



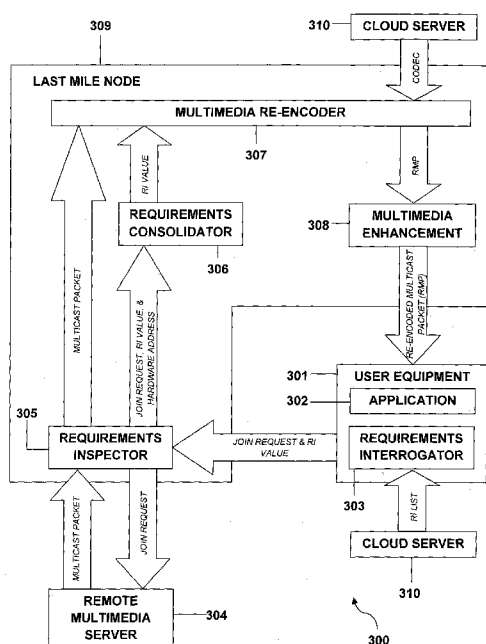
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[Continued on next page]

(54) **Title:** SYSTEM AND METHOD FOR OPTIMIZATION OF A MULTICAST TRANSMISSION HAVING A MULTIMEDIA CONTENT



(57) **Abstract:** The present invention discloses a system (300) for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment (301). The system (300) works by having a requirements interrogator (303) residing in the user equipment (301) to probe at least one component of the user equipment (301) and proceed to define the overall capability of the user equipment (301) based on the results of the probing. The system (300) next introduces a requirements consolidator (306) to determine the appropriate codec to be used for re-encoding the multimedia content based on the overall capability of the user equipment (301). Subsequently, a multimedia re-encoder (307) proceeds to re-encode the multimedia content and transmits the re-encoded multimedia content in a multicast packet to the multimedia enhancement (308) for further transmission to the user equipment (301). A method (400) therefor is also disclosed herein.



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SYSTEM AND METHOD FOR OPTIMIZATION OF A MULTICAST TRANSMISSION HAVING A MULTIMEDIA CONTENT

5 TECHNICAL FIELD OF THE INVENTION

The present invention relates to multicast transmission. More particularly, the present invention relates to optimization of a multicast transmission having a multimedia content.

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BACKGROUND OF THE INVENTION

Multimedia can be defined as a media containing a mixture of content forms such as texts, still images, audios, animations, and videos. It is typically recorded and played, displayed or accessed by computerized or electronic devices.

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With recent marvel advancements in computer networking and communication, it is now possible for users to access and stream multimedia that is situated on remote multimedia servers. Upon receiving join requests from the users who show interest to access and playback the multimedia, the remote multimedia servers are able to immediately transmit the requested multimedia to the users, allowing the users to enjoy the multimedia almost instantly even before the entire multimedia has been completely transferred.

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General speaking, there are four types of communication modes in computer networking, namely, unicast, multicast, broadcast, and anycast. Of the above-mentioned communication modes, unicast and multicast are the most used and appropriate communications modes for streaming multimedia.

25

In brief, unicast transmission, which is also called point-to-point communication, is described as a communication mode that allows data, information and/or messages in a packet form to be delivered from a single source to another specific single destination. Some examples of standard unicast transmission include HTTP, SMTP, TELNET, and SSH in which the request for information is

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directed in between one-to-one nodes. It is one of the most predominant forms of transmission used on local area networks and within the Internet as well as for streaming multimedia.

- 5 In streaming multimedia, unicast-based multimedia server opens and provides copy of the multimedia stream for each unique user. The obvious disadvantage of this type of transmission is that it has a scalability issue when there are too many unique users who request for and wish to stream the same multimedia concurrently. It is therefore very cost consuming to employ unicast transmission
10 for streaming media as every single network connection consumes hefty amount of computing resources on the server and requires its own separate network bandwidth for transmission. This is the case for Internet radio and Internet TV utilizing this particular transmission, where simultaneous delivery of high quality audio and video, respectively, to each of a large number of receivers will exhaust
15 the capability of even a high bandwidth network with a powerful server.

In view of the disadvantages posed by the unicast transmission in streaming multimedia, it seems that multicast transmission is another form of communication mode that is more appropriate for streaming multimedia. This
20 mode of transmission is particular useful and is the preferred way as it is significantly easier to scale when compared to unicast transmission.

Generally in the field of computer networking, multicast transmission is described as a networking technique that permits a plurality of sources to delivers data,
25 information, and/or messages in a packet form to a plurality of specific/selected destinations. Copies of the packet are automatically generated in other elements/hardwares of network, such as routers, but only when the network topology requires it. In other words, only a single copy of the packet is transmitted in the network and duplicated only where paths diverge, and hence
30 resulting in drastic reduction of bandwidth consumption as well as reduction of load on the remote multimedia servers. However, the receivers are only able to receive the packet only if they have previously elected to do so by joining a specific multicast address. The receivers have the choice to join or leave the

specific multicast address, thus the membership of the group is dynamic. Multicast transmission in the inter-networking between a fixed network, like for example the Internet or any other IP-based backbone network, and a mobile network, like for example the General Packet Radio System (GPRS) or Universal Mobile Telecommunication System (UMTS) is currently well developed. However, there are still new challenges to be overcome.

One of the many obvious challenges is the lack or absence of control over the necessary requirements or resources for accessing and streaming a multicast transmission having a rich multimedia content on a user equipment with low capability. Although the multicast transmission manages to ease the burden of the remote multimedia server in addition to saving significant bandwidth consumption, the multicast transmission is actually not tailored and designed in mind to benefit the user equipments. Figure 1 depicts a general network architecture for streaming multimedia via multicast transmission from a remote multimedia server (101) to multiple user equipments (104) (105) (106), and is now being referred. User equipment (104) may represent a high-end personal computer, whereas user equipment (105), and user equipment (106) may represent a high-end smart phone. All the three user equipments (104) (105) (106) have concurrently requested for a multicast packet containing a multimedia content. A remote multimedia server (101) responds to each request by delivering one copy of the requested multicast packet to an intermediate node (102) and subsequently to a last mile node (103). The packet is then being duplicated at the last mile node (103) and transmitted to the user equipments (104) (105) (106) using a bandwidth of 10 Mbps for each transmission. As it can be seen here, there is a lack of a means to optimize the multicast transmission, resulting in high consumption of bandwidth and the user equipments (104) (105) (106), in particular user equipments (105) and user equipment (106), to be overwhelmed with the unnecessary huge multicast transmission. Clearly, the capability of each user equipment (104) (105) (106) is very much different and has not been taken into account during the multicast transmission.

In light of the above, it therefore has become the aim of the present invention to overcome the above-identified technical issue by providing a novel and inventive system and method for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment.

SUMMARY OF THE INVENTION

The present invention is directed to a system for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment.

In one of the embodiments of the present invention, the system comprises an application residing in the user equipment that allows a user to subscribe the user equipment to a multicast address by sending a join request; a requirements interrogator residing in the user equipment that probes at least one component of the user equipment in order to define the overall capability of the user equipment; a requirements inspector that receives the incoming request, the define overall capability and a multicast packet having a multimedia content requested by the user from a remote multimedia server, and identifies the hardware address of the user equipment; a requirements consolidators that determines and selects an appropriate codec to be used for re-encoding the multimedia content based on the defined overall capability of the user equipment, associate the defined overall capability with the join request and the hardware address; a multimedia re-encoder that extracts the multimedia content from its multicast packet, proceeds to re-encode the multimedia content with the determined and selected appropriate codec, and subsequently reintegrates the re-encoded multimedia packet into the multicast packet; and a multimedia enhancement that transmits the multicast packet having the re-encoded multimedia content to the user equipment.

The present invention is further directed to a method for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment.

- 5 In an embodiment of the present invention, the method comprises the steps of sending a join request to subscribe the user equipment to a multicast address; probing at least one component of the user equipment, and defining the overall capability of the user equipment based on the result of the probing; identifying the hardware address of the user equipment that sends the join request;
- 10 associating the defined overall capability with the join request and the hardware address; determining and selecting an appropriate codec for re-encoding the multimedia content based on the defined overall capability of the user equipment; receiving a multicast packet having the multimedia content from a remote multimedia server; extracting and re-encoding the multimedia content with the
- 15 determined and selected appropriate codec; reintegrating the re-encoded multimedia content into the multicast packet; and transmitting the multicast packet to the user equipment.

20 BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a general network architecture for streaming multimedia via multicast transmission from a remote multimedia server to multiple user equipments;

- 25 Figure 2 illustrates a general network architecture for streaming multimedia via multicast transmission from a remote multimedia server to multiple user equipments, wherein the multimedia has been optimized accordingly to suit the capability of each user equipment;

- 30 Figure 3 illustrates the system in accordance with the present invention for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content with an appropriate codec according to and to match the capability of a user equipment; and

Figure 4 illustrates the method in accordance with the present invention for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content with an appropriate codec according to and to match the capability of a user equipment.

DETAILED DESCRIPTION OF THE INVENTION

The above mentioned and other features and objects of this invention will become more apparent and better understood by reference to the following detailed description. It should be understood that the detailed description made known below is not intended to be exhaustive or limit the invention to the precise form disclosed as the invention may assume various alternative forms. On the contrary, the detailed description covers all the relevant modifications and alterations made to the present invention, unless the claims expressly state otherwise.

The first aspect of the present invention relates to a system that enables optimization of a multicast transmission having a multimedia content with an appropriate codec according to and to match the capability of a user equipment.

Figure 2, which depicts a general network architecture for streaming multimedia via multicast transmission from a remote multimedia server (201) to multiple user equipments (204) (205) (206), wherein the multicast transmission having the multimedia content has been optimized accordingly to suit the capability of each user equipment (204) (205) (206), is now being referred. User equipment (204) may represent a high-end personal computer, whereas user equipment (205), and user equipment (206) may represent a high-end smart phone. In fact, the user equipments (204) (205) (206) can be represented with any device that has low capability such as notebook, netbook, mobile tablet, personal digital assistant, low-end smart phone, e-reader, etc. All the three user equipments (204) (205) (206) have concurrently requested to join a multicast address to stream the multimedia. The remote multimedia server (201) responds to each

request by delivering one copy of the multimedia content in a multicast packet to an intermediate node (202) and subsequently to a last mile node (203). At this point, the multicast transmission is optimized in order not to overwhelm the low capability user equipment with unnecessary burden such as large multimedia content, high quality multimedia content, etc. The optimization allows the multimedia content to be reduced in accordance with and in order to suit the capability of the user equipments (204) (205) (206). This is made possible by probing and determining the capability of each user equipment (204) (205) (206) and to re-encode the multimedia content with an appropriate codec that matches the capability of each user equipment (204) (205) (206). Specifically, the multimedia content is re-encoded with two separate appropriate codecs, wherein the first codec manages to reduce the size of the multimedia content that uses only 5 Mbps bandwidth, and the second codec manages to reduce the size of the multimedia content that uses only 1 Mbps bandwidth. The multicast packet having the multimedia content re-encoded with the first codec is immediately transmitted to the user equipment (204). As the user equipment (205) and user equipment (206) have similar capability, the multicast packet having the multimedia content re-encoded with the second codec is duplicated to produce two copies, wherein the user equipment (205) and user equipment (206) will each receive a copy of the duplicated multicast packet. As it can be seen here, the system and method in accordance with the present invention make it possible to significantly reduce bandwidth consumption, and also not to burden the user equipments (204) (205) (206), in particular user equipments (205) and user equipment (206), with the unnecessary huge multicast transmission.

The present system (300) can be understood in even more details with reference to Figure 3. Generally, the system involves at least one user equipment (301), at least one last mile node (309), at least one cloud server (310) and at least one remote multimedia server (304). Within the user equipment (301), the system (300) introduces at least one application (302), and at least one requirements interrogator (303), whereas within the last mile node (309), the system (300) introduces at least one requirements inspector (305), at least one requirements

consolidator (306), at least one multimedia re-encoder (307), and at least one multimedia enhancement (308).

5 The application (302) residing in the user equipment (301) in this instance for example is a multimedia multicast client application (302). It allows a user, who is interested to listen to and stream a particular multimedia, to subscribe the user equipment (301) to a particular multicast address that streams the multimedia by sending a join request. Consequently, the join request is being sent to the network and received at the last mile node (309), more particularly, by the requirements inspector (305).
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Being aware of the outgoing transmission of the join request, the requirements interrogator (303) commences to probe at least one component of the user equipment (301) to obtain a capability parameter that relates to the probed component. In more details, the capability parameter is a value that represents the capability feature or current condition of the component of the user equipment (301). The component in this case may include but not limited to screen resolution, pixel density, connectivity type components, link speed, audio processor, video processor, computing processor, or the like. For detailed example, the screen resolution and pixel density can be probed to obtain a capability parameter that can be used to indicate the capability of the user equipment (301) in displaying at certain resolution quality (e.g. 960-by-640 pixel resolution at 326 ppi). In another detailed example, the link speed can be probed to obtain a capability parameter that can be used to indicate the connection speed of the user equipment (301) (e.g. 120 Mbps, 54 Mbps, 22 Mbps, etc).
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Once the capability parameter of the probed component has been obtained, the requirements interrogator (303) proceeds to map the capability parameter with a local reference list to obtain a correct reference index (RI) value that represents the overall capability of the user equipment (301). The local reference list is a list having readily mapped information of relationship between capability parameters and reference index (RI) values. Consequently, the correct RI value is being sent
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to the network and received at the last mile node (309), more particularly, by the requirements inspector (305).

It is essential to maintain the same version of reference list throughout the network. Therefore prior to the mapping, the requirements interrogator (303) will
5 check the version of the local reference list, ensuring that the local reference list is the most updated one and having the same version with the reference list existing on the network and maintained by the cloud server (310). The requirements interrogator (303) does so by sending a query containing the
10 version of the local reference list to the cloud server (310), which in turn replies to the requirements interrogator (303) with the version of the reference list existing on the network. If, upon comparison, the requirements interrogator (303) finds that the version of the local reference list is not the latest, it (303) will proceed to request and download the latest version of reference list existing on
15 the network from the cloud server (310).

At the last mile node (309), the requirements inspector (305) forwards the join request to the remote multimedia server (304), which in turn responds to the join request by transmitting one copy of the requested multimedia content in a
20 multicast packet to the requirements inspector (305). Upon receiving the multicast packet, the requirements inspector (305) sends the multicast packet to the multimedia re-encoder (307) for re-encoding.

Further, upon receipt of the join request and the correct RI value from the
25 requirements interrogator (303), the requirements inspector (305) proceeds to identify the hardware address of the user equipment (310). As the requirements inspector (305) has to receive a lot of data and/or information such as the join request, the correct RI value, the hardware address and the multicast packet, it also has the ability to filter and sort all the received data and/or information.

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Subsequently, the requirements inspector (305) transmits the join request, the correct RI value, and the hardware address to the requirements consolidator (306). The requirements consolidator (306) has two main responsibilities. The

- first one is to create a table entry associating the correct RI value with its respective join request and hardware address. The second one is to determine an appropriate codec for re-encoding the requested multimedia content within the multicast packet premised upon the correct RI value. Once the appropriate
- 5 codec is determined, the requirements consolidator (306) then checks for the local availability of the appropriate codec. If, upon checking, the appropriate codec is not available locally, the requirements consolidator (306) sends a request to download the appropriate codec from the cloud server (310).
- 10 After the determination of the appropriate codec, the multimedia re-encoder (307) extracts the multimedia content from the received multicast packet and proceeds to re-encode the extracted multimedia content with the appropriate codec. Once the re-encoding task is completed, the multimedia re-encoder (307) re-integrates the re-encoded multimedia content into the multicast packet, and transmits the
- 15 same to the multimedia enhancement (308) for further transmission to the user equipment (301). If necessary and depending on the number of join requests, which may be received from a plurality of user equipments, the multimedia re-encoder (307) will do the necessary duplication on the multicast packet having the re-encoded multimedia content before transmitting the same to the
- 20 multimedia enhancement (308) for further transmission to the plurality of user equipments. The duplication is done premised upon the table which associates the correct RI value to its respective join request and hardware address.

25 The multimedia enhancement (308) is able to correctly transmit the multicast packet having the re-encoded multimedia content to the user equipment by referring to the table which associates the correct RI value to its respective join request and hardware address.

30 Periodically, the requirements interrogator (303) monitors for ongoing interest of the user equipment (301) in listening to and streaming the multimedia. If the requirements interrogator (303) finds that there is no listener/subscriber (e.g. no join request being sent out) in its network, it (303) will unsubscribe the user equipment (301) from the multicast address. When the requirements

consolidator (306) detects that the subscription has been cancelled, it (306) will eliminate the relevant correct RI value from the table together with its respective join request and hardware address.

- 5 The second aspect of the present invention relates to a method (400) that enable optimization of a multicast transmission having a multimedia content with an appropriate codec according to and to match the capability of a user equipment.

We refer now to Figure 4. The method (400) comprises a first step of sending a
10 join request (401) to subscribe the user equipment to a particular multicast address that provides the multimedia content in a form of multicast packet.

Upon detection of the transmission of the join request (401), at least one component of the user equipment is being probed (402). This step (402) allows
15 the probed component to be rated with a value identified as capability parameter that represents the capability feature or current condition of the probed component of the user equipment. The component in this case may include but not limited to screen resolution, pixel density, connectivity type components, link speed, audio processor, video processor, computing processor, or the like. For
20 detailed example, the screen resolution and pixel density can be probed to obtain a capability parameter that can be used to indicate the capability of the user equipment in displaying at certain resolution quality (e.g. 960-by-640 pixel resolution at 326 ppi). In another detailed example, the link speed can be probed to obtain a capability parameter that can be used to indicate the connection
25 speed of the user equipment (e.g. 120 Mbps, 54 Mbps, 22 Mbps, etc).

Subsequently, the obtained capability parameter is mapped to a local reference list to obtain a correct RI value (404) that defines the overall capability of the user equipment. In more details, the local reference list is a list having readily
30 mapped information of relationship between capability parameters and RI values.

Prior to obtaining the correct RI value for this particular user equipment, the method (400) also comprises the step of checking the version of the local

reference list (403) to ensure that the local reference list is the most updated one and having the same version with the reference list existing on the network. In this case, a query containing the version of the local reference list is compared with the version of the reference list existing on the network. If, upon comparison,
5 the version of the local reference list is not the latest, a request will be sent to the network to download the latest reference list existing on the network.

The next step would be the identification of the hardware address of the user equipment (405), and to associate the correct RI value with its respective join
10 request and hardware address (406). The association obtained from step (406) is presented in a table form.

Consequently, the correct RI value is utilized to select and determine the appropriate codec for re-encoding the requested multimedia content within the
15 multicast packet (407).

Once the appropriate codec is determined, the local availability of the appropriate codec is checked (408). If, upon checking, the appropriate codec is not available locally, a request will be sent to the network to download the
20 appropriate codec from the network.

Just like any other standard multicast transmission procedure, the join request is being sent to a remote multimedia server specified by the multicast address. A waiting state for the arrival of the multicast packet having the multimedia content
25 from the remote multimedia server ensues. Once the multicast packet arrives (409), the multimedia content is extracted from the multicast packet and re-encoded with the appropriate codec (410).

Once the re-encoding task is completed, the re-encoded multimedia content is
30 re-integrated into the multicast packet, and transmits to the user equipment (412). If necessary and depending on the number of join requests, which may be received from a plurality of user equipments, the multicast packet having the re-encoded multimedia content will be duplicated before further transmission to the

plurality of user equipments (411). The duplication is done premised upon the table which associates the correct RI value to its respective join request and hardware address.

- 5 Upon detection of no further join request being sent out, such in the case the user does not wish to continue to listen to and stream the multimedia, the user equipment will be unsubscribed from the multicast address. This, in turn, leads to the elimination of the relevant correct RI value from the table together with its respective join request and hardware address.

CLAIMS

- 1) A system (300) for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment (301) comprises:
- a) an application (302) residing in the user equipment (301) that allows a user to subscribe the user equipment (301) to a remote multimedia server (304) specified by a multicast address by sending a join request;
 - b) a requirements interrogator (302) residing in the user equipment (301) that probes at least one component of the user equipment (301) to obtain a capability parameter that relates to the probed component, and mapping the obtained capability parameter to a local reference list having readily mapped information of relationship between capability parameters and reference index (RI) values to obtain a correct RI value that defines the overall capability of the user equipment (301);
 - c) a requirements inspector (305) that receives and filters the join request and the correct RI value, identifies the hardware address of the user equipment (301), transmits the join request to the remote multimedia server (304), and receives the multimedia content in a multicast packet from the remote multimedia server (304);
 - d) a requirements consolidator (306) that associates the correct RI value with its respective join request and hardware address and present this particular information in a table form, determines an appropriate codec for re-encoding the multimedia content based on the correct RI value, and verifies the local availability of the appropriate codec;
 - e) a multimedia re-encoder (307) that receives the multicast packet from the requirements inspector (305), extracts the multimedia content from the multicast packet, re-encodes the multimedia content using the appropriate codec determined by the

requirements consolidator (306), and re-integrates the re-encoded multimedia content into the multicast packet; and

- f) a multimedia enhancement (308) that transmits the multicast packet having the re-encoded multimedia content to the user equipment (301).

- 2) A system (300) in accordance with claim 1, wherein the requirements interrogator (303) starts to probe the component upon detecting the join request being sent out.

- 3) A system (300) in accordance with claim 1, wherein the requirements interrogator (303) unsubscribes the user equipment (301) from the remote multimedia server (304) specified by the multicast address upon detecting no join request being sent out.

- 4) A system (300) in accordance with claim 1, wherein the requirements interrogator (303) sends a request to a cloud server (310) to download the latest reference list when the local reference list is not up to date.

- 5) A system (300) in accordance with claim 1, wherein the component includes but not limited to screen resolution, pixel density, connectivity type components, link speed, audio processor, video processor, computing processor, and the like.

- 6) A system (300) in accordance with claim 1, wherein the requirements consolidator (306) eliminates the correct RI value together with its respective join request and hardware address from the table upon detecting no subscription to the remote multimedia server (304) specified by the multicast address.

- 7) A system (300) in accordance with claim 1, wherein the requirement consolidator (306) sends a request to a cloud server (310) to download

the appropriate codec when the appropriate codec according to the correct RI value is not available locally.

5 8) A system (300) in accordance with claim 1, wherein the multimedia re-encoder (307) duplicates the multicast packet having the re-encoded multimedia content according to the table which associates the correct RI value to its respective join request and hardware address.

10 9) A method (400) for optimizing a multicast transmission having a multimedia content by re-encoding the multimedia content according to and to match the capability of a user equipment comprises the steps of:

- 15 a) sending a join request to subscribe the user equipment to a remote multimedia server specified by a multicast address (401);
- b) probing at least one component of the user equipment to obtain a capability parameter that relates to the component, wherein the component includes but not limited to screen resolution, pixel density, connectivity type components, link speed, audio processor, video processor, computing processor, and the like (402);
- 20 c) checking the version of a local reference list having readily mapped information of relationship between capability parameters and reference index (RI) values and proceed to download the latest reference list from the network when said local reference list is not up to date (403);
- 25 d) mapping the obtained capability parameter to the local reference list or the latest reference list from the network to obtain a correct RI value that defines the overall capability of the user equipment (404);
- e) identifying the hardware address of the user equipment (405);
- 30 f) associating the correct RI value with its respective join request and hardware address and presenting this particular information in a table form (406);
- g) determining an appropriate codec for re-encoding the multimedia content based on the correct RI value (407);

- h) verifying the local availability of the appropriate codec and proceed to download the appropriate codec from the network when the appropriate codec according to the correct RI value is not available locally (408);
 - 5 i) receiving the multimedia content in a multicast packet (409);
 - j) re-encoding the multimedia content using the appropriate codec (410)
 - k) duplicating the multicast packet having the re-encoded multimedia content according to the table which associates the correct RI value with its respective join request and hardware address (411);
 - 10 and
 - l) transmitting the multicast packet having the re-encoded multimedia content to the user equipment (412).
- 15 10) A method (400) in accordance with claim 9 further comprises the step of unsubscribing the user equipment from the remote multimedia server specified by the multicast address upon detecting no join request being sent out, and eliminating the correct RI value together with its respective join request and hardware address from the table upon detecting no
- 20 subscription to the remote multimedia server specified by the multicast address.

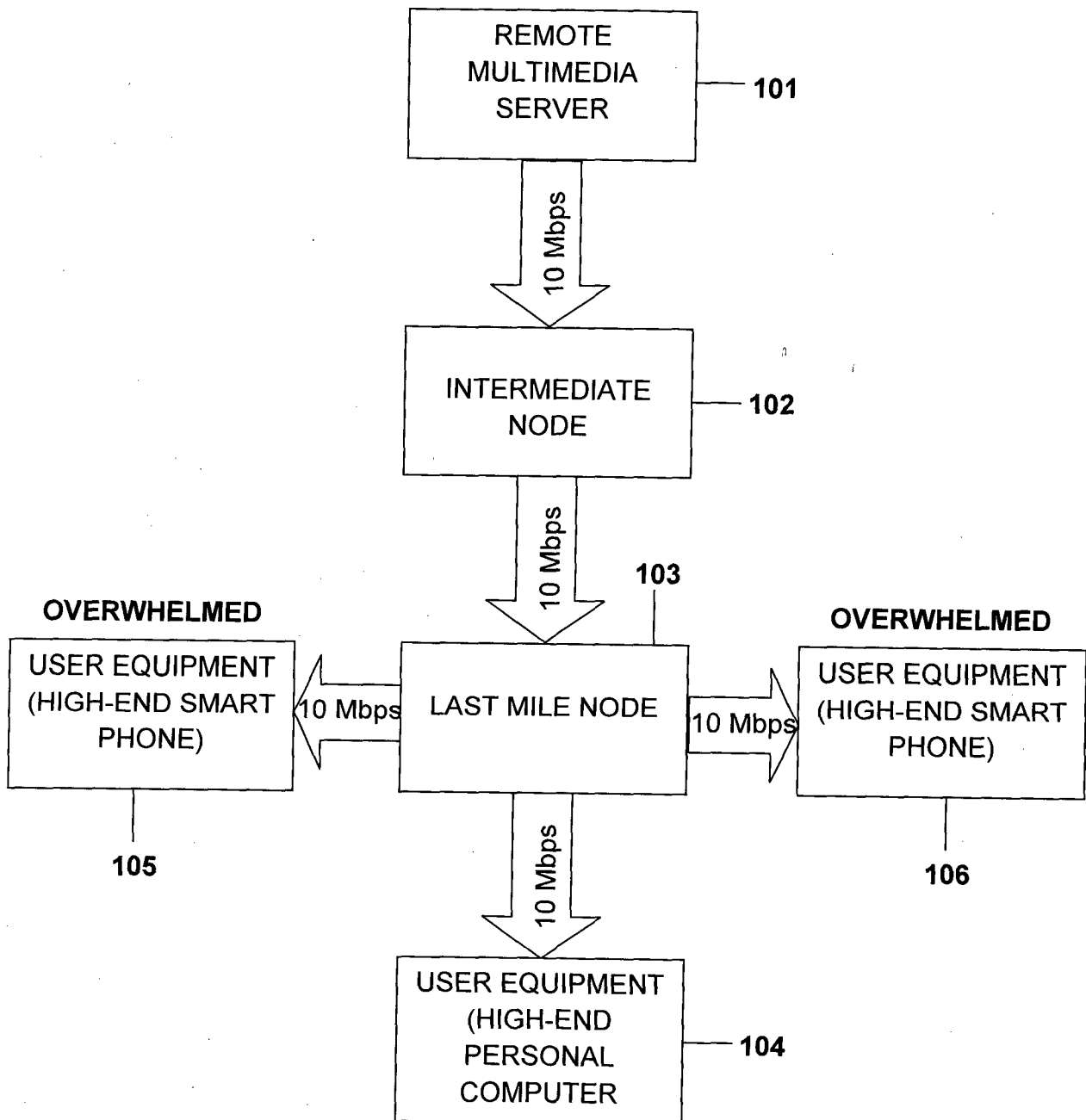


FIGURE 1

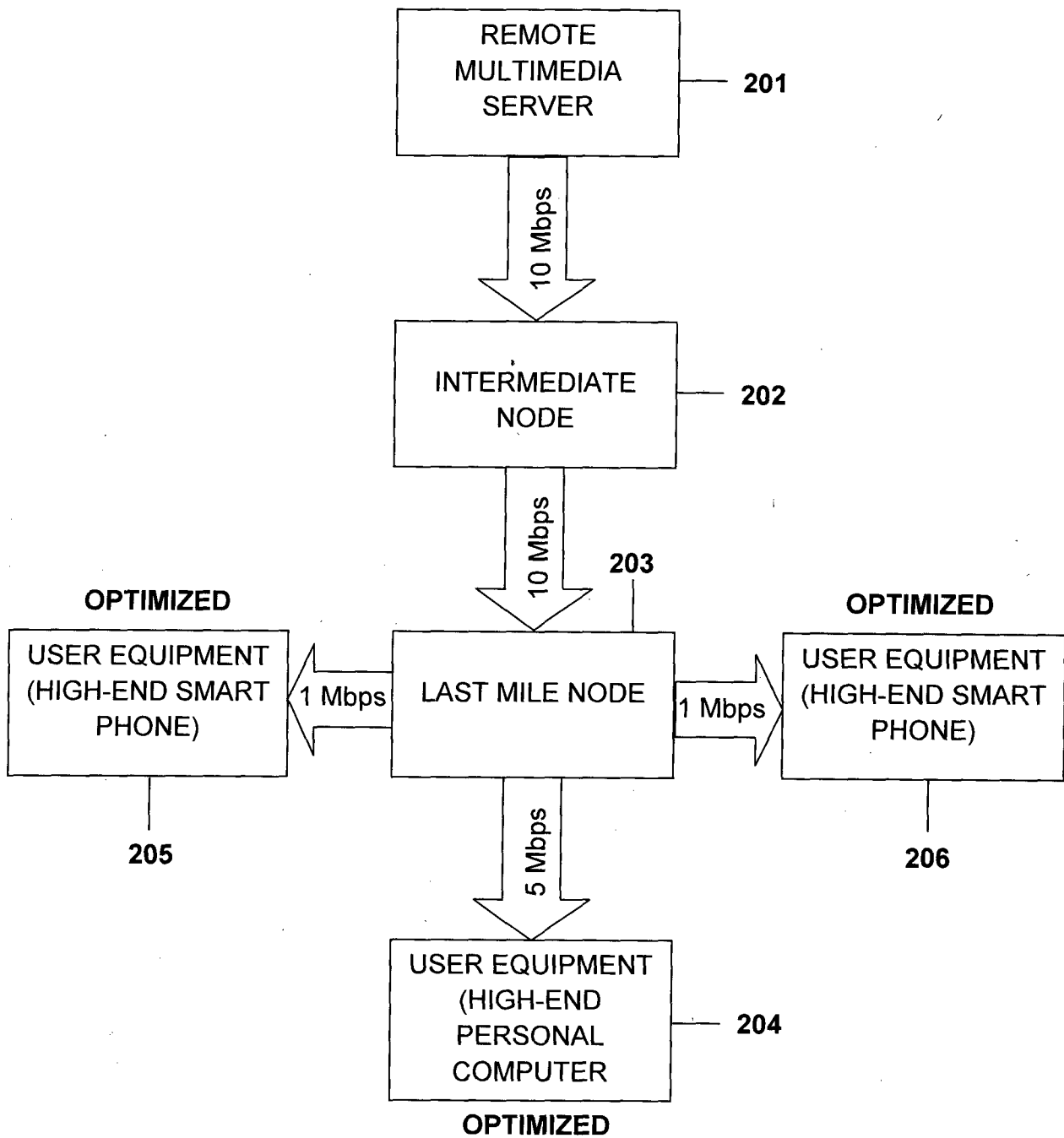


FIGURE 2

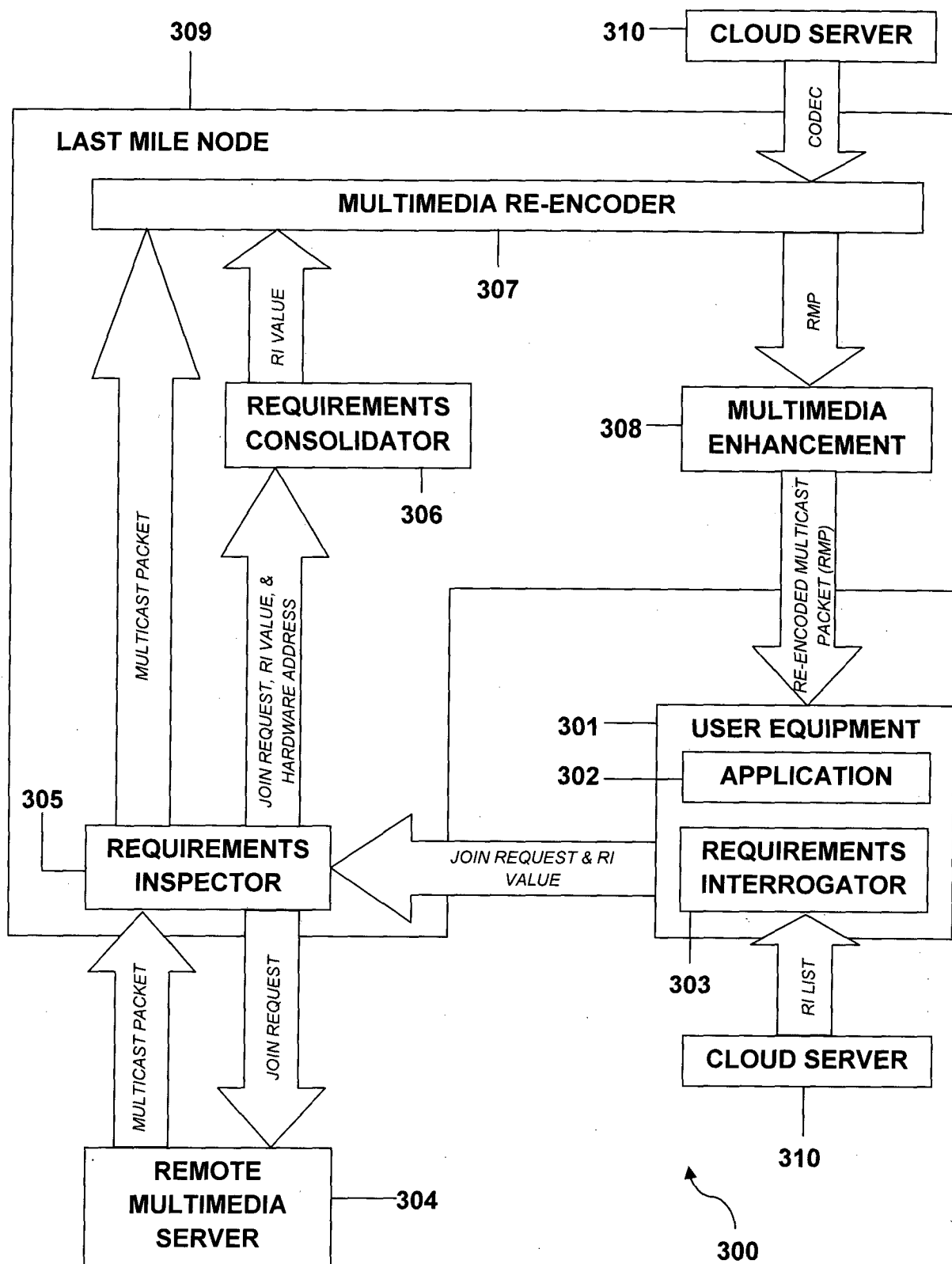


FIGURE 3

4/4

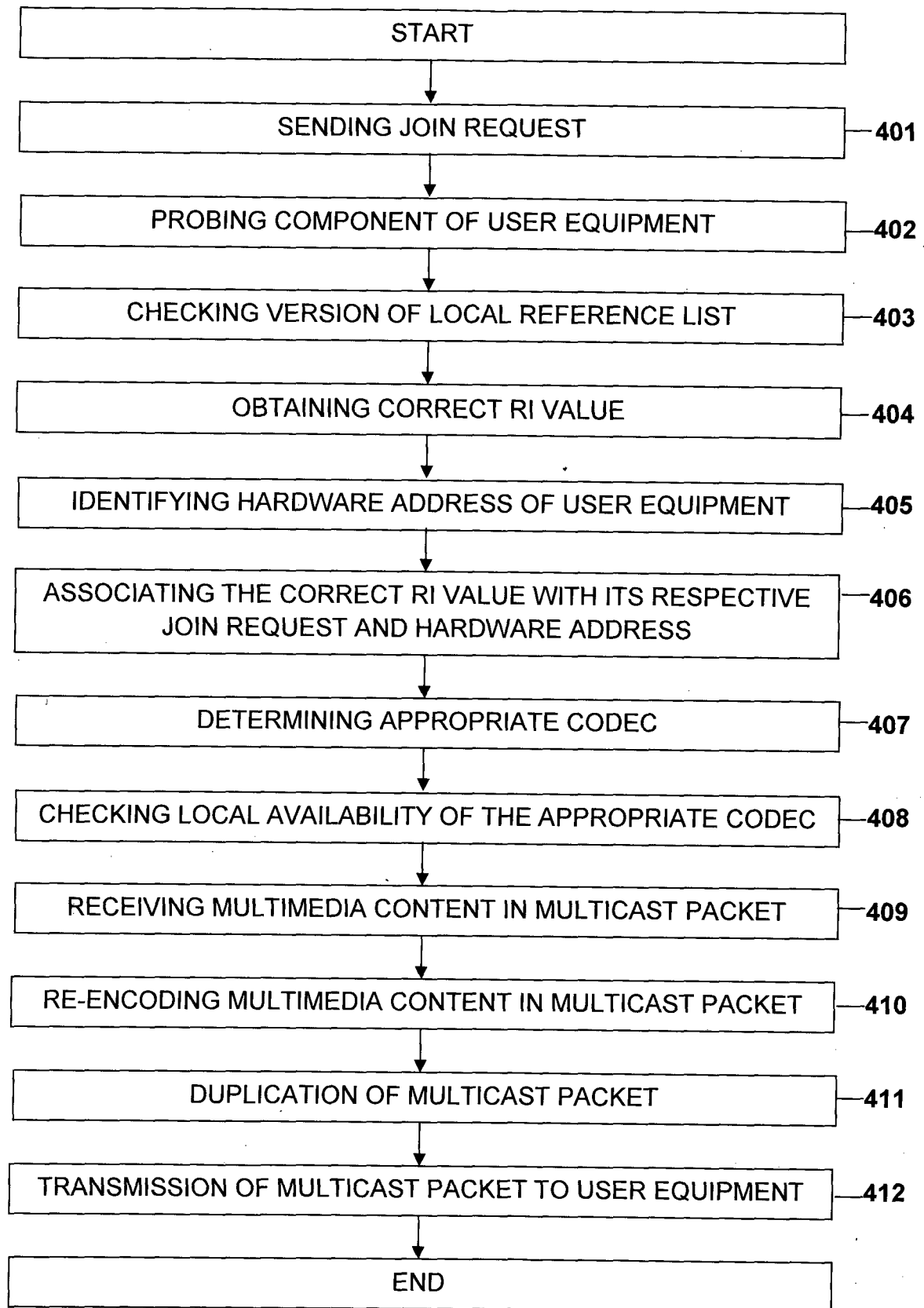


FIGURE 4

400

INTERNATIONAL SEARCH REPORT

International application No

PCT/MY2013/000174

A. CLASSIFICATION OF SUBJECT MATTER
 INV. H04L29/06
 ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 H04L

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

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

EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/158948 A1 (PANG TAK MING [US] ET AL) 21 June 2012 (2012-06-21) page 1, paragraph 17 - page 3, paragraph 40 page 5, paragraph 57 - paragraph 66; claims 11, 15, 18, 21	1-10
A	US 2011/216685 A1 (KISH WILLIAM S [US] ET AL) 8 September 2011 (2011-09-08) page 3, paragraph 35 - page 5, paragraph 52	1-10



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search

20 January 2014

Date of mailing of the international search report

27/01/2014

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/MY2013/000174

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2012158948	A1	21-06-2012	NONE
US 2011216685	A1	08-09-2011	NONE