

SYSTEM AND METHOD FOR BI-DIRECTIONAL COMMUNICATION BETWEEN A BROADCAST SOURCE AND AT LEAST ONE TARGET UNIT

FIELD OF INVENTION

5 The invention relates to a bi-directional communication between a broadcast source and at least one target unit. In particular, the invention is suited for (but not limited to) simultaneous interpretation (SI) system and will be described in this context.

BACKGROUND TO THE INVENTION

10 The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general knowledge in any jurisdiction as at the priority date of the application.

15 Simultaneous Interpretation (SI) systems are typically used in multilingual conference/meeting where the interpreted language is transmitted from an interpreter's main console (producer) to one or more receivers (consumer) wirelessly.

A typical SI system comprises the following main components:-

- 20 1. An interpreter console comprising transmission capabilities
2. Transmission system (over Antenna, Infrared radiators for example); and
3. One or more portable receiver units.

25 In the context of operating an existing SI system in a conference hall, the floor (main) language that is used in a conference is fed from the conference hall's sound system to the interpreter console where the interpreter will listen to via a pair of headphones for example. The interpreter will then interpret the floor language simultaneously (on the fly). The voice of the interpreter is picked up by a microphone; after which the voice is processed and transmitted via the

transmission system. The voice may be processed prior to transmission in the form of analogue modulation (e.g. FM) and transmitted through the air using wireless means (example Wireless RF and Infrared). The processed information may be transmitted in the form of analog modulation (e.g. FM) or in a form of encoded digital modulation e.g. Frequency-shift keying (FSK).

A user (consumer) of the language having a receiver unit will select the relevant channel for the language so that he can listen to the voice of the interpreter. However, as the information flow in only one direction (such one directional information flow hereinafter referred to as simplex communication) from the interpreter to the receiver, the SI system has no way to receive feedback such as the listening experience and quality of interpretation service from the user. Feedbacks are important to SI system providers to improve and better focus their services to cater to the needs of users.

One possible way to allow user(s) to provide feedback is to implement a point to point bi-directional communication protocol between the transmitter and the receiver. Such an approach will allow the each user to provide a feedback. However, this communication protocol's addressing scheme has its limitation as there are always a maximum of simultaneous user that are allowed to communicate directly with the transmitter console.

As a subset of the feedback, an attractive feature which appeals to users is to be able to provide feedback in the form of a vote system. Currently, a vote system is usually implemented using a separate system from the SI system where eligible users (voters) each holds a voting device, when the vote process is called, the person in charge (e.g. a chairman) will initiate the process where each voter will enter their choice on the voting device. The results are then tabulated by the console and displayed on a screen.

As the Interpretation and voting systems are 2 separate systems and are independent of each other where there is no connection between them, In the event where a vote need to be taken, the user will need to be issued with a separate voting device using a different frequency channel and have to be carried and registered separately in order to access the voting system.

It is desirable to provide a system and method that overcomes, or at least alleviates, the above problems.

5 SUMMARY OF THE INVENTION

Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

In accordance with a first aspect of the present invention there is provided a
10 system for bi-directional communication between a broadcast source and at least one target unit; the broadcast source operable to transmit a data signal to the at least one target unit; wherein the data signal comprises a broadcast payload portion and a target payload portion; the broadcast payload portion comprising broadcast content accessible by the at least one target unit; the target payload
15 portion comprising an activating message for selected target unit(s) of the at least one target unit to respond or reply to the activating message.

Preferably, each of the at least one target unit comprises a unique identifier for identification of each target unit. According to one embodiment, the target payload
20 portion comprises a unit identifier portion for selection of the target unit to transmit a reply to the broadcast source.

Preferably, the target payload portion comprises a system unique identifier for identification of the system.
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Preferably, the data signal is transmitted based on an asymmetrical time division multiple access (TDMA) communication protocol on a same frequency channel.

Preferably, the broadcast payload portion is raw or compressed before
30 transmission to the at least one target unit.

In accordance with a second aspect of the present invention there is provided a method for bi-directional communication between a broadcast source and at least one target unit comprising the steps as follows:-a. generating a broadcast payload portion, the broadcast payload portion comprising broadcast content accessible by
5 the at least one target unit; b. generating a target payload portion, the target payload portion comprising an activating message for selected target unit(s) of the at least one target unit to respond or reply to the broadcast source; c. combining the broadcast payload portion and target payload portion into a data signal; and
10 d. transmitting the data signal from the broadcast source to the at least one target unit.

Preferably each of the at least one target unit comprises a unique identifier for identification of each target unit. In one embodiment, the target payload portion comprises a unit identifier portion for selection of the target unit to transmit a reply
15 to the broadcast source. Further, the method may include the step of matching the unique identifier of each of the at least one target device with the unit identifier portion.

Preferably, the system comprises a system unique identifier for identification of the
20 system.

Preferably, the transmission of the broadcast payload portion and target payload portion is based on an asymmetrical time division multiple access (TDMA) communication protocol on a same frequency channel.
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Preferably, the broadcast payload portion is raw or compressed before transmission to the at least one target unit.

In accordance with a third aspect of the invention there is provided an
30 electromagnetic data signal for facilitating bi-directional communication between a broadcast source and a target device, the data signal comprising a broadcast payload portion and a target payload portion;
wherein the broadcast payload portion comprises broadcast content accessible by the at least one target unit; and the target payload portion comprises an activating

message for selected target unit(s) of the at least one target unit to respond or reply to the activating message.

Preferably, the data signal is transmitted or received based on an asymmetrical
5 time division multiple access (TDMA) communication protocol.

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures, which illustrate, by way of example only, embodiments of the present invention,

10 **Fig. 1** is a schematic set-up of the system for bi-directional communication between a broadcast source and a plurality of target units in accordance with an embodiment of the invention;

Fig. 2 is a schematic diagram illustrating the connection between multiple broadcast sources to a control computer in accordance with an embodiment of the
15 invention;

Fig. 3a to Fig. 3c illustrate the source transmitted signal; a target unit reply signal; and a asymmetrical TDMA time slot in accordance with an embodiment of the invention;

Fig. 4 is a flow chart illustrating the transmission operation of the broadcast
20 source; and

Fig. 5 is a flow chart illustrating the receiving operation of a particular target unit.

Other arrangements of the invention are possible and, consequently, the accompanying drawings are not to be understood as superseding the generality of
25 the preceding description of the invention.

DETAILED DESCRIPTION

In accordance with a first embodiment of the invention, there is provided a system 10 for bi-directional communication between a broadcast source 12 and at least one target units 14 as shown in Fig. 1. The system is especially suited (but not limited to) for application to a simultaneous interpretation (SI) system for multilingual conference/meeting where the interpreted language is transmitted from an interpreter's main console 12 to one or more target unit receivers 14 and will be described in the context.

The broadcast source 12 is typically a console unit comprising a transmitter 16, receiver 18, a sound-in jack 20 connectable to a voice pickup device such as a microphone 22, a sound output jack 24 connectable to a hearing device such as a headphone 26.

Console unit 12 may optionally comprise data communication means for communication with a computer device 28. Data communications means enable the system 10 to download and assess large amounts of information. The console unit 12 may be connected to the computer 28 through a communication link to enable bi-directional data transfer and control commands to be exchanged between the console unit 12 and computer 28.

As an example of data transfer and command, computer device 28 is operable to receive status data from the console unit 12 and returns a control data signal once the console unit 12 is ready to receive input.

Console unit 12 may be arranged to receive audio input from a house sound system 30.

Each of the at least one target unit 14 is preferably a portable unit comprising transmission and receiving capabilities.

For the purpose of implementing and/or utilizing extended functionalities, a plurality of consoles 12 may be connected to a computer 28 via a concentrator 32 (see Fig. 2). Concentrator 32 may be an Ethernet switch. Each console 12 may be assigned a different IP address and operable to be in data communication with computer 28.

The console unit 12 is capable of bi-directional communication with at least one target unit 14 via a communication protocol. In the embodiment the communication protocol is advantageously an Asymmetrical Time division multiple access (TDMA) communication protocol on the same frequency channel. In particular, each console 12 is operable to broadcast a large amount of data to all target units 14 at the same time without affecting the quality of service. In addition, the/each console unit 12 is capable of addressing and receiving information from each target unit 14 without penalty to the listening experience of any of the target unit 14.

The TDMA communication protocol is configured to allow different types of information to be sent over the same frequency channel. The asymmetrical TDMA protocol uses a hybrid of a broadcast and point to point communication system. Part of the data transmitted by the broadcast console 12 is used for broadcast of the actual data content (e.g. voice for a SI system) whereas the other parts are for unicast or broadcast point to point communication with each target unit 14 for authentication security and/or bi-directional communication.

To utilize the asymmetrical TDMA communication protocol, each target unit 14 comprises a unique address such that any feedback or status of each target unit may be read independently in a secured manner by the master console unit 12.

Fig. 3a illustrates the payload of the transmitted signal 40 from the main console 12 to a target device 14. The signal comprises a preamble portion 42, a broadcast source payload portion 44, a unicast/broadcast payload portion 46, and an error checking portion 48.

The preamble portion 42 is a header bit string used to synchronize transmission timing between the console 12 and target unit 14. Proper timing is required to ensure the start of the information transfer correctly. The actual preamble may vary depending on the network communication technology in use.

The broadcast source payload portion 44 comprises the actual information to be utilized by the target device 14. For the purpose of SI system, payload portion 44 comprises the interpreted audio voice data.

The unicast/broadcast payload 46 may be used for security and encryption so that only target device(s) 14 having the matching (same) key will be able to reply or communicate with the main console 12 in a bi-directional manner and/or make use of other enhanced functions.

- 5 The payload portion 46 comprises an activating message which may be in the form of command 462, system identification code (system ID) 464, and a user identification code (user ID) 466 for security measure and authentication. In addition, there may be an encryption key for authorization purpose.

10 Command 462 is used for activating certain instructions to elicit a response from the target unit 14. An example of command 462 may be an initiation for a voting process sent by a chairman of a meeting, where the chairman controls the console 12 via providing command inputs from the computer 28.

15 The system ID 464 allows the owner of the console 12 a means to address each individual target unit 14. System ID 464 is a unique identifier shared between the console 12 and at least one target unit 14, such that only target unit(s) 14 having the same system ID 464 matching the console 12 will be able to respond to the command 462.

20 The User ID is used to identify the individual target unit 14. User ID 466 is a unique identifier for each individual target unit 14. The unique identifier allows the console 12 to address each individual target unit 14.

25 The system ID 464 may be shared by all consoles 12 and target units 14 and utilized such that only target units 14 having the system ID 464 may respond to the command 462. In addition, the system ID 464 may be used to segregate different system so that target device 14 sold to different owners of main console 12 may be configured in a consistent manner.

30 The user ID 466 may be utilized in conjunction with the system ID 464 such that only target units 14 which match both the system ID and User ID will be able to reply to the console unit 12. The ID scan of the transmission console may be based on a linear progression, generated by a polynomial or from a look out table.

For a Target unit 14 to reply (transmit) to the master console 12, it must have the same System ID and User ID in which the target system will reply to the master 12. In the event where the System ID does not match, the Target unit 14 will not reply but will instead decode the payload that is sent with the master 12, similar
5 action will be taken when the target receive a matching System ID while having a different User ID.

The error checking portion 48 comprises a forward error correction (FEC) for example.

10 Fig. 3b illustrates the reply signal 50 in response to the command 462 in the situation where the IDs 464, 466 matches. It is to be appreciated that without matching of the IDs 464, 466 the command 462 will not be executed by a target device 14 and accordingly no reply signal 50 will be sent.

Reply signal 50 comprises a preamble portion 52, a reply payload 54, and an error
15 checking portion 58.

The preamble portion 52 is a header bit string used to synchronize transmission timing between the console 12 and target unit 14. Proper timing is required to ensure the start of the information transfer correctly. The actual preamble may vary depending on the network communication technology in use.

20 The reply payload 54 comprises the reply data in response to the command 462.

The error checking portion 58 comprises a forward error correction (FEC) for example.

As illustrated in Fig. 3c, an asymmetrical TDMA time frame slot comprises a master transmit slot, a turn-around delay time, and a slave reply time slot. The total system
25 cycle time is thus the number of TDMA time frame slot multiply by the total number of target units 14 as follows:-

System Cycle time = Frame time * total number of slave to be polled.

To ensure security of the transmission, the entire block of the payload data may be encrypted using an encryption algorithm before sending, thus providing positive
30 authentication to the data sent. The entire block of payload data may be encrypted with an encryption key such that without a valid key, neither master console 12 nor

target unit 14 may decrypt the broadcast payload 44, command 462, system ID 464 and user ID 466. Without the encryption key, the above information will not be available to the target unit 14.

To further frustrate any attempt to spoof any reply, a free sequence code is added to the reply, as the sequence number will not repeat itself before the entire cycle is over, unless the encrypt key is known, a captured reply will not able provide the necessary sequence and hence authentication of the reply data may therefore be done using this sequence number.

The invention will next be described in the context of using the simultaneous interpretation system. The system operation is similar to that of a standard interpretation system where the interpreter interprets the floor language or any interpreted language into a target language in an interpreter booth, each booth comprising a console 12 connected as described in Fig. 1 and/or Fig. 2.

As illustrated in Fig. 4 showing a logic flow diagram from the main console's perspective, a user (interpreter) seeks to broadcast his/her interpreted voice signal 40 in a specified language (step 402). At each console 12, the broadcast payload 44 comprising the voice data is generated with relevant encryption and compression if required (step 404). After the generation of the broadcast payload 44, the command 462 and IDs 464, 466 are generated (step 406). As an illustration, the command 462 may be in the form of an invitation for eligible target units 14, i.e. those with matching IDs 464, 466 to vote.

The FEC is the generated and the signal 40 transmitted to a target unit 14 (step 408). Once transmitted, the main console 12 waits for a valid reply from the target units 14 (step 410).

When a valid reply (e.g. a valid vote) is obtained from the target unit 14, the reply is decoded and an action, for example display on the screen or send information to computer 28 etc is performed (step 412).

If no valid replies have been received, the system checks if time out has been reached (step 414); if no time out is received, the system continues to wait for valid replies from the eligible target devices 14.

Upon reaching a timeout or once valid replies from eligible devices have been decoded and received, the process ends (step 416).

From the perspective of a target device 14, the process starts with the receipt of a source signal 40 (step 502). The target device next checks if a proper frame/package; command 462 is received (step 504). If a proper command is received, checks are performed to determine if there is a match with the system ID and user IDs 464 and/or 466 (step 506 and step 508).

Once there is a system ID 464 match, a response to command 462 (step 507) is sent. The response may be in the form of an acknowledgement that there is a system ID match. A non-limiting example of a response may be an action which the receiving target device(s) 14 needs to perform. In the context of a voting system, the action may include the initiating of the voting process when a target device 14 enters a voting mode.

Once a user ID 466 match is detected, the target device 14 replies to the command 462 via the reply signal 50 (step 509). The reply signal is specific to the command 462 and may include a reply to the main console 12 with its status when it is polled by the console 12, reply status of RSSI and Battery voltage etc.

Upon replying, the broadcast source payload portion 44 is decoded. As an example, the payload portion 44 may be the playback of audio (step 510).

It is to be appreciated that if either of the checking steps 504, 506, 508 fails, i.e. either the command 462 is not valid for the target device 14 or there is no match with IDs 464 and/or 466; the target device 14 executes step 510 to decode and playback the broadcast source payload 44.

The afore-described embodiments provide the following advantages. The asymmetrical TDMA communication protocol/scheme allows very large number of user participating in the network without the need to increase system bandwidth nor cause any degradation of quality of service to the users as the broadcast information is already part of the design protocol.

Among the transmitted console data 40 sent, the broadcast source data containing the audio interpreted voice are broadcast by the system to all the portable units 14 within the transmission radiation pattern. This ensures that all portable units 14 may

tune in to a specific channel (language) and can receive decode and decompress the source broadcast data 44 (in this case voice) without the need for further authentication. There is theoretically no limit on the number of listeners tuning in to listen to the broadcast content 44.

- 5 With the implementation of the encryption and keys via the system in addition to unit IDs 464, 466, a target unit 14 without the key cannot listen to the content of the meeting or multi-language conference nor participate with the feedback (e.g. the voting process); thus providing the security feature which may be required during some multi-language conference and meetings and votings.
- 10 The feedback feature allows the system designer to merge two or more systems (SI and voting system) to work together without the need to make change to the systems or incorporate additional system as mentioned in the prior art. This feedback features allow the users of the target units 14 to perform one or more of the following functions:
 - 15 a. Electronic voting
 - b. Provide feedback on quality of service
 - c. Interpreter to know of any listener tune to his/ her channel; and
 - d. Distribute information and collect feedback of each individual user using this system.
- 20 In particular, with reference to the description of Fig. 4 and 5, when a vote is required to be taken from the eligible voters, the chairman of the meeting may start the voting process through user interface on the computer 28 which in turn inform each individual console 12 to broadcast a starting command to all the receiver units 14 listening in to the channel.
- 25 Each portable unit 14 upon receiving the command will enter into a voting screen and will remain there until the eligible voters of the corresponding target units 14 has selected their options or when the chairman decided to end the voting session (i.e. timeout).

During the voting process, the quality of the interpreted audio information (i.e.

- 30 broadcast payload 44) will not be affected in anyway as the broadcast information is

already part of the design protocol. Each console 12 will scan through the individual system and User ID to receive the respond from each target unit 14. During the vote, the information is send to the respective console 12 and then to the computer device 28 once the voting information is made available.

- 5 The computer device 28 may then collate the feedback based on the user ID 466. The information may be used to update a database or to provide a result to be print on the screen or uploaded to the Internet.

It is to be appreciated that besides voting information, the system 10 may also collect other operational information (such as battery voltage and received power)
10 from each target system 14 to ensure the service quality of the portable user. The interpreter at the console 12 may also find out if there is any receiver to the channel, in the case where there are at lease a receiver tuning in on the channel, an indication light on the console will start blinking.

- 15 Through the user ID 466, the system allows an operator (interpreter using the system) to be aware of specific users listening into his / her channel if he wishes to.

Although the foregoing invention has been described in some detail by way of illustration and example, and with regard to one or more embodiments, for the purposes of clarity of understanding, it is readily apparent to those of ordinary skill
20 in the art in light of the teachings of this invention that certain changes, variations and modifications may be made thereto without departing from the spirit or scope of the invention as described in the appended claims. In particular, the invention may be applied to any system where a single source 12 (master) need to distribute or broadcast large amount of information to one or more slaves 14 and collect the
25 response of each of the slave units 14 securely on a single channel. For example, the scheme may be used for a classroom context embodied in a system where multiple choice questions are distributed to all students (tablet computers 14) in the vicinity from the instructor's console 12. When the instructor start the test, the question are distributed to all students in the form of the broadcast payload 44,
30 and upon receiving the questions, each student may proceed to answer the questions received and their responses are store in the tablet 14 which they can alter throughout the test.

When the instructor / invigilator decide to end the test process, a command 462 from the instructor's console 12 stops the answering process. The educational system then retrieves all the answers (in the form of reply signal 50) from each of the student / participant's tablet 14.

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It is to be further appreciated that various aspects of the embodiments as described may be combined to form further embodiments without departing from the scope of the invention.

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CLAIMS:

1. A system for bi-directional communication between a broadcast source and at least one target unit; the broadcast source operable to transmit a data signal to the at least one target unit; wherein the data signal comprises a broadcast payload portion and a target payload portion; the broadcast payload portion comprising broadcast content accessible by the at least one target unit; the target payload portion comprising an activating message for selected target unit(s) of the at least one target unit to respond or reply to the activating message.
2. A system according to claim 1, wherein each of the at least one target unit comprises a unique identifier for identification of each target unit.
3. A system according to claim 2, wherein the target payload portion comprises a unit identifier portion for selection of the target unit to transmit a reply to the broadcast source.
4. A system according to claim 1, wherein the target payload portion comprises a system unique identifier for identification of the system.
5. A system according to claim 1, wherein the data signal is transmitted based on an asymmetrical time division multiple access (TDMA) communication protocol on a same frequency channel.
6. A system according to claim 1, wherein the broadcast payload portion is raw or compressed before transmission to the at least one target unit.
7. A method for bi-directional communication between a broadcast source and at least one target unit comprising the steps as follows:-
 - a. generating a broadcast payload portion, the broadcast payload portion comprising broadcast content accessible by the at least one target unit;
 - b. generating a target payload portion, the target payload portion comprising an activating message for selected target unit(s) of the at least one target unit to respond or reply to the broadcast source;

- c. combining the broadcast payload portion and target payload portion into a data signal; and
- d. transmitting the data signal from the broadcast source to the at least one target unit.

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8. A method according to claim 7, wherein each of the at least one target unit comprises a unique identifier for identification of each target unit.

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9. A method according to claim 8, wherein the target payload portion comprises a unit identifier portion for selection of the target unit to transmit a reply to the broadcast source.

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10. A method according to claim 9 further comprising the step of matching the unique identifier of each of the at least one target device with the unit identifier portion.

11. A method according to claim 7, wherein the system comprises a system unique identifier for identification of the system.

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12. A method according to claim 7, wherein the transmission of the broadcast payload portion and target payload portion is based on an asymmetrical time division multiple access (TDMA) communication protocol on a same frequency channel.

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13. A method according to claim 7, wherein the broadcast payload portion is raw or compressed before transmission to the at least one target unit.

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14. An electromagnetic data signal for facilitating bi-directional communication between a broadcast source and a target device, the data signal comprising a broadcast payload portion and a target payload portion;
wherein the broadcast payload portion comprises broadcast content accessible by the at least one target unit; and the target payload portion comprises an activating message for selected target unit(s) of the at least one target unit to respond or reply to the activating message.

15. An electromagnetic data signal according to claim 14 wherein the data signal is transmitted or received based on an asymmetrical time division multiple access (TDMA) communication protocol.