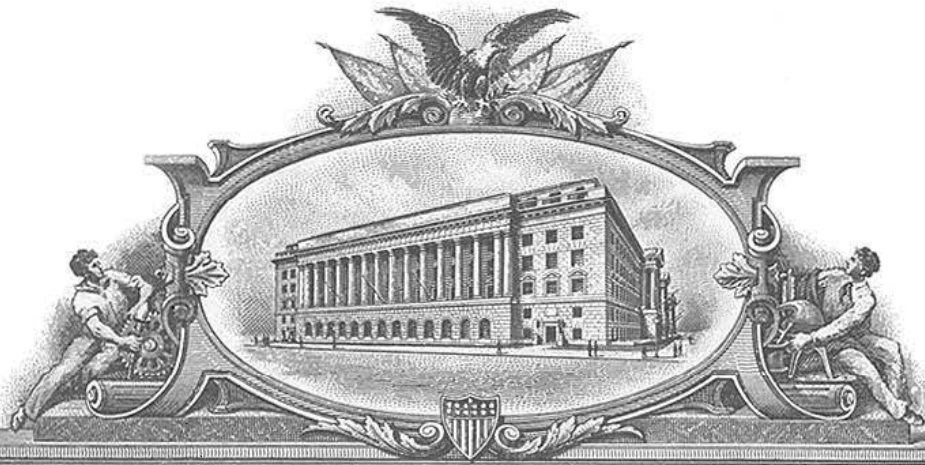


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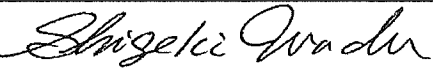
Application Number	Not Yet Assigned
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First Named Inventor	Masaharu Morimoto
Title	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
Art Unit	Not Yet Assigned
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Attorney Docket Number	11USFP2759-C1

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NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

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Inventor's Signature Masaharu Morimoto Date 03/11/2016

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NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

The present application is a Continuation
Application of U.S. Patent Application No. 13/983,001,
5 filed on July 31, 2013, which is based on
International Application No. PCT/JP2011/078439, filed
on December 8, 2011, which is based on Japanese Patent
Application No. 2011-031752, filed on February 17,
2011, the entire contents of which are incorporated
10 herein by reference.

Technical Field

The present invention relates to a network
15 system, and especially to a network flow tracing
method in a network system.

Background Art

As one of control systems of a network
20 system, a CU (C: control plane /U: user plane)
separation type network system is proposed in which a
node unit (user plane) is controlled from an external
control unit (control plane).

As an example of the CU separation type
25 network system, an open flow network system is
exemplified which uses an open flow (OpenFlow)
technique for controlling switches from a controller
for route control of the network. The details of the
open flow technique have been described in Non-Patent
30 Literature 1. It should be noted that the opening
flow network system is only an example.

(Explanation of open flow network system)

In the open flow network system, the
controller such as an OFC (OpenFlow Controller)
35 controls the conducts of switches such as OFSS
(OpenFlow Switches) by operating flow tables of the

switches. The controller and the switches are connected with secure channels.

The switches in the open flow network system form an open flow network, and are edge switches and
5 core switches which are under the control of the controller. A series of processing from the reception of packets (packets) in the edge switch on the input side to the transmission of the packets to the edge switch on the output side in the open flow network is
10 called a flow.

A packet may be referred to as a frame. A difference between the packet and the frame is only a difference in the unit of the data manipulated in the protocol (PDU: Protocol Data Unit). The packet is the
15 PDU of "TCP/IP" (Transmission Control Protocol/Internet Protocol). On the other hand, the frame is the PDU of "the Ethernet (the registered trademark)".

A flow table is a table which stores a flow
20 entry defining a predetermined operation (action) to be carried out to the packets (communication data) which match a predetermined match condition (rule).

The rule of the flow entry is defined based on various combinations of all or some of a destination
25 address, a source address, a destination port, and a source port, which are contained in a header field of each protocol hierarchy of the packet, and is identifiable. Also, the above address contains a MAC address (Media Access Control Address) and an IP
30 address (Internet Protocol Address). Also, in addition to the above, the data of an entrance port (Ingress Port) can be used for the rule of the flow entry. Also, a normal expression, an expression with wildcard "*" and so on of a part (or all) of a value
35 of the header field of the packet showing a flow can be used as the rule of the flow entry.

The action of the flow entry is any of operations such as operations of "outputting to a specific port", "discarding", and "rewriting a header". For example, the switch outputs a packet to
5 a corresponding port if data for identifying the output port (output port number and so on) is shown in the action of the flow entry, and discards the packet if data for identifying the output port is not shown. Or, the switch rewrites the header of the packet based
10 on header data if the header data is shown in the action of the flow entry.

The switch in the open flow network system executes the action of the flow entry to a packet group (a series of packets) which matches the rule of
15 the flow entry.

In the flow-based network like the open flow network system, a group of packets (a series of packets) which match the rule (predetermined header condition) of the flow entry is handled as a flow. By
20 carrying out the monitoring and control of the traffic in a flow unit, the network can be controlled more flexibly than in a conventional network.

For example, when traffic between the server and the client should be controlled for every user, it
25 becomes possible to monitor the flow based on a combination of the IP addresses of the server and of the client in the end-to-end and to control a traffic quantity.

It should be noted that the current network
30 has a very complicated configuration, and equipments having various functions such as a firewall and a load balancer (load distribution apparatus) are often arranged in the front-stage of the server and the client machine. An advantage in the control of the
35 flow-based network control is sometimes lost because of these equipments.

The equipments having a function of NAT (Network Address Translation) and NAPT (Network Address Port Translation) translate a packet header. For example, the equipment having the function of the NAT rewrites an IP header, and the equipment having the function of NAPT rewrites an IP header and a layer 4 header.

Because the packet header has been translated when passing through such an equipment (hereinafter, to be referred to as a header translating unit), the flow after the passage is different from the flow before the passage. Therefore, when relayed by such a header translating unit, the monitoring and control for every flow in end-to-end cannot be carried out.

As the technique to solve such a problem, for example, a method of using header translation data retained by the header translating unit is known. Specifically, a method is thought of in which a unit outputs an inquiry to the header translating unit to refer to an address translation table, and acquires the data of the packet header before the translation from the data of the packet header after the translation to find a corresponding flow.

However, this method can be realized if the header translating unit has an interface which can be inquired from an external unit and moreover the data of the address translation table can be referred to. If such conditions are not met, the header translating unit must be changed and the conditions must be fit.

Also, as another method, Patent Literature 1 (JP 2005-210518A) discloses a transmission source tracing data providing apparatus and a transmission source tracing apparatus as an apparatus which carries out IP trace-back.

As a representative example of the IP trace-back technique, there is ICMP trace-back (Internet

Control Message Protocol Traceback) proposed by the ICMP traceback working group of IETF (Internet Engineering Task Force). In the ICMP trace-back, a router unit on a route selects an IP packet of a trace
5 target in a predetermined probability, generates trace data to this IP packet, and transmits the trace data to the destination of the IP packet by use of an ICMP message, and then the destination unit displays the trace data.

10 There is a possibility that the correspondence relation of the separated flow by applying a similar technique to the above can be acquired.

 However, in order to realize such a
15 technique, the header translating unit needs a mechanism to transmit address translation data to the outside. Therefore, it is difficult to realize this without remodeling the header translating unit.

20 **Citation List**

 [Patent Literature 1] JP 2005-210518A
 [Non-Patent Literature 1] "OpenFlow Switch Specification, Version 1.0.0",
 [online] December 31, 2009, the Internet (URL: [http: 25 //www.openflowswitch.org/documents/openflow-spec-v1.0.0.pdf](http://www.openflowswitch.org/documents/openflow-spec-v1.0.0.pdf))

Summary of the invention

 An object of the present invention is to
30 provide a network system and a network flow tracing method in which a packet is encapsulated by using the same header as a current header in a switch, and has two kinds of headers before translation and after the translation after passing through a network appliance.
35 It should be noted that the headers contain all the headers from layer 2 to layer 4. Specifically, the

above-mentioned header is read as "all or a part of data for a rule of a flow entry".

The network system according to the present invention is provided with a switch having a function
5 to process a reception packet based on a set entry of a flow table; a controller having a function to receive an inquiry of the packet from the switch, and to set the entry defining a rule and an operation to uniformly control packets to the flow table of the
10 switch; and an encapsulating module having a function to receive the packet from at least one of the switch and the controller and to encapsulate the packet by using a same header as a header of the packet.

The computer according to the present invention having a function as an encapsulating
15 module, comprising: a unit for receiving a packet from at least one of a switch which has a function to process a reception packet based on a set entry of a flow table, and a controller which has a function to
20 receive an inquiry of the packet from the switch, and to set the entry defining a rule and an operation to uniformly control packets to the flow table of the switch; and a unit for encapsulating the packet by using a same header as a header of the packet.

25 In the network flow tracing method according to the present invention, a reception packet is processed based on a set entry of a flow table in a switch. Also, an inquiry of the packet from the switch is received, and the entry defining a rule and
30 an operation to uniformly control packets is set to the flow table of the switch, in a controller. Also, the packet from at least one of the switch and the controller is received and the packet is encapsulated by using a same header as a header of the packet, in
35 an encapsulating module.

The program according to the present invention makes a computer which has a function as an encapsulating module, execute: a step of receiving a packet from at least one of a switch which has a
5 function to process a reception packet based on a set entry of a flow table, and a controller which has a function to receive an inquiry of the packet from the switch, and to set the entry defining a rule and an operation to uniformly control packets to the flow
10 table of the switch; and a step of encapsulating the packet by using a same header as a header of the packet. That is, the program according to the present invention is a program to make a computer execute processing in the above-mentioned network flow tracing
15 method. It should be noted that the program according to present invention can be stored in a storage unit or a storage medium.

In the flow-based network like the open flow network system, even when passed through network
20 appliance such as NAT and NAPT for translating the packet header, a corresponding relation between two flows before and after the passage can be grasped, and the tracing of the flow in end-to-end becomes possible.

25

Brief Description of the Drawings

FIG. 1 is a diagram showing a basic configuration example of a network system according to the present invention and change of a packet in the
30 system;

FIG. 2 is a flow chart showing processing of an encapsulating module to a switch in the front of a header translating unit;

FIG. 3 is a flow chart showing processing of
35 the encapsulating module to the switch in the back of the header translating unit; and

FIG. 4 is a diagram showing the concept of the network system according to the present invention and exemplary embodiments.

5 **Description of Exemplary Embodiments**

The present invention deals with a CU separation type network system. In this case, an open flow network system as one of the CU separation type network systems will be described, using it as an
10 example. However, actually, the present invention is not limited to the open flow network system.

[Exemplary Embodiments]

Hereinafter, exemplary embodiments of the present invention will be described with reference to
15 the attached drawings.

(Basic structure)

As shown in FIG. 1, the network system according to the present invention includes a controller 10, switches 20 (20-i, $i = 1$ to n : n is the
20 number of switches), and a header translating unit 30.

(Controller)

When detecting the switch 20 (20-i, $i = 1$ to n), the controller 10 calculates a packet transfer route based on topology data showing a connection
25 state of the switches in the network, and registers an entry (flow entry) on a flow table of each of the switches related to the calculated route.

(Switch)

Each of the switches 20 (20-i, $i = 1$ to n)
30 transfers a received packet according to an entry registered on its own flow table. In this case, it is supposed that each of the switches 20 (20-i, $i = 1$ to n) is a virtual switch. The virtual switch is a switch realized by a virtual machine which operates on
35 a physical machine. However, actually, each of the switches 20 (20-i, $i = 1$ to n) may be a physical

switch in which software to realize a function as the switch according to the present invention is installed.

Also, the switch 20 (20-i, i = 1 to n)
5 cooperates with an encapsulating module 21 (21-i, i = 1 to n). The encapsulating module 21 (21-i, i = 1 to n) carries out encapsulation of an IP packet.

It should be noted that the encapsulating module 21 (21-i, i = 1 to n) may be built in the
10 physical machine in which the switch 20 (20-i, i = 1 to n) operates and may be connected with the physical machine. For example, the encapsulating module 21 (21-i, i = 1 to n) may operate on a computer which can communicate with the physical machine.

15 (Header translating unit)

The header translating unit 30 translates the header data of a packet received from a predetermined switch 20 and transfers to another switch 20.

(Exemplification of hardware)

20 An example of the specific hardware to realize the network system according to the present invention will be described below.

As an example of the controller 10, computers such as a PC (personal computer), appliance, a thin
25 client terminal/server, a workstation, a mainframe, and a supercomputer are assumed. Also, the controller 10 may be an extension board which is installed in the computer and a virtual machine (VM) built on a physical machine.

30 As an example of a physical machine on which the switch 20 (20-i, i = 1 to n) operates as a virtual switch and the header translating unit 30, a network switch, a router, a proxy, a gateway, a firewall, a load balancer, a base station, an access point, a
35 computer which has a plurality of communication ports and so on are exemplified.

Each of the controller 10 and the physical machine on which the switch 20 (20-i, i = 1 to n) operates, and the header translating unit 30 is realized by a processor which executes predetermined
5 processing based on a program, a memory which stores the program and all kinds of data, and a communication interface to connect with network.

As an example of the above-mentioned processor, a CPU (Central Processing Unit), a network
10 processor (NP), a microprocessor, a microcontroller and a semiconductor integrated circuit (LSI) and so on which has a function of an exclusive use are exemplified.

As an example of the above-mentioned memory,
15 a semiconductor memory device such as RAM (Random Access Memory), ROM (Read Only Memory), EEPROM (Electrically Erasable and Programmable Read Only Memory) and a flash memory, an auxiliary storage such as HDD (Hard Disk Drive) and SSD (Solid State Drive),
20 a removable disk such as DVD (Digital Versatile Disk), a storage medium such as an SD memory card (Secure Digital memory card) and so on are exemplified.

It should be noted that the above-mentioned processor and the above-mentioned memory may be
25 unified. For example, in recent years, a 1-chip microcomputer is being developed. Therefore, a case that the 1-chip microcomputer installed in the computer and so on is composed of a processor and a memory is thought of.

30 As an example of the above-mentioned communication interface, a substrate (motherboard, and an I/O board) corresponding to the network communication, a semiconductor integrated circuit of a chip and so on, a network adapter such as NIC (Network
35 Interface Card), a similar expansion card, a communication device such as an antenna, a

communication port such as a connection mouth (connector) and so on are exemplified.

Also, an an example of the network, the Internet, LAN (Local Area Network), wireless LAN (Wireless LAN), WAN (Wide Area Network), backbone, CATV line, fixation telephone network, mobile phone network, WiMAX (IEEE 802.16a), 3G (3rd Generation), dedicated line (leased line), IrDA (Infrared Data Association), Bluetooth (registered trademark), serial communication line, data bus and so on are exemplified.

As an example of the encapsulating module 21 (21-i, $i = 1$ to n), software or virtual machine which operates on the same physical machine as the switch 20 (20-i, $i = 1$ to n) are assumed. However, actually, the encapsulating module 21 (21-i, $i = 1$ to n) may be the software or the virtual machine which operates on an external server to which each of the switches 20 (20-i, $i = 1$ to n) can access. Also, the encapsulating module 21 (21-i, $i = 1$ to n) may be an exclusive use device, an expansion board or a peripheral device which is installed in the physical machine, an intermediate equipment (middle box) on the network in addition to the software.

However, actually, the present invention is not limited to these examples.
(Operation of controller)

The controller 10 previously sets "the encapsulation of a packet in a predetermined flow" to the encapsulating module 21-1 of the switch 20-1. Specifically, the controller 10 previously sets "duplicating the IP header of the packet in a predetermined flow, encapsulating a packet with the same header as the IP header, and transferring the encapsulated packet" to the encapsulating module 21-1 of the switch 20-1. In this case, an example of using

the IP header is described, but the IP header is only an example of the header. Actually, all the headers from layer 2 to layer 4 may be dealt with without limiting to the IP header of layer 3. Specifically,
5 "the IP header" may be read as "a part or all of data which can function as a rule of the flow entry".

Also, the controller 10 previously sets "transmitting a pair of a header before translation and a header after the translation as header
10 translation data to the controller and cancelling capsulation of a received packet by removing the header after the translation if there is the header after the translation, and replacing the header before the translation with the header after the translation
15 if there is the header before the translation" to the encapsulating module 21-2 of the switch 20-2. It should be noted that "removing all the headers from the reception packet once and then giving only the header after the translation" may be set. Also,
20 "removing the second stage header (the header before the translation) in the reception packet if there is it" may be set.

(Operation of first switch)

Next, the switch 20-1 hands an inputted
25 packet to the encapsulating module 21-1. Here, the inputted packet has the structure of "the IP header 1 - the payload".

The encapsulating module 21-1 duplicates the IP header 1 of the packet as set from the controller
30 10, encapsulates the packet with the same header as the IP header 1 and transfers the packet. That is, the IP header 1 is given to the payload doubly (two stages) in the transferred packet. Therefore, the packet transferred from the switch 20-1 has the
35 structure of "the IP header 1 - the IP header 1 - the payload".

In this case, "the IP header 1" at the head of "the IP header 1 - the IP header 1 - the payload" is the IP header of the encapsulated packet, and the remaining part of "the IP header 1 - the payload" (original packet) is a payload of the encapsulated packet.

It should be noted that as for the encapsulation of the packet, for example, a method such as GRE (Generic Routing Encapsulation) shown in RFC1701 and RFC2784 may be used.
(Operation of header translating unit)

Next, the header translating unit 30 refers to the IP header 1 of the inputted packet, carries out the address translation processing to translate the IP header 1 into the IP header 2.

For example, when the destination IP address is a private address of "192.168.0.10", the header translating unit 30 translates the IP header 1 of the inputted packet into the IP header 2 having the global address of "10.0.0.10" as the destination IP address.

In this way, the header translating unit 30 translates the IP header 1 of the inputted packet into the IP header 2 having a different value and transfers the packet. In this case, the header translating unit 30 removes or translates a head part of the IP header 1 given doubly, and then transfers the packet after giving the IP header 2 to the payload.

Therefore, the transferred packet has the structure of "the IP header 2 - the IP header 1 - the payload".

That is, when receiving the encapsulated packet from the switch 20-1, the header translating unit 30 translates "the IP header 1" of "the IP header 1 - the IP header 1 - the payload" at the head of of the IP header of the encapsulated packet into "the IP header 2". In this case, "the IP header 2" at the head of "the IP header 2 - the IP header 1 - the

payload" is set as the IP header of the transferred packet, and the remaining part (original packet) of "the IP header 1 - the payload" is set as the payload of the transferred packet.

5 (Operation of second switch)

Next, the switch 20-2 hands an inputted packet to the encapsulating module 21-2.

"Transmitting a pair of the header after the translation and the header before translation as
10 header translation data to the controller, carrying out processing of removing the header after the translation if it is present, and replacing the header before the translation with the header after the translation if it is preset" is set to the
15 encapsulating module 21-2 from the controller 10. Or, "giving only the header after the translation after removing all the headers from the reception packet once" may be set. Or, "if there is a second-stage header (the header before the translation) in the
20 reception packet, removing it" may be set.

In this case, the encapsulating module 21-2 checks whether or not the inputted packet is an encapsulated packet. If being the encapsulated packet, the encapsulating module 21-2 refers to the IP
25 header 2 and the IP header 1 of "the IP header 2 - the IP header 1 - the payload", and generates header translation data based on a pair (or set) of them and transmits it to the controller 10.

In the above example, the header translation
30 data indicates that the source IP address of "192.168.0.10" is changed to "10.0.0.10".

Also, the encapsulating module 21-2 removes the IP header 2 at the head of "the IP header 2 - the IP header 1 - the payload" to decapsulate the inputted
35 encapsulated packet, and replaces "the IP header 1"

with "the IP header 2" of the remaining portion of
"the IP header 1 - the payload" (original packet).

In this way, the encapsulating module 21-2
removes the IP header 1 from the original packet and
5 adds the IP header 2 to the payload, and then
transfers the packet. Therefore, the configuration of
the transferred packet is of "the IP header 2 - the
payload".

By operating as mentioned above, the
10 controller 10 can acquire the header translation data
without improving the header translating unit 30, and
trace the flow by using the data.

(Application example)

It should be noted that the controller 10
15 itself may carry out the processing of the switch 20
(20-i, $i = 1$ to n) ("encapsulation" on the
transmission side and "decapsulation on the reception
side"). In this case, the controller 10 cooperates
with the encapsulating module 21 (21-i, $i = 1$ to n).
20 Also, the controller 10 and the encapsulating module
21 (21-i, $i = 1$ to n) may be an identical unit. The
switch 20 (20-i, $i = 1$ to n) transmits the whole of
inputted packet to the controller 10 and receives the
processing result as a response. For example, it is
25 supposed that the controller 10 cooperates with the
encapsulating module 21-1 and the encapsulating module
21-2 in FIG. 1, and that they are unified. The switch
20-1 transmits "the reception packet" to the
controller 10 and receives "an encapsulated packet"
30 from the controller 10 as the response. Also, the
switch 20-2 transmits the "encapsulated packet" to the
controller 10 and receives a "packet having only the
translated header" from the controller 10 as the
response. Therefore, if the necessary processing can
35 be carried out in a necessary place, the location of
the encapsulating module 21 (21-i, $i = 1$ to n) may be

on the side of the controller 10 or on the side of the switch 20 (20-i, i = 1 to n). Of course, the processing may be carried out in both of the switch 20 (20-i, i = 1 to n) and the controller 10. For
5 example, usual packets are processed on the switch 20 (20-i, i = 1 to n), and packets of an important flow may be processed on the controller 10.

At this time, the encapsulating module 21 (21-i, i = 1 to n) may operate on a computer which can
10 communicate with each of the controller 10 and the switches 20 (20-i, i = 1 to n).

Also, an example that the IP packet is translated by using NAT has been described here for simplification of description. A case that a MAC
15 frame is translated by using MAT (MAC Address Translation) and a case that a TCP/UDP packet is translated by using NAPT can be carried out in the same way. Not only the IP header of layer 3 but also the headers from layer 2 to layer 4 can be dealt with
20 for the translation. Specifically, "the IP header (or header)" in the above description of the present invention is read as "a part or whole of data for a rule of a flow entry".

(Operation of first encapsulating module)

25 Referring to a flow chart of FIG. 2, an operation of the encapsulating module 21-1 will be described.

(1) Step S101

The encapsulating module 21-1 receives a
30 packet. In this case, the configuration of the reception packet is of "the IP header 1 - the payload".

(2) Step S102

Next, the encapsulating module 21-1 checks
35 whether or not the reception packet is a packet of an encapsulation target.

(3) Step S103

In case of being the packet of the encapsulation target, the encapsulating module 21-1 refers to the IP header 1, duplicates the IP header 1
5 and carries out encapsulation by using the same IP header 1. In this case, the configuration of the packet is of "the IP header 1 - IP header 1 - the payload".

(4) Step S104

10 The encapsulating module 21-1 transfers the packet through the switch 20-1. In case of being the packet of the encapsulation target, the configuration of the packet is of "the IP header 1 - the IP header 1 - the payload". In case of not being the packet of
15 the encapsulation target, the configuration of the packet is of "the IP header 1 - the payload".

(Operation of header translating unit)

The header translating unit 30 translates the IP header of the transferred packet. In case of being
20 the encapsulated packet, the header translating unit 30 translates the configuration of the packet from "the IP header 1 - the IP header 1 - the payload" into "the IP header 2 - the IP header 1 - the payload". In case of not being the encapsulated packet, the header
25 translating unit 30 translates the configuration of the packet from "the IP header 1 - the payload" into "the IP header 2 - the payload".

Because the processing of the header translating unit 30 is not processing peculiar to the
30 present invention but general header translation processing, the description is omitted.

(Operation of second encapsulating module)

Next, referring to a flow chart of FIG. 3, the processing of the encapsulating module 21-2 will
35 be described.

(1) Step S201

The encapsulating module 21-2 receives a packet.

(2) Step S202

Next, the encapsulating module 21-2 checks
5 whether or not the reception packet is an encapsulated packet. In case of being the encapsulated packet, the configuration of the packet is of "the IP header 2 - the IP header 1 - the payload". In case of not being the encapsulated packet, the configuration of the
10 packet is of "the IP header 2 - the payload".

(3) Step S203

In case of being the encapsulated packet, the encapsulating module 21-2 refers to the IP headers 2 and the IP headers 1 and generates header translation
15 data. The header translation data is a pair (set) of "the IP header 1" before the translation and "the IP header 2" after the translation.

(4) Step S204

Next, the encapsulating module 21-2 transmits
20 the generated header translation data to the controller 10.

(5) Step S205

Next, the encapsulating module 21-2 removes "the IP header 2" from the encapsulated packet of "the
25 IP header 2 - the IP header 1 - the payload" and replaces "the IP header 1" of "the IP header 1 - the payload" with "the IP header 2". At this time, the encapsulating module 21-2 retains "the IP header 2", which has been first removed, as the header after the
30 translation, removes "the IP header 1" as the header before the translation from "the IP header 1 - the payload", and adds "the IP header 2" as the header after the translation to "the payload". That is, "the IP header 1" as the header before the translation is
35 substituted by "the IP header 2" as the header after the translation. Or, after all the headers of "the IP

header 2 - the IP header 1" are removed from the encapsulated packet of "the IP header 2 - the IP header 1 - the payload" once, only the header of "the IP header 2" is added to the payload after the
5 translation. Or, processing is carried out to remove the second header ("the IP header 1" as the header before the translation) from the reception packet. Thus, the configuration of the packet is of "the IP header 2 - the payload".

10 (6) Step S206

The encapsulating module 21-2 transfers the packet through the switch 20-2. The configuration of the packet is of "the IP header 2 - the payload".
(Supplement)

15 It should be noted that it is enough that the controller 10 can acquire the header translation data once. The encapsulation of the packet may be stopped after the acquisition.

As mentioned above, by the encapsulating
20 module 21-1 and the encapsulating module 21-2 carrying out encapsulation of the packet and acquisition of the header translation data, the controller grasps a corresponding relation of the flows before the translation and after the translation, and the trace
25 of the flow can be carried out even when passing through the header translating unit.

<Points of the present invention>

In the present invention, a technique is disclosed which identifies flows in the front and back
30 of the header translating unit by using the encapsulating function of the packet which is installed in "OpenV Switch" as one of the switches in the open flow.

In the present invention, the switch in the
35 front of the header translating unit duplicates the

same header as the header of a packet and encapsulates the packet, as shown in FIG. 4.

Here, it is supposed that the status that the packet PKT0 has the header H0 and the payload P0 is
5 represented as being "the packet PKT0 = (H0, P0)".

When receiving the packet PKT0, the switch S0 refers to the header H0 to duplicate the same header H0, and encapsulates the packet PKT0 to generate the packet PKT1. That is, because the packet PKT1 has the
10 header H0 and the payload (H0, P0), the packet PKT1 is represented as "the packet PKT1 = (H0, (H0, P0))".

Supposing that the packet after this packet PKT1 passes through the header translating unit T0 is PKT2, the packet PKT2 is represented as "the packet
15 PKT2= (H1, (H0, P0))" because the header of the packet PKT2 is changed from the header H0 into header H1.

Next, when receiving the packet PKT2, the switch S1 compares (compares and refers) the header H1 and the header H0 in the payload. Thus, the switch S1
20 recognizes that the original header H0 is changed into the header H1 by the header translating unit T0.

The switch S1 decapsulates the packet PKT2, removes the header H1 from the packet PKT2, replaces the header H0 in the payload with the header H1, and
25 forms the packet PKT3. That is, the switch S1 replaces "the packet PKT2= (H1, (H0, P0))" with "the packet PKT3= (H1, P0)".

After that, the switch S1 transmits the packet PKT3.

30 In this way, the present invention can acquire the corresponding relation of the flows in the front and back of the header translating unit without remodeling the header translating unit T0. Therefore, the trace of the flow becomes possible.

35 At mentioned above, in the present invention, a packet is encapsulated in the switch (in the

controller which receives a request from the switch).
In such a case, by encapsulating by using the same
header as the current header, two kinds of headers
before the translation and after the translation are
5 attached to the packet after the packet has passed
through the network appliance. The trace of the flow
becomes possible using this.

<Summary>

In the present invention, in the flow-based
10 network like the open flow network system, by
encapsulating a packet by using the same header as the
current packet header, even when passed through a
network appliance such as NAT and NAPT for changing
the packet header, the corresponding relation of two
15 flows before and after the passage can be grasped and
the trace of the flows in end-to-end becomes possible.

Also, in the present invention, because only
the packet header given by the encapsulation is
translated and the translation data can be acquired by
20 comparing with the packet header before the
translation, the acquisition of the translation data
of the packet header and the trace of the flows become
possible without remodeling the network appliance by
which a packet header is translated.

25 <Supplemental notes>

A part or all of the above-mentioned
exemplary embodiments can be mentioned like the
following supplemental notes. However, actually, the
present invention is not limited to the following
30 specified examples.

(Supplemental note 1)

A network system includes:

a switch having a function of) searching a
flow table which stores an entry defining a rule and
35 an operation to uniformly control packets of a flow
and carrying out the operation defined in the entry,

to the reception packet matching the rule defined in the entry in case of the packet reception;

a controller having a function to receive an inquiry of the packet from the switch, and to set the
5 entry to the flow table of the switch;

a header translating unit having a function to translate header data at a head of the reception packet and to transfer the packet, in case of the packet reception; and

10 an encapsulating module having a function to check whether or not the packet received by the switch is an encapsulated packet; to duplicate header data of the packet in case of not being the encapsulated packet, to give the duplicated header data to the
15 reception packet to encapsulate and to hand to the switch; to remove header data at a head of the encapsulated packet and to replace header data in a remaining part with the removed header data to hand to the switch in case of being the encapsulated packet;
20 and to notify a set of the removed header data and the header data in the remaining part to the controller as header translation data.

(Supplemental note 2)

The network system according to supplemental
25 note 1, wherein the encapsulating module has a function to duplicate a first header which is the header data of the reception packet of a first switch when the switch is the first switch in a front of the header translating unit, and to give the first header
30 to the reception packet to transfer a packet, which has a configuration called "the first header - the first header - the payload" in which the first header is given doubly to the payload, through the first switch as the encapsulated packet,

35 wherein the header translating unit has a function to translate the first header at a head of

the encapsulated packet into a second header when receiving the packet from the first switch, and to generate and transfer a packet which has a configuration called "the second header - the first
5 header - the payload", and

wherein the encapsulating module has a function to refer to header data of a reception packet of a second switch to notify a set of the first header and the second header to the controller as the header
10 translation data, when the switch is the second switch in a back of the header translating unit, to remove the second header at a head of the reception packet, to replace the first header in a remaining part with the second header, to generate a packet with a
15 configuration called "the second header - the payload" and to transfer through the second switch.

(Supplemental note 3)

The network system according to supplemental note 1, wherein the encapsulating module is provided
20 on a side of at least one of the switch and the controller, and has a function to receive the packet directly from the switch when provided on the side of the switch, and to receive the packet from the switch through the controller when provided on the side of
25 the controller.

(Supplemental note 4)

A computer having a function as an encapsulating module, and includes:

a unit for checking whether or not the
30 reception packet is an encapsulated packet;

a unit for duplicating header data of the packet when the reception packet is not the encapsulated packet;

a unit for giving the duplicated header data
35 to the reception packet for encapsulation;

a unit for removing header data at a head of the encapsulated packet when the reception packet is the encapsulated packet;

5 a unit for replacing the header data in the remaining part of the encapsulated packet with the removed header data; and

a unit for generating header translation data based on a set of the header data in the remaining part and the removed header data.

10 <Remarks>

As such, the exemplary embodiments of the present invention have been described in detail. However, actually, the present invention is not limited to the above-mentioned exemplary embodiments
15 and a modification which does not deviate from the features of the present invention is contained in the present invention.

It should be noted that the present application claims a priority based on Japan Patent
20 Application No. JP 2011-031752. The disclosure thereof is incorporated herein by reference.

CLAIMS

What is claimed is:

- 5 1. A switch apparatus, comprising:
a storage storing a table, the table including
rules and actions corresponding to the rules; and
a controller comprising:
a memory storing instructions; and
10 a processor configured to execute the
instructions to:
receive the rules and the actions from
a control apparatus;
identify, based on the rules, a
15 received packet;
duplicate a part of a header of the
identified packet as an additional header
when the identified packet comprises a
target of encapsulation;
20 encapsulate the identified packet by
the additional header; and
process, based on the actions, the
identified packet.
- 25 2. The switch apparatus according to claim 1,
wherein the processor is further configured to execute
the instructions to
send header information to the control apparatus when
the identified packet comprises an encapsulated packet.
- 30 3. The switch apparatus according to claim 2,
wherein the header information includes the additional
header.
- 35 4. The switch apparatus according to claim 3,
wherein the processor is further configured to execute

further instructions to decapsulate the encapsulated packet.

5. The switch apparatus according to claim 1,
5 wherein the processor is further configured to execute the instructions for translation of first header data of a head of the received packet into second header data.

10 6. The switch apparatus according to claim 5, wherein the instructions to encapsulate the identified packet includes notifying the controller of the first header data before the translation and the second header data after the translation.

15

7. A communication system, comprising:
 a control apparatus configured to control a plurality of switch apparatuses; and
 a switch apparatus of the switch apparatuses
20 comprising:

 a storage storing a table, the table including rules and actions corresponding to the rules; and

 a controller comprising:

25

 a memory storing instructions; and
 a processor configured to execute the instructions to:

 receive the rules and the actions from a controller;

30

 identify, based on the rules, a received packet;

 duplicate a part of a header of the identified packet as an additional header when the identified packet

35

 comprises a target of encapsulation;
 encapsulate the identified packet

by the additional header; and
process, based on the actions,
the identified packet.

5 8. The communication system according to claim 7,
wherein the processor is further configured to execute
the instructions to send header information to the
control apparatus when the identified packet comprises
an encapsulated packet.

10

9. The communication system according to claim 8,
wherein the header information includes the additional
header.

15 10. The communication system according to claim 9,
wherein the processor is further configured to execute
further instructions to decapsulate the encapsulated
packet.

20 11. The communication system according to claim 7,
wherein the processor is further configured to execute
the instructions for translation of the first header
data of a head of the received packet into the second
header data.

25

12. The communication system according to claim 11,
wherein the instructions to encapsulate the identified
packet includes notifying the controller of first
header data before the translation and second header
30 data after the translation.

13. A communication method, comprising:
receiving rules and actions from a controller;
identifying, based on the rules, a received
35 packet;
duplicating a part of a header of the identified

packet as an additional header when the identified packet comprises a target of encapsulation;

encapsulating the identified packet by the additional header; and

5 processing, based on the actions, the identified packet.

14. The communication method according to claim 13, further comprising:

10 sending header information to a controller when the identified packet comprises an encapsulated packet.

15 15. The communication method according to claim 14, wherein the header information includes the additional header.

16. The communication method according to claim 15, further comprising:

20 executing further instructions to decapsulate the encapsulated packet.

17. The communication method according to claim 14, further comprising:

25 translating first header data of a head of the received packet into second header data.

18. The communication method according to claim 17, further comprising:

30 notifying the controller of the first header data before the translating and the second header data after the translating.

19. A non-transitory recording medium recording a program which when executed causes a switch to perform
35 a method, the method comprising:

receiving rules and actions from a controller;

identifying, based on the rules, a received
packet;

 duplicating a part of a header of the identified
packet as an additional header when the identified
5 packet comprises a target of encapsulation;

 encapsulating the identified packet by the
additional header; and

 processing, based on the actions, the identified
packet.

10

20. The non-transitory recording medium, according
to claim 19, the method further comprising:

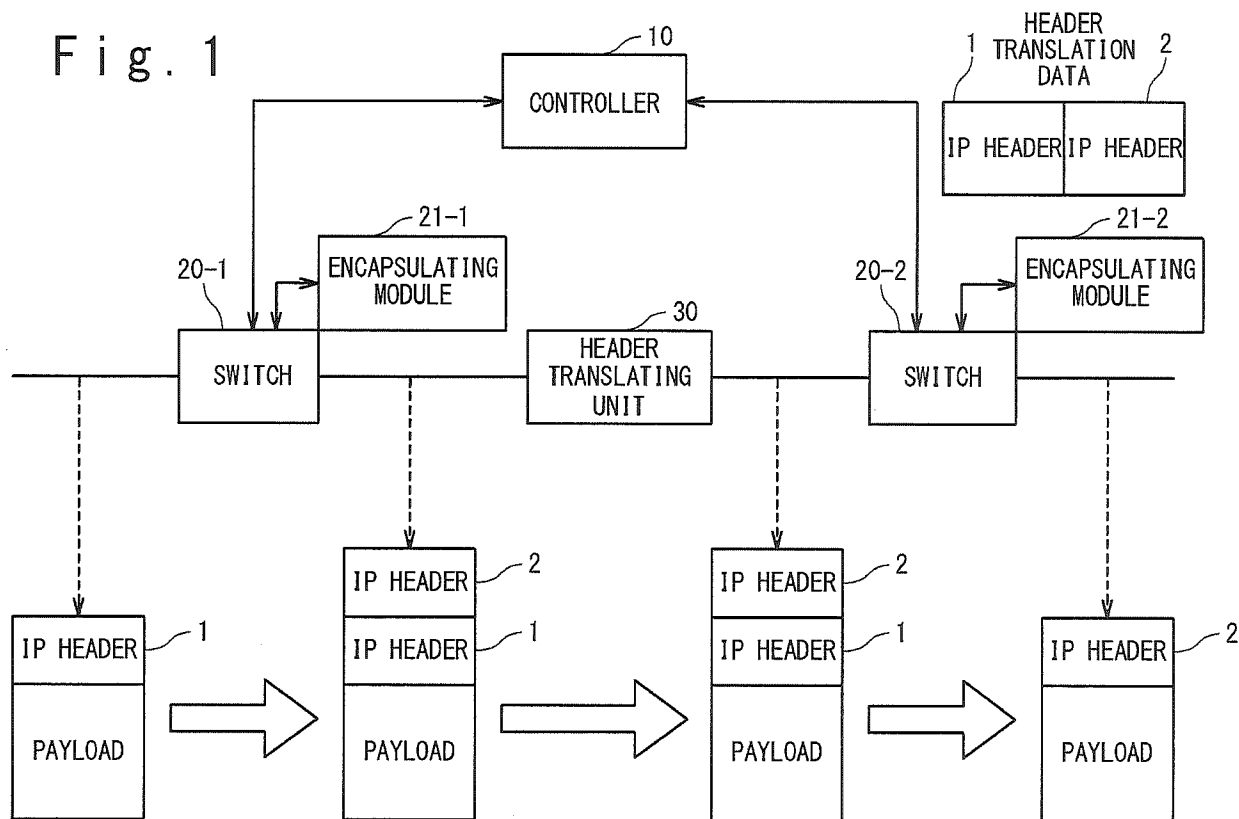
 sending header information to the controller when
the identified packet comprises an encapsulated packet,

15 wherein the header information includes the
additional header.

ABSTRACT

A switch apparatus includes a storage storing
5 a table, the table including rules and actions
corresponding to the rules, and a controller including
a memory storing instructions, and a processor
configured to execute the instructions to receive the
rules and the actions from a control apparatus,
10 identify, based on the rules, a received packet,
duplicate a part of a header of the identified packet
as an additional header when the identified packet
includes a target of encapsulation, encapsulate the
identified packet by the additional header, and
15 process, based on the actions, the identified packet.

Fig. 1



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Fig. 2

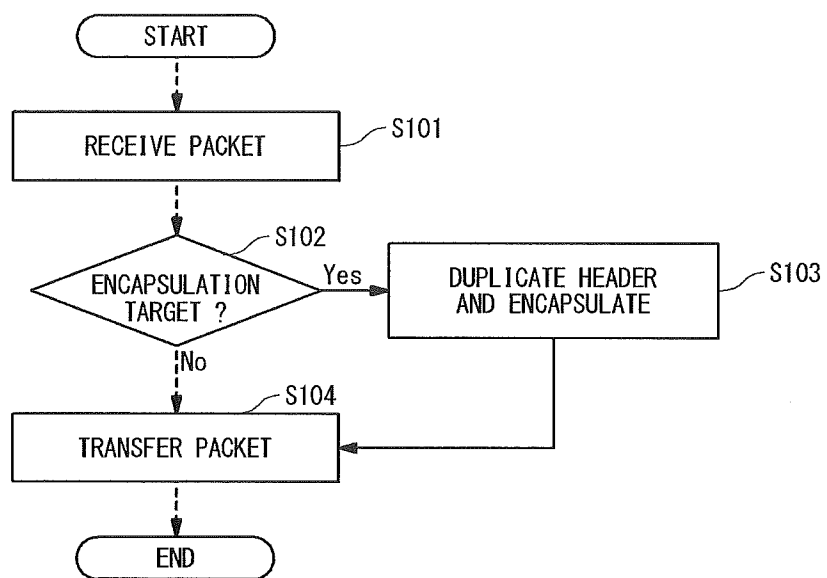


Fig. 3

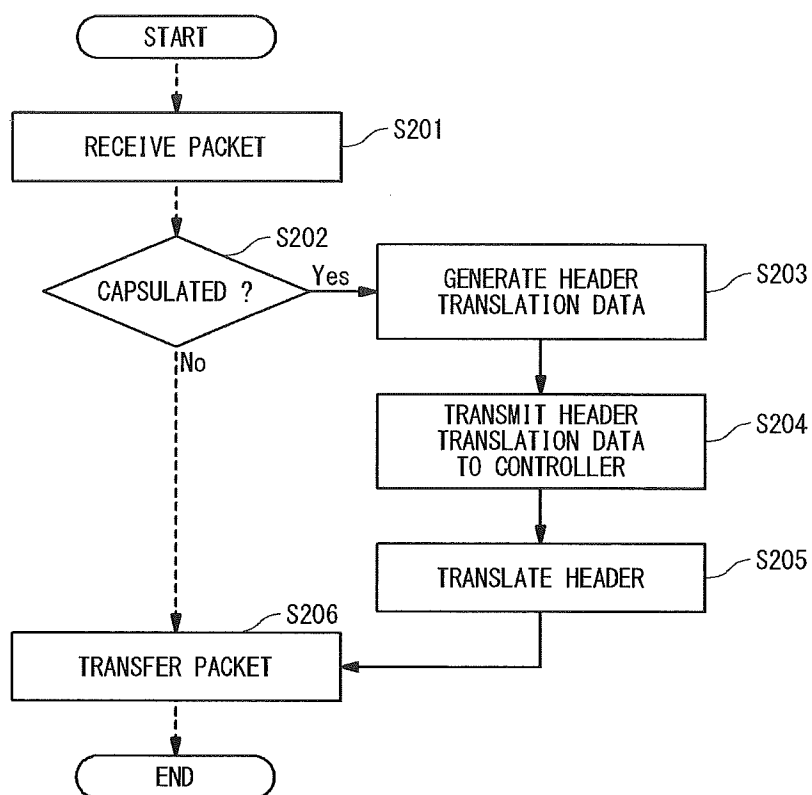
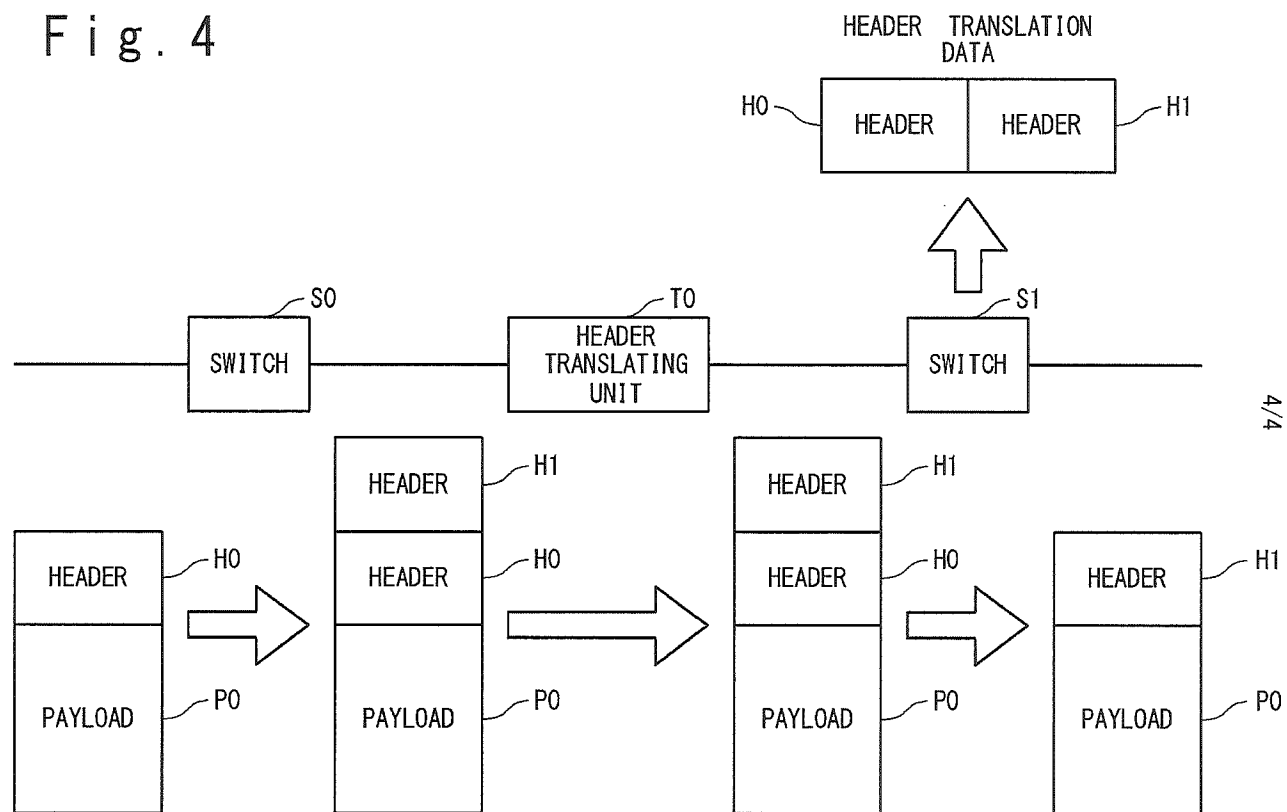


Fig. 4



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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
		Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

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Title of the Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		
Attorney Docket Number	11USFP2759-C1	Small Entity Status Claimed ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
		Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		

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For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a):

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	13983001	2013-07-31

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
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Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		

Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13983001	a 371 of international	PCT/JP2011/078439	2011-12-08
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2011-031752	JP	2011-02-17	Access Code ^j (if applicable)
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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
		Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		

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When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
		Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		

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If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	11USFP2759-C1
		Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		

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Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the **INITIAL** filing of the application and either box A or B is **not** checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature			Date (YYYY-MM-DD)	2016-03-17	
First Name	Farhad	Last Name	Shir	Registration Number	59,403

Additional Signature may be generated within this form by selecting the Add button.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	11USFP2759-C1
	Application Number	
Title of Invention	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re continuation patent application of 13/983,001 filed on July 31, 2013

For: Masaharu Morimoto

Serial No.: Not Yet Assigned

Group Art Unit: Not Yet Assigned

Filing Date: Concurrently Herewith

Examiner: Not Yet Assigned

For: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Honorable Commissioner of Patents
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Sir:

Under the provisions of 37 CFR §1.97 through §1.98 and pursuant to applicants' duty of disclosure under 37 CFR §1.56, applicants respectfully bring the following documents listed on the attached form PTO-1449, to the attention of the Examiner in charge of the above-identified application. All of these references were either cited or submitted in parent Application No. 13/983,001 and thus copies of these references are not provided in accordance with 37 C.F.R. §1.98(d).

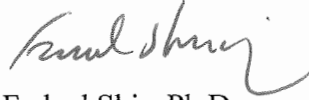
This citation does not constitute an admission that the references are relevant or material to the claims. They are only cited as constituting related art of which the applicants are aware.

It is respectfully requested that the listed references be considered by the Examiner and formally made of record in this application.

Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's

Deposit Account No. 50-0481.

Respectfully submitted,



Farhad Shir, Ph.D.
Registration No. 59,403
Sean M. McGinn, Esq.
Registration No. 34,386

Date: 3/17/16
**MCGINN INTELLECTUAL PROPERTY
LAW GROUP, PLLC**
8321 Old Courthouse Road, Suite 200
Vienna, Virginia 22182-3817
(703) 761-4100
Customer No. 21254

Information Disclosure Citation				Docket Number 11USFP2759- C1			Application Number Not Yet Assigned			
				Applicant Masaharu MORIMOTO						
				Filing Date Concurrently Herewith			Group Art Unit Not Yet Assigned			
U. S. Patent Documents										
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
U. S. Patent Application Publications										
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
Foreign Patent Documents										
Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation			
							Yes	No		
		JP 2005-210518 (A)	08/04/2005	Japan			ABS			
		JP 2010-199669 (A)	09/09/2010	Japan			ABS			
Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)										
		International Search Report (ISR) (PCT Form PCT/ISA/210), in PCT/JP2011/004601, dated January 17, 2012.								
		"OpenFlow Switch Specification, Version1.0.0", [online] December 31, 2009, the Internet (URL: http://www.openflowswitch.org/documents/openflow-spec-v1.0.0.pdf)								
		Yokoyama, et al. "Proposal of the mechanism to identify the End-to-End flow over NAT gateways." IPSJ SIG Notes, vol.2001, No. 59, June 8, 2001, pages 95-100.								
Examiner					Date Considered					
Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.										

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		
First Named Inventor/Applicant Name:		MASAHARU MORIMOTO		
Filer:		Farhad Shir		
Attorney Docket Number:		11USFP2759-C1		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Independent claims in excess of 3	1201	1	420	420
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				2020

Electronic Acknowledgement Receipt

EFS ID:	25222595
Application Number:	15072558
International Application Number:	
Confirmation Number:	7407
Title of Invention:	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
First Named Inventor/Applicant Name:	MASAHARU MORIMOTO
Customer Number:	21254
Filer:	Farhad Shir
Filer Authorized By:	
Attorney Docket Number:	11USFP2759-C1
Receipt Date:	17-MAR-2016
Filing Date:	
Time Stamp:	12:15:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 2020
RAM confirmation Number	11988
Deposit Account	500481
Authorized User	SHIR, FARHAD

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 CFR 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 CFR 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 CFR 1.19 (Document supply fees)

Charge any Additional Fees required under 37 CFR 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	201603171050.pdf	305873	no	2
			e773501b9171cd9c92838f0554f2ab22fe4ee6d		
Warnings:					
Information:					
2	Power of Attorney	201603171050-1.pdf	282700	no	2
			abb4cf5947dd85b8137fdbcd9b6623711c19dc93		
Warnings:					
Information:					
3	Oath or Declaration filed	201603171050-2.pdf	73593	no	1
			5daddeb084b02ac9e3b5873c6e779fa67a9ca29c		
Warnings:					
Information:					
4	Specification	201603171051.pdf	2328223	no	30
			d6ec629f84da7ac0c630b7897094c8d2e4cba667		
Warnings:					
Information:					
5	Drawings-only black and white line drawings	201603171051-1.pdf	165408	no	4
			0dae09bae0b64fddd9be9820e8824c1667508ef9		
Warnings:					
Information:					
6	Application Data Sheet	201603171052.pdf	833728	no	7
			5ed4417dc6dc30721b3180d97486c503497fef1e		
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
7	Information Disclosure Statement (IDS) Form (SB08)	201603171052-1.pdf	584517	no	6
			4f4d5ba2a3595745964c19d3af145a7633fae1fe		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					

8	Fee Worksheet (SB06)	fee-info.pdf	36810	no	2
			d11e41cf9c448e9069b55e1019e608cea138b70		
Warnings:					
Information:					
Total Files Size (in bytes):				4610852	
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

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**UTILITY
PATENT APPLICATION
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	11USFP2759-C1
First Inventor	Masaharu Morimoto
Title	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☒ **Fee Transmittal Form.**
(PTO/SB/17 or equivalent)
2. ☐ **Applicant claims small entity status.**
See 37 CFR 1.27.
3. ☒ **Specification.** [Total Pages 30]
Both the claims and abstract must start on a new page
(For information on the preferred arrangement, see MPEP § 608.01(a))
4. ☒ **Drawing(s).** (35 U.S.C. 113) [Total Sheets 4 (FIG 1-4)]
5. **Inventor's Oath or Declaration.** [Total Sheets 1]
(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))
 - a. ☒ Newly executed (original or copy)
 - b. ☐ A copy from a prior application (37 CFR 1.63(d))
6. ☒ **Application Data Sheet.** *See Note below.
See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
7. ☐ **CD-ROM or CD-R.**
in duplicate, large table or Computer Program (Appendix)
☐ Landscape Table on CD
8. **Nucleotide and/or Amino Acid Sequence Submission.**
(if applicable, items a. - c. are required)
 - a. ☐ Computer Readable Form (CRF)
 - b. ☐ Specification Sequence Listing on:
 - i. ☐ CD-ROM or CD-R (2 copies); or
 - ii. ☐ Paper
 - c. ☐ Statements verifying identity of above copies

ADDRESS TO: Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450**ACCOMPANYING APPLICATION PARTS**

9. ☐ **Assignment Papers.**
(cover sheet & document(s))
Name of Assignee NEC CORPORATION.
10. ☐ **37 CFR 3.73(c) Statement.** ☒ **Power of Attorney.**
(when there is an assignee)
11. ☐ **English Translation Document.**
(if applicable)
12. ☒ **Information Disclosure Statement.**
(PTO/SB/08 or PTO-1449)
☐ Copies of citations attached
13. ☐ **Preliminary Amendment.**
14. ☐ **Return Receipt Postcard.**
(MPEP § 503) (Should be specifically itemized)
15. ☐ **Certified Copy of Priority Document(s).**
(if foreign priority is claimed)
16. ☐ **Nonpublication Request.**
Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
17. ☒ **Other:** Transmittal of Power of Attorney to One or More
Registered Practitioners

***Note:** (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

18. CORRESPONDENCE ADDRESS

☒ The address associated with Customer Number: <u>21254</u>	OR ☐ Correspondence address below				
Name	McGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC				
Address	8321 OLD COURTHOUSE ROAD, SUITE 200				
City	Vienna	State	VA	Zip Code	22182-3817
Country	USA	Telephone	(703) 761-4100	Email	ADMIN@MCGINNIPLAW.COM
Signature				Date	<u>3/17/16</u>
Name (Print/Type)	Farhad Shir, Ph.D.			Registration No. (Attorney/Agent)	59,403

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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FEE TRANSMITTAL		Complete if known	
		Application Number	Not Yet Assigned
☐ Applicant asserts small entity status. See 37 CFR 1.27.		Filing Date	Currently Herewith
☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.		First Named Inventor	Masaharu Morimoto
TOTAL AMOUNT OF PAYMENT (\$)		Examiner Name	Not Yet Assigned
		Art Unit	Not Yet Assigned
(\$)		Practitioner Docket No.	11USFP2759-C1

METHOD OF PAYMENT (check all that apply)

☐ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☒ Deposit Account Deposit Account Number: 50-0481 Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☒ Charge fee(s) indicated below ☒ Charge fee(s) indicated below, **except for the filing fee**

☒ Charge any additional fee(s) or underpayment of fee(s) ☐ Credit any overpayment of fee(s)
under 37 CFR 1.16 and 1.17

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

Application Type	FILING FEES			SEARCH FEES			EXAMINATION FEES			Fees Paid (\$)
	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	
Utility	280	140*	70	600	300	150	720	360	180	1,600.00
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The \$140 small entity status filing fee for a utility application is further reduced to \$70 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee (\$)	Small Entity Fee (\$)	Micro Entity Fee (\$)
Each claim over 20 (including Reissues)	80	40	20
Each independent claim over 3 (including Reissues)	420	210	105
Multiple dependent claims	780	390	195

Total Claims	Extra Claims	Fee (\$)	Fee Paid (\$)	Multiple Dependent Claims	Fee (\$)	Fee Paid (\$)
20	-20 or HP =	x	=			
HP = highest number of total claims paid for, if greater than 20.						
Indep. Claims	Extra Claims	Fee (\$)	Fee Paid (\$)			
4	-3 or HP =	1 x	420.00	=	420.00	
HP = highest number of independent claims paid for, if greater than 3.						

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is \$400 (\$200 for small entity) (\$100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee (\$)	Fee Paid (\$)
30	- 100 =	/ 50 = (round up to a whole number) x	=	

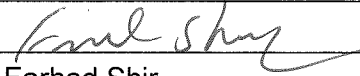
4. OTHER FEE(S)

Non-English specification, \$130 fee (no small or micro entity discount) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, \$400 fee (\$200 small or micro entity) _____

Other (e.g., late filing surcharge): _____

SUBMITTED BY

Signature		Registration No. (Attorney/Agent) 59,403	Telephone (703) 761-4100
Name (Print/Type)	Farhad Shir	Date	3/17/16

This collection of information is required by 37 CFR 1.136. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/072,558	03/17/2016	2414	2020	11USFP2759-C1	20	4

CONFIRMATION NO. 7407

FILING RECEIPT



0000000081842221

21254
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

Date Mailed: 03/31/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

MASAHARU MORIMOTO, Tokyo, JAPAN;

Applicant(s)

NEC Corporation, Tokyo, JAPAN;

Power of Attorney: The patent practitioners associated with Customer Number 21254

Domestic Priority data as claimed by applicant

This application is a CON of 13/983,001 07/31/2013 PAT 9313128
which is a 371 of PCT/JP2011/078439 12/08/2011

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.)
JAPAN 2011-031752 02/17/2011

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to**

Retrieve Electronic Priority Application(s) (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

If Required, Foreign Filing License Granted: 03/30/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/072,558**

Projected Publication Date: 07/07/2016

Non-Publication Request: No

Early Publication Request: No

Title

NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/072,558				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	600			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720			
TOTAL CLAIMS (37 CFR 1.16(j))	20	minus 20 = *			OR	x 80 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4	minus 3 = *	1			x 420 =	420			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	2020			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										

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Date of Application:

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to be used for filing abroad
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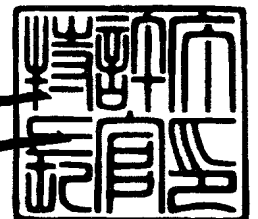
出 願 人 日本電気株式会社
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【書類名】明細書

【発明の名称】ネットワークシステム、ネットワークフロー追跡方法

【技術分野】

【0001】

本発明は、ネットワークシステムに関し、特にネットワークシステムにおけるネットワークフロー追跡方法に関する。

【背景技術】

【0002】

コンピュータネットワークにおける経路制御について、非特許文献1に示すように、通信機器の制御プロトコルであるオープンフロー（OpenFlow）技術を使用した経路制御方式が研究されている。オープンフロー技術による経路制御が行われるネットワークを、オープンフローネットワークと呼ぶ。

【0003】

オープンフローネットワークでは、OFC（OpenFlow Controller）等のコントローラが、OFS（OpenFlow Switch）等のスイッチのフローテーブルを操作することによりスイッチの挙動を制御する。コントローラとスイッチは、セキュアチャネル（Secure Channel）で接続されている。

【0004】

フローテーブルとは、所定のマッチ条件（ルール）に適合するパケット（通信データ）に対して行うべき所定の処理内容（アクション）を定義したエントリ（entry）が登録されたテーブルである。

【0005】

ルールに適合するパケット群（パケット系列）をフロー（Flow）と呼ぶ。

【0006】

フローのルールは、パケットの各プロトコル階層のヘッダ領域に含まれる宛先アドレス（Destination Address）、送信元アドレス（Source Address）、宛先ポート（Destination Port）、送信元ポート（Source Port）のいずれか又は全てを用いた様々な組み合わせにより定義され、区別可能である。なお、上記のアドレスには、MACアドレス（Media Access Control Address）やIPアドレス（Internet Protocol Address）を含むものとする。また、上記に加えて、入口ポート（Ingress Port）の情報も、フローのルールとして使用可能である。

【0007】

フローのアクションは、「特定のポートに出力する」、「廃棄する」、「ヘッダを書き換える」といった動作である。

【0008】

オープンフローネットワークのようなフローベースのネットワークでは、あるヘッダの条件にマッチするパケットの列をフローとして扱う。フロー単位でトラヒックの監視や制御を行うことで、従来のネットワークよりも柔軟にネットワークを制御することができる。

【0009】

例えば、サーバとクライアント間のトラヒックをユーザ毎に制御したい場合、サーバとクライアントのIPアドレスを組み合わせでエンド・ツー・エンドでフローを監視したり、トラヒック量を制御したり、といったことが可能となる。

【0010】

なお、現在のネットワークは非常に複雑な構成となっており、サーバやクライアントマシンの前段にはファイアウォール（firewall）やロードバランサ（負荷分散装置）といった様々な機能を持った機器が配置されていることが多く、これらの装置によってフローベースのネットワーク制御の利点が失われることがある。

【0011】

中でも、NAT (Network Address Translation) やNAPT (Network Address Port Translation) の機能を持つ装置は、パケットヘッダの変換を行う。例えば、NATの機能を持つ装置は、IPヘッダを書換え、NAPTの機能を持つ装置は、IPヘッダ、及び、レイヤ4ヘッダをも書き換える。

【0012】

このような装置（以後、ヘッダ変換装置と称する）を経由した場合、パケットヘッダが変換されてしまうため、経路前のフローと経路後のフローが別のフローになる。

【0013】

したがって、このようなヘッダ変換装置を中継した場合は、エンド・ツー・エンドのフロー毎の監視や制御ができない。

【0014】

このような課題を解決する手法として、例えば、ヘッダ変換装置が保持するヘッダ変換情報を利用する方法がある。

【0015】

具体的には、ヘッダ変換装置に問い合わせたアドレス変換テーブルを参照し、変換後のパケットヘッダの情報から変換前のパケットヘッダの情報を取得して、対応するフローを見つける、という方法が考えられる。

【0016】

しかしながら、こういった方法はヘッダ変換装置が、装置の外部から問い合わせ可能なインターフェースを持っており、かつ、アドレス変換テーブルの情報を参照可能な場合にのみ実現できる。もし、このような条件が揃っていなければ、装置を改造する必要がある。

【0017】

また、別の手法として、特許文献1（特開2005-210518号公報）では、IPトレースバックを行う装置である発信源追跡情報提供装置及び発信源追跡装置が開示されている。

【0018】

このIPトレースバック技術の代表例として、IETF (Internet Engineering Task Force) のICMPトレースバックワーキンググループが提唱するICMPトレースバック (Internet Control Message Protocol Traceback) がある。

【0019】

ICMPトレースバックは、途中経路上のルータ装置が一定確率で追跡対象のIPパケットを選択し、このIPパケットに対する追跡情報を生成し、この追跡情報をICMPメッセージでIPパケットの宛先に送信し、そして、宛先の装置がこの追跡情報を表示するものである。

【0020】

これと同様な手法を適用することで、分断されたフローの対応関係を取得できる可能性もある。

【0021】

しかし、このような手法を実現するには、ヘッダ変換装置にアドレス変換情報を外部に送信する仕組みが必要である。

【0022】

したがって、ヘッダ変換装置を改造せずに実現することは難しい。

【先行技術文献】

【特許文献】

【0023】

【特許文献1】特開2005-210518号公報

【非特許文献】

【0024】

【非特許文献1】OpenFlow Switch Specification, Version 1.0.0 (<http://www.openflowswitch.org/documents/openflow-spec-v1.0.0.pdf>)

【発明の概要】

【発明が解決しようとする課題】

【0025】

本発明の目的は、スイッチにて、パケットを、現在のヘッダと同じヘッダでカプセル化することにより、ネットワーク・アプライアンス通過後には、パケットに変換前と変換後の2種類のヘッダが付属している状態となるネットワークシステム及びネットワークフロー追跡方法を提供することである。なお、ヘッダは、レイヤ2からレイヤ4までの全てのヘッダを含む。具体的には、上記のヘッダは、「フローのルールとなり得る情報の全部又は一部」と読み替える。

【課題を解決するための手段】

【0026】

本発明に係るネットワークシステムは、設定されたフローテーブルのエントリの内容に従って受信パケットを処理する機能を持つスイッチと、該スイッチからパケットの問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、該スイッチのフローテーブルに設定する機能を持つコントローラと、該スイッチ及び該コントローラのうち少なくとも一方からパケットを受け取り、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化する機能を持つカプセル化モジュールとを含む。

【0027】

本発明に係る計算機は、カプセル化モジュールとしての機能を持つ計算機であって、設定されたフローテーブルのエントリの内容に従って受信パケットを処理する機能を持つスイッチと、該スイッチからパケットの問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、該スイッチのフローテーブルに設定する機能を持つコントローラと、のうち少なくとも一方からパケットを受け取る手段と、該パケットに対し、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化する手段とを具備する。

【0028】

本発明に係るネットワークフロー追跡方法では、スイッチにおいて、設定されたフローテーブルのエントリの内容に従って受信パケットを処理する。また、コントローラにおいて、該スイッチからパケットの問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、該スイッチのフローテーブルに設定する。また、カプセル化モジュールにおいて、該スイッチ及びコントローラのうち少なくとも一方からパケットを受け取り、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化する。

【0029】

本発明に係るプログラムは、カプセル化モジュールとしての機能を持つ計算機により実行されるプログラムであって、設定されたフローテーブルのエントリの内容に従って受信パケットを処理する機能を持つスイッチと、該スイッチからパケットの問い合わせを受けて該パケットを一律に制御するためのルールと動作が定義されたエントリを該スイッチのフローテーブルに設定する機能を持つコントローラと、のうち少なくとも一方からパケットを受け取るステップと、該パケットに対し、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化するステップとを計算機に実行させるためのプログラムである。

【0030】

本発明に係るプログラムは、上記のネットワークフロー追跡方法における処理を、計算機に実行させるためのプログラムである。なお、本発明に係るプログラムは、記憶装置や記憶媒体に格納することが可能である。

【発明の効果】

【0031】

オープンフローネットワークのようなフローベースのネットワークにおいて、NATや、NAPT等のパケットヘッダを変換するようなネットワーク・アプライアンスを経由した場合にも、その前後での2つのフローの対応関係が把握でき、エンド・ツー・エンドでのフローの追跡が可能となる。

【図面の簡単な説明】

【0032】

【図1】本発明に係るネットワークシステムの基本的な構成例、及び当該システムにおけるパケットの変化を説明するための図である。

【図2】ヘッダ変換装置の前段にあるスイッチに対するカプセル化モジュールの処理を説明するためのフローチャートである。

【図3】ヘッダ変換装置の後段にあるスイッチに対するカプセル化モジュールの処理を説明するためのフローチャートである。

【図4】本発明に係るネットワークシステムの概念及び実施例を説明するための図である。

【発明を実施するための形態】

【0033】

＜実施形態＞

以下に、本発明の実施形態について添付図面を参照して説明する。

【0034】

〔基本構成〕

図1に示すように、本発明に係るネットワークシステムは、コントローラ10と、スイッチ20（20-i、i=1～n：nは台数）と、ヘッダ変換装置30を含む。

【0035】

〔コントローラ〕

コントローラ10は、ネットワークの接続状態を示すトポロジ情報（topology）を基に、スイッチ20（20-i、i=1～n）を検知した際、パケット転送経路を計算し、当該経路に関連するスイッチのフローテーブルにエントリの登録を行う。

【0036】

〔スイッチ〕

スイッチ20（20-i、i=1～n）の各々は、受信したパケットを、自身のフローテーブルに登録されたエントリに従って転送する。

【0037】

ここでは、スイッチ20（20-i、i=1～n）の各々は、仮想スイッチであるものとする。仮想スイッチとは、物理マシン上で稼働する仮想マシンにより実現されるスイッチである。但し、実際には、スイッチ20（20-i、i=1～n）の各々は、本発明に係るスイッチとしての機能を実現するためのソフトウェアがインストールされた物理スイッチでも良い。

【0038】

また、スイッチ20（20-i、i=1～n）は、カプセル化モジュール21（21-i、i=1～n）を備える。

【0039】

カプセル化モジュール21（21-i、i=1～n）は、IPパケットのカプセル化処理（encapsulation）を行う。

【0040】

なお、カプセル化モジュール21（21-i、i=1～n）は、スイッチ20（20-i、i=1～n）が稼働する物理マシンに内蔵されていても良いし、当該物理マシンに外部接続されていても良い。

【0041】

[ヘッダ変換装置]

ヘッダ変換装置30は、所定のスイッチ20から受信したパケットのヘッダ情報の変換を行い、他のスイッチ20に転送する。

【0042】

[ハードウェアの例示]

コントローラ10の例として、PC（パソコン）、アプライアンス（appliance）、シンクライアント端末／サーバ、ワークステーション、メインフレーム、スーパーコンピュータ等の計算機を想定している。また、コントローラ10は、計算機に搭載される拡張ボードや、物理マシン上に構築された仮想マシン（Virtual Machine（VM））でも良い。

【0043】

仮想スイッチとしてスイッチ20（20-i、i=1～n）が動作する物理マシン、及びヘッダ変換装置30の例として、ネットワークスイッチ（network switch）、ルータ（router）、プロキシ（proxy）、ゲートウェイ（gateway）、ファイアウォール、ロードバランサ、基地局、アクセスポイント、或いは、複数の通信ポートを有する計算機等が考えられる。

【0044】

コントローラ10、スイッチ20（20-i、i=1～n）が動作する物理マシン、及びヘッダ変換装置30は、プログラムに基づいて駆動し所定の処理を実行するプロセッサと、当該プログラムや各種データを記憶するメモリと、ネットワークに接続するための通信インターフェースによって実現される。

【0045】

上記のプロセッサの例として、CPU（Central Processing Unit）、マイクロプロセッサ（microprocessor）、マイクロコントローラ、或いは、専用の機能を有する半導体集積回路（Integrated Circuit（IC））等が考えられる。

【0046】

上記のメモリの例として、RAM（Random Access Memory）、ROM（Read Only Memory）、EEPROM（Electrically Erasable and Programmable Read Only Memory）やフラッシュメモリ等の半導体記憶装置、HDD（Hard Disk Drive）やSSD（Solid State Drive）等の補助記憶装置、又は、DVD（Digital Versatile Disk）等のリムーバブルディスクや、SDメモリカード（Secure Digital memory card）等の記憶媒体（メディア）等が考えられる。

【0047】

なお、上記のプロセッサ及び上記のメモリは、一体化していても良い。例えば、近年では、マイコン等の1チップ化が進んでいる。したがって、計算機等に搭載される1チップマイコンが、プロセッサ及びメモリを備えている事例が考えられる。

【0048】

上記の通信インターフェースの例として、ネットワーク通信に対応した基板（マザーボード、I/Oボード）やチップ等の半導体集積回路、NIC（Network Interface Card）等のネットワークアダプタや同様の拡張カード、アンテナ等の通信装置、接続口（コネクタ）等の通信ポート等が考えられる。

【0049】

また、ネットワークの例として、インターネット、LAN（Local Area Network）、無線LAN（Wireless LAN）、WAN（Wide Area Network）、バックボーン（Backbone）、ケーブルテレビ（CATV）回線、固定電話網、携帯電話網、WiMAX（IEEE 802.16a）、3G（3rd Generation）、専用線（lease line）、IrDA（Infr

ared Data Association)、Bluetooth (登録商標)、シリアル通信回線、データバス等が考えられる。

【0050】

カプセル化モジュール21 (21-i、i=1~n) の例として、スイッチ20 (20-i、i=1~n) と同じ物理マシン上で稼働するソフトウェア又は仮想マシンを想定している。但し、実際には、カプセル化モジュール21 (21-i、i=1~n) は、スイッチ20 (20-i、i=1~n) の各々がアクセス可能なサーバ上で稼働するソフトウェア又は仮想マシンでも良い。また、カプセル化モジュール21 (21-i、i=1~n) は、ソフトウェアに限らず、専用デバイス、物理マシンに搭載される拡張ボード又は周辺機器、或いはネットワーク上の中間装置 (ミドルボックス) でも良い。

【0051】

但し、実際には、これらの例に限定されない。

【0052】

[コントローラの動作]

コントローラ10は、事前に、スイッチ20-1のカプセル化モジュール21-1に対して、「所定のフローに関するパケットのカプセル化を行う」ように設定しておく。

【0053】

具体的には、コントローラ10は、事前に、スイッチ20-1のカプセル化モジュール21-1に対して、「所定のフローに関するパケットのIPヘッダを複製 (コピー) し、当該IPヘッダと同じヘッダでパケットをカプセル化し、カプセル化されたパケットを転送する」ように設定しておく。ここでは、IPヘッダを例に説明するが、IPヘッダはヘッダの一例に過ぎない。実際には、レイヤ3のIPヘッダに限らず、レイヤ2からレイヤ4までの全てのヘッダを対象としても良い。具体的には、「IPヘッダ」を「フローのルールとなり得る情報の全部又は一部」と読み替える。

【0054】

また、コントローラ10は、事前に、スイッチ20-2のカプセル化モジュール21-2に対して、「変換前ヘッダと変換後ヘッダのペア (組) をヘッダ変換情報としてコントローラに送信すると共に、受信パケットに変換後ヘッダがあれば除去し、変換前ヘッダがあれば変換後ヘッダに置き換える処理を行う」ように設定しておく。なお、「受信パケットから一旦ヘッダを全て除去した後、変換後ヘッダのみ付与する処理を行う」ように設定しても良い。また、「受信パケットに2段目のヘッダ (変換前ヘッダ) があれば除去する処理を行う」ように設定しても良い。

【0055】

[第1スイッチの動作]

次に、スイッチ20-1は、入力されたパケットをカプセル化モジュール21-1に渡す。ここでは、入力されたパケットの構成は、「IPヘッダ1-ペイロード」とする。

【0056】

カプセル化モジュール21-1は、コントローラ10から設定された通り、パケットのIPヘッダ1を複製し、IPヘッダ1と同じヘッダでパケットをカプセル化し、パケットを転送する。すなわち、転送されるパケットは、ペイロードにIPヘッダ1が二重 (二段) に付与されている。したがって、スイッチ20-1から転送されるパケットの構成は、「IPヘッダ1-IPヘッダ1-ペイロード」となる。

【0057】

この場合、「IPヘッダ1-IPヘッダ1-ペイロード」のうち、先頭の「IPヘッダ1」の部分がカプセル化されたパケットのIPヘッダとなり、残りの「IPヘッダ1-ペイロード」の部分 (本来のパケット) がカプセル化されたパケットのペイロードとなる。

【0058】

なお、パケットのカプセル化の処理については、例えば、RFC1701、RFC2784で提示されているGRE (Generic Routing Encapsulation) のような方式を用いれば良い。

【0059】

[ヘッダ変換装置の動作]

次に、ヘッダ変換装置30は、入力されたパケットのIPヘッダ1を参照し、アドレス変換処理を行い、IPヘッダ1をIPヘッダ2に変換する。

【0060】

例えば、ヘッダ変換装置30は、入力されたパケットのIPヘッダ1において、送信先IPアドレスがプライベートアドレス「192. 168. 0. 10」の場合、このIPヘッダ1を、送信先IPアドレスがグローバルアドレス「10. 0. 0. 10」のIPヘッダ2に変換する。

【0061】

このようにして、ヘッダ変換装置30は、入力されたパケットのIPヘッダ1を、異なる値を持つIPヘッダ2に変換し、パケットを転送する。ここでは、ヘッダ変換装置30は、二重（二段）に付与されているIPヘッダ1のうち先頭のものを除去／変換して、代わりにIPヘッダ2をペイロードに付与した後、パケットを転送する。したがって、転送されるパケットの構成は、「IPヘッダ2－IPヘッダ1－ペイロード」となる。

【0062】

すなわち、ヘッダ変換装置30は、スイッチ20－1からカプセル化されたパケットを受信した際、「IPヘッダ1－IPヘッダ1－ペイロード」のうち、カプセル化されたパケットのIPヘッダである先頭の「IPヘッダ1」の部分を、「IPヘッダ2」に変換する。

【0063】

この場合、「IPヘッダ2－IPヘッダ1－ペイロード」のうち、先頭の「IPヘッダ2」の部分が転送されるパケットのIPヘッダとなり、残りの「IPヘッダ1－ペイロード」の部分（本来のパケット）が転送されるパケットのペイロードとなる。

【0064】

[第2スイッチの動作]

次に、スイッチ20－2は、入力されたパケットをカプセル化モジュール21－2に渡す。

【0065】

カプセル化モジュール21－2は、コントローラ10から設定された通り、変換前ヘッダと変換後ヘッダのペア（組）をヘッダ変換情報としてコントローラに送信すると共に、受信パケットに変換後ヘッダがあれば除去し、変換前ヘッダがあれば変換後ヘッダに置き換える処理を行う。或いは、受信パケットから一旦ヘッダを全て除去した後、変換後ヘッダのみ付与する処理を行う。又は、「受信パケットに2段目のヘッダ（変換前ヘッダ）があれば除去する処理を行う」ように設定しても良い。

【0066】

ここでは、カプセル化モジュール21－2は、入力されたパケットがカプセル化されたパケットであるか確認し、カプセル化されたパケットであれば、「IPヘッダ2－IPヘッダ1－ペイロード」のうち、IPヘッダ2とIPヘッダ1を参照して、これらのペア（組）を基にヘッダ変換情報を作成し、コントローラ10に送信する。

【0067】

上述の例であれば、ヘッダ変換情報は、「送信元IPアドレスが「192. 168. 0. 10」が「10. 0. 0. 10」に変換された」ということを表す情報になる。

【0068】

また、カプセル化モジュール21－2は、入力されたパケットについて、「IPヘッダ2－IPヘッダ1－ペイロード」のうち、先頭のIPヘッダ2を除去し、残りの「IPヘッダ1－ペイロード」の部分（本来のパケット）のうち、「IPヘッダ1」を「IPヘッダ2」に置き換える。

【0069】

このようにして、カプセル化モジュール21－2は、本来のパケットに対して、IPヘ

ッダ 1 を除去して I P ヘッダ 2 をペイロードに付与した後、パケットを転送する。したがって、転送されるパケットの構成は、「I P ヘッダ 2 - ペイロード」となる。

【0070】

以上のように動作することで、ヘッダ変換装置 30 を一切改良・変更することなく、コントローラ 10 は、ヘッダ変換情報を取得することができ、その情報を用いてフローの追跡が可能となる。

【0071】

[応用例]

なお、スイッチ 20 (20-i、i=1~n) における処理(送信側での「カプセル化」、及び受信側での「カプセル化の解除」)は、コントローラ 10 自身が行っても良い。この場合、コントローラ 10 は、カプセル化モジュール 21 (21-i、i=1~n) を備える。スイッチ 20 (20-i、i=1~n) は、入力されたパケット全体をコントローラ 10 に送信し、応答として処理結果を受信する。例えば、図 1 において、スイッチ 20-1 は、「受信パケット」をコントローラ 10 に送信し、応答としてコントローラ 10 から「カプセル化されたパケット」を受信する。また、スイッチ 20-2 は、「カプセル化されたパケット」をコントローラ 10 に送信し、応答としてコントローラ 10 から「変換後ヘッダのみ付与されたパケット」を受信する。したがって、必要な場所で必要な処理を行うことができるならば、カプセル化モジュール 21 (21-i、i=1~n) の配置(所在)は、コントローラ 10 側及びスイッチ 20 (20-i、i=1~n) 側のいずれでも良い。無論、スイッチ 20 (20-i、i=1~n) とコントローラ 10 の両方で処理を行うことも可能である。例えば、通常のパケットはスイッチ 20 (20-i、i=1~n) 上で処理を行い、重要フローのパケットはコントローラ 10 上で処理を行うようにしても良い。

【0072】

また、ここでは、説明の簡略化のため、I P パケットを NAT で変換する事例について説明しているが、MAC フレームを MAT (MAC Address Translation) で変換する事例や、TCP/UDP パケットを NAT で変換する事例についても、同様の方法で実施することができる。実際には、レイヤ 3 の I P ヘッダに限らず、レイヤ 2 からレイヤ 4 までの全てのヘッダを変換の対象とすることができる。具体的には、本発明の説明における「I P ヘッダ(又はヘッダ)」を「フローのルールとなり得る情報の全部又は一部」と読み替える。

【0073】

[第 1 のカプセル化モジュールの動作]

図 2 のフローチャートを用いて、カプセル化モジュール 21-1 の処理について説明する。

【0074】

(1) ステップ S101

カプセル化モジュール 21-1 は、パケットを受信する。ここでは、受信パケットの構成は、「I P ヘッダ 1 - ペイロード」とする。

【0075】

(2) ステップ S102

次に、カプセル化モジュール 21-1 は、受信パケットがカプセル化対象のパケットであるかどうかを確認する。

【0076】

(3) ステップ S103

カプセル化対象のパケットである場合、カプセル化モジュール 21-1 は、I P ヘッダ 1 を参照し、I P ヘッダ 1 を複製して、同じ I P ヘッダ 1 でカプセル化を行う。この場合、パケットの構成は、「I P ヘッダ 1 - I P ヘッダ 1 - ペイロード」となる。

【0077】

(4) ステップ S104

カプセル化モジュール21-1は、スイッチ20-1を介してパケットを転送する。カプセル化対象のパケットである場合、パケットの構成は、「IPヘッダ1-IPヘッダ1-ペイロード」である。カプセル化対象のパケットでない場合、パケットの構成は、「IPヘッダ1-ペイロード」である。

【0078】

[ヘッダ変換装置の動作]

ヘッダ変換装置30は、転送されたパケットのIPヘッダを変換する。カプセル化されたパケットである場合、ヘッダ変換装置30は、パケットの構成を、「IPヘッダ1-IPヘッダ1-ペイロード」から「IPヘッダ2-IPヘッダ1-ペイロード」に変換する。カプセル化されたパケットでない場合、ヘッダ変換装置30は、パケットの構成を、「IPヘッダ1-ペイロード」から「IPヘッダ2-ペイロード」に変換する。

【0079】

ヘッダ変換装置30の処理については、本発明独自の処理ではなく、一般的なヘッダ変換であるため、説明を省略する。

【0080】

[第2のカプセル化モジュールの動作]

次に、図3のフローチャートを用いて、カプセル化モジュール21-2の処理について説明する。

【0081】

(1) ステップS201

カプセル化モジュール21-2は、パケットを受信する。

【0082】

(2) ステップS202

次に、カプセル化モジュール21-2は、受信パケットがカプセル化されたパケットであるかどうかを確認する。カプセル化されたパケットである場合、パケットの構成は、「IPヘッダ2-IPヘッダ1-ペイロード」である。カプセル化されたパケットでない場合、パケットの構成は、「IPヘッダ2-ペイロード」である。

【0083】

(3) ステップS203

カプセル化されたパケットである場合、カプセル化モジュール21-2は、IPヘッダ2とIPヘッダ1の二つを参照し、ヘッダ変換情報を作成する。ヘッダ変換情報は、変換前ヘッダ「IPヘッダ1」と、変換後ヘッダ「IPヘッダ2」のペア(組)となる。

【0084】

(4) ステップS204

次に、カプセル化モジュール21-2は、作成されたヘッダ変換情報をコントローラ10に送信する。

【0085】

(5) ステップS205

次に、カプセル化モジュール21-2は、カプセル化されたパケット「IPヘッダ2-IPヘッダ1-ペイロード」から「IPヘッダ2」を除去し、残りの「IPヘッダ1-ペイロード」の部分に対して、「IPヘッダ1」と「IPヘッダ2」を置き換える。このとき、カプセル化モジュール21-2は、最初に除去した「IPヘッダ2」を変換後ヘッダとして保持しておき、残りの「IPヘッダ1-ペイロード」の部分から変換前ヘッダ「IPヘッダ1」を除去し、変換後ヘッダ「IPヘッダ2」をペイロードに付け替える。すなわち、変換前ヘッダ「IPヘッダ1」を変換後ヘッダ「IPヘッダ2」に置換する。或いは、カプセル化されたパケット「IPヘッダ2-IPヘッダ1-ペイロード」から一旦全てのヘッダ「IPヘッダ2-IPヘッダ1」を除去した後、変換後ヘッダ「IPヘッダ2」のみペイロードに付与する。又は、受信パケットに付与された2段目のヘッダ(変換前ヘッダ「IPヘッダ1」)を除去する処理を行う。これにより、パケットの構成は、「IPヘッダ2-ペイロード」となる。

【0086】

(6) ステップS206

カプセル化モジュール21-2は、スイッチ20-2を介してパケットを転送する。パケットの構成は、「IPヘッダ2-ペイロード」である。

【0087】

[補足]

なお、コントローラ10は、ヘッダ変換情報を一度取得できれば良く、取得後はパケットのカプセル化を停止するように処理しても良い。

【0088】

以上のように、カプセル化モジュール21-1とカプセル化モジュール21-2がそれぞれ、パケットのカプセル化、及びヘッダ変換情報の取得を行うことにより、コントローラは変換前と変換後のフローの対応関係を把握することができ、ヘッダ変換装置を経由した場合でもフローの追跡が可能となる。

【0089】

<本発明の要点>

本発明では、オープンフローにおけるスイッチの一つであるOpenVSwitch等が実装しているパケットのカプセル化機能を利用して、ヘッダ変換装置の前後でフローを識別する手法を開示する。

【0090】

本発明では、図4に示すように、パケットのヘッダ変換装置の前段にあるスイッチは、パケットが持つヘッダと同じヘッダを複製してパケットをカプセル化する。

【0091】

ここでは、パケットPKT0がヘッダH0、ペイロードP0を持っていることをPKT0=(H0、P0)と表すことにする。すなわち、パケットPKT0を受け取ったスイッチS0は、H0を参照して同じヘッダH0を複製し、パケットPKT0をカプセル化してパケットPKT1を作成する。つまり、パケットPKT1=(H0、(H0、P0))となる。

【0092】

このパケットPKT1がヘッダ変換装置T0を経由した後のパケットをPKT2とすると、PKT2=(H1、(H0、P0))となり、ヘッダがH0からH1に変換されることになる。

【0093】

次に、このPKT2を受け取ったスイッチS1は、H1とH0を見比べることにより、ヘッダ変換装置T0により、元のH0のヘッダがH1に変換されたことが分かる。

【0094】

その後、スイッチS1はPKT2を(H1、P0)に置き換えてパケットを送信する。

【0095】

このようにすることで、ヘッダ変換装置T0に改造を加えることなく、ヘッダ変換装置の前後でフローの対応関係を取得することができ、フローの追跡が可能となる。

【0096】

以上のように、本発明では、スイッチにて（又はスイッチから要求を受けたコントローラにて）、パケットをカプセル化する。その際に、現在のヘッダと同じヘッダでカプセル化することにより、ネットワーク・アプライアンス通過後には、パケットに変換前と変換後の2種類のヘッダが付属していることになる。これを利用して、フローの追跡が可能となる。

【0097】

<まとめ>

本発明では、オープンフローネットワークのようなフローベースのネットワークにおいて、現在のパケットヘッダと同じヘッダを使ってパケットをカプセル化することにより、NATや、NAPT等のパケットヘッダを変換するようなネットワーク・アプライアンス

を經由した場合にも、その前後での2つのフローの対応関係が把握でき、エンド・ツー・エンドでのフローの追跡が可能となる。

【0098】

また、本発明では、カプセル化によって付与されたパケットヘッダのみが変換され、その変換前のパケットヘッダと比較することで変換情報が取得できるため、パケットヘッダの変換を行うネットワーク・アプライアンス装置を改造することなく、パケットヘッダの変換情報の取得や、フローの追跡が可能となる。

【0099】

<付記>

上記の実施形態の一部又は全部は、以下の付記のように記載することも可能である。但し、実際には、以下の記載例に限定されない。

【0100】

(付記1)

パケット受信時に、フローを構成する各パケットを一律に制御するためのルールと動作が定義されたエントリが設定されたフローエントリを検索して、前記エントリに定義されたルールに適合する受信パケットに対して、前記エントリに定義された動作を行う機能を持つスイッチと、

前記スイッチからパケットの問い合わせを受け、当該パケットを一律に制御するためのルールと動作が定義されたエントリを、前記スイッチのフローテーブルに設定する機能を持つコントローラと、

パケット受信時に、受信パケットの先頭のヘッダ情報の変換を行って転送する機能を持つヘッダ変換装置と、

前記スイッチが受信したパケットがカプセル化されたパケットかどうか確認し、カプセル化されたパケットでない場合、該パケットのヘッダ情報を複製し、複製したヘッダ情報を該受信パケットに付与してカプセル化して前記スイッチに渡し、カプセル化されたパケットである場合、該カプセル化されたパケットの先頭のヘッダ情報を除去し、残りの部分にあるヘッダ情報を該除去したヘッダ情報と置き換えて前記スイッチに渡し、該残りの部分にあるヘッダ情報と該除去したヘッダ情報との組をヘッダ変換情報として前記コントローラに通知する機能を持つカプセル化モジュールと

を含む

ネットワークシステム。

【0101】

(付記2)

付記1に記載のネットワークシステムであって、

前記カプセル化モジュールは、前記スイッチが前記ヘッダ変換装置の前段にある第1スイッチである場合、前記第1スイッチの受信パケットのヘッダ情報である第1ヘッダを複製し、前記第1ヘッダを該受信パケットに付与して、ペイロードに前記第1ヘッダが二重に付与されている「第1ヘッダー第1ヘッダーペイロード」という構成のパケットを、前記カプセル化されたパケットとして前記第1スイッチ経由で転送する機能を持ち、

前記ヘッダ変換装置は、前記第1スイッチからのパケットを受信した際、前記カプセル化されたパケットの先頭の第1ヘッダを第2ヘッダに変換して、「第2ヘッダー第1ヘッダーペイロード」という構成のパケットにして転送する機能を持ち、

前記カプセル化モジュールは、前記スイッチが前記ヘッダ変換装置の後段にある第2スイッチである場合、前記第2スイッチの受信パケットのヘッダ情報を参照し、前記第1ヘッダと前記第2ヘッダとの組をヘッダ変換情報として前記コントローラに通知し、該受信パケットの先頭の第2ヘッダを除去し、残りの部分にある第1ヘッダを第2ヘッダ2と置き換えて、「第2ヘッダーペイロード」という構成のパケットにした上で、前記第2スイッチ経由で転送する機能を持つ

ネットワークシステム。

【0102】

(付記3)

付記1に記載のネットワークシステムであって、

前記カプセル化モジュールは、前記スイッチ及び前記コントローラのうち少なくとも一方の側に設けられ、前記スイッチの側に設けられた場合、前記スイッチから直接パケットを受け取り、前記コントローラの側に設けられた場合、前記スイッチから前記コントローラ経由でパケットを受け取る機能を持つ

ネットワークシステム。

【0103】

(付記4)

カプセル化モジュールとしての機能を持つ計算機であって、

受信パケットがカプセル化されたパケットかどうか確認する手段と、

前記受信パケットがカプセル化されたパケットでない場合、該パケットのヘッダ情報を複製する手段と、

複製したヘッダ情報を該受信パケットに付与してカプセル化する手段と、

前記受信パケットがカプセル化されたパケットである場合、該カプセル化されたパケットの先頭のヘッダ情報を除去する手段と、

該カプセル化されたパケットの残りの部分にあるヘッダ情報を該除去したヘッダ情報と置き換える手段と、

該残りの部分にあるヘッダ情報と該除去したヘッダ情報との組を基にヘッダ変換情報を生成する手段と

を具備する

計算機。

【0104】

<備考>

以上、本発明の実施形態を詳述してきたが、実際には、上記の実施形態に限られるものではなく、本発明の要旨を逸脱しない範囲の変更があっても本発明に含まれる。

【符号の説明】

【0105】

10… コントローラ

20 (20-i、i=1～n) … スイッチ

21 (21-i、i=1～n) … カプセル化モジュール

30… ヘッダ変換装置

【書類名】特許請求の範囲

【請求項1】

設定されたフロレーターのエントリの内容に従って受信パケットを処理する機能を持つスィッチと、前記スィッチからパケットの間の問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、前記スィッチのフロレータに設定する機能を持つコントローラと、前記スィッチ及び前記コントローラのうち少なくとも一方からパケットを受け取り、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化する機能を持つカプセル化モジュールとを含むネットワークシステム。

【請求項2】

請求項1に記載のネットワークシステムであって、前記スィッチからパケットを受信した時に、受信パケットの先頭のヘッダ情報の交換を行って、他のスィッチに転送する機能を持つヘッダ交換装置を更に含み、

前記カプセル化モジュールは、前記カプセル化されたパケットが前記ヘッダ交換装置を経過した場合、交換前と交換後の2種類のヘッダが付与されたパケットを受け取り、交換前と交換後の2種類のヘッダの組を前記コントローラに通知する機能を持つネットワークシステム。

【請求項3】

請求項2に記載のネットワークシステムであって、前記カプセル化モジュールは、前記スィッチが受信したパケットがカプセル化されたパケットかどうかを確認する機能を持ち、

カプセル化されたパケットでない場合、該パケットのヘッダ情報を複製し、複製したヘッダ情報を該受信パケットに付与してカプセル化して前記スィッチに渡す機能を持ち、カプセル化されたパケットである場合、該カプセル化されたパケットの先頭のヘッダ情報と本来のパケットのヘッダ情報との組をヘッダ交換情報として前記コントローラに通知する機能を持ち、

該カプセル化されたパケットを、前記先頭のヘッダ情報のみ付与されたパケットに変換して前記スィッチに渡す機能を持つネットワークシステム。

【請求項4】

カプセル化モジュールとしての機能を持つ計算機であって、設定されたフロレーターのエントリの内容に従って受信パケットを処理する機能を持つスィッチと、前記スィッチからパケットの間の問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、前記スィッチのフロレータに設定する機能を持つコントローラと、のうち少なくとも一方からパケットを受け取る手段と、該パケットに対し、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化する手段と

を具備する計算機。

【請求項5】

請求項4に記載の計算機であって、前記カプセル化されたパケットが、受信パケットの先頭のヘッダ情報の交換を行って転送する機能を持つヘッダ交換装置を経過した場合、交換前と交換後の2種類のヘッダが付与されたパケットを受け取り、交換前と交換後の2種類のヘッダを参照する手段を更に具備する

計算機。

【請求項 6】

請求項 4 又は 5 に記載の計算機であって、

受信パケットがカプセル化されたパケットかどうか確認する手段と、

前記受信パケットがカプセル化されたパケットでない場合、該パケットのヘッダ情報を複製する手段と、

複製したヘッダ情報を該受信パケットに付与してカプセル化する手段と、

前記受信パケットがカプセル化されたパケットである場合、該カプセル化されたパケットの先頭のヘッダ情報と本来のパケットのヘッダ情報との組を基にヘッダ変換情報を生成する手段と、

該カプセル化されたパケットを、前記先頭のヘッダ情報のみ付与されたパケットに変換する手段と

を具備する

計算機。

【請求項 7】

スイッチにおいて、設定されたフローテーブルのエントリの内容に従って受信パケットを処理することと、

コントローラにおいて、前記スイッチからパケットの問い合わせを受け、該パケットを一律に制御するためのルールと動作が定義されたエントリを、前記スイッチのフローテーブルに設定することと、

カプセル化モジュールにおいて、前記スイッチ及び前記コントローラのうち少なくとも一方からパケットを受け取り、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化することと

を含む

ネットワークフロー追跡方法。

【請求項 8】

カプセル化モジュールとしての機能を持つ計算機により実行されるプログラムであって

、
設定されたフローテーブルのエントリの内容に従って受信パケットを処理する機能を持つスイッチと、前記スイッチからパケットの問い合わせを受けて該パケットを一律に制御するためのルールと動作が定義されたエントリを前記スイッチのフローテーブルに設定する機能を持つコントローラと、のうち少なくとも一方からパケットを受け取るステップと

、
該パケットに対し、該パケットのヘッダと同じヘッダを使ってパケットをカプセル化するステップと

を計算機に実行させるための

プログラム。

【書類名】 要約書

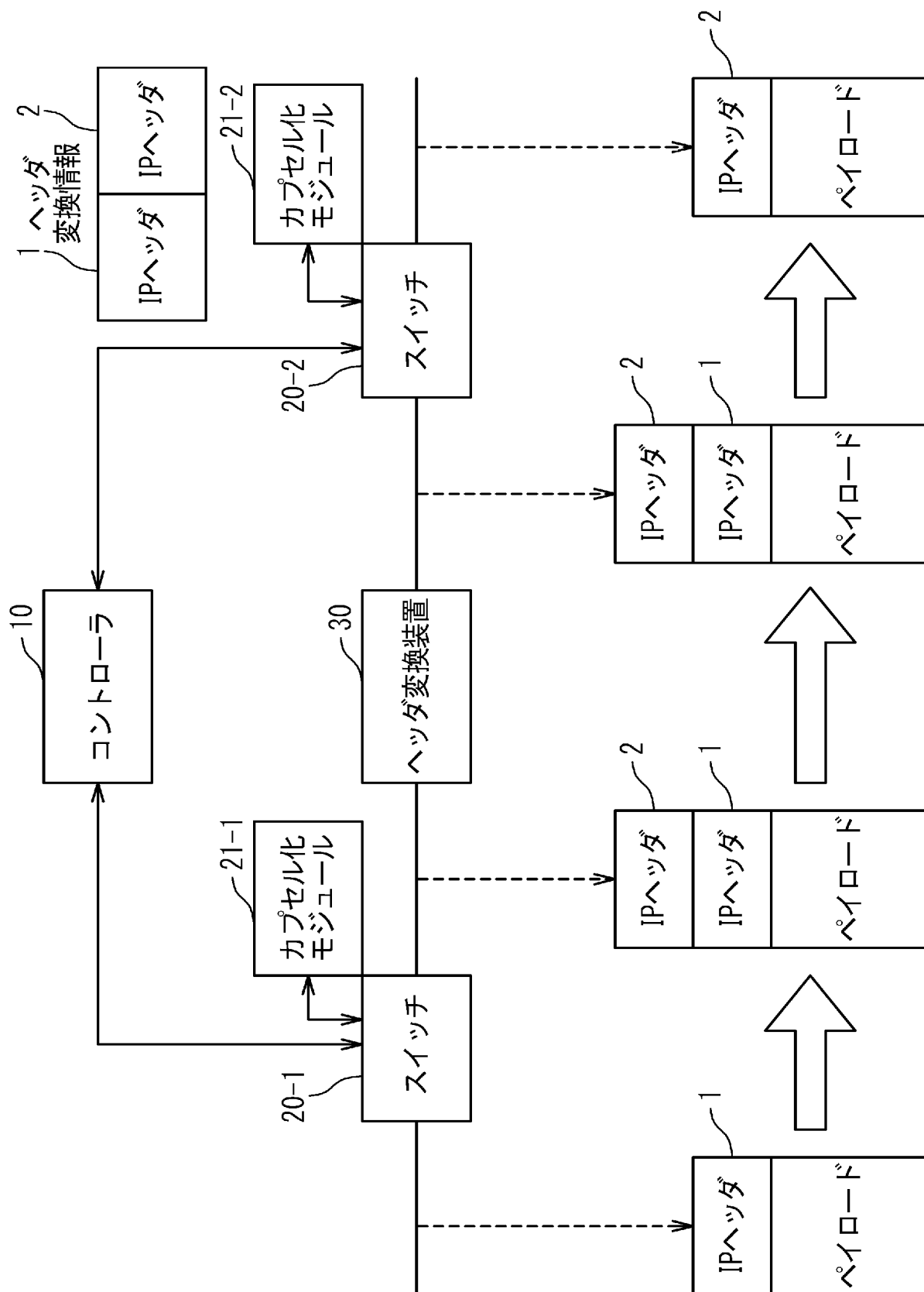
【要約】

【課題】 オープンフローネットワークのようなフローベースのネットワークにおいて、NATや、NAPT等のパケットヘッダを変換するようなネットワーク・アプライアンスを経由した場合にも、その前後での2つのフローの対応関係が把握でき、エンド・ツー・エンドでのフローの追跡ができるようにする。

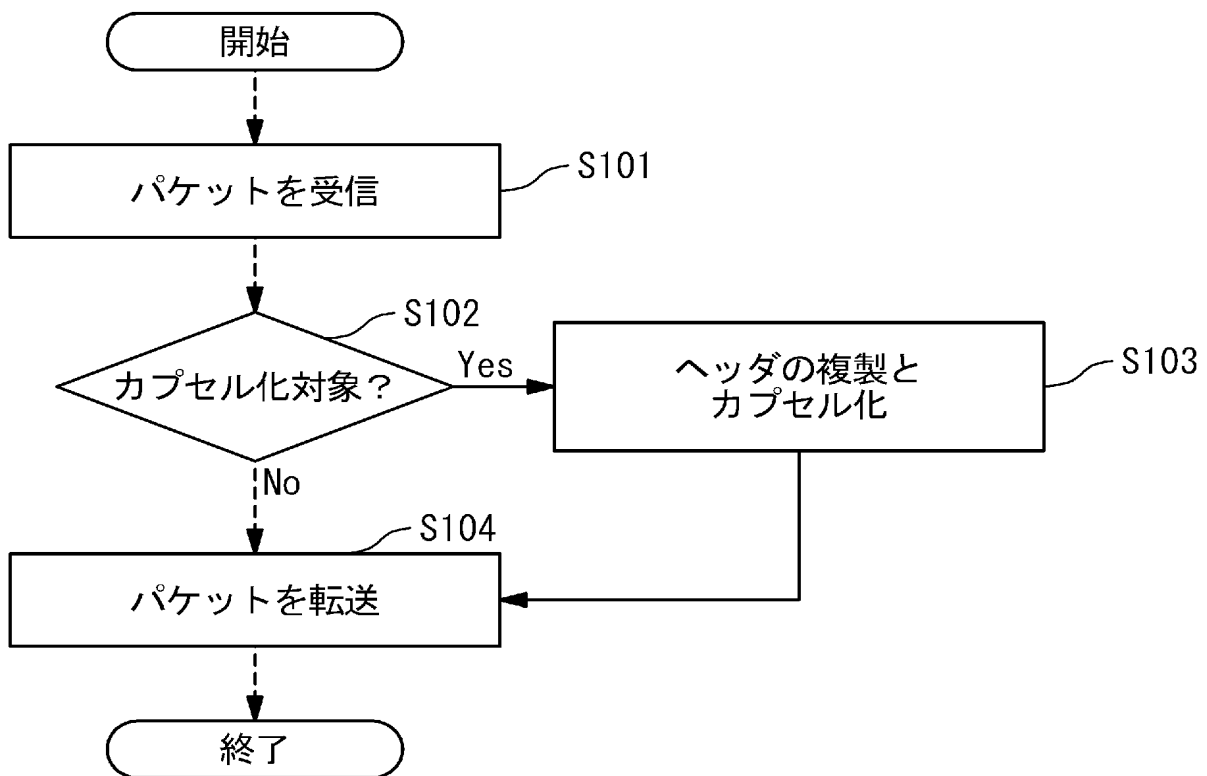
【解決手段】 スイッチにて（又はスイッチから要求を受けたコントローラにて）、パケットをカプセル化する。その際に、現在のヘッダと同じヘッダでカプセル化することにより、ネットワーク・アプライアンス通過後には、パケットに変換前と変換後の2種類のヘッダが付属していることになる。

【選択図】 図1

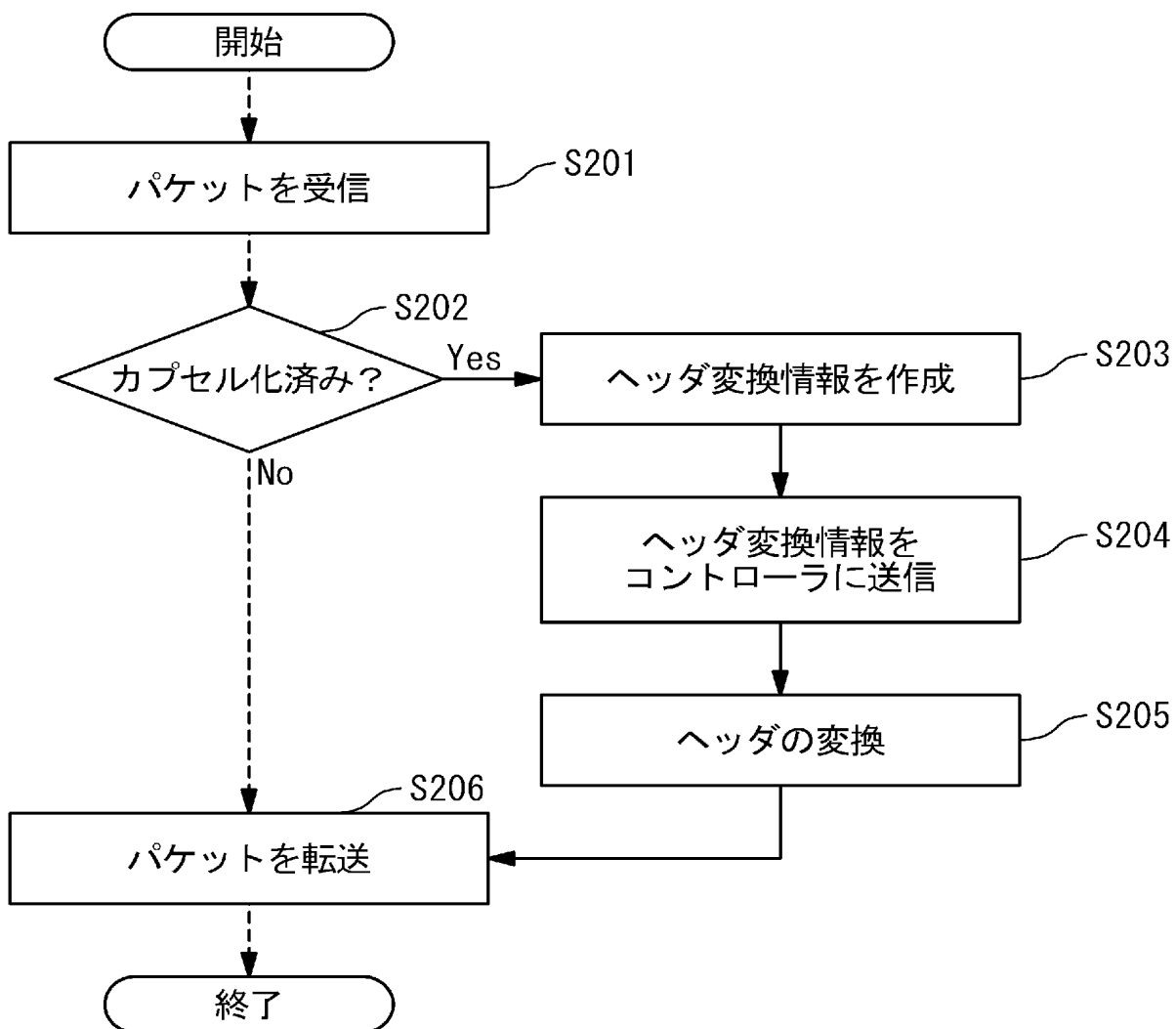
【書類名】 図面
【図 1】



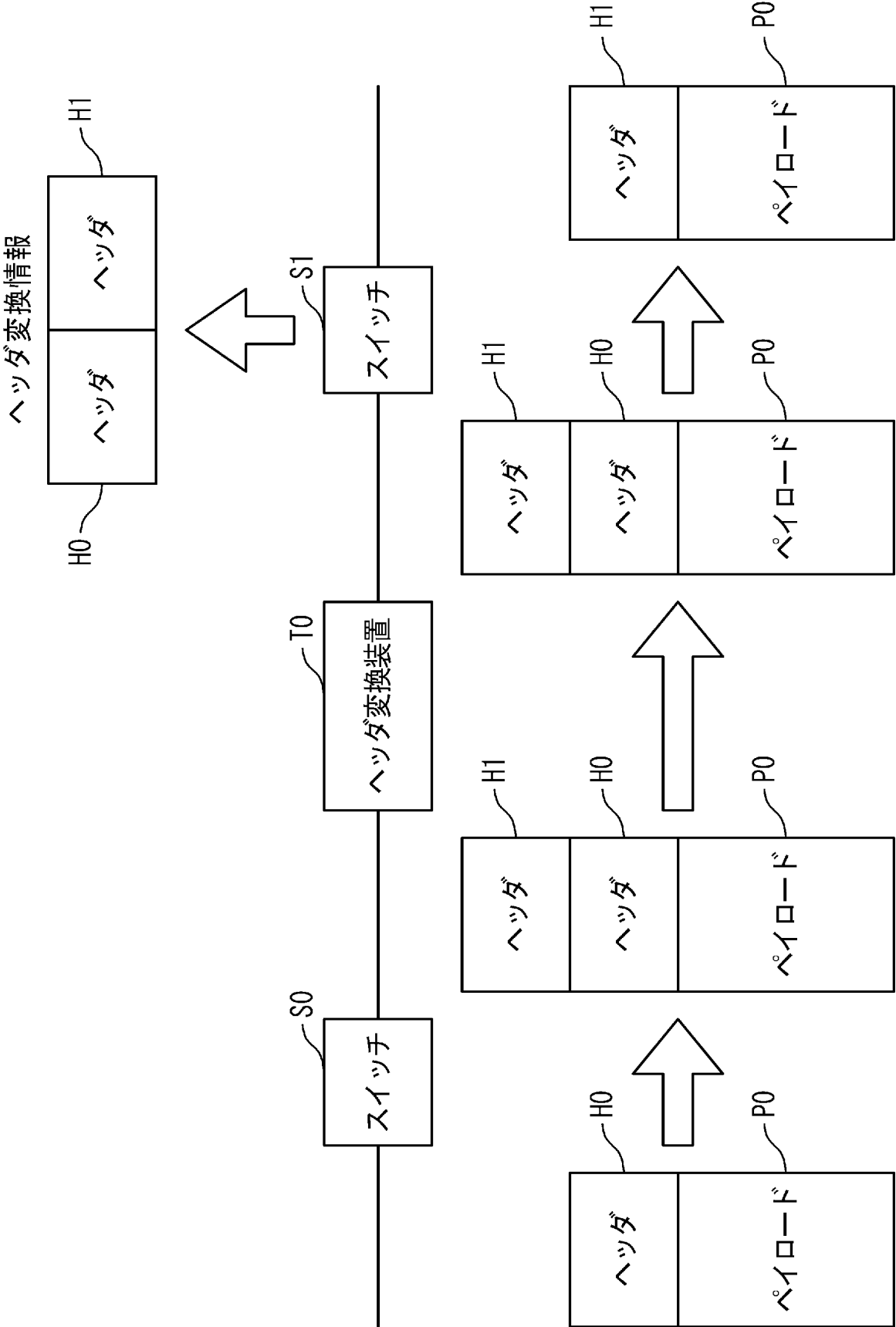
【図 2】



【図 3】



【図4】



出願人履歴

0 0 0 0 0 4 2 3 7

19900829

新規登録

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1	7407

21254 7590 04/11/2016
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER

ONAMUTI, GBEMILEKE J

ART UNIT	PAPER NUMBER
----------	--------------

2463

MAIL DATE	DELIVERY MODE
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04/11/2016

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 15/072,558	Applicant(s) MORIMOTO, MASAHARU	
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03/17/2016.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) ☒ Claim(s) 1-20 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) _____ is/are allowed.
- 7) ☒ Claim(s) 1-20 is/are rejected.
- 8) ☐ Claim(s) _____ is/are objected to.
- 9) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on 03/17/2016 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☒ All b) ☐ Some** c) ☐ None of the:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) ☐ Notice of References Cited (PTO-892) | 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date _____ | 4) ☐ Other: _____ |

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

Claims 1-20 are rejected under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention and the claimed invention is directed to non-statutory subject matter.

Claims 1-20 disclose abstract idea(s) in the defined claimed invention, directed to a judicial exception without adding significantly more. Specifically, the defined claimed invention recites an abstract idea, which comprises 'receiving rules and actions from a controller; identifying, based on the rules, a received packet; duplicating a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation; encapsulating the identified packet by the additional header; and processing, based on the actions, the identified packet', which, when analyzed as a whole, while considering the additional limitations individually and as an ordered combination, adds nothing significant beyond organizing, storing, encapsulating and transmitting of packets, which have been recognized as examples of abstract ideas.

Hence, the defined invention is directed to a judicial exception per the United States Supreme Court in **Alice Corporation v. CLS Bank (2014)** since the defined invention does not amount to significantly more than the underlying abstract idea of organizing, storing, encapsulating and transmitting of packets, which have been recognized as examples of abstract ideas.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to

Art Unit: 2463

be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(I)(1) - 706.02(I)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/forms/. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to

<http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

4. **Claims 1-20** are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over **Claims 1, 3, 4 and 6-20** of copending application No.: 13/983,001 to Morimoto, Masaharu. Although the claims at issue are not identical, they are not patentably distinct from each other because **Claims 1-20** of this instant application is obvious variant of **Claims 1, 3, 4 and 6-20** of copending application No.: 13/983,001 to Morimoto, Masaharu in that they contain substantially the same subject matter.

This is a provisional nonstatutory double patenting rejection because the patentably indistinct claims have not in fact been patented. See the table below:

Co-Pending Application 13/983,001	Instant Application 15/072,558
Claim 1	Claim 1
Claim 1	Claim 2
Claim 1	Claim 3
Claim 3	Claim 4
Claim 4	Claim 5
Claim 3	Claim 6
Claim 4	Claim 7
Claim 4	Claim 8
Claim 4	Claim 9
Claim 6	Claim 10
Claim 7	Claim 11
Claim 7	Claim 12
Claim 7	Claim 13
Claim 10	Claim 14
Claim 7	Claim 15
Claim 11	Claim 16
Claim 15	Claim 17

Claim 7	Claim 18
Claim 8	Claim 19
Claim 8	Claim 20

Examiner's Note

5. Examiner has cited particular columns and line numbers in the references applied to the claims above for the convenience of the applicant. Although the specified citations are representative of the teachings of the art and are applied to specific limitations within the individual claim, other passages and figures may apply as well. It is respectfully requested from the applicant in preparing responses, to fully consider the references in their entirety as potentially teaching all or part of the claimed invention, as well as the context of the passage as taught by the prior art or disclosed by the examiner.

In the case of amending the claimed invention, applicant is respectfully requested to indicate the portion(s) of the specification which dictate(s) the structure relied on for proper interpretation and also to verify and ascertain the metes and bounds of the claimed invention.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GBEMILEKE ONAMUTI whose telephone number is

Art Unit: 2463

(571)270-5619. The examiner can normally be reached on Monday-Friday, 8:30 AM - 5:00 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, MARK RINEHART can be reached on (571)272-3632. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/GBEMILEKE ONAMUTI/
Examiner, Art Unit 2463

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	57	switch with (receiv\$3 or receipt\$3) near3 (data or frame or packet) same (table or database) with flow same (rule or policy or policies) and (modif\$7 or chang\$3 or adjust\$3 or translat\$3) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:31
L5	1659018	H04L\$.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:33
L6	56	3 and 5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:34
L7	98	encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:38
L8	3	(rule or policy) same (packet or data or frame) same (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:41
L9	55	encapsulat\$3 near2 (packet or data) with ("same" or similar or duplicat\$3 or correspond\$3 or equivalent) near2 (header or preamble) with (packet or data) near2 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:42
L10	88	H04L\$.CPC. and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 13:45

L12	1	(receiv\$3 or recept\$3) near3 (rule or policy) with (packet or frame oe data) same (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) and encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/04/04 14:17
S1	14	((MASAHARU) near2 (MORIMOTO)).INV.	US-PGPUB; USPAT	ADJ	ON	2016/04/04 11:45
S2	22	((MASAHARU) near2 (MORIMOTO)).INV.	EPO; JPO; DERWENT	ADJ	ON	2016/04/04 11:45

EAST Search History (Interference)

<This search history is empty>

4/ 4/ 2016 2:41:30 PM

C:\ Users\ gonamuti\ Documents\ EAST\ Workspaces\ 15072558.wsp

Information Disclosure Citation				Docket Number 11USFP2759-C1			Application Number Not Yet Assigned			
				Inventor Masaharu Morimoto						
				Filing Date Concurrently Herewith			Group Art Unit Not Yet Assigned			
U. S. Patent Documents										
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
		US 6,907,036 B1	06-2005	Malalur, Govind						
		US 8,705,527 B1	04-2014	Addepalli, et al.						
U. S. Patent Application Publications										
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
		US 2006/0227807 A1	10-2006	Jakubik, et al.						
		US 2012/0014386 A1	01-2012	Xiong, et al.						
		US 2004/0246991 A1	12-2004	Tsuzuki, et al.						
Foreign Patent Documents										
Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation Yes No			
Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)										
		U.S. Notice of Allowance dated December 2, 2015 in co-pending Application No. 13/983,001.								
		US Office Action dated August 18, 2015 in co-pending Application No. 13/983,001.								
		US Office Action dated January 15, 2015 in co-pending Application No. 13/983,001.								
		English Translation of PCT/ISA/237 (written opinion of the international searching authority, dated January 17, 2012).								
		PCT/IB/373 dated August 21, 2013.								
Examiner /Gbemileke Onamuti/					Date Considered 04/04/2016					
Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.										

Information Disclosure Citation				Docket Number 11USFP2759-C1			Application Number Not Yet Assigned	
				Applicant Masaharu Morimoto				
				Filing Date Concurrently Herewith			Group Art Unit Not Yet Assigned	
U. S. Patent Documents								
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	
		US 7,817,549 B1	10/19/2010	Kasralikar, et al.				
U. S. Patent Application Publications								
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	
		US 2011/0289230 A1	11/24/2011	Ueno				
		US 2010/0189103 A1	07/29/2010	Bachmann, et al.				
Foreign Patent Documents								
Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation	
							Yes	No
		WO 2010/090182 A1	08/12/2010	WIPO			ABS	
		CN 101779421 A	07/14/2010	China			ABS	
		WO 2010/103909 A1	09/16/2010	WIPO			ABS	
		CN 1937574 A	03/28/2007	China			ABS	
		CN 101155143 A	04/02/2008	China			ABS	
		CN 101637000 A	01/27/2010	China			ABS	
Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)								
		Chinese Office Action dated June 3, 2015 with an English translation thereof.						
Examiner		/Gbemileke Onamuti/			Date Considered		04/04/2016	
Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.								

DELL - Exhibit 1002 - Page 99

Information Disclosure Citation				Docket Number 11USFP2759- C1			Application Number Not Yet Assigned			
				Applicant Masaharu MORIMOTO						
				Filing Date Concurrently Herewith			Group Art Unit Not Yet Assigned			
				U. S. Patent Documents						
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
U. S. Patent Application Publications										
Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)			
Foreign Patent Documents										
Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation			
							Yes	No		
		JP 2005-210518 (A)	08/04/2005	Japan			ABS			
		JP 2010-199669 (A)	09/09/2010	Japan			ABS			
Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)										
		International Search Report (ISR) (PCT Form PCT/ISA/210), in PCT/JP2011/004601, dated January 17, 2012.								
		"OpenFlow Switch Specification, Version1.0.0", [online] December 31, 2009, the Internet (URL: http://www.openflowswitch.org/documents/openflow-spec-v1.0.0.pdf)								
		Yokoyama, et al. "Proposal of the mechanism to identify the End-to-End flow over NAT gateways." IPSJ SIG Notes, vol.2001, No. 59, June 8, 2001, pages 95-100.								
Examiner /Gbemileke Onamuti/					Date Considered 04/04/2016					
Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.										

Search Notes 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463

CPC- SEARCHED		
Symbol	Date	Examiner
H04L 12/4633	04/04/2016	GJO
H04L 49/3009	04/04/2016	GJO
H04L 12/413	04/04/2016	GJO
H04L 45/745	04/04/2016	GJO

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
PLUS Search	04/04/2016	GJO
Inventive Name Search	04/04/2016	GJO
EAST Search Strategy	04/04/2016	GJO
Text searching with class H04L	04/04/2016	GJO

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

/GBEMILEKE ONAMUTI/ Examiner.Art Unit 2463	
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BIB DATA SHEET

CONFIRMATION NO. 7407

SERIAL NUMBER 15/072,558	FILING or 371(c) DATE 03/17/2016 RULE	CLASS 370	GROUP ART UNIT 2463	ATTORNEY DOCKET NO. 11USFP2759-C1	
APPLICANTS NEC Corporation, Tokyo, JAPAN; INVENTORS MASAHARU MORIMOTO, Tokyo, JAPAN; ** CONTINUING DATA ***** This application is a CON of 13/983,001 07/31/2013 PAT 9313128 which is a 371 of PCT/JP2011/078439 12/08/2011 ** FOREIGN APPLICATIONS ***** JAPAN 2011-031752 02/17/2011 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/30/2016					
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and /GBEMILEKE J ONAMUTI/ Acknowledged Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY JAPAN	SHEETS DRAWINGS 4	TOTAL CLAIMS 20	INDEPENDENT CLAIMS 4
ADDRESS MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC 8321 OLD COURTHOUSE ROAD SUITE 200 VIENNA, VA 22182-3817 UNITED STATES					
TITLE NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD					
FILING FEE RECEIVED 2020	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

<i>Index of Claims</i> 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant		☐ CPA		☐ T.D.		☐ R.1.47			
CLAIM		DATE							
Final	Original	04/04/2016							
	1	✓							
	2	✓							
	3	✓							
	4	✓							
	5	✓							
	6	✓							
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	8	✓							
	9	✓							
	10	✓							
	11	✓							
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	13	✓							
	14	✓							
	15	✓							
	16	✓							
	17	✓							
	18	✓							
	19	✓							
	20	✓							



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www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1

CONFIRMATION NO. 7407

PUBLICATION NOTICE



OC000000084196436

21254
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

Title:NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Publication No.US-2016-0198025-A1

Publication Date:07/07/2016

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <http://pair.uspto.gov/>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

Masaharu Morimoto

Serial No.: 15/072,558

Group Art Unit: 2463

Filed: March 17, 2016

Examiner: ONAMUTI, GBEMILEKE J

For: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Honorable Commissioner of Patents
Alexandria, VA 22313-1450

INFORMATION DISCLOSURE STATEMENT

Sir:

Under the provisions of 37 CFR §1.97 through §1.98 and pursuant to applicant's duty of disclosure under 37 CFR §1.56, applicant respectfully brings the following documents, cited in the Extended European Search Report and listed on the attached form PTO-1449, to the attention of the Examiner in charge of the above-identified application. Copies of the listed documents are provided herewith for the convenience of the Examiner.

In compliance with the concise explanation requirement under 37 CFR §1.98(a)(3) for foreign language documents, Applicant encloses herewith a copy of a corresponding Search Report citing such documents, together with an English-language version (if not already included) of that portion of the Search Report indicating the degree of relevance found by the foreign office.

This citation does not constitute an admission that the references are relevant or material to the claims. They are only cited as constituting related art of which the applicant is aware.

I hereby certify that each item of information contained in this Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Information Disclosure Statement.

It is respectfully requested that the listed references be considered by the Examiner and formally made of record in this application.

Please charge any deficiencies in fees and credit any overpayment of fees to Attorney's Deposit Account No. 50-0481.

Respectfully submitted,



Farhad Shir
Registration No. 59,403
Sean M. McGinn, Esq.
Registration No. 34,386

Date:

8/2/16

McGinn Intellectual Property Law Group, PLLC
8321 Old Courthouse Road, Suite 200
Vienna, VA 22182-3817
(703) 761-4100
Customer No. 21254

Information Disclosure Citation	Docket Number 11USFP2759-C1-SU (KUD.486CONT)		Application Number 15/072,558
	Inventor: Masaharu Morimoto		
	Filing Date March 17, 2016		Group Art Unit 2463

U. S. Patent Documents

Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	

U. S. Patent Application Publications

Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	
		2005/0208947 A1	09-22-05	Bahl				
		2010/0161795 A1	06-24-10	Deridder, et al.				

Foreign Patent Documents

Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation	
							Yes	No

Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)

		Extended European Search Report dated May 4, 2016.
		Wang, et al. "Tracking Anonymous Peer-to-Peer VoIP Calls on the Internet", Proceedings of the 12 th ACM Conference on Computer and Communications Security, 7 Nov. 2005, p. 81-91, XP001241622.
		Lee, et al. "ICMP Traceback with Cumulative Path, An Efficient Solution for IP Traceback", In: "Correct System Design", 1 Jan. 2003, Springer International Publishing, Cham 032548, XP055268616, vol. 2836, p. 124-135.

Examiner	Date Considered
-----------------	------------------------

Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.



US 20050208947A1

(19) **United States**(12) **Patent Application Publication** (10) Pub. No.: US 2005/0208947 A1
Bahl (43) Pub. Date: Sep. 22, 2005(54) **VIRTUAL PRIVATE NETWORK STRUCTURE
REUSE FOR MOBILE COMPUTING
DEVICES**

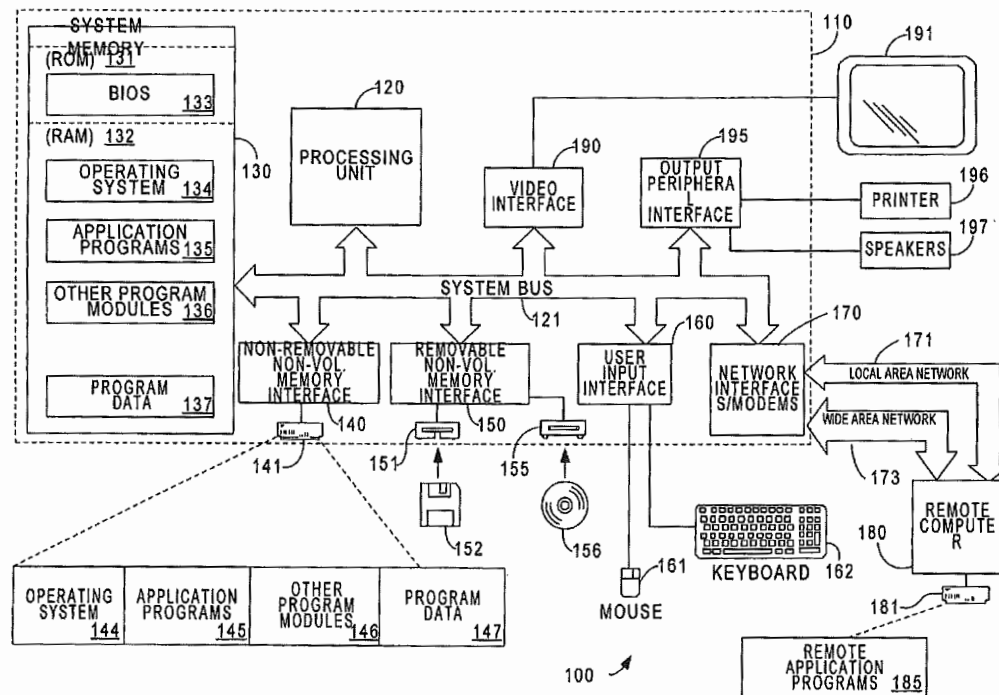
(52) U.S. Cl. 455/450

(75) Inventor: **Pradeep Bahl, Redmond, WA (US)**(57) **ABSTRACT**

Correspondence Address:
LEYDIG, VOIT & MAYER, LTD.
TWO PRUDENTIAL PLAZA, SUITE 4900
180 NORTH STETSON
CHICAGO, IL 60601-6780 (US)

(73) Assignee: **Microsoft Corporation, Redmond, WA**(21) Appl. No.: **10/804,357**(22) Filed: **Mar. 19, 2004****Publication Classification**(51) Int. Cl.⁷ **H04J 3/24**

A method and mobile node are disclosed that facilitate persisting virtual private network structures across multiple network addresses assigned to the mobile node. The method includes initially setting up a virtual private network tunnel between a mobile node and a virtual private network tunnel server. Virtual private network structures that support the virtual private network tunnel are based upon a home address specified for the mobile node. When the mobile node changes addresses, the mobile node transmits a binding update to the virtual private network tunnel server specifying the new network address. Thereafter, a mapped relation is created from the new network address to the home address for the mobile node, thereby facilitating continued use of virtual private network structures that are based upon the home address for the mobile node.





US 20100161795A1

(19) **United States**(12) **Patent Application Publication**
Deridder et al.(10) **Pub. No.: US 2010/0161795 A1**(43) **Pub. Date: Jun. 24, 2010**(54) **APPARATUS AND METHOD FOR
MULTI-USER NAT SESSION
IDENTIFICATION AND TRACKING****Publication Classification**(51) **Int. Cl.**
G06F 15/16 (2006.01)(52) **U.S. Cl.** 709/224(57) **ABSTRACT**

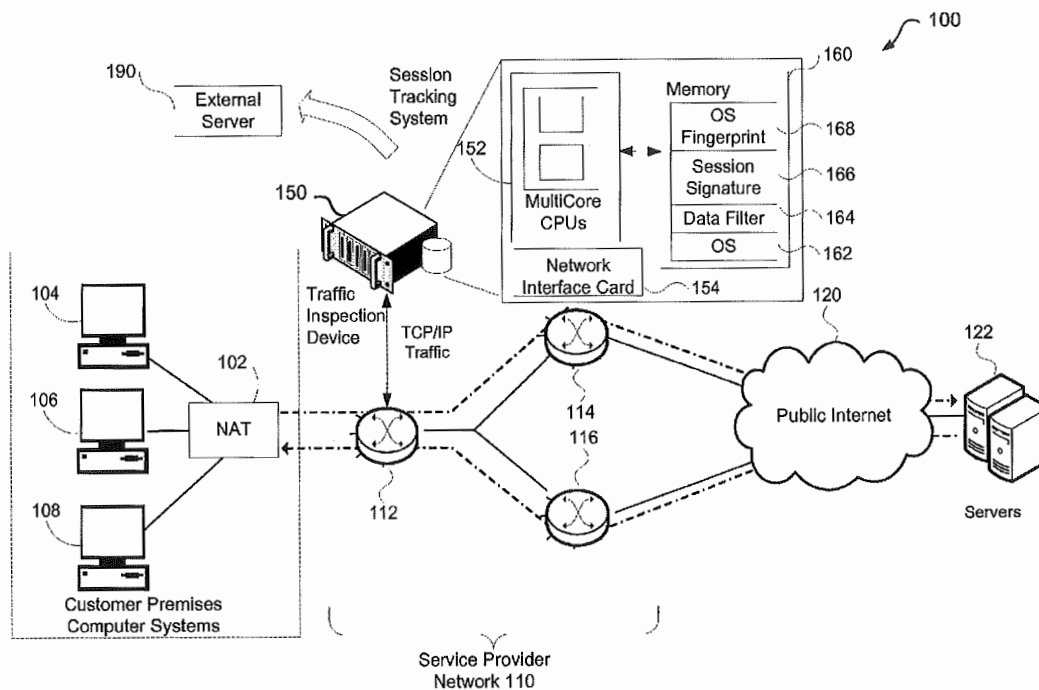
A method and apparatus are provided for identifying and tracking multiple computer user sessions associated with a network address translation (NAT) device coupled to a computer network. Data packets originating from the NAT device containing a request to a destination server coupled to the computer network are received. A client source address associated with the data packets is determined where the source address associated with the NAT device. One or more session entries associated with the client source address can then be determined, wherein the session entries are stored in system state information. A session signature can then be determined based one or more characteristics defined by the data packet header information and/or request header information in the one or more data packets, the session signature uniquely identifying one of the multiple computer user sessions coupled to the NAT device.

(75) **Inventors:** **Darren Deridder**, Ottawa (CA);
Kelvin Edmison, Ottawa (CA);
Robert Gaudet, Ottawa (CA)

Correspondence Address:

OSHA LIANG L.L.P.**TWO HOUSTON CENTER, 909 FANNIN, SUITE
3500****HOUSTON, TX 77010 (US)**(73) **Assignee:** **KINDSIGHT**, Sunnyvale, CA (US)(21) **Appl. No.:** **12/645,332**(22) **Filed:** **Dec. 22, 2009****Related U.S. Application Data**

(60) Provisional application No. 61/140,066, filed on Dec. 22, 2008.





European Patent Office
80298 MUNICH
GERMANY

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Vossius & Partner
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München
ALLEMAGNE

EINGEGANGEN Vossius & Partner 04. Mai 2016	
Frist bearb.:	rtm

Date
04.05.16

Reference W2364 EP	Application No./Patent No. 11858533.0 - 1505 / 2677705 PCT/JP2011078439
Applicant/Proprietor NEC Corporation	

Communication

The extended European search report is enclosed.

The extended European search report includes, pursuant to Rule 62 EPC, the supplementary European search report (Art. 153(7) EPC) and the European search opinion.

Copies of documents cited in the European search report are attached.

☒ 1 additional set(s) of copies of such documents is (are) enclosed as well.

Refund of the search fee

If applicable under Article 9 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Should you wish to further prosecute this application in the examination phase, your attention is drawn to the provisions of Rule 70a EPC. An invitation to respond to the extended European search report will be issued shortly (R. 70(2) EPC).





**SUPPLEMENTARY
EUROPEAN SEARCH REPORT**

Application Number
EP 11 85 8533

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	Henry C. J. Lee ET AL: "ICMP Traceback with Cumulative Path, an Efficient Solution for IP Traceback" In: "Correct System Design", 1 January 2003 (2003-01-01), Springer International Publishing, Cham 032548, XP055268616, ISSN: 0302-9743 ISBN: 978-3-642-23953-3 vol. 2836, pages 124-135, DOI: 10.1007/978-3-540-39927-8_12, * Section 1-2.3 *	1-8	INV. H04L12/413 H04L12/46 H04L12/935 H04L12/741 H04L12/26
A,D	"OpenFlow Switch Specification Version 1.0.0 (Wire Protocol 0x01)", INTERNET CITATION, 31 December 2009 (2009-12-31), pages 1-42, XP002719303, Retrieved from the Internet: URL:http://archive.openflow.org/documents/openflow-spec-v1.0.0.pdf [retrieved on 2014-01-27] * the whole document *	1-8	TECHNICAL FIELDS SEARCHED (IPC) H04L
X	US 2010/161795 A1 (DERIDDER DARREN [CA] ET AL) 24 June 2010 (2010-06-24) * abstract * * figure 3 * * paragraph [0003] - paragraph [0006] * * paragraph [0019] - paragraph [0021] * * paragraph [0027] - paragraph [0037] * ----- -/--	1-8	
The supplementary search report has been based on the last set of claims valid and available at the start of the search.			
Place of search Berlin		Date of completion of the search 27 April 2016	Examiner Siebel, Christian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

2
EPO FORM 1503 08.02 (P04C04)



**SUPPLEMENTARY
EUROPEAN SEARCH REPORT**

Application Number
EP 11 85 8533

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WANG X ET AL: "TRACKING ANONYMOUS PEER-TO-PEER VOIP CALLS ON THE INTERNET", PROCEEDINGS OF THE 12TH. ACM CONFERENCE ON COMPUTER AND COMMUNICATIONS SECURITY. (CCS'05). ALEXANDRIA, VA, NOV. 7 - 11, 2005; [ACM CONFERENCE ON COMPUTER AND COMMUNICATIONS SECURITY], NEW YORK, NY : ACM, US, vol. CONF. 12, 7 November 2005 (2005-11-07), pages 81-91, XP001241622, DOI: 10.1145/1102120.1102133 ISBN: 978-1-59593-226-6 * abstract * * Section 1 *	1-8	
X	US 2005/208947 A1 (BAHL PRADEEP [US]) 22 September 2005 (2005-09-22) * abstract *	1-8	
			TECHNICAL FIELDS SEARCHED (IPC)
The supplementary search report has been based on the last set of claims valid and available at the start of the search.			
Place of search Berlin		Date of completion of the search 27 April 2016	Examiner Siebel, Christian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

2
EPO FORM 1503 03.02 (P04C04)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 85 8533

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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27-04-2016

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2010161795	A1	24-06-2010	NONE	

US 2005208947	A1	22-09-2005	AT 412301 T	15-11-2008
			CN 1677976 A	05-10-2005
			EP 1578083 A1	21-09-2005
			JP 4762581 B2	31-08-2011
			JP 2005269661 A	29-09-2005
			KR 20060044435 A	16-05-2006
			US 2005208947 A1	22-09-2005

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

TITLE: NETWORK SYSTEM AND NETWORK FLOW TRACKING METHOD

APPLICANT: NEC Corporation

IPC CLASSIFICATION: H04L12/413, H04L12/46, H04L12/935, H04L12/741, H04L12/26

EXAMINER: Siebel, Christian

CONSULTED DATABASES: DOSYS, EPODOC, INET, NPL, WPI, XP3GPP, XPESP, XPETSI,
XPI3E, XPI3ES, XPIEE, XPIETF, XPITU, XPMISC, XPRD, XPSPRNG

CLASSIFICATION SYMBOLS DEFINING EXTENT OF THE SEARCH:

IPC:

CPC: H04L43/026, H04L12/413, H04L12/4633, H04L49/3009, H04L45/745, H04L43/02
/LOW

FI/F-TERMS:

KEYWORDS OR OTHER ELEMENTS FEATURING THE INVENTION:

Field: Network management

Aim: Flow tracking

Problem: Flow tracking in case a flow traverses NAT or NAPT

Solution: Enveloping the packet by an envelope, the envelope header being the
same as the current header of the received packet. NAT, NAPT changes then only
the envelope header. Both headers are available behind the NAT/NAPT for
analysis purposes.

The examination is being carried out on the **following application documents**

Description, Pages

1-24 filed with entry into the regional phase before the EPO

Claims, Numbers

1-8 filed with entry into the regional phase before the EPO

Drawings, Sheets

1/4-4/4 filed with entry into the regional phase before the EPO

Reference is made to the following documents; the numbering will be adhered to in the rest of the procedure.

- D1 "OpenFlow Switch Specification Version 1.0.0 (Wire Protocol 0x01)",INTERNET CITATION, 31 December 2009 (2009-12-31), pages 1-42, XP002719303,Retrieved from the Internet:URL:http://archive.openflow.org/documents/openflow-spec-v1.0.0.pdf [retrieved on 2014-01-27]
- D2 US 2010/161795 A1 (DERIDDER DARREN [CA] ET AL) 24 June 2010 (2010-06-24)
- D3 Henry C. J. Lee ET AL: "ICMP Traceback with Cumulative Path, an Efficient Solution for IP Traceback", In: "Correct System Design", 1 January 2003 (2003-01-01), Springer International Publishing, Cham 032548, XP055268616, ISSN: 0302-9743, ISBN: 978-3-642-23953-3, vol. 2836, pages 124-135, DOI: 10.1007/978-3-540-39927-8_12,
- D4 WANG X ET AL: "TRACKING ANONYMOUS PEER-TO-PEER VOIP CALLS ON THE INTERNET", PROCEEDINGS OF THE 12TH. ACM CONFERENCE ON COMPUTER AND COMMUNICATIONS SECURITY. (CCS'05). ALEXANDRIA, VA, NOV. 7 - 11, 2005; [ACM CONFERENCE ON COMPUTER AND COMMUNICATIONS SECURITY], NEW YORK, NY : ACM, US, vol. CONF. 12, 7 November 2005 (2005-11-07), pages 81-91, XP001241622, DOI: 10.1145/1102120.1102133, ISBN: 978-1-59593-226-6

D5 US 2005/208947 A1 (BAHL PRADEEP [US]) 22 September 2005
(2005-09-22)

D1 is seen as being known to the person skilled in the art (standard).

I. Clarity (Art. 84 EPC)

The following subject matter is not clear.

I-1.1 Each invention should solve a problem. Reading the independent claims, even claim 7, it is unclear which problem is solved by encapsulating a packet with the same header, OpenFlow being state of the art and independent of whether a header is added to a packet or not. Hence, essential features (Art. 84 EPC with Rules 43(1) and (3) EPC) are missing.

I-1.2 Claim 2 (see also claim 5): Here again no problem is solved by transmitting two headers to a controller, NAP/NAPT being state of the art. Hence, essential features (Art. 84 EPC with Rules 43(1) and (3) EPC) are missing.

I-1.3 Claim 3 (see also claim 6) cites "said encapsulating module has ...
- a function to translate the encapsulated packet to a packet to which only the header data at the head is given, and to hand to said switch."

This is not understood. What is meant by translating an encapsulated packet? In any case there is a header data at the head: this is always valid for a packet, encapsulated or not.

And finally, here again no problem is solved. Hence, essential features (Art. 84 EPC with Rules 43(1) and (3) EPC) are missing.

II. Inventive step (Article 56 EPC)

Furthermore, the above-mentioned lack of clarity notwithstanding, the present application does not meet the requirements of Article 52(1) EPC, because the subject-matter of independent claims 1, 4, 7-8 does not involve an inventive step in the sense of Article 56 EPC.

II-1 Independent claims

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and discloses (the references in parentheses applying to this document):

A network system comprising:

- a switch having a function to process a reception packet based on a set entry of a flow table;
- a controller having a function to receive an inquiry of the packet from said switch, and to set the entry defining a rule and an operation to uniformly control packets to said flow table of said switch; and
- an ~~encapsulating~~ module having a function to receive the packet from at least one of said switch and said controller ~~and to encapsulate the packet by using a same header as a header of the packet.~~ **to forward the packet** (Features describing OpenFlow method: D1, section 2 eg.).

II-1.1 The subject-matter of independent claim 1 differs from that disclosure in that an **encapsulating** module having a function to receive the packet from at least one of said switch and said controller **and to encapsulate the packet by using a same header as a header of the packet.**

II-1.2 The indicated difference does not solve any problem, hence it cannot be inventive.

II-1.3 The argumentation of points II-1.1 to II-1.2 above applies also for claims 4, 7-8.

Note also, that a priori, there is no link between tracking via NAT/NAPT and OpenFlow. Hence, these topics can be treated independently.

II-2 Dependent claims

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Furthermore, the above-mentioned lack of clarity notwithstanding (see section I above), dependent claims 2-3 and 5-6 do not appear to contain any additional features which, in combination with the features of any claim to which they refer, meet the requirements of the EPC with respect to inventive step in the sense of Article 56 EPC, the reasons being that in no case a problem is solved, see under section I above.

II-3 Conclusion

Reading the description, it seems that a problem is solved, i.e. tracking a flow passing NAT, NAPT by using encapsulation. D2-D4 proposes many alternative solutions thereto, however none being comparable to the proposed one, as the exact mapping cannot be determined (no access to the translation engine). D5, abstract, however discloses to sending a binding update in case an address is changing, i.e. the idea to send somewhere information to allow a mapping between "old" and "new" address. This is in fact the most straightforward idea. Hence, the Applicant is asked to provide new claims with all essential features and a comment about advantages about its costly encapsulation related proposal instead of just sending a message with a mapping between these two addresses. Alternatively, SMTP could be used by a tracking tool to read out the translation table.

III. Further Comments

- The features of the claims should be provided with reference signs placed in parentheses to increase the intelligibility of the claims (Rule 43(7) EPC, Guidelines, F-IV, 4.19).
- "incorporated by reference", p.24 , I.15 . Referring to the Guidelines, Part H-IV, 2.3.1 , either the matter should explicitly be incorporated in the description if essential or otherwise be deleted.
- D2-D5 should be identified in the description and the relevant background art disclosed therein should be briefly discussed (Rule 42(1)(b) EPC).
- The applicant should furthermore bring the description into conformity with the amended claims, whereas:

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- new subject-matter should not extend beyond the content of the application as originally filed (Article 123(2) EPC).
- all the described **embodiments** (description/figures) should fall within the scope of the claims to avoid rendering the claims unclear (Article 84 EPC). Inconsistencies should be removed (amending the claims/deleting "excess" subject-matter from the description, drawings/indicating in the description that the embodiments concerned do not form part of the invention but represents background art, see the Guidelines, F-IV, 4.3(iii)).
- Amendments should be made by filing replacement pages. Unnecessary recasting of the description should be avoided. An amended abstract is not required. The applicant should also take account of the requirements of Rule 50(1) EPC.
- In order to comply with the requirements of Rule 137(4) EPC, the applicant should **clearly identify the amendments** made, irrespective of whether they concern amendments by addition, replacement or deletion, and **indicate the passages of the application as filed on which these amendments are based** (see Guidelines H-III, 21). If the applicant considers it appropriate, these indications could be submitted in handwritten form on a copy of the relevant parts of the application as filed.

ICMP Traceback with Cumulative Path, An Efficient Solution for IP Traceback

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Abstract. DoS/DDoS attacks constitute one of the major classes of security threats in the Internet today. The attackers usually use IP spoofing to conceal their real location. The current Internet protocols and infrastructure do not provide intrinsic support to traceback the real attack sources. The objective of IP Traceback is to determine the real attack sources, as well as the full path taken by the attack packets. Different traceback methods have been proposed, such as IP logging, IP marking and IETF ICMP Traceback (ITrace). In this paper, we propose an enhancement to the ICMP Traceback approach, called ICMP Traceback with Cumulative Path (ITrace-CP). The enhancement consists in encoding the entire attack path information in the ICMP Traceback message. Analytical and simulation studies have been performed to evaluate the performance improvements. We demonstrated that our enhanced solution provides faster construction of the attack graph, with only marginal increase in computation, storage and bandwidth.

1 Introduction

The Internet is increasingly becoming the pervasive means of communications for all media. At the same time, this has also generated many security problems. In this paper, we look at the issue relating to Denial-of-Service (DoS) [1] and Distributed DoS (DDoS) attacks. In a DoS attack, typically huge quantity of malicious packets are generated and directed towards one or many victims. DDoS is a variation of DoS in that the attacker launches an attack not from one single source, but from several sources that the attacker has already penetrated. As a result, legitimate data traffics are disrupted, servers are compromised, and services are denied to the legitimate users. In such attacks scenario, attackers usually send packets with spoofed IP addresses so as to hide their true network location from the victims and the network infrastructure.

The IP [2] packet contains two addresses: source and destination. The destination address is used by the routing architecture to deliver the packet. The IP network routing infrastructure does not verify the authenticity of the source address carried in IP packets. The source address is used by the destination host to determine the source for message reply. In general, no entity is responsible for the correctness of source address. The scenario is the same as sending a letter using the postal service; the postal service does not care about the correctness or authenticity of the source address, it merely makes sure that the letter is delivered to the correct destination. Consequently, the design of the IP protocol and forwarding mechanism makes it difficult to identify the real origin of a

packet. This characteristic of the Internet is exploited by some malicious users to hide their source and identify. Some mechanisms such as "Ingress filtering" [3] have been proposed to enforce the validity of source IP address originating from a stub network. However, such mechanisms are quite limited as they can only be used in edge networks and the universal enforcement of which is difficult.

The objective of IP Traceback is to determine the actual origin of IP packets, so as to institute accountability. Several approaches have been proposed to address this issue. IP Logging has been proposed in [5], where the intermediate routers log the passage of all IP packets. The log information is then stored in the routers. The combination of this log from the various routers can then be used, if necessary, to trace the path taken by any IP packet. IP marking has been proposed in [6], where the intermediate routers add router's information derived from its address into the IP packets (e.g. in the "Identification" field) with certain probability. The victim of an attack can thus examine this information found in the attack packets so as to construct the path taken, which eventually leads to the true attack origin. ICMP Traceback has been proposed in [4], where intermediate routers generate an ICMP Traceback message probabilistically with every IP packet, and send the ICMP Traceback message to the same destination as the IP packet. The victim of an attack can thus use the received ICMP Traceback messages to construct the attack path.

This paper is organized as follows: section 1 gives an introduction to the paper. Section 2 describes the various current approaches for IP Traceback, namely IP logging, IP marking and ICMP Traceback. Section 3 describes our proposed enhancement to the ICMP Traceback messages. Section 4 describes the comparisons between our approach and the ICMP Traceback. Section 5 describes simulation studies and results. Section 6 concludes the paper.

2 Background

The challenge of IP Traceback is to find an efficient and scalable way to track the source of an arbitrary IP packet. The source can be an Ingress point to the traceback-enabled network, the actual host or network of origin, or compromised routers within the enabled network. It depends on the extent to which the traceback framework is deployed. In an attack, it is possible that some routers may be subverted, hence there is a need to construct the attack path, which comprises the routers traversed by packets from the "source" to the victim. In the case of a DDoS attack where packets come from potentially many secondary sources, there'll be many attack paths. The attack graph is defined as the set of attack paths. The objective of the IP traceback mechanism is to construct the attack graph with the constraint that it should minimize the time that routers spend on tracking and minimize the storage used to keep the tracking information. Lastly, the solution should not adversely impact the privacy of legitimate users.

There are two main approaches to perform traceback: infrastructure scheme and end host scheme. In the first approach, infrastructure scheme, the network is responsible for maintaining the traceback state information necessary for the victim and the network to construct the attack graph. IP logging scheme belongs to this category. In the end host

scheme, the end hosts, which are the potential victims, maintain the traceback state information. IP marking and ICMP Traceback belong to this category.

2.1 IP Logging

In this approach, the network routers log the passage of all IP packets. The key challenge here lies in the potential huge amount of information storage requirement. For example, if a router were to log all the packets in its entirety, each OC-192 link at 1.25 GB/s at the router requires 75 GB of storage for a 1-minute query buffer. The storage requirement quickly becomes prohibitive as the number of router links increases. One solution, SPIE (Source Path Isolation Engine) [5], has been proposed for IP version 4. The mechanism is designed to identify the true source of a particular IP packet given a copy of the packet to be traced and an approximate time of receipt. In order to take care of packets transformation as they are routed from source to destination, the mechanism identified the invariant portions of the 20-byte IPv4 header. The fields that are susceptible to changes include: TOS (Type of Service), TTL (Time to Live), Checksum and Options field. The logging is based on the invariant portion of the IP header and the first 8 bytes of payload. Based on statistics collected, the 28-byte prefix described above results in a rate of collision of approximately 0.00092% in a WAN environment and 0.139% in a LAN environment. To further reduce the storage requirement, instead of storing the entire 28-byte prefix, hashing is performed on it, followed by a Bloom filter processing. The scheme reduces memory storage requirement in the router to 0.5% of link bandwidth per unit time. It also maintains privacy, prevents eavesdropping of legitimate traffic stream.

2.2 IP Marking

The intermediate routers marks the IP packets with additional information so that the victim can use them to determine the attack path. Approaches proposed include node append, node sampling and edge sampling [6]. The node append mechanism is similar to the IP Record Route Option [2], in that the addresses of successive routers traversed by an IP packets are appended to the packets. The victim can thus easily traceback the source of such attack packets. However, this method introduces very high overhead in terms of router processing and packet space. The node sampling approach reduces such overhead by the probabilistic marking of IP packets. The edge sampling approach, as its name imply, marks an edge of the network topology, traversed by the IP packets, instead of just the node. Most algorithms proposed to put the marking information in the Identification field of the IP header. This type of mechanism has an inherent disadvantage in that it affects the format of IP packets. The necessary changes in the IP packet format depends on the algorithm used. The standardization of format for IP marking becomes an issue.

2.3 ICMP Traceback (ITrace)

In the ICMP Traceback mechanism, a new ICMP message type, ICMP Traceback (ITrace), is defined to carry information on routes that an IP packet has taken. As the

IP Marking requires to overload some fields in the IP header, which raises backward protocol compatibility problem, the ICMP Traceback utilizes out-band messaging to achieve the packet tracing purpose.

As an IP packet passes through a router, ICMP Traceback message (ITrace) [4] is generated with a low probability of about 1/20000. Assuming that the average diameter of the Internet is 20 hops, this probability value translates to a net increase in traffic of about 0.1%. This ITrace message is then sent randomly, with equal probability, to the destination or to the origin of the IP packet. In the event of a DoS/DDoS attack, the destination node can then use it to traceback the attack path. On the other hand, the ITrace message provides information for the origin to decipher reflector attacks.

When a router generates an ITrace message, it may generate one of the followings: back link, forward link, or both. Each link element defines a link along which the packet will or has travelled through. The link element comprises of 3 components: the interface name at the generating router, source and destination IP address of the link, and finally a link-level association string that is used to tie together Traceback messages emitted by adjacent routers. On LANs, this string is constructed by concatenating the source and destination MAC addresses of the two interfaces. Finally, each ITrace message contains a variable length RouterID field.

3 ICMP Traceback with Cumulative Path (ITrace-CP)

The current IETF's ITrace message proposal allows routers to generate ITrace messages for the source and destination of IP packets. In the context of DoS / DDoS attack, the victims can make use of the received ITrace messages to construct the attack paths and ultimately identify the attackers. Since each ITrace message only carry one or two links of the entire path, the victim will have to re-construct the various attack paths from the various segments. The task will be especially difficult in the event of a DDoS attack.

This attack graph construction procedure will be facilitated if the ITrace messages are made to carry the entire path information from the routers nearest to the attackers all the way to the victim. With this approach, the victim will only need to identify the attack packets in order to establish the entire attack path or attack graph. In the following section, we will propose and analyze various solutions to encode the path traversed by the attack packets into the ITrace message. Our enhancement only applies to the ITrace messages sent to the destination address.

A simple approach will be to generate ITrace message with the IP Record Route option, so that the subsequent routers will append their addresses to the ITrace message. However, this approach has some drawbacks. Firstly, the ITrace message may not take the same path as the corresponding attack packet to the victim. In this case, the ITrace message will record the wrong route information. Furthermore, the record route option is limited to 9 routers. This is because the header length of IP header is a 4-bit field, limiting the entire IP header to 60 bytes. Since the fixed size of the IP header is 20 bytes, and the RR option uses 3 bytes for overhead, this leaves 37 bytes for the list, allowing up to 9 IP addresses. As such, it may be sufficient in the early days of ARPANET but it is of limited use given the extent of Internet today. Last but not least, most hosts/routers ignore or discard this option.

Our approach constructs ITrace message in a different way. Instead of encoding the path information in the IP packet header record route option, we use an enhanced ITrace message, called the ICMP Traceback with Cumulative Path (ITrace-CP) to store the path information. When a router receives an IP packet, it generates an ITrace-CP message with a certain probability. However, instead of sending the ITrace-CP message to the destination address of the IP packet, it is sent to the next hop router. This "next hop" should be as far as possible the same as the next hop for the corresponding IP packet. The ITrace-CP packet will also contain as much of the IP packet as possible, including the final destination address. In addition, the ITrace-CP message should be sent after the corresponding IP packet.

At the next hop router, the router will process the ITrace-CP message as follows. There are two possibilities:

1. If the ITrace-CP packet is forwarded to the same router as the corresponding IP packet, then the router will generate a new ITrace-CP message and append its own IP address. The new ITrace-CP then forwarded to the next hop router of the corresponding IP packet.
2. Otherwise, the router that processes the ITrace-CP will generate a new ITrace-CP message for the final destination, without making any changes to the payload.

As a result, full or partial path information is stored in the ITrace-CP message when it reaches its destination.

The problem now is how to identify corresponding IP and ITrace-CP messages. The simplest way is for the routers to store the IP packets for a short duration and compare them to the received ITrace-CP messages. However, if we take the example of a Router with 16 OC-192 links at 1.25 GB per second, this would translate to a storage requirement of 2 GB for 100 ms seconds of buffer. We propose three schemes to reduce the storage requirement for matching corresponding IP packets and ITrace-CP messages. In the subsequent analysis, we use 100 ms as the upper bound for the inter-arrival time between an IP packet and its corresponding ITrace-CP message, if any. We will also use the same router configuration as above and assume that the average IP packet size is 256 bytes.

3.1 Scheme 1: Basic Packet Identification (BPI)

Typically, the source of an IP packet sets the identification field to a value that must be unique for that source-destination pair and protocol for the time the packet will be active in the Internet. Hence, the value of the "Identification" field can be used, together with the source and destination addresses and the protocol number to uniquely identify an IP packet in a short time window. In order to take care of possible fragmentation, the flags and fragment offset field of the IP packet can also be included for packet identification. In this way, if fragmentation did occur, the victims will be able to construct paths taken by the fragmented packets, and paths taken by the non-fragmented packets and link them together through the Identification field mentioned earlier that uniquely identifies the packet stream.

3.2 Scheme 2: Hash-based Packet Identification

In this approach, instead of storing the BPI of a packet, the routers determine the hash of the BPI to reduce the storage requirement. The Hash function used must satisfy the following requirements. Firstly, the function must distribute a highly correlated set of input values (i.e. the BPI information) as uniformly as possible over the hash function's output space. Secondly, the hash function should be computationally efficient so as to minimize the computation overload. A hash of 16 bits of hash will result in a collision rate of less than 0.002%. For our router configuration, 100 ms of hash will require a buffer size of less than 16 MB.

3.3 Scheme 3: Hash-based Packet Identification with indicator bit

In addition to scheme 2, this approach set a bit in the IP packets to indicate that an ITrace-CP message has been generated for a specific IP packet. One possibility is to use the first bit of the 3-bit flags field, which is not used currently. This reduces the need to keep those packets, where the bit is not set, or their hashes in downstream routers, hence reducing significantly the storage and processing requirement. The disadvantage is that some changes to the IP packet processing is required.

Let *ITRACE_CP_DONE* be the bit in IP packet that indicate if an ITrace-CP message has been generated for it. The pseudo code of the algorithm at each router is shown as follows. For each IP packet received at a router:

```
if (ITRACE_CP_DONE is set) then {
    Calculate the packet's hash and store it in the buffer
    (this hash will be kept for 100 ms)
    forward the IP packet to R (next hop router)
    (record R in the buffer)
} else {
    generate an ITrace-CP message with a probability p
    set the ITRACE_CP_DONE bit in the IP packet
    forward the IP packet to R (next hop router)
    send the new ITrace-CP message to R
}
```

If an ITrace-CP packet has not been received within 100 ms for an IP packet that has been stored in the buffer, it is possible that the ICMP packet is routed differently as the IP packet or that the inter-arrival time between the IP packet and its corresponding ITrace-CP is higher than 100 ms. In all cases, a new ITrace-CP message will be generated.

Using the bit information, assuming that the max number of hops traversed by the packets is 20, the hash storage requirement is reduced to 16 KB ($16 \text{ MB} * 20 / 20000$). However, this scheme is vulnerable to another form of exploitation. If the attacker artificially set this bit in all attack packets, then ITrace messages will be generated at the first router for all the packets and all the subsequent routers will construct the cumulative path. Although this mechanism worsens the DoS / DDoS attacks by doubling the attack traffic, the victims will be able to detect the attack, construct the attack graphs and determine the true sources almost instantaneously.

4 Comparison of ITrace-CP with ITrace

We compare the ITrace-SP and ITrace mechanisms in terms of computation overhead, bandwidth and storage overheads. Firstly, in terms of bandwidth, the overhead is minimal as the additional information carried is the IP addresses of the intermediate routers. Assuming that the average path length is 10, the additional bytes carried is only 40 bytes per ITrace-CP message. Given the message infrequency, the overhead is still minimal even if more router information needs to be included. In terms of storage, each router only need to cater less than 16 MB (for ITrace-CP scheme 2) for an inter-arrival time of 100 ms between an IP packet and its corresponding ITrace-CP message. If a bit is used to mark the IP packet (for ITrace-CP scheme 3), the storage overhead will only be 16 KB. In terms of computation, the hash function will introduce minimum overheads. In summary, the additional overheads of ITrace-CP are relatively minimal compared to the ITrace scheme, similarly as compared to other IP Traceback proposals such as IP logging and IP marking.

However, the ITrace-CP scheme will perform much better than the ITrace scheme in its ability to traceback the attack source faster, because more information on the attack path is carried inside the ITrace-CP message. We will now look at a network scenario where the attack path comprises L routers. Let p be the probability of generating an ITrace or ITrace-CP message. We determine their respective performances in attack path construction. The performance metric is expressed as the probability that the full attack path can be constructed with a given number of attack IP packets (N).

For the ITrace-CP scheme, the entire attack path can be constructed by the victim when the router furthest from the victim generates at least one ITrace-CP. Hence, the probability P_E that the full path can be constructed after the victim has received N IP packets is given by (1). Note that P_E is independent of the path length L .

$$P_E = 1 - (1 - p)^N \quad (1)$$

For the basic ITrace scheme, each ITrace message can contain either the forward link, back link or both links. For simplicity, we assume that ITrace messages with either the forward or back link enable the victim to discover two routers addresses on the attack path, whereas the ITrace messages with both links enable the victim to discover three. P_{B1} and P_{B2} denote the full path construction probabilities for ITrace (forward or back link) and ITrace (both links) respectively.

$$P_{B1} = (P_E)^{\frac{L}{2}} \quad (2)$$

$$P_{B2} = (P_E)^{\frac{L}{3}} \quad (3)$$

Figure 1 and 2 plot the Probability of Path Construction as a function of the number of IP packets received. With 20,000 attack packets, the ITrace-CP has a 63% chance of constructing the entire path, versus the ITrace (Forward and Back links) which has chances of 47%, 22% and 10% for 5, 15 and 20 hop attack paths respectively. With 50,000 packets, the probabilities are 92% for ITrace-CP, 87% for 5-hop ITrace, 65% for 15-hop ITrace, and 57% for 20-hop ITrace. The figures show clearly that the ITrace-CP

mechanism requires much less packets to construct the entire attack path as compared to the ITrace.

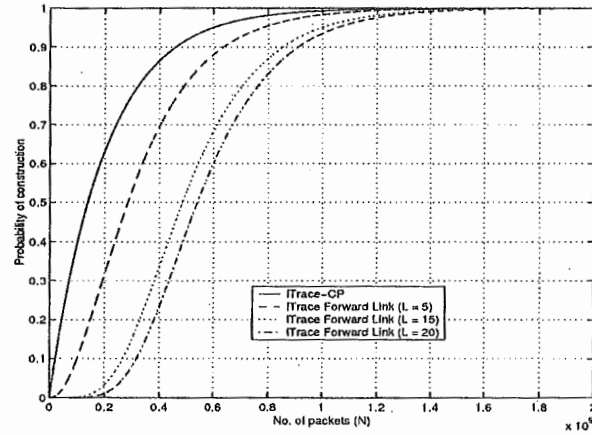


Fig. 1. Performance Comparison between ITrace-CP with ITrace (Forward Link)

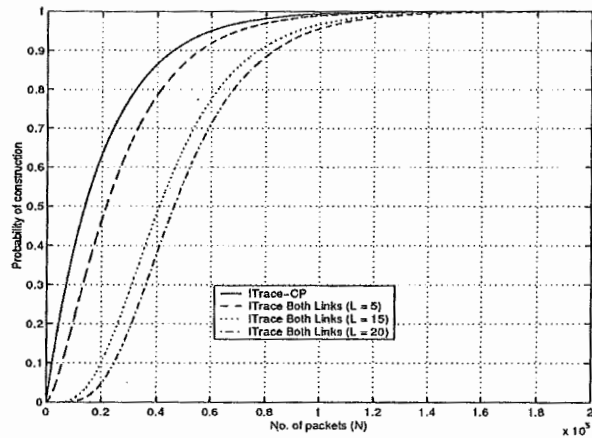


Fig. 2. Performance Comparison between ITrace-CP with ITrace (Forward & Back Link)

5 Simulation studies

Our simulation studies evaluate the effectiveness of the ITrace-CP and ITrace (Forward or back link, both links) mechanism, in terms of time taken to establish the attack graphs in the event of DoS and DDoS attacks. We use the ns-2 network simulation software to model both traceback mechanisms. We constructed the agents for the attacker, the router and the victim.

5.1 Simulations model

As discussed earlier, we assume that, for the ITrace forward or back link, 2 routers would be detected per each ITrace message, and 3 routers in the case of both links encoding option. For the ITrace-CP scheme, the number of routers detected is the number of routers addresses encoded in the message.

Since we are comparing in terms of time taken to establish the attack graphs, evaluation based on false positive was not considered. Therefore, only attack traffic was generated and hash collision was not simulated. In this simulation, each router would generate ITrace or ITrace-CP messages with a probability of 1/20,000 (determined by a random number generator) on the attack traffic they received. When the victim received these messages, it would discover the intermediate routers of the attack graphs. The time taken to detect various numbers of routers on the attack graphs was recorded.

5.2 Network scenario

We performed simulation studies on the two schemes using the linear network topology, for attackers situated 5, 15, and 20 hops away from the victim. The tree topology was not simulated as in the case of multiple attackers at the leaves of the tree, they would have been treated as independent attack paths. This would be similar to simulating the linear topology. For example, in Figure 3, if an attacker sends packets through routers 3 and 2 to the victim node at 1, and that ITrace messages are generated by router 2 based on these packets, it should not be treated as if the router 2 is detected for attack path by another attacker sending packets through router 4 and 2.

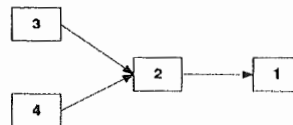


Fig. 3. Tree Topology

In all simulation scenarios, the effective attack traffic arriving at the victim is 1 Mbits/s. However, as we are interested in the relative performances of the two schemes, this number is only indicative.

5.3 Results

The average times (for 30 runs) for the construction of various hops of the attack path for the ITrace (forward link and both links) and ITrace-CP were obtained. The graphs were plotted and shown in Figure 4 to 6. In all the figures, the x-axis represents the number of hops of the attack path discovered while the y-axis represents the time taken in seconds. The 3 figures corresponds to attack paths of length 5, 15 and 20 respectively.

In Figure 4, the performance of the ITrace-CP scheme improved over the ITrace for the forward link option but not the both links option. The average times taken to detect the full path were 27 secs, 19 secs, and 23 secs for the ITrace forward link option, ITrace both links option, and ITrace-CP scheme respectively.

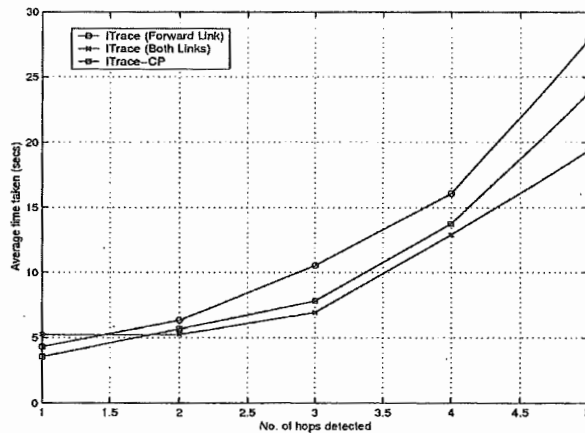


Fig. 4. Average time taken to detect various numbers of hops (5-hop attack path)

In Figure 5, the performance of the ITrace-CP scheme becomes better than the ITrace schemes starting from the detection of 4 hops of the attack path. The window from 10 to 13 hops showed significant improvement by the ITrace-CP scheme; with peak improvement at the 13th hop detection. However, the high average time taken to detect the 14th and 15th hop resulted in the drop in improvement. The average times taken to detect the full path were 40 sec, 27 sec, and 22 sec for the ITrace forward link option, ITrace both links option, and ITrace-CP respectively.

In Figure 6, the performance of the ITrace-CP scheme become better than the other 2 schemes starting from the detection of 4 hops of the attack path. The low gradient of the curve for the ITrace-CP scheme from detection of the 1st to 14th hop indicated that about 14 hops of the attack path could be detected within the same average time taken. The window from 10 to 18 hops showed significant improvement by the ITrace-CP

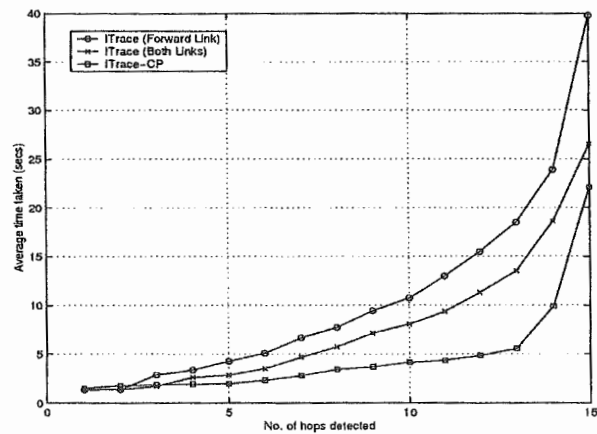


Fig. 5. Average time taken to detect various numbers of hops (15-hop attack path)

scheme; with peak improvement at the 18th hop detection. However, the high average time taken to detect the 19th and 20th hop resulted in the drop in improvement. The average time taken to detect the full path was 39 sec, 24 sec, and 18 sec for the ITrace forward link option, ITrace both links option, and ITrace-CP respectively.

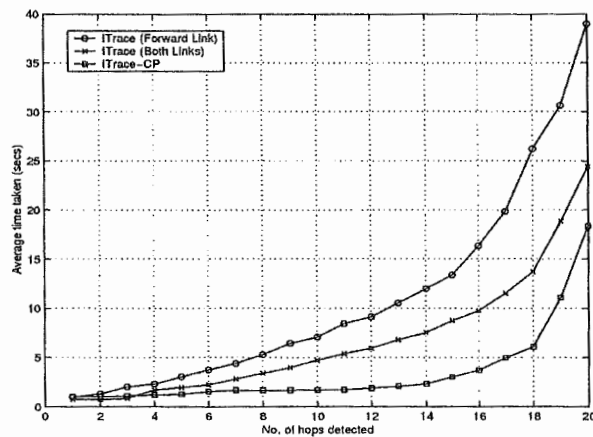


Fig. 6. Average time taken to detect various numbers of hops (20-hop attack path)

6 Conclusion

The objective of IP Traceback is to determine the true source of DoS/DDoS attacks. This paper first gives an overview of the respective approaches for IP Traceback. We then proposed an enhanced ICMP Traceback scheme, called ITrace-CP (ICMP Traceback with Cumulative Path) that encodes cumulative attack path information. We described the ITrace-CP protocol and the mechanism for constructing ITrace-CP messages so that it contains the addresses of all the routers on the attack path. As part of the ITrace-CP protocol, we proposed three schemes for the routers to match corresponding IP and ITrace-CP messages. We have carried out qualitative comparison of the ITrace-CP scheme with the ITrace scheme in terms of storage, bandwidth and computational requirements. We deduced that the ITrace-CP introduces marginal overhead in terms of storage and bandwidth and acceptable computational overhead. Analytical studies were done to compare the performances in terms of the probability of attack path construction as a function of number of attack packets and attack path length. We found that the performance of the ITrace-CP is independent of the attack length and that the probability of path construction of ITrace-CP is significantly higher than that of the ITrace, for all hop lengths. Simulation studies have also been conducted to further evaluate their relative effectiveness in constructing the DoS and DDoS attack paths. Our simulation showed that the ITrace-CP mechanism performs better than the ITrace mechanism and takes significantly less time to construct the entire attack path in longer attack paths.

7 Future Work

In the ICMP Traceback proposal, it is recommended that ITrace messages be generated with a probability of $1/20,000$ so as to limit the increase in data traffic to less than 0.1%. However, in ITrace-CP scheme, given that path information are generated, it is more logical to generate ICMP messages nearer to the attackers, or in other words further from the victim. We will investigate how the probability can be determined to further improve the performance. Also, we have assumed an upper-bound of 100 ms for the packets inter-arrival time. A more rigorous study of this will enable a more accurate determination of the buffer allocation as well as optimal performance of ITrace-CP.

References

1. K.J. Houle, G.M. Weaver, "Trends in Denial of Service Attack Technology", CERT Coordination Center, Oct 2001. http://www.cert.org/archive/pdf/DoS_trends.pdf
2. J. Postel, "Internet Protocol", Request for Comments 0791, Internet Engineering Task Force, 1981.
3. P. Ferguson, D. Senie, "Network Ingress Filtering: Defeating Denial of Service Attacks which employ IP Source Address Spoofing", Request for Comments 2827, Internet Engineering Task Force, May 2000.
4. Steve Bellovin et al, "ICMP Traceback messages", IETF Internet Draft "draft-ietf-itrace-04.txt", Feb 2003. Work in progress.
5. Alex C. Snoeren et al, "Hash-Based IP Traceback", ACM SIGCOMM 2001, August 2001.
6. Stefan Savage et al, "Practical network support for IP traceback", ACM SIGCOMM 2000.

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Tracking Anonymous Peer-to-Peer VoIP Calls on the Internet

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ABSTRACT

Peer-to-peer VoIP calls are becoming increasingly popular due to their advantages in cost and convenience. When these calls are encrypted from end to end and anonymized by low latency anonymizing network, they are considered by many people to be both secure and anonymous.

In this paper, we present a watermark technique that could be used for effectively identifying and correlating encrypted, peer-to-peer VoIP calls even if they are anonymized by low latency anonymizing networks. This result is in contrast to many people's perception. The key idea is to embed a unique watermark into the encrypted VoIP flow by slightly adjusting the timing of selected packets. Our analysis shows that it only takes several milliseconds time adjustment to make normal VoIP flows highly unique and the embedded watermark could be preserved across the low latency anonymizing network if appropriate redundancy is applied. Our analytical results are backed up by the real-time experiments performed on leading peer-to-peer VoIP client and on a commercially deployed anonymizing network. Our results demonstrate that (1) tracking anonymous peer-to-peer VoIP calls on the Internet is feasible and (2) low latency anonymizing networks are susceptible to timing attacks.

Categories and Subject Descriptors

C.2.0 [Computer-Communication Networks]: General—Security and protection (e.g., firewalls); C.2.3 [Computer-Communication Networks]: Network Operations—Network monitoring

General Terms

Security

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Keywords

VoIP, Anonymous VoIP Calls, VoIP Tracing, Peer-to-Peer Anonymous Communication

1. INTRODUCTION

VoIP is a technology that allows people to make phone calls through the public Internet rather than traditional Public Switched Telephone Network (PSTN). Because VoIP offers significant cost savings with more flexible and advanced features over Plain Old Telephone System (POTS), more and more voice calls are now carried at least partially via VoIP. In fact, consulting firm Frost & Sullivan has predicted that VoIP will account for approximately 75% of world voice services by 2007.

For privacy reasons, people sometimes want their phone conversation to be anonymous and do not want other people know that they have even talked over the phone. The use of VoIP has made it much easier to achieve anonymity in voice communications, especially when VoIP calls are made between computers. This is because VoIP calls between peer computers have no phone numbers associated with them, and they could easily be protected by end to end encryption and routed through low latency anonymizing networks (e.g., Onion Routing [13], Tor [6], Freedom [3], and Tarzan [12]) to achieve anonymity. People intuitively think their computer to computer VoIP calls could remain anonymous if they are encrypted end to end and routed through some low latency anonymizing network.

On the other hand, law enforcement agencies (LEA) often need to conduct lawful electronic surveillance in order to combat crime and terrorism. For example, the LEAs need techniques to determine who has called the surveillance target and to whom the surveillance target has called. In a letter to FCC [8], several federal law enforcement agencies have considered the capability of tracking VoIP calls "of paramount importance to the law enforcement and the national security interests of the United States."

How to balance people's needs for privacy and anonymity and the security requirements of the law enforcement agencies has been a subject of controversy. In this paper, we leave the controversy between anonymity and security aside and instead focus on the technical feasibility of tracking anonymous peer-to-peer VoIP calls on the Internet. Our goal is to investigate practical techniques for the effective tracking of anonymous VoIP calls on the Internet and identify the weakness of some of the currently deployed anonymous communication systems.

We choose to investigate the popular Skype [28] peer-to-peer VoIP calls in the context of the anonymous VPN provided by findnot.com [11]. Skype offers free computer to computer VoIP calls based on KaZaa [16] peer-to-peer technology. Several properties of Skype have made it an attractive candidate for the investigation of tracking anonymous VoIP calls on the Internet:

- It is free and widely used. Since August 2003, there are over 100 million downloads of the Skype client. It is being actively used by millions of people all over the world. Skype is now included in Kazaa v3.0.
- All the Skype traffic is encrypted from end to end by 256-bit AES encryption.
- Skype can automatically traverse most firewalls and NAT (Network Address Translation) gateways with the help of intermediate peers.
- Skype intelligently and dynamically routes the encrypted calls through different peers to achieve low latency. This means that the route and the intermediate peer(s) of one VoIP call could be changed during a call.
- It uses proprietary peer-to-peer signaling protocol to set up the VoIP calls.

Since most Skype calls are carried in UDP, we can not directly use those anonymizing systems (such as Onion Routing [13], Tor [6] or anonymizer.com [1]), who do not support anonymization of all UDP flows, to anonymize Skype VoIP calls. We choose to use the anonymous communication services by findnot.com [11] that support anonymization of all IP protocols through point to point tunnel protocol (PTTP).

The key challenge in tracking encrypted VoIP calls across anonymous communication system is how to identify the correlation between the VoIP flows of the caller and the callee. Since all the traffic of the peer-to-peer VoIP calls are encrypted, no signaling information is available for correlation. To be able to track encrypted, anonymous VoIP calls across the Internet, we use the timing characteristics of the anonymized VoIP flow. Unfortunately, the original inter-packet arrival characteristics of VoIP flows are not distinct enough as the inter-packet timing arrival time of VoIP traffic is determined by the frame packetization interval used. This means that passive comparison of the original inter-packet timing characteristics of VoIP flows will not be able to distinguish different VoIP calls.

In order to uniquely identify the anonymous VoIP calls through inter-packet timing characteristics, we use an active approach to deliberately make the inter-packet timing of VoIP calls more distinctive. The idea is to embed a unique watermark into the inter-packet timing of the VoIP flows by slightly adjusting the timing of selected packets. If the embedded watermark is unique enough and robust enough, the watermarked VoIP flows could be effectively identified. By utilizing redundancy techniques, we can make the embedded watermark robust against random timing perturbation provided there are enough packets in the VoIP flow.

Our analytical and experimental results demonstrate that (1) tracking anonymous peer-to-peer VoIP calls on the Internet is feasible and (2) low latency anonymizing systems are susceptible to timing attack. Our VoIP tracking technique does not require the global monitoring capability, and

it could be used to determine if party A is communicating (or has communicated) with party B via peer-to-peer VoIP even if the VoIP traffic is (or has been) disguised by low latency anonymous communication systems.

The rest of the paper is organized as follows. Section 2 formulates the problem of tracking anonymous peer-to-peer VoIP calls, and describes the overall tracing model. Section 3 presents the active timing based tracking method and analyzes its effectiveness. Section 4 describes our implementation of the high precision VoIP watermarking engine in real-time Linux kernel. Section 5 evaluates the effectiveness of our method empirically. Section 6 summarizes related works. Section 7 concludes the paper.

2. THE OVERALL MODEL OF TRACING ANONYMOUS PEER-TO-PEER VOIP CALLS

Given any two different Skype peers A and B, we are interested in determining if A is talking (or has talked) to B via Skype peer-to-peer VoIP. As shown in Figure 1, both Skype peers A and B have outgoing and incoming VoIP flows to and from the Internet cloud. The Skype peers could be behind firewall and NAT, and peer A and/or B could be connected to some low latency anonymizing network. Here we view the Internet cloud and any low latency anonymizing network as a black box, and we are interested only in the Skype flows that enter or exit the black box. We assume that (1) we can monitor the Skype flow from the black box to the Skype peer; (2) we can perturb the timing of the Skype flow from the Skype peer to the black box.

Here we do not intend to track all the peer-to-peer VoIP calls from anyone to anyone, nor do we assume the global monitoring and intercepting capability. Instead we focus on finding out if some parties in which we are interested have communicated via peer-to-peer VoIP calls anonymously, and we only need the capability to monitor and intercept IP flows to and from those interested parties. This model is consistent with our understanding of the common practice of lawful electronic surveillance by the law enforcement agencies.

Because the Skype VoIP flows are encrypted from end to end, no correlation could be found from the flow content. Given that the Skype VoIP flow could pass some intermediate Skype peers and some low latency anonymizing network, there is no correlation from the VoIP flow headers. Among all the characteristics of the VoIP flows, the inter-packet timing characteristics are likely to be preserved across intermediate Skype peers and low latency anonymizing network. This invariant property of VoIP flows forms the very foundation for tracking anonymous, peer-to-peer VoIP calls on the Internet.

A number of timing based correlation methods have been proposed, and they can be classified into two categories: passive and active. Passive timing based correlation approaches (e.g. [35], [34], [33] [7], [5]) correlate the encrypted flows based on passive comparison of their timing characteristics, and they have been shown to be effective when the timing characteristics of each flow are unique enough. However, the inter-packet timing characteristics of all VoIP flows are very similar to each other. The inter-packet arrival time of VoIP flows is determined by the voice codec and the corresponding packetization interval, and there are only a few commonly used VoIP packetization intervals (i.e.

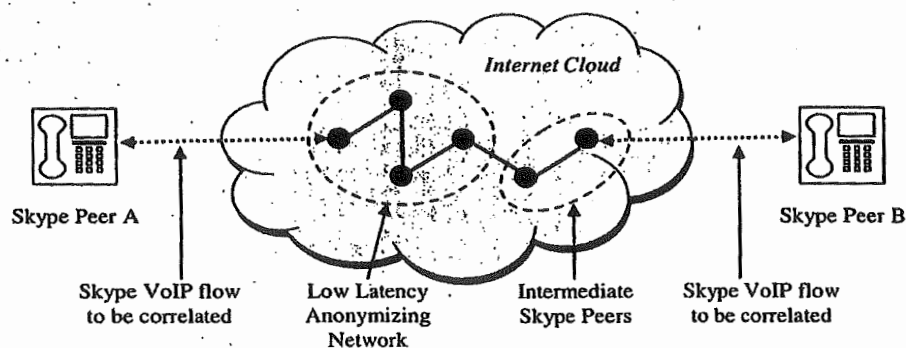


Figure 1: Anonymous Peer-to-Peer VoIP Calls Tracing Model

20ms or 30ms). Therefore, passively comparing the timing characteristics of VoIP flows will not be able to distinguish different VoIP flows.

Wang and Reeves [32] proposed the first active approach to correlate the encrypted flows. They suggested embedding a unique watermark into the inter-packet timing domain of the interactive flow through deliberate timing adjustment of selected packets, and correlating based on the embedded watermark. Because the embedded watermark could make an otherwise non-distinctive flow unique, their active method has the potential to differentiate flows with very similar timing characteristics. However, the method proposed in [32] can not be directly used to correlate VoIP flows due to the following reasons:

- The VoIP traffic has stringent real-time constraints, and the total end to end delay should be less than 150ms.
- The inter-packet arrival time of VoIP flows is very short (i.e. 20ms or 30ms). This requires any time adjustment on VoIP packet to be very precise and small.
- The watermarking method proposed by Wang and Reeves is based on the quantization of averaged Inter-Packet Delays (IPDs), and it requires packet buffering in order to achieve the even timing adjustment over different packets. The required buffering would be too long for the real-time VoIP flows.

To correlate anonymous VoIP flows with similar inter-packet timing characteristics, we use an active approach to deliberately yet subtly make the inter-packet timing characteristics of the VoIP flows more unique. This is achieved by embedding a unique watermark into the inter-packet timing domain of the VoIP flow in real-time.

To address the limitations of previous work [32], we use a new watermarking scheme that is suited for tracking anonymous VoIP traffic in real-time. The key challenge in tracking anonymous VoIP calls by the active approach is how to precisely adjust the packet timing without buffering and guarantee the even time adjustment of those selected packets.

3. ACTIVE TIMING BASED TRACKING OF VOIP FLOWS

We present the new watermarking scheme which guarantees the even time adjustment for embedding the watermark in real time and has all the theoretical strengths of work [32]. Unlike the watermarking scheme proposed in previous work [32], our new watermarking scheme is probabilistic in the sense that the watermark embedding success rate is not guaranteed 100%. In other words, the new watermarking scheme trades off the guaranteed 100% watermark embedding success rate with the guaranteed even time adjustment for embedding the watermark. By exploiting the inherent inter-packet timing characteristics of the VoIP flows, our new watermarking scheme achieves virtually 100% watermark embedding success rate with guaranteed even time adjustment for embedding the watermark.

3.1 Basic Concept and Notion

Given any packet flow $P_1, \dots, P_n$ with time stamps $t_1, \dots, t_n$ respectively ($t_i < t_j$ for $1 \leq i < j \leq n$), we can independently and probabilistically choose a number of packets through the following process: (1) sequentially look at each of the first $n-d$ ($0 < d \ll n$) packets; and (2) independently determine if the current packet will be probabilistically chosen, with probability $p = \frac{2r}{n-d}$ ($0 < r < \frac{n-d}{2}$).

Here whether or not choosing the current packet is not affected by any previously chosen packets and it will not affect whether to choose any other packets. In other word, all the selected packets are selected independently from each other. Therefore, we can expect to have $2r$ distinct packets independently and randomly selected from any packet flow of n packets. We denote the $2r$ randomly selected packets as $P_{z_1}, \dots, P_{z_{2r}}$ ($1 \leq z_k \leq n-d$ for $1 \leq k \leq 2r$), and create $2r$ packet pairs: (P_{z_k}, P_{z_k+d}) ($d \geq 1, k = 1, \dots, 2r$).

The IPD (Inter-Packet Delay) between P_{z_k+d} and P_{z_k} is defined as

$$ipd_{z_k,d} = t_{z_k+d} - t_{z_k}, (k = 1, \dots, 2r) \quad (1)$$

Because all P_{z_k} ($k = 1, \dots, 2r$) are selected independently, $ipd_{z_k,d}$ is independent from each other. Since each P_{z_k} is randomly and independently selected through the same process, $ipd_{z_k,d}$ is identically distributed no matter what inter-packet timing distribution the packet flow $P_1, \dots, P_n$ may have. Therefore, $ipd_{z_k,d}$ ($k = 1, \dots, 2r$) is independent and

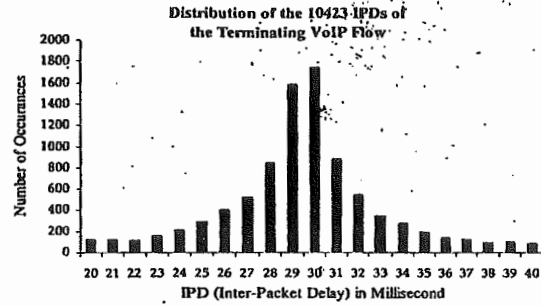
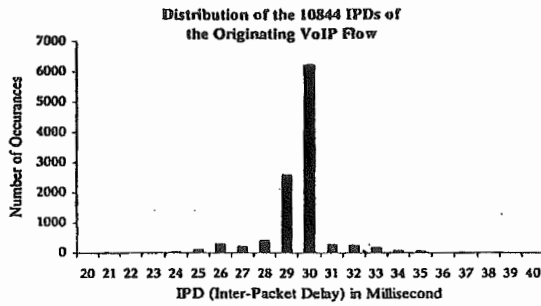


Figure 2: Distribution of IPDs of the originating and terminating Skype flows

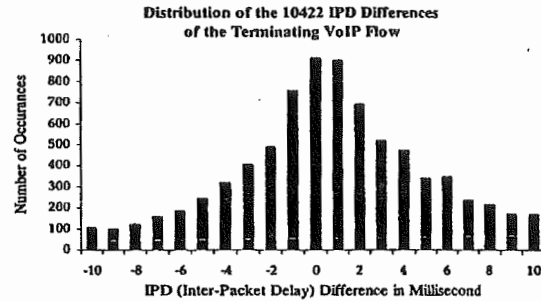
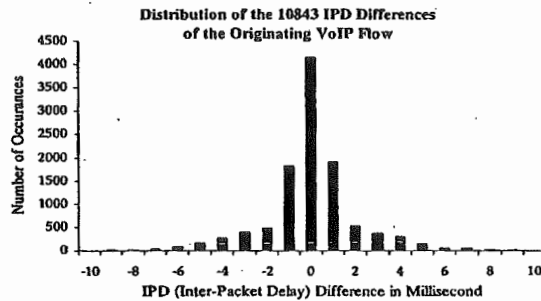


Figure 3: Distribution of IPD Differences of the originating and terminating Skype flows

identically distributed (*iid*).

We then randomly divide the $2r$ IPDs into 2 distinct groups of equal size. Let $ipd_{1,k,d}$ and $ipd_{2,k,d}$ ($k = 1, \dots, r$) denote the IPDs in group 1 and group 2 respectively. Apparently both $ipd_{1,k,d}$ and $ipd_{2,k,d}$ ($k = 1, \dots, r$) are *iid*. Therefore $E(ipd_{1,k,d}) = E(ipd_{2,k,d})$, and $Var(ipd_{1,k,d}) = Var(ipd_{2,k,d})$. Let

$$Y_{k,d} = \frac{ipd_{1,k,d} - ipd_{2,k,d}}{2} \quad (k = 1, \dots, r) \quad (2)$$

Then we have $E(Y_{k,d}) = (E(ipd_{1,k,d}) - E(ipd_{2,k,d}))/2 = 0$. Because $ipd_{1,k,d}$ and $ipd_{2,k,d}$ are *iid*, $Y_{k,d}$ is also *iid*. We use $\sigma_{Y,d}^2$ to represent the variance.

We represent the average of r $Y_{k,d}$'s as

$$\bar{Y}_{r,d} = \frac{1}{r} \sum_{k=1}^r Y_{k,d} \quad (3)$$

Here $\bar{Y}_{r,d}$ represents the average of a group of normalized IPD differences, and we call r the redundancy number. According to the property of variance of independent random variables, we have $Var(\bar{Y}_{r,d}) = \sigma_{Y,d}^2/r$. Because $E(Y_{k,d}) = 0$ ($k = 1, \dots, r$), $E(\bar{Y}_{r,d}) = 0$. Because $Y_{k,d}$ is symmetric ($k = 1, \dots, r$), $\bar{Y}_{r,d}$ is also symmetric. Therefore, the distribution of $\bar{Y}_{r,d}$ is symmetrically centered around 0.

To illustrate the validity of concepts of $Y_{k,d}$ and $\bar{Y}_{r,d}$, we collected two traces of the packet flows of a real Skype call from two communicating Skype peers that are 27 hops and over a thousand miles away (when the Skype call is routed through the commercial findnot.com anonymizing network). One trace is for the Skype flow that originated from one

Skype peer, and the other trace is for the Skype flow that terminated at the other Skype peer. We call them the *originating flow* and the *terminating flow* respectively. The left and right chart of Figure 2 show the IPD histograms of the originating flow and the terminating flow respectively. They all have 30ms average IPD, which indicates that the packetization interval of Skype VoIP call is 30ms. While the IPDs of the originating Skype flow is more concentrated around 30ms, the IPDs of the terminating Skype flow is less clustered due to the network delay jitter. The left and right chart of Figure 3 show the histograms of $Y_{k,d}$ with $d=1$ (or equivalently $\bar{Y}_{r,d}$ with $r=1$ and $d=1$) of the Skype originating flow and the terminating flow respectively. They both confirm that the distribution of $\bar{Y}_{r,d}$ of Skype VoIP flows is indeed symmetric and centered around 0.

3.2 Embedding and Decoding A Binary Bit Probabilistically

Since the distribution of $\bar{Y}_{r,d}$ is symmetric and centered around 0, the probabilities of $\bar{Y}_{r,d}$ to be positive and negative are equal. If we decrease or increase $\bar{Y}_{r,d}$ by an amount $a > 0$, we can shift its distribution to the left or right by a so that $\bar{Y}_{r,d}$ will be more likely to be negative or positive. This gives us a way to embed and decode a single binary bit probabilistically.

To embed a bit 0, we decrease $\bar{Y}_{r,d}$ by a , so that $\bar{Y}_{r,d}$ will have > 0.5 probability to be less than 0. To embed a bit 1, we increase $\bar{Y}_{r,d}$ by a , so that $\bar{Y}_{r,d}$ will have > 0.5 probability to be greater than 0. By definition in equation (3), the decrease or increase of $\bar{Y}_{r,d}$ can be easily achieved by decreasing or increasing each of the r $Y_{k,d}$'s by a . By

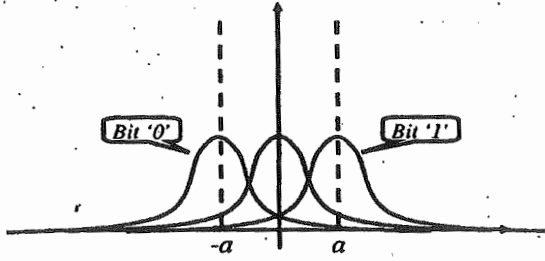


Figure 4: Embedding Binary Bit by Shifting the Distribution of $\bar{Y}_{r,d}$ by a to the Left or Right

definition in equation (2), the decrease of $Y_{k,d}$ by a can be achieved by decreasing each $ipd_{1,k,d}$ by a and increasing each $ipd_{2,k,d}$ by a ; the increase of $Y_{k,d}$ by a can be achieved by increasing each $ipd_{1,k,d}$ by a and decreasing each $ipd_{2,k,d}$ by a .

After $\bar{Y}_{r,d}$ has been decreased or increased by a , we can decode the embedded binary bit by checking whether $\bar{Y}_{r,d}$ is less than or greater than 0. The decoding of the embedded binary bit is 1 if the value of $\bar{Y}_{r,d}$ is greater than 0, or 0 if the value of $\bar{Y}_{r,d}$ is less than or equal to 0. It is easy to see that probability of correct decoding is always greater than that of wrong decoding.

However, as shown in Figure 4, there is always a non-zero probability such that the embedded bit (with adjustment $a > 0$) will be decoded incorrectly (i.e. $\bar{Y}_{r,d} > a$ or $\bar{Y}_{r,d} < -a$). We define the probability that the embedded bit will be decoded correctly as the *bit embedding success rate w.r.t. adjustment a* , which can be quantitatively expressed as $\Pr(\bar{Y}_{r,d} < a)$.

Here the adjustment a is a representation of the watermark embedding strength. The larger the a is, the higher the bit embedding success rate will be. We now show that even with arbitrarily small $a > 0$ (or equivalently arbitrarily weak watermark embedding strength), we can achieve arbitrarily close to a 100% bit embedding success rate by having a sufficiently large redundancy number r .

Central Limit Theorem If the random variables $X_1, \dots, X_n$ form a random sample of size n from a given distribution X with mean μ and finite variance σ^2 , then for any fixed number x

$$\lim_{n \rightarrow \infty} \Pr\left[\frac{\sqrt{n}(\bar{X}_n - \mu)}{\sigma} \leq x\right] = \Phi(x) \quad (4)$$

where $\Phi(x) = \int_{-\infty}^x \frac{1}{\sqrt{2\pi}} e^{-\frac{u^2}{2}} du$.

The theorem indicates that whenever a random sample of size n is taken from any distribution with mean μ and finite variance σ^2 , the sample mean $\bar{X}_n$ will be approximately normally distributed with mean μ and variance σ^2/n , or equivalently the distribution of random variable $\sqrt{n}(\bar{X}_n - \mu)/\sigma$ will be approximately a standard normal distribution.

Applying the Central Limit Theorem to random sample $Y_{1,d}, \dots, Y_{r,d}$, where $\text{Var}(Y_{k,d}) = \sigma_{Y,d}^2$, $E(Y_{k,d}) = 0$, we have

$$\Pr\left[\frac{\sqrt{r}(\bar{Y}_{r,d} - E(Y_{k,d}))}{\sqrt{\text{Var}(\bar{Y}_{r,d})}} < x\right] = \Pr\left[\frac{\sqrt{r}\bar{Y}_{r,d}}{\sigma_{Y,d}} < x\right] \approx \Phi(x) \quad (5)$$

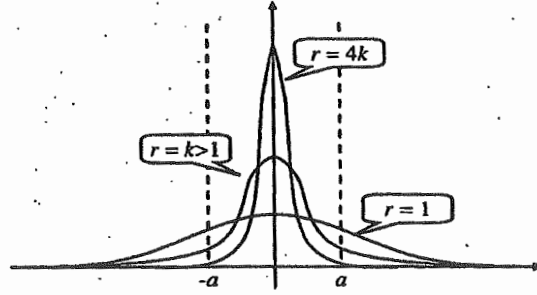


Figure 5: Probability Distribution of $\bar{Y}_{r,d}$ With Different r

Therefore

$$\Pr[\bar{Y}_{r,d} < a] = \Pr\left[\frac{\sqrt{r}\bar{Y}_{r,d}}{\sigma_{Y,d}} < \frac{a\sqrt{r}}{\sigma_{Y,d}}\right] \approx \Phi\left(\frac{a\sqrt{r}}{\sigma_{Y,d}}\right) \quad (6)$$

This means that the distribution of the probabilistic watermark bit embedding success rate is approximately normally distributed with zero mean and variance σ^2/r .

Equation (6) gives us an accurate estimate of the probabilistic watermark bit embedding success rate. It indicates that no matter what distribution $Y_{k,d}$ may be, no matter what variance $Y_{k,d}$ may have (as long as it exists), no matter how small the timing adjustment $a > 0$ (or the watermark embedding strength) might be, we can always make the watermark bit embedding success rate arbitrarily close to 100% by increasing the redundancy number r . This result holds true regardless of the distribution of the inter-packet timing of the packet flow.

Figure 5 illustrates how the distribution of $\bar{Y}_{r,d}$ can be "squeezed" into range $[-a, a]$ by increasing the redundancy number r .

Because the routers, intermediate Skype peers and the anonymizing network along the Skype VoIP call could introduce different delays over VoIP packets, we need to consider the negative impact of such delay jitters over the watermark decoding.

Let σ_d^2 be the variance of all delays added to all packets, X_k be the random variable that denotes the perturbation over $Y_{k,d}$ by the delay jitter, and $Y'_{k,d}$ be the random variable that denotes the resulting value of $Y_{k,d}$ after it has been perturbed by the delay jitter. We have the following quantitative tradeoff among the watermark bit detection rate, the defining characteristics of the delay jitter, and the defining characteristics of the original inter-packet timing of the VoIP flow, whose derivation can be found in the Appendix:

$$\begin{aligned} \Pr[\bar{Y}'_{r,d} < a] &\approx \Phi\left(\frac{a\sqrt{r}}{\sqrt{\sigma_{Y,d}^2 + \sigma_d^2 + 2\text{Cor}(Y_{k,d}, X_k)\sigma_{Y,d}\sigma_d}}\right) \\ &\geq \Phi\left(\frac{a\sqrt{r}}{\sigma_{Y,d} + \sigma_d}\right) \end{aligned} \quad (7)$$

Equation (7) gives us an accurate estimate of the watermark bit detection rate in the presence of delay jitters. The correlation coefficient $\text{Cor}(Y_{k,d}, X_k)$, whose value range is $[-1, 1]$, models any correlation between the network delay

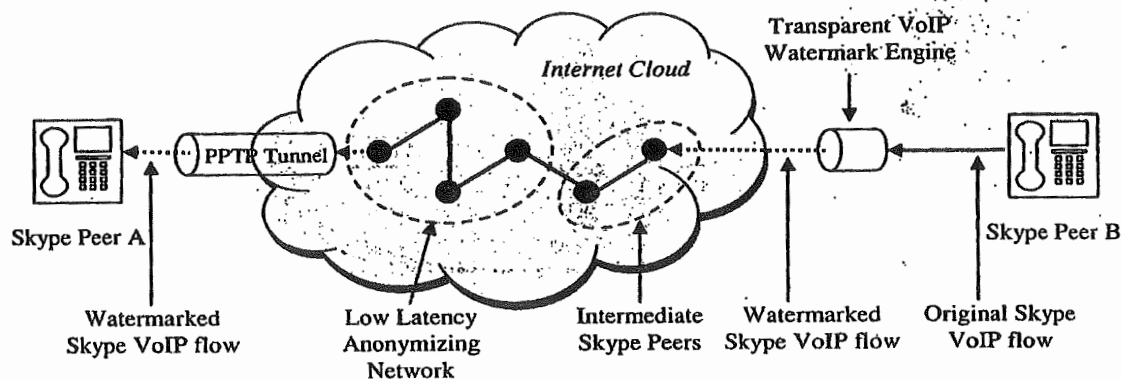


Figure 6: Experimental Setup for the Real-Time Tracking of Anonymous, Peer to Peer Skype VoIP Calls across the Internet

jitter and the packet timing of the original packet flow. In case the delay jitter is independent from the packet timing of the packet flow, $\text{Cor}(Y_{k,d}, X_k)$ will be 0.

The important result here is that no matter what variance $Y_{k,d}$ may have (as long as it exists), no matter how large a variance the network jitter may have, no matter how small the timing adjustment $\alpha > 0$ (or the watermark embedding strength) might be, we can always make the watermark bit detection rate arbitrarily close to 100% by increasing the redundancy number r . This result holds true regardless of the distribution of the network delay jitter.

4. TRANSPARENT WATERMARKING OF VOIP FLOWS IN REAL TIME

In order to be able to watermark any VoIP flows transparently, it is desirable to have a VoIP gateway which forwards the VoIP flows and watermarks any specified bypassing VoIP flows with specified watermarks. To embed the watermark into the inter-packet timing of a VoIP flow, we need a capability to delay specified packet of specified flow for specified duration. We choose to implement such a capability in the kernel of the Linux operating system.

One key challenge in implementing the transparent and real-time VoIP watermarking engine is how to precisely delay an outgoing packet in real-time. The inter-packet arrival time of normal VoIP flows is either 20ms or 30ms. This means that the delay of any VoIP packet must be less than 20ms. In order to hide the watermark embedding into the "background noise" introduced by the normal network delay jitter, the delay of any VoIP packet should be no more than a few milliseconds. To achieve packet delay of such a precision, the operating system must provide a hard real-time scheduling capability.

However, the standard Linux kernel lacks the hard real-time scheduling capability and it does not support time-critical tasks. Because the standard Linux is a time-sharing OS, the execution of any process depends on not only the priority of the process but also the current load in the OS, and there is no guarantee that a time-critical task will be processed and completed on time. In addition, the resolution of the software timer in the Linux kernel is by default 10ms, which is too coarse for our needs.

To achieve the guaranteed high precision, we choose to build our packet delay capability upon the Real Time Application Interface (RTAI) [23] of Linux. The following features of RTAI have made it an attractive platform for implementing the high precision packet delay capability:

- The hard real-time scheduling functions introduced by The RTAI coexist with all the original Linux kernel services. This makes it possible to leverage existing Linux kernel services, especially the IP stack components, from within the real-time task.
- The RTAI guarantees the execution time of real-time tasks regardless of the current load of non real-time tasks.
- The RTAI supports high precision software timer with the resolution of microseconds.

We built our transparent and real-time VoIP watermarking engine upon RTAI 3.1 in Linux kernel 2.6.8.1, and we implemented the VoIP watermarking engine as a RTAI kernel module. To facilitate the management of the kernel VoIP watermarking engine from user space, we also extended the netfilter/iptables mechanism in Linux kernel.

By integrating the RTAI hard real-time scheduling and the Linux kernel functionality, our real-time VoIP watermarking engine achieves the guaranteed delay precision of 100 microseconds over any specified packets of any specified flows despite the workload of the Linux kernel.

5. EXPERIMENTS

In this section, we empirically validate our active watermark based tracking of anonymous, peer-to-peer VoIP calls on the Internet. In specific, we conduct our experiments with real-time Skype peer-to-peer VoIP calls over the commercially deployed anonymizing system of findnot.com. Figure 6 shows the setup of our experiments. The Skype peer A is connected to some entry point of the anonymizing network of findnot.com via PPTP (Point to Point Tunnel Protocol) and all the Internet traffic of Skype peer A is routed through and anonymized by the anonymizing network of findnot.com. As a result, Skype peer B never sees the real

IP address of Skype peer A, and Skype peer A could appear to be some host of thousands miles away. In our experimental setup, the two communicating Skype peers are at least 27 hops away with about 60ms end to end latency.

We place our high precision VoIP watermarking engine between Skype peer B and the Internet and let it transparently watermark the VoIP flow from Skype peer B to peer A. We intercept the VoIP flow from the anonymizing network of findnot.com to Skype peer A, and try to detect the watermark from the intercepted VoIP flow.

While Skype VoIP call can use both TCP and UDP, we have found that it almost always use UDP. In our experiments, all the Skype calls happen to be UDP, and none of them has noticeable packet loss.

5.1 Watermarking Parameter Selection

Equation (7) gives us the quantitative tradeoff between the watermark bit detection rate, watermark embedding parameters and the defining characteristics of the network delay jitters.

To make the embedded watermark more robust against the network delay jitters and have high watermark bit detection rate, it is desirable to have larger watermark embedding delay α and bigger redundancy number r . However, a bigger watermark embedding delay means bigger distortion of the original inter-packet timing of the VoIP flow, which could potentially be used by the adversary to determine if a VoIP flow has been watermarked or not. Ideally, the delay introduced by the watermark embedding should be indistinguishable from the normal network delay.

To understand the normal network delay jitter as well as the hiding space for embedding our transparent watermark into the inter-packet timing of VoIP flows, we made a Skype call of 6 minutes long without watermarking, and collected the traces of the VoIP flows from both Skype peer A and B. We calculated the network delay jitter by comparing the timestamps of 10424 corresponding packets between the two VoIP flows. Figure 7 shows the distribution of the normalized network delay jitters. It indicates that there are about 50% chances that the network delay jitter will be equal to or bigger than 3ms. Therefore, it would be hard to distinguish any watermarked VoIP flow from unwatermarked ones if we embed the watermark with 3ms delay.

With watermark embedding delay $\alpha=3$ ms, we tried different redundancy numbers r to embed a 24-bit watermark into the Skype VoIP calls over the same anonymizing network of findnot.com. Figure 8 shows the average number of the error bits of the decoded watermarks of 10 Skype calls with a range of redundancy numbers. It clearly shows that the number of error bits can be effectively decreased by increasing the redundancy number r . With redundancy number $r=25$, the average number of error bits of the decoded 24-bit watermark is only 1.4.

In all of the following experiments, we use 24-bit watermarks with embedding delay $\alpha=3$ ms and redundancy number $r=25$. With this set of watermarking parameters, the watermarking of VoIP flow only requires 1200 packets to be delayed by 3ms. Given the 30ms packetization interval of Skype VoIP calls, the transparent watermarking can be applied to any VoIP calls that are as short as 90 seconds.

5.2 True Positive Experiments

We randomly generated 100 24-bit watermarks such that

the Hamming distance between any two of them is at least 9. We then made 100 Skype calls of 2 minutes long and watermarked each of them with different watermark. We collected the originating and terminating watermarked VoIP flows from Skype peer B and A respectively, and decoded the 24-bit watermarks from them. We call any bit in the decoded 24-bit watermark that is different from the corresponding embedded bit as an *error bit*. Figure 9 shows the number of error bits of the 100 Skype VoIP calls and the watermark detection true positive rates given different numbers of allowed error bits. It indicates that very few of the 100 watermarked originating flows has 1 or 2 error bits, and a number of watermarked terminating flows has 1 to 6 error bits. If we require the exact match between the embedded watermark and the detected watermark, then we have 59% true positive rate. If the number of allowed error bits is increased to 4, the true positive rate becomes 99%. With number of allowed error bits being 6 or greater, we have 100% true positive rate.

5.3 False Positive Experiments

No matter what watermark we choose, it is always possible that an unwatermarked VoIP flow happens to have the chosen watermark naturally. We call this case as a *false positive* in correlating the VoIP flows.

We have shown that the true positive rate is generally higher if the number of allowed error bits is bigger. However, a bigger number of allowed error bits tends to increase the false positive rate. Therefore, it is important to choose an appropriate number of allowed error bits that will yield both high true positive rate and low false positive rate at the same time. To find the appropriate number of allowed error bits, we need to know the false positive rates under different numbers of allowed error bits.

Assuming the 24-bit watermark decoded from a random flow is uniformly distributed, then the expected false positive rate with $h \geq 0$ allowed error bits will be

$$\sum_{i=0}^h \binom{24}{i} \left(\frac{1}{2}\right)^{24} \quad (8)$$

Because each of the 100 Skype calls is watermarked with different watermark, any of the 100 watermarked Skype flows has 99 uncorrelated watermarked Skype flows. Ideally, the number of different bits between the 24-bit watermarks decoded from different watermarked flows should be high.

Figure 10 shows the expected and measured numbers of different bits between the 24-watermarks decoded from the 9900 pairs of uncorrelated VoIP flows as well as the expected and measured watermark detection false positive rates under various numbers of allowed error bits. It indicates that the measured values are very close to expected value. This validates our assumption that the 24-bit watermark decoded from a random flow is uniformly distributed.

Out of the 9900 pairs of uncorrelated flows, no one has less than 6 different bits between the two watermarks decoded. There are 10 pairs of uncorrelated flows that have 6 different bits. Therefore, if we choose 5 as the number of allowed error bits, we would have 99% true positive rate and 0% false positive rate. If we use 6 as the number of allowed error bits, we would get 100% true positive rate and 0.1% false positive rate.

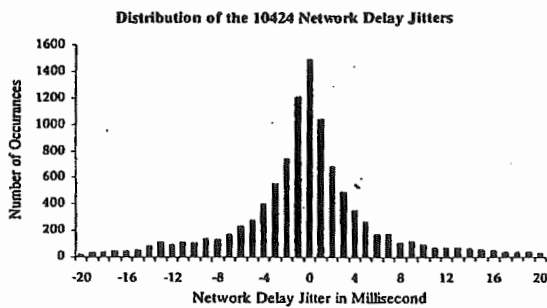


Figure 7: Distribution of the Network Delay Jitters of Skype VoIP Call

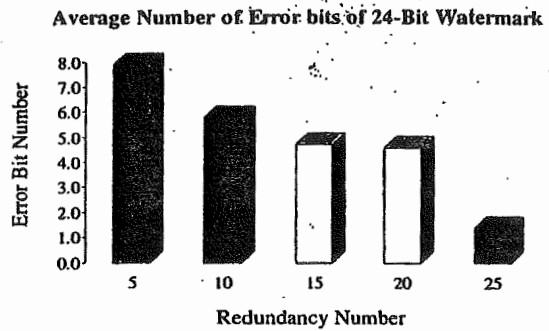


Figure 8: Average Number of Bit Errors vs the Redundancy Number r

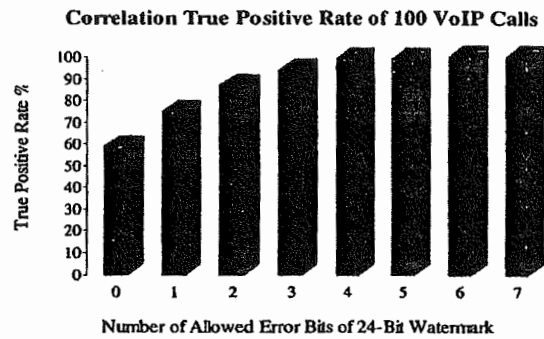
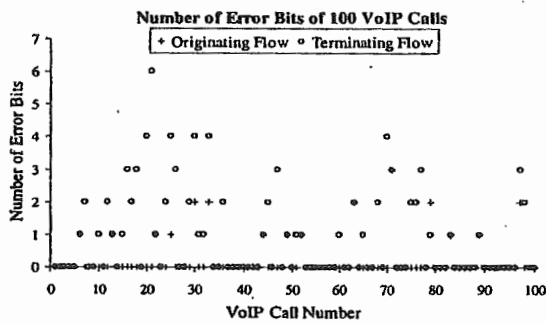


Figure 9: The Numbers of Error Bits and Correlation True Positive Rates of 100 Skype VoIP Calls

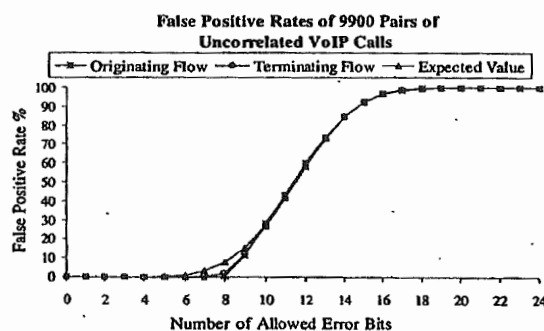
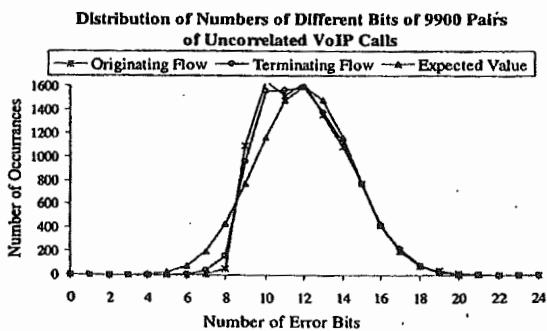


Figure 10: The Numbers of Error Bits and Correlation False Positive Rates of 9900 Pairs of Uncorrelated Skype VoIP Flows

6. RELATED WORKS

There have been substantial research works on how to trace attack packets with spoofed source address. Notably, Savage *et al.* [24] proposed IP traceback approach based on probabilistic packet marking (PPM), and Snoeren *et al.* [30] proposed logging based IP traceback approach. While both approaches have been shown to be effective in tracing the real source of large number of packets with spoofed source address, they can not be used directly to trace VoIP flows. Nevertheless, Savage's work demonstrated the potentials of active approach in tracing IP packets.

There are a number of works [34, 35, 33, 7, 32, 5] on how to trace encrypted attack traffic through stepping stones based on the inter-packet timing characteristics. Except Wang and Reeves' work [32], all other timing based approaches are passive. As the timing characteristics of VoIP flows are not distinct enough, passive examination of existing inter-packet timing of VoIP flows won't be able to distinguish different VoIP flows. Our proposed work differs from work [32] in that it does not require packet buffering to achieve the even time adjustment for embedding the watermark.

A number of low-latency anonymizing systems have been proposed to provide various levels of anonymity. Notably, Onion Routing [13] and its second generation Tor [6] aim to provide anonymous transport of TCP flows over the Internet. ISDN mixes [21] proposed a technique to anonymize the phone calls over the traditional PSTN. Tarzan [12] is an anonymizing network layer based on peer-to-peer model. Unlike most other anonymizing systems, Tarzan introduces cover traffic in addition to encrypting and relaying the normal traffic.

Felton and Schneider [10] identified a web caching exploiting technique that would allow malicious web site to infer whether its visitors have visited some other web pages, even if the browsing is protected by anonymizing services. Murdoch *et al.* [20] have recently investigated timing based attack on Tor with the assumption that the attacker controls a corrupt Tor node. Levine *et al.* [18] investigated passive timing based attack on low-latency anonymizing systems with the assumption that the attacker controls both the first and the last mix in the anonymizing network. However, none of these timing based approaches can be directly used to track VoIP calls.

7. CONCLUSIONS

Tracking encrypted, peer-to-peer VoIP calls has been widely viewed as impossible, especially when the VoIP calls are anonymized by the low latency anonymizing system. The key contribution of our work is that it demonstrates (1) tracking anonymous, peer-to-peer VoIP calls on the Internet is feasible; and (2) low latency anonymizing system is susceptible to timing based attack.

Our technique for tracking anonymous, peer-to-peer VoIP calls is based on subtle and deliberate manipulation of the inter-packet timing of selected packets of the VoIP flow. Our experiments of the real-time peer-to-peer VoIP calls over a commercially deployed anonymizing system show that the encrypted and anonymized VoIP flow could be made highly unique with only 3ms timing adjustment on selected packets. This level of timing adjustment is well within the range of normal network delay jitters. Our results also show that our watermark based tracking technique can be effectively

applied to any peer-to-peer VoIP calls that are at least 90 seconds long.

8. REFERENCES

- [1] Anonymizer. URL. <http://www.anonymizer.com>
- [2] M. Arango, A. Dugan, I. Elliott, C. Huitema and S. Pickett. *RFC 2705: Media Gateway Control Protocol (MGCP) Version 1.0*. IETF, October 1999.
- [3] A. Back, I. Goldberg, and A. Shostack. Freedom 2.1 Security Issues and Analysis. Zero-Knowledge Systems, Inc. white paper, May 2001
- [4] S. A. Baset and H. Schulzrinne. An Analysis of the Skype Peer-to-Peer Internet Telephony Protocol. Columbia Technical Report CUCS-039-04, December 2004
- [5] A. Blum, D. Song, and S. Venkataraman. Detection of Interactive Stepping Stones: Algorithms and Confidence Bounds. In *Proceedings of the 7th International Symposium on Recent Advances in Intrusion Detection (RAID 2004)*. Springer, October 2004.
- [6] R. Dingledine, N. Mathewson and P. Syverson. Tor: The Second Generation Onion Router. In *Proceedings of the 13th USENIX Security Symposium*, August 2000.
- [7] D. L. Donoho, A. G. Flesia, U. Shankar, V. Paxson, J. Coit and S. Stanford. Multiscale Stepping Stone Detection: Detecting Pairs of Jittered Interactive Streams by Exploiting Maximum Tolerable Delay. In *Proceedings of the 5th International Symposium on Recent Advances in Intrusion Detection (RAID 2002): LNCS-2516*, pages 17-35. Springer, October 2002.
- [8] FBI. Letter to FCC <http://www.askcalea.com/docs/20040128.jper.letter.pdf>
- [9] Federal Communications Commission. Notice of Proposed Rulemaking (NPRM) and Declaratory Ruling RM-10865, ET Docket No. 04-295, FCC 04-187. In *Federal Register at 69 Fed. Reg. 56956*, August, 2004.
- [10] E. W. Felton and M. A. Schneider. Timing Attacks on Web Privacy. In *Proceedings of the 7th ACM Conference on Computer and Communications Security (CCS 2000)*, pages 25-32. ACM, November 2000.
- [11] Findnot. URL. <http://www.findnot.com>
- [12] M. J. Freedman and R. Morris. Tarzan: A Peer-to-Peer Anonymizing Network Layer. In *Proceedings of the 9th ACM Conference on Computer and Communications Security (CCS 2002)*, pages 193-206. ACM, November 2003.
- [13] D. Goldschlag, M. Reed and P. Syverson. Onion Routing for Anonymous and Private Internet Connections In *Communications of ACM*, volume 42(2), February 1999.
- [14] M. T. Goodrich. Efficient Packet Marking for Large-scale IP Traceback. In *Proceedings of the 9th ACM Conference on Computer and Communications Security (CCS 2002)*, pages 117-126. ACM, October 2002.
- [15] ITU-T Recommendation H.323v.4 Packet-based Multimedia Communications Systems. November 2000.

- [16] Kazaa. URL: <http://www.kazaa.com/>
- [17] T. Kohno, A. Brodo and K. Claffy. Remote Physical Device Fingerprinting. In *Proceedings of the 2005 IEEE Symposium on Security and Privacy*, IEEE, 2005.
- [18] B. Levine, M. Reiter, C. Wang, and M. Wright. Timing Attacks in Low-Latency Mix Systems. In *Proceedings of Financial Cryptography: 8th International Conference (FC 2004): LNCS-3110*, 2004.
- [19] J. Li, M. Sung, J. Xu and L. Li. Large Scale IP Traceback in High-Speed Internet: Practical Techniques and Theoretical Foundation. In *Proceedings of the 2004 IEEE Symposium on Security and Privacy*, IEEE, 2004.
- [20] S. J. Murdoch and G. Danezis. Low-Cost Traffic Analysis of Tor. In *Proceedings of the 2005 IEEE Symposium on Security and Privacy*, IEEE, 2005.
- [21] A. Pfitzmann, B. Pfitzmann and M. Waidner. "ISDN-MIXes" Untraceable Communication with Small Bandwidth Overhead. In *Proceedings of GI/ITG Conference: Communication in Distributed Systems, Mannheim*, Informatik-Fachberichte 267, pages 451-463, Springer-Verlag, 1991.
- [22] J. Rosenberg, H. Schulzrinne, G. Camarillo, A. R. Johnston, J. Peterson, R. Sparks, M. Handley, and E. Schooler. *RFC 3261: SIP: Session Initiation Protocol*. IETF, June 2002.
- [23] RTAI. URL: <http://www.rtai.org>
- [24] S. Savage, D. Wetherall, A. Karlin, and T. Anderson. Practical Network Support for IP Traceback. In *Proceedings of ACM SIGCOMM 2000*, pages 295-306. ACM, September 2000.
- [25] H. Schulzrinne. Internet Telephony. In *Practical Handbook of Internet Computing*, CRC, 2004
- [26] H. Schulzrinne and J. Rosenberg. A Comparison of SIP and H.323 for Internet Telephony. In *Proceedings of International Workshop on Network and Operating System Support for Digital Audio and Video (NOSSDAV 1998)*, pages 83-86, Cambridge, England, July 1998.
- [27] H. Schulzrinne and J. Rosenberg. Signaling for Internet Telephony. In *Proceedings of The 6th IEEE International Conference on Network Protocols (ICNP'98)*, October 1998.
- [28] Skype - the Global Internet Telephony Company. URL: <http://www.skype.org>
- [29] S. Snapp, J. Brentano, G. V. Dias, T. L. Goan, L. T. Heberlein, C. Ho, K. N. Levitt, B. Mukherjee, S. E. Smahal, T. Grance, D. M. Teal, and D. Mansur. DIDS (Distributed Intrusion Detection System) - Motivation, Architecture, and Early Prototype. In *Proceedings of the 14th National Computer Security Conference*, pages 167-176, 1991.
- [30] A. Snoeren, C. Patridge, L. A. Sanchez, C. E. Jones, F. Tchakountio, S. T. Kent, and W. T. Strayer. Hash-based IP Traceback. In *Proceedings of ACM SIGCOMM 2001*, pages 3-14. ACM, September 2001.
- [31] S. Stanford-Chen and L. Heberlein. Holding Intruders Accountable on the Internet. In *Proceedings of the 1995 IEEE Symposium on Security and Privacy*, pages 39-49. IEEE, 1995.
- [32] X. Wang and D. Reeves. Robust Correlation of Encrypted Attack Traffic Through Stepping Stones by Manipulation of Interpacket Delays. In *Proceedings of the 10th ACM Conference on Computer and Communications Security (CCS 2003)*, pages 20-29. ACM, October 2003.
- [33] X. Wang, D. Reeves, and S. Wu. Inter-packet Delay Based Correlation for Tracing Encrypted Connections Through Stepping Stones. In *Proceedings of the 7th European Symposium on Research in Computer Security (ESORICS 2002)*, LNCS-2502, pages 244-263. Springer-Verlag, October 2002.
- [34] K. Yoda and H. Etoh. Finding a Connection Chain for Tracing Intruders. In *Proceedings of the 6th European Symposium on Research in Computer Security (ESORICS 2000)*, LNCS-1895, pages 191-205. Springer-Verlag, October 2002.
- [35] Y. Zhang and V. Paxson. Detecting Stepping Stones. In *Proceedings of the 9th USENIX Security Symposium*, pages 171-184. USENIX, 2000.

APPENDIX

Let D_i ($i = 1, \dots, n$) represent the random delays added to packet P_i by the adversary, let $D > 0$ be the maximum delay the adversary could add to any packet, and let σ_d^2 be the variance of all delays added to all packets. Here we make no assumption about the distribution of random delay the adversary could add to each packet except that the delay is bounded. For example, D_i and D_j ($i \neq j$) could be correlated to each other and/or have different distributions. This models all the possible bounded random delays the adversary could add to a packet flow.

Given the assumption that the adversary does not know how and which packets are selected by the information hider, the selection of information embedding packet P_{z_k} ($k = 1, \dots, 2r$) is independent from any random delay D_i the adversary could add. Therefore, the impact of the random delays by the adversary over randomly selected P_{z_k} is equivalent to randomly choosing one from the random variable list: $D_1, \dots, D_n$. Let b_k ($k = 1, \dots, 2r$) represent the impact of the random delays by the adversary over the k -th randomly selected packet P_{z_k} . Apparently the distribution of b_k is a compound one that depends on the probability that each D_i would be selected. Since each P_{z_k} is randomly selected according to the same probability distribution over $P_1, \dots, P_n$, each b_k has the same compound distribution. Furthermore, because each P_{z_k} is selected independently, b_k is also independent from each other. In other words, the impact of any random delays by the adversary over those independently and randomly selected information bearing packets is independent and identically distributed (*iid*), and it is essentially an *iid* random sample from the random delays the adversary added to all packets.

Let $x_{1,k}$ and $x_{2,k}$ be the random variables that denote the random impact over $ipd_{1,k,d}$ and $ipd_{2,k,d}$ respectively. Apparently both $x_{1,k}$ and $x_{2,k}$ are *iid*. It is also easy to see that $x_{1,k}, x_{2,k} \in [-D, D]$, $E(x_{1,k}) = E(x_{2,k}) = 0$, and $\text{Var}(x_{1,k}) = \text{Var}(x_{2,k}) = 2\sigma_d^2$. Let $X_k = (x_{1,k} - x_{2,k})/2$, then X_k is *iid*, $E(X_k) = 0$, and $\text{Var}(X_k) = \sigma_d^2$.

Let $Y'_{k,d}$ be the random variable that denotes the resulting value of $Y_{k,d}$ after it is perturbed by $x_{1,k}$ and $x_{2,k}$, then we have

$$\begin{aligned}
Y'_{k,d} &= [(ipd_{1,k,d} + x_{1,k}) - (ipd_{2,k,d} + x_{2,k})]/2 \\
&= (ipd_{1,k,d} - ipd_{2,k,d})/2 + (x_{1,k} - x_{2,k})/2 \\
&= Y_{k,d} + X_k
\end{aligned} \tag{A-1}$$

Therefore, $E(Y'_{k,d}) = 0$. Since $Y_{k,d}$ is iid and X_k is iid, $Y'_{k,d}$ is also iid.

$$\begin{aligned}
\text{Var}(Y'_{k,d}) &= \text{Var}(Y_{k,d}) + \text{Var}(X_k) + 2\text{Cov}(Y_{k,d}, X_k) \\
&= \sigma_{Y,d}^2 + \sigma_d^2 + 2\text{Cor}(Y_{k,d}, X_k)\sigma_{Y,d}\sigma_d \\
&\leq \sigma_{Y,d}^2 + \sigma_d^2 + 2\sigma_{Y,d}\sigma_d \\
&= (\sigma_{Y,d} + \sigma_d)^2
\end{aligned} \tag{A-2}$$

Let $\bar{Y}'_{r,d}$ be the random variable that denotes the resulting value of $\bar{Y}_{r,d}$ after it is perturbed by $x_{1,k}$ and $x_{2,k}$, then we have

$$\bar{Y}'_{r,d} = \frac{1}{r} \sum_{k=1}^r Y'_{r,d} \tag{A-3}$$

According to the property of variance of independent random variables, $\text{Var}(\bar{Y}'_{r,d}) = \text{Var}(Y'_{k,d})/r$. It is also easy to see that $E(\bar{Y}'_{r,d}) = 0$.

By applying the Central Limit Theorem to random sample $Y'_{1,d}, \dots, Y'_{r,d}$, where $E(Y'_{k,d}) = 0$, and $\text{Var}(Y'_{k,d}) = \sigma_{Y,d}^2 + \sigma_d^2 + 2\text{Cor}(Y_{k,d}, X_k)\sigma_{Y,d}\sigma_d$, we have

$$\begin{aligned}
\Pr\left[\frac{\sqrt{r}(\bar{Y}'_{r,d} - E(Y'_{k,d}))}{\sqrt{\text{Var}(Y'_{k,d})}} < x\right] &= \Pr\left[\frac{\sqrt{r}\bar{Y}'_{r,d}}{\sqrt{\text{Var}(Y'_{k,d})}} < x\right] \\
&= \Phi(x)
\end{aligned} \tag{A-4}$$

Therefore

$$\begin{aligned}
\Pr[\bar{Y}'_{r,d} < a] &= \Pr\left[\frac{\sqrt{r}\bar{Y}'_{r,d}}{\sqrt{\text{Var}(Y'_{k,d})}} < \frac{a\sqrt{r}}{\sqrt{\text{Var}(Y'_{k,d})}}\right] \\
&\approx \Phi\left(\frac{a\sqrt{r}}{\sqrt{\text{Var}(Y'_{k,d})}}\right) \\
&= \Phi\left(\frac{a\sqrt{r}}{\sqrt{\sigma_{Y,d}^2 + \sigma_d^2 + 2\text{Cor}(Y_{k,d}, X_k)\sigma_{Y,d}\sigma_d}}\right) \\
&\geq \Phi\left(\frac{a\sqrt{r}}{\sigma_{Y,d} + \sigma_d}\right)
\end{aligned} \tag{A-5}$$

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Application Number:	15072558
International Application Number:	
Confirmation Number:	7407
Title of Invention:	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
First Named Inventor/Applicant Name:	MASAHARU MORIMOTO
Customer Number:	21254
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Receipt Date:	02-AUG-2016
Filing Date:	17-MAR-2016
Time Stamp:	16:48:02
Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDS.pdf	279703	no	3
			f0f2ed31be623dde170cb8de7d16e45cc59 bcd2c		

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Other Reference-Patent/App/Search documents	References.pdf	224373 40c18e1c543a70895d6a04ec7e64ea65c349bc94	no	2
Warnings:					
Information:					
3	Non Patent Literature	Literature1.pdf	881943 13b04013fd6f76667d875e85585f5b540b74a80f	no	10
Warnings:					
Information:					
4	Non Patent Literature	Literature2.pdf	1087565 7dd94aac54c92d54344b1e2057f0dfdbc715b6c0	no	12
Warnings:					
Information:					
5	Non Patent Literature	Literature3.pdf	1783059 f832f8267635312b6de0d8cc410edb2085a64cac	no	11
Warnings:					
Information:					
Total Files Size (in bytes):			4256643		
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of

Masaharu MORIMOTO

Serial No.: 15/072,558

Group Art Unit: 2463

Filing Date: March 17, 2016

Examiner: Gbemileke J. Onamuti

For: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Honorable Commissioner of Patents
Alexandria, VA 22313 - 1450

STATEMENT OF SUBSTANCE OF THE INTERVIEW

Sir:

Applicant thanks the Examiner for the Personal Interview of August 9, 2016.

The Examiner agreed that Applicant's rebuttal arguments against the rejection under 35 U.S.C. § 101 were persuasive. The Examiner indicated that he would reconsider his position in the next office communication and would remove the rejections of the record.

Date: 8/10/16

Respectfully Submitted,



Farhad Shir, Ph.D.
Registration No. 59,403

Sean M. McGinn, Esq.
Registration No. 34,386

**MCGINN INTELLECTUAL PROPERTY
LAW GROUP, PLLC**
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Customer No. 21254

Electronic Acknowledgement Receipt

EFS ID:	26598576
Application Number:	15072558
International Application Number:	
Confirmation Number:	7407
Title of Invention:	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
First Named Inventor/Applicant Name:	MASAHARU MORIMOTO
Customer Number:	21254
Filer:	Farhad Shir
Filer Authorized By:	
Attorney Docket Number:	11USFP2759-C1
Receipt Date:	10-AUG-2016
Filing Date:	17-MAR-2016
Time Stamp:	11:02:48
Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Applicant summary of interview with examiner	201608101053.pdf	68086	no	1
			252089476aecd9ddcde5cc83bc453f94f6520c26f		

Warnings:

Information:	
Total Files Size (in bytes):	68086
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1	7407

21254 7590 08/11/2016
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8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER

ONAMUTI, GBEMILEKE J

ART UNIT	PAPER NUMBER
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2463

MAIL DATE	DELIVERY MODE
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08/11/2016

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

<i>Applicant-Initiated Interview Summary</i>	Application No. 15/072,558	Applicant(s) MORIMOTO, MASAHARU	
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463	

All participants (applicant, applicant's representative, PTO personnel):

- (1) GBEMILEKE ONAMUTI. (3) ISHILL SATORU.
 (2) FARHAD SHIR (Reg. #: 59,403). (4) ____.

Date of Interview: 09 August 2016.

Type: ☐ Telephonic ☐ Video Conference
☒ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
 If Yes, brief description: _____.

Issues Discussed ☒ 101 ☐ 112 ☐ 102 ☐ 103 ☒ Others
 (For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: _____.

Identification of prior art discussed: _____.

Substance of Interview

(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

The rejection(s) of Claims 1-20 under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention and the claimed invention is directed to non-statutory subject matter because the claims is directed to judicial exception without adding significantly more is withdrawn because applicant's argument is persuasive. Regarding the rejection(s) of Claims 1-20 on the grounds of nonstatutory double patenting over Claims 1,3,4 and 6-20 of copending application No.: 13/983,001, the applicant agreed to file a terminal disclaimer to overcome this rejection.

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/GBEMILEKE ONAMUTI/
 Examiner, Art Unit 2463

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of
Masaharu MORIMOTO

Serial No.: 15/072,558

Group Art Unit: 2463

Filing Date: March 17, 2016

Examiner: Gbemileke J. Onamuti

For: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

Honorable Commissioner of Patents
Alexandria, VA 22313 - 1450

RESPONSE UNDER 37 C.F.R. §1.111

Sir:

In response to the Office Action dated April 11, 2016, please consider the above-identified application as follows:

INTRODUCTORY COMMENTS

A listing of the Claims begins on page 2 of this paper. There are no new claim amendments, but a clean version of the claims is included for reference. No new matter is added.

Remarks begin on page 6 of this paper.

Serial No.: 15/072,558
KUD.486 CONT

CLAIMS

1. (Original) A switch apparatus, comprising:
 - a storage storing a table, the table including rules and actions corresponding to the rules; and
 - a controller comprising:
 - a memory storing instructions; and
 - a processor configured to execute the instructions to:
 - receive the rules and the actions from a control apparatus;
 - identify, based on the rules, a received packet;
 - duplicate a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;
 - encapsulate the identified packet by the additional header; and
 - process, based on the actions, the identified packet.
2. (Original) The switch apparatus according to claim 1, wherein the processor is further configured to execute the instructions to send header information to the control apparatus when the identified packet comprises an encapsulated packet.
3. (Original) The switch apparatus according to claim 2, wherein the header information includes the additional header.
4. (Original) The switch apparatus according to claim 3, wherein the processor is further configured to execute further instructions to decapsulate the encapsulated packet.
5. (Original) The switch apparatus according to claim 1, wherein the processor is further configured to execute the instructions for translation of first header data of a head of the received packet into second header data.
6. (Original) The switch apparatus according to claim 5, wherein the instructions to

Serial No.: 15/072,558
KUD.486 CONT

encapsulate the identified packet includes notifying the controller of the first header data before the translation and the second header data after the translation.

7. (Original) A communication system, comprising:
 - a control apparatus configured to control a plurality of switch apparatuses; and
 - a switch apparatus of the switch apparatuses comprising:
 - a storage storing a table, the table including rules and actions corresponding to the rules; and
 - a controller comprising:
 - a memory storing instructions; and
 - a processor configured to execute the instructions to:
 - receive the rules and the actions from a controller;
 - identify, based on the rules, a received packet;
 - duplicate a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;
 - encapsulate the identified packet by the additional header;
 - and
 - process, based on the actions, the identified packet.
8. (Original) The communication system according to claim 7, wherein the processor is further configured to execute the instructions to send header information to the control apparatus when the identified packet comprises an encapsulated packet.
9. (Original) The communication system according to claim 8, wherein the header information includes the additional header.
10. (Original) The communication system according to claim 9, wherein the processor is further configured to execute further instructions to decapsulate the encapsulated packet.
11. (Original) The communication system according to claim 7, wherein the processor is

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further configured to execute the instructions for translation of the first header data of a head of the received packet into the second header data.

12. (Original) The communication system according to claim 11, wherein the instructions to encapsulate the identified packet includes notifying the controller of first header data before the translation and second header data after the translation.

13. (Original) A communication method, comprising:
receiving rules and actions from a controller;
identifying, based on the rules, a received packet;
duplicating a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;
encapsulating the identified packet by the additional header; and
processing, based on the actions, the identified packet.

14. (Original) The communication method according to claim 13, further comprising:
sending header information to a controller when the identified packet comprises an encapsulated packet.

15. (Original) The communication method according to claim 14, wherein the header information includes the additional header.

16. (Original) The communication method according to claim 15, further comprising:
executing further instructions to decapsulate the encapsulated packet.

17. (Original) The communication method according to claim 14, further comprising:
translating first header data of a head of the received packet into second header data.

18. (Original) The communication method according to claim 17, further comprising:
notifying the controller of the first header data before the translating and the second header data after the translating.

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KUD.486 CONT

19. (Original) A non-transitory recording medium recording a program which when executed causes a switch to perform a method, the method comprising:
- receiving rules and actions from a controller;
 - identifying, based on the rules, a received packet;
 - duplicating a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;
 - encapsulating the identified packet by the additional header; and
 - processing, based on the actions, the identified packet.
20. (Original) The non-transitory recording medium, according to claim 19, the method further comprising:
- sending header information to the controller when the identified packet comprises an encapsulated packet,
 - wherein the header information includes the additional header.

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REMARKS

Applicant concurrently files herewith a petition (and fee) for a one-month extension of time.

Claims 1-20 are pending in this Application.

Claim 1-20 stand rejected under 35 U.S.C. § 101.

Claims 1-20 stand rejected on the ground of obviousness-type double patenting, as being allegedly unpatentable over claims 1, 3, 4, and 6-20 of U.S. Patent App. No. 13/983,001, now U.S. Patent No. 9,313,128 B2.

Applicant respectfully traverses these rejections in the following discussion.

I. THE DOUBLE PATENTING REJECTION

Claims 1-20 stand rejected on the ground of obviousness-type double patenting, as being allegedly unpatentable over claims 1, 3, 4, and 6-20 of U.S. Patent App. No. 13/983,001, now U.S. Patent No. 9,313,128 B2.

While Applicant completely disagrees with the Examiner's double-patenting rejection, to speed prosecution, Applicant herewith files a Terminal Disclaimer to alleviate the Examiner's concerns.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

II. THE 35 USC §101 REJECTION

Claims 1-20 stand rejected under 35 U.S.C. §101 based on Alice Corp. Pty. v. CLS Bank Int'l (hereinafter Alice).

However, Applicant note that, in the Personal Interview of August 9, 2016, the Examiner agreed that Applicant's arguments were persuasive, and would overcome the rejection under 35 U.S.C. § 101.

Further, Applicant submits that the Examiner has unreasonably rejected the claimed invention as directed to a judicial exception without "significantly more".

That is, the Examiner has erred in Step 2A and Step 2B of the USPTO interim guidelines.

The claimed invention recites a series of devices and steps for communication and for

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processing an identified packet. Thus, the claimed invention is a device (which is a machine), a method (which is a process), and a non-transitory programmable storage medium (which is a manufacture), each of which is one of the statutory categories of invention (Step 1: YES).

The claim is then analyzed to determine whether the claim is directed to any judicial exception. Applicant refers the Examiner to Example 1 of the “2014 Interim Eligibility Guidance Quick Reference Sheet” found at the following URL:

http://www.uspto.gov/patents/law/exam/abstract_idea_examples.pdf

Similar to the example related to software technology for detecting viruses, the claimed invention is related to a technology for communication and for processing an identified packet.

As a result, a corresponding relation between two flows before and after the passage can be grasped, and the tracing of the flow in end-to-end becomes possible.

Such action does not describe an abstract concept or is not solely based on a mathematical relationship and a transition model, or a concept similar to those found by the courts to be abstract, such as a fundamental economic practice, a method of organizing human activity, an idea itself (standing alone), or a mathematical relationship.

In contrast, the invention claimed here is directed towards a concept inextricably tied to computer technology and distinct from the types of concepts found by the courts to be abstract.

That is, and as similarly held in Enfish, the claimed invention is clearly an improvement in a computer-related technology that is appropriately claimed such that the claimed invention is undoubtedly not abstract, let alone direct to a mathematical relationship or a transition model.

That is to say, Enfish held that software can make non-abstract improvements to computer technology just as hardware can, and the court noted that claims directed to software, as opposed to hardware, also are not inherently abstract.

Accordingly, the claimed steps do not recite an abstract idea, let alone directed to the mathematical relationship and transition model. Nor do they implicate any other judicial exception. As similarly held in the USPTO example for virus software, the claim is not directed to any judicial exception (Step 2A: NO). The claim is eligible.

That is, the Examiner merely made a conclusory statement on page 3 of the Office

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Action without fully examining the claimed invention as above and as required by the USPTO guidelines. Clearly, when a full analysis according to the USTPO guidelines is performed (as above), the claimed invention is not directed to any judicial exception.

Assuming *arguendo* that the claims are directed to a judicial exception, the claims recite “significantly more” than the alleged abstract idea (or a quasi-area between a law of nature and an abstract idea).

Indeed, Justice Thomas stated in the Alice opinion that:

Accordingly, in applying the § 101 exception, we must **distinguish between** patents that claim the “ ‘**buildin[g] block[s]**’ ” of human ingenuity and **those that integrate the building blocks into something more**, *Mayo*, 566 U.S., at —, 132 S.Ct., at 1303, thereby “**transform[ing] them into a patent-eligible invention**, *id.*, at —, 132 S.Ct., at 1294. The former “would risk disproportionately tying up the use of the underlying” ideas, *2355 *id.*, at —, 132 S.Ct., at 1294, and are therefore ineligible for patent protection. **The latter pose no comparable risk of pre-emption**, and therefore **remain eligible** for the monopoly granted under our patent laws (emphasis Applicant’s). *Alice Corp. Pty. v. CLS Bank Int’l*, 134 S. Ct. 2347, 2354-55, 189 L. Ed. 2d 296 (2014).

In the Application at hand, the claimed invention is not directed towards merely an “abstract idea” and in essence the “building blocks” as Justice Thomas states such that it would “pre-empt” each and every invention that searches a database.

That is, it cannot reasonably be concluded that even originally-filed claim 1 somehow totally pre-empts, as would be required under the objective evaluation defined in *Alice*.

Therefore, claim 1 clearly does not totally pre-empt the abstract idea of, since the claimed invention uses this abstract concept as only one step in its method.

Turning to the Step 2B analysis, the claimed invention recites “significantly more” than “*organizing, storing, encapsulating and transmitting of packets*”.

The claimed invention recites the additional limitations such that “*receive the rules and the actions from a control apparatus;*

identify, based on the rules, a received packet;

duplicate a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;

encapsulate the identified packet by the additional header; and

process, based on the actions, the identified packet.”

That is, when viewing these computer limitations as an **ordered combination** along

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with the remaining limitations, the claims clearly amount to “significantly more” than the abstract idea of “organizing, storing, encapsulating and transmitting of packets”.

Even further, the claimed invention improves the functioning of the computer itself which qualifies as “significantly more” under the USPTO guidelines.

Even if the Examiner maintains that the claimed invention is directed to an abstract idea, and pre-empts arguendo the entirety of the abstract idea, the claimed invention is so tied to a computer that it improves the function of the computer itself (e.g., See Enfish).

Therefore, the claimed invention is directed to patent-eligible subject matter.

Further, Applicant submits that the Examiner has improperly relied on Alice Corp. Pty. v. CLS Bank Int'l, 134 S. Ct. 2347, 189 L. Ed. 2d 296 (2014) in forming his rejection of the claimed invention in Step 2 of the U.S.P.T.O. guidelines. The Examiner’s rejection contradicts Justice Thomas’s opinion in the aforementioned case. More specifically, Justice Thomas states:

“We have described the concern that drives this exclusionary principle as one of pre-emption. See, e.g., *Bilski, supra*, at 611–612, 130 S.Ct. 3218 (upholding the patent “would pre-empt use of this approach in all fields, and would effectively grant a monopoly over an abstract idea”). Laws of nature, natural phenomena, and abstract ideas are “ ‘the basic tools of scientific and technological work.’ ” *Myriad, supra*, at —, 133 S.Ct., at 2116. “[M]onopolization of those tools through the grant of a patent might tend to impede innovation more than it would tend to promote it,” thereby thwarting the primary object of the patent laws. *Mayo, supra*, at —, 132 S.Ct., at 1923; see U.S. Const., Art. I, § 8, cl. 8 (Congress “shall have Power ... To promote the Progress of Science and useful Arts”). We have “repeatedly emphasized this ... concern that patent law not inhibit further discovery by improperly tying up the future use of” these building blocks of human ingenuity. *Mayo, supra*, at —, 132 S.Ct., at 1301 (citing *Morse, supra*, at 113)” (emphasis Applicant’s). *Alice Corp. Pty. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354, 189 L. Ed. 2d 296 (2014).

In other words, Justice Thomas held that an abstract idea that would pre-empt all other inventions in the field and grant a monopoly should be held as ineligible. On the contrary, this is not the case with the claimed invention.

Applicant directs the Examiner to the recently decided Court of Appeals for the Federal Circuit decision in Bascom Global Internet Services Inc., v. AT&T Mobility, AT&T Corp (hereinafter ‘Bascom’) decided on June 27, 2016, which provides further guidance to

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the U.S.P.T.O. (and Examiner's) on what provides significantly more in Step 2 and the issue of pre-emption as discussed in Alice by Justice Thomas.

Judge Chen in the majority opinion of Bascom held that:

“The inventive concept inquiry (e.g., if claims provide significantly more than the alleged abstract idea) requires more than recognizing that each claim element, by itself, was known in the art. As is the case here, an inventive concept can be found in the non-conventional and non-generic arrangement of known, conventional pieces.”

Judge Chen reasoned that the claims of Bascom were patent-eligible because:

“the claims do not merely recite the abstract idea of filtering content along with the requirement to perform it on the Internet, or to perform it on a set of generic computer components. Such claims would not contain an inventive concept. See *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1370 (Fed. Cir. 2011) (reasoning that the use of the Internet to verify a credit card transaction does not meaningfully add to the abstract idea of verifying the transaction). **Nor do the claims preempt all ways of filtering content on the Internet; rather, they recite a specific, discrete implementation of the abstract idea of filtering content.** Filtering content on the Internet was already a known concept, and the patent describes how its particular arrangement of elements is a technical improvement over prior art ways of filtering such content. As explained earlier, prior art filters were either susceptible to hacking and dependent on local hardware and software, or confined to an inflexible one-size-fits-all scheme. BASCOM asserts that the inventors recognized there could be a filter implementation versatile enough that it could be adapted to many different users' preferences while also installed remotely in a single location. Thus, construed in favor of the nonmovant—BASCOM—the claims are “more than a drafting effort designed to monopolize the [abstract idea].” *Alice*, 134 S. Ct. at 2357. **Instead, the claims may be read to “im-prove[] an existing technological process.”** *Id.* at 2358 (discussing the claims in *Diehr*, 450 U.S. 175).

That is, Judge Chen clearly set forth a three-prong test to determine that an inventive concept can be found in the non-conventional and non-generic arrangement of known, conventional pieces such that the claims provide significantly more than the alleged abstract idea if:

(1) the claims do not merely recite the abstract idea along with the requirement to perform it on a set of generic computer components;

Serial No.: 15/072,558
KUD.486 CONT

(2) recite a specific, discrete implementation of the abstract idea such that there is no pre-emption of the abstract idea itself; and

(3) the claims improve an existing technology.

The claimed invention at hand passes each of the three-prongs of Judge Chen's test under the U.S.P.T.O. 35 U.S.C. §101 guidelines under Alice such that the claimed invention is patent-eligible as being significantly more than the alleged abstract idea.

More specifically, the claimed invention does not merely recite the alleged abstract idea of "comparing new and stored information and using rules to identify options" with the requirement to perform it on a set of generic computer components (e.g., the first prong).

Although the invention in the Bascom patent is engineered in the context of filtering content, the invention is not claiming the idea of filtering content simply applied to (generic computer components). The Bascom patent is instead claiming a technology-based solution (not an abstract-idea-based solution implemented with generic technical components in a conventional way) to filter content on the Internet that overcomes existing problems with other Internet filtering systems.

Similarly, the claimed invention is clearly not claiming the idea of comparing new and stored information and using rules to identify options by using the steps of detecting an anomaly and notifying when the anomaly is detected simply being applied to generic computer components.

Instead, and similar to the Bascom patent and rationale of Judge Chen, the claimed invention claims a technology-based solution (not an abstract-idea-based solution implemented with generic technical components in a conventional way) to "*receive the rules and the actions from a control apparatus;*

identify, based on the rules, a received packet;

duplicate a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation;

encapsulate the identified packet by the additional header; and

process, based on the actions, the identified packet" that overcomes existing problems with other conventional methods, as described on pages 1-5 of the specification).

That is, an exemplary technology based solution to the existing problem as identified in the present invention.

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KUD.486 CONT

There are an infinite number of ways for a network system and a network flow tracing method. The claimed invention presented herein clearly does pre-empt each and every way to perform the abstract idea (e.g., passes the second-prong).

Further, as stated above, the claims further improve the existing technology.

That is, “[I]nventions with specific applications or improvements to technologies in the marketplace are not likely to be so abstract that they override the statutory language and framework of the Patent Act”. See Research Corp. Techs. v. Microsoft Corp., 627 F.3d 859, 869 (Fed. Cir. 2010) cited by Judge Chen in the Bascom decision.

Therefore, the inventive concept can be found in the non-conventional and non-generic arrangement of the claimed elements such that the claims provide significantly more than the alleged abstract idea because the claims do not merely recite the abstract idea along with the requirement to perform it on a set of generic computer components, because the claims recite a specific, discrete implementation of the abstract idea such that there is no pre-emption of the abstract idea itself, and because the claims improve an existing technology, Applicant submits for similar reasons as the recently held Bascom decision that the claimed invention is patent-eligible under 35 U.S.C. §101.

In other words, the inventors have invented a technical solution to a technical problem in an existing technology such that there is no risk of pre-emption because the old technology which the invention improves can clearly perform a similar concept of “comparing new and stored information and use rules to identify options” in a similar but deficient way that caused the Inventor’s to consider the new and non-obvious technical solution recited in the claimed invention.

Therefore, Applicant respectfully requests the Examiner to reconsider and withdraw this rejection.

III. FORMAL MATTERS AND CONCLUSION

In view of the foregoing, Applicant submits that claims 1-20, all the claims presently under examination, are patentably distinct over the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance,

Serial No.: 15/072,558
KUD.486 CONT

the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary in a telephonic or personal interview.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0481.

Respectfully Submitted,



Farhad Shir, Ph.D.
Registration No. 59,403

Sean M. McGinn, Esq.
Registration No. 34,386

Date: 8/11/16

**MCGINN INTELLECTUAL PROPERTY
LAW GROUP, PLLC**
8321 Old Courthouse Road, Suite 200
Vienna, Virginia 22182-3817
(703) 761-4100
Customer No. 21254

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional)
Application Number 15/072,558	Filed March 17, 2016	
For NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		
Art Unit 2463	Examiner Gbemileke J. Onamuti	

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☒ One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ <u>200.00</u>
☐ Two months (37 CFR 1.17(a)(2))	\$600	\$300	\$150	\$ _____
☐ Three months (37 CFR 1.17(a)(3))	\$1,400	\$700	\$350	\$ _____
☐ Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$ _____
☐ Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$ _____

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to
Deposit Account Number 50-0481.

☐ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☒ attorney or agent of record. Registration number 59,403

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____



Signature

Farhad Shir

Typed or printed name

8/11/16

Date

(703) 761-4100

Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING
REJECTION OVER A "PRIOR" PATENT**Docket Number (Optional)
11USFP2759-C1-SU

In re Application of: Masaharu MORIMOTO

Application No.: 15/072,558

Filed: March 17, 2016

For: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

The applicant, NEC Corporation, owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent** No. 9,313,128 B2 as the term of said **prior patent** is presently shortened by any terminal disclaimer. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for any during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 59,403



Signature

8/11/16

Date

Farhad Shir

Typed or printed name

Practitioner of record

Title

703-761-4100

Telephone Number

- ☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Patent Application Fee Transmittal				
Application Number:		15072558		
Filing Date:		17-Mar-2016		
Title of Invention:		NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD		
First Named Inventor/Applicant Name:		MASAHARU MORIMOTO		
Filer:		Farhad Shir		
Attorney Docket Number:		11USFP2759-C1		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Statutory or Terminal Disclaimer	1814	1	160	160

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				160

Electronic Acknowledgement Receipt

EFS ID:	26621282
Application Number:	15072558
International Application Number:	
Confirmation Number:	7407
Title of Invention:	NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD
First Named Inventor/Applicant Name:	MASAHARU MORIMOTO
Customer Number:	21254
Filer:	Farhad Shir
Filer Authorized By:	
Attorney Docket Number:	11USFP2759-C1
Receipt Date:	11-AUG-2016
Filing Date:	17-MAR-2016
Time Stamp:	19:04:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 160
RAM confirmation Number	5399
Deposit Account	500481
Authorized User	SHIR, FARHAD

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 CFR 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 CFR 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 CFR 1.19 (Document supply fees)

Charge any Additional Fees required under 37 CFR 1.20 (Post Issuance fees)

Charge any Additional Fees required under 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	201608111854.pdf	1167583	no	13
			475836d0caf5952afb1e5d3874103e575db7df0e		
Warnings:					
Information:					
2	Extension of Time	201608111854-1.pdf	143815	no	1
			0b19f6bc0517a03fa94ba8333303ab08b9a1377b		
Warnings:					
Information:					
3	Terminal Disclaimer Filed	201608111855.pdf	132683	no	1
			4b66f328f460c741c21be8b816e9f3ceea8b984c		
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	30373	no	2
			62e6e1ee151d7fa7b6ea06b2edc32c6ebe4e710f		
Warnings:					
Information:					
Total Files Size (in bytes):			1474454		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/072,558	Filing Date 03/17/2016	☐ To be Mailed
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ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

(Column 1)

(Column 2)

FOR	NUMBER FILED	NUMBER EXTRA	RATE (\$)	FEE (\$)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X \$ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X \$ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	

APPLICATION AS AMENDED – PART II

(Column 1)

(Column 2)

(Column 3)

AMENDMENT	08/11/2016	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X \$80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 0	X \$420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
TOTAL ADD'L FEE						0	

(Column 1)

(Column 2)

(Column 3)

AMENDMENT	CLAIMS REMAINING AFTER AMENDMENT	MINUS	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X \$ =
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$ =
	☐ Application Size Fee (37 CFR 1.16(s))					
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					
TOTAL ADD'L FEE						

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
VANESSA HODGES

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Application Number 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASAHARU
Document Code - DISQ		Internal Document – DO NOT MAIL

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed: 08/11/2016	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:	
9,313,128	/RENEE M PRESTON/ Paralegal Specialist.Art Unit OCRU

U.S. Patent and Trademark Office



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NOTICE OF ALLOWANCE AND FEE(S) DUE

21254 7590 09/19/2016
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER

ONAMUTI, GBEMILEKE J

ART UNIT

PAPER NUMBER

2463

DATE MAILED: 09/19/2016

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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15/072,558

03/17/2016

MASAHARU MORIMOTO

11USFP2759-C1

7407

TITLE OF INVENTION: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	12/19/2016

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

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II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax **(571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

21254 7590 09/19/2016
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1	7407

TITLE OF INVENTION: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	12/19/2016

EXAMINER	ART UNIT	CLASS-SUBCLASS
ONAMUTI, GBEMILEKE J	2463	370-392000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively, 1 _____
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1	7407

21254 7590 09/19/2016
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

EXAMINER

ONAMUTI, GBEMILEKE J

ART UNIT	PAPER NUMBER
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2463

DATE MAILED: 09/19/2016

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/072,558	Applicant(s) MORIMOTO, MASAHARU	
	Examiner GBEMILEKE J. ONAMUTI	Art Unit 2463	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to 08/11/2016.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-20. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some *c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892) 2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____ 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.	5. ☐ Examiner's Amendment/Comment 6. ☒ Examiner's Statement of Reasons for Allowance 7. ☒ Other <u>See attached EAST Search Strategy.</u>
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/GBEMILEKE J ONAMUTI/ Examiner, Art Unit 2463	
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DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Response to Remark

2. This communication is considered fully responsive to the response filed on the 11th of August, 2016.
 - (a). The rejection of **Claims 1-20** under 35 U.S.C. 101 as not falling within one of the four statutory categories of invention and the claimed invention is directed to non-statutory subject matter is withdrawn because applicant's argument is persuasive.
 - (b). The rejection of **Claims 1-20** on the ground of nonstatutory double patenting as being unpatentable over **Claims 1, 3, 4 and 6-20** of copending application No.: 13/983,001 to Morimoto, Masaharu is withdrawn since the terminal disclaimer filed is approved.

Allowable Subject Matter

3. **Claims 1-20** are allowed. The following is an examiner's statement of reason(s) for allowance:

Claims 1-20 are allowable over prior art(s) on record since the prior art taken individual or in combination fails to particularly disclose or render obvious the claimed invention of the present application.

Regarding Independent Claims 1, 7 and 13, the closest prior art on record, i.e., Publication No.: US 2009/0138610 A1 to Gobara et al. does not disclose ‘.....duplicate a part of a header of the identified packet as an additional header when the identified packet comprises a target of encapsulation; encapsulate the identified packet by the additional header; and process, based on the actions, the identified packet’

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GBEMILEKE J. ONAMUTI whose telephone number is (571)270-5619. The examiner can normally be reached on Monday-Friday, 8:30 AM - 5:00 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, MARK RINEHART can be reached on (571)272-3632. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2463

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/GBEMILEKE J ONAMUTI/
Examiner, Art Unit 2463

Notice of References Cited	Application/Control No. 15/072,558		Applicant(s)/Patent Under Reexamination MORIMOTO, MASAHARU	
	Examiner GBEMILEKE J. ONAMUTI		Art Unit 2463	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-2009/0138610 A1	05-2009	Gobara; Kunio	H04L12/4604	709/228
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	1	H04L45/745.CPC. and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 11:26
L4	6590	H04L12/413.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 11:30
L5	137	(duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 11:30
L6	1	4 and 5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 11:31
L7	23	("20040246991" "20060227807" "20120014386" "6907036" "8705527").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 12:05
L10	35573	(duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 12:07
L11	1	7 and 10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 12:08

L12	5484	(addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 12:08
L13	3	7 and 12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 12:09
S17	17	((MASAHARU) near2 (MORI MOTO)).INV.	US-PGPUB; USPAT	ADJ	ON	2016/09/06 04:22
S18	22	((MASAHARU) near2 (MORI MOTO)).INV.	EPO; JPO; DERWENT	ADJ	ON	2016/09/06 04:22
S19	1747930	H04L\$.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 04:24
S20	14	S17 and S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 04:25
S21	113	encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 05:05
S22	7	encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) with part with (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 05:20
S27	28	H04L12/4633.CPCI. and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 06:50
S28	1	H04L45/745.CPCI. and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	ADJ	ON	2016/09/06 07:02

		equivalent or replicat\$3 or double) near3 (header or preamble)	IBM_TDB			
S30	28	H04L12/4633.CPC. and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) near3 (header or preamble)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 07:03
S31	2	(receiv\$3 or recept\$3) near3 (rule or policy or policies) with (packet or frame or data) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3) near3 (header or preamble) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) and encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 07:45
S32	3484	H04L43/026.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 07:48
S33	1	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 07:48
S35	137	(duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:36
S36	122	(duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3 and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:38
S37	1	H04L49/3009.CPCI. and (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3 and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:56

		(preamble or header)				
S38	1	H04L49/3009.CPC. and (duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3 and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:56
S39	20634	H04L69/22.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:57
S40	16	S35 and S39	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2016/09/06 09:57

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	5	encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3 or double) near3 (header or preamble).clm.	US-PGPUB; USPAT	ADJ	ON	2016/09/06 11:28
S23	17	((MASAHARU) near2 (MORIMOTO)).INV.	US-PGPUB; USPAT	ADJ	ON	2016/09/06 04:35
S24	576383	H04L\$.CPC.	US-PGPUB; USPAT	ADJ	ON	2016/09/06 04:36
S25	14	S23 and S24	US-PGPUB; USPAT	ADJ	ON	2016/09/06 04:36
S34	1	(receiv\$3 or recept\$3) near3 (rule or policy or policies) with (packet or frame or data) same (duplicat\$3 or correspond\$3 or "same" or equivalent or replicat\$3) near3 (header or preamble) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header) and encapsulat\$3.clm.	US-PGPUB; USPAT	ADJ	ON	2016/09/06 07:47
S41	13	(duplicat\$3 or correspond\$3 or "same" or equivalent) near3 (header or preamble) same (packet or data or frame) same (addition\$3 or extra or add\$3 or	US-PGPUB; USPAT	ADJ	ON	2016/09/06 09:53

		supplement\$3 or new or padd\$3) near2 (preamble or header) same encapsulat\$3 and encapsulat\$3 near3 (packet or frame or data) same (addition\$3 or extra or add\$3 or supplement\$3 or new or padd\$3) near2 (preamble or header).clm.				
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 P.O. Box 1450
 Alexandria, Virginia 22313-1450
 www.uspto.gov

BIB DATA SHEET

CONFIRMATION NO. 7407

SERIAL NUMBER 15/072,558	FILING or 371(c) DATE 03/17/2016 RULE	CLASS 370	GROUP ART UNIT 2463	ATTORNEY DOCKET NO. 11USFP2759-C1	
APPLICANTS NEC Corporation, Tokyo, JAPAN; INVENTORS MASAHARU MORIMOTO, Tokyo, JAPAN; ** CONTINUING DATA ***** This application is a CON of 13/983,001 07/31/2013 PAT 9313128 which is a 371 of PCT/JP2011/078439 12/08/2011 ** FOREIGN APPLICATIONS ***** JAPAN 2011-031752 02/17/2011 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 03/30/2016					
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and /GBEMILEKE J ONAMUTI/ Acknowledged Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY JAPAN	SHEETS DRAWINGS 4	TOTAL CLAIMS 20	INDEPENDENT CLAIMS 4
ADDRESS MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC 8321 OLD COURTHOUSE ROAD SUITE 200 VIENNA, VA 22182-3817 UNITED STATES					
TITLE NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD					
FILING FEE RECEIVED 2020	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:		☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

Information Disclosure Citation	Docket Number 11USFP2759-C1-SU (KUD.486CONT)	Application Number 15/072,558
	Inventor: Masaharu Morimoto	
	Filing Date March 17, 2016	Group Art Unit 2463

U. S. Patent Documents

Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	

U. S. Patent Application Publications

Examiner Initial	Ref	Document Number	Date	Name	Class	Subclass	Filing Date (If Appropriate)	
/G.O./		2005/0208947 A1	09-22-05	Bahl				
/G.O./		2010/0161795 A1	06-24-10	Deridder, et al.				

Foreign Patent Documents

Examiner Initial	Ref	Document Number	Date	Country	Class	Subclass	Translation	
							Yes	No

Other Documents (Including Author, Title, Date, Pertinent Pages, etc.)

		Extended European Search Report dated May 4, 2016.
/G.O./		Wang, et al. "Tracking Anonymous Peer-to-Peer VoIP Calls on the Internet", Proceedings of the 12 th ACM Conference on Computer and Communications Security, 7 Nov. 2005, p. 81-91, XP001241622.
/G.O./		Lee, et al. "ICMP Traceback with Cumulative Path, An Efficient Solution for IP Traceback", In: "Correct System Design", 1 Jan. 2003, Springer International Publishing, Cham 032548, XP055268616, vol. 2836, p. 124-135.

Examiner /Gbemileke Onamuti/	Date Considered 09/05/2016
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Examiner: Initial if citation considered, whether citation is in conformance with MPEP Section 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Search Notes 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463

CPC- SEARCHED		
Symbol	Date	Examiner
H04L 12/4633	04/04/2016	GJO
H04L 49/3009	04/04/2016	GJO
H04L 12/413	04/04/2016	GJO
H04L 45/745	04/04/2016	GJO
H04L 12/4633	09/06/2016	GJO
H04L 45/745	09/06/2016	GJO
H04L 43/026	09/06/2016	GJO
H04L 49/3009	09/06/2016	GJO
H04L 69/22	09/06/2016	GJO
H04L 12/413	09/06/2016	GJO

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES		
Search Notes	Date	Examiner
PLUS Search	04/04/2016	GJO
Inventive Name Search	04/04/2016	GJO
EAST Search Strategy	04/04/2016	GJO
Text searching with class H04L	04/04/2016	GJO
Updated Inventive Name Search	09/06/2016	GJO
Updated EAST Search Strategy	09/06/2016	GJO
Text Searching with class H04L	09/06/2016	GJO
Search classes H04L 12/4633, H04L 45/745, H04L 43/026, H04L 49/3009, H04L 69/22 and H04L 12/413	09/06/2016	GJO

/GBEMILEKE J ONAMUTI/ Examiner.Art Unit 2463	
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INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
H04L	12/4633	09/06/2016	GJO
H04L	45/745	09/06/2016	GJO
H04L	43/026	09/06/2016	GJO
H04L	49/3009	09/06/2016	GJO
H04L	69/22	09/06/2016	GJO
H04L	12/413	09/06/2016	GJO

/GBEMILEKE J ONAMUTI/
Examiner.Art Unit 2463

Issue Classification 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU	
	Examiner GBEMILEKE J ONAMUTI	Art Unit 2463	

CPC						
Symbol					Type	Version
H04L		69	/	22	F	2013-01-01
H04L		12	/	4633	I	2013-01-01
H04L		45	/	745	I	2013-01-01
H04L		12	/	413	I	2013-01-01
H04L		49	/	3009	I	2013-01-01
H04L		43	/	026	I	2013-01-01
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CPC Combination Sets				
Symbol	Type	Set	Ranking	Version

		Total Claims Allowed:	
		20	
(Assistant Examiner) /GBEMILEKE J ONAMUTI/ Examiner.Art Unit 2463	(Date) 09/06/2016	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU
	Examiner GBEMILEKE J ONAMUTI	Art Unit 2463

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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	2		18												
	3		19												
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(Assistant Examiner) (Date)		Total Claims Allowed: 20	
/GBEMILEKE J ONAMUTI/ Examiner.Art Unit 2463 (Primary Examiner)		09/06/2016 (Date)	O.G. Print Claim(s) 1 O.G. Print Figure 4

<i>Index of Claims</i> 	Application/Control No. 15072558	Applicant(s)/Patent Under Reexamination MORIMOTO, MASA HARU
	Examiner GBEMILEKE ONAMUTI	Art Unit 2463

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☒ Claims renumbered in the same order as presented by applicant				☐ CPA				☒ T.D.				☐ R.1.47			
CLAIM		DATE													
Final	Original	04/04/2016	09/06/2016												
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	19	✓	=												
	20	✓	=												

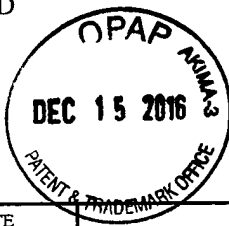
PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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21254 7590 09/19/2016
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
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VIENNA, VA 22182-3817



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Hand Delivered	(Depositor's name)
	(Signature)
	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	03/17/2016	MASAHARU MORIMOTO	11USFP2759-C1	7407

TITLE OF INVENTION: NETWORK SYSTEM AND NETWORK FLOW TRACING METHOD

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$15	\$0	\$975	12/19/2016

12/16/2016 SMOHAMM1 00000154 15072558

EXAMINER	ART UNIT	CLASS-SUBCLASS
ONAMUTI, GBEMILEKE J	2463	370-392000

01 FC:1501 960.00 OP
02 FC:8001 15.00 OP

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
- (1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
- (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
- 1 McGinn IP Law Group, PLLC
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

NEC CORPORATION

TOKYO, JAPAN

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
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5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature

Farhad Shir

Date

12/15/16

Typed or printed name

Farhad Shir

Registration No.

59,403

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- 3 _____

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(B) RESIDENCE: (CITY and STATE OR COUNTRY)
 TOKYO, JAPAN

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

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Authorized Signature Farhad Shir

Typed or printed name Farhad Shir

Date 12/15/16

Registration No. 59,403



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/072,558	01/31/2017	9560177	11USFP2759-C1	7407

21254 7590 01/11/2017
MCGINN INTELLECTUAL PROPERTY LAW GROUP, PLLC
8321 OLD COURTHOUSE ROAD
SUITE 200
VIENNA, VA 22182-3817

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

MASAHARU MORIMOTO, Tokyo, JAPAN;
NEC Corporation, Tokyo, JAPAN;

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