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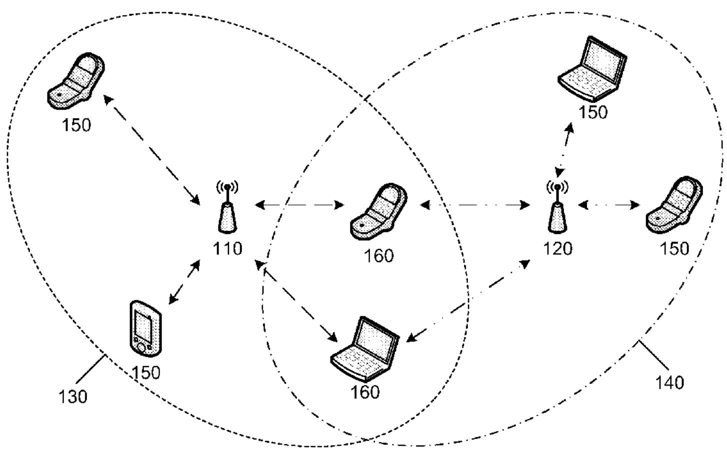
(54) **Title**: TECHNIQUES TO REDUCE FALSE DETECTION OF CONTROL CHANNEL MESSAGES IN A WIRELESS NETWORK



100 FIG. 1

(57) **Abstract**: A method and system of reducing false detection of control channel messages in a wireless communication system. This facilitates blind detection of control channel messages in the wireless communication network. In one embodiment of the invention, the control messages in the wireless communication system are randomized or scrambled to minimize or lower the probability of false detection of the control channel messages. The control channel message includes, but is not limited to, an Assignment Advanced Media Access Protocol (A-A-MAP) Information Element (IE) and the like. In one embodiment of the invention, the contents of the A-A-MAP IE are randomized or scrambled before encoding into A-A-MAP symbols.

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TECHNIQUES TO REDUCE FALSE DETECTION OF CONTROL CHANNEL MESSAGES IN A WIRELESS NETWORK

FIELD OF THE INVENTION

This invention relates to false detection, and more specifically but not exclusively, to a method and system of reducing false detection of control channel messages in a wireless system.

BACKGROUND DESCRIPTION

In a wireless network, a base station sends control channel messages such Assignment Advanced Media Access Protocol (A-A-MAP) to the advanced mobile stations (AMS) in the wireless network. Each AMS decodes a plurality of the A-A-MAP from the base station to determine whether it is the intended recipient of the A-A-MAP. In some cases, false detection of the A-A-MAP may occur when a particular AMS has erroneously determined that it is the intended recipient of a particular A-A-MAP message when the particular A-A-MAP is intended for another AMS.

When there is a false detection of an Uplink A-A-MAP, the erroneous AMS can transmit data using the wrong resources and can cause collision of other value traffic. This causes a system level impact on the reliability of the Uplink Hybrid Automatic Repeat Request (HARQ) transmission. When there is a false detection of a Downlink A-A-MAP and when the contents of the A-A-MAP Information Element (IE) are decoded with errors, the erroneous AMS will not be able to decode the data burst correctly. When there is a false detection of a Downlink A-A-MAP and when the contents of the A-A-MAP Information Element (IE) are decoded without any error, the erroneous AMS can decode the corresponding physical data correctly and pass the results to higher layers, which can cause ARQ level corruption.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of embodiments of the invention will become apparent from the following detailed description of the subject matter in which:

Figure 1 illustrates a wireless communication network in accordance with one embodiment of the invention;

Figure 2 illustrates the location of an advanced MAP in a time division duplex mode in one embodiment of the invention;

Figure 3 illustrates a structure of an A-MAP region in accordance with one embodiment of the invention;

Figure 4 illustrates a coding chain of A-A-MAP IE to A-A-MAP symbols in accordance with one embodiment of the invention;

Figure 5 illustrates a decoding chain of A-A-MAP symbols to A-A-MAP IE in accordance with one embodiment of the invention;

Figure 6 illustrates a Pseudo Random Binary Sequence module in accordance with one embodiment of the invention;

Figure 7 illustrates a flowchart of a scrambling operation in accordance with one embodiment of the invention;

Figure 8 illustrates a flowchart of a descrambling operation in accordance with one embodiment of the invention; and

Figure 9 illustrates a system to implement the methods disclosed herein in accordance with one embodiment of the invention.

DETAILED DESCRIPTION

Embodiments of the invention described herein are illustrated by way of example and not by way of limitation in the accompanying figures. For simplicity and clarity of illustration, elements illustrated in the figures are not necessarily drawn to scale. For example, the dimensions of some elements may be exaggerated relative to other elements for clarity. Further, where considered appropriate, reference numerals have been repeated among the figures to indicate corresponding or analogous elements. Reference in the specification to “one embodiment” or “an embodiment” of the invention means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. Thus, the appearances of the phrase “in one embodiment” in various places throughout the specification are not necessarily all referring to the same embodiment.

Embodiments of the invention provide a method and system of reducing false detection of control channel messages in a wireless communication system. This facilitates blind detection of control channel messages in the wireless communication network. In one embodiment of the invention, the control messages in the wireless communication system are randomized or scrambled to minimize or lower the probability of false detection of the control channel messages. The control channel message includes, but is not limited to, an Assignment Advanced Media Access Protocol (A-A-MAP) Information Element (IE) and the like. In one embodiment of the invention, the contents of the A-A-MAP IE are randomized or scrambled before encoding into A-A-MAP symbols.

Figure 1 illustrates a wireless communication network **100** in accordance with one embodiment of the invention. The wireless communication network **100** includes a plurality of wired and/or wireless networks, generally shown as **130** and **140**. In particular, the wireless communication network **100** may comprise a Wireless Local Area Network (WLAN) **130**, and a Wireless Metropolitan Area Network (WMAN) **140**. Although Figure 1 depicts two wireless networks, the wireless communication system **100** may include additional or fewer wireless communication networks and one or more wired networks. For example, the wireless communication network **100** may include additional WMANs, WLANs, and/or Wireless Personal Area Networks (WPANs). The methods and apparatus described herein are not limited in this regard.

The wireless communication network **100** has one or more platforms or stations (STA) that include, but are not limited to, base stations, advanced base stations (ABSs), subscriber stations, mobile stations, and advanced mobile STAs (AMSs). The AMSs **160** illustrate multi-radio AMSs capable of heterogeneous wireless communication by accessing a plurality of wireless networks and/or wired networks. The AMSs **150** illustrate single-radio AMSs capable of accessing a single wireless network or a plurality of networks at any one time.

In one embodiment of the invention, the AMSs **150** and **160** include, but are not limited to, wireless electronic devices such as a desktop computer, a laptop computer, a handheld computer, a tablet computer, a cellular telephone, a pager, an audio and/or video player (e.g., an MP3 player or a DVD player), a gaming device, a video camera, a digital camera, a navigation device (e.g., a GPS device), a wireless peripheral (e.g., a printer, a scanner, a headset, a keyboard, a mouse, etc.), a medical device (e.g., a heart rate monitor, a blood pressure monitor, etc.), and/or other suitable fixed, portable, or mobile electronic devices. Although Figure 1 depicts six AMSs, the wireless communication network **100** may include more or less multi-radio AMSs **150** and/or single-radio AMSs **160** in other embodiments of the invention.

The STAs may use a variety of modulation techniques such as spread spectrum modulation (e.g., direct sequence code division multiple access (DS-CDMA) and/or frequency hopping code division multiple access (FH-CDMA)), time-division multiplexing (TDM) modulation, frequency-division multiplexing (FDM) modulation, orthogonal frequency-division multiplexing (OFDM) modulation, orthogonal frequency-division multiple access (OFDMA), multi-carrier modulation (MDM), and/or other suitable modulation techniques to communicate via wireless communication links.

The subscriber stations, mobile stations, or advanced mobile stations (e.g. multi-radio AMS **160** and a single-radio AMS **150**) may use OFDM or OFDMA modulation to transmit digital data by splitting a radio frequency signal into multiple small sub-signals, which in turn, are transmitted simultaneously at different frequencies. In particular, the stations may use OFDM or OFDMA modulation to implement the WMAN **140**. The multi-radio AMS **160** and the single-radio AMS **140** may operate in accordance with the 802.16 family of standards developed by Institute of Electrical and Electronic Engineers IEEE to provide for fixed, portable, and/or mobile broadband wireless access (BWA) networks (e.g., the IEEE std. 802.16, published 2004) to communicate with the base station **120**, which may be an advanced base station (ABS) via wireless communication link(s).

Although some of the above examples are described above with respect to standards developed by IEEE, the methods and apparatus disclosed herein are readily applicable to many specifications and/or standards developed by other special interest groups and/or standard development organizations (e.g., Wireless Fidelity (Wi-Fi) Alliance, Worldwide Interoperability for Microwave Access (WiMAX) Forum, Infrared Data Association (IrDA), Third Generation Partnership Project (3GPP), etc.). For example, in one embodiment of the invention, the wireless communication network **100** is operable in accordance with 3GPP Long Term Evolution (LTE) standard.

In one embodiment of the invention, the access point **110** and the base station **120** communicate in accordance with specific communication standards, such as the IEEE standards including, but are not limited to, IEEE 802.11(a), 802.11(b), 802.11(g), 802.11(h), 802.11(n), 802.16-2004, 802.16(e), 802.16(m) and their variations and evolutions thereof standards, and/or proposed specifications for WLANs, although the scope of the invention is not limited in this respect as they may also be suitable to transmit and/or receive communications in accordance with other techniques and standards.

For more information with respect to the IEEE 802.11 and IEEE 802.16 standards, please refer to “IEEE Standards for Information Technology -- Telecommunications and Information Exchange between Systems” - Local Area Networks - Specific Requirements – Part 11 “Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY), ISO/IEC 8802-11: 1999”, and Metropolitan Area Networks - Specific Requirements – Part 16: “Air Interface for Fixed Broadband Wireless Access Systems,” May 2005 and related amendments/versions.

The WLAN **130** and the WMAN **140** may be operatively coupled to a common public or private network such as the Internet, a telephone network (e.g., public switched telephone network (PSTN)), a local area network (LAN), a cable network, and/or another wireless network via connection to an Ethernet, a digital subscriber line (DSL), a telephone line, a coaxial cable, and/or any wireless connection, etc.

The wireless communication network **100** may include other suitable wireless communication networks. For example, the wireless communication network **100** may include a wireless wide area network (WWAN) (not shown). The stations may operate in accordance with other wireless communication protocols to support a WWAN. In particular, these wireless communication protocols may be based on analog, digital, and/or dual-mode communication system technologies such as Global System for Mobile Communications (GSM) technology, Wideband Code Division Multiple Access (WCDMA) technology, General Packet Radio Services (GPRS) technology, Enhanced Data GSM Environment (EDGE) technology, Universal Mobile Telecommunications System (UMTS) technology, standards based on these technologies, variations and evolutions of these standards, and/or other suitable wireless communication standards.

The wireless communication network **100** may further include other WPAN, WLAN, WMAN, and/or WWAN devices (not shown) such as network interface devices and peripherals (e.g., network interface cards (NICs)), access points (APs), redistribution points, end points, gateways, bridges, hubs, etc. to implement a cellular telephone system, a satellite system, a personal communication system (PCS), a two-way radio system, a one-way pager system, a two-way pager system, a personal computer (PC) system, a personal data assistant (PDA) system, a personal computing accessory (PCA) system, and/or any other suitable communication system. Although certain examples have been described above, the scope of coverage of this disclosure is not limited thereto.

In one embodiment of the invention, the base station **120** generates an A-A-MAP IE and randomizes the contents of the A-A-MAP IE to generate a randomized A-A-MAP IE. The base station **120** processes the randomized A-A-MAP IE to form A-A-MAP symbols and sends the A-A-MAP symbols to the AMSs **150** and **160**. The randomization of the contents of the A-A-MAP IE reduces the probability of false detection by the AMSs **150** and **160** when they decode the contents of the A-A-MAP IE.

Figure 2 illustrates the location **200** of an advanced MAP (A-MAP) in a time domain division (TDD) mode in one embodiment of the invention. In one embodiment of the invention, the base station **120** sends a superframe to the AMSs **150** and **160**. Each superframe is made up of a number of frames and each frame is made up of a number of advanced air interface (AAI) subframes. Figure 2 illustrates seven AAI sub-frames that are configured in a TDD mode.

The AAI subframes have four Downlink (DL) subframes (SF), DL SF0 – SF3 **212**, **222**, **232** and **242** and four Uplink subframes UL SF0 – SF3 **252**, **262**, **272** and **282** in one embodiment of the invention. Each of the DL SF0 – SF3 **212**, **222**, **232** and **242** has an A-MAP **210**, **220**, **230** and **240** in one embodiment of the invention. The A-MAP carries service control information that includes, but is not limited to, user-specific control information and non-user-specific control information. The user-specific control information is divided into assignment information, HARQ feedback information, and power control information, and they are transmitted in the assignment A-MAP, HARQ feedback A-MAP, and power control A-MAP respectively. All the A-MAPs share a region of physical resources called the A-MAP region.

The non-user-specific A-MAP includes information that is not dedicated to a specific user or a specific group of users. The HARQ feedback A-MAP carries HARQ Acknowledge (ACK) / Not ACK (NACK) information for uplink data transmission. The power control A-MAP carries fast power control command to the AMSs. The Assignment A-MAP has resource assignment information that is categorized into multiple types of assignment A-MAP IEs. Each assignment A-MAP IE is coded separately and carries information for one or a group of AMSs.

Figure 3 illustrates a structure **300** of an A-MAP region in accordance with one embodiment of the invention. The primary frequency partition **310** has an A-MAP region **312**, a distributed region **314** and a localized region **316**. The A-MAP region **312** has a HARQ feedback A-MAP **320**, a power control A-MAP **330**, a non-user-specific A-MAP **340** and an assignment A-MAP **350**. Each of the A-MAPs has a plurality of symbols **370**.

The assignment A-MAP **350** includes, but is not limited to, a Down Link (DL) basic A-A-MAP IE, an Up Link (UL) basic A-A-MAP IE, a DL Subband A-A-MAP IE, an UL Subband A-A-MAP IE, a Feedback Allocation A-A-MAP IE, a UL Sounding Command A-MAP IE, a Code Division Multiple Access (CDMA) Allocation A-MAP IE, a DL Persistent Allocation A-MAP IE, an UL Persistent Allocation A-MAP IE, and a Feedback Polling A-MAP IE.

Figure 4 illustrates a coding chain **400** of A-A-MAP IE **410** to A-A-MAP symbols **470** in accordance with one embodiment of the invention. For clarity of illustration, figure 4 is discussed with reference to figure 1. The base station **120** generates an A-A-MAP IE for each AMS in one embodiment of the invention. The base station **120** sends the A-A-MAP IE to a randomization module **420** to generate a randomized A-A-MAP IE.

In one embodiment of the invention, the randomization module **420** has a Pseudo Random Binary Sequence (PRBS) generator to randomize or scramble the contents of the A-A-MAP IE. In one embodiment of the invention, the PRBS generator uses an initial vector to randomize the contents of the A-A-MAP IE. The initial vector includes, but is not limited to, an A-A-MAP CRC mask. When a unicast A-A-MAP is to be sent to a particular AMS, the base station **120** uses a station identification (STID) of the particular AMS A-A-MAP as the CRC mask.

This allows the resulting random sequence to be different for different AMS and it allows only the AMS with the correct STID to decode the A-A-MAP IE.

The base station **120** sends the randomized A-A-MAP IE to the CRC addition module **430**. The CRC addition module **430** generates a CRC checksum based on the randomized A-A-MAP IE. In one embodiment of the invention, the generated CRC checksum is masked using the A-A-MAP CRC mask. The CRC addition module **430** generates a masked CRC checksum by performing an exclusive OR operation on the generated CRC checksum with the A-A-MAP CRC mask to generate a masked CRC checksum. The CRC addition module **430** appends the masked CRC checksum to the randomized A-A-MAP IE and sends it to the channel encoding module **440**.

The channel encoding module **440** performs channel encoding of the randomized A-A-MAP IE and the masked CRC checksum to generate channel encoded data. The generated channel encoded data is sent to the Quadrature Phase Shift Keying (QPSK) modulator **450**. The QPSK modulator **450** performs QPSK modulation of the channel encoded data to generate QPSK modulated data and sends the QPSK modulated data to the Multiple-Input and Multiple-Output (MIMO) encoder / precoder **460**. The MIMO encoder / precoder **460** performs MIMO encoding / precoding of the QPSK modulated data to generate the A-A-MAP symbols **470**. The base station **120** sends the A-A-MAP symbols **470** to the AMSs **150** and **160** via the wireless communication links.

Figure 5 illustrates a decoding chain **500** of A-A-MAP symbols **510** to A-A-MAP IE **570** in accordance with one embodiment of the invention. For clarity of illustration, figure 5 is discussed with reference to figure 1. In one embodiment of the invention, an AMS receives the A-A-MAP symbols **510** from the base station **120**. The MIMO decoder **520** performs MIMO decoding of the A-A-MAP symbols **510** to generate QPSK modulated data.

The QPSK demodulator **530** receives the QPSK modulated data and performs QPSK demodulation of the QPSK modulated data to generate QPSK demodulated data. The channel decoding module **540** receives the QPSK demodulated data and performs channel decoding of the QPSK demodulated data to generate channel decoded data.

In one embodiment of the invention, the channel decoded data has a randomized A-A-MAP IE and a masked CRC. The CRC removal module **550** receives the channel decoded data and removes the mask of the masked CRC. In one embodiment of the invention, the CRC removal module **550** removes the mask of the masked CRC by performing bitwise exclusive OR operations on the masked CRC with a CRC mask to generate an unmasked CRC checksum. In one embodiment of the invention, the CRC mask comprises the STID of the AMS decoding the A-A-MAP symbols **510**.

The CRC removal module **550** calculates a checksum of the randomized A-A-MAP IE and compares the calculated checksum with the unmasked CRC checksum. If the calculated checksum matches the unmasked CRC checksum, it indicates that the AMS is the intended recipient of the A-A-MAP IE and the CRC removal module **550** sends the randomized A-A-MAP IE to the descrambler module **560**. This is because each AMS has a unique STID and only the AMS with the correct STID can unmask the masked CRC checksum to obtain the correct CRC checksum. If the calculated checksum does not match the unmasked CRC checksum, it indicates that the AMS is not the intended recipient of the A-A-MAP IE and the CRC removal module **550** discards the randomized A-A-MAP IE.

When the descrambler module **560** receives the randomized A-A-MAP IE, it descrambles the received randomized A-A-MAP IE to obtain a descrambled A-A-MAP IE. The AMS performs a sanity check on the descrambled A-A-MAP IE to determine whether the descrambled A-A-MAP IE is corrupted. In one embodiment of the invention, the AMS determines whether the descrambled A-A-MAP IE is corrupted by determining whether one or more parts of the descrambled A-A-MAP IE are set according to a pre-determined value.

For example, in one embodiment of the invention, the A-A-MAP IE has one or more reserved bits. The AMS determines whether the descrambled A-A-MAP IE is corrupted by determining whether the reserved bits are set to a pre-determined value. In another embodiment of the invention, the AMS determines whether the descrambled A-A-MAP IE is corrupted by determining whether one or more particular fields of the descrambled A-A-MAP IE is set beyond a pre-determined value or range. For example, a particular field in the A-A-MAP IE has a minimum range and/or a maximum range setting. The AMS determines whether the descrambled A-A-MAP IE is corrupted by determining whether the particular field of the descrambled A-A-MAP IE is set beyond minimum range and/or a maximum range setting. One of ordinary skill in the relevant art will readily appreciate that other ways of determining whether the descrambled A-A-MAP IE is corrupted can be used without affecting the workings of the invention.

In one embodiment of the invention, the randomization of the contents of the A-A-MAP IE increased the probability of detecting false A-A-MAP IE. This is because when the A-A-MAP IE is sent without any randomization, an error pattern is detectable by sanity check only if it occupies all or part of the reserved bits. With A-A-MAP IE randomization, the detection of error(s) is independent of the error pattern because the scrambling can create invalid values in the reserved bits. The reserved bits in any location of the A-A-MAP IE are randomized automatically to achieve full usage of the reserved bits in any configuration. In addition, if there are one or more bits in the A-A-MAP IE that are set to a fixed value, these one or more bits are also scrambled to allow more sanity checks to reduce the probability of false detection.

Figure 6 illustrates a PRBS module **600** in accordance with one embodiment of the invention. For clarity of illustration, figure 6 is discussed with reference to figures 4 and 5. In one embodiment of the invention, the PRBS module **600** is present in the randomization module **420** and the descrambler module **560**. The PRBS module **600** has an initial vector **610** that has fifteen bits in one embodiment of the invention. In one embodiment of the invention, the polynomial of the PRBS module is set as $1 + X^{14} + X^{15}$. The exclusive OR (XOR) gate **620** uses the output of bits 13 and 14 of the initial vector **610** as its inputs. The XOR gate **620** generates an output for bit 0 of the initial vector **610**.

In the randomization module **420**, the input data **640** comprises the A-A-MAP IE **410**. The initial vector **610** is set as the STID of the AMS associated with the A-A-MAP IE **410**. The contents of the A-A-MAP IE **410** is fed or read sequentially / serially (Most Significant Bit (MSB) first) to the PRBS module **600**. The bits of the A-A-MAP IE **410** are XOR-ed with the output of the PRBS module **600** using the XOR gate **630**, where the MSB of the A-A-MAP IE **410** is XOR-ed with the first bit of the output of the PRBS module **600**. The output data **640** of the

PRBS module **600** forms the randomized A-A-MAP IE in one embodiment of the invention.

In the descrambler module **560**, the input data **640** comprises the randomized A-A-MAP IE. The initial vector **610** is set as the STID of the AMS associated with the A-A-MAP IE **410**. The contents of the randomized A-A-MAP IE is fed or read sequentially / serially (MSB first) to the PRBS module **600**. The bits of the randomized A-A-MAP IE are XOR-ed with the output of the PRBS module **600** using the XOR gate **630**, where the MSB of the randomized A-A-MAP IE is XOR-ed with the first bit of the output of the PRBS module **600**. The output data **640** of the PRBS module **600** forms the de-randomized or descrambled A-A-MAP IE in one embodiment of the invention.

The PRBS module **600** illustrated in figure 6 is not meant to be limiting. In other embodiments of the invention, the PRBS module uses a different polynomial to scramble or unscramble the input data **640** without affecting the workings of the invention.

Figure 7 illustrates a flowchart **700** of a scrambling operation in accordance with one embodiment of the invention. In step **710**, the flow **700** receives an A-A-MAP IE. In step **720**, the contents of the A-A-MAP IE are scrambled to generate a randomized A-A-MAP IE. In one embodiment of the invention, the contents of the A-A-MAP IE are scrambled using the PRBS module **600** that uses a STID of the AMS associated with the A-A-MAP IE as the initial vector.

In step **730**, the CRC checksum of the randomized A-A-MAP IE is calculated. In step **740**, the flow **700** performs an operation to mask the CRC checksum and appends the masked CRC checksum to the randomized A-A-MAP IE. In step **750**, the flow **700** performs a channel encoding of the randomized A-A-MAP IE and the masked CRC checksum. In step **760**, the flow **700** performs a QPSK modulation of the channel encoded data. In step **770**, the flow **700** performs a MIMO encoding / precoding of the QPSK modulated data to generate the A-A-MAP symbols. The A-A-MAP symbols are transmitted to the AMS via a wireless communication link.

Figure 8 illustrates a flowchart **800** of a descrambling operation in accordance with one embodiment of the invention. In step **810**, the flow **800** receives a plurality of A-A-MAP symbols via a wireless communication link. In step

820, the flow **800** performs a MIMO decoding of the plurality of A-A-MAP symbols to generate QPSK modulated data. In step **830**, the flow **800** performs a QPSK demodulation of the QPSK modulated data to generate channel encoded data.

In step **840**, the flow **800** performs a channel decoding of the channel encoded data to generate channel decoded data. In one embodiment of the invention, the channel decoded data comprises a randomized A-A-MAP IE and a masked CRC checksum. In step **850**, the flow **800** performs a CRC calculation of the randomized A-A-MAP IE to generate or create a CRC checksum. In step **860**, the flow **800** removes the mask of the masked CRC checksum. In one embodiment of the invention, the mask of the masked CRC checksum is removed by performing an XOR operation on the masked CRC checksum with a STID of the AMS receiving the plurality of A-A-MAP symbols.

In step **870**, the flow **800** checks whether the calculated checksum from step **850** is the same as the unmasked CRC checksum from step **860**. If the CRC checksums are matching, it indicates that the AMS receiving the plurality of A-A-MAP symbols is the intended recipient. This is because when the base station creates the masked CRC checksum, it uses the STID of the intended AMS and only the intended AMS is able to unmask the masked CRC checksum correctly. The flow **800** goes to step **880** when the CRC checksums are matching. If the CRC check sums do not match, the flow **800** ends.

In step **880**, the flow **800** descrambles the randomized A-A-MAP IE. In one embodiment of the invention, the randomized A-A-MAP IE is descrambled by the PRBS module **600** that uses the STID of the AMS receiving the plurality of A-A-MAP symbols as its initial vector. In step **890**, the flow **800** verifies the contents of the descrambled A-A-MAP IE. In one embodiment of the invention, the flow **800** verifies the contents of the descrambled A-A-MAP IE by checking whether the reserved bits in the descrambled A-A-MAP IE are set to a known value. In another embodiment of the invention, one or more fields in the descrambled A-A-MAP IE have a minimum and/or maximum range of settings. The flow **800** verifies the contents of the descrambled A-A-MAP IE by checking whether the one or more fields in the descrambled A-A-MAP IE are set beyond their minimum and/or maximum range of settings.

Figure 9 illustrates a system **900** to implement the methods disclosed herein in accordance with one embodiment of the invention. The system **900** includes, but is not limited to, a desktop computer, a laptop computer, a net book, a notebook computer, a personal digital assistant (PDA), a server, a workstation, a cellular telephone, a mobile computing device, an Internet appliance or any other type of computing device. In another embodiment, the system **900** used to implement the methods disclosed herein may be a system on a chip (SOC) system.

The processor **910** has a processing core **912** to execute instructions of the system **900**. The processing core **912** includes, but is not limited to, pre-fetch logic to fetch instructions, decode logic to decode the instructions, execution logic to execute instructions and the like. The processor **910** has a cache memory **916** to cache instructions and/or data of the system **900**. In another embodiment of the invention, the cache memory **916** includes, but is not limited to, level one, level two and level three, cache memory or any other configuration of the cache memory within the processor **910**.

The memory control hub (MCH) **914** performs functions that enable the processor **910** to access and communicate with a memory **930** that includes a volatile memory **932** and/or a non-volatile memory **934**. The volatile memory **932** includes, but is not limited to, Synchronous Dynamic Random Access Memory (SDRAM), Dynamic Random Access Memory (DRAM), RAMBUS Dynamic Random Access Memory (RDRAM), and/or any other type of random access memory device. The non-volatile memory **934** includes, but is not limited to, NAND flash memory, phase change memory (PCM), read only memory (ROM), electrically erasable programmable read only memory (EEPROM), or any other type of non-volatile memory device.

The memory **930** stores information and instructions to be executed by the processor **910**. The memory **930** may also stores temporary variables or other intermediate information while the processor **910** is executing instructions. The chipset **920** connects with the processor **910** via Point-to-Point (PtP) interfaces **917** and **922**. The chipset **920** enables the processor **910** to connect to other modules in the system **900**. In one embodiment of the invention, the interfaces **917** and **922** operate in accordance with a PtP communication protocol such as the Intel® QuickPath Interconnect (QPI) or the like. The chipset **920** connects to a display device **940** that includes, but is not limited to, liquid crystal display (LCD), cathode ray tube (CRT) display, or any other form of visual display device.

In addition, the chipset **920** connects to one or more buses **950** and **955** that interconnect the various modules **974**, **960**, **962**, **964,** and **966**. Buses **950** and **955** may be interconnected together via a bus bridge **972** if there is a mismatch in bus speed or communication protocol. The chipset **920** couples with, but is not limited to, a non-volatile memory **960**, a mass storage device(s) **962**, a keyboard/mouse **964** and a network interface **966**. The mass storage device **962** includes, but is not limited to, a solid state drive, a hard disk drive, an universal serial bus flash memory drive, or any other form of computer data storage medium. The network interface **966** is implemented using any type of well known network interface standard including, but not limited to, an Ethernet interface, a universal serial bus (USB) interface, a Peripheral Component Interconnect (PCI) Express interface, a wireless interface and/or any other suitable type of interface. The wireless interface operates in accordance with, but is not limited to, the IEEE 802.11 standard and its related family, Home Plug AV (HPAV), Ultra Wide Band (UWB), Bluetooth, WiMax, or any form of wireless communication protocol.

While the modules shown in figure 9 are depicted as separate blocks within the system **900**, the functions performed by some of these blocks may be integrated within a single semiconductor circuit or may be implemented using two or more separate integrated circuits. For example, although the cache memory **916** is depicted as a separate block within the processor **910**, the cache memory **916** can be incorporated into the processor core **912** respectively. The system **900** may include more than one processor / processing core in another embodiment of the invention.

The methods disclosed herein can be implemented in hardware, software, firmware, or any other combination thereof. Although examples of the embodiments of the disclosed subject matter are described, one of ordinary skill in the relevant art will readily appreciate that many other methods of implementing the disclosed subject matter may alternatively be used. In the preceding description, various aspects of the disclosed subject matter have been described. For purposes of explanation, specific numbers, systems and configurations were set forth in order to provide a thorough understanding of the subject matter. However, it is apparent to one skilled in the relevant art having the benefit of this disclosure that the subject matter may be practiced without the specific details. In other instances, well-known features, components, or modules were omitted, simplified, combined, or split in order not to obscure the disclosed subject matter.

The term “is operable” used herein means that the device, system, protocol etc, is able to operate or is adapted to operate for its desired functionality when the device or system is in off-powered state. Various embodiments of the disclosed subject matter may be implemented in hardware, firmware, software, or combination thereof, and may be described by reference to or in conjunction with program code, such as instructions, functions, procedures, data structures, logic, application programs, design representations or formats for simulation, emulation, and fabrication of a design, which when accessed by a machine results in the machine performing tasks, defining abstract data types or low-level hardware contexts, or producing a result.

The techniques shown in the figures can be implemented using code and data stored and executed on one or more computing devices such as general purpose computers or computing devices. Such computing devices store and communicate (internally and with other computing devices over a network) code and data using machine-readable media, such as machine readable storage media (e.g., magnetic disks; optical disks; random access memory; read only memory; flash memory devices; phase-change memory) and machine readable communication media (e.g., electrical, optical, acoustical or other form of propagated signals – such as carrier waves, infrared signals, digital signals, etc.).

While the disclosed subject matter has been described with reference to illustrative embodiments, this description is not intended to be construed in a limiting sense. Various modifications of the illustrative embodiments, as well as other embodiments of the subject matter, which are apparent to persons skilled in the art to which the disclosed subject matter pertains are deemed to lie within the scope of the disclosed subject matter.

CLAIMS

What is claimed is:

1. An apparatus comprising:

logic to:

generate an Assignment Advanced Media Access Protocol (A-A-MAP) Information Element (IE); and

generate a randomized A-A-MAP IE.

2. The apparatus of claim 1, wherein the logic to generate the randomized A-A-MAP-IE is to:

generate a Pseudo Random Binary Sequence (PRBS) based at least in part on the A-A-MAP IE and a A-A-MAP Cyclic Redundancy Check (CRC) mask.

3. The apparatus of claim 2, wherein the A-A-MAP IE is associated with an advanced mobile station (AMS), and wherein the A-A-MAP CRC mask comprises a station identification (STID) of the AMS.

4. The apparatus of claim 1, wherein the logic is further to:

generate a Cyclic Redundancy Check (CRC) checksum based on the randomized A-A-MAP IE;

perform an exclusive OR operation on the generated CRC checksum with a CRC mask to generate a masked CRC checksum; and

append the masked CRC checksum to the randomized A-A-MAP IE.

5. The apparatus of claim 4, wherein the logic is further to:

perform channel encoding of the randomized A-A-MAP IE and the masked CRC checksum to generate channel encoded data;

perform Quadrature Phase Shift Keying (QPSK) modulation of the channel encoded encoded data to generate QPSK modulated data; and

perform Multiple-Input and Multiple-Output (MIMO) encoding of the QPSK modulated data to generate A-A-MAP symbols.

6. The apparatus of claim 1, wherein the A-A-MAP IE comprises one of a Down Link (DL) basic A-A-MAP IE, an Up Link (UL) basic A-A-MAP IE, a DL Subband A-A-MAP IE, an UL Subband A-A-MAP IE, a Feedback Allocation A-A-MAP IE, a UL Sounding Command A-MAP IE, a Code Division Multiple Access (CDMA) Allocation A-MAP IE, a DL Persistent Allocation A-MAP IE, an UL Persistent Allocation A-MAP IE, and a Feedback Polling A-MAP IE.

7. The apparatus of claim 1, wherein the apparatus is operable at least in part with one of Institute of Electrical and Electronics Engineers (IEEE) 802.16m standard, and a 3rd Generation Partnership Project (3GPP) Long Term Evolution standard.

8. An apparatus comprising:

logic to:

receive a randomized A-A-MAP IE;

descramble the received randomized A-A-MAP IE to obtain an descrambled A-A-MAP IE; and

determine whether the descrambled A-A-MAP IE is corrupted.

9. The apparatus of claim 8, wherein the logic to descramble the received randomized A-A-MAP IE to obtain the descrambled A-A-MAP is to:

perform an exclusive OR operation on the received randomized A-A-MAP IE with a Cyclic Redundancy Check (CRC) mask to generate the descrambled A-A-MAP.

10. The apparatus of claim 9, wherein the CRC mask comprises an identification of the apparatus.

11. The apparatus of claim 8, wherein the logic to determine whether the descrambled A-A-MAP IE is corrupted is to:

determine whether one or more parts of the descrambled A-A-MAP IE are set according to a pre-determined value.

12. The apparatus of claim 8, wherein the logic to determine whether the descrambled A-A-MAP IE is corrupted is to:

determine whether one or more parts of the descrambled A-A-MAP IE are set beyond a pre-determined value.

13. The apparatus of claim 11, wherein the one or more parts of the descrambled A-A-MAP IE comprise one or more of a reserved bit field, and a fixed value field of the descrambled A-A-MAP IE.

14. The apparatus of claim 9, wherein the logic is further to:

receive a plurality of A-A-MAP symbols;

perform Multiple-Input and Multiple-Output (MIMO) decoding of the plurality of A-A-MAP symbols to generate A-A-MAP modulated data;

perform Quadrature Phase Shift Keying (QPSK) demodulation of the A-A-MAP modulated data to generate QPSK demodulated data; and

perform channel decoding of the QPSK demodulated data to generate channel decoded data.

15. The apparatus of claim 14, wherein the channel decoded data comprises the received randomized A-A-MAP IE and a masked CRC, and wherein the logic is further to:

perform a bitwise exclusive OR operation on the masked CRC with the CRC mask to generate a CRC checksum; and

determine whether the CRC checksum is correct.

16. The apparatus of claim 8, wherein the descrambled A-A-MAP IE is an unicast A-A-MAP IE and wherein the unicast A-A-MAP IE comprises one of a Down Link (DL) basic A-A-MAP IE, an Up Link (UL) basic A-A-MAP IE, a DL Subband A-A-MAP IE, an UL Subband A-A-MAP IE, a Feedback Allocation A-A-MAP IE, a UL Sounding Command A-MAP IE, a Code Division Multiple Access (CDMA) Allocation A-MAP IE, a DL Persistent Allocation A-MAP IE, an UL Persistent Allocation A-MAP IE, and a Feedback Polling A-MAP IE.

17. The apparatus of claim 8, wherein the apparatus is operable at least in part with one of Institute of Electrical and Electronics Engineers (IEEE) 802.16m standard, and a 3rd Generation Partnership Project (3GPP) Long Term Evolution standard.

18. A method comprising:

constructing a plurality of Assignment Advanced Media Access Protocol (A-A-MAP) symbols by encoding an A-A-MAP Information Element (IE), wherein the A-A-MAP IE is randomized.

19. The method of claim 18, further comprising:

generate a Pseudo Random Binary Sequence (PRBS) based at least in part on the A-A-MAP IE and a A-A-MAP Cyclic Redundancy Check (CRC) mask, wherein the randomized A-A-MAP IE comprises the generated PRBS.

20. The method of claim 19, wherein the A-A-MAP IE is associated with an advanced mobile station (AMS), and wherein the A-A-MAP CRC mask comprises a station identification (STID) of the AMS.

21. The method of claim 19, wherein constructing the plurality of A-A-MAP symbols by encoding the A-A-MAP IE comprises:

generating a CRC checksum based on the randomized A-A-MAP IE;

performing an exclusive OR operation on the generated CRC checksum with the A-A-MAP CRC mask to generate a masked CRC checksum; and

appending the masked CRC checksum to the randomized A-A-MAP IE.

22. The method of claim 21, wherein constructing the plurality of A-A-MAP symbols by encoding the A-A-MAP IE further comprises:

performing channel encoding of the randomized A-A-MAP IE and the masked CRC checksum to generate channel encoded data;

performing Quadrature Phase Shift Keying (QPSK) modulation of the channel encoded data to generate QPSK modulated data; and

performing Multiple-Input and Multiple-Output (MIMO) encoding of the QPSK modulated data to generate the plurality of A-A-MAP symbols.

23. A method comprising:

descrambling a received randomized A-A-MAP IE to obtain a descrambled A-A-MAP IE; and

determining whether the descrambled A-A-MAP IE is corrupted.

24. The method of claim 23, wherein descrambling the received randomized A-A-MAP IE to obtain the descrambled A-A-MAP IE comprises:

performing an exclusive OR operation on the received randomized A-A-MAP IE with a Cyclic Redundancy Check (CRC) mask to generate the descrambled A-A-MAP.

25. The method of claim 23, wherein determining whether the descrambled A-A-MAP IE is corrupted comprises:

determine whether one or more parts of the descrambled A-A-MAP IE are set according to a pre-determined value or set beyond a pre-determined value, wherein the one or more parts of the descrambled A-A-MAP IE comprise one or more of a reserved bit field, and a fixed value field of the descrambled A-A-MAP IE.

26. The method of claim 23, further comprising:

receiving a plurality of A-A-MAP symbols;

performing Multiple-Input and Multiple-Output (MIMO) decoding of the plurality of A-A-MAP symbols to generate A-A-MAP modulated data;

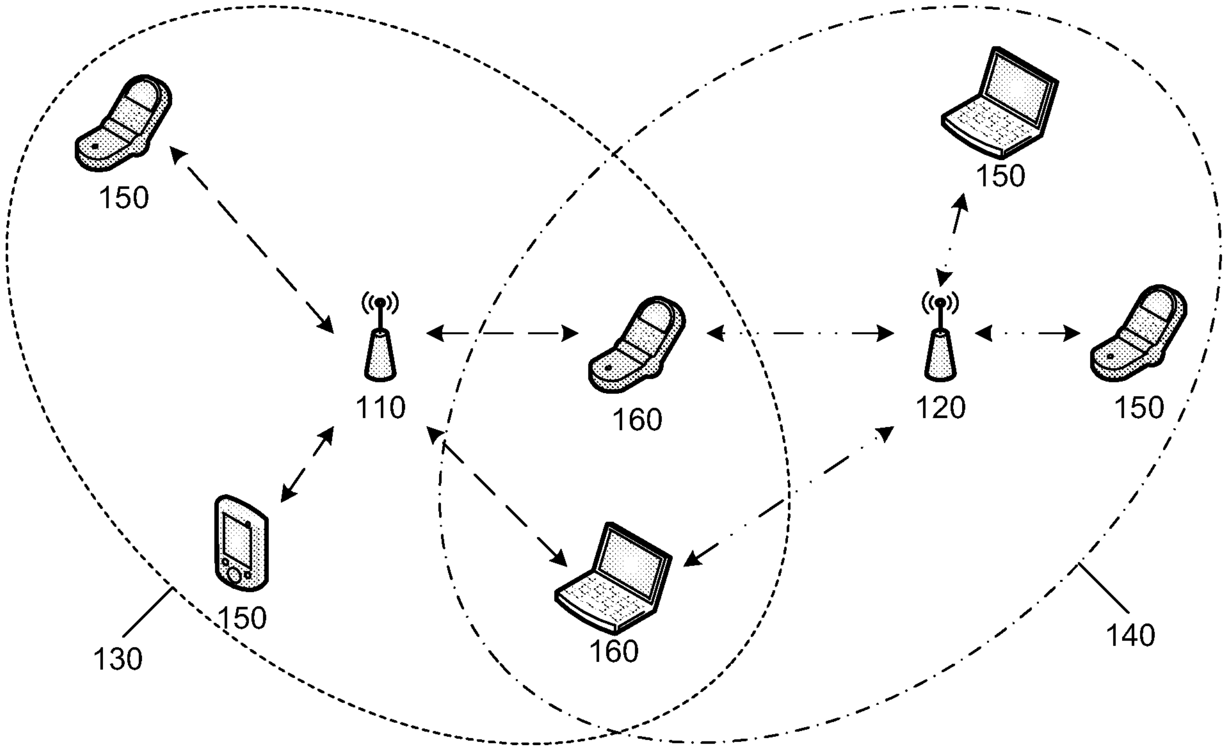
performing Quadrature Phase Shift Keying (QPSK) demodulation of the A-A-MAP modulated data to generate QPSK demodulated data; and

performing channel decoding of the QPSK demodulated data to generate channel decoded data.

27. The method of claim 26, wherein the channel decoded data comprises the received randomized A-A-MAP IE and a masked CRC, the method further comprising:

performing a bitwise exclusive OR operation on the masked CRC with the CRC mask to generate a CRC checksum; and

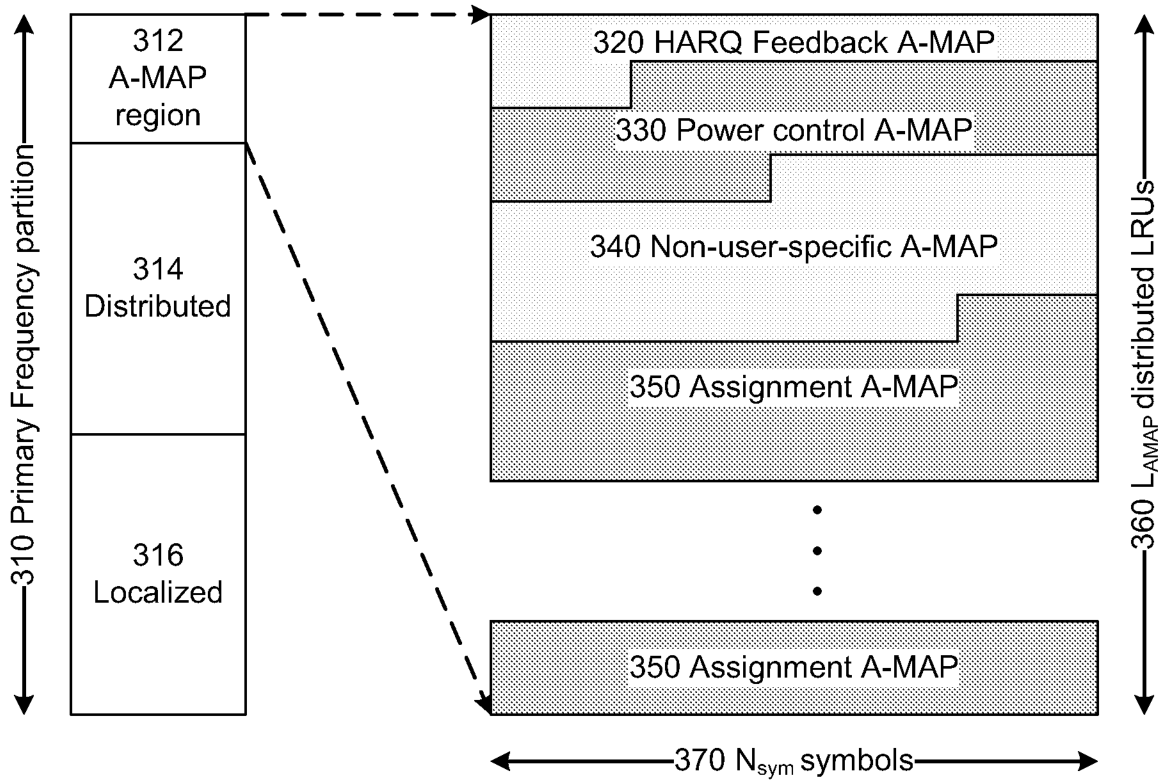
determine whether the CRC checksum is correct.



100 FIG. 1

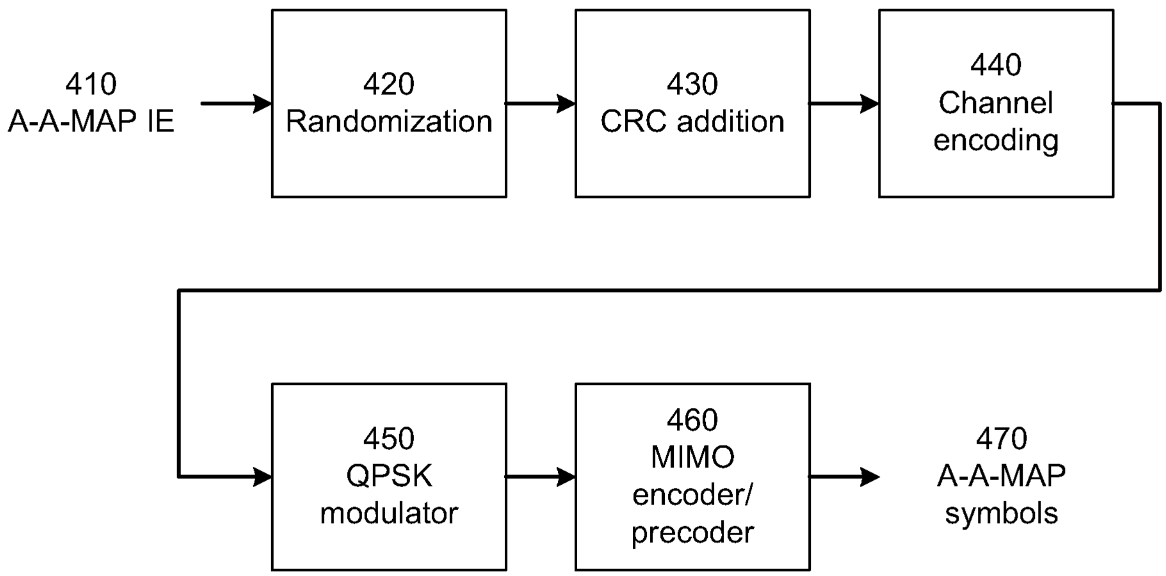
210 A-MAP	220 A-MAP	230 A-MAP	240 A-MAP	252 UL SF0	262 UL SF1	272 UL SF2	282 UL SF3
212 DL SF0	222 DL SF1	232 DL SF2	242 DL SF3				

200 FIG. 2



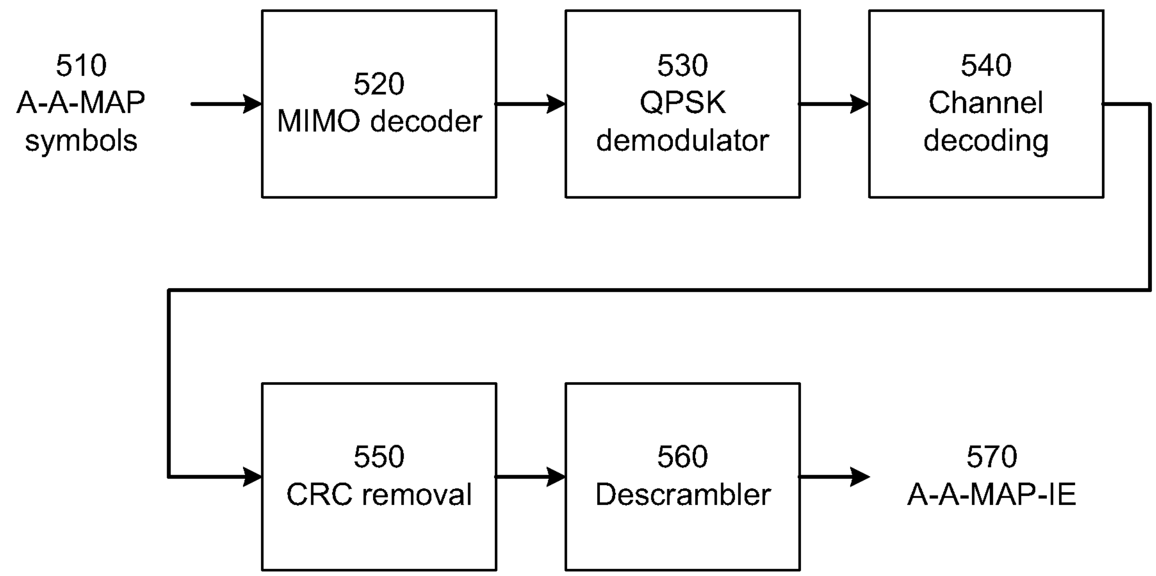
300

FIG. 3



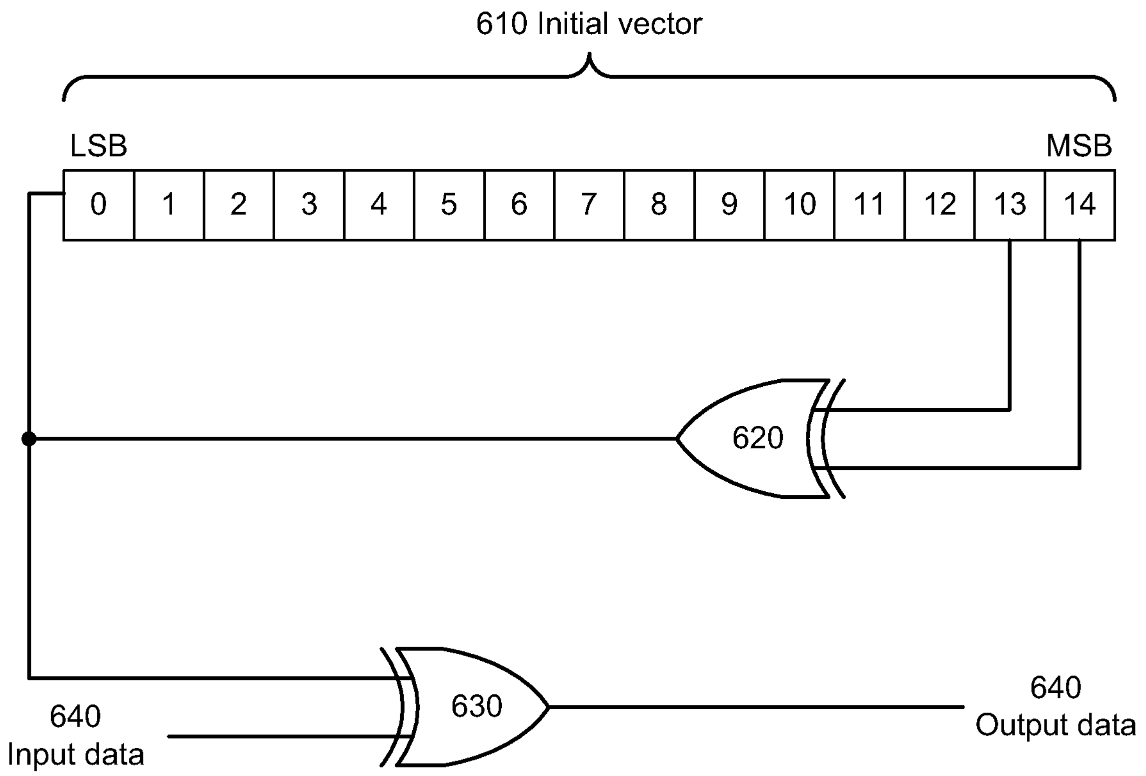
400

FIG. 4



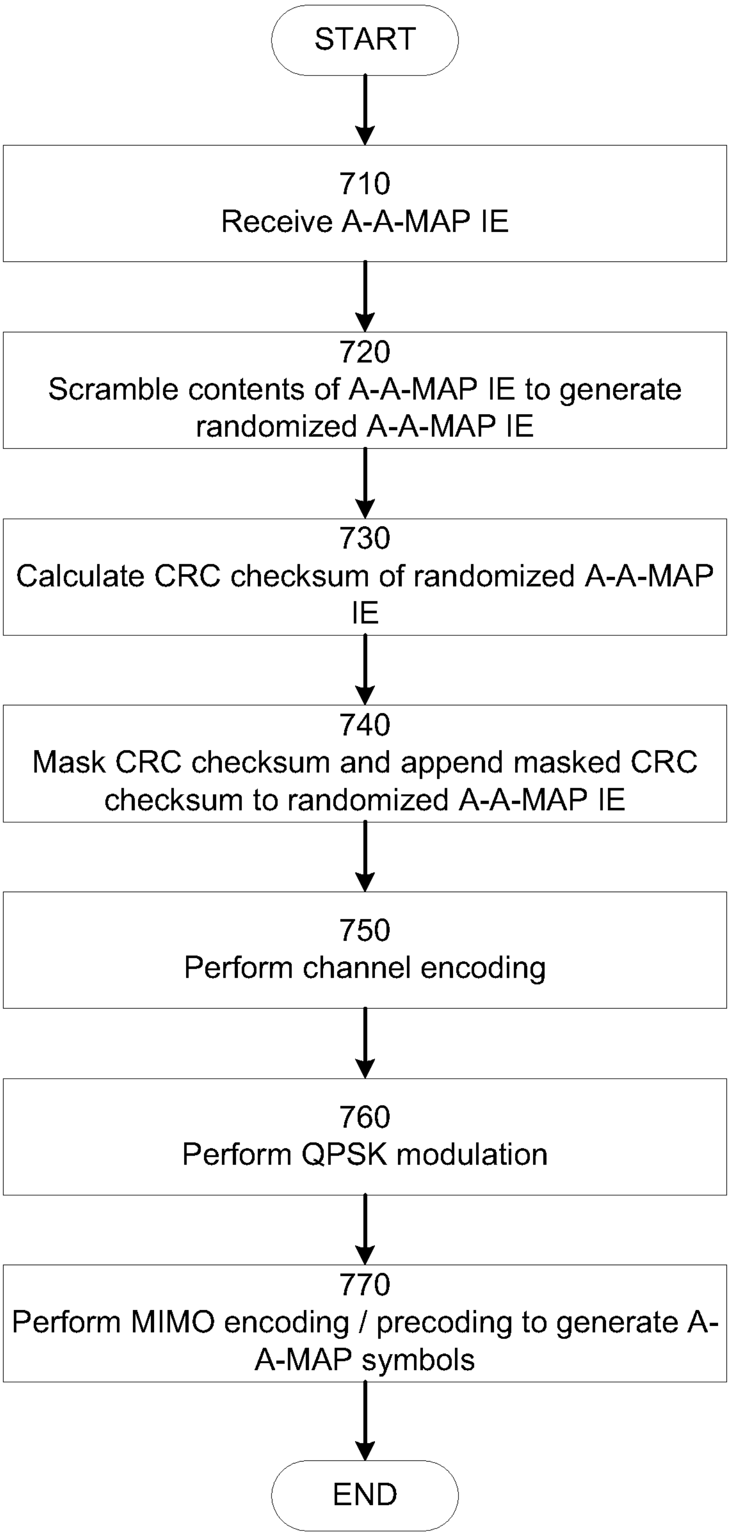
500

FIG. 5



600

FIG. 6


START
710
Receive A-A-MAP IE
720
Scramble contents of A-A-MAP IE to generate randomized A-A-MAP IE
730
Calculate CRC checksum of randomized A-A-MAP IE
740
Mask CRC checksum and append masked CRC checksum to randomized A-A-MAP IE
750
Perform channel encoding
760
Perform QPSK modulation
770
Perform MIMO encoding / precoding to generate A-A-MAP symbols
END

700

FIG. 7

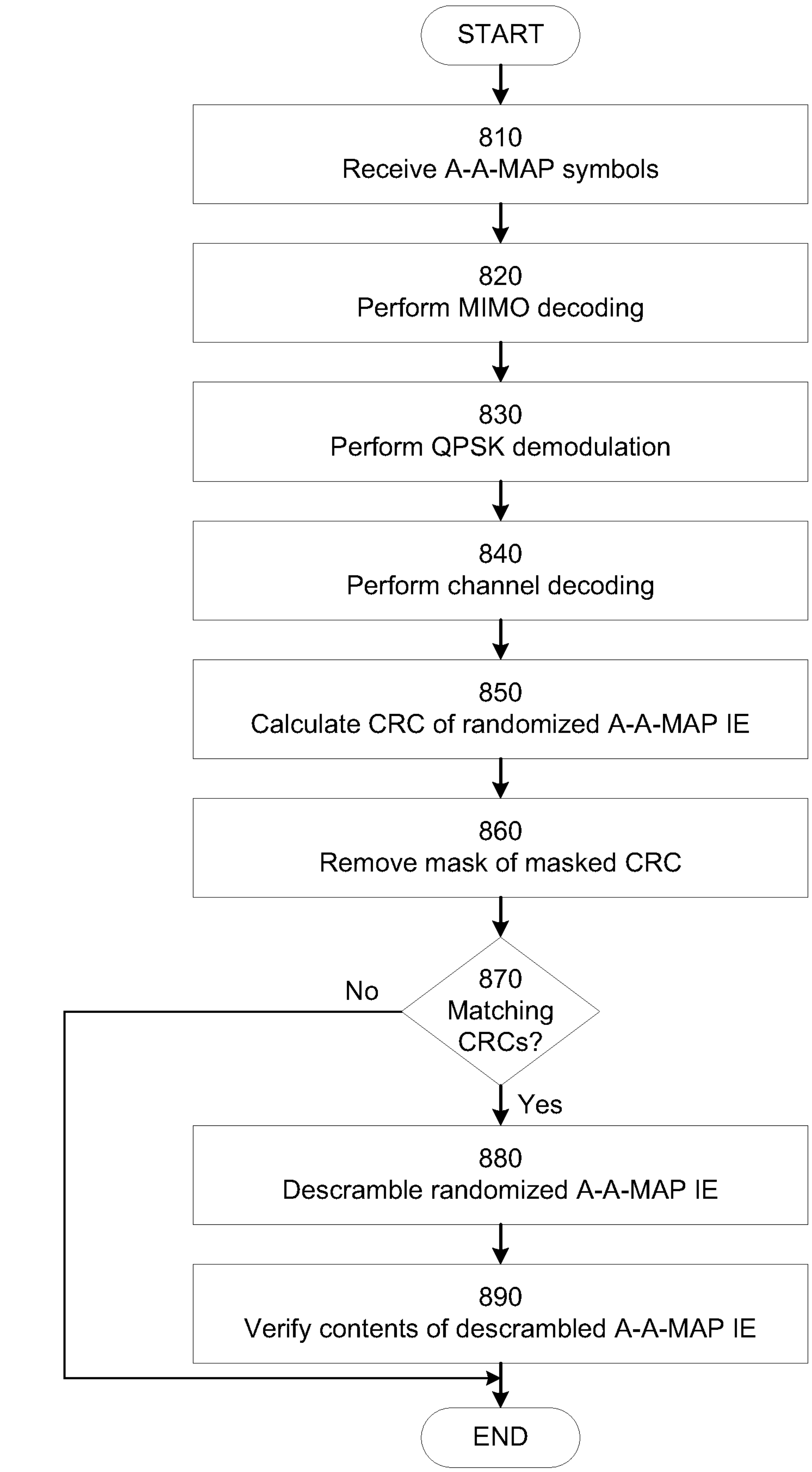

START
810
Receive A-A-MAP symbols
820
Perform MIMO decoding
830
Perform QPSK demodulation
840
Perform channel decoding
850
Calculate CRC of randomized A-A-MAP IE
860
Remove mask of masked CRC
870
Matching CRCs?
No
Yes
880
Descramble randomized A-A-MAP IE
890
Verify contents of descrambled A-A-MAP IE
END
800

FIG. 8

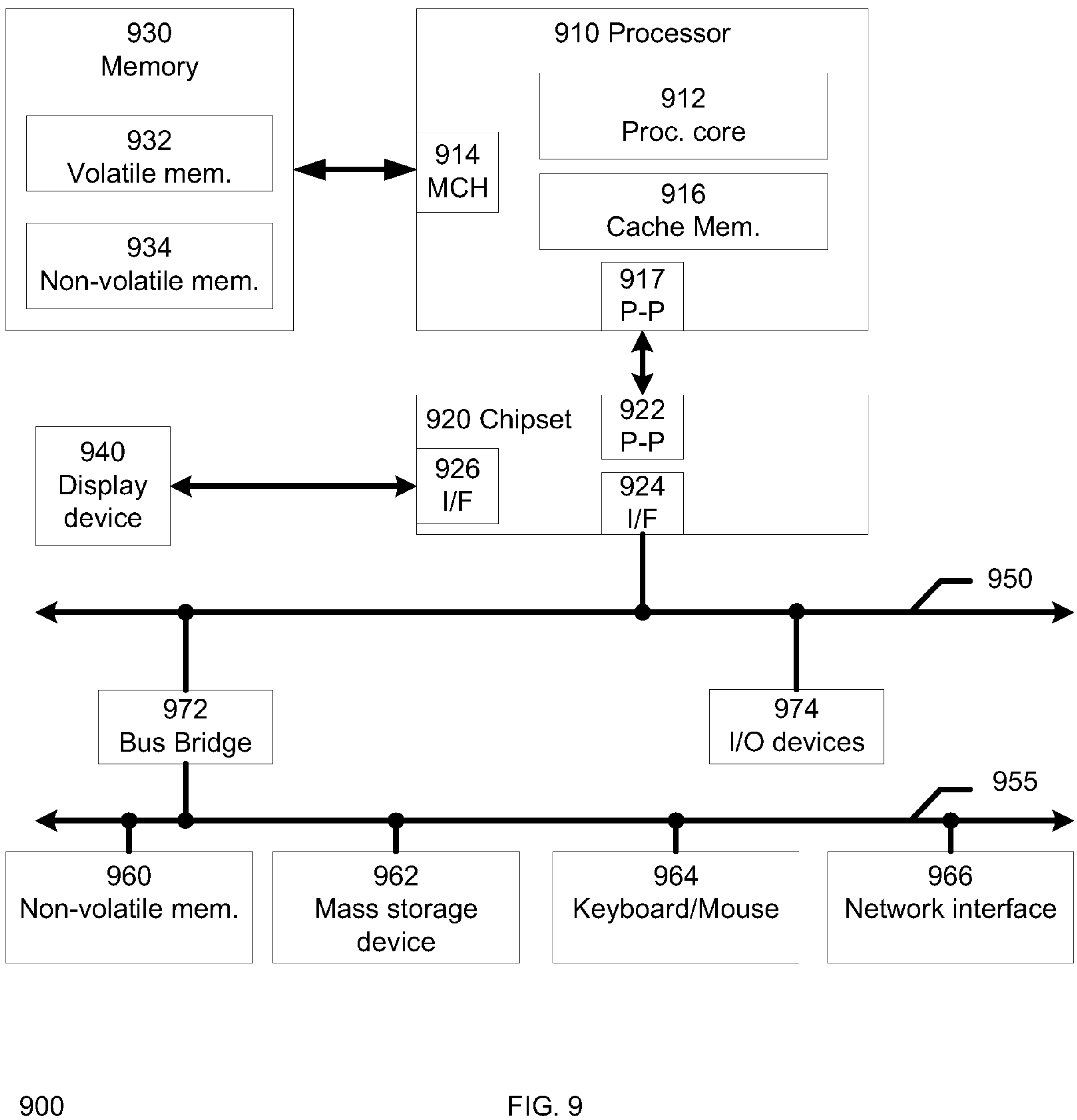

930
Memory
932
Volatile mem.
934
Non-volatile mem.
910 Processor
912
Proc. core
914
MCH
916
Cache Mem.
917
P-P
920 Chipset
922
P-P
926
I/F
924
I/F
940
Display
device
950
972
Bus Bridge
974
I/O devices
955
960
Non-volatile mem.
962
Mass storage
device
964
Keyboard/Mouse
966
Network interface
900

FIG. 9