control device 234 and an interlocking device 236. The respective devices are mutually connected by an exclusive-use LAN (Local Area Network) 238 to be bi-directionally communicable. The operation control device 230 controls the whole operation. The interlocking device 236 carries out the protection of traveling routes of the trains. The ATP ground device 232 prevents a collision between the trains. The station control device 234 attains the function safety of the opening/closing control of the doors of a platform screen door and a train at a station.

[0004]

Each of the (group of) trains is provided with an on-board device 210. The on-board device 210 controls the operation of the train based on the control of the control center. The on-board device 210 is connected with the ATP ground device 232 by the exclusive-use LAN 250 to be bi-directionally communicable. The station is provided with a remote I/O 220. The remote I/O 220 carries out the opening/closing control of the platform screen door 240 and the control of railroad switches 250 on the railroad track based on the control of the control center. The remote I/O 220 is connected with the station control device 234 and the interlocking device 236 by an exclusive-use LAN 252 to be bi-directionally communicable.

[0005]

The operation of this conventional signaling system (the operation of a train) is as described below, for example, with reference to FIG. 1A.

When a departure time of an optional train comes gets closer based on the train diagram, the operation control device 230 refers to the on-rail state 205 from the ATP ground device 232 to check the on-rail state in the railroad division. When

and receiving unit which carries out a data communication through the general-purpose LAN 60. The center communication device 33 transmits data and the software program which are outputted from the center control device 31, to the on-board device 10 and the station I/F device 20, and receives data and the software program which are transmitted from the on-board device 10 and the station I/F device 20 to output to the center control device 31.

[0037]

The general-purpose LAN 60 is provided with a plurality of base stations 61. The plurality of base stations 61 are arranged in the control center 4 and each station 3 and at a plurality of locations along the railroad track 500. The base station 61 mediates a radio communication among the operation control device 30, the plurality of the on-board devices 10 and the plurality of the station I/F devices 20 to allow data to be sent and received among them. Note that in the present embodiment, an example using the radio LAN as the communication means is shown. However, different communication means may be used if it is possible to send and receive data among them.

[0038]

The on-board device 10 of the train 2 is provided with a control device 11, a storage unit 12 and a communication device 13. The control device 11 is an information processing device which is exemplified by a computer, and is provided with a CPU, a storage section, an input section, an output section and an interface, which are not shown. The control device 11 executes information processing for the on-board device 10. The storage unit 12 is a storage which is exemplified by a hard disk drive, RAM and ROM, and stores data and a software program which are used in the control device 11, and data and a software

the train to be stopped next, data related to a previous station as the station 3 (hereinafter, to be referred to as the station 3C) for the train to have been stopped last time. When the train 2 is traveling, the station related data 132 contains data related to the previous station as the station 3 for the train 2 to have departed and data related to the next station as the station 3. The station related data 132 is updated appropriately (e.g. regularly) and is different for every train 2. The station related data 132 contains the railroad switch switching position data and the inter-station section related data. The railroad switch switching position data shows a switching position of each of the plurality of railroad switches 51 which belongs to the targeted stations 3A, 3B and 3C (the previous station, the current station, the next station), and contains the railroad switch command data (to be described later) of each railroad switch 51. Moreover, the railroad switch switching position data may contain the locked state or the unlocked state of the railroad switch 51. The inter-station section related data shows whether or not there is a failure in an inter-station section (e.g. between the station 3A and the station 3B, between the station 3A and the station 3C) among the targeted stations 3A, 3B and 3C, and whether or not a different train is not in the on-rail state between the stations (the on-rail clearance between the stations).

[0056]

The train related data 133 contains data showing the moving (traveling) of the train 2 (hereinafter, to be referred to as the train 2A) and a different train 2 (hereinafter, to be referred to as the train 2B) around the train 2A and related to the traveling. The train related data 133 is updated

contains railroad switch switching position data and inter-station section related data. The railroad switch switching position data shows a switching position of each of a plurality of railroad switches 51 which belong to the station 3, and contains railroad switch command data of each railroad switch 51. The railroad switch command data shows the railroad switch switching command from the train 2 to each of the plurality of railroad switches 51 which belong to the station 3. The railroad switch switching command is a command which instructs the switching of the railroad switch 51, and is related with data of a command source side train 2 and is stored. While the railroad switch switching command is retained, the railroad switch 51 maintains (locks) the switching state. When the railroad switch switching command is erased in response to a railroad switch release command from the command source side train 2, the lock state of the railroad switch 51 is released. The inter-station section related data shows whether or not there is a failure between the station 3 and a neighbor station 3. The railroad switch command data and the inter-station section related data are transmitted to the on-board device 10 and the operation control device 30, and are stored as the station related data 132 and the center station related data 152.

[0060]

FIG. 5C is a block diagram showing the configuration of the center (CTR.) storage unit 32 of the operation control device 30 of the signaling system according to the present embodiment. The center storage unit 32 contains center (CTR.) operation mode data 150, center (CTR.) train diagram data 151, center (CTR.) station related data 152, center (CTR.) train related data 153 and center (CTR.)

basic data 154 at least.

[0061]

The center operation mode data 150 is the same as the operation mode data 130.

[0062]

The center train diagram data 151 contains data showing a train diagram of a railroad line and contains the train diagrams for all the trains 2. The train diagram data may be data of the operation interval.

[0063]

The center station related data 152 contains data related to all stations 3. The center station related data 152 contains the railroad switch switching position data and inter-station section related data of the station in-station related data 142 acquired from all the stations 3. The center station related data 152 are appropriately acquired from the station I/F devices 20 of all the stations 3.

[0064]

The center train related data 153 contains data related to the moving (traveling) of all the trains 2. The center train related data 153 contains the train position data, the traveling permission limit position data, the arrival scheduled platform data, traveling direction data, the traveling route data and the traveling line data of the train related data 133 acquired from all the trains 2. The center train related data 153 are appropriately acquired from the on-board devices 10 of all the trains 2.

[0065]

The center basic data 154 contains data of basic structures of the train 2, the railroad track 50 and so on. The center basic data 154 is the same as the basic data 134.

[0066]

control device 234 and an interlocking device 236. The respective devices are mutually connected by an exclusive-use LAN (Local Area Network) 238 to be bi-directionally communicable. The operation control device 230 controls the whole operation. The interlocking device 236 carries out the protection of traveling routes of the trains. The ATP ground device 232 prevents a collision between the trains. The station control device 234 attains the function safety of the opening/closing control of the doors of a platform screen door and a train at a station.

[0004]

Each of the (group of) trains is provided with an on-board device 210. The on-board device 210 controls the operation of the train based on the control of the control center. The on-board device 210 is connected with the ATP ground device 232 by the exclusive-use LAN 238 to be bi-directionally communicable. The station is provided with a remote I/O 220. The remote I/O 220 carries out the opening/closing control of the platform screen door 240 and the control of railroad switches 250 on the railroad track based on the control of the control center. The remote I/O 220 is connected with the station control device 234 and the interlocking device 236 by an exclusive-use LAN to be bi-directionally communicable.

[0005]

The operation of this conventional signaling system (the operation of a train) is as described below, for example, with reference to FIG. 1A.

When a departure time of an optional train comes gets closer based on the train diagram, the operation control device 230 refers to the on-rail state 205 from the ATP ground device 232 to check the on-rail state in the railroad division. When

and receiving unit which carries out a data communication through the general-purpose LAN 60. The center communication device 33 transmits data and the software program which are outputted from the center control device 31, to the on-board device 10 and the station I/F device 20, and receives data and the software program which are transmitted from the on-board device 10 and the station I/F device 20 to output to the center control device 31.

[0037]

The general-purpose LAN 60 is provided with a plurality of base stations 61. The plurality of base stations 61 are arranged in the control center 4 and each station 3 and at a plurality of locations along the railroad track 50. The base station 61 mediates a radio communication among the operation control device 30, the plurality of the on-board devices 10 and the plurality of the station I/F devices 20 to allow data to be sent and received among them. Note that in the present embodiment, an example using the radio LAN as the communication means is shown. However, different communication means may be used if it is possible to send and receive data among them.

[0038]

The on-board device 10 of the train 2 is provided with a control device 11, a storage unit 12 and a communication device 13. The control device 11 is an information processing device which is exemplified by a computer, and is provided with a CPU, a storage section, an input section, an output section and an interface, which are not shown. The control device 11 executes information processing for the on-board device 10. The storage unit 12 is a storage which is exemplified by a hard disk drive, RAM and ROM, and stores data and a software program which are used in the control device 11, and data and a software

the train to be stopped next, data related to a previous station as the station 3 (hereinafter, to be referred to as the station 3C) for the train to have been stopped last time. When the train 2 is traveling, the station related data 132 contains data related to the previous station as the station 3 for the train 2 to have departed and data related to the next station as the station 3. The station related data 132 is updated appropriately (e.g. regularly) and is different for every train 2. The station related data 132 contains the railroad switch switching position data and the inter-station section state data. The railroad switch switching position data shows a switching position of each of the plurality of railroad switches 51 which belongs to the targeted stations 3A, 3B and 3C (the previous station, the current station, the next station), and contains the railroad switch command data (to be described later) of each railroad switch 51. Moreover, the railroad switch switching position data may contain the locked state or the unlocked state of the railroad switch 51. The inter-station section state data shows whether or not there is a failure in an inter-station section (e.g. between the station 3A and the station 3B, between the station 3A and the station 3C) among the targeted stations 3A, 3B and 3C, and whether or not a different train is not in the on-rail state between the stations (the on-rail clearance between the stations).

[0056]

The train related data 133 contains data showing the moving (traveling) of the train 2 (hereinafter, to be referred to as the train 2A) and a different train 2 (hereinafter, to be referred to as the train 2B) around the train 2A and related to the traveling. The train related data 133 is updated

contains railroad switch switching position data and inter-station section state data. The railroad switch switching position data shows a switching position of each of a plurality of railroad switches 51 which belong to the station 3, and contains railroad switch command data of each railroad switch 51. The railroad switch command data shows the railroad switch switching command from the train 2 to each of the plurality of railroad switches 51 which belong to the station 3. The railroad switch switching command is a command which instructs the switching of the railroad switch 51, and is related with data of a command source side train 2 and is stored. While the railroad switch switching command is retained, the railroad switch 51 maintains (locks) the switching state. When the railroad switch switching command is erased in response to a railroad switch release command from the command source side train 2, the lock state of the railroad switch 51 is released. The inter-station section state data shows whether or not there is a failure between the station 3 and a neighbor station 3. The railroad switch command data and the inter-station section state data are transmitted to the on-board device 10 and the operation control device 30, and are stored as the station related data 132 and the center station related data 152.

[0060]

FIG. 5C is a block diagram showing the configuration of the center (CTR.) storage unit 32 of the operation control device 30 of the signaling system according to the present embodiment. The center storage unit 32 contains center (CTR.) operation mode data 150, center (CTR.) train diagram data 151, center (CTR.) station related data 152, center (CTR.) train related data 153 and center (CTR.)

basic data 154 at least.

[0061]

The center operation mode data 150 is the same as the operation mode data 130.

[0062]

The center train diagram data 151 contains data showing a train diagram of a railroad line and contains the train diagrams for all the trains 2. The train diagram data may be data of the operation interval.

[0063]

The center station related data 152 contains data related to all stations 3. The center station related data 152 contains the railroad switch switching position data and inter-station section state data of the station in-station related data 142 acquired from all the stations 3. The center station related data 152 are appropriately acquired from the station I/F devices 20 of all the stations 3.

[0064]

The center train related data 153 contains data related to the moving (traveling) of all the trains 2. The center train related data 153 contains the train position data, the traveling permission limit position data, the arrival scheduled platform data, traveling direction data, the traveling route data and the traveling line data of the train related data 133 acquired from all the trains 2. The center train related data 153 are appropriately acquired from the on-board devices 10 of all the trains 2.

[0065]

The center basic data 154 contains data of basic structures of the train 2, the railroad track 50 and so on. The center basic data 154 is the same as the basic data 134.

[0066]