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Inventeur(s):
MA Jianguo – Guangdong 510060 (Chine), ZHOU
Shaohua – Guangdong 510060 (Chine)

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Mandataire(s):
OFFICE FREYLINGER S.A. – L-
8001 STRASSEN (Luxembourg)

47

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Titulaire(s):
Guangdong University of Technology – Guangdong
510060 (Chine)

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New high-speed railway communication system based on 5G technology.

- 57 The present invention discloses a new high-speed railway communication system based on a 5G technology, comprising a plurality of ground base stations arranged along a high-speed railway transportation line, a high-speed railway mobile base station where a high-speed railway train as a whole is used as a mobile base station, and various mobile terminals carried by high-speed railway passengers, wherein the new high-speed railway communication system based on the 5G technology adopts a two-layer architecture scheme, the mobile terminal is directly linked with the high-speed railway mobile base station, and the high-speed railway mobile base station is directly linked wirelessly with the ground base station. Compared with the prior art, the technical solution of the present invention has advantages such as strong communication signal quality, fast Internet access speed and high call quality, and can also achieve accurate positioning, provide fast and high-quality mobile communication services for high-speed railway users in a high-speed moving scene, and improve the Quos experience of high-speed railway users in the high-speed moving scene.

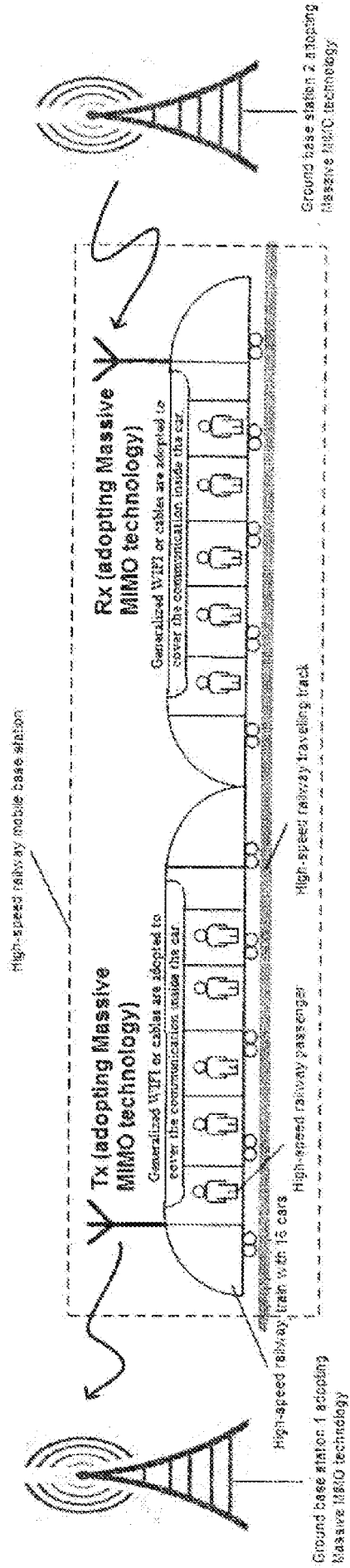


Fig.1

NEW HIGH-SPEED RAILWAY COMMUNICATION SYSTEM BASED ON 5G TECHNOLOGY

Technical field

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The present invention relates to the field of high-speed railway communication, in particular to a new high-speed railway communication system based on 5G technology.

10 Technical background

As a safe, comfortable and convenient means of transportation, the high-speed railway can greatly enhance the happiness index of travellers, and the increased speed of high-speed railway trains and the emergence of new-type trains bring
15 great convenience to numerous travellers. At the same time, people's requirements for the types and quality of communication services in high-speed railway train cars in a high-speed environment are gradually increasing. This not only requires the enjoyment of voice and SMS services on the high-speed railway train cars, but also achieves network information services such as web browsing, instant messaging,
20 and game video, which imposes more stringent requirements on high-speed railway wireless communications in the high-speed environment.

Due to different application scenes and environments, the high-speed railway wireless communication in the high-speed environment has the following three
25 technical problems compared to a common mobile communication. Firstly, Doppler frequency shift effect of the high-speed moving environment is significantly increased, which seriously affects the demodulation performance of a base station, so that the user's Internet access rate drops significantly and seriously affects the user's perception. Secondly, the time of a mobile terminal traversing a handover
30 area in a high-speed moving environment is less than a system processing switching time, which is prone to network problems such as off-network and seriously affects the normal use of the user. Thirdly, the loss of wireless signals in a process of penetrating through a high-speed railway train car in the high-speed moving environment increases with the increase of the vehicle speed, which may

lead to changes in KPI indicators such as a call drop rate, a handover success rate, and an access success rate, and eventually seriously degrade the network performance.

5 With respect to the above problems faced by the high-speed railway wireless communication of the high-speed environment, major communication operators and scientific research institutions have successively proposed high-speed railway communication system solutions, mainly including satellite technology-based solutions, universal mobile communication system solutions, and Long Time
10 Evolution Advanced (LTE) communication scheme, and so on. The LTE communication scheme can meet the basic use requirements of high-speed railway users in a high-speed moving scene, improve the mobile communication service quality experience of the users, and can support 3G and 2G technologies to form multi-mode gateways. Therefore, this communication scheme attracts
15 tremendous attention. However, in the high-speed moving scene, the LTE network in the high-speed railway train car still faces the conventional problems such as the large loss caused by the high-speed railway train vehicle body, Doppler frequency shift effect, and the extremely short switching time of the mobile terminal.

20 Summary of the invention

A main object of the present invention is to provide a new high-speed railway communication system based on a 5G technology with strong communication signal quality, a fast Internet access speed and high call quality, which is intended
25 to provide fast and high-quality mobile communication services for high-speed railway users in a high-speed moving scene, and improve the QoS experience of the high-speed railway users in the high-speed moving scene.

To achieve the above object, the present invention proposes a new high-speed
30 railway communication system based on a 5G technology, comprising a plurality of ground base stations arranged along a high-speed railway transportation line, a high-speed railway mobile base station where a high-speed railway train as a whole is used as a mobile base station, and various mobile terminals carried by high-speed railway passengers, wherein the new high-speed railway

communication system based on the 5G technology adopts a two-layer architecture scheme, the mobile terminal is directly linked with the high-speed railway mobile base station, and the high-speed railway mobile base station is directly linked wirelessly with the ground base station. Therefore, the present invention can avoid the defects due to a direct link between a single mobile terminal and a ground base station in the prior art, and can also accurately locate the high-speed railway train.

Preferably, the high-speed railway mobile base station comprises a receiving end and a transmitting end; the receiving end and the transmitting end are completely separated structures and are disposed on two ends of a vehicle body of the high-speed railway train, respectively; and the receiving end and the transmitting end of the high-speed railway mobile base station are separately linked one-to-one with the ground base station. Therefore, the present invention completely distinguishes from a 1-to-N link mode of a conventional ground base station where a single ground base station is simultaneously linked with N mobile terminals, and thereby interference or coupling between a receiving end (Rx) and a transmitting end (TX) during signal high-speed transmission in the high-speed moving scene can be effectively avoided.

Preferably, the receiving end, the transmitting end and the ground base station each adopt a large-scale antenna Massive MIMO technology.

Preferably, the mobile terminal and the high-speed railway mobile base station are linked by generalized WiFi or wired communication. Since the high-speed railway passengers sit in their seats most of the time, they can be connected directly using wired communication.

Preferably, the plurality of ground base stations is arranged in equal or non-equal intervals.

Preferably, the high-speed railway train comprises at least $8N$ cars, where N is a positive integer, and 8 cars are the minimum installation unit of the high-speed railway mobile base station.

The technical solution of the present invention has the following advantages over the prior art:

5 The new high-speed railway communication system proposed by the technical solution of the present invention adopts a two-layer architecture scheme, that is, the high-speed railway train as a whole is used as a mobile base station that is linked with a ground base station, and the generalized WiFi or cables (since the high-speed railway passengers sit in their seats most of the time) are adopted to
10 cover the inside of the high-speed railway train cars, ensuring the links between the high-speed railway train mobile base station and various mobile terminals of the passengers, and avoiding the direct link between the single mobile terminal and the ground base station. The new high-speed railway communication system of the technical solution of the present invention can effectively improve the problems of
15 poor communication signal quality, slow Internet access speed and poor call quality inside the high-speed railway train cars due to the large loss caused by the high-speed railway train vehicle body, and the extremely short switching time of the mobile terminal.

20 The technical solution of the present invention completely separates the receiving end (Rx) and transmitting end (TX) portions of the high-speed railway train mobile station, and can effectively avoid the interference or coupling between the receiving end (Rx) and the transmitting end (TX) during signal high-speed transmission in the high-speed moving scene.

25 The high-speed railway train of the technical solution of the present invention as a whole is used as a mobile base station, the receiving (Rx) and transmitting (TX) portions of the mobile base station are completely separated, and are separately linked with the ground base station, and the 1-to-N link mode of the conventional
30 ground base station is changed to a 1-to-1 link (link between the ground base station with Rx or TX) mode.

In the new high-speed railway communication system proposed by the technical solution of the present invention, the receiving (Rx)/transmitting (TX) *portions of the*

ground base station and the high-speed railway mobile base station each adopt the large-scale antenna Massive MIMO technology, and have the following advantages. Firstly, transmit power can be effectively reduced, thereby reducing power consumption of the transmitter system and improving power efficiency. Secondly, the beam of the antenna is very narrow, which can greatly reduce the interference of various spurious signals in the free space. Thirdly, the resources of this dimension of space can be fully utilized, and links to ground base stations are provided for different high-speed railway train mobile base stations in the network within the same time and spectrum resources. Fourthly, interference to peripheral base stations is reduced. Fifthly, the Doppler frequency shift effect is fixed and does not increase significantly with the increase of the vehicle speed, which can effectively improve the problems of the poor demodulation performance of the base station and the slow Internet access speed of the user due to the significant increase of the Doppler frequency shift effect in the high-speed moving scene.

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The new high-speed railway communication system proposed by the technical solution of the present invention can realize real-time and precise positioning of high-speed railway trains in a high-speed moving scene. In the high-speed moving scene, because the traveling speed of high-speed railway trains is very fast, this will greatly increase the difficulty of updating GPS positioning information, especially when the high-speed railway trains pass through urban viaduct bottoms, mountain jungles, mountain canyons, tunnels, and the like. GPS signals are weak or there is even no signal, and the high-speed railway trains will not be able to locate via GPS. In the new communication system proposed by the present invention, the high-speed railway train as a whole is used as the mobile base station and performs real-time vehicle-to-ground communication with the ground base station. Since the location of the ground base station is strictly known, the traveling track of the high-speed railway train is strictly known, and the traveling speed of the high-speed railway train is strictly known, the real-time position of the high-speed railway train can be strictly calculated according to the Doppler radar principle, and then is uploaded by the high-speed railway train mobile base station to the ground base station in real time and is downloaded to the high-speed railway train.

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Brief description of the drawings

In order to more clearly illustrate the technical solutions in embodiments of the present invention or the prior art, the accompanying drawings needed to be used in the description of the embodiments or the prior art will be briefly described below. Obviously, the accompanying drawings in the following description are only some embodiments of the present invention, and other accompanying drawings can be obtained by ordinary persons skilled in the art from the structures illustrated in these accompanying drawings without any inventive efforts.

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Fig. 1 is a schematic structural diagram of a new high-speed railway communication system based on a 5G technology according to the present invention.

15 The implementation, functional features and advantages of the present invention will be further described with reference to the accompanying drawing.

Detailed description of the embodiments

20 The technical solutions in the embodiments of the present invention are clearly and completely described in the following with reference to the accompanying drawings in the embodiments of the present invention. Obviously, the described embodiments are only a part of the embodiments of the present invention, and not all the embodiments. All other embodiments obtained by ordinary persons skilled in the art based on the embodiments of the present invention without creative efforts are within the scope of the present invention.

30 It should be noted that if there is a directional indication (such as up, down, left, right, front, back, ...) mentioned in the embodiments of the present invention, the directional indication is only used to explain the relative positional relationship between components, motion status, and the like in a specific posture (as shown in the drawing), and if the specific posture changes, the directional indication also changes accordingly.

In addition, if there is a description of "first", "second", etc. in the embodiments of the present invention, the description of the "first", "second", etc. is used for the purpose of description only, and is not to be construed as an its relative importance or implicit indication of the number of technical features indicated. Thus, the features defined by "first" or "second" may include at least one of the features, either explicitly or implicitly. In addition, the technical solutions among the various embodiments may be combined with each other, but must be based on the enablement of those skilled in the art, and when the combination of the technical solutions is contradictory or impossible to implement, it should be considered that the combination of the technical solutions does not exist, and is not within the scope of protection claimed by the present invention.

The present invention proposes a new high-speed railway communication system based on a 5G technology.

15

Referring to Fig. 1, a new high-speed railway communication system based on a 5G technology according to an embodiment of the present invention includes a plurality of ground base stations arranged along a line, a high-speed railway mobile base station where a high-speed railway train as a whole is used as a mobile base station, and various mobile terminals carried by high-speed railway passengers, wherein the ground base stations arranged along a line are arranged in equal or non-equal intervals and adopt a large-scale antenna Massive MIMO technology, the high-speed railway mobile base station includes a receiving end Rx and a transmitting end TX of which functions are separated from each other, and the receiving end Rx and the transmitting end TX of the present embodiment each adopt the large-scale antenna Massive MIMO technology.

25

Specifically, the new high-speed railway communication system of the present embodiment adopts the entire high-speed railway train with 16 cars as a mobile base station, and the receiving end Rx and the transmitting end TX adopt completely separated structures, and the receiving end Rx and the transmitting end TX are disposed on two ends of the high-speed railway train, respectively.

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Since the entire high-speed railway train is used as the mobile base station, communication inside the high-speed railway train cars adopts a generalized WiFi wireless communication link mode or a wired link mode, wherein the wired link mode is applicable for the high-speed railway passengers who sit in their seats most of time to use electronic devices. With the above technical solutions, a reliable link between the high-speed railway train mobile station and the ground base station and link requirements of various mobile terminals carried by the high-speed railway passengers can be ensured, and finally the broadband service requirements of various mobile terminals carried by the high-speed railway passengers can be met.

The new high-speed railway communication system proposed in the present embodiment adopts a two-layer architecture scheme, that is, the high-speed railway train as a whole is used as a mobile base station and is linked to the ground base station, and a generalized WiFi or wired link is adopted inside the high-speed railway train car to ensure the link between the high-speed railway train mobile base station and various mobile terminals carried of the passengers and avoid the direct link between the single mobile terminal and the ground base station. Therefore, the communication system of the present embodiment can effectively improve the problems of poor communication signal quality, slow Internet access speed and poor call quality inside the high-speed railway train cars due to a large communication loss caused by the high-speed railway train vehicle body, and extremely short switching time of the mobile terminal.

In the present embodiment, the entire high-speed railway train is used as a mobile base station, and the receiving end Rx and the transmitting end TX are completely separated structures, and are each linked one-to-one with the ground base station (as shown in Fig. 1, TX is linked with the ground base station 1, and Rx is linked with the ground base station 2). Therefore, the 1-to-N link mode of the conventional ground base station is changed to a 1-to-1 link mode, and the mutually separated receiving end and transmitting end can effectively avoid interference or coupling between the receiving end (Rx) and the transmitting end (TX) during signal high-speed transmission in the high-speed moving scene.

In addition, the receiving end Rx, the transmitting end TX and the ground base station proposed by the technical solution of the present embodiment each adopt the large-scale antenna Massive MIMO technology, and have the following advantages. Firstly, transmit power can be effectively reduced, thereby reducing power consumption of the transmitter system and improving power efficiency. Secondly, the beam of the antenna is very narrow, which can greatly reduce the interference of various spurious signals in the free space. Thirdly, the resources of this dimension of space can be fully utilized, and links to ground base stations are provided for different high-speed railway train mobile base stations in the network within the same time and spectrum resources. Fourthly, interference to peripheral base stations is reduced. Fifthly, since the Doppler frequency shift effect is fixed and does not increase significantly with the increase of the vehicle speed, the present embodiment can effectively improve the problems of the poor demodulation performance of the base station and the slow Internet access speed of the user due to the significant increase of the Doppler frequency shift effect in the high-speed moving scene.

In addition, the technical solution of the present embodiment can also realize real-time and precise positioning of high-speed railway trains in the high-speed moving scene. In the high-speed moving scene, since the traveling speed of the high-speed railway trains is very fast, this will greatly increase the difficulty of updating GPS positioning information, especially when the high-speed railway trains pass through urban viaduct bottoms, mountain jungles, mountain canyons, tunnels, and the like, and since GPS signals are weak or there is even no signal, the high-speed railway trains will not be able to locate via GPS. In the technical solution of the present embodiment, the high-speed railway train as a whole is used as the mobile base station and performs real-time vehicle-to-ground communication with the ground base station. Since the location of the ground base station is strictly known, the traveling track of the high-speed railway train is strictly known, and the traveling speed of the high-speed railway train is strictly known, a real-time position of the high-speed railway train can be strictly calculated according to the Doppler radar principle, and then is uploaded by the high-speed railway train mobile base station to the ground base station in real time and is downloaded to the high-speed railway train.

The above is only a preferred embodiment of the present invention, and is not intended to limit the scope of the invention. All equivalent structural variants made by using the description and drawings of the present invention, or direct or indirect
5 applications thereof in other related technical fields, in the concept of the present invention, are encompassed within the scope of patent protection of the present invention.

Claims

1. A new high-speed railway communication system based on a 5G technology, characterized in that it comprises a plurality of ground base stations arranged along a high-speed railway transportation line, a high-speed railway mobile base station where a high-speed railway train as a whole is used as a mobile base station, and various mobile terminals carried by high-speed railway passengers, wherein the new high-speed railway communication system based on the 5G technology adopts a two-layer architecture scheme, the mobile terminals are directly linked with the high-speed railway mobile base station, and the high-speed railway mobile base station is directly linked wirelessly with the ground base station.
2. The new high-speed railway communication system based on the 5G technology of claim 1, characterized in that the high-speed railway mobile base station comprises a receiving end and a transmitting end; the receiving end and the transmitting end are completely separated structures and are disposed on two ends of a vehicle body of the high-speed railway train, respectively; and the receiving end and the transmitting end of the high-speed railway mobile base station are separately linked one-to-one with the ground base station.
3. The new high-speed railway communication system based on the 5G technology of claim 2, characterized in that the receiving end, the transmitting end and the ground base station each adopt a large-scale antenna Massive MIMO technology.
4. The new high-speed railway communication system based on the 5G technology of claim 3, characterized in that the mobile terminals and the high-speed railway mobile base station are linked by generalized WiFi or wired communication.
5. The new high-speed railway communication system based on the 5G technology of claim 4, characterized in that the plurality of ground base stations are arranged in equal or non-equal intervals.
6. The new high-speed railway communication system based on the 5G technology

of claim 5, characterized in that the high-speed railway train comprises at least $8N$ cars, where N is a positive integer, and 8 cars are the minimum installation unit of the high-speed railway mobile base station.

1. Ein neues Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie, dadurch gekennzeichnet, dass es eine Vielzahl von Bodenbasisstationen, die entlang einer Transportlinie der Hochgeschwindigkeitsbahn angeordnet sind, eine mobile Hochgeschwindigkeitsbahnbasisstation, an der ein Hochgeschwindigkeitsbahnzug als Ganzes als mobile Basisstation verwendet wird, und verschiedene mobile Endgeräte, die von Fahrgästen der Hochgeschwindigkeitsbahn gehalten werden, umfasst, wobei das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie ein zweischichtiges Architekturschema übernimmt, und wobei die mobilen Endgeräte direkt mit der mobilen Hochgeschwindigkeitsbahnbasisstation verbunden sind, und die mobile Hochgeschwindigkeitsbahnbasisstation direkt drahtlos mit der Bodenbasisstation verbunden ist.

2. Das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie nach Anspruch 1, dadurch gekennzeichnet, dass die mobile Hochgeschwindigkeitsbahnbasisstation ein Empfangsende und ein Sendeende umfasst; das Empfangsende und das Sendeende vollständig getrennte Strukturen sind und jeweils an einer Ende einer Fahrzeugkarosserie des Hochgeschwindigkeitszuges angeordnet sind; und das Empfangsende und das Sendeende der mobilen Hochgeschwindigkeitsbahnbasisstation getrennt eins zu eins mit der Bodenbasisstation verbunden sind.

3. Das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie nach Anspruch 2, dadurch gekennzeichnet, dass das Empfangsende Ende, das Sendeende und die Bodenbasisstation jeweils eine Massive MIMO-Technologie für Großantennen verwenden.

4. Das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von

5G-Technologie nach Anspruch 3, dadurch gekennzeichnet, dass die mobilen Endgeräte und die mobile Hochgeschwindigkeitsbahnbasisstation über eine allgemeine drahtlose oder drahtgebundene Kommunikation miteinander verbunden sind.

5. Das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie nach Anspruch 4, dadurch gekennzeichnet, dass die mehreren Bodenbasisstationen in gleichen oder ungleichen Intervallen angeordnet sind.

6. Das neue Kommunikationssystem für Hochgeschwindigkeitsbahn auf der Basis von 5G-Technologie nach Anspruch 5, dadurch gekennzeichnet, dass der Hochgeschwindigkeitszug aus mindestens $8N$ Wagen besteht, wobei N eine positive ganze Zahl ist, und 8 Wagen die minimale Installationseinheit der mobilen Hochgeschwindigkeitsbahnbasisstation sind.

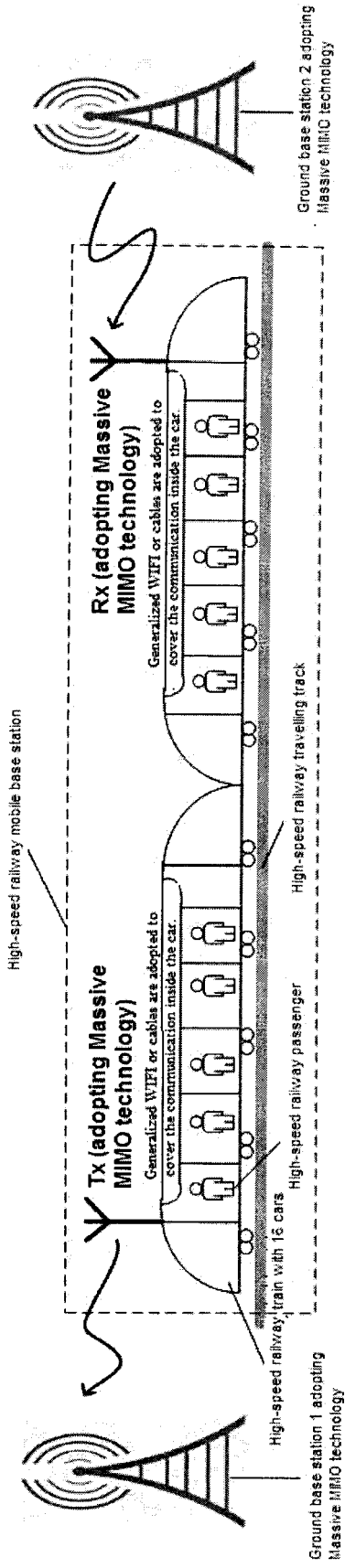


Fig.1