US 20070044147A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0044147 A1**

Choi et al. (43) **Pub. Date: Feb. 22, 2007**

(54) **APPARATUS AND METHOD FOR MONITORING NETWORK USING THE PARALLEL COORDINATE SYSTEM**

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(21) Appl. No.: **11/324,698**

(22) Filed: **Jan. 3, 2006**

(30) **Foreign Application Priority Data**

Aug. 17, 2005 (KR) 10-2005-0075223

Publication Classification

(51) **Int. Cl.**
G06F 15/16 (2006.01)

(52) **U.S. Cl.** **726/12**

(57) **ABSTRACT**

A network monitoring apparatus collects packets of a first network, and generates visual information by displaying the packets on a parallel coordinate system which has one or more parallel axis for parameters of the packets. The network monitoring apparatus may extract attack packets from the packet, and the network monitoring apparatus may transmit the visual information to a remote server. Through the network monitoring apparatus, the network manager can visually grasp the state of the network or the existence of a network attack.

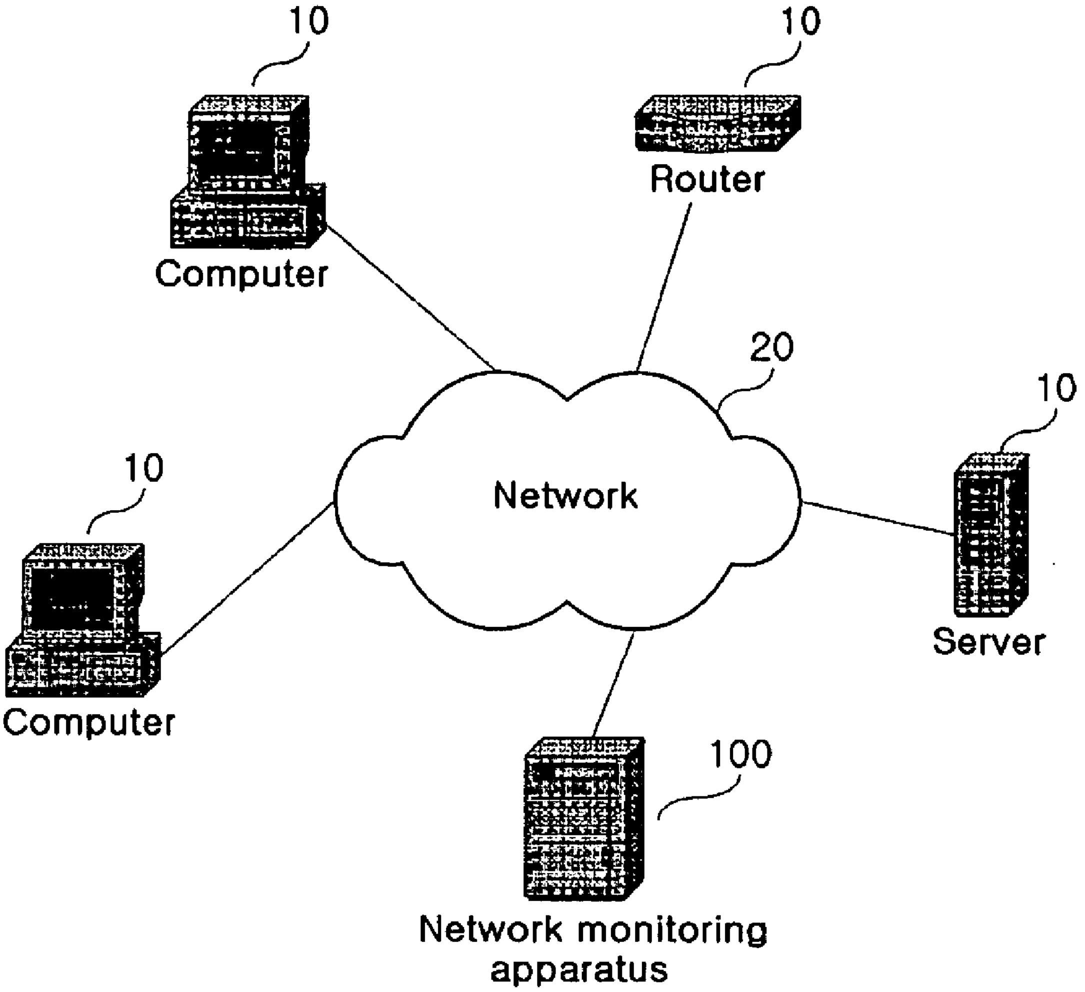


FIG.1

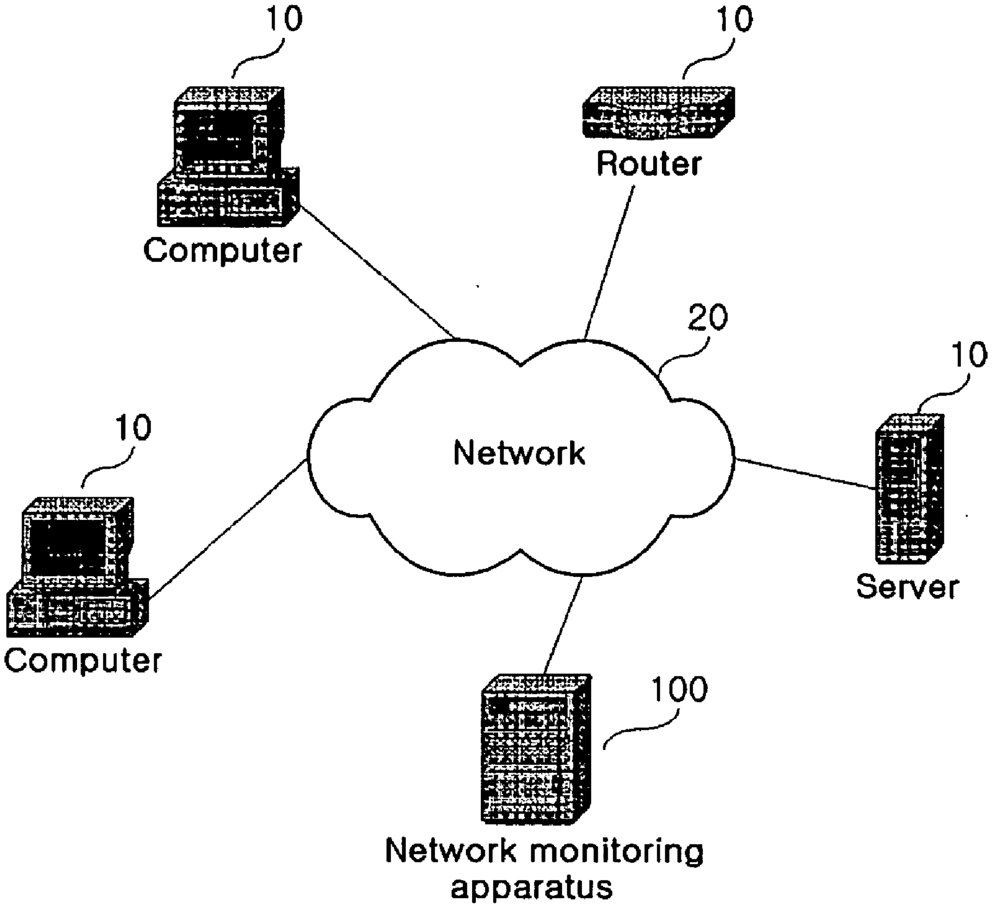

10
Computer
10
Router
20
Network
10
Server
10
Computer
100
Network monitoring apparatus

FIG.2

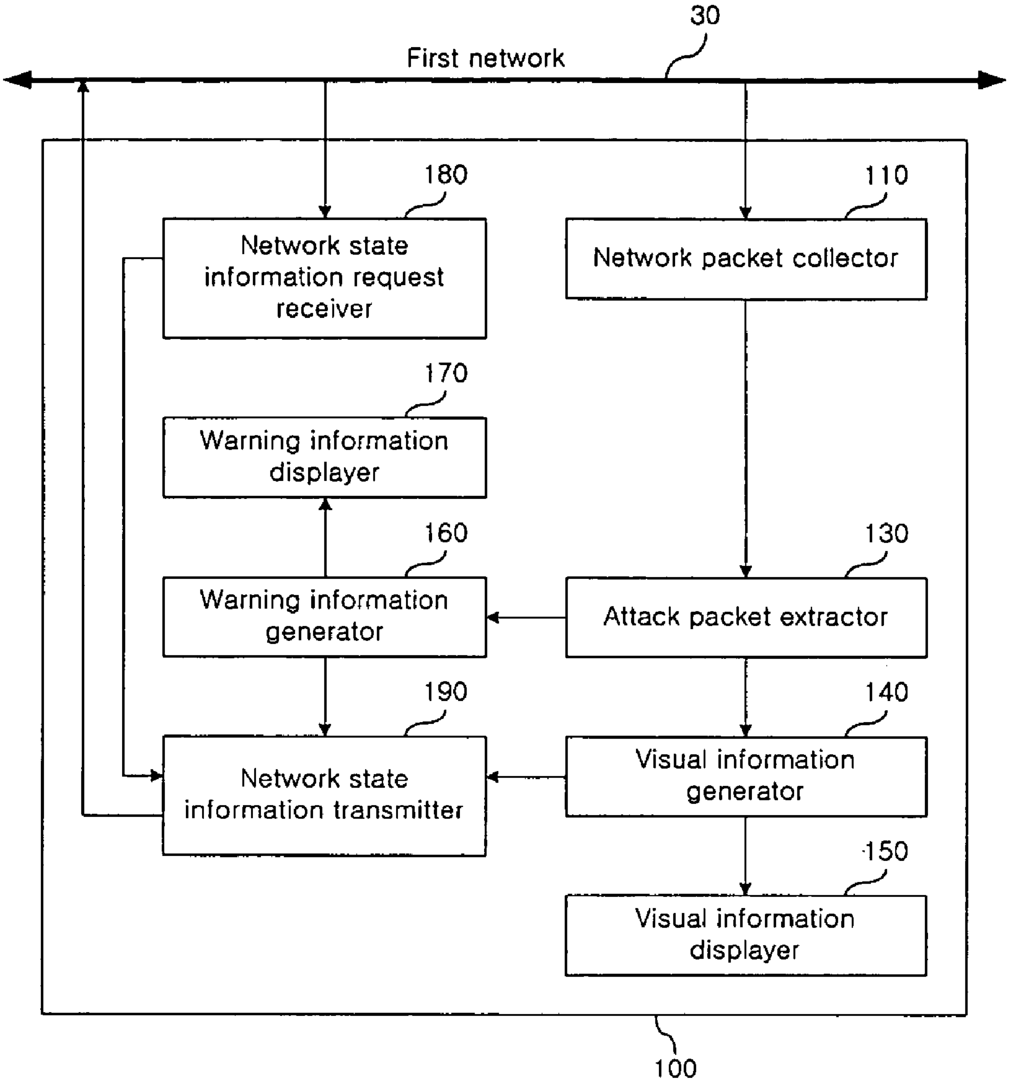

30
First network
180
Network state information request receiver
110
Network packet collector
170
Warning information displayer
160
130
Warning information generator
Attack packet extractor
190
140
Network state information transmitter
Visual information generator
150
Visual information displayer
100

FIG.3

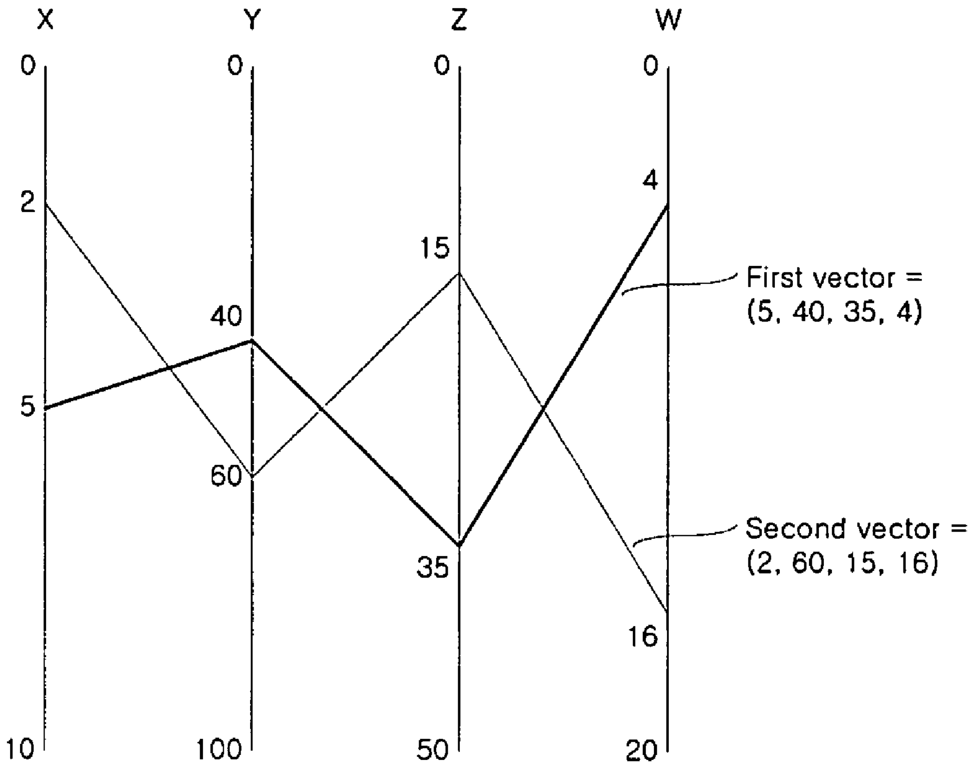

X
Y
Z
W
0
0
0
0
2
4
15
40
5
60
35
16
10
100
50
20
First vector =
(5, 40, 35, 4)
Second vector =
(2, 60, 15, 16)

FIG.4

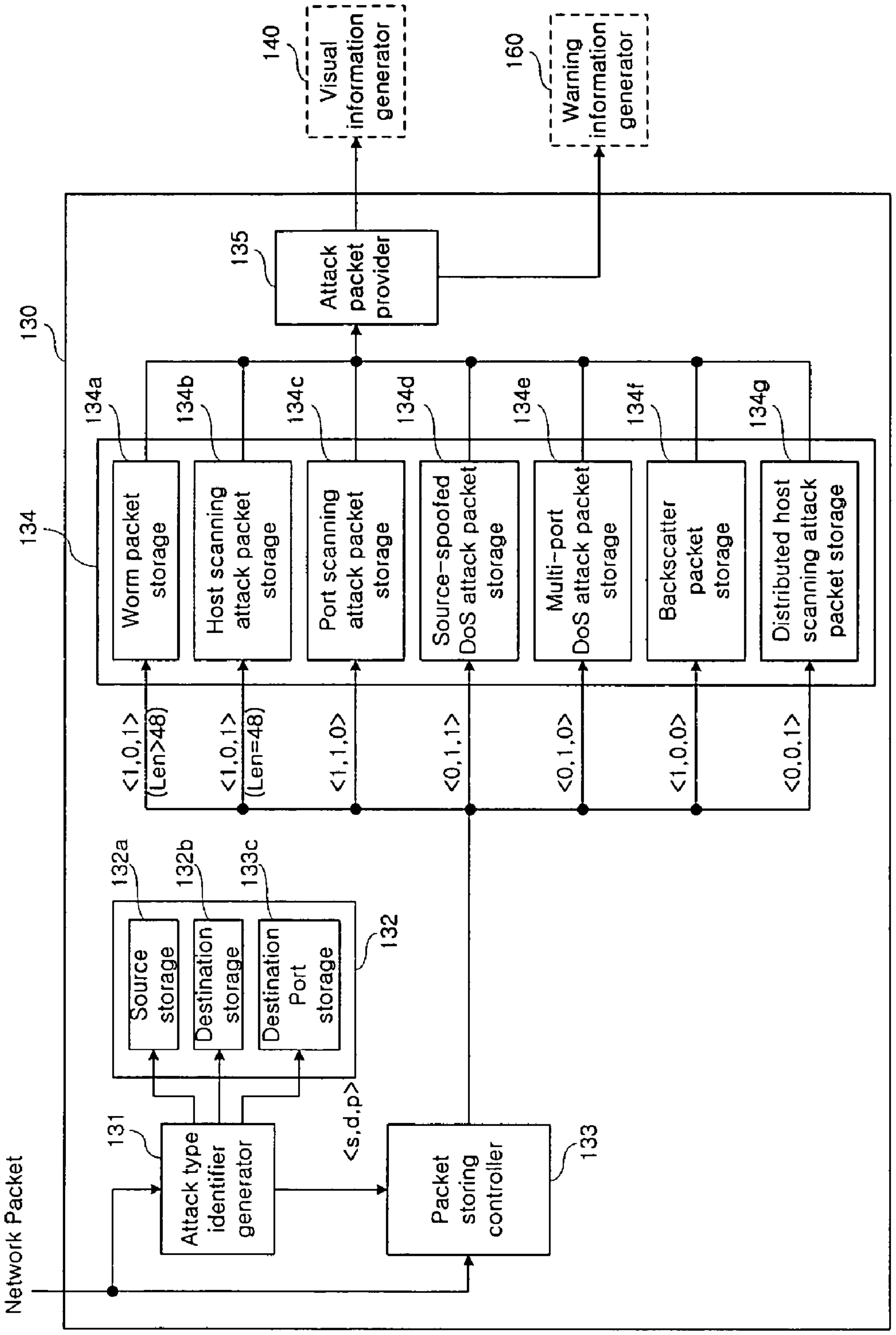

Network Packet
131
Attack type identifier generator
132
132a
Source storage
132b
Destination storage
133c
Destination Port storage
<s,d,p>
133
Packet storing controller
130
134
134a
Worm packet storage
134b
Host scanning attack packet storage
134c
Port scanning attack packet storage
134d
Source-spoofed DoS attack packet storage
134e
Multi-port DoS attack packet storage
134f
Backscatter packet storage
134g
Distributed host scanning attack packet storage
<1,0,1> (Len>48)
<1,0,1> (Len=48)
<1,1,0>
<0,1,1>
<0,1,0>
<1,0,0>
<0,0,1>
135
Attack packet provider
140
Visual information generator
160
Warning information generator

FIG.5

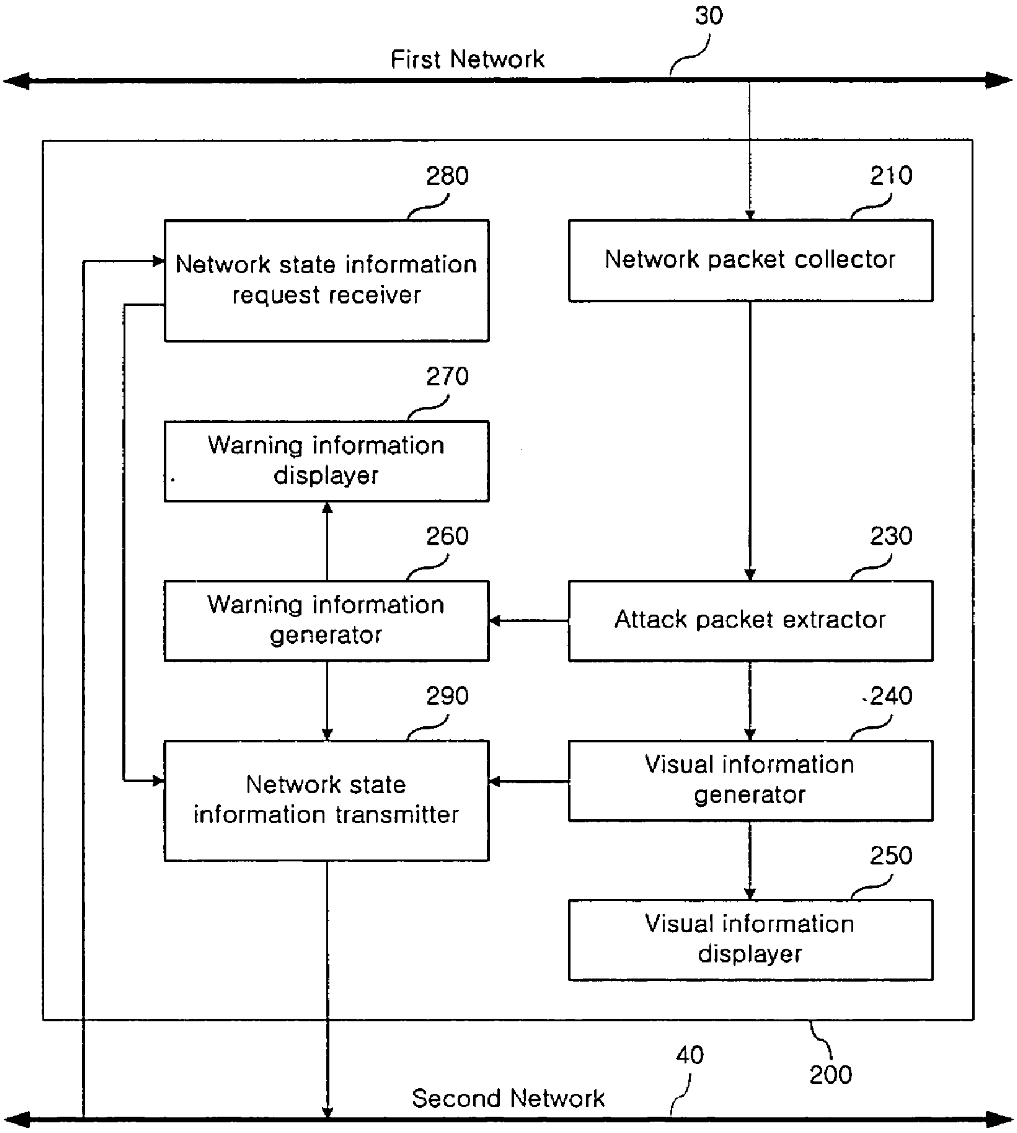

30
First Network
280
Network state information request receiver
210
Network packet collector
270
Warning information displayer
260
Warning information generator
230
Attack packet extractor
290
Network state information transmitter
240
Visual information generator
250
Visual information displayer
200
40
Second Network

FIG.6

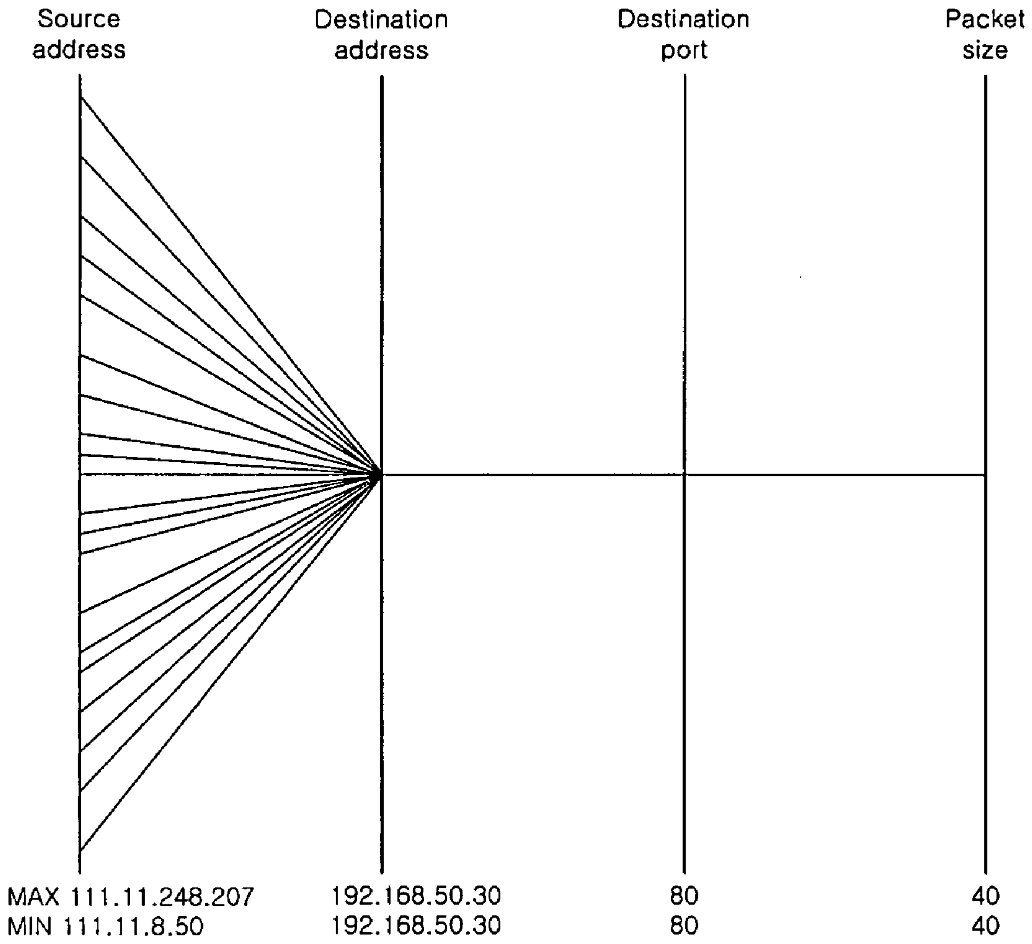

Source address
Destination address
Destination port
Packet size
MAX 111.11.248.207
MIN 111.11.8.50
192.168.50.30
192.168.50.30
80
80
40
40

FIG.7

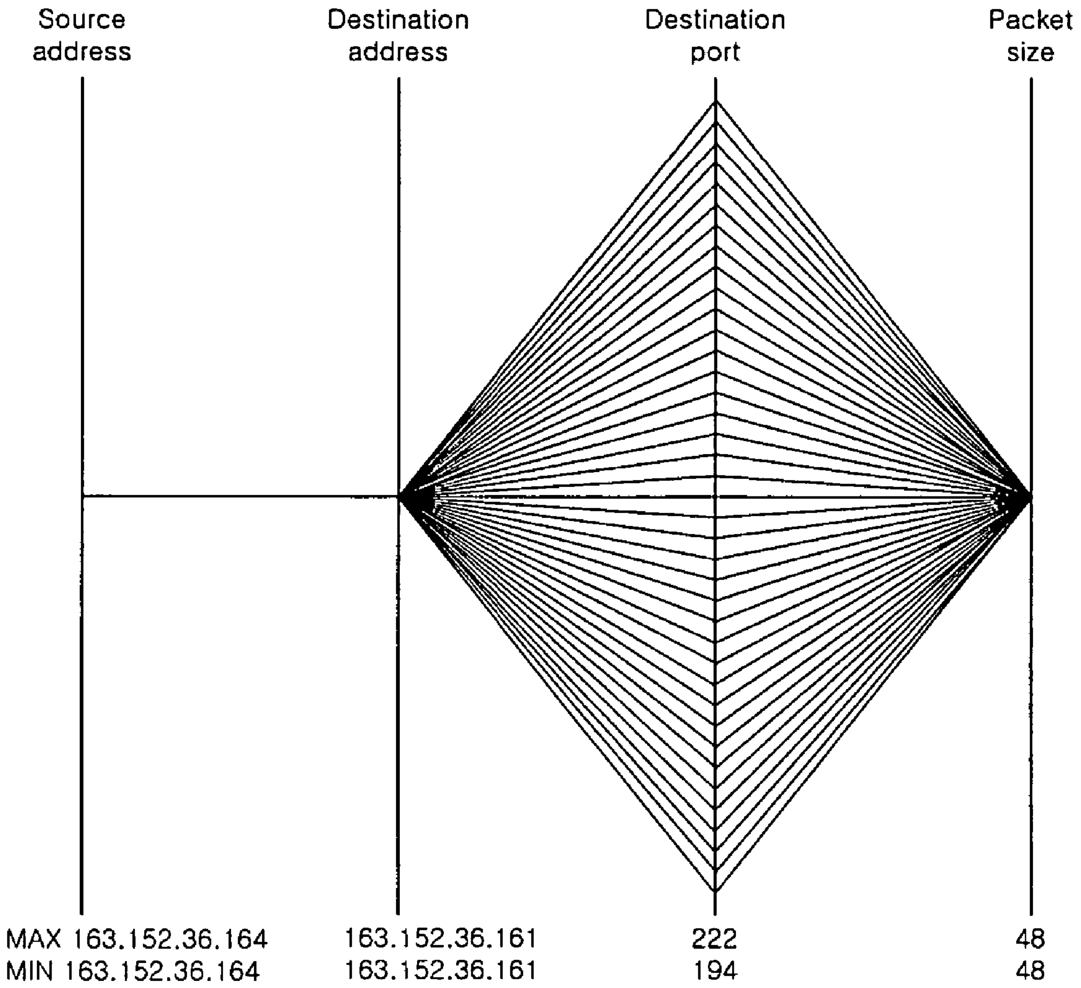

Source address
Destination address
Destination port
Packet size
MAX 163.152.36.164
MIN 163.152.36.164
163.152.36.161
163.152.36.161
222
194
48
48

FIG.8

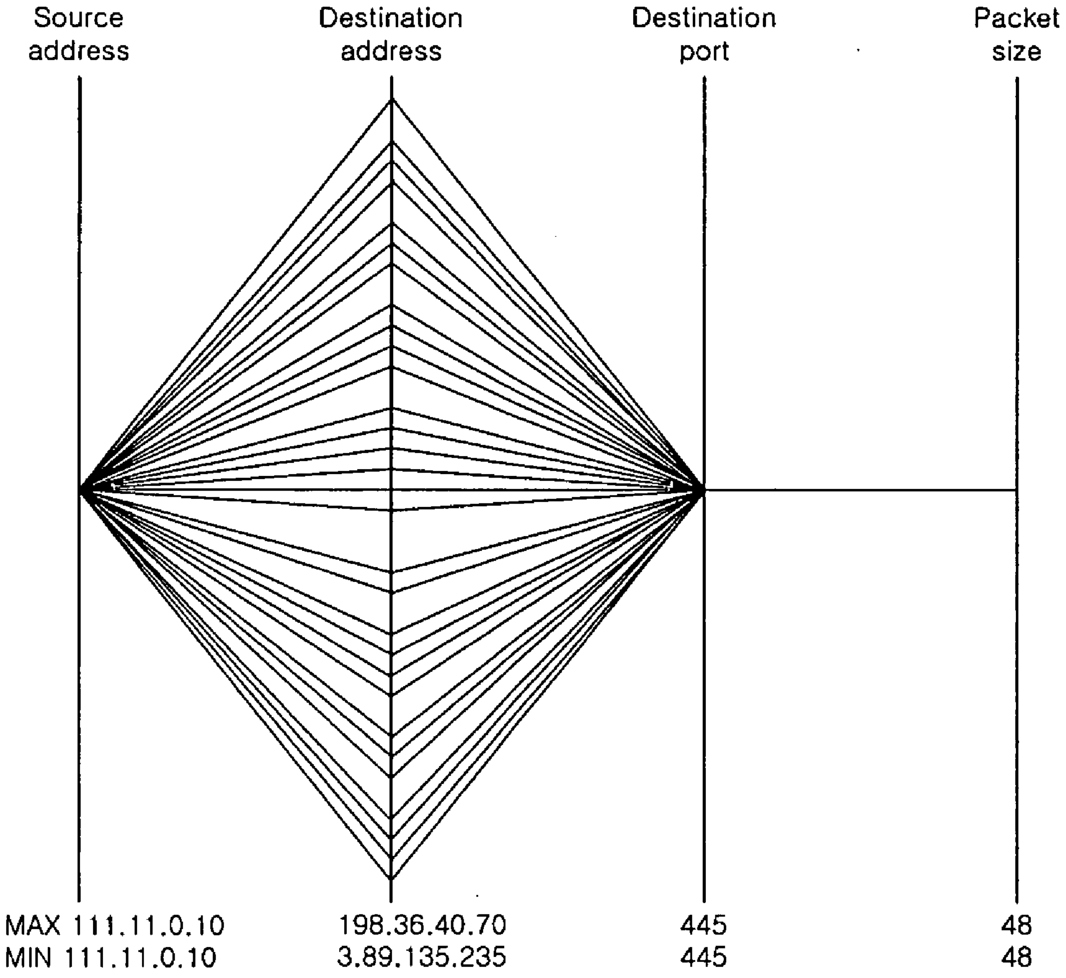

Source address
Destination address
Destination port
Packet size
MAX 111.11.0.10
MIN 111.11.0.10
198.36.40.70
3.89.135.235
445
445
48
48

FIG.9

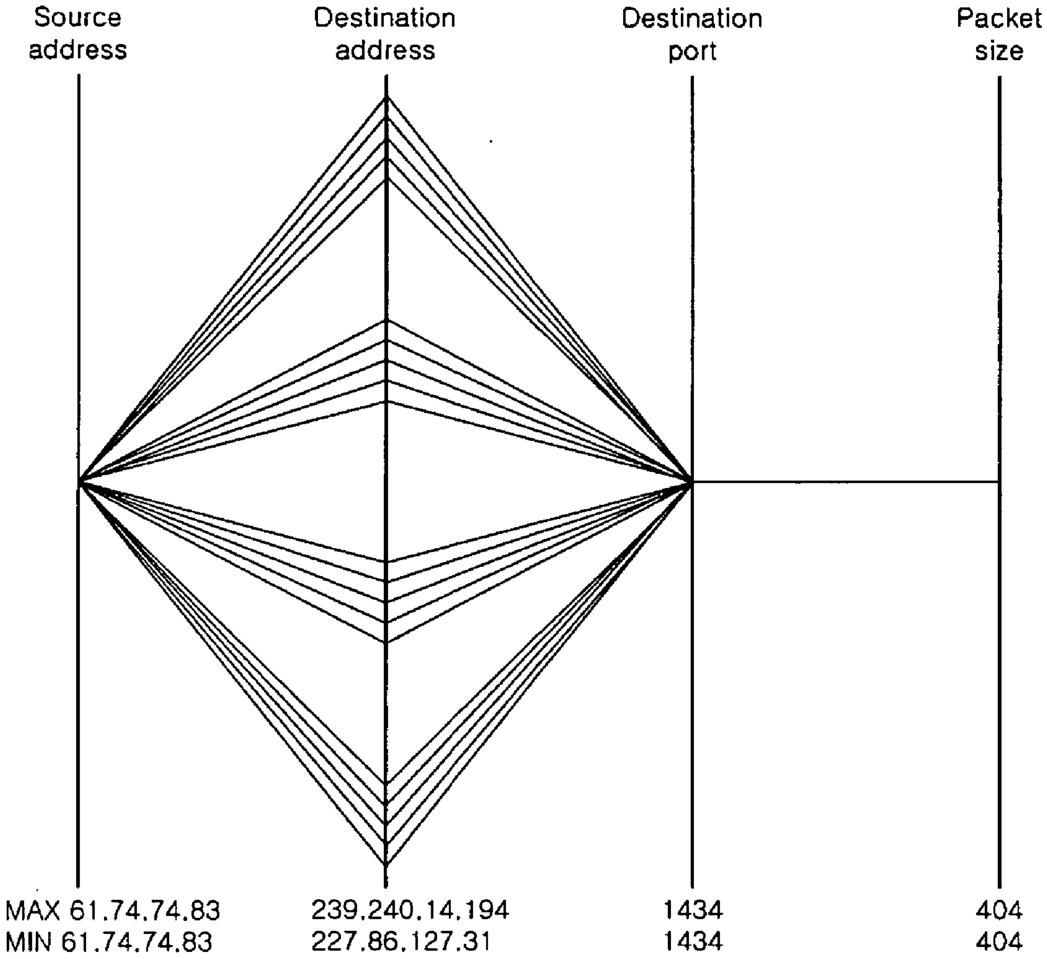

Source address
Destination address
Destination port
Packet size
MAX 61.74.74.83
MIN 61.74.74.83
239.240.14.194
227.86.127.31
1434
1434
404
404

FIG.10

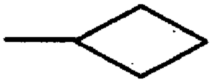
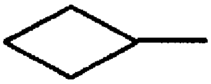
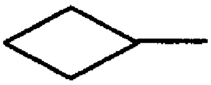
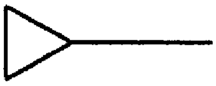
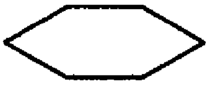
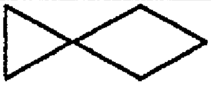
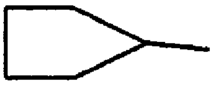
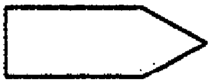
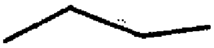
The type of attack	Pattern	Divergence
Port scanning attack		1:1:m:1
Host scanning attack		1:m:1:1
Worm		1:m:1:1
Source-spoofed DoS attack		m:1:1:1
Backscatter		1:m:m:1
Multi-port DoS attack		m:1:m:1
Distributed host scanning attack		m:m:1:1
Network-directed DoS attack		m:m:m:1
Single-source Dos attack		1:1:1:1

FIG.11

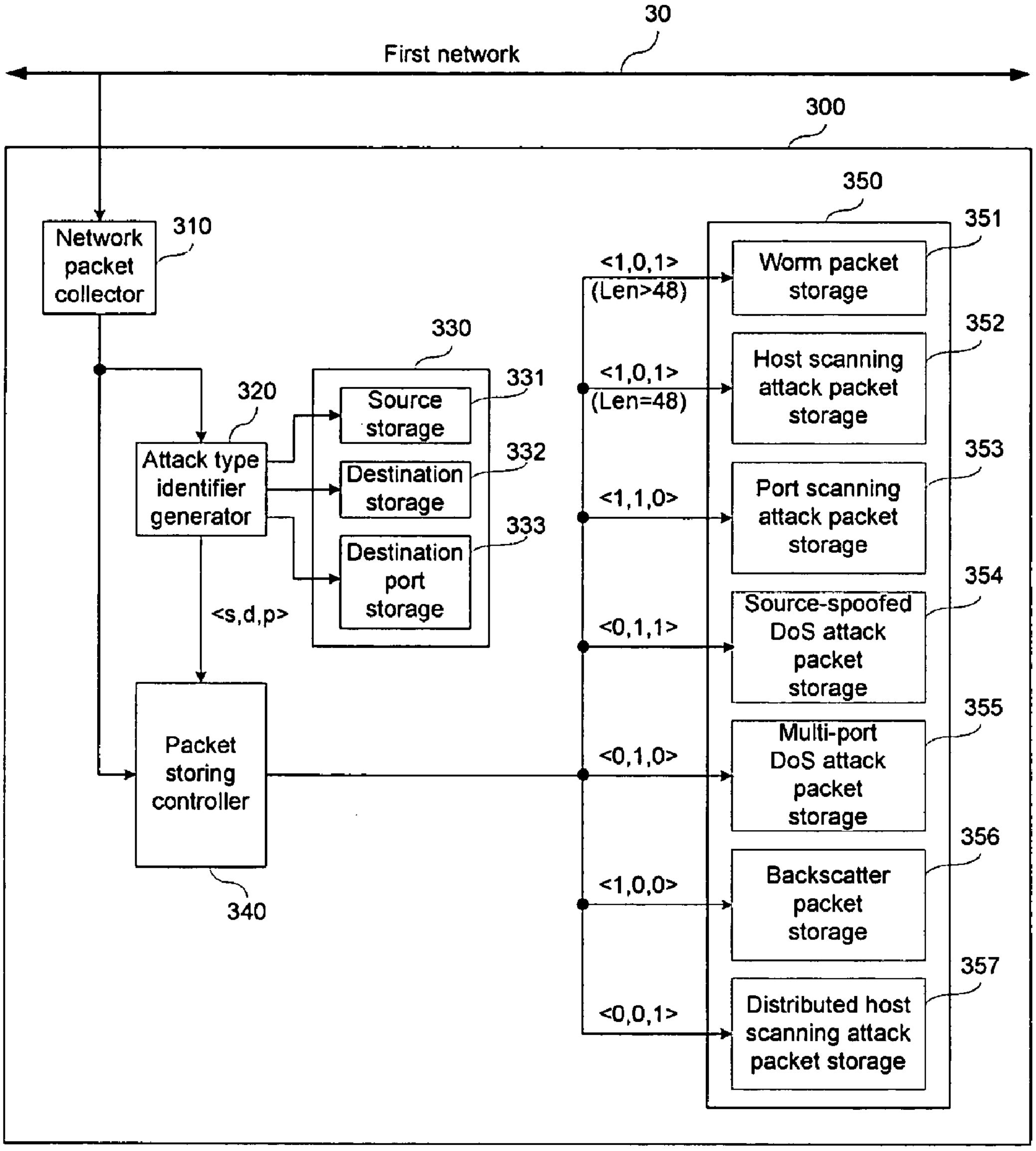

30
First network
300
310
Network packet collector
320
Attack type identifier generator
330
331
Source storage
332
Destination storage
333
Destination port storage
<s,d,p>
Packet storing controller
340
350
351
<1,0,1>
(Len>48)
Worm packet storage
352
<1,0,1>
(Len=48)
Host scanning attack packet storage
353
<1,1,0>
Port scanning attack packet storage
354
<0,1,1>
Source-spoofed DoS attack packet storage
355
<0,1,0>
Multi-port DoS attack packet storage
356
<1,0,0>
Backscatter packet storage
357
<0,0,1>
Distributed host scanning attack packet storage

FIG.12

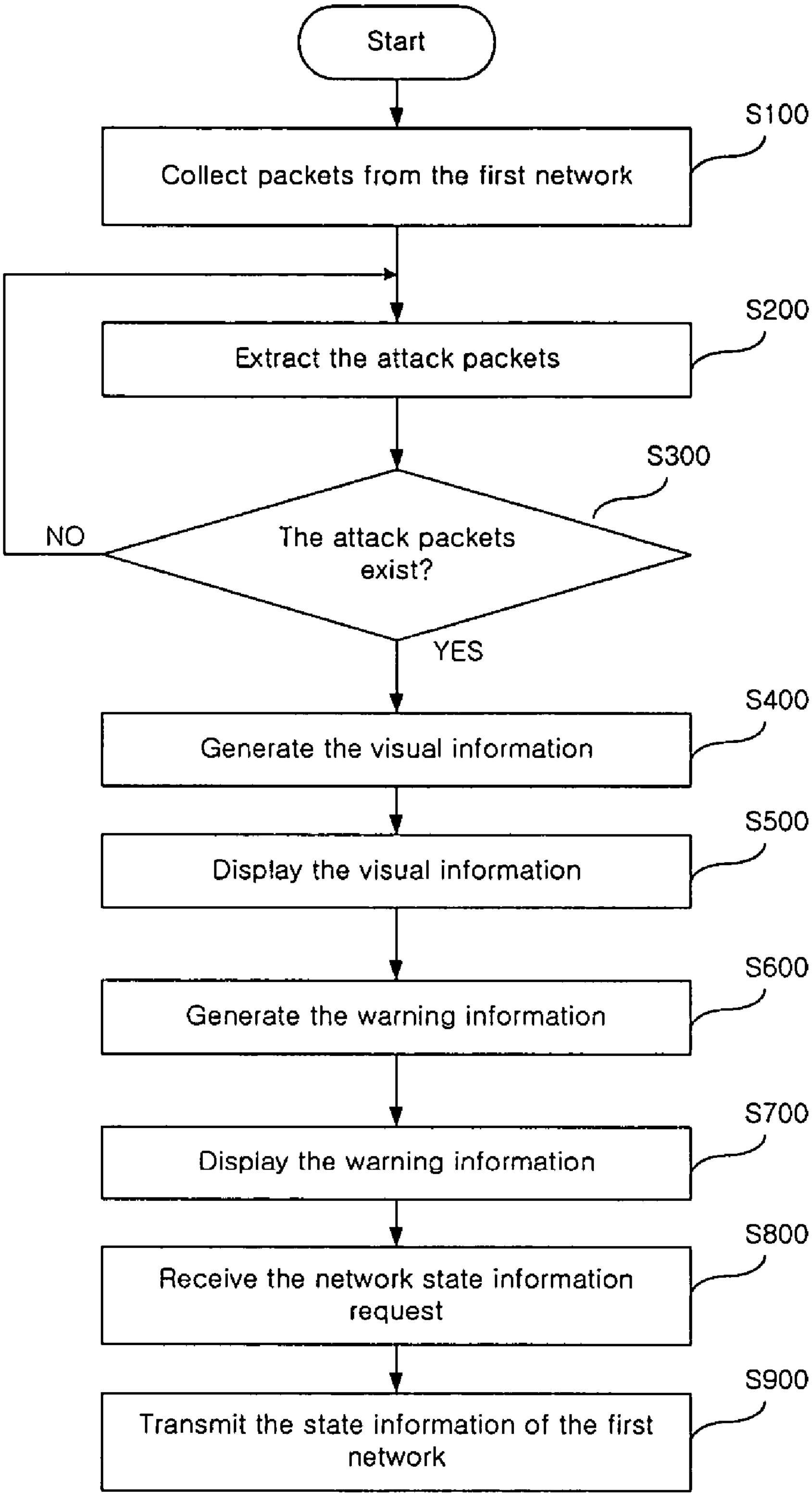

Start
S100
Collect packets from the first network
S200
Extract the attack packets
S300
The attack packets exist?
NO
YES
S400
Generate the visual information
S500
Display the visual information
S600
Generate the warning information
S700
Display the warning information
S800
Receive the network state information request
S900
Transmit the state information of the first network

FIG.13

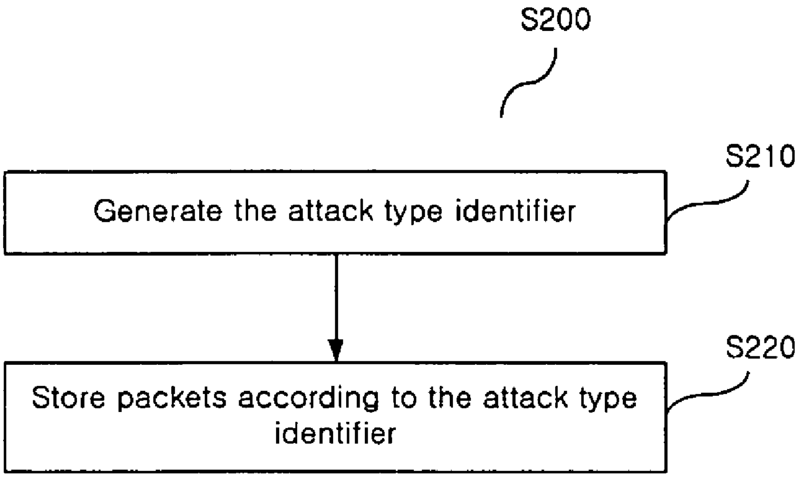

S200
S210
Generate the attack type identifier
S220
Store packets according to the attack type identifier

FIG.14

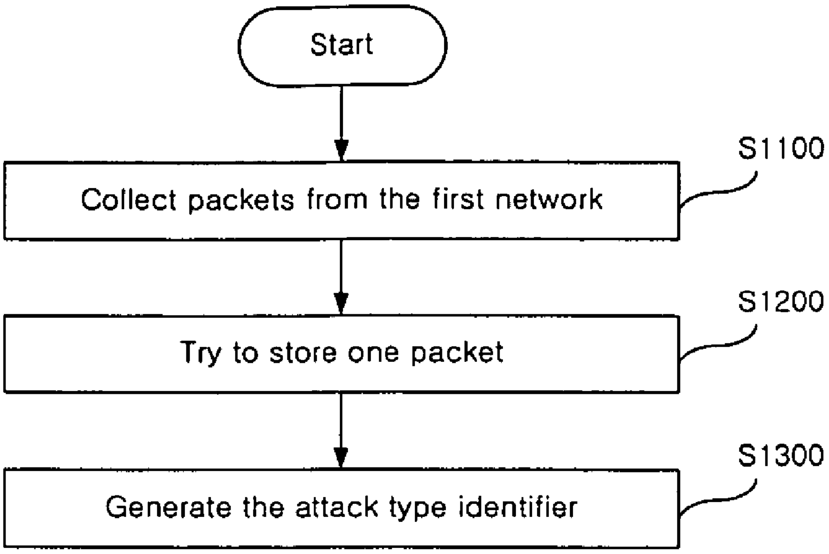
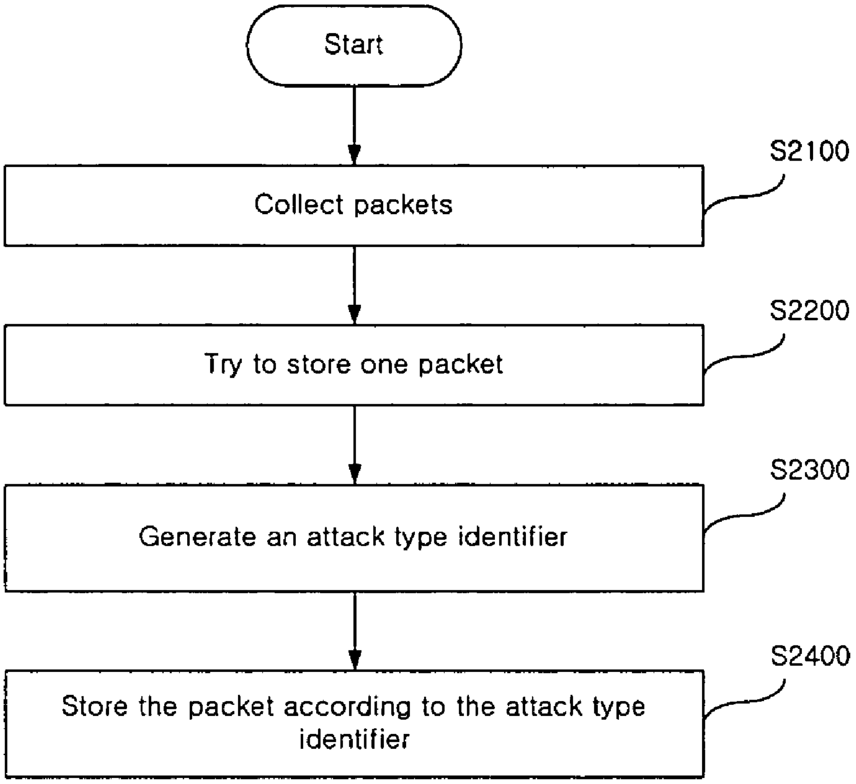

Start
S1100
Collect packets from the first network
S1200
Try to store one packet
S1300
Generate the attack type identifier

FIG.15


Start
S2100
Collect packets
S2200
Try to store one packet
S2300
Generate an attack type identifier
S2400
Store the packet according to the attack type identifier

APPARATUS AND METHOD FOR MONITORING NETWORK USING THE PARALLEL COORDINATE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to and the benefit of Korean Patent Application 10-2005-0075223 filed in the Korean Intellectual Property Office on Aug. 17, 2005, the entire content of which is incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to an apparatus and a method for monitoring a network. More specifically, the present invention relates to a monitoring apparatus and a monitoring method for grasping a network state visually.

BACKGROUND OF THE INVENTION

[0003] With the growth of the Internet and the rapid increment of users, today's networks are full of complex and various traffic. Therefore, it is not easy to detect malignant traffic from the massive amount of traffic.

[0004] The malignant traffic includes scanning attacks, denial-of-service(DoS) attacks, and Internet worms.

[0005] Scanning attacks are activities for searching for weak points of systems or networks, etc. Scanning attacks include port scanning attacks, host scanning attacks, etc. Port scanning attacks are activities for searching for open ports of a host computer, and host scanning attacks are activities for searching for attackable host computers.

[0006] DoS attacks are activities for keeping normal users from using services of a system or a network by possessing exclusively resources of the system or the network. Generally DoS attacks prevent the access of normal users by overloading the system or the network by providing a great deal of unnecessary information. DoS attacks include source-spoofed DoS attacks, multi-port DoS attacks, network-directed DoS attacks, etc. Source-spoofed DoS attacks are activities for making a server unavailable or out-of-order by providing excessive information to the server, and they make it difficult to detect a attacking server and the existence of attacks by deceiving of a source IP address. Multi-port DoS attacks are activities for making a server unavailable or overloaded by varying the source IP address and by providing the server with excessive information which have the various port numbers and the various source IP addresses. Network-directed DoS attacks are activities for making the network unavailable by providing the network with excessive information which has the various source IP addresses, the various destination IP addresses, the various port numbers, etc. The Internet worms are malignant codes that transfer themselves to an unspecified destination. The traffic data of Internet worms are similar to that of the host scanning attacks, but while the size of packets of the host scanning attacks is generally 40 bytes or 48 bytes, the size of packets of the Internet worms is larger than 48 bytes. This is because packets of the host scanning attacks generally consist of a header and don't comprise a body, but packets of the Internet worms comprise a header and a body. The Internet worms have definite size according to the type.

[0007] In addition, special traffic such as backscatter, which is not actually an attack but is caused by other attacks, exists. Backscatter consists of response packets that the destination server generates against the distributed DoS attacks. The backscatter has a peculiar pattern with one source IP address, many destination IP addresses, and one or more port numbers.

[0008] The malignant traffics like this cause inconvenience to the user of the network, and take the majority of bandwidth. Therefore much research on easy detection of the malignant traffic is proceeding.

[0009] Specifically, Korean Published Patent Application No. 10-2004-0072365 introduces a method for displaying a state of a network using 3-dimension orthogonal graphs. But it is difficult to use the method, because it is not easy to make 3-dimension orthogonal graphs. In addition, because 3-dimensional figures are displayed in a 2-dimension plane, it is not easy to grasp the state of the network. Moreover, because a 3-dimension orthogonal graph has only 3 axes, only 3 parameters are used for grasping the state of the network.

SUMMARY OF THE INVENTION

[0010] The present invention has been made in an effort to provide a monitoring apparatus and a monitoring method for visually grasping a state of a network.

[0011] A network monitoring apparatus for monitoring a first network, according to an exemplary embodiment of the present invention, includes a network packet collector, and a visual information generator. The network packet collector collects packets of the first network and the visual information generator generates visual information by displaying the packets on a parallel coordinate system which has at least two parallel axes for parameters of the packets.

[0012] A network monitoring method for monitoring a first network according to an exemplary embodiment of the present invention includes collecting packets of the first network, and generating visual information by displaying the packets on a parallel coordinate system which has at least two parallel axes for parameters of the packets.

[0013] A network analyzing apparatus for analyzing a first network according to an exemplary embodiment of the present invention includes a network packet collector, at least two parameter storages, and an attack type identifier generator. The network packet collector collects packets of the first network, the parameter storages store the same value only once, and the attack type identifier generator generates an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in the parameter storages.

[0014] An attack type identifying method for identifying an attack type of a packet on a first network according to an exemplary embodiment of the present invention includes collecting packets of the first network, and generating an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in parameter storages in which the same value is stored only once.

[0015] A packet classifying method for classifying packets on a first network by attack types according to an exemplary embodiment of the present invention includes collecting packets of the first network, generating an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in parameter storages in which the same value is stored only once, and storing the packet in an attack packet storage according to the attack type identifier.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] FIG. **1** is shows a network environment in which a network monitoring apparatus according to an exemplary embodiment of the present invention is installed.

[0017] FIG. **2** is a block diagram of a network monitoring apparatus according to an exemplary embodiment of the present invention.

[0018] FIG. **3** shows an example of a four-dimensional parallel coordinate system.

[0019] FIG. **4** is a block diagram for an attack packet extractor according to an exemplary embodiment of the present invention.

[0020] FIG. **5** is a block diagram for a network monitoring apparatus according to an exemplary embodiment of the present invention.

[0021] FIG. **6** is a drawing of visual information of a source-spoofed DoS attack according to an exemplary embodiment of the present invention.

[0022] FIG. **7** is a drawing of visual information of a port scanning attack according to an exemplary embodiment of the present invention.

[0023] FIG. **8** is a drawing of visual information of a host scanning attack according to an exemplary embodiment of the present invention.

[0024] FIG. **9** is a drawing of visual information of a worm according to an exemplary embodiment of the present invention.

[0025] FIG. **10** is a drawing of patterns and divergences of visual informations according to variable attack types.

[0026] FIG. **11** is a block diagram of a network analysis apparatus according to an exemplary embodiment of the present invention.

[0027] FIG. **12** is a flowchart of a network monitoring method according to an exemplary embodiment of the present invention.

[0028] FIG. **13** shows a method for extracting attack packets according to an exemplary embodiment of the present invention.

[0029] FIG. **14** shows a method for identifying an attack type of network packets according to an exemplary embodiment of the present invention.

[0030] FIG. **15** shows a method for classifying network packets according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0031] An exemplary embodiment of the present invention will hereinafter be described in detail with reference to the accompanying drawings.

[0032] In the following detailed description, only certain exemplary embodiments of the present invention have been shown and described, simply by way of illustration. As those skilled in the art would realize, the described embodiments may be modified in various different ways, all without departing from the spirit or scope of the present invention. In addition, the drawings and description are to be regarded as illustrative in nature and not restrictive, and like reference numerals designate like elements throughout the specification.

[0033] Throughout this specification and the claims that follow, unless explicitly described to the contrary, the word "comprise" or variations such as "comprises" or "comprising" will be understood to imply the inclusion of stated elements but not the exclusion of any other elements.

[0034] A network environment in which a network monitoring apparatus according to an exemplary embodiment of the present invention is installed will now be described with reference to FIG. **1**.

[0035] FIG. **1** shows a network environment in which a network monitoring apparatus according to an exemplary embodiment of the present invention is installed.

[0036] As shown in FIG. **1**, a network environment in which a network monitoring apparatus according to an exemplary embodiment of the present invention is installed includes a network apparatus **10**, a network **20**, and a network monitoring apparatus **100**.

[0037] The network apparatus **10** includes a computer, a router, and a server.

[0038] The network **20** is a network for exchanging information between network apparatuses **10** or between the network apparatus **10** and the network monitoring apparatus **100**. The network **20** may be a wire network and a wireless network. For example, the network **20** may be a wireless local area network(WLAN), a TCP/IP(transmission control protocol/Internet protocol) network, or a Bluetooth network. Hereinafter, the network **20** will be regarded as a TCP/IP network.

[0039] The network monitoring apparatus according to an exemplary embodiment of the present invention will now be described with reference to FIG. **2** to FIG. **4**.

[0040] FIG. **2** is a block diagram of a network monitoring apparatus **100** according to an exemplary embodiment of the present invention.

[0041] As shown in FIG. **2**, the network monitoring apparatus **100** according to an exemplary embodiment of the present invention monitors a first network **30**, and comprises a network packet collector **110**, an attack packet extractor **130**, a visual information generator **140**, a visual information displayer **150**, a warning information generator **160**, a warning information displayer **170**, a network state information request receiver **180**, and a network state information transmitter **190**.

[0042] The network packet collector **110** collects packets of the first network **30**, and the network packet collector **110** may collect flows of the first network **30**. A flow is defined as IP traffic with the same source address, destination address, source port and destination port. A router will output a flow when it determines that the flow is finished, so the network packet collector **110** may receive a flow from the router. If the network monitoring apparatus **100** monitors a network with the flow, it may rapidly analyze the network and be connected to usual apparatuses such as routers. Therefore, a packet herein includes a flow.

[0043] The attack packet extractor **130** extracts attack packets from the packets that the network packet collector **110** collects. The attack packet extractor **130** may extract packets that are regarded as attack packets, and it may collect the extracted attack packets according to the type of attack. When the attack packet extractor **130** collects more than a predetermined quantity of attack packets for unit time, it may provide the attack packets to the visual information generator **140** according to the type of attack. The unit time may be predetermined and changed by a network manager. The attack packets include worm packets, host scanning attack packets, port scanning attack packets, source-spoofed DoS attack packets, multi-port DoS attack packets, backscatter packets, and distributed host scanning attack packets.

[0044] The visual information generator **140** generates visual information by displaying the attack packets on the parallel coordinate system. The visual information generator **140** may be provided with one type of attack packets by the attack packet extractor **130** and generate visual information. In this case, the visual information has different patterns according to the type of attack. The visual information generator **140** may be provided with packets by the network packet collector **110**, and the visual information generated in this case shows the network state when the network packet collector **110** collects packets of the first network **30**. Each of axes in the parallel coordinate system indicates the parameter included in the attack packets such as the source address, the destination address, the destination port, and the packet size. In exemplary embodiments of the present invention, the parallel coordinate system has an axis of the source address, an axis of the destination address, an axis of the destination port, and an axis of the packet size. However, in various modified embodiments, the parallel coordinate system may exclude one or more axes, and may include one or more axes for other parameters, such as TCP flags and TTL field of TCP/IP header.

[0045] The parallel coordinate system is a coordinate system that has two or more parallel axes. A vector on the orthogonal coordinate system is a point, but a vector on the parallel coordinate system is a bent line. While it is difficult or impossible to input four or more axes into the orthogonal coordinate system, it is very easy to input additional axes into the parallel coordinate system.

[0046] FIG. **3** shows an example of a four-dimensional parallel coordinate system.

[0047] The parallel coordinate system of FIG. **3** includes four axes, i.e., an X-axis, a Y-axis, a Z-axis, and a W-axis. It includes first vector(**5**, **40**, **35**, **4**) and second vector(**2**, **60**, **15**, **16**). As shown in FIG. **3**, each of the vectors on the parallel coordinate system is a bent line made by connecting points. As shown in FIG. **3**, it is possible to input four or more axes into the parallel coordinate system.

[0048] Again the description about FIG. **2** will continue.

[0049] The visual information displayer **150** as shown in FIG. **2** displays the visual information on a display device such as a cathode ray tube(CRT), a liquid crystal display(LCD), and a plasma display panel(PDP).

[0050] The attack packet extractor **130** determines whether the attack packets exist, and provides attack packet existence information to the warning information generator **160**. The warning information generator **160** receives the attack packet existence information and generates warning information.

[0051] The warning information displayer **170** receives the warning information generated by the warning information generator **160**, and displays it. The warning information displayer **170** indicates the warning information through a display device or a speaker. The warning information displayer **170** informs the network manager about the existence of the attack packets, so the network manager can rapidly deal with the attack.

[0052] The network state information request receiver **180** receives a network state information request to request state information of first network **30** from a remote apparatus through the first network **30**.

[0053] When the network state information transmitter **190** receives the network state information request from the network state information request receiver **180**, it transmits the warning information from the warning information generator **160** and/or the visual information from the visual information generator **140** to a remote apparatus through the first network **30**. The network manager may thereby monitor the state of the first network **30** using the remote apparatus.

[0054] Even if the network state information transmitter **190** does not receive a network state information request, it may still determine whether the attack packets exist and transmit the warning information and/or the visual information to the remote apparatus. Therefore the network manager can rapidly deal with the attack.

[0055] Particularly if the network monitoring apparatus **100** is a HTTP server, the network manager may monitor the state of the network through the Internet browser installed in the remote apparatus.

[0056] An attack packet extractor **130** will now be described with reference to FIG. **4**.

[0057] FIG. **4** is a block diagram for an attack packet extractor according to an exemplary embodiment of the present invention.

[0058] As shown in FIG. **4**, the attack packet extractor **130** comprises an attack type identifier generator **131**, a parameter storage **132**, a packet storing controller **133**, an attack packet storage **134**, and an attack packet provider **135**.

[0059] The attack type identifier generator **131** receives packets and stores the value of parameters of the packets in the parameter storage **132**.

[0060] The parameter storage **132** is a storage in which the same value is stored only once. The structure of the parameter storage **132** includes a linked list, a binary search tree, a MULTOPS(MUlti-Level Tree for Online Packet Statistics), and a hash table. As shown in FIG. **4**, the parameter storage **132** comprises a source storage **132***a*, a destination storage **132***b*, and a destination port storage **133***c*. The source storage **132***a* is a storage in which the source address of packets is stored, the destination storage **132***b* is a storage in which the destination address is stored, and the destination port storage **133***c* is a storage in which the destination port is stored. The attack type identifier generator **131** receives packets and stores the source address of the packets in the source storage **132***a,* the destination address of the packets in the destination storage **132***b,* and the destination port of the packets in the destination port storage **133***c.* In this case, the attack type identifier generator **131** generates an attack type identifier according to whether or not the value of each parameters already exists in the parameter storage **132**. In an exemplary embodiment of the present invention, the form of the attack type identifier is defined as <s, d, p>. "s" is the value according to whether or not the source address exists in the source storage **132***a,* "d" is the value according to whether or not the destination address exists in the destination storage **132***b,* and "p" is the value according to whether or not the destination port exists in the destination port storage **132***c.* In an exemplary embodiment of the present invention, if the source address exists in the source storage **132***a,* "s" is defined as 1, and if the source address does not exist in the source storage **132***a,* "s" is defined as 0. "d" and "p" is similarly defined. If the attack type identifier generator **131** stores the source address, the destination address, and the destination port of one packet in the parameter storage **132**, and the source address and the destination address of the packet are already stored in the parameter storage **132**, the attack type identifier generator **131** generates an attack type identifier such as <1, 1, 0>.

[0061] In addition, the attack type identifier generator **131** may have a period for maintaining the value of parameters. The attack type identifier generator **131** may clear the parameter storage **132** when the period has expired, and because the parameter storage **132** doesn't hold the parameter values for a long time, the attack type identifier generator **131** can evaluate the type of attack more accurately.

[0062] The network packets are stored in the attack packet storage **134** according to the type of attack. The attack packet storage **134** includes a worm packet storage **134***a,* a host scanning attack packet storage **134***b,* a port scanning attack packet storage **134***c,* a source-spoofed DoS attack packet storage **134***d,* a multi-port DoS attack packet storage **134***e,* a backscatter packet storage **134***f,* and a distributed host scanning attack packet storage **134***g.* Packets that are judged to be worm packets are stored in the worm packet storage **134***a,* packets that are judged to be host scanning attack packets are stored in the attack packet storage **134***b,* packets that are judged to be port scanning attack packets are stored in the port scanning attack packet storage **134***c,* and packets that are judged to be source-spoofed DoS attack packets are stored in the source-spoofed DoS attack packet storage **134***d.*

[0063] Packets that are judged to be multi-port DoS attack packets are stored in the multi-port DoS attack packet storage **134***e,* packets that are judged to be backscatter packets are stored in the backscatter packet storage **134***f,* and packets that are judged to be distributed host scanning attack packets are stored in the distributed host scanning attack packet storage **134***g.*

[0064] The packet storing controller **133** judges the type of attack with the attack type identifier, and stores packets in the attack packet storage **134** according to the attack type identifier. For example, if the attack type identifier of one packet is <1,1,0>, the packet storing controller **133** judges the attack type of the packet to be the port scanning attack, and stores the packet in the attack packet storage **134***c.* If the attack type identifier of another packet is <1,0,1> and the size of the packet is larger than 48 bytes, the packet storing controller **133** judges the attack type of the packet to be a worm attack, and stores the packet or the parameters of the packet in the worm packet storage **134***a.*

[0065] Additionally, the packet storing controller **133** may have a period for extracting the attack packets. The packet storing controller may clear the attack packet storage **134** at the expiration of the period. Because the attack packet storage **134** holds the attack packets for a fixed time, the attack packet extractor **130** can extract the attack packets more effectively. If the attack packet storage **134** stores the attack packets for a long period of time, because various types of attack packets are stored in the attack packet storage **134**, the attack packet extractor **130** can extract packets of mixed attacks.

[0066] If the attack packet storage **134** has more than a predetermined number of packets, the attack packet provider **135** judges the first network **30** to have attack packets and provides information about the attack packets to the visual information generator **140**. For example, when the multi-port DoS attack packet storage **134***e* has 50 packets, the attack packet provider **135** judges the first network **30** to have the multi-port DoS attack packets and provides information about the attack packets to the visual information generator **140**. In this case, the visual information generator **140** displays the provided information on the parallel coordinate system, and generates the visual information.

[0067] The attack packet provider **135** may provide the information about the existence of the attack packets to the warning information generator **160**. If the multi-port DoS attack packet storage **134***e* has more than 50 packets, the attack packet provider **135** judges the first network **30** to be under a multi-port DoS attack, and provides the information about the attack to the warning information generator **160**. In this case, the warning information generator **160** generates the warning information about the existence of the multi-port DoS attack, and provides the warning information to the warning information displayer **170** or the network state information transmitter **190**. If the warning information displayer **170** receives the warning information, it can inform of the existence of the network attack to a network manager through a display device or a speaker. The network state information transmitter **190** can also inform of the existence of the network attack to a remote network manager by transmitting the warning information to the first network **30**.

[0068] A network monitoring apparatus **200** according to an exemplary embodiment of the present invention will now be described with reference to FIG. **5**.

[0069] FIG. **5** is a block diagram of a network monitoring apparatus according to an exemplary embodiment of the present invention.

[0070] As shown in FIG. **5**, the network monitoring apparatus **200** according to an exemplary embodiment of the present invention monitors the first network **30**, and comprises a network packet collector **210**, an attack packet extractor **230**, a visual information generator **240**, a visual information displayer **250**, a warning information generator **260**, a warning information displayer **270**, a network state information request receiver **280**, and a network state information transmitter **290**.

[0071] Because the elements **210** to **270** of the network monitoring apparatus **200** of FIG. **5** are the same as elements **110** to **170** of the network monitoring apparatus **100** of FIG. **2**, a description of elements **210** to **270** will be omitted.

[0072] The network state information request receiver **280** receives a network state information request to request states of the first network **30** from a remote apparatus through the second network **40**.

[0073] If the network state information transmitter **290** receives a network state information request, it transmits the warning information from the warning information generator **260** and/or the visual information from the visual information generator **240** to a remote apparatus through the second network **40**. Therefore, a network manager can monitor the state of the remote first network **30**, and even if the first network **30** is unavailable because of network attack, the first network **30** can be monitored through the second network **40**. The second network **40** includes the wire network, and the wireless network. If the second network **40** is more stable than the first network **30**, the network manager can monitor the first network **30** more effectively.

[0074] Even if the network state information transmitter **290** does not receive a network state information request, it may determine whether the attack packets exist and transmit the warning information and/or the visual information to the remote apparatus. Therefore the network manager can rapidly deal with the attack.

[0075] Various examples of the visual information according to the type of attack will now be described in relation to FIG. **6** to FIG. **10**. In exemplary embodiments of the present invention, the parallel coordinate system for the visual information has an axis of the source address, an axis of the destination address, an axis of the destination port, and an axis of the packet size.

[0076] FIG. **6** is a drawing for visual information of a source-spoofed DoS attack according to an exemplary embodiment of the present invention. The source-spoofed DoS attack drawn on FIG. **6** has source addresses from 111.11.8.50 to 111.11.248.207, a destination address of 192.168.50.30, a destination port of 80, and an average packet size of 40 bytes.

[0077] FIG. **7** is a drawing for visual information of a port scan attack according to an exemplary embodiment of the present invention, FIG. **8** is a drawing for visual information of a host scan attack according to an exemplary embodiment of the present invention, and FIG. **9** is a drawing for visual information of a worm according to an exemplary embodiment of the present invention.

[0078] As shown in FIG. **6** to FIG. **9**, the visual information has different configurations according to the type of attack. Therefore, the network manager can easily grasp the type of attack in the network.

[0079] FIG. **10** is a drawing of patterns and divergences of visual informations according to various attack types.

[0080] As shown in FIG. **10**, the attacks of the network have different patterns according to type. Therefore, the network manager can easily grasp the type of attack in the network.

[0081] The network analysis apparatus **300** according to an exemplary embodiment of the present invention will now be described with reference to FIG. **11**.

[0082] FIG. **11** is a block diagram of a network analysis apparatus **300** according to an exemplary embodiment of the present invention.

[0083] As shown in FIG. **11**, a network analysis apparatus **300** analyzes packets in the first network **30**, and comprises a network packet collector **310**, an attack type identifier generator **320**, a parameter storage **330**, a packet storing controller **340**, and an attack packet storage **350**.

[0084] The network packet collector **310** collects packets in the first network **30**.

[0085] The attack type identifier generator **320** generates an attack type identifier with the packets that the network packet collector **310** collects. Because the attack type identifier generator **320** is the same as the attack type identifier generator **131** in FIG. **4**, a detailed description thereof will be omitted.

[0086] And because elements **330** to **350** of the network analysis apparatus **300** of FIG. **11** are the same as elements **132** to **134** of FIG. **4**, a description thereof will be omitted.

[0087] The network analysis apparatus **300** can easily classify suspicious packets according to the type of attack. The packets that are classified by the network analysis apparatus **300** are used in the various analyses.

[0088] A network monitoring method according to an exemplary embodiment of the present invention will now be described with reference to FIG. **12** and FIG. **13**.

[0089] FIG. **12** is a flowchart of a network monitoring method according to an exemplary embodiment of the present invention, and FIG. **13** shows a method for extracting attack packets according to an exemplary embodiment of the present invention.

[0090] Firstly, to monitor the first network **30**, the network packet collector **110** collects packets of the first network **30** in step **S100**.

[0091] The attack packet extractor **130** then extracts attack packets from the packets that the network packet collector **110** collects in step **S200**. Cconcretely, the attack type identifier generator **131** generates an attack type identifier according to whether or not the value of each parameter of the attack packets already exists in the parameter storage **132** in step **S210**. After that, the packet storing controller **133** determines the type of attack with the attack type identifier, and stores packets in the attack packet storage **134** according to the attack type identifier in step S**220**.

[0092] If the attack packets that the attack packet extractor **130** extracts exist in step **S300**, the visual information generator **140** generates visual information by displaying the attack packets on the parallel coordinate system in **S400**.

[0093] The visual information displayer **150** then displays the visual information on a display device in **S500**. With this, the network manager can visually grasp the state of the first network **30** by using the network monitoring apparatus **100**. Moreover, the network manager can recognize the existence of the attack in the first network **30**. Even when an attack with new pattern appears, the network manager can easily recognize the existence of the new attack.

[0094] The warning information generator **160** receives the attack packet existence information from the attack packet extractor **130** and generates warning information in step S**600**.

[0095] After that, the warning information displayer **170** indicates the warning information through a display device or a speaker in step S**700**. With this, even though the network manager does not analyze the visual information, the existence of the attack can be rapidly recognized.

[0096] If the network state information request receiver **180** receives the network state information request from the remote server in step S**800**, the network state information transmitter **190** transmits the warning information or the visual information to the remote server in S**900**. With this, the network manager can grasp the state of the first network **30** from a remote place.

[0097] Even if the network state information request receiver **180** has not received a network state information request from the remote server, the network state information transmitter **190** may transmit the warning information or the visual information to the remote server in step S**900**. In particular, in case of existence of attack packets, the network state information transmitter **190** may transmit the warning information or the visual information to the remote server. With this, even if the network manager has not requested the state information to the network monitoring apparatus **100**, the state of the first network **30** can be grasped.

[0098] A method for identifying an attack type of network packets according to an exemplary embodiment of the present invention will now be described with reference to FIG. **14**.

[0099] FIG. **14** shows a method for identifying an attack type of network packets according to an exemplary embodiment of the present invention.

[0100] To identify the attack type of the packets of the first network **30**, the network packet collector **310** collects packets from the first network **30** in step S**1100**.

[0101] Next, the attack type identifier generator **320** tries to store one packet that is collected by the network packet collector **310** in the parameter storage **330** in step S**1200**.

[0102] The attack type identifier generator **320** generates an attack type identifier according to whether or not the value of each parameters of the packet already exists in the parameter storage **132** in step S**1300**.

[0103] According to the method for identifying an attack type of network packets of an exemplary embodiment of the present invention, many packets can be classified according to the type of attack, and visual information with various formats can be generated.

[0104] A method for classifying network packets according to an exemplary embodiment of the present invention will now be described with reference to FIG. **15**.

[0105] FIG. **15** shows a method for classifying network packets according to an exemplary embodiment of the present invention.

[0106] To classify packets of the first network **30** according to the type of attack, the network packet collector **310** collects packets from the first network **30** in step S**2100**.

[0107] The attack type identifier generator **320** tries to store one packet that is collected by the network packet collector **310** in the parameter storage **330** in step S**2200**.

[0108] After that, the attack type identifier generator **320** generates an attack type identifier according to whether or not the value of each parameter of the packet already exists in the parameter storage **132** in step S**2300**.

[0109] The packet storing controller **340** then stores the packet in the attack packet storage **134** according to the attack type identifier in step S**2400**.

[0110] According to the method for classifying network packets of an exemplary embodiment of the present invention, the packet storing controller **340** stores packets in the attack packet storage **134** according to the type of attack, and the network manager can analyze the classified packets in detail. Moreover, many packets can be classified according to the type of attack, and visual informations with various formats can be generated.

[0111] According to the present invention, the network manager can visually grasp the state of the network or the existence of a network attack. Further, it is easy to add one or more parameters for analyzing the network. Moreover, according to the present invention, even when an attack with a new pattern appears, the network manager can easily recognize the existence of the new attack.

[0112] According to the present invention, many packets can be classified according to the type of attack, and the network manager can analyze the classified packets in detail.

[0113] The above-described methods and apparatuses are not only realized by the exemplary embodiment of the present invention, but, on the contrary, are intended to be realized by a program for realizing functions corresponding to the configuration of the exemplary embodiment of the present invention or a recoding medium recoding the program.

[0114] While this invention has been described in connection with what is presently considered to be practical exemplary embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A network monitoring apparatus for monitoring a first network, comprising:

a network packet collector collecting packets of the first network; and

a visual information generator generating visual information by displaying the packets on a parallel coordinate system which has at least two parallel axes for parameters of the packets.

2. The network monitoring apparatus of claim 1, further comprising an attack packet extractor extracting attack packets from the packets, wherein the visual information generator generates the visual information with the attack packets.

3. The network monitoring apparatus of claim 2, wherein the attack packet extractor comprises:

at least two parameter storages in which the same value is stored only once;

an attack type identifier generator generating an attack type identifier of a packet according to whether or not the value of each parameters of the packet is already stored in the parameter storages;

at least one attack packet storage in which packets are stored according to types of attack;

a packet storing controller storing the packet in the attack packet storage according to the attack type identifier; and

an attack packet provider providing packets of the attack packet storage to the visual information generator in case the attack packet storage has more packets than a predetermined number.

4. The network monitoring apparatus of claim 3, wherein the parameter storages is cleared after a predetermined time period elapses.

5. The network monitoring apparatus of claim 3, wherein the attack packet storage is cleared after a predetermined time period elapses.

6. The network monitoring apparatus of claim 2, further comprising:

a warning information generator generating warning information in a case that the attack packets exist; and

a network state information transmitter transmitting the warning information to a remote apparatus through the first network.

7. The network monitoring apparatus of claim 2, further comprising:

a warning information generator generating a warning information in a case that the attack packets exist; and

a network state information transmitter transmitting the

8. The network monitoring apparatus of claim 1, further comprising: a network state information transmitter transmitting the visual information to a remote apparatus through the first network.

9. The network monitoring apparatus of claim 1, further comprising:

a network state information request receiver receiving a network state information request to request states of the first network through the first network; and

a network state information transmitter transmitting the visual information to a remote apparatus through the first network in response to the network state information request.

10. The network monitoring apparatus of claim 1, further comprising: a network state information transmitter transmitting the visual information to a remote apparatus through a second network.

11. The network monitoring apparatus of claim 1, further comprising:

a network state information request receiver receiving a network state information request to request states of the first network through a second network; and

a network state information transmitter transmitting the visual information to a remote apparatus through the second network in response to the network state information request.

12. The network monitoring apparatus of claim 1, further comprising: a visual information displayer displaying the visual information in a display device.

13. A network monitoring method for monitoring a first network, comprising:

collecting packets of the first network; and

generating visual information by displaying the packets on a parallel coordinate system which has one or more parallel axes for parameters of the packets.

14. The network monitoring method of claim 13, further comprising extracting attack packets from the packets of the first network, wherein generating the visual informaion comprises generating the visual information by displaying the attack packets.

15. The network monitoring method of claim 14, wherein extracting the attack packets comprises:

generating an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in parameter storages in which the same value is stored only once; and

storing the packet in an attack packet storage according to the attack type identifier.

16. The network monitoring method of claim 15, wherein the parameter storages are cleared after a predetermined time period elapses.

17. The network monitoring method of claim 15, wherein the attack packet storage is cleared after a predetermined time period elapses.

18. The network monitoring method of claim 14, further comprising: generating warning information in a case that the attack packets exist; and transmitting the warning information to a remote apparatus through the first network.

19. The network monitoring method of claim 14, further comprising: generating a warning information in a case that the attack packets exist; and transmitting the warning information to a remote apparatus through a second network.

20. The network monitoring method of claim 13, further comprising transmitting the visual information to a remote apparatus through the first network.

21. The network monitoring method of claim 13, further comprising:

receiving a network state information request to request states of the first network through the first network; and

transmitting the visual information to a remote apparatus through the first network in response to the network state information request.

22. The network monitoring method of claim 13, further comprising transmitting the visual information to a remote apparatus through a second network.

23. The network monitoring method of claim 13, further comprising:

receiving a network state information request to request states of the first network through a second network; and

transmitting the visual information to a remote apparatus through the second network in response to the network state information request.

24. The network monitoring method of claim 13, further comprising displaying the visual information in a display device.

25. A network analyzing apparatus for analyzing a first network, comprising:

a network packet collector collecting packets of the first network;

at least two parameter storages in which the same value is stored only once; and

an attack type identifier generator generating an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in the parameter storages.

26. The network analyzing apparatus of claim 25, further comprising:

at least one attack packet storage in which packets are stored according to types of attack; and

a packet storing controller storing the packet in the attack packet storage according to the attack type identifier.

27. An attack type identifying method for identifying an attack type of a packet on a first network, comprising:

collecting packets of the first network; and

generating an attack type identifier of a packet according to whether or not the value of each parameter of the packet is already stored in parameter storages in which the same value is stored only once.

28. A packet classifying method for classifying packets on a first network according to attack type, comprising:

collecting packets of the first network;

generating an attack type identifier of a packet according to whether or not the values of each parameter of the packet are already stored in parameter storages in which the same value is stored only once; and

storing the packet in an attack packet storage according to the attack type identifier.

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