



- (51) **International Patent Classification:**  
*H04N 21/20* (2011.01) *G06F 15/16* (2006.01)
- (21) **International Application Number:**  
PCT/AU2017/050401
- (22) **International Filing Date:**  
02 May 2017 (02.05.2017)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
2016901610 02 May 2016 (02.05.2016) AU
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(81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

(54) **Title: SYSTEM AND METHOD FOR STREAMING DIGITAL CONTENT**

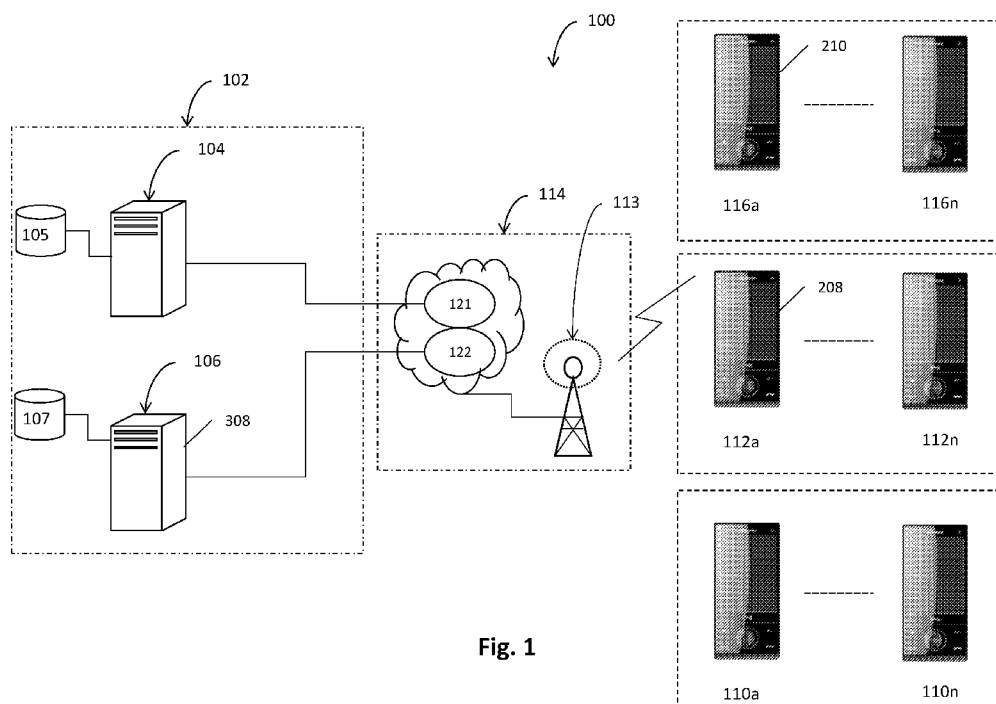


Fig. 1

(57) **Abstract:** A computer implemented method for inserting digital content into a content stream comprises: streaming the content stream to an end user device; receiving digital content recorded by a publisher; storing the digital content in a central data store in association with one or more stream insertion conditions; evaluating one or more insertion parameters associated with the content stream in order to determine whether the one or more conditions for the stored digital content have been met, and responsive to making a positive determination inserting the stored digital content into the content stream at a predefined time.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW,  
KM, ML, MR, NE, SN, TD, TG).

**Published:**

— *with international search report (Art. 21(3))*

## System and Method for Streaming Digital Content

### Technical Field

The present invention relates generally to a system and method for streaming digital content to a user device and more particularly, but by no means exclusively, for inserting audio visual content into a digital content stream.

### Background

Internet or "streaming" radio is becoming increasingly popular. This is largely due to the ubiquity of portable devices on which Internet radio is playable, as well as the greater bandwidths available for streaming such radio.

The vast majority of Internet Radio providers currently implement a streaming methodology known in the industry as "Pure Play". This is where the radio stream is linear; i.e., it has one point of origin casting out the same stream simultaneously to multiple users (i.e. mimicking terrestrial radio).

For example, the new Apple Music application "Beats 1" offers real time Disc Jockey (DJ) performances 24/7. The DJs are programmed live from a professional studio which is connected as a standard traditional "multi-task" solution as a standard linear radio station. All users logged in to stream will listen to the same content at the same time.

The alternative streaming methodology is referred to in the industry as "Semi-interactive Internet Radio". This methodology is not a multi task linear solution, rather the stream is point to point from origin to each individual user. The result is a stream which is unique to each user.

However, both forms of Internet radio streaming fall short of conventional terrestrial style radio in that they both do not cater for immediate streaming of dynamic content to end users.

40

Summary of the Invention

In accordance with a first aspect there is provided a computer implemented method for inserting digital content into a digital content stream, the method comprising:

5 streaming the digital content stream to an end user device; receiving digital content recorded by a publisher; storing the digital content in a central data store in association with one or more stream insertion conditions; evaluating one or more insertion parameters associated with the digital  
10 content stream in order to determine whether the one or more conditions for the stored digital content have been met, and responsive to making a positive determination inserting the stored digital content into the digital content stream.

15 In an embodiment the step of storing the digital content in the data store triggers the insertion parameters to be evaluated.

In an embodiment the insertion parameters are periodically  
20 evaluated.

In an embodiment the method further comprises inserting the stored digital content into the content stream either: (a) immediately, such that the stream is interrupted; or (b)  
25 once a current track has finished playing, depending on whether an immediacy condition has been selected for the stored digital content.

In an embodiment the parameters comprise at least one:  
30 - a location of the end user;  
- a time of day at the location of the end user;  
- an age of the user;  
- a profile of the user;  
- a current or future content parameter of the stream;  
35 - a channel identifier of the stream.

In an embodiment the digital content is recorded using a client side application which is configured to send the digital content over a communications network for storing in  
40 the data store.

In an embodiment the digital content comprises at least one of a video and audio component.

In an embodiment the client side application is configured to set various constraints for the recorded digital content including one or more of the following:

- minimum and/or maximum content length;
- one or more streams that the digital content can be inserted into;
- a content life for the digital content, such that one the content life has expired the digital content is no longer suitable for insertion;
- repeatability and frequency for content insertion.

In an embodiment the method further comprises requiring the publisher to log in to a user account via the client side application in order to record the digital content.

In an embodiment the method further comprises requiring the publisher to log in to a corresponding user account via the client side application in order to record the digital content.

In an embodiment each user account is associated with one or more authorising entities and wherein the authorising entities are able to accept or reject the digital content for storing in the data store.

In an embodiment once the digital content has been recorded the client side application sends an alert to the authorising entities requesting authorisation.

In an embodiment the authorising entities determine the one or more insertion conditions that the digital content is to be stored in association with.

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In accordance with a second aspect there is provided a computer system for inserting digital content into a digital

content stream, the system comprising: a streaming server for streaming the content stream to an end user device; a web server communicable with a client side application of a publisher device for receiving digital content recorded by the publisher, the digital content being communicated over a communications network after the client-side application has established a communication session with the server; a database for storing the digital content in association with one or more stream insertion conditions; a processing arrangement for evaluating one or more insertion parameters associated with the content stream in order to determine whether the one or more conditions for the stored digital content have been met, and responsive to making a positive determination causing the stored digital content to be inserted into the content stream at a predefined time.

In accordance with a third aspect there is provided a computer implemented method for inserting digital content into an audio stream, the method comprising: sending a content request communication to a client- application implemented by a publisher device, the communication requesting a piece of digital content from an operator of the publisher device; receiving digital content recorded by the publisher via the client application; storing the digital content in a central data store in association with one or more stream insertion conditions; evaluating one or more insertion parameters associated with the audio content stream in order to determine whether the one or more conditions for the stored digital content have been met, and responsive to making a positive determination inserting the stored digital content into the audio content stream at a predefined time.

In accordance with a fourth aspect there is provided a computer program including at least one instruction which, when implemented by a processor of a computing system, causes the computing system to implement the method steps in accordance with any one of the preceding claims.

### Brief Description of the Drawings

Features and advantages of the present invention will become apparent from the following description of embodiments thereof, by way of example only, with reference to the accompanying drawings, in which;

Figure 1 is a schematic illustration of a system for carrying out an embodiment of the present invention;

Figure 2 is a schematic of a streaming server, in accordance with an embodiment of the present invention;

Figure 3 is a process flow illustrating steps for recording digital publisher content, in accordance with an embodiment of the invention; and

Figure 4 is a process flow illustrating steps for streaming the digital publisher content, in accordance with an embodiment of the invention.

### Detailed Description of an Embodiment

Embodiments of the present invention relate to computer implemented systems and methods which utilise a broadcast digital content stream for connecting content publishers to individual users. Hereafter the term "content stream" will be understood as referring to any form of digital video and/or audio stream.

More particularly, embodiments allow content publishers to record audio visual content (via a client application resident on an Internet connected computing device, such as a smartphone) that can be inserted into a live content stream being broadcast to an end user device, based on predefined insertion conditions. Thus, embodiments advantageously provide a communication channel for publishers that is both programmatic and immediate (i.e. utilising a broadcast communication medium to facilitate a narrowcast environment). Certain rules and checks may also be implemented to ensure both the publisher and user are protected from inappropriate or irrelevant content.

With reference to Fig. 1, there is shown a schematic of a system 100 for carrying out an embodiment of the present invention.

5 The system 100 comprises a server system 102 operable to communicate with a plurality of network-enabled end user computing devices 110a to 110n for streaming digital content.

10 The server system 102 is also operable to communicate with network-enabled publisher computing devices 112a to 112n for receiving digital publisher content to be inserted into one or more content streams, as will be described in more detail in subsequent paragraphs.

15 According to the illustrated embodiment, both the end user devices 110 and publisher devices 112 take the form of smartphones. It will be appreciated, however, that the devices 110, 112 may take the form of any network connected  
20 client computing device (e.g. laptop, tablet, PDA, etc.) that is suitably configured to communicate with the server system 102 according to techniques described herein.

As shown in Figure 1, the devices 110, 112 are communicable  
25 with the server system 102 over a communications network 114. More particularly, the devices 110, 112 communicate with the server system 102 via a data communications network, which in the illustrated embodiment comprises a combined mobile broadband 121 and IP data  
30 network 122 taking the form of the Internet. Although not illustrated in Figure 1, the broadband network includes standard network elements including a base station controller, home location register, mobile switching centre, message centre, equipment identity register, message  
35 gateway, etc.

In more detail, the server system 102 comprises a streaming server 104 which is operable to simultaneously stream digital content to each of the end user devices 110. The  
40 streams may comprise the same or different types of content (e.g. classified by a channel, such as a jazz channel, rock channel, talk back channel, etc.) and each consist of a



number of pre-programed (i.e. queued) video and/or audio tracks which are stored in a track database 105. The end user devices 110 utilise a resident application to play the content streams, as is well understood in the art.

5

The server system 102 additionally comprises a web server 106. The web server 106 is communicable with a client-side application stored on the publisher devices 112 for receiving digital content recorded by the respective publishers for insertion into one or more of the content streams at a predefined time.

10

The web server 106 is additionally communicable with a database 107 that stores the digital content recorded by the publishers in association with one or more insertion and immediacy conditions.

15

Each publisher is associated with one or more authorising entities 116a to 116n. The authorising entities 116 review the digital content recorded by one or more publishers that they are responsible for prior to the digital content being streamed to the end users 110. This is largely to protect both the publisher's reputation and the end user from receiving inappropriate content.

20

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In a particular embodiment, the authorising entities 116 also determine one or more insertions and immediacy condition(s) to associate with the digital content recorded by their corresponding publisher(s). Again, a client side application 210 (resident on a suitable network-enabled computing device, in the illustrated embodiment taking the form of a smartphone) communicable with the web server 106 is utilised by the authorising entities to carry out the afore-mentioned functions. In an alternative embodiment, the insertion and immediacy condition(s) may be set by the publishers or the entity responsible for providing the streaming service.

30

35

It will be understood that in an alternative embodiment to that shown in Figure 1, the client computing devices 110, 112 and 116 may be communicable directly with the IP data network 122 (i.e. such that the broadband network connection

40

may be omitted), e.g. via a wireless hotspot or a direct wired connection.

5 In more detail, and with additional reference to Figure 2, a publisher device 112 capable of recording digital content in accordance with embodiments described herein comprises standard hardware such as memory, microphone, speaker, display, camera, user interface/input device (e.g. keyboard, keypad, or touch screen) and a network communication means  
10 comprising a cellular antenna for communication over the network 114.

The publisher device 112 further comprises a processor implementing an operating system 204 based on program code  
15 stored in memory 206. The operating system is capable of running the client side software program (hereafter client-side application 208, e.g. downloadable to the smartphone) comprising computer code for controlling the device 112 to record publisher content (which may comprise of audio  
20 content, video content, or a combination of the two) using the device microphone and camera.

In a particular embodiment, the application 208 may control a minimum and/or maximum length of time for the recorded  
25 content. The application may also store certain metadata with the content which is evaluated by the server 106 for setting insertion conditions. The metadata may for example, specify one or more audio or video streams that the digital content should be associated with; a content life for the  
30 digital content (i.e. such that one the content life has expired the digital content is no longer suitable for insertion); a repeatability and frequency for content insertion, etc.

35 An embodiment of a process flow for storing digital content for insertion into an audio stream will now be described with additional reference to the flow diagram of Figure 3. It will be understood that the same general process flow could also apply for digital content insertion into a video  
40 content stream.

At step S1, a publisher opens the client-side application 208 on their device 112 and logs into their user account (using standard log in techniques) and are prompted to record a digital content message. At step S2 the message is then recorded, with the application implementing any relevant control conditions (e.g. setting bounds on the length of the recording, etc. as previously described). The application 208 then saves the recorded message in a desired digital format, including any predefined or publisher defined metadata (e.g. the channel the stored message is to be associated with, a life span for the message, identifiers for the corresponding authorising entities that are linked to the account, etc.).

At step S3 the application determines whether the device 112 is connected to the network 114. If not the application 208 pools the Internet connection until it is available (step S4). Otherwise the digital file is sent to the server 106 and the process continues to step S5.

In a particular embodiment, the client-side application 208 is configured to upload the recorded message to the server system 102 using a "chunking" methodology to allow for real time message insertion (i.e. such that the end user may be presented with the content even as it is still being recorded by the publisher, as described in more detail below). More particularly, this involves uploading a first smaller sized portion of the file and then increasing the size of the portion until a maximum portion size is reached, with each portion being encoded (e.g. wrapped using a DRM protocol using techniques well understood in the art). In a particular embodiment, the client-side application 208 is configured to initially upload a 64k portion and then doubling the size of each subsequent chunk for uploading until a maximum chunk size of 512k is reached, with each chunk being DRM wrapped.

At Step S5 a server side publisher application 308 running on the server 106 saves the file as a new entry (hereafter "post") in the database 107.

At Step S6, the server side application 308 strips any audio included in the post and the resultant video is saved in the database 107.

- 5 At Step S7, server side application 308 optimises the video and saves it as multiple CODECS (i.e. allowing the video to be communicated to a range of different video playback devices).
- 10 At Step S8 the server side application 308 send a push notification to the linked authorising entities (via their respective devices 116) to approve the content. The push notification action causes the application 210 to open and commence playing the recorded message (step S9).
- 15 At Step S10 the entity 116 adds one or more insertion conditions. By way of example, the insertion conditions may specify:
- 20 the type of audio stream that the post is to be inserted into (e.g. based on an channel identifier);  
a song/artist/album that the post is to be played before or after, etc;  
a geographical location that the end user must be in;
- 25 a time of day that the post is to be played at;  
that the post is only to be played to users having a particular profile or attribute (e.g. age, sex, etc.).
- An immediacy condition may also be set by the entity 116 such that the post is immediately inserted into a desired stream (i.e. such that the current track is interrupted). For example, the immediacy condition may be selected where the content of the post has a short life span, or is immediately relevant to the user and/or content they are
- 35 receiving. These are referred to as "break in" posts. The break-in can be tailored per user and hence the broadcast experience of a "News Flash" is available in a narrow cast environment.
- 40 The entity 116 may also enhance the post by added selectable URLs and/or providing other interactive elements within the post. For example, the post may provide fields, user

selectable radio buttons or the like that allow the user to respond to queries otherwise interact with the post. The user responses may be gathered and evaluated for tailoring subsequent content to be sent to that user. Other  
5 interactive elements may allow the user to purchase products, respond to surveys or indeed provide any form of interactivity depending on the desired implementation.

At Step S11 the authorising entity 116 either authorises or  
10 rejects the post. If the post is not authorised, it is removed from the database (step S12). Otherwise, the process proceeds to step S13.

At Step S13, the server side application is instructed to  
15 insert the post when the insertion conditions have been met. In a particular embodiment, the audio level for the post may be set such that it differs to that from the content being previously streamed to the user. For example, the audio level may be increased relative to the previously streamed  
20 content in order to achieve a higher level of awareness. This may be achieved, for example, by way of volume tags that are included in the metadata sent with the post and which are processed by the client side application 208 for setting a relative playback volume.

25 In a particular embodiment, the system 100 utilises a Google cloud messaging function for sending a payload that is evaluated by the client-side application 208 for use in determining whether and when to play the post. The payload  
30 may contain, for example, information that relates to the content of the post, such as type, length, time and geographical boundaries. The end user device then allows play based on these variables. Live content can be tagged to play for users in the next fixed period of time if that  
35 user utilises the application in that time period. In an alternative embodiment, the client-side application 208 may periodically poll the server 104 for determining whether there are any relevant posts to insert (e.g. at the end of the next track).

40 In an alternative embodiment to that described above, an authorising entity 116 may request content from one of their

corresponding publishers. In this scenario, the entity 116 utilised a feature on their client side application 210 to send a push message to the publisher's application 208 with an appropriate message for consideration by the publisher  
5 (e.g. "please record message relevant to your new song/album"). Thereafter, the process proceeds in the same manner as outlined above.

An embodiment of a process flow for inserting digital  
10 content into an audio stream will now be described with additional reference to the flow diagram of Figure 4.

At Step S1, an end user opens a suitable application on their device 110 and starts streaming an audio  
15 stream/channel.

At Step S2, prior to the next audio track being queued for playback, the server side application 308 polls the database for any new posts.  
20

At Step S3, if a new post is available, the application 308 evaluates whether the insertion conditions for that post are satisfied for any one of the streams currently being  
25 streamed by the streaming server 104.

At Step S4, if the conditions are met, the application 308 instructs the streaming server 104 to pause the current audio currently being streamed and insert the post.

At Step S5, a determination is made as to whether the user device 110 is awake and thus capable of presenting video to the corresponding user. If the media player within the application is a "native" application to the OS, then via  
30 utilisation of a HLS protocol the media player will automatically be unable to play the video component and will  
35 play the alternate stream that has been delivered. Where the media player is non "native" to the OS the media player will return an error that defines it as unable to play the content as the device is asleep and the application will  
40 then programmatically attempt to play the alternate content delivered. If the device 110 is not awake, only the audio component of the post is streamed to the user (step S6).

Otherwise, the video and audio components of the post are played (Step S7).

To achieve the afore-described web server functionality, the server system 102 comprises standard server hardware including a motherboard, central processing unit, read only memory (ROM), random access memory (RAM), hard disk and networking hardware. In an embodiment, the server system 102 communicates with the network 114 using gateway techniques well understood by persons skilled in the art.

In addition to the hardware, the web server 104 comprises a PHP processor module for communicating with the client side applications 208, 210, although it will be understood any suitable communication software and hardware may be implemented for facilitating this communication.

In a particular embodiment, the web server 106 is constructed on an open source architecture of Apache web servers (see URL: <http://httpd.apache.org/>) calling a MySQL database through custom built applications built on the Django web application framework (see URL: <https://www.djangoproject.com/>). This same open source architecture is implemented on the streaming server system 104, which also utilises a MySQL database accessed via custom built Django applications.

As discussed in preceding paragraphs, semi-interactive Internet Radio available today is unable to provide dynamic content and immediacy due to its inability to interrupt a unique stream to deliver such content. Rather, all content for semi-interactive radio needs to be pre-recorded and built into the stream in advance to provide a suitable user experience.

Embodiments described herein advantageously combine the functionality of "Pure Play" with the characteristics of live commentary (Dynamic Content and Immediacy) using a new form of semi-interactive Internet Radio. This results in a unique and exciting user experience.

Embodiments advantageously provide a solution that mimics the user experience of terrestrial radio but brings it to a non-professional level enabling the content to be created by a mobile device and near real time played in the point to point stream (e.g. the content will be played next in queue for each user varied by when the individual user logs in to the service and what constitutes their queue).

Further, embodiments described herein provide a novel technological implementation for delivering user generated content in real time to the semi-interactive stream. Aspects of the technology:

1. ensure against the vagaries of wifi / 3G networks;
2. secure the content;
3. assign digital rights management (DRM) to the content; and
4. provide immediacy of availability of the content to the point to point stream.

While the invention has been described with reference to the present embodiment, it will be understood by those skilled in the art that alterations, changes and improvements may be made and equivalents may be substituted for the elements thereof and steps thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt the invention to a particular situation or material to the teachings of the invention without departing from the central scope thereof. Such alterations, changes, modifications and improvements, though not expressly described above, are nevertheless intended and implied to be within the scope and spirit of the invention. Therefore, it is intended that the invention not be limited to the particular embodiment described herein and will include all embodiments falling within the scope of the independent claims.

In the claims which follow and in the preceding description of the invention, except where the context requires otherwise due to express language or necessary implication, the word "comprise" or variations such as "comprises" or "comprising" is used in an inclusive sense, i.e. to specify



the presence of the stated features but not to preclude the presence or addition of further features in various embodiments of the invention.

## CLAIMS

1. A computer implemented method for inserting digital content into a digital content stream, the method  
5 comprising:
  - streaming the digital content stream to an end user device;
  - receiving digital content recorded by a publisher;
  - storing the digital content in a central data store in  
10 association with one or more stream insertion conditions;
  - evaluating one or more insertion parameters associated with the digital content stream in order to determine whether the one or more stream insertion conditions have  
15 been met, and responsive to making a positive determination inserting the stored digital content into the digital content stream.
2. A computer implemented method in accordance with claim 1, wherein the step of storing the digital content in the  
20 data store triggers the insertion parameters to be evaluated.
3. A computer implemented method in accordance with claim 1, wherein the insertion parameters are periodically  
25 evaluated.
4. A computer implemented method in accordance with claim 2 or 3, further comprising storing the digital content in  
association with an immediacy condition, and wherein  
30 provided that the other one or more stream insertion conditions have been met, the stored digital content is immediately inserted into the stream so as to interrupt any content contained therein.
- 35 5. A computer implemented method in accordance with claim 2 or 3, further comprising storing the digital content in association with a non-immediacy condition, and wherein provided that the other one or more stream insertion  
conditions have been met, the stored digital content is  
40 inserted after a currently playing track in the stream has concluded.

6. A computer implemented method in accordance with any one of the preceding claims, wherein the parameters comprise at least one:

- 5 - a location of the end user;
- a time of day at the location of the end user;
- an age of the user;
- a profile of the user;
- a current or future content parameter of the stream;
- 10 - a channel identifier of the stream.

7. A computer implemented method in accordance with any one of the preceding claims, wherein the digital content is recorded using a client side application which is configured  
15 to send the digital content over a communications network for storing in the data store.

8. A computer implemented method in accordance with claim 7, wherein the digital content comprises at least one of a  
20 video and audio component.

9. A computer implemented method in accordance with claim 7 or 8, wherein the client side application is configured to set various constraints for the recorded digital content  
25 including one or more of the following:

- minimum and/or maximum content length;
- one or more streams that the digital content can be inserted into;
- a content life for the digital content, such that  
30 once the content life has expired the digital content is no longer suitable for insertion;
- repeatability and frequency for content insertion.

10. A computer implemented method in accordance with any  
35 one of claims 7 to 9, further comprising requiring the publisher to log in to a corresponding user account via the client side application in order to record the digital content.

40 11. A computer implemented method in accordance with claim 10, wherein each user account is associated with one or more authorising entities and wherein the authorising entities

are able to accept or reject the digital content for storing in the data store.

12. A computer implemented method in accordance with claim 5 11, wherein once the digital content has been recorded the client side application sends an alert to the authorising entities requesting authorisation.

13. A computer implemented method in accordance with claim 10 11 or 12, wherein the authorising entities determine the one or more insertion conditions that the digital content is to be stored in association with.

14. A computer system for inserting digital content into a 15 digital content stream, the system comprising:

a streaming server for streaming the content stream to an end user device;

a web server communicable with a client side application of a publisher device for receiving digital 20 content recorded by the publisher, the digital content being communicated over a communications network after the client-side application has established a communication session with the server;

a database for storing the digital content in 25 association with one or more stream insertion conditions;

a processing arrangement for evaluating one or more insertion parameters associated with the content stream in order to determine whether the one or more conditions for the stored digital content have been met, and responsive to 30 making a positive determination, causing the stored digital content to be inserted into the content stream at a predefined time or stream content state.

15. A computer implemented method for inserting digital 35 content into an audio stream, the method comprising:

sending a content request communication to a client-application implemented by a publisher device, the communication requesting digital content from an operator of the publisher device;

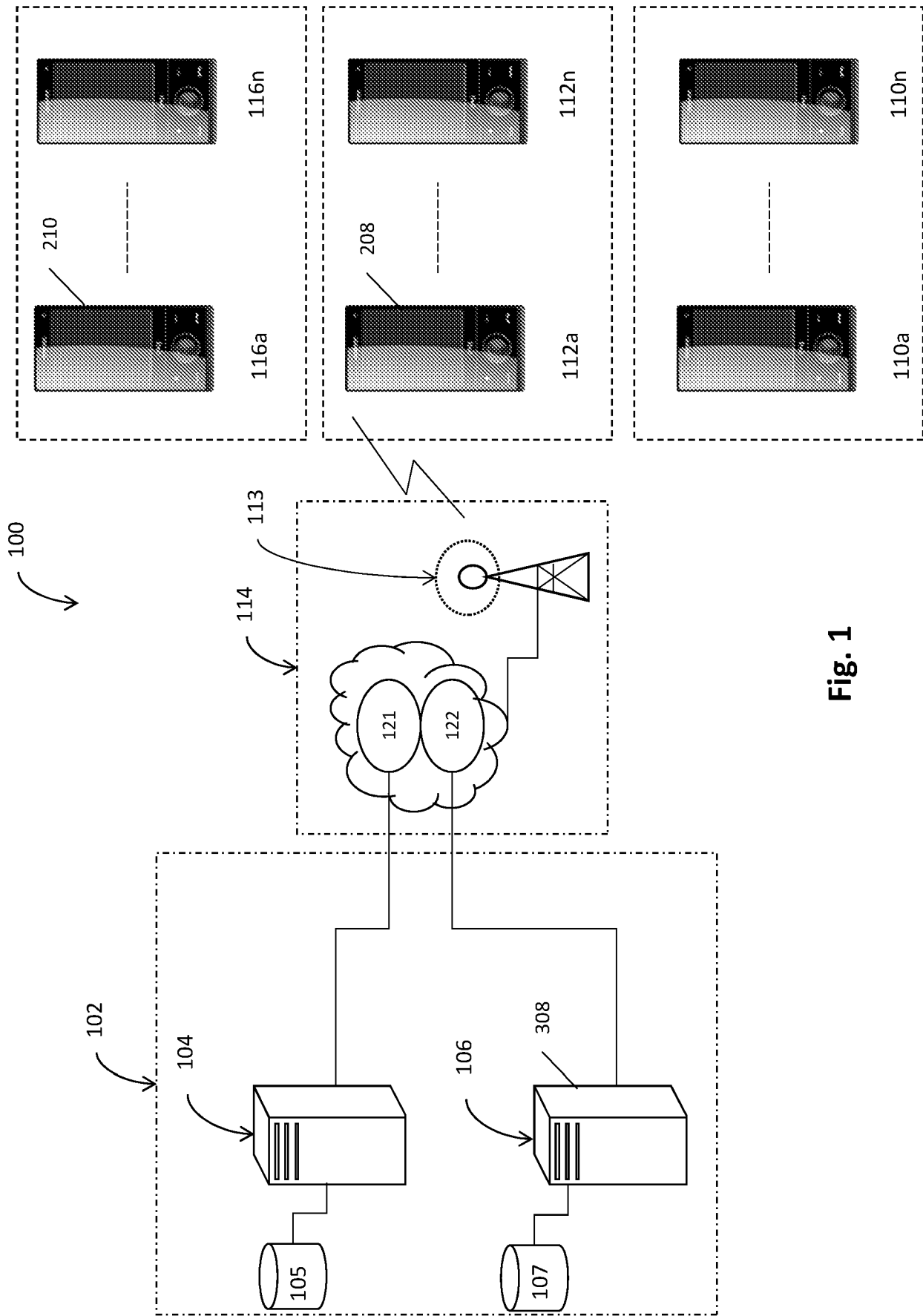
40 receiving digital content recorded by the publisher via the client application;

storing the digital content in a central data store in association with one or more stream insertion conditions;

evaluating one or more insertion parameters associated with the audio content stream in order to determine whether  
5 the one or more conditions for the stored digital content have been met, and responsive to making a positive determination, inserting the stored digital content into the audio content stream at a predefined time.

10 16. A computer program including at least one instruction which, when implemented by a processor of a computing system, causes the computing system to implement the method steps in accordance with any one of preceding claims 1 to 13.

15 17. A computer readable medium providing a computer program in accordance with claim 16.



2/4

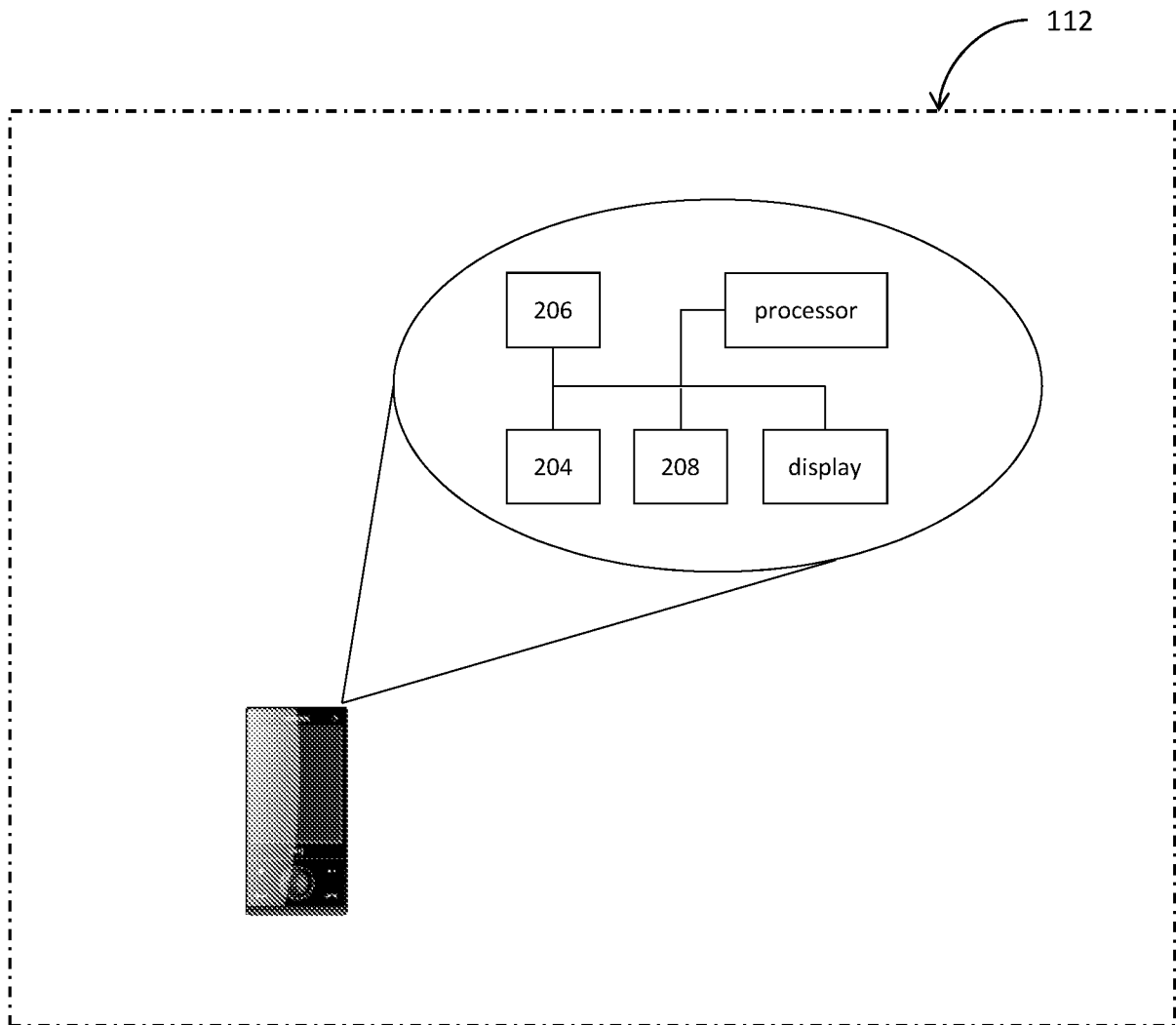


Fig. 2

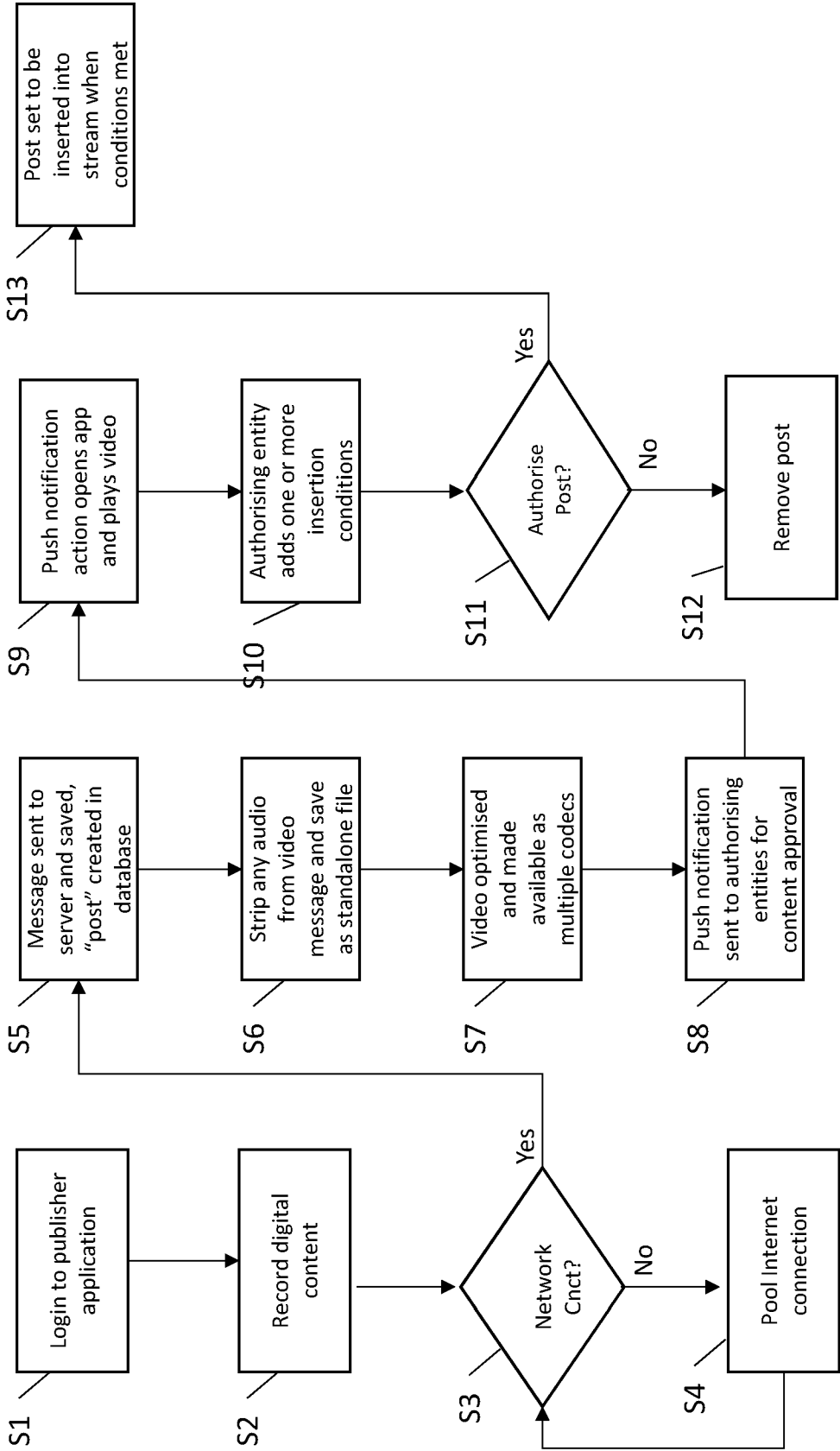


Fig. 3



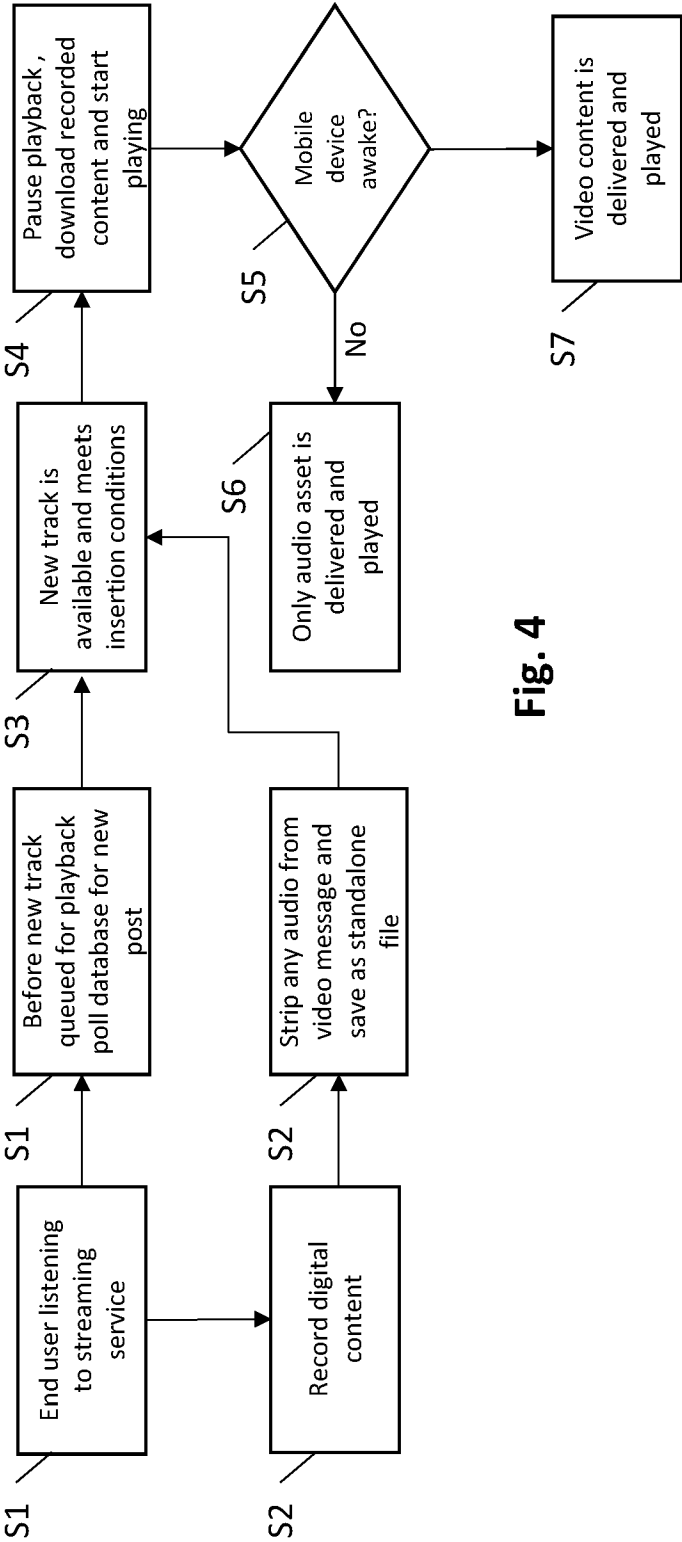


Fig. 4

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/AU2017/050401**

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| <b>A. CLASSIFICATION OF SUBJECT MATTER</b><br><b>H04N 21/20 (2011.01) G06F 15/16 (2006.01)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
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| <b>B. FIELDS SEARCHED</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
| Minimum documentation searched (classification system followed by classification symbols)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
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| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
| Category*                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Relevant to claim No.                                                                                                                         |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Documents are listed in the continuation of Box C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                               |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                               |
| * Special categories of cited documents:<br>"A" document defining the general state of the art which is not considered to be of particular relevance<br><br>"E" earlier application or patent but published on or after the international filing date<br><br>"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)<br>"O" document referring to an oral disclosure, use, exhibition or other means<br>"P" document published prior to the international filing date but later than the priority date claimed | "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention<br>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone<br>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art<br>"&" document member of the same patent family |                                                                                                                                               |
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Form PCT/ISA/210 (fifth sheet) (July 2009)

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