



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
19.12.2018 Bulletin 2018/51

(51) Int Cl.:
G08C 15/06 (2006.01)

(21) Application number: **18176264.2**

(22) Date of filing: **06.06.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **12.06.2017 JP 2017115105**

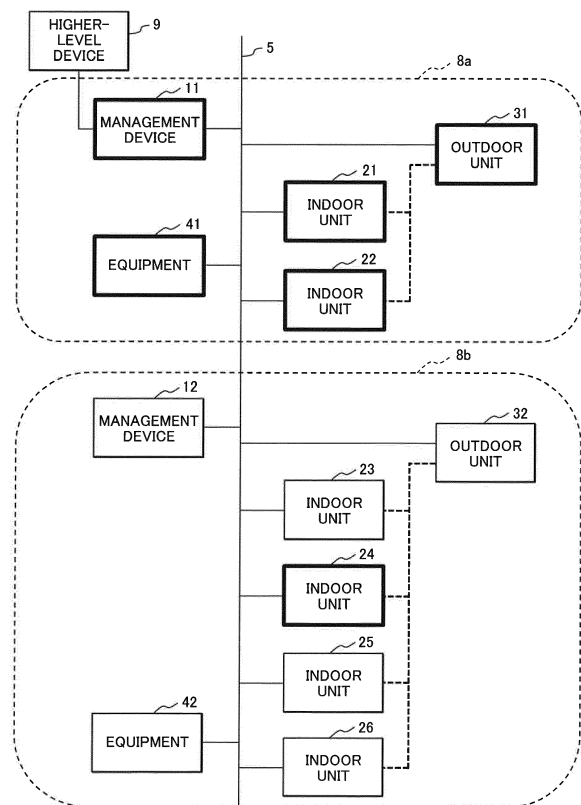
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(54) **COMMUNICATION CONTROL DEVICE AND FACILITY COMMUNICATION SYSTEM**

(57) To provide a communication control device which avoids interference of data of a first communication system in a transmission path through which data of a second communication system is being transmitted and improves convenience of a facility network as a whole under an environment that facility devices of various communication performances are present in a mixed state and a facility communication system is defined as a major issue. A communication control device which is equipped with a communication unit which makes communication possible by switching a first communication system or a second communication system of a time-division multiple-access system and a first communication detection term generation instruction unit which instructs to generate a detection term for use of a channel of the first communication system when communication is performed by the second communication system and in which the communication unit transmits a signal which includes the channel use detection term onto a transmission path on the basis of instructions to generate the channel use detection term from the first communication detection term generation instruction unit.

FIG. 1



Description

BACKGROUND OF THE INVENTION

5 (1) Field of the Invention

[0001] The present invention relates to a communication control device which performs bus-connection by vacant channel detection time-division multiple access and a facility communication system.

10 (2) Description of the Related Art

[0002] A communication network of industrial facility is adapted to transmit a small amount of information such as an operation state, a control command and so forth of facility equipment and therefore cost-reduction has been promoted by using serial communication which is low in speed in comparison with the Internet. On the other hand, recently, high-performance of the facility equipment and diversification of transmission information are advanced and also the facility equipment which is adaptive to high-speed communication is increased.

[0003] In Japanese Patent No. 4958640, a method of reducing communication failures (such as retransmission and so forth) caused by interference between respective communication systems in a case of performing communication using signals of a plurality of kinds of communication systems on one transmission path is described.

[0004] In Japanese Patent No. 5761432, a method of suppressing communication errors in a case of superimposing high frequency transmission data on low frequency transmission data on one transmission path is described.

SUMMARY OF THE INVENTION

[0005] In facility devices to be installed in a building and so forth, although there are cases where devices of the same performance are introduced all together at the same time, there are also many cases where old products and new products are introduced in a mixed state. For example, although the old product is adaptive to only low-speed communication, the new product is adaptive to also high-speed communication. Even under an environment in which the facility devices of such various communication performances are present in the mixed state, it is necessary to operate them correctly.

[0006] If communication is performed using only the low-speed communication which is adaptive to both the old product and the new product, connectivity would be ensured. However, efficiency of utilization of a communication network is lowered because a high-speed communication function of the new product is not used.

[0007] In addition, when only the high-speed communication function is continuously utilized, although the efficiency of utilization of the communication network is increased, a control signal of an air-conditioning system whose transmission is possible only by the low-speed communication is compressed by the high-speed communication. As a result, arrival of the control signal (such as an air-conditioner temperature change signal and so forth) whose immediate reflection on the facility device is desired is delayed and inconvenience is forced upon a user. It is necessary to achieve improvement of communication efficiency together with sure transmission of an important signal for utilization of a facility network which connects between/among the facility devices in this way.

[0008] However, the above-described prior art is not adaptive to the use under the environment that the low-speed communication equipment and the high-speed communication equipment are present in the mixed state, and in a case where communication using signals of the plurality of kinds of communication systems (the low-speed communication of an old system and the high-speed communication of a new system) is performed on the same transmission path, no due consideration has not been given to a flaw which would occur in a communication device which is adaptive to only the low-speed communication.

[0009] For example, in Japanese Patent No. 4958640, since the communication device which is adaptive to only the low-speed communication (a first communication system) is not able to detect a signal of the high-speed communication (a second communication system), there is the possibility that it may transmit a signal for the low-speed communication without noticing that a signal for the high-speed communication is transmitted from another communication device. In this case, interference occurs on the transmission path and the communication quality is deteriorated.

[0010] In addition, in Japanese Patent No. 5761432, in a case of a random-access communication system for avoiding collision by detection of a vacant channel, a communication device of the old system is not able to detect high-speed communication data (high-frequency transmission data) and therefore there is the possibility that it may transmit low-speed communication data (low-frequency transmission data) without noticing that the high-speed communication data is transmitted from another communication device. In this case, the interference occurs on the transmission path and the communication quality is deteriorated.

[0011] Accordingly, the present invention sets provision of a communication control device which avoids interference

of data of the first communication system in a transmission path through which data of the second communication system is being transmitted under an environment that the facility devices of various communication performances are present in the mixed state so as to improve convenience of the facility network as a whole, and a facility communication system as a main issue.

Solution to Problem

[0012] In order to solve the above-described issue, the communication control device of the present invention has the following configurations.

[0013] A communication control device which includes a communication unit which makes communication possible by switching a first communication system or a second communication system of a time-division multiple-access system and a first communication detection term generation instruction unit which instructs to generate a detection term for use of a channel of the first communication system when communication is performed by the second communication system and in which the communication unit transmits a signal which includes the channel use detection term onto a transmission path on the basis of instructions to generate the channel use detection term from the first communication detection term generation instruction unit.

[0014] Other means are as described in Scope of Patent Claims

ADVANTAGEOUS EFFECTS OF INVENTION

[0015] According to the present invention, it is possible to provide the communication control device which avoids the interference of the data of the first communication system in the transmission path through which the data of the second communication system is being transmitted under the environment that the facility devices of various communication performances are present in the mixed state so as to improve the convenience of the facility network as a whole, and the facility communication system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

Figure 1 is a configuration diagram of a facility communication system in an embodiment 1.

Figure 2 is a device management table of the facility communication system in the embodiment 1.

Figure 3 is a detailed configuration diagram of each facility device of the facility communication system in the embodiment 1.

Figure 4 is a diagram showing one example of a communication data format in the embodiment 1.

Figure 5A is an explanatory diagram of a communication mode of a facility network in the embodiment 1.

Figure 5B is an explanatory diagram of a communication mode of the facility network in the embodiment 1.

Figure 6 is a sequence diagram of unicast communication in the embodiment 1.

Figure 7 is a sequence diagram of multicast communication in the embodiment 1.

Figure 8A is an explanatory diagram of a high-speed communication detecting operation of a low-speed device in the embodiment 1.

Figure 8B is an explanatory diagram of a high-speed communication detecting operation of the low-speed device in the embodiment 1.

Figure 9A is an explanatory diagram of a high-speed communication detecting operation of the low-speed device in the embodiment 1.

Figure 9B is an explanatory diagram of a high-speed communication detecting operation of the low-speed device in the embodiment 1.

FIG. 10 is a diagram showing one example of a signal waveform in the embodiment 1.

Figure 11 is a detailed configuration diagram of each facility device of a facility communication system in an embodiment 2.

Figure 12 is a diagram showing one example of a signal waveform in the embodiment 2.

Figure 13 is a diagram showing one example of a signal waveform in the embodiment 2.

Figure 14 is a diagram showing one example of a signal waveform in the embodiment 2.

Figure 15 is a detailed configuration diagram of a high-speed device of a facility communication system in an embodiment 3.

Figure 16 is a detailed configuration diagram of a low-speed device of the facility communication system in the embodiment 3.

Figure 17 is a diagram showing one example of a frequency spectrum of a signal in the embodiment 3.

Figure 18 is a flowchart showing transmission and reception processing of the low-speed device in the embodiments 1 to 3.

Figure 19 is a flowchart showing the details of packet preparation processing in the embodiments 1 to 3.

Figure 20 is a flowchart showing the details of packet transmission processing in the embodiments 1 to 3.

Figure 21 is a flowchart showing reception processing of the high-speed device in the embodiments 1 to 3.

Figure 22 is a flowchart showing transmission processing (the first time) of the high-speed device in the embodiments 1 to 3.

Figure 23 is a flowchart showing transmission processing (after the second time) of the high-speed device in the embodiments 1 to 3.

Figure 24 is an explanatory diagram of a data partitioning method in the embodiments 1 to 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] In the following, embodiments of the present invention will be described in detail with reference to the drawings.

Embodiment 1

(System Configuration)

[0018] First, a facility communication system of the embodiment 1 will be described using Fig. 1 to Fig. 10.

[0019] Fig. 1 is a configuration diagram of the facility communication system of the present embodiment. The facility communication system is configured by a higher-level device 9 which manages facilities of the whole building and each facility device which is connected to a facility network 5. Here, each facility device is a general term of indoor units 21 to 26 and outdoor units 31, 32 of an air conditioner, pieces of concomitant equipment 41, 42 such as lighting equipment, security equipment and so forth, and management devices 11, 12 adapted to manage those respective devices.

[0020] Each facility device is configured as a computer which has a CPU (Central Processing Unit), a memory, storage means (a storage unit) such as a hard disk and so forth, and a network interface. The CPU executes programs (also called an application and other apps) which are read on the memory and thereby the computer operates a control unit (control means) which is configured by each processing unit.

[0021] The higher-level device 9 is connected to the management device 11 over a network which is different from the facility network 5. The higher-level device 9 transmits a command for equipment control to the management device 11 in order to optimize, for example, power consumption of the whole building and thereby controls each facility device from the management device 11 via the facility network 5.

[0022] Incidentally, bi-directional (optional direction) transmission/reception is possible for each facility device which is connected to the facility network 5. For example, an air-conditioner temperature adjustment signal is transmitted from the management device 11 to the indoor unit 21 and indoor temperature information is notified from the indoor unit 21 to the management device 11.

[0023] The facility network 5 is a network which makes communication possible by switching a plurality of communication modes in time series.

[0024] The facility network 5 makes the switch between, for example, low-speed communication as a first communication mode and high-speed communication as a second communication mode. Then, it is possible to effectively make use of the facility network 5 by transmission of data content according to each communication mode such as transmission of an important control signal such as an air-conditioner temperature adjustment signal and so forth in a time zone for the low-speed communication, transmission of large capacity data such as the latest version of air-conditioner firmware and so forth in a time zone for the high-speed communication and so forth.

[0025] Here, it is supposed that in communication mode switching, a normal communication mode is set as the base and when a communication mode change trigger is generated, one communication mode is switched to another mode. Incidentally, in the following, description will be made by setting the low-speed communication as a normal communication mode and the high-speed communication as a trigger-induced communication mode. On the other hand, the high-speed communication may be set as the normal communication mode and the low-speed communication may be set as the trigger-induced communication mode.

[0026] In addition, each facility device of the facility communication system is classified into a low-speed device which is adaptive to only the low-speed communication or a high-speed device which is adaptive to both the low-speed communication and the high-speed communication.

[0027] In Fig. 1, a bold-lined device shows the high-speed device which is adaptive to both the high-speed communication and the low-speed communication (the indoor unit 21 and so forth) and a thin-lined device shows the low-speed device which is adaptive to only the low-speed communication (the indoor unit 23 and so forth). Then, in the facility communication system of the present embodiment, the respective facility devices are grouped into two groups. A first

group 8a is a group of only the high-speed devices which are configured by including the management device 11, the indoor units 21, 22, the outdoor unit 31, the equipment 41 which are shown by the bold lines. On the other hand, a second group 8b is a group which is configured by including the management device 12, the indoor units 23, 25, 26, the outdoor unit 32, the equipment 42 which are shown by the thin lines and the indoor unit 24 which is shown by the bold line and in which the low-speed devices and the high-speed device are present in the mixed state.

[0028] Each group is an aggregate of the facility devices which belong to the same refrigerant system, the indoor units 21, 22 and the outdoor unit 31 are connected with one another by a first refrigerant piping (shown by a broken line) which supplies refrigerant gas, the indoor units 23 to 26, the outdoor unit 32 are connected with one another by a second refrigerant piping (shown by a broken line) which supplies the refrigerant gas.

[0029] Fig. 2 is one example of a device management table 101 of the facility communication system. As exemplified here, a device type, a device individual address, adaptability to the high-speed communication (O is an adaptable high-speed device and x is an unadaptable low-speed device), and a group to which the device belongs are described in the device management table 101 for every facility device. Although this device management table 101 is stored into each facility device individually, the content of the device management table which is stored into each facility device may be all entries of the table and an entry of a device which does not become a communications partner when viewing from itself may be excluded. The device which does not become the communications partner is a device of the device type which is the same as that of itself such as, for example, the indoor unit 22 and so forth when itself is the indoor unit 21.

(Communication Device Configuration)

[0030] Fig. 3 is a detailed configuration diagram of data transmission/reception related parts in each facility device of the facility communication system. It has a storage unit 51, a load unit 52, a communication unit 53, and a control unit 54 (for example, a microcomputer), and a mechanism as the low-speed device and a mechanism as the high-speed device are built in one housing. Various kinds of parameters and so forth (a rotational speed of a fan and so forth) relating to the load unit 52 are stored in the storage unit 51. The load unit 52 is, for example, an indication display in a case where the device type is "Management Device", a fan in a case where the device type is "Indoor Unit", a compressor in a case where the device type is "Outdoor Unit", and an illumination lamp, an imaging sensor and so forth in a case where the device type is "Equipment". Incidentally, in the following, there are cases where the communication unit 53 and the control unit 54 are called a communication control device in combination.

[0031] When this facility device is operated as the "low-speed device", an encoding section 61, a modulation/demodulation section 62, a decoding section 63, a vacant channel detection section 64 in the communication unit 53 may be used and a transmission data generation section 71, a transmission section 72, a reception section 73, a reception data analysis section 74, a communication control section 75 in the control unit 5 may be used.

[0032] On the other hand, when this facility device is operated as the "high-speed device", it may be equipped with a communication speed decision section 76, a communication speed switch section 77, a low-speed detection term generation instruction section 78 in the control unit 54 in addition to the configurations of the above-described low-speed device.

[0033] First, a case where the facility device is operated as the low-speed device will be described. As the low-speed device, a communication function which will be indicated in the following is used.

[0034] The encoding section 61 performs an encoding process (example: conversion from a Non Return to Zero (in the following, referred to as NRZ) code into a Return to Zero (in the following, referred to as RZ) code) on transmission data 501 which is notified from the transmission section 72 (example: a UART transmission circuit).

[0035] The modulation/demodulation section 62 is equipped with a modulation circuit and a demodulation circuit, modulates a transmission encoded signal 502 that the encoding section 61 encoded and transmits it to the facility network 5. In addition, it demodulates a signal received from the facility network 5 and notifies the decoding section 63 of it. Incidentally, a configuration that a low-pass filter is installed at the front stage of the demodulation circuit is general. In addition, description will be made assuming that processes of transmitting and receiving signals by a baseband system which does not utilize a high frequency are also included in the modulation/demodulation section 62 in a broad sense.

[0036] The decoding section 63 performs a decoding process (example, conversion from the RZ code to the NRZ code) on a reception encoded signal 503 that the modulation/demodulation section 62 demodulated and notifies the reception section 73 of reception data 504.

[0037] The vacant channel detection section 64 monitors the signal that the modulation/demodulation section 62 demodulated and notifies the transmission section 72 and the reception section 73 of a vacant status of the facility network 5 which is the transmission path. Incidentally, the facility network 5 is the bus-type one and gains vacant channel detection time-division multiple access to another facility communication system.

[0038] The reception section 70 (example: a UART reception circuit) receives a signal from the decoding section 63 and notifies the reception data analysis section 74 of the reception data 504.

[0039] The reception data analysis section 74 analyzes the content of a packet contained in the reception data 504

and notifies the communication control section 75 of it.

[0040] The communication control section 75 executes a data accessing process on the storage unit 51 and a controlling process on the load unit 52 on the basis of the analyzed content of the packet. Further, the transmission data generation section 71 generates a packet to be notified to other devices on the basis of the instructions from the communication control section 75 and notifies the transmission section 72 of it. The transmission section 72 notifies the decoding section 61 of the transmission data 501. Incidentally, the communication control section 75 may spontaneously issue instructions to generate the transmission data on the basis of a state of the load unit 52.

[0041] Next, a case where the facility device is operated as the high-speed device will be described. The high-speed device is the one which is able to make the switch between the high-speed communication and the low-speed communication so as to communicate with the low-speed device by using the low-speed communication and to communicate with the high-speed device by using the high-speed communication.

[0042] The communication speed decision section 76 decides whether the switch is made between the low-speed communication and the high-speed communication on the basis of a speed-switching trigger signal that the reception data analysis section 74 received. A result of this decision is notified to the communication control section 75 and the communication speed switch section 77.

[0043] When the communication speed switch section 77 instructs the transmission section 72, the reception section 73 and the communication unit 53 so as to receive and transmit signals by switching from the low-speed communication to the high-speed communication, the transmission section 72, the reception section 73, the communication unit 53 perform processes for the high-speed communication. On the other hand, when the communication speed switch section 77 instructs the transmission section 72, the reception section 73 and the communication unit 53 so as to transmit and receive the signals by switching from the high-speed communication to the low-speed communication, the transmission section 72, the reception section 73, the communication unit 52 perform processes for the low-speed communication. Incidentally, when the device itself needs the high-speed communication, the communication control section 75 may generate a trigger for switching from the low-speed communication to the high-speed communication, in place of receiving the trigger signal from the outside.

[0044] The low-speed detection term generation instruction section 78 instructs a timing of inserting a channel use detection signal (a low-speed detection term) for the low-speed device as will be described later.

(Basic Communication Method)

[0045] Fig. 4 is an explanatory diagram of a packet which is given and taken in the facility communication system. A packet format 80 is configured by including a header column 81, a data column 82, a parity column 83 in order from the top. Incidentally, the parenthesized one in each column in the packet format 80 indicates a data volume (unit B: byte) in each column. For example, the header column 81 has a fixed length of 8 bytes and the data column 8 has a variable length.

[0046] The header column 81 is configured by including a device type column 84, a source address column 85, a destination address column 86, a communication type column 87, a data length column 88. The data length column 88 indicates a data length of the data column 82.

[0047] An address of a packet source device is described in the source address column 85 and an address of a packet destination device is described in the destination address column 86. Otherwise, when a plurality of the packet destination devices are to be designated in a lump, a multicast address "OxFFFF" for designating all the devices or a multicast address for designating a group of devices which are grouped by using a specific bit is described as the address of the destination devices.

[0048] Incidentally, the same data format may be used for the low-speed communication and the high-speed communication as the packet format 80. In a case of performing the high-speed communication, the high-speed device may transmit the header column 81 by using the low-speed communication and thereafter may transmit the succeeding data column 82 and parity column 83 by switching to the high-speed communication. Alternatively, the high-speed device may transmit the header column 81, the data column 82 and the parity column 83 all at once by the high-speed communication.

[0049] In addition, in the present embodiment, the term "multicast" is used in the sense of generically naming transmission to the plurality of destination devices. In order to achieve this broadly interpreted multicast, for example, narrowly interpreted multicast and broadcast which are defined in IP (Internet Protocol) may be also used.

[0050] A table 111 shown in Table 1 shows a description example of the device type column 84 which indicates the device type of the source device. For example, when the source device is the indoor unit 21, "0 x 02" which indicates the indoor unit is described in the device type column 84. In addition, the device type "Equipment" may be more subdivided on the basis of the kinds of the facility and different values may be allocated thereto.

[Table 1]

[0051]

Table 1

No.	Device Type Value	Definition
1	0 x 01	Outdoor Unit
2	0 x 02	Indoor Unit
3	0 x 03	Management Device
4	0 x 04	Equipment

[0052] A table 112 shown in Table 2 shows a description example of the communication type column 87 which indicates the object of the packet. It is possible to designate either ON or OFF for respective values from No. 1 (Control) to No. 6 (High-Speed Communication) respectively. Therefore, a logical sum of the respective values shown in Fig. 4 is described in the communication type column 87. For example, when simultaneous designation of "Response Needed" and "Batch Control" is wished, a logical sum "0 x 84" of "0 x 80" and "0 x 04" is described in the communication type column 87. In addition, "0 x 0F" is a value which is not defined in the low-speed device and indicates that succeeding communication is the high-speed one in the header column 81 in the high-speed device.

[Table 2]

[0053]

Table 2

No.	Communication Type Value	Low-Speed Device Definition	High-Speed Device Definition
1	0 x 01	Control	
2	0 x 02	State Acquisition	
3	0 x 03	State Notification	
4	0 x 04	Batch Control	
5	0 x 80	Response Needed	
6	0 x 0F	Not Defined	High-Speed Communication

[0054] A table 113 shown in Table 3 is a description example of the data length column 88. When the value of the data length column 88 is 0 x 0000 to 0 x 0030, the value directly indicates the data length. On the other hand, when the value of the data length column 88 is 0 x 0040 or more, it is possible to designate information (high-speed communication frequency, a high-speed communication term) on the high-speed communication only in a case of the high-speed device as shown in Fig. 4.

[Table 3]

[0055]

Table 3

No.	Data Length	Low-Speed Device Definition	High-Speed Device Definition
1		Data Length	
2		Not Defined	
3		Not Defined	High-Speed Communication Frequency
4		Not Defined	High-speed Communication Term
5		Not Defined	

[0056] Fig. 5A and Fig. 5B are explanatory diagrams of signals to be demodulated on the facility network 5 and communication modes of the facility devices. Time-series graphs 121, 122 each show a packet which is transmitted by the low-speed communication, a packet which is transmitted by the high-speed communication, a communication mode (state) of the facility network 5 in order from the top. A term which is described as "High Speed" is a term for the high-speed communication and others are terms for the low-speed communication in the communication mode of the facility network 5.

[0057] The time-series graph 121 shown in Fig. 5A shows an example that the high-speed communication is performed one time in accordance with a one-time trigger which was transmitted by the low-speed communication. In this example, the one-time trigger which makes one-time high-speed communication possible is transmitted by the low-speed communication after transmission of a data packet for the low-speed communication. This one-time trigger is the header column 81 for which 0 x OF is set in the communication type column 87 and will be also called a high-speed trigger in the following.

[0058] The high-speed device which received this high-speed trigger is able to make a preparation for reception of the packet by the high-speed communication and therefore succeeding packets are transmitted by the high-speed communication. Then, the communication mode of the facility network 5 returns to the normal low-speed communication because of no occurrence of transmission/reception for a predetermined term after one-time high-speed communication. Incidentally, even when the low-speed device received the high-speed trigger, the value "0 x OF" in the communication type column 87 is not defined for the low-speed device and therefore the high-speed trigger is appropriately ignored and the low-speed device does not make an abnormal response.

[0059] On the other hand, the time-series graph 122 shown in Fig. 5B shows an example in which the high-speed communication is performed a plurality of times in accordance with a term trigger which was transmitted by the low-speed communication. In this example, the term trigger which makes the high-speed communication possible is transmitted by the low-speed communication continuously for a predetermined term after a term T1 which is a standby time which is set after data packet transmission by the low-speed communication. This term trigger is the header column 81 for which 0 x OF is set in the communication type column 87 and the high-speed communication term (or the high-speed communication frequency) is designated in the data length column 88.

[0060] All the high-speed devices which received this term trigger are able to make a preparation for packet transmission/reception by the high-speed communication. Then, any high-speed device may perform the high-speed communication if it is performed in the high-speed communication term. A margin of a term T2 is set between the respective packets which are transmitted by the high-speed communication so as not to collide with each other. Then, after termination of the high-speed communication term, it returns to the low-speed communication after a not-used term T3 for which no packet flows into the facility network 5. Incidentally, it is possible to avoid data transmission by the low-speed device in the high-speed communication term by setting such that the term $T1 \leq$ the term T3, the term $T2 <$ the term T3.

[0061] Fig. 6 is a sequence diagram of one-to-one communication between the respective facility devices. In the respective sequence diagrams including Fig. 6, the high-speed devices and the high-speed communication are described with bold lines and the low-speed devices and the low-speed communication are described with thin lines after the manner in Fig. 1. Incidentally, an operation subject in each sequence diagram is absolutely exemplification for clearly explaining the operations of the high-speed devices and the operations of the low-speed devices and devices other than the exemplified ones may be operated as the high-speed devices and the low-speed devices.

[0062] In a sequence in S11, the management device 12 transmits the packet of "Response Needed" individually described in the table 112 by the low-speed communication to the respective facility devices (the indoor unit 23, the indoor unit 21, the management device 11) (shown as "send"). Then, the respective facility devices which received the packet of "Response Needed" perform packet response to the management device 12 by the low-speed communication individually (shown as "ack"). Thereby, the management device 12 is able to grasp that communication with each facility device is possible.

[0063] S12 is an example in which only packet transmission is performed by the high-speed communication between the management device 11 and the indoor unit 21 which are the high-speed devices. First, the indoor unit 21 transmits the one-time high-speed trigger shown in the time-series graph 121 to the management device 11 by the low-speed communication (a broken arrow shows the trigger). Thereby, subsequent packets are communicated from the indoor unit 21 to the management device 11 at a high speed. On the other hand, a packet response from the management device 11 to the indoor unit 21 is not the one which is transmitted following the high-speed trigger and therefore it is transmitted in a low-speed communication mode.

[0064] S13 is an example in which a combination of packet transmission and response thereto is subjected to high-speed communication. The management device 11 transmits the high-speed trigger to the indoor unit 21 and thereby transmits the succeeding packet of "Response Needed" to the indoor unit in the high-speed communication mode similarly to S12. Further, the indoor unit 21 transmits the high-speed trigger to the management device 11 and thereby transmits the succeeding response packet to the management device 11 in the high-speed communication mode.

[0065] S14 is an example in which the combination of transmission of the packet of "Response Needed" with the

response packet thereto is continuously subjected to high-speed communication by designating the high-speed communication term. In this example, the management device 11 transmits the high-speed trigger shown on the time-series graph 122 to the indoor unit 21 in a low-speed communication mode and thereby packet transmission/reception between the indoor unit 21 and the management device 11 are performed in the high-speed communication mode in a later high-speed communication term.

[0066] On the other hand, after the high-speed communication term set by the term trigger has elapsed, it returns from the high-speed communication mode to the low-speed communication mode and therefore packet transmission from the indoor unit 21 to the management device 11 and packet response from the management device 11 to the indoor unit 21 in S15 are performed by the low-speed communication.

[0067] In Fig. 6, the low-speed communication between the low-speed devices, the low-speed communication between the low-speed device and the high-speed device, the low-speed communication between the high-speed devices, the high-speed communication between the high-speed devices become possible respectively as the communication on the same facility network 5 by making use of the high-speed trigger in this way. Further, in S14, it is possible to efficiently perform the high-speed communication by using the high-speed trigger which designated the high-speed communication term in comparison with a method of transmitting the high-speed trigger every time.

[0068] Fig. 7 is a sequence diagram of multicast communication between/among the respective facility devices.

[0069] In a sequence in S12, the management device 12 transmits the packet of "Response Needed" to the respective facility devices (the indoor unit 23, the management device 11, the indoor unit 21, the indoor unit 22) by multicast by the low-speed communication (in the drawing, "send" which shows the transmission packet comes after "M" which shows multicast). Then, the respective facility devices which received the packet of "Response Needed" make responses to the management device 12 individually by the low-speed communication (shown as "ack"). Here, since four packet responses reach one management device 12 and therefore it is preferable for each facility device to make a response after waiting for a transmission wait time (an offset time) which is different from those of other devices in such a manner that respective arrival times do not collide with one another/each other. This offset time is calculated from, for example, a device address and so forth of each facility device.

[0070] In addition, in S22, the management device 11 notifies the respective high-speed devices (the indoor unit 21, the indoor unit 22) of the high-speed trigger which designates the high-speed communication term by multicast (shown as "M-term trigger"). Then, the management device 11 communicates the packet of "Response Needed" to the respective high-speed devices by multicast at the high speed. The respective high-speed devices which received this packet transmit the response packets individually in the high-speed communication mode in the high-speed communication term.

[0071] In S23, after termination of the high-speed communication term designated in S22, the management device 11 performs multicast transmission to which no response is needed to the respective facility devices (four units on the left and right).

[0072] In Fig. 7, it is possible to perform batch communication by the low-speed communication and batch communication by the high-speed communication as the communication on the same facility network 5 by using the multicast communication together with the high-speed trigger in this way.

(Interference Occurrence Case and Basis of Countermeasure Method thereto)

[0073] Next, comparative description of a time-series graph 131 in Fig. 8A that communication between the high-speed device and the low-speed device is not normally performed after transmission of the one-time trigger with a time-series graph 132 in Fig. 8B that it is avoided by the present embodiment and comparative description of a time-series graph 133 in Fig. 9A that the communication between the high-speed device and the low-speed device is not normally performed after transmission of the term trigger with a time-series graph 134 in Fig. 9B that it is avoided by the present embodiment will be made. Incidentally, the respective graphs of the time-series graphs 131, 132, 133, 134 show data on the low-speed communication by which the low-speed device performs transmission, data on the low-speed communication by which the high-speed device performs transmission and data on the high-speed communication by which the high-speed device performs transmission in order from the top respectively.

[0074] The time-series graph in Fig. 8A shows an example in which one-time high-speed communication is performed after the one-time trigger by the low-speed communication. At this time, the low-speed device is able to perform carrier detection of the one-time trigger. However, it is not able to perform carrier detection of the succeeding high-speed data by the high-speed communication (shown by "x" in Fig. 8A). Therefore, there are cases where the low-speed data is transmitted after the term T1 which is the standby time after carrier detection of the one-time trigger has elapsed. Then, when high-speed data transmission from the high-speed device and low-speed data transmission from the low-speed device are performed simultaneously, communication collision occurs on the transmission path. A vacant channel detecting process is performed on the low-speed device by the vacant channel detection section 64. However, for example, in a case where the vacant channel detection section 64 is equipped with a low-pass filter and is not able to detect the high-speed communication, this defect occurs.

[0075] On the other hand, the time-series graph 132 in Fig. 8B is adapted to describe a method of avoiding the defect in Fig. 8A and to make it possible for the low-speed device to perform carrier detection even in a high-speed signal transmission term by timely transmitting a low-speed detection term (a channel use detection signal) detection of which is possible for the low-speed device. Specifically, in a case where the high-speed device transmits the data for the high-speed communication, a channel use detection signal (a low-speed detection term) for the low-speed device is inserted into the head of that data every time the term T_4 ($< T_1$) elapses. On this occasion, transmission data for the high-speed communication is partitioned in units of packets and in the example in Fig. 8B, one piece of high-speed data is partitioned into four pieces. It becomes possible for the low-speed device to perform carrier detection that the transmission path is in use at predetermined intervals from the low-speed detection term so inserted. Then, after completion of transmission of the last low-speed detection term, the low-speed device performs the process of detecting the vacant channel in the term T_1 so as to confirm that the transmission path is not used and thereafter transmits the low-speed communication data. Thereby, it becomes possible to avoid communication collision on the transmission path and to normally perform communication. The one which instructs a timing for inserting this low-speed detection term is the low-speed detection term instruction section 78 shown in Fig. 3.

[0076] The time-series graph 133 in Fig. 9A shows an example in which the high-speed communication is performed the plurality of times after the term trigger by the low-speed communication. There are cases where the carrier-detection that the communication is performed on the transmission path is impossible for the low-speed device even when performing the vacant channel detecting process while the high-speed device is transmitting the data for the high-speed communication similarly to Fig. 8A and it transmits the data for the low-speed communication after the vacant channel detecting process in the term T_1 and thereby the communication collision occurs on the transmission path.

[0077] On the other hand, the time series graph 134 in Fig. 9B is adapted to describe the method of avoiding the defect in Fig. 9A and to make it possible for the low-speed device to perform carrier detection even in the high-speed signal transmission term by timely inserting the low-speed detection term in which carrier-detection is made possible by the low-speed device. Specifically, in a case where the high-speed device transmits the data for the high-speed communication, a channel use detection signal (the low-speed detection term) for the low-speed device is inserted into the head of each piece of the high-speed communication data. The carrier-detection that the transmission path is in use becomes possible for the low-speed device at predetermined intervals from the low-speed detection term so inserted. Then, after completion of transmission of the last low-speed detection term, the high-speed device performs the vacant channel detecting process in the term T_1 so as to confirm that the transmission path is not used and thereafter the low-speed communication data is transmitted. Thereby, it becomes possible to avoid communication collision on the transmission path and to normally perform communication. The low-speed detection term instruction section 78 instructs the timing for inserting this low-speed detection term also in Fig. 9B similarly to Fig. 8B.

[0078] Incidentally, in the time-series graph 133 in Fig. 9A, when it is possible for the low-speed device to receive the term trigger by the low-speed communication so as to confirm that the high-speed communication is performed for a predetermined time, it becomes possible to avoid occurrence of the communication collision on the transmission path. However, in the facility communication system which is long in product life, the low-speed device which has already been installed is not able to recognize "Term Trigger by Low-Speed Communication" which is based on a new specification. Even in such a case, the method of the present embodiment is effective. In addition, although the low-speed detection term is shown as the high-speed communication data in Fig. 8B and Fig. 9B, this signal may be also handled as low-speed communication data.

[0079] Next, a relation between a specific example of the low-speed detection term and propriety of carrier-detection of the high-speed data by the vacant channel detection section 64 of the low-speed device depending on presence/absence thereof will be described by using Fig. 10.

[0080] In Fig. 10, signal waveforms 141, 143 are transmission signals on the facility network 5. The signal waveform 141 shows the one which does not include the low-speed detection term and the signal waveform 143 shows the one which includes it. In addition, signal waveforms 142, 144 are reception signals in the vacant channel detection section 64 of the low speed device. The signal waveform 142 shows the one that the signal waveform 141 was subjected to low-pass filtering and the signal waveform 144 shows the one that the signal waveform 143 was subjected to low-pass filtering.

[0081] Here, as one example of a communication system, a case where the modulation/demodulation section 62 uses a base-band system and the transmission section 72 uses start-stop synchronization communication system will be described. In this case, the vacant channel detection section 64 of the low-speed device performs carrier-detection on the facility network 5 by Start bit detection in start-stop synchronous communication. In the following, description will be made by setting a HIGH level as a non-signal state and a LOW level as Start bit.

[0082] The signal waveform 141 shows the signal waveform of the high-speed communication data that the high-speed device transmits on the facility network 5. Since it is the start-stop synchronous communication of the base-band system, it becomes a rectangular wave that a HIGH signal and a LOW signal are present in the mixed state.

[0083] The signal waveform 142 shows the signal waveform that the signal waveform 141 was received in the vacant

channel detection section 64 of the low-speed device. The vacant channel detection section 64 is generally equipped with a low-pass filter. Since this low-pass filter designs the time constant large in order to receive a signal for the low-speed communication, the waveform of the signal for the high-speed communication which passed through this is distorted. In addition, since the LOW term is short, a case where it is not able to be completely lowered down to the LOW level arises. That is, there are cases where the low-speed device is not able to detect Start bit of the LOW level and to detect that the communication is being performed on the transmission path even when performing the vacant channel detecting process while the high-speed device is receiving the high-speed communication data.

[0084] Accordingly, in the present embodiment, as shown in the waveform 143, the signal waveform when the high-speed device inserted the low-speed detection term between the high-speed communication packets on the basis of the instructions from the low-speed detection term generation instruction section 78 is shown. Here, it is made so as to transmit Start bit for the low-speed communication, that is, the LOW signal continuously the plurality of times on the basis of a clock signal for the high-speed communication as the low-speed detection term. The communication unit 53 which received the instructions from the low-speed detection term generation instruction section 78 performs this.

[0085] The signal waveform 144 shows the signal waveform that the signal waveform 143 was received in the vacant channel detection section 64 of the low-speed device. The LOW signal which is included in the signal waveform 143 and is sufficiently longer than the time constant of the low-pass filter is received and thereby it becomes possible to receive a signal which is completely lowered down to the LOW level in the waveform 144 unlike the signal waveform 142.

[0086] Thereby, it becomes possible for the vacant channel detection section 64 of the low-speed device to detect Start bit in either an edge-triggered format or a level-triggered format and to correctly detect use of the transmission path. Accordingly, even in the case where the low-speed device which is adaptive to only the low-speed communication of the old system and the high-speed device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to avoid such a situation that the low-speed device transmits the low-speed communication data while the high-speed communication data from the high-speed device is being transmitted and it is possible to perform communication with no interference on the transmission path.

[0087] Incidentally, in a case where the low-speed device received the signal waveform 143, the signal flows to the modulation/demodulation section 62, the decoding section 63, the reception section 73, the reception data analysis section 74. However, in a case of the low-speed device, since no synchronization is attained, it is construed as abnormal data by parity check and CRC and is discarded and therefore no particular problem occurs. Also, in a case of the high-speed device, when such data is defined as an abnormal value, it is construed as the abnormal data by parity check and CRC and is discarded.

[0088] In addition, as another method, a method of transmitting Start bit for the low-speed communication by temporarily switching the communication unit 53 to the low-speed communication mode in the low-speed detection term and transmitting the LOW signal one time on the basis of the clock for low-speed communication is conceivable. The communication unit 52 which received the instructions from the low-speed detection term generation instruction section 78 performs this. Thereby, even in the case where the low-speed device which is adaptive to only the low-speed communication of the old system and the high-speed device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to perform the communication with no interference on the transmission path.

[0089] In addition, as a further another method, a method of transmitting 1-character data for the high-speed communication that all bits are 0s (LOW) in the low-speed detection term is conceivable. The transmission data generation section 71 which received the instructions from the low speed detection term generation instruction section 78 performs this. Thereby, even in the case where the low-speed device which is adaptive to only the low-speed communication of the old system and the high-speed device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to perform the communication with no interference on the transmission path. In addition, although that the signal that the communication unit 53 transmits is the NRZ signal is set as a condition, it is possible to cope with it only by software change of the control unit 54 and therefore it can be achieved more easily than the above-described example in which the signal for low-speed detection is inserted by the communication unit 51.

Embodiment 2

[0090] Next, a facility communication system of the embodiment 2 will be described using Fig. 11 to Fig. 14. Although in the facility communication system of the embodiment 1, an example in which start-stop synchronization is used as the communication system is described, an example in which an AMI code is used as the communication system will be described in the present embodiment. Incidentally, duplicated description on points in common between it and the embodiment 1 is omitted.

[0091] As the facility communication system of the embodiment 2, in a case where the modulation/demodulation section 62 is of a communication system using the start-stop synchronous communication of the baseband system and

further using the AMI (Alternate Mark Inversion) code, a case where detection of the high-speed communication data is impossible by the vacant channel detecting process of the low-speed device and a method of inserting the low-speed detection term on the basis of the instructions from the low-speed detection term generation instruction section 78 for the purpose of solving that defect will be described. In this embodiment, description will be made focusing not on the influence of the low-pass filter but on the influence of a code conversion circuit. For simplicity, 1 bit of the high-speed signal is made sufficiently larger than the time constant of the low-pass filter of the reception circuit of the low-speed device and the influence of the waveform distortion described in the embodiment 1 is eliminated in this description.

[0092] Fig. 11 is a detailed configuration circuit of each facility device of the facility communication system pertaining to the present embodiment. The same numerals are assigned to the functions which are the same as those of the facility device shown in Fig. 3 and description thereof is omitted.

[0093] In Fig. 11, the encoding section 61, the decoding section 63 shown in Fig. 3 are specified to an NRZ/RZ conversion section 201, an RZ/NRZ conversion section 202 respectively. In addition, the control unit 54 is equipped with a vacant channel detection section 203 in place of the vacant channel detection section 64 included in the communication unit 53.

[0094] The NRZ/RZ conversion section 201 converts an NRZ system signal received from the transmission section 72 into the RZ system one and notifies the modulation/demodulation section 62 of it. The RZ system has such an advantage that the potential is returned to 0 bit by bit and therefore it is easy to take timing.

[0095] The RZ/NRZ conversion section 202 converts an RZ system signal received from the modulation/demodulation section 62 into the NRZ system one and notifies the reception section 73 and the vacant channel detection section 203 of it.

[0096] The vacant channel detection section 203 monitors the signal (the reception data signal 504) received from the RZ/RZN conversion section 202 and decides the vacant status of the transmission path. Specifically, it performs the Start bit detection of the start-stop synchronous communication.

[0097] Next, signal waveforms at respective measurement points from when the low-speed device transmits the low-speed communication signal to when it is received will be described by using Fig. 12.

[0098] A signal waveform 151 shows the waveform of the NRZ system reception data 501 that the transmission section 72 of the low-speed device outputs.

[0099] A signal waveform 152 shows the waveform of the RZ system transmission encoded signal 502 that the NRZ/RZ conversion section 201 of the low-speed device outputs. The NRZ/RZ conversion section 201 converts the 1-bit LOW signal into a 2-bit LOW-HIGH signal which is halved in time width, construes a 1-bit HIGH signal as a 2-bit HIGH-HIGH signal which is halved in time width and thereby generates the RZ system signal.

[0100] A signal waveform 153 shows the waveform of a demodulated signal that the modulation/demodulation section 62 of the low-speed device transmits on the facility network 5 and which was subjected to AMI code modulation.

[0101] A signal waveform 154 shows the waveform of the reception encoded signal 503 that the modulation/demodulation section 62 of another low-speed device which received the signal waveform 153 from the facility network 5 performed AMI code demodulation on the signal waveform 153. Incidentally, this is the same as the signal waveform 152 in form.

[0102] A signal waveform 155 shows the waveform of the NRZ system that the RZ/NRZ conversion section 202 of another low-speed device which received the signal waveform 153 from the facility network 5 outputs. The RZ/NRZ conversion section 202 extends the LOW signal in the RZ system signal by a fixed time length by a so-called waveform extension circuit and thereby converts it into the NRZ system signal. Incidentally, this is the same as the signal waveform 151 in form. This signal is the reception data 504 in Fig. 11 and is notified to the reception section 73. In addition, the vacant channel detection section 203 decides whether the transmission path is in use by utilizing the same reception data 504. The vacant channel detection section 203 recognizes Start bit of the start-stop synchronous communication by detecting falling from HIGH to LOW and decides that the transmission path is in use. Then, since it is possible to detect falling from HIGH to LOW in the signal waveform 155, it is possible to detect the use of the transmission path.

[0103] On the other hand, Fig. 13 is an explanatory diagram of signal waveforms at respective measurement points until a conventional low-speed device receives a high-speed communication signal that the high-speed device transmitted and is adapted to describe a situation where the low-speed device is not able to detect the use of the transmission path.

[0104] A signal waveform 161 shows the waveform of the NRZ system transmission data 501 that the transmission section 72 of the high-speed device outputs.

[0105] A signal waveform 162 shows the waveform of the RZ system transmission encoded signal 502 that the NRZ/RZ conversion section 201 of the high-speed device outputs. The NRZ/RZ conversion section 201 converts the 1-bit LOW signal into a 2-bit LOW-HIGH signal which is halved in time width, construes a 1-bit HIGH signal as a 2-bit HIGH-HIGH signal which is halved in time width and thereby generates the RZ system signal.

[0106] A signal waveform 163 shows the waveform that the modulation/demodulation section 62 of the high-speed device transmits on the facility network 5 and which was subjected to AMI code modulation.

[0107] A signal waveform 164 shows the waveform of the reception encoded signal 503 that the modulation/demodulation section 62 of the low-speed device which received the signal waveform 163 from the facility network 5 performed

AMI code demodulation on the signal waveform 163. Incidentally, this is the same as the signal waveform 162 in form.

[0108] A signal waveform 165 shows the waveform of the NRZ system that the RZ/NRZ conversion section 202 of the low-speed device which received the signal waveform 163 from the facility network 5 outputs. The RZ/NRZ conversion section 202 extends the LOW signal of the input waveform 164 by the waveform extension circuit by the fixed time length as also described in Fig. 12 and therefore the NRZ system waveform 165 which was converted from the RZ system waveform 164 in which the LOW signal frequently appears is brought into a state of sticking to LOW and the initial waveform 161 is not restored. This signal waveform 165 is notified to the reception section 73 and the vacant channel detection section 203 as the reception data 504.

[0109] Since this reception data 504 is originally the signal for the high-speed communication that the high-speed device transmitted, it is construed as the abnormal data by parity check and CRC by the reception section 73 or the reception data analysis section 74 which is located at the rear stage thereof in the low-speed device in which no synchronization is taken and is discarded and therefore no particular problem occurs. On the other hand, the vacant channel detection section 203 is not able to detect falling from HIGH to LOW and is not able to recognize Start bit of the start-stop synchronous communication, and therefore decides that the transmission path is in a vacant state. That is, there are cases where the low-speed device is not able to detect Start bit even when the vacant channel detecting process is performed and is not able to detect that the communication is being performed on the transmission path while the high-speed device is transmitting the high-speed communication data. Then, when the low-speed device which misunderstood that the transmission path is vacant starts data transmission, the carrier collision shown in Fig. 8A and Fig. 9A occurs on the transmission path.

[0110] Fig. 14 is adapted to describe a technique of the present embodiment for eliminating the defect described in Fig. 13 and is an explanatory diagram of signal waveforms at respective measurement points until the low-speed receives it in a case where the high-speed device inserted the low-speed detection term between the packets for the high-speed communication on the basis of the instructions from the low-speed detection term generation instruction section 78.

[0111] A signal waveform 171 shows the waveform of the transmission data 501 of the NRZ system that the transmission section 72 of the high-speed device outputs. Here, the high-speed device inserts the low-speed detection term signal between the packets for the high-speed communication on the basis of the instructions from the low-speed detection term generation instruction section 78. In this example, it is made so as to transmit 1-character data for the high-speed communication that all the bits become 1s (HIGH) as the low-speed detection term. The transmission data generation section 71 which received the instructions from the low-speed detection term generation instruction section 78 performs this.

[0112] A signal waveform 172 shows the waveform of the transmission encoded signal 502 of the RZ system that the NRZ/RZ conversion section 201 of the high-speed device outputs. The NRZ/RZ conversion section 201 converts the 1-bit LOW signal into a 2-bit LOW-HIGH signal which is halved in time width, construes the 1-bit HIGH signal as a 2-bit HIGH-HIGH signal which is halved in time width and thereby generates the signal of the RZ system.

[0113] A signal waveform 173 shows the waveform that the modulation/demodulation section 62 of the high-speed device transmits on the facility network 5 and which was subjected to AMI code modulation.

[0114] A signal waveform 174 shows the waveform of the reception encoded signal 503 that the modulation/demodulation section 62 of the low-speed device which received the signal waveform 173 from the facility network 5 performed AMI code demodulation on the signal waveform 173. Incidentally, this is the same as the signal waveform 172 in form.

[0115] A signal waveform 175 shows the waveform of the NRZ system that the RZ/NRZ conversion section 202 of the low-speed device which received the signal waveform 173 from the facility network 5 outputs. The RZ/NRZ conversion section 202 extends the LOW signal of the input waveform 174 by the fixed time length by the waveform extension circuit as also described in Figs. 12, 13. However, since a low-speed detection term (a HIGH signal term) which is sufficiently longer than an extended time by the waveform extension circuit is provided in the signal waveform 171 that the high-speed device transmits, the signal waveform 175 which was restored by the low-speed device is able to return to HIGH unlike the signal waveform 165 in Fig. 13. This signal waveform 175 is notified to the reception section 73 and the vacant channel detection section 203 as the reception data 504.

[0116] Since this reception data 504 is originally the signal for the high-speed communication that the high-speed device transmitted, it is construed as the abnormal data by parity check and CRC in the reception section 73 or the reception data analysis section 74 which is located at the rear stage thereof in the low-speed device in which no synchronization is taken and is discarded and therefore no particular problem occurs. In addition, since the next character causes falling from HIGH to LOW to occur, the vacant channel detection section 203 is able to recognize Start bit of the start-stop synchronous communication and decides that the transmission path is in use.

[0117] Thereby, it is possible to detect Start bit by the vacant channel detection section 203 of the low-speed device and it is possible to correctly detect use of the transmission path. Accordingly, even in the case where the low-speed communication device which is adaptive to only the low-speed communication of the old system and the high-speed communication device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to avoid such a situation that the low-speed communication device transmits the low-

speed communication data while the high-speed communication data from the high-speed communication device is being transmitted and it is possible to perform communication on the transmission path with no interference.

[0118] Incidentally, in a case where the high-speed device received the signal waveform 173, the signal flows to the modulation/demodulation section 62, the RZ/NRZ conversion section 202, the reception section 73, the reception data analysis section 74. However, when data which continuously becomes HIGH is defined as the abnormal value, it is construed as the abnormal data by parity check and CRC and is discarded.

[0119] In addition, as another method, a method that the communication unit 53 which received the instructions from the low-speed detection term generation instruction section 78 inserts the low-speed detection term (the HIGH signal term) which is sufficiently longer than the extended time by the waveform extension circuit is conceivable.

[0120] Thereby, even in the case where the communication device which is adaptive to only the low-speed communication of the old system and the communication device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to perform the communication on the transmission path with no interference. Moreover, since it is possible to insert the low-speed detection term which is longer than 1-character data for the high-speed communication, it is also possible to cope with higher speed communication.

Embodiment 3

[0121] Next, a facility communication system of the embodiment 3 will be described using Fig. 15 to Fig. 17. Although in the facility communication systems in the above embodiments, the examples in which start-stop synchronization and the AMI code are used as the communication system were described, an example in which FSK modulation is used as the communication system will be described in the present embodiment. Incidentally, duplicated description on the points in common between it and the above-described embodiments is omitted.

[0122] As the facility communication system of the embodiment 3, in a case where the modulation/demodulation section 62 is of the FSK (Frequency Shift Keying) modulation system, a case where detection of the high-speed communication data is impossible by the vacant channel detecting process of the low-speed device and a method of inserting the low-speed detection term on the basis of the instructions from the low-speed detection term generation instruction section 78 for the purpose of solving the defect will be described.

[0123] Fig. 15 is a detailed configuration circuit of the high-speed device of the facility communication system pertaining to the present embodiment. Fig. 16 is a detailed configuration diagram of the low-speed device. The same numerals are assigned to the functions which are the same as those of the facility device shown in Fig. 3 and description thereof is omitted.

[0124] The high-speed device shown in Fig. 15 is equipped with a high-frequency low pass filter (LPS) 901 on the transmission side of the communication unit and is equipped with a high-frequency low pass filter 902 on the reception side of the communication unit. In addition, it is equipped with a low-speed FSK modulation section 211, a high-speed FSK modulation section 212, a low-speed FSK demodulation section 213, a high-speed FSK demodulation section 214 in place of the modulation/demodulation section 62 shown in Fig. 3. That is, it is a configuration of the LPF through which the low-speed FSK signal is able to pass for both of the high-speed communication and the low-speed communication. On the other hand, the low-speed device shown in Fig. 16 is equipped with a low-frequency band pass filter (BPF) 903 on the transmission side of the communication unit and is equipped with a low-frequency band pass filter 904 on the reception side of the communication unit. In addition, it is equipped with the low-speed FSK modulation section 211, the low-speed FSK demodulation section 213 in place of the modulation/demodulation section 62 shown in Fig. 3. Incidentally, in both of FIG. 15, Fig. 16, although a configuration that the encoding section 61 and the decoding section 63 are not included is shown, a configuration which includes them may be also made.

[0125] For example, the transmission section 72 in Fig. 15 transmits transmission data 501 to the low-speed FSK modulation section 211 at 2.4 kbps in the low-speed communication and transmits the transmission data 501 to the high-speed FSK modulation section 212 at 80 kbps in the high-speed communication. The low-speed FSK modulation section 211 transmits the transmission data 501 to the facility network 5 by FSK-modulating a mark "1" to a 2.4 kHz sine wave, and a space "0" to a 3.6 kHz sine wave and making it pass through the high-frequency low pass filter 901. On the other hand, the high-speed FSK modulation section 212 transmits the transmission data 501 to the facility network 5 by FSK-modulating the mark "1" to a 80-kHz sine wave and the space "0" to a 120-kHz sine wave and making it pass through the high frequency low-pass filter 901. Such a modulation system is also called MSK (Minimum Shift Keying).

[0126] On the other hand, the low-speed FSK demodulation section 213 FSK-demodulates a signal received from the facility network 5 at a carrier frequency for the low-speed communication and notifies the reception section 73 of reception data 504. The high-speed FSK demodulation section 214 FSK-demodulates the signal received from the facility network 5 at a carrier frequency for the high-speed communication and notifies the reception section 73 of the reception data 504.

[0127] Which one is used, the low-speed FSK modulation section 211 or the high-speed FSK modulation section 212, the low-speed FSK demodulation section 213 or the high-speed FSK demodulation section 214 is changed over by a switch on the basis of the communication speed switch section 77 and the instructions from the low-speed detection

term generation instruction section 78.

[0128] Then, an operation of the vacant channel detection section 64 of the present embodiment will be described using Fig. 17.

[0129] A frequency graph 181 shows a positional relation between frequency spectra of a low-speed signal and a high-speed signal in the present embodiment. In the present embodiment, the spectrum is distributed centering on $fc1 = 2.4$ kHz in the low-speed communication and the spectrum is distributed centering on $fc2 = 80$ kHz in the high-speed communication.

[0130] The vacant channel detection section 64 of the low-speed device decides the vacant status of the transmission path by detecting signal energy of the carrier frequency $fc1$ using a frequency detection circuit and so forth. The vacant channel detection section 64 of the high-speed device decides the vacant status of the transmission path by detecting the signal energies of the carrier frequency $fc1$ and the carrier frequency $fc2$ also using the frequency detection circuit and so forth.

[0131] A frequency graph 182 shows the frequency spectrum when the high-speed signal was received by the vacant channel detection section 64 of the high-speed device. The vacant channel detection section 64 of the high-speed device receives it by removing a high frequency component of the carrier frequency $fc2$ other than the high-speed signal by the high-frequency low pass filter 902. In this case, since the high-speed device receives a signal of the carrier frequency $fc2$, the vacant channel detection section 64 decides that the transmission path is in use.

[0132] A frequency graph 183 shows the frequency spectrum when the low-speed signal was received by the vacant channel detection section 64 of the high-speed device. The vacant channel detection section 64 of the high-speed device receives it by removing the high frequency component of the carrier frequency $fc2$ other than the high-speed signal by the high-frequency low pass filter 902. In this case, since the high-speed device receives a signal of the carrier frequency $fc1$, the vacant channel detection section 64 decides that the transmission path is in use.

[0133] A frequency graph 184 shows the frequency spectrum when the low-speed signal was received by the vacant channel detection section 64 of the low-speed device. The vacant channel detection section 64 of the low-speed device receives it by removing the high frequency component and a low frequency component of the carrier frequency $fc1$ other than the low-speed signal by the low-frequency band pass filter 904. In this case, since the low-speed device receives the signal of the carrier frequency $fc1$, the vacant channel detection section 64 decides that the transmission path is in use.

[0134] A frequency graph 185 shows the frequency spectrum when the high-speed signal was received by the vacant channel detection section 64 of the low-speed device. The vacant channel detection section 64 of the low-speed device receives it by removing the high frequency component and the low frequency component of the carrier frequency $fc1$ other than the low-speed signal by the low-frequency band pass filter 904. In this case, since the low-speed device is not able to detect the signal energy of the carrier frequency $fc1$, the vacant channel detection section 64 decides that the transmission path is in the vacant state. That is, a case where the low-speed device is not able to detect the signal energy of the carrier frequency $fc1$ even when it performs the vacant channel detecting process while the high-speed device is transmitting data for the high-speed communication and therefore is not able to detect that the communication is being performed on the transmission path arises. Then, a case where the low-speed device transmits the low-speed signal while the high-speed communication is being performed on the transmission path arises. In this case, the high-speed device which originally wishes to receive only the high-speed FSK signal receives interference of the low-speed FSK signal that the low-speed device erroneously transmitted as shown in the frequency graph 183.

[0135] Therefore, in the present embodiment, as described in Fig. 5A, Fig. 5B, the interference between the two is avoided by making the switch between the low-speed communication and the high-speed communication in time-division. The high-speed device inserts the low-speed detection term into the high-speed communication on the basis of the instructions from the low-speed detection term generation instruction section 78 in order to surely perform time-divisional switching. Specifically, the FSK signal of the carrier frequency $fc1$ is transmitted in the low-speed detection term. A signal which is longer than the shortest-time resolution whose detection is possible by the vacant channel detection section 64 of the low-speed device is transmitted. The communication unit 53 which received the instructions from the low-speed detection term generation instruction section 78 performs this.

[0136] Thereby, it is possible to detect the signal energy of the carrier frequency $fc1$ by the vacant channel detection process by the low-speed device and it is possible to correctly detect that the transmission path is in use. Accordingly, even in the case where the communication device which is adaptive to only the low-speed communication of the old system and the communication device which is adaptive to the high-speed communication of the new system are present on the same transmission path, it is possible to perform the communication on the transmission path with no interference.

[0137] Incidentally, in a case where the low-speed device received such a signal, the signal flows to the low-speed FSK demodulation section 213, the reception section 73, the reception data analysis section 74. However, when the data to be loaded on the carrier wave is made null and it is defined as the abnormal value, it is construed as the abnormal data by parity check and CRC and is discarded.

[0138] In a case where the high-speed device received it, since demodulation thereof is impossible by the high-speed FSK demodulation section 214 and it is discarded as the abnormal data, no particular problem occurs.

(Flowchart of Processing of Low-Speed Detection Term Generation Instruction Section 78)

[0139] Transmission/reception processing of the facility device in the embodiments 1 to 3 will be described using Fig. 18 to Fig. 24.

[0140] Fig. 18 is a flowchart showing the transmission/reception processing of the low-speed device. In the following, a packet which is transmitted by the low-speed communication will be referred to as a "low-speed packet" and a packet which is transmitted by the high-speed communication will be referred to as a "high-speed packet".

[0141] First, in S101, the low-speed device waits for reception of the low-speed packet, in S102, the low-speed device decides whether the low-speed packet is received. In S102, if Yes, it proceeds to S103, if No, it proceeds to Sill.

[0142] In S103, the low-speed device receives the low-speed packet, in S104, the low-speed device decides whether the received packet is normal. In S104, if Yes, it proceeds to S105, if No, it returns to S101.

[0143] In a case where the packet was normal, in S105, the low-speed device decides whether the received packet is addressed to itself. When its own address or a multicast address to which it belongs is present in the destination address column 86 of the received packet, the received packet is addressed to itself. In S105, if Yes, it proceeds to S106, if No, it returns to S101.

[0144] In S106, the low-speed device performs a process based on the received packet and thereafter decides whether a response to the received packet is needed. In S106, if Yes, it proceeds to S107, if No, it returns to S101.

[0145] In S107, the low-speed device prepares ack data for responding to the packet and in S113 it performs a process of transmitting the prepared ack data.

[0146] On the other hand, when there is no low-speed reception in S102, in Sill, the low-speed device decides where there exists a packet to be transmitted from itself. In Sill, if Yes, it proceeds to S112, if No, it returns to S101.

[0147] In S112, the low-speed device performs a process of preparing a packet (a transmission packet) which will be transmitted hereafter (FIG. 19 for the details).

[0148] In S113, the low-speed device performs a packet transmitting process on the ack data prepared in S107 or the packet prepared in S112 Z after a wait time of the term T3 (Fig. 20 for the details).

[0149] Fig. 19 is a flowchart showing the details of the transmission packet preparing process S112 and so forth in the high-speed communication and the low-speed communication. Here, description will be made by setting an operation subject as the facility equipment of the packet source.

[0150] First, in S201, the facility equipment decides whether a header of the transmission packet is to be prepared. In S201, if Yes, it proceeds to S202, if No, it proceeds to S208. Incidentally, the ack and so forth shown in Fig. 6 and so forth are data with no header and therefore it proceeds to S208 when preparing them.

[0151] In S202, the facility equipment decides whether the destination of the transmission packet is one unit (a plurality of units). In S202, if Yes, it proceeds to S203, if No, it proceeds to S204. In S203, the facility equipment describes an address for one unit which will become the destination in the header column 81 of the transmission packet as unicast. On the other hand, in S204, the facility equipment describes an address showing the plurality of destinations in the header column 81 of the transmission packet as multicast.

[0152] Thereafter, in S205, the facility equipment decides whether the response to the transmission packet is needed. In S205, if Yes, it proceeds to S206, if No, it proceeds to S207. In S206, the facility equipment describes Response Needed in the communication type column 87 of the transmission packet. On the other hand, in S207, the facility equipment does not describe Response Needed in the communication type column 87 of the transmission packet. Incidentally, other necessary type values which are listed in Fig. 4 may be described in the communication type column 87.

[0153] Thereafter, in S208, the facility equipment decides whether data on the transmission packet is to be prepared. In a case where only the header column 81 is transmitted antecedently, this branching results in No. In S208, if Yes, it proceeds to S209, if No, it proceeds to S210. In S209, the facility equipment prepares the data column 82 of the transmission packet and the data length column 88 thereof.

[0154] Finally, in S210, data partitioning is performed in the high-speed communication and this step is omitted in the low-speed communication.

[0155] Fig. 24 is a diagram for explaining a data partitioning method to be executed in S210. 301 shows an example of a data structure, a data string 311 indicates the data column 82 which is an original data division prepared in S209. A data string 312 indicates a state where the data string 311 (the data column 82) is partitioned. When a maximum transmission speed of the low-speed communication is already known, it is possible to calculate a maximum data length which is transmittable in the term T4. Therefore, the data is partitioned to be less than the maximum data length. Incidentally, here, an example in which the data column 82 is partitioned into four parts of a partition 1 to a partition 4 is shown.

[0156] In addition, a data string 313 indicates transmission packets P1 to P4 that respective pieces of partitioned data are packetized. The header column 81, the parity column 83 in each packet are the same as those shown in Fig. 4. Here, an example in which a partitioning flag column 321 is further added to be used as a new extension header for a partitioned packet together with the header column 81 is shown.

[0157] A table 303 shown in Table 4 shows a description example of the partitioning flag column 321. For example, a case where partitioning is not performed and a case of a packet including partitioned final data "0 x 00" is described. In addition, a case of a packet including data which is partitioned data and in which succeeding data is present "0 x 01" is described.

[Table 4]

[0158]

Table 4

No.	Partitioning Flag	Definition
1	0 x 00	Final Packet Without Partitioning or With Partitioning
2	0 x 01	With Partitioning and With Succeeding Packets

[0159] Fig. 20 which will be described the next is a flowchart showing details of packet transmission processing in the high-speed communication and the low-speed communication.

[0160] First, in S221, the facility equipment waits for the term (any one of T1, T2, T3) which is designated from the caller of the flowchart in Fig. 20 and when no carrier is detected in the term, it decides that the facility network 5 is vacant and communication is possible.

[0161] In S222, a process of inserting the low-speed detection term is performed in the high-speed communication. The specific example of this process is as already described in Fig. 10 and so forth, and predetermined data is transmitted and a predetermined non-signal term is set. Incidentally, the present step is omitted in the low-speed communication.

[0162] In S223, the facility equipment transmits the transmission packet (data) to the facility column 5. Here, whether the high-speed communication or the low-speed communication is performed is as designated from the caller of the flowchart in Fig. 20.

[0163] In S224, the facility equipment decides whether the data in S223 could be normally transmitted. In S224, if Yes, it proceeds to S225, if No, it returns to S225. Incidentally, in a case where normal transmission is impossible even when repeating re-transmission of the data a plurality of times, it terminates retransmission by regarding it as an abnormal state.

[0164] As S225, when not-transmitted data such as remaining packets and so forth when partitioned are present, it returns to S221, when they are not present, it terminates.

[0165] Fig. 21 which will be described the next is a flowchart showing reception processing of the high-speed device.

[0166] First, in S301, the high-speed device waits for reception of a low-speed packet, in S302, the high-speed device decides whether the low-speed packet was received. In S302, if Yes, it proceeds to S303, if No, it proceeds to a terminal B1 (S401 in Fig. 22).

[0167] In S303, the high-speed device receives the low-speed packet. This low-speed packet is, for example, a high-speed trigger for preparation for the high-speed communication.

[0168] In S304, the high-speed device decides whether the received packet is normal. In S304, if Yes, it proceeds to S305, if No, it returns to S301. In a case where the packet was normal, in S305, the high-speed device decides whether the high-speed trigger is designated in the received packet. In S305, if Yes, it proceeds to S306, if No, it proceeds to a terminal A (S105 in Fig. 18). Incidentally, when returning from the terminal A to S101 after execution of the processing, it returns not to S101 but to S301.

[0169] In S306, the high-speed device decides whether a high-speed communication term is designated in the received high-speed trigger. In S306, if Yes, it proceeds to S307, if No, it proceeds to S311. In S307, the high-speed device starts a high-speed communication counter which measures the high-speed communication term (or high-speed transmission/reception frequency). This counter always performs monitoring separately from the present processing of the flowchart in Fig. 21 and so forth and the counter is updated to make the high-speed communication possible in a designated range.

[0170] Next, in S311, the high-speed device receives the high-speed packet, in S312, the high-speed device decides whether the received high-speed packet is normal. In S312, if Yes, it proceeds to S313, if No, it proceeds to S320. In a case where the packet was normal, in S313, the high-speed device decides whether the received high-speed packet is addressed to itself. In S313, if Yes, it proceeds to S314, if No, it proceeds to S320.

[0171] In S314, the high-speed device performs a process which is based on the received packet and thereafter decides whether the response to the received packet is needed. In S314, if Yes, it proceeds to S315, if No, it proceeds to S320.

[0172] In S315, the high-speed device prepares the ack data for response to the packet, in S316, the high-speed

device waits for passage of a predetermined wait time (the term T1 if the low-speed communication is being performed, the term T2 if the high-speed communication is being performed) and transmits the response packet of "Response Needed".

[0173] Thereafter, in S320, the high-speed device decides whether the high-speed communication counter in S307 is currently in a valid term (or valid frequency). In S320, if Yes, it proceeds to S321, if No, it returns to S310. In S321, the high-speed device waits for reception of the high-speed packet which follows the antecedently received high-speed packet, in S322, the high-speed device decides whether the high-speed packet is received. In S322, if Yes, it proceeds to S323, if No, it proceeds to a terminal B2 (S421 in Fig. 23).

[0174] In S323, when the high-speed device receives the high-speed packet, in S324, the high-speed device decides whether the received packet is normal. In S324, if Yes, it returns to a terminal C (S306), if No, it returns to S320. It is possible to receive all the high-speed packets and to restore necessary data by repeating these processes while the high-speed term counter is valid.

[0175] Fig. 22 which will be described the next is a flowchart showing transmission processing for the initial time when continuously performing the transmission processing of the high-speed device a plurality of times.

[0176] First, in S401, the high-speed device decides whether a packet to be transmitted from itself is present. In S401, if Yes, it proceeds to S402, if No, it proceeds to a terminal D (S301 in Fig. 21).

[0177] In S402, the high-speed device decides whether the high-speed communication is to be performed. In S402, if Yes, it proceeds to S403, if No, it proceeds to a terminal F (S112 in Fig. 18). Incidentally, in the flow in Fig. 18, it returns to S301 in place of returning to S101. In a case where the high-speed communication is performed, in S403, the high-speed device sets the high-speed trigger in the communication type column 87 of the transmission packet.

[0178] In S404, the high-speed device decides whether designation of the high-speed communication is to be made. In S404, if Yes, it proceeds to S405, if No, it proceeds to S406. In S405, the high-speed device sets the high-speed communication term (or the high-speed communication frequency) in the data length column 88 of the transmission packet. In addition, in S406, the high-speed device prepares the transmission packet which includes the data column 82 of the high-speed trigger (Fig. 19 for details).

[0179] In the next S407, the high-speed device waits for the wait time T3 and thereafter transmits the packet prepared in S406 by the low-speed communication (Fig. 20 for details). In S411, the high-speed device starts the high-speed communication counter similarly to S307. Incidentally, in a case where the high-speed communication term is not designated, this step is omitted. In the last S412, the high-speed device transmits the packet by the high-speed communication (Fig. 20 for details). Then, it proceeds to a terminal E (S320 in Fig. 21) after S412.

[0180] Fig. 23 which will be described the next is a flowchart showing second and subsequent transmission processing of the high-speed device.

[0181] First, in S421, the high-speed device decides whether packets to be transmitted from itself in the second and subsequent times are present. In S421, if Yes, it proceeds to S422, if No, it proceeds to the terminal E (the S320 in Fig. 21).

[0182] In S422, the high-speed device decides whether the high-speed communication is to be performed. In S422, if Yes, it proceeds to S424, if No, it proceeds to S423. In a case where the high-speed communication is not performed, in S423, the high-speed device waits for termination of the high-speed communication counter and then proceeds to the terminal F (S112 in Fig. 18). Incidentally, it returns to S301 in place of returning to S101 in the flow in Fig. 18. On the other hand, in a case where the high-speed communication is performed, in S424, the high-speed device decides whether the current high-speed communication term is to be reviewed. In S424, if Yes, it proceeds to S425, if No, it proceeds to S426.

[0183] In a case where the high-speed communication term is reviewed, in S425, the high-speed device re-designates the high-speed communication term in the data length column 88 of the transmission packet. Thereby, the high-speed communication term is extended.

[0184] Thereafter, in S426, the high-speed device prepares the transmission packet which includes the communication data (Fig. 19 for details). Then, in S427, the high-speed device waits for the wait time T2 and then transmits the packet by the high-speed communication (Fig. 20 for details). Finally, in S431, the high-speed device starts the reset high-speed communication counter similarly to S411 and proceeds to the terminal E (S320 in Fig. 21).

[0185] In the facility communication system of the present embodiment which has been described above, even on the facility network 5 in which the low-speed devices and the high-speed devices are present in the mixed state, the high-speed device inserts the low-speed communication detection term and thereby it becomes possible for the low-speed device to detect that the high-speed communication is being performed and it becomes possible to properly use the low-speed communication and the high-speed communication on the same facility network 5. Therefore, it is possible to increase the availability of the system.

[0186] Incidentally, the present invention is not limited to the afore-mentioned embodiments and various modified examples are included. For example, the afore-mentioned embodiments are described in detail for the purpose of intelligibly describing the present invention and are not necessarily limited to the ones equipped with all the configurations so described.

[0187] In addition, it is possible to replace part of one configuration of one embodiment with one configuration of another embodiment and it is also possible to add one configuration of another embodiment to one configuration of one embodiment.

[0188] In addition, it is possible to add/delete/replace another configuration to/from/with part of one configuration of each embodiment. In addition, the above-described respective configurations, functions, processing units, processing means and so forth may be implemented in hardware by designing some or all of them, for example, by an integrated circuit.

[0189] In addition, the afore-mentioned respective configurations, functions and so forth may be implemented in software by construing and executing a program for implementing the respective functions by a processor.

[0190] It is possible to put information in programs, tables, files and so forth for implementing the respective functions into recording devices such as a memory, a hard disk, an SSD (Solid State Drive) and so forth or recording media such as an IC (Integrated Circuit) card, an SD card, a DVD (Digital Versatile Disc) and so forth.

[0191] In addition, control lines and information lines which are thought to be necessary for description are shown and all the control lines and information lines in a product are not necessarily shown. It may be considered that almost all the configurations are really connected with one another.

[0192] Further, communication means which connects between/among the respective devices may be changed to a wireless LAN, a wired LAN, and other communication means.

Claims

1. A communication control device **characterized by** comprising:

a communication unit (53) which makes communication possible by switching a first communication system or a second communication system of a time-division multiple-access system; and
a first communication detection term generation instruction unit which instructs to generate a detection term for use of a channel of the first communication system when communication is performed by the second communication system, wherein
the communication unit (53) transmits a signal which includes the channel use detection term onto a transmission path on the basis of instructions to generate the channel use detection term from the first communication detection term generation instruction unit.

2. The communication control device according to claim 1, wherein
the first communication detection term generation instruction unit issues instructions to generate the channel use detection term immediately before communication by the second communication system.

3. The communication control device according to claim 1, wherein
the first communication detection term generation instruction unit issues instructions to generate the channel use detection term at an interval which is shorter than a vacant channel detection execution term of the first communication system.

4. The communication control device according to claims 1 to 3, wherein
the communication unit (53) includes a first communication signal detection circuit which detects a signal of the first communication system, and
the channel use detection term is longer than a time resolution of the first communication signal detection circuit.

5. The communication control device according to claim 4, wherein
the first communication system is start-stop synchronous communication, and
the channel use detection term is a transmission term of a signal which includes a Start bit for the start-stop synchronous communication.

6. The communication control device according to claim 5, wherein
the first communication system is communication using AMI modulation/demodulation.

7. The communication control device according to claim 6, wherein
the communication unit (53) includes a waveform extension circuit which performs RZ/NRZ conversion, and
the channel use detection term includes a non-signal term which is longer than a time constant of the waveform extension circuit.

8. The communication control device according to claim 6, wherein the communication unit (53) includes a waveform extension circuit which performs RZ/NRZ conversion, and the channel use detection term is a transmission term of a signal which includes a detection-use bit string which is longer than a time constant of the waveform extension circuit.

9. The communication control device according to claims 1 to 4, wherein the first communication system is communication using FSK modulation/demodulation, and the channel use detection term is a transmission term of a signal which includes a frequency component of a carrier wave which is subjected to the FSK modulation/demodulation.

10. A communication control device **characterized by** comprising:

a communication unit (53) which makes communication possible by switching a first communication system or a second communication system of a time-division multiple-access system; and
a control unit (54) which transmits transmission data before encoded to the communication unit (53) and receives reception data after decoded from the communication unit (53), wherein
the control unit (54) transmits the transmission data which includes a signal for detection of use of a channel of the first communication system to the communication unit (53) when the communication unit (53) performs communication by the second communication system.

11. A communication control device **characterized by** comprising:

a communication unit (53) which makes communication possible by switching a first communication system or a second communication system of a time-division multiple-access system; and
a control unit (54) which transmits transmission data before encoded to the communication unit (53) and receives reception data after decoded from the communication unit (53), wherein
when communication is performed by the second communication system, the transmission data including a signal for detection of use of a channel of the first communication system is transmitted onto a transmission path.

12. An equipment communication system which is configured by including:

a first communication control device which makes communication possible by a first communication system of a time-division multiple-access system; and
a second communication control device which makes communication possible by switching the first communication system or a second communication system of the time-division multiple-access system, **characterized in that** when performing communication by the second communication system, the second communication control device transmits a signal which includes a detection term for use of a channel of the first communication system onto a transmission path.

13. The equipment communication system according to claim 12, wherein the first communication control device includes a first communication signal detection circuit which detects a signal of the first communication system, and the channel use detection term that the second communication control device transmits is longer than a time resolution of the first communication signal detection circuit.

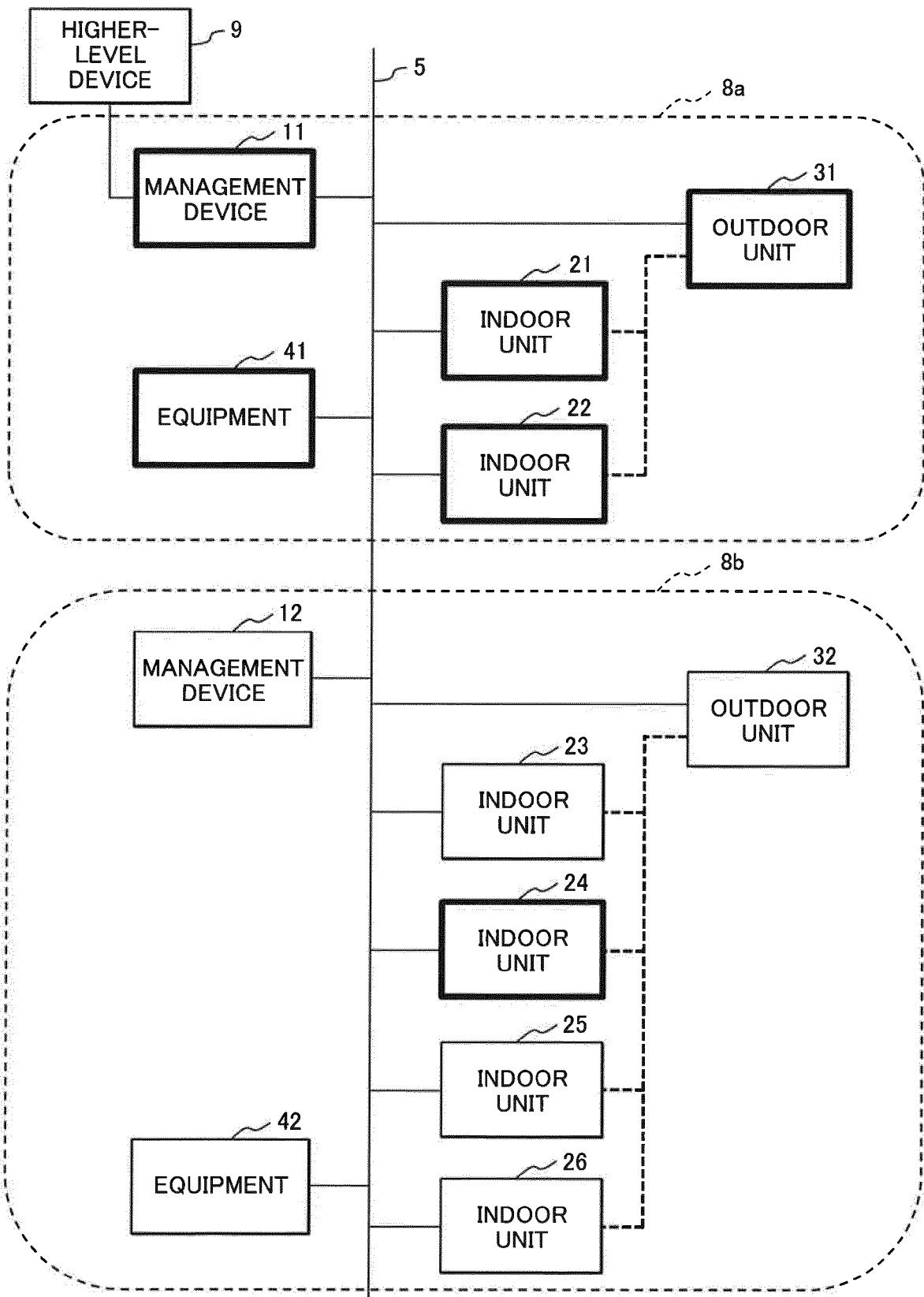
FIG. 1

FIG. 2
 101

No	FACILITY DEVICE	DEVICE TYPE	ADDRESS	ADAPTABILITY TO HIGH SPEED	GROUP
1	MANAGEMENT DEVICE 11	MANEGEMENT DEVICE	0x0000	○	1
2	MANAGEMENT DEVICE 12	MANEGEMENT DEVICE	0x0001	×	2
3	INDOOR UNIT 21	INDOOR UNIT	0x0102	○	1
4	INDOOR UNIT 22	INDOOR UNIT	0x0103	○	1
5	INDOOR UNIT 23	INDOOR UNIT	0x0104	×	2
6	INDOOR UNIT 24	INDOOR UNIT	0x0105	○	2
7	INDOOR UNIT 25	INDOOR UNIT	0x0106	×	2
8	INDOOR UNIT 26	INDOOR UNIT	0x0107	×	2
9	OUTDOOR UNIT 31	OUTDOOR UNIT	0x0002	○	1
10	OUTDOOR UNIT 32	OUTDOOR UNIT	0x0003	×	2
11	EQUIPMENT 41	EQUIPMENT	0x1001	○	—
12	EQUIPMENT 42	EQUIPMENT	0x1001	×	—

FIG. 3

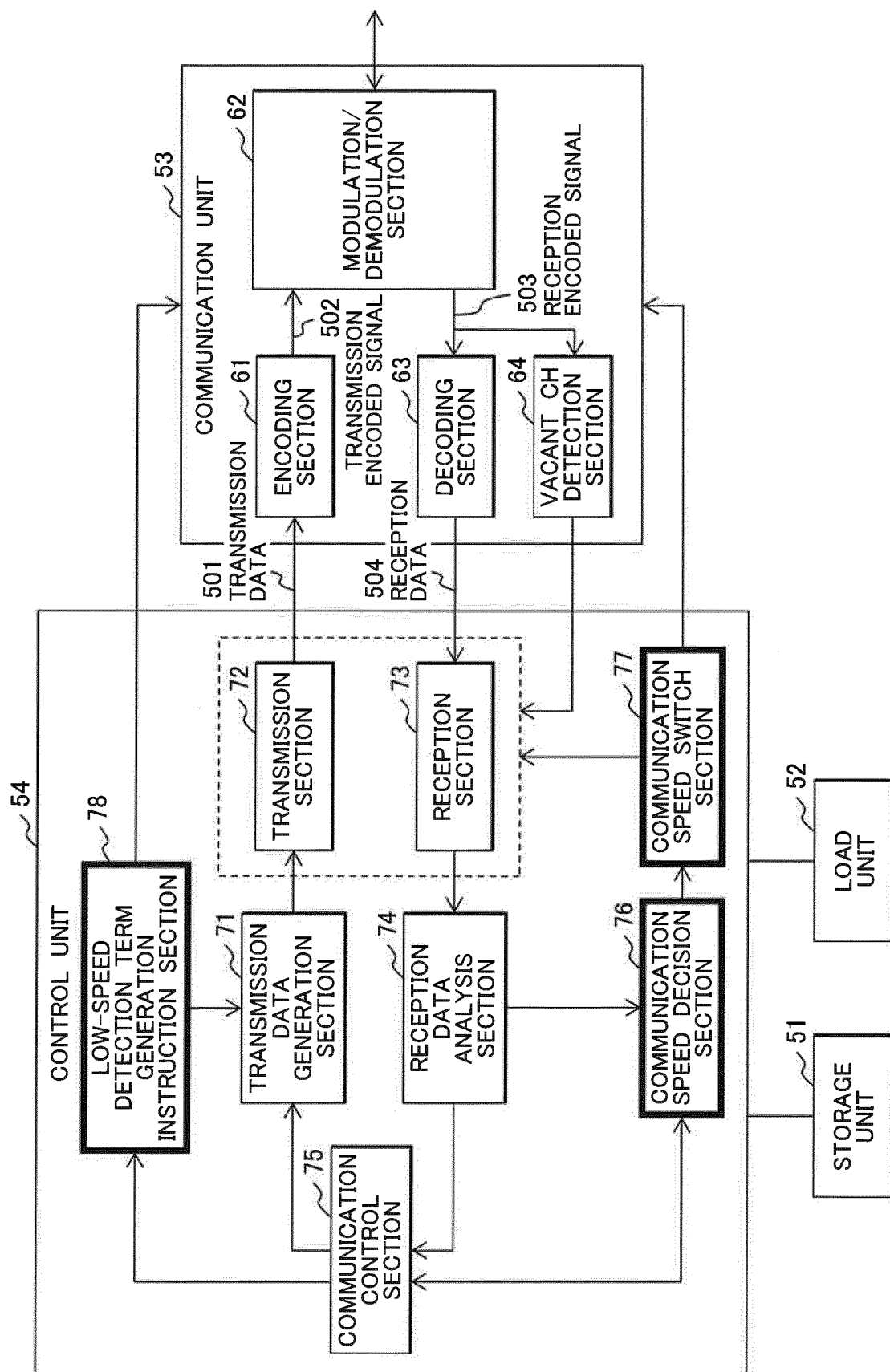


FIG. 4

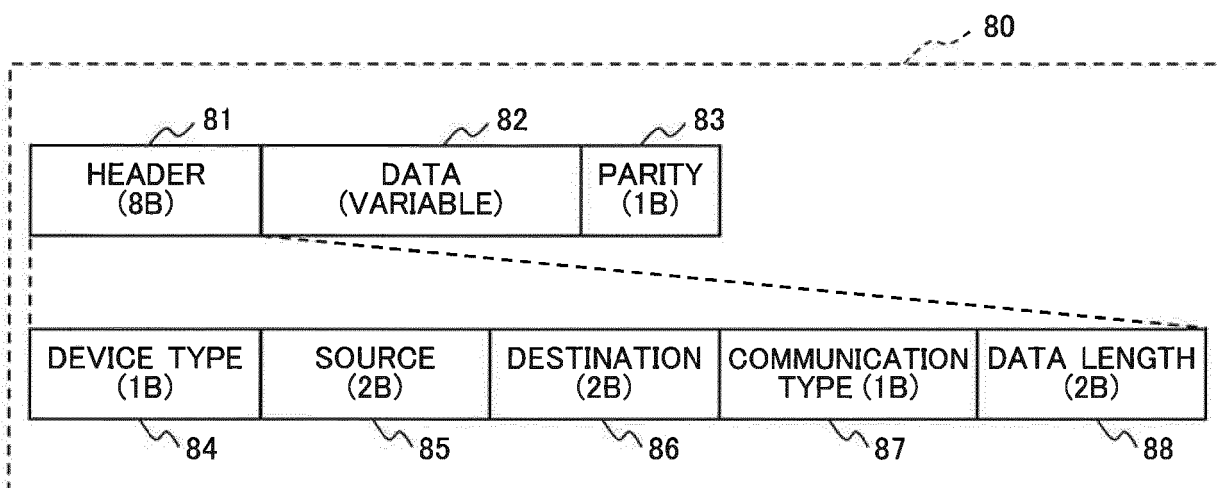


FIG. 5A

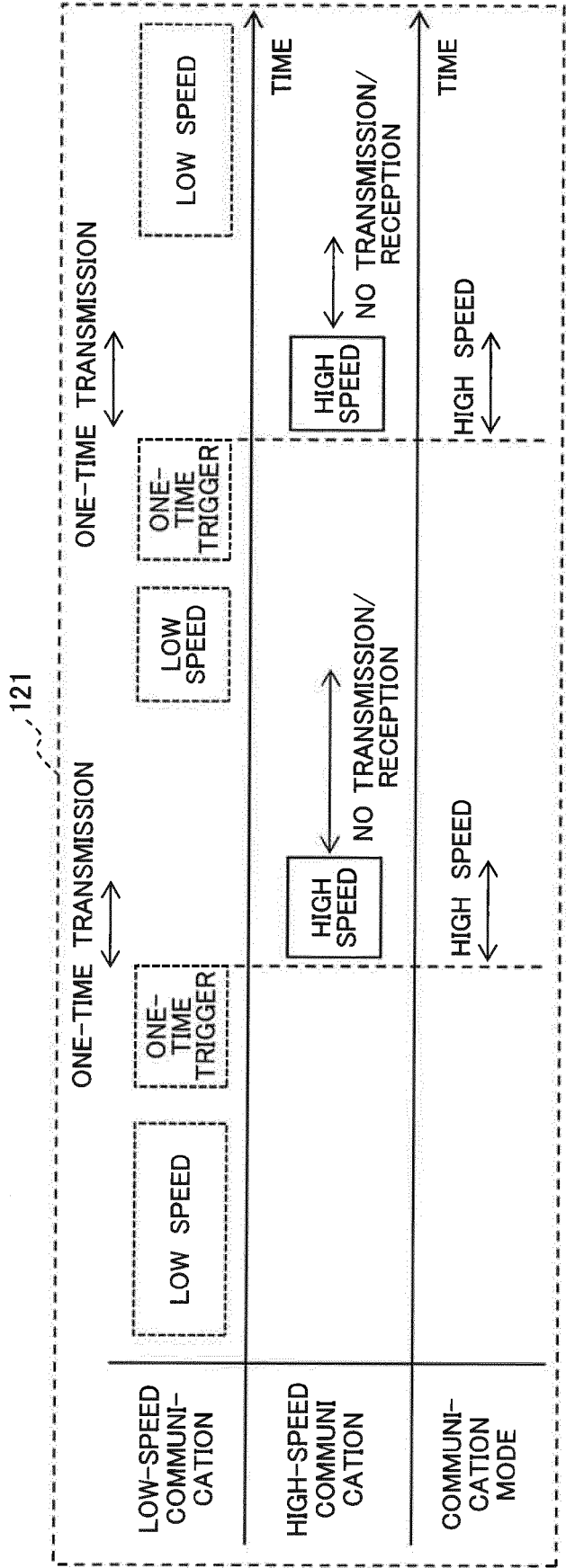


FIG. 5B

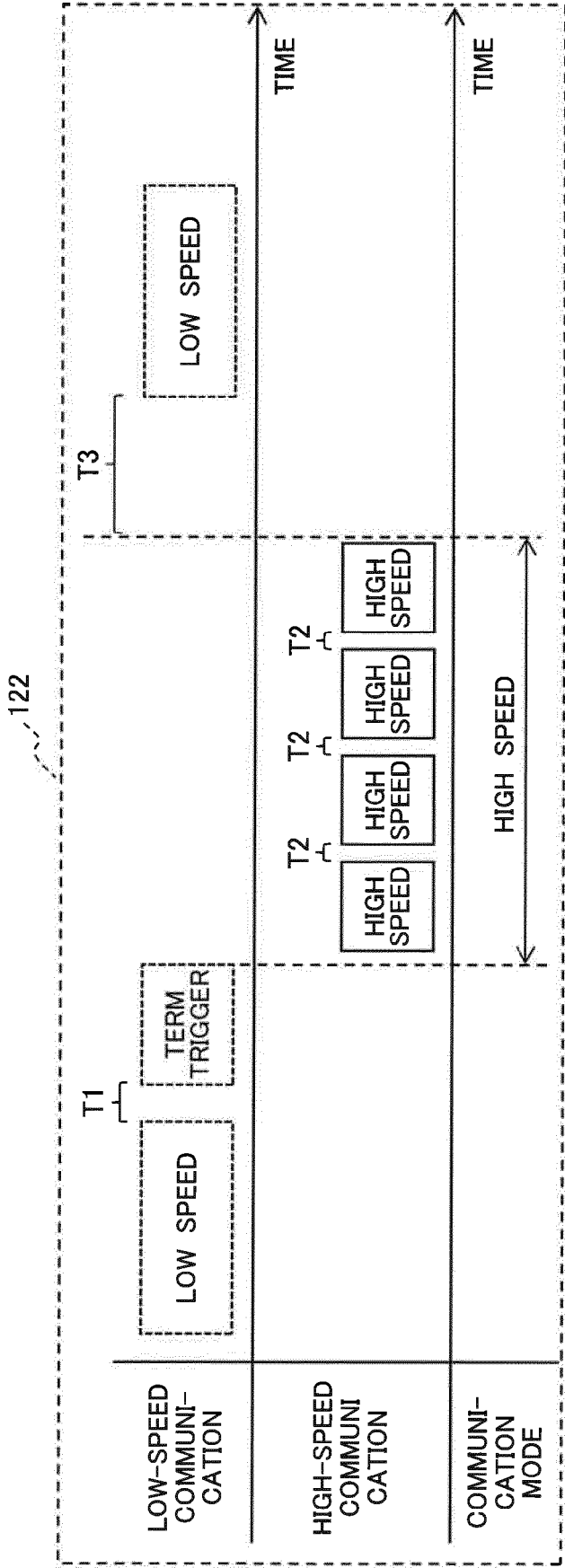


FIG. 6

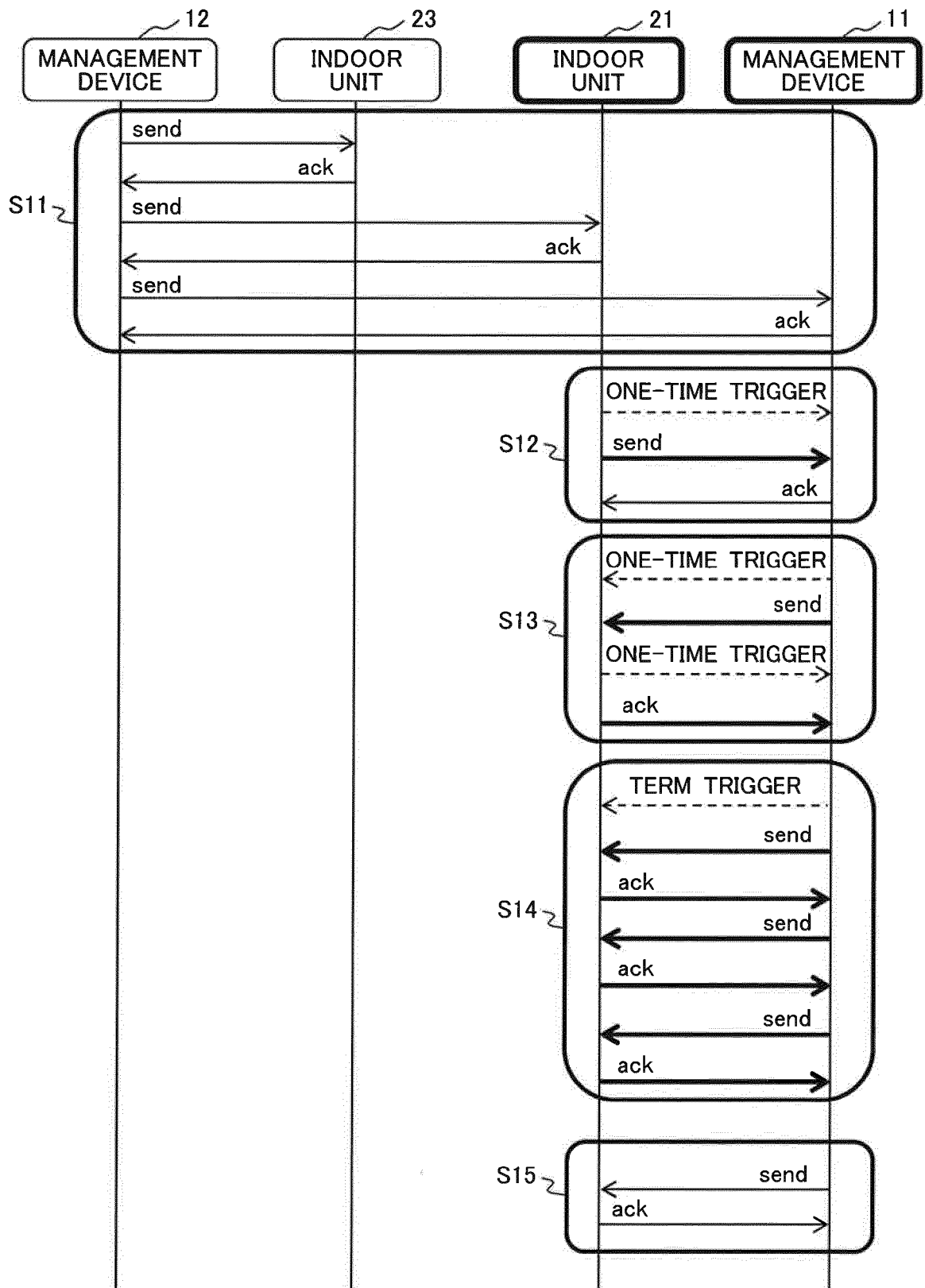


FIG. 7

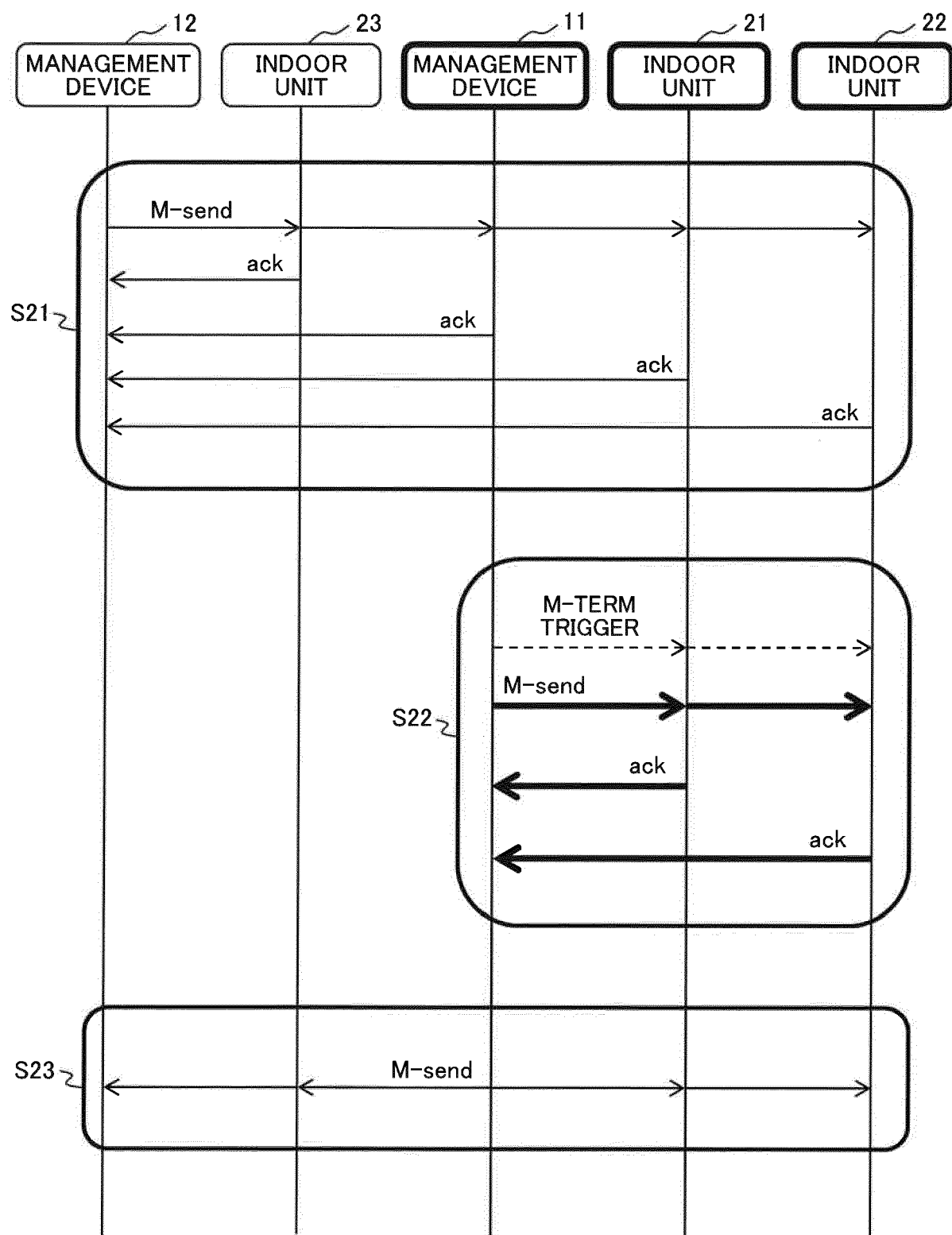


FIG. 8A

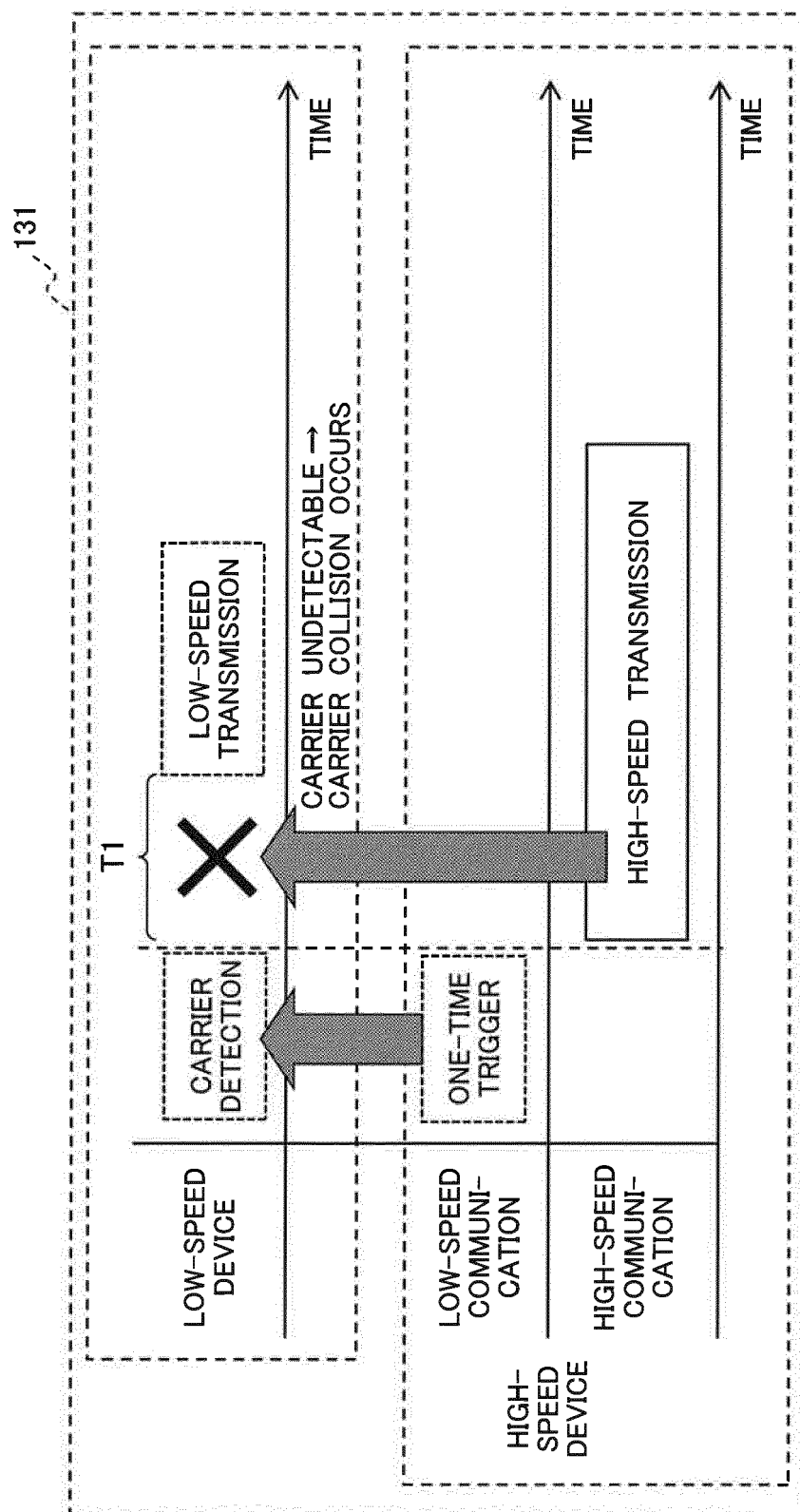


FIG. 8B

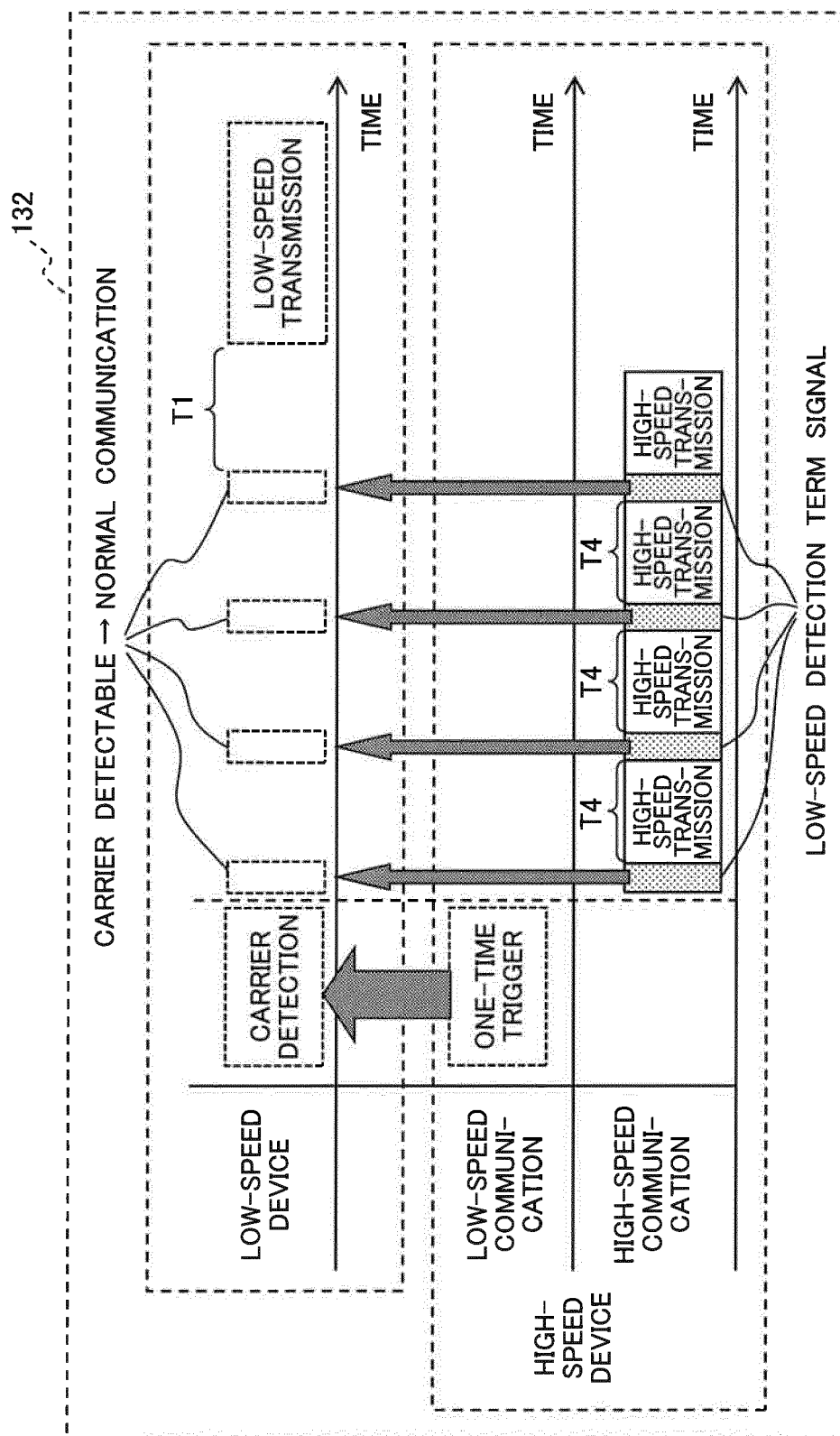


FIG. 9A

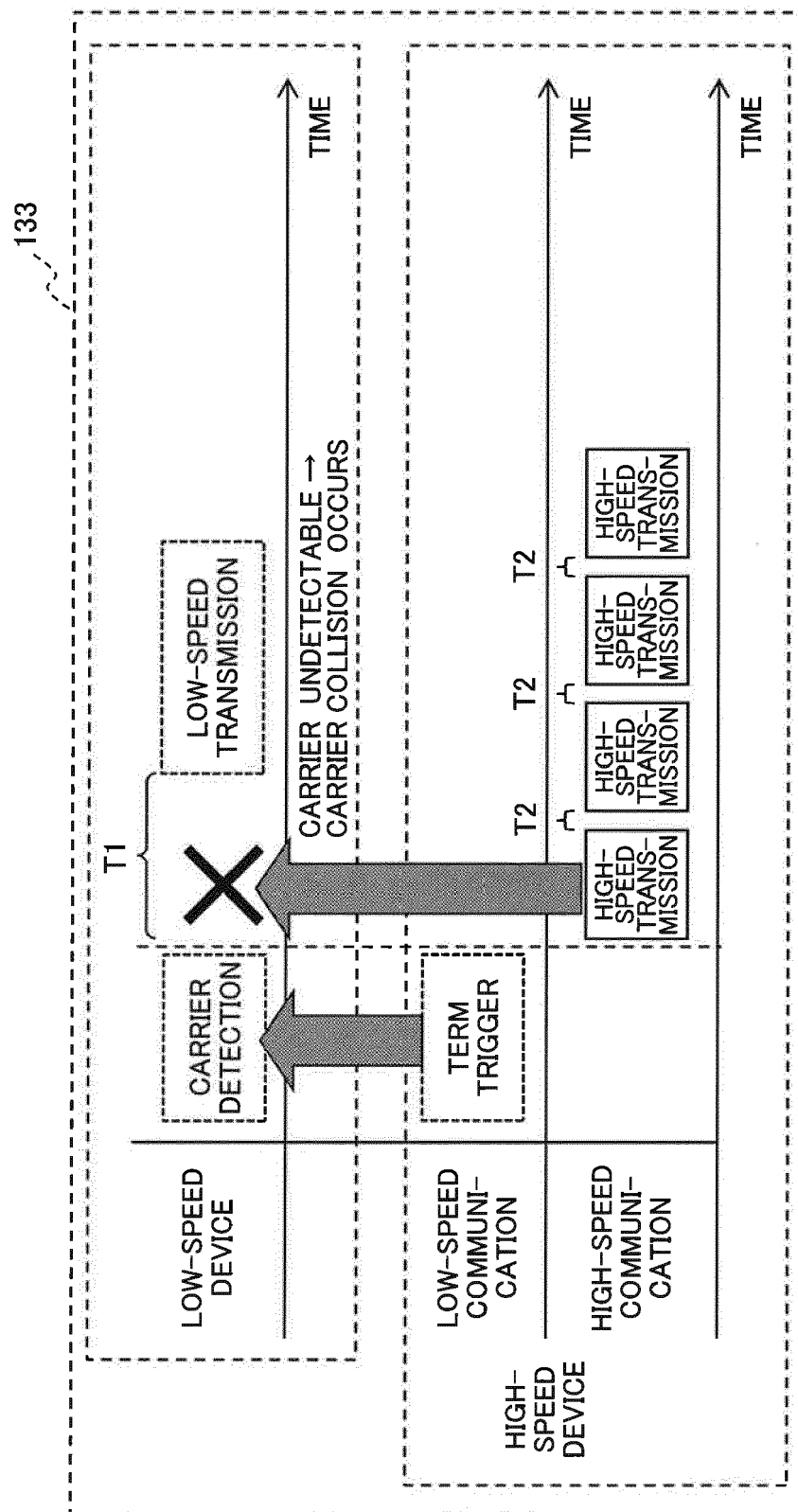


FIG. 9B

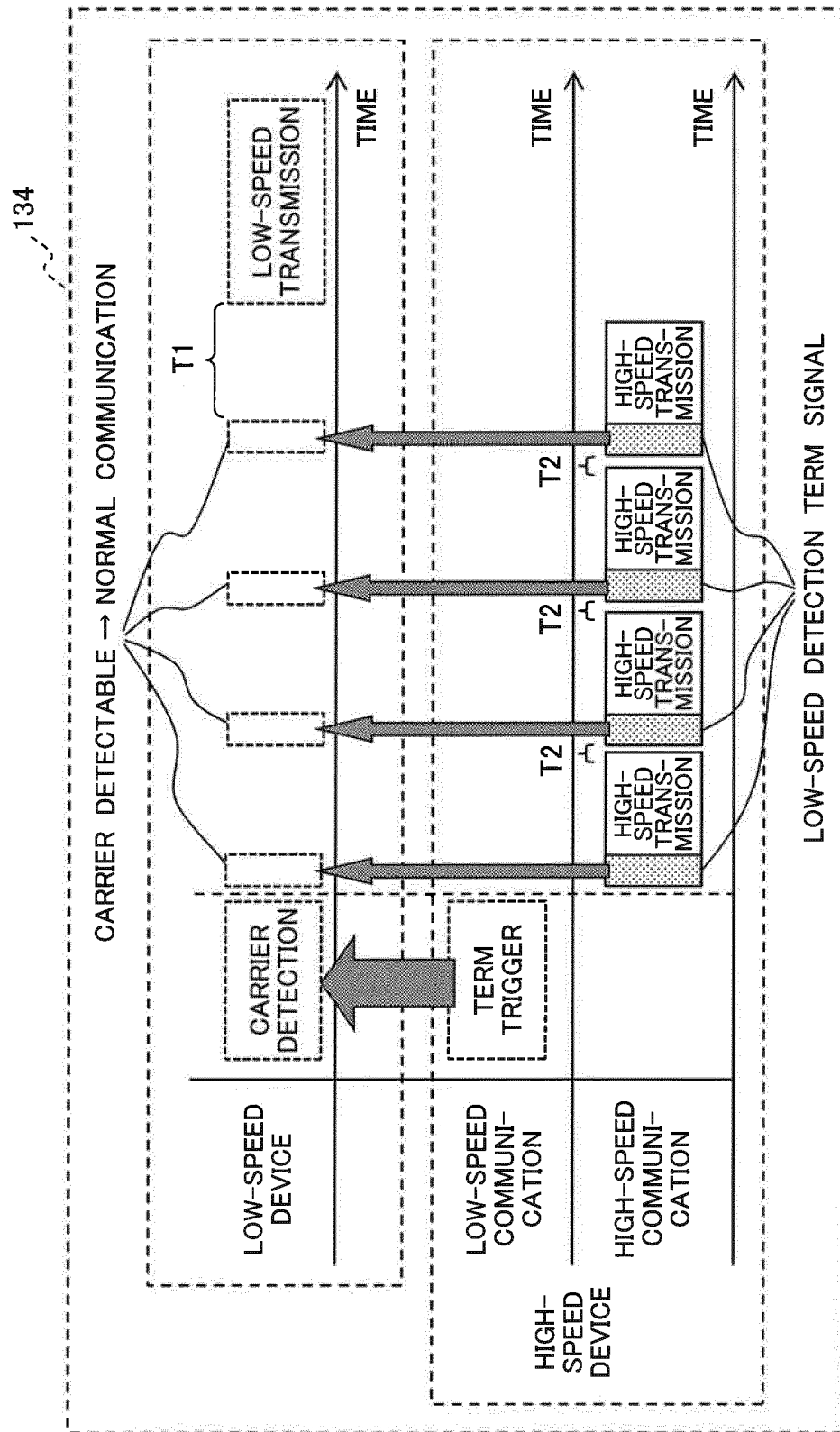


FIG. 10

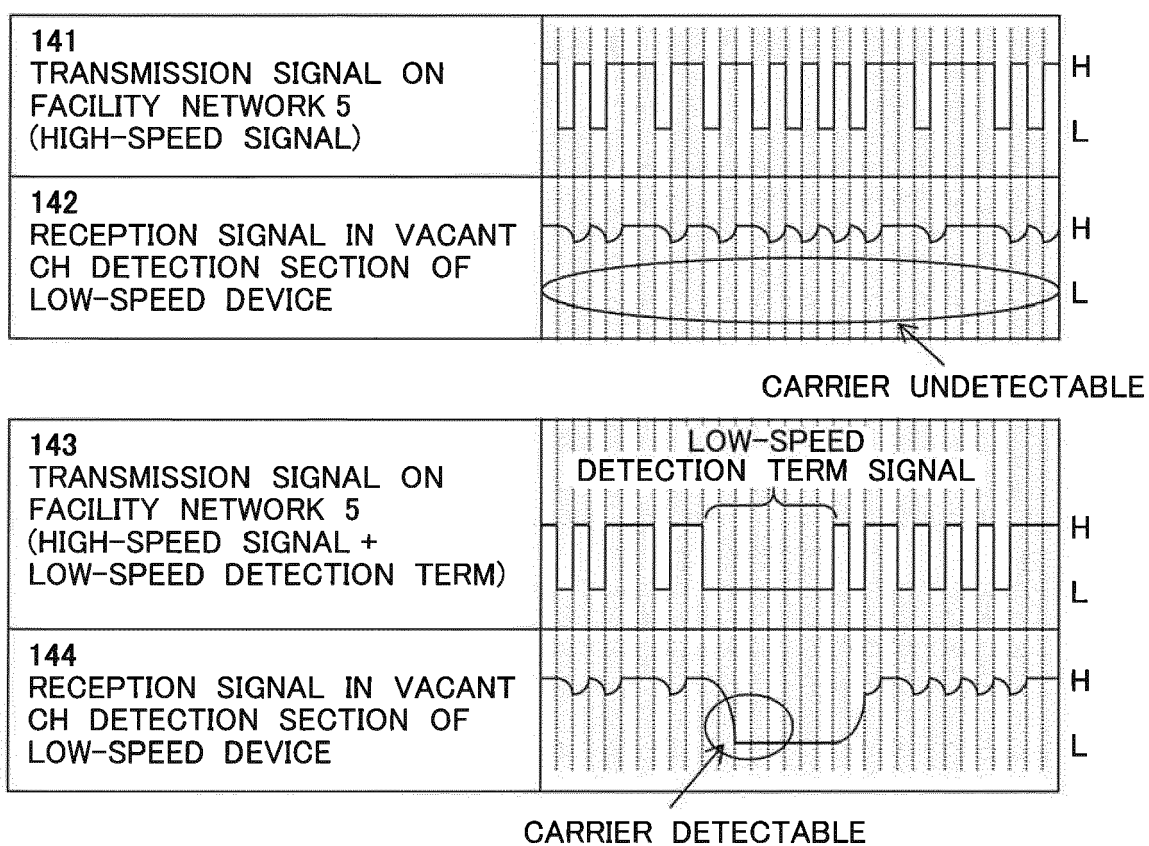


FIG. 11

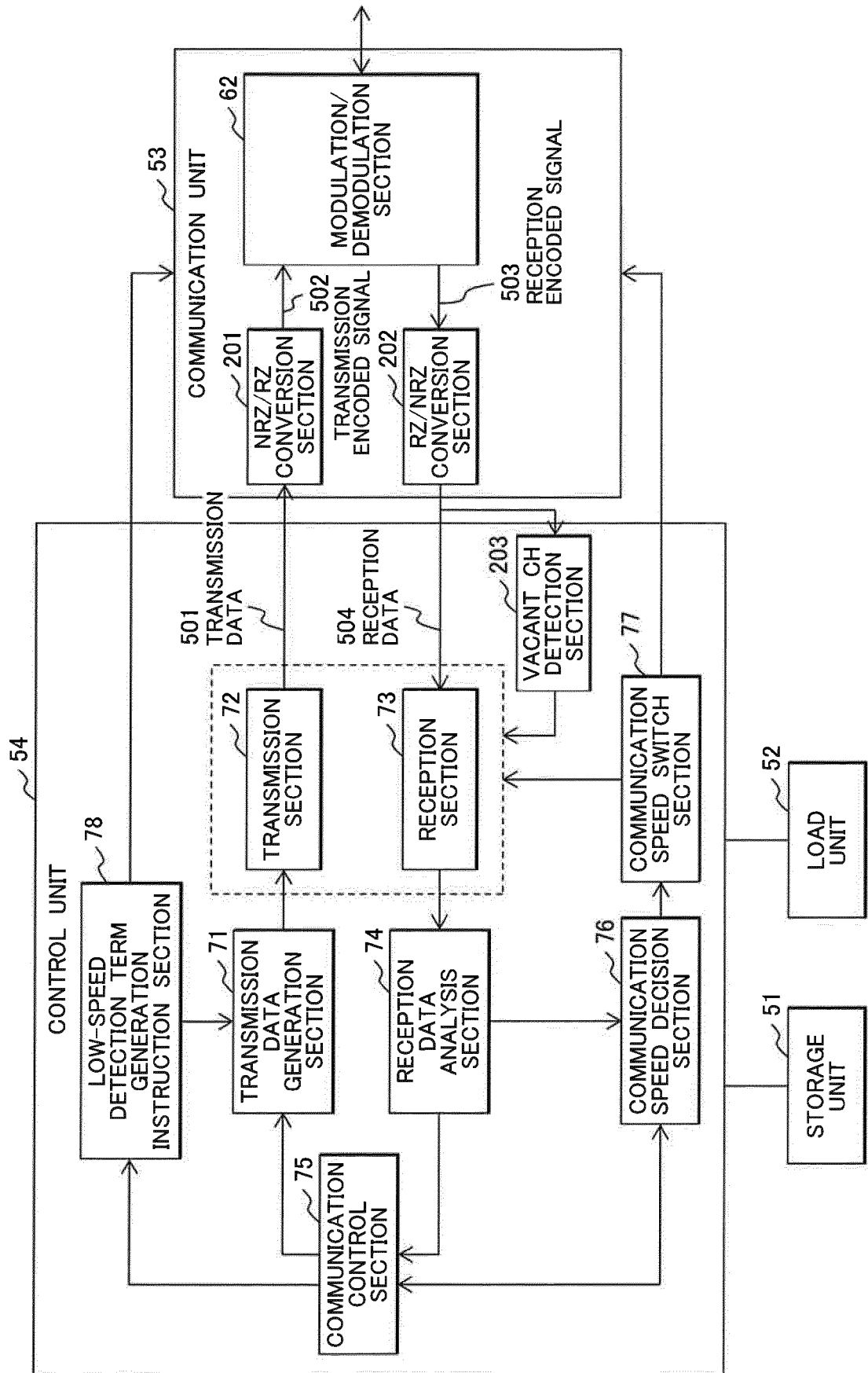


FIG. 12

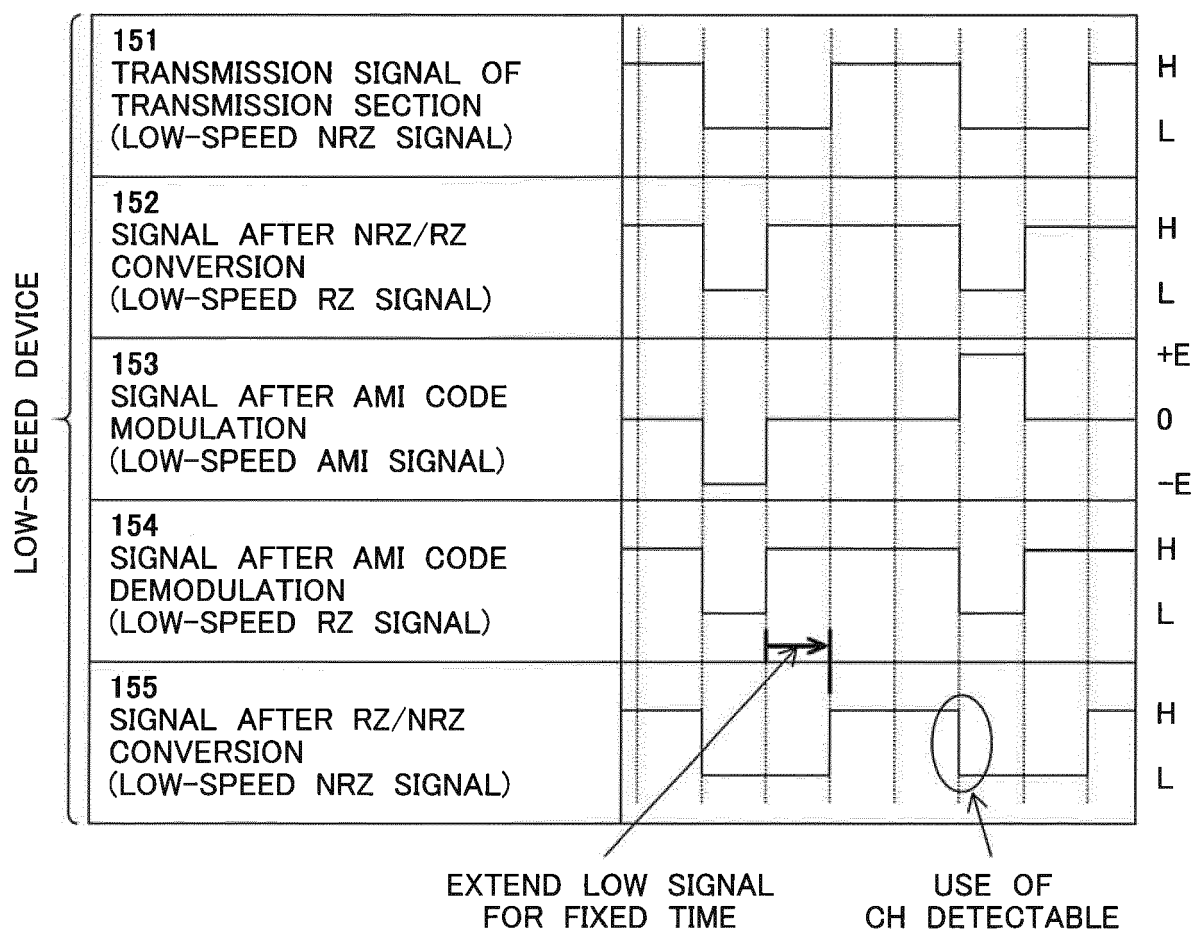


FIG. 13

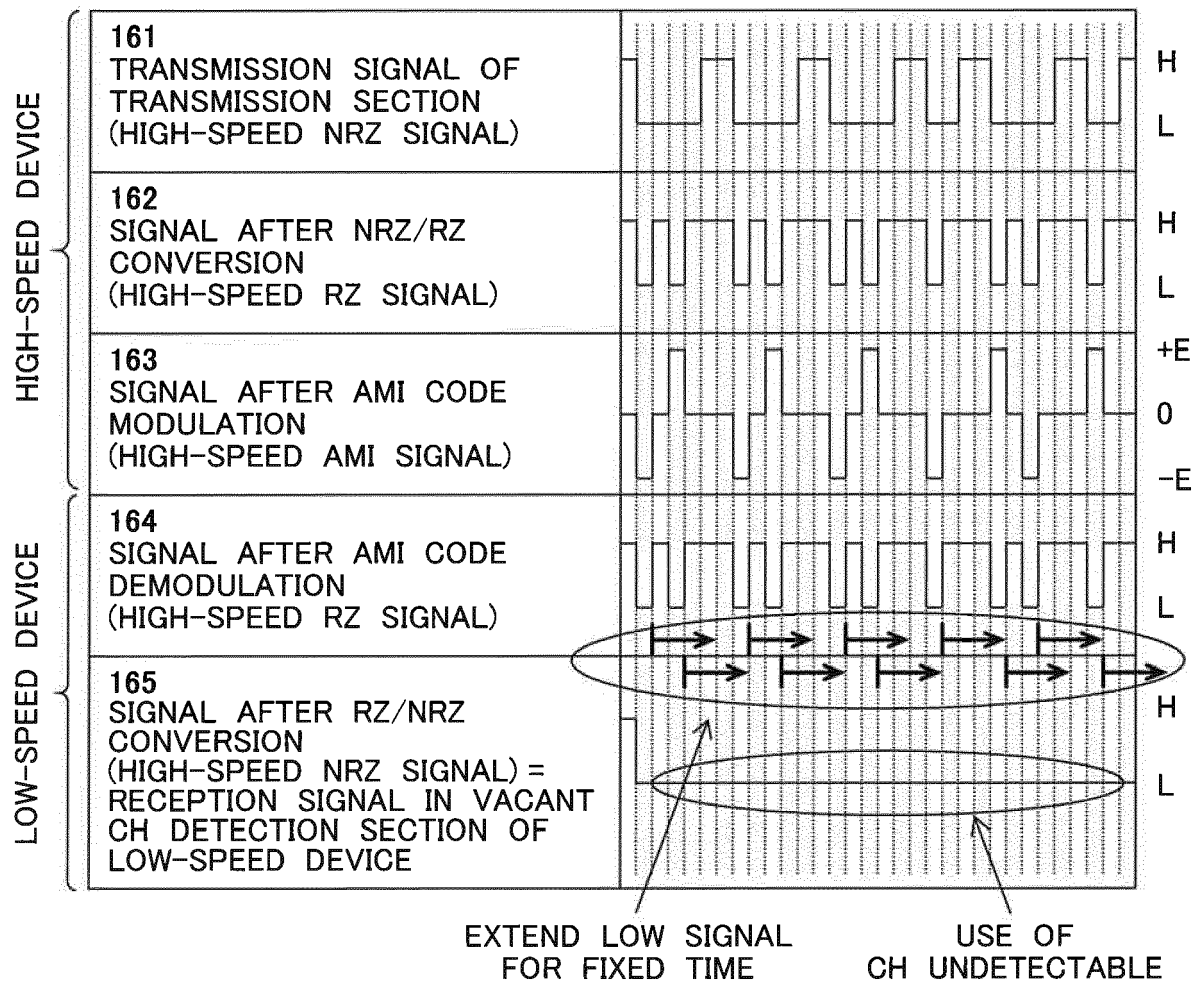


FIG. 14

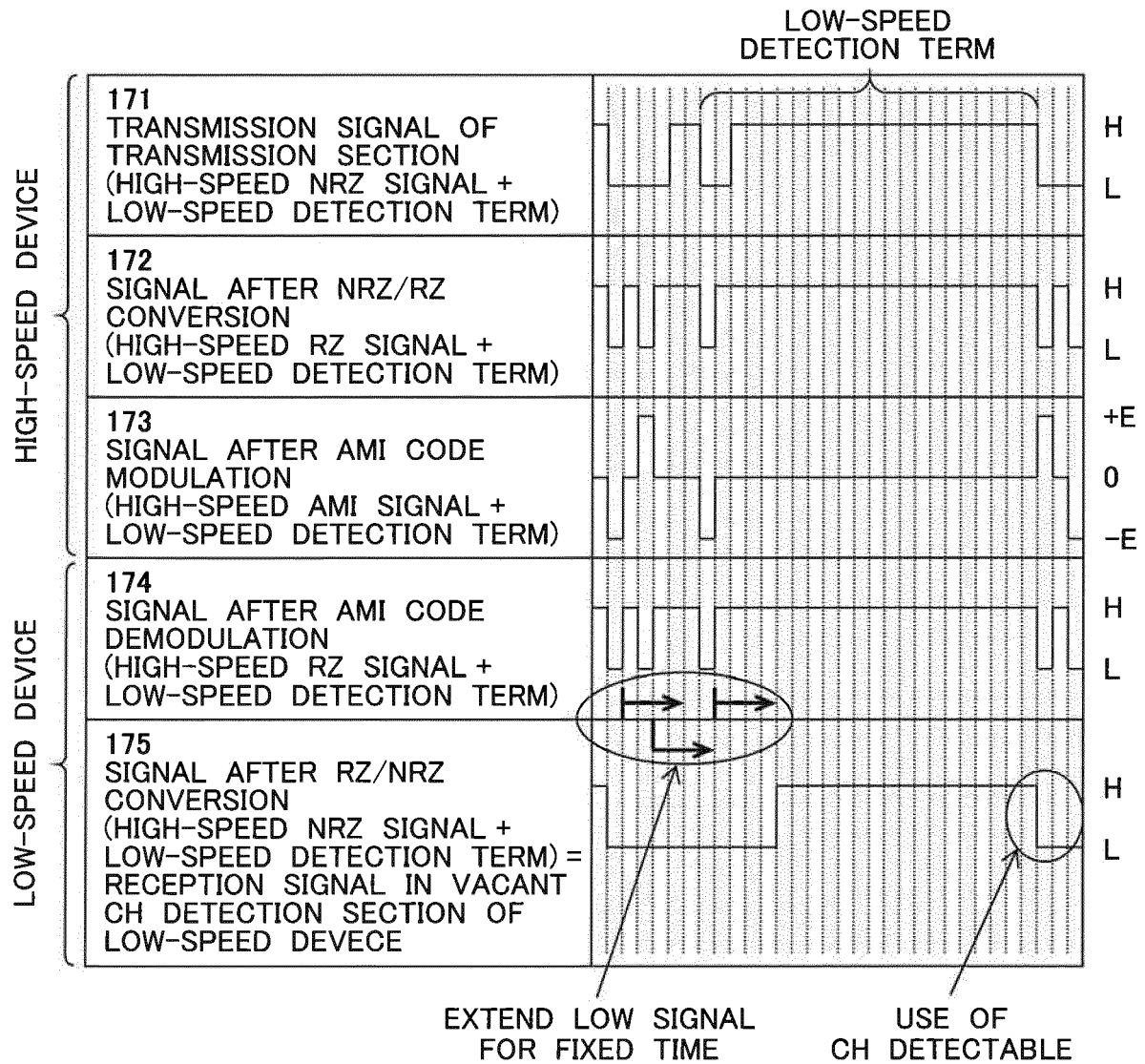


FIG. 15

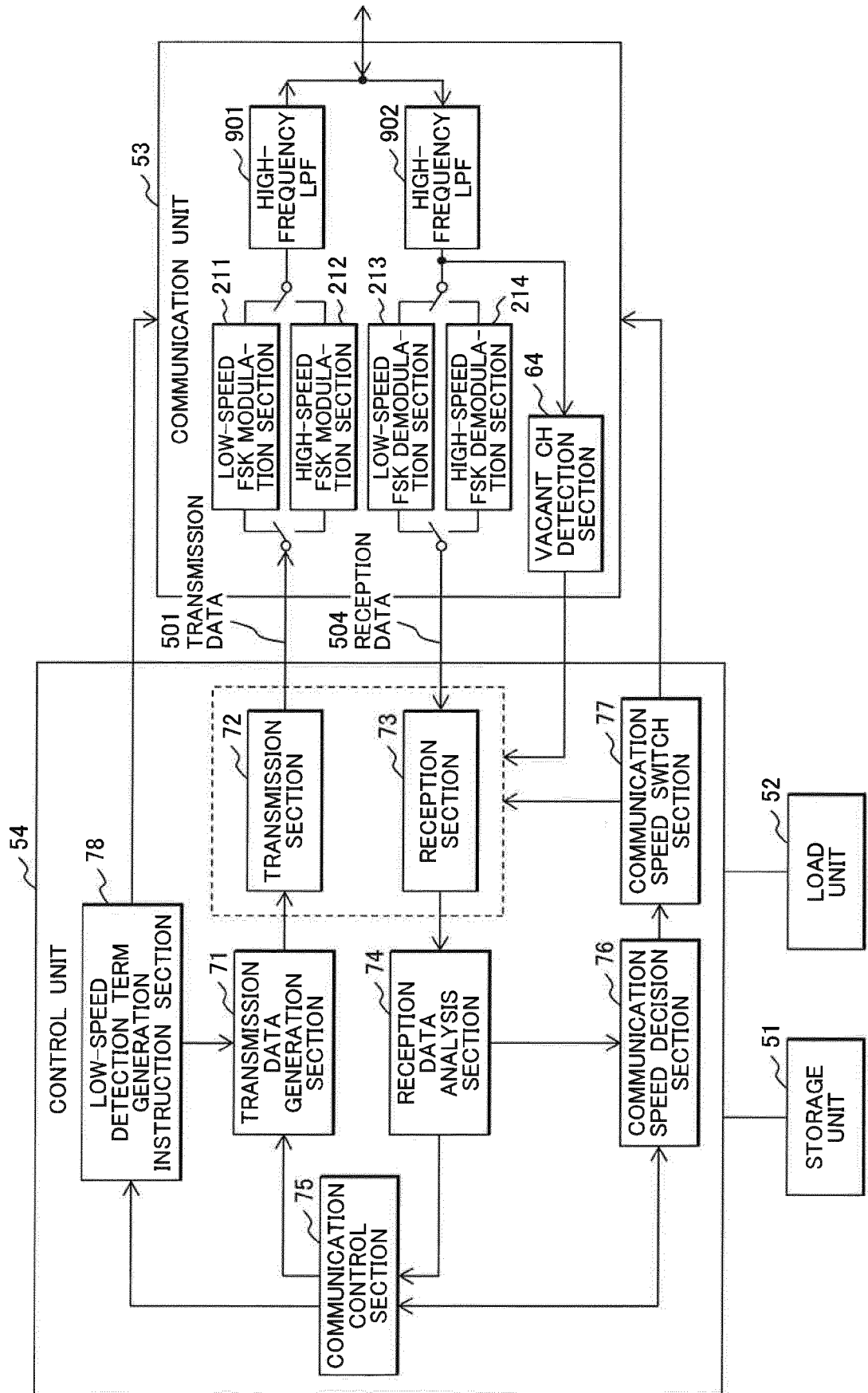


FIG. 16

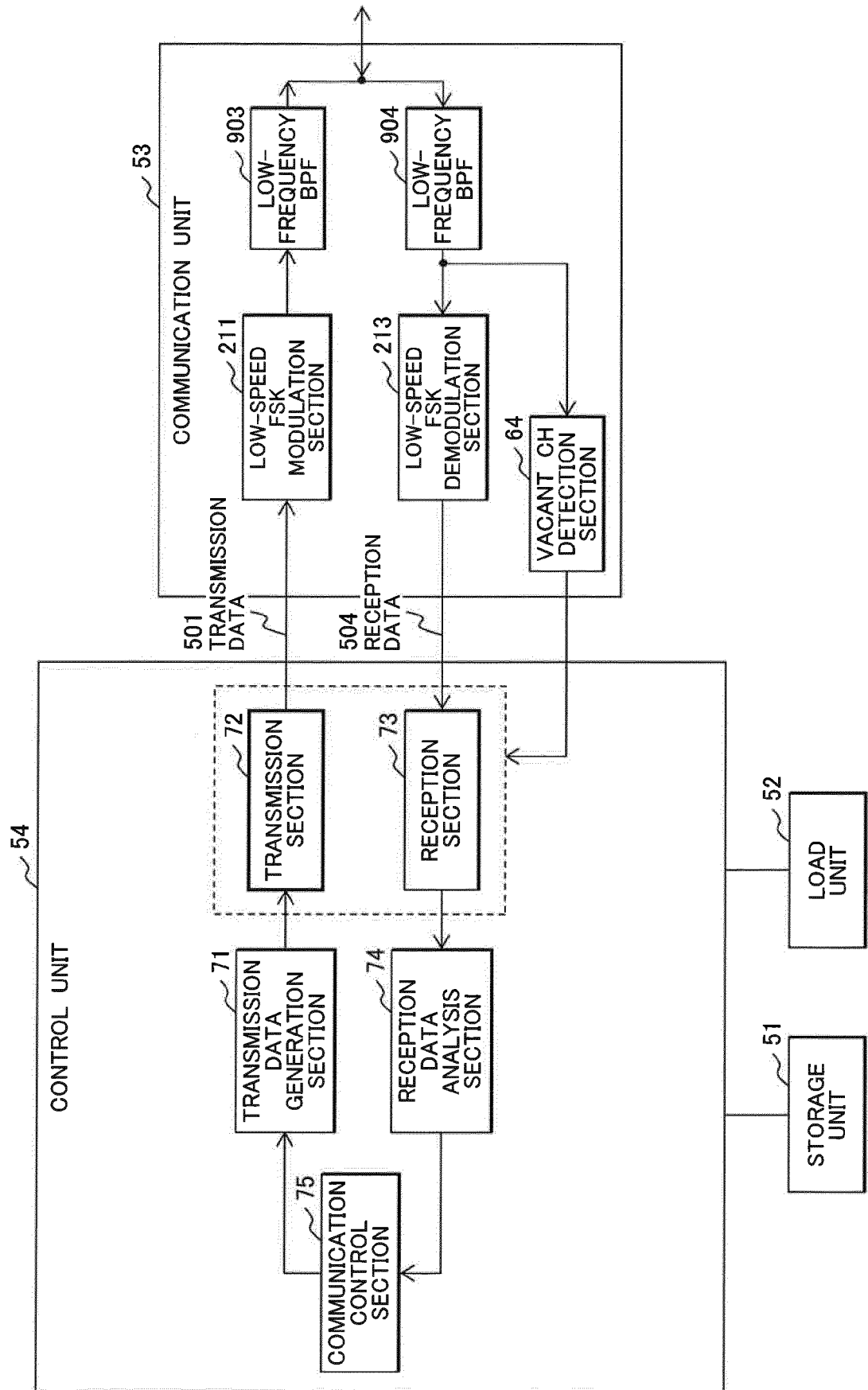


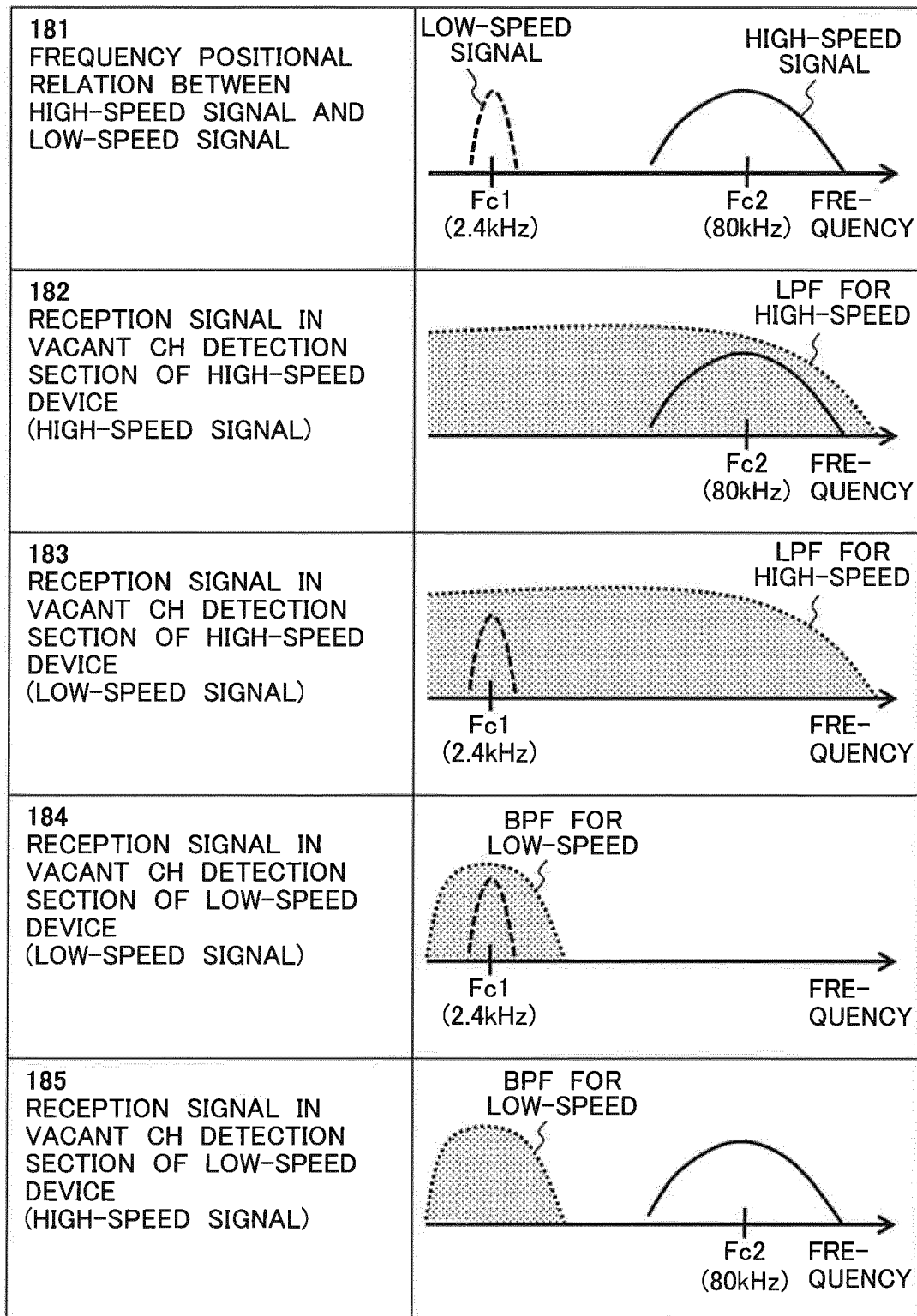
FIG. 17

FIG. 18

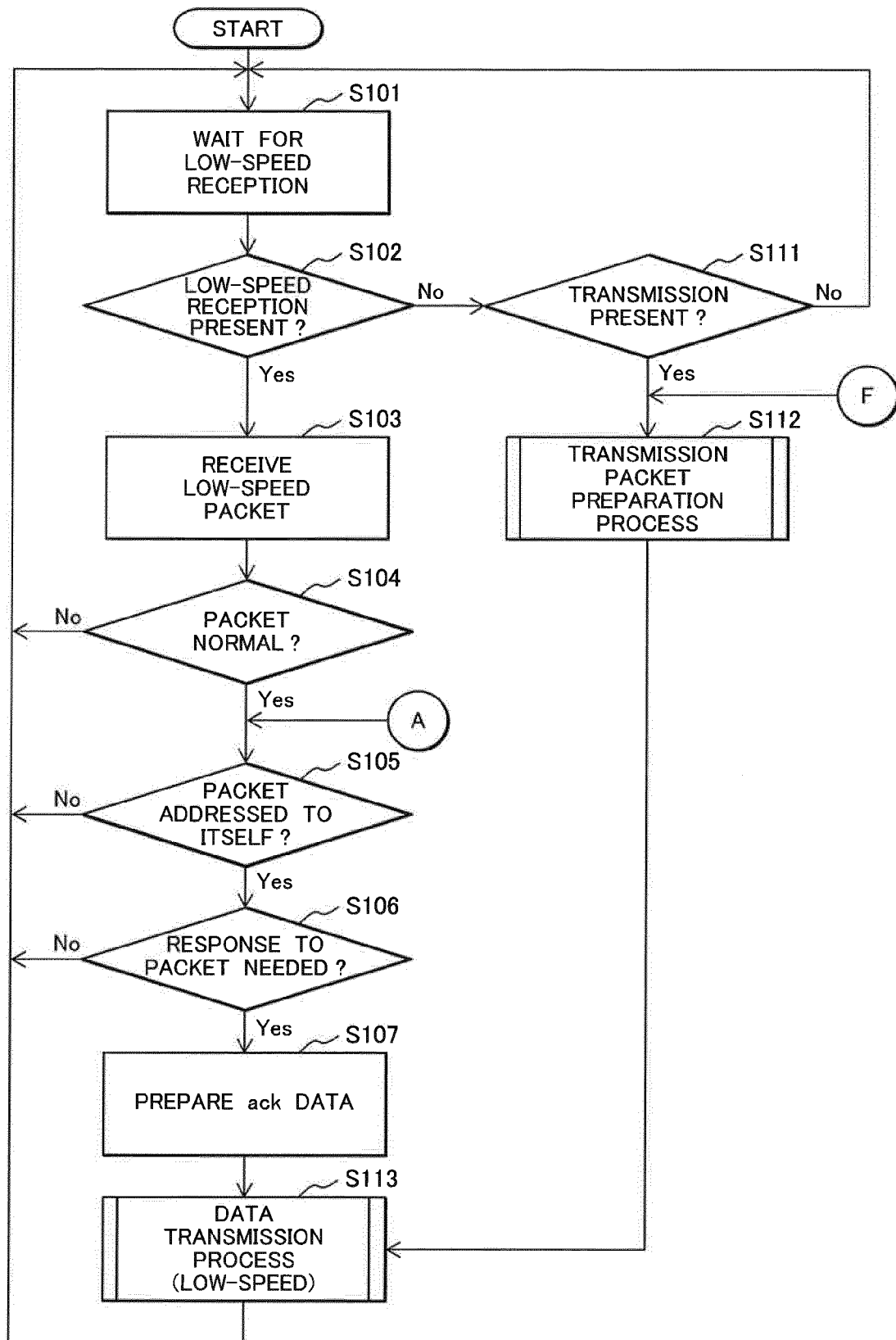


FIG. 19

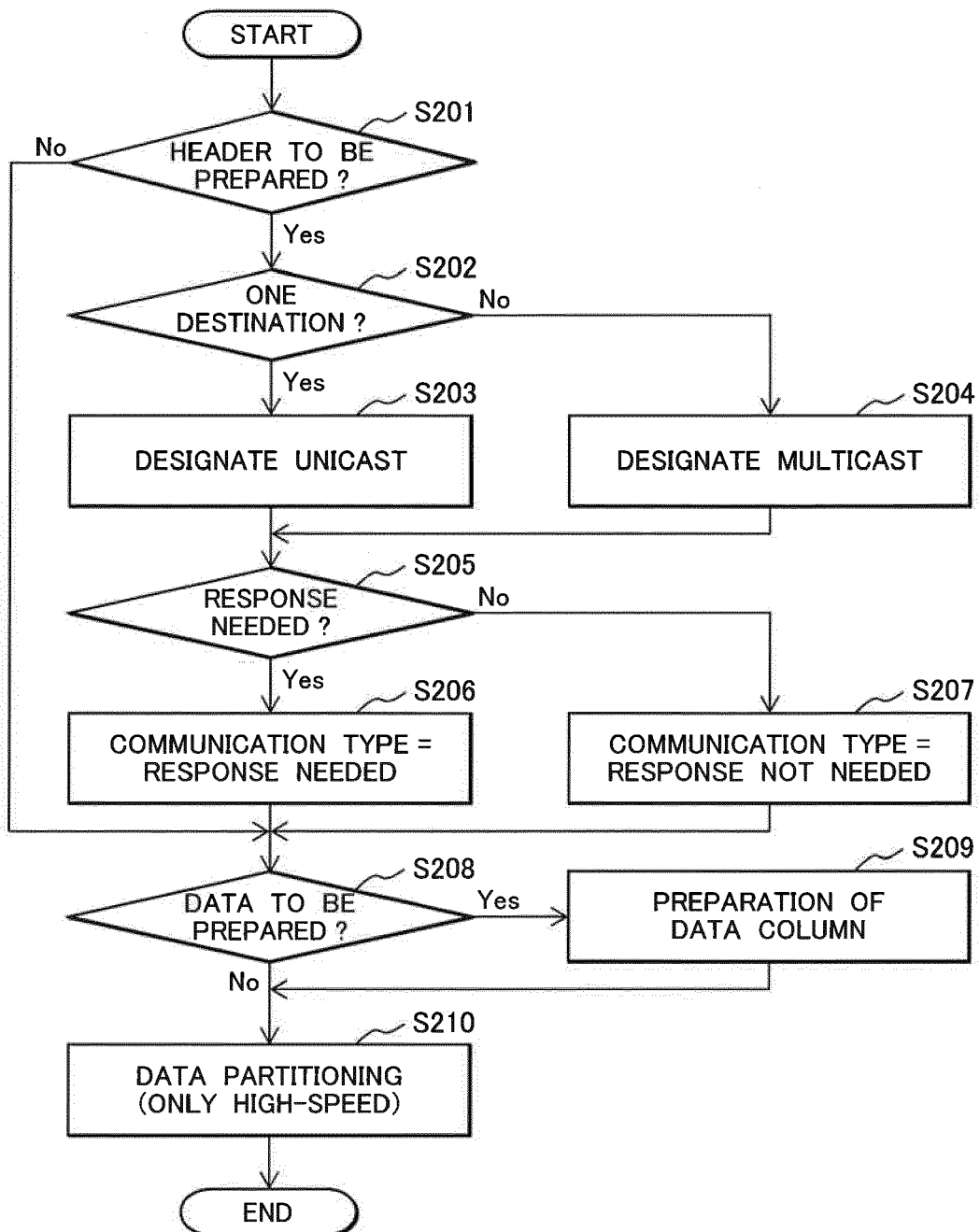


FIG. 20

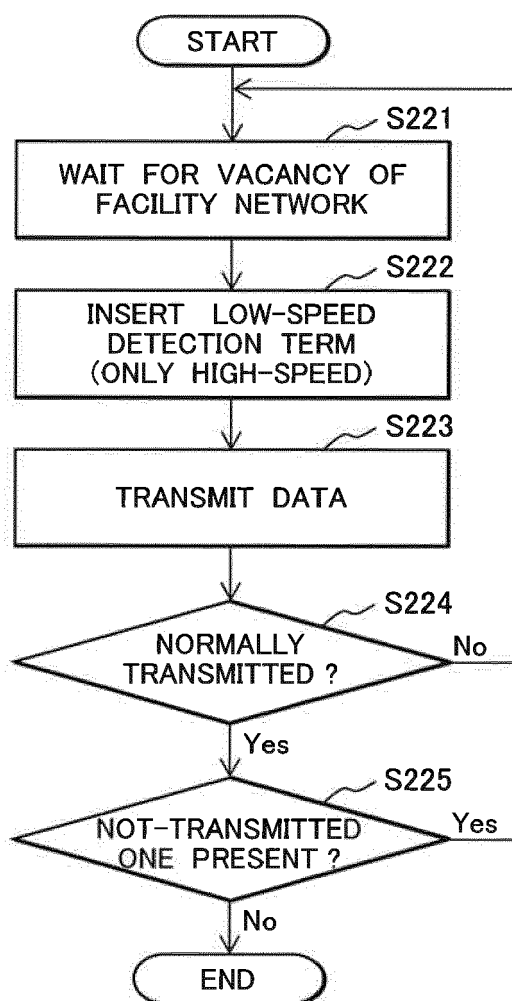


FIG. 21

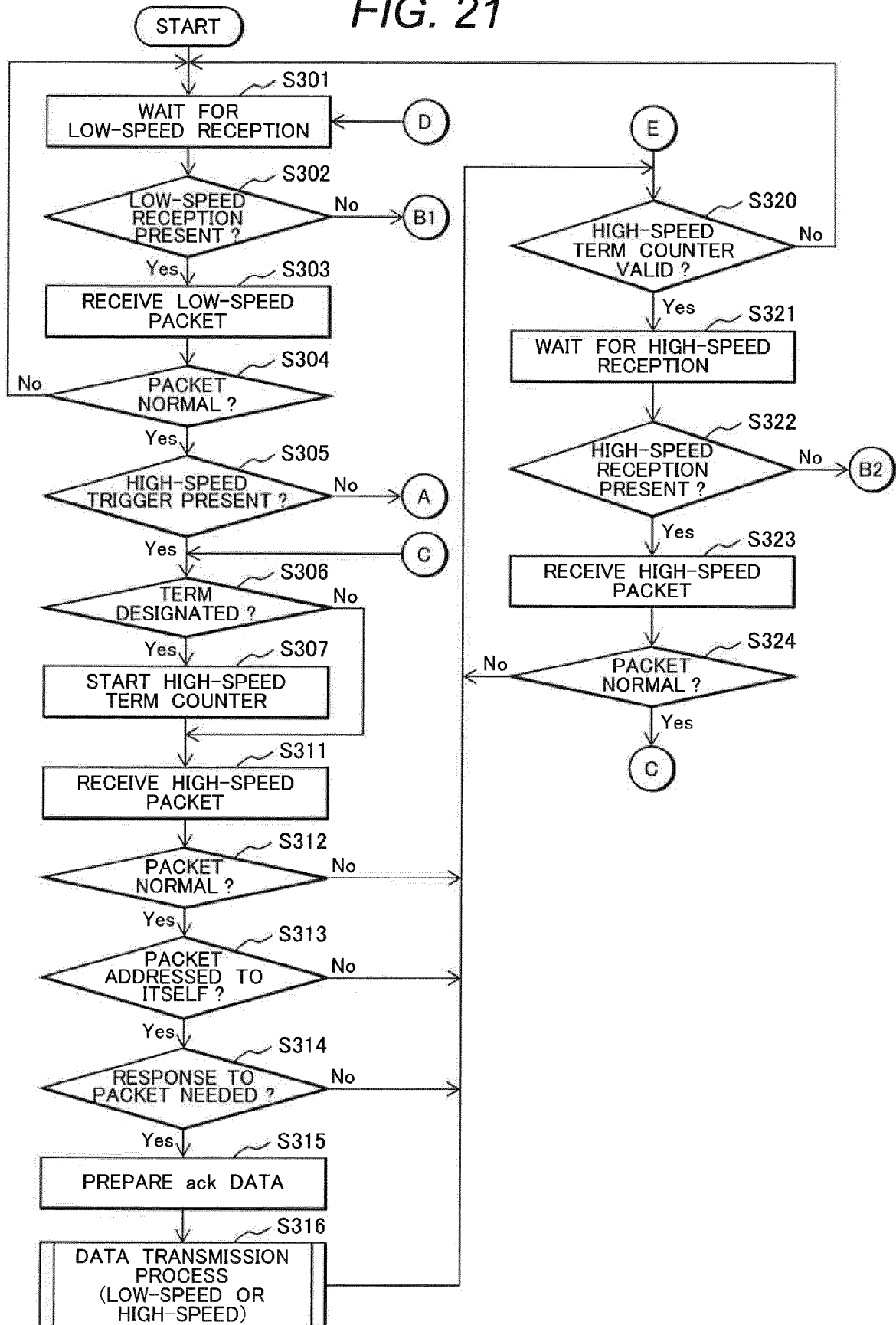


FIG. 22

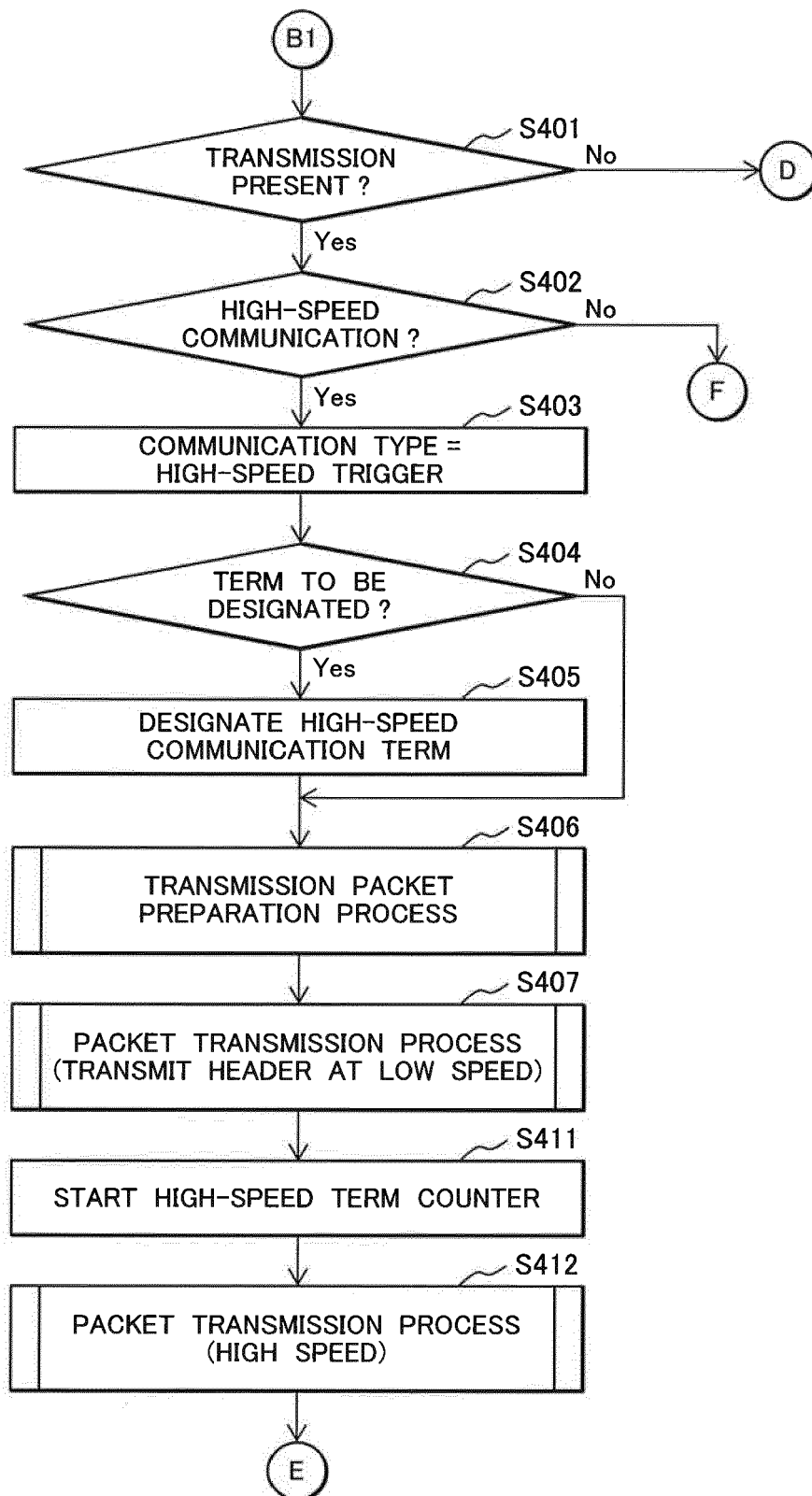


FIG. 23

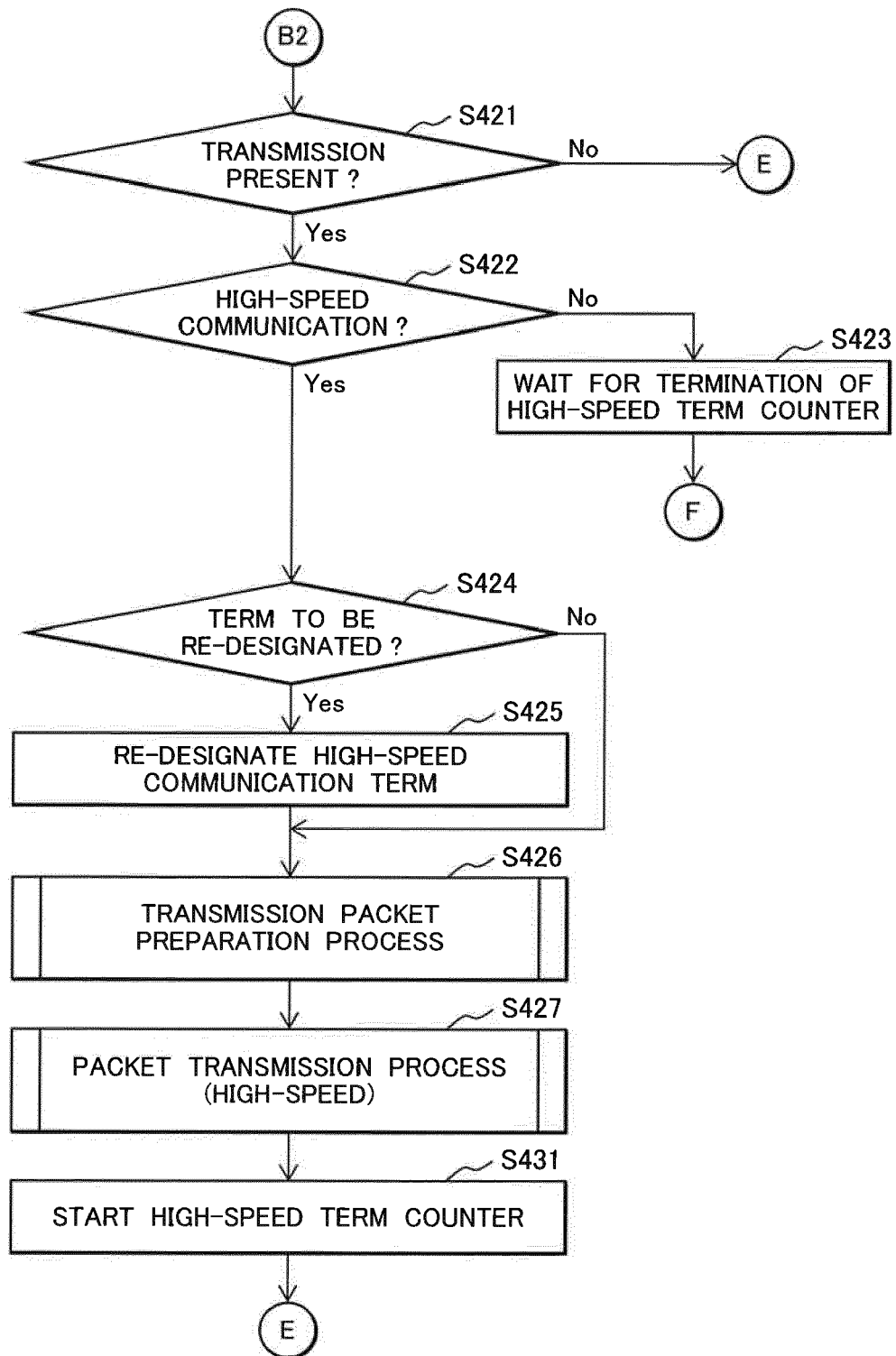
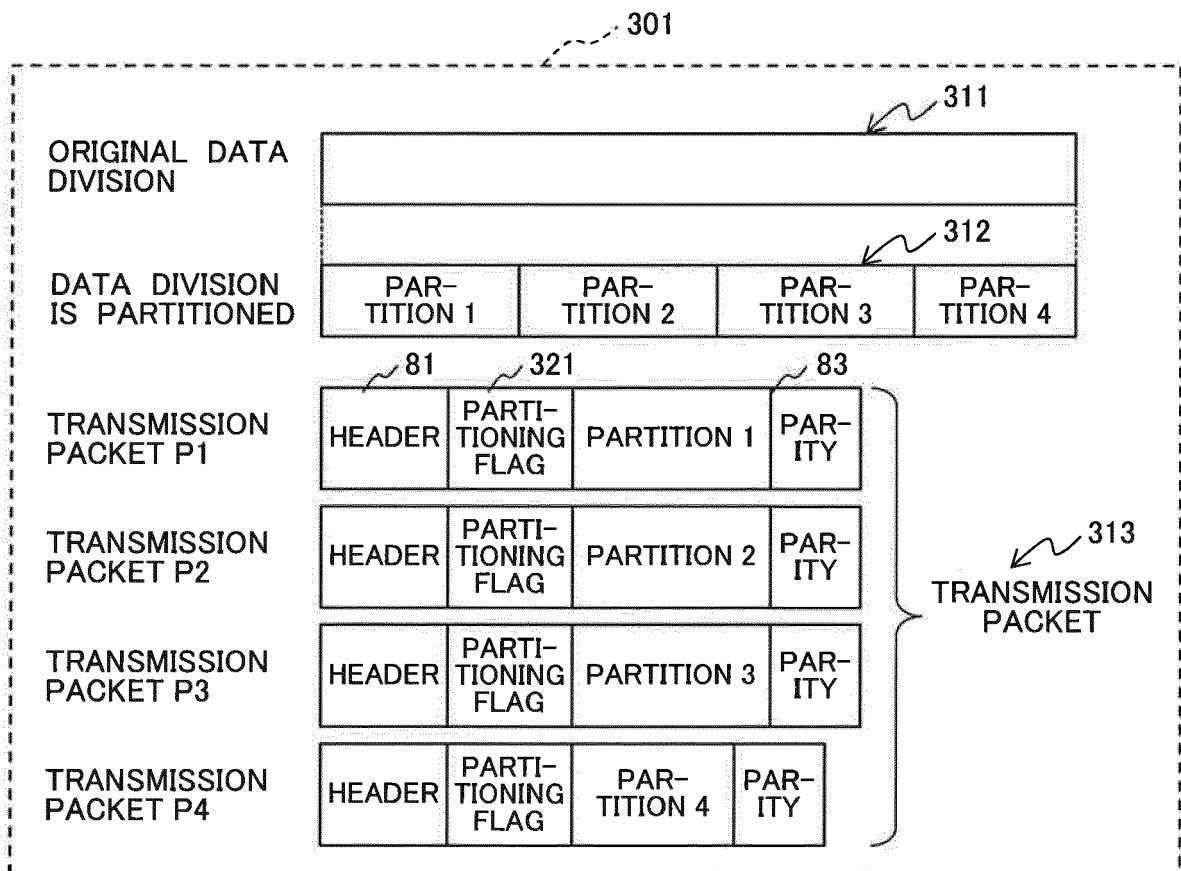


FIG. 24





EUROPEAN SEARCH REPORT

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Place of search The Hague		Date of completion of the search 9 October 2018	Examiner Gijssels, Willem
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