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(71) Applicant *(for all designated States except US)*: **KONINKLUKE PHILIPS ELECTRONICS N.V.** [NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven (NL).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WALRANT, Thierry, G., C.** [BE/BE]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL). **DEROM, Koen** [BE/BE]; c/o Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

(74) Agents: **GROENENDAAL, Antonius, W., M.** et al.; Prof. Holstlaan 6, NL-5656 AA Eindhoven (NL).

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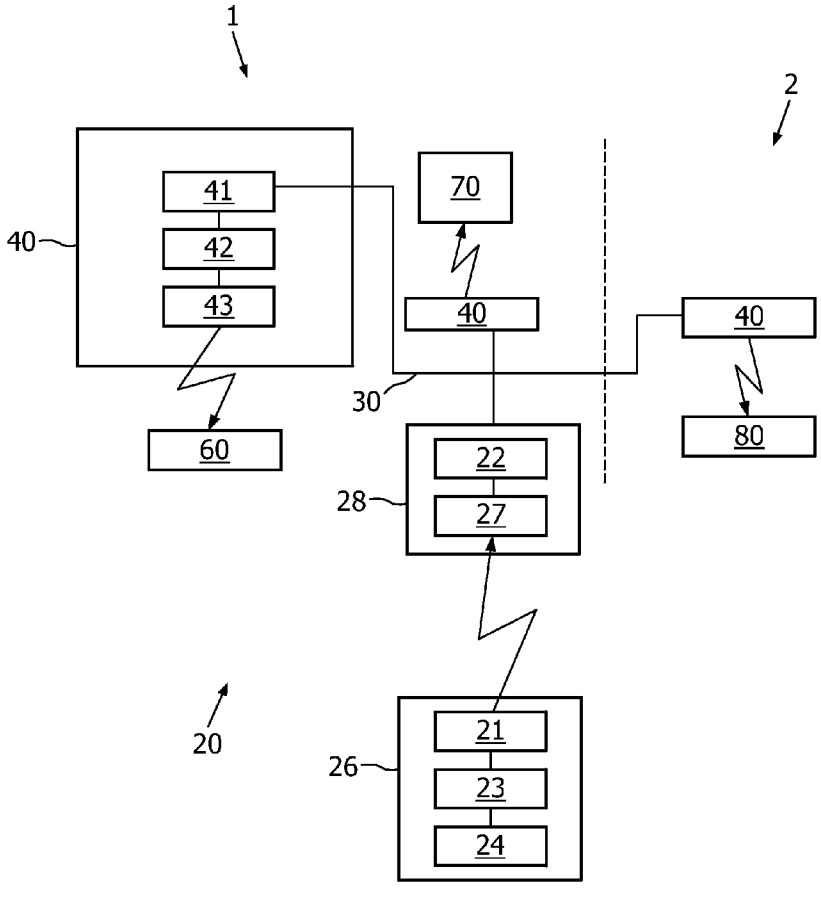
(54) **Title:** REMOTE CONTROL EXTENSION FOR COMMANDS HAVING PLURAL CODES




**(57) Abstract:** The system comprises a remote control (20) and an extender (40) coupled thereto by means of a network (30). It is used for remote control of an appliance (60,70,80) with commands having a plurality of codes. Such commands are for example so called macro commands (10) and repeat commands (11). The remote control (20) generates a message (50) comprising a description of the codes of the command and in some cases also the idle periods (di,d2,d3) between the codes of the command (15) and transmits the message (50) to the extender (40). The extender (40) receives the message (50). It generates the command (14,15) based on the description. The command is then transmitted to the appliance (60,70,80). In this way, uncontrolled idle times introduced by the network layer are avoided in case of a macro command and the effect of lost messages is reduced in the case of repeat commands.

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# Remote control extension for commands having plural codes

## BACKGROUND OF THE INVENTION

### TECHNICAL FIELD

The present invention relates to a system for remote control of at least an appliance, the system comprising a remote control and an extender coupled thereto.

The present invention also relates to a method for remote control of at least an appliance in a system comprising a remote control and an extender coupled thereto.

### DESCRIPTION OF RELATED ART

A network infra red (IR) extender is a device specially designed to extend the coverage of a regular remote control, still using standard IR receivers for the appliances. The extender is able to reach the receiver of the appliance, for example because it is located in line of sight of the receiver, while the Remote Control (RC) is not able to reach the receiver. Remote control extender systems are particularly useful for control of hidden (e.g. built-in) devices in the same room or for control of appliances in another room. Also the combination of multiple extenders permits the control of multiple appliances at the same time without the need to move the RC around in different directions. The remote control is coupled to the extenders via a (home) network.

An existing network extender system of Philips uses a connection-based IP protocol, the Transmission Control Protocol (TCP), to communicate the commands between the RC and the extender. The remote control of this system is available under the product name TSi6400 and the extender of this system is available under the product name NXT6400. A connection-based protocol such as TCP is designed to reliably deliver the data to a peer device using acknowledgements, retransmissions and congestion control to reduce the transmission errors over congested networks. As a consequence, a connection-based protocol does not provide timely data delivery. Indeed, the protocol depends on network behaviour and, if necessary, it will retransmit the same data multiple times to ensure guaranteed delivery in detriment of time constrains. In that context a RC cannot guarantee the time at which a command is delivered to an extender.

While the connection-based protocol works mostly well on a wired home network, it suffers significantly from perturbation of a wireless home network.

The requirement for time control of command execution is critical in the context of macro commands. A macro command is a special command, which is a collection of single commands or codes separated by specific idle periods or delays. The macro command is meant for a single application.

Figure 1 shows an example of a macro command 10: There are four codes $C_{15}C_2,C_3,C_4$ separated by specific idle periods or delays di,d2,d3. Each code represents a single instruction for the appliance. The combination of the codes and delays has a special meaning for a specific IR receiver. For example, the idle periods or delays that can be programmed into a macro depend on the way that a receiver of a certain appliance is able to interpret codes and/or accept further codes.

In the context of a remote control network extender system, it may be difficult, if not impossible, to guarantee fine grain delays. The network layer introduces some uncontrolled delays. When a remote control requests the execution of a code (Ci), waits di then request the execution of the next IR code ($C_2$), it is not guaranteed that the extender will actually reproduce the macro command correctly. This is schematically shown in figure 2. Figure 2 shows the macro command 10 generated by the remote control 20 and the macro command 15 received over the network 30 by the extender 40. The idle periods d'i,d'$_2$,d'3 between codes $C_{15}C_2,C_3,C_4$ of macro command 15 are not equivalent to the delays di,d$_2$,d3 of macro command 10. So, there is an inconsistency between the expected macro command and the macro command effectively generated by the extender.

The requirement for time control of command execution is also critical in the context of repeat commands. Repeat commands have a variable time duration. A repeat command 11 according to the state of the art is described with reference to figure 3. A repeat command is a special command that begins with a special start code (S), continues with continuation codes (C) and optionally finishes with an end code (E). The start code instructs the receiver of the appliance to start an operation that is maintained as long as the continuation code is sent to the receiver. Finally, the optional end code may be used to close the repeat command. Furthermore, the start code and the continuation code of the repeat command may be the same.

As an example, the user action Volume UP is executed by a repeat command. The start code requests a volume up. The volume is raised further by a predetermined dB

value as long as the continuation code is received by the appliance. The receiver knows to stop incrementing volume when the continuation code is not received anymore.

The RC repeat command duration is determined by the time interval between depressing (ti) and releasing a key/button ($t_2$). The duration of a repeat command is critical and must be respected, as it is the receiver of the appliance that interprets the duration in its context. For example, using a repeat command a receiver will be able to differentiate a stop ( ) action from an eject request on DVD player. A short repeat command duration meaning 'stop', while a longer repeat command duration requests the DVD player to stop and open the disc tray.

The errors of repeat command duration, in particular for repeat commands executed over an IP network by a TCP connection are critical. Sometimes, the duration may be even 3 seconds longer than expected. This means that the IR extender will transmit volume UP for 3 additional seconds after the user has released the key of the remote control.

So, in the known remote control extension system there may be problems with the correct execution of commands comprising more than one code, such as the macro command and the repeat command. This is due to transmission errors introduced by the network layer, such as uncontrolled delays and lost messages.

It is an object of the invention to provide a solution making command execution of commands with a plurality of codes less vulnerable from network layer errors.

## SUMMARY OF THE INVENTION

This and other objects of the invention are achieved by a system according to independent claim 1, a remote control according to independent claim 10, an extender according to independent claim 11, a method according to independent claim 12, computer programs according to claims 19 and 20, a computer readable medium according to claim 21 and a carrier medium according to claim 22. Favourable embodiments are defined by the dependent claims 2-9 and 13-18.

According to the invention, remote control of at least an appliance is provided in a system comprising a remote control and an extender coupled thereto. In the system commands having a plurality of codes are used for controlling the appliance. Each code represents a single instruction for the appliance. The remote control generates a message comprising information regarding a first code of the command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code. It transmits the message to the extender. The extender receives the message. It

generates the command at least partially based on the information present in the message, and it transmits the command to the appliance.

In this way, the extender receives parameters relating to the part of the command to be transmitted later in time together with the first code of the command. So, at an early moment in time the extender already has the necessary information for the transmission of (at least a part of) the command at a later stage. In some situations the transmission of the command can be made immune against perturbations caused by the network layer. In other situations network perturbations only affect the transmission of the command to a limited extent.

This only applies of course, if the message is received correctly by the extender. If the message is not received by the extender no command is transmitted at all. In this case, the user has to repeat the action on the remote control, so that the command is transmitted to the extender, again.

According to a preferred embodiment the one or more parameters relate to the timing requirements for the transmission of one or more of the further codes of the command. With this information, the extender is able to generate these codes with the correct timing. Uncontrolled idle times introduced by the network layer are avoided. This is in particular advantageous for macro commands.

According to a further preferred embodiment the one or more parameters relate to one or more idle periods between the codes. In this way, the extender is able to reproduce the command with the correct idle times between the codes. This is in particular advantageous in case of macro commands. The network delivery time of the message has no effect on the execution of the command. It influences only the execution start time.

According to a preferred embodiment the one or more parameters relate to one or more of the further codes of the command. The extender generates the one or more further codes in the command based on the information present in the message. So, if a packet to be received from the remote control is lost or delayed, the extender is still able to transmit the appropriate codes of the repeat command such as the continuation codes or the end code in case that the command is a repeat command. So, the effect of lost messages is reduced.

The information in the message may be a complete description of the further codes but it may, alternatively also be a reference to the further codes. In this latter case, the complete description of the codes is stored in a database of the extender. The size of the message may be reduced in this case.

According to a further preferred embodiment, the remote control transmits the message in a single packet to the extender. In this way, it is guaranteed, that the information needed for generating the command is transmitted in one go to the extender.

The remote control may be a single device coupled to a network.

Alternatively, the remote control comprises a handheld device and a receiver device coupled to a network. The handheld device transmits a command to the receiver device. Based on this command the receiver device generates the information comprised in the message to be transmitted to the extender.

Preferably, the invention is implemented by computer programs loaded to the remote control and the extender.

These and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawing, in conjunction with the accompanying specification, in which:

Figure 1 shows an example of a macro command according to the state of the art.

Figure 2 shows a macro command in which the idle times are incorrect due to transmission over a network.

Figure 3 shows an example of a repeat command according to the state of the art.

Figure 4 shows the generation of a macro command with correct idle times according to an embodiment of the invention.

Figure 5 shows the transmission of messages from the remote control to the extender for generating a repeat command according to an embodiment of the invention.

Figure 6 shows the limitation of the duration of the repeat command in case that one of the messages transmitted by the remote control to the extender is lost.

Figure 7 shows a block diagram depicting the network architecture of a remote control network extender system according to an embodiment of the invention.

Figure 8 shows a block diagram depicting the network architecture of a remote control network extender system according to another embodiment of the invention.

Throughout the figures like reference numerals refer to like elements.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

With reference to figure 4 it is shown how a macro command with correct idle times is generated. The remote control 20 generates a message 50 with a description of the codes $C_{15}C_2,C_3,C_4$ and the idle times di,d2,d3 between the codes of a macro command. Preferably, the remote control transmits the message over the network 30 to the extender 40 in a single packet but it is also possible that the message is transmitted in several packets. The network 30 may be any suitable network for remote control extension systems, such as a wireless LAN, a wired Ethernet network, a network using the power lines or a network using the in-house telephone lines. A connectionless protocol such as the User Datagram Protocol (UDP) is used for communication over the network. This network protocol provides one-way communication with the peer device. The return channel is implemented using the same protocol. Upon receiving the message, the extender 40 reads and interprets the description of the macro command and generates the different codes $Ci,C_2,C_3,C_4$ with appropriate idle times $di,d_2,d_3$. The macro command 15 is transmitted by the extender 40 to an appliance.

In an alternative implementation, the message comprises a description of the idle times $di,d_2,d3$ and only a reference to each of the codes $C_1,C_2,C_3,C_4$ to be transmitted. The complete description of the codes is stored in a database of the extender. The extender uses the reference received in the message 50 for retrieving the correct complete description of the code from the database. The size of the message 50 may be reduced.

Figure 5 shows the transmission of messages from the remote control to the extender for generating a repeat command according to an embodiment of the invention in case that there are no network interferences. A key is depressed on the remote control 20 from a first time ti to a second time $t_2$. The expected repeat command 12 has a duration corresponding to the time interval during which the key is pressed. When a key is depressed on the remote control at time $t_1$, the remote control generates a start message 100 comprising a complete description of the repeat command, including a start code S, a continuation code C and an end code E (step 600). The start message is transmitted to the extender 40 using a duplication mechanism (5 times in figure 5). The duplicate transmissions are spread in time by a delay, which provides better robustness against network interference. The next transmission of the message is most probably not affected by the interference of the previous transmission. Upon receiving the start message at time $t_3$ the extender starts the transmission of the effective repeat command 14 by sending IR codes, commencing with the start code S followed by continuation codes C (step 610). The start message is followed by periodic alive

messages 110 as long as the key on remote control 20 is depressed. The alive messages are periodically sent by the remote control during the live time of the repeat command. As long as alive messages 110 are received from the remote control, the extender continues the transmission of the repeat command by sending continuation codes. When the key on the remote control is released at time $t_2$, the remote control 20 generates a stop message 120 (step 620). Upon receiving the stop message at time *U* the extender finishes the transmission of the repeat command (step 630). Thereto it transmits the end code. In this example all the messages of the remote control are correctly received by the extender. The duration of the effective repeat command transmitted by the extender corresponds to the duration of the expected repeat command.

Figure 6 shows the relation between, the expected repeat command 12 and the effective repeat command 14 in case of network interferences resulting in the loss of a alive message. The IR codes generated by the IR extender are not similar to the expected scheme. After a predetermined time out $\Delta t3$ without receiving any alive messages from the remote control, the extender finishes the transmission of the repeat command using the end command. So, even in case that the network is not able to deliver the stop message in time, because a packet is lost or delayed, the extender is still able to automatically terminate the repeat command with the expected end code thanks to the encapsulation of all IR codes of the repeat command into the network start message. However, the end code is generated earlier than expected.

So, as a result of the use of this time-out mechanism, the duration of the effective repeat command may be smaller than the duration of the expected repeat command in case of network interferences. Generally, this is not critical. Consider the following exemplary situation. A user has requested to eject the DVD by holding the stop/eject button for a long period. However, the repeat command is automatically stopped by the extender before the required repeat command duration for eject action, because it does not receive messages from the remote control for a certain time-out. In this case the DVD is stopped but it is not ejected. In this case the user has to repeat the operation to get the tray opened.

The invention may also be used with repeat commands that do not comprise the optional end code. In this case the start message only comprises a description of the start code and the continuation code. The extender finishes the transmission of the repeat command without transmitting any further codes, when it receives the stop message or in case of time-out.

Furthermore, the invention is also applicable for repeat commands in which the start code and the continuation code are the same.

Figure 7 shows a first network architecture of the remote control network extender system according to the invention. The system comprises a remote control 20 coupled by means of a network 30 to three extenders 40. Only one of the three extenders 40 is shown in detail in the figure. The network 30 is for example a home network and may be wired or wireless. Two of the extenders 40 are in a first room 1 and one is in a second room 2. The commands of the remote control 20 are transmitted over the network 30 to the extenders 40. The extenders 40 transmit the command using infra red to appliances, such as a DVD 60, a recorder 70 and a television set 80, respectively. The system is able to handle multiple appliances in a single room without moving the RC around and is also able to include an appliance in the second room into the global operations. The remote control 20 may also comprise a local transmitter 21 for directly transmitting a command to one of the appliances 60 in the first room 1. The remote control further comprises amongst others:

- A network module 22 for distributing IR commands to the extender and collecting notifications and results (if any) from the extender.

- A net scheduler 23 for dispatching IR commands.

- An Application/User Interface 24 for providing the user-interface to execute user commands.

The Application/User Interface 24 is adapted for generating the message 50 comprising a description of the codes C1,C2,C3,C4 and the idle times dl,d2,d3 between the codes of a macro command. The network module 22 is adapted for generating the start message 100, alive messages 110 and stop messages 120. This functionality is preferably implemented by a processor loaded with a suitable computer program. The computer program may be embodied on a computer readable medium or may be downloaded from a server using a suitable carrier medium.

The extender 40 further comprises:

- A network module 41 for handling IR commands for the extender and dispatching notifications/acknowledgements, if required.

- A net service module 42 for parsing, interpreting and executing commands.

- An extender IR transmitter 43 for transmitting IR commands to the local appliances

The net service module 42 is adapted for reading and interpreting the description of the macro command and generating the different codes $Ci,C_2,C_3,C_4$ with

appropriate idle times dl,d2,d3. The net service module 42 is furthermore adapted for reading and interpreting the received start, continuation and stop messages and generating the repeat command as described herein above. This functionality is preferably implemented by a processor loaded with a suitable computer program. The computer program may be embodied on a computer readable medium or may be downloaded from a server using a suitable carrier medium.

Figure 8 shows a second network architecture of the remote control network extender system according to the invention. The remote control 20 comprises a handheld device 26 that transmits a macro command with certain idle times between the codes to a device 28 connected to the network. The device 28 comprises a receiver device 27. The receiver device 27 forwards the macro command to the network module 22. The network module 22 generates a message comprising a description of the codes and the idle times of this macro command and transmits it to the extenders 40 in the same way as described herein above with reference to figure 4.

The handheld device is also adapted for transmitting a repeat command with a certain duration to a device 28 connected to the network. After completely receiving the repeat command, the receiver device 27 forwards it to the network module 22. In this way, the network module 22 has information related to all the parameters of the repeat command. It generates a message 50 with a completely description of the repeat command in the same way as described herein above for the macro command. The description comprises the start code, the continuation code and the end code as well as the delays between these codes. The network module transmits the message to the extenders 40. The extender 40 generates the repeat command based on this description.

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a wide range of applications. In the embodiments described with reference to the drawings infra red transmission is used between the extenders and the appliances but of course the invention can also be implemented in network extenders that use other transmission media like (low power) RF or ultra sound. Furthermore, the invention has been described with reference to a macro command and a repeat command but of course it can also be used for other commands having a plurality of codes. In the described embodiments the used network protocol is a User Datagram Protocol (UDP) but of course the invention may also be used with other network protocols. Accordingly, the scope of patented subject matter should not be limited to any of

the specific exemplary teachings discussed, but is instead defined by the following claims. Any reference signs in the claims shall not be construed as limiting the scope.

CLAIMS:

1. A system for remote control of at least an appliance (60,70,80), the system comprising a remote control (20) and an extender (40) coupled thereto, wherein commands (10,1 1) having a plurality of codes are used for controlling the appliance,

the remote control (20) being adapted

- for generating a message (50,100) comprising information regarding a first code (Ci, S) of the command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code and

- for transmitting the message (50) to the extender (40);

the extender (40) being adapted

- for receiving the message (50),

- for generating the command (15) at least partially based on the information present in the message, and

- for transmitting the command (15) to the appliance (60,70,80).

2. A system according to claim 1, wherein the one or more parameters relate to the timing requirements for the transmission of one or more of the further codes ($C_2$,$C_3$,$C_4$) of the command.

3. A system according to claim 2, wherein the one or more parameters relate to one or more idle periods (di ,$d_2$,d3) between the codes.

4. A system according to any of the claims 1-3, wherein the one or more parameters relate to one or more of the further codes ($C_2$,C3,$C_4$,S,E) of the command and wherein the extender is adapted for generating the one or more further codes in the command based on the information present in the message.

5. A system according to claim 4, wherein the information comprises a description of one or more of the further codes.

6. A system according to claim 4, wherein the information comprises a reference to one or more of the further codes.

7. A system according to any of the claims 1-6, wherein the remote control is adapted to transmit the message in a single packet to the extender.

8. A system according to any of the claims 1-7, wherein the remote control is a single device coupled to a network (30).

9. A system according to any of the claims 1-7, wherein the remote control comprises a handheld device (26) and a receiver device (27) coupled to a network (30), the handheld device is adapted for transmitting a command having a plurality of codes to the receiver device and the receiver device is adapted for generating the information comprised in the message to be transmitted based on the command received from the handheld device.

10. Remote control (20) for use in a system for remote control of at least an appliance according to any of the claims 1-9, wherein commands (10,1 1) having a plurality of codes are used for controlling the appliance, the remote control being adapted

- for generating a message (50,100) comprising information regarding a first code (Ci, S) of the command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code and

- for transmitting the message (50) to the extender (40).

11. Extender (40) for use in a system for remote control of at least an appliance according to any of the claims 1-9, wherein commands (10,1 1) having a plurality of codes are used for controlling the appliance,

the extender being adapted

- for receiving a message (50) from a remote control, the message (50,100) comprising information regarding a first code (Ci, S) of the command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code and

- for generating the command (15) at least partially based on the information present in the message, and

- for transmitting the command (15) to the appliance (60,70,80).

12. A method for remote control of at least an appliance the system comprising a remote control (20) and an extender (40) coupled thereto, wherein commands (10,1 1) having a plurality of codes are used for controlling the appliance,, comprising the steps of:

by a remote control (20)

- generating a message (50,100) comprising information regarding a first code (Ci, S) of the command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code and

- for transmitting the message (50) to the extender (40);

by the extender

- receiving the message (50),

- generating the command (15) at least partially based on the information present in the message, and

- transmitting the command (15) to the appliance (60,70,80).

13. A method according to claim 12, wherein the one or more parameters relate to the timing requirements for the transmission of one or more of the further codes ($C_2$,$C_3$,$C_4$) of the command.

14. A method according to claim 13, wherein the one or more parameters relate to one or more idle periods ($d_1$,$d_2$,d3) between the codes.

15. A method according to any of the claims 12-14, wherein the one or more parameters relate to one or more of the further codes ($C_2$,C3,$C_4$,S,E) of the command and wherein the extender generates the one or more further codes in the command based on the information present in the message.

16. A method according to claim 15, wherein the information comprises a description of one or more of the further codes.

17. A method according to claim 15, wherein the information comprises a reference to one or more of the further codes.

18. A method according to any of the claims 12-17, wherein the remote control is transmits the message in a single packet to the extender.

19. A computer program comprising computer program code means adapted to perform the following steps, when said program is run on a computer:

by a remote control (20)

- generating a message (50,100) comprising information regarding a first code (Ci, S) of a command to be transmitted from an extender to an appliance and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code and

- transmitting the message (50) to the extender (40).

20. A computer program comprising computer program code means adapted to perform the following steps, when said program is run on a computer:

by an extender (40)

- receiving a message (50,100) from a remote control, the message (50,100) comprising information regarding a first code (Ci, S) of a command and comprising information regarding one or more parameters of the part of the command to be transmitted after the first code,

- generating the command (15) at least partially based on the information present in the message, and

- transmitting the command (15) to an appliance (60,70,80).

21. A computer program as claimed in claim 19 or 20 embodied on a computer readable medium.

22. A carrier medium carrying the computer executable program of claim 19 or 20.

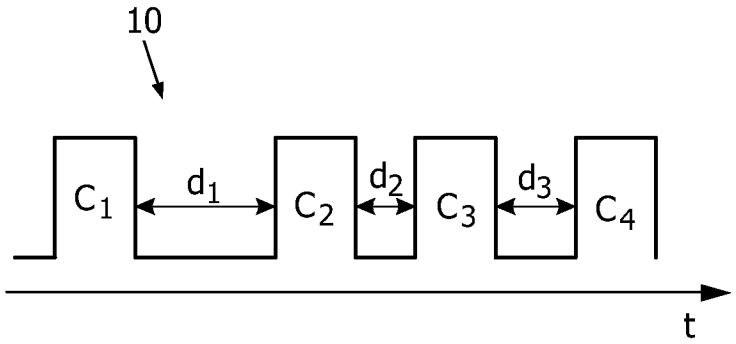
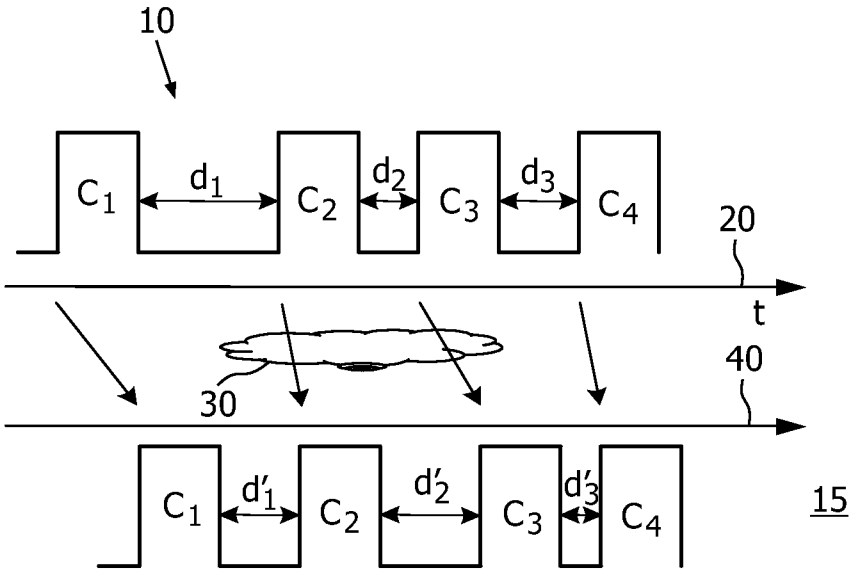



FIG. 1




$d'_1 < d_1$
$d'_2 > d_2$
$d'_3 < d_3$

FIG. 2

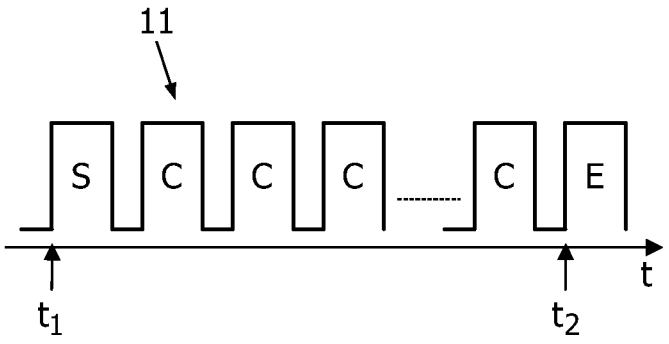

11
S
C
C
C
C
E
t
t1
t2

FIG. 3

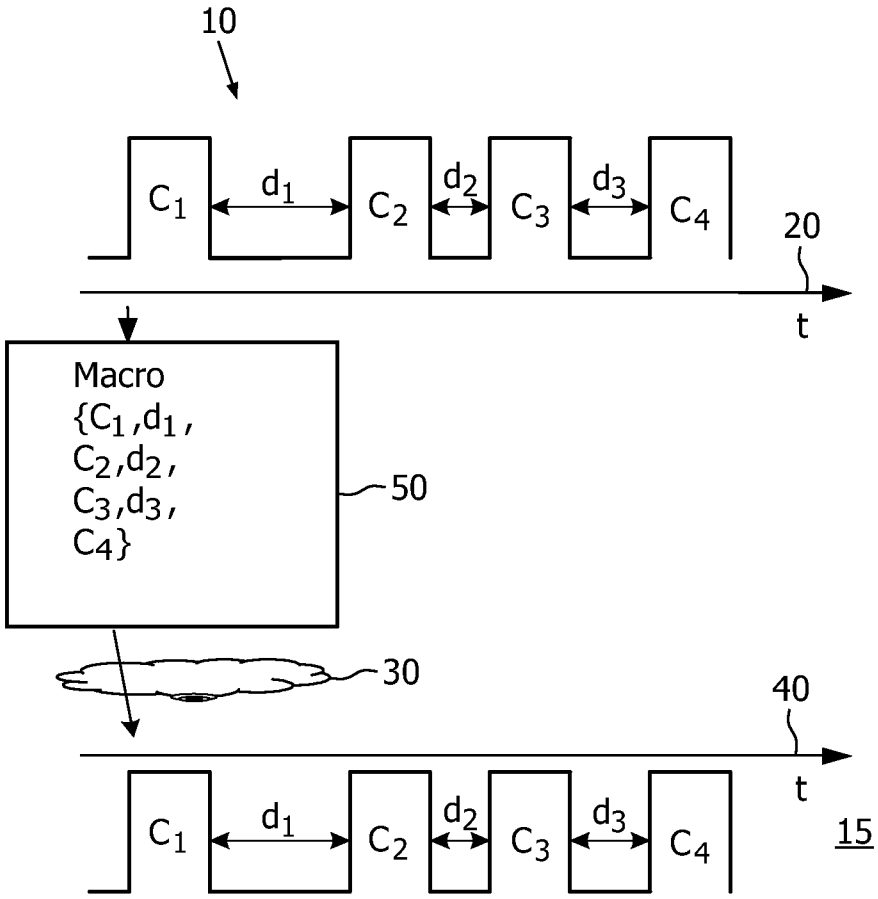

10
C1
d1
C2
d2
C3
d3
C4
20
t
Macro
{C1,d1,
C2,d2,
C3,d3,
C4}
50
30
40
t
C1
d1
C2
d2
C3
d3
C4
15

FIG. 4

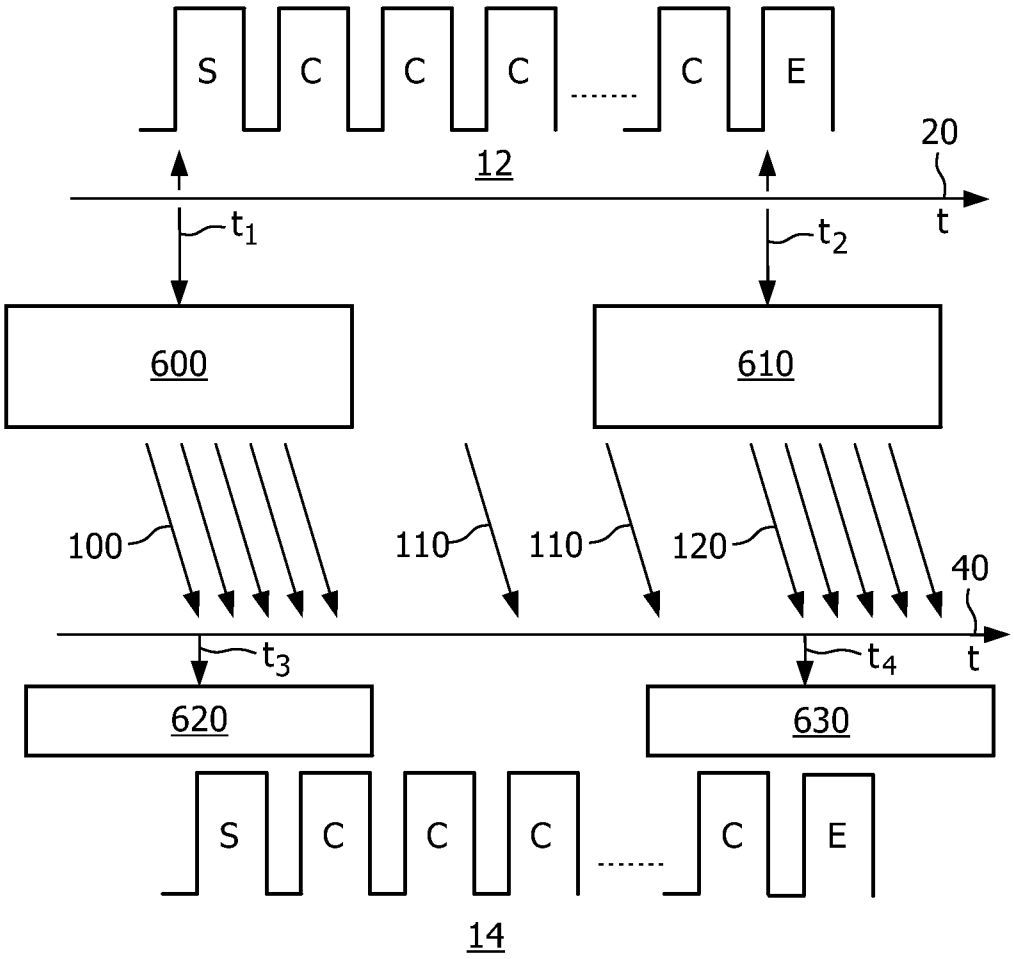



FIG. 5

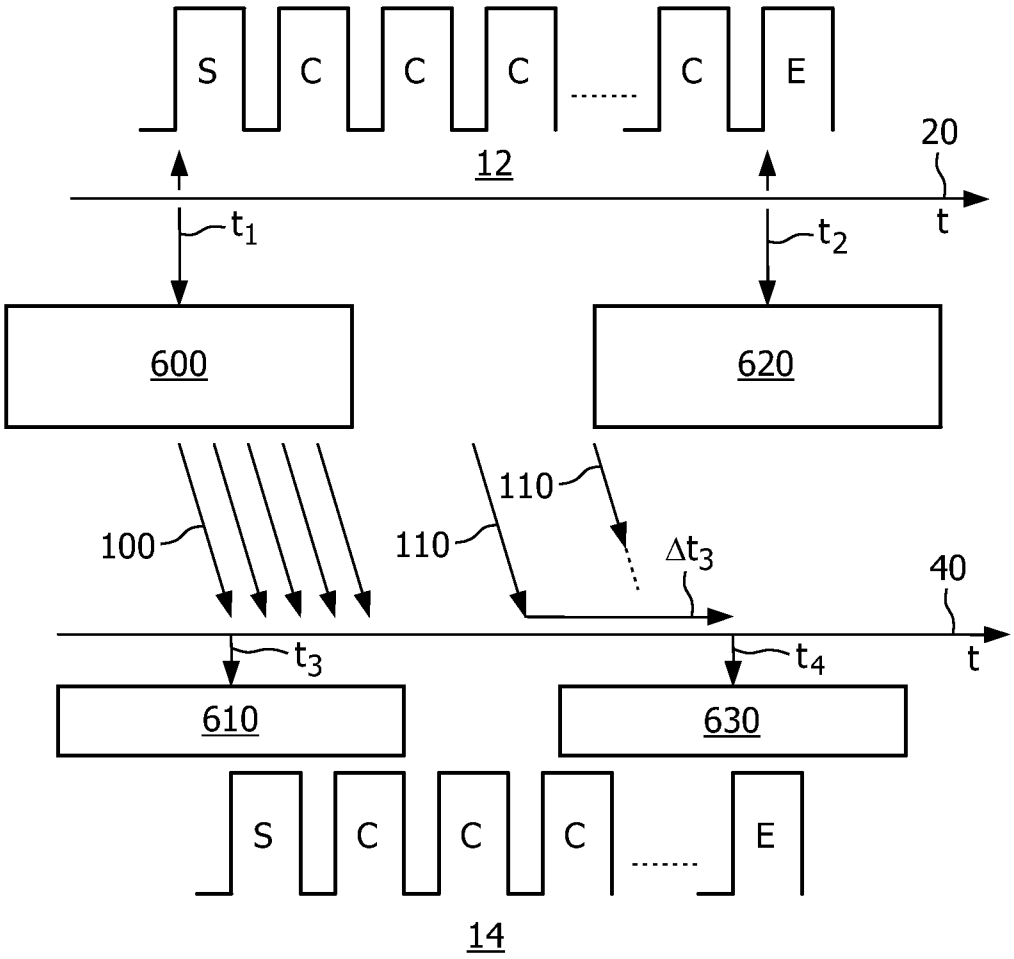

S
C
C
C
C
E
12
20
t
$t_1$
$t_2$
600
620
100
110
110
$\Delta t_3$
40
t
$t_3$
$t_4$
610
630
S
C
C
C
E
14

FIG. 6

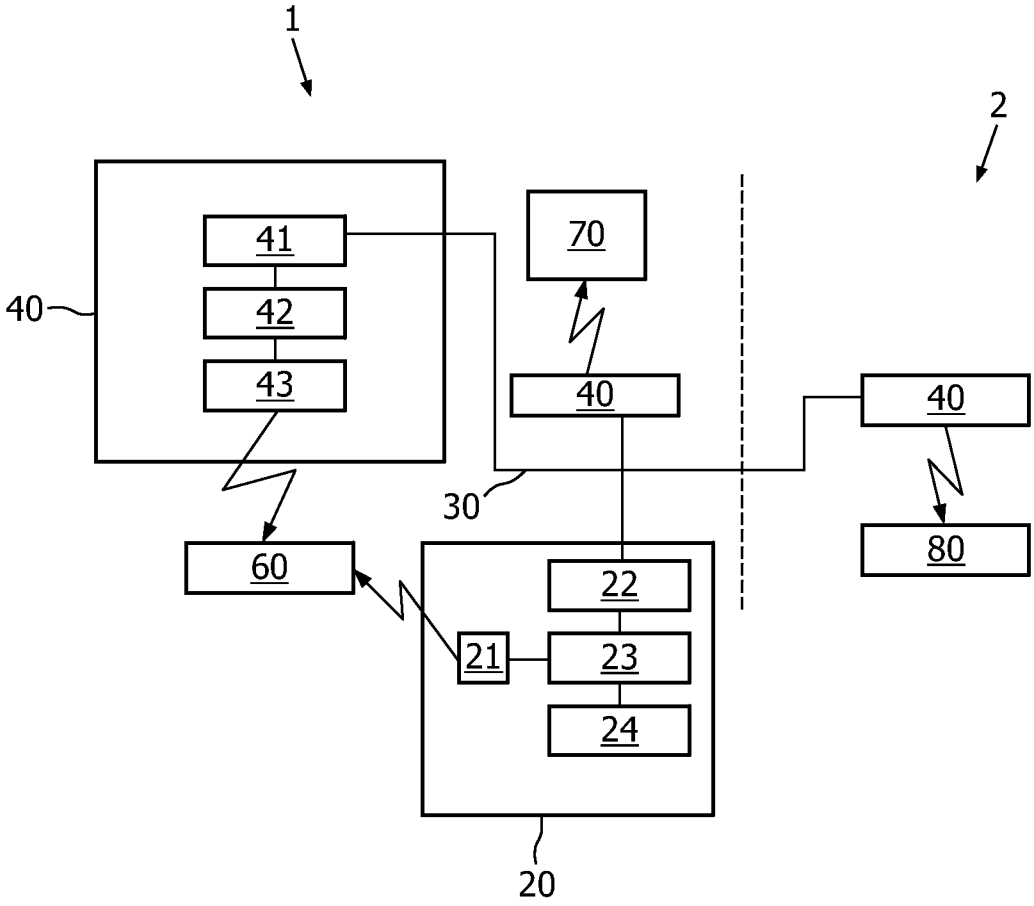



FIG. 7

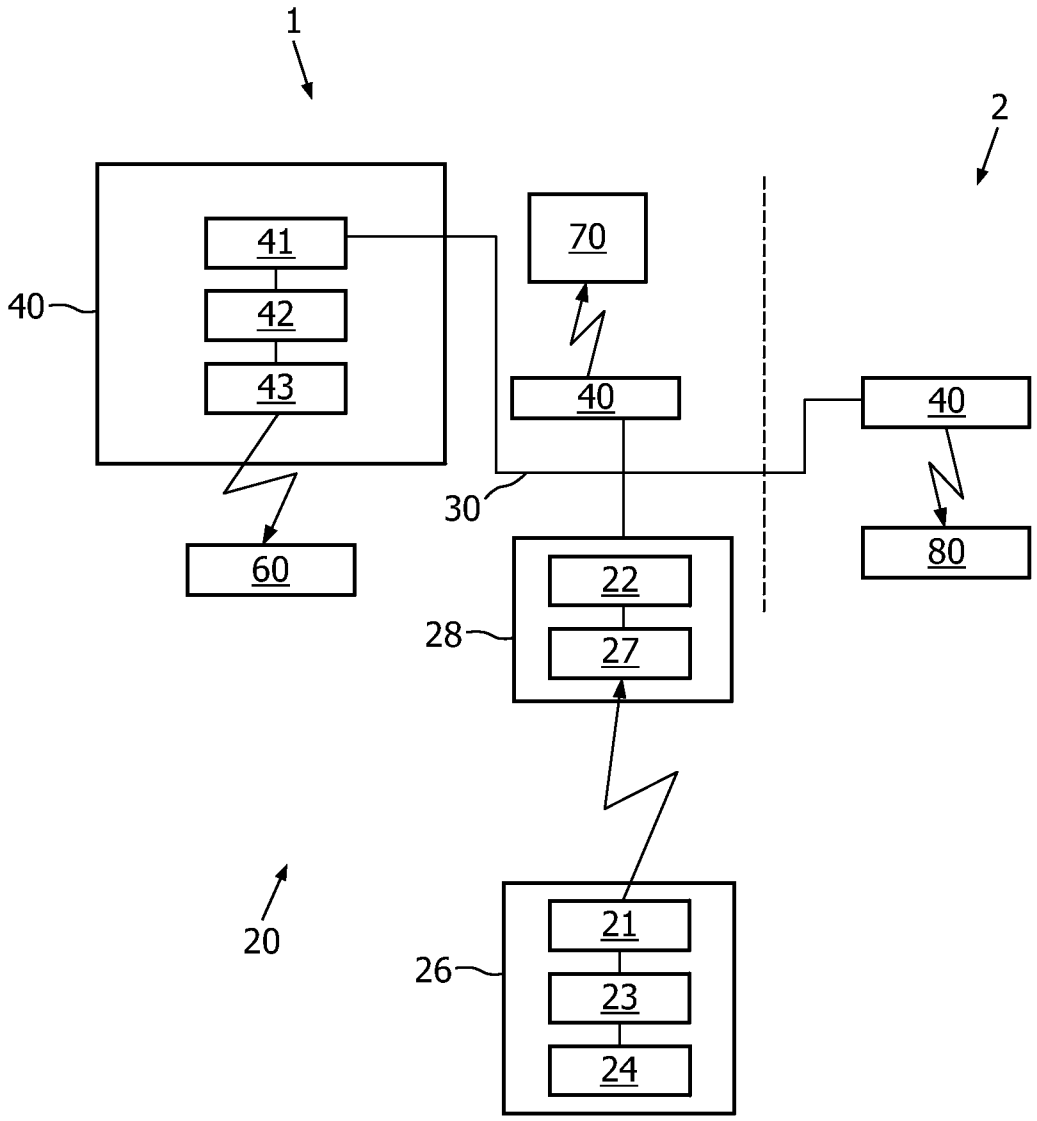



FIG. 8