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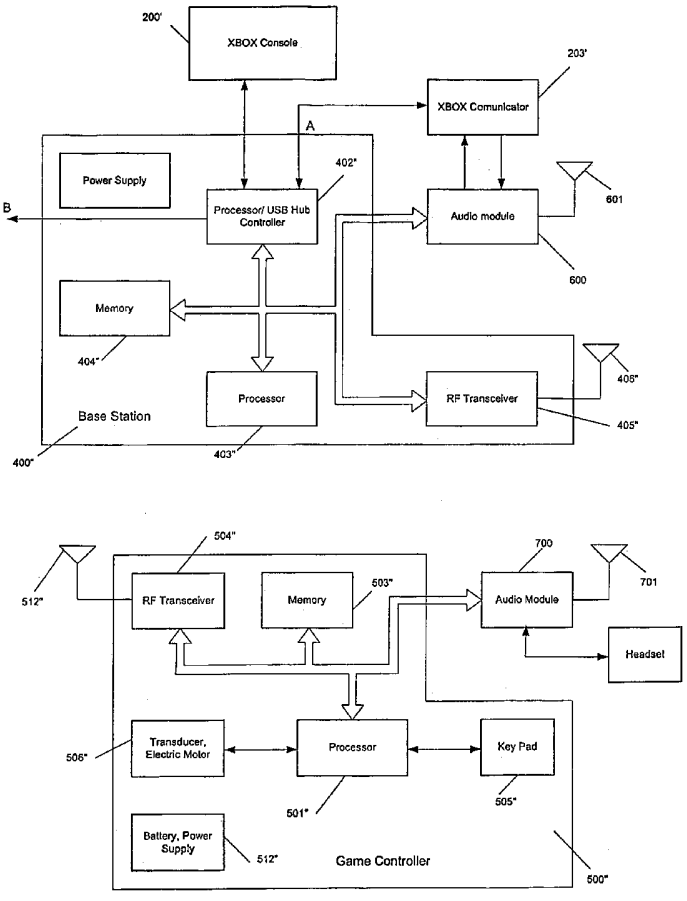
(54) Title: ELECTRONIC GAME PLAYING APPARATUS



(57) Abstract: In one embodiment, electronic game playing apparatus comprising a game controller 500" and a base station 400" connectable to or forming part of a game console 200", and an audio module connectable to or forming part of the base station is disclosed herein. The base station 400" is arranged to receive digital game data and/or digital audio from the game console and the audio module includes means for transmitting the audio in analog form by wireless transmission to the game controller 500". The game controller 500" has a headset connected thereto whereby the audio signals are able to be output from the game controller via the headset.

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Electronic Game Playing Apparatus

Background and Field of the Invention

This invention relates to an electronic game playing apparatus, more particularly but not exclusively, to a game playing apparatus with wireless and/or audio communication capability to support a plurality of game players.

In the game accessories industry for products such as the Sony Playstation 1 (PS-1), Playstation 2 (PS-2) or Microsoft X-Box, there is a shift from wired to wireless game controllers which allow more flexibility for the game users. Typically, an external base station having a radio frequency transceiver is connected to a controller port of a game console for wireless communication to a remote wireless game controller. For example, there are two controller ports on a Sony PS-2 game console. To increase the number of controller ports an adapter such as the PS-2 Multitap offered by Sony is required. A PS-2 Multitap has four extended ports each and since up to two PS-2 Multitaps can be connected to a PS-2 game console, a maximum of eight controller ports can be supported. This allows more base stations to be used and thus increases the number of users. However, a disadvantage is that each base station still serves only one game controller and thus a same number of additional base stations are required for every additional game player. This disadvantage greatly increases the hardware costs in a wireless electronic game playing apparatus for multiple game players.

To alleviate the above disadvantage, there has been proposed a base station which can support more than one game controller by multiplexing the game data in time but such a base station has difficulty supporting reliably all the different game data time frame used by different electronic games.

In addition, with on-line gaming gaining popularity, game consoles such as XBOX is equipped with an audio feature known as "Xbox communicator" for a game player using a wired headset and microphone connected to the game controller. Such a console supports voice recognition means to receive voice commands from the game player via the game controller to activate certain functions in the game software. The game player can also conduct voice communications with another game player connected to the on-line game network over the Internet. However, movement of the game player may be constrained by the length of the wire attached to the headset/microphone.

It is an object of the invention to provide an alternative game playing apparatus which alleviates at least one of the above disadvantages and/or to provide the public with a useful choice.

Summary of the invention

According to a first aspect of the invention, a base station connectable to or forming part of a game console, the base station comprising

means for transferring time division multiplexed game and/or audio data between the game console and the base station in a first TDMA time frame;

a memory buffer to store the game and/or audio data; and

means for transferring the game and/or audio data in a second TDMA time frame by wireless transmission between the base station and a game controller, wherein the second time frame is independent of the first TDMA time frame.

The first TDMA time frame varies depending on the type of electronic game and thus an advantage of the described embodiment is that since the second time frame is independent of the first time frame, the time division multiplexing between the base unit and the game controller (or a plurality of game controllers) can be performed based on the second time frame. The second TDMA time frame can be fixed or constant to allow for a robust and reliable digital wireless communication between the base station and the game controller(s).

Preferably, the second TDMA time frame is further divided into smaller time slots for multiplexing of game and/or audio data to a plurality of game controllers and different game controllers use different time slots.

Typically, the first TDMA time frame varies depending on type of electronic game. Specifically, the first TDMA time frame may be a SPI time frame for a Sony Playstation.

Preferably, the base station further comprises means to transmit and/or receive the game and/or audio digitally by wireless transmission to/from the game controller.

In a second aspect of the invention, there is provided a method of processing game data for electronic game playing apparatus comprising a game controller and a base station connectable to or forming part of a game console, the method comprising the steps of:

the base station, transferring time division multiplexed game and/or audio data between the game console and the base station in a first TDMA time frame, buffering the game and/or audio data; and

transferring the game and/or audio data in a second TDMA time frame by wireless transmission between the base station and the game controller wherein the second TDMA time frame is independent of the first TDMA time frame.

Preferably, the method further comprises the steps of: receiving time division multiplexed game and/or audio data by wireless means from the game controller in the second time frame; buffering the game and/or audio data, sending the game and/or audio data in the first time frame to the game console.

The method may further comprise dividing the second TDMA time frame into smaller time slots for multiplexing of game and/or audio data to a plurality of game controllers.

In a third aspect of the invention, there is provided an audio module for electronic game playing apparatus, the audio module being connectable to or forming part of a base station, the base station being arranged to transfer digital

game data and/or digital audio between the base station and a game console, the audio module comprising means for transferring the audio in analog form by wireless transmission between the audio module and a game controller.

In a fourth aspect of the invention, there is provided electronic game playing apparatus comprising a game controller and a base station connectable to or forming part of a game console, and an audio module connectable to or forming part of the base station,

the base station being arranged to transfer digital game data and/or digital audio between the base station and the game console, the audio module including means for transferring the audio in analog form by wireless transmission between the audio module and the game controller, the game controller having a loudspeaker and/or audio means arranged to connect thereto whereby the audio are able to be output from the game controller via said loudspeaker and/or audio means.

The base station thus performs the main processing of the digital game data and/or audio data and this simplifies the design of the audio module to process only the audio in analog form. This can allow efficient use of resources since the management of the separate wireless communication channel for the analog audio can be handled by the base station.

Preferably, the base station and/or the game controller comprise means to scan a frequency spectrum for suitable transmission channels for the wireless transmission.

The base station and/or the game controller may automatically select a transmission channel from the suitable transmission channels for the wireless audio transmission. The game controller may further comprise means to change a current transmission channel manually to another suitable channel for the wireless transmission.

Preferably, the game data are transmitted in digital wireless format and the game data and the analog audio is transmitted in a different RF channel. If the audio module is connectable to the base station, the audio module comprises means for plug-and-play so that the audio module is hot swappable. The game console may be a Microsoft XBOX.

In a fifth aspect of the invention, there is provided a base station connectable to or forming part of a game console, the base station comprising

means for transferring time division multiplexed game and/or audio data between the game console and the base station in a first time period within a TDMA time frame;

a memory buffer to store the game and/or audio data; and

means for transferring the game and/or audio data in a second time period outside of the first time period and within the TDMA time frame by wireless transmission between the base station and a game controller.

Brief Description of the Drawings

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which: -

Figure 1A shows a block diagram of a game playing apparatus including a game console, a visual display unit and a game controller;

Figure 1B shows a detail block diagram of a typical wireless base station of Figure 1A ;

Figure 1C shows the base station of Figure 1B being connected to a PS-2 game console and which is capable of multiplexing up to four game controllers;

Figure 1D shows another example of the base station of Figure 1B adapted to be connected to a XBOX game console and which is capable of multiplexing up to four game controllers;

Figure 1E shows the base station of Figure 1D being adapted to support one game controller;

Figure 1F shows a detail block diagram of a wireless game controller;

Figure 1G shows another embodiment of a base station and a game controller being connected to respective analog audio modules for wireless communication;

Figure 1H shows a detail block diagram of an analog audio module of Figure 1G adapted to connect to the base station ;

Figure 1I shows a detail block diagram of an analog audio module of Figure 1G adapted to connect to the game controller ;

Figure 2A shows a typical Serial Peripheral Interface (SPI) data exchange between a Sony PS2 base station (Multitap) and a Sony PS2 game console

Figures 2B and 2C illustrate a constant time frame structure for sequential and parallel data exchange between a PS2 base station and a plurality of PS2 game controllers in a time division multi-access and time division duplex (TDMA/TDD) manner;

Figure 2D illustrate how USB data to and from each of the four USB ports of a XBOX console are buffered and packed into a TDMA/TDD time frame for communicating with four XBOX game controllers;

Figure 2E shows a 40-channel frequency allocation table for the base station's audio module over a 900MHz ISM band suitable for analog audio wireless transmission;

Figure 2F shows a corresponding 40 channel frequency allocation table of Figure 2E for the game controller's audio module;

Figure 2G shows a frequency spectrum of the 40 channel frequencies of Figure 2E and 2F;

Figure 2H is a flowchart on the channel selection and set up procedure for an analog audio module ;

Figure 2I is a flowchart depicting the channel auto-scan described in the flowchart of Figure 2H;

Figure 2J is an example of a Channel Status Register for recording quality of carriers after completion of the scanning described in the flowchart of Figure 2I;

Figure 2K is an example of a channel selection method described in the flowchart of Figure 2H.

Detailed Description of the Preferred Embodiments

Figure 1 shows a game playing apparatus 100 for playing an electronic game loaded in a game console 200 and a visual display unit 300. The game playing apparatus 100 comprises a base station 400 and a plurality of game controllers 500 of which three are illustrated as 500a, 500b and 500c.

The game console 200 can be any gaming device, for example the Sony PS-2, for processing the electronic game. The visual display unit 300 may be a television or any commercially available display unit, for example a computer monitor. To play the electronic game, a game player views the video on the visual display unit 300 and interacts with the electronic game using the game controller 500via the base station 400. The interaction involves the transfer of game data between the game console 200 and the game controller 500 and this may include game control date, game response data and/or protocol data from the game controller to the game console to control the game.

In this application, the term "game control data" represents the data generated as a result of the player depressing a keypad on the wireless game controller 500 to control or interact with the electronic game. The term 'game response' data represents the data generated from the game console 200 to a game controller 500. The term "protocol data", on the other hand, is used to represent

other types of data, for example handshaking, and this may be generated by the game controller 500, the base station 400, or the game console 200. Such data is usually generated automatically, typically for link set-up, link maintenance and link release between the game console 200 and the base station 400, or between the base station 400 and the game controller 500. Typically, game control data, game response data and protocol data are in digital form.

If the game console 200 provides an audio feature such as that provided by the XBOX console this will also involve the transfer of audio to the headset and/or audio from a microphone back to the console 200. The audio would thus include both the audio signals from the game console and voice from a game player and the audio may be processed digitally or using analog means.

An embodiment of a base station 400 will now be described with reference to Figure 1B which includes a connector 401 for coupling to a controller port 201 on the game console 200 for data transfer between the two devices. Alternatively, the base station 400 can form part of the game console 200 by integrating the base station 400 within the game console 200. As shown in Figure 1B, the base station includes processing means for digitally processing the game data. In this example, such processing means includes a main processor 402 and a co-processor 403. The co-processor 403 includes a digital signal processor 403a for digitising audio signals and a burst mode controller 403b for multiplexing game data in a digital communication scheme employing Time Division Multiplex Access (TDMA) and Time Division Duplex (TDD). Depending on design architecture, the main processor 402 may be tasked to

handle all data transfer between the game console 200 and the base station 400, while the co-processor 403 processes other tasks including the wireless transmission between base station 400 and the plurality of game controllers 500a, 500b, 500c.

Alternatively, a suitably high performance processor may be used as the main processor 402 and all the processing required in base station 400 can be handled by this processor 402 eliminating the need of the co-processor 403.

The base station 400 further comprises a memory unit 404, a radio frequency (RF) transceiver 405 and an antenna 406 for transmitting and receiving RF signals. The memory unit 404 includes any volatile and/or non-volatile memory including a memory buffer 404a for temporary storage for data flow management. The base station 400 also includes a power supply circuit 407 which taps the required power from the game console 200 to power the components of the base station 400. For transmission from the base station 400, the RF transceiver 405 receives a time division multiplexed and modulated signal from the co-processor 403 and converts the modulated signal to RF for transmission. For reception, the RF transceiver 405 receives a RF signal and converts it to base band for demodulation and de-multiplexing by the co-processor 403.

Figure 1C illustrates an embodiment of the base station 400 of Figure 1B adapted to connect to a Sony PS-2 game console so that the RF transceiver 405 can support up to four wireless game controllers 500 simultaneously. In

Figure 1C, the game data is transferred to and from a controller port on the game console via a Serial Peripheral Interface (SPI). The base station 400 also includes an input/output port 408 for connecting to an external memory card 409 which are used for storing game setting information. In this embodiment, the main processor 402 contains a suitable algorithm provided by the game console manufacturer and in this case Sony, for multiplexing up to four wired game controllers in a conventional manner and for transferring game setting information to the memory cards. Such a processor 402 may be performed by a dedicated integrated circuit available off-the-shelf.

Figure 2A shows a SPI TDMA time frame T1 of four data pulses each representing a SPI bi-directional data transfer. Each of these data pulses represents the game data between the game console 200 and a conventional wired PS-2 game controller. Therefore, for data exchange by wireless transmission between the base station 400 and a plurality of game controllers, for example 500a,500b,500c, this will be performed within the same TDMA time frame T1. To perform this, a very fast or multitasking processor is required which can receive the SPI data pulses and sent the data to the game controllers 500. Figure 2B shows an embodiment which obviates a need for such a processor.

Figure 2B depicts a TDMA time frame T1 (depicted as 16ms here) and slot structures which use sequential communication to transfer data (game and/or audio) between the base station 400 and the game controllers 500. The base station 400 receives the SPI data (in this case, represented by the four SPI data

pulses) from the game console 200 in a first time period TP1 which is shorter than the TDMA time frame T1. The data is then temporarily stored in respective Tx buffers 404a for transmitting to the game controllers in a second time period TP2 which is the remaining time period within the same TDMA time frame. When the base station 400 receives data from a game controller 500, the data is similarly buffered and then arranged to be transmitted to the game console 200 in a time period TP3 of the next TDMA time frame T1' different from that used by the base station 400 to receive data from the game console 200. Thus, the base station 400 overcomes a need of a multi-tasking processor by buffering the data to receive and send the data in different time periods within the same TDMA time frame T1.

However, based on collected data, the inventors realised that the SPI time frame T1 varies depending on the type of game software being processed by the game console 200. Such variations in time frames may pose a problem when implementing a reliable time division slot structure for wireless transmission since it is difficult to cater to the whole range of gaming software available on the market. Although, this problem can be mitigated by having a reasonably powerful processor as the main processor 402 so that all exchanges of data between the base station 400 and the four game controllers 500 can still be completed within the same SPI time frame T1, an improvement, hereinafter described, to the scheme explained above is contemplated by the inventors which obviates a need for such a powerful processor.

Figure 2C shows a preferred arrangement according to the present invention in which a fixed or constant TDMA time frame T2 is generated for parallel data exchange between the base station 400 and up to four game controllers 500. This fixed time frame T2 is independent of the SPI TDMA time frame T1 used by the SPI interface and which is depending on the game software. To compensate for the time frame difference, buffers 404a comprising transmit buffers Tx and receive buffers Rx, are provided to temporarily store the data destined for the respective game controllers 500. It should be apparent that the transmit and receive buffers Tx,Rx should be large enough to avoid any buffer overflow or under flow. With reference to Figure 2C, the buffered data is then multiplexed over the fixed time frame T2, of for example 16 ms, so that data for each game controller occupies a 4ms time-slot with each time slot being allocated for data transfer between the base station 400 and a wireless game controller 500. In this way, the varying SPI time frame T1 can be "transformed" into a fixed TDMA time frame T2 thus providing robust digital wireless communication between the base station 400 and the game controllers 500a,500b,500c. When receiving, the reverse happens. This means that the data from each game controller is received in respective time-slots T,R, for example 4ms as in this case, and temporarily stored in the Rx buffers and then arranged in respective SPI pulses within the SPI time frame T1 for transmission to the game console 200.

To provide for audio communication in the game console 200 such as that in Sony PS-2 for on-line gaming and for multiplexing protocol data with game control/response data, each time slot is further subdivided into smaller sub-slots

so that transferring of digitised audio signals between game console 200 and a wireless game controller 500 can be performed in time division duplex manner. It should be noted that a few variations of time slot structures are possible.

In this preferred arrangement, the co-processor 403 is used for sharing the processing needs in the base station 400 so that the main processor 402 can be dedicated to handling the SPI bi-directional data transfer between game console 200 and the base station 400, while co-processor 402 can handle all other functions including wireless transmission and an algorithm for frequency hopping.

In addition, if audio data transfer is to be supported, the co-processor 403 is responsible for processing the digitised audio signal into data packets, multiplexing and modulating the data packets using any suitable digital modulation technique, for example GFSK for transmission by the RF transceiver 405. When receiving, the reverse process is undertaken similar to that for the game data. The TDMA slot structure would thus include the digital audio data as shown in Figure 2C.

For digital wireless audio transmission to a game controller when analog audio is available from the game console, a CODEC 411 is provided in the base station 400 for digitising the analog audio. Alternatively, the audio may be processed in an analog manner and the CODEC 411 is similarly not needed (see embodiment and related description illustrated in Figure 1G). It should be

apparent that if the audio signal is provided in digital format then the CODEC 411 is also not needed.

A similar multi-access wireless base station can be implemented for other types of game consoles having a different interface such as XBOX which uses USB interface. In a typical XBOX console 200' shown in Figure 1D, there are four USB ports 201' and each port 201' is conventionally wired to a game controller so that up to four game controllers 500 can be used simultaneously for the XBOX console 200'.

A wireless base station 400' is suggested for a XBOX game console 200'. The wireless base station 400' can be adapted to connect to all the four USB ports on the XBOX game console 200'. In addition, the base station 400' also includes two USB ports A and B for connecting to XBOX game accessories such as memory card and X-box communicator. These ports A,B are similar to the port 408 (see Figure 1C) provided in the base station 400 for the Sony PS-2 console to connect to a memory card.

In the wireless embodiment, a USB hub controller 402' channels game data via the USB port from the XBOX game console 200' to the ports A and B so that accessories such as memory cards can extract the relevant data for game setting storage. A processor 412 also extracts game control/response/protocol data as well as digitised audio signal for voice communication from the four USB channels for each of the game controller. Functionally this can be achieved by having an equivalent of a quad USB device controller chip 413.

The extracted data is temporarily stored in a memory/buffer 404' for processing by the processor 412 which sends the buffered data to the plurality of game controllers using a 500a,500b,500c Time Division Multiple Access (TDMA) scheme similar to the one illustrated in Figure 2D.

The data transfer between the XBOX game console 200' and each of the USB interface in the base station 400' is independent of each other and within the first TDMA time frame T1". Thus, each USB interface has a corresponding memory buffer within the memory block 404' (transmit buffers Tx' and receive buffers Rx' for both directions) for data flow management between each game controller 500 and the base station 400'. The transmit and receive buffers Tx', Rx' should also be large enough to avoid any buffer overflow or under flow. The TDMA time frame T2' between base station 400' and the game controllers 500 is chosen to be equal to the average cycle time to complete the data transfer to and from all the four USB ports measured over a long period of time. The TDMA time frame T2' for data transfer between the base station 400' and a plurality of game controllers 500 is a fixed time frame, for example 16ms, which is divided equally between the four game controllers.

If the wireless XBOX base station 400' with audio data communication capability is needed to support only one game controller, then the USB hub controller 402' in the base station 400' may comprise a processor 402' (without processor 412) as illustrated in Figure 1E. Only a pair of data buffers Tx', Rx' (one for transmit and one for receive) is needed to support one game controller.

Therefore, the base station 400' can be adapted to support different game consoles to compensate for the timing variations between a first TDMA time frame T1,T1" between the game console and the base station, and a second TDMA time frame T2,T2' between the base station and the game controller.

Figure 1F shows a detail block diagram of a wireless game controller 500 comprising processing means and in this example, the processing means is in the form of a main processor 501 and a co-processor 502 for processing digitised audio data and/or wireless transmission. The game controller 500 further comprises a memory unit 503 and a RF transceiver 504 whose functions are similar to those already described in the base station 400. The game controller 500 also comprises a keypad 505 connected to the processor 501. The keypad 505 allows the game player to play or interact with the electronic game in the game console 200. The processor 501 controls a transducer 506 for providing sensory response to the game player, for example, to vibrate the game controller 500. Game control data, game response data, protocol data and digital audio data are exchanged with other functional blocks via an inter-processor data bus 507. A CODEC 508 converts the digital audio signal into analog which in turns is processed by the audio circuit 509 before reaching the speaker 510. A game player's voice is input into a microphone 511 and converted into digital audio by the CODEC 508. The microphone 511 and speaker 510 can be integrated in a headset unit attached to the game controller 500. The co-processor 502 processes the digital audio data for transmission to the base station 400. The game controller 500 also comprises a power supply

circuit 512 that includes batteries to provide the necessary power to the components of the game controller 500.

The transmission of game and/or audio data will be based on the fixed time frame as determined by the base station and thus there is no need for buffering of data at the game controller 500.

In a further embodiment, an analog scheme is proposed for processing and transmitting audio instead of using a CODEC 508 to digitise the data. This is different from the earlier embodiments in which the audio is processed digitally and multiplexed with the game data for transmission to the game controller. In this case, processing the audio in analog form obviates the need for the CODEC 411,508 and other digital processing hardware and thus this may be a cheaper alternative to processing the audio signal.

Figure 1G illustrates a block diagram of a base station 400" coupled to a XBOX game console 200' for communication with a game controller 500. In this embodiment, the digital audio are processed via a commercially available XBOX accessory known as XBOX communicator 203'. The XBOX communicator 203' has means to extract the digital audio from the XBOX console 200' via USB port A in the base station 400" and converts the digital audio into analog. In the reverse direction, the XBOX communicator 203 converts analog audio into digital audio and sends the digital audio to the XBOX console 200' via the USB port A.

In this embodiment, the game playing apparatus comprises an audio module 600 attached to the base station 400". It should be apparent that the audio module can be integrated into the base station 400". Similarly, the game controller 500 has an audio module 700 attached thereto and which may be integrated into the game controller 500.

The audio module 600 coupled to the base station 400 can be controlled by the processor 402" in the base station 400. Similarly the audio module 700 coupled to the game controller 500 can be controlled by the same processor 501" used in the game controller 500. The audio modules 600,700 may be hot swappable. The processors 402", 501" constantly monitor the respective interface ports to dynamically support the exchange of data.

The internal components for the base station 400" and the game controller 500" are similar to that depicted respectively in Figures 1B and 1F except that the audio processing means is now provided by the respective analog audio modules 600,700.

Each of the analog audio modules 600,700 may be provided with an antenna 601,701 which is separate from the antenna 406",512" provided for the respective RF transceivers 405",504" for transmission and reception of game control data, game response data and protocol data. However, it is also possible that antenna 406", 512" may be shared by the analog audio modules 600,700 respectively using appropriate isolation or filtering measures such as antenna duplexer and bandpass and/or band rejection filters.

Figure 1H shows a detail block diagram of the analog audio module 600 for the base station 400" of Figure 1G. A detail block diagram of the analog audio module 700 for the game controller 500 is shown in Figure 1I. It will be apparent that such audio modules 600,700 are commonly used in most commercial FM applications and no detailed explanation is provided herewith except a general outline below.

The processor 402" in the base station 400" functions in a similar manner as before except that this component also controls the RF synthesize control circuit 602, the PLL 603 and selects a RF channel for audio transmission. Similarly, processor 501" in the game controller 500 provides RF control of the audio module 700. For example, a 900MHz ISM band may be divided into 40 full duplex channels over 902MHz to 928MHz for the base station and the game controller as shown in Figures 2E and 2F respectively. Figure 2G illustrates a simplified frequency spectrum of the 40 frequency channels of Figures 2E and 2F. The quality of each of the duplex channel can be determined through a certain channel selection scheme such as measuring the Receive Signal Strength Indicator RSSI. The quality status of all the RF channels used for audio communication is exchanged between the base station 400 and the game controller 500 via the wireless communication channel used for game data.

An example of how the processor 402" and processor 501" manages the analog audio communication link set-up is depicted in a flow chart in Figure 2H which illustrates a channel selection and set up procedure for the analog audio

modules 600,700. When the audio module 600 is powered up, a channel auto-scan procedure at step 1.1 will commence separately and independently within the base station 400" and the game controller 500. An explanation of the auto-scan procedure is provided in a flowchart in Figure 2G. The scan begins by performing a "scanning test" of all available channels and marks each channel as "good" (logic "1") or "bad" (logic 0). After the scanning is completed, the channel quality information is updated into a channel status register marking the "bad" channels unsuitable for transmission.

A format of the channel status register is shown in Figure 2J comprising 48bits (or 6 bytes). Bits 1 to 40 contains the respective logic values "1" or "0" with each logic value representing the quality of a transmission channel. With the channel status register updated, next at step 1.2 of Figure 2H, the channel quality information is exchanged between the game controller 500 and the base station 400". To do this, the information in the Channel Status Register can be inserted into a data field which forms part of the string of data to be exchanged between the base station 400" and the game controller 500. For example, in an initial registration between base station 400" and a game controller 500, the string of data normally includes identity codes, , a pre-determined frequency hopping sequence, system information and analog audio channel status register can be combined with this data for exchange. The following explains such a method:

An example of a typical TDMA data structure is shown below:

ID	D	F ··	CHKSUM

The ID field contains the "Identity code" of the game controller. The D field includes the "game control" and "game response" data. The "F" field can be used for conveying user functions such as manual channel change. The CHKSUM is for representing the checksum of the data package for error detection.

The channel status can be exchanged via two methods. The first is during the initial registration between the game controller(s) 500 and the base station 400" and thus the status register can be included in the D field of the digital wireless communication protocol for sending to the game controller or the base station 400". During initial registration, there is no game data being generated and thus the D field can be used solely for the purpose of exchanging the status register between the game controller 500 and the base station 400".

Alternatively, the channel status register may be combined with game control and response data for inclusion in the D field. This is when the game data is already being exchanged (i.e. a game is being played) and a channel status register needs to be updated between the base station 400" and the game controller 500.

After the channel quality information is known to both the base station 400" and the game controller 500, a list of common suitable channels can be obtained by doing a logical 'AND' operation. A channel selection algorithm can be one described in Figure 2K. In this example, the highest channel number in the set is considered the most recent suitable channel common to both devices and

thus this channel will be selected. Therefore, the channel selection and set-up procedure of Figure 2H complete at step 1.3 with the selection of a suitable transmission channel common to both the base station 400" and the game controller. The audio modules 600,700 can then begin to transmit or receive audio via the selected transmission channel.

A manual change channel button can be incorporated in the game controller so that a game player can change the currently used audio channel if he or she wishes to, for example when there is interference in the current audio channel being used.

As described above, in this way, the base station is arranged to receive the digital game data and/or digital audio from a game console and the audio modules 600,700 transmits and receives the audio in analog form. More specifically, the communication channel for the audio signal in this embodiment can be implemented at a lower cost since the use of CODEC 411, 508 chips in the game controllers are minimised.

The described embodiment is not to be construed as limitative. The frequency band for the audio transmission can be other frequencies and not limited to that shown in Figures 2E and 2F.

It is also envisaged that the sequential communication depicted in Figure 2B can also include a fixed TDMA time frame similar to that used in the embodiment illustrated in Figure 2C.

Having now fully described the invention, it will be apparent to one of ordinary skill in the art that many changes and modifications can be made thereto without departing from the scope of the invention as claimed.

Claims

1. A base station connectable to or forming part of a game console, the base station comprising

means for transferring time division multiplexed game and/or audio data between the game console and the base station in a first TDMA time frame;

a memory buffer to store the game and/or audio data; and

means for transferring the game and/or audio data in a second TDMA time frame by wireless transmission between the base station and a game controller, wherein the second time frame is independent of the first TDMA time frame.

2. A base station according to claim 1, wherein the second TDMA time frame is further divided into smaller time slots for multiplexing of game and/or audio data to a plurality of game controllers.

3. A base station according to claim 2, wherein different game controllers use different time slots.

4. A base station according to any one of the preceding claims, wherein the first TDMA time frame varies depending on type of electronic game.

5. A base station according to any one of the preceding claims, wherein the first TDMA time frame is a SPI time frame for a Sony Playstation.

6. A base station according to any one of the preceding claims, further comprising means to transmit and/or receive the game and/or audio digitally by wireless transmission to/from the game controller.

7. A method of processing game data for electronic game playing apparatus comprising a game controller and a base station connectable to or forming part of a game console, the method comprising the steps of:

the base station, transferring time division multiplexed game and/or audio data between the game console and the base station in a first TDMA time frame,

buffering the game and/or audio data; and

transferring the game and/or audio data in a second TDMA time frame by wireless transmission between the base station and the game controller wherein the second TDMA time frame is independent of the first TDMA time frame.

8. A method according to claim 7, further comprising the steps of:

receiving time division multiplexed game and/or audio data by wireless means from the game controller in the second time frame;

buffering the game and/or audio data,

sending the game and/or audio data in the first time frame to the game console.

9. A method according to claim 7 or claim 8, further comprising dividing the second TDMA time frame into smaller time slots for multiplexing of game and/or audio data to a plurality of game controllers.

10. An audio module for electronic game playing apparatus, the audio module being connectable to or forming part of a base station, the base station being arranged to transfer digital game data and/or digital audio between the base station and a game console, the audio module comprising means for transferring the audio in analog form by wireless transmission between the audio module and a game controller.

11. Electronic game playing apparatus comprising a game controller and a base station connectable to or forming part of a game console, and an audio module connectable to or forming part of the base station, the base station being arranged to transfer digital game data and/or digital audio between the base station and the game console, the audio module including means for transferring the audio in analog form by wireless transmission between the audio module and the game controller, the game controller having a loudspeaker and/or audio means arranged to connect thereto whereby the audio are able to be output from the game controller via said loudspeaker and/or audio means.

12. Apparatus according to claim 11, wherein the base station comprises means to scan a frequency spectrum for suitable transmission channels for the wireless audio transmission.

13. Apparatus according to claim 11 or claim 12, wherein the game controller comprises means to scan a frequency spectrum for suitable transmission channels for the wireless audio transmission.

14. Apparatus according to claim 12 or claim 13, wherein the base station and the game controller automatically select a transmission channel from the suitable transmission channels for the wireless audio transmission.

15. Apparatus according to any one of claims 12 to 14, wherein the game controller comprises means to change a current transmission channel to another suitable channel for the wireless transmission.

16. Apparatus according to any one of claims 11 to 15, wherein the game data is transmitted in digital wireless format.

17. Apparatus according to any one of claims 11 to 14, wherein the game data and the analog audio is transmitted in a different RF channel.

18. Apparatus according to any one of claims 10 to 17, wherein if the audio module is connectable to the base station, the audio module comprises means for plug-and-play.

19. Apparatus according to any one of claims 11 to 17, wherein the game console is Microsoft XBOX.

20. A base station connectable to or forming part of a game console, the base station comprising

means for transferring time division multiplexed game and/or audio data between the game console and the base station in a first time period within a TDMA time frame;

a memory buffer to store the game and/or audio data; and

means for transferring the game and/or audio data in a second time period outside of the first time period and within the TDMA time frame by wireless transmission between the base station and a game controller.

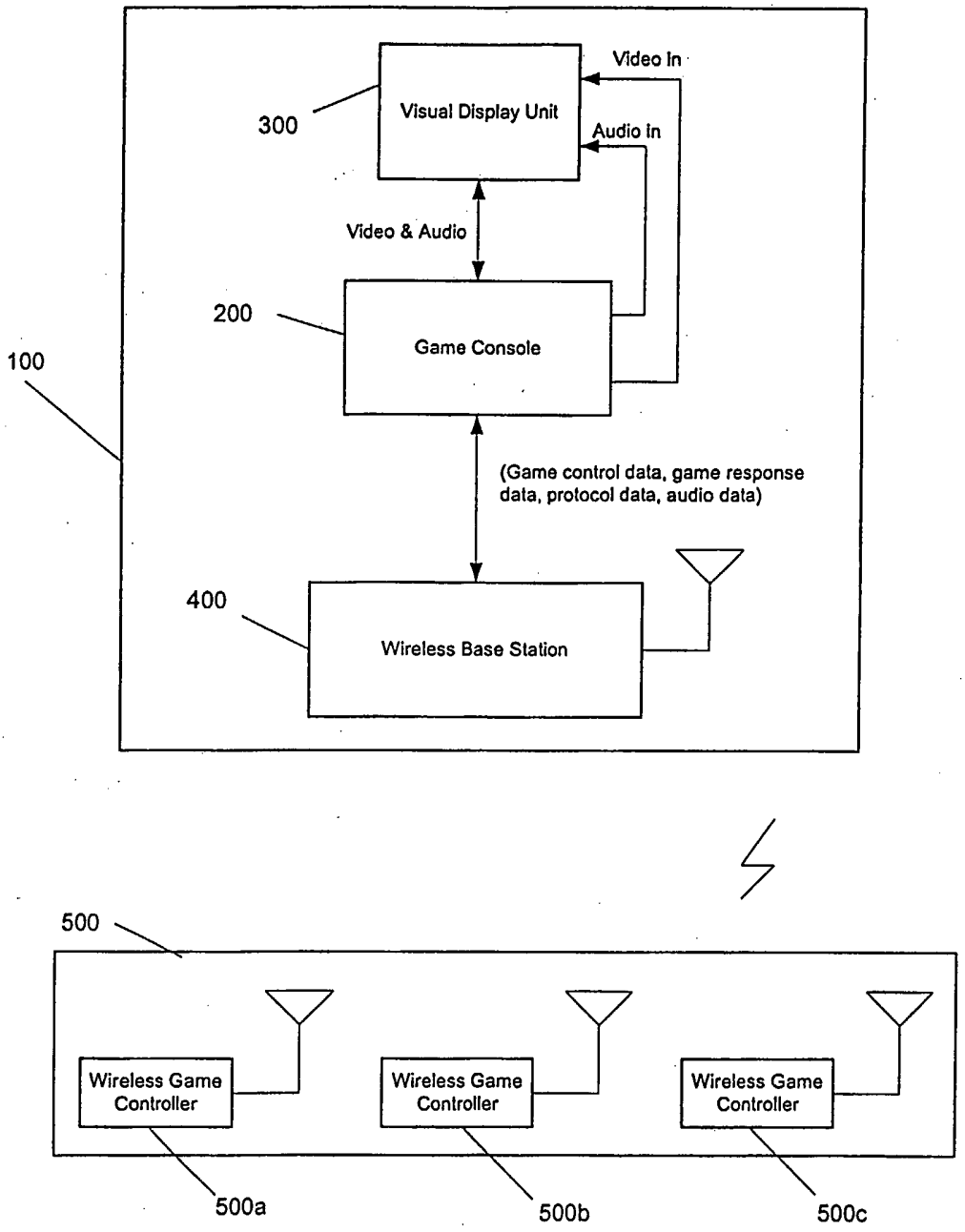

Video In
300
Visual Display Unit
Audio in
Video & Audio
200
Game Console
100
(Game control data, game response data, protocol data, audio data)
400
Wireless Base Station
500
Wireless Game Controller
Wireless Game Controller
Wireless Game Controller
500a
500b
500c

Figure 1A

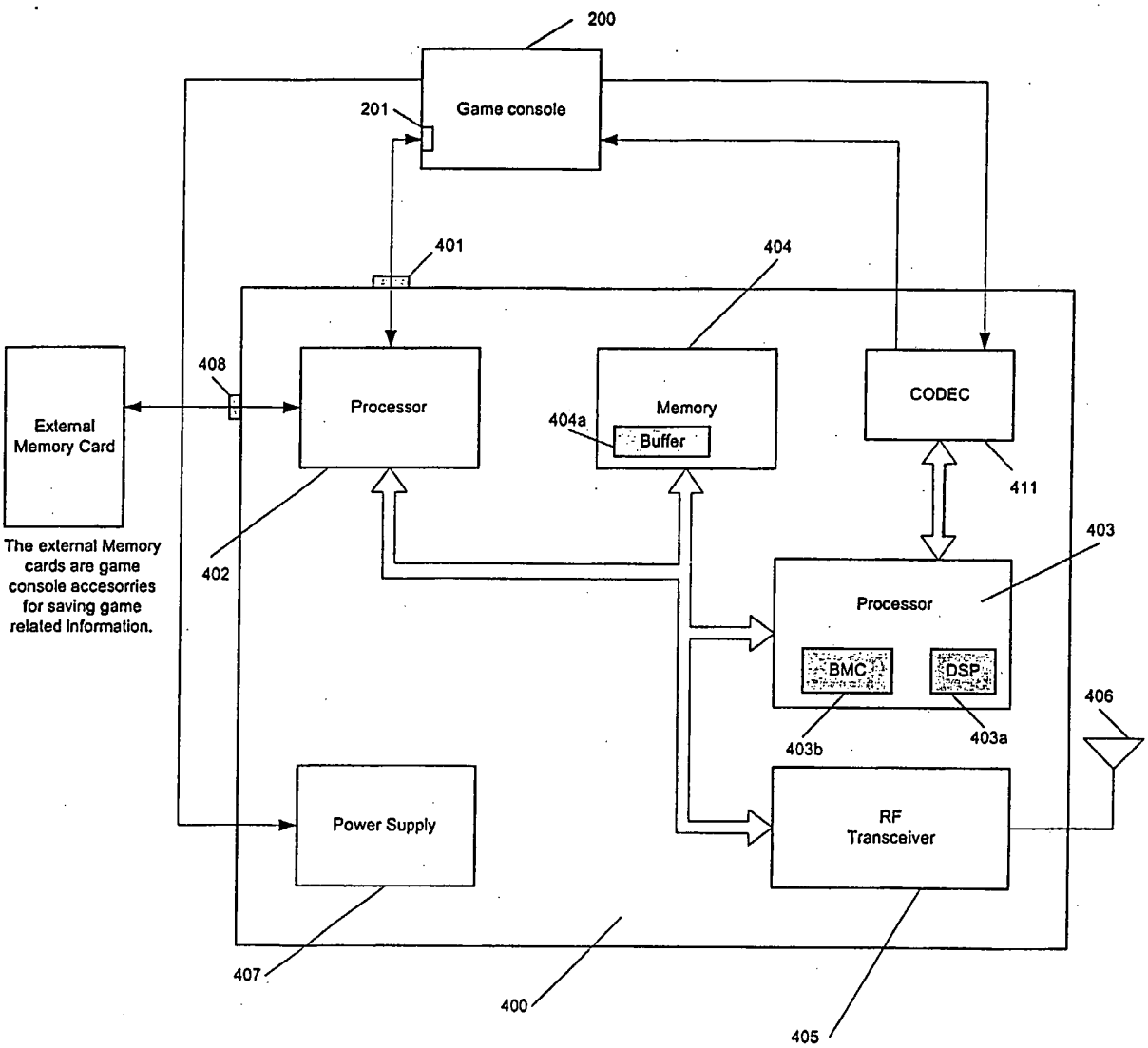

200
Game console
201
401
404
408
Processor
Memory
404a
Buffer
CODEC
411
External Memory Card
The external Memory cards are game console accesorries for saving game related information.
402
403
Processor
BMC
DSP
403b
403a
406
Power Supply
RF Transceiver
407
400
405

Figure 1B

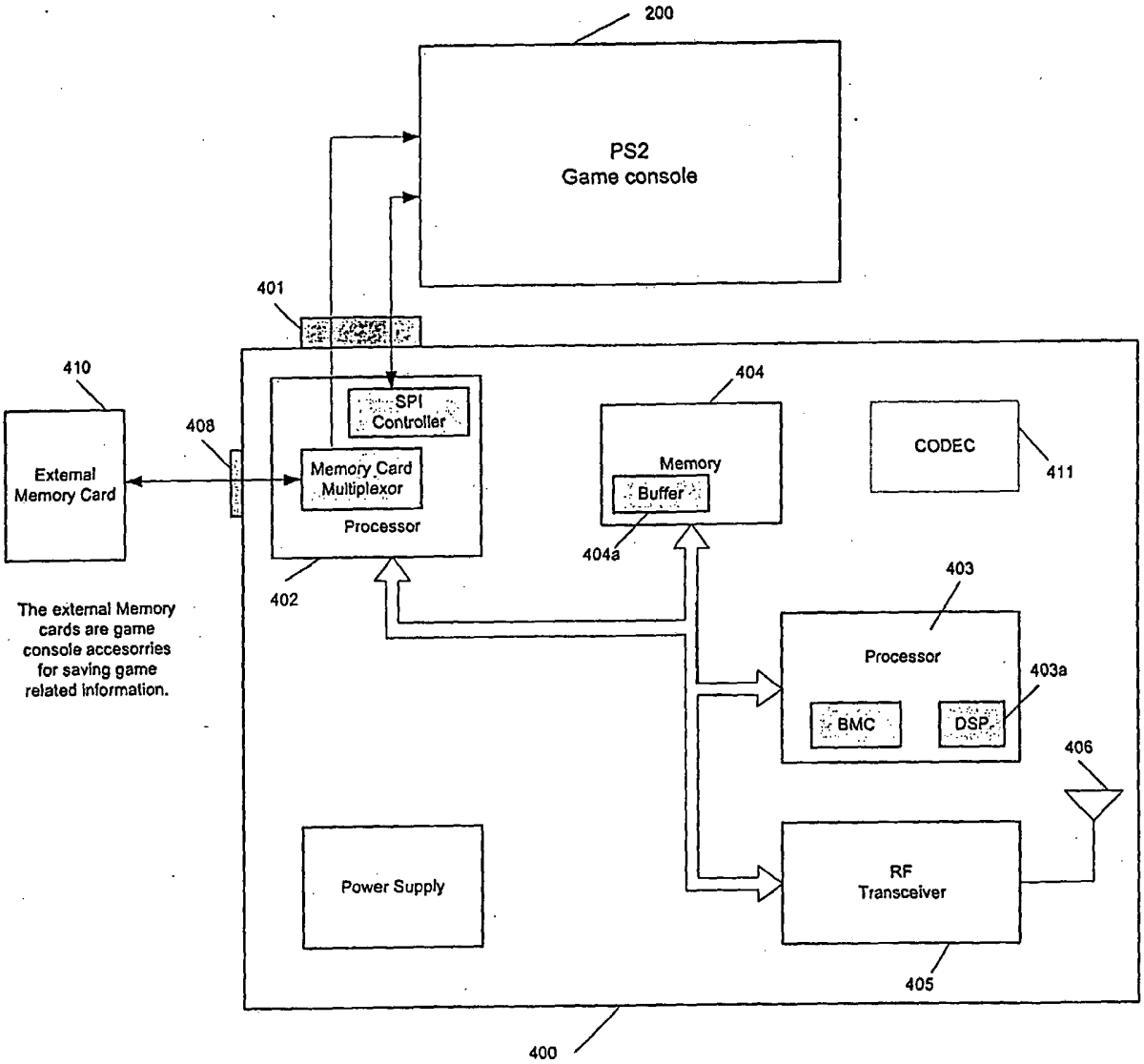

200
PS2
Game console
401
410
External
Memory Card
408
SPI
Controller
Memory Card
Multiplexor
Processor
402
404
Memory
Buffer
404a
CODEC
411
403
Processor
403a
BMC
DSP
406
Power Supply
RF
Transceiver
405
400
The external Memory cards are game console accesorries for saving game related information.

Figure 1C

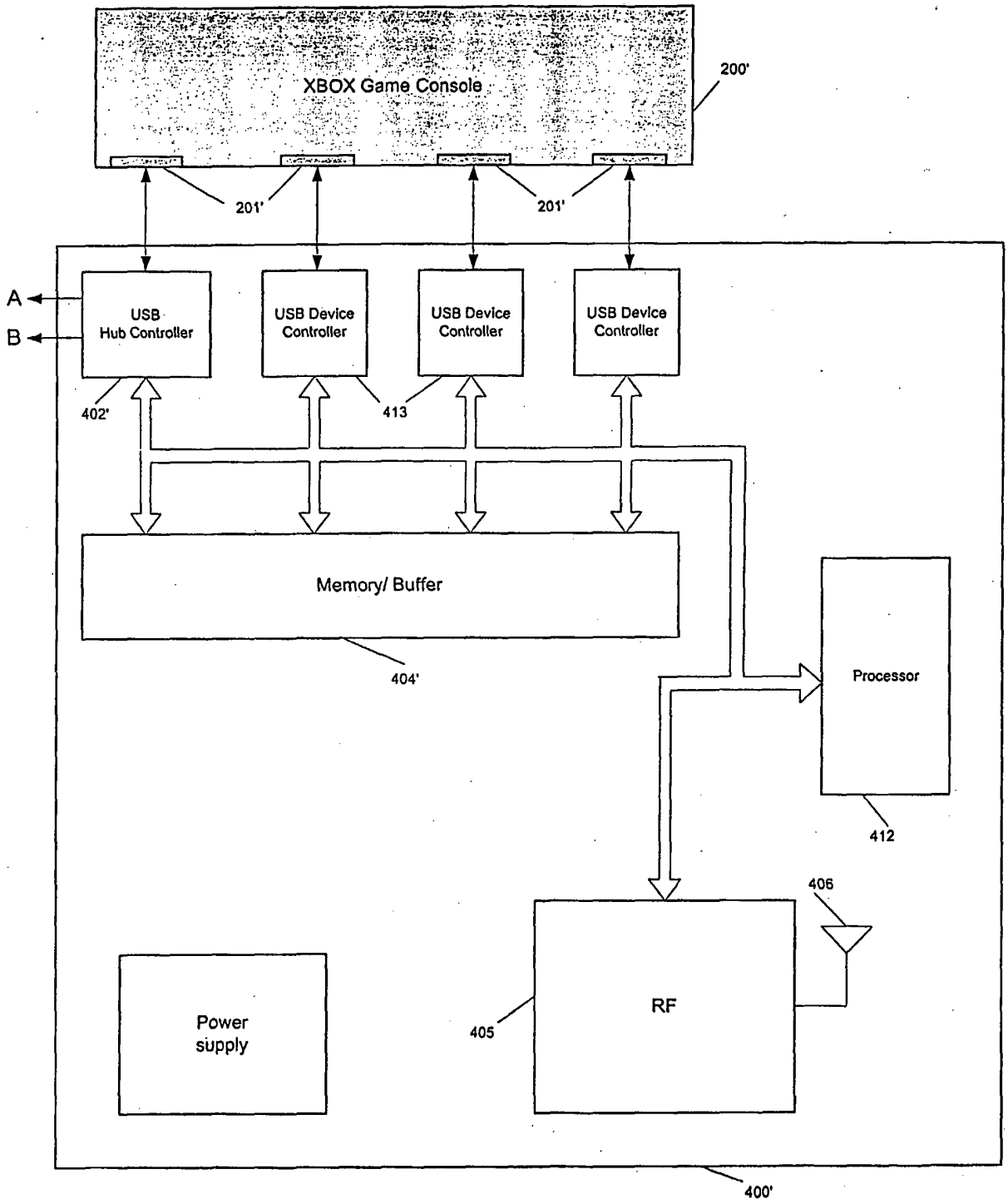

XBOX Game Console
200'
201'
201'
A
B
USB Hub Controller
USB Device Controller
USB Device Controller
USB Device Controller
402'
413
Memory/ Buffer
404'
Processor
412
406
RF
405
Power supply
400'

Figure 1D

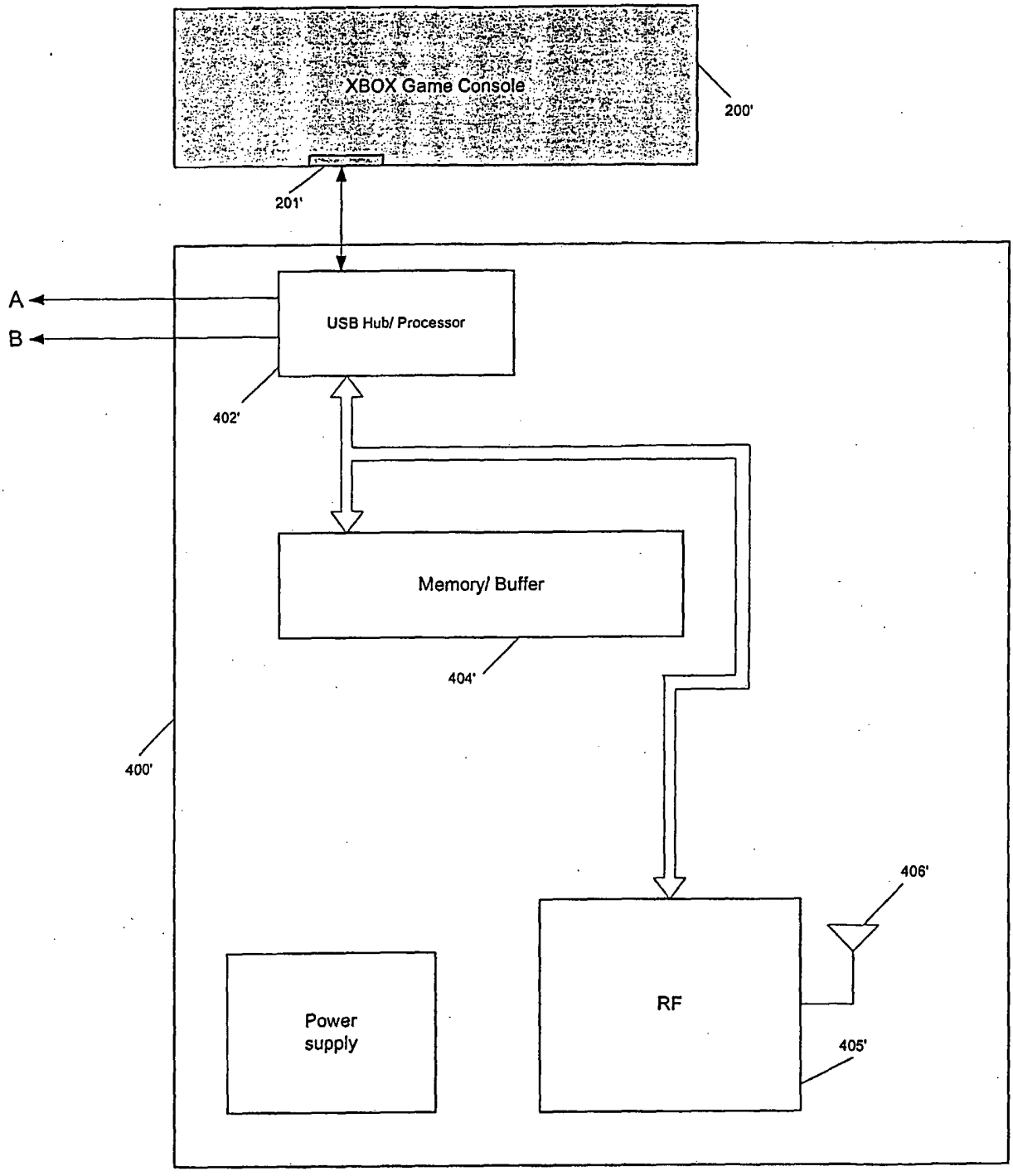

XBOX Game Console
200'
201'
A
B
USB Hub/ Processor
402'
Memory/ Buffer
404'
400'
406'
RF
405'
Power
supply

Figure 1E

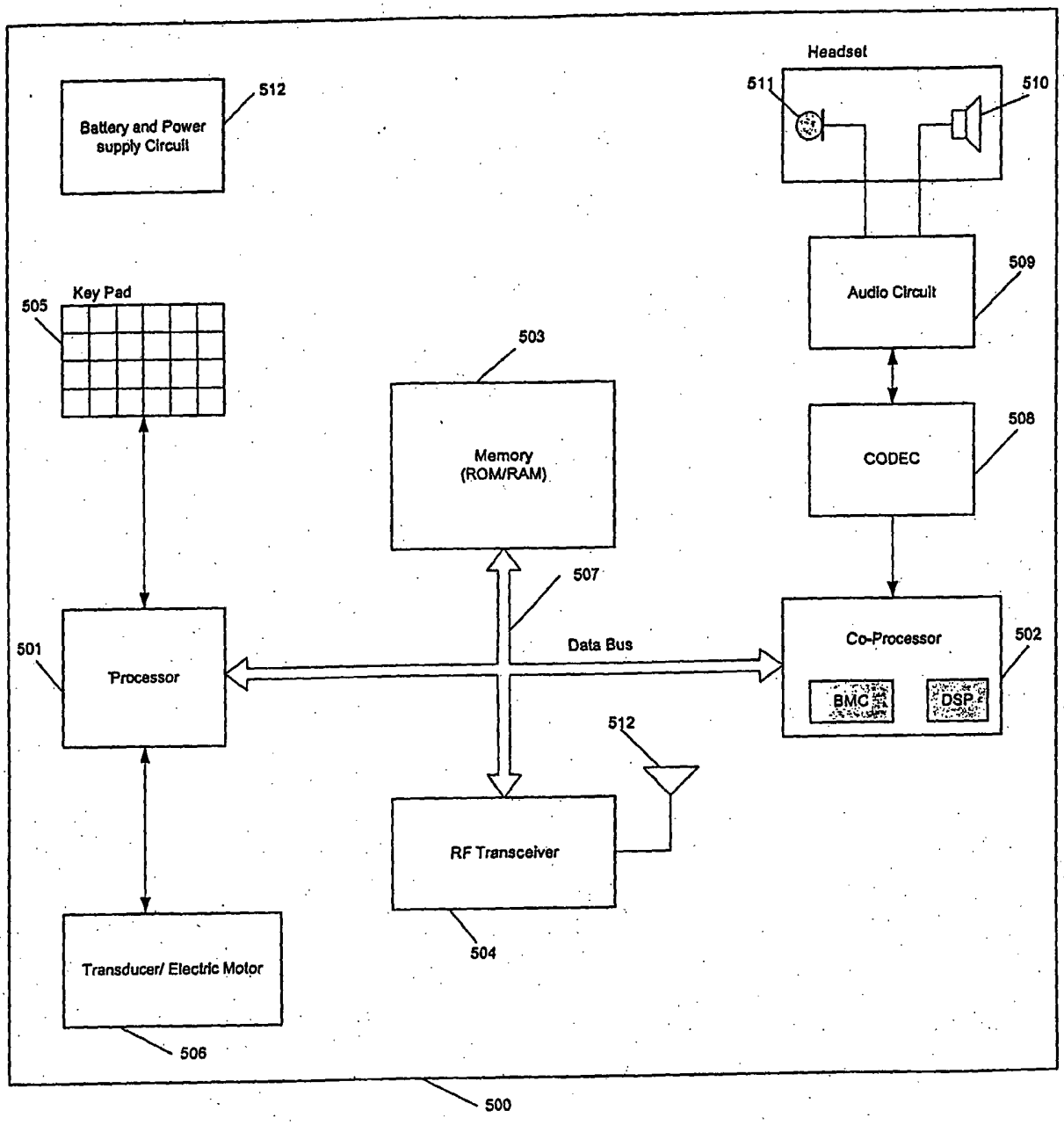

Headset
511
510
512
Battery and Power supply Circuit
Audio Circuit
509
Key Pad
505
503
Memory (ROM/RAM)
CODEC
508
507
501
Processor
Data Bus
Co-Processor
502
BMC
DSP
512
RF Transceiver
504
Transducer/ Electric Motor
506
500

Figure 1F

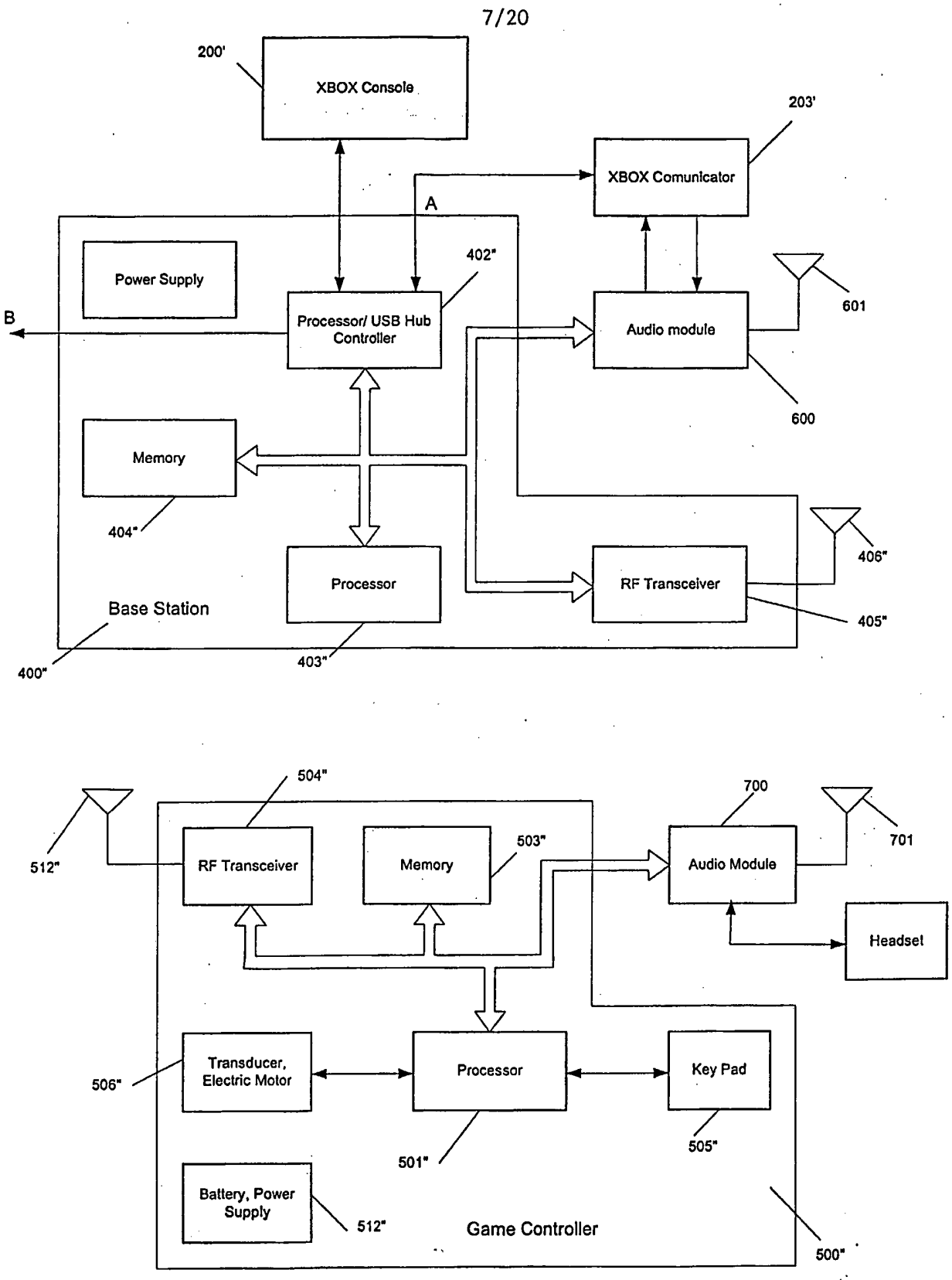

200'
XBOX Console
203'
XBOX Comunicator
A
Power Supply
402"
B
Processor/ USB Hub Controller
Audio module
601
600
Memory
404"
406"
Processor
RF Transceiver
405"
Base Station
400"
403"
504"
700
701
512"
RF Transceiver
Memory
503"
Audio Module
Headset
Transducer, Electric Motor
506"
Processor
Key Pad
501"
505"
Battery, Power Supply
512"
Game Controller
500"

Figure 1G

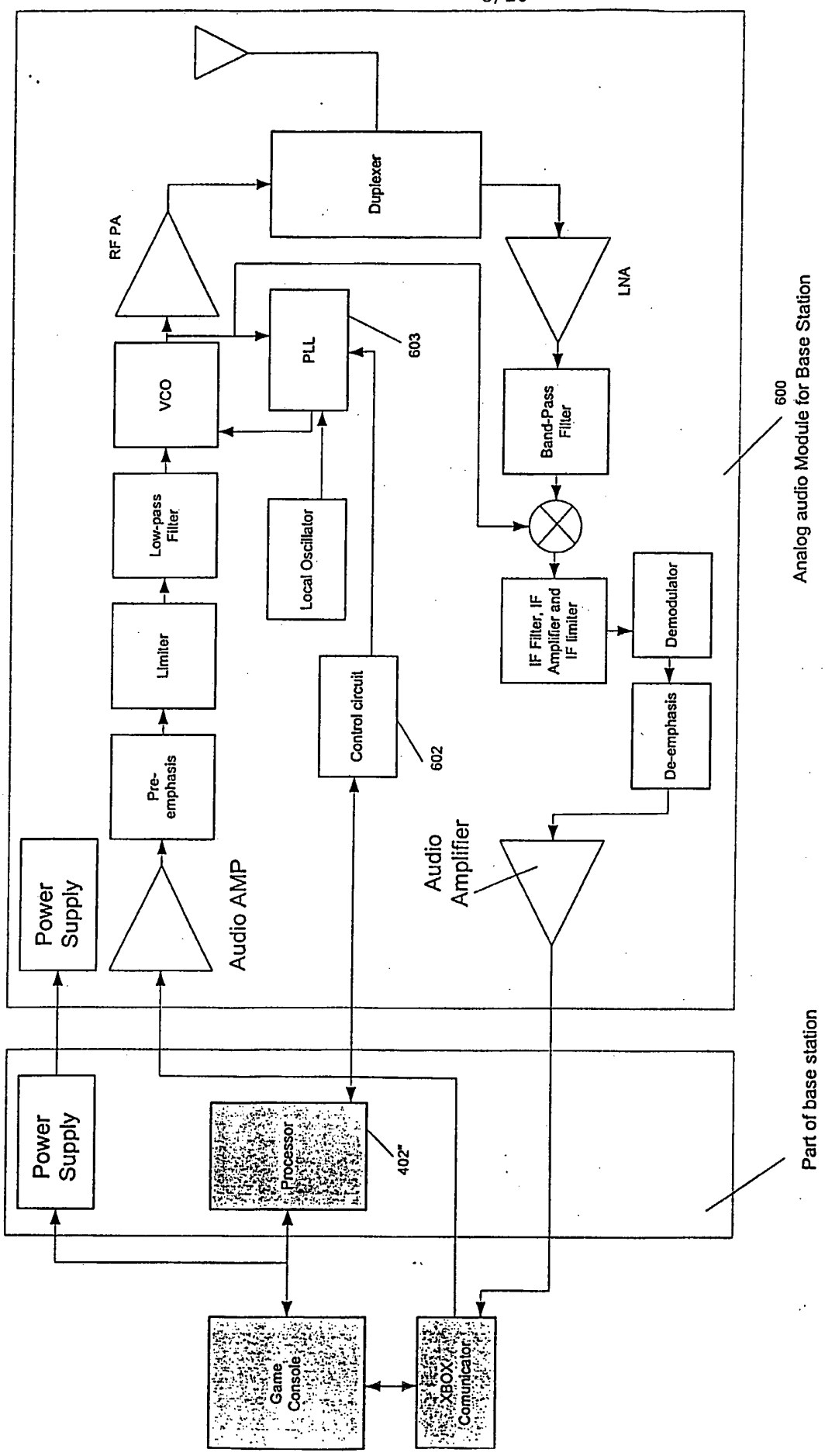

Duplexer
RF PA
LNA
PLL
603
VCO
Band-Pass Filter
600
Analog audio Module for Base Station
Low-pass Filter
Local Oscillator
Limiter
IF Filter, IF Amplifier and IF limiter
Demodulator
Control circuit
602
Pre-emphasis
De-emphasis
Power Supply
Audio AMP
Audio Amplifier
Power Supply
Processor
402"
Part of base station
Game Console
XBOX Comunicator

Figure 1H

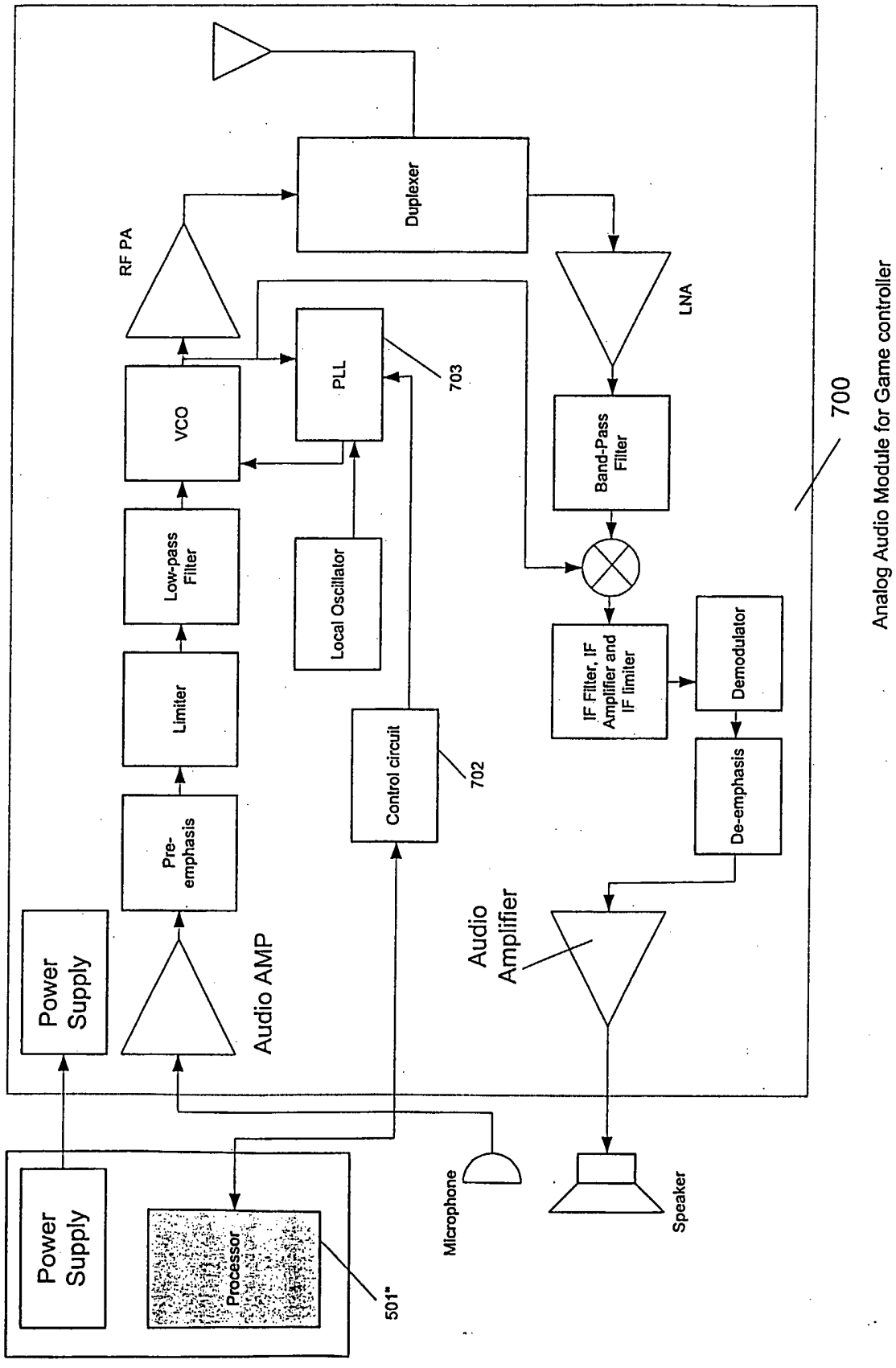

Duplexer
RF PA
LNA
PLL
703
VCO
Band-Pass Filter
700
Analog Audio Module for Game controller
Low-pass Filter
Local Oscillator
Limiter
IF Filter, IF Amplifier and IF limiter
Demodulator
Pre-emphasis
Control circuit
702
De-emphasis
Power Supply
Audio AMP
Audio Amplifier
Power Supply
Processor
501"
Microphone
Speaker

Figure 11

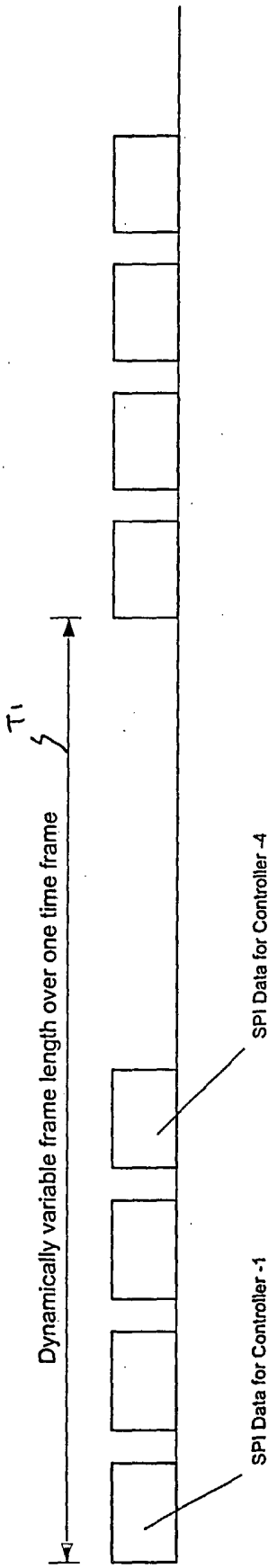

Dynamically variable frame length over one time frame
T1
SPI Data for Controller -4
SPI Data for Controller -1

Figure 2A

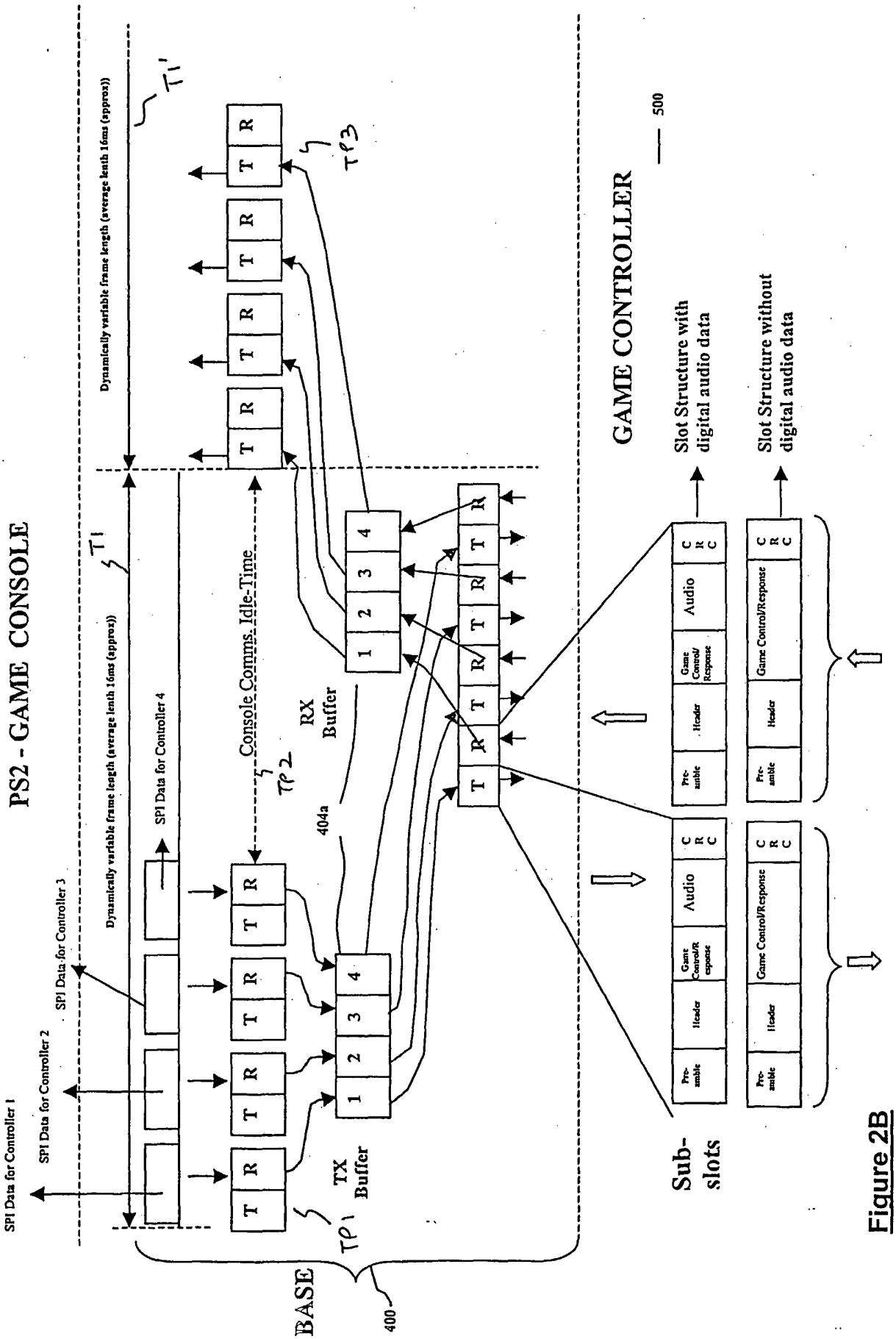

PS2 - GAME CONSOLE
SPI Data for Controller 1
SPI Data for Controller 2
SPI Data for Controller 3
SPI Data for Controller 4
Dynamically variable frame length (average length 16ms (approx))
Dynamically variable frame length (average length 16ms (approx))
T1
T1'
Console Comms. Idle-Time
TP1
TP2
TP3
TX Buffer
RX Buffer
404a
BASE
400
GAME CONTROLLER
500
Slot Structure with digital audio data
Slot Structure without digital audio data
Sub-slots
Pre-amble
Header
Game Control/Response
Audio
CRC
T
R
1
2
3
4

Figure 2B

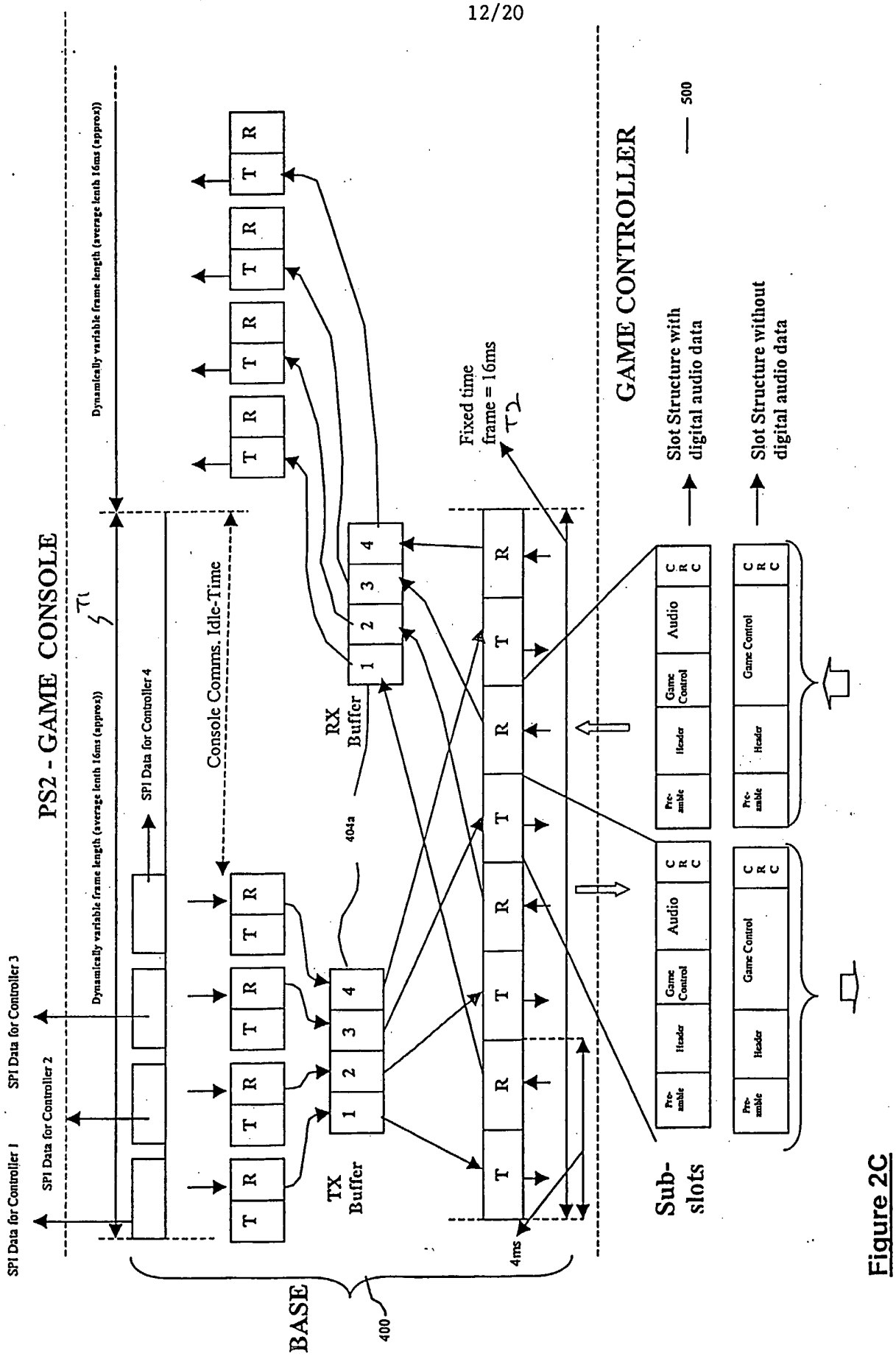

PS2 - GAME CONSOLE
GAME CONTROLLER
500
BASE
400
SPI Data for Controller 1
SPI Data for Controller 2
SPI Data for Controller 3
SPI Data for Controller 4
Dynamically variable frame length (average lenth 16ms (approx))
Console Comms. Idle-Time
Fixed time frame = 16ms
T1
T2
TX Buffer
RX Buffer
404a
4ms
Slot Structure with digital audio data
Slot Structure without digital audio data
Sub-slots
Pre-amble
Header
Game Control
Audio
Game Control
CRC
T
R

Figure 2C

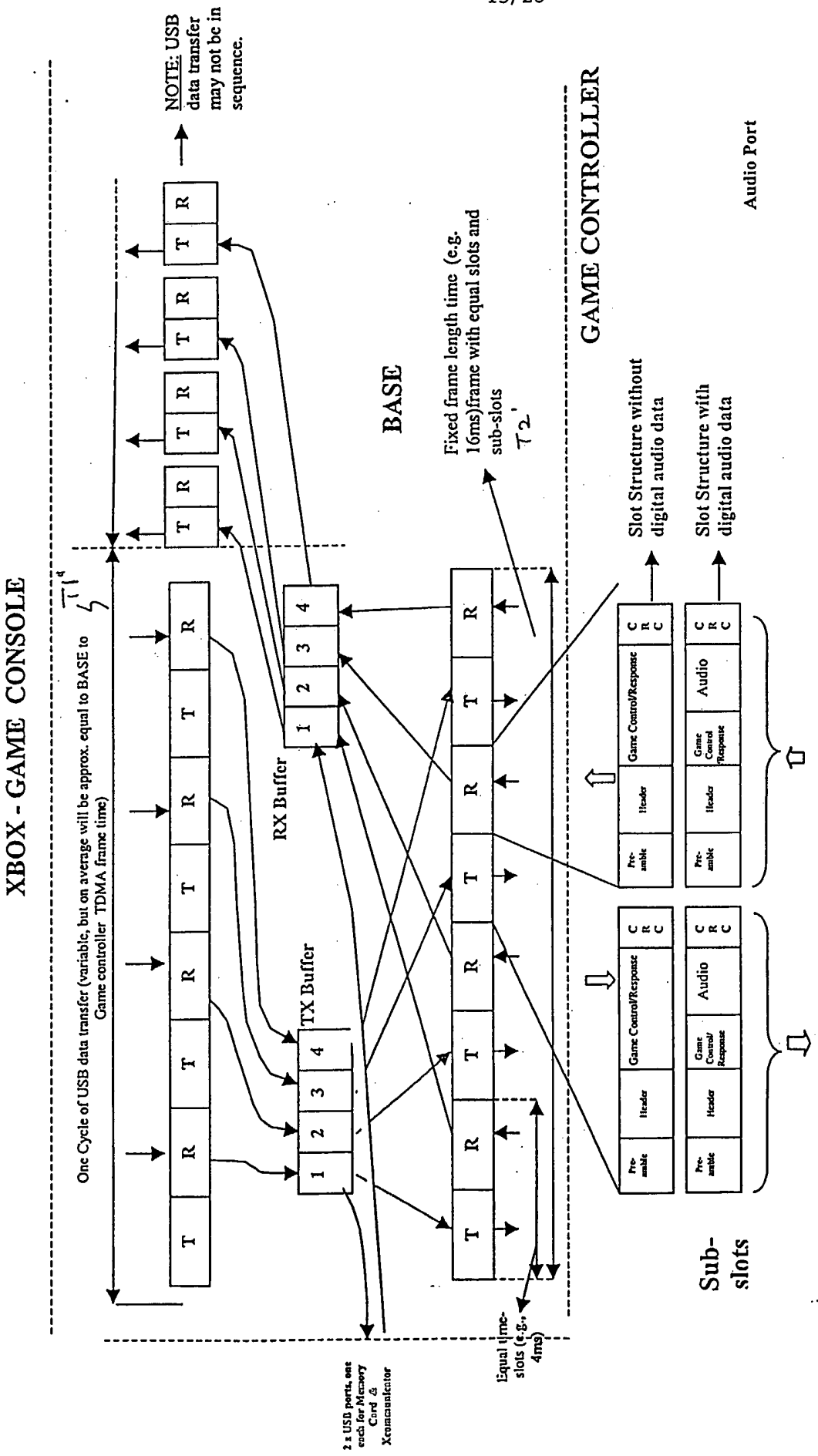

XBOX - GAME CONSOLE
NOTE: USB data transfer may not be in sequence.
One Cycle of USB data transfer (variable, but on average will be approx. equal to BASE to Game controller TDMA frame time)
T1'
RX Buffer
TX Buffer
BASE
Fixed frame length time (e.g. 16ms)frame with equal slots and sub-slots
T2'
GAME CONTROLLER
Slot Structure without digital audio data
Slot Structure with digital audio data
Audio Port
Pre-amble
Header
Game Control/Response
Audio
CRC
Sub-slots
Equal time-slots (e.g., 4ms)
2 x USB ports, one each for Memory Card & Communicator

Figure 2D

Figure 2E:

40 Channels Analog Audio Module Frequency Allocation

40 Analog Audio Channels Implementation

Base Frequency Allocation

Channel	Transmit Frequency MHz)	Receive Frequency (MHz)
1	902.4350	924.9350
2	902.5000	925.0000
3	902.5650	925.0650
4	902.6300	925.1300
5	902.6950	925.1950
6	902.7600	925.2600
7	902.8250	925.3250
8	902.8900	925.3900
9	902.9550	925.4550
10	903.0200	925.5200
11	903.0850	925.5850
12	903.1500	925.6500
13	903.2150	925.7150
14	903.2800	925.7800
15	903.3450	925.8450
16	903.4100	925.9100
17	903.4750	925.9750
18	903.5400	926.0400
19	903.6050	926.1050
20	903.6700	926.1700
21	903.7350	926.2350
22	903.8000	926.3000
23	903.8650	926.3650
24	903.9300	926.4300
25	903.9950	926.4950
26	904.0600	926.5600
27	904.1250	926.6250
28	904.1900	926.6900
29	904.2550	926.7550
30	904.3200	926.8200
31	904.3850	926.8850
32	904.4500	926.9500
33	904.5150	927.0150
34	904.5800	927.0800
35	904.6450	927.1450
36	904.7100	927.2100
37	904.7750	927.2750
38	904.8400	927.3400
39	904.9050	927.4050
40	904.9700	927.4700

Game Controller Frequency Allocation

Channel	Transmit Frequency (MHz)	Receive Frequency (MHz)
1	924.9350	902.4350
2	925.0000	902.5000
3	925.0650	902.5650
4	925.1300	902.6300
5	925.1950	902.6950
6	925.2600	902.7600
7	925.3250	902.8250
8	925.3900	902.8900
9	925.4550	902.9550
10	925.5200	903.0200
11	925.5850	903.0850
12	925.6500	903.1500
13	925.7150	903.2150
14	925.7800	903.2800
15	925.8450	903.3450
16	925.9100	903.4100
17	925.9750	903.4750
18	926.0400	903.5400
19	926.1050	903.6050
20	926.1700	903.6700
21	926.2350	903.7350
22	926.3000	903.8000
23	926.3650	903.8650
24	926.4300	903.9300
25	926.4950	903.9950
26	926.5600	904.0600
27	926.6250	904.1250
28	926.6900	904.1900
29	926.7550	904.2550
30	926.8200	904.3200
31	926.8850	904.3850
32	926.9500	904.4500
33	927.0150	904.5150
34	927.0800	904.5800
35	927.1450	904.6450
36	927.2100	904.7100
37	927.2750	904.7750
38	927.3400	904.8400
39	927.4050	904.9050
40	927.4700	904.9700

Figure 2F

40 Analog Audio Channels Frequency Spectrum

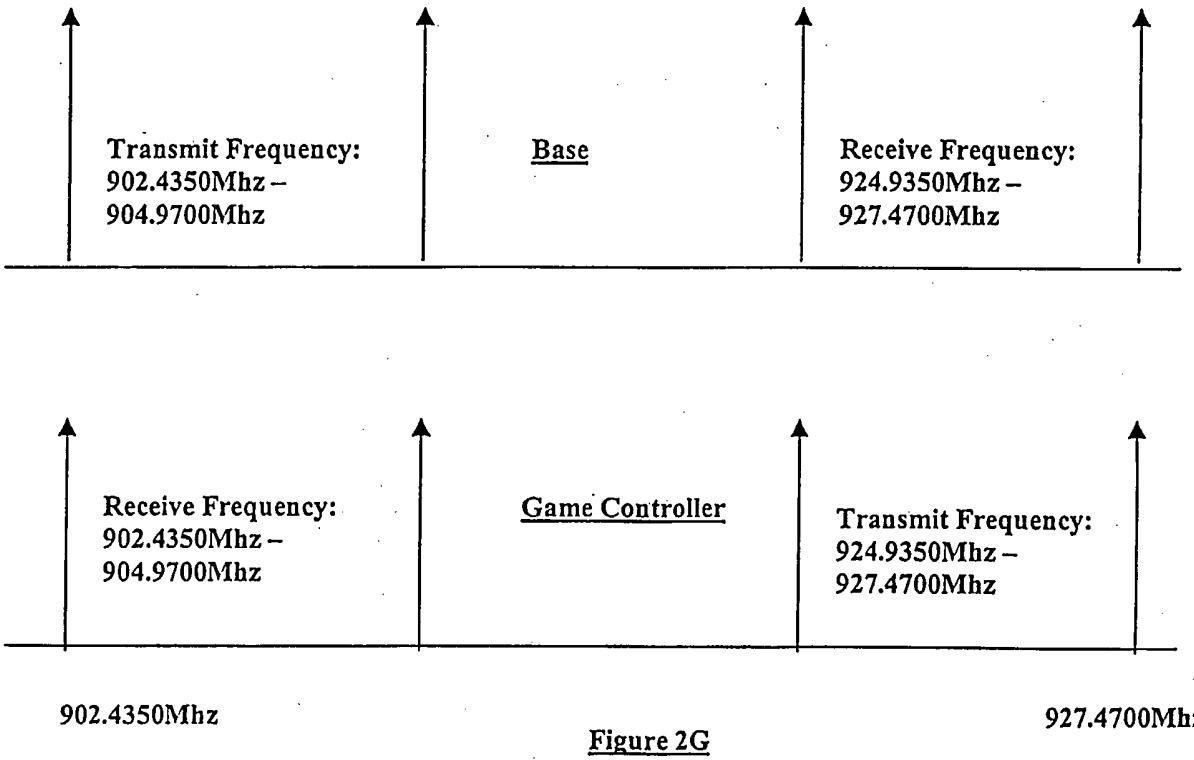


Figure 2G

Figure 2H

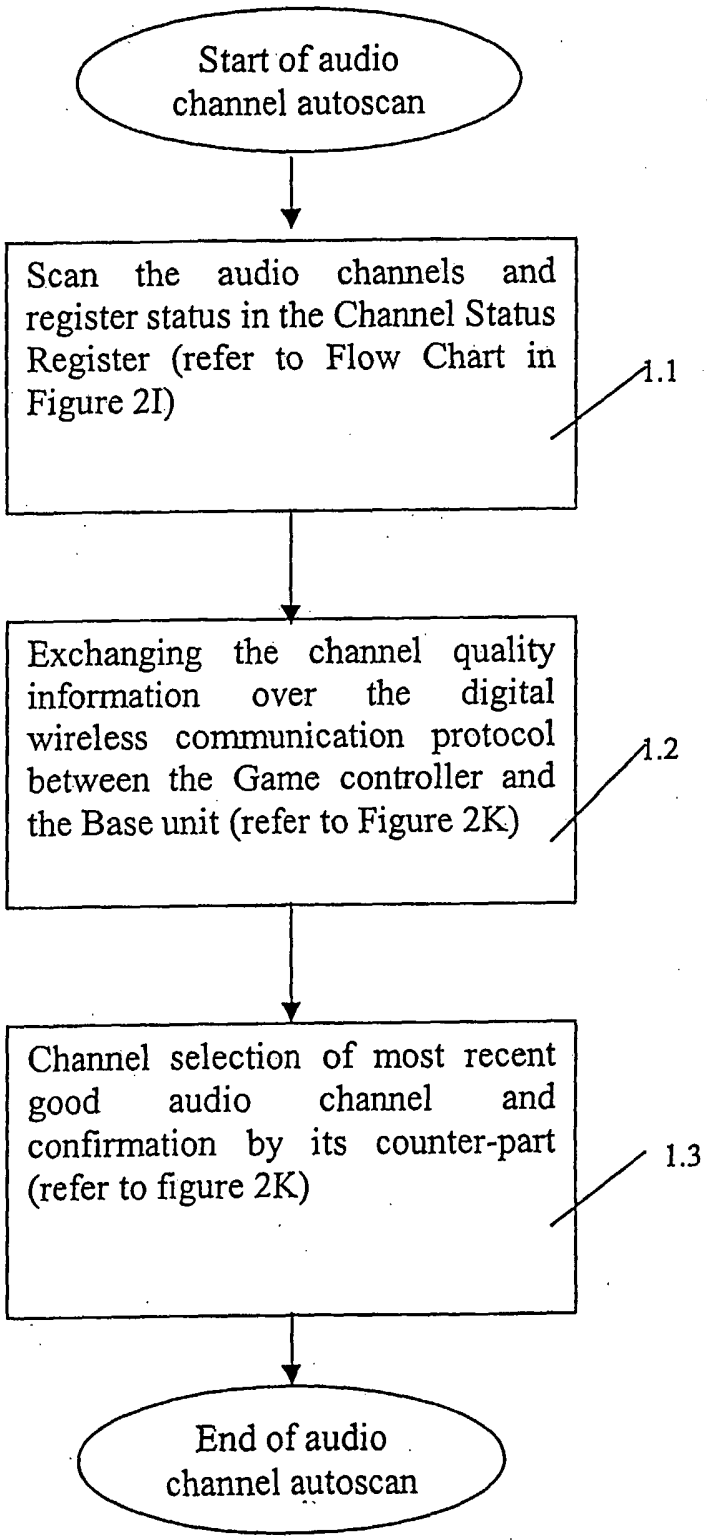

Start of audio channel autoscan
Scan the audio channels and register status in the Channel Status Register (refer to Flow Chart in Figure 2I)
1.1
Exchanging the channel quality information over the digital wireless communication protocol between the Game controller and the Base unit (refer to Figure 2K)
1.2
Channel selection of most recent good audio channel and confirmation by its counter-part (refer to figure 2K)
1.3
End of audio channel autoscan

Figure 2I

Channel Autoscan Algorithm

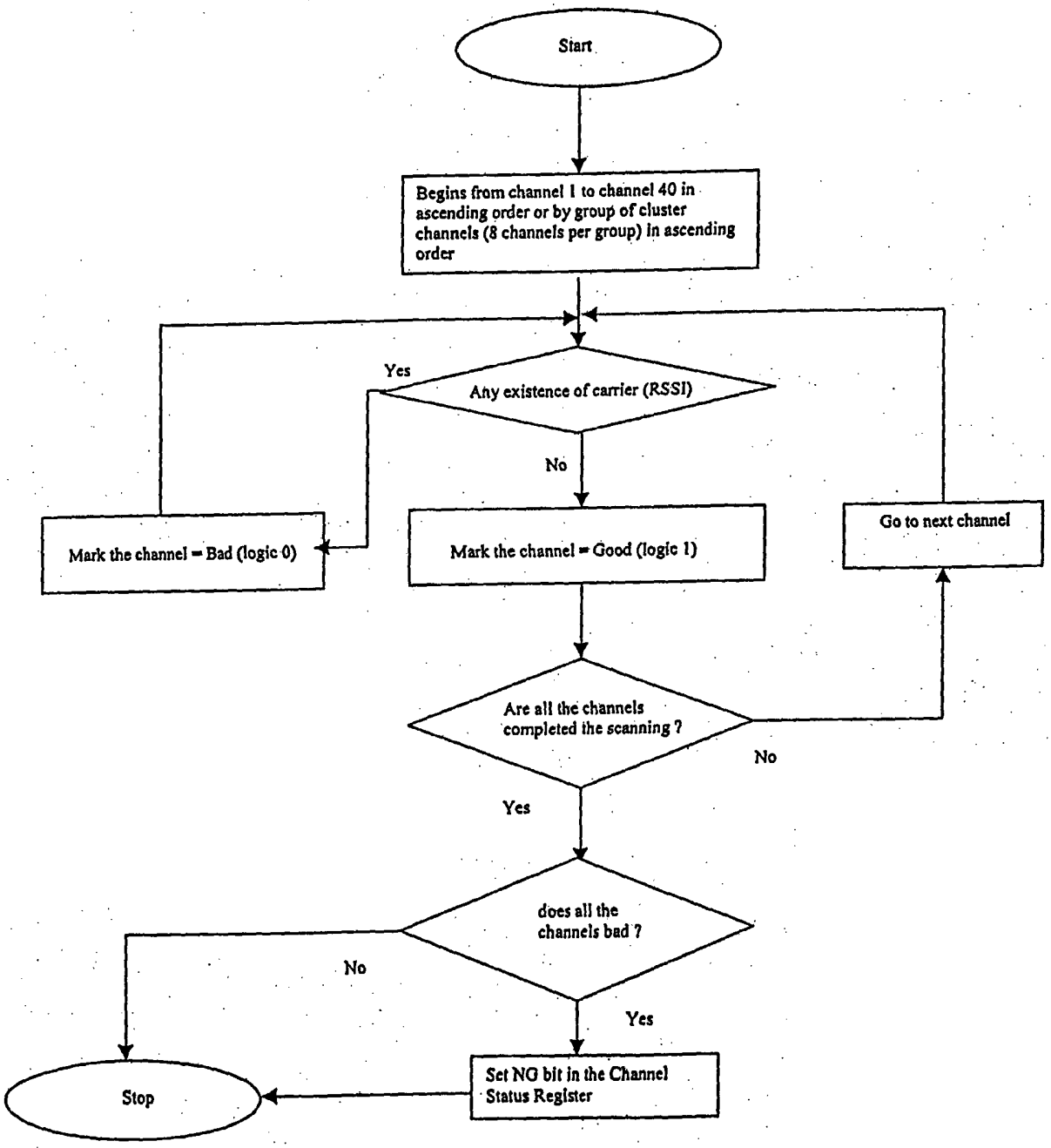


Figure 2J

Channel Status Register

Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Bit 8	Byte 1
Bit 9	Bit 10	Bit 11	Bit 12	Bit 13	Bit 14	Bit 15	Bit 16	Byte 2
Bit 17	Bit 18	Bit 19	Bit 20	Bit 21	Bit 22	Bit 23	Bit24	Byte 3
Bit 25	Bit 26	Bit 27	Bit 28	Bit 29	Bit 30	Bit 31	Bit 32	Byte 4
Bit 33	Bit 34	Bit 35	Bit 36	Bit 37	Bit 38	Bit 39	Bit 40	Byte 5
Bit 41	res	res	res	res	res	res	res	Byte 6

1) Channel Status Register = 41 bits (6 bytes)

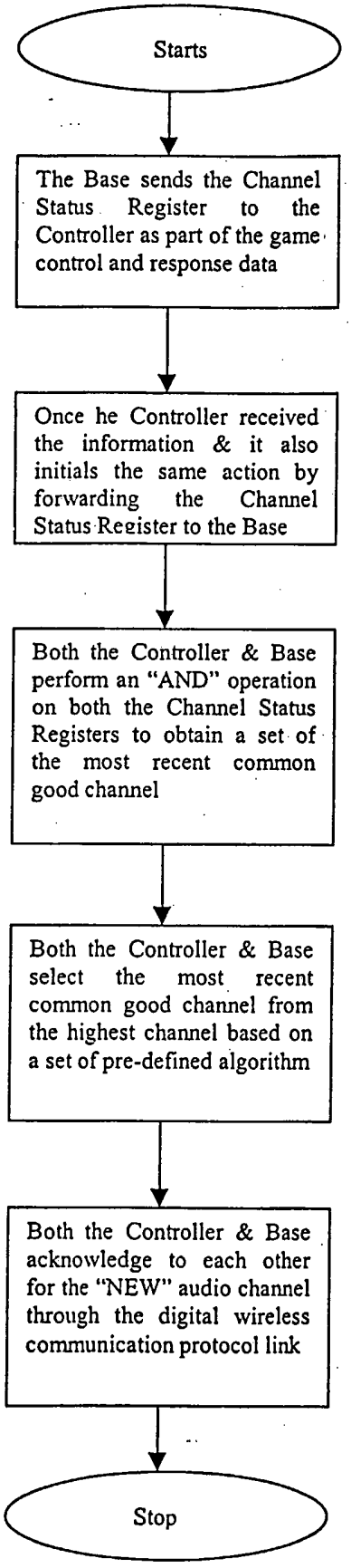
2) Audio Channel = 1 to 40 Channels

3) Channel Status Register :

- bit 1 = status of channel #1
- bit 10 = status of channel #10
- bit 40 = status of channel #40
- bit 41 = NO_GOOD flag (All channels are bad)

4) res = Reserved bits

Figure 2K


Starts
The Base sends the Channel Status Register to the Controller as part of the game control and response data
Once he Controller received the information & it also initials the same action by forwarding the Channel Status Register to the Base
Both the Controller & Base perform an "AND" operation on both the Channel Status Registers to obtain a set of the most recent common good channel
Both the Controller & Base select the most recent common good channel from the highest channel based on a set of pre-defined algorithm
Both the Controller & Base acknowledge to each other for the "NEW" audio channel through the digital wireless communication protocol link
Stop

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 2004/000058

A. CLASSIFICATION OF SUBJECT MATTER
A63F 9/24, A63F 13/02, A63F 13/12, H04B 7/212
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A63F, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Epodoc, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002110246 A1 (HAMPSON) 15 August 2002 (15.08.2002) *paragraphs 0041-0054; figure 2; claims.* --	1-20
X	WO 2002/034345 A2 (ELEVEN ENGINEERING) 2 May 2002 (02.05.2002) *page 5, line 18 - page 7, line 28; figures 3, 8, 9.* --	1-5, 7-9, 20
A	US 5806849 A (RUTKOWSKI) 15 September 1998 (15.09.1998) *column 4, lines 9-23.* --	10-19

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
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Date of the actual completion of the international search	Date of mailing of the international search report
21 May 2004 (21.05.2004)	25 August 2004 (25.08.2004)

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SG 2004/000058

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