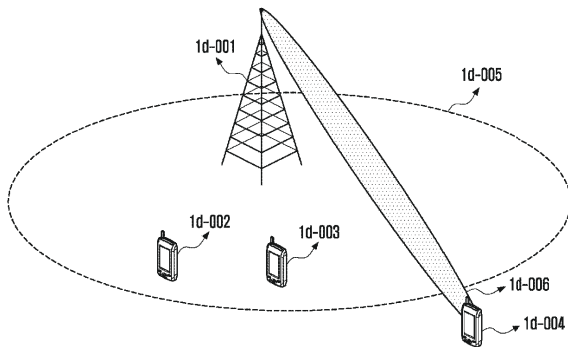


231-214

[FIG. 3v]

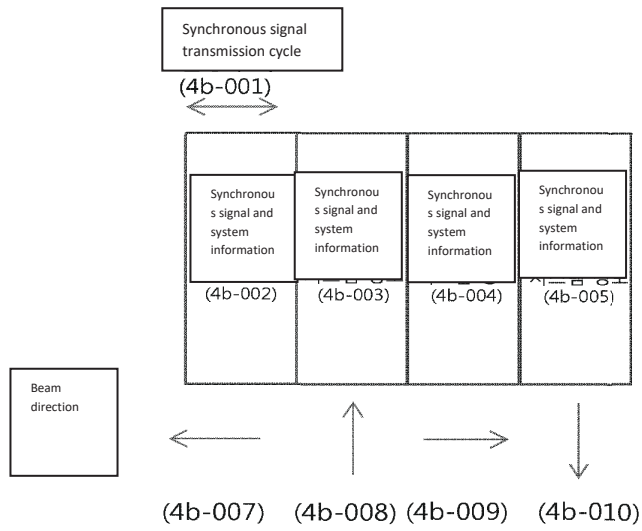


[FIG. 4a]



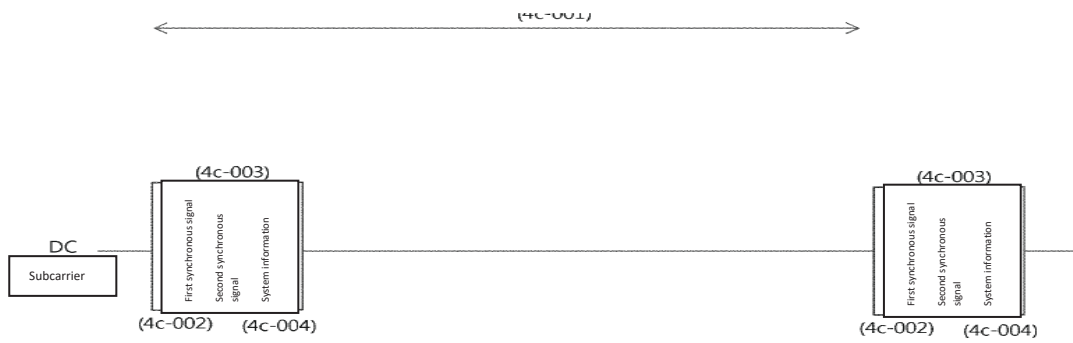
231-215

[FIG. 4b]



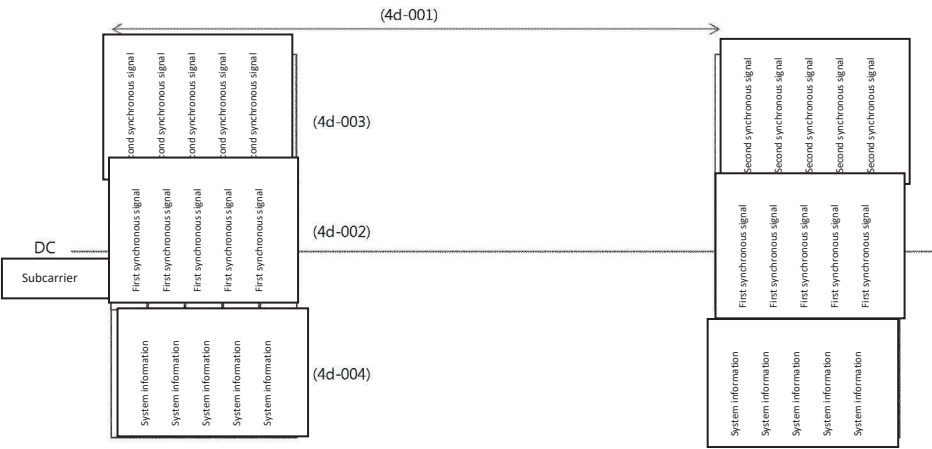
231-216

[FIG. 4c]



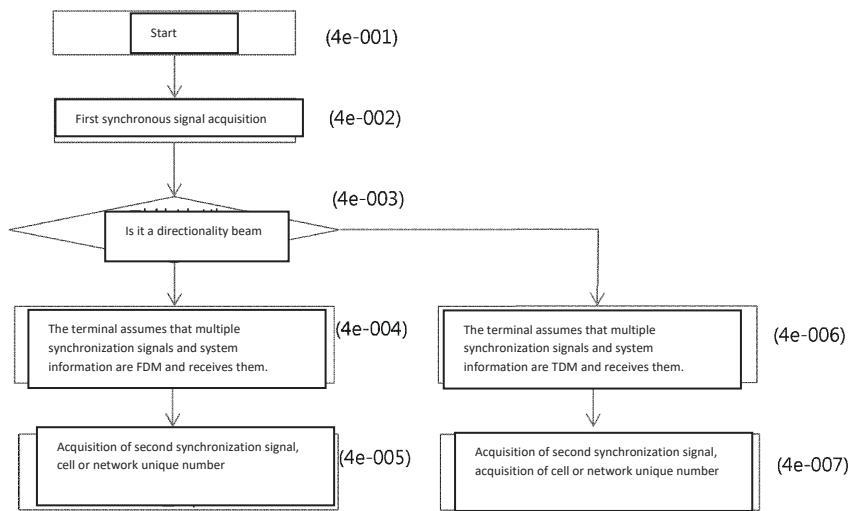
231-217

[FIG. 4d]



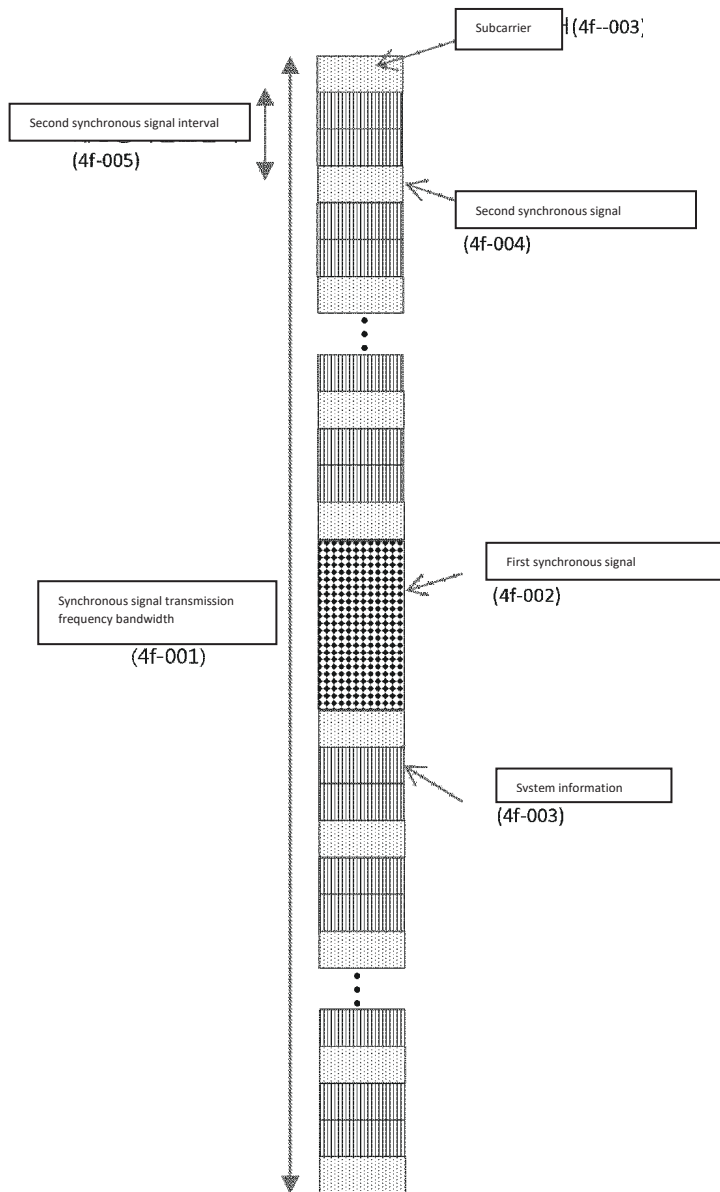
231-218

[FIG. 4e]



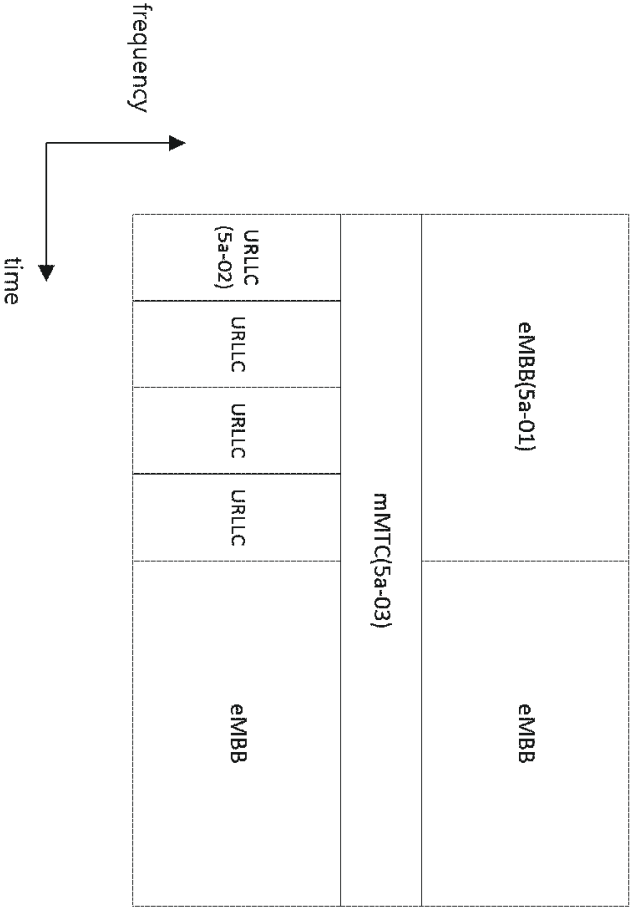
231-219

[FIG. 4f]



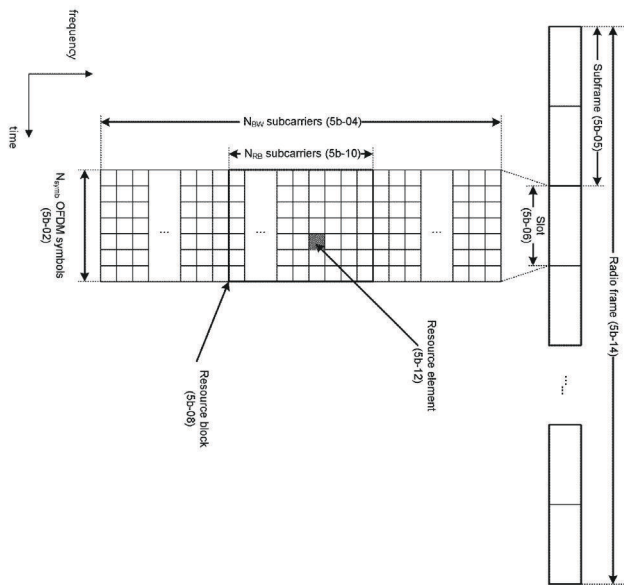
231-220

[FIG. 5a]



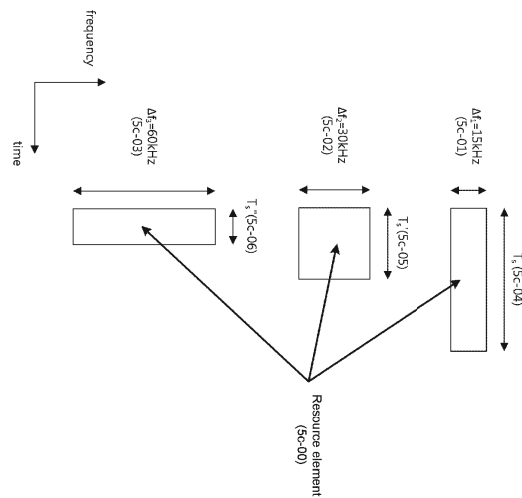
231-221

[FIG. 5b]

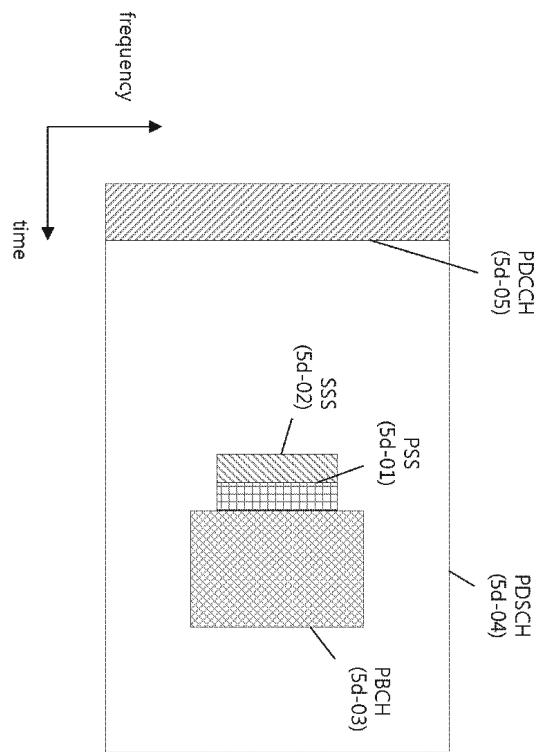


231-222

[FIG. 5c]

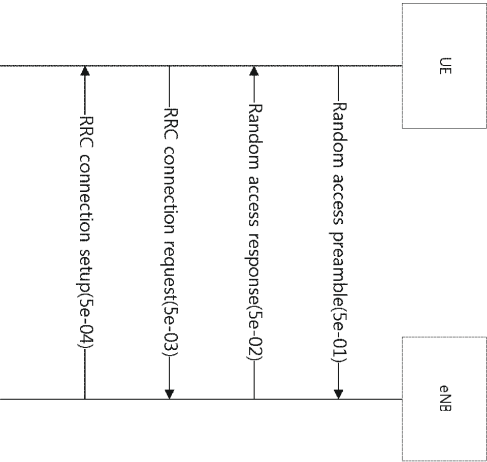


[FIG. 5d]

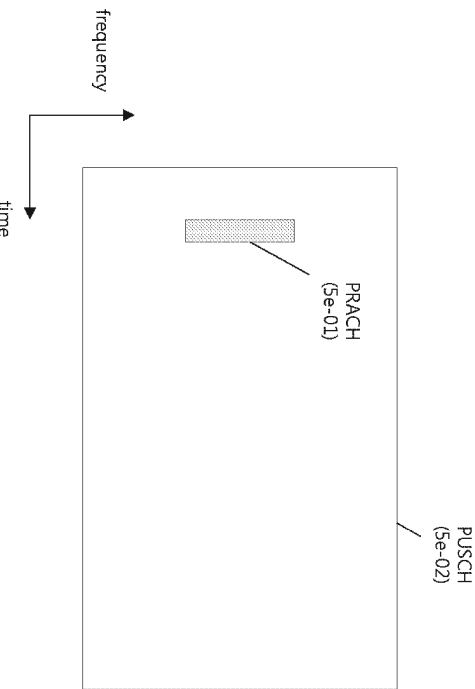


231-223

[FIG. 5e]

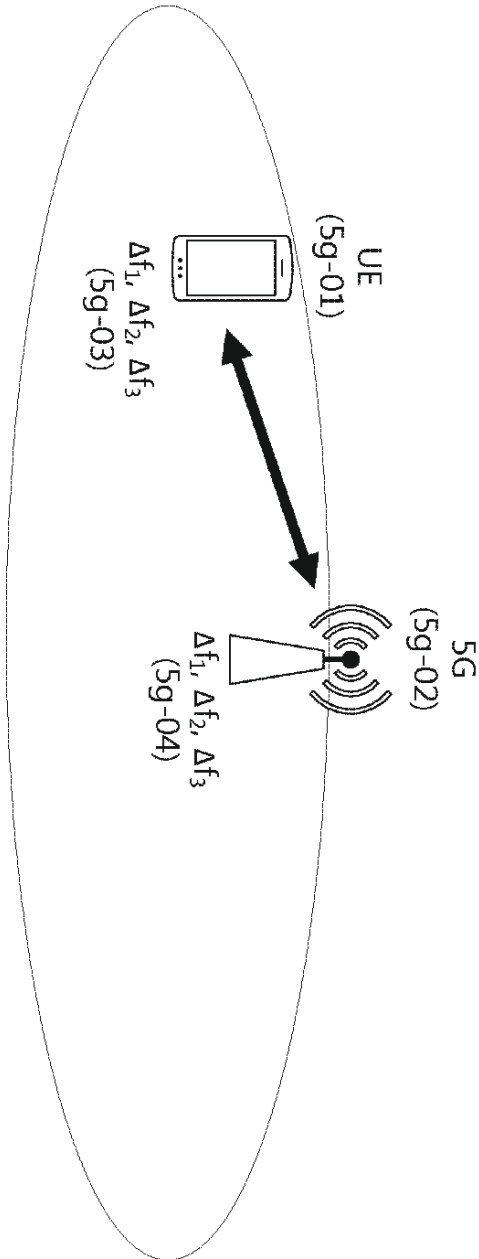


[FIG. 5f]

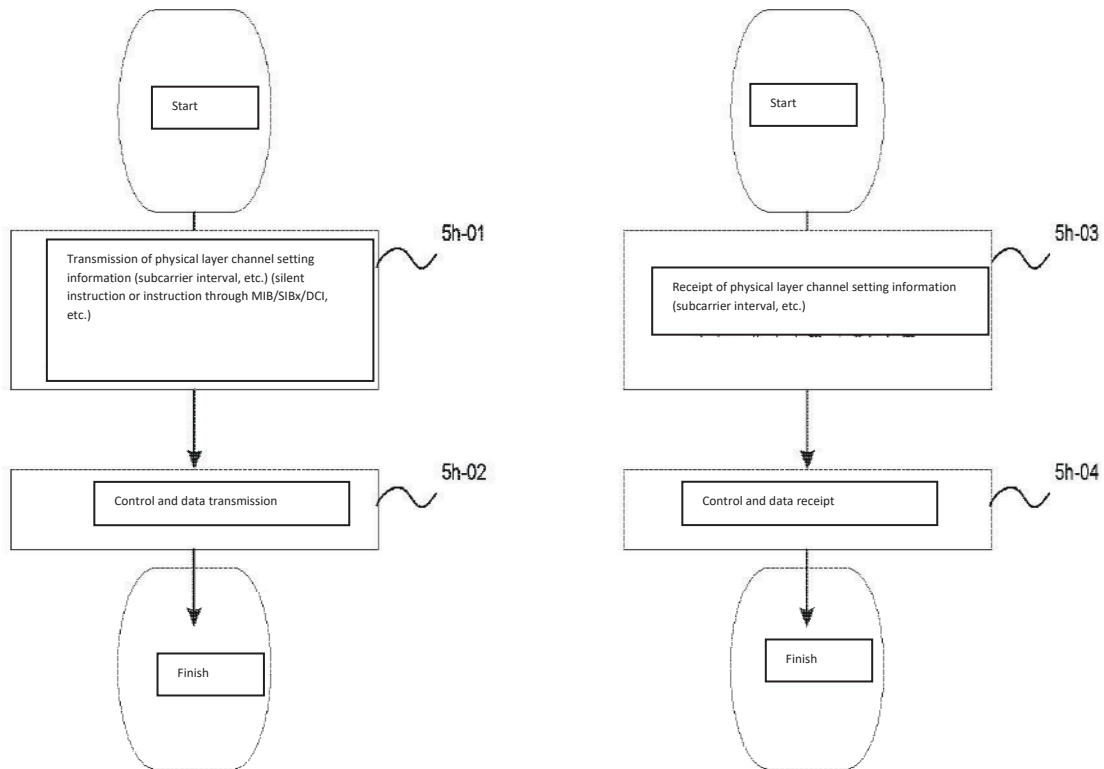


231-224

[FIG. 5g]

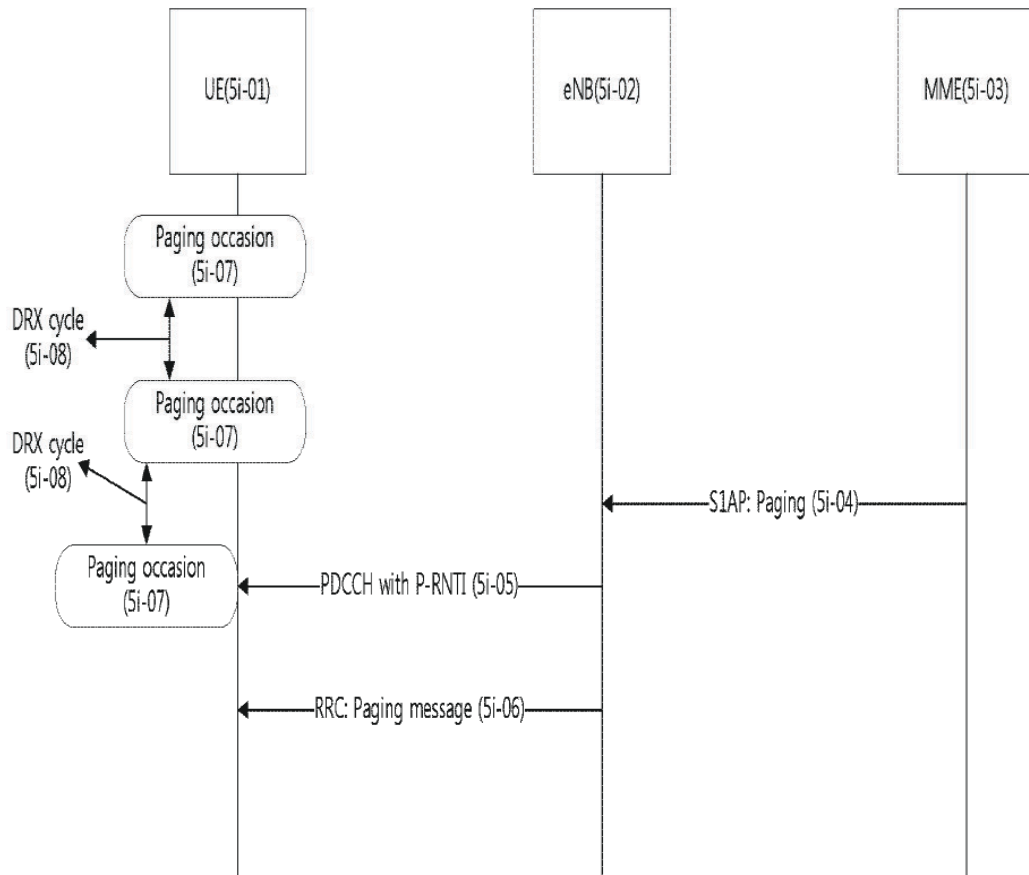


[FIG. 5h]



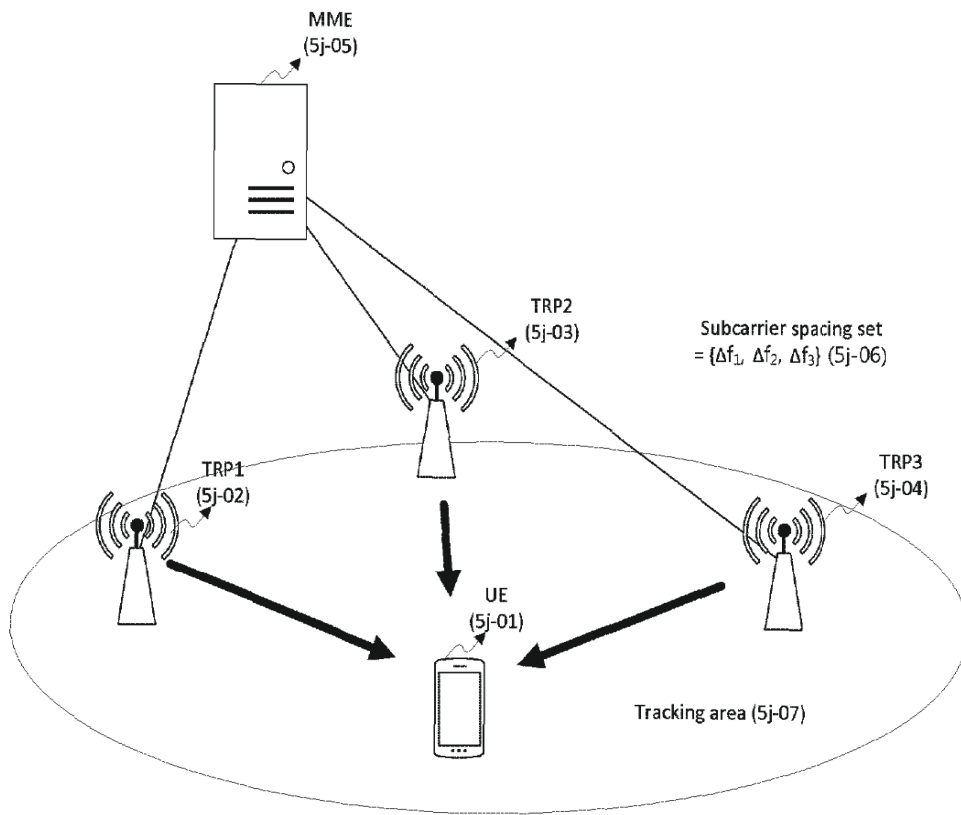
231-226

[FIG. 5i]



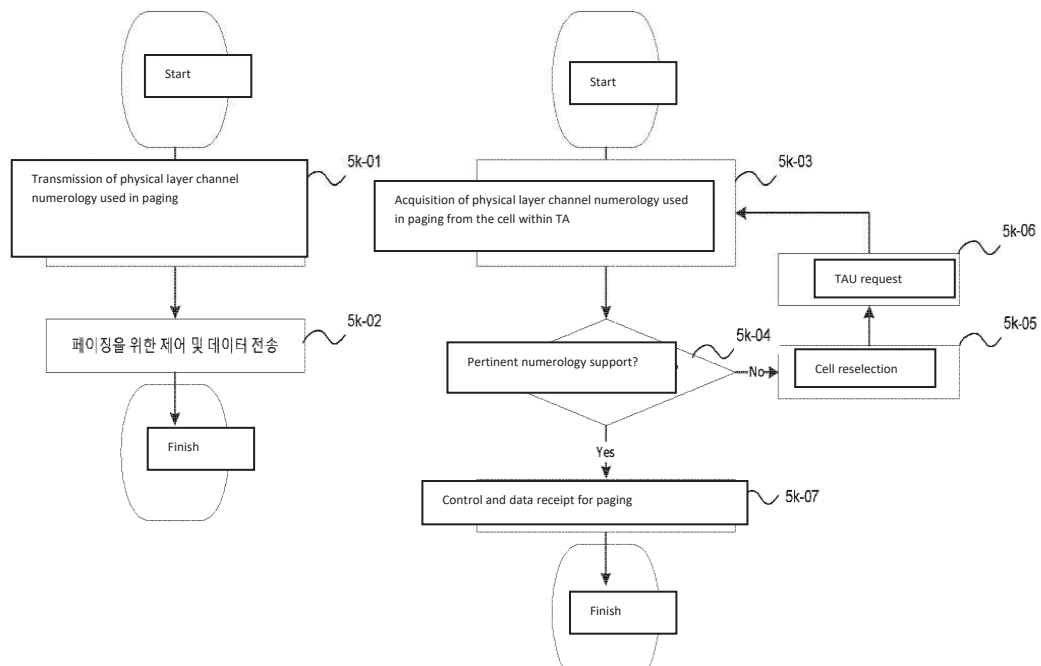
231-227

[FIG. 5j]



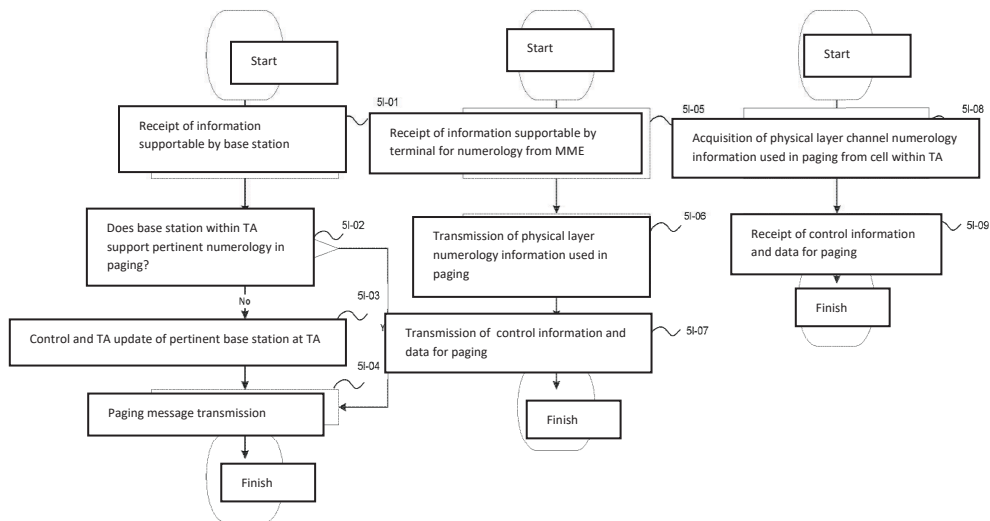
231-228

[FIG. 5k]



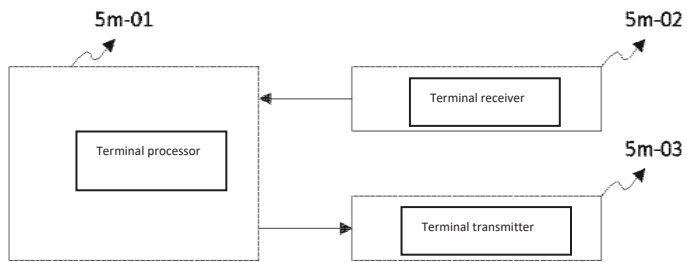
231-229

[FIG. 51]

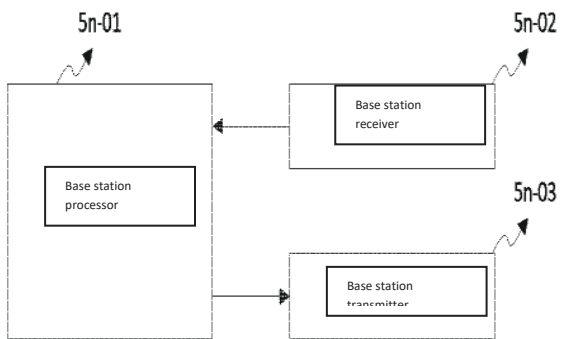


231-230

[FIG. 5m]



[FIG. 5n]



231-231