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(54) **METHODS AND APPARATUS TO MONITOR MEDIA EXPOSURE IN VEHICLES**

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CPC ..... **H04R 29/00** (2013.01)  
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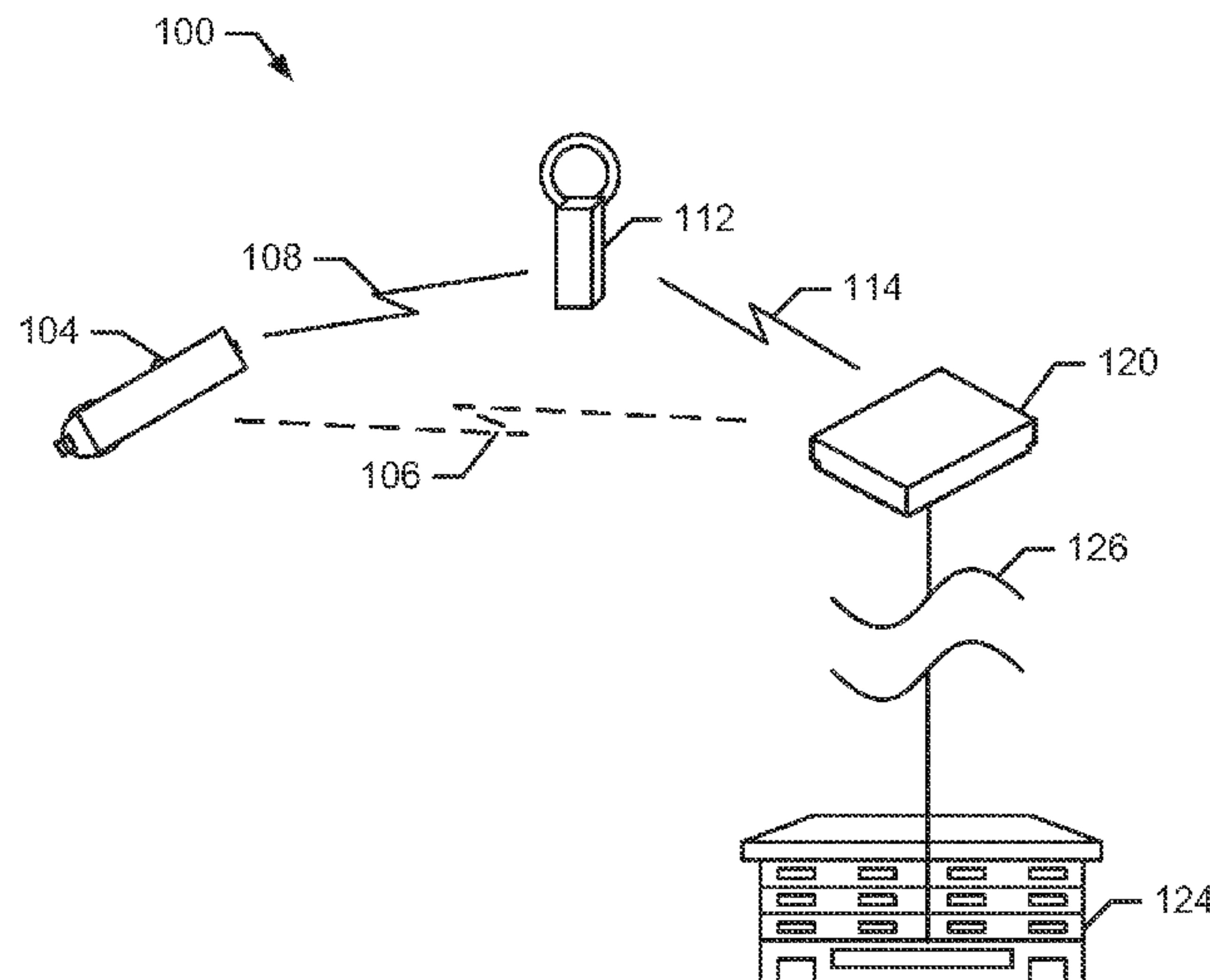
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(57) **ABSTRACT**

Methods and apparatus to monitor media exposure in vehicles are disclosed. An example implementation includes collecting audience measurement data with a media monitoring device fixed in a vehicle and transmitting the audience measurement data from the media monitoring device to a shuttle located within the vehicle, the shuttle being incapable of collecting audience measurement data independent of the media monitoring device.

**12 Claims, 12 Drawing Sheets**



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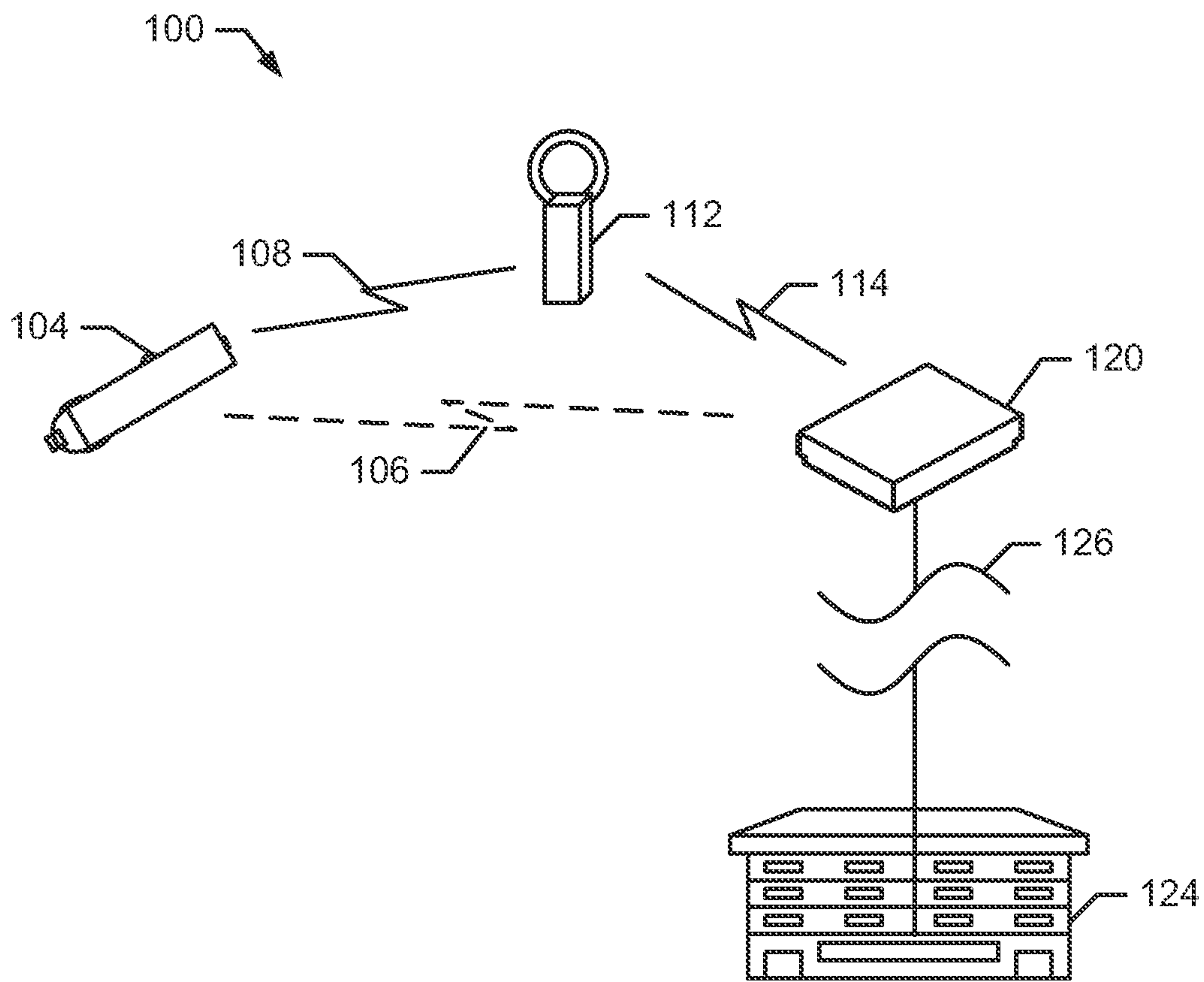


FIG. 1

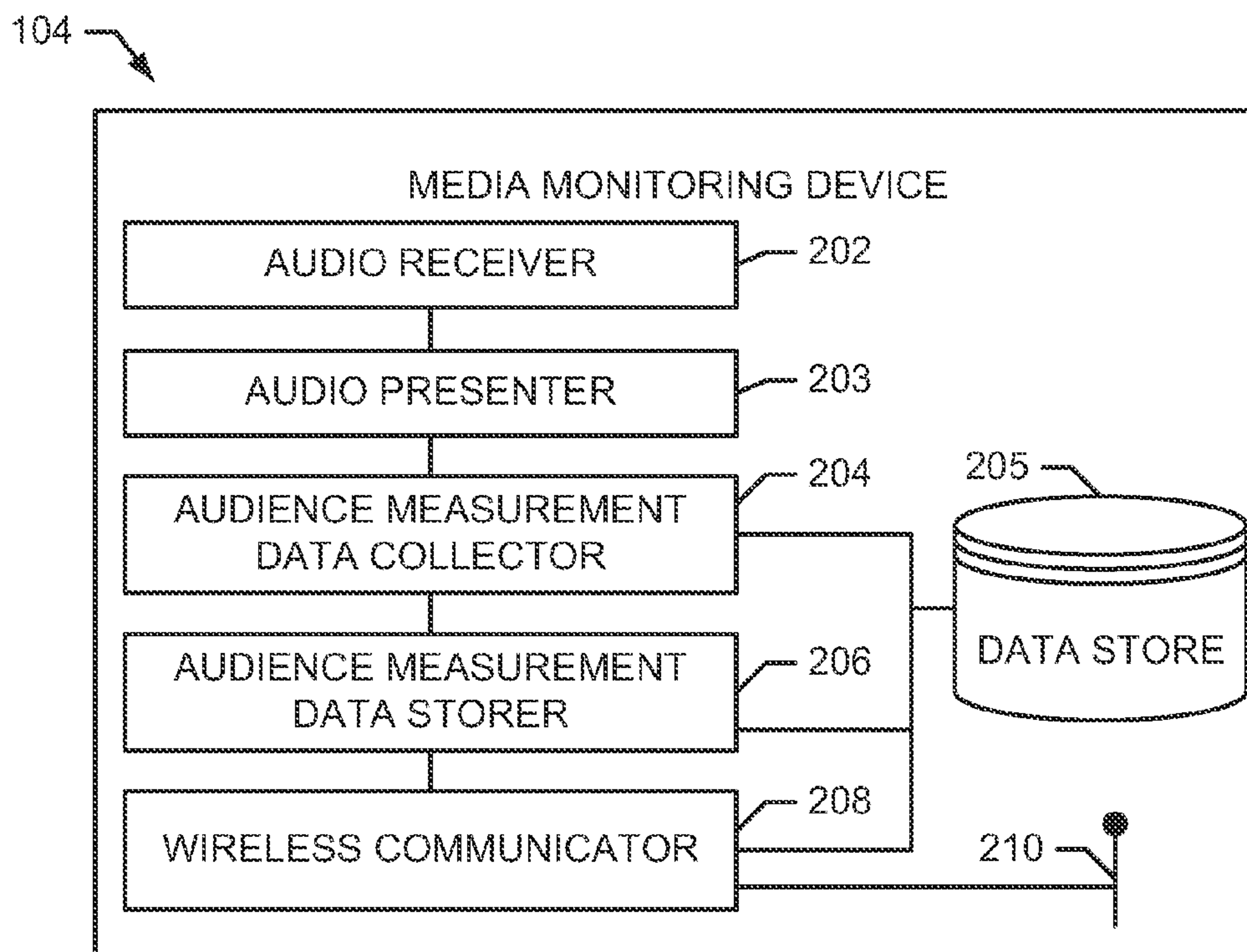


FIG. 2

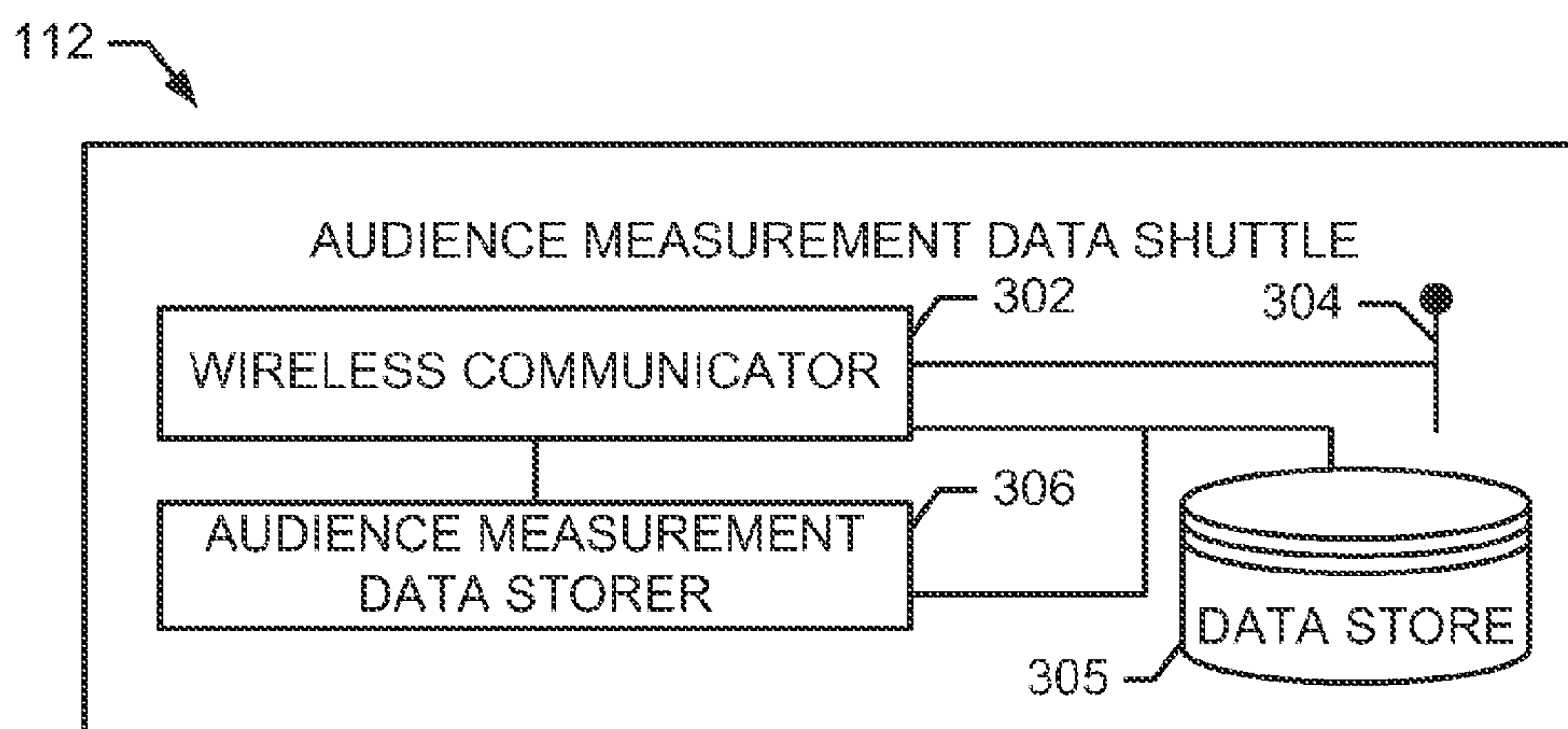


FIG. 3

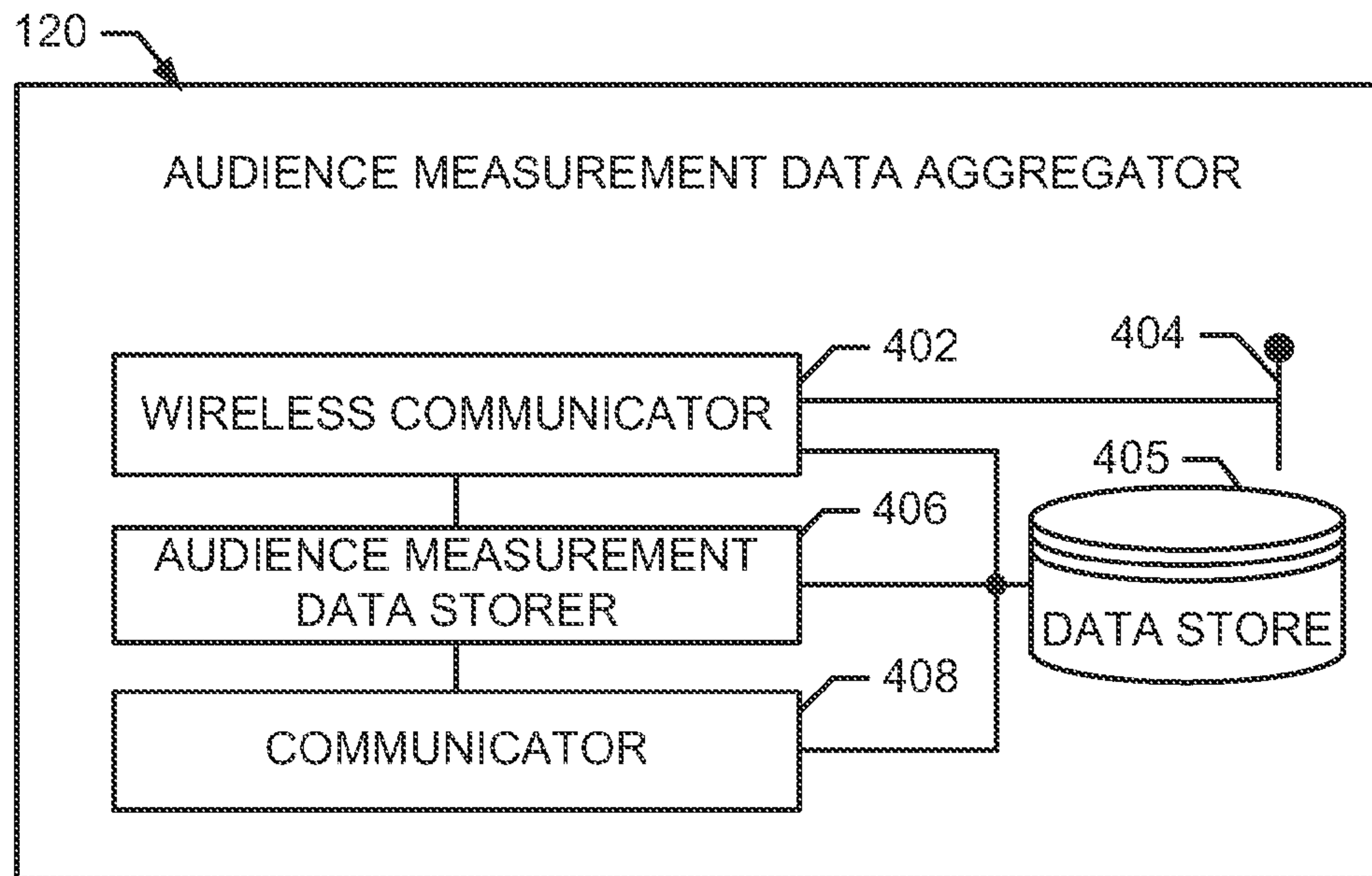


FIG. 4

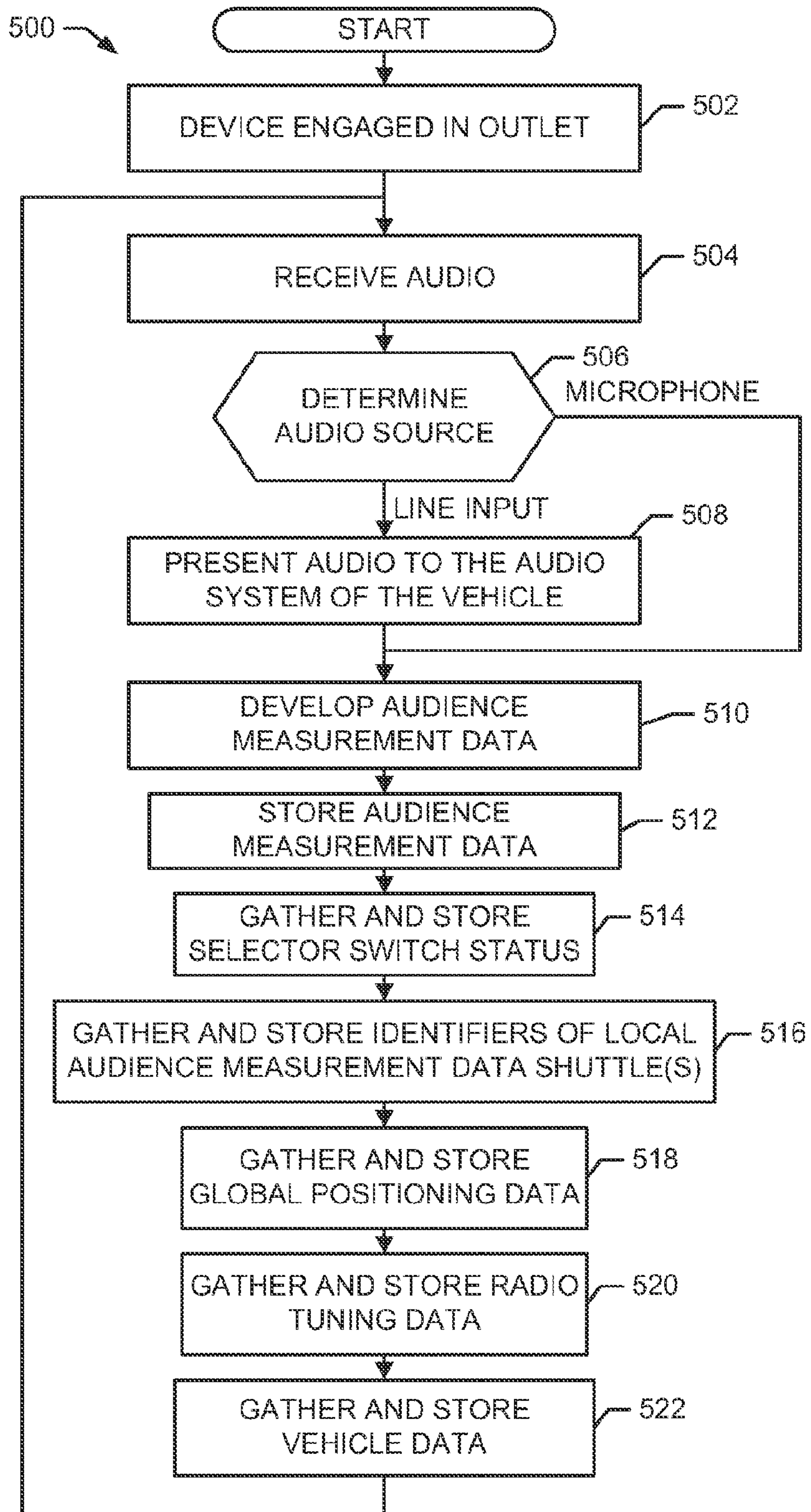


FIG. 5



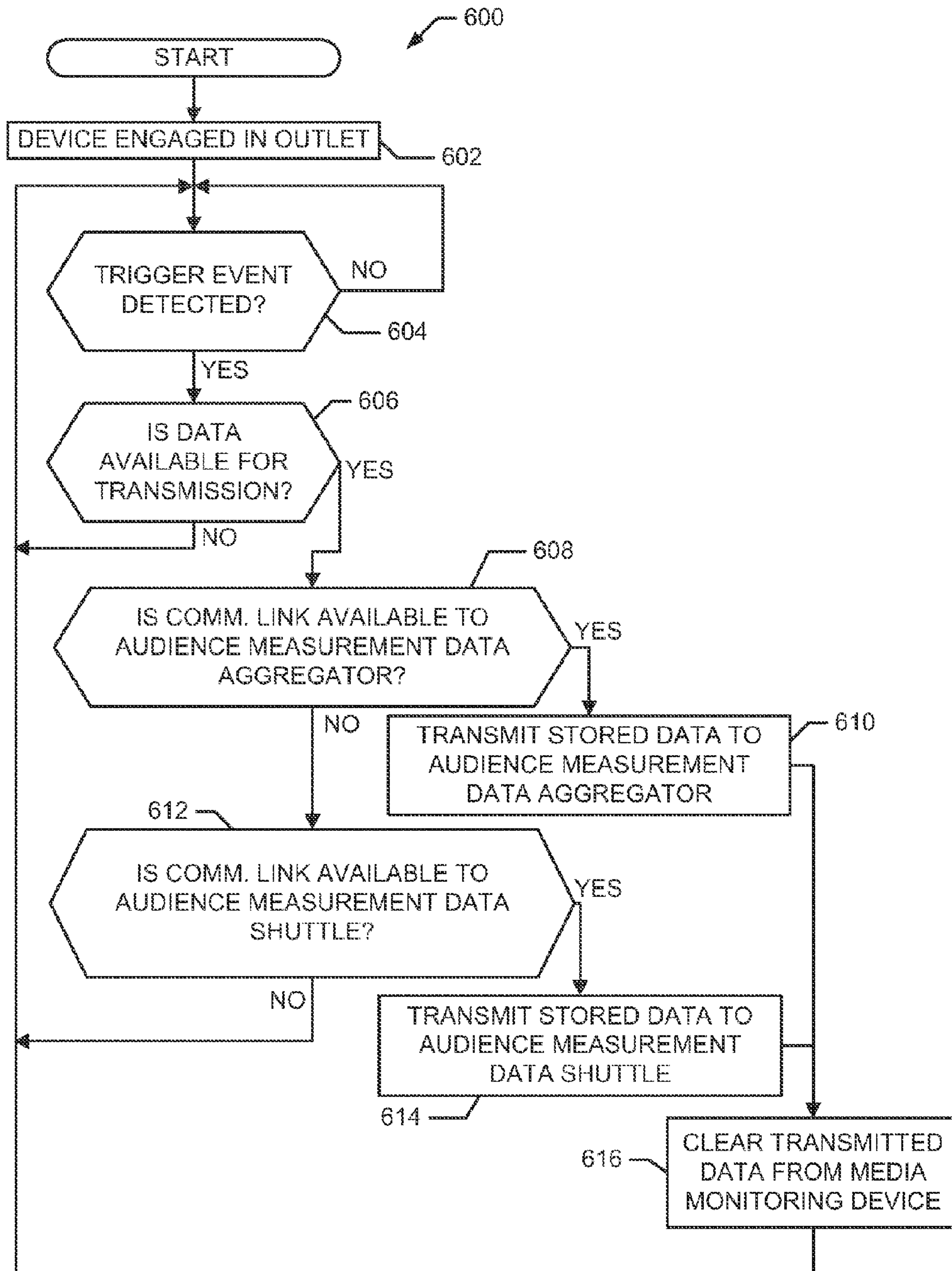


FIG. 6



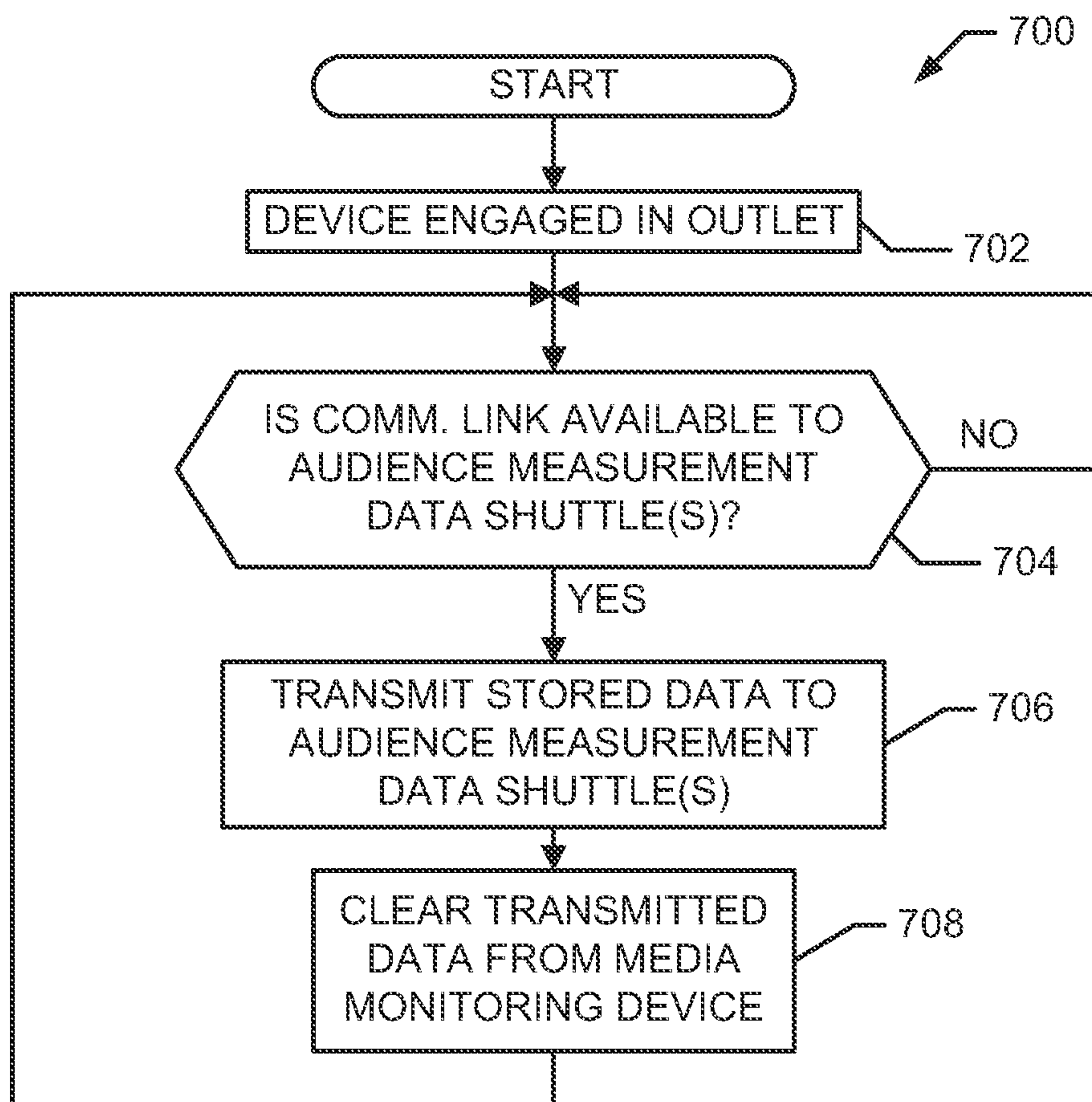


FIG. 7

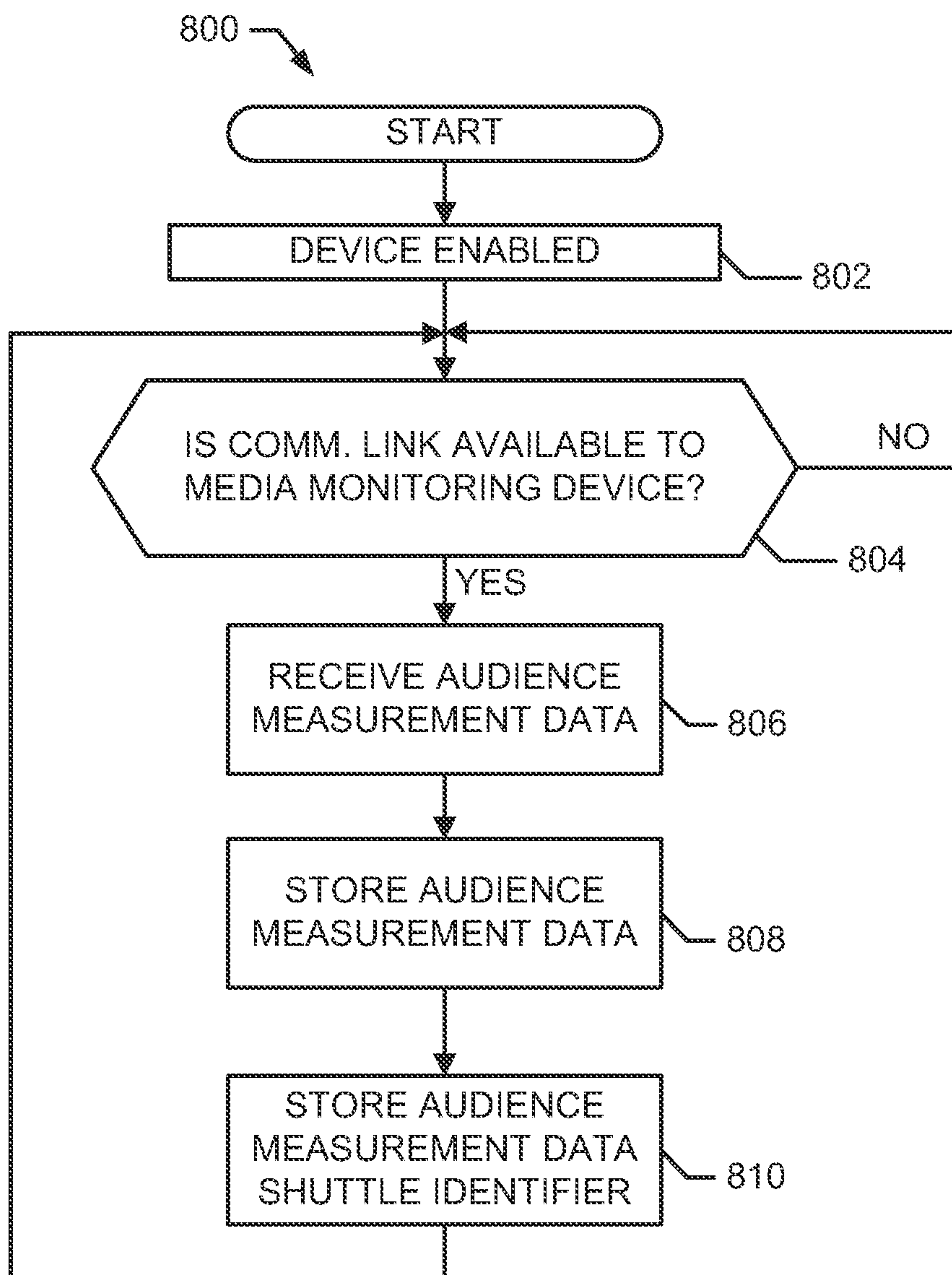


FIG. 8

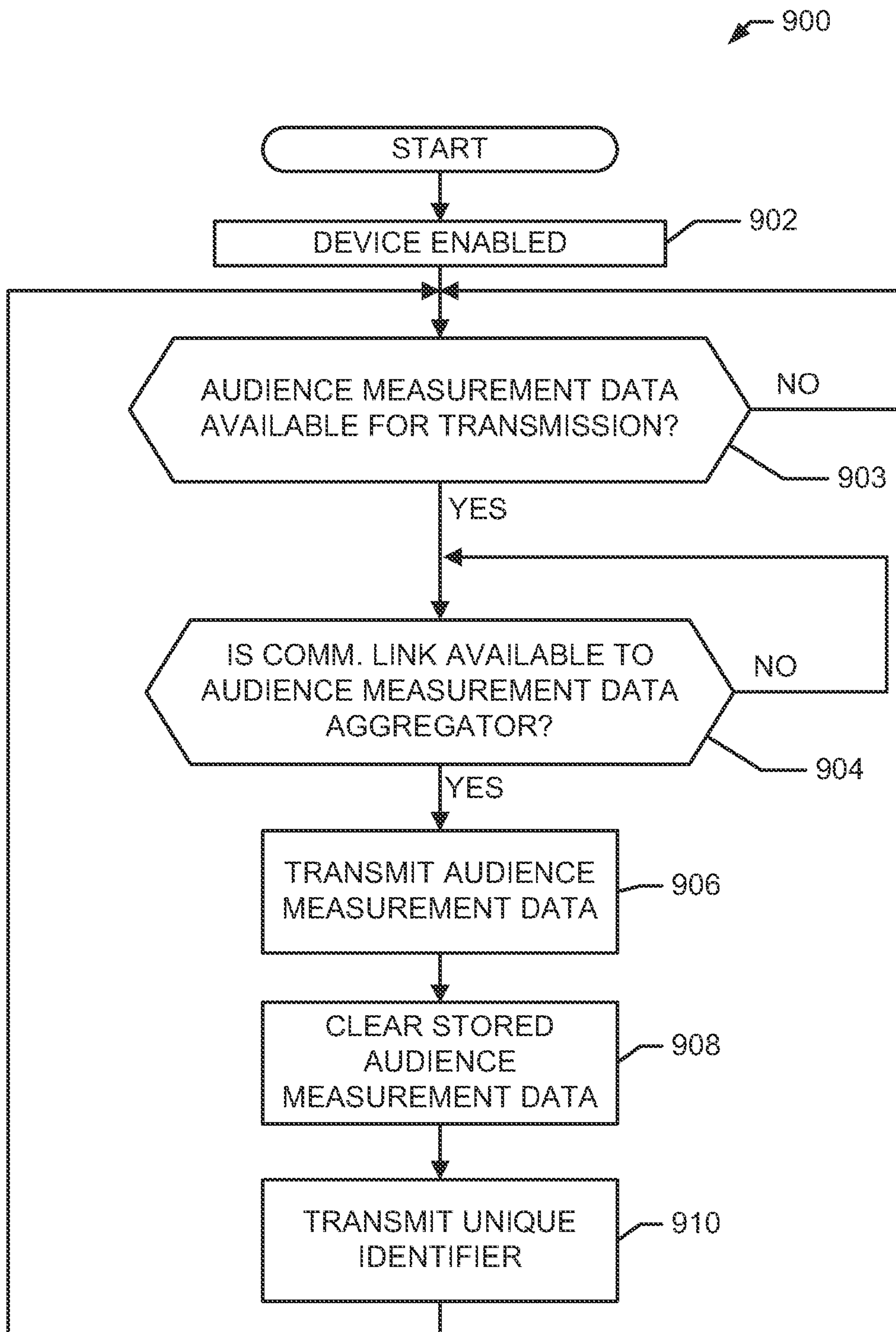


FIG. 9



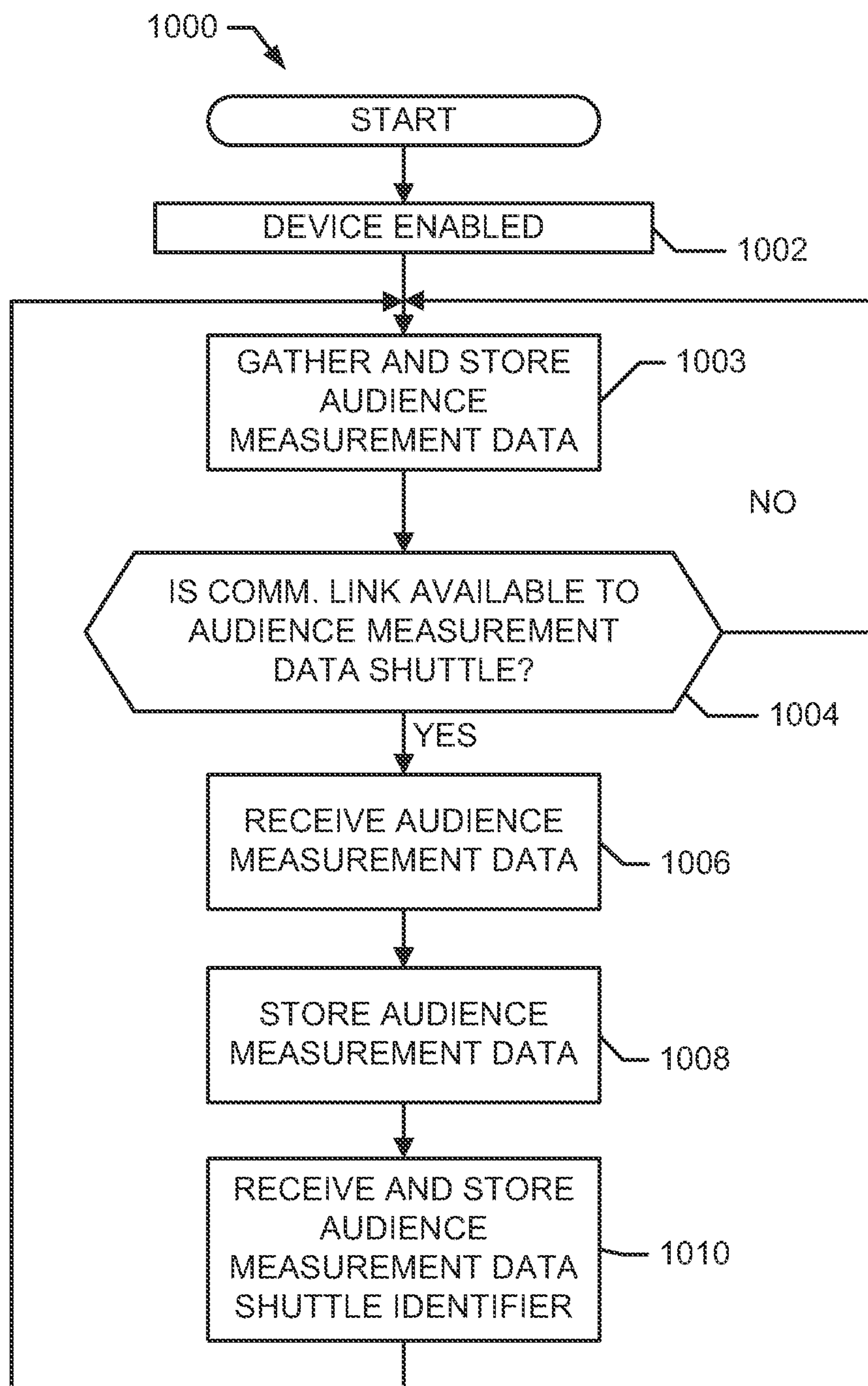


FIG. 10

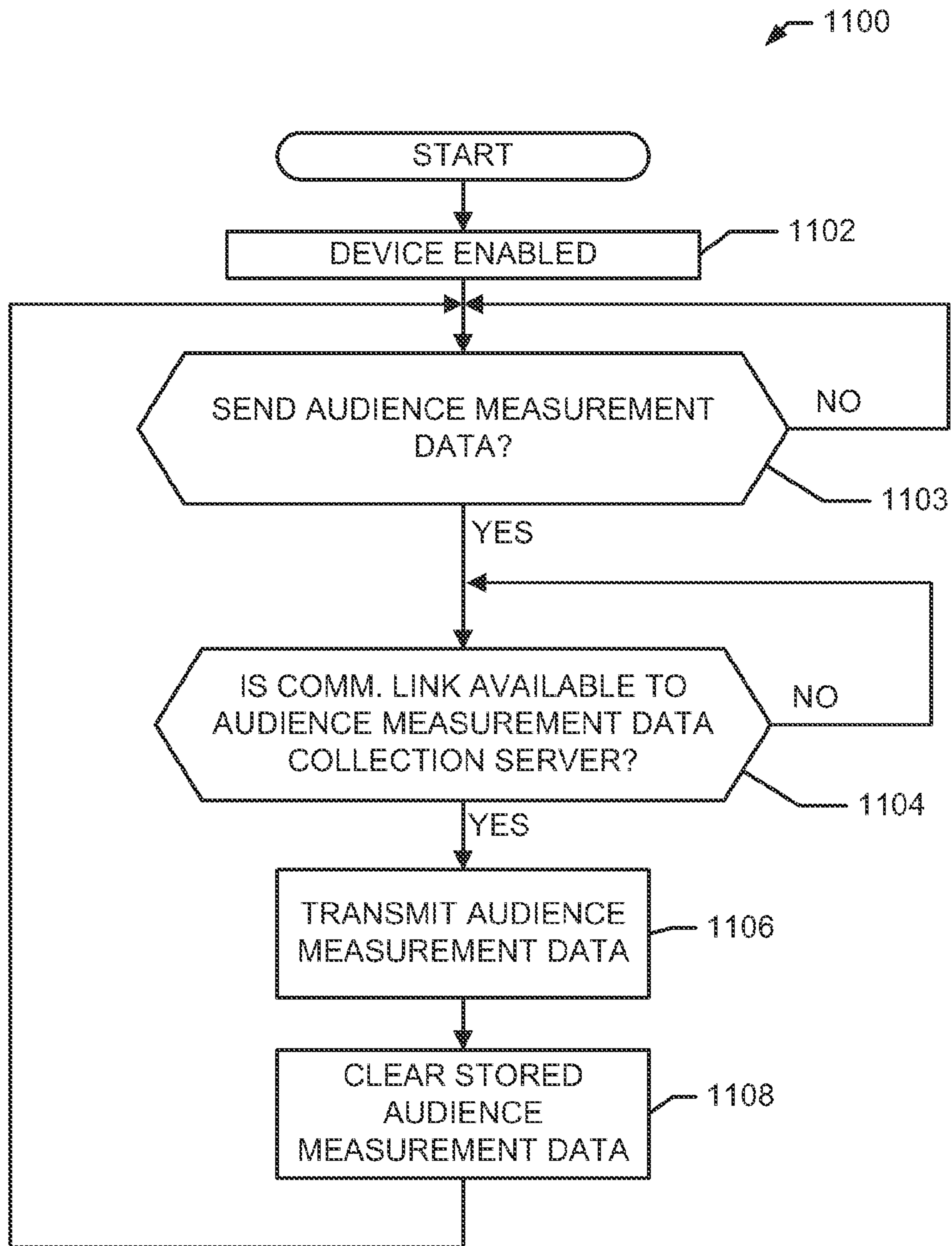


FIG. 11

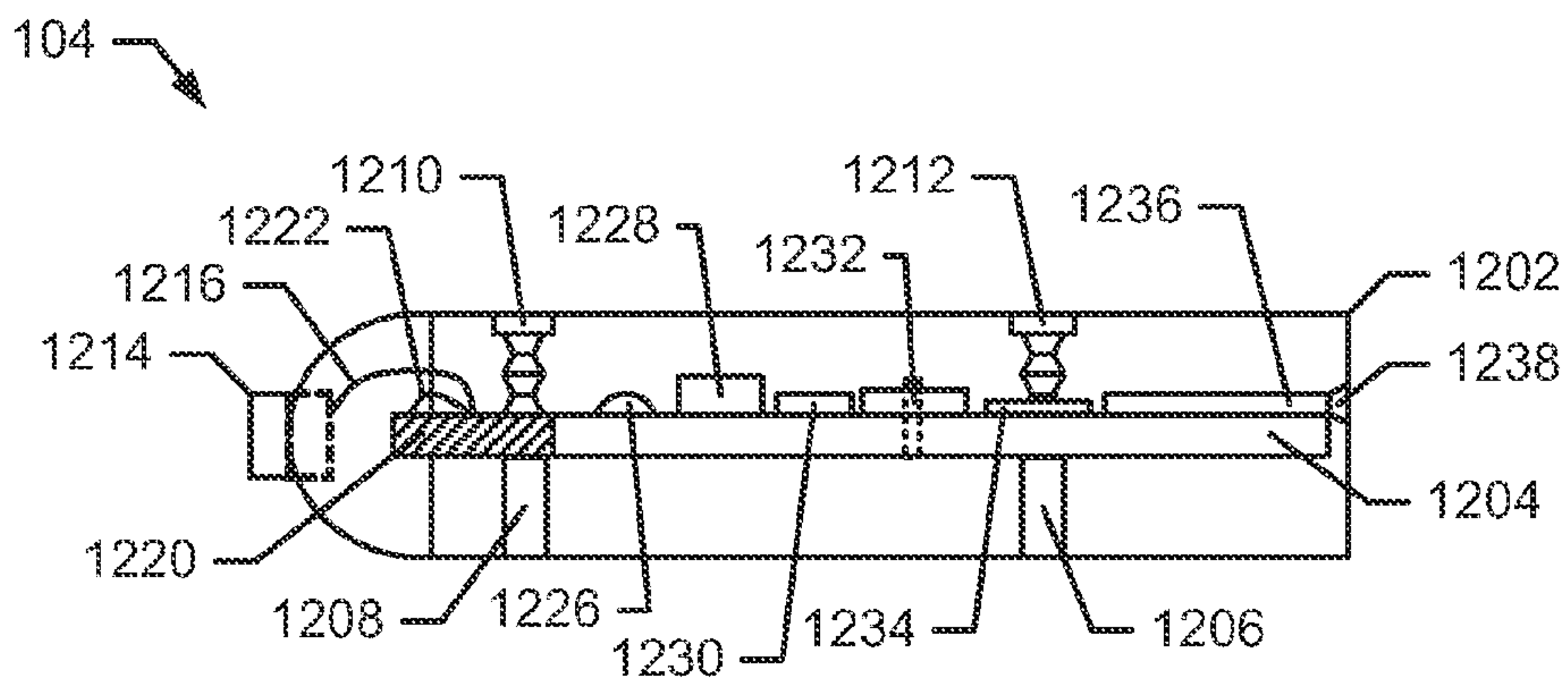


FIG. 12

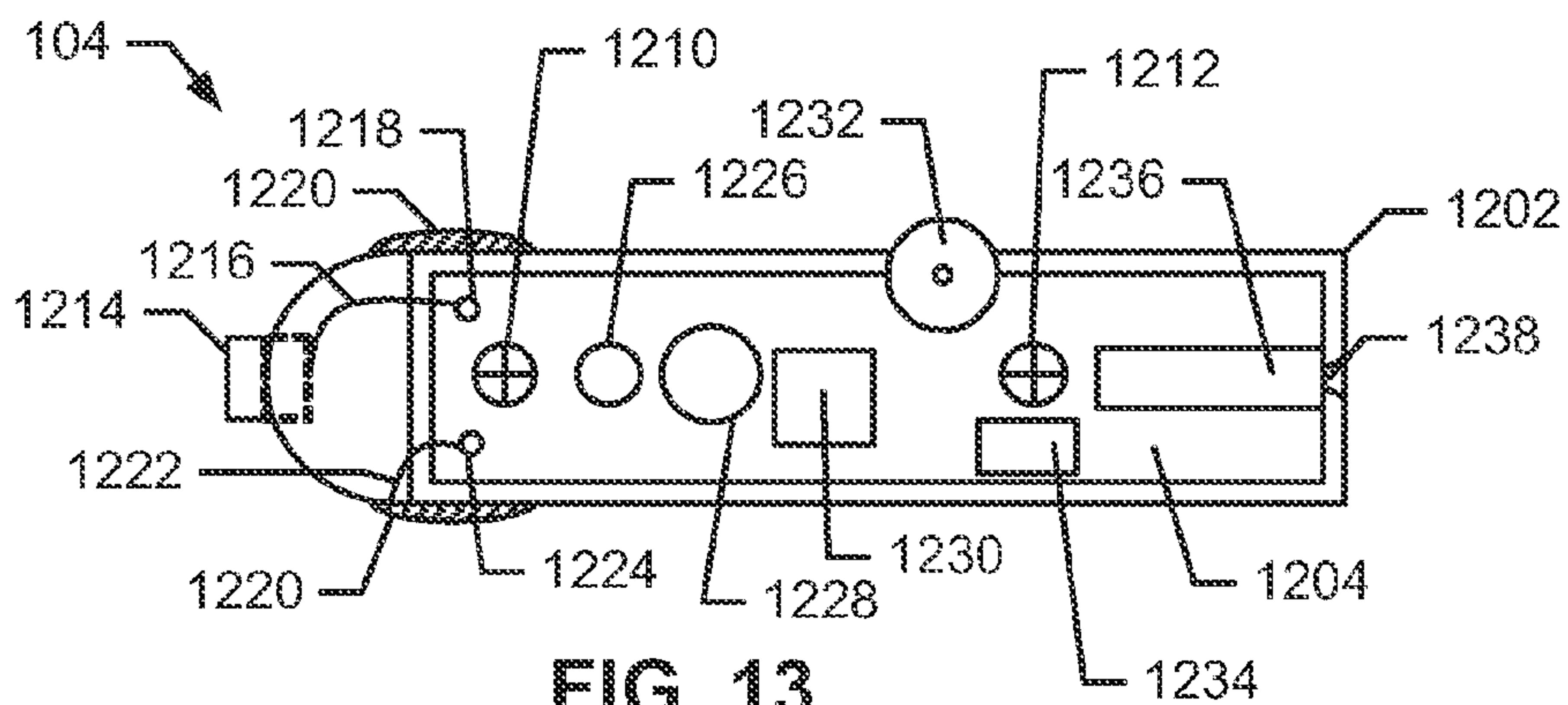


FIG. 13

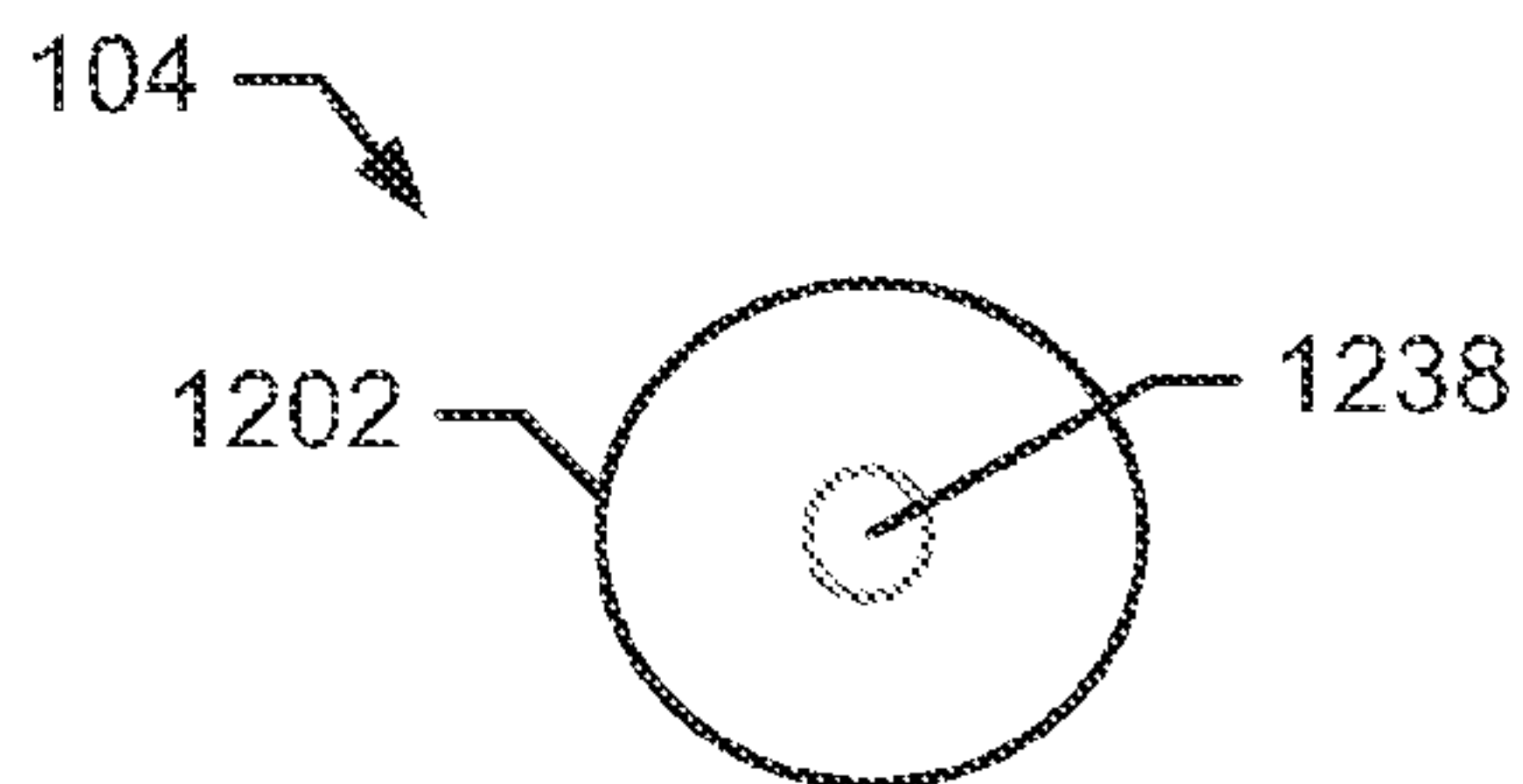


FIG. 14



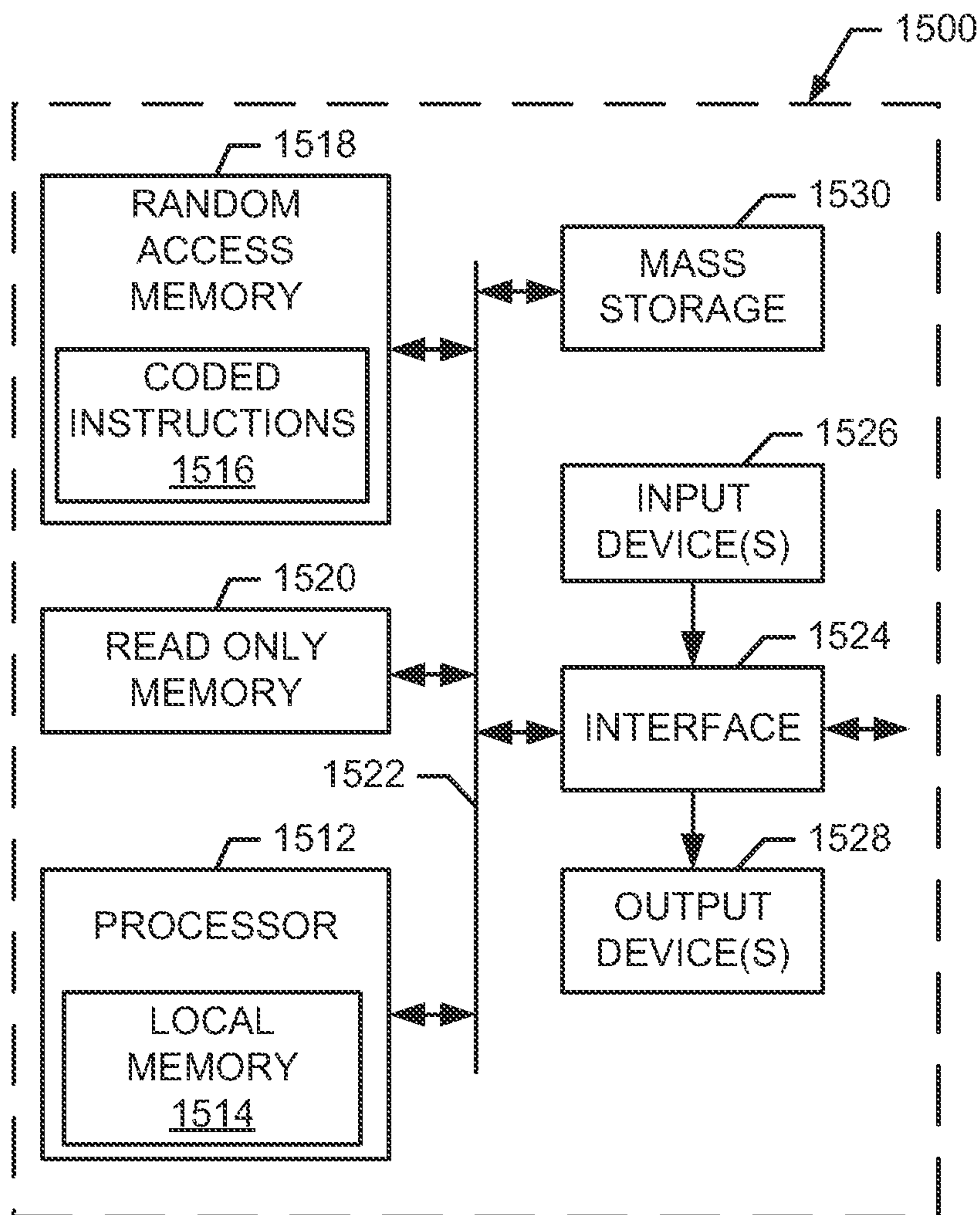


FIG. 15

## METHODS AND APPARATUS TO MONITOR MEDIA EXPOSURE IN VEHICLES

**Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.**

*Notice: More than one reissue application has been filed for the reissue of U.S. Pat. No. 8,549,552. The reissue applications are U.S. patent application Ser. Nos. 14/667,315 and 14/260,890. This application is a reissue divisional application of application Ser. No. 14/260,890 filed on Apr. 24, 2014 which is an application for reissue of U.S. Pat. No. 8,549,552 filed on Nov. 3, 2009.*

### TECHNICAL FIELD

The present disclosure pertains to media monitoring and, more specifically to, methods and apparatus to monitor media exposure in vehicles.

### BACKGROUND

Determining size, demographics, and media exposure and/or consumption patterns of a media audience helps media providers to understand their audience and better tailor their media content. Further, accurate media exposure demographics allow advertisers to target media content to audiences of a desired size and/or audiences comprising members having a set of common desired characteristics (e.g., income level, lifestyles, interests, etc.) associated with typical buyers of the advertised product or service.

In order to collect demographics of audiences, an audience measurement company may enlist a number of media utilizing households and/or consumers (e.g., panelists) to cooperate in an audience measurement study for a period of time. The media usage habits of these panelists, as well as demographic data about these panelists, are collected using automated and/or manual collection methods. The collected data is subsequently used to generate informational statistics related to media exposure, including, for example, audience sizes, audience demographics, audience preferences, the total number of hours of media exposed per audience member and/or per region, program ratings, etc.

Traditional audience measurement systems have employed a client/server architecture wherein the client (e.g., a metering device) and server (e.g., a data collection unit to collect data from the metering device) are in different physical locations. For example, in a typical system, the client is located near an audience member being monitored (e.g., attached to or otherwise in proximity to a television, included in a portable device carried by the audience member, etc.). The server is typically located at an off-site location that is away from the client (e.g., a central office of an audience measurement company such as the Nielsen Company, etc.) The client typically collects audience measurement data and transmits the same to the server. The server then analyzes audience measurement data from a number of panelists to identify ratings, trends, etc.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of an example system to monitor media exposure in vehicles.

FIG. 2 is a block diagram of the example media monitoring device of FIG. 1.

FIG. 3 is a block diagram of the example audience measurement data shuttle of FIG. 1.

FIG. 4 is a block diagram of the example audience measurement data aggregator of FIG. 1.

FIG. 5 is a flowchart representative of example machine readable instructions that may be executed to implement the example media monitoring device of FIGS. 1 and 2.

FIG. 6 is a flowchart representative of example machine readable instructions that may be executed to implement the audience measurement data transmission process of the example media monitoring device of FIGS. 1 and 2.

FIG. 7 is a flowchart representative of example machine readable instructions that may be executed to implement a second example audience measurement data transmission process of the example media monitoring device of FIGS. 1 and 2.

FIG. 8 is a flowchart representative of example machine readable instructions that may be executed to implement the audience measurement data reception process of the example audience measurement data shuttle of FIGS. 1 and 3.

FIG. 9 is a flowchart representative of example machine readable instructions that may be executed to implement the audience measurement data transmission process of the example audience measurement data shuttle of FIGS. 1 and 3.

FIG. 10 is a flowchart representative of example machine readable instructions that may be executed to implement the audience measurement data reception process of the example audience measurement data aggregator of FIGS. 1 and 4.

FIG. 11 is a flowchart representative of example machine readable instructions that may be executed to implement the audience measurement data transmission process of the example audience measurement data aggregator of FIGS. 1 and 4.

FIG. 12 is a side, cross-sectional view of the example media monitoring device of FIGS. 1 and 2.

FIG. 13 is a top, cross-sectional view of the example media monitoring device of FIG. 12.

FIG. 14 is a rear, cross-sectional view of the example media monitoring device of FIGS. 12 and 13.

FIG. 15 is a block diagram of an example processor system that may execute, for example, the machine readable instructions of FIGS. 5 through 11 to implement the example media monitoring device of FIGS. 1, 2, and 12 through 14; the example audience measurement data shuttle of FIGS. 1 and 3; and/or the example audience measurement data aggregator of FIGS. 1 and 4.

### DETAILED DESCRIPTION

Media monitoring systems may be implemented in different configurations based on their intended use. For example, vehicles typically include a media receiver capable of tuning a plurality of inputs (e.g., AM Radio, FM Radio, satellite radio, CD player, MP3 player, DVD player, etc.) via wired and/or wireless connections. As described herein, an example media monitoring device communicates with the media receiver to extract or generate information about media content presented by the media receiver. The media monitoring device may be implemented by any combination of hardware, firmware, and/or software. Such hardware, firmware, and/or software may be adapted to perform a number of monitoring tasks including, by way of example,



not limitation, detecting a channel tuning status of a tuner disposed in the media receiver, extracting program identification codes embedded in or otherwise associated with signals tuned by the media receiver, generating signatures characteristic of signals tuned by the media receiver, etc. 5 Alternatively, the media monitoring device may not communicate with the media receiver of the vehicle. In such an implementation, the media monitoring device wirelessly monitors media presented to the audience by the media receiver (e.g., by collecting free field audio). In the illustrated example, collected media exposure data is transported out of the vehicle via an audience measurement data shuttle and is then transmitted to a data collection facility for processing. If an audience measurement data shuttle is assigned to each individual panelist, the audience measurement data shuttle may add a unique identifier to the data to thereby associate demographic data with the collected audience measurement data.

In the field of media monitoring, media companies seek high accuracy media exposure data. To achieve such accuracy, it is desirable to reduce the level of involvement of the panelists. The more panelists are asked to do, the more likely the panelists will forget or intentionally fail to perform a requested task. The degree to which the panelists perform requested tasks (e.g., carrying a meter, logging into a meter, etc.) is referred to as the degree of compliance of the panelist.

Media monitoring systems are designed to result in high levels of audience member compliance, resulting in data that more accurately reflects the actual exposure of panelists to media content. Media monitoring in vehicles presents challenges that are different in degree or type from the challenges faced by in home media monitoring. If panelists are required to take more extensive action to enable in-vehicle data collection than to enable in-home data collection, the in-vehicle collection system may exhibit lower levels of audience member compliance than are experienced in home media monitoring systems due to the constraints of the in-vehicle environment, the amount of time audience members spend in vehicles, and/or the occurrence of frequently entering/exiting of the vehicle (e.g., short trips). Additionally, the physical aspects of vehicles present constraints on the in-vehicle monitoring. Such constraints include limited physical space, limited selection of power sources, and limited methods of transmitting collected monitoring data.

In examples disclosed herein, an example media monitoring device is placed in a vehicle to monitor media exposure and an audience measurement data shuttle is used to transport and/or transmit stored audience measurement data to a central location. To increase the probability of audience member compliance, example implementations of the media monitoring device use automated methods to collect and wirelessly transmit audience measurement data. In some implementations, audience measurement data is transmitted to an intermediate collection site or audience measurement data aggregator in, for example, the audience member's residence to aggregate audience measurement data before being sent to a processing location (e.g., an audience measurement data collection server, a central facility, etc.) A direct communication link between the in-vehicle media monitoring device and a collection site is typically not available. Accordingly, example media monitoring systems as disclosed herein include an intermediary audience measurement data shuttle to wirelessly receive audience measurement data from the in-vehicle media monitoring device and to wirelessly transmit that data to the audience measurement data aggregator when the audience measurement

data shuttle is removed from the vehicle and brought into communication range of the audience measurement data aggregator. For example, the intermediate audience measurement data shuttle may be implemented as a key chain or other small device to be carried by the panelist. In this way, the panelist will naturally carry the audience measurement data shuttle into proximity of the audience measurement data aggregator when the panelist returns home. Because the audience measurement data shuttle is implemented as a device that the panelist will naturally carry in and out of the house (e.g., a car key chain), the panelist is not required to take any extraordinary measures to facilitate in-vehicle data collection and panelist compliance is improved.

FIG. 1 is a block diagram of an example system 100 for in-vehicle audience measurement. The example audience measurement system 100 of FIG. 1 is adapted to monitor media exposure in a vehicle. The example system 100 includes a media monitoring device 104 fixed in the vehicle; an audience measurement data shuttle 112; an audience measurement data aggregator 120; and an audience measurement data collection server 124. The audience measurement data aggregator 120 of the illustrated example is located in the home of the panelist. The audience measurement data collection server 124 communicates with the audience measurement data aggregator 120 via a communication link 126 such as, for example, the internet, the plain old telephone system (POTS), etc. The media monitoring device 104, the audience measurement data shuttle 112, and the audience measurement data aggregator 120 of the illustrated example communicate via the communication links 106, 108, and 114.

The example media monitoring device 104 of the illustrated example is fixed in the vehicle. The media monitoring device 104 may have any structure and/or form factor that enables the device to be permanently or semi-permanently installed in the vehicle. In the illustrated example, the media monitoring device 104 is configured to be engaged within a power socket of the vehicle (e.g., a 12 volt power socket such as a cigarette lighter socket or other multi-purpose electrical socket.) However, the media monitoring device 104 may be fixed in a vehicle by any other means. For example, the media monitoring device 104 may be mounted on a windshield, secured to a dashboard, placed in a glove box or vehicle console, attached to a visor, mounted inside a vehicle, mounted outside a vehicle, etc. Further, where the media monitoring device is engaged within a vehicle power socket, the socket may be of any voltage, current, or configuration. For example, the power socket may be a 115-120 volt outlet. In alternative examples, the in-vehicle media monitoring device 104 may be integrated into a GPS receiver, an MP3 player, a portable (e.g., cellular) telephone and/or a garage door opener.

The example media monitoring device 104 of FIG. 1 monitors media exposure within the vehicle, and captures audience measurement data reflecting that exposure. The captured audience measurement data is stored within a memory of the media monitoring device 104 until it is wirelessly transferred to one or more audience measurement data shuttles 112 and/or directly to the audience measurement data aggregator 120.

In operation, the media monitoring device 104 may enter a wireless transmission range of the audience measurement data aggregator 120 (e.g., when the vehicle is parked in a garage associated with the house) and transmit the collected audience measurement data to the audience measurement data aggregator 120, via wireless transmission 106. In some cases, the media monitoring device 104 may not come



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within the wireless transmission range of the audience measurement data aggregator **120**. In other cases, the media monitoring device **104** may enter the wireless transmission range of the audience measurement data aggregator **120** on a limited basis or infrequently. For example, an audience member may park their vehicle at a distance which exceeds the wireless transmission range of the audience measurement data aggregator **120** and/or the in-vehicle media monitoring device **104**. If the wireless transmission **106** is only performed on a limited basis (e.g. once a week, once a month, etc.), the memory of the media monitoring device **104** may become full, resulting in loss of audience measurement data, and/or data may not be received for analysis in a timely manner.

To address this issue, in the illustrated example, one or more audience measurement data shuttle(s) **112** are used to transport audience measurement data from the media monitoring device **104** into a wireless transmission range of the audience measurement data aggregator **120**. In the illustrated example, the audience measurement data shuttle **112** is a key fob, which may be carried by an audience member along with their keys (e.g., on an audience member's keychain). When the audience measurement data shuttle **112** is within wireless transmission range of the media monitoring device **104**, the media monitoring device **104** wirelessly transmits the audience measurement data to the audience measurement data shuttle **112** via wireless transmission **108**.

The audience measurement data shuttle **112** may be provided to each panelist in a given household (e.g., father, mother, son, daughter, etc.) As a result, each audience measurement data shuttle **112** within the vehicle may collect wirelessly transmitted audience measurement data from the same media monitoring device **104**. Each audience measurement data shuttle is preferably provided with a unique identifier that is appended or otherwise associated with the audience measurement data that the audience measurement data shuttle receives (e.g., the audience measurement data shuttle includes functionality to add the identifier to the data it receives and/or transmits). The unique identifiers are associated with the individuals that carry the audience measurement data shuttles **112** in, for example, a database at the audience measurement data collection server **124**. As a result, when received at the audience measurement data collection server **124**, the audience measurement company may associate demographic data (e.g., white male, age 43, income \$50,000 per annum, etc) with the received audience measurement data. To ensure correct data is stored in each audience measurement data shuttle **112**, the fixed, in-vehicle media monitoring device **104** transmits the collected data substantially continuously (e.g., when the vehicle is powered on), at predetermined intervals, or whenever an event associated with a passenger change occurs (e.g., when the car is placed in park, when the tuned channel of the radio or the source of the media is changed, when the car is turned off, when the car is turned on, etc.)

The audience measurement data shuttle(s) **112** are likely to enter the wireless transmission range of the audience measurement data aggregator **120** at a greater frequency than the media monitoring device **104** (e.g., once a day, twice a day, etc.) because the audience member(s) will carry their respective audience measurement data shuttles **112** with them as they enter buildings (e.g., the panelist's home or other locations) that may be equipped with an audience measurement data aggregator **120**. Advantageously, little or no out of the ordinary panelist involvement is required to collect and return the audience measurement data to the

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audience measurement data collection server **124**. Audience member compliance is thereby improved, allowing more accurate data to be collected.

To achieve enhanced granularity of demographic data, even when the media monitoring device **104** is within the wireless transmission range of the audience measurement data aggregator **120**, the media monitoring device **104** may still be configured to transmit audience measurement data only to the audience measurement data shuttle(s) **112**, rather than directly to the audience measurement data aggregator. In other implementations, the media monitoring device **104** may be configured to transmit data to the audience measurement data shuttle(s) **112** when the audience measurement data shuttle(s) **112** are present and to transmit data to the audience measurement data aggregator **120** only when no audience measurement data shuttle **112** is present. This latter approach (i.e., always transmitting data via the shuttle(s)) may prevent data loss due to transmission being interrupted when the vehicle is moved out of the wireless transmission range of audience measurement data aggregator **120**. For example, when the audience measurement data shuttle **112** is carried on an audience member's keychain, the audience measurement data shuttle **112** will remain in the wireless transmission range of the audience measurement data aggregator **120** even when the vehicle is driven away from the audience measurement data aggregator **120** in the panelist's home as long as the panelist with the audience measurement data shuttle **112** remains at home.

When an audience measurement data shuttle **112** is within the wireless transmission range of the audience measurement data aggregator **120**, the audience measurement data shuttle **112** wirelessly transmits the audience measurement data stored therein to the audience measurement data aggregator **120** via wireless transmission **114**. As discussed above, there may be multiple audience measurement data shuttles **112** which may communicate with the media monitoring device **104** and the audience measurement data aggregator **120**. For example, a group of audience members may travel in the same vehicle and each audience member may have their own audience measurement data shuttle **112**, which collects audience measurement data for media presented near the audience member via the media monitoring device **104**. Advantageously, each of the audience measurement data shuttles **112** can transmit audience measurement data to the data collection server **124** so that media consumption specific to each audience member can be collected. For example, each audience measurement data shuttle **112** may be associated with the demographics of an audience member that is carrying the shuttle and the media content exposure can be credited based on those demographics.

Additionally or alternatively, panelists may travel in different vehicles (e.g., a household with two or more vehicles). In such examples, an in-vehicle media monitoring device **104** is installed in each vehicle. Preferably, the data collected by each in-vehicle media monitoring device **104** is stamped or otherwise associated with a unique identifier associated with the in-vehicle media monitoring device **104** that collected the audience measurement data. In this way (i.e., by addressing a database associating the unique identifier of the in-vehicle media monitoring device **104** with the vehicle in which it is installed), the audience measurement data can be associated with the vehicle in which the audience measurement data was collected. As a result, the shuttles of panelists can be used to collect data in any vehicle associated with the monitored household as well as in any vehicle associated with another monitored household that carries an in-vehicle media monitoring device **104**.



The audience measurement data aggregator **120** of the illustrated example is located in a building such as the panelist's home. The location of the audience measurement data aggregator **120** may be advantageously selected so as to increase the availability of a wireless transmission area of the audience measurement data aggregator **120** and to increase the likelihood that the audience measurement data shuttle **112** will enter the wireless transmission area. Alternatively, the building may be any type of building. For example, the building may be a public building such as a grocery store, a library, a parking garage, a department store, a convenience store, etc. Alternatively, the audience measurement data aggregator **120** may not be located inside the building, and may be placed on the exterior of the building or away from the building. For example, the audience measurement data aggregator **120** may be placed in a parking lot, a park, along a street, along a highway, etc.

Periodically and/or a-periodically (e.g., upon expiration of a timer, when a threshold of collected audience measurement data is reached, etc.) the aggregator **120** transmits the audience measurement data to the audience measurement data collection server **124** via the communication medium **126**. Any method of determining when to transmit audience measurement data may be used. For example, the audience measurement data aggregator **120** may store audience measurement data up to a specified amount (e.g., 1 kB, 64 kB, 1 MB) before transmitting the audience measurement data, the audience measurement data aggregator **120** may transmit audience measurement data at a fixed interval (e.g., 30 minutes, 3 hours, 1 day, 1 week, etc.), and/or the audience measurement data aggregator **120** may transmit audience measurement data in response to an external event (e.g., user pushes a synchronize button, audience measurement data collection server **124** requests updated audience measurement data, audience measurement data shuttle **112** comes within the wireless transmission range of the audience measurement data aggregator **120**, etc.). The transmission medium **126** could be implemented by any transmission medium such as, for example, a Digital Subscriber Line (DSL), Satellite, T1, Cellular radio, Ethernet, Wi-Fi, or any collection of transmission media.

As described above, the example system **100** facilitates transmission of audience measurement data from the in-vehicle media monitoring device **104** to the audience measurement data collection server **124** via the audience measurement data shuttle(s) **112** and the audience measurement data aggregator **120**. The system **100** may also facilitate bidirectional data transmission from, for example, the audience measurement data collection server **124** to the in-vehicle media monitoring device **104** via the audience measurement data aggregator **120** and/or the audience measurement data shuttle(s) **112**. The data transmitted by the audience measurement data collection server **124** may be software and/or firmware for devices such as, for example, the media monitoring device **104**, the audience measurement data shuttle **112**, or the audience measurement data aggregator **120**. Additionally or alternatively, the data may be reference signatures, reference watermarks, reference codes, or any other data to facilitate the identification of media and/or, more generally, collection of audience measurement data. Further, the media monitoring device **104** may have the facility to transmit audience measurement data directly to the audience measurement data collection server **124**. For example, the media monitoring device **104** may contain a cellular modem which would allow audience measurement data to be transmitted via a cellular network.

FIG. 2 is a block diagram of the example in-vehicle media monitoring device **104** of FIG. 1. The example media monitoring device **104** includes an audio receiver **202**, an audio presenter **203**, an audience measurement data collector **204**, a data store **205**, an audience measurement data storer **206**, a wireless communicator **208**, and an antenna **210**.

In the illustrated example, the audio receiver **202** of the in-vehicle media monitoring device **104** is a microphone that may be implemented internal or external to the media monitoring device **104**. The microphone receives ambient sound including audible media content presented in the vicinity of the media monitoring device **104**. Alternatively, the audio receiver **202** may be implemented by a line input connection. The line input connection may allow a media presentation device such as a radio, CD player, MP3 player, DVD player, and/or television (not shown) to be communicatively coupled to the media monitoring device **104**. The line input connector of the audio receiver may be implemented by, for example, a connector within the media monitoring device **104**, a cable extended from the media monitoring device **104**, a cradle associated with the media monitoring device **104**, etc. Any other connection to receive information about media content presented within the vehicle may alternatively or additionally be used.

The audio presenter **203** of the illustrated example is implemented by a processor executing machine readable instructions, but it could alternatively be implemented by an application specific integrated circuit (ASIC), digital signal processor (DSP), field programmable gate array (FPGA), and/or other circuitry. In the illustrated example, when audio is received, the audio presenter **203** determines the source of the audio and, if applicable, presents the audio to the audio system of the vehicle. The audio presenter **203** of the illustrated example presents audio only when audio is received via a line input connector (e.g., from a panelist's MP3 player.) However, other configurations may also be acceptable (e.g., presenting audio only when received via a microphone, presenting audio regardless of the source, presenting audio only when a panelist enables the presentation.) Further, there may exist different presentation settings based on the determined audio source. For example, if audio is received via a Bluetooth connection (e.g., from a panelist's cellular phone, from a panelist's MP3 player, etc.), the audio presenter **203** may be configured to always present audio to the audio system of the vehicle.

In the illustrated example, audio is presented to the audio system of the vehicle by means of a radio frequency transmitter transmitting a frequency modulated (FM) signal. In such an implementation, the panelist tunes the audio system of the vehicle to the frequency that the audio presenter **203** transmits on. Any alternative method of audio presentation may additionally or alternatively be used such as, for example, an analog line-input, a digital interface, a Bluetooth communicator, etc.

The audience measurement data collector **204** of the illustrated example is implemented by a processor executing machine readable instructions, but it could alternatively be implemented by an application specific integrated circuit (ASIC), digital signal processor (DSP), field programmable gate array (FPGA), and/or other circuitry. In the illustrated example, the audience measurement data collector **204** determines content identifiers from audio received via the audio receiver **202**. As used herein, a "content identifier" is any type of data and/or information associated with, inherent to, embedded with, inferable from and/or injected into a piece of content, and which may be used to identify that



piece of content. Audience measurement codes (e.g., watermarks), public or private identifiers in bit streams (e.g., program identification (PID) headers), closed captioning information, signatures, metadata or any other type(s) of data can serve as content identifiers. A content identifier is generally not noticeable to the audience during playback, but this is not necessarily so. Signatures may be any unique or semi-unique aspect of content (e.g., luminance characteristics, audio spectrum characteristics, etc.) that may be used to identify the content based on comparison to reference signatures. A code may be any type of data that may be inserted in, embedded in, encoded in, or otherwise associated with content that may be extracted or determined from the content for comparison to reference codes. However, any data that may be useful in monitoring, identifying, crediting, or otherwise analyzing media content may be used.

The example audience measurement data storer **206** of FIG. **2** is implemented by a processor executing instructions, but it could alternatively be implemented by an ASIC, DSP, FPGA, or other circuitry. The data storer **206** receives audience measurement data from the audience measurement data collector **204** and stores the received audience measurement data in the data store **205**. The data store **205** may also be capable of storing data which is not audience measurement data. For example, updated software and/or updated firmware may be stored in the data store **205**. Further, updated software and/or updated firmware may be applied to the media monitoring device **104** to update the functionality of the media monitoring device **104**. The data store **205** may be any device for storing data such as, for example, flash memory, magnetic media, etc. Furthermore, the data stored in the data store **205**, may be in any data format such as, for example, binary data, comma delimited data, tab delimited data, structured query language (SQL) structures, etc.

The example wireless communicator **208** of FIG. **2** is implemented according to the Institute of Electrical and Electronics Engineers 802.15.4 communication protocol. However, any method of wired or wireless communication may alternatively be used (e.g., Bluetooth, Wi-Fi, Ethernet, Universal Serial Bus, Zigbee, etc.). The wireless communicator **208** may be configured to communicate with an external device via the antenna **210**. Many different antenna configurations may be used. Example implementations may include the antenna **210** being an internal component of the media monitoring device **104**, the antenna **210** being an external component of the media monitoring device **104**, or the antenna **210** being integrated into the wireless communicator **208**.

FIG. **3** is a block diagram of the example audience measurement data shuttle **112** of FIG. **1**. The example audience measurement data shuttle **112** includes a wireless communicator **302**, an antenna **304**, a data store **305**, and an audience measurement storer **306**. The example wireless communicator **302** is implemented according to the Institute of Electrical and Electronics Engineers 802.15.4 communication protocol. However, any method of wired or wireless communication may alternatively be used (e.g., Bluetooth, Wi-Fi, Ethernet, Universal Serial Bus, ZigBee, etc.). The wireless communicator **302** may be configured to communicate with an external device via the antenna **304**. Many different antenna configurations may be used. Example implementations may include the antenna **304** being an internal component of the audience measurement data shuttle **112**, the antenna **304** being an external component of the audience measurement data shuttle **112**, or the antenna **304** being integrated into the wireless communicator **302**.

The example audience measurement data storer **306** of FIG. **3** is implemented by a processor executing instructions but it could alternatively be implemented by an ASIC, DSP, FPGA, or other circuitry. The audience measurement data storer **306** receives audience measurement data from the wireless communicator **302** and stores the received-audience measurement data in the data store **305**. The data store **305** may also be capable of storing data which is not audience measurement data. For example, updated software and/or updated firmware may be stored in the data store **305**. Further, updated software and/or updated firmware may be applied to the audience measurement data shuttle **112** so as to update the functionality of the audience measurement data shuttle **112**. The data store **305** may be any device for storing data such as, for example, flash memory, magnetic media, etc. Furthermore, the data stored in the data store **305**, may be in any data format such as, for example, binary data, comma delimited data, tab delimited data, structured query language (SQL) structures, etc.

FIG. **4** is a block diagram of the example audience measurement data aggregator **120** of FIG. **1**. The example audience measurement data aggregator **120** includes a wireless communicator **402**, an antenna **404**, a data store **405**, an audience measurement data storer **406**, and a wired communicator **408**. The example wireless communicator **402** is implemented according to the Institute of Electrical and Electronics Engineers 802.15.4 communication protocol. However, any method of wired or wireless communication may alternatively be used (e.g., Bluetooth, Wi-Fi, Ethernet, Universal Serial Bus, ZigBee, etc.). The wireless communicator **402** may be configured to communicate with an external device via the antenna **404**. Many different antenna configurations may be used. Example implementations may include the antenna **404** being an internal component of the audience measurement data aggregator **120**, the antenna **404** being an external component of the audience measurement data aggregator **120**, or the antenna **404** being integrated into the wireless communicator **402**.

The example audience measurement data storer **406** of FIG. **4** is implemented by a processor executing instructions but it could alternatively be implemented by an ASIC, DSP, FPGA, or other circuitry. The audience measurement data storer **406** receives audience measurement data from the wireless communicator **402** and stores the received audience measurement data in the data store **405**. The data store **405** may also be capable of storing data which is not audience measurement data. For example, updated software and/or updated firmware may be stored in the data store **405**. Further, updated software and/or updated firmware may be applied to the audience measurement data aggregator **120** so as to update the functionality of the audience measurement data aggregator **120**. The data store **405** may be any device for storing data such as, for example, flash memory, magnetic media, etc. Furthermore, the data stored in the data store **405**, may be in any data format such as, for example, binary data, comma delimited data, tab delimited data, structured query language (SQL) structures, etc.

The wired communicator **408** sends stored audience measurement data to the audience measurement data collection server **124** via the communication medium **126**. The communication medium of the illustrated example is implemented by an Ethernet connection. However, any type of communication medium may be used such as, for example, a cellular module, a satellite module, a Digital Subscriber Line (DSL), etc. Advantageously, the communication medium is capable of communicating with the audience measurement data collection server **124** via the internet (e.g.,



an Internet Protocol connection). However, other communication methods and systems may be used such as, for example, a point to point connection, a private line, etc.

While an example manner of implementing the example audience measurement system **100** has been illustrated in FIGS. **1** through **4**, one or more of the elements, processes and/or devices illustrated in FIGS. **1** through **4** may be combined, divided, re-arranged, omitted, eliminated and/or implemented in any other way. Further, the example media monitoring device **104**, the audio receiver **202**, the audio presenter **203**, the audience measurement data collector **204**, the data store **205**, the audience measurement data storer **206**, the wireless communicator **208**, the audience measurement data shuttle **112**, the wireless communicator **302**, the data store **305**, the audience measurement storer **306**, the audience measurement data aggregator **120**, the wireless communicator **402**, the data store **405**, the audience measurement data storer **406**, the wired communicator **408**, and/or more generally, the example audience measurement system **100** of FIGS. **1** through **4** may be implemented by hardware, software, firmware and/or any combination of hardware, software and/or firmware. Thus, for example, any of the example media monitoring device **104**, the audio receiver **202**, the audio presenter **203**, the audience measurement data collector **204**, the data store **205**, the audience measurement data storer **206**, the wireless communicator **208**, the audience measurement data shuttle **112**, the wireless communicator **302**, the data store **305**, the audience measurement storer **306**, the audience measurement data aggregator **120**, the wireless communicator **402**, the data store **405**, the audience measurement data storer **406**, the wired communicator **408**, and/or more generally, the example audience measurement system **100** could be implemented by one or more circuit(s), programmable processor(s), application specific integrated circuit(s) (ASIC(s)), programmable logic device(s) (PLD(s)) and/or field programmable logic device(s) (FPLD(s)), etc. When any of the appended apparatus claims are read to cover a purely software and/or firmware implementation, at least one of the example media monitoring device **104**, the audio receiver **202**, the audio presenter **203**, the audience measurement data collector **204**, the data store **205**, the audience measurement data storer **206**, the wireless communicator **208**, the audience measurement data shuttle **112**, the wireless communicator **302**, the data store **305**, the audience measurement storer **306**, the audience measurement data aggregator **120**, the wireless communicator **402**, the data store **405**, the audience measurement data storer **406**, and/or the wired communicator **408** are hereby expressly defined to include a tangible medium such as a memory, DVD, CD, etc. storing the software and/or firmware. Further still, the example media monitoring device **104**, the audio receiver **202**, the audio presenter **203**, the audience measurement data collector **204**, the data store **205**, the audience measurement data storer **206**, the wireless communicator **208**, the audience measurement data shuttle **112**, the wireless communicator **302**, the data store **305**, the audience measurement storer **306**, and/or the audience measurement data aggregator **120**, the wireless communicator **402**, the data store **405**, the audience measurement data storer **406**, and/or the wired communicator **408** of FIGS. **1** through **4** may include one or more elements, processes and/or devices in addition to, or instead of, those illustrated in FIGS. **1** through **4**, and/or may include more than one of any or all of the illustrated elements, processes and devices.

FIGS. **5** through **11** are flowcharts representative of example machine readable instructions that may be executed

to implement the system **100** and/or components of the system **100** including the media monitoring device **104** and the audience measurement data shuttle **112**. In these examples, the machine readable instructions represented by each flowchart may comprise one or more programs for execution by: (a) a processor, such as the processor **1512** shown in the example computer **1500** discussed below in connection with FIG. **15**, (b) a controller, and/or (c) any other suitable device. The one or more programs may be embodied in software stored on a non-transitory tangible medium such as, for example, a flash memory, a CD-ROM, a floppy disk, a hard drive, a DVD, or a memory associated with the processor **1512**, but the entire program or programs and/or portions thereof could alternatively be executed by a device other than the processor **1512** and/or embodied in firmware or dedicated hardware (e.g., implemented by an application specific integrated circuit (ASIC), a programmable logic device (PLD), a field programmable logic device (FPLD), discreet logic, etc.). For example, any or all of the machine readable instructions represented by the flowcharts of FIGS. **5** through **11** could be implemented by any combination of software, hardware, and/or firmware. Also, some or all of the machine readable instructions represented by the flowchart of FIGS. **5** through **11** may be implemented manually. Further, although the example machine readable instructions are described with reference to the flowcharts illustrated in FIGS. **5** through **9**, many other techniques for implementing the example methods and apparatus described herein may alternatively be used. For example, with reference to the flowcharts illustrated in FIGS. **5** through **11**, the order of execution of the blocks may be changed, and/or some of the blocks described may be changed, eliminated, combined, and/or subdivided into multiple blocks.

FIG. **5** is a flowchart representative of example machine readable instructions **500** which may be executed by the processor **1512** to implement the audience measurement data collection process of the media monitoring device **104**.

The example process **500** begins when the media monitoring device **104** is engaged within a power outlet of the vehicle (block **502**). In the illustrated example, engaging the media monitoring device **104** supplies power to the media monitoring device **104** and causes the media monitoring device **104** to be enabled. The media monitoring device **104** may have an alternate power supply such as, for example, a battery or a solar panel. Such alternate power supplies may enable the media monitoring device **104** to be active even when power is not supplied by the power outlet of the vehicle. Additionally or alternatively, the media monitoring device **104** may include a switch or other control that enables the panelist to selectively enable or disable the media monitoring device **104**.

The media monitoring device **104** detects audio via the audio receiver **202** (block **504**). The audio presenter **203** of the media monitoring device **104** then determines the source of the audio (block **506**). If the audio presenter **203** determines that the audio is being received via a line input connector (e.g., the line input receptacle **1236**), the audio presenter **203** presents the audio to the audio system of the vehicle (block **508**). If the audio presenter **203** determines that the audio is being received via a microphone (e.g., the microphone **1228**), control proceeds to block **510**.

The audience measurement data collector **204** of the media monitoring device **104** processes the received audio to develop audience measurement data (block **510**). The audience measurement data may be developed in any manner. In the illustrated example, audience measurement data



is developed by detecting a code or watermark within the received audio. Alternatively or additionally, audience measurement data development may involve recording segments of the received audio, developing signatures from the audio, etc. The audience measurement data storer **208** then stores the audience measurement data in the data store **205** of the media monitoring device **104** (block **512**).

In the illustrated example, additional data is added to the data store **205** by the audience measurement data storer **206**. This additional data may be derived from any input. In the illustrated example, there exists a selector switch **1232** attached to the media monitoring device **104**. The selector switch **1232** may be user actionable, allowing an audience member to identify the number of occupants of the vehicle by adjusting the position of the switch. The audience measurement data storer **206** of the media monitoring device **104** detects and stores the status of the selector switch **1232** in the data store **205** (block **514**).

In addition to storing a setting of the selector switch, the audience measurement data storer **206** detects and stores identifiers of local audience measurement data shuttles (block **516**). The gathered identifiers are stored in the data store **205**. In the illustrated example, each member in a family of panelists (e.g., a father, a mother, a son, a daughter) is provided with a audience measurement data shuttle **112** and each shuttle has a unique identifier. By collecting the identifiers of local audience measurement data shuttles, media exposure can be more closely tied to individual panelists. For example, a panelist may tune to different media when alone in a vehicle, compared to when there are other panelists or persons present in the vehicle. To facilitate associating tuned audio with the actual panelist(s) located in a vehicle, the shuttle(s) **112** may broadcast their identifier(s) and the media monitoring device **104** may wirelessly collect such identifier(s) and store them with timestamps in the data store **205**. In addition to storing an identifier of the audience measurement data shuttles, the audience measurement data storer **206** may additionally store an identifier associated with the media monitoring device **104**. As explained in conjunction with FIGS. **6** and **7**, there may be different audience measurement data transmission processes which may alleviate the need for block **516**.

Further, in the example of FIG. **5**, the audience measurement data storer **206** gathers local computer data from the computer system of the vehicle (blocks **518**, **520**, and **522**). The local computer data may include many different types of data such as, for example, global positioning data, radio tuning data, vehicle data, audio system data, etc.

The audience measurement data storer **206** gathers and stores global positioning data (block **518**). The global positioning data is stored in the data store **205**. Global positioning data may be gathered via a Bluetooth connection to a Global Positioning System (GPS) receiver mounted within the vehicle. Alternatively, the GPS receiver may be integrated into the vehicle's computer system. In such a case, a communication link may be formed between the audience measurement data storer **206** and a computer system of the vehicle. The communication link may be implemented by an On Board Diagnostics (OBD-II) connector. Further, the media monitoring device **104** may also include an integrated GPS receiver. An integrated GPS receiver allows the audience measurement data storer **206** to collect global positioning data without being required to interface with an external device.

In addition to gathering global positioning data, the audience measurement data storer **206** gathers and stores radio tuning data (block **520**). The radio tuning data is stored in the

data store **205**. Radio tuning data, when coupled with global positioning data, provides a method for audience measurement companies to more accurately determine the originator of the media. For instance, a media broadcaster may transmit media on a first frequency at one location, and on a second frequency at another location. A vehicle may move between different geographic regions such that the broadcaster to frequency relationship may be different. The GPS data thereby enables more accurate mapping of radio data to broadcasters. Radio tuning data may be gathered via a communication link between the audience measurement data storer **206** and the audio system of the vehicle. In the illustrated example, the communication link is implemented by a Bluetooth connection. However, many alternative types of communication links may alternatively be used such as, for example, and RS-232 connection, an Institute of Electrical and Electronics Engineers 802.15.4 connection, etc. Radio tuning data gathered by the audience measurement data storer **206** is stored in the data store **205**.

Additionally, the audience measurement data storer **206** of the media monitoring device **104** of the example of FIG. **5** gathers vehicle data from a computer system of the vehicle (block **522**). The vehicle data may include, for example, vehicle speed, vehicle make/model, door lock status, window status, vehicle temperature, external temperature, audience presence data (e.g., is a specific seat occupied as indicated by, for example, a pressure sensor used to turn an airbag off or on) etc. In the illustrated example, the audience measurement data storer **206** is communicatively coupled with the computer system of the vehicle via an OBD-II connector. The audience measurement data storer **206** collects the data via the OBD-II connector and then stores the vehicle data in the data store **205**. After data has been stored, control returns to block **504**.

FIG. **6** is a flowchart representative of example machine readable instructions **600** to implement a first example audience measurement data transmission process of the media monitoring device **104**. In the illustrated example, the instructions of process **600** are implemented in parallel with the instructions of process **500**.

The example process **600** begins when the media monitoring device **104** is engaged within a power outlet of the vehicle (block **602**). Block **602** is substantially the same as block **502**, as the media monitoring device **104** is enabled by receiving power from the power outlet of the vehicle.

The wireless communicator **208** of the media monitoring device **104** waits for a trigger event (block **604**). A trigger event may be any sort of trigger event such as, for example, the expiration of a timer, the detection of an audio signal via the audio receiver **202** of the media monitoring device **104**, the detection of stored audience measurement data reaching a threshold, the detection of an external audience measurement data receiving device (e.g. the audience measurement data shuttle **112**, etc.) Once the trigger event has been detected, the wireless communicator **208** queries the data store **205** to determine the availability of audience measurement data for transmission (block **606**). If audience measurement data is available for transmission, the media monitoring device determines the availability of an external audience measurement data receiving device (e.g., an audience measurement data shuttle **112**, the audience measurement data aggregator **120**). Since identifiers of audience measurement data shuttle(s) **112** are gathered in block **516**, the audience measurement data stored in the data store **205** is already associated with the panelist(s) to which the media was presented. Therefore, the audience measurement data



does not need to have audience measurement data shuttle identifiers added at a later point.

Returning to FIG. 6, the wireless communicator 208 determines if a communication link is available to the audience measurement data aggregator 120 (block 608). If a communication link between the wireless communicator 208 and the audience measurement data aggregator 120 is available, the stored audience measurement data is transmitted to the audience measurement data gateway 120 (block 610). After the wireless communicator 208 completes transmission of the stored audience measurement data to the audience measurement data aggregator 120, the wireless communicator 208 clears the transmitted audience measurement data from the data store 205 (block 616). Control then returns to block 604.

If the wireless communicator 208 determines that a communication link is not available to the audience measurement data aggregator 120, the wireless communicator 208 determines if a communication link is available to an audience measurement data shuttle 112 (block 612). If a communication link between the wireless communicator 208 and one or more audience measurement data shuttle(s) 112 is available, stored audience measurement data is transmitted to the audience measurement data shuttle 112 (block 614). After the wireless communicator 208 of the media monitoring device 104 has successfully transmitted the stored audience measurement data to the audience measurement data shuttle 112, the wireless communicator 208 clears the transmitted audience measurement data from the data store 205 (block 614). Control then returns to block 604. If no communication link between the wireless communicator 208 and an audience measurement data shuttle 112 is available (block 612), control returns to block 604.

FIG. 7 is a flowchart representative of example machine readable instructions 700 to implement a second example audience measurement data transmission process of the media monitoring device 104. In the illustrated example, the instructions of process 700 are implemented in parallel with the instructions of process 500. Additionally, the illustrated process 700 may be implemented as an alternative to process 600.

The example process 700 begins when the media monitoring device 104 is engaged within a power outlet of the vehicle (block 702). Block 702 is substantially the same as blocks 502 and 602, as the media monitoring device 104 is enabled by receiving power from the power outlet of the vehicle.

After the media monitoring device 104 is powered on, the wireless communicator 208 of the media monitoring device 104 begins searching for available communication links to audience measurement data shuttle(s) 112 (block 704). If no communication link is available (block 704), the wireless communicator 208 continues to search for available communication links (block 704). If a communication link is available, the wireless communicator 208 transmits stored audience measurement data to the available audience measurement data shuttle(s) 112 (block 706). In the illustrated example, audience measurement data is transmitted to all local audience measurement data shuttles. Therefore, each audience measurement data shuttle 112 receives audience measurement data only when in the presence of the media monitoring device 104. In the illustrated example, block 516 may not be implemented (i.e., the media monitoring device 104 may not collect and store shuttle identifiers), therefore an identifier of the audience measurement data shuttle should be added by each of the audience measurement data shuttle(s) 112 that receive the data, or by the audience

measurement data aggregator 120 when it receives the data from the audience measurement data shuttles 112. After the wireless communicator 208 has transmitted the audience measurement data, it clears the transmitted data from the data store 205 (block 708.) Control then returns to block 704.

FIGS. 8 and 9 are flowcharts representative of example machine readable instructions 800 and 900 which may be executed to implement the audience measurement data shuttle 112. In the illustrated example, the instructions of process 800 are implemented in parallel with the instructions of process 900.

The example process 800 begins when the audience measurement data shuttle 112 is enabled (block 802). In the illustrated example, the audience measurement data shuttle 112 is enabled when it is constructed (e.g., a battery is inserted, thereby powering the shuttle). Many other means of enabling the audience measurement data shuttle 112 may be used such as, for example, a solar panel, an inductive power transmission, etc. Additionally or alternatively, the audience measurement data shuttle 112 may include a switch or other control that permits the panelist to selectively enable the audience measurement data shuttle 112. This method, however, is not preferred, as it requires additional panelist interaction.

After being enabled, the wireless communicator 302 of the audience measurement data shuttle 112 determines if a communication link 108 is available to a media monitoring device 104 (block 804). If a communication link 108 is available, control proceeds to block 806. If no communication link 108 is available, control returns to block 804 where the wireless communicator 302 waits for a communication link 108 to become available. When a communication link is available (block 804), the wireless communicator 302 receives audience measurement data from the media monitoring device 104 (block 806). Received audience measurement data is then stored by the audience measurement data storer 306 of the audience measurement data shuttle 112 (block 808). The received audience measurement data is stored in the data store 305 of the audience measurement data shuttle 112. After the audience measurement data has been received and stored, the audience measurement data storer 306 inserts a unique identifier of the audience measurement data shuttle 112 into the data store 305 (block 810). The unique identifier may be added to unique identifiers already present in the audience measurement data. For example, the audience measurement data storer 206 of the media monitoring device 104 may have inserted unique identifiers for local audience measurement data shuttles 112 (block 516). The audience measurement data storer 306 adds the unique identifier to the audience measurement data stored in the data store 305 regardless of whether unique identifiers are present. Additionally or alternatively, the audience measurement data storer 306 may determine if unique identifiers are present and add a unique identifier of the audience measurement data shuttle 112 if necessary. After data has been stored, control then returns to block 804 to await another communication of audience measurement data from the media monitoring device 104.

The example process 900 of FIG. 9 begins when the audience measurement data shuttle 112 is enabled (block 902). Block 902 is substantially the same as block 802, as the audience measurement data shuttle 112 is enabled in both blocks. After being enabled, the wireless communicator 302 of the audience measurement data shuttle 112 determines if audience measurement data is present in the data store 305 (block 903). If audience measurement data is not



present, control returns to block 903, wherein the wireless communicator 302 waits for audience measurement data to be populated in the data store 305. If audience measurement data is present in the data store 305, control proceeds to block 904.

Once the wireless communicator 302 has determined that audience measurement data is present in the data store 305, the wireless communicator 302 proceeds to determine if a communication link 114 is available to an audience measurement data aggregator 120 (block 904). If a communication link 114 is available, control proceeds to block 906. If no communication link 114 is available, control returns to block 904 where the wireless communicator 302 waits for the communication link 114 to become available. The wireless communicator 302 then transmits audience measurement data from the data store 305 to the audience measurement data aggregator (block 906). After successfully transmitting audience measurement data via the wireless communicator 302, the audience measurement data storer 306 clears stored audience measurement data from the data store 305 (block 908). In the illustrated example, the wireless communicator 302 then transmits the unique identifier of the audience measurement data shuttle 112 to the audience measurement data aggregator 120. This provides an additional means of linking specific panelists to media data. For example, if neither block 516 nor block 810 were implemented, by implementing block 910 the audience measurement data aggregator 120 is able to link the panelist to audience measurement data from a specific audience measurement data shuttle 112. If block 516 and/or block 810 is implemented, block 910 may be omitted. Control then returns to block 903 to await additional audience measurement data.

FIGS. 10 and 11 are flowcharts representative of example machine readable instructions 1000 and 1100 which may be executed to implement the audience measurement data aggregator 120. In the illustrated example, the instructions of process 1000 are implemented in parallel with the instructions of process 1100.

The example process 1000 begins when the audience measurement data aggregator 120 is enabled (block 1002). In the illustrated example, the audience measurement data aggregator 120 is enabled when it is powered (e.g., plugged into a power outlet). Many other means of enabling the audience measurement data aggregator 120 may be used. For example, a battery may be used to power the audience measurement data aggregator. Additionally or alternatively, the audience measurement data aggregator 120 may include a switch or other control that enables the panelist to enable the audience measurement data aggregator 120.

After being enabled, the audience measurement data storer 406 gathers and stores local audience measurement data (block 1003). This local audience measurement data may be from any source other than the audience measurement data shuttle 112. In the illustrated example, the audience measurement data storer 406 gathers and stores audience measurement from a local meter that collects codes and/or signatures from free field audio to measure media exposure in the household. The audience measurement data storer 406 may also collect data from a people meter that identifies members of the audience. The local meter may monitor any sort of information presenting devices such as a set top box, a television set, a personal computer, a radio, etc. The audience measurement data gathered by the audience measurement data storer 406 is stored in the data store 405. In the illustrated example, audience measurement data is gathered serially, however other methods of audience

measurement data aggregation may be used. For example, audience measurement data aggregation from multiple audience measurement devices may be performed in parallel.

The wireless communicator 402 of the audience measurement data aggregator 120 determines if a communication link 114 is available to the audience measurement data shuttle 112 (block 1004). If a communication link 114 is not available, control returns to block 1004 where the audience measurement data storer 406 gathers and stores local audience measurement data. If a communication link 114 is available, the wireless communicator receives audience measurement data from the audience measurement data shuttle 112 (block 1006). The audience measurement data storer 406 then stores the received audience measurement data in the data store 405 (block 1008). In the illustrated example, the wireless communicator 402 of the audience measurement data aggregator 120 also receives and stores the unique identifier of the audience measurement data shuttle 112 to log the source of the data (block 1010). After receiving and storing audience measurement data from the audience measurement data shuttle 112, control returns to block 1003 where data from a second audience measurement data shuttle 112 may be received.

The example process 1100 begins when the audience measurement data aggregator 120 is enabled (block 1102). Block 1102 is substantially the same as block 1002, as the audience measurement data aggregator 120 is enabled in both blocks.

After being enabled, the communicator 408 determines whether audience measurement data should be sent (block 1103). In the illustrated example, audience measurement data is sent on a regular interval (e.g., every day, every hour, etc.). Additionally or alternatively, audience measurement data may be sent a-periodically in response to non-time based triggers, such as, for example, a threshold of audience measurement data being reached in the data store 405, a request received from an external source, etc. Irrespective of the triggering mechanism, once the communicator 408 has determined that audience measurement data should be transmitted, the communicator 408 determines if a communication link 126 is available to the audience measurement data collection server 124. If a communication link 126 is not available, control returns to block 1104 where the communicator 408 waits for a communication link 126 to become available. If the communication link 126 is available, control proceeds to block 1106. The communicator 408 transmits audience measurement data that was stored in the data store 405 to the audience measurement data collection server 124 via the communication link 126 (block 1106). After the audience measurement data has been successfully transmitted, the wireless communicator 408 clears the stored audience measurement data from the data store 405 (block 1108). Control then returns to block 1103.

FIGS. 12, 13, and 14 are views of the example in-vehicle media monitoring device 104 of FIGS. 1 and 2. The example media monitoring device 104 comprises a housing 1202. The example housing 1202 is made of plastic. However, any other material may alternatively be used to create the housing 1202. Internal to the housing 1202 is a Printed Circuit Board (PCB) 1204, to which additional components are affixed. To support the PCB 1204 within the housing 1202, a set of standoffs 1206, 1208, 1210, and 1212 may be used. The standoffs 1206, 1208, 1210, and 1212 may be of any form factor and may be made of any material. Additionally or alternatively, the stand-offs 1206, 1208, 1210, and 1212 may be integral to the construction of the housing 1202.



The example housing **1202** is dimensioned to engage within a 12 volt power outlet of the vehicle. In order to draw power from the 12 volt power outlet of the vehicle, a positive power connector **1214** connects to a 12 volt connector of the 12 volt power outlet, while a ground power connector **1220** connects to a ground connector of the 12 volt power outlet. A wire **1216** is used to connect the positive power connector **1214** to the PCB **1204**, via a connection point **1218** (see FIG. **13**). Likewise, a wire **1222** connects the ground power connector **1220** to the PCB **1204**, via a connection point **1224**. Additionally or alternatively, a fuse may be inserted between the positive power connector **1214** and the positive connection point **1218** of the PCB **1204** along the wire **1216**.

The PCB **1204** supports different components to provide the functionality of the in-vehicle media monitoring device **104**. In the illustrated example, such components include a power indicator **1226**, a microphone **1228**, a processor **1230**, a selector switch **1232**, a wireless communicator **1234**, and a line-input receptacle **1236**.

The power indicator **1226** may be any type of power indication component. In the illustrated example, the power indicator **1226** is a light emitting diode. Alternative forms of display may be used. For example, a display screen may be used to convey additional information about the operation of the media monitoring device **104**.

The microphone **1228** receives audio for use by the media monitoring device **104**. The microphone **1228** may be any type of microphone (e.g., passive, active). Additionally, the housing **1202** may be created with openings near the microphone **1228** to allow sound to enter the housing **1202** and reach the microphone **1228**.

The processor **1230** may be configured to interface with the other components of the media monitoring device **104**. In the illustrated example, the processor **1230** is a microcontroller. However, any type of processing device may be used (e.g., a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA), or a microcontroller) to implement the processor **1230**. The processor **1230** may additionally include a memory for storing audience measurement data.

The selector switch **1232** is used to provide additional input parameters to the media monitoring device **104**. The physical selector switch may be implemented by any switch design (e.g., button, knob, slider, touch screen, etc.). In the illustrated example, a rotator is used to allow an audience member to select the number of occupants of the vehicle. The housing **1202** may be configured to allow exposure of the rotator switch **1232**, so that the audience member can physically adjust the setting. Any physical or virtual switch (s) of any style or type may alternatively or additionally be used to input selections to the media monitoring device **104**. For instance, an audio recognition system might be used to allow an audience member to provide an input to the media monitoring device **104** without having to physically manipulate the device.

The wireless communicator **1234** interfaces wirelessly with external audience measurement data receiving devices (e.g., the audience measurement data shuttle **112**, the audience measurement data aggregator **120**). In the illustrated example, the wireless communicator **1234** is an Institute of Electrical and Electronics Engineers 802.15.4 wireless module. However, any type of wireless communication device may alternatively be used (e.g., Bluetooth, Wi-Fi, etc.). Furthermore, the wireless antenna **210** may be integral to the design of the wireless communicator component **1234**, the wireless antenna **210** may be integral to the PCB **1204**, the

wireless antenna **210** may be external to the PCB **1204**, or the wireless antenna **210** may be in some other configuration.

The line input receptacle **1236** may be provided in addition to or as an alternative to the microphone **1228** to input audio to the media monitoring device **104**. The line-input receptacle **1236** may be of any configuration that would allow an external connector to be affixed. In the illustrated example, a 3.5 mm receptacle is used to allow for an external audio device to be connected to the media monitoring device **104**. However, any type or style of receptacle could alternatively be used. For example, a 2.5 mm receptacle could be used to reduce the physical size of the receptacle. Alternatively, the line-input receptacle **1236** may be a cable extending from the media monitoring device **104** which would allow for a direct connection to an external audio device. Furthermore, the housing **1202** may include an opening **1238** which would allow for external input cables to be affixed to the line-input receptacle **1236**.

FIG. **13** is a top, cross-sectional view of the example media monitoring device of FIG. **12**.

FIG. **14** is a rear, cross-sectional view of the example media monitoring device of FIGS. **12** and **13**.

FIG. **15** is a block diagram of an example processor platform **1500** capable of implementing the apparatus and methods disclosed herein. The processor platform **1500** can be, for example, a server, a personal computer, a personal digital assistant (PDA), an Internet appliance, a DVD player, a CD player, a digital video recorder, a personal video recorder, a set top box, a dedicated device, or any other type of computing device.

The system **1500** of the instant example includes a processor **1512** such as a general purpose programmable processor. The processor **1512** includes a local memory **1514**, and executes coded instructions **1516** present in the local memory **1514** and/or in another memory device. The processor **1512** may execute, among other things, the machine readable instructions represented in FIGS. **5-9**. The processor **1512** may be any type of processing unit, such as one or more microprocessors from the Intel® Centrino® family of microprocessors, the Intel® Pentium family of microprocessors, the Intel® Itanium® family of microprocessors, and/or the Intel XScale® family of processors. Of course, other processors from other families are also appropriate.

The processor **1512** is in communication with a main memory including a volatile memory **1518** and a non-volatile memory **1520** via a bus **1522**. The volatile memory **1518** may be implemented by Static Random Access Memory (SRAM), 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 **1520** may be implemented by flash memory and/or any other desired type of memory device. Access to the main memory **1518**, **1520** is typically controlled by a memory controller (not shown).

The processor platform **1500** also includes an interface circuit **1524**. The interface circuit **1524** may be implemented by any type of interface standard, such as an Ethernet interface, a universal serial bus (USB), and/or a third generation input/output (3GIO) interface.

One or more input devices **1526** are connected to the interface circuit **1524**. The input device(s) **1526** permit a user to enter data and commands into the processor **1512**. The input device(s) can be implemented by, for example, a



keyboard, a mouse, a touchscreen, a track-pad, a trackball, an isopoint and/or a voice recognition system.

One or more output devices **1528** are also connected to the interface circuit **1524**. The output devices **1528** can be implemented, for example, by display devices (e.g., a liquid crystal display, a cathode ray tube display (CRT)), by a printer and/or by speakers. The interface circuit **1524**, thus, typically includes a graphics driver card.

The interface circuit **1524** also includes a communication device such as a modem or network interface card to facilitate exchange of data with external computers via a network (e.g., an Ethernet connection, a digital subscriber line (DSL), a telephone line, coaxial cable, a cellular telephone system, etc.).

The processor platform **1500** also includes one or more mass storage devices **1530** for storing software and data. Examples of such mass storage devices **1530** include floppy disk drives, hard drive disks, compact disk drives and digital versatile disk (DVD) drives. The mass storage device **1530** may implement the example data stores **205**, **305**, and **405**. Alternatively, the volatile memory **1518** may implement the example data stores **205**, **305**, and **405**.

As an alternative to implementing the methods and/or apparatus described herein in a system such as the device of FIG. **15**, the methods and or apparatus described herein may be embedded in a structure such as a processor and/or an ASIC (application specific integrated circuit). As discussed above, small form factor processors and devices are preferred for the in-vehicle media monitoring device **104** and the audience measurement data shuttle **112**.

Although the above discloses example systems including, among other components, software executed on hardware, it should be noted that such systems are merely illustrative and should not be considered as limiting. For example, it is contemplated that any or all of the disclosed hardware and software components could be embodied exclusively in dedicated hardware, exclusively in software, exclusively in firmware or in some combination of hardware, firmware and/or software.

In addition, although certain methods, apparatus, and articles of manufacture have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all apparatus, methods and articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

What is claimed is:

**[1.** A method of monitoring media exposure in an automobile, the method comprising:

collecting audience measurement data with a media monitoring device fixed in an automobile, the audience measurement data based on audio received within the automobile by the media monitoring device;

storing the audience measurement data in a memory of the media monitoring device;

detecting the presence of a shuttle located within the automobile, the shuttle being incapable of collecting audience measurement data independent of the media monitoring device;

transmitting the audience measurement data from the media monitoring device to the shuttle;

moving the shuttle from the automobile and into proximity of an audience measurement data aggregator;

transmitting the audience measurement data from the shuttle to the audience measurement data aggregator; and

transmitting the audience measurement data from the audience measurement data aggregator to an audience measurement data collection server.]

**[2.** The method as described in claim **1**, wherein the media monitoring device collects audio via at least one of a microphone or a line input connection.]

**[3.** The method as described in claim **2**, wherein the media monitoring device provides audio to an audio system of the automobile.]

**[4.** The method as described in claim **1**, wherein the media monitoring device is communicatively coupled with a computer system of the automobile.]

**[5.** The method as described in claim **4**, wherein the audience measurement data includes local computer data from the computer system of the automobile.]

**[6.** The method as described in claim **1**, wherein the shuttle includes a wireless transmitter and a memory.]

**[7.** The method as described in claim **1**, further comprising deleting the audience measurement data from the memory of the media monitoring device after the audience measurement data is transmitted to the shuttle.]

**[8.** The method as described in claim **1**, further comprising determining if a communication link is available to the shuttle.]

**[9.** A system to monitor media exposure in an automobile, the system comprising:

a media monitoring device fixed in an automobile to:

collect audience measurement data based on audio presented within the automobile;

store the audience measurement data in a memory of the media monitoring device;

transmit the audience measurement data;

an audience measurement data shuttle to receive the audience measurement data, the shuttle being incapable of collecting audience measurement data independent of the media monitoring device; and

an audience measurement data aggregator to receive the audience measurement data when transmitted by the shuttle, to store the audience measurement data in a tangible memory, and to transmit the audience measurement data to a media monitoring collection server.]

**[10.** The system as described in claim **9**, wherein the media monitoring device is to receive power from a power system of the automobile.]

**[11.** The system as described in claim **9**, wherein the media monitoring device is to receive the audio via at least one of a microphone or a line input connector.]

**[12.** The system as described in claim **11**, wherein the media monitoring device is to transmit audio to an audio system of the automobile.]

**[13.** The system as described in claim **9**, wherein the media monitoring device is to add first data to the audience measurement data, the first data being derived from a computer system of the automobile.]

**[14.** The system as described in claim **9**, wherein the shuttle is a key fob.]

**[15.** The system as described in claim **9**, wherein the transmission between the media monitor and the shuttle is implemented according to the Institute of Electrical and Electronics Engineers 802.15.4 standard.]

**[16.** The system as described in claim **9**, wherein the transmission between the shuttle and the aggregator is implemented according to the Institute of Electrical and Electronics Engineers 802.15.4 standard.]

**[17.** The system as described in claim **9**, wherein the aggregator is to receive the audience measurement data from multiple shuttles.]



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[18. The system as described in claim 9, wherein the media monitoring device is communicatively coupled with a computer system of the automobile via an On Board Diagnostics (OBD-II) connector.]

[19. The system as described in claim 9, wherein the media monitoring device adds first data to the audience measurement data, the first data being derived from a physical selector switch located on the media monitoring device.]

20. *An apparatus for monitoring media exposure in a vehicle, the apparatus comprising:*

*a housing with a male 12 volt power connector at a first end of the housing to engage within a 12 volt power outlet of the vehicle;*

*at least one of a microphone or a line input within the housing;*

*a printed circuit (PC) board mounted within the housing;*

*a processor mounted on the PC board, the processor to collect audience measurement data;*

*a memory within the housing; and*

*a wireless communicator within the housing structured to detect the presence of a shuttle located within the automobile, the shuttle being incapable of collecting audience measurement data independent of the media monitoring device;*

*the wireless communicator structured to, when the shuttle is detected, transmit the audience measurement data from the media monitoring device to the shuttle.*

21. *The apparatus as described in claim 20, further including a physical selector switch within the housing.*

22. *The apparatus as described in claim 20, further including a power indicator within the housing.*

23. *The apparatus as described in claim 20, wherein the wireless communicator is a radio transmitter.*

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24. *The apparatus as described in claim 20, further including a button within the housing.*

25. *An apparatus for monitoring media exposure in a vehicle, the apparatus comprising:*

*a housing having a male power connector at a first end of the housing to engage within a power outlet of the vehicle;*

*at least one of a microphone or a line input within the housing;*

*a processor within the housing;*

*a memory within the housing; and*

*a wireless communicator within the housing structured to detect the presence of a shuttle located within the automobile, the shuttle being incapable of collecting audience measurement data independent of the media monitoring device;*

*the wireless communicator structured to, when the shuttle is detected, transmit the audience measurement data from the media monitoring device to the shuttle.*

26. *The apparatus as described in claim 25, wherein the power outlet is for one of the following voltages: 5 volts, 12 volts, 20 volts and 120 volts.*

27. *The apparatus as described in claim 25, further including a physical selector switch within the housing.*

28. *The apparatus as described in claim 25, further including a power indicator within the housing.*

29. *The apparatus as described in claim 25, wherein the wireless communicator is a radio transmitter.*

30. *The apparatus as described in claim 25, further including a printed circuit board within the housing.*

31. *The apparatus as described in claim 25, further including a button within the housing.*

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