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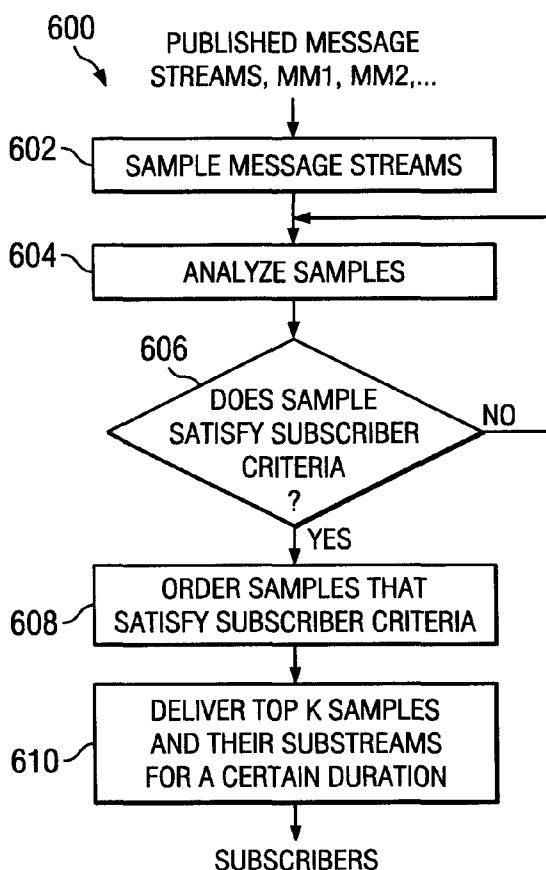
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(54) Title: METHOD AND SYSTEM FOR MEDIATING PUBLISHED MESSAGE STREAMS FOR SELECTIVE DISTRIBUTION



(57) Abstract: A computer implemented method, system and computer program product for delivering published messages to at least one subscriber in a publish-subscribe messaging system. A computer implemented method for delivering published messages to a subscriber includes receiving a plurality of message streams, and analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality. At least one message that satisfies the criteria is delivered to the subscriber.

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**METHOD AND SYSTEM FOR MEDIATING PUBLISHED MESSAGE  
STREAMS FOR SELECTIVE DISTRIBUTION**

**BACKGROUND OF THE INVENTION**

5

**Field of the Invention**

The present invention relates generally to the data processing field, and more particularly, to a computer implemented method, system and computer  
10 program product for routing and delivering messages based on evaluation of quality of information payloads.

**Description of the Related Art**

15 A publish-subscribe messaging system has two types of clients. Publisher clients generate messages, also referred to as events, containing a topic and some data content. Subscriber clients request a criterion, also called a subscription, specifying the kind of information, based on published messages, the system is to deliver in the future. Publishers and  
20 subscribers are anonymous to each other, meaning that publishers do not necessarily know how many subscribers there are or where they are located; and subscribers do not necessarily know where the publishers are located.

A topic-based publish-subscribe messaging system is a system in which  
25 subscriptions specify topics of messages which subscriber clients wish to receive. A content-based, publish-subscribe messaging system is a system in which delivered messages are a possibly filtered subset based on the content of published messages; and the subscription criterion is a property that can be tested on each message independent of any other  
30 message. For example, a filter may determine whether "topic = stock-ticker/GE" or "Stock/IBM/trade:volume > 1000". Content-based or topic-based publish-subscribe systems are referred to herein as "stateless" systems.

35 There are pre-existing and emerging technologies to solve deficiencies of content-based publish-subscribe systems as they only support limited filtering capability. For example, mediators to process or transform messages may be introduced into the flow of traditional messaging  
middleware. Although this is a useful concept, in current manifestations,  
40 mediators are complex to program and require external database services in

order to store and access state. Also, groups of mediators cannot be automatically combined in current implementations.

In addition, with the advent of highly capable, wirelessly connected, widely distributed sensor networks, scenarios are emerging which require intelligent delivery of collected data in a timely fashion. These distributed sensor networks include sensors that capture audio and video, and they can provide a wealth of data, which may overlap in scope (for example, fields of view) and coverage (for example, spatial and temporal), thus varying in quality of data as well as provide potentially new types of messages. While the evolution of the Web has increased information available via user pull, these new scenarios also describe increased information available via push and via rich media streams.

Consider, for example, location information published by various sources including GPS, cell phone triangulation, etc. A subscription to receive messages is needed not only about the location of interest, but also about the quality of the location information, for example, the precision of location data in terms of longitudinal or latitude degrees, or to a finer level of within a few millimeters of the desired location. As an example, an employer may subscribe to information about an employee engaged in repair services, carrying a wireless device including location information. The employer may wish to obtain messages containing such location, selected for their precision. A location message based on GPS can provide the location of an office building which the employee has entered, and a wifi triangulation service might provide a location of which office the employee had entered.

Another example is temperature information published by various sources including weather bureaus, car thermometers, sensors on a manufacturing floor, etc. Often, a subscription to trigger an alarm, for example, needs to specify not only the temperature of interest, but also the quality of the temperature granularity. If a person monitors weather information, a precision within a few degrees may be tolerable. On the other hand, a temperature sensor mounted on a manufacturing floor needs to provide information to a finer level of granularity, for example, to the tenth of a degree. An individual interested in how to dress for the day may subscribe to temperatures precise to a 5 degree range. The same individual may require temperature precise to a fraction of a degree in order to determine if gardens are in danger of freezing.

In addition, when messages carry multimedia payloads, different kinds of quality requirements become paramount. Consider, for example, a problem encountered by a battlefield commander. The commander must keep aware of events transpiring on the battlefield. Low resolution satellite image feeds, higher resolution tank image feeds, and other multimedia information of relevance is being captured, but the commander bears the burden of sorting all the images after they are received in order to obtain the most informative image or images. It would be advantageous to provide a mechanism that enables the commander to set up desired criteria for these multimedia messages ahead of time in such a way that he or she can choose to preferentially receive the most desired image(s).

Current publish-subscribe messaging systems do not provide such a capability. As indicated previously, they may contain some filtering capabilities as well as mediations that perform message transformation of single or multiple messages. Generally, however, these mediations examine individual messages and perform their task in relation to those individual messages. There are some mediations or message transformations which examine multiple messages in order to perform their task. An example is a mediation that provides an "average" computation. These mediations, however, only operate on simple text or numeric message attributes to provide a derived state to the subscriber.

Continuing the battlefield scenario described above, there may be other subscribers, in addition to the battlefield commander, with different criteria. For example, a tank commander may want to receive images of a long view ahead of the tank in order to avoid ambush. This subscription must be satisfied from the same sensor data as that of the battlefield commander; however, for this user, the criteria will be different (for example, depth-of-view, movement identified or the like).

For the most part, current technology acts on individual messages rather than on a stream of messages. However, aggregation of message data is known. For example, SMILE technology (see "Relational Subscription Middleware for Internet-Scale Publish-Subscribe", Yuhui Jin and Rob Strom, 2<sup>nd</sup> International Workshop on Distributed Event-Based Systems (DEBS'03), 2003) can aggregate information from multiple streams, and deliver a message based on this aggregation. SMILE technology, for example, is capable of taking streams representing sales of seats on multiple airline flights, and delivering a current number of available seats on the  $k$  cheapest flights to London to a subscriber.

**SUMMARY OF THE INVENTION**

According to a first aspect, there is provided a computer implemented  
5 method for delivering published messages to a subscriber, comprising:  
receiving a plurality of message streams; analyzing at least one message  
from each of the plurality of message streams in accordance with criteria  
established by the subscriber specifying a message content and a message  
content quality; selecting, based on the analyzing step, at least one  
10 message stream which comprises messages satisfying the criteria for  
delivery to the subscriber; and delivering at least one message that  
satisfies the criteria to the subscriber from each selected stream.

According to a second aspect, there is provided a computer program  
15 product, comprising: a computer usable medium having computer usable  
program code for delivering published messages to a subscriber, the  
computer program product comprising: computer usable program code  
configured for receiving a plurality of message streams; computer usable  
program code configured for analyzing at least one message from each of  
20 the plurality of message streams in accordance with criteria established  
by the subscriber specifying a message content and a message content  
quality; and computer usable program code configured for selecting, based  
on output from the analyzing code, at least one message stream which  
comprises messages satisfying the criteria for delivery to the subscriber;  
25 and computer usable program code configured for delivering at least one  
message that satisfies the criteria to the subscriber from each selected  
stream.

According to a third aspect, there is provided a publish-subscribe  
30 messaging system for delivering published messages to at least one  
subscriber, comprising: at least one message broker for receiving a  
plurality of message streams; an analyzer for analyzing at least one  
message from each of the plurality of message streams in accordance with  
criteria established by the subscriber specifying a message content and a  
message content quality; and a selector for selecting, based on output  
35 from the analyzer, at least one message stream which comprises messages  
satisfying the criteria for delivery to the subscriber; and a mechanism  
for delivering at least one message that satisfies the criteria from the  
message broker to the subscriber from each selected stream.

There is preferably provided a solution which uses samples from a multimedia stream in order to determine whether to deliver multiple messages from the stream. There is further preferably provided a solution which compares messages from different streams in order to determine which of them should be delivered.

There is preferably provided a mechanism that can analyze message streams to determine which streams, or parts of streams, should be delivered to one or more users to provide a higher quality of information as specified by the one or more users.

#### BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described, by way of example only, and with reference to the following drawings:

**Figure 1** depicts a pictorial representation of a network of data processing systems in which aspects of the present invention may be implemented in accordance with a preferred embodiment;

**Figure 2** depicts a block diagram of a data processing system in which aspects of the present invention may be implemented in accordance with a preferred embodiment of the present invention;

**Figure 3** is a diagram that schematically illustrates a broker network for a publish-subscribe messaging system according to an exemplary embodiment of the present invention;

**Figure 4** is a diagram that schematically illustrates a publish-subscribe messaging system according to an exemplary embodiment of the present invention;

**Figure 5** is a diagram that schematically illustrates selection of message streams among multiple message streams according to an exemplary embodiment of the present invention; and

**Figure 6** is a flowchart that illustrates a method for delivering published messages to a plurality of subscribers according to an exemplary embodiment of the present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

**Figures 1-2** are provided as exemplary diagrams of data processing environments in which embodiments of the present invention may be implemented. It should be appreciated that **Figures 1-2** are only exemplary and are not intended to assert or imply any limitation with regard to the environments in which embodiments of the present invention may be implemented. Many modifications to the depicted environments may be made without departing from the spirit and scope of the present invention.

With reference now to the figures, **Figure 1** depicts a pictorial representation of a network of data processing systems in which aspects of the present invention may be implemented in accordance with a preferred embodiment. Network data processing system **100** is a network of computers in which embodiments of the present invention may be implemented. Network data processing system **100** contains network **102**, which is the medium used to provide communications links between various devices and computers connected together within network data processing system **100**. Network **102** may include connections, such as wire, wireless communication links, or fiber optic cables.

In the depicted example, server **104** and server **106** connect to network **102** along with storage unit **108**. In addition, clients **110**, **112**, and **114** connect to network **102**. These clients **110**, **112**, and **114** may be, for example, personal computers or network computers. In the depicted example, server **104** provides data, such as boot files, operating system images, and applications to clients **110**, **112**, and **114**. Clients **110**, **112**, and **114** are clients to server **104** in this example. Network data processing system **100** may include additional servers, clients, and other devices not shown.

In the depicted example, network data processing system **100** is the Internet with network **102** representing a worldwide collection of networks and gateways that use the Transmission Control Protocol/Internet Protocol (TCP/IP) suite of protocols to communicate with one another. At the heart of the Internet is a backbone of high-speed data communication lines between major nodes or host computers, consisting of thousands of commercial, government, educational and other computer systems that route data and messages. Of course, network data processing system **100** also may be implemented as a number of different types of networks, such as for example, an intranet, a local area network (LAN), or a wide area network



(WAN). **Figure 1** is intended as an example, and not as an architectural limitation for different embodiments of the present invention.

With reference now to **Figure 2**, a block diagram of a data processing system is depicted in which the present invention may be implemented in accordance with a preferred embodiment. Data processing system **200** is an example of a computer, such as server **104** or client **110** in **Figure 1**, in which computer usable code or instructions implementing the processes for embodiments of the present invention may be located.

In the depicted example, data processing system **200** employs a hub architecture including north bridge and memory controller hub (MCH) **202** and south bridge and input/output (I/O) controller hub (ICH) **204**. Processing unit **206**, main memory **208**, and graphics processor **210** are connected to north bridge and memory controller hub **202**. Graphics processor **210** may be connected to north bridge and memory controller hub **202** through an accelerated graphics port (AGP).

In the depicted example, local area network (LAN) adapter **212** connects to south bridge and I/O controller hub **204**. Audio adapter **216**, keyboard and mouse adapter **220**, modem **222**, read only memory (ROM) **224**, hard disk drive (HDD) **226**, CD-ROM drive **230**, universal serial bus (USB) ports and other communications ports **232**, and PCI/PCIe devices **234** connect to south bridge and I/O controller hub **204** through bus **238** and bus **240**. PCI/PCIe devices may include, for example, Ethernet adapters, add-in cards and PC cards for notebook computers. PCI uses a card bus controller, while PCIe does not. ROM **224** may be, for example, a flash binary input/output system (BIOS).

Hard disk drive **226** and CD-ROM drive **230** connect to south bridge and I/O controller hub **204** through bus **240**. Hard disk drive **226** and CD-ROM drive **230** may use, for example, an integrated drive electronics (IDE) or serial advanced technology attachment (SATA) interface. Super I/O (SIO) device **236** may be connected to south bridge and I/O controller hub **204**.

An operating system runs on processing unit **206** and coordinates and provides control of various components within data processing system **200** in **Figure 2**. As a client, the operating system may be a commercially available operating system such as Microsoft® Windows® XP (Microsoft and Windows are trademarks of Microsoft Corporation in the United States, other countries, or both). An object-oriented programming system, such as the Java™ programming system,

may run in conjunction with the operating system and provides calls to the operating system from Java programs or applications executing on data processing system **200** (Java is a trademark of Sun Microsystems, Inc. in the United States, other countries, or both).

As a server, data processing system **200** may be, for example, an IBM® eServer™ pSeries® computer system, running the Advanced Interactive Executive (AIX®) operating system or LINUX® operating system (IBM, eServer, pSeries and AIX are trademarks of International Business Machines Corporation in the United States, other countries, or both while Line is a trademark of Linus Torvalds in the United States, other countries, or both). Data processing system **200** may be a symmetric multiprocessor (SMP) system including a plurality of processors in processing unit **206**. Alternatively, a single processor system may be employed.

Instructions for the operating system, the object-oriented programming system, and applications or programs are located on storage devices, such as hard disk drive **226**, and may be loaded into main memory **208** for execution by processing unit **206**. The processes for embodiments of the present invention are performed by processing unit **206** using computer usable program code, which may be located in a memory such as, for example, main memory **208**, read only memory **224**, or in one or more peripheral devices **226** and **230**.

Those of ordinary skill in the art will appreciate that the hardware in **Figures 1-2** may vary depending on the implementation. Other internal hardware or peripheral devices, such as flash memory, equivalent non-volatile memory, or optical disk drives and the like, may be used in addition to or in place of the hardware depicted in **Figures 1-2**. Also, the processes of the present invention may be applied to a multiprocessor data processing system.

In some illustrative examples, data processing system **200** may be a personal digital assistant (PDA), which is configured with flash memory to provide non-volatile memory for storing operating system files and/or user-generated data.

A bus system may be comprised of one or more buses, such as bus **238** or bus **240** as shown in **Figure 2**. Of course the bus system may be implemented using any type of communications fabric or architecture that provides for a transfer of data between different components or devices attached to the

fabric or architecture. A communications unit may include one or more devices used to transmit and receive data, such as modem **222** or network adapter **212** of **Figure 2**. A memory may be, for example, main memory **208**, read only memory **224**, or a cache such as found in north bridge and memory controller hub **202** in **Figure 2**. The depicted examples in **Figures 1-2** and above-described examples are not meant to imply architectural limitations. For example, data processing system **200** also may be a tablet computer, laptop computer, or telephone device in addition to taking the form of a PDA.

The preferred embodiment provides a computer implemented method, system and computer program product for mediating published message streams in a distributed messaging system. A data processing device of the distributed messaging system may be implemented as a stand-alone computing device, or as a distributed data processing system in which multiple computing devices are utilized to perform various aspects of the preferred embodiment.

In accordance with an exemplary embodiment of the present invention, a network data processing system, such as network data processing system **100** illustrated in **Figure 1**, provides a distributed messaging system that supports subscriptions. A subset of clients, for example, a subset of clients **110**, **112** and **114** in **Figure 1**, may be publishing clients, while others of the clients may be subscribing clients. Published events may also be generated by one or more servers, such as one or more of servers **104** and **106** in **Figure 1**.

**Figure 3** is a diagram that schematically illustrates a broker network for a publish-subscribe messaging system according to an exemplary embodiment of the present invention. The messaging system is implemented within an overlay network of service machines referred to as "brokers". One or more of servers **104** and **106** in **Figure 1**, may, for example, be broker machines. A plurality of broker machines are responsible for delivery of messages sent by publishing clients towards subscribing clients based on the content of the messages and the subscriptions requested by the subscribing clients. Some broker machines may be specialized for hosting publishing clients, referred to as publisher hosting brokers (PHB), and others for hosting subscribing clients, referred to as subscriber hosting brokers (SHB). Between the PHBs and the SHBs, there may be any number of intermediate nodes that include routing and filtering. The brokers at the

intermediate nodes are referred to as intermediate brokers or IBs. For expository purposes, this separation of brokers is assumed; however, in actual deployment, some or all of the broker machines may combine the functions of PHB, SHB and/or IB. A publishing client, such as one of  
5 publishers **302a-302d** establish a connection to a PHB, such as PHB **304a** or **304b**, over a corresponding one of client connections **306a-306d**.  
Independently, a subscribing client, such as one of subscribers **312a-312d**, establishes a connection to a SHB, such as SHB **310a** or SHB **310b**, over a corresponding one of client connections **314a-314d**. The PHBs and SHBs are  
10 connected, via intermediate brokers **308a-308b**, through an array of broker-to-broker links.

In the exemplary broker network depicted in **Figure 3**, one or more execution engines may run on the brokers in the network and be  
15 interconnected. The one or more execution engines may be interconnected to form a distributed execution engine. The execution engines running on the plurality of broker machines receive input messages; process the input messages using transform objects, and route output messages toward subscribers. The broker-to-client and broker-to-broker connections may be,  
20 for example, any reliable first in-first out (FIFO) connection, such as a Transmission Control Protocol/Internet Protocol (TCP/IP) socket connection.

The present invention preferably provides a computer implemented method and system for analyzing message streams in order to determine which  
25 streams (and parts of streams) of a plurality of message streams can be delivered to a correct recipient among, possibly, a plurality of users in order to provide high quality information as specified by the users. According to an exemplary embodiment of the present invention, one or more message streams that contain one or more messages that satisfy a user's  
30 criteria are selected and evaluated, and this evaluation is used to deliver further messages to the user from the one or more message streams.

**Figure 4** is a diagram that schematically illustrates a publish-subscribe messaging system according to an exemplary embodiment of the present  
35 invention. The system is generally designated by reference number **400**, and includes broker network **402**, which may, for example, be implemented as broker network **300** illustrated in **Figure 3**. System **400** receives a plurality of streams of multimedia messages **404**, **406** and **408** from a plurality of message stream sources **410**, **412** and **414**, respectively,  
40 analyzes the received message streams, and delivers one or more messages

from one or more of the plurality of message streams to subscribers **416**, **418** and **420** in accordance with criteria established by the subscribers specifying message content and message content quality.

5 In **Figure 4**, message sources **410**, **412** and **414** include a satellite feed, a ground camera and a roof-mounted sensor. It should be understood that these are intended to be exemplary only as the message sources can comprise any number of message sources of any suitable type. Also in **Figure 4**, three subscribers **416**, **418** and **420** including subscribers  
10 utilizing a PDA, a mobile phone and a laptop computer are shown. This is also intended to be exemplary only as the subscribers can include any number of subscribers utilizing any type of message receiving mechanism.

Broker **430** in broker network **402** analyzes comparable message samples from  
15 each of message streams **404**, **406** and **408** to identify samples that meet the criteria specified by the subscribers. According to an exemplary embodiment of the present invention, all samples which meet the criteria are ranked, and a subset comprising the top k streams are chosen for delivery for the duration of a sample period. In a simple exemplary  
20 embodiment, for example, k = 1, and exactly one sample is taken per stream per period. At the next sample period, the process is repeated. The determination of what constitutes a comparable message may depend on various factors including the time a message is received, the time a message is sensed, message location, spatial coverage of a message, a time  
25 code associated with a message (e.g., SMPTE time codes), and the like.

A subscriber's criteria can include any criteria desired by the subscriber relating to message content and message content quality. For example, in the battlefield environment described previously, criteria may include  
30 that a scene be brightly lit, well-focused or least noisy. The evaluation of whether a sample meets the subscriber's criteria is achieved by using multimedia analysis involving either image or audio analysis. For example, if a criterion is "brightly lit", then an image analysis algorithm can be used that can compute the brightness distribution within an image and  
35 measure the contrast to determine a level of brightness. Other useful criteria include (1) the image showing the best contrast, (2) the image showing the greatest detail, and (3) the image showing the fullest view. Such image analysis algorithms are part of image analysis libraries that are readily available both commercially and to the general public. These  
40 can be implemented as mediators in the stateful publish-subscribe system as schematically illustrated at **432** and **434** in **Figure 4**.

Received messages can be switched back and forth from one source to another depending on the degree of satisfaction of the criteria. For example, a camera focused on a military objective may provide images for a first time slot; however, if the camera becomes obscured, a satellite image feed may be used to provide images for a second time slot. Once the first camera is clear of the obstruction, it may once again provide images for a third time slot.

According to a further exemplary embodiment of the present invention, multiple comparable message streams are delivered. When a sample image from a message stream is identified that most satisfies a subscriber's criteria, other messages in the local neighborhood of the same stream (i.e., from frames close in time to the sample image such as immediately before and immediately after the sample image) are examined. If these messages also meet the criteria, the sample and the neighborhood messages are delivered to the subscriber.

The size of the neighborhood may be constrained via system parameters or user specifications, or may be adaptive. Note that even when  $k = 1$ , samples and their neighborhood messages from multiple sources that overlap in time can be promptly provided. This exemplary embodiment also enables scenarios where as much information as possible about a single event, from multiple sources is desirable. For example, if the event is an explosion, this exemplary embodiment can provide not only one or more close-up views of the explosion, but also a wide angle view from satellite imagery.

**Figure 5** is a diagram that schematically illustrates selection of message streams among multiple message streams according to an exemplary embodiment of the present invention. As shown, a plurality of published message streams MM1, MM2 and MM3 are received by a broker **500**. Broker **500** samples and analyzes the message streams, for example, using mediation as illustrated in **Figure 4**, to determine if they meet criteria specified by a subscriber. The top samples from a substream that best meet the criteria are then sent to the subscriber. As shown in **Figure 5**, samples from message stream MM2 are sent to the subscriber during a first time interval **502** as best meeting the criteria, while samples from message streams MM1 and MM3 are sent during subsequent time intervals **504** and **506**, respectively, as best meeting the criteria during those time intervals.

**Figure 6** is a flowchart that illustrates a method for delivering published messages to a plurality of subscribers according to an exemplary embodiment of the present invention. The method is generally designated by reference number **600**, and begins by sampling a plurality of published message streams MM1, MM2, etc. (Step **602**). The samples are then analyzed (Step **604**), and a determination is made whether the samples satisfy criteria established by subscribers specifying message content and message content quality (Step **606**). If a sample does not satisfy the criteria (No output of Step **606**), the method returns to Step **604** to continue analyzing samples.

If samples do satisfy the criteria (Yes output of Step **606**), the samples are ordered (Step **608**). The top k samples and, optionally, their substreams (for example, the samples together with messages before and after the samples) are then delivered to the appropriate subscribers for a specified time duration (Step **610**). The process is then repeated for subsequent time durations.

The present invention thus provides a computer implemented method, system and computer program product for delivering published messages to at least one subscriber in a publish-subscribe messaging system. A computer implemented method for delivering published messages to a subscriber includes receiving a plurality of message streams, and analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality. At least one message that satisfies the criteria is delivered to the subscriber.

The invention can take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment containing both hardware and software elements. In a preferred embodiment, the invention is implemented in software, which includes but is not limited to firmware, resident software, microcode, etc.

Furthermore, the invention can take the form of a computer program product accessible from a computer-usable or computer-readable medium providing program code for use by or in connection with a computer or any instruction execution system. For the purposes of this description, a computer-usable or computer readable medium can be any tangible apparatus that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

The medium can be an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system (or apparatus or device) or a propagation medium. Examples of a computer-readable medium include a semiconductor or solid state memory, magnetic tape, a removable computer diskette, a random access memory (RAM), a read-only memory (ROM), a rigid magnetic disk and an optical disk. Current examples of optical disks include compact disk - read only memory (CD-ROM), compact disk - read/write (CD-R/W) and DVD.

A data processing system suitable for storing and/or executing program code will include at least one processor coupled directly or indirectly to memory elements through a system bus. The memory elements can include local memory employed during actual execution of the program code, bulk storage, and cache memories which provide temporary storage of at least some program code in order to reduce the number of times code must be retrieved from bulk storage during execution.

Input/output or I/O devices (including but not limited to keyboards, displays, pointing devices, etc.) can be coupled to the system either directly or through intervening I/O controllers.

Network adapters may also be coupled to the system to enable the data processing system to become coupled to other data processing systems or remote printers or storage devices through intervening private or public networks. Modems, cable modem and Ethernet cards are just a few of the currently available types of network adapters.

The description of the present invention has been presented for purposes of illustration and description, and is not intended to be exhaustive or limited to the invention in the form disclosed. Many modifications and variations will be apparent to those of ordinary skill in the art. The embodiment was chosen and described in order to best explain the principles of the invention, the practical application, and to enable others of ordinary skill in the art to understand the invention for various embodiments with various modifications as are suited to the particular use contemplated.



**CLAIMS**

1. A computer implemented method for delivering published messages to a subscriber, comprising:

5 receiving a plurality of message streams;  
analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality;

10 selecting, based on the analyzing step, at least one message stream which comprises messages satisfying the criteria for delivery to the subscriber and

delivering at least one message that satisfies the criteria to the subscriber from each selected stream.

15 2. The computer implemented method according to claim 1, wherein analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

20 analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria.

3. The computer implemented method according to claim 2, wherein analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria, comprises:

25 ranking message samples from each of the plurality of message streams that satisfy the criteria, and wherein selecting at least one stream comprises selecting a subset of the message streams in accordance with the ranking step.

30 4. The computer implemented method according to claim 3, and further comprising:

selecting the number of streams selected.

35 5. The computer implemented method according to claim 2, wherein analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria, comprises:

ranking messages from each of the plurality of message streams that satisfy the criteria, and wherein delivering at least one message that satisfies the criteria to the subscriber, comprises:

40 delivering a subset of the ranked messages that most satisfies the subscriber criteria to the subscriber.

6. The computer implemented method according to claim 5, and further comprising:

selecting the number of ranked messages comprising the subset.

5

7. The computer implemented method according to any preceding claim, wherein analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

10 analyzing messages from each of the plurality of message streams that are in a neighborhood of an analyzed message; and wherein delivering at least one message that satisfies the criteria to the subscriber, comprises:

15 delivering at least one message that is in a neighborhood of an analyzed message and that satisfies the criteria to the subscriber.

8. The computer implemented method according to any preceding claim, wherein delivering at least one message that satisfies the criteria to the subscriber, comprises:

20 delivering all messages from all message streams containing said at least one message that satisfies the criteria to the subscriber for a predetermined time period.

9. The computer implemented method according to any preceding claim, and further comprising:

repeating the receiving, analyzing and delivering steps for each of a plurality of consecutive predetermined time periods.

10. The computer implemented method according to any preceding claim, wherein analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

30 analyzing at least one message from each of the plurality of message streams in accordance with criteria established by a plurality of subscribers, wherein each of the plurality of subscribers specify a message content and a message content quality; and wherein selecting a message stream that satisfies the criteria, comprises:

40 selecting a message stream that satisfies the criteria of each of the plurality of subscribers for delivery to each subscriber; and wherein

delivering at least one message that satisfies the criteria to the subscriber, comprises:

delivering at least one message that satisfies the criteria of each of the plurality of subscribers to each subscriber.

5

11. The computer implemented method according to any preceding claim, wherein the message content quality criteria comprises:

at least one of brightness, focus, noisiness, image clarity, image resolution, sound clarity and measurement precision.

10

12. A computer program product, comprising:

a computer usable medium having computer usable program code for delivering published messages to a subscriber, the computer program product comprising:

15 computer usable program code configured for receiving a plurality of message streams;

computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a  
20 message content quality; and

computer usable program code configured for selecting, based on output from the analyzing code, at least one message stream which comprises messages satisfying the criteria for delivery to the subscriber; and

25 computer usable program code configured for delivering at least one message that satisfies the criteria to the subscriber from each selected stream.

13. The computer program product of claim 12, wherein computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

35 computer usable program code configured for analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria.

14. The computer program product of claim 13, wherein the computer usable program code configured for analyzing at least one comparable  
40 message from each of the plurality of message streams in accordance with the criteria, comprises:

computer usable program code configured for ranking message samples from each of the plurality of message streams that satisfy the criteria, and wherein computer usable program code configured for selecting at least one stream comprises computer usable program code configured for selecting a subset of the message streams in accordance with the ranking.

15. The computer program product of claim 14, and further comprising: computer usable program code configured for selecting the number of streams selected.

16. The computer program product according to claim 12 or 13, wherein the computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

computer usable program code configured for ranking messages from each of the plurality of message streams that satisfy the criteria, and wherein the computer usable program code configured for delivering at least one message that satisfies the criteria to the subscriber,

comprises:

computer usable program code configured for delivering a subset of the ranked messages that most satisfies the subscriber criteria to the subscriber.

17. The computer program product according to claim 16, and further comprising:

computer usable program code configured for selecting the number of ranked messages comprising the subset.

18. The computer program product according to any of claims 12 to 17, wherein the computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

computer usable program code configured for analyzing messages from each of the plurality of message streams that are in a neighborhood of an analyzed message, and wherein the computer usable program code configured for delivering at least one of the at least one ordered message to each at least one subscriber, comprises:

computer usable program code configured for delivering at least one message that is in a neighborhood of an analyzed message and that satisfies the criteria to the subscriber.

- 5 19. The computer program product according to any of claims 12 to 18, wherein the computer usable program code configured for delivering at least one message that satisfies the criteria to the subscriber, comprises:

10 computer usable program code configured for delivering at least one message that satisfies the criteria to the subscriber for a predetermined time period.

20. The computer program product according to any of claims 12 to 19, and further comprising:

15 computer usable program code configured for repeating the receiving, analyzing and delivering steps for each of a plurality of consecutive predetermined time periods

21. The computer program product according to any of claims 12 to 20, wherein the computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying message content and message content quality, comprises:

25 computer usable program code configured for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by a plurality of subscribers, wherein each of the plurality of subscribers specify a message content and a message content quality, and wherein the computer usable program code configured for selecting a message stream that satisfies the criteria comprises:

30 computer usable program code configured for selecting a message stream that satisfies the criteria of each of the plurality of subscribers for delivery to each subscriber, and wherein the computer usable program code configured for delivering at least one message that satisfies the criteria to the subscriber, comprises:

35 computer usable program code configured for delivering at least one message that satisfies the criteria of each of the plurality of subscribers to each subscriber.

- 40 22. The computer program product according to any of claims 12 to 21, wherein the message content quality criteria comprises:

at least one of brightness, focus, noisiness, image clarity, image resolution, sound clarity and measurement precision.

23. A publish-subscribe messaging system for delivering published  
5 messages to at least one subscriber, comprising:

at least one message broker for receiving a plurality of message streams;

an analyzer for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by  
10 the subscriber specifying a message content and a message content quality; and

a selector for selecting, based on output from the analyzer, at least one message stream which comprises messages satisfying the criteria for delivery to the subscriber; and

15 a mechanism for delivering at least one message that satisfies the criteria from the message broker to the subscriber from each selected stream.

24. The system of claim 23, wherein the analyzer for analyzing at least  
20 one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

a mechanism for analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria.  
25

25. The system of claim 24, wherein the analyzer for analyzing at least one comparable message from each of the plurality of message streams in accordance with the criteria, comprises:

a ranking mechanism for ranking message samples from each of the  
30 plurality of message streams that satisfy the criteria, and wherein the selector for selecting at least one stream comprises a mechanism for selecting a subset of the message streams in accordance with output from the ranking mechanism.

35 26. The system of claim 25, and further comprising:

a selector for selecting the number of streams selected.

27. The publish-subscribe messaging system according to claim 23 or 24, wherein the analyzer comprises a mechanism for ranking messages from each  
40 of the plurality of message streams that satisfy the criteria, and wherein the delivering mechanism comprises a mechanism for delivering a subset of

the ranked messages that most satisfies the subscriber criteria to the subscriber.

28. The system according to claim 27, and further comprising:

5 a selector for selecting the number of ranked messages comprising the subset.

29. The system according to any of claims 23 to 28, wherein the analyzer for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

10 a mechanism for analyzing messages from each of the plurality of message streams that are in a neighborhood of an analyzed message; and wherein the mechanism for delivering at least one message that satisfies the criteria to the subscriber, comprises:

15 a mechanism for delivering at least one message that is in a neighborhood of an analyzed message and that satisfies the criteria to the subscriber.

20 30. The system according to any of claims 23 to 29, wherein the mechanism for delivering at least one message that satisfies the criteria to the subscriber, comprises:

25 a mechanism for delivering all messages from all message streams containing said at least one message that satisfies the criteria to the subscriber for a predetermined time period.

31. The system according to any of claims 23 to 30, and further comprising:

30 a mechanism for repeating the receiving, analyzing and delivering steps for each of a plurality of consecutive predetermined time periods.

32. The publish-subscribe messaging system according to any of claims 23 to 30, wherein the delivering mechanism comprises a mechanism for delivering at least one message that satisfies the criteria to the subscriber for a plurality of consecutive predetermined time periods.

33. The system according to any of claims 23 to 32, wherein the analyzer for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by the subscriber specifying a message content and a message content quality, comprises:

40

a mechanism for analyzing at least one message from each of the plurality of message streams in accordance with criteria established by a plurality of subscribers, wherein each of the plurality of subscribers specify a message content and a message content quality; and wherein the  
5 selector for selecting a message stream that satisfies the criteria, comprises:

a mechanism for selecting a message stream that satisfies the criteria of each of the plurality of subscribers for delivery to each subscriber; and wherein the mechanism for delivering at least one message  
10 that satisfies the criteria to the subscriber, comprises:

a mechanism for delivering at least one message that satisfies the criteria of each of the plurality of subscribers to each subscriber.

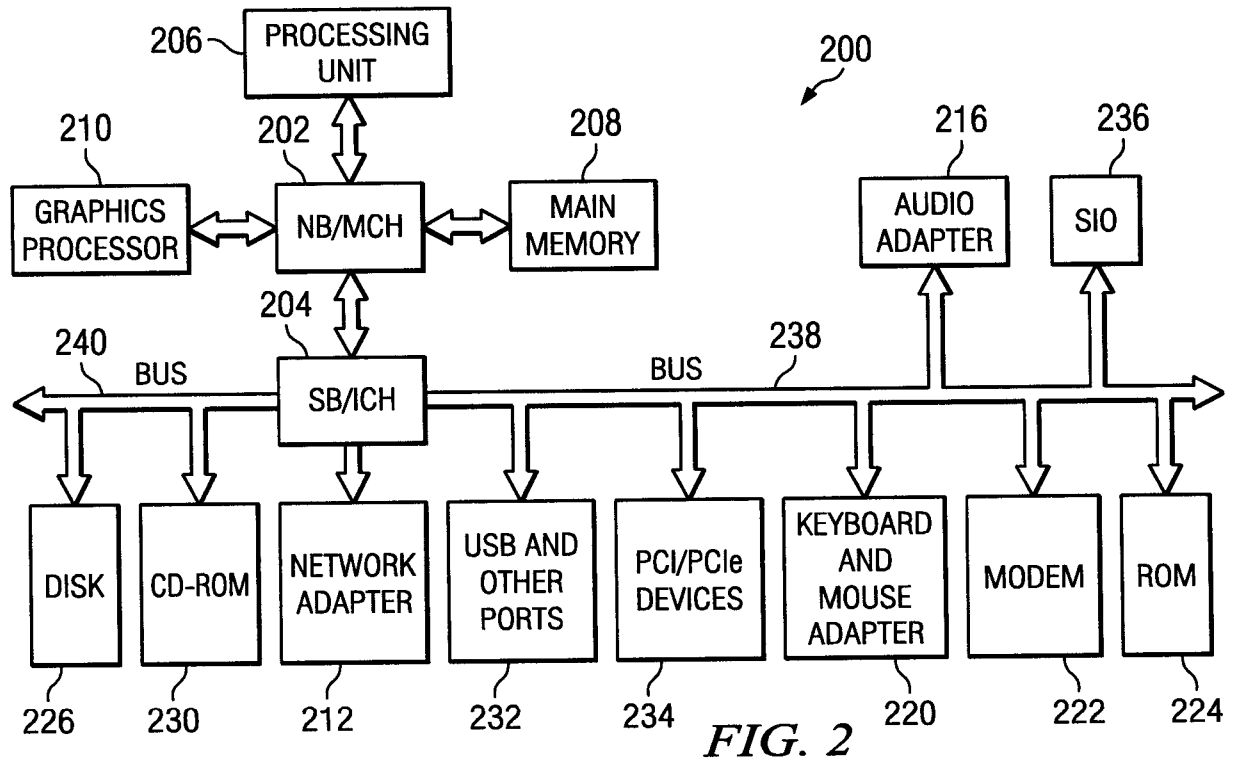
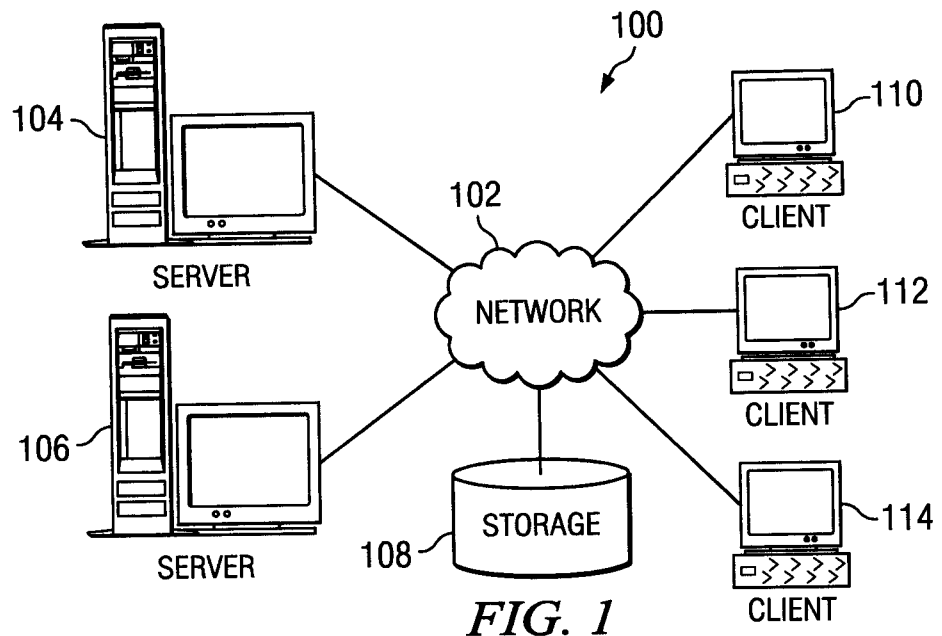
34. The system according to any of claims 23 to 33, wherein the message  
15 content quality criteria comprises:

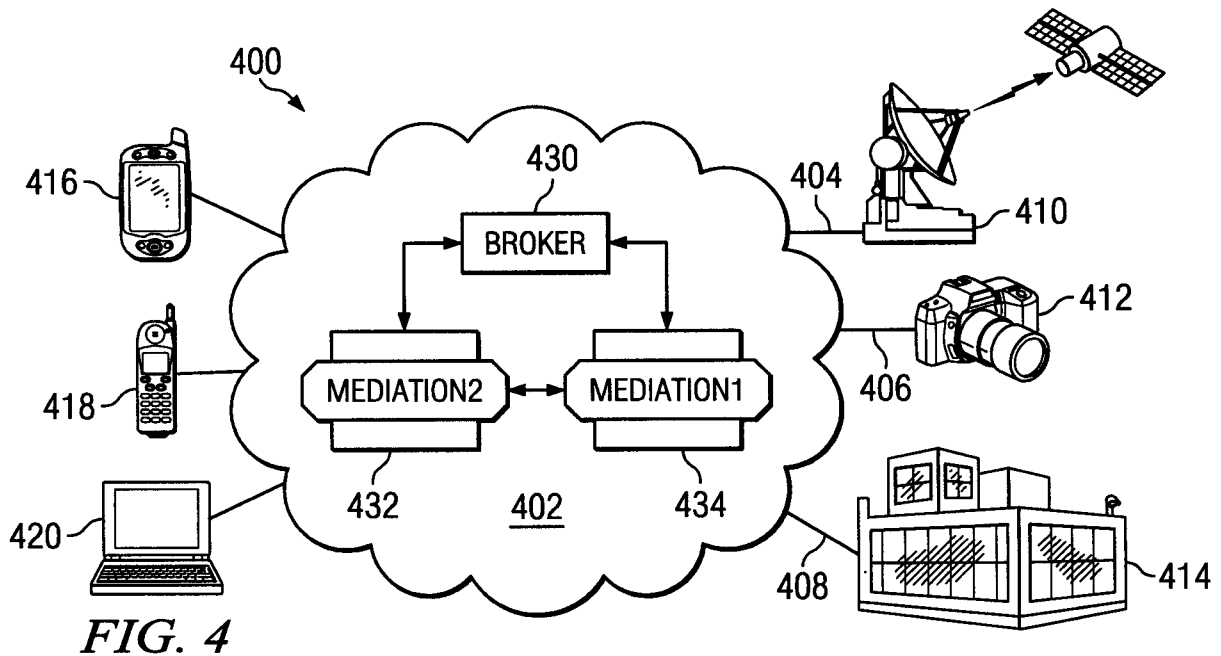
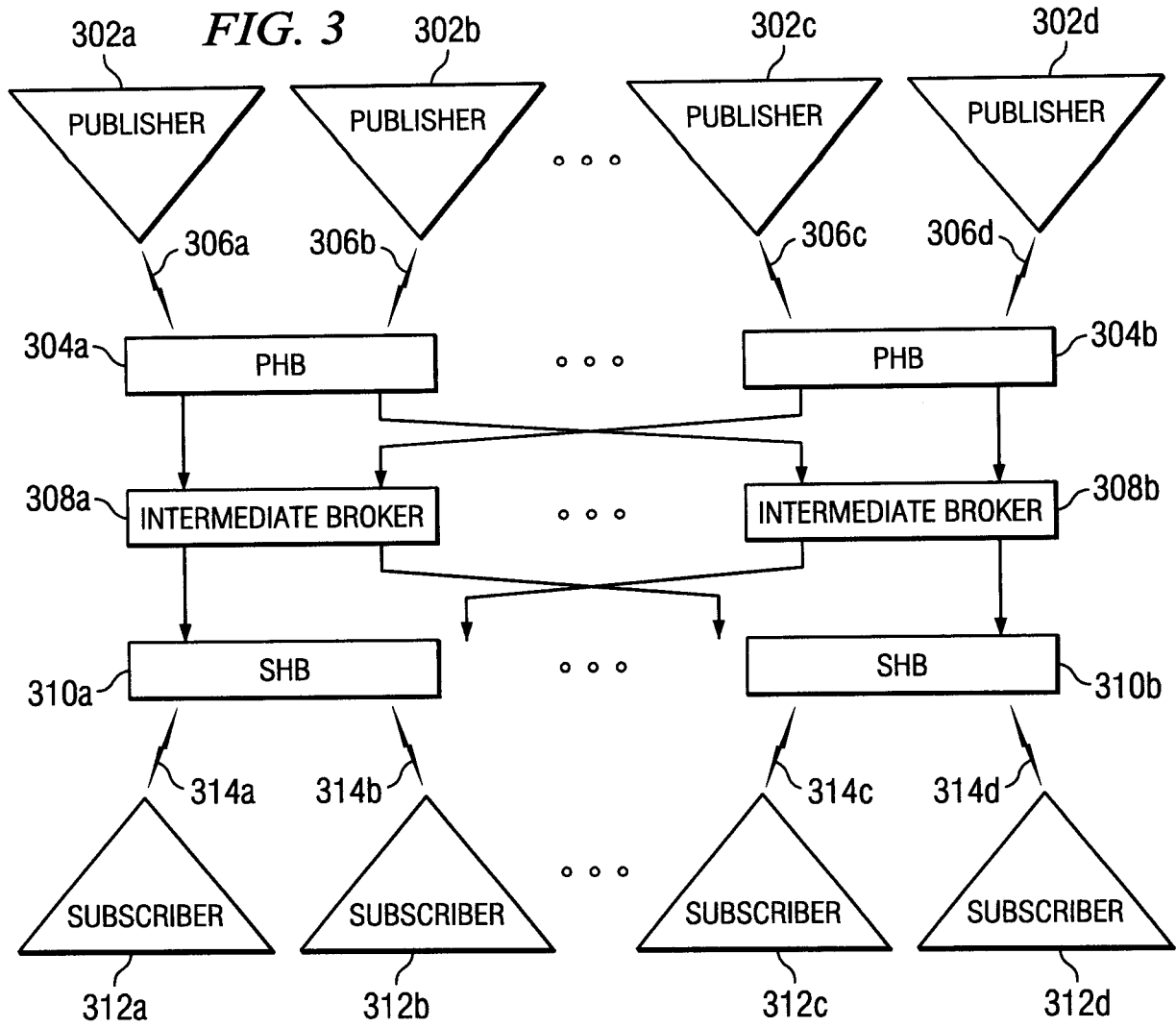
at least one of brightness, focus, noisiness, image clarity, image resolution, sound clarity and measurement precision.

35. A computer program comprising program code means adapted to perform  
20 the method of any of claims 1 to 11 when said program is run on a computer.

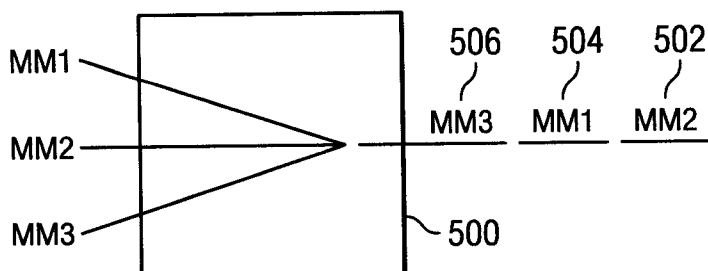
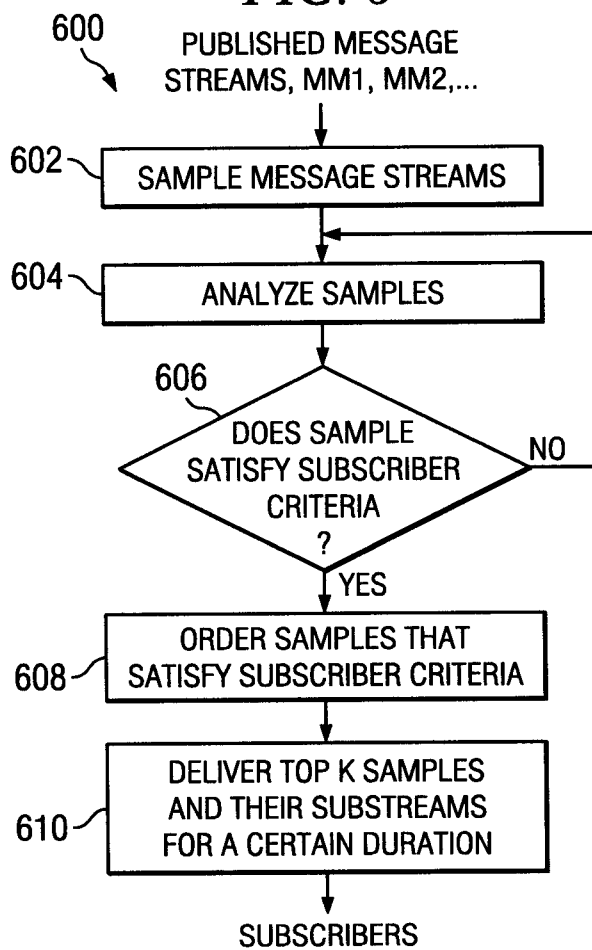


1/3





3/3

**FIG. 5****FIG. 6**

# INTERNATIONAL SEARCH REPORT

International application No  
PCT/EP2007/051476

**A. CLASSIFICATION OF SUBJECT MATTER**  
INV. H04L29/08

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)  
G06F G06Q 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 practical, search terms used)

EPO-Internal, WPI Data, INSPEC, COMPENDEX

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99/45480 A (VIGILTECH LTD [IL]; COHEN GIDEON DAVID [IL]) 10 September 1999 (1999-09-10) abstract; claims 1-31; figures 2-4 pages 1-9	1-35
X	US 2005/251556 A1 (GINIS ROMAN [US] ET AL) 10 November 2005 (2005-11-10) abstract; claims 1-23; figures 1-8 paragraphs [0009], [0010], [0027] - [0031], [0045], [0046]  ----- -/--	1-35

☒ 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 document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

24 May 2007

Date of mailing of the international search report

13/06/2007

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Authorized officer

Streit, Stefan

## INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/051476

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>YUHUI JIN, ROB STROM: "Relational Subscription Middleware for Internet-Scale Publish-Subscribe"</p> <p>2ND INTERNATIONAL WORKSHOP ON DISTRIBUTED EVENT-BASED SYSTEMS (DEBS 03), [Online] 8 June 2003 (2003-06-08), XP002434902 San Diego</p> <p>Retrieved from the Internet: URL:<a href="http://citeseer.ist.psu.edu/cache/papers/cs/32162/http%3A%2F%2Fwww.eecg.utoronto.ca%2Fdebs03%2Fpapers%2Fstrom_etal_debs03.pdf">http://citeseer.ist.psu.edu/cache/papers/cs/32162/http:zSzzSzwww.eecg.utoronto.ca%2Fdebs03zSzpaperszSzstrom_etal_debs03.pdf</a> f/jin03relational.pdf&gt; [retrieved on 2007-05-23] cited in the application the whole document</p> <p>-----</p>	1-35

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2007/051476

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WO 9945480	A	10-09-1999	AU	2870199 A		20-09-1999
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