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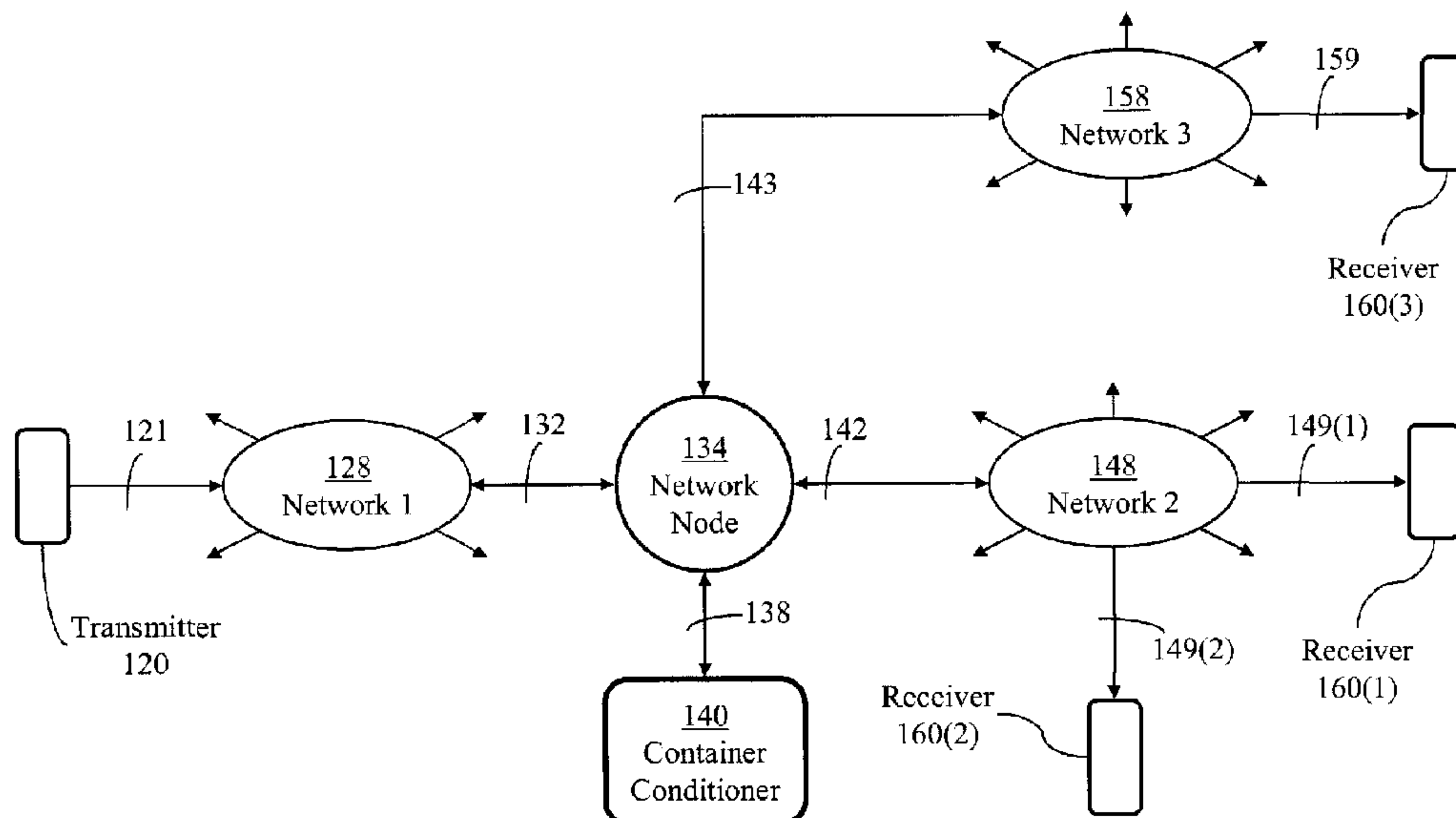
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(54) **Titre : GENERATION ET FOURNITURE DE NOTIFICATIONS D'ADAPTATION DE CONTENU MULTIMEDIA**

(54) **Title: GENERATION AND DELIVERY OF MULTIMEDIA CONTENT-ADAPTATION NOTIFICATIONS**



(57) **Abrégé/Abstract:**

A method for conditioning multimedia containers to be compatible with decoding facilities of receivers of diverse types is disclosed. Content of a multimedia container may include components of different encoding formats. Container conditioning also detects and, where feasible, removes undesirable insertions within each content component of a multimedia container. A content component of a container may be filtered, re-encoded, or deleted. Notifications indicating conditions of a container and any modifications performed are appended to the container. A notification may be presented in at least one form compatible with characteristics of a respective receiver. An editing engine implementing the method is associated with a network entity to which multimedia containers are directed. The editing engine accesses a receiver database storing information on several types of receivers and a repository of notification templates encoded in several forms.

ABSTRACT

A method for conditioning multimedia containers to be compatible with decoding facilities of receivers of diverse types is disclosed. Content of a multimedia container may include components of different encoding formats. Container conditioning also detects and, where feasible, removes undesirable insertions within each content component of a multimedia container. A content component of a container may be filtered, re-encoded, or deleted. Notifications indicating conditions of a container and any modifications performed are appended to the container. A notification may be presented in at least one form compatible with characteristics of a respective receiver. An editing engine implementing the method is associated with a network entity to which multimedia containers are directed. The editing engine accesses a receiver database storing information on several types of receivers and a repository of notification templates encoded in several forms.

GENERATION AND DELIVERY OF MULTIMEDIA CONTENT-ADAPTATION NOTIFICATIONS

FIELD OF THE INVENTION

The present invention relates to multimedia messaging services and, in particular, to a method and system for notifying users of modifications performed during message-transcoding processes within a network.

BACKGROUND

Multimedia messaging provides an outstanding business opportunity for mobile network operators. The higher access capacity available with third generation (3G) wireless access have paved the way for richer messages that include various combinations of text, voice, still and animated graphics, photos, video clips, and music. To capitalize on this massive market potential, however, network operators must ensure quality and reliability. Currently, operators are confronted with problems that impede interoperability across different networks and among the wide variety of multimedia formats and wireless devices. Multimedia messages may not be delivered successfully due to incompatible capabilities of an originating terminal and a destination terminal. The incompatibility may relate to message size, encoding methods, or file format. The problem occurs in both peer-to-peer and application-to-peer messaging.

Multimedia content adaptation directly addresses these interoperability issues. Adaptation allows dynamic transcoding of multimedia elements, including multimedia messages. Dynamic transcoding of multimedia elements adapts them to match the characteristics of the receiving devices so that users have universal access to multimedia content and their experience meets their expectations for quality. In an adaptation scheme, a requesting application sends requests to a transcoding device. Multimedia content adaptation ensures interoperability between devices within a network and across networks that follow different standards.

Content elements in a multimedia message may be altered or even removed during adaptation. It is desirable that a recipient, and perhaps a sender, of a modified

message be informed of the nature of modification. There is a need, therefore, for a system for generation and delivery of appropriate notifications.

SUMMARY

In accordance with one aspect, the present invention provides a system for conditioning data containers for delivery to receivers. The system comprises a container conditioner and an editing engine. The container conditioner has a dual link to a node in a telecommunication network and is equipped to receive data containers from the node for conditioning and transmitting conditioned data containers back to said node. The editing engine is communicatively coupled to the container conditioner. The editing engine comprises a screening module, an adaptation module, and a module for generating notifications.

The screening module comprises means for inspecting the data containers to detect and remove undesirable insertions and indicate respective container-content conditions. The adaptation module comprises means for determining conformity of content components of the data containers to decoding facilities of intended receivers of the data containers and for indicating conformity conditions of each content component. Non-conforming content components are modified to suit the decoding capabilities of respective receivers. The module for generating notifications comprises means for synthesizing notifications according to the container-content conditions and the conformity conditions, and appending the notifications to respective data containers to produce the conditioned data containers.

The system further comprises a server computer communicatively coupled to the container conditioner. The server computer has a receiver database stored in a computer readable medium, the receiver database containing information pertinent to decoding facilities of a plurality of receiver types.

The system further comprises a computing device communicatively coupled to the container conditioner, the computing device accessing a versatile dictionary comprising data stored in a memory device. The versatile dictionary contains encoded comprehensible displays corresponding to a predefined set of container-content conditions and conformity conditions.

The comprehensible displays may comprise several forms such as a text, an image, an encoded audio signal, and an encoded video signal.

According to one aspect of the invention, there is provided a system for data container adaptation, comprising:

- a plurality of container conditioners; and

- a plurality of input selectors, each input selector connecting a respective container conditioner to a subset of input ports of a set of input ports of a switching node;

- each container conditioner comprising:

- a plurality of pipelined processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

- a plurality of buffers, each coupled to a respective processing unit, for holding characterizing data relevant to a respective container condition; and

- an output selector for transferring characterizing data held in said plurality of buffers to a notification module for generating notifications based on content of said characterizing data;

- each input port of said set of input ports configured to:

- receive incoming data containers;

- direct said incoming data containers to a respective container conditioner through a respective input selector; receive processed data containers from said respective container conditioner through said respective input selector; and

- direct said processed data containers to a switching fabric of said switching node for switching to respective receivers.

In the system described above, said respective input selector is configured to:

- time multiplex incoming data containers received from said subset of input ports for submission to said respective container conditioner; and

distribute processed data containers sent from said respective container conditioner to individual input ports of said subset of input ports.

In the system described above, said each input port is further configured to:

receive said incoming data containers together with data units of other types;
and
direct said data units of other types to said switching fabric.

In the system described above, respective container conditioner is configured to:

examine each incoming data container received from said subset of input ports;
remove any undesirable content from said each incoming data container; and
append a respective notification to said each incoming data container to produce a respective processed data container.

In the system described above, an upper bound of a number of input ports of said subset of input ports is determined according to:

a flow rate of said incoming data containers; and
processing throughput of said respective container conditioner.

In the system described above, said respective container conditioner comprises:

a content-screening module configured to:

filter out undesirable insertions; and
mark said container accordingly;

and

a content-adaptation module configured to:

determine compatibility of content of an incoming data container with a receiver type of an addressed receiver; and
subject to a determination of incompatibility, decode a content component to produce a decoded content component and re-encode said decoded content component to a form compatible with said receiver type.

The system further comprises a module for merging notifications with respective data containers.

The system further comprises a transmitter-notification module for sending said notifications to respective transmitters.

The system further comprises at least one memory device organized into multiple virtual queues, each virtual queue corresponding to a respective condition type.

According to another aspect of the invention, there is provided a method for data container adaptation, comprising:

- coupling each container conditioner of a plurality of container conditioners to a subset of input ports of a set of input ports of a switching node through a respective input selector;

- configuring at least one container conditioner to:

- pipeline a plurality of processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

- determine, at each processing unit, characterizing data of an incoming data container;

- hold said characterizing data in a respective buffer coupled to said each processing unit; and

- transfer said characterizing data to a notification module for generating notifications based on said characterizing data;

and

- configuring each input port of said set of input ports to perform processes of:

- separating incoming data containers from received data;

- directing said incoming data containers to a respective container conditioner;

- receiving processed data containers from said respective container conditioner; and

directing said processed data containers to a switching fabric of said switching node for switching to respective receivers.

The method further comprises configuring said respective container conditioner to perform processes of:

examining each incoming data container received from said subset of input ports;

removing any undesirable content from said each incoming data container;

determining compatibility of content of said each incoming data container with a receiver type of an addressed receiver;

subject to a determination of incompatibility, decoding a content component to produce a decoded content component and re-encoding said decoded content component to a form compatible with said receiver type to produce a respective processed data container;

and

appending a respective notification to said respective processed data container.

The method further comprises sending said respective notification to a respective transmitter of said each incoming data container.

According to yet another aspect of the invention, there is provided a system for data container adaptation, comprising:

a plurality of container conditioners, each container conditioner having a dual channel to a switching fabric of a switching node; and

a controller of said switching node configured to:

direct incoming data containers received at a plurality of input ports of said switching node to a respective container conditioner through said switching fabric; and

direct processed data containers produced by said respective container conditioner to respective output channels of said switching fabric;

each container conditioner comprising:

a plurality of pipelined processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

a plurality of buffers, each coupled to a respective processing unit, for holding characterizing data relevant to a respective container condition; and

an output selector for transferring characterizing data held in said plurality of buffers to a notification module for generating notifications based on said characterizing data.

In the system described above, said controller is further configured to equitably distribute said incoming data containers among said plurality of container conditioners.

In the system described above, a requisite number of container conditioners of said plurality of container conditioners is determined according to:

a total flow rate of said incoming data containers; and

processing throughput of said each container conditioner.

In the system described above, said each container conditioner comprises:

a content-screening module configured to:

filter out undesirable insertions; and

mark a data container accordingly;

and

a content-adaptation module configured to:

determine compatibility of content of an incoming data container with a receiver type of an addressed receiver; and

subject to a determination of incompatibility, decode a content component to produce a decoded content component and re-encode said decoded content component to a form compatible with said receiver type.

The system further comprises a transmitter-notification module for sending said notifications to respective transmitters.

The system further comprises at least one memory device organized into multiple virtual queues, each virtual queue corresponding to a respective condition type.

In the system described above, at least one container conditioner of said plurality of container conditioners is collocated with said switching node.

In the system described above, said processing units store processor-readable instructions to process the incoming data containers to:

- remove any undesirable content;
- determine compatibility with a respective addressed receiver;
- modify content subject to a determination of incompatibility; and
- append a respective notification to produce a respective processed data container.

According to one more aspect of the invention, there is provided a method for data container adaptation, comprising:

- connecting each container conditioner of a plurality of container conditioners to a switching fabric of a switching node through a dual channel;
- configuring a controller of said switching node to equitably distribute incoming data containers received at a plurality of input ports of said switching node to container conditioners through said switching fabric to produce processed data containers and to direct said processed data containers to respective output channels of said switching node;
- configuring at least one container conditioner to:
 - pipeline a plurality of processing units, each for identifying a container condition of a respective condition type;
 - determine, at each processing unit, characterizing data of an incoming data container;
 - hold said characterizing data in a respective buffer coupled to said each processing unit;

and

transfer said characterizing data to a notification module for generating notifications based on said characterizing data.

The method further comprises determining a requisite number of container conditioners of said plurality of container conditioners according to:

a total flow rate of said incoming data containers; and

processing throughput of said each container conditioner.

The method further comprises storing, at said processing units, processor-executable instructions to perform, for each incoming data container, processes of:

removing any undesirable content; determining compatibility with a respective addressed receiver;

modifying content subject to a determination of incompatibility; and

appending a respective notification of any modification to produce a respective processed container.

In the method described above, said modifying comprises:

decoding a content component of said each incoming data container; and

re-encoding said content component to a form compatible with said addressed receiver.

Thus, improved methods and systems for data container adaptation have been provided.

BRIEF DESCRIPTION OF THE DRAWINGS

In the figures which illustrate example embodiments of this invention:

FIG. 1 illustrates a container conditioner associated with a network node for examining, and where necessary altering, multimedia containers, and generating notifications indicating a state of each container, in accordance with an embodiment of the present invention;

FIG. 2 illustrates components associated with the container conditioner of FIG. 1;

FIG. 3 illustrates a generic form of a data container which may be encoded in a variety of ways;

FIG. 4 illustrates functions of a container conditioner in accordance with one embodiment of the present invention;

FIG. 5 illustrates functions of a container conditioner in accordance with another embodiment of the present invention;

FIG. 6 details a process of modifying a container in accordance with an embodiment of the present invention;

FIG. 7 illustrates an exemplary structure of a data container comprising a header part and a content part;

FIG. 8 illustrates an original data container having four content components;

FIG. 9 illustrates a case where two content components of the original container of FIG. 8 are altered;

FIG. 10 illustrates a case where a content component of the original data container of FIG. 8 is deleted and another content component is shortened due to partial removal of data;

FIG. 11 illustrates a pipelined processing operation in accordance with an embodiment of the present invention;

FIG. 12 illustrates the operation an editing engine generating notifications, in accordance with an embodiment of the present invention;

FIG. 13 illustrates aggregation of notifications related to common conditions, in accordance with an embodiment of the present invention;

FIG. 14 illustrates a process of formulating and aggregating notifications in accordance with an embodiment of the present invention;

FIG. 15 illustrates exemplary conditioning of a container directed to two receivers, the conditioning involving virus removal and adaptation of content components to encoding facilities of the two receivers, in accordance with an embodiment of the present invention;

FIG. 16 illustrates output containers resulting from the conditioning processes of FIG. 15;

FIG. 17 illustrates a network node supporting more than one container conditioner associated with input ports of the node, in accordance with an embodiment of the present invention; and

FIG. 18 illustrates a network node supporting more than one container conditioner accessed through the switching fabric of the node, in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

Terminology

Medium: The term “medium” refers to any hardware means for storage and delivery of information. The term “multimedia” refers to a medium communicating information of multiple content forms. The content forms may include encoded text, audio signals, still images, animation (rapid display of images), and video signals.

Multi-Media Service (MMS): The term is used colloquially to refer to multi-content communication services where information contents of different forms such as text, audio signals, video signals, images, presentations, etc., are exchanged among terminals through a network. Encoded information transferred from one terminal to another is typically arranged in a single data stream with time-interleaved segments corresponding to the different information contents.

Container: A container is a computer file stored on a computer readable medium and transmitted over a computer network. The container is structured to contain various types of data. The container may support multiple text, audio, and video streams with synchronization information to enable coordinated play back of various streams.

Container component: A container includes sections, each comprising data encoded in a specific form, such as a text, audio data, image data, or video data. The term container component refers to data in one section. A container component may be referenced as a “component” for brevity. In a multimedia messaging system, a component is also known as “media”.

Container screening: “Container screening” refers to a process of examining the content of a container, including all components, to ensure absence of any undesirable insertions, especially harmful insertions.

Container adaptation: “Container adaptation” refers to a process of modifying the form of a container component found to be incompatible with the decoding capability of a respective receiver. If it is not feasible to present a container component to suit a receiver, the container component may be deleted. A container-adaptation process is receiver specific while the process of container screening is independent of the type of intended receiver.

Container editing: The term “container editing” refers to the combined processes of container screening and container adaptation.

Container conditioning: The term may be used synonymously with “container editing”. However, container conditioning also appends an appropriate notification with a container, even when a container is not modified.

Compression: The term refers to data compression where data of a container component may be re-coded to use fewer bits. Compression may or may not affect the information content of a component.

JPEG: JPEG a commonly used method of data compression for photographic images developed by the Joint Photographic Experts Group. The degree of compression can be adjusted, allowing a selectable tradeoff between storage size and image quality.

Advanced Audio Coding (AAC): AAC is a standardized encoding scheme for digital audio signals.

3GP: The acronym refers to a multimedia container format for use with mobile phones.

Transcoder: A transcoder is a device which performs direct digital-to-digital translation of encoded information to enable an information record of one format to be reproduced in a different format suitable for a specific receiver.

Transcoding

In a telecommunications network connecting transmitters of different types to receivers of different types, a transmitter devised to transmit signals encoded in a certain form may connect to a receiver devised to receive signals encoded in the same form through a passive path through the network. If the receiver is devised to receive signals encoded in a form different from the transmitted form, an intermediate device – a transcoder – provided somewhere along the path – would be needed to modify the transmitted signal to be compatible with the receiver's capability.

In a network supporting terminals (transmitters and receivers) exchanging homogeneous data, such as plain-text data or encoded voice-signals, the terminals are likely to be compatible. In a network supporting versatile terminals exchanging data streams of heterogeneous content, where a single data container may include data representing plain alphabet characters, encoded audio signals, encoded video signals, static images, presentations, etc., problems of transmitter-receiver incompatibility are likely to arise. The process of communicating data representing information of more than one type is often referenced as multimedia communications or multimedia services (MMS), where the term "media" refers to an information type. Multimedia services are commonly based on exchanging multi-content messages (data containers).

A significant amount of work has been devoted to enhancements of multimedia services. However the issue of notifying users of message alterations performed during transcoding and necessitated by limitations of receiving terminals or viral contamination, has been largely overlooked. The embodiment of this invention fills this gap by providing a generic warning system using notifications inserted in a presentation of an altered message to inform a recipient of the message

that the message has been altered in a way that affects the final presentation of the message. If, for example, a content element of a message is removed, then a "Synchronized Multimedia Integration Language" (SMIL) slide with text notification of the removal is inserted into the message.

SMIL is a standard language devised by the World Wide Web Consortium for creating multimedia presentations where audio, video, text and graphics are combined and coordinated in real time. SMIL is used to define markups for timing, animations, and media embeddings associated with a multimedia presentation. SMIL enables displaying multiple file types such as text, video, and audio.

An MMS message is a container that has a SMIL presentation that may reference media attachments as components of the MMS message (images, video, text, audio). The presentation is displayed as a slide show, which displays the content within the message. When the content is altered, for example when a video recording that is too large is removed, or when an image is removed because of a virus, a new text slide is generated, based on, e.g., a template corresponding to the specific reason, and inserted into the slide show. The slide is built from a language-selectable template which inserts information relevant to the notification content in the correct position.

The embodiment of the present invention provides a method for intelligently deciding when to insert the attachment notification based on a set of states: adaptations, filtering, and removal. A notification template is acquired from a repository, which may be available locally or at a remote location accessible through a network, based on language and character set, and a text notification is created filling in details specific to the notification. The notification may be inserted into the message presentation or communicated separately.

Different types of actions, such as adapting, filtering, and removal may be performed on attachments originally contained within a message. Content removal may be necessitated by: an error occurring while manipulating media message, e.g., successfully parsed content considered invalid; restricted message size; content-filtering; detecting a virus; or the whole content being a virus.

A removal notification may not be generated for each possible case in which content is removed from a message. For example, content that cannot be parsed successfully from an original message and, hence, is not extracted from the original message is ignored and no removal notification need be included in the output message. Whenever content is removed, a method according to an embodiment of the invention evaluates whether or not to actually add a respective notification. So if it is appropriate to add a removal notification, then the message is marked appropriately.

Optionally, a number of removal events may be amalgamated in one notification. Only one notification of each type would ever be created. For example, even if multiple attachments are removed, only one removal notification may be added to the output message.

Upon creating the removal notification, the system evaluates all media attachments that have a "removed" state and that were marked as appropriate for creation of removal notification. If the removal notification template contains variables, then the system replaces the variables with appropriate values from the characteristics of the content being removed and appends the entry to the removal notification being created. On the other hand, if the removal notification template contains generic text and no variables then only one entry is added in the removal notification being assembled. When a removal notification is created, a notification is added as a new attachment to the output message and to the presentation being built.

Network Considerations

FIG. 1 illustrates paths from a transmitter 120 to a number of receivers 160, individually identified as 160(1), 160(2), 160(3), etc. Transmitter 120 sends data containers (MMS messages) directed to selected receivers 160 through a channel 121 to a node in a network segment 128, labeled "network 1". A container conditioner 140 comprises a computing device having a processor and a computer readable medium, e.g., a random access memory, having computer readable instructions stored thereon. The container conditioner 140 is associated with a network node 134 which connects to network segment 128 through a link 132. The

container conditioner 140 examines a data container received from transmitter 120 and directed to a receiver 160 to determine compatibility with the receiver's capability. The container conditioner 140 may also acquire information on a current condition of a designated path to a specific receiver 160 through other network segments, such as network segment 148, labeled "Network 2" and network segment 158, labeled "Network 3".

The container conditioner 140 receives data containers from network node 134 through a link 138 which may comprise several channels. Network node 134 transmits examined data containers to receivers 160(1) and 160(2) through a link 142 to a first node (not illustrated) in network segment 148. A data container directed to receiver 160(1) is switched to a second node (not illustrated) within network segment 148 connecting to receiver 160(1) through a channel 149(1). A data container directed to receiver 160(2) is switched to a third node (not illustrated) within network segment 148 connecting to receiver 160(2) through a channel 149(2). Likewise, network node 134 transmits examined data containers to receiver 160(3) through a link 143 to a first node (not illustrated) in network segment 158 from which a data container is switched to a second node (not illustrated) within network segment 158 connecting to receiver 160(3) through a channel 159. Link 142 may comprise multiple channels and similarly link 143 may comprise multiple channels.

Any of channels 121, 149, or 159, or links 132, 142, and 143, may be configured within a wireless or wireline communication medium.

Container conditioner 140 may acquire receiver characterization data for a number of receivers and maintain the receiver-characterization data in a storage medium for recurrent use. The receiver-characterization data may be acquired through registration where each added receiver communicates its own characteristics to the container conditioner 140. Alternatively, the container conditioner 140 may query receivers to which data containers are directed.

The container conditioner 140 receives a container and may alter the content of the container to remove malicious insertions, or any other undesirable insertions, or to adapt the content to the capability of a receiver. If the container is found to be free of undesirable content and compatible with a receiver, the container is

forwarded in its original form, except – perhaps- for appending an indication that container has not been altered.

A container may comprise multiple content components which may be of different component types, such as text, audio data, image data, and video data. A component type may be encoded in one of several formats. For example, several protocols, standardized and proprietary, exist for encoding, compression, storage, and transmission of audio and video digital signals. The container may be directed to more than one receiver of different receiver types and a component may be incompatible with some receivers.

A component may include one of many types of malicious insertions which may be detected using a variety of specialized software tools.

FIG. 2 illustrates devices associated with the container conditioner 140. Container conditioner 140 may be connected to a host node, such as node 134 (FIG. 1), in different ways, as will be described with reference to FIG. 17 and FIG. 18. The output containers of container conditioner 140 are switched through the host node to their respective destinations.

Container conditioner 140 is associated with a receiver database 220, which maintains characteristics of a number of receivers, and an editing engine 240 which modifies containers having harmful or undesirable content, or having content incompatible with a destined receiver. Editing engine 240 produces adaptation codes to identify changes made to a container; a “Null” adaptation code may be associated with an unchanged container. Container conditioner 140 may also access a dictionary 230, which provides a comprehensible description of each adaptation code, and a cache memory 250 which holds data acquired by querying specific receivers and results of recent containers’ examination.

The database 220 is maintained by a server communicatively coupled to the container conditioner 140. The versatile dictionary 230 is stored in a memory device accessed by a computing device communicatively coupled to the container conditioner 140.

Container conditioner 140 determines addressed receivers indicated in each incoming data container and accesses receiver database 220 to determine capabilities of the addressed receivers. The editing engine 240 may query a destined receiver for which no characterizing data is stored in receiver database 220 and hold acquired characterizing data in cache memory 250. The editing engine 240 implements a method for determining whether certain content parts of a container destined to a specific receiver need be changed to suit the capabilities of the specific receiver. Modifications of several types may be made to parts of a data container and each modification type is internally identified by an adaptation code. Dictionary 230 provides an intelligible description of each adaptation code for delivery to a receiver of an adapted container and to a transmitter of the adapted container. The adaptation codes resulting from examining containers may be sent to a processing unit (not illustrated) for statistical analyses and for service evaluation and planning purposes.

The editing engine 240 comprises a processor (not illustrated) and a memory device (not illustrated) having stored thereon a container-editing software for executing the method of the embodiment of the invention. The container-editing software may be acquired from a software medium which could be a disk, a tape, a chip or a random access memory containing a file downloaded from a local source or from a remote source through a network.

The receiver database 220 comprises encoded characteristics of a set of receiver types stored on a computer readable medium of a computing device (not illustrated) loaded with information retrieval software. Receiver-characteristic information is needed for adapting container-content and generating relevant notifications. The information retrieval software may be acquired from a software medium which could be a disk, a tape, a chip or a random access memory containing a file downloaded from a local source or from a remote source through a network.

The versatile dictionary 230 comprises notification patterns encoded for different forms of display, such as a text, an audio signal, an image, etc. stored on a computer readable medium of a computing device (not illustrated). The dictionary 230 may be acquired from a software medium such as a disk, a tape, a chip or a

random access memory containing a file downloaded from a local source or from a remote source through a network.

Any of well known data structures may be used to organize containers' data in a manner which facilitates containers' examination and adaptation. FIG. 3 illustrates a generic form of a data container 300 which may be structured in a variety of ways. Container 300 comprises a first part 320 containing a directory which defines the organization of the rest of the container, a second part 340 containing source-destination information, and a third part 360 containing the content (i.e., the payload) of the container. In a composite container, the content part 360 may comprise several sections 361, 362, ..., which may store data encoded in different forms. For example, a section of the content part 360 may include data encoded as one of a plain text, an encrypted text, a high-fidelity voice message, a high-quality video, a static image, a paced display, etc.

FIG. 4 illustrates functions of a container conditioner 140 in accordance with one embodiment of the present invention. A container conditioner 140 receives a data container from a transmitter 120 (step 410). The container conditioner then performs the series of functions indicated in steps 420 to 480. In step 420, container directory 320 is parsed to determine pointers to addressed receivers encoded in the source-destination part 340 of the container and the content components encoded in the content part 360 of the container. In step 430, the type of each addressed receiver is determined according to the receiver's address from receiver addresses stored in associated receiver database 220, from cache memory 250 holding data on recent transactions, or by directly querying a respective receiver.

The number of receivers served by a single container conditioner 140 may be enormous, but the number of receiver types is likely to be quite small; less than a hundred for example. Thus, container conditioner 140 preferably stores basic characterizing information on receiver types to be used to determine relevant characteristics of an addressed receiver (step 432). Receivers of a given type may, however, be configured differently leading to different capabilities, in which case such receivers may be individually identified in receiver database 220.

A received data container may be a composite container carrying payload data (content) of several content types. An addressed receiver may not be able to process contents of specific types. Step 434 determines which content types, *if any*, are incompatible with capabilities of an addressed receiver. If step 434 determines that the content in its entirety is compatible with the addressed receiver, steps 440 to 480 are skipped; the data container is left intact and transmitted to a subsequent node towards destination. Otherwise, step 440 identifies content parts to be modified. The conditional transition from step 434 to step 440 is not illustrated in FIG. 4 to avoid cluttering the figure with obvious steps.

In step 450, the required content modifications are determined and replacement parts of the content are produced. Step 450 implements a screening-adaptation procedure for determining the form and extent of each modification. The procedure determines whether a specific part of the content need be deleted, corrected, or translated to another form. Step 450 is further detailed in FIG. 6.

In step 460, a new container is produced to replace the received container. While the new container may include most of the information contained in the received container, even minor payload (content) changes may force changes in the container's directory and size.

In step 470, a notification is formulated to be sent to a respective receiver of an altered data container. In its simplest form, a notification may be a numerical code, or a set of numerical codes, to accompany an altered data container. A notification may, however, be produced in one of comprehensible forms such as a clear text, an intelligible voice message, or an image. A notification may also combine two or more comprehensible forms.

In step 480, the container conditioner 140 may produce a notification, in any of the above forms or any combination thereof, to be sent to the transmitter 120. A notification sent to a transmitter may carry further information to enable the transmitter to correlate the notification with a respective, already transmitted, data container.

A container received at container conditioner 140 and directed to multiple receivers may be modified for only one receiver and left intact for the remaining receivers, in which case container conditioner 140 may send the modified container accompanied by a notification in the form of a comprehensible text, for example, to the respective addressed receiver.

Notably, modifying a data container to be compatible with an addressed receiver is needed for proper reception and processing of the data container. However, an associated comprehensible notification is provided for the benefit of a human user of the receiver. The comprehensible notification may also be sent to the transmitter for the benefit of a human user of the transmitter.

Frequent notifications related to common causes, such as a container size exceeding a preset limit, methods of video encoding, and methods of data compression, may be sent as numerical codes to be translated into comprehensive texts (or other comprehensible modes such as clear voice messages) at a respective receiver.

FIG. 5 illustrates functions of a container conditioner 140 in accordance with another embodiment. In the process of FIG. 4, a part of a container's content is modified if found to be incompatible with corresponding capabilities of an addressed receiver. In the process of FIG. 5, characteristics of a path to an addressed receiver are also considered in deciding alterations to a data container.

Steps 410, 420, 430, 432, and 434 in FIG. 5 are identical to likewise-numbered steps in the process of FIG. 4. In step 520, the container conditioner 140 may acquire network-related data to characterize a path, or at least a segment of a path, to an addressed receiver. A current condition of the path may force a size reduction of each container traversing the path to avoid data loss at a node along the path (step 530). As in the case of FIG. 4, container-size reduction may also be dictated by limitations of an addressed receiver.

If step 530 determines that the content size and the content in its entirety are compatible with the addressed receiver and conforming to a condition of a designated path to the addressed receiver, the data container is transmitted in its original form to a subsequent node towards destination and steps 540 to 580 are

skipped. Otherwise, step 540 is exercised. The conditional transition from step 530 to step 540 is not illustrated in FIG. 5.

In step 540, a procedure for judicious selection of content parts to be modified is exercised. For example, a data container may include a video signal encoded for high-quality reproduction accompanied by an encrypted text or an encoded audio signal. To reduce a container size to a specified value, the procedure has to choose from a number of options such as: deleting the text, deleting the audio content, or decoding and re-encoding the video content using an alternative encoding technique which produces an encoded record of a smaller size. Selection of an option may be influenced by a predetermined priority classification of the content components of a container. Thus, if one of a text or an image is to be sacrificed, the editing engine 240 may base the decision on a priority classification of the two components.

In step 550, modified content is produced according to a decision made in step 540. Step 550 is similar to step 450 which is detailed in FIG. 6. In step 560, a new container is produced to replace the received container. In step 570, a notification is formulated to be sent with an altered data container to a respective receiver. In step 580, the container conditioner 140 may produce a notification to be sent to the transmitter.

The steps of FIG. 4 and FIG. 5 are implemented according to instructions stored in a computer readable medium, such as a semiconductor-based integrated circuit, a flash memory device, a compact disc (CD), or a digital versatile disc (DVD).

Container Editing and Adaptation

A container received at container conditioner 140, and stored in the memory thereon, may be directed to multiple receivers of different capabilities, which may result in dissimilar output containers directed to respective receivers. A received container, which is found to include malicious software or other undesirable data strings is edited first to remove affected content before individually adapting the container, if necessary, according to respective destinations.

FIG. 6 details step 450 of FIG. 4 (or step 550 of FIG. 5). A container 610 received at the container conditioner 140 is first examined in a content-screening

module 620, which may delete an entire content component or filter out undesirable insertions, if any. The screened container 612 is marked to indicate whether any alterations were performed. When no modification takes place, the screened container 612 is identical to the received container 610 except for an associated indication of the screening result.

The screened container 612 may then be adapted in content-adaptation module 640 to suit each addressed receiver type. Content-adaptation module 640 may filter out part of a content component, decode a content component and re-encode the decoded data to a form compatible with a respective receiver, or delete an entire content component. With R receiver types ($R \geq 1$), R output containers, 650(1), ..., 650(R), are produced and directed to respective receivers. The content of an output container directed to a specific receiver may be identical to the content of received container 610 or may be altered in either or both of the content screening module 620 and the content adaptation module 640. In any case, a notification is generated to indicate the condition of the container and actions taken, if any.

The combined content-screening module 620 and content-adaptation module 640 constitute an editing module. The editing module may be implemented as special purpose circuitry. Preferably, however, the editing module is implemented as a computing device having stored thereon computer readable instructions which, when executed, cause the computing device to screen content of containers and, where necessary, adapt content of containers to be compatible with characteristics (such as decoding facilities) of respective receivers. The computer readable instructions also cause the computing device to mark containers according to results of screening and adaptation.

Data-Container Structure

FIG. 7 illustrates a composite data container 700 comprising a header part and a content part. The header part comprises external identification data and internal identification data. The content part comprises multiple sections each section corresponds to a respective information type and data format. The content of a section constitutes a content component (often referenced as a "media").

A variety of container structures may be used. The structure of FIG. 7 corresponds to a data container belonging to a data stream for which a connection has been established. Thus, a single stream identifier 720 suffices to replace field 340 for determining an address of a source, an address for a destination in a unicast connection, an address of each destination in a multicast connection, and relevant routing information.

The content of container 700 may be modified, for any of a variety of reasons, at a point along the container's path from source to destination. Thus, the container's size may change and some fields in the header part may also change.

The external identification data relate to a source of the container, at least one destination of the container, and other relevant network information. The internal identification data may indicate, for each section, a position within the content part, a respective information type, and any content changes.

Container 700 is modeled after container 300 of FIG. 3. The data-container directory 320 includes fields 722, 724, 726, 728, 732, and 734. Container 700 is considered to belong to a data stream identified by a stream number (reference numeral 720). The network node supporting container conditioner 140 stores detailed source-destination information 340, in addition to other descriptors, for each data stream. In an independent container, detailed source-destination information would be included in the second part 340 of the container.

A message status field 722 may be used to determine if any content changes were made *en route* to destination. A message-size field 724 indicates a total current size of the container. A field 726 includes a current number, η , of sections. Each of fields 728(1), 728(2), ..., 728(η) indicates a current position within the content part of the data container at which a corresponding section starts. Each of fields 732(1), 732(2), ..., 732(η) indicates a current data type in a respective section, and each of fields 734(1), 734(2), ..., 734(η) indicates changes, if any, made to the content of a respective section.

The message status in field 722 may take any of a predefined number of values. For example, a value of 0 may indicate that the container's content is in its

original form and no changes took place. A value other than 0 may indicate a respective number of changes. Likewise, a section status in a field 734(j) indicates a number of changes, if any, made in the content of section j, $1 \leq j \leq \eta$. Message status 722 and a section status 634(j), $1 \leq j \leq \eta$, may include an additional indication of severity of a modification.

FIG. 8 illustrates a specific data container 700 which belongs to a data stream identified by an index 1089 (reference numeral 720). The index "1089" would have been assigned in a connection setup process. Field 722 indicates that no changes took place in the entire container. The size of the container, including the header, is 416 bytes (field 724). A typical container may have a size of tens of kilobytes; a much smaller size is selected herein for ease of illustration. The content comprises 4 sections (field 726), and the sections start at indices 0, 106, 206, and 322 of the content part. The length of each field is predefined and, hence, the number η of sections decides the length of the header part. The value in field 732(j) indicates a type of data in section j, $1 \leq j \leq \eta$. The data types may be predefined and standardized. For example a value of "0" may indicate plain text, a value of "1" may indicate an encrypted text according to a first encryption key, a value of "2", may indicate an encrypted text according to a second encryption key, a value of 5 may indicate an encoded audio signal, a value of 29 may indicate a video signal encoded according to a specific compression algorithm, and so on. In the example of FIG. 8, the four section contain data of types 0, 5, 2, and 29 respectively, and the each field 734(j), $1 \leq j \leq 4$, stores a value of "0", which is already known because field 722 contains a value of "0".

FIG. 9 illustrates a case where the content of container of FIG. 8 is altered. Field 722 has a value of 2, indicating that changes took place in two sections (the value in field 722 does not necessarily indicate a number of changes). The size of the container, including the header, has been reduced from 416 bytes to 392 bytes. Field 734(1) has a value of 2 indicating a respective type of change. The size of the first section decreased from 106 bytes to 94 bytes. Each of fields 734(2) and 734(3) has a value of "0", hence indicating that no changes took place in the second and third sections. However, the data of the second section now starts at index 94, instead of 106, within the content part and the data of the third section now start at

index 194, instead of 206, within the content part due to the shortening of the first section. Field 734(4) has a value of 7, indicating a respective type of change in the encoded video signal, perhaps related to the compression method.

FIG. 10 illustrates a case where the second section of the content of container of FIG. 8 is deleted (field 728(2) indicates a NULL position ϕ) and the fourth content section is shortened due to partial removal of data. The indices of the third and fourth section are modified accordingly and the size of the container, including the header, is reduced from 416 units to 287 units.

FIG. 11 provides an overview of exemplary editing operations, where pipeline units 1102(1), 1102(2), 1102(3), and 1102(4), forming a pipeline 1104, perform tasks related to different aspects of container editing, and identify respective conditions, which may require content editing. Data relevant to identified conditions are held in buffers 1122(1), 1122(2), 1122(3), and 1122(4) to be transferred to a module 1180, through a selector 1150 and a buffer 1140. Module 1180 generates notifications based on the identified conditions and provides the notifications to a module 1190 which combines notifications with respective containers. A module 1170 optionally directs notifications to respective sources (respective transmitters 120). Modules 1170, 1180 and 1190 and the units 1102(1), 1102(2), 1102(3), and 1102(4), forming the pipeline 1104 can be implemented as a special purposes circuitry. Alternatively, they may comprise computer readable instructions installed on a computer readable medium and accessible by a computing device.

Example

An example of content removal is provided next to explain how notifications may be inserted in a message.

Consider an input message, named *input.mms*, having the components:

- (1) *SMIL* presentation
- (2) compressed photographic image, named "*image.jpg*";

(3) encoded audio signal, named "*audio.aac*", generated according to the standardized "advanced audio coding" scheme; and

(4) audio-video recording, named "*audio-video.3gp*", encoded according to the "3GP format".

Two main processes need be implemented before transferring the input message to a respective receiving terminal. The first process modifies the message, if deemed necessary, to produce a respective output message. The second process produces appropriate notifications where needed and associates the notifications with the modified message. Naturally, the output message would be identical to the input message if no modifications take place, unless it is desired to add an indication that the message has been examined and found to be free of undesirable insertions and compatible with the receiving terminal.

The first process of modifying the input message "*input.mms*" to produce a corresponding output message, designated as "*output.mms*", comprises:

- (a) reading and parsing *input.mms*;
- (b) identifying and setting-up any required adaptations for subsequent execution;
- (c) executing all required adaptations;
- (d) determining the expected size of *output.mms* – if the size exceeds a specified limit, 100 kilobytes for example, the component "*audio.aac*" may be sacrificed and the component "*audio.aac*" is associated with a state labeled "removed", and
- (e) assembling the output message "*output mms*".

Having determined that component *audio.aac* is to be removed, the second process comprises:

- (i) creating a "removal notification" using a respective template – the template has a *variable* that corresponds to the name of the component being removed;

- (ii) setting the text entry to a string such as: "Removed media 'audio.aac' from the input message";
- (iii) adding the text entry created in (ii) to the removal notification;
- (iv) Adding the removal notification to *output.mms*; and
- (v) if *output.mms* includes a presentation, adding a reference to the "removal notification" in the presentation.

Thus, the assembled *output.mms* contains:

- (1) adapted *image.jpg*;
- (2) adapted *audio-video.3gp*;
- (3) entity that represents removal notification; and
- (4) *SMIL* presentation

The operation of the system for generating MMS notifications according to the embodiment of the invention is explained with the help of FIG. 12.

An editing pipeline 1204 executes a set of operations that perform required content-editing tasks. Pipeline units 1202(1) to 1202(L), $L > 1$, perform pipeline operations in sequence. During any operation, a problem that requires the generation of a notification may be identified. After all the pipeline operations are completed the system executes process 1212 which synthesizes and merges notifications.

Identifiers 1208(1), 1208(2), ..., of content conditions are generated and inserted in a buffer 1206. A condition identifier 1208 may contain multiple key-value pairs. The key-value parameters and a condition type characterize a condition. For example, an editing process may produce a virus notification with the key-value pairs of the form:

```
{ key:InputMediaName      value:media.jpg
  key:VirusName            value:CommWarrior-B
  key:VirusScanningEngine  value:Kaspersky}.
```

The notification indicates which component ("media") is affected, the type of malicious software (malware) detected ("commonWarrior-B" in this example), and the software tool which detected the malware (product of Kaspersky).

These values (media.jpg, CommonWarrior-B, Kaspersky) are just exemplary. The key-value pairs are substituted in a respective template where variables are defined. Any of available data portions within a notification-message attachment may be used. A key in a key-value pair may indicate a content-component, a cause of content removal, a virus name, or a virus scanning engine. A value in a key-value pair may indicate a specific content-encoding method, an identifier of a specific virus, an identifier of a specific engine used to detect and remove a virus, or an indication of a message size and corresponding size limit.

After all the pipeline operations in pipeline units 1202 are completed, the container conditioner 140 formulates and amalgamates notifications (process 1212). The container conditioner 140 uses a template which may be available on a local repository or retrieved from a remote storage medium via a network 1214. Process 1212 provides a template identifier (name) 1213 and receives a file 1217 from template repository 1216. Multiple notifications may be combined. For example, notifications regarding the removal of multiple viruses may be amalgamated into one notification. Notification records produced in process 1212 are appended to respective messages in step 1220. An output message containing a number of components which include a SMIL presentation 1224, contents 1226(1), 1226(2), ..., and notification records 1228(1), 1228(2), etc., are held in a buffer 1222 for subsequent delivery to a respective receiver.

Notably, a template source repository 1216 comprises files stored on a computer memory and accessible by the computing device of the container conditioner 140 and the editing engine 240. To build a template name, in accordance with an embodiment of the present invention, a root name of the notification type (such as "content-adaptation" or "removal") may be concatenated with a language identifier (such as "English") and a character set (such as "US-ascii"), separated by underscore "_" symbols. The filename preferably has an extension ".txt". The language and the character set are provided by a controller of the editing engine and

are based on system defaults. An example of a template name used for a removal notification is: "removal_english_us-ascii.txt".

The pipeline 1204 may be implemented as special purpose circuitry. Preferably, however, the pipeline 1204 is implemented as a computing device having stored thereon computer readable instructions which, when executed, cause the computing device to screen content of containers and, where necessary, adapt content of containers to be compatible with characteristics (such as decoding facilities) of respective receivers. The computer readable instructions also cause the computing device to mark containers according to results of screening and adaptation.

The buffer 1206 and the output container buffer 1222 are stored in a memory controlled by the computing device.

The processes 1212 and 1220 of building and merging notifications and appending the notifications to messages (containers) are implemented as computer readable instructions stored on a computer readable medium, e.g., random access memory, non-volatile memory, CD-ROM, DVD, etc.

FIG. 13 illustrates a number q , $q \geq 1$ of virtual queues 1320(1), ..., 1320(q) each of which corresponding to container conditions of a common type. A queue 1320(j), $1 \leq j \leq q$, contains pointers 1322 to locations of container-condition identifiers 1208 in buffer 1206. A single notification is produced for container conditions of the same condition type.

FIG. 14 details process 1212 of FIG. 12, which formulates and amalgamates notifications. The process starts in step 1402 in response to a request for transcoding. Conditions of the same condition type are considered together and reported in a single notification. Thus, step 1404 selects one of queues 1320 (FIG. 13) which holds pointers to condition identifiers 1208, in buffer 1206, corresponding to a set of conditions of a common condition type. In step 1405, one of the conditions in the set of conditions is selected. Step 1406 constructs a template name corresponding to the common condition type. Step 1408 uses the template name to acquire a respective template from template source 1216 which may be collocated

with the editing engine 240 or accessible through a network. Step 1410 synthesizes and composes a notification corresponding to the common condition type. Step 1440 adds particulars of the remaining conditions in the set of conditions to the composed notification. The resulting notification is then ready to be communicated to a respective receiver 160.

If buffer 1206 still holds unprocessed condition identifiers 1208 (FIG. 12), i.e., if there is at least one virtual queue 1320 (FIG. 13) not yet considered, step 1404 is revisited to select a queue 1320 and steps 1405, 1406, 1408, 1410, and 1440 are executed. If step 1418 indicates that all identified conditions in buffer 1206 have been considered, process 1212 of FIG. 12 ends (step 1420) to be restarted in response to a new request for transcoding.

FIG. 15 illustrates modification of contents of a container destined to two receivers 160 of different characteristics. The container has six content components labeled component (1), component (2), ..., component (6). As described above, a content component may be encoded as a text, audio data, image, or video data of different formats. Component (1) is of type (1-A), both component (2) and component (3) are of type (2-A), both component (4) and component (5) are of type (3-A), and component (6) is of type (4-A). Types (1-A), (2-A), (3-A), and (4-A) may correspond to specific encoding techniques which may be standardized or proprietary. Receiver 1 is devised to decode components of type (1-C), (2-A), (3-A), and (4-E). Type (1-C) is a counterpart of type (1-A), for example, both relate to image display but with different resolutions. Likewise, type (4-E) is a counterpart of type (4-A). Receiver 2 is devised to decode components of type (1-A), (2-W), (3-B), and (4-A). Type (2-W) is a counterpart of type (2-A), and type (3-B) is a counterpart of type (3-A).

Before using module 640, FIG. 6, for transcoding component (1) and component (4) to produce a first output container suitable for receiver 1, and transcoding component (2), component (3), component (4), and component (5) to produce a second output container suitable for receiver 2, module 620, FIG. 6, performs content editing to detect any undesirable insertions. Component (2) and component (6) were found to contain a virus known as "Virus X" and component (5) was found to contain a virus known as "Virus Y". The editing engine 240 acquires a

tool for removing Virus X, but is unable to find a tool for removing Virus Y. Thus, the editing engine 240 decides to delete component (5) in its entirety.

The first output container (FIG. 16) includes a translated component (1) from type (1-A) to type (1-C), filtered component (2) where Virus X is removed, original component (3) and component (4), and a translated component (6) from type (4-A) to type (4-E) with Virus X removed. Component (5) is deleted.

The second output container (FIG. 16) includes original component (1), a translated component (2) from type (2-A) to type (2-W) with Virus X removed, a translated component (3) from type (2-A) to type (2-W), a translated component (4) from type (3-A) to type (3-B), and filtered component (6) where Virus X is removed. Component (5) is deleted.

Multiple Container Conditioners

A set of container conditioners 140 may be associated with network elements in a variety of ways. Two exemplary arrangements where container conditioners are associated with a switching node are illustrated in FIG. 17 and FIG. 18. Notably, the arrangement of FIG. 17 is suitable for a case where container conditioners are collocated with a switching node while in the arrangement of FIG. 18 a container conditioner may be remotely located with respect to the switching node. Other arrangements for positioning container conditioners within a network may be devised.

FIG. 17 illustrates an arrangement where two container conditioners, individually identified as 140(1) and 140(2) are associated with network node 134 (FIG. 1), considered to comprise input ports 1720 and a switching fabric 1740. Each input port 1720 has a unidirectional channel 1722 to switching fabric 1740. Each input port 1720 of a first set 1725(1) of input ports has a dual channel to a selector 1728(1) connecting to container conditioner 140(1). Likewise, each input port 1720 of a second set 1725(2) of input ports has a dual channel 1724 to a second selector 1728(2) connecting to a second container conditioner 140(2). Selectors 1728(1) and 1728(2) may include buffers (not illustrated). Each of selectors 1724(1) and 1724(2) time multiplexes incoming multimedia containers received from respective input ports 1720 and distributes processed containers back to the input ports. Data units

received at input ports 1720 through input channels 1712 are switched through switching fabric 1740 to output channels 1714 leading to other network nodes. The received data units may include multimedia containers together with conventional forms of data traffic. Before switching a multimedia container through the switching fabric 1740, an input port 1720 directs the multimedia container to a respective container conditioner 140. The container conditioner examines the container and may modify its content to remove harmful insertions or to adapt content components to decoding facilities of a respective receiver. The container conditioner augments the container by appending a notification and directs the augmented container to the input port for subsequent switching through the switching fabric 1740 to an output channel 1714 leading to a destination of the container. The number of input ports 1720 sharing a container conditioner 140 through a selector 1724 is determined by the flow rate (in bits per second) of multimedia-container traffic received at the network node 134 and the processing speed of the container conditioners 140.

FIG. 18 illustrates an arrangement where two container conditioners 140(1) and 140(2) are associated with network node 134, considered to comprise a switching fabric 1840 and input ports 1820 receiving data through input channels 1812. Each of container conditioner 140(1) and container conditioner 140(2) has a dual channel, comprising a channel 1841 from switching fabric 1840 a channel 1842, connecting to switching fabric 1840. Either of container conditioners 140(1) and 140(2) may be collocated with network node 134 or remotely located.

Each input port 1820 has a unidirectional channel 1822 to switching fabric 1840. Conventional data traffic is switched through switching fabric to respective output channels 1814. However, a multimedia container received at input ports 1820 is first switched through switching fabric 1840 to one of the container conditioners 140(1) and 140(2) for processing as described above with reference to FIGS. 4-6. The processed containers, augmented with appropriate notifications, are switched to respective destinations through the switching fabric 1840. In general, an arbitrary number of container conditioners 140 may be associated with a network node depending on the number of input channels 1812, and the total flow rate (in bits per second) of multimedia traffic. A controller (not illustrated) of network node 134

distributes incoming multimedia containers equitably among the container conditioners 140.

Although specific embodiments of the invention have been described in detail, it should be understood that the described embodiments are intended to be illustrative and not restrictive. Various changes and modifications of the embodiments shown in the drawings and described in the specification may be made within the scope of the following claims without departing from the scope of the invention in its broader aspect.

WHAT IS CLAIMED IS:**1. A system for data container adaptation, comprising:**

a plurality of container conditioners; and

a plurality of input selectors, each input selector connecting a respective container conditioner to a subset of input ports of a set of input ports of a switching node;

each container conditioner comprising:

a plurality of pipelined processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

a plurality of buffers, each coupled to a respective processing unit, for holding characterizing data relevant to a respective container condition; and

an output selector for transferring characterizing data held in said plurality of buffers to a notification module for generating notifications based on content of said characterizing data;

each input port of said set of input ports configured to:

receive incoming data containers;

direct said incoming data containers to a respective container conditioner through a respective input selector; receive processed data containers from said respective container conditioner through said respective input selector; and

direct said processed data containers to a switching fabric of said switching node for switching to respective receivers.

2. The system of claim 1 wherein said respective input selector is configured to:

time multiplex incoming data containers received from said subset of input ports for submission to said respective container conditioner; and

distribute processed data containers sent from said respective container conditioner to individual input ports of said subset of input ports.

3. The system of claim 1 wherein said each input port is further configured to:

receive said incoming data containers together with data units of other types;
and

direct said data units of other types to said switching fabric.

4. The system of claim 1 wherein said respective container conditioner is configured to:

examine each incoming data container received from said subset of input ports;

remove any undesirable content from said each incoming data container; and

append a respective notification to said each incoming data container to produce a respective processed data container.

5. The system of claim 1 wherein an upper bound of a number of input ports of said subset of input ports is determined according to:

a flow rate of said incoming data containers; and

processing throughput of said respective container conditioner.

6. The system of claim 1 wherein said respective container conditioner comprises:

a content-screening module configured to:

filter out undesirable insertions; and

mark said container accordingly;

and

a content-adaptation module configured to:

determine compatibility of content of an incoming data container with a receiver type of an addressed receiver; and

subject to a determination of incompatibility, decode a content component to produce a decoded content component and re-encode said decoded content component to a form compatible with said receiver type.

7. The system of claim 1 further comprising a module for merging notifications with respective data containers.

8. The system of claim 1 further comprising a transmitter-notification module for sending said notifications to respective transmitters.

9. The system of claim 1 further comprising at least one memory device organized into multiple virtual queues, each virtual queue corresponding to a respective condition type.

10. A method for data container adaptation, comprising:

coupling each container conditioner of a plurality of container conditioners to a subset of input ports of a set of input ports of a switching node through a respective input selector;

configuring at least one container conditioner to:

pipeline a plurality of processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

determine, at each processing unit, characterizing data of an incoming data container;

hold said characterizing data in a respective buffer coupled to said each processing unit; and

transfer said characterizing data to a notification module for generating notifications based on said characterizing data;

and

configuring each input port of said set of input ports to perform processes of:

- separating incoming data containers from received data;
- directing said incoming data containers to a respective container conditioner;
- receiving processed data containers from said respective container conditioner; and
- directing said processed data containers to a switching fabric of said switching node for switching to respective receivers.

11. The method of claim 10 further comprising configuring said respective container conditioner to perform processes of:

- examining each incoming data container received from said subset of input ports;
- removing any undesirable content from said each incoming data container;
- determining compatibility of content of said each incoming data container with a receiver type of an addressed receiver;
- subject to a determination of incompatibility, decoding a content component to produce a decoded content component and re-encoding said decoded content component to a form compatible with said receiver type to produce a respective processed data container;
- and
- appending a respective notification to said respective processed data container.

12. The method of claim 11 further comprising sending said respective notification to a respective transmitter of said each incoming data container.

13. A system for data container adaptation, comprising:

a plurality of container conditioners, each container conditioner having a dual channel to a switching fabric of a switching node; and

a controller of said switching node configured to:

direct incoming data containers received at a plurality of input ports of said switching node to a respective container conditioner through said switching fabric; and

direct processed data containers produced by said respective container conditioner to respective output channels of said switching fabric;

each container conditioner comprising:

a plurality of pipelined processing units, each for identifying a container condition of a respective condition type of a predefined set of condition types;

a plurality of buffers, each coupled to a respective processing unit, for holding characterizing data relevant to a respective container condition; and

an output selector for transferring characterizing data held in said plurality of buffers to a notification module for generating notifications based on said characterizing data.

14. The system of claim 13 wherein said controller is further configured to equitably distribute said incoming data containers among said plurality of container conditioners.

15. The system of claim 13 wherein a requisite number of container conditioners of said plurality of container conditioners is determined according to:

a total flow rate of said incoming data containers; and

processing throughput of said each container conditioner.

16. The system of claim 13 wherein said each container conditioner comprises:

a content-screening module configured to:

filter out undesirable insertions; and
mark a data container accordingly;
and
a content-adaptation module configured to:
determine compatibility of content of an incoming data container with a
receiver type of an addressed receiver; and
subject to a determination of incompatibility, decode a content
component to produce a decoded content component and re-encode
said decoded content component to a form compatible with said
receiver type.

17. The system of claim 13 further comprising a transmitter-notification module for
sending said notifications to respective transmitters.

18. The system of claim 13 further comprising at least one memory device organized
into multiple virtual queues, each virtual queue corresponding to a respective
condition type.

19. The system of claim 13 wherein at least one container conditioner of said
plurality of container conditioners is collocated with said switching node.

20. The system of claim 13 wherein said processing units store processor-readable
instructions to process the incoming data containers to:

remove any undesirable content;
determine compatibility with a respective addressed receiver;
modify content subject to a determination of incompatibility; and
append a respective notification to produce a respective processed data
container.

21. A method for data container adaptation, comprising:

- connecting each container conditioner of a plurality of container conditioners to a switching fabric of a switching node through a dual channel;
- configuring a controller of said switching node to equitably distribute incoming data containers received at a plurality of input ports of said switching node to container conditioners through said switching fabric to produce processed data containers and to direct said processed data containers to respective output channels of said switching node;
- configuring at least one container conditioner to:
 - pipeline a plurality of processing units, each for identifying a container condition of a respective condition type;
 - determine, at each processing unit, characterizing data of an incoming data container;
 - hold said characterizing data in a respective buffer coupled to said each processing unit;
 - and
 - transfer said characterizing data to a notification module for generating notifications based on said characterizing data.

22. The method of claim 21 further comprising determining a requisite number of container conditioners of said plurality of container conditioners according to:

- a total flow rate of said incoming data containers; and
- processing throughput of said each container conditioner.

23. The method of claim 21 further comprising storing, at said processing units, processor-executable instructions to perform, for each incoming data container, processes of:

- removing any undesirable content; determining compatibility with a respective addressed receiver;

modifying content subject to a determination of incompatibility; and
appending a respective notification of any modification to produce a
respective processed container.

24. The method of claim 23 wherein said modifying comprises:

decoding a content component of said each incoming data container; and
re-encoding said content component to a form compatible with said
addressed receiver.

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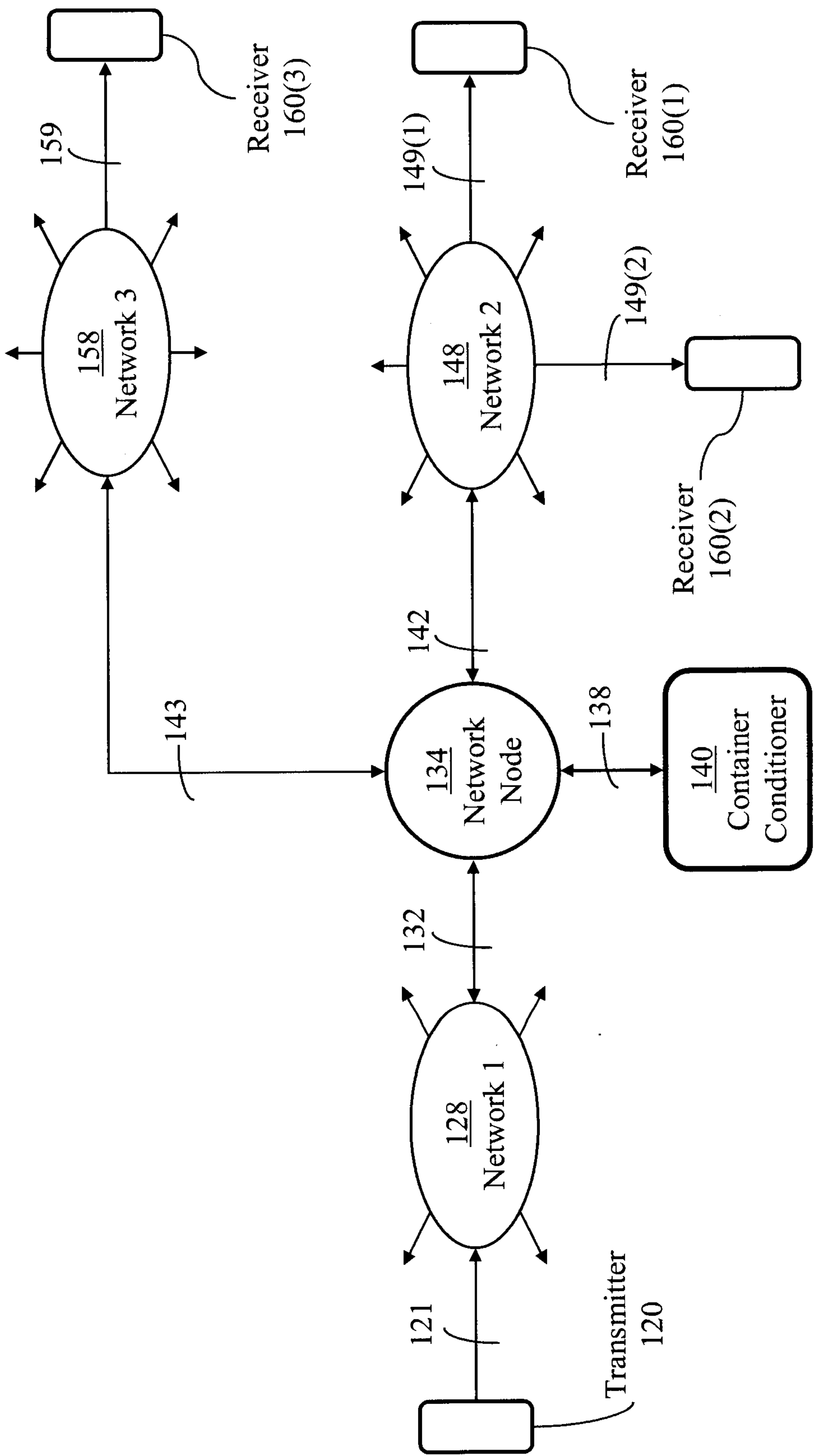


FIG. 1

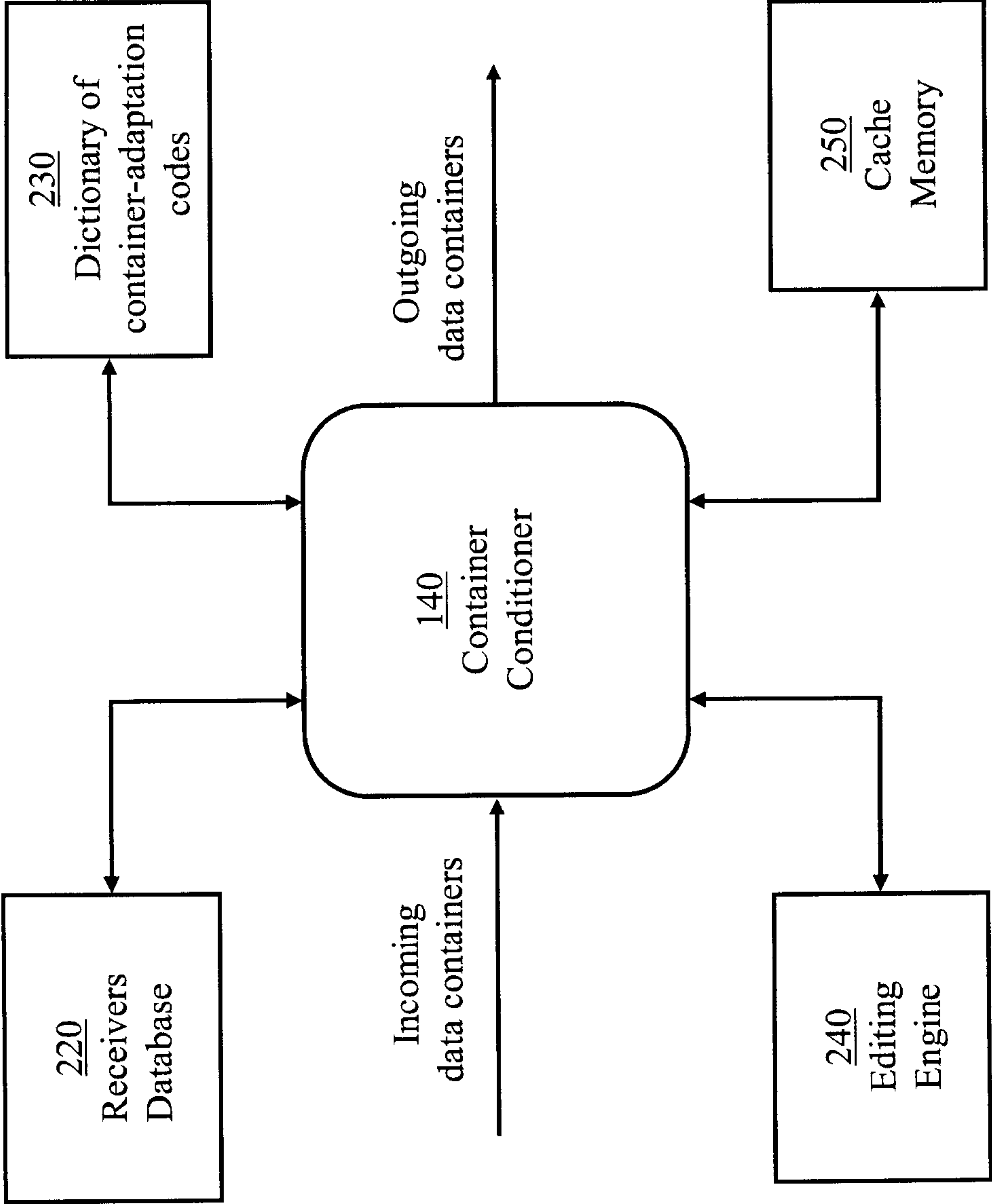


FIG. 2

300 ↗

<u>320</u> Data-Container Directory			
<u>340</u> Source-destination information			
Section <u>361</u>	Section <u>362</u>	•••••	•••••
360 Contents			

FIG. 3

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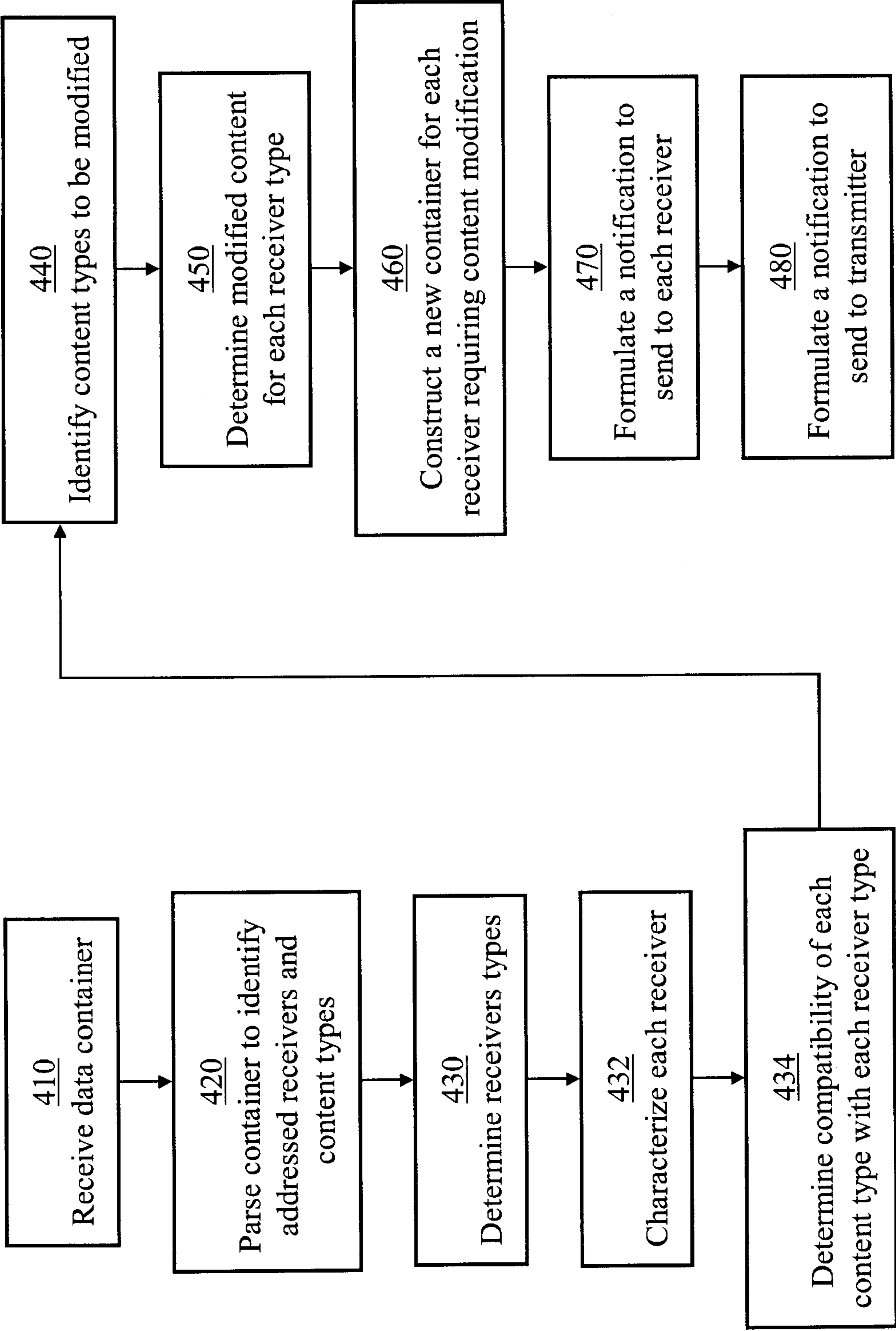


FIG. 4

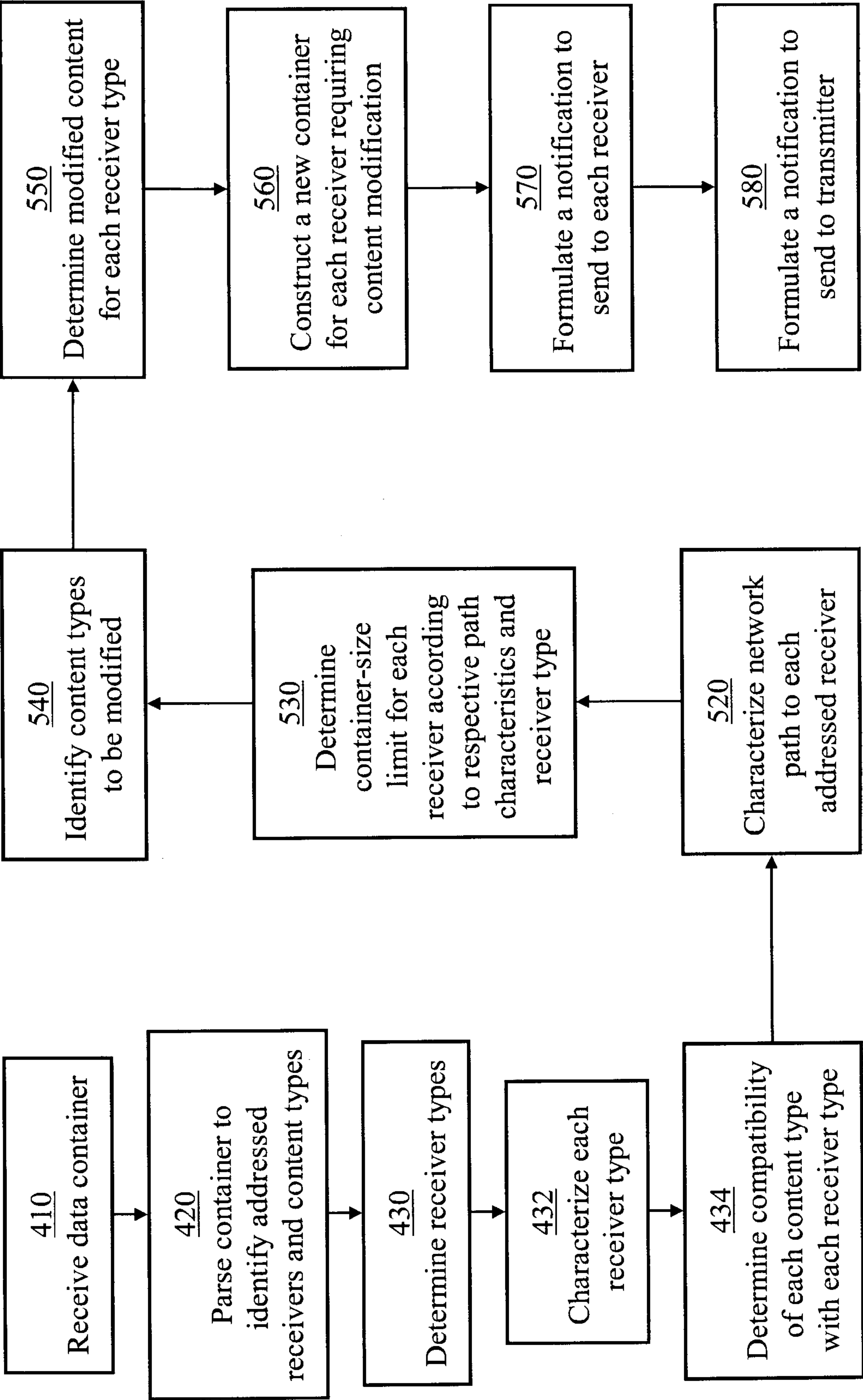


FIG. 5

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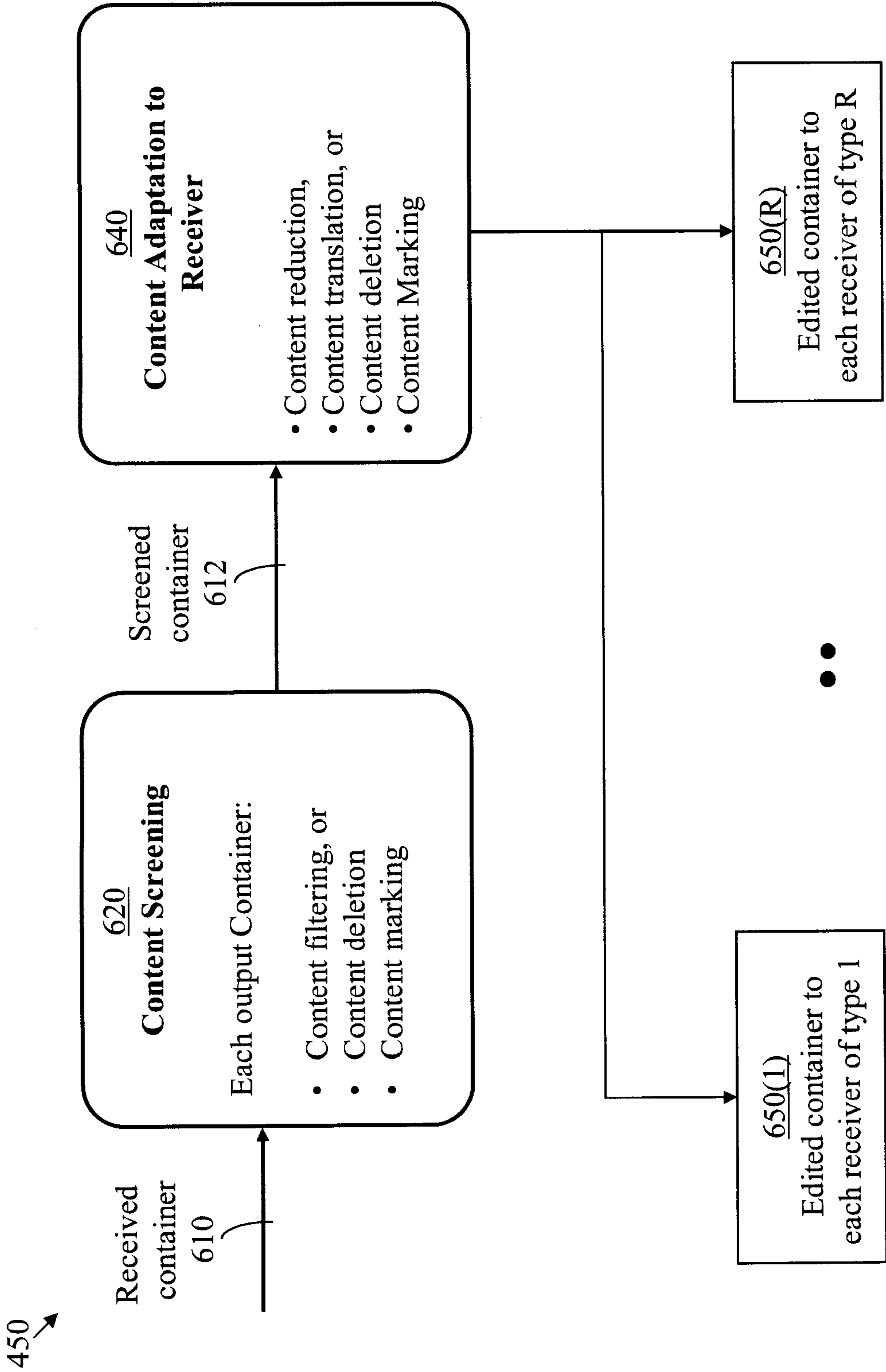


FIG. 6

700 

[illegible]

$\overline{720}$	$\overline{722}$	$\overline{724}$	$\overline{726}$	$\overline{728(1)}$	$\overline{728(2)}$	$\overline{728(3)}$	$\overline{728(4)}$
1089	0	416	4	0	106	206	322
$\overline{732(1)}$	$\overline{734(1)}$	$\overline{732(2)}$	$\overline{734(2)}$	$\overline{732(3)}$	$\overline{734(3)}$	$\overline{732(4)}$	$\overline{734(4)}$
0	0	5	0	2	0	29	0

FIG. 8

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[illegible]

FIG. 9

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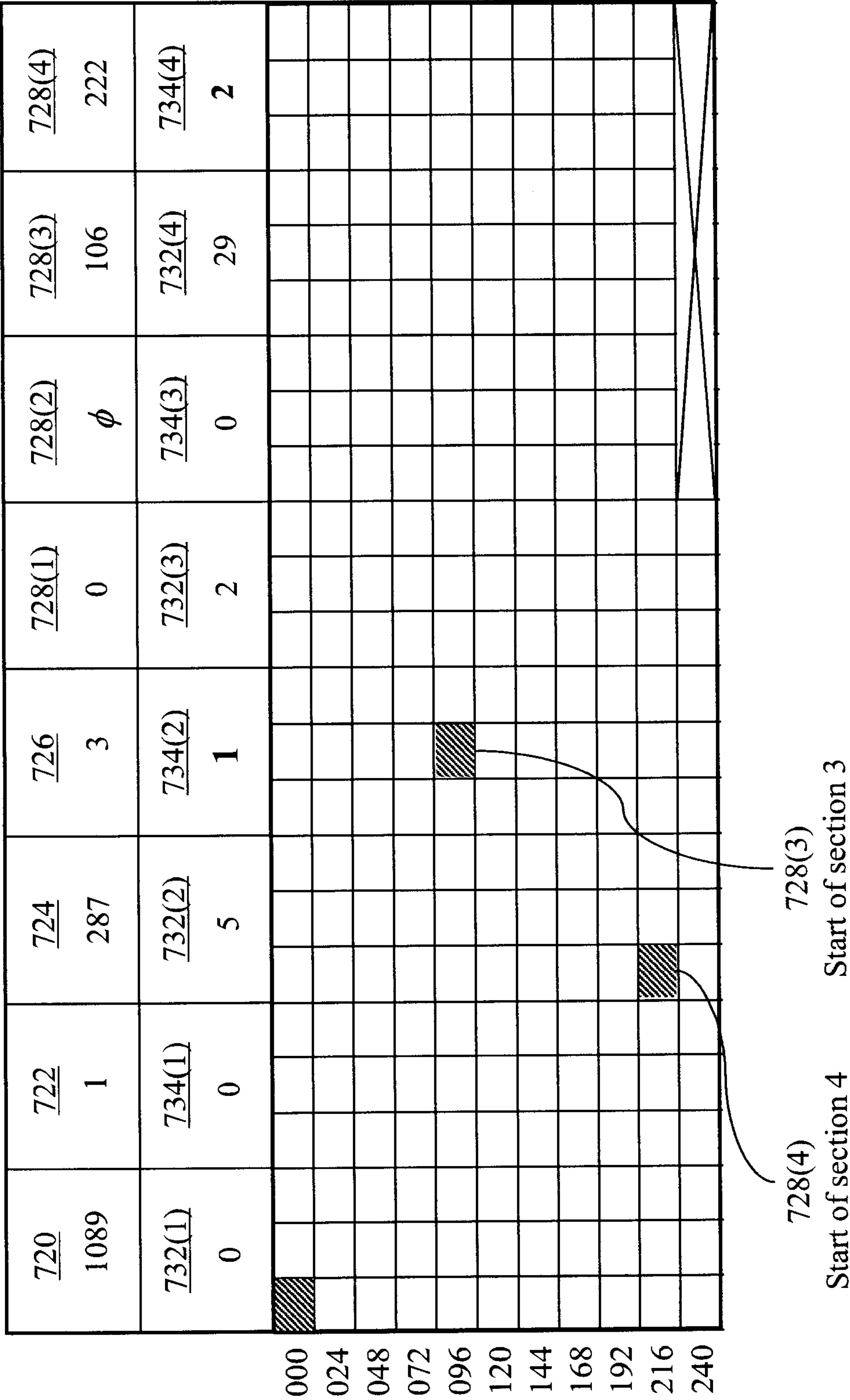


FIG. 10

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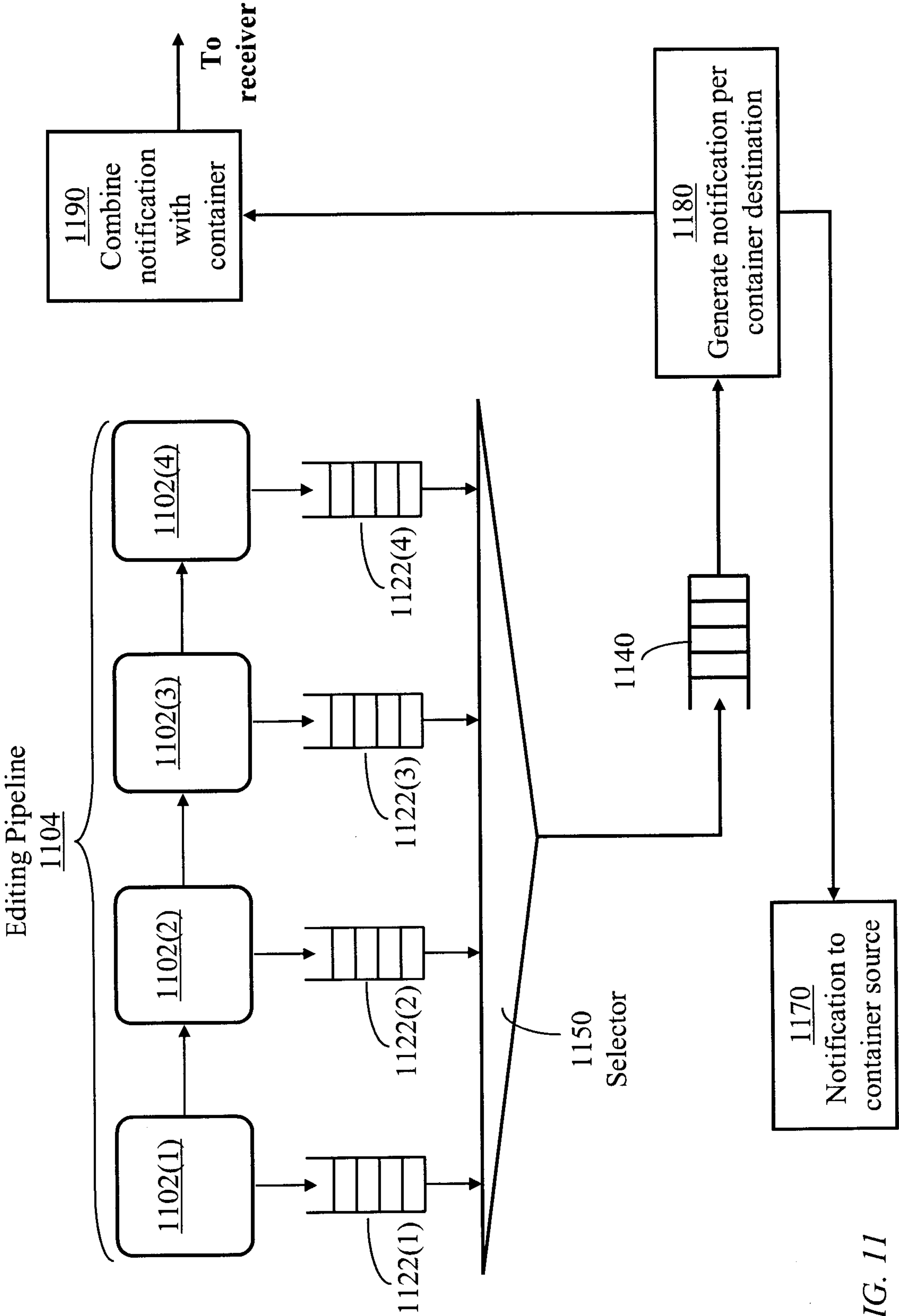


FIG. 11

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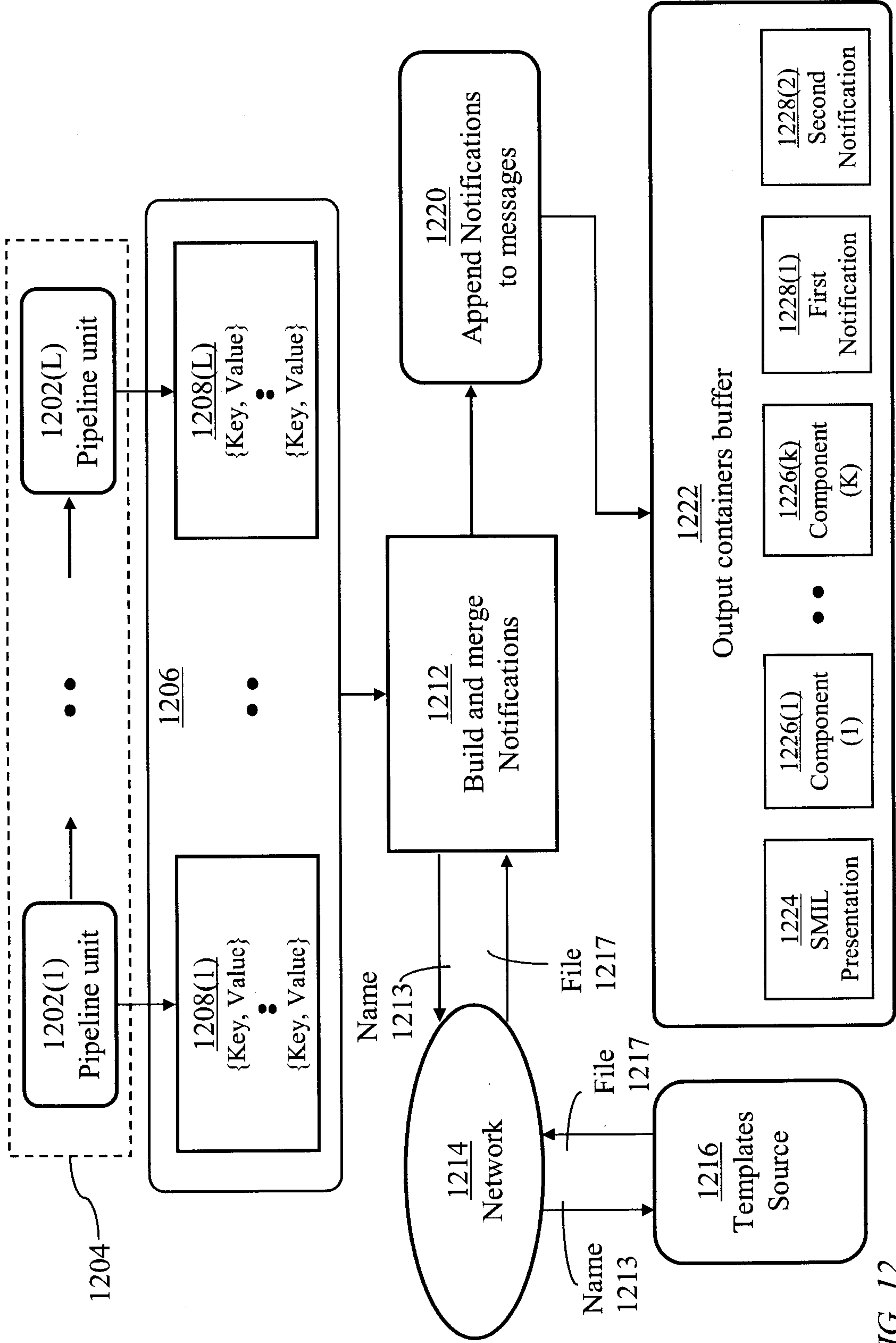


FIG. 12

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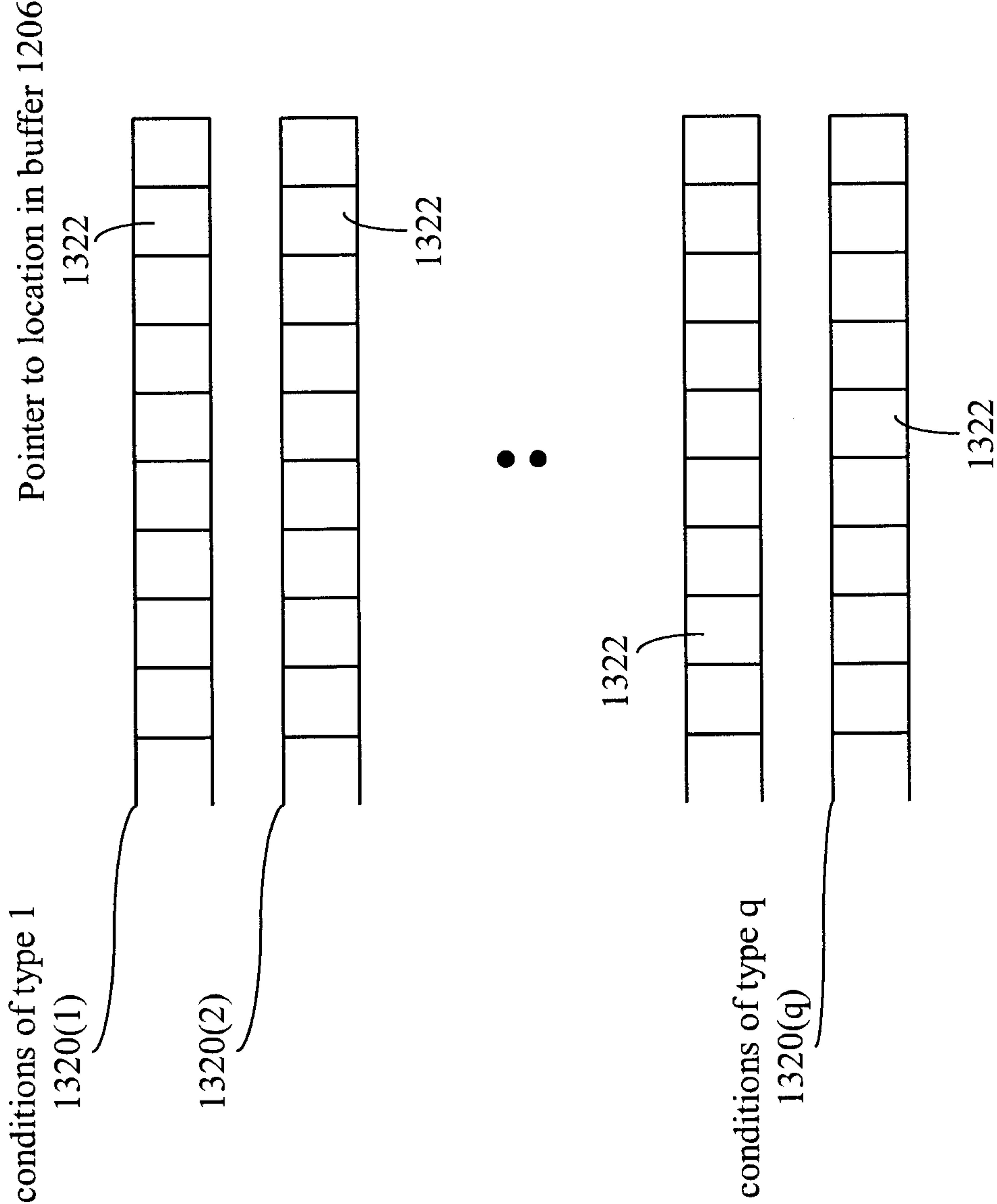


FIG. 13

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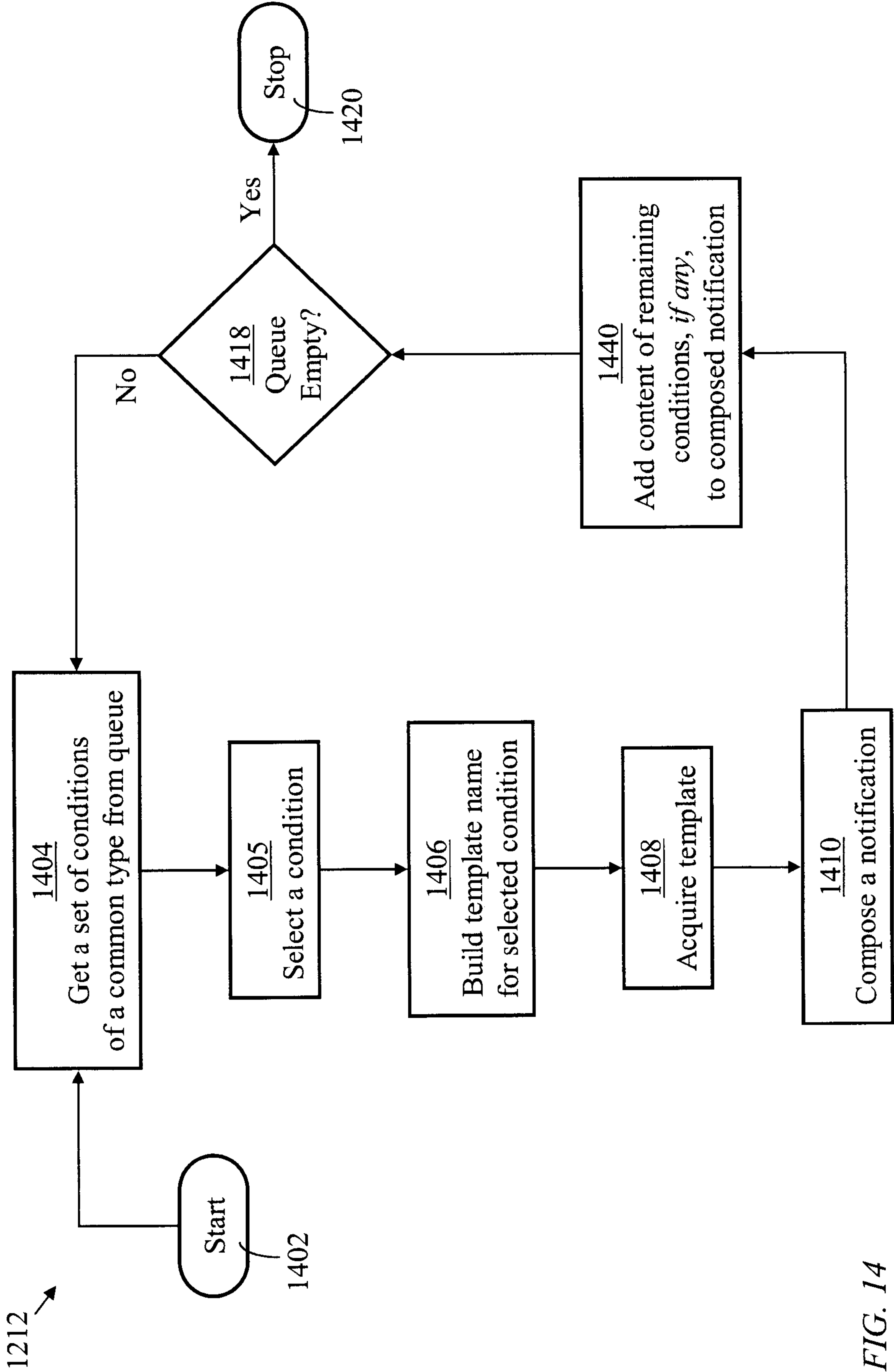


FIG. 14

Original Container

Component(1)	Component(2)	Component(3)	Component(4)	Component(5)	Component(6)
Component-Type (1-A)	Component-type (2-A)		Component-type (3-A)		Component-Type (4-A)

Component(1) <i>Pass</i>	Component(2) <i>Virus X</i>	Component(3) <i>Pass</i>	Component(4) <i>Pass</i>	Component(5) <i>Virus Y</i>	Component(6) <i>Virus X</i>
-----------------------------	--------------------------------	-----------------------------	-----------------------------	--------------------------------	--------------------------------

Receiver 1

Component-Type (1-C)	Component-Type (2-A)	Component-Type (3-A)	Component-Type (4-E)
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Receiver 2

Component-Type (1-A)	Component-Type (2-W)	Component-Type (3-B)	Component-Type (4-A)
----------------------	----------------------	----------------------	----------------------

FIG. 15

Output Container to receiver 1

Component(1) Translated to Type (1-C)	Component(2) Virus X removed	Component(3) No change	Component(4) No change	Component(5) Deleted: Virus Y not removed	Component(6) Translated to Type (4-E) Virus X removed
---	------------------------------------	---------------------------	---------------------------	--	---

Output Container to receiver 2

Component(1) No change	Component(2) Translated to Type (2-W) Virus X removed	Component(3) Translated to Type (2-W)	Component(4) Translated to Type (3-B)	Component(5) Deleted: Virus Y not removed	Component(6) Virus X removed
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FIG. 16

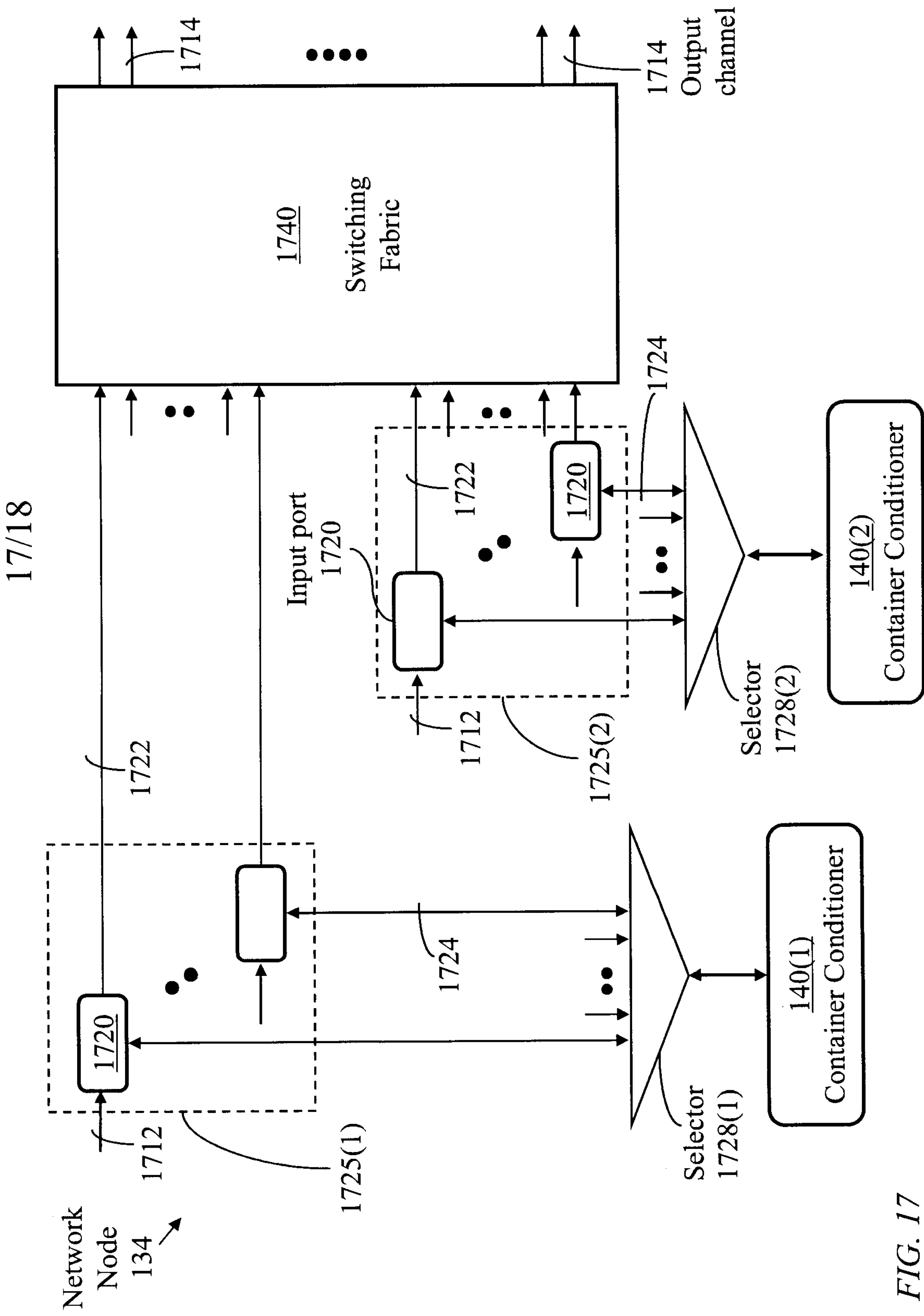


FIG. 17

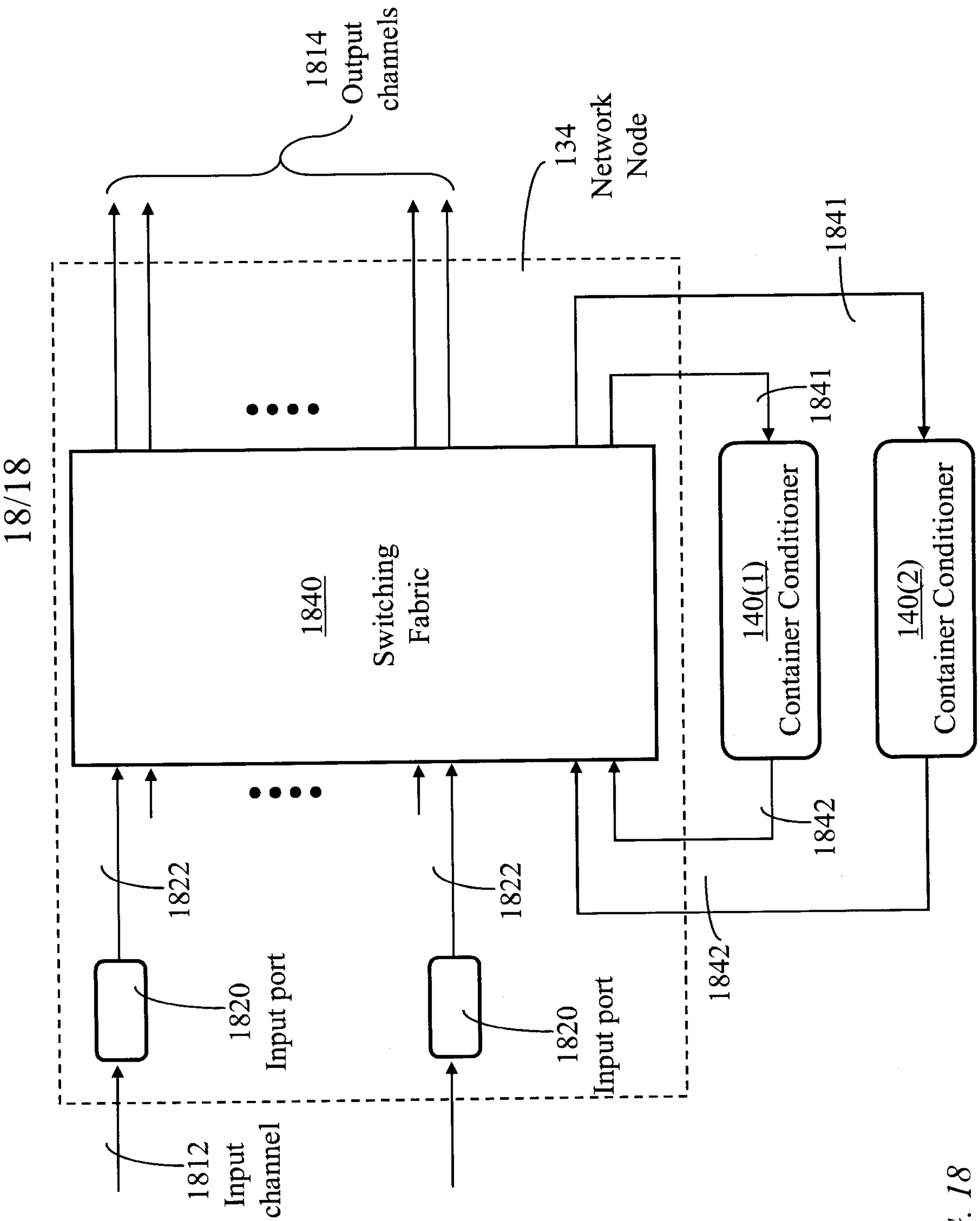


FIG. 18

