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(54) **Train control method, device and system**

(57) A train control method is disclosed. The method includes: backing up train control data of a radio block centre (RBC) and obtaining backup data, where the train control data is used for controlling the train managed by the RBC; obtaining the alternative control information of the trains and controlling the trains by using the backup

data. An RBC, an on-board device and a train control system are also provided. When the trains managed by the RBC need alternative control, the RBC may be replaced to control the trains, which guarantees that the trains run normally under control and improves the safety of the trains.

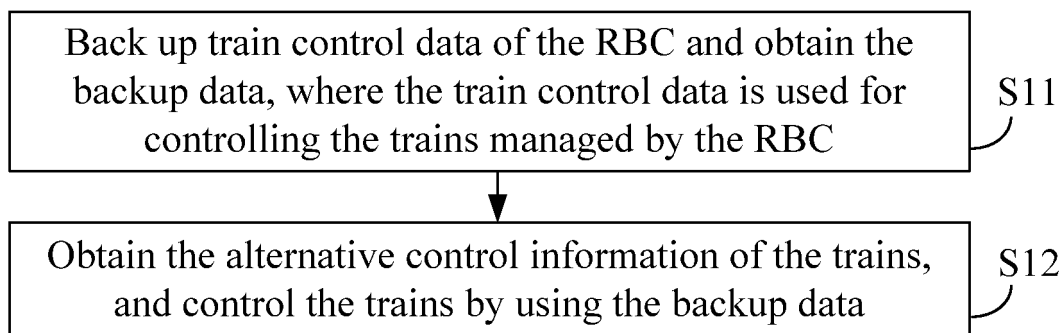


FIG. 1

Description

Field of the Invention

[0001] The present invention relates to a control technology, and in particular, to a train control method, device and system.

Background of the Invention

[0002] A train control system is used to guarantee the safety of trains and to avoid such accidents as over speed, rear collision and side collision. With the development of high-speed railways and urban mass transit systems, the speeds of trains are faster, the densities of trains are higher, and the safety requirements of trains are more stricter, which raises higher requirements for the train control system. A communication based train control system (CBTC) is a widely used train control system. To control the trains, the CBTC system may include an interlocking (IL) device, a radio block centre (RBC) and a centralized traffic control (CTC) device. The CTC is adapted to dispatch trains in centralized mode and may include a temporary speed restriction server (TSRS), which is adapted to send temporary speed restriction commands. The IL is adapted to: detect the occupancy states of train tracks, dispatch trains to routes according to the commands from the CTC, and notify the RBC of the occupancy states of the train tracks and train route information. The RBC is adapted to: authorize the operation of an on-board device in a train and control the startup, stop, speed and direction of the train.

[0003] The prior art has at least following weaknesses: When the RBC is faulty, the train will be affected; the system may be degraded; the speed of the train may be affected; and the train schedule has to be changed. In particular, the safety of the train may be greatly reduced due to RBC failures in cases of sudden accidents or natural disasters.

Summary of the Invention

[0004] Embodiments of the present invention provide a train control method, device and system to improve the safety of the trains.

[0005] A train control system provided in an embodiment of the present invention includes:

a first RBC, adapted to control trains by using train control data; and
a second RBC, adapted to: back up the train control data of the first RBC and obtain backup data; obtain alternative control information of the trains, and control the trains by using the backup data.

[0006] An RBC provided in another embodiment of the present invention includes:

a data backup module, adapted to: back up train control data of another RBC and obtain backup data, where the train control data is used for controlling the trains managed by the another RBC; and
a train controlling module, adapted to obtain the alternative control information of the trains, and control the trains by using the backup data.

[0007] An on-board device provided in another embodiment of the present invention includes:

a sending module, adapted to send alternative control information to a second RBC when failing to establish a connection with a first RBC; and
an acceptance controlling module, adapted to accept the control of the second RBC.

[0008] A train control method provided in an embodiment of the present invention includes:

backing up train control data of an RBC and obtaining backup data, where the backup data is used for controlling the trains managed by the RBC; and
obtaining the alternative control information of the trains, and controlling the trains by using the backup data.

[0009] According to the preceding description of the technical solution, embodiments of the present invention have the following merits: The train control data of the RBC is backed up so that the RBC may be replaced to control the trains when the trains controlled by the RBC need alternative control. In particular, when the RBC cannot control the trains due to failures, the RBC may be replaced to control the trains, which guarantees that the trains run normally under control and improves the safety of the trains.

Brief Description of the Drawings

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[0010] To make the technical solution under the present invention or in the prior art clearer, the accompanying drawings for illustrating the embodiments of the present invention or illustrating the prior art are outlined below. Evidently, the accompanying drawings are exemplary only, and those skilled in the art can derive other drawings from such accompanying drawings without creative work.

FIG. 1 is a flowchart of a train control method in a first embodiment of the present invention;
FIG. 2 is a flowchart of a train control method in a second embodiment of the present invention;
FIG. 3 is a flowchart of a preferred train control method in a third embodiment of the present invention;
FIG. 4 is a schematic diagram illustrating a standby RBC in a fourth embodiment of the present invention;
FIG. 5 is a schematic diagram illustrating an on-

board device in a fifth embodiment of the present invention; and

FIG. 6 is a schematic diagram illustrating a train control system in a sixth embodiment of the present invention.

Detailed Description of the Invention

[0011] The technical solution of the present invention is hereinafter described in detail with reference to the accompanying drawings. It is evident that the embodiments are exemplary only and the present invention is not limited to such embodiments. Other embodiments that those skilled in the art derive from the embodiments of the present invention also fall in the scope of protection of the present invention.

First Embodiment

[0012] FIG. 1 is a flowchart of a train control method in the first embodiment of the present invention. The method includes the following steps:

S11. Back up train control data of the RBC and obtain backup data, where the backup data is used for controlling the trains managed by the RBC.

S12. Obtain the alternative control information of the trains, and control the trains by using the backup data.

[0013] In this embodiment, when the trains managed by the RBC need alternative control, the RBC may be replaced to control the trains to guarantee that the trains run normally, which improves the safety of the trains.

[0014] Further, the step of backing up the data of the RBC in the method may include: obtaining the train control data of the RBC at a preset interval, and backing up the train control data of the RBC on a real-time and synchronous basis. A standby RBC may be set to back up the train control data of the RBC on a real-time and synchronous basis, to synchronize the backup data with the train control data of the RBC on a real-time basis, so that alternative control may be performed when necessary. The train control data may include the ID, speed and location of a train.

[0015] Before controlling the trains by using the backup data, the method further includes: judging whether the trains are controlled by the RBC according to the backup data; and controlling the trains by using the backup data if the trains are controlled by the RBC.

[0016] In the preceding embodiment, the alternative control information is used for requesting alternative control. In a specific implementation mode, S11 may include: obtaining the alternative control information of a running train by receiving a session request from an on-board device in the train. A standby RBC is set to receive the session request from the on-board device, where the session request indicates that the train where the on-board

device is located needs to communicate with the standby RBC to seek alternative control.

[0017] The method may further include: before controlling the trains by using the backup data, judging whether the RBC is abnormal through a heartbeat connection with the RBC; if so, replacing the RBC to control the trains managed by the RBC by using the backup data. In this step, after obtaining the alternative control requests from the trains, the standby RBC does not perform alternative control immediately but judges whether the RBC is working normally through the heartbeat connection with the RBC. If the heartbeat connection is abnormal, it is indicated that the RBC cannot work normally, and the standby RBC performs alternative control; if the heartbeat connection is normal, the standby RBC does not perform alternative control. For example, if a temporary control failure occurs due to communication delays or transient failures between the RBC and a train but the heartbeat connection with the RBC is normal, the standby RBC does not perform alternative control. After the temporary failure is removed and the communication between the RBC and the train is restored, the RBC still can control the train, which avoids handing over alternative control due to the temporary failure.

[0018] In another specific implementation mode, S11 may include: obtaining the alternative control information of the trains managed by the RBC from the RBC. In this step, when the RBC cannot control all or part of the trains managed by the RBC, the RBC notifies the standby RBC of uncontrollable trains as trains that require alternative control. The RBC may actively notify the standby RBC of alternative control information of the trains that require alternative control; or the standby RBC may obtain the alternative control information of the trains through the heartbeat connection with the RBC. When the heartbeat connection is already established between the standby RBC and the RBC, the standby RBC performs alternative control on the trains controlled by the RBC if the standby RBC finds that the heartbeat of the RBC is abnormal, which indicates that the RBC may not control the trains managed by the RBC due to failures. It is understandable that the standby RBC may obtain the alternative control information from a third party entity besides the RBC or on-board device.

[0019] In this embodiment, the step of replacing the RBC to control the trains may include: performing move authorization for the trains, and controlling the trains, where the move authorization is to provide the trains with train control information.

[0020] The method may further include: providing other RBCs with the train control data of an RBC. The train control data of the standby RBC may also be backed up by other RBCs, so that other RBCs may perform alternative control on the trains controlled by the standby RBC in case of alternative control requirements.

[0021] In a specific implementation mode, two RBCs may act as the standby RBC of each other and back up data of each other. An RBC A may store its own train

control data in its database, and also store the train control data of an RBC B to back up the data of the RBC B; the RBC B also stores its own train control data and train control data of the RBC A. When either of the RBC A and RBC B requires the other party to perform alternative control on the trains controlled by one party due to failures, the other party may perform alternative control on such trains by using the backup data to hand over the control and guarantee the normal running of the trains.

Second Embodiment

[0022] FIG. 2 is a flowchart of a train control method in the second embodiment of the present invention. The method may include the following steps:

- S21. Send alternative control information to the standby RBC if the connection with the RBC fails.
- S22. Accept the control of the standby RBC.

[0023] In this embodiment, if the connection with the RBC fails, it is indicated that the RBC may be faulty, and the standby RBC may replace the RBC to control the trains and guarantee the safety of the trains.

[0024] In this embodiment, the alternative control information may be a session request. The on-board devices of trains may send a session request to notify the standby RBC of performing alternative control. Accordingly, after sending the session request, the on-board devices of the trains may obtain session permission from the standby RBC. After obtaining the session permission from the standby RBC, the method may further include: obtaining the move authorization of the standby RBC. After obtaining the authorization, the trains may accept the control of the standby RBC and keep normal running. The on-board devices of the trains may be preset to know the existence of the standby RBC in advance before the trains run, so that the trains may send the alternative control information to the standby RBC when necessary. Certainly, the trains may know existence of the standby RBC through the RBC or other third party entities.

[0025] The connection with the RBC may fail several times. Specifically, when the on-board devices in the trains cannot keep normal communications with the RBC due to connection failures, the on-board devices may send a session request to the standby RBC or continue establishing a connection with the RBC. After the connection fails several times, the on-board devices may send a session request to the standby RBC to seek alternative control.

[0026] The method may further include: receiving and managing the device data of the RBC or the standby RBC or both the device data of the RBC and the standby RBC. The trains may obtain the information of the standby RBC by receiving and managing the device data of the RBC and the standby RBC, so that the trains can send a session request for seeking alternative control to the standby RBC when necessary. The device data of the RBC in-

cludes the ID and telephone number of the RBC.

Third Embodiment

[0027] FIG. 3 is a flowchart of a preferred train control method in the third embodiment of the present invention. The method may include the following steps:

- S31. If the connection between an on-board device and the RBC fails several times, the RBC is considered faulty.

[0028] Specifically, after the connection between the on-board device of a train and the RBC fails, the RBC is considered faulty if the connection fails three times.

[0029] S32. The on-board device calls the standby RBC, and sends a session request to the standby RBC after the call connection succeeds.

[0030] Specifically, the on-board device may call the telephone number of the access server in the standby RBC through the vehicle mounted station. After the call connection succeeds, the on-board device sends a session request to the standby RBC, requesting to accept the control of the standby RBC.

[0031] S33. The standby RBC judges whether the train where the on-board device is located is controlled by the RBC; if so, the process proceeds to S34; otherwise, the standby RBC does not perform any operation.

[0032] Specifically, the standby RBC backs up the data of the RBC. After receiving the call, the standby RBC judges whether the train where the on-board device is located is controlled by the RBC. When the backup data of the standby RBC includes the backup train control data of the train, it is indicated that the train is controlled by the RBC, and the standby RBC may use the backup data to control the train controlled by the RBC.

[0033] S34. The standby RBC judges whether the RBC is faulty through a heartbeat connection with the RBC; if so, the standby RBC provides the on-board device with session permission.

[0034] If finding that the heartbeat of the RBC is abnormal, the standby RBC determines that the RBC is faulty and continues to provide the on-board device with session permission to perform alternative control; if finding that the heartbeat of the RBC is normal, the standby RBC may continue to provide the on-board device with session permission, or reject the alternative control request of the on-board device, or report related information to the CTC for processing by the superior traffic control unit.

[0035] S35. After receiving the session permission, the on-board device notifies the standby RBC of its own location report and mobile authorization request.

[0036] S36. The standby RBC generates move authorization for the on-board device according to the signal authorization of the IL, and controls the train where the on-board device is located.

[0037] S37. The standby RBC sends a report to the

CTC, notifying the CTC of completion of alternative control.

[0038] After replacing the old RBC to control the train managed by the RBC, the standby RBC notifies the CTC of the completion of alternative control. The CTC receives a notification from the standby RBC, where the notification indicates that the train control is handed over and that the train can run normally. In this embodiment, the standby RBC may control the direction, speed, acceleration, startup and stop of the train according to the related train control information in the backup data of the standby RBC. In addition, the standby RBC may contact the train at any time to update the information of the train and know the details of the train at any time.

[0039] In this embodiment, when the on-board device cannot establish a normal connection with the RBC, the on-board device sends a request to the standby RBC, requesting the standby RBC to perform alternative control. It is understandable that the alternative control request may be initiated by the RBC instead of the train. If the RBC wants the standby RBC to perform alternative control on the train controlled by the RBC, the RBC may send alternative control information to the standby RBC. The standby RBC may judge whether the RBC is faulty through a heartbeat connection with the RBC, which facilitates the implementation of alternative control. For example, the RBC may actively disconnect the heartbeat connection with the standby RBC when wanting the standby RBC to perform alternative control. Thus, the standby RBC may find that the heartbeat connection is already disconnected, and begin to perform alternative control. When the standby RBC initiates alternative control to the train, the standby RBC may call the number of the on-board device to establish a connection. After the connection succeeds, the standby RBC sends an alternative control request to the train; if the train accepts the request, the standby RBC may provide the train with move authorization.

[0040] In the preceding embodiment, the RBC and the standby RBC may obtain the temporary speed restriction command of the CTC or track occupancy state or both the temporary speed restriction command of the CTC and track occupancy state, and obtain route information of the IL to control the train during the movement process. In a specific implementation mode, two RBCs may act as the standby RBC of each other. When either of the two RBCs cannot continue controlling its trains, the other RBC may perform alternative control. Similarly, when the standby RBC backs up the data of a corresponding RBC, the standby RBC may also back up its own data to the RBC.

[0041] When an RBC controls its trains, the RBC may control the trains by using the information such as locations, speeds and IDs of the trains. The RBC may also back up such information to a corresponding standby RBC. The on-board devices of the trains may send the information of the trains to the RBC and the standby RBC on a real-time basis, so that the standby RBC backs up

the train data. The on-board devices of the trains may also obtain the data of the RBC or the corresponding standby RBC, where the data may include telephone number and ID information, so that the trains interact with the RBC according to such data, which facilitates the implementation of control. When the trains obtain the data of the RBC, the on-board devices may input data through a driver machine interface (DMI) or read the data of the RBC through a balise.

[0042] In the preceding embodiments, the sender may send its data or information to the receiver through a third party. For example, when an on-board device sends a session request to the standby RBC, it may send the session request to the standby RBC directly or send the session request to the standby RBC through a third party (for example, a terrestrial access server). Generally, the former mode is preferred.

Fourth Embodiment

[0043] FIG. 4 is a schematic diagram illustrating an RBC 40 in the fourth embodiment of the present invention. The RBC 40 may include:

a data backup module 41, adapted to back up train control data of another RBC and obtain the backup data, where the train control data is used for controlling the trains managed by the another RBC; and a train controlling module 42, adapted to obtain alternative control information of the trains, and control the trains by using the backup data.

[0044] In this embodiment, the RBC 40 backs up the data of the another RBC, so that the RBC 40 can perform alternative control when the another RBC cannot control its trains, which improves the safety of the trains.

[0045] In an optimized implementation mode, the data backup module 41 may include:

a data obtaining unit 411, adapted to obtain train control data of the another RBC at a preset interval, where the train control data is used for controlling the trains managed by the another RBC; and a storing unit 412, adapted to store the train control data of the another RBC obtained by the data obtaining unit 411 as backup data.

[0046] In another optimized implementation mode, the train controlling module 42 may include:

a judging unit 421, adapted to obtain alternative control information of trains of the another RBC, judge whether the another RBC is faulty by establishing a heartbeat connection with the another RBC, and obtain the judgment result; and a controlling unit 422, adapted to obtain the judgment result of the judging unit 421, and replace the another RBC to control the trains by using the backup data

when the another RBC is faulty.

[0047] The judging unit 421 in the RBC 40 may judge whether the old RBC that controls the trains is faulty after obtaining a session request from the trains. If the RBC is faulty, alternative control may be performed, which may guarantee reliable alternative control and avoid unnecessary alternative control due to temporary failures of the old RBC.

[0048] The RBC 40 may further include a data providing module, which is adapted to provide other RBCs with the train control data of the RBC 40, where other RBCs are adapted to back up the train control data of the RBC 40. When the RBC 40 is faulty, the other RBCs may replace the RBC 40 to control the trains according to the data of the RBC 40 backed up by the other RBCs.

[0049] In a specific implementation mode, two RBCs may act as the standby RBC of each other. When either of the two RBCs cannot continue controlling its trains, the other RBC may replace the RBC to control these trains, which improves the safety of the trains.

Fifth Embodiment

[0050] FIG. 5 is a schematic diagram illustrating an on-board device in the fifth embodiment of the present invention. The on-board device 50 may include:

a sending module 51, adapted to send alternative control information to a second RBC 40 when failing to establish a connection with a first RBC; and
an acceptance controlling module 52, adapted to accept the control of the second RBC 40.

[0051] In this embodiment, after failing to establish a connection with the first RBC, the on-board device 50 requests the second RBC 40 to replace the first RBC to control the trains, thus guaranteeing the safety of the trains.

[0052] In a specific implementation, the sending module 51 may include:

a failure detecting unit 511, adapted to establish a connection with the first RBC, and generate connection failure information when the number of connection failures reaches a threshold; and
a sending unit 512, adapted to obtain connection failure information generated by the failure detecting unit 51, and send alternative control information to the second RBC 40. After the on-board device fails to establish a connection with the first RBC, the on-board device may attempt to re-establish the connection. After the connection fails several times, the on-board device may seek alternative control. In this embodiment, the threshold for the number of connection failures may be set to 3.

[0053] Further, the alternative control information may

be a session request initiated by the on-board device 50. The on-board device 50 provides the second RBC 40 with alternative control information through the session request. Accordingly, the on-board device 50 may further include: a permission accepting module 53, adapted to obtain session permission from the second RBC 40. After the session permission is obtained, it is indicated that the session request is permitted by the second RBC 40, and the second RBC 40 may establish sessions with the on-board device 50 to perform alternative control.

[0054] The on-board device 50 may further include: a data managing module 54, adapted to receive and manage the device data of the first RBC or the second RBC 40. The device data may be used for interactions with the first RBC or the second RBC 40, which facilitates the control acceptance. The device data of an RBC includes the telephone number and ID of the RBC.

Sixth Embodiment

[0055] FIG. 6 is schematic diagram illustrating a train control system in the sixth embodiment of the present invention. The train control system may include:

a first RBC 61, adapted to control the trains by using the train control data; and
a second RBC 62, adapted to: back up the train control data of the first RBC 61, obtain the backup data, and control the trains by using the backup data if obtaining the alternative control information of the trains.

[0056] In this embodiment, the second RBC 62 of the train control system may replace the first RBC 61 to control the trains managed by the first RBC 61 when necessary. Thus, when the first RBC 61 cannot continue controlling its trains, the trains are still controllable, which improves the safety of the trains.

[0057] In an implementation mode, the first RBC 61 may provide the second RBC 62 with the alternative control information of the trains, notifying the second RBC 62 of performing alternative control.

[0058] It is understandable that the alternative control information of the trains may be provided to the second RBC 62 by the on-board devices of the trains or other third party entities. For example, in another implementation mode, the system may further include: an on-board device 63, located in the trains and adapted to provide the second RBC 62 with the alternative control information of the trains to indicate that the trains need alternative control when failing to establish a connection with the RBC 61. Then, the on-board device 63 may accept the control of the second RBC 62.

[0059] The system may further include a CTC 64, adapted to send a temporary speed restriction command to the first RBC 61 or the second RBC 62 or both. The system may further include an IL 65, adapted to provide the first RBC 61 or the second RBC 62 or both RBC with

the track occupancy state and route information.

[0060] The first RBC 61 or the second RBC 62 may control the trains according to the temporary speed restriction command of the CTC and route information of the IL 65, or according to track occupancy state and route information of the IL 65.

[0061] In this system, the second RBC 62 may be an independent standby device or a normal RBC. When the second RBC 62 is a normal RBC, the second RBC 62 and the first RBC 61 may act as the standby device of each other. When either of the first RBC 61 and the second RBC 62 cannot continue controlling its trains, the other party may take its place to control the trains. The first RBC 61 and the second RBC 62 may, by establishing a heartbeat connection, detect the state of each other on a real-time basis, find failures of each other and perform alternative control immediately. In actual applications, there may be more than one second RBC 62.

[0062] It is understandable to those skilled in the art that all or part of processes in the preceding methods may be performed by hardware instructed by a computer program. The program may be stored in a computer readable storage medium. When the program is executed, the processes of the preceding methods may be involved. The storage medium may be a magnetic disk, a compact disk (CD), a read-only memory (ROM) or a random access memory (RAM).

[0063] In conclusion, in embodiments of the present invention, when the trains controlled by an RBC need alternative control, a standby RBC may be used to perform alternative control and replace the RBC to control the trains. In particular, when the RBC cannot continue controlling the trains due to failures, the method can guarantee that the trains run normally under control and improve the safety of the trains.

[0064] Although the present invention has been described through several preferred embodiments and accompanying drawings, the invention is not limited to such embodiments. It is apparent that those skilled in the art can make various modifications and variations to the invention without departing from the scope of the invention.

Claims

1. A train control system, comprising:

a first radio block centre, RBC, adapted to control train by using train control data;
and
a second RBC, adapted to back up the train control data of the first RBC and obtain backup data; obtain alternative control information of the train, and control the train by using the backup data.

2. The system according to the claim 1, wherein the first RBC is further adapted to provide alternative control information to the second RBC.

3. The system according to the claim 1, further comprising:

an on-board device, adapted to send alternative control information to the second RBC when failing to establish a connection with a first RBC and accept the control of the second RBC.

4. The system according to the claim 1 or 2 or 3, further comprising, a centralized traffic control, CTC, adapted to send a temporary speed restriction command to the first RBC 61 or the second RBC.

5. The system according to the claim 1 or 2 or 3, further comprising, an interlocking, IL, device, adapted to provide the first RBC or the second RBC with the track occupancy state and route information.

6. A radio block centre, RBC, comprising, a data backup module, adapted to back up train control data of another RBC and obtain backup data, wherein the train control data is used for controlling a train managed by the another RBC; and a train controlling module, adapted to obtain alternative control information of the train, and control the train by using the backup data.

7. The RBC according to the claim 6, wherein the data backup module comprises a data obtaining unit, adapted to obtain train control data of the another RBC at a preset interval, wherein the train control data is used for controlling the train managed by the another RBC; and a storing unit, adapted to store the train control data of the another RBC obtained by the data obtaining unit as backup data.

8. The RBC according to the claim 6, further comprising:

a data providing module, adapted to provide other RBCs with the train control data of the RBC.

9. The RBC according to the claim 6 or 7 or 8, wherein the train controlling module comprises :

a judging unit, adapted to obtain alternative control information of train of the another RBC, judge whether the another RBC is faulty by establishing a heartbeat connection with the another RBC, and obtain the judgment result; and
a controlling unit, adapted to obtain the judgment result of the judging unit, and replace the another RBC to control the train by using the backup data when the another RBC is faulty.

10. An on-board device, comprising:

a sending module, adapted to send alternative control information to a second radio block centre, RBC, when failing to establish a connection with a first RBC; and
 an acceptance controlling module, adapted to accept the control of the second RBC.

judging whether the train is controlled by the RBC according to the backup data; and controlling the train by using the backup data if the train is controlled by the RBC.

11. The device according to the claim 10, wherein the sending module comprises:

a failure detecting unit, adapted to establish a connection with the first RBC, and generate connection failure information when the number of connection failures reaches a threshold; and
 a sending unit, adapted to obtain connection failure information generated by the failure detecting unit 51, and send alternative control information to the second RBC.

12. The device according to the claim 10 or 11, wherein the alternative control information is a session request, and the device further comprises:

a permission accepting module, adapted to obtain session permission from the second RBC.

13. A method for controlling trains, comprising:

backing up train control data of a radio block centre, RBC, and obtaining backup data, wherein the backup data is used for controlling a train managed by the RBC; and
 obtaining an alternative control information of the train, and controlling the train by using the backup data.

14. The method according to the claim13, wherein the backing up train control data of an RBC comprises:

obtaining the train control data of the RBC at a preset interval, and backing up the train control data of the RBC on a real-time and synchronous basis.

15. The method according to the claim13, further comprising:

judging whether the RBC is abnormal by heartbeat connection with the RBC; and
 replacing the RBC to control the train by using the backup data if the RBC is abnormal.

16. The method according to the claim 13 or14, before controlling the train by using the backup data, further comprising:

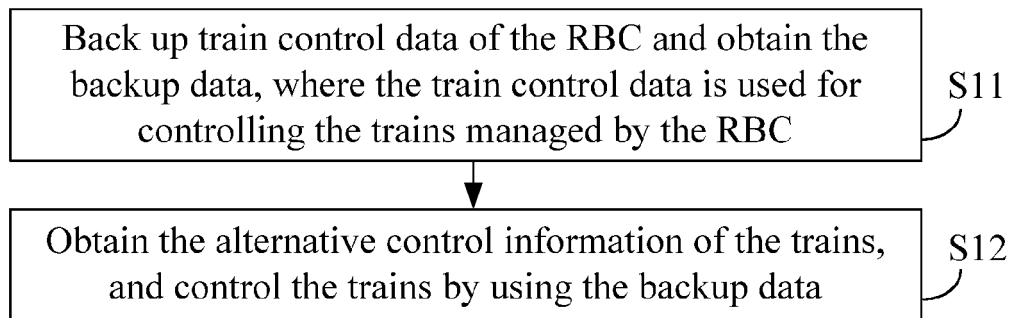


FIG. 1

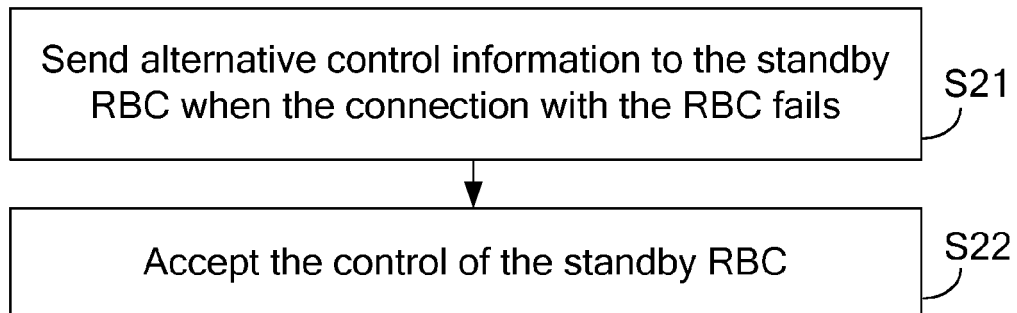


FIG. 2

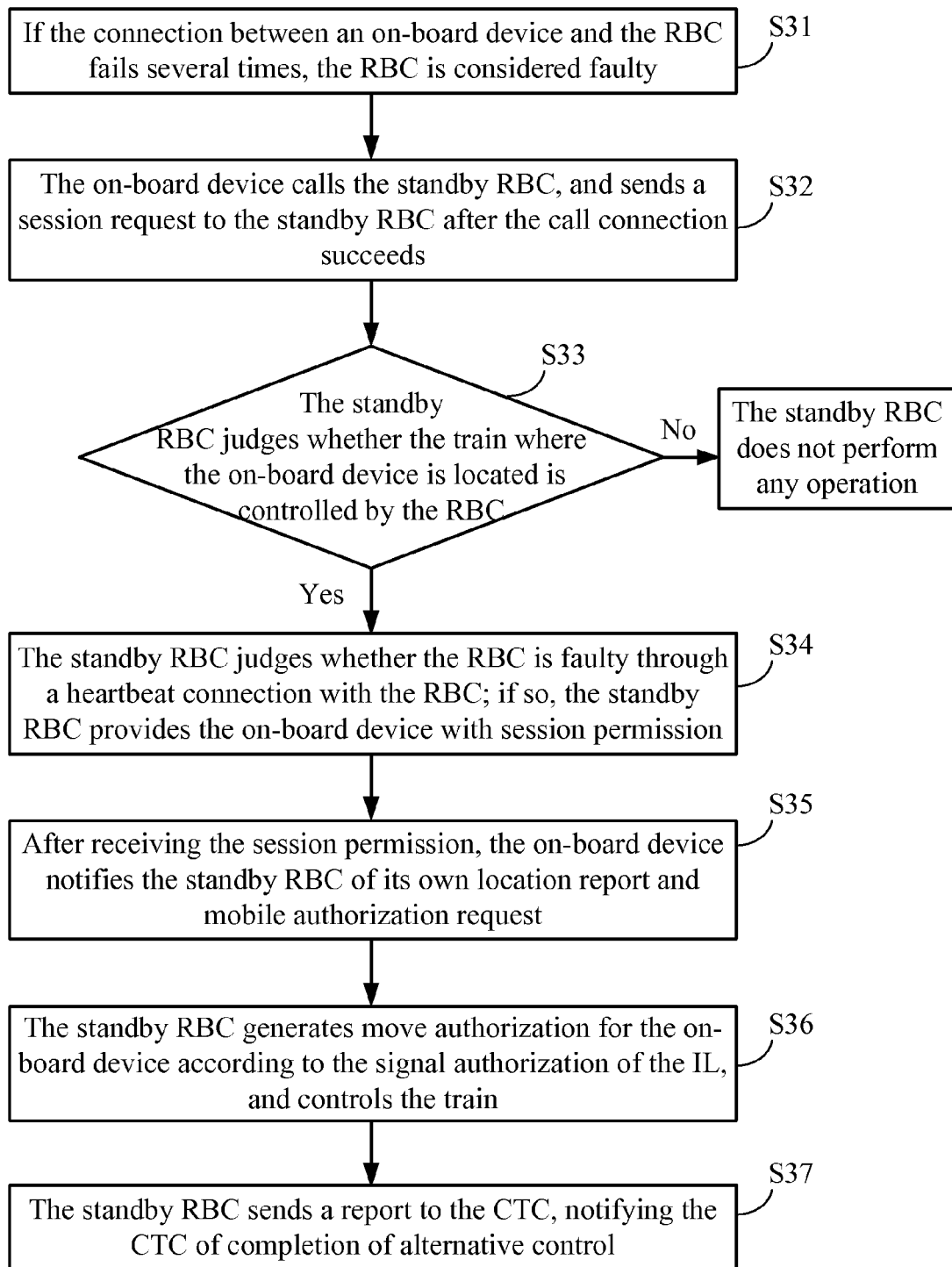


FIG. 3

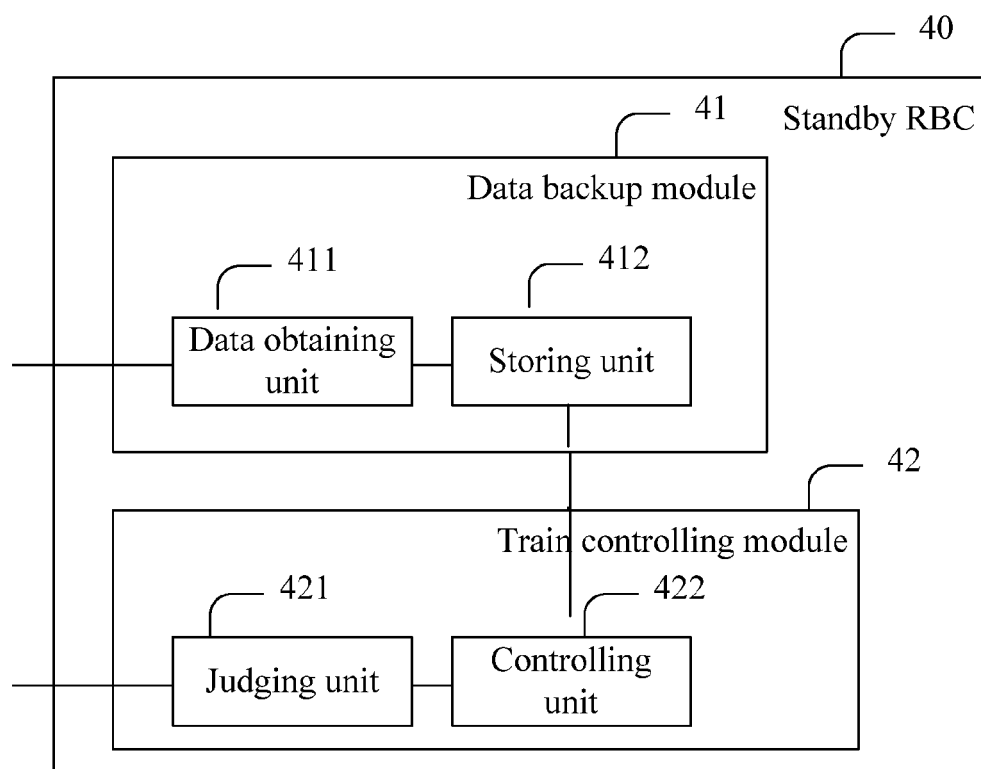


FIG. 4

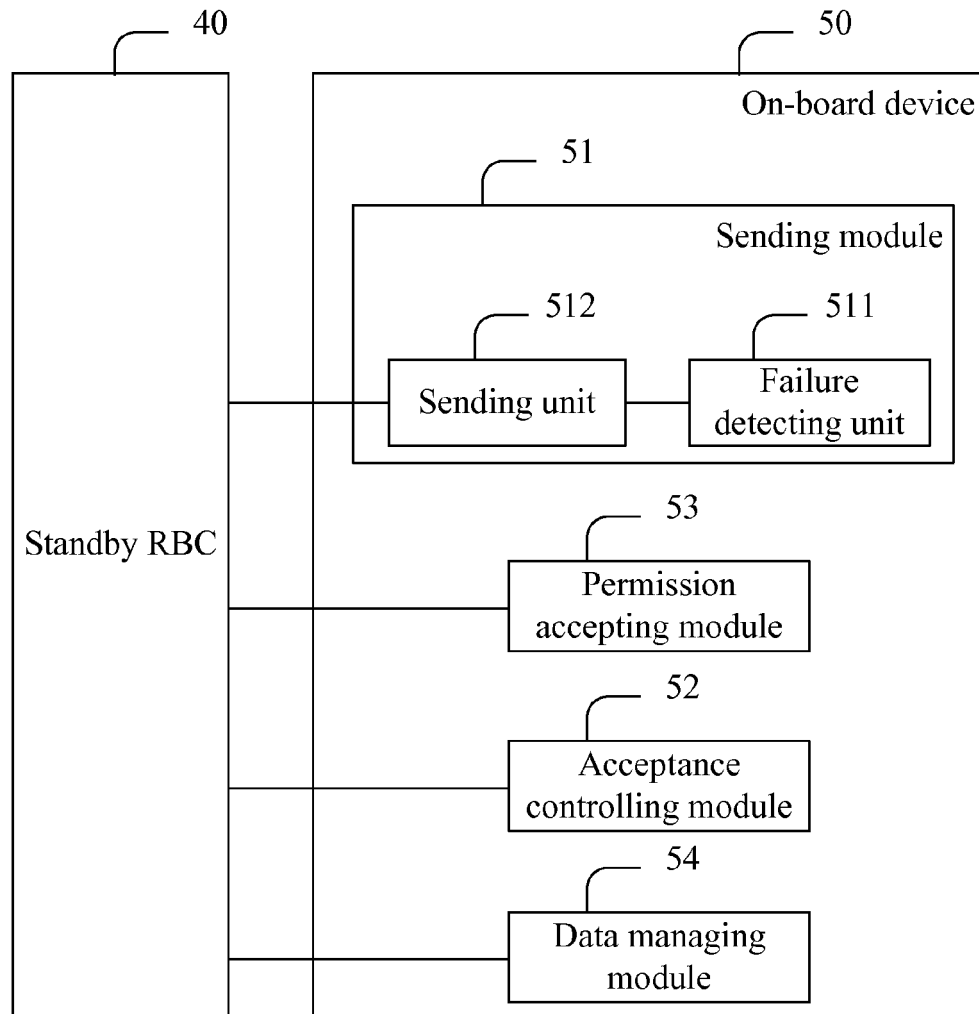


FIG. 5

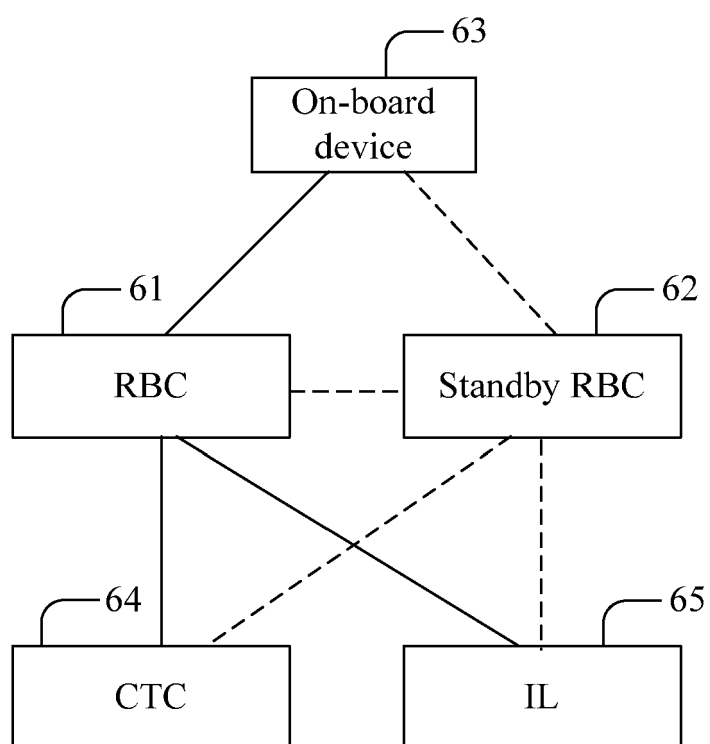


FIG. 6



EUROPEAN SEARCH REPORT

Application Number
EP 10 15 9207

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2007 041177 A1 (SIEMENS AG [DE]) 5 March 2009 (2009-03-05)	1-3,6-8, 13,14	INV. B61L27/00
Y	* paragraph [0001] - paragraph [0033] *	4,5	
A	-----	9,15,16	
A	EP 1 510 430 A1 (DB NETZ AG [DE]) 2 March 2005 (2005-03-02)	1-3,6-9, 13-16	
	* paragraph [0003] - paragraph [0019] *		
A	-----		
A	EP 1 370 054 A1 (SIEMENS AG [DE]) 10 December 2003 (2003-12-10)	1-3,6-9, 13-16	
	* paragraph [0001] - paragraph [0004]; figure 1 *		
Y	-----	4,5	
	ALCATEL ET AL: "SYSTEM REQUIREMENTS SPECIFICATION CHAPTER 3 PRINCIPLES (ERTMS/ETCS - Class 1, ref.: SUBSET-026-3; issue 2.2.2)" UNISIG SRS, XX, XX, vol. chapter 3, no. 2.2.2, 2 February 2001 (2001-02-02), pages 1-97, XP009069628 * chapter 3, page 32/97; chapter 3, page 51/97 * & "SYSTEM REQUIREMENTS SPECIFICATION. CHAPTER 2. BASIC SYSTEM DESCRIPTION" UNISIG SRS, XX, XX, vol. 2, 1 February 2002 (2002-02-01), pages 1-24, XP009069604 * page 8/24; figure 1 *		

The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 October 2010	Examiner Janhsen, Axel
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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EPO FORM 1503 03.82 (P04C01)



Application Number

EP 10 15 9207

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

☒ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☐ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 10 15 9207

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-3, 6-9, 13-16

Backing up between radio block centers

2. claim: 4

Speed restrictions from central traffic control

3. claim: 5

interlocking information for a plurality of radio block centers

4. claims: 10-12

Communication handling with RBCs in trains

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 10 15 9207

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-10-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102007041177 A1	05-03-2009	WO 2009027380 A1	05-03-2009
EP 1510430 A1	02-03-2005	AT 318745 T	15-03-2006
		DE 10336022 A1	24-02-2005
EP 1370054 A1	10-12-2003	DE 10225547 A1	08-01-2004