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(54) METHOD AND DEVICE FOR VIRTUAL PORT MAPPING FOR MASSIVE MIMO

VERFAHREN UND VORRICHTUNG ZUR ABBILDUNG VIRTUELLER PORTS FÜR MASSIVE-MIMO

PROCÉDÉ ET DISPOSITIF DE MAPPAGE DE PORT VIRTUEL POUR MIMO MASSIF

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to the field of communications, in particular to a virtual port mapping technology of massive MIMO.

BACKGROUND

[0002] The miniaturization of single antenna and the high frequency in 5G wireless systems increase the path loss, making massive MIMO (massive Multiple-Input Multiple-Output) become a solution in 5G, that is, massive MIMO with a large number of antennas is used in an antenna array of the same size to compensate for the high path loss. In this scheme, a large number of antennas (e.g., hundreds or thousands) are deployed to provide better spectrum efficiency and better energy efficiency.

[0003] However, for practical products, it is infeasible to employ full digital precoding to achieve massive MIMO gain on the whole radio frequency chains (e.g., 64RF chain or more). The main bottlenecks are hardware processing complexity and cost, channel measurement and feedback overhead.

[0004] Considering the practical constraints in product implementation, the prior art mainly reduces the size of the array by reducing the antenna elements, such as selecting partial transceiver units (TRX). Due to the reduction of antenna elements, the elements used to transmit data are reduced, this approach results in the potential risk of significant loss of performance in both cell coverage and cell throughput.

[0005] WO 2017/195183 A1 discloses precoding and channel state information acquisition for multi-stram transmissions in massive MIMO systems. EP 3 068 060 A1 discloses method and apparatus for transmitting a signal in a wireless communication system. EP 2 777 172 A1 discloses a method of antenna array dynamic configuration for 3-Dimension beamforming in a wireless network. US 2015/312919 A1 discloses a Virtual Antenna Mapping method of a base station and a transmission apparatus.

SUMMARY

[0006] The object of the present disclosure is to provide a method and apparatus for virtual port mapping of a massive MIMO unit according to independent claims 1 and 6. Further embodiments are described in the dependent claims.

[0007] Compared with the prior art, the present disclosure maps one or more transceiver units to a virtual port by performing hybrid beamforming for at least one transceiver unit in massive MIMO, and then performs digital precoding based on the virtual port; thus, the present disclosure can have the following advantages:

1) The present disclosure is an adaptive technology adapted to the existing architecture, especially suitable for baseband processing of massive MIMO in 5G NR.
2) The present disclosure is based on virtual port mapping technology, which reduces the number of ports required for baseband processing, thus simplifying baseband processing, and furthermore, the present disclosure does not reduce the number of antenna elements utilized. Compared with the mode of reducing physical ports in the prior art, the performance of the present disclosure in single user scheduling and multi-user scheduling is greatly improved.
3) The present disclosure can utilize digital precoding in hybrid beamforming to perform energy efficiency management.
4) The present disclosure can be used more flexibly as a medium-term beamforming scheme in different frequency domain and time domain, while traditional analog beamforming is a long-term/semi-static beamforming scheme in time domain.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0008] Other features, objectives, and advantages of the present disclosure will become more apparent through reading the following detailed depiction of the non-limitative embodiments with reference to the accompanying drawings:

Fig. 1 shows a flow diagram of a method for virtual port mapping of massive MIMO according to an embodiment of the present disclosure;
FIG. 2 shows a schematic diagram of a virtual port mapping according to a preferred embodiment of the present disclosure;
Fig. 3 shows a flow diagram of a method for virtual port mapping of massive MIMO according to another embodiment of the present disclosure;
FIG. 4 shows a schematic diagram of a virtual port mapping mode according to a preferred embodiment of the present disclosure;
Fig. 5 shows a schematic diagram of a mapping device for virtual port mapping of massive MIMO according to an embodiment of the present disclosure;
Fig. 6 shows a schematic diagram of a mapping device for virtual port mapping of massive MIMO according to another embodiment of the present disclosure;
FIG. 7 shows an exemplary system that can be used to implement the various embodiments described in the present disclosure.

[0009] Same or similar reference numbers in the drawings represent the same or similar components.

DETAILED DESCRIPTION

[0010] The present disclosure will be further described in detail below with reference to the accompanying drawings.

[0011] In a typical configuration of the present disclosure, both the device and the trusted party include one or more processors (CPUs), input/output interfaces, network interfaces and memory.

[0012] The memory may include non-permanent memory, Random Access Memory (RAM) and/or non-volatile memory in computer readable media, such as Read Only Memory (ROM) or flash memory (flash RAM). Memory is an example of a computer readable medium.

[0013] Computer readable media include permanent and non-permanent, removable and non-removable media, may implement the information storage by any method or technology. The information may be computer readable instructions, data structures, modules of a program, or other data. Examples of computer storage media include, but are not limited to, Phase Change Memory (PRAM), Static Random Access Memory (SRAM), Dynamic Random Access Memory (DRAM), other types of Random Access Memory (RAM), Read Only Memory (ROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), flash memory or other memory technology, Compact Disc Read-Only Memory (CD-ROM), Digital Versatile Disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other non-transmission medium, which can be used to store information that can be accessed by a computing device.

[0014] The mapping device referred to in the present disclosure includes, but is not limited to, a network device or a base station device. The network device includes an electronic device capable of automatically performing numerical calculation and information processing according to preset or stored instructions, and hardware thereof includes, but is not limited to, a microprocessor, an Application Specific Integrated Circuit (ASIC), a Programmable Logic Device (PLD), a Field Programmable Gate Array (FPGA), a Digital Signal Processor (DSP), an embedded device, and the like. The network device includes, but is not limited to, a computer, a network host, a single network server, multiple network server sets, or a cloud composed of multiple servers; here, the cloud is composed of a large number of computers or network servers based on Cloud Computing, wherein cloud computing is a type of distributed computing, a virtual supercomputer composed of a cluster of loosely coupled computer sets. The network includes, but not limited to, the internet, a wide area network, a metropolitan area network, a local area network, a VPN network, a wireless Ad Hoc network, etc.

[0015] The base station device may be considered synonymous with and/or refer to the following: a Base Transceiver Station (BTS), base station (NodeB), extended base station (eNB), femtocell, access point, etc., and may be described as a device that provides radio baseband functionality for data and/or voice connectivity between the network and one or more users.

[0016] In addition, the user equipment in the present disclosure includes, but is not limited to, any mobile electronic product, such as a smart phone, a tablet computer, etc., which can perform human-computer interaction with a user (for example, human-computer interaction through a touch panel), and the mobile electronic product may employ any operating system, such as an android operating system, an iOS operating system, etc.

[0017] Communication from the base station to the user equipment is commonly referred to as downlink or forward link communication. Communication from the user equipment to the base station is commonly referred to as uplink or reverse link communication.

[0018] Preferably, the present disclosure can be applied to a 5G system.

[0019] Of course, those skilled in the art will understand that the above-described devices are merely exemplary, and that other existing or future existing devices, as may be suitable for use in the present disclosure, are intended to be encompassed within the scope of the present disclosure and are hereby incorporated by reference.

[0020] In the description of the present disclosure, "plurality" means two or more, unless otherwise clearly defined.

[0021] Fig. 1 shows a flow diagram of a method for virtual port mapping of massive MIMO according to an embodiment of the present disclosure. In step S1, the mapping device maps at least one transceiver unit in massive MIMO to a virtual port through hybrid beamforming; in step S2, the mapping device performs digital precoding based on the virtual port.

[0022] Specifically, in step S1, the hybrid beamforming includes analog beamforming and digital precoding.

[0023] Here, if the number of the transceiver units mapped to the same virtual port is greater than 1, the hybrid beamforming step includes: performing analog beamforming in a plurality of transceiver units in massive MIMO; performing digital precoding between the plurality of transceiver units after the analog beamforming to combine them into a virtual port. Thus, after analog beamforming and digital precoding, the plurality of transceiver units are mapped to a virtual port.

[0024] If the number of the transceiver units mapped to the same virtual port is equal to 1, the mapping device may use hybrid beamforming step to perform analog beamforming and digital precoding on the transceiver unit, so as to map the transceiver unit to a virtual port. Alternatively, the mapping device may only perform analog beamforming on the transceiver unit.

[0025] Then, in step S2, the mapping device performs digital precoding based on the virtual port. Here, for a virtual port formed by one transceiver unit, its digital precoding is regarded as a unit matrix.

[0026] Through the above steps, the present disclosure designs an intermediate layer between analog beamforming and traditional baseband digital precoding, and each virtual port includes at least one transceiver unit to be mapped to antenna port as a minimum unit. Then, the traditional digital precoding is transferred from the transceiver units onto the virtual port.

[0027] Those skilled in the art should understand that, for the same massive MIMO, the plurality of transceiver units included therein may be mapped to different virtual ports in one or more ways.

[0028] Fig. 2 shows a schematic diagram of a virtual port mapping according to a preferred embodiment of the present disclosure. Massive MIMO 20 contains 192 antenna elements (AE) in total; the transceiver unit 201 includes 6 antenna elements, and since these 6 antenna elements belong to two poles, the transceiver unit 201 represents 2 transceiver units (TRX), that is, each transceiver unit contains 3 antenna elements on the same pole. It can be seen that the massive MIMO 20 includes 64 transceiver units (TRX) in total.

[0029] The virtual port 205 includes 16 transceiver units, through virtual port mapping technique, the 16 transceiver units are mapped to 2 virtual ports (corresponding to two poles respectively), and each virtual port includes 8 transceiver units.

[0030] The virtual port 206 includes 4 transceiver units, through virtual port mapping technique, the 4 transceiver units are mapped to 2 virtual ports (corresponding to two poles respectively), and each virtual port includes 2 transceiver units.

[0031] Here, the position of the transceiver unit(s) between antenna arrays can affect the performance of the virtual port.

[0032] For example, as shown in fig. 2, if the transceiver 201 and the transceiver 202 are mapped to a first virtual port, the transceiver 203 and the transceiver 204 are mapped to a second virtual port, the transceiver 201 and the transceiver 203 are mapped to a third virtual port, and the transceiver 202 and the transceiver 204 are mapped to a fourth virtual port, the performance corresponding to the above four virtual ports are all different.

[0033] Preferably, the present disclosure further includes step S3 (not shown), wherein in step S3, the mapping device determines hybrid beamforming weight corresponding to at least one transceiver unit in massive MIMO; then, in step S1, the mapping device maps the at least one transceiver unit to a virtual port through hybrid beamforming according to the hybrid beamforming weight.

[0034] Here, the hybrid beamforming weight includes analog beamforming weight in transceiver unit and/or digital precoding weight between transceiver units.

[0035] The analog beamforming weight in transceiver unit includes two setting modes: one is that the weight corresponding to each transceiver unit is different; the other is that the weight corresponding to each transceiver unit is the same. The former has higher diversity gain and the latter has higher beam gain. An appropriate weight setting manner may be selected based on actual demand and processing performance.

[0036] The digital precoding weight between transceiver units includes two setting modes: one is to set the digital precoding weight based on user measurement feedback and/or uplink channel measurement, for example, first configure a part of transceiver units to map to a virtual port in a 1:1 manner to send pilot signals for user measurement feedback and/or base station uplink channel measurement, when the user measurement feedback and/or the base station uplink channel measurement information are obtained, the digital precoding weight is set based on the above information, and digital precoding is performed on the transceiver unit; and the other is to set a fixed digital precoding weight. In step S3, the mapping device can determine the hybrid beamforming weight based on a default scheme, or can determine the hybrid beamforming weight in real time based on the current actual demand and processing performance. Then, in step S1, the mapping device performs mapping on the at least one transceiver unit according to the hybrid beamforming weight.

[0037] Fig. 3 shows a flow diagram of a method for virtual port mapping of massive MIMO according to another embodiment of the present disclosure. In step S4, the mapping device determines one or more virtual port modes for massive MIMO according to user distribution of the cell served by the massive MIMO, where the virtual port modes comprise the number of virtual ports corresponding to the massive MIMO, the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays; in step S1, the mapping device maps, based on the virtual port mode, at least one transceiver unit in the massive MIMO to a virtual port corresponding to the transceiver unit in the virtual port mode through hybrid beamforming; in step S2, the mapping device performs digital precoding based on the virtual port.

[0038] Wherein, the step S2 is the same as or similar to the step S2 shown in Fig. 1, so it is not repeated here and is included here by reference.

[0039] Specifically, in step S4, the mapping device determines one or more virtual port modes for the massive MIMO in a real-time determined or predetermined manner.

[0040] Wherein, when in a real-time determined manner:

In step S4, the mapping device obtains the user distribution of the cell served by the massive MIMO directly, or analyzes the current scenario to obtain the user distribution; wherein the user distribution includes the position of user in the cell, the distance between user and the massive MIMO, the angle between user and the massive MIMO, the signal strength of user, and the like.

[0041] Then, the mapping device determines one or more virtual port modes for the massive MIMO according to the determined user distribution, where the virtual port mode is a mapping mode for mapping at least one transceiver unit in the massive MIMO to different virtual ports in a grouped manner, and the virtual port mode includes the number of virtual ports corresponding to the massive MIMO, the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays.

[0042] When in a predetermined manner:
In step S4, the mapping device determines one or more candidate virtual port modes for the massive MIMO in advance according to the potential user distribution of the cell served by the massive MIMO, wherein the potential user distribution may be determined based on historical data of the serving cell or other serving cells, or may be determined based on system default settings.

[0043] Then, the mapping device determines at least one candidate virtual port mode as the virtual port modes corresponding to the massive MIMO by a preset or real-time selection mode according to the current time domain and/or frequency domain demand information of the cell served by the massive MIMO.

[0044] For example, for cell edge users, a greater number of virtual ports or a greater virtual port size is required. Furthermore, in principle, the more antenna ports separated between an antenna array, the better the performance.

[0045] Preferably, for users at different distances, the downlink virtual port number/virtual port size and downlink transmit power allocation can be automatically adjusted based on the following two factors:

One is based on Uplink Power Control Transmit Power (ULPC TxPw) and Power Headroom, for example, the Power Headroom and Reference Signal Received Power (RSRP) of cell edge users are lower;

The second is based on Downlink Channel State Information (DL CSI) feedback, for example, the Channel Quality Indication (CQI) of cell edge users is lower.

[0046] Therefore, the present disclosure can judge the distance of the user based on the above two factors, and further determine the required downlink virtual port number/virtual port size and the downlink transmission power. For example, a greater number of virtual ports or a greater virtual port size may be allocated for cell edge users.

[0047] Since the scenario of the serving cell is constantly changing, the mapping device may determine a plurality of virtual port modes for use. In step S 1, based on the virtual port modes, at least one transceiver unit in the massive MIMO is mapped to a virtual port corresponding to the transceiver unit in the virtual port modes through hybrid beamforming.

[0048] Fig. 4 shows a schematic diagram of a virtual port mapping mode according to a preferred embodiment of the present disclosure.

[0049] The massive MIMO 40 includes a total of 192 Antenna Elements (AE), and the 192 Antenna elements constitute 64 transceiver units. Through mapping, the 64 transceiver units are mapped to 24 virtual ports, wherein the virtual port 401 includes 8 transceiver units, the virtual port 402 and the virtual port 403 include 4 transceiver units.

[0050] The virtual port 401 is used for user equipment 404 at the cell edge; while the virtual port 402 and the virtual port 403 are used for user equipment 405, user equipment 406, user equipment 407 and user equipment 408 inside the cell.

[0051] Fig. 5 shows a schematic diagram of a mapping device for virtual port mapping of massive MIMO according to an embodiment of the present disclosure; wherein, the mapping device 50 includes a first means 501 and a second means 502.

[0052] Specifically, the first means 501 maps at least one transceiver unit in massive MIMO to a virtual port through hybrid beamforming; the second means 502 performs digital precoding based on the virtual port.

[0053] The hybrid beamforming includes analog beamforming and digital precoding.

[0054] Here, if the number of the transceiver units mapped to the same virtual port is greater than 1, the hybrid beamforming step includes: performing analog beamforming in a plurality of transceiver units in massive MIMO; performing digital precoding between the plurality of transceiver units after the analog beamforming to combine them into a virtual port. Thus, after analog beamforming and digital precoding, the plurality of transceiver units are mapped to a virtual port.

[0055] If the number of the transceiver units mapped to the same virtual port is equal to 1, the mapping device may use hybrid beamforming step to perform analog beamforming and digital precoding on the transceiver unit, so as to map the transceiver unit to a virtual port. Alternatively, the mapping device may only perform analog beamforming on the transceiver unit.

[0056] Then, the second means 502 performs digital precoding based on the virtual port. Here, for a virtual port formed by one transceiver unit, its digital precoding is regarded as a unit matrix.

[0057] Through the above steps, the present disclosure designs an intermediate layer between analog beamforming and traditional baseband digital precoding, and each virtual port includes at least one transceiver unit to be mapped to antenna port as a minimum unit. Then, the traditional digital precoding is transferred from the transceiver units onto the virtual port.

[0058] Those skilled in the art should understand that, for the same massive MIMO, the plurality of transceiver units included therein may be mapped to different virtual ports in one or more ways.

[0059] Preferably, the mapping device 50 further includes a third means (not shown), wherein, the third means determines hybrid beamforming weight corresponding to at least one transceiver unit in massive MIMO; then, the first means 501 maps the at least one transceiver unit to a virtual port through hybrid beamforming according to the hybrid beamforming weight.

[0060] Here, the hybrid beamforming weight includes analog beamforming weight in transceiver unit and/or digital precoding weight between transceiver units.

[0061] The analog beamforming weight in transceiver unit includes two setting modes: one is that the weight corresponding to each transceiver unit is different; the other is that the weight corresponding to each transceiver unit is the same. The former has higher diversity gain and the latter has higher beam gain. An appropriate weight setting manner may be selected based on actual demand and processing performance.

[0062] The digital preceding weight between transceiver units includes two setting modes: one is to set the digital precoding weight based on user measurement feedback and/or uplink channel measurement, for example, first configure a part of transceiver units to map to a virtual port in a 1:1 manner to send pilot signals for user measurement feedback and/or base station uplink channel measurement, when the user measurement feedback and/or the base station uplink channel measurement information are obtained, the digital precoding weight is set based on the above information, and digital precoding is performed on the transceiver unit; and the other is to set a fixed digital precoding weight.

[0063] The third means can determine the hybrid beamforming weight based on a default scheme, or can determine the hybrid beamforming weight in real time based on the current actual demand and processing performance. Then, the first means 501 performs mapping on the at least one transceiver unit according to the hybrid beamforming weight.

[0064] Fig. 6 shows a schematic diagram of a mapping device for virtual port mapping of massive MIMO according to another embodiment of the present disclosure. Wherein, the mapping device 50 includes a fourth means 604, a first means 601 and a second means 602.

[0065] Specifically, the fourth means 604 determines one or more virtual port modes for massive MIMO according to user distribution of the cell served by the massive MIMO, where the virtual port modes comprise the number of virtual ports corresponding to the massive MIMO, the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays; the first means 601 maps, based on the virtual port mode, at least one transceiver unit in the massive MIMO to a virtual port corresponding to the transceiver unit in the virtual port mode through hybrid beamforming; the second means 602 performs digital precoding based on the virtual port.

[0066] Wherein, the second means 602 is the same as or similar to the second means 502 shown in Fig. 5, so it is not repeated here and is included here by reference.

[0067] Specifically, the fourth means 604 determines one or more virtual port modes for the massive MIMO in a real-time determined or predetermined manner.

[0068] Wherein, when in a real-time determined manner:

The fourth means 604 obtains the user distribution of the cell served by the massive MIMO directly, or analyzes the current scenario to obtain the user distribution; wherein the user distribution includes the position of user in the cell, the distance between user and the massive MIMO, the angle between user and the massive MIMO, the signal strength of user, and the like.

[0069] Then, the mapping device determines one or more virtual port modes for the massive MIMO according to the determined user distribution, where the virtual port mode is a mapping mode for mapping at least one transceiver unit in the massive MIMO to different virtual ports in a grouped manner, and the virtual port mode includes the number of virtual ports corresponding to the massive MIMO, the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays.

[0070] When in a predetermined manner:

The fourth means 604 determines one or more candidate virtual port modes for the massive MIMO in advance according to the potential user distribution of the cell served by the massive MIMO, wherein the potential user distribution may be determined based on historical data of the serving cell or other serving cells, or may be determined based on system default settings.

[0071] Then, the fourth means 604 determines at least one candidate virtual port mode as the virtual port modes corresponding to the massive MIMO by a preset or real-time selection mode according to the current time domain and/or frequency domain demand information of the cell served by the massive MIMO.

[0072] For example, for cell edge users, a greater number of virtual ports or a greater virtual port size is required. Furthermore, in principle, the more antenna ports separated between an antenna array, the better the performance.

[0073] Preferably, for users at different distances, the downlink virtual port number/virtual port size and downlink transmit power allocation can be automatically adjusted based on the following two factors:

> One is based on Uplink Power Control Transmit Power (ULPC TxPw) and Power Headroom, for example, the Power Headroom and Reference Signal Received Power (RSRP) of cell edge users are lower;
>
> The second is based on Downlink Channel State Information (DL CSI) feedback, for example, the Channel Quality Indication (CQI) of cell edge users is lower.

[0074] Therefore, the present disclosure can judge the distance of the user based on the above two factors, and further determine the required downlink virtual port number/virtual port size and the downlink transmission power. For example, a greater number of virtual ports or a greater virtual port size may be allocated for cell edge users.

[0075] Since the scenario of the serving cell is constantly changing, the mapping device may determine a plurality of virtual port modes for use. The first means 601, based on the virtual port modes, at least one transceiver unit in the massive MIMO is mapped to a virtual port corresponding to the transceiver unit in the virtual port modes through hybrid beamforming.

[0076] FIG. 7 shows an exemplary system that can be used to implement the various embodiments described in the present disclosure.

[0077] In some embodiments, the system 70 can be implemented as any device in the embodiments shown in Fig. 1, Fig. 2, Fig. 3, Fig. 4, Fig. 5, Fig. 6, or other described embodiments. In some embodiments, system 70 may include one or more computer readable media (e.g., system memory or NVM/storage device 720) having instructions and one or more processors (e.g., processor(s) 705) coupled with the one or more computer readable media and configured to execute the instructions to implement modules to perform the actions described in the present disclosure.

[0078] For one embodiment, system control module 710 may include any suitable interface controller to provide any suitable interface to at least one of processor(s) 705 and/or to any suitable device or component in communication with system control module 710.

[0079] The system control module 710 may include a memory controller module 730 to provide an interface to the system memory 715. Memory controller module 730 may be a hardware module, a software module, and/or a firmware module.

[0080] System memory 715 may be used to load and store data and/or instructions, for example, for system 70. For one embodiment, system memory 715 may include any suitable volatile memory, such as suitable DRAM. In some embodiments, system memory 715 may include a Double Data Rate type Fourth Synchronous Dynamic Random Access Memory (DDR4 SDRAM).

[0081] For one embodiment, system control module 710 may include one or more input/output (I/O) controllers to provide an interface to NVM/storage device 720 and communication interface(s) 725.

[0082] For example, NVM/storage device 720 may be used to store data and/or instructions. NVM/storage device 720 may include any suitable non-volatile memory (e.g., flash memory) and/or may include any suitable non-volatile storage device(s) (e.g., one or more hard disk drives (HDD), one or more Compact Disc (CD) drives, and/or one or more Digital Versatile Disc (DVD) drives).

[0083] NVM/storage device 720 may include storage resources that are physically part of the device on which system 70 is installed, or it may be accessible by the device and not necessarily to be part of the device. For example, NVM/storage device 720 may be accessed via the communication interface(s) 725 through the network.

[0084] Communication interface(s) 725 may provide an interface for system 70 to communicate via one or more networks and/or with any other suitable devices. System 70 may wirelessly communicate with one or more components of a wireless network according to any of one or more wireless network standards and/or protocols.

[0085] For one embodiment, at least one of the processor(s) 705 may be packaged together with logic for one or more controller(s) (e.g., memory controller module 730) of the system control module 710. For one embodiment, at least one of the processor(s) 705 may be packaged together with logic for one or more controller(s) of the system control module 710 to form a System in Package (SiP). For one embodiment, at least one of the processor(s) 705 may be integrated with logic for one or more controller(s) of the system control module 710 on the same mold. For one embodiment, at least one of the processor(s) 705 may be integrated with logic for one or more controller(s) of system control module 710 on the same mold to form a system on chip (SoC).

[0086] In various embodiments, the system 70 may be, but is not limited to being: a server, a workstation, a desktop computing device, or a mobile computing device (for example, a laptop computing device, a handheld computing device, a tablet, a netbook, etc.). In various embodiments, the system 70 may have more or fewer components and/or different architectures. For example, in some embodiments, the system 70 includes one or more cameras, a keyboard, a Liquid Crystal Display (LCD) screen (including a touch screen display), a non-volatile memory port, multiple antennas, a graphics chip, an Application Specific Integrated Circuit (ASIC), and speakers.

[0087] It should be noted that the present application may be implemented in software and/or a combination of software and hardware, for example, it can be implemented using an Application Specific Integrated Circuit (ASIC), a general purpose computer or any other similar hardware device. In one embodiment, the software programs of the present application may be executed by a processor to implement the steps or functions described above. Similarly, the software programs (including associated data structures) of the present application can be stored in a computer readable recording medium, such as RAM memory, magnetic or optical drive or diskette and the like. Further, some steps or functions of the present application may be implemented by hardware, for example, as a circuit that cooperates with the processor to perform each step or function.

[0088] In addition, a part of the present application may be applied as a computer program product, such as computer program instructions, which, when executed by a computer, may invoke or provide the method and/or solution according to the present application through the operation of the computer. Those skilled in the art should understand that the forms of computer program instructions that reside on a computer readable medium include, but are not limited to, source files, executable files, installation package files, and the like, and that the manner in which the computer program instructions are executed by a computer includes, but is not limited to: the computer directly executes the instruction, or the computer compiles the instruction and then executes the corresponding compiled program, or the computer reads and executes the instruction, or the computer reads and installs the instruction and then executes the corresponding installed program. In this regard, computer readable media can be any available computer readable storage media or communication media that can be accessed by a computer.

[0089] Communication media includes media whereby communication signals, including, for example, computer readable instructions, data structures, program modules, or other data, are transmitted from one system to another. Communication media may include conductive transmission media (such as cables and wires (e.g., fiber optics, coaxial, etc.)) and wireless (non-conductive transmission) media capable of propagating energy waves, such as sound, electromagnetic, RF, microwave, and infrared. Computer readable instructions, data structures, program modules or other data may be embodied as, for example, a modulated data signal in a wireless medium (such as a carrier wave or such as a similar mechanism embodied as part of spread spectrum technology). The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. The modulation may be analog, digital, or hybrid modulation techniques.

[0090] By way of example, and not limitation, computer-readable storage media may include volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. For example, computer-readable storage media include, but are not limited to, volatile memory such as random access memory (RAM, DRAM, SRAM); and non-volatile memory such as flash memory, various read-only memories (ROM, PROM, EPROM, EEPROM), magnetic and ferromagnetic/ferroelectric memories (MRAM, FeRAM); and magnetic and optical storage devices (hard disk, magnetic tape, CD, DVD); or other now known media or later developed that are capable of storing computer-readable information/data for use by a computer system.

[0091] An embodiment according to the present application herein comprises an apparatus comprising a memory for storing computer program instructions and a processor for executing the program instructions, wherein the computer program instructions, when executed by the processor, trigger the apparatus to perform a method and/or solution according to embodiments of the present application as described above.

[0092] To those skilled in the art, it is apparent that the present disclosure is not limited to the details of the above exemplary embodiments.

[0093] Thus, in any way, the embodiments should be regarded as exemplary, not limitative; the scope of the present disclosure is limited by the appended claims.

[0094] No reference signs in the claims should be regarded as limiting the involved claims. Besides, it is apparent that the term "comprise/comprising/include/including" does not exclude other units or steps, and singularity does not exclude plurality. A plurality of units or means stated in the apparatus claims may also be implemented by a single unit or means through software or hardware. Terms such as the first and the second are used to indicate names, but do not indicate any particular sequence.

[0095] The various aspects of the various embodiments are specified in the claims.

Claims

1. A method for virtual port mapping of a massive MIMO unit (20),

wherein the method comprises: mapping (S1) at least one transceiver unit in the massive MIMO unit (20) to a virtual port through hybrid beamforming; performing (S2) digital precoding based on the virtual port, wherein the method further comprises: determining (S4) one or more virtual port modes for the massive MIMO unit (20) according to user distribution of the cell served by the massive MIMO unit (20),
wherein the virtual port modes comprise the number of virtual ports corresponding to the massive MIMO unit (20), the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays; Wherein the step of mapping (S1) to a virtual port comprises: mapping, based on the virtual port mode, at least one transceiver unit in the massive MIMO unit (20) to a virtual port corresponding to the transceiver unit in the virtual port mode through hybrid beamforming.

2. The method according to claim 1, wherein the step of hybrid beamforming comprises: performing analog beamforming in at least one transceiver unit in the massive MIMO unit (20); performing digital precoding between the transceiver units after the analog beamforming.

3. The method according to claim 1 or 2, wherein the method further comprises: determining hybrid beamforming weight corresponding to at least one transceiver unit in the massive MIMO unit (20);
wherein the step of mapping to a virtual port comprises: mapping the at least one transceiver unit to a virtual port through hybrid beamforming according to the hybrid beamforming weight.

4. The method according to claim 3, wherein the hybrid beamforming weight comprises analog beamforming weight in transceiver unit and/or digital precoding weight between transceiver units.

5. The method according to claim 1, wherein the step of determining (S4) one or more virtual port modes for the massive MIMO unit (20) comprises: determining one or more candidate virtual port modes for the massive MIMO unit (20) according to the potential user distribution of the cell served by the massive MIMO unit (20), wherein the candidate virtual port modes comprise the number of virtual ports corresponding to the massive MIMO unit (20), the number of transceiver units in each virtual port and position information of the transceiver units among antenna arrays; determining at least one candidate virtual port mode as the virtual port modes corresponding to the massive unit (20) according to the current time domain and/or frequency domain demand information of the cell served by the massive MIMO unit (20) .

6. A mapping device (50) for virtual port mapping of a massive MIMO unit (20), wherein the mapping device (50) comprises: means (501) for mapping (S1) at least one transceiver unit in the massive MIMO unit (20) to a virtual port through hybrid beamforming; means (502) for performing digital precoding (S2) based on the virtual port, wherein the mapping device further comprises: means for determining one or more virtual port modes for the massive MIMO unit (20) according to user distribution of the cell served by the massive MIMO unit (20), wherein the virtual port modes comprise the number of virtual ports corresponding to the massive MIMO unit (20), the number of transceiver units in each virtual port, and position information of the transceiver units among antenna arrays; Wherein the means for mapping at least one transceiver unit in the massive MIMO unit (20) to a virtual port through hybrid beamforming is configured for: mapping, based on the virtual port mode, at least one transceiver unit in the massive MIMO unit (20) to a virtual port corresponding to the transceiver unit in the virtual port mode through hybrid beamforming.

7. The mapping device (50) according to claim 6, wherein the means for mapping at least one transceiver unit in the massive MIMO unit (20) to a virtual port through hybrid beamforming is configured for: performing analog beamforming in at least one transceiver unit in the massive MIMO unit (20); performing digital precoding between the transceiver units after the analog beamforming.

8. The mapping device (50) according to claim 6 or 7, wherein the mapping device further comprises: means for determining hybrid beamforming weight corresponding to at least one transceiver unit in the massive MIMO unit (20) ; wherein the means for mapping at least one transceiver unit in the massive MIMO unit (20) to a virtual port through hybrid beamforming is configured for: mapping the at least one transceiver unit to a virtual port through hybrid beamforming according to the hybrid beamforming weight.

9. The mapping device (50) according to claim 8, wherein the hybrid beamforming weight comprises analog beamforming weight in transceiver unit and/or digital precoding weight between transceiver units.

10. The mapping device (50) according to claim 6, wherein the means for determining one or more virtual port modes for the massive MIMO unit (20) is configured for: determining one or more candidate virtual port modes for the massive MIMO unit (20) according to the potential user distribution of the cell served by the massive MIMO unit (20), wherein the candidate virtual port modes comprise the number of virtual ports corresponding to the massive MIMO unit (20), the number of transceiver units in each virtual port and position information of the transceiver units among antenna arrays; determining at least one candidate virtual port mode as the virtual port modes corresponding to the massive MIMO unit (20) according to the current time domain and/or frequency domain demand information of the cell served by the massive MIMO unit (20).

11. A base station for virtual port mapping of a massive MIMO unit (20, wherein the base station comprises the mapping device according to any of claims 6 to 10.

12. A computer readable storage medium (720) having computer readable instructions stored therein which, when executed by one or more processors, cause the mapping device according to claim 6 to perform the method according to any of claims 1 to 5.

13. A computer device, the computer device comprising: one or more processors (705); a memory for storing one or more computer programs; the one or more computer programs, when executed by the one or more processors (705), cause the mapping device according to claim 6 to implement the method according to any of claims 1 to 5.

Patentansprüche

1. Verfahren für eine virtuelle Portzuordnung einer Massive-MIMO-Einheit (20), wobei das Verfahren Folgendes umfasst:

Zuordnen (S1) von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) über eine hybride Strahlformung zu einem virtuellen Port;
Durchführen (S2) einer digitalen Vorcodierung auf Basis des virtuellen Ports, wobei das Verfahren ferner Folgendes umfasst:

Bestimmen (S4) von einem oder mehreren virtuellen Portmodi für die Massive-MIMO-Einheit (20) gemäß einer Benutzerverteilung der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird, wobei die virtuellen Portmodi die Anzahl von virtuellen Ports, die der Massive-MIMO-Einheit (20) entsprechen, die Anzahl von Sendeempfängereinheiten in jedem virtuellen Port und Positionsinformationen der Sendeempfängereinheiten unter Antennenarrays umfassen;
wobei der Schritt des Zuordnens (S1) zu einem virtuellen Port Folgendes umfasst:
Zuordnen von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) auf Basis des virtuellen Portmodus zu einem virtuellen Port, der der Sendeempfängereinheit im virtuellen Portmodus entspricht, über eine hybride Strahlformung.

2. Verfahren nach Anspruch 1, wobei der Schritt der hybriden Strahlformung Folgendes umfasst:

Durchführen einer analogen Strahlformung in mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20);
Durchführen einer digitalen Vorcodierung zwischen den Sendeempfängereinheiten nach der analogen Strahlformung.

3. Verfahren nach Anspruch 1 oder 2, wobei das Verfahren ferner Folgendes umfasst:

Durchführen einer hybriden Strahlformungsgewichtung, die mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) entspricht;
wobei der Schritt des Zuordnens zu einem virtuellen Port Folgendes umfasst:
Zuordnen der mindestens einen Sendeempfängereinheit über eine hybride Strahlformung gemäß der hybriden Strahlformungsgewichtung zu einem virtuellen Port.

4. Verfahren nach Anspruch 3, wobei die hybride Strahlformungsgewichtung eine analoge Strahlformungsgewichtung in einer Sendeempfängereinheit und/oder eine digitale Vorcodierungsgewichtung zwischen Sendeempfängereinheiten umfasst.

5. Verfahren nach Anspruch 1, wobei der Schritt des Bestimmens (S4) von einem oder mehreren virtuellen Portmodi für die Massive-MIMO-Einheit (20) Folgendes umfasst:

Bestimmen von einem oder mehreren virtuellen Portmoduskandidaten für die Massive-MIMO-Einheit (20) gemäß der potenziellen Benutzerverteilung der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird, wobei die virtuellen Portmoduskandidaten die Anzahl von virtuellen Ports, die der Massive-MIMO-Einheit (20) entsprechen, die Anzahl von Sendeempfängereinheiten in jedem virtuellen Port und Positionsinformationen der Sendeempfängereinheiten unter Antennenarrays umfassen;
Bestimmen von mindestens einem virtuellen Portmoduskandidaten als die virtuellen Portmodi, die der Massive-MIMO-Einheit (20) entsprechen, gemäß den Informationen zu einem aktuellen Zeitdomänen- und/oder Frequenzdomänenbedarf der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird.

6. Zuordnungsvorrichtung (50) für eine virtuelle Portzuordnung einer Massive-MIMO-Einheit (20), wobei die Zuordnungsvorrichtung (50) Folgendes umfasst:

Mittel (501) zum Zuordnen (S1) von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) über eine hybride Strahlformung zu einem virtuellen Port;
Mittel (502) zum Durchführen einer digitalen Vorcodierung (S2) auf Basis des virtuellen Ports, wobei die Zuordnungsvorrichtung ferner Folgendes umfasst:

Mittel zum Bestimmen von einem oder mehreren virtuellen Portmodi für die Massive-MIMO-Einheit (20) gemäß einer Benutzerverteilung der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird, wobei die virtuellen Portmodi die Anzahl von virtuellen Ports, die der Massive-MIMO-Einheit (20) entsprechen, die Anzahl von Sendeempfängereinheiten in jedem virtuellen Port und Positionsinformationen der Sendeempfängereinheiten unter Antennenarrays umfassen;
wobei die Mittel zum Zuordnen von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) über eine hybride Strahlformung zu einem virtuellen Port zu Folgendem ausgelegt sind:
Zuordnen von mindestens einer Sendeempfängereinheit in der Massive-MIMO-

Einheit (20) auf Basis des virtuellen Portmodus zu einem virtuellen Port, der der Sendeempfängereinheit im virtuellen Portmodus entspricht, über eine hybride Strahlformung.

7. Zuordnungsvorrichtung (50) nach Anspruch 6, wobei die Mittel zum Zuordnen von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) über eine hybride Strahlformung zu einem virtuellen Port zu Folgendem ausgelegt sind:

   Durchführen einer analogen Strahlformung in mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20);
   Durchführen einer digitalen Vorcodierung zwischen den Sendeempfängereinheiten nach der analogen Strahlformung.

8. Zuordnungsvorrichtung (50) nach Anspruch 6 oder 7, wobei die Zuordnungsvorrichtung ferner Folgendes umfasst:

   Mittel zum Durchführen einer hybriden Strahlformungsgewichtung, die mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) entspricht;
   wobei die Mittel zum Zuordnen von mindestens einer Sendeempfängereinheit in der Massive-MIMO-Einheit (20) über eine hybride Strahlformung zu einem virtuellen Port zu Folgendem ausgelegt sind:
   Zuordnen der mindestens einen Sendeempfängereinheit über eine hybride Strahlformung gemäß der hybriden Strahlformungsgewichtung zu einem virtuellen Port.

9. Zuordnungsvorrichtung (50) nach Anspruch 8, wobei die hybride Strahlformungsgewichtung eine analoge Strahlformungsgewichtung in einer Sendeempfängereinheit und/oder eine digitale Vorcodierungsgewichtung zwischen Sendeempfängereinheiten umfasst.

10. Zuordnungsvorrichtung (50) nach Anspruch 6, wobei die Mittel zum Bestimmen von einem oder mehreren virtuellen Portmodi für die Massive-MIMO-Einheit (20) zu Folgendem ausgelegt sind:

   Bestimmen von einem oder mehreren virtuellen Portmoduskandidaten für die Massive-MIMO-Einheit (20) gemäß der potenziellen Benutzerverteilung der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird, wobei die virtuellen Portmoduskandidaten die Anzahl von virtuellen Ports, die der Massive-MIMO-Einheit (20) entsprechen, die Anzahl von Sendeempfängereinheiten in jedem virtuellen Port und Positionsinformationen der Sendeempfängereinheiten unter Antennenarrays umfassen;
   Bestimmen von mindestens einem virtuellen Portmoduskandidaten als die virtuellen Portmodi, die der Massive-MIMO-Einheit (20) entsprechen, gemäß den Informationen zu einem aktuellen Zeitdomänen- und/oder Frequenzdomänenbedarf der Zelle, die von der Massive-MIMO-Einheit (20) bedient wird.

11. Basisstation für eine virtuelle Zuordnung einer Massive-MIMO-Einheit (20), wobei die Basisstation die Zuordnungsvorrichtung nach einem der Ansprüche 6 bis 10 umfasst.

12. Computerlesbares Speichermedium (720), auf dem computerlesbare Anweisungen gespeichert sind, die, wenn sie von einem oder mehreren Prozessoren ausgeführt werden, die Zuordnungsvorrichtung nach Anspruch 6 veranlassen, das Verfahren nach einem der Ansprüche 1 bis 5 durchzuführen.

13. Computervorrichtung, wobei die Computervorrichtung Folgendes umfasst:

   einen oder mehrere Prozessoren (705);
   einen Speicher zum Speichern von einem oder mehreren Computerprogrammen;
   wobei das eine oder die mehreren Computerprogramme, wenn sie von dem einen oder den mehreren Prozessoren (705) ausgeführt werden, die Zuordnungsvorrichtung nach Anspruch 6 veranlassen, das Verfahren nach einem der Ansprüche 1 bis 5 zu implementieren.

Revendications

1. Procédé de mappage des ports virtuels d'une unité MIMO massif (20),

   dans lequel le procédé comprend : le mappage (S1) d'au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel par formation de faisceau hybride ; la réalisation (S2) d'un pré-codage numérique sur la base du port virtuel, dans lequel le procédé comprend en outre : la détermination (S4) d'un ou plusieurs modes de port virtuel pour l'unité MIMO massif (20) selon une distribution d'utilisateur de la cellule desservie par l'unité MIMO massif (20),
   dans lequel les modes de port virtuel comprennent le nombre de ports virtuels correspondant à l'unité MIMO massif (20), le nombre d'unités émettrices-réceptrices dans chaque port virtuel, et des informations de position des unités émettrices-réceptrices parmi les réseaux d'antennes ; dans lequel l'étape de mappage

(S1) à un port virtuel comprend : le mappage, sur la base du mode de port virtuel, d'au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel correspondant à l'unité émettrice-réceptrice dans le mode de port virtuel par formation de faisceau hybride.

2. Procédé selon la revendication 1, dans lequel l'étape de formation de faisceau hybride comprend : la réalisation d'une formation de faisceau analogique dans au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) ; la réalisation d'un pré-codage numérique entre les unités émettrices-réceptrices après la formation de faisceau analogique.

3. Procédé selon la revendication 1 ou 2, dans lequel le procédé comprend en outre : la détermination d'un poids de formation de faisceau hybride correspondant à au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) ;
dans lequel l'étape de mappage à un port virtuel comprend : le mappage de l'au moins une unité émettrice-réceptrice à un port virtuel par formation de faisceau hybride selon le poids de formation de faisceau hybride.

4. Procédé selon la revendication 3, dans lequel le poids de formation de faisceau hybride comprend le poids de formation de faisceau analogique dans l'unité émettrice-réceptrice et/ou le poids de pré-codage numérique entre les unités émettrices-réceptrices.

5. Procédé selon la revendication 1, dans lequel l'étape de détermination (S4) d'un ou plusieurs modes de port virtuel pour l'unité MIMO massif (20) comprend : la détermination d'un ou plusieurs modes de port virtuel candidats pour l'unité MIMO massif (20) selon la distribution d'utilisateur potentielle de la cellule desservie par l'unité MIMO massif (20), dans lequel les modes de port virtuel candidats comprennent le nombre de ports virtuels correspondant à l'unité MIMO massif (20), le nombre d'unités émettrices-réceptrices dans chaque port virtuel et des informations de position des unités émettrices-réceptrices parmi les réseaux d'antennes ; la détermination d'un ou plusieurs modes de port virtuel candidat en tant que modes de port virtuel correspondant à l'unité MIMO massif (20) selon les informations de demande du domaine temporel et/ou du domaine fréquentiel actuelles de la cellule desservie par l'unité MIMO massif (20) .

6. Dispositif de mappage (50) de mappage des ports virtuels d'une unité MIMO massif (20), dans lequel le dispositif de mappage (50) comprend : des moyens (501) pour mapper (S1) au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel par formation de faisceau hybride ; des moyens (502) pour réaliser un pré-codage numérique (S2) sur la base du port virtuel, dans lequel le dispositif de mappage comprend en outre : des moyens pour déterminer un ou plusieurs modes de port virtuel pour l'unité MIMO massif (20) selon une distribution d'utilisateur de la cellule desservie par l'unité MIMO massif (20), dans lequel les modes de port virtuel comprennent le nombre de ports virtuels correspondant à l'unité MIMO massif (20), le nombre d'unités émettrices-réceptrices dans chaque port virtuel, et des informations de position des unités émettrices-réceptrices parmi les réseaux d'antennes ; dans lequel les moyens pour mapper au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel par formation de faisceau hybride sont configurés pour : mapper, sur la base du mode de port virtuel, au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel correspondant à l'unité émettrice-réceptrice dans le mode de port virtuel par formation de faisceau hybride.

7. Dispositif de mappage (50) selon la revendication 6, dans lequel les moyens pour mapper au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel par formation de faisceau hybride sont configurés pour : réaliser une formation de faisceau analogique dans au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) ; réaliser un pré-codage numérique entre les unités émettrices-réceptrices après la formation de faisceau analogique.

8. Dispositif de mappage (50) selon la revendication 6 ou 7, dans lequel le dispositif de mappage comprend en outre : des moyens pour déterminer un poids de formation de faisceau hybride correspondant à au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) ; dans lequel les moyens pour mapper au moins une unité émettrice-réceptrice dans l'unité MIMO massif (20) à un port virtuel par formation de faisceau hybride sont configurés pour : mapper l'au moins une unité émettrice-réceptrice à un port virtuel par formation de faisceau hybride selon le poids de formation de faisceau hybride.

9. Dispositif de mappage (50) selon la revendication 8, dans lequel le poids de formation de faisceau hybride comprend le poids de formation de faisceau analogique dans l'unité émettrice-réceptrice et/ou le poids de pré-codage numérique entre les unités émettrices-réceptrices.

10. Dispositif de mappage (50) selon la revendication 6, dans lequel les moyens pour déterminer un ou plusieurs modes de port virtuel pour l'unité MIMO massif (20) sont configurés pour : déterminer un ou plusieurs modes de port virtuel candidats pour l'unité MIMO massif (20) selon la distribution d'utilisateur potentielle de la cellule desservie par l'unité MIMO massif (20), dans lequel les modes de port virtuel candidats comprennent le nombre de ports virtuels correspondant à l'unité MIMO massif (20), le nombre d'unités émettrices-réceptrices dans chaque port virtuel et des informations de position des unités émettrices-réceptrices parmi les réseaux d'antennes ; déterminer un ou plusieurs modes de port virtuel candidat en tant que modes de port virtuel correspondant à l'unité MIMO massif (20) selon les informations de demande du domaine temporel et/ou du domaine fréquentiel actuelles de la cellule desservie par l'unité MIMO massif (20).

11. Station de base de mappage des ports virtuels d'une unité MIMO massif (20) dans laquelle la station de base comprend le dispositif de mappage selon l'une des revendications 6 à 10.

12. Support de stockage lisible par ordinateur (720) dans lequel sont stockées des instructions lisibles par ordinateur qui, lorsqu'elles sont exécutées par un ou plusieurs processeurs, amènent le dispositif de mappage selon la revendication 6 à réaliser le procédé selon l'une des revendications 1 à 5.

13. Dispositif informatique, le dispositif informatique comprenant: un ou plusieurs processeurs (705) ; une mémoire pour le stockage d'un ou plusieurs programmes informatiques ; les un ou plusieurs programmes informatiques, lorsqu'ils sont exécutés par les un ou plusieurs processeurs (705), amènent le dispositif de mappage selon la revendication 6 à mettre en œuvre le procédé selon l'une des revendications 1 à 5.

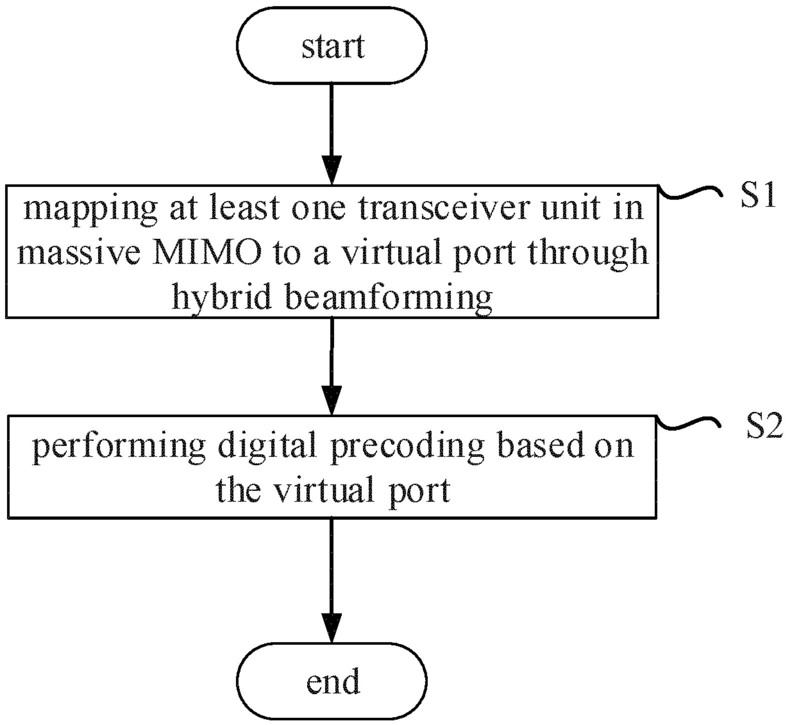
start
mapping at least one transceiver unit in massive MIMO to a virtual port through hybrid beamforming
S1
performing digital precoding based on the virtual port
S2
end

Fig. 1

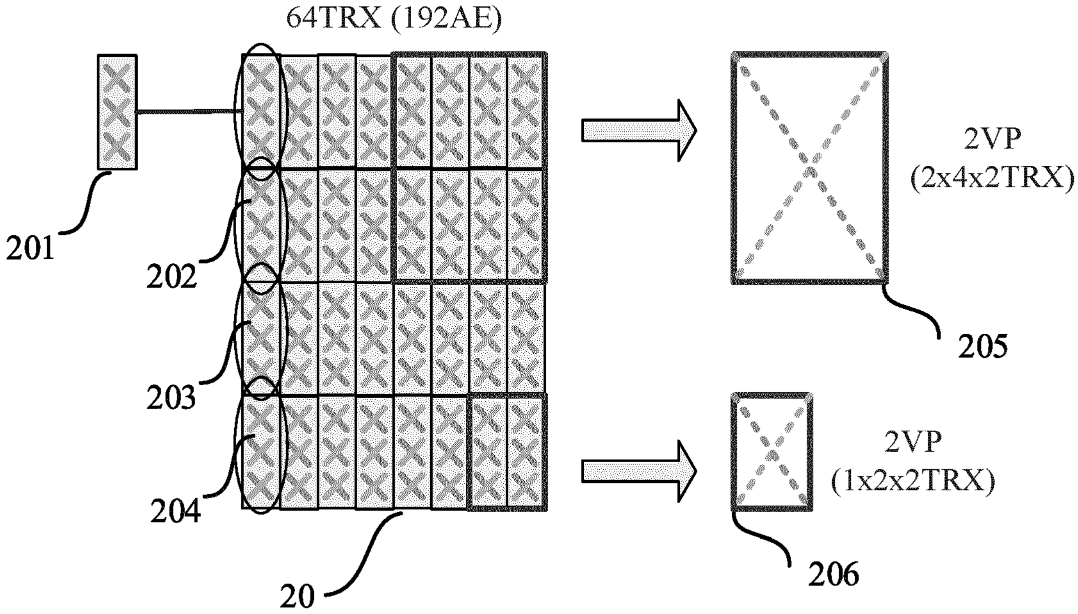
64TRX (192AE)
201
202
203
204
20
2VP
(2x4x2TRX)
205
2VP
(1x2x2TRX)
206

Fig. 2

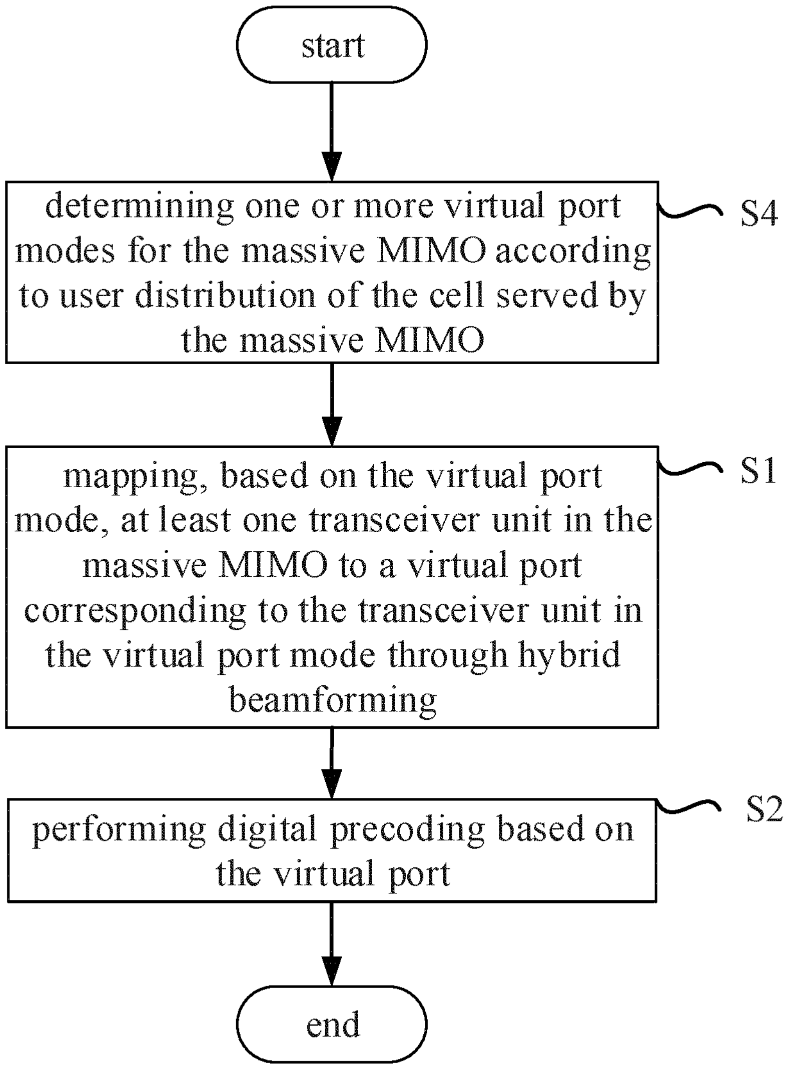
start
determining one or more virtual port modes for the massive MIMO according to user distribution of the cell served by the massive MIMO
S4
mapping, based on the virtual port mode, at least one transceiver unit in the massive MIMO to a virtual port corresponding to the transceiver unit in the virtual port mode through hybrid beamforming
S1
performing digital precoding based on the virtual port
S2
end

Fig. 3

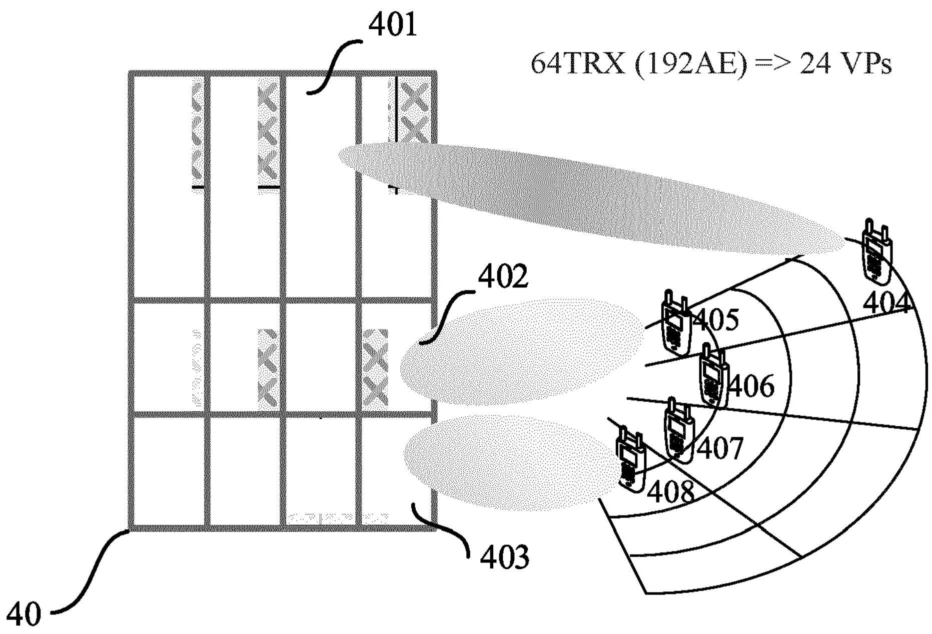

Fig. 4

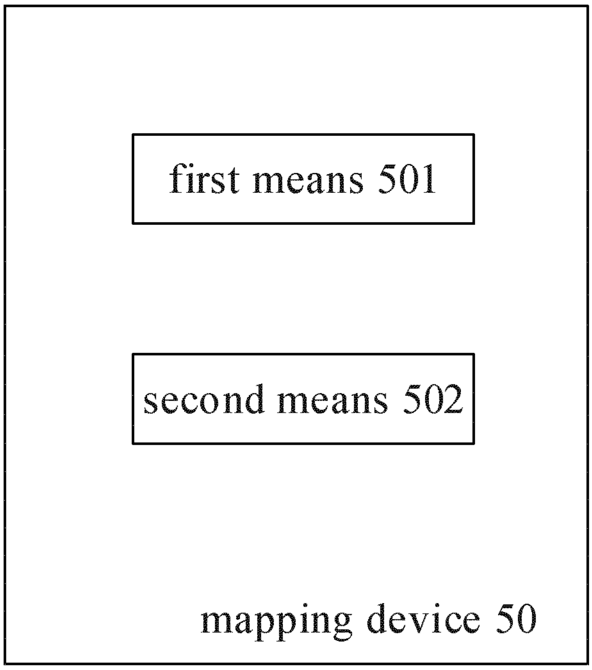

Fig. 5

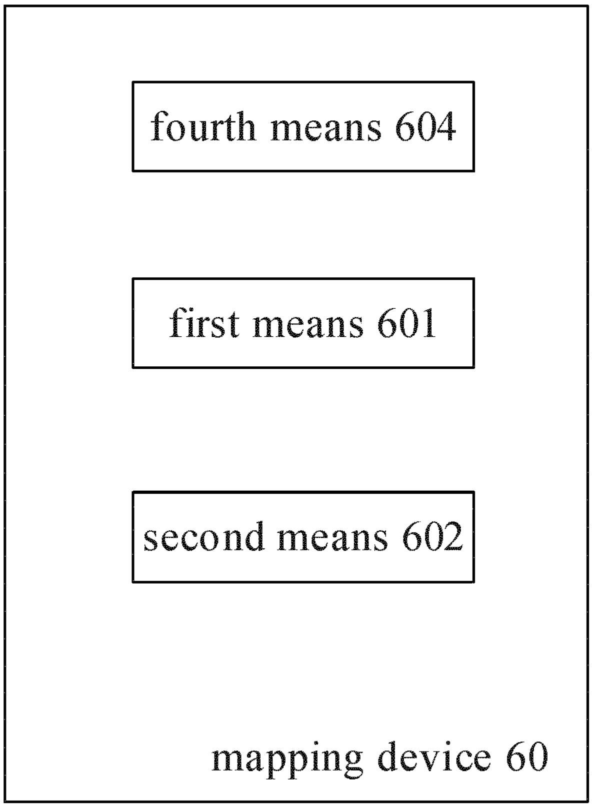
fourth means 604
first means 601
second means 602
mapping device 60

Fig. 6

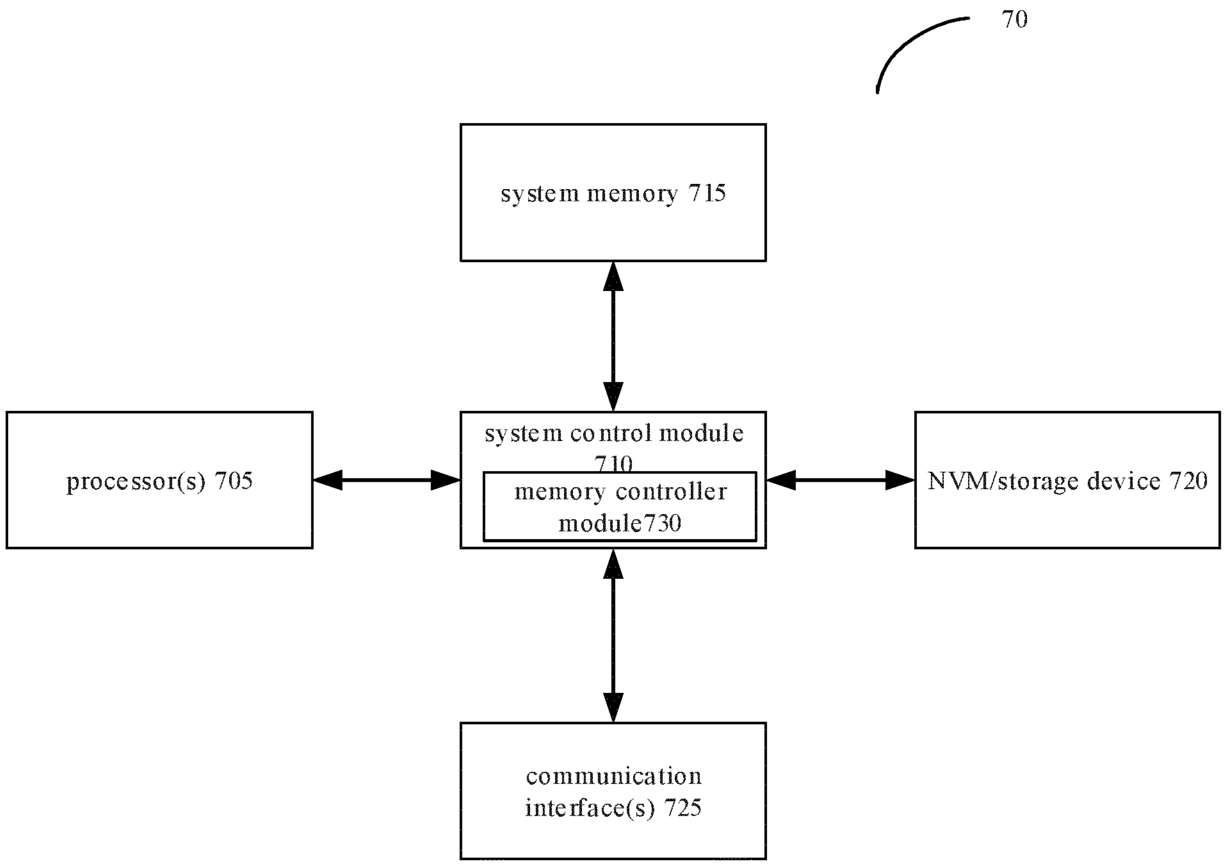
70
system memory 715
processor(s) 705
system control module 710
memory controller module730
NVM/storage device 720
communication interface(s) 725

Fig. 7

REFERENCES CITED IN THE DESCRIPTION

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