
POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint the practitioners associated with the

Customer Number 26530

(Ladas & Parry LLP - Chicago Office)

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(c).

Please recognize or change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

The address associated with **Customer Number 26530**

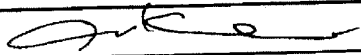
Assignee Name and Address:

Electronics & Telecommunications Research Institute, located at 161 Gajeong-dong, Yuseong-gu, Daejeon, 305-700, Republic of Korea

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of the practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date September 17, 2012
Name	KIM, Gilwon	Telephone 042-860-4908
Title	Director	

/from PTO/ALIA/80 (07-12)

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.

STATEMENT UNDER 37 CFR 3.73(c)Applicant/Patent Owner: ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

Application No./Patent No.: _____ Filed/Issue Date: _____

Titled: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATIONELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE, a _____

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose one of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is _____. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose one of options A or B below):

- A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
- B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☐ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Loren K. Thompson/

Signature

Loren K. Thompson

Printed or Typed Name

December 26, 2014

Date

45918

Title or Registration Number

[Page 2 of 2]

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.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
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.			

Secrecy Order 37 CFR 5.2

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
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Inventor Information:

Inventor 1 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Sung Hyuk		BYUN	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Daejeon	Country of Residence i	KR	
Mailing Address of Inventor:				
Address 1	603-1504 Banseok 6 Danji Apt., 98, Banseokseo-ro,			
Address 2	Yuseong-gu			
City	Daejeon	State/Province		
Postal Code		Country i	KR	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).	
☐ An Address is being provided for the correspondence Information of this application.	
Customer Number	26530
Email Address	Add Email Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
Attorney Docket Number	CU-71729 AVL	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

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

Publication Information:

☐ 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.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	26530		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove			
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
10-2013-0165299	KR	2013-10-27	
Remove			
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
10-2014-0136067	KR	2014-10-08	
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			Add

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			Remove
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.			
Clear			
☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor :			
If the Applicant is an Organization check here. ☒			
Organization Name	ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE		
Mailing Address Information:			
Address 1	218 Gajeong-ro, Yuseong-gu		
Address 2			
City	Daejeon	State/Province	
Country ⁱ	KR	Postal Code	305-700
Phone Number		Fax Number	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
				Remove
If the Assignee or Non-Applicant Assignee is an Organization check here.				☐
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				Add

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Loren K. Thompson/		Date (YYYY-MM-DD)	2014-12-26	
First Name	Loren K.	Last Name	Thompson	Registration Number	45918
Additional Signature may be generated within this form by selecting the Add button.				Add	

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

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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).
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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.
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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.

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION			
First Named Inventor/Applicant Name:	Sung Hyuk BYUN			
Filer:	Loren Keith Thompson/Ciara Serrato			
Attorney Docket Number:	CU-71729 ALV			
Filed as Small Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	70	70
Utility Search Fee	2111	1	300	300
Utility Examination Fee	2311	1	360	360
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				730

Electronic Acknowledgement Receipt

EFS ID:	21066845
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Loren Keith Thompson/Ciara Serrato
Filer Authorized By:	Loren Keith Thompson
Attorney Docket Number:	CU-71729 ALV
Receipt Date:	26-DEC-2014
Filing Date:	
Time Stamp:	12:37:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 730
RAM confirmation Number	11909
Deposit Account	120400
Authorized User	

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 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 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		CU71729_Application.pdf	1183880	yes	22
			12197942c0fab697d8352d49bc71102647730f78		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	15	
	Claims		16	21	
	Abstract		22	22	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	CU71729_Drawings.pdf	139317	no	4
			440f1f5f7c099b086525fd6ad138edcb335cb92b		
Warnings:					
Information:					
3	Oath or Declaration filed	CU71729_Declaration.pdf	167792	no	2
			3677d3728d7ee6ecb0d96cc92449ac9f9b3bf35c		
Warnings:					
Information:					
4	Power of Attorney	CU71729_Power.pdf	314452	no	4
			6798ef28947f02a13d2fbc033bc265c2430c191e		
Warnings:					
Information:					
5	Application Data Sheet	Application_Data_Sheet_aia0014.pdf	1561034	no	7
			c4bd6899c35afe5e04544b88c4f884da5eaa637		
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	35306	no	2
			c2ddd44d7eb257568267cb9a03e4150c4a7eaa0		

Warnings:	
Information:	
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METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority to Korean patent application numbers
5 10-2013-0165299, filed on December 27, 2013 and 10-2014-0136067, filed on
October 8, 2014, the entire disclosure of which is incorporated herein in its entirety by
reference.

BACKGROUND

Field of Invention

10 **[0002]** Various embodiments of the present invention relate to a network, and more
particularly, to a method and apparatus for multi-domain network virtualization.

Description of Related Art

[0003] Recent trends of IT (information technology) include server virtualization, VM
(virtual machine)-based computing, concentration of IT resources on data center, and
15 network virtualization. Network virtualization is a technology where a plurality of
virtual networks may be created on a physical network when necessary and can be
deleted. This technology may be utilized to configure a network between virtual
machines. A generally used overlay-based virtual network is a L2 network that may
be realized on top of a L3 network in an overlay method. In the overlay-based
20 virtual network, tunneling may be performed that is attaching a L3 IP (internet
protocol) header to a L2 Ethernet frame being transmitted between virtual machines.

[0004] Most representative overlay-based network virtualization includes a VXLAN
(virtual extensible local area network) and NVGRE (network virtualization using
generic routing encapsulation). In a VXLAN or NVGRE, a virtual L2 network may

be created by connecting a tunnel between servers. For this purpose, a full-mesh tunnel must be set between TEPs (Tunnel End Points) being realized in a server or gateway. In order to set a full-mesh tunnel between N number of TEPs, $N \times (N-1)$ number of tunnels are needed. This restricts expandability, thereby causing a
5 problem of restricting the size of the network (number of network nodes) where a VXLAN or NVGRE may be applied.

[0005] Specifically, the greater the N, the more complex the setting becomes, and due to the restriction on the number of tunnels that may be set in TEPs and the restriction on the number of tunnels that may be managed by one network virtualization manager,
10 a network virtualization domain must be restricted to a certain size. For these reasons, one network virtualization domain may generally be restricted to one IDC (Internet Data Center). There is need for a virtual network existing over a plurality of IDCs located far from one another geographically, but it is not easy to provide these requirements with conventional network virtualization methods since they lack
15 expandability.

SUMMARY

[0006] A first purpose of various embodiments of the present invention is to provide a method and apparatus capable of providing expandability in an overlay-based virtual network.

20 **[0007]** According to an embodiment of the present invention, there is provided a network virtualization apparatus including a tunnel manager configured to collect tunnel end point information within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected; a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2

switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance); the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the packet to a tunnel packet generator; and the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet.

[0008] According to another embodiment of the present invention, there is provided an operating method of a network virtualization apparatus, the method including collecting tunnel end point information within a virtual network, and connecting each tunnel end point with a tunnel based on the tunnel end point information collected; receiving a tunnel packet and processing the packet such that a L2 switching may be performed; performing the L2 switching on the processed packet; and adding a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and transmitting the new tunnel packet.

[0009] According to another embodiment of the present invention, there is provided a network virtualization method including generating at least two network virtualization domains consisting of a domain tunnel end point and at least one edge tunnel end point; and connecting domain tunnel end points of each of the network virtualization domain with L3 tunnels in full-mesh topology, wherein the domain tunnel end point and the at least one edge tunnel end point are connected based on the L3 tunnel.

[0010] As aforementioned, by using a method and apparatus for multi-domain network virtualization according to embodiments of the present invention, it is possible to provide expandability in an overlay-based virtual network configured by an L3 tunnel. According to an embodiment of the present invention, by creating a

plurality of network virtualization domains of an appropriate size that may be created in a full-mesh tunnel manner, and then having a domain tunnel end point in every domain, and then simply adding a full-mesh connection between domain tunnel end points, it is possible to create one large scale network virtualization domain where a plurality of domains are integrated. In this way, the number of tunnels necessary in a network virtualization domain may be significantly reduced, and thus a large scale network virtualization domain may be constructed.

BRIEF DESCRIPTION OF THE DRAWINGS

10 **[0011]** The above and other features and advantages of the present invention will become more apparent to those of ordinary skill in the art by describing in detail embodiments with reference to the attached drawings in which:

[0012] FIG. 1 is a conceptual view illustrating a network virtualization method according to an embodiment of the present invention;

15 **[0013]** FIGs. 2a, 2b, and 2c are conceptual views illustrating a packet according to an embodiment of the present invention;

[0014] FIG. 3 is a conceptual view illustrating a domain tunnel end point according to an embodiment of the present invention;

20 **[0015]** FIG. 4 is a flowchart illustrating a packet processing procedure in a domain tunnel end point according to an embodiment of the present invention;

[0016] FIG. 5 is a flowchart illustrating an L2 switching performed in a domain VSI according to an embodiment of the present invention; and

[0017] FIGs. 6a and 6b are conceptual views illustrating a flooding in a domain VSI according to an embodiment of the present invention.

DETAILED DESCRIPTION

[0018] Hereinafter, embodiments will be described in greater detail with reference to the accompanying drawings. Embodiments are described herein with reference to
5 cross-sectional illustrations that are schematic illustrations of embodiments (and intermediate structures). As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments should not be construed as limited to the particular shapes of regions illustrated herein but may include deviations in shapes that result, for example,
10 from manufacturing. In the drawings, lengths and sizes of layers and regions may be exaggerated for clarity. Like reference numerals in the drawings denote like elements.

[0019] Terms such as ‘first’ and ‘second’ may be used to describe various components, but they should not limit the various components. Those terms are only used for the
15 purpose of differentiating a component from other components. For example, a first component may be referred to as a second component, and a second component may be referred to as a first component and so forth without departing from the spirit and scope of the present invention. Furthermore, ‘and/or’ may include any one of or a combination of the components mentioned.

20 [0020] It is also noted that in this specification, “connected/coupled” refers to one component not only directly coupling another component but also indirectly coupling another component through an intermediate component. On the other hand, “directly connected/directly coupled” refers to one component directly coupling another component without an intermediate component.

[0021] Furthermore, a singular form may include a plural form as long as it is not specifically mentioned in a sentence. Furthermore, “include/comprise” or “including/comprising” used in the specification represents that one or more components, steps, operations, and elements exist or are added.

5 **[0022]** Furthermore, unless defined otherwise, all the terms used in this specification including technical and scientific terms have the same meanings as would be generally understood by those skilled in the related art. The terms defined in generally used dictionaries should be construed as having the same meanings as would be construed in the context of the related art, and unless clearly defined otherwise in this
10 specification, should not be construed as having idealistic or overly formal meanings.

[0023] FIG. 1 is a conceptual view illustrating a network virtualization method according to an embodiment of the present invention.

[0024] FIG. 1 illustrates a method for connecting a plurality of network virtualization domains 110, 120, 130, and 140 having appropriate sizes that may be realized in an
15 overlay L3 tunnel method so as to make one high rank network virtualization domain.

[0025] Referring to FIG. 1, the plurality of network virtualization domains 110, 120, 130, and 140 may be connected to one another. Each of the network virtualization domains 110, 120, 130, and 140 may include a plurality of edge tunnel end points 113, 123, 133, and 143, and at least one domain tunnel end point 116, 126, 136, and 146.
20 A network virtualization manager 100 may be configured to set and manage an edge tunnel end point and domain tunnel end point for each network virtualization domain. A multi-domain network virtualization may be performed based on the network virtualization manager 100 according to an embodiment of the present invention. Specifically, the network virtualization manager (or network virtualization apparatus)

may set each network virtualization domain based on a processor to perform a multi-domain network virtualization.

[0026] Edge tunnel end points 113, 123, 133, and 143 are servers having virtual machines or gateways that connect legacy networks to virtualized network. Edge
5 tunnel end points 113, 123, 133, and 143 may instruct a tunnel end point in a conventional overlay-based network virtualization method. For example, in a VXLAN, a VTEP (VXLAN Tunnel End Point) may be an edge tunnel end point 113, 123, 133, and 143. In one network virtualization domain, the edge tunnel end points 113, 123, 133, and 143 may be connected to one another with an unicast tunnel in full-
10 mesh topology.

[0027] According to an embodiment of the present invention, a domain tunnel end point 116, 126, 136, and 146 may be realized in each of the network domains 110, 120, 130, and 140 having an appropriate size, thereby virtualizing a network. Each of the domain tunnel end points 116, 126, 136, and 146 may be connected to all the edge
15 tunnel end points 113, 123, 133, and 143 by a tunnel. Furthermore, between the domain tunnel end points 116, 126, 136, and 146 of each of the network virtualization domains 110, 120, 130, and 140, an L3 tunnel may be set in full-mesh topology.

[0028] Each tunnel has a same structure, and in a tunneled packet structure, there may exist a packet being transmitted from an edge tunnel end point to an edge tunnel end
20 point, a packet being transmitted from an edge tunnel end point to a domain tunnel end point, and a packet being transmitted from a domain tunnel end point to a domain tunnel end point. Hereinafter, FIG. 2 illustrates a packet being transmitted from each end point.

[0029] FIGs. 2a, 2b, and 2c are conceptual views illustrating a packet according to an

embodiment of the present invention.

[0030] (a) of FIG. 2 indicates a packet being transmitted from an edge tunnel end point to another edge tunnel end point, (b) of FIG. 2 indicates a packet being transmitted from an edge tunnel end point to a domain tunnel end point, and (c) of FIG. 2 indicates a packet being transmitted from a domain tunnel end point to another domain tunnel end point.

[0031] Referring to FIG. 2, all tunnel packets may include an original packet and a tunnel header. The original packet may include an L2 header caused by an L2 layer, an L3 header caused by an L3 layer, and payload for containing data being transmitted.

[0032] The tunnel header may include a VN header for containing a VNID (Virtual Network Identifier) meaning a virtual network where a packet belongs to. The tunnel header may include an L3 tunnel header in front of the VN header. The L3 tunnel header may include an L3 DA (destination address) header and an L3 SA (source address) header.

[0033] Referring to (a) of FIG. 2, in the case of a packet between edge tunnel end points, the L3 SA header may include an L3 address of an edge tunnel end point that transmits the original packet, and the L3 DA header may include an L3 address of an edge tunnel end point that receives the original packet. That is, the L3 DA header may include the L3 address of a destination edge tunnel end point connected to an actual destination host of the original packet.

[0034] Referring to (b) of FIG. 2, in the case of a packet heading from an edge tunnel end point towards a domain tunnel end point, an L3 SA header may include an L3 address of an edge tunnel end point that transmits the packet, and an L3 DA header may include an L3 address of a domain tunnel end point to which the packet is being

transmitted.

[0035] Referring to (c) of FIG. 2, in the case of a packet being transmitted between domain tunnel end points, an L3 SA header of the packet may include an L3 address of a domain tunnel end point that transmits the packet, and an L3 DA header may
5 include an L3 address of a domain tunnel end point corresponding to a destination of the packet.

[0036] There may be a case where a packet is transmitted from an edge tunnel end point included in a certain network virtualization domain to a domain tunnel end point, and the packet is then transmitted to a domain tunnel end point of another
10 virtualization network domain. In such a case, according to an embodiment of the present invention, the L3 tunnel header of the packet may be changed from (b) of FIG. 2 to (c) of FIG. 2 while going through the domain tunnel end point.

[0037] According to an embodiment of the present invention, instead of being connected with all edge tunnel end points belonging to other domains with a tunnel in
15 full-mesh topology, an edge tunnel end point may be connected with a domain tunnel end point by only one tunnel, and thus logically operate as if it is connected to all the edge tunnel end points belonging to other domains with a tunnel in full-mesh topology. That is, according to an embodiment of the present invention, each domain tunnel end point included in a virtual network domain may be configured to perform like a tunnel
20 switch which can relay the single-hop tunnel packet from each each tunnel end point to any other tunnel end points not reachable by single-hop tunnel.

[0038] FIG. 3 is a conceptual view illustrating a domain tunnel end point according to an embodiment of the present invention.

[0039] Referring to FIG. 3, a domain tunnel end point may include a tunnel manager

300, domain VSI (Domain Virtual Switching Instance) manager 310, a plurality of domain VSIs 320, 330, tunnel packet end point 340, and tunnel packet generator 350.

[0040] The tunnel manager 300 may be configured to connect a tunnel between all edge tunnel end points and a domain tunnel end point within a network domain, and
5 between another domain tunnel end point and a corresponding domain tunnel end point.. The tunnel manager 300 receive information on all the edge tunnel end points within the domain and information on another domain tunnel end point transmitted by an operator's setting or a protocol.

[0041] Furthermore, the tunnel manager 300 may connect an individual tunnel
10 between each edge tunnel end point within the domain based on the received edge tunnel end point information and domain tunnel end point information, and also connect a tunnel in full-mesh topology between another domain tunnel end point as well. Tunnels between end points may be configured in various ways. For example, one tunnel may be created between two tunnel end points, and packets belonging to all
15 VNID may be transmitted through that one tunnel. Alternatively, a plurality of tunnels may be created for each VNID between two tunnel end points, and packets may be transmitted through the plurality of tunnels.

[0042] In the case where the end point of the tunnel created is an edge tunnel end point, the tunnel manager 300 may create in each domain VSI 320, 330 an edge
20 virtual port associated with a corresponding edge tunnel end point. In the case where the end point of the tunnel created is a domain tunnel end point, the tunnel manager 300 may create in each domain VSI 320, 330 a domain virtual port associated with the corresponding domain tunnel end point. According to an embodiment of the present invention, the virtual port may be created in the domain VSI 320, 330 corresponding

to each VNID belonging to an tunnel end point, or created in all domain VSIs 320, 330 within the domain tunnel end point.,

[0043] The domain VSI manager 310 may receive a virtual network identifier transmitted from outside and create a domain VSI corresponding to the VNID received. When the network virtualization manager that manages the entire network virtualization want to create a virtual network, the network virtualization manager may transmit information on the VNID (virtual network identifier) of the virtual network should be created to corresponding domain tunnel end point. The domain VSI manager 320 according to an embodiment of the present invention receives the VNID and creates a domain VSI corresponding thereto.

[0044] The domain VSI 320, 330 may exist for each VNID. The domain VSI 320, 330 may perform a switching according to a modified L2 switching rule applied to the domain VSI 320, 330 based on an original L2 header of the received packet and transmit the packet to a destination virtual port associated with a destination tunnel end point. That is, in the case where the original destination host is in another network virtualization domain, in the domain VSI 320, 330, the packet may be output to a virtual port associated with the domain tunnel end point of the network virtualization domain where the original destination host exists based on the switching and transmit the packet to the tunnel packet generator 350. Furthermore, in the case where the destination host is in a same virtualization domain, in the domain VSI 320, 330, L2 switching may be performed and the packet may be output to a virtual port associated to the edge tunnel end point where the destination host belongs to, and the packet may be transmitted to the tunnel packet generator 350.

[0045] The tunnel packet end point 340 may obtain information on the VNID and the

L3 address of a sending tunnel end point from the tunnel header of the input packet. The tunnel packet end point 340 may transmit the packet to the domain VSI corresponding to the VNID of the packet.

[0046] The tunnel packet generator 350 may find the VNID from the domain VSI information of the received packet and include a VN header to the received packet. Specifically, the tunnel packet generator 350 may find an L3 address of the destination tunnel end point from the domain VSI output virtual port information, create a tunnel L3 header, attach the generated header and complete a new tunnel packet, and transmit the new tunnel packet to another virtual network domain.

[0047] FIG. 4 is a flowchart illustrating a packet processing procedure in a domain tunnel end point according to an embodiment of the present invention.

[0048] Referring to FIG. 4, a packet is transmitted from a tunnel packet end point to a domain VSI (S400).

[0049] The tunnel packet end point may obtain information an L3 address of a tunnel end point and information on an VNID corresponding to the packet from a tunnel header of the tunnel packet received. The tunnel packet end point may modify the packet such that an L2 switching may be performed based on the L2 header of the packet in the domain VSI. The tunnel packet end point may transmit the modified packet to the domain VSI associated with the VNID. Herein, the packet may be input to the virtual port, 1:1 mapped to the L3 source address of the tunnel packet.

[0050] The domain VSI performs an L2 switching on the packet (S410).

[0051] The domain VSI may perform a modified L2 switching based on the L2 header included in the packet. In the domain VSI, the packet processing based on the L2 switching may be performed based on the L2 source address and the L2

destination address of the packet. The method of performing the L2 switching on the packet in the domain VSI will be explained in detail hereinafter.

[0052] The domain VSI transmits the packet to a tunnel packet generator (S420).

[0053] The packet is transmitted to the tunnel packet generator to be transmitted to
5 the edge tunnel end point within the corresponding domain or to the domain tunnel end point of another virtual network domain according to the destination virtual port.

[0054] The tunnel packet generator adds a tunnel header to the packet and transmits the packet (S430).

[0055] The packet switched in the domain VSI may be added with a tunnel header in
10 the tunnel packet generator and then be transmitted outside. The VN header of the tunnel header being added to the packet may be generated based on the VNID of the domain VSI that switched the packet. Furthermore, the L3 SA header of the tunnel header generated in the tunnel packet generator may include an address of the current domain tunnel end point, and the L3 DA header of the tunnel header may include
15 another domain tunnel end point obtained from the domain VSI output virtual port information of the packet, or an address of the destination edge tunnel end point within the same domain.

[0056] FIG. 5 is a flowchart illustrating a L2 switching performed in the domain VSI according to an embodiment of the present invention.

20 **[0057]** Referring to FIG. 5, the domain VSI obtains information on the L2 SA of the packet input (S500).

[0058] The domain VSI determines whether or not the L2 DA of the packet input is a unicast address already known (S510).

[0059] In the case where the L2 DA is a unicast address already learned in the domain

VSI, the domain VSI may find a corresponding virtual port and transmit the packet to the corresponding virtual port (S520).

[0060] On the other hand, in the case where the destination L2 address is an unknown unicast address, or the destination L2 indicates a multicast or broadcast, a changed
5 flooding method may be determined according to a type of the input virtual port (S530).

[0061] In the case where the type of the input virtual port is an edge virtual port, flooding is performed on only all the domain virtual ports within the domain VSI (S540).

10 **[0062]** In the case where the type of the input virtual port is a domain virtual port, flooding is performed on only all the edge virtual ports within the domain VSI (S550).

[0063] FIGs. 6a and 6b are conceptual views illustrating flooding in a domain VSI according to an embodiment of the present invention.

[0064] Referring to FIGs. 6a and 6b, if the type of the input virtual port is an edge
15 virtual port, packet is flooded to only domain virtual ports.. On the other hand, if the type of the input virtual port is a domain virtual port, packet is flooded to only edge virtual ports. Such a modified flooding rule may be used to prevent generation of a forwarding loop by flooding.

[0065] As aforementioned, by using a method and apparatus for multi-domain
20 network virtualization according to embodiments of the present invention, it is possible to provide expandability in an overlay-based virtual network using L3 tunnel. According to an embodiment of the present invention, by creating a plurality of network virtualization domains of an appropriate size that may be created in a full-mesh tunnel manner, and then having a domain tunnel end point in every domain, and

then simply adding a full-mesh connection between domain tunnel end points, it is possible to create one large scale network virtualization domain where a plurality of domains are integrated. In this way, the number of tunnels necessary in a network virtualization domain may be significantly reduced, and thus a large scale network
5 virtualization domain may be constructed.

[0066] In the drawings and specification, there have been disclosed typical embodiments of the invention, and although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation. As for the scope of the invention, it is to be set forth in the following claims. Therefore,
10 it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

WHAT IS CLAIMED IS:

1. A network virtualization apparatus comprising:

5 a tunnel manager configured to collect tunnel end point information within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected;

a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to
10 a domain VSI (virtual switching instance);

the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the packet to a tunnel packet generator; and

the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to
15 transmit the new tunnel packet.

2. The apparatus according to claim 1,

wherein the domain VSI, when perform the L2 switching, obtains L2 SA (source address) information for the processed packet
20 determines whether or not L2 DA (destination address) information of the processed packet is a unicast address already learned, and

performs a flooding based on the type of the input virtual port, when the L2 DA information is not already learned unicast address, or is multicast or broadcast address;

wherein the flooding is performed on only domain virtual ports within the domain VSI, when the type of the input virtual port being an edge virtual port, and the flooding is performed on only edge virtual ports within the domain VSI when the type of the input virtual port being a domain virtual port.

5

3. The apparatus according to claim 2,

wherein, the domain VSI, when performing the L2 switching,

in response to the L2 DA information being a unicast address already learned, transmits the processed packet to a destination virtual port corresponding to the unicast address, and obtains an L3 address of a destination tunnel end point of the packet from the destination virtual port.

10

4. The apparatus according to claim 1,

wherein the tunnel packet end point obtains a VNID (Virtual Network ID) of the tunnel packet and L3 address information of a sending tunnel end point from a tunnel header of the tunnel packet,

15

processes the tunnel packet such that the L2 switching may be performed, and transmits the processed packet to a domain VSI corresponding to the VNID through a virtual port associated with the sending tunnel end point.

20

5. The apparatus according to claim 1,

wherein the tunnel packet generator is configured, for the packet for which the L2 switching has been performed, to generate a VN header (virtual network header) including a VNID corresponding to a domain VSI and a L3 tunnel header based on a

destination tunnel end point L3 address obtained from a destination virtual port of the packet for which the L2 switching has been performed, and to combine the VN header and the L3 tunnel header with the processed packet for which the L2 switching has been performed, and transmit the same.

5

6. The apparatus according to claim 1,

further comprising a domain VSI manager configured to receive a VNID (virtual network ID) of a virtual network from a network virtualization manager that manages network virtualization of an entire network, and to generate a domain VSI
10 (domain virtual switching instance) corresponding thereto.

7. An operating method of a network virtualization apparatus, the method comprising:

collecting tunnel end point information within a network, and connecting
15 each tunnel end point with a tunnel based on the tunnel end point information collected;

receiving a tunnel packet and processing the packet such that a L2 switching may be performed;

performing the L2 switching on the processed packet; and

20 adding a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and transmitting the new tunnel packet.

8. The method according to claim 7,

wherein the performing the L2 switching comprises:

obtaining L2 SA (source address) information for the processed packet such that the L2 switching may be performed;

determining whether or not L2 DA (destination address) information of the processed packet is a unicast address already learned; and

5 performing a flooding based on the type of the input virtual port, when the L2 DA information is not the unicast address already learned, or indicates multicast or broadcast address,,

wherein the flooding is performed on only domain virtual ports within the domain VSI when the type of the input virtual port being an edge virtual port, and the
10 flooding is performed on only edge virtual ports within the domain VSI when the type of the input virtual port being a domain virtual port.

9. The method according to claim 8,

wherein the determining whether or not the L2 DA (destination address)
15 information of the processed packet is a unicast address already learned further comprises:

in response to the L2 DA information being the unicast address already learned, transmitting the processed packet to a destination virtual port corresponding to the unicast address, and obtaining the L3 address of destination tunnel end point of
20 the packet from the destination virtual port.

10. The method according to claim 7,

wherein the receiving the tunnel packet and processing the packet such that the L2 switching may be performed comprises:

obtaining a VNID of the tunnel packet and L3 address information of a sending tunnel end point from a tunnel header of the tunnel packet;

processing the tunnel packet such that the L2 switching may be performed;
and

5 transmitting the processed packet to a domain VSI corresponding to the VNID through a virtual port associated with the sending tunnel end point.

11. The method according to claim 7,

 wherein the adding a tunnel header to the packet for which the L2 switching
10 has been performed to generate a new tunnel packet, and transmitting the new tunnel packet comprises:

 generating, for the packet for which the L2 switching has been performed, a VN header (Virtual Network Header) including a VNID corresponding to a domain VSI, and an L3 tunnel header based on a destination tunnel end point L3 address
15 obtained from a destination virtual port of the packet for which the L2 switching has been performed; and

 combining the VN header and the L3 tunnel header with the packet for which the L2 switching has been performed, and transmitting the same.

20 12. The method according to claim 7,

 prior to collecting tunnel end points information within a network, and connecting each tunnel end point with a tunnel based on the tunnel end point information collected,

 further comprising receiving a VNID (Virtual Network ID) of the virtual

network from a network virtualization manager that manages network virtualization of an entire network and generating a domain VSI (Domain Virtual Switching Instance) corresponding thereto.

5 13. A network virtualization method comprising:

generating at least two network virtualization domains consisting of a domain tunnel end point and at least one edge tunnel end point; and

connecting domain tunnel end points of each of the network virtualization domain with L3 tunnels in full-mesh topology,

10 wherein the domain tunnel end point and the at least one edge tunnel end point are connected based on the L3 tunnel.

14. The method according to claim 13,

15 wherein the domain tunnel end point performs removing a tunnel header of a packet received from the edge tunnel end point and other domain tunnel end points;

performing an L2 header-based L2 switching of an original packet in a virtual switch generated for each virtual network where the packet belongs to; and

20 finding a tunnel which belongs to the routing path toward a tunnel end point where a destination host belongs to, and tunneling the original packet again and transmitting the tunneled original packet.

ABSTRACT

Provided herein a network virtualization apparatus and method, the apparatus including a tunnel manager configured to collect tunnel end points information within
5 a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected; a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance); the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the
10 packet to a tunnel packet generator; and the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet.

FIG. 1

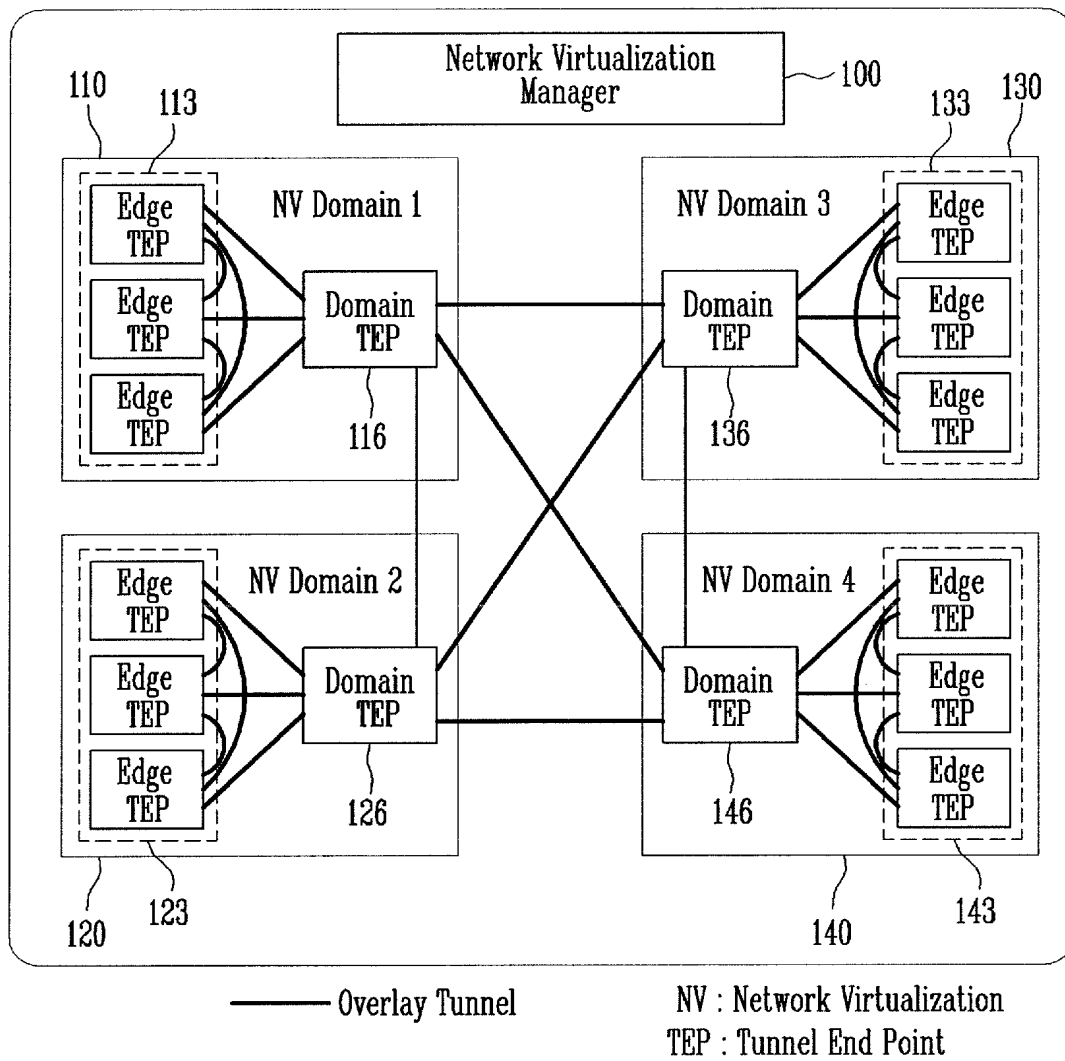


FIG. 2A

a) Edge TEP(E-TEP)-to-Edge TEP packet format

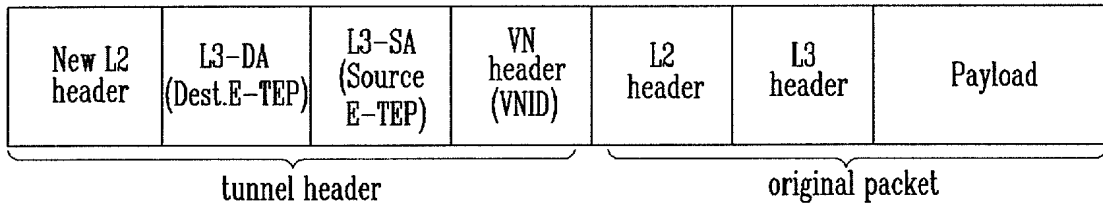


FIG. 2B

b) Edge TEP-to-Domain TEP(D-TEP) packet format

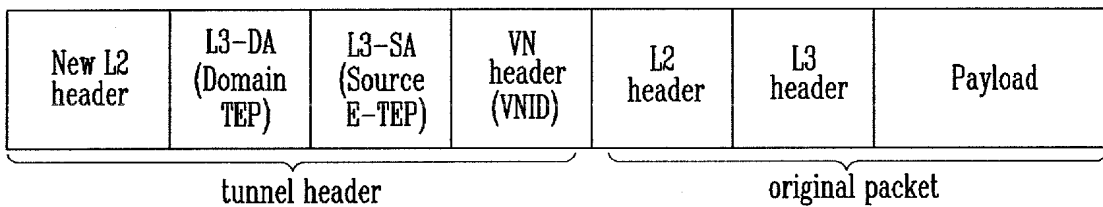


FIG. 2C

c) Domain TEP - to - Domain TEP packet format

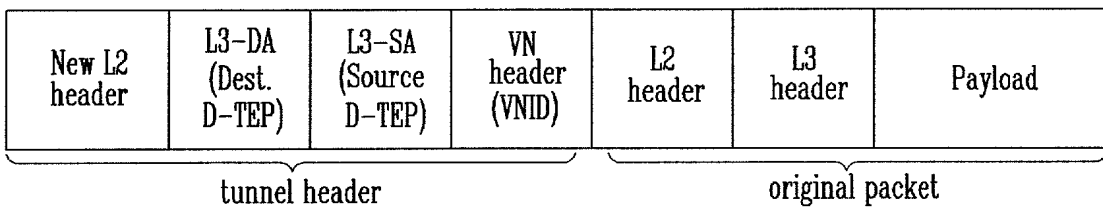


FIG. 3

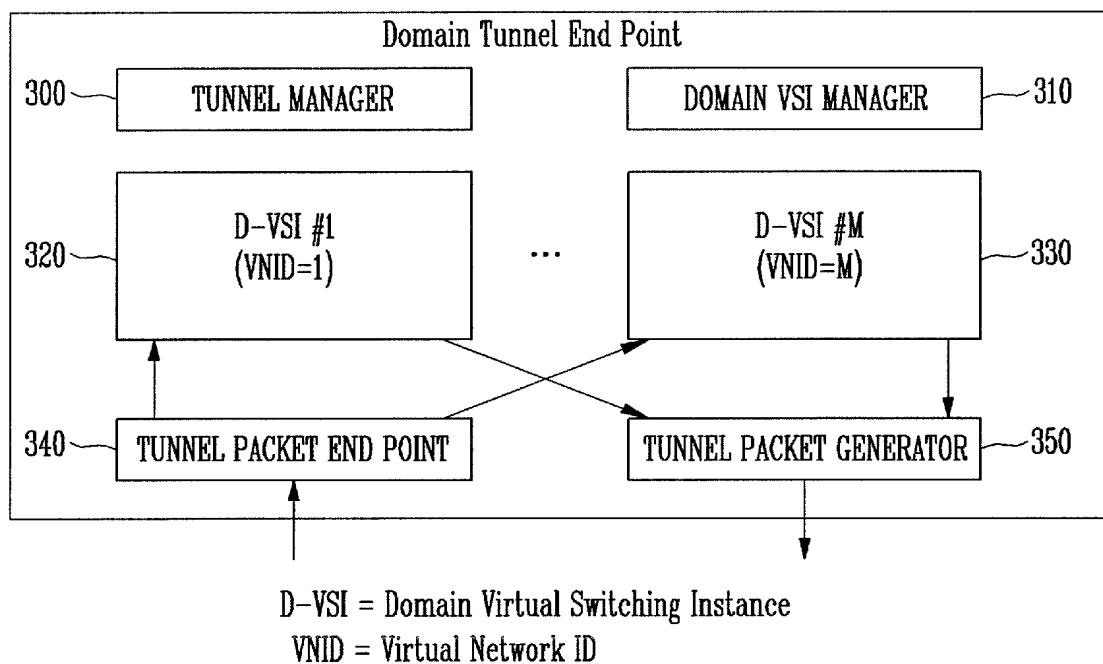


FIG. 4

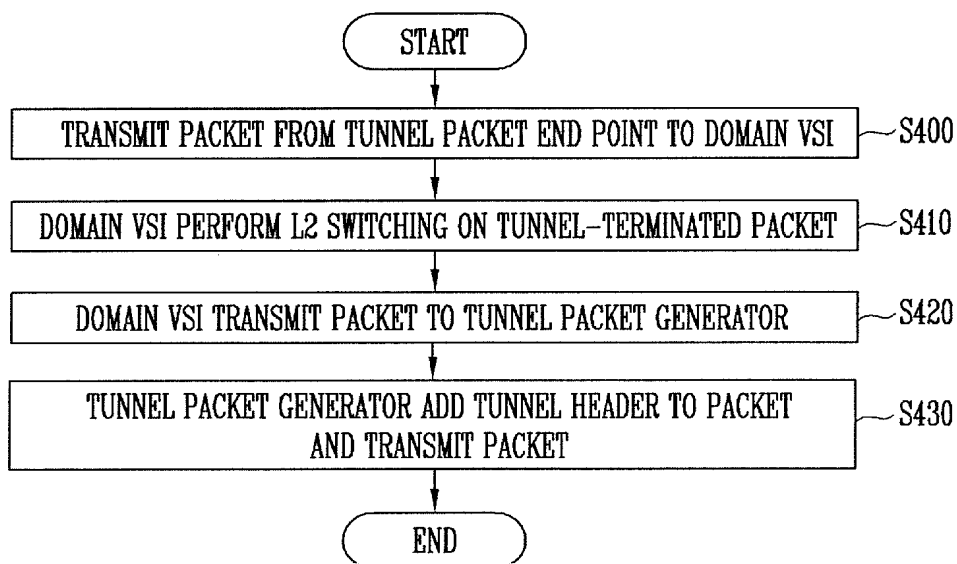


FIG. 5

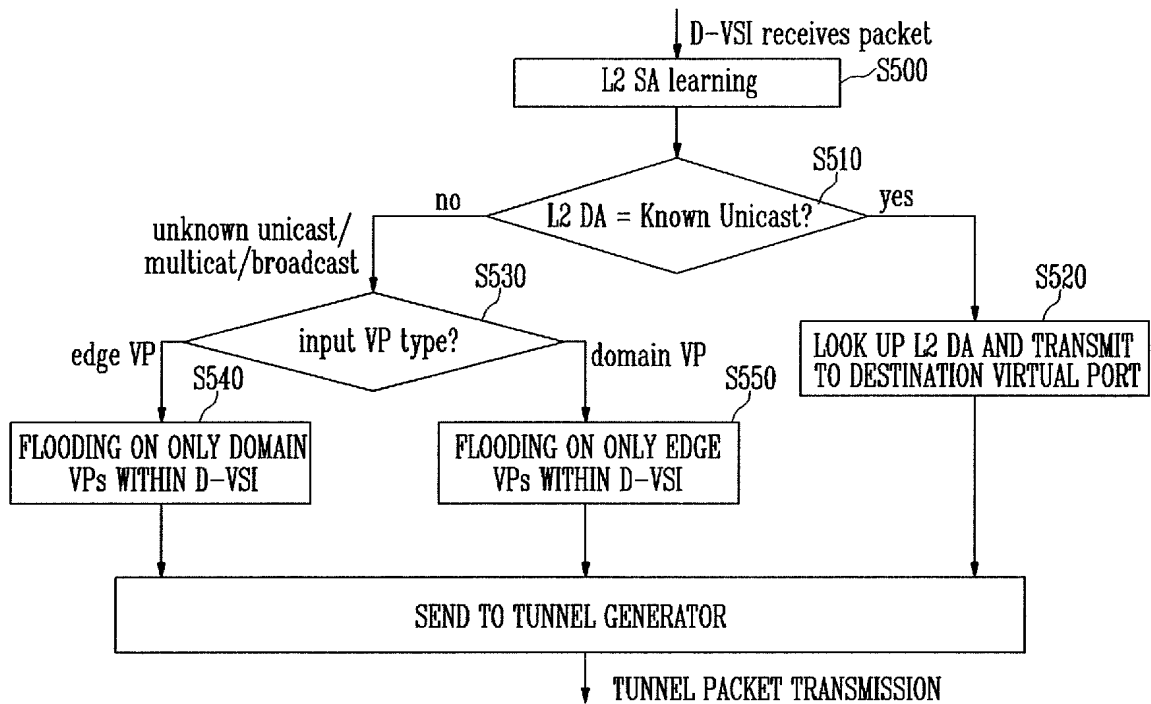


FIG. 6A

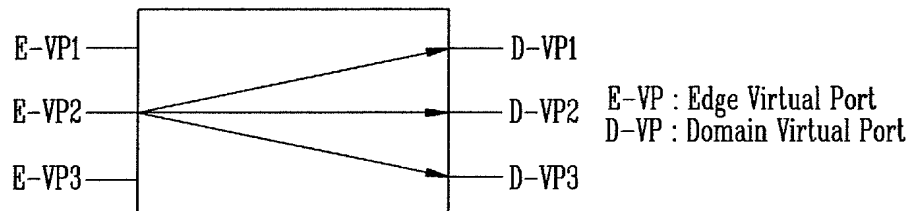
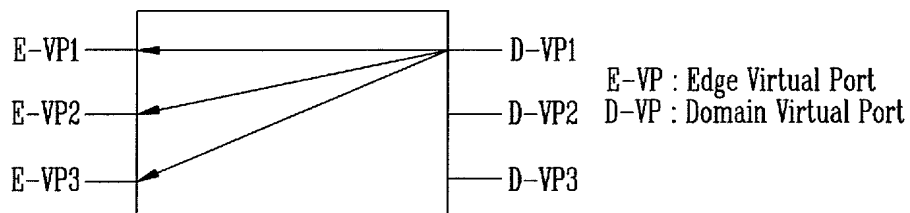


FIG. 6B



**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION
USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

TITLE OF INVENTION:

METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

As the below named inventor, I hereby declare that:

This declaration is directed to:

(check one applicable item below)

☒ The attached application, or

☐ United States application or PCT international application
Number _____ filed on _____

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

Page 1 of #

LEGAL NAME OF INVENTOR(s):

Inventor: Sung Hyuk BYUN

Date (Optional): December 23, 2014

Signature: Sung Hyuk Byun

Note: An Application Data Sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form.

Separate forms may be used for each inventor.

For applications entering US national phase where PCT application was filed prior to September 16, 2012, use former Declaration pre-AIA provisions

L&P 09/2012 (From Form PTO/AIA/01)

Page 2 of #

Electronic Acknowledgement Receipt

EFS ID:	21066845
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Loren Keith Thompson/Ciara Serrato
Filer Authorized By:	Loren Keith Thompson
Attorney Docket Number:	CU-71729 ALV
Receipt Date:	26-DEC-2014
Filing Date:	
Time Stamp:	12:37:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 730
RAM confirmation Number	11909
Deposit Account	120400
Authorized User	

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 C.F.R. Section 1.16 (National application filing, search, and examination fees)

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

Charge any Additional Fees required under 37 C.F.R. Section 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		CU71729_Application.pdf	1183880	yes	22
			12197942c0fab697d8352d49bc71102647730f78		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	15	
	Claims		16	21	
	Abstract		22	22	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	CU71729_Drawings.pdf	139317	no	4
			440f1f5f7c099b086525fd6ad138edcb335cb92b		
Warnings:					
Information:					
3	Oath or Declaration filed	CU71729_Declaration.pdf	167792	no	2
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Warnings:					
Information:					
4	Power of Attorney	CU71729_Power.pdf	314452	no	4
			6798ef28947f02a13d2fbc033bc265c2430c191e		
Warnings:					
Information:					
5	Application Data Sheet	Application_Data_Sheet_aia0014.pdf	1561034	no	7
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Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	35306	no	2
			c2ddd44d7eb257568267cb9a03e4150c4a7eaa0		

Warnings:	
Information:	
Total Files Size (in bytes):	3401781
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.	

DOCKET: CU-71729

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR: Sung Hyuk BYUN
SERIAL NO: 14/583,303
FILED: December 26, 2014
TITLE: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**SUBMISSION OF SUBSTITUTE APPLICATION DATA SHEET
TO CORRECT PRIORITY APPLICATION FILING DATE
AND REQUEST FOR CORRECTED FILING RECEIPT**

Dear Sir:

This application claims priority to Korean Patent Application 10-2013-0165299 filed **December 27, 2013** and Korean Patent Application 10-2014-0136067 filed October 8, 2014.

Attached is a Substitute Application Data Sheet, in which the typographical error in the filing date of the first Korean priority application has been corrected.

Should any fee be deemed necessary in connection with this request, the Commissioner is authorized to charge our Deposit Account No. 12-0400 in the amount thereof.

Issuance of a corrected filing receipt is respectfully requested.

Respectfully submitted,

December 30, 2014

Date

/35


Attorney for Applicant

Loren K. Thompson, Reg. 45918
c/o Ladas & Parry LLP
224 South Michigan Avenue
Chicago, Illinois 60604
(312) 427-1300

SUBSTITUTE / SUPPLEMENTAL

PTO/AIA/14 (12-13)

Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	14/583,303
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
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.			

Secrecy Order 37 CFR 5.2

☐	Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)
--------------------------	---

Inventor Information:

Inventor 1 Remove				
Legal Name				
Prefix	Given Name	Middle Name	Family Name	Suffix
	Sung Hyuk		BYUN	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Daejeon	Country of Residence ⁱ	KR	
Mailing Address of Inventor:				
Address 1		603-1504 Banseok 6 Danji Apt., 98, Banseokseo-ro,		
Address 2		Yuseong-gu		
City	Daejeon	State/Province		
Postal Code		Country ⁱ	KR	
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button. Add				

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below. For further information see 37 CFR 1.33(a).	
☐ An Address is being provided for the correspondence information of this application.	
Customer Number	26530
Email Address	Add Email Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
Attorney Docket Number	CU-71729 AVL	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	Suggested Figure for Publication (if any)	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

Filing By Reference :

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

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

Publication Information:

☐ 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.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	26530		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the application number blank.

Prior Application Status		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)¹ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)
10-2013-0165299	KR	~~2013-10-27~~ 2013-12-27	
Remove			
Application Number	Country ¹	Filing Date (YYYY-MM-DD)	Access Code ¹ (if applicable)
10-2014-0136067	KR	2014-10-08	
Remove			

Additional Foreign Priority Data may be generated within this form by selecting the Add button.

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			
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.			
Clear			
☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE		
Mailing Address Information For Applicant:			
Address 1	218 Gajeong-ro, Yuseong-gu		
Address 2			
City	Daejeon	State/Province	
Country	KR	Postal Code	305-700
Phone Number		Fax Number	

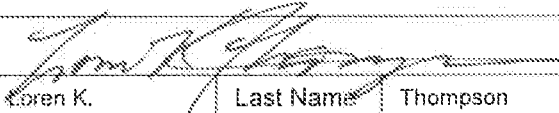
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.				
Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.				

Signature:

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications.				
Signature			Date (YYYY-MM-DD)	2014-12-30
First Name	Loren K.	Last Name	Thompson	Registration Number
45918				
Additional Signature may be generated within this form by selecting the Add button.				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	CU-71729 AVL
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION		

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.

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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 the Freedom of Information Act requires disclosure of these records.
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.
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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.
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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 inspections 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.

Electronic Acknowledgement Receipt

EFS ID:	21090309
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Loren Keith Thompson/Samantha Lingo
Filer Authorized By:	Loren Keith Thompson
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	30-DEC-2014
Filing Date:	
Time Stamp:	15:44:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2014-12-30_CU-71729_Submission_of_ADS_and_Request_for_Corrected_FR.pdf	614655 8ec02c7d365605e1c0ae3abaa8d4ee107b28c397	yes	8

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Applicant Response to Pre-Exam Formalities Notice	1	1
	Application Data Sheet	2	8
Warnings:			
Information:			
Total Files Size (in bytes):		614655	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14583303
	Filing Date		2014-12-26
	First Named Inventor	Sung Hyuk BYUN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		CU-71729

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	8223770	B2	2012-07-17	Wray et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS						
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20130294231	A1	2013-11-07	Nodir et al.	
	2	20130343385	A1	2013-12-26	Benny et al.	

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**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
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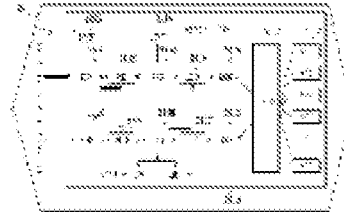
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(54) HIGH SPEED SWITCHING METHOD AND HIGH SPEED VIRTUAL SWITCH FOR NETWORK VIRTUALIZATION

(57) Abstract:

A high speed switching method of a virtual switch and an input packet for a network virtualization service is provided. The packet is transmitted between logical interfaces or between a physical interface and the logical interface at high speeds by efficiently using the information of the input packet.

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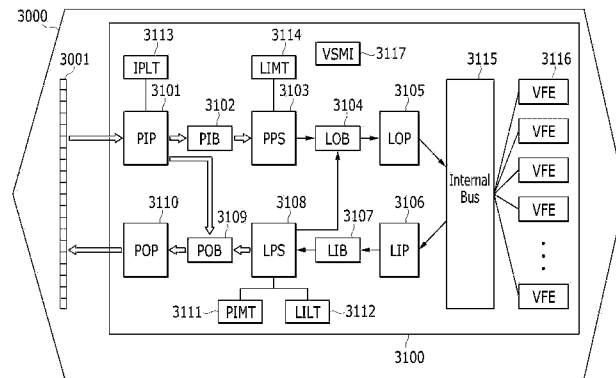
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(54) 발명의 명칭 네트워크 가상화를 위한 고속 스위칭 방법 및 고속 가상 스위치

(57) 요약

네트워크 가상화 서비스를 제공하기 위한 가상 스위치와 입력 패킷의 고속 스위칭 방법이 제공된다. 입력 패킷의 정보를 효율적으로 이용하여 물리 인터페이스와 논리 인터페이스 사이에서, 또는 논리 인터페이스 상호 간에 패킷을 고속으로 전송한다.

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연구

기 여 율 1/1

주관기관 한국전자통신연구원

연구기간 2010.03.01~2013.02.28

특허청구의 범위

청구항 1

네트워크 가상화 스위치에서 패킷을 스위칭하는 방법으로서,
 패킷을 수신하는 단계,
 상기 패킷을 논리 인터페이스로 전달할 패킷과 물리 인터페이스로 전달할 패킷으로 구분하는 단계,
 상기 패킷이 상기 논리 인터페이스로 전달할 패킷인 경우,
 상기 패킷을 논리 인터페이스 매핑 테이블을 이용하여 복수의 논리 인터페이스 중 어느 하나의 논리 인터페이스로 매핑하는 단계,
 상기 패킷의 MAC 주소를 상기 매핑한 논리 인터페이스 주소로 변경하는 단계,
 상기 패킷을 상기 매핑한 논리 인터페이스에 대응하는 가상 포워딩 요소로 전달하는 단계,
 상기 가상 포워딩 요소에서 전달되는 패킷을 물리 인터페이스 매핑 테이블을 이용하여 물리 인터페이스에 매핑하는 단계,
 상기 패킷의 논리 인터페이스 주소를 MAC 주소로 변환하여 상기 매핑한 물리 인터페이스로 전송하는 단계를 포함하는
 입력 패킷의 스위칭 방법.

청구항 2

제1항에서,
 상기 구분하는 단계에서, 상기 패킷이 상기 물리 인터페이스로 전송할 패킷인 경우,
 상기 패킷을 상기 물리 인터페이스로 전송하는 단계를 더 포함하는 입력 패킷의 스위칭 방법.

청구항 3

제1항에서,
 상기 물리 인터페이스에 매핑하는 단계에서 상기 패킷에 대응하는 물리 인터페이스가 존재하지 않으면,
 논리 인터페이스 특업 테이블을 이용하여 상기 패킷에 대응하는 논리 인터페이스가 존재하는지 판단하는 단계,
 그리고
 상기 대응하는 논리 인터페이스로 상기 패킷을 전송하는 단계를
 더 포함하는 입력 패킷의 스위칭 방법.

청구항 4

제3항에서,
 상기 패킷에 대응하는 논리 인터페이스가 존재하지 않으면, 상기 패킷을 폐기하는 단계를 더 포함하는 입력 패킷의 스위칭 방법.

청구항 5

제1항에서,

상기 패킷이 상기 논리 인터페이스로 전송할 패킷인 경우, 상기 패킷의 참조 값을 버퍼에 저장하는 단계를 더 포함하며,

상기 논리 인터페이스로 매핑하는 단계는 상기 참조 값에 기초하여 상기 패킷을 읽는 단계를 포함하는 입력 패킷의 스위칭 방법.

청구항 6

제1항에서,

상기 논리 인터페이스 주소로 변경한 패킷을 버퍼에 저장하는 단계를 더 포함하며,

상기 가상 포워딩 요소로 전달하는 단계는 상기 버퍼에 저장된 패킷을 전달하는 입력 패킷의 스위칭 방법.

청구항 7

제1항에서,

상기 물리 인터페이스에 매핑하는 단계는,

상기 가상 포워딩 요소에서 전달되는 패킷을 버퍼에 저장하는 단계, 그리고

상기 버퍼에 저장된 패킷을 상기 물리 인터페이스 매핑 테이블을 이용하여 상기 물리 인터페이스에 매핑하는 단계를 포함하는 입력 패킷의 스위칭 방법.

청구항 8

네트워크 가상화 스위치로서,

외부 노드와 패킷을 송수신하며, 복수의 물리 인터페이스를 포함하는 물리 인터페이스부,

각각 논리 인터페이스를 가지는 복수의 가상 포워딩 요소,

상기 물리 인터페이스부에서 수신한 패킷을 상기 논리 인터페이스로 전달할 패킷과 상기 물리 인터페이스부로 전달할 패킷으로 구분하는 입력 패킷 프로세서,

상기 논리 인터페이스부로 전달될 패킷을 논리 인터페이스 매핑 테이블을 이용하여 복수의 논리 인터페이스 중 어느 하나의 논리 인터페이스로 매핑하고, 상기 패킷의 MAC 주소를 상기 매핑한 논리 인터페이스 주소로 변환하는 물리 패킷 스위칭부,

상기 패킷을 상기 매핑한 논리 인터페이스에 대응하는 가상 포워딩 요소로 전달하는 논리 출력 프로세서,

상기 가상 포워딩 요소에서 전달되는 패킷을 물리 인터페이스 매핑 테이블을 이용하여 물리 인터페이스에 매핑하고, 상기 패킷의 논리 인터페이스 주소를 MAC 주소로 변환하는 논리 패킷 스위칭부, 그리고

상기 패킷을 상기 매핑한 물리 인터페이스로 전송하는 물리 출력 프로세서

를 포함하는 네트워크 가상화 스위치.

청구항 9

제8항에서,

상위 가상 스위치 정책 관리자(virtual switch policy manager, VSPM)와 가상 스위치의 정책 수행을 위한 통신을 하는 가상 스위치 관리 인터페이스부(virtual switch management interface, VSMI)를 더 포함하는 네트워크

가상화 스위치.

청구항 10

제8항에서,

상기 입력 패킷 프로세서는 심층 패킷 조사(deep packet inspection, DPI) 전용 프로세서를 이용함으로써 입력된 패킷의 내용에 특정 시그니처의 존재여부를 검색하여 바이러스 트래픽의 탐지 및 정밀 응용 서비스의 식별기능을 수행하는 네트워크 가상화 스위치.

청구항 11

제8항에서,

상기 입력 패킷 프로세서는 비정상적 트래픽을 탐지하고 차단하는 기능을 수행하는 네트워크 가상화 스위치.

청구항 12

제8항에서,

상기 플리 출력 프로세서는 플로우 또는 목적지 IP 주소를 기반으로 하는 rate-limit 기능 및 QoS 보장을 위한 트래픽 관리 기능을 수행하는 네트워크 가상화 스위치.

명세서

기술분야

[0001] 본 발명은 네트워크 가상화를 위한 패킷 고속 스위칭 방법 및 고속 스위칭을 구현하는 가상 스위치에 관한 것이다.

배경기술

[0002] 클라우드 컴퓨팅은 개인용 컴퓨터(personal computer, 이하 'PC'라 함)나 기업의 서버에 개별적으로 저장해 두었던 자료와 소프트웨어를 중앙시스템인 대형 컴퓨터에 저장하고, 사용자가 PC나 휴대폰과 같은 각종 단말기를 이용해 원격으로 원하는 작업을 수행할 수 있는 사용 환경을 말한다. 즉, 다수의 사용자는 인터넷 기술을 이용해서 하나의 서비스로서 방대한 아이티(informational technology, 이하 'IT'라 함) 능력을 제공받을 수 있게 된다.

[0003] 클라우드 컴퓨팅은 사용자 측면에서는 컴퓨팅 자원을 사용한 만큼 비용을 지불한다는 점에서 유틸리티 컴퓨팅이나 서비스로서의 소프트웨어(Software as a Service, SaaS)와 유사하고, 서비스 제공자 측면에서는 분산된 여러 컴퓨팅 자원을 취합하여 하나의 컴퓨팅 자원처럼 사용할 수 있도록 제공한다는 점에서 그리드 컴퓨팅의 개념과 유사하다. 즉, 기술적으로는 그리드 컴퓨팅을, 과금모델로는 유틸리티 컴퓨팅을 혼합한 것이 클라우드 컴퓨팅의 개념이다.

[0004] 이러한 클라우드 서비스는 운영 및 관리가 효율적으로 이루어질 수 있고 구축 비용이 적게 들기 때문에 서비스 사업자들이 중요한 미래 서비스로 간주하고 있으며, 특히 클라우드 데이터센터 서비스는 대부분의 IT 사업자들이 관심을 가지는 분야이다.

[0005] 일반적인 클라우드 데이터 센터 네트워크를 개략적으로 보면, 데이터 센터의 각 서버들은 랙(rack)에 장착되어 최종 서버 그룹을 이루고, 상기 서버 그룹의 모든 서버들은 탑-오브-랙(top of rack, 이하 'ToR'이라 함) 스위치를 통하여 연결된다. 각 서버는 하이퍼바이저 기능을 이용하여 운영체제(operating system, 이하 'OS'라 함) 및 버추얼 머신(virtual machine, 이하 'VM'이라 함) 가상화를 지원하고, 내부 VM 간의 연결을 위한 VM 가상스

위치가 각 서버에 존재한다.

- [0006] 복수의 상기 ToR 스위치는 상위 집합 스위치(aggregation switch, 이하 'AS'라 함)를 통해서 계층2 스위치 연결을 구성하고, 복수의 AS는 상위 접근 라우터(access router, 이하 'AR'이라 함)와 연결된 후, 복수의 AR이 다시 상위 경계 라우터(border router, 이하 'BR'이라 함)와 연결됨으로써 복수의 AR과 복수의 BR은 계층3 라우터 연결을 구성한다. 최종적으로 복수의 BR이 백본 인터넷에 연결됨으로써 클라우드 데이터 센터 네트워크가 구현될 수 있다.
- [0007] 상기 데이터 센터 네트워크와 같은 물리 네트워크 자원을 바탕으로 가상 네트워크를 사용자들에게 제공하기 위해서는 네트워크 가상화 기술이 필수적으로 필요하다. 네트워크 가상화에서는 제어 평면과 전송 평면이 분리되어야 하고, 인터페이스 가상화 및 전송 엔진의 가상화가 요구된다.
- [0008] 무엇보다 물리 인터페이스와 가상 인터페이스 간의 패킷 전달뿐만 아니라 내부 가상 엔진 간의 가상 인터페이스를 통한 패킷 전달을 위한 고성능의 가상 스위치가 가상화된 네트워크 환경에서 핵심적인 역할을 담당한다.
- [0009] 일반적으로 네트워크 가상화를 위한 가상 스위치는 멀티코어 네트워크 프로세서 유닛(multi-core network processor unit, multi-core NPU)을 이용하여 구현되는데, 이때 구현된 가상 스위치는 물리 인터페이스로부터 입력된 패킷을 손실 없이 내부의 가상 엔진에 전달할 수 있어야 하고, 가상 엔진들 간의 가상 인터페이스를 통해서도 손실 없이 패킷을 전송해야 하기 때문에, 패킷의 고속 스위칭을 구현하기 위한 가상 스위치를 설계하는 기술은 매우 중요한 문제이다.

발명의 내용

해결하려는 과제

- [0010] 본 발명이 이루고자 하는 과제는 네트워크 가상화에 핵심적으로 요구되는 가상 스위치를 설계함에 있어, 일반 상용 네트워크 프로세서 유닛 상에서 물리 인터페이스와 가상 엔진 사이에서 패킷을 고속으로 스위칭하는 방법 및 고속 스위칭 기능이 구현된 가상 스위치를 제공하는 것이다.

과제의 해결 수단

- [0011] 본 발명의 한 실시예에 따르면, 네트워크 가상화를 위한 스위치에서 패킷을 스위칭하는 방법이 제공된다. 상기 패킷의 스위칭 방법은, 패킷을 수신하는 단계, 패킷을 논리 인터페이스로 전달할 패킷과 물리 인터페이스로 전달할 패킷으로 구분하는 단계, 패킷이 상기 논리 인터페이스로 전달할 패킷인 경우, 패킷을 논리 인터페이스 매핑 테이블을 이용하여 복수의 논리 인터페이스 중 어느 하나의 논리 인터페이스로 매핑하는 단계, 패킷의 매체 접근 제어(media access control, 이하 'MAC'이라 함) 주소를 상기 매핑한 논리 인터페이스 주소로 변경하는 단계, 패킷을 상기 매핑한 논리 인터페이스에 대응하는 가상 포워딩 요소로 전달하는 단계, 가상 포워딩 요소에서 전달되는 패킷을 물리 인터페이스 매핑 테이블을 이용하여 물리 인터페이스에 매핑하는 단계, 패킷의 논리 인터페이스 주소를 MAC 주소로 변환하여 상기 매핑한 물리 인터페이스로 전송하는 단계를 포함한다.
- [0012] 상기 패킷의 스위칭 방법은, 구분하는 단계에서, 패킷이 물리 인터페이스로 전송할 패킷인 경우, 패킷을 물리 인터페이스로 전송하는 단계를 더 포함할 수 있다.
- [0013] 상기 패킷의 스위칭 방법은, 물리 인터페이스에 매핑하는 단계에서 패킷에 대응하는 물리 인터페이스가 존재하지 않으면, 논리 인터페이스 룩업 테이블을 이용하여 패킷에 대응하는 논리 인터페이스가 존재하는지 판단하는 단계, 그리고 대응하는 논리 인터페이스로 패킷을 전송하는 단계를 더 포함할 수 있다.
- [0014] 상기 패킷의 스위칭 방법은 패킷에 대응하는 논리 인터페이스가 존재하지 않으면, 패킷을 폐기하는 단계를 더 포함할 수 있다.
- [0015] 상기 패킷의 스위칭 방법에서 패킷이 논리 인터페이스로 전송할 패킷인 경우, 패킷의 참조 값을 버퍼에 저장하는 단계를 더 포함하며, 논리 인터페이스로 매핑하는 단계는 참조 값에 기초하여 패킷을 읽는 단계를 포함할 수 있다.
- [0016] 상기 패킷의 스위칭 방법은, 논리 인터페이스 주소로 변경한 패킷을 버퍼에 저장하는 단계를 더 포함하며, 가상

포워딩 요소로 전달하는 단계는 버퍼에 저장된 패킷을 전달할 수 있다.

- [0017] 상기 패킷의 스위칭 방법에서, 물리 인터페이스에 매핑하는 단계는, 가상 포워딩 요소에서 전달되는 패킷을 버퍼에 저장하는 단계, 그리고 버퍼에 저장된 패킷을 물리 인터페이스 매핑 테이블을 이용하여 물리 인터페이스에 매핑하는 단계를 포함할 수 있다.
- [0018] 본 발명의 다른 실시 예에 따르면, 네트워크 가상화를 위해 패킷을 스위칭하는 가상 스위치가 제공된다. 상기 가상 스위치는, 외부 노드와 패킷을 송수신하며, 복수의 물리 인터페이스를 포함하는 물리 인터페이스부, 각각 논리 인터페이스를 가지는 복수의 가상 포워딩 요소, 물리 인터페이스부에서 수신한 패킷을 논리 인터페이스로 전달할 패킷과 물리 인터페이스부로 전달할 패킷으로 구분하는 입력 패킷 프로세서, 논리 인터페이스부로 전달될 패킷을 논리 인터페이스 매핑 테이블을 이용하여 복수의 논리 인터페이스 중 어느 하나의 논리 인터페이스로 매핑하고, 상기 패킷의 MAC 주소를 상기 매핑한 논리 인터페이스 주소로 변환하는 물리 패킷 스위칭부, 패킷을 매핑한 논리 인터페이스에 대응하는 가상 포워딩 요소로 전달하는 논리 출력 프로세서, 가상 포워딩 요소에서 전달되는 패킷을 물리 인터페이스 매핑 테이블을 이용하여 물리 인터페이스에 매핑하고, 패킷의 논리 인터페이스 주소를 MAC 주소로 변환하는 논리 패킷 스위칭부, 그리고 패킷을 매핑한 물리 인터페이스로 전송하는 물리 출력 프로세서를 포함한다.
- [0019] 상기 가상 스위치는, 상위 가상 스위치 정책 관리자(virtual switch policy manager, VSPM)와 가상 스위치의 정책 수행을 위한 통신을 하는 가상 스위치 관리 인터페이스부(virtual switch management interface, VSMI)를 더 포함할 수 있다.
- [0020] 상기 가상 스위치에서 입력 패킷 프로세서는, 심층 패킷 조사(deep packet inspection, DPI) 전용 프로세서를 이용함으로써 입력된 패킷의 내용에 특정 시그니처의 존재여부를 검색하여 바이러스 트래픽의 탐지 및 정밀 응용 서비스의 식별기능을 추가 수행할 수 있다.
- [0021] 상기 가상 스위치에서 입력 패킷 프로세서는, 비정상적 트래픽을 탐지하고 차단하는 기능을 추가 수행할 수 있다.
- [0022] 상기 가상 스위치에서 물리 출력 프로세서는, 플로우 또는 목적지 아이피(internet protocol, 이하 'IP'라 함) 주소를 기반으로 하는 대역폭 제한(rate-limit) 기능 및 서비스 품질(quality of service, 이하 'QoS'라 함) 보장을 위한 트래픽 관리 기능을 추가 수행할 수 있다.

발명의 효과

- [0023] 본 발명의 한 실시 예에 따른 가상 스위치는 기존에 구현된 클라우드 데이터 센터 네트워크에 부가적으로 설치될 수 있어 경제적인 운용이 가능한 이점이 있고, 가상 스위치로 입력된 입력 패킷의 처리 과정에서 전체 패킷 중 일부를 사용함으로써 고속의 스위칭 성능을 구현하여 손실 없이 물리 및 논리 인터페이스에 전달할 수 있으며, 입력 패킷의 내용을 검색하여 바이러스 트래픽을 탐지하거나 정밀 응용서비스를 식별해낼 수 있다.
- [0024] 또한, 가상 스위치는 입력 패킷의 처리를 네트워크 프로세서 유닛 내부의 고속 메모리를 사용하거나 전용 터캄(ternary content addressable memory, 이하 'TCAM'이라 함)을 사용함으로써 고속의 스위칭 성능을 구현할 수 있다.

도면의 간단한 설명

- [0025] 도 1은 본 발명의 한 실시 예에 따른 클라우드 데이터 센터 네트워크를 나타낸 도면이다.
- 도 2는 본 발명의 한 실시 예에 따른 가상 스위치를 나타낸 도면이다.
- 도 3은 본 발명의 한 실시 예에 따른 가상 스위치로 입력된 패킷의 처리 과정을 나타낸 순서도이다.

발명을 실시하기 위한 구체적인 내용

- [0026] 아래에서는 첨부한 도면을 참고로 하여 본 발명의 실시 예에 대하여 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자가 용이하게 실시할 수 있도록 상세히 설명한다. 그러나 본 발명은 여러 가지 상이한 형태로 구현될 수 있으며 여기에서 설명하는 실시 예에 한정되지 않는다. 그리고 도면에서 본 발명을 명확하게 설명하기 위

해서 설명과 관계없는 부분은 생략하였으며, 명세서 전체를 통하여 유사한 부분에 대해서는 유사한 도면 부호를 붙였다.

- [0027] 명세서 및 청구범위 전체에서, 어떤 부분이 어떤 구성요소를 "포함"한다고 할 때, 이는 특별히 반대되는 기재가 없는 한 다른 구성요소를 제외하는 것이 아니라 다른 구성요소를 더 포함할 수 있는 것을 의미한다.
- [0028] 이제 본 발명의 실시 예에 따른 클라우드 네트워크의 가상화를 위한 가상 스위치 및 그 스위칭 방법에 대하여 도면을 참고로 하여 상세하게 설명한다.
- [0029] 도 1은 본 발명의 한 실시 예에 따른 클라우드 데이터 센터 네트워크를 나타낸 도면이다.
- [0030] 도 1을 참고하면, 본 발명의 가상 스위치(3000)는 클라우드 네트워크의 계층2 스위치(1100)와 계층3 라우터(1200) 사이에 위치하여 클라우드 가상 서버들을 위한 스마트 가상 스위치(smart virtual switch, SVS) 기능을 수행함으로써 네트워크 가상화 서비스를 가능하게 한다.
- [0031] 이때, 망운영자는 가상 스위치 정책 관리자(virtual switch policy manager, VSPM)(2000)를 통하여 가상 스위치(3000)에 정책을 설정함으로써, 네트워크 가상화 서비스의 다양한 정책운동을 가능하게 할 수 있다.
- [0032] 클라우드 데이터 센터 네트워크는, 각 서버(1000)들은 랙(rack)에 장착되어 최종 서버 그룹을 이루고, 상기 서버 그룹의 모든 서버(1000)들은 탑-오브-랙(top of rack, 이하 'ToR'이라 함) 스위치(1101)를 통하여 연결된다. 각 서버(1000)는 하이퍼바이저 기능을 이용하여 OS 및 버추얼 머신(virtual machine, 이하 'VM'이라 함) 가상화를 지원하고, 내부 VM 간의 연결을 위한 VM 가상스위치가 각 서버에 존재한다.
- [0033] 복수의 ToR 스위치(1101)는 상위 집합 스위치(aggregation switch, 이하 'AS'라 함)(1102)를 통해서 계층2 스위치 연결(1100)을 구성한다.
- [0034] 복수의 상위 접근 라우터(access router, 이하 'AR'이라 함)와, 복수의 AR과 연결된 복수의 상위 경계 라우터(border router, 이하 'BR'이라 함)는 계층3 라우터 연결을 구성한다. 최종적으로 복수의 BR이 백본 인터넷에 연결됨으로써 클라우드 데이터 센터 네트워크가 구현될 수 있다.
- [0035] 위와 같이 기존에 구현된 가상화 서비스 지원하기 위한 클라우드 네트워크의 계층2 스위치(1100)와 계층3 라우터(1200)의 사이에 추가적으로 본 발명의 한 실시 예에 따른 가상 스위치(3000)를 설치하여, 네트워크 제공자는 소프트웨어 기반의 가상 스위치만이 설치되어 있던 클라우드 네트워크 장비를 그대로 사용할 수 있게 됨으로써, 비용절감의 효과를 거둘 수 있고, 소프트웨어 기반의 가상 스위치의 성능 문제 등 한계를 극복할 수 있다.
- [0036] 도 2는 본 발명의 한 실시 예에 따른 가상 스위치를 나타낸 도면이고, 도 3은 가상 스위치로 입력된 패킷의 처리 과정을 나타낸 순서도이다.
- [0037] 도 2를 참고하면, 가상 스위치(3000)는 물리 인터페이스부(3001)와 네트워크 프로세서 유닛(3100)을 포함한다.
- [0038] 물리 인터페이스부(3001)는 클라우드 네트워크의 L2 스위치(1100) 및 L3 라우터(1200)와 물리적으로 연결된다.
- [0039] 네트워크 프로세서 유닛(3100)은 물리 인터페이스부(3001)와 연결되어 패킷을 입력받아 처리하고, 처리된 패킷을 물리 인터페이스부(3001)를 통해 출력한다.
- [0040] 네트워크 프로세서 유닛(3100)은 가상 스위치 정책 관리자(2000)와 연결된 가상 스위치 관리 인터페이스(virtual switch management interface, VSMI)(3117)를 포함하여, 망운영자가 설정한 정책에 따라 가상 스위치(3000)가 운영될 수 있도록 한다. 예를 들어 망운영자는 가상 스위치에 패킷의 내용을 검색하는 정책을 적용하여 바이러스 트래픽을 탐지하거나 정밀 응용서비스를 식별해낼 수 있다.
- [0041] 또한, 네트워크 프로세서 유닛(3100)은, 내부 버스(internal bus)(3115)와 논리 인터페이스로 연결되어 패킷을 포워딩해주는 복수의 가상 포워딩 요소(virtual forwarding element, VFE)(3116)를 포함한다.
- [0042] 그러면, 도 3을 참고하여 가상 스위치(3000)로 입력된 패킷이 물리 인터페이스부(3001)를 거쳐, 네트워크 프로세서 유닛(3100)에서 분류 및 처리된 후, 다시 물리 인터페이스부(3001)를 거쳐, 가상 스위치(3000)로부터 출력되는 과정에 대해 자세히 설명한다.
- [0043] 도 3을 참고하면, 먼저, 네트워크의 물리 인터페이스부(3001)는 L2 스위치(1100)와 L3 라우터(1200) 둘 중 어느 한쪽으로부터 패킷을 입력 받게 되고 해당 패킷을 네트워크 프로세서 유닛(3100)으로 전달한다(S100).
- [0044] 상기 패킷은 네트워크 프로세서 유닛(3100)의 입력 패킷 프로세서(packet input processor, PIP)(3101)로 전달

된다.

- [0045] 입력 패킷 프로세서(3101)는 입력 패킷 룩업 테이블(Input packet lookup table, IPLT)(3113)을 이용하여, 입력된 패킷을 논리 인터페이스에 대응된 가상 포워딩 요소(3116)로 전달할 패킷인지, 아니면 물리 인터페이스부(3001)로 전송할 패킷인지 구분한다(S101).
- [0046] 입력 패킷 룩업 테이블(3113)은 통상 5-튜플(tuple) 조건(소스 IP, 목적지 IP, TCP/UDP 소스 포트, TCP/UDP 목적지 포트, 그리고 IP 프로토콜)과 해당하는 패킷 처리 액션들의 집합을 포함할 수 있으며, 더 정밀한 입력 패킷 처리를 위한 룩업 기능을 수행하기 위해서는 10-튜플(입력 포트, 소스 MAC 주소, 목적지 MAC 주소, 이더넷 타입, VLAN id, 그리고 5-튜플)을 포함할 수 있다.
- [0047] 입력 패킷 프로세서(3101)는 입력 패킷 룩업 테이블(3113)을 이용하여 접근 제어 목록(access control list, ACL)을 탐색한 뒤 입력된 패킷을 처리한다.
- [0048] 이때, 물리 인터페이스부(3001)로 전달할 패킷은 물리 출력 버퍼(physical output buffer, POB)(3109)에 저장된다(S111).
- [0049] 반면, 입력 패킷 프로세서(3101)의 판단 결과 가상 포워딩 요소(3116)로 전달할 패킷은 물리 입력 버퍼(physical input buffer, PIB)(3102)에 저장된다(S102).
- [0050] 이 경우 실제 패킷 전체가 저장되면 가상 스위치(3000)의 스위칭 속도가 현저하게 저하될 수 있기 때문에, 패킷의 참조 값들만 물리 입력 버퍼(3102)에 저장됨으로써 가상 스위치(3000)의 고속 스위칭 성능을 구현할 수 있다.
- [0051] 패킷의 참조 값이 물리 입력 버퍼(3102)에 저장된 후, 상기 참조 값이 네트워크 프로세서 유닛(3100)에서 각종 분류 및 처리과정을 거친다.
- [0052] 한편 입력 패킷 룩업 테이블(3113)의 저장, 검색수행에 사용되는 메모리도 있는데, 이때 사용되는 메모리로는 네트워크 프로세서 유닛(3100)에 포함된 고속 메모리가 사용될 수도 있고, 고속의 스위칭 성능을 보장하기 위해서 전용 TCAM도 사용될 수 있다.
- [0053] 이 밖에, 입력 패킷 프로세서(3101)는 패킷의 내용(페이로드, payload) 자체에 포함된 특정 시그니처를 검색함으로써, 바이러스 트래픽을 탐지하고 정밀 응용서비스를 식별하는 기능도 수행할 수 있다.
- [0054] 이 경우, 심층 패킷 조사(deep packet inspection, DPI) 전용 필드 프로그래머블 게이트 어레이(field programmable gate array, FPGA) 또는 주문형 집적회로(Application Specific Integrated Circuit, ASIC)과 같은 보조 프로세서 칩을 사용하여 시그니처 검색 성능을 고속화시킬 수 있다.
- [0055] 또한, 입력 패킷 프로세서(3101)는 가상 스위치(3000)의 시스템 안정성을 위해서 맥 플러딩(media access control flooding, MAC flooding)이나 디도스(distributed denial of service, DDoS)와 같은 비정상적인 트래픽을 탐지하고 차단하는 기능도 수행할 수 있다.
- [0056] 위와 같은 기능을 수행함으로써, 상용화된 클라우드 네트워크 가상화 서비스의 안정성을 확보하고 가용성을 보장할 수 있다.
- [0057] 이때, 입력 패킷 프로세서(3101)의 특정 시그니처의 검색 기능 및 비정상적 트래픽의 차단 기능 등은 망운영자가 가상 스위치 관리 인터페이스(3117)를 통해 해당 기능을 수행하는 정책을 적용함으로써 구현될 수 있다.
- [0058] 입력 패킷 프로세서(3101)에서 위와 같은 기능을 수행한 뒤, 패킷은 물리 패킷 스위칭부(physical packet switching, PPS)(3103)로 전달되고, 물리 패킷 스위칭부(3103)에서는 상기 패킷을 논리 인터페이스로 매핑함으로써, 해당 가상 포워딩 요소(3116)의 논리 인터페이스로 스위칭한다(S103).
- [0059] 이 경우 물리 패킷 스위칭부(3103)는 논리 인터페이스 매핑 테이블(logical interface mapping table, LIMT)(3114)을 이용하여 패킷의 MAC 주소를 가상 포워딩 요소(3116)의 논리 인터페이스 주소로 변경함으로써 패킷의 스위칭 기능을 수행한다. 이때, 물리 패킷 스위칭부(3103)에서 스위칭되는 패킷은 패킷의 참조 값일 수 있다.
- [0060] 이후, 논리 인터페이스의 주소로 MAC 주소가 변경된 패킷은 논리 출력 버퍼(logical output buffer, LOB)(3104)에 저장된다(S104).
- [0061] 이후, 논리 출력 프로세서(logical output process, LOP)(3105)에서는 논리 출력 버퍼(3104)에 저장된 상기 패

킷을 내부 버스(internal bus)(3115)를 이용하여 내부 버스(3115)와 논리 인터페이스로 연결된 가상 포워딩 요소(3116)로 전달한다(S105). 이때, 논리 출력 프로세서(3105)에서 가상 포워딩 요소(3116)로 전달되는 패킷은 패킷의 참조 값일 수 있다.

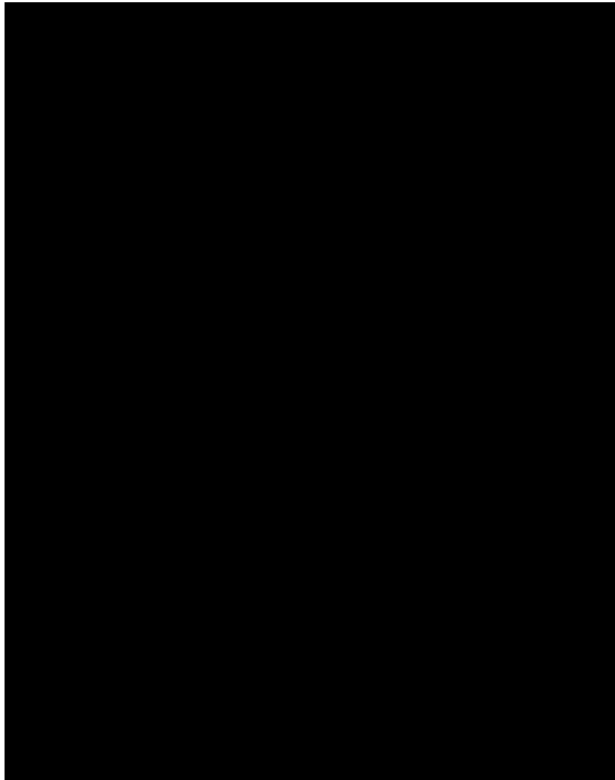
- [0062] 가상 포워딩 요소(3116)는 상기 패킷을 각 서버(1000)로 전달하기 위한 가상 라우터 역할을 수행한다. 그리고, 가상 포워딩 요소(3116)는 가상 인터페이스 설정 기능, 주소결정 프로토콜(address resolution protocol, ARP) 기능, IP 포워딩 룩업 기능, 또는 가상 인터페이스 패킷 전달 기능을 수행할 수 있다. 또한, 가상 포워딩 요소(3116)는 VM 가상화 플랫폼을 이용하여 플로우 모니터링, 메타정보 수집, 터널링, 또는 암호화 및 복호화 등의 임의의 IP 미들박스(middle box) 기능을 추가로 수행할 수도 있다.
- [0063] 가상 포워딩 요소(3116)에서 포워딩된 상기 패킷은 내부 버스(3115)를 거쳐 논리 입력 프로세서(logical input process, LIP)(3106)로 전달된다(S106).
- [0064] 논리 입력 프로세서(3106)는 내부 버스(3115)로부터 전달받은 상기 패킷을 논리 입력 버퍼(logical input buffer, LIB)(3107)에 저장한다(S107). 이때, 논리 입력 프로세서(3106)으로 전달되고, 논리 입력 버퍼(3107)에 저장되는 패킷은 패킷의 참조 값일 수 있다.
- [0065] 이후, 논리 패킷 스위칭부(logical packet switching, LPS)(3108)는 논리 입력 버퍼(3107)에 저장된 패킷을 물리 인터페이스 매핑 테이블(physical interface mapping table, PIMT)(3111)을 이용하여 외부의 물리 인터페이스로 전달할 것인지 판단한다(S108).
- [0066] 판단결과, 패킷에 해당 물리 인터페이스가 존재하지 않을 경우에는 패킷을 물리 출력 버퍼(3109)에 저장하지 않고, 논리 인터페이스 룩업 테이블(logical interface lookup table, LILT)(3112)을 이용하여 다시 논리 인터페이스로 전달할 것인지 판단한다(S109).
- [0067] 이 경우, 논리 인터페이스가 패킷에 포함되어 있다면, 다시 해당 논리 인터페이스로 전송해야 하므로, 패킷 논리 출력 버퍼(3104)에 저장(S104)되어 재차 논리 출력 프로세서(3105)에 의해 내부 버스(3115)로 이동하여 가상 포워딩 요소(3116)로 전송된다. 이때, 논리 패킷 스위칭부(3108)에서 판단되는 패킷은 패킷의 참조 값일 수 있다.
- [0068] 하지만, 논리 인터페이스 룩업 테이블(3112)를 검색하였음에도 불구하고 논리 인터페이스가 존재하지 않는다면 그 패킷은 폐기한다(S110).
- [0069] 한편, 패킷에 대한 물리 인터페이스 매핑 테이블(3111)의 검색결과 물리 인터페이스부(3001)로 전송할 패킷인 것으로 판단된다면, 해당 패킷은 MAC 주소 변환 및 터널링 헤더 삽입 등의 추가 기능이 수행된 후 물리 출력 버퍼(3109)에 저장된다(S111).
- [0070] 이때, 패킷의 참조 값을 이용하여 물리 인터페이스 매핑 테이블(3111)을 검색했다면, 상기 패킷의 참조 값은 MAC 주소 변환 및 터널링 헤더 삽입 등의 추가 기능이 수행된 후 패킷과 결합되어 물리 출력 버퍼(3109)에 저장될 수 있다.
- [0071] 이후, 물리 출력 프로세서(physical output process, POP)(3110)는 물리 출력 버퍼(3109)에 저장된 패킷을 물리 인터페이스부(3001)로 전송한다(S112).
- [0072] 이때 추가적으로 물리 출력 프로세서(3110)는 플로우 또는 목적지 IP 주소 기반의 레이트 리밋(Rate Limit) 기능 및 서비스품질 (Quality of Service, QoS)의 보장을 위한 트래픽 매니저(Traffic Manager, TM) 기능을 수행할 수 있다.
- [0073] 마지막으로 패킷이 물리 인터페이스부(3001)를 거쳐 가상 스위치(3000)에서 출력되면(S113), 가상 스위치(3000)로 입력된 패킷의 처리 과정이 종료된다.
- [0074] 이와 같이, 본 발명의 한 실시 예에 따르면, 가상 스위치로 입력된 패킷은 손실 없이 물리 및/또는 논리 인터페이스로 전달될 수 있고, 전체 패킷 중 일부(예를 들면, 패킷의 참조 값)가 사용됨으로써 패킷의 처리에 있어 고속의 스위칭 성능을 구현할 수 있다.
- [0075] 또한, 본 발명의 다른 실시 예에 따르면, 가상 스위치에 패킷의 내용을 검색하는 정책을 적용하여 바이러스 트래픽을 탐지하거나 정밀 응용서비스를 식별해낼 수 있고, 네트워크 프로세서 유닛 내부의 고속 메모리를 사용하거나 전용 TCAM를 사용하여 패킷을 처리함으로써 고속의 스위칭 성능을 구현할 수 있다.

[0076] 본 발명의 실시 예는 이상에서 설명한 장치 및/또는 방법을 통해서만 구현되는 것은 아니며, 본 발명의 실시 예의 구성에 대응하는 기능을 실현하는 프로그램 또는 그 프로그램이 기록된 기록 매체를 통해 구현될 수도 있으며, 이러한 구현은 앞서 설명한 실시 예의 기재로부터 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자라면 쉽게 가능한 것이다.

[0077] 이상에서 본 발명의 실시 예에 대하여 상세하게 설명하였지만 본 발명의 권리 범위는 이에 한정되는 것은 아니고 다음의 청구범위에서 정의하고 있는 본 발명의 기본 개념을 이용한 당업자의 여러 변형 및 개량 형태 또한 본 발명의 권리 범위에 속하는 것이다.

도면

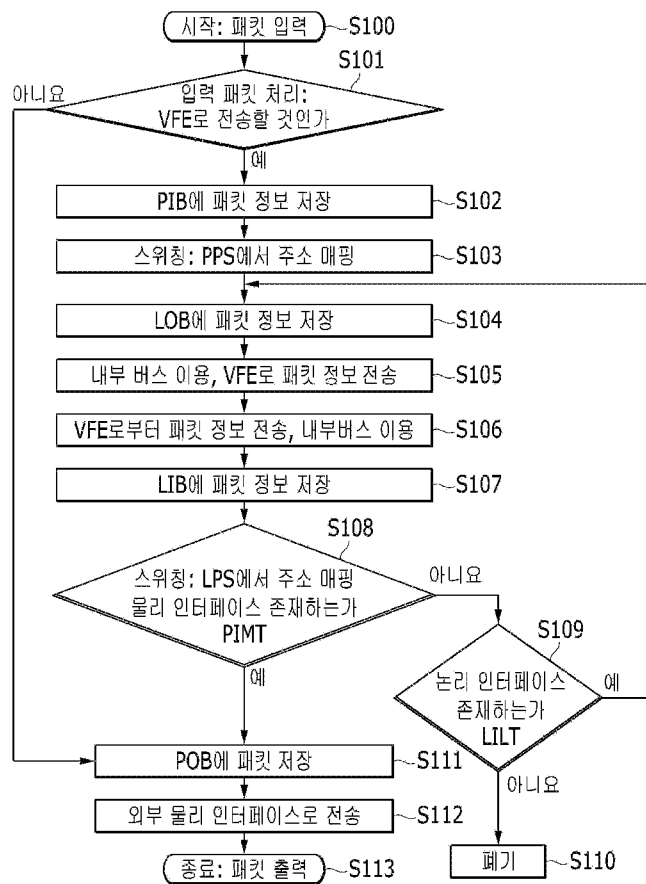
도면



도면2



도면3



Electronic Acknowledgement Receipt

EFS ID:	21113258
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Adam Vincent Litteken/Louise Johnson
Filer Authorized By:	Adam Vincent Litteken
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	05-JAN-2015
Filing Date:	
Time Stamp:	10:44:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		IDS-CU71729.pdf	195793 48e7c5b29e50ad9708f51812a2279f3af3253949	yes	3

	Multipart Description/PDF files in .zip description								
	Document Description		Start	End					
	Transmittal Letter		1	1					
	Information Disclosure Statement (IDS) Form (SB08)		2	3					
Warnings:									
Information:									
2	Foreign Reference	KR1020130126833.pdf	7672379	no	13				
			f2f25f6ad7c7ae45ef50e123145df19d8f1a67fa						
Warnings:									
Information:									
Total Files Size (in bytes):			7868172						
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.									

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	14583303
Filing Date	2014-12-26
First Named Inventor	Sung Hyuk BYUN
Art Unit	
Examiner Name	
Attorney Docket Number	CU-71729

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the 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 the information disclosure statement. See 37 CFR 1.97(e)(1).

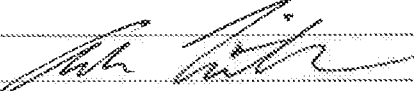
OR

- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2014-12-29
Name/Print	Adam V. Litteken	Registration Number	72,076

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour 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	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
14/583,303	12/26/2014	2414	730	CU-71729 AVL	14	3

CONFIRMATION NO. 1528

FILING RECEIPT



OC000000072849565

26530
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

Date Mailed: 01/16/2015

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)

Sung Hyuk BYUN, Daejeon, KOREA, REPUBLIC OF;

Applicant(s)

ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE, Daejeon, KOREA,
REPUBLIC OF**Power of Attorney:** The patent practitioners associated with Customer Number 26530**Domestic Applications for which benefit is claimed - None.**

A proper domestic benefit claim must be provided in an Application Data Sheet in order to constitute a claim for domestic benefit. See 37 CFR 1.76 and 1.78.

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.)

REPUBLIC OF KOREA 10-2013-0165299 12/27/2013

REPUBLIC OF KOREA 10-2014-0136067 10/08/2014

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: 01/14/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/583,303**

Projected Publication Date: 07/02/2015

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

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).

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Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

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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.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 14/583,303			
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	70	N/A			
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	300	N/A			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	360	N/A			
TOTAL CLAIMS (37 CFR 1.16(i))	14	minus 20 =	*	x 40 =	0.00	OR			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 =	*	x 210 =	0.00				
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	730	TOTAL			
APPLICATION AS AMENDED - PART II									
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	MINUS	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		
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	MINUS	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.									



별첨 사본은 아래 출원의 원본과 동일함을 증명함.

This is to certify that the following application annexed hereto
is a true copy from the records of the Korean Intellectual
Property Office

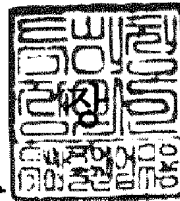
출 원 번 호 : 10-2013-0165299
Application Number

출 원 년 월 일 : 2013년 12월 27일
Filing Date DEC. 27, 2013

출 원 인 : 한국전자통신연구원
Applicant(s) Electronics and Telecommunications
Research Institute

2015년 02월 03일

특 허 청
COMMISSIONER



제출 일자 : 2013-12-27

【서지사항】

【서류명】	특허출원서
【출원구분】	특허출원
【출원인】	
【명칭】	한국전자통신연구원
【출원인코드】	3-1998-007763-8
【대리인】	
【성명】	강신섭
【대리인코드】	9-2009-002845-0
【포괄위임등록번호】	2013-065681-9
【대리인】	
【성명】	이용우
【대리인코드】	9-2009-001530-4
【포괄위임등록번호】	2013-065682-6
【대리인】	
【성명】	문용호
【대리인코드】	9-2007-000883-3
【포괄위임등록번호】	2013-065683-3
【발명의 국문명칭】	멀티도메인 네트워크 가상화 방법 및 장치
【발명의 영문명칭】	Method and Apparatus for Multi-domain Network Virtualization
【발명자】	
【성명】	변성혁
【성명의 영문표기】	BYUN, Sung Hyuk
【주민등록번호】	700402-1XXXXXX
【우편번호】	305-750

제출 일자 : 2013-12-27

【주소】 대전광역시 유성구 반석서로98 반석6단지아파트 603동 150
4호

【국적】 KR

【취지】 위와 같이 특허청장에게 제출합니다.

대리인 강신섭 (서명 또는 인)

대리인 이용우 (서명 또는 인)

대리인 문용호 (서명 또는 인)

【수수료】

【출원료】 0 면 38,000 원

【가산출원료】 13 면 0 원

【우선권주장료】 0 건 0 원

【심사청구료】 0 항 0 원

【합계】 38,000 원

【감면사유】 정부출연연구기관

【감면후 수수료】 19,000 원

【명세서】

【발명의 명칭】

멀티도메인 네트워크 가상화 방법 및 장치{Method and Apparatus for Multi-domain Network Virtualization}

【기술분야】

<1> 본 발명은 유니캐스트 터널만으로 오버레이(Overlay) 방식의 네트워크 가상화를 구현할 때, 여러 개의 네트워크 가상화 도메인을 연결하여 대규모의 하나의 네트워크 가상화 도메인으로 만들 수 있는 방법에 관한 것이다.

【배경기술】

<2> 최근 IT 추세는 서버 가상화, 가상머신 (VM:virtual machine) 기반의 컴퓨팅, IT 자원의 데이터센터 집중, 그리고 네트워크 가상화이다. 네트워크 가상화(Network Virtualization)은 물리 네트워크 위에 필요에 따라 다수의 가상 네트워크를 생성하고 삭제를 가능하게 하는 기술로서 가상머신 사이의 네트워크 구성에 주로 활용된다. 일반적으로 사용되는 overlay 기반 가상 네트워크는 하나의 2계층 네트워크이고 하부의 3계층 네트워크 위에 overlay 방식으로 구현되며, 가상머신에서 주고 받는 2계층 이더넷 프레임에 3계층 IP 헤더를 붙이는 터널링 시킨다. 대표적인 overlay 기반 네트워크 가상화는 VXLAN(virtual extensible local area network)과 NVGRE(network virtualization using generic routing encapsulation)가 있다. VXLAN과 NVGRE는 서버간에 터널을 연결해서 가상 2계층 네트워크를 만드

는데, 터널을 유니캐스트 터널만으로 구현할 수 있고, 또는 멀티캐스트 터널과 유니캐스트 터널을 같이 사용할 수도 있다. 멀티캐스트 터널은 멀티캐스트 트래픽을 효율적으로 보낼 수 있는 장점이 있으나, 하부의 IP 네트워크에서 IP 멀티캐스트를 지원해야 한다는 제약사항 있다.

<3> 그런데 현재 대부분의 IP 네트워크에서 IP 멀티캐스트를 지원하지 않기 때문에, 하부 네트워크 구성에 영향받지 않고 임의로 가상 네트워크를 구성하고자 하는 대부분의 네트워크 가상화 솔루션들은 유니캐스트 터널만을 사용하는 방식이 대세이다. 유니캐스트터널만 사용할 경우 서버나 게이트웨이에서 구현되는 터널종단점(TEP:Tunnel End Point) 간에 full-mesh 유니캐스트 터널을 설정해야 한다. N개 터널종단점 사이에 full-mesh 터널을 설정한다면 $N \times (N-1)$ 개의 터널이 필요하기에, full-mesh 유니캐스트 터널방식은 확장성에 제약을 받을 수 밖에 없어서 VXLAN이나 NVGRE를 적용할 수 있는 네트워크 크기(네트워크 노드 수)에 제약이 생긴다.

【발명의 내용】

【해결하려는 과제】

<4> 본 발명은 유니캐스트 터널만으로 구성하는 네트워크 가상화 방법의 확장성을 제공하기 위한 것이다.

【과제의 해결 수단】

<5> 본 발명의 일 실시예에 따르면, full-mesh 유니캐스트 터널 방식으로 만들 수 있는 적정 규모의 네트워크 가상화 도메인(domain)을 여러 개 만들고, 각 도메

인마다 도메인 터널종단점(Domain Tunnel End Point)을 두고, 도메인 터널종단점간의 full-mesh 연결을 추가하는 것 만으로 다수의 도메인을 통합한 대규모의 하나의 네트워크 가상화 도메인을 만들 수 있게 하기 위한 장치 및 방법이다. 이를 통해 네트워크 가상화 도메인에 필요한 tunnel의 수를 크게 줄여 대규모의 네트워크 가상화 도메인을 구축할 수 있도록 하고자 한다.

【발명의 효과】

<6> 본 발명은 유니캐스트 터널만으로 구성하는 오버레이 기반 네트워크 가상화 방법의 확장성을 제공하기 위한 것으로, full-mesh 유니캐스트 터널 방식으로 만들 수 있는 적정 규모의 네트워크 가상화 도메인(domain)을 여러 개 만들고, 각 도메인마다 도메인 터널종단점(Domain Tunnel End Point)을 두고, 도메인 터널종단점간의 full-mesh 연결을 추가하는 것 만으로 다수의 도메인을 통합한 대규모의 하나의 네트워크 가상화 도메인을 만들 수 있게 하기 위한 장치 및 방법이다. 이를 통해 네트워크 가상화 도메인에 필요한 tunnel의 수를 크게 줄여 대규모의 네트워크 가상화 도메인을 구축할 수 있도록 한다.

【도면의 간단한 설명】

<7> 도 1은 네트워크 도메인 다수 개를 상호 연결하여 하나의 네트워크 가상화 도메인으로 만드는 방법을 나타내는 도면이다.

도 2는 터널링된 패킷 구조를 나타내는 도면이다.

도 3은 패킷 터널 종단점을 나타내는 도면이다.

도 4는 본 발명의 일 실시예에 따른 순서도를 나타내는 도면이다.

도 5는 도메인 VSI에서의 패킷처리과정을 나타내는 도면이다.

도 6은 도메인 VSI에서의 flooding을 나타내는 도면이다.

【발명을 실시하기 위한 구체적인 내용】

<8> VXLAN이나 NVGRE같은 오버레이기반 네트워크 가상화 방식에서 일반적으로 선회되는 유니캐스트 터널만 사용하는 방식에서는 네트워크 가상화를 적용하는 네트워크인 네트워크 가상화 도메인 내의 모든 터널종단점간 full-mesh 유니캐스트 터널을 설정해야 하며, 터널종단점이 N개일 경우 $N \times (N-1)$ 개의 터널이 설정되어야 한다. , N이 크면 설정의 복잡도가 급격히 증가하고, 한 터널종단점에서 설정 가능한 터널 수의 제약, 한 네트워크 가상화 매니저(Network Virtualization Manager)가 관리할 수 있는 터널의 수 등의 제약 등 때문에 네트워크 가상화 도메인은 적정 규모 이하가 되어야 한다. 그래서 일반적으로 하나의 네트워크 가상화 도메인은 하나의 IDC(Internet Data Center) 이내에 국한되기 쉽다. 그런데 지리적으로 떨어진 여러 개의 IDC에 걸친 가상네트워크의 필요성이 크게 대두되면서 기존의 네트워크 가상화 방식으로는 확장성의 부족으로 이러한 요구사항을 지원하기 쉽지 않다.

<9> 본 발명은 그림 1에서와 같이, full-mesh 유니캐스트 터널방식으로 구현 가능한 적정 규모의 네트워크 도메인 다수개를 상호 연결하여 하나의 네트워크 가상화 도메인으로 만드는 방법을 제시한다. 그림 1에서 에지 터널종단점(Edge Tunnel

End Point)는 가상머신을 가진 서버나 레거시 망을 연결해주는 게이트웨이에 해당하며 기존의 오버레이 기반 네트워크 가상화 방식에서의 터널종단점을 의미하며, VXLAN에서는 VTEP(VXLAN Tunnel End Point)에 해당된다. 하나의 네트워크 가상화 도메인 내에서 에지 터널종단점 간에는 기존 방식과 같이 full-mesh로 유니캐스트 터널로 연결되어 있다. 그림 1의 도메인 터널종단점은 본 발명에서 새로 제시하는 장치로서 네트워크 가상화 도메인마다 하나씩 존재하며, 도메인 내의 모든 에지 터널종단점과 각기 하나의 유니캐스트 터널로 연결되어 있다. 그리고 도메인 터널종단점 간에도 full-mesh로 유니캐스트 터널을 설정하고 있다.

<10> 각각의 터널은 모두 같은 구조이며, 터널링된 패킷 구조는 그림 2에서 보여준다. 모든 터널 패킷은 오리지널 L2 패킷 앞에 패킷이 속한 가상네트워크를 의미하는 VNID(Virtual Network Identifier)를 담은 VN 헤더를 갖는다. VN 헤더 앞에 새로운 L3 터널헤더를 붙였는데, 그림 4 a)의 에지 터널종단점간 패킷의 경우 L3 소스(L3-SA)주소는 오리지널 패킷의 송신 에지 터널종단점의 L3 주소, 목적지 L3주소(L3-DA)는 오리지널 패킷의 실제 목적 호스트와 연결된 목적지 에지 터널종단점의 L3 주소가 된다. 그림 4 b)의 에지 터널종단점에서 도메인 터널종단점으로 향하는 패킷의 경우 L3 소스 주소는 송신 에지 터널종단점의 L3 주소이고, 목적지 L3 주소는 도메인 터널종단점의 L3 주소이다. 그림 4 c)는 도메인 터널종단점간 주고 받는 패킷 구조인데, 터널의 L3 소스 주소는 송신 도메인 터널종단점의 L3주소, 목적지 L3 주소는 오리지널 패킷의 목적지가 있는 목적지 도메인의 도메인 터널종단점의 L3주소가 된다. 즉, 에지 터널종단점에서 도메인터널 종단점으로 송신

된 패킷의 L3 터널헤더는, 도메인 터널종단점을 거치면서 그림 4 b)에서 그림 4 c)처럼 변경되게 된다.

<11> 에지 터널종단점은 다른 도메인에 속한 모든 에지 터널종단점과 full-mesh로 터널을 연결하는 대신 해당 도메인 터널종단점과 하나의 터널만 만들고, 각 도메인 터널종단점이 터널을 스위칭해서 다른 모든 에지 터널종단점과 터널이 연결되도록 하는 것이다.

<12> 도메인 터널종단점의 구성은 그림 2에서 보여주는데, 터널관리부와 도메인 VSI(Domain Virtual Switching Instance) 관리부, 다수의 도메인 VSI, 터널패킷종단부와 터널패킷 생성부로 구성된다.

<13> 망 전체의 네트워크 가상화를 관리하는 네트워크 가상화 매니저가 가상네트워크를 하나 만들면 해당 VNID를 도메인 터널종단점에 알리고, 도메인 VSI 관리부는 이를 받아서 VNID에 해당하는 도메인 VSI를 생성한다.

<14> 터널관리부는 운용자의 설정 혹은 프로토콜에 의해 전달된 도메인 내의 모든 에지 터널종단점 정보와 다른 도메인 터널종단점 정보를 수신하고, 이에 따라 도메인 내의 각 에지 터널종단점과 개별 터널을 연결하고, 다른 도메인 터널종단점과도 full-mesh로 터널을 연결한다. 이 때 터널의 구현 방법에 따라서, 두 터널종단점간에 하나의 터널을 생성하고 모든 VNID에 속한 패킷을 이를 통해서 전달할 수도 있고, 아니면 두 터널종단점간에 VNID별로 터널을 다수개 만들어서 구현할 수도 있다. 터널 관리부는 생성한 터널의 상대방 터널종단점이 에지 터널종단점이면, 각 도메인 VSI에 해당 에지 터널종단점과 연계된 에지 가상포트(Edge Virtual Port)를

생성하고, 도메인 터널종단점이면 각 도메인 VSI에 해당 도메인 터널종단점과 연계된 도메인 가상포트(Domain Virtual Port)를 생성한다. 이 때 구현방법에 따라서, 상대방 터널종단점이 속해있는 VNID에 해당하는 도메인 VSI에 가상포트를 만들 수도 있고, 또는 관리의 편리성을 위해서 모든 도메인 VSI에 가상포트를 만들 수도 있다.

<15> 터널패킷종단부는 입력된 터널패킷의 터널헤더로부터 VNID와 송신 터널종단점의 L3 주소를 얻고, VNID에 해당하는 도메인 VSI에 보내는데, 보낼 때 송신 터널종단점과 연계된 가상포트로 입력시킨다.

<16> 도메인 VSI는 VNID 별로 존재하며, 수신 터널패킷의 오리지널 L2 헤더를 바탕으로 도메인 VSI에 적용되는 변형된 L2 스위칭 규칙에 따라서 스위칭해서, 오리지널 목적지 호스트가 있는 가상화 도메인의 도메인 터널종단점과 연계된 가상포트로 출력시켜 터널생성부로 보낸다.

<17> 터널패킷생성부는 수신패킷의 도메인 VSI 정보에서 VNID를 알아내어 VN헤더를 만들고, 도메인 VSI 출력가상포트 정보로부터 목적지 터널종단점의 L3 주소를 알아내어 터널 L3 헤더를 만들고 이를 붙여서 새로운 터널패킷을 완성시킨 후에 송신한다.

<18> 도메인 터널종단점에서의 패킷처리과정은 그림 4에 설명되어 있다.

<19> 입력된 터널패킷은 터널종단부에서 터널헤더로부터 송신한 터널종단점의 L3 주소와 패킷이 속한 VNID를 알아내고, 도메인 VSI에서 오리지널 L2 헤더로 L2스위

칭을 할 수 있도록 패킷을 수정해서 VNID와 연계된 도메인 VSI로 보내며, 이 때, 송신 L3주소와 1:1로 매핑되어 있는 가상포트로 입력되도록 한다.

<20> 도메인 VSI에서는 오리지널 L2 헤더를 바탕으로 변형된 L2 스위칭을 수행한다. 도메인 VSI에서의 패킷처리과정은 그림 5에서 설명하고 있다. 도메인 VSI에 입력된 패킷의 소스 L2 를 learning하고, 목적지 L2주소의 타입을 판별한다. 목적지 L2주소가 이미 learning되어 있는 유니캐스트 주소라면 해당 가상포트를 찾아서 출력한다. 목적지 L2 주소가 unknown unicast, 또는 multicast 또는 broadcast 주소라면 입력 가상포트 타입에 따라 변형된 flooding을 수행한다. 도메인 VSI에서의 flooding은 그림 6에서 자세히 보여주고 있는데, 입력 가상포트 타입이 에지 가상포트라면, 에지 가상포트로는 flooding하지 않고 도메인 가상포트로만 flooding 한다. 입력 가상포트 타입이 도메인 가상포트일 때는 같은 타입인 도메인 가상포트로는 flooding하지 않고 에지 가상포트로만 flooding한다. 이러한 변형 flooding 규칙은 flooding에 의한 포워딩 루프(forwarding loop) 생성을 방지하기 위함이다.

<21> 도메인 VSI에서 스위칭된 패킷은 터널패킷생성부에서 터널헤더를 붙여서 출력된다. 새로운 터널헤더의 VN헤더는 패킷을 스위칭한 도메인 VSI의 VNID를 기반으로 만들어지며, 새 L3 터널헤더의 목적지 L3 주소는 패킷의 도메인 VSI 출력가상포트 정보로부터 얻는다.

【요약서】

【요약】

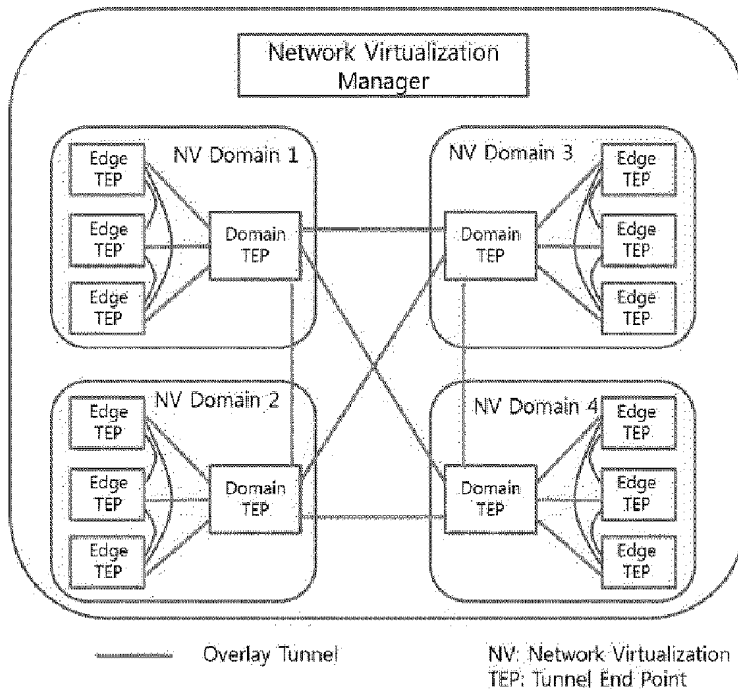
본 발명은 유니캐스트 터널만으로 오버레이(Overlay) 방식의 네트워크 가상화를 구현할 때, 여러 개의 네트워크 가상화 도메인을 연결하여 대규모의 하나의 네트워크 가상화 도메인으로 만들 수 있는 방법에 관한 것이다.

【대표도】

도 1

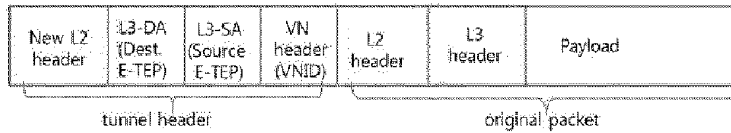
【도면】

【도 1】

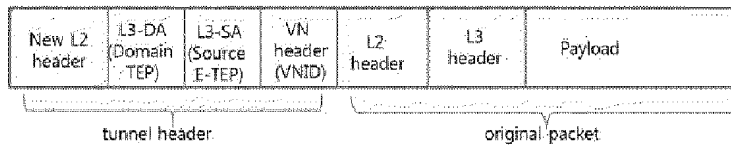


【도 2】

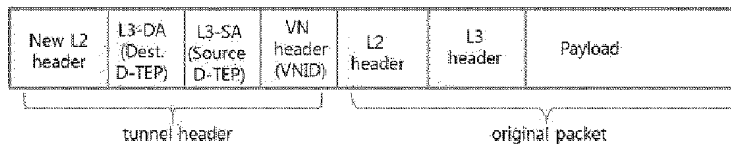
a) Edge TEP(E-TEP) – to – Edge TEP packet format



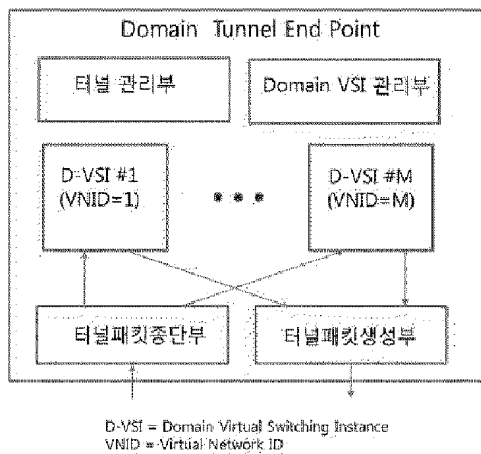
b) Edge TEP – to – Domain TEP(D-TEP) packet format



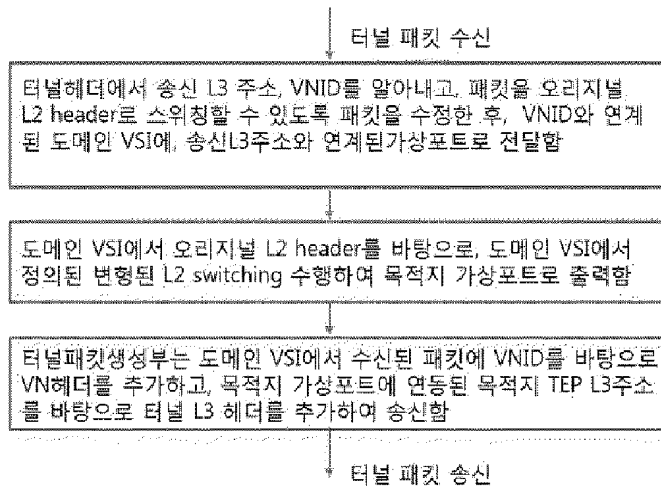
c) Domain TEP – to – Domain TEP packet format



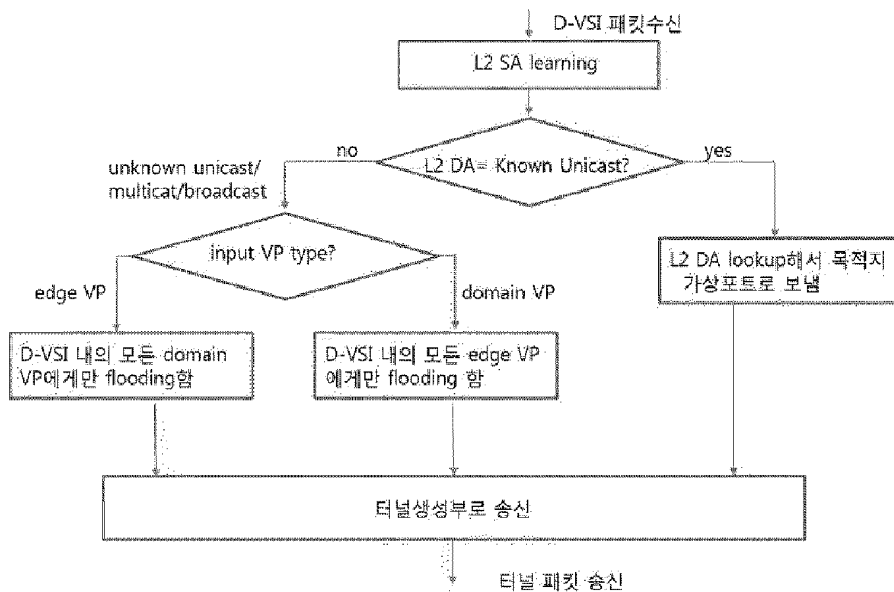
【도 3】



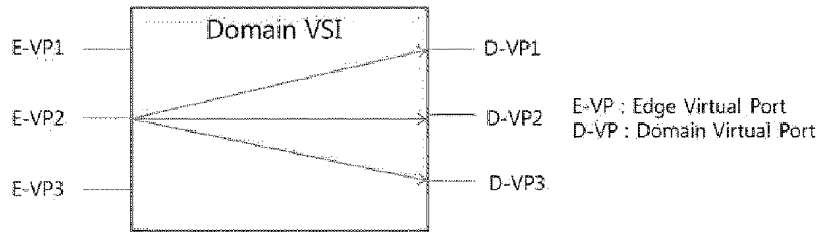
【도 4】



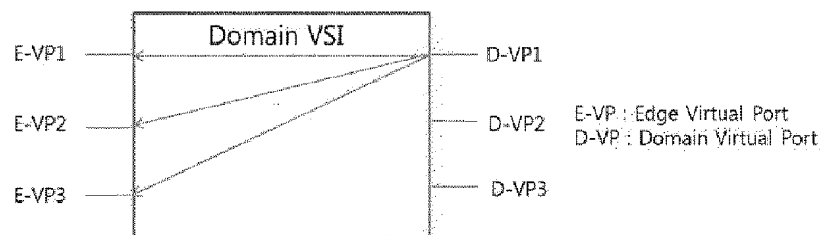
【도 5】



【도 6】



a) 입력 VP가 에지 VP일 때 multicast/broadcast/unknown unicast 패킷의 flooding



b) 입력 VP가 도메인 VP일 때 multicast/broadcast/unknown unicast 패킷의 flooding



별첨 사본은 아래 출원의 원본과 동일함을 증명함.

This is to certify that the following application annexed hereto
is a true copy from the records of the Korean Intellectual
Property Office

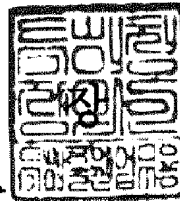
출 원 번 호 : 10-2014-0136067
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Applicant(s) Electronics and Telecommunications
Research Institute

2015년 02월 03일

특 허 청
COMMISSIONER



【서지사항】

【서류명】	특허출원서
【출원구분】	특허출원
【출원인】	
【명칭】	한국전자통신연구원
【출원인코드】	3-1998-007763-8
【대리인】	
【성명】	강신섭
【대리인코드】	9-2009-002845-0
【포괄위임등록번호】	2013-065681-9
【대리인】	
【성명】	이용우
【대리인코드】	9-2009-001530-4
【포괄위임등록번호】	2013-065682-6
【대리인】	
【성명】	문용호
【대리인코드】	9-2007-000883-3
【포괄위임등록번호】	2013-065683-3
【발명의 국문명칭】	네트워크 가상화 방법 및 장치
【발명의 영문명칭】	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
【발명자】	
【성명】	변성혁
【성명의 영문표기】	BYUN, Sung Hyuk
【주민등록번호】	700402-1XXXXXX
【우편번호】	305-750

제출 일자 : 2014-10-08

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【출원국명】 KR

【출원번호】 10-2013-0165299

【출원일자】 2013.12.27

【증명서류】 미첨부

【취지】 위와 같이 특허청장에게 제출합니다.

대리인 강신섭 (서명 또는 인)

대리인 이용우 (서명 또는 인)

대리인 문용호 (서명 또는 인)

【수수료】

【출원료】 0 면 46,000 원

【가산출원료】 29 면 0 원

【우선권주장료】 1 건 18,000 원

【심사청구료】 0 항 0 원

【합계】 64,000 원

【감면사유】 정부출연연구기관[1]

【감면후 수수료】 41,000 원

【명세서】

【발명의 명칭】

네트워크 가상화 방법 및 장치 {METHOD AND APPARATUS FOR NETWORK
VIRTUALIZATION}

【기술분야】

<1> 본 발명은 네트워크에 관한 것으로써 보다 상세하게는 멀티 도메인 네트워크
가상화 방법 및 장치에 관한 것이다.

【배경기술】

<2> 최근 IT(information technology) 추세는 서버 가상화, 가상 머신(virtual
machine, VM) 기반의 컴퓨팅, IT 자원의 데이터 센터 집중, 그리고 네트워크의 가
상화(network virtualization)이다. 네트워크 가상화는 물리 네트워크 위에 필요에
따라 다수의 가상 네트워크를 생성하고 삭제를 가능하게 하는 기술로써 가상 머신
사이의 네트워크 구성을 위해 주로 활용될 수 있다. 일반적으로 사용되는 오버레이
(overlay) 기반 가상 네트워크는 하나의 2 계층 네트워크로써 하부의 3계층 네트워크
위에 오버레이 방식으로 구현될 수 있다. 오버레이 기반의 가상 네트워크에서는
가상 머신에서 주고 받는 2계층 이더넷 프레임에 3계층 IP(internet protocol) 헤
더를 붙이는 터널링을 수행할 수 있다.

<3> 대표적인 오버레이 기반의 네트워크 가상화는 VXLAN(virtual extensible
local area network)과 NVGRE(network virtualization using generic routing

encapsulation)가 있다. VXLAN과 NVGRE는 서버 간에 터널을 연결해서 가상 2계층 네트워크를 만들 수 있다. 이를 위해서는 서버나 게이트웨이에서 구현되는 터널 종단점(TEP:Tunnel End Point) 간에 풀-메쉬(full-mesh) 터널을 설정해야 한다. N개 터널 종단점 사이에 풀-메쉬 터널을 설정한다면 $N \times (N-1)$ 개의 터널이 필요하다. 따라서, 확장성에 제약을 받을 수 밖에 없기 때문에 VXLAN이나 NVGRE를 적용할 수 있는 네트워크 크기(네트워크 노드 수)에 제약이 생길 수 있다는 문제점이 있다.

<4> 구체적으로, N이 크면 설정의 복잡도가 급격히 증가하고, 터널 종단점에서 설정이 가능한 터널 수의 제약, 하나의 네트워크 가상화 매니저(Network Virtualization Manager)가 관리할 수 있는 터널의 수의 제약 등 때문에 네트워크 가상화 도메인은 적정 규모 이하가 되어야 한다. 이러한 이유로 인해 일반적으로 하나의 네트워크 가상화 도메인은 하나의 IDC(Internet Data Center) 이내에 국한되기 쉽다. 그런데 지리적으로 떨어진 복수개의 IDC에 걸친 가상 네트워크의 필요성이 존재하나, 기존의 네트워크 가상화 방식으로는 확장성이 부족하기 때문에 이러한 요구사항을 지원하기가 쉽지 않다는 문제점이 있다.

【발명의 내용】

【해결하려는 과제】

<5> 본 발명은 오버레이 기반의 가상 네트워크에 대해 확장성을 제공하는 방법 및 장치를 제공하는데 그 목적이 있다.

【과제의 해결 수단】

<6> 본 발명의 일 실시예에 따른 네트워크 가상화 장치는, 가상 네트워크의 터널 중단점 정보를 수집하고, 상기 수집한 터널 중단점 정보를 바탕으로 각 터널 중단점과 터널을 연결하는 터널 관리부, 터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하여 도메인 VSI(virtual switching instance)로 전달하는 터널 패킷 중단부, 상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 스위칭을 수행하여 터널 패킷 생성부로 전달하는 도메인 VSI 및 상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 터널 패킷 생성부를 포함하는 것을 특징으로 한다.

<7> 본 발명의 다른 실시예에 따른 네트워크 가상화 장치의 동작 방법은, 가상 네트워크의 터널 중단점 정보를 수집하고, 상기 수집한 터널 중단점 정보를 바탕으로 각 터널 중단점과 터널을 연결하는 단계, 터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하는 단계, 상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 스위칭을 수행하는 단계 및 상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 단계를 수행하는 것을 특징으로 한다.

<8> 본 발명의 또다른 실시예에 따른 네트워크 가상화 방법은, 도메인 터널 중단점과 적어도 하나 이상의 에지 터널 중단점으로 구성된 네트워크 가상 도메인을 적어도 두 개 이상 생성하는 단계 및 상기 각 네트워크 가상 도메인의 터널 중단점

간에 L3 터널을 이용하여 풀-메쉬(full-mesh)로 연결하는 단계를 포함하고, 상기 도메인 터널 종단점과 상기 적어도 하나 이상의 에지 터널 종단점은 L3 터널을 기반으로 연결되는 것을 특징으로 한다.

【발명의 효과】

<9> 상술한 바와 같이 본 발명의 실시예에 따른 멀티 도메인 네트워크 가상화 방법 및 장치를 사용함으로써 L3 터널로 구성하는 오버레이 기반 가상 네트워크에서 확장성을 제공할 수 있다. 본 발명의 실시예에 따르면, 풀-메쉬(full-mesh) 터널 방식으로 만들 수 있는 적정 규모의 네트워크 가상화 도메인(domain)을 복수 개 만들고, 각 도메인마다 도메인 터널 종단점(Domain Tunnel End Point)을 두고, 도메인 터널 종단점 간의 풀-메쉬 연결을 추가하는 것만으로 다수의 도메인을 통합한 대규모의 하나의 네트워크 가상화 도메인을 만들 수 있다. 이를 통해 네트워크 가상화 도메인에 필요한 터널의 수를 크게 줄여 대규모의 네트워크 가상화 도메인을 구축할 수 있다.

【도면의 간단한 설명】

<10> 도 1은 본 발명의 실시예에 따른 네트워크 가상화 방법을 나타낸 개념도이다.

도 2a, 2b 및 2c는 본 발명의 실시예에 따른 패킷을 나타낸 개념도이다.

도 3은 본 발명의 실시예에 따른 도메인 터널 종단점을 나타낸 개념도이다.

도 4는 본 발명의 실시예에 따른 도메인 터널 종단점에서의 패킷 처리 과정

을 나타낸 순서도이다.

도 5는 본 발명의 실시예에 따른 도메인 VSI에서 수행되는 L2 스위칭을 나타낸 순서도이다.

도 6a 및 도6b는 본 발명의 실시예에 따른 도메인 VSI에서의 플로딩을 나타낸 개념도이다.

【발명을 실시하기 위한 구체적인 내용】

<11> 본 발명은 다양한 변경을 가할 수 있고 여러 가지 실시예를 가질 수 있는 바, 특정 실시예들을 도면에 예시하고 상세한 설명에 상세하게 설명하고자 한다. 그러나, 이는 본 발명을 특정한 실시 형태에 대해 한정하려는 것이 아니며, 본 발명의 사상 및 기술 범위에 포함되는 모든 변경, 균등물 내지 대체물을 포함하는 것으로 이해되어야 한다. 각 도면을 설명하면서 유사한 참조부호를 유사한 구성요소에 대해 사용하였다.

<12> 제1, 제2 등의 용어는 다양한 구성요소들을 설명하는데 사용될 수 있지만, 상기 구성요소들은 상기 용어들에 의해 한정되어서는 안 된다. 상기 용어들은 하나의 구성요소를 다른 구성요소로부터 구별하는 목적으로만 사용된다. 예를 들어, 본 발명의 권리 범위를 벗어나지 않으면서 제1 구성요소는 제2 구성요소로 명명될 수 있고, 유사하게 제2 구성요소도 제1 구성요소로 명명될 수 있다. 및/또는 이라는 용어는 복수의 관련된 기재된 항목들의 조합 또는 복수의 관련된 기재된 항목들 중의 어느 항목을 포함한다.

<13> 어떤 구성요소가 다른 구성요소에 "연결되어" 있다거나 "접속되어" 있다고 언급된 때에는, 그 다른 구성요소에 직접적으로 연결되어 있거나 또는 접속되어 있을 수도 있지만, 중간에 다른 구성요소가 존재할 수도 있다고 이해되어야 할 것이다. 반면에, 어떤 구성요소가 다른 구성요소에 "직접 연결되어" 있다거나 "직접 접속되어" 있다고 언급된 때에는, 중간에 다른 구성요소가 존재하지 않는 것으로 이해되어야 할 것이다.

<14> 본 출원에서 사용한 용어는 단지 특정한 실시예를 설명하기 위해 사용된 것으로, 본 발명을 한정하려는 의도가 아니다. 단수의 표현은 문맥상 명백하게 다르게 뜻하지 않는 한, 복수의 표현을 포함한다. 본 출원에서, "포함하다" 또는 "가지다" 등의 용어는 명세서상에 기재된 특징, 숫자, 단계, 동작, 구성요소, 부품 또는 이들을 조합한 것이 존재함을 지정하려는 것이지, 하나 또는 그 이상의 다른 특징들이나 숫자, 단계, 동작, 구성요소, 부품 또는 이들을 조합한 것들의 존재 또는 부가 가능성을 미리 배제하지 않는 것으로 이해되어야 한다.

<15> 이하, 첨부한 도면들을 참조하여, 본 발명의 바람직한 실시예를 보다 상세하게 설명하고자 한다. 이하, 도면상의 동일한 구성 요소에 대해서는 동일한 참조부호를 사용하고 동일한 구성 요소에 대해서 중복된 설명은 생략한다.

<16> 도 1은 본 발명의 실시예에 따른 네트워크 가상화 방법을 나타낸 개념도이다.

<17> 도 1에서는 오버레이 L3 터널 방식으로 구현이 가능한 적정 규모를 가진 복수개의 네트워크 가상화 도메인(network virtualization domain)(110, 120, 130, 140)을 상호 간에 연결하여 하나의 상위 네트워크 가상화 도메인으로 만드는 방법에 대해 게시한다.

<18> 도 1을 참조하면, 복수개의 네트워크 가상화 도메인(110, 120, 130, 140) 상호간에 연결이 될 수 있다. 각각의 네트워크 가상화 도메인(110, 120, 130, 140)은 복수개의 에지 터널 종단점(Edge Tunnel End Point)(113, 123, 133, 143) 및 적어도 하나의 도메인 터널 종단점(Domain Tunnel End Point)(116, 126, 136, 146)을 포함할 수 있다. 네트워크 가상화 관리부(network virtualization manager)(100)는 각각의 네트워크 가상화 도메인에 에지 터널 종단점 및 도메인 터널 종단점을 설정하고 관리하기 위해 구현될 수 있다. 네트워크 관리 가상화 관리부(100)를 기반으로 본 발명의 실시예에 따른 멀티 도메인 네트워크 가상화가 수행될 수 있다. 구체적으로 네트워크 가상화 관리부(또는 네트워크 가상화 장치)는 프로세서를 기반으로 각각의 네트워크 가상화 도메인을 설정하여 멀티 도메인 네트워크의 가상화를 수행할 수 있다.

<19> 에지 터널 종단점(113, 123, 133, 143)은 가상 머신을 가진 서버나 레거시 망을 연결해주는 게이트웨이에 해당하며 기존의 오버레이 기반 네트워크 가상화 방식에서의 터널 종단점을 지시할 수 있다. 예를 들어, VXLAN에서는 VTEP(VXLAN Tunnel End Point)이 에지 터널 종단점(113, 123, 133, 143)일 수 있다. 하나의 네트워크 가상화 도메인에서 에지 터널 종단점(113, 123, 133, 143) 간은 풀-메쉬로

유니캐스트 터널을 기반으로 연결될 수 있다.

<20> 본 발명의 실시예에 따르면, 오버레이 L3 터널 방식으로 만들 수 있는 적정 규모의 네트워크 가상화 도메인 각각(110, 120, 130, 140)에 도메인 터널 종단점(116, 126, 136, 146)을 구현하여 네트워크를 가상화할 수 있다. 도메인 터널 종단점(116, 126, 136, 146)은 네트워크 가상화 도메인(110, 120, 130, 140) 내의 모든 에지 터널 종단점(113, 123, 133, 143)과 각각 터널로 연결될 수 있다. 그리고 네트워크 가상화 도메인(110, 120, 130, 140) 각각의 도메인 터널 종단점(116, 126, 136, 146) 간에도 풀-메쉬로 L3 터널이 설정될 수 있다.

<21> 각각의 터널은 모두 같은 구조이며, 터널링된 패킷 구조는 에지 터널 종단점에서 에지 터널 종단점으로 전달되는 패킷, 에지 터널 종단점에서 도메인 터널 종단점으로 전달되는 패킷, 도메인 터널 종단점에서 도메인 터널 종단점으로 전달되는 패킷이 존재할 수 있다. 아래의 도 2에서는 각 종단점에서 전달되는 패킷에 대해 제시한다.

<22> 도 2a, 2b 및 2c는 본 발명의 실시예에 따른 패킷을 나타낸 개념도이다.

<23> 도 2의 (a)는 에지 터널 종단점에서 다른 에지 터널 종단점으로 전달되는 패킷, 도 2의 (b)는 에지 터널 종단점에서 도메인 터널 종단점으로 전달되는 패킷, 도 2의 (c)는 도메인 터널 종단점에서 다른 도메인 터널 종단점으로 전달되는 패킷을 지시한다.

<24> 도 2를 참조하면, 모든 터널 패킷은 오리지널 패킷(original packet)과 터널 헤더(tunnel header)를 포함할 수 있다. 오리지널 패킷은 L2 계층으로 인한 L2 헤더, L3 계층으로 인한 L3 헤더 및 전송되는 데이터가 포함되는 페이로드를 포함할 수 있다.

<25> 터널 헤더는 오리지널 패킷에 포함된 L2 헤더의 전단에 패킷이 속한 가상 네트워크를 의미하는 VNID(Virtual Network Identifier)를 담은 VN 헤더를 포함할 수 있다. 터널 헤더는 VN 헤더 앞에 L3 터널 헤더를 포함할 수 있다. L3 터널 헤더는 L3 DA(destination address) 헤더 및 L3 SA(source address) 헤더를 포함할 수 있다.

<26> 도 2의 (a)를 참조하면, 에지 터널 종단점 간 패킷의 경우, L3 터널 헤더는 L3 SA 헤더는 오리지널 패킷을 송신한 에지 터널 종단점의 L3 주소, L3 DA 헤더는 오리지널 패킷을 수신한 에지 터널 종단점의 L3 주소를 포함할 수 있다. 즉, L3 DA 헤더는 오리지널 패킷의 실제 목적 호스트와 연결된 목적지 에지 터널 종단점의 L3 주소를 포함할 수 있다.

<27> 도 2의 (b)를 참조하면, 에지 터널 종단점에서 도메인 터널 종단점으로 향하는 패킷의 경우, L3 SA 헤더는 패킷을 송신한 에지 터널 종단점의 L3 주소를 포함하고 L3 DA 헤더는 패킷이 전송되는 도메인 터널 종단점의 L3 주소를 포함할 수 있다.

<28> 도 2의 (c)를 참조하면, 도메인 터널 종단점 간에 주고 받는 패킷의 경우,

패킷의 L3 SA 헤더는 패킷을 전송하는 도메인 터널 종단점의 L3 주소를 포함하고, L3 DA 헤더는 패킷의 목적지에 대응되는 도메인 터널 종단점의 L3 주소를 포함할 수 있다.

<29> 특정 네트워크 가상 도메인에 포함된 에지 터널 종단점에서 도메인 터널 종단점으로 패킷이 송신되고, 패킷이 다시 다른 가상 네트워크 도메인의 도메인 터널 종단점으로 전송되는 경우를 가정할 수 있다. 이러한 경우, 본 발명의 실시예에 따르면 패킷의 L3 터널 헤더는 도메인 터널 종단점을 거치면서 도 2의 (b)에서 도 2의 (c)로 변경될 수 있다.

<30> 본 발명의 실시예에 따르면, 에지 터널 종단점은 다른 도메인에 속한 모든 에지 터널 종단점과 풀-메쉬로 터널을 연결하지 않고 도메인 터널 종단점과 하나의 터널만 만들어서, 논리적으로는 서로 다른 도메인에 속한 모든 에지 터널 종단점 간에 풀-메쉬 터널로 연결된 것 처럼 동작할 수 있다. 즉, 본 발명의 실시예에 따르면, 가상 네트워크 도메인에 포함되는 각 도메인 터널 종단점이 터널을 스위칭해서 다른 모든 에지 터널 종단점과 터널이 연결되도록 할 수 있다.

<31> 도 3은 본 발명의 실시예에 따른 도메인 터널 종단점을 나타낸 개념도이다.

<32> 도 3을 참조하면, 도메인 터널 종단점은 터널 관리부(300)와 도메인 VSI(Domain Virtual Switching Instance) 관리부(310), 다수의 도메인 VSI(320, 330), 터널 패킷 종단부(340)와 터널 패킷 생성부(350)를 포함할 수 있다.

<33> 터널 관리부(300)는 가상 네트워크 도메인 내의 모든 에지 터널 종단점과 도메인 터널 종단점 사이에, 그리고 다른 도메인 터널 종단점과 해당 도메인 터널 종단점 사이에 터널을 연결하고 연결한 터널을 관리하기 위해 구현될 수 있다. 터널 관리부(300)는 운용자의 설정 또는 프로토콜에 의해 전달된 도메인 내의 모든 에지 터널 종단점 정보와 다른 도메인 터널 종단점 정보를 수신할 수 있다.

<34> 또한, 터널 관리부(300)는 수신한 에지 터널 종단점 정보와 도메인 터널 종단점 정보를 기반으로 도메인 내의 각 에지 터널 종단점과 개별 터널을 연결하고, 다른 도메인 터널 종단점과도 폴 메쉬로 터널을 연결할 수 있다. 각 종단점 간의 터널은 다양한 방법으로 구현될 수 있다. 예를 들어, 두 터널 종단점 간에 하나의 터널을 생성하고 모든 VNID에 속한 패킷을 생성된 하나의 터널을 통해 전달할 수도 있다. 또 다른 방법으로 두 터널의 종단점 간에 VNID 별로 터널을 복수개 만들어서 복수개의 터널을 통해 패킷을 전달할 수도 있다.

<35> 터널 관리부(300)는 생성한 터널의 종단점이 에지 터널 종단점인 경우, 각 도메인 VSI(320, 330)에 해당 에지 터널 종단점과 연계된 에지 가상 포트(edge virtual port)를 생성할 수 있다. 터널 관리부(300)는 생성한 터널의 종단점이 도메인 터널 종단점인 경우, 각 도메인 VSI(320, 330)에 해당 도메인 터널 종단점과 연계된 도메인 가상 포트(domain virtual port)를 생성할 수 있다. 본 발명의 실시예에 따르면, 가상 포트는 터널의 종단점이 속해있는 각각의 VNID에 대응되는 도메인 VSI(320, 330)에 가상 포트를 생성하거나 또는 관리의 편리성을 위해서 도메인 터널 종단점 내의 모든 도메인 VSI(320, 330)에 터널 종단점 별로 가상 포트를 생

성할 수 있다.

<36> 도메인 VSI 관리부(310)는 외부로부터 전달된 가상 네트워크 식별자를 수신하여 수신한 VNID에 대응되는 도메인 VSI를 생성할 수 있다. 망 전체의 네트워크 가상화를 관리하는 네트워크 가상화 관리부(network virtualization manager)가 가상 네트워크를 생성하게 되면, 네트워크 가상화 관리부는 생성된 가상 네트워크의 식별자인 VNID(virtual network identifier)에 대한 정보를 각 도메인 터널 종단점으로 전송할 수 있다. 본 발명의 일 실시예에 따른 도메인 VSI 관리부(320)는 이러한 VNID를 수신하여 그에 대응되는 도메인 VSI를 생성하는 것이다.

<37> 도메인 VSI(320, 330)는 VNID 별로 존재할 수 있다. 도메인 VSI(320, 330)는 수신한 패킷의 오리지널 L2 헤더를 기반으로 도메인 VSI(320, 330)에 적용되는 변형된 L2 스위칭 규칙에 따라서 스위칭을 수행하여 패킷을 목적지 터널 종단점과 연결된 목적지 가상 포트에 전달할 수 있다. 즉, 오리지널 목적지 호스트가 다른 네트워크 가상화 도메인에 있는 경우, 도메인 VSI(320, 330)에서는 스위칭을 기반으로 오리지널 목적지 호스트가 있는 네트워크 가상화 도메인의 도메인 터널 종단점과 연결된 가상 포트에 패킷을 출력하여 터널 패킷 생성부(350)로 패킷을 전달할 수 있다. 그리고, 목적지 호스트가 동일 가상화 도메인에 있는 경우, 도메인 VSI(320, 330)에서는 L2 스위칭을 수행하여 목적지 호스트가 속한 에지 터널 종단점과 연결된 가상 포트에 패킷을 출력하여 터널 패킷 생성부(350)로 패킷을 전달할 수 있다.

<38> 터널 패킷 종단부(340)는 입력된 패킷의 터널 헤더로부터 VNID 및 송신 터널

종단점의 L3 주소에 대한 정보를 획득할 수 있다. 터널 패킷 종단부(340)는 패킷의 VNID에 해당하는 도메인 VSI에 패킷을 전달할 수 있다.

<39> 터널 패킷 생성부(350)는 수신 패킷의 도메인 VSI 정보에서 VNID를 알아내어 수신 패킷에 VN 헤더를 포함시킬 수 있다. 구체적으로 터널 패킷 생성부(350)는 도메인 VSI 출력 가상 포트 정보로부터 목적지 터널 종단점의 L3 주소를 알아내어 터널 L3 헤더를 생성하고 생성된 헤더를 붙여서 새로운 터널 패킷을 완성시킨 후에 다른 가상 네트워크 도메인으로 전달할 수 있다.

<40> 도 4는 본 발명의 실시예에 따른 도메인 터널 종단점에서의 패킷 처리 과정을 나타낸 순서도이다.

<41> 도 4를 참조하면, 터널 패킷 종단부에서 도메인 VSI로 패킷을 전달한다(단계 S400).

<42> 터널 패킷 종단부는 외부로부터 수신한 터널 패킷의 터널 헤더로부터 터널 종단점의 L3 주소와 패킷에 대응되는 VNID에 대한 정보를 획득할 수 있다. 터널 패킷 종단부는 도메인 VSI에서 패킷의 L2 헤더를 기반으로 L2 스위칭을 할 수 있도록 패킷을 수정할 수 있다. 터널 패킷 종단부는 수정한 패킷을 VNID와 연계된 도메인 VSI로 전송할 수 있다. 이때, 패킷은 송신 L3 주소와 1:1로 맵핑되어 있는 가상 포트에 입력될 수 있다.

<43> 도메인 VSI가 패킷에 대해 L2 스위칭을 수행한다(단계 S410).

<44> 도메인 VSI는 패킷에 포함된 L2 헤더를 기반으로 변형된 L2 스위칭을 수행할 수 있다. 도메인 VSI에서 L2 스위칭을 기반으로 한 패킷 처리는 패킷의 L2 소스 주소, L2 목적지 주소를 기반으로 수행될 수 있다. 도메인 VSI에서 패킷에 대해 L2 스위칭이 수행되는 방법에 대해서는 구체적으로 후술한다.

<45> 도메인 VSI에서 터널 패킷 생성부로 패킷을 전송한다(단계 S420).

<46> L2 스위칭을 수행한 패킷은 목적지 가상 포트에 따라 해당 도메인 내의 에지 터널 종단점 또는 다른 가상 네트워크 도메인의 도메인 터널 종단점으로 전달되기 위해 터널 패킷 생성부로 전달된다.

<47> 터널 패킷 생성부에서 패킷에 터널 헤더를 추가하여 전송한다(단계 S430).

<48> 도메인 VSI에서 스위칭된 패킷은 터널 패킷 생성부에서 터널 헤더를 붙여서 외부로 전송될 수 있다. 패킷에 추가되는 터널 헤더의 VN 헤더는 패킷을 스위칭한 도메인 VSI의 VNID를 기반으로 생성될 수 있다. 또한, 터널 패킷 생성부에서 생성되는 터널 헤더의 L3 SA 헤더는 현재 도메인 터널 종단점의 주소를 포함하고, 터널 헤더의 L3 DA 헤더는 패킷의 도메인 VSI 출력 가상 포트 정보로부터 획득된 다른 도메인 터널 종단점, 또는 동일 도메인 내의 목적지 에지 터널 종단점의 주소가 포함될 수 있다.

<49> 도 5는 본 발명의 실시예에 따른 도메인 VSI에서 수행되는 L2 스위칭을 나타낸 순서도이다.

- <50> 도 5를 참조하면, 도메인 VSI는 입력된 패킷의 L2 SA에 대한 정보를 획득한다(단계 S500).
- <51> 도메인 VSI는 입력된 패킷의 L2 DA가 이미 알고 있는 유니캐스트 주소인지 여부를 판단한다(단계 S510).
- <52> L2 DA가 도메인 VSI에 이미 러닝된 유니캐스트 주소인 경우, 도메인 VSI에서 해당 가상 포트를 찾아서 해당 가상 포트에 패킷을 전달할 수 있다(단계 S520).
- <53> 반대로 목적지 L2 주소가 알 수 없는 유니캐스트 주소이거나, 목적지 L2가 멀티캐스트, 브로드캐스트를 지시하는 경우, 입력 가상 포트 타입에 따라 변형된 플로딩(flooding) 방법을 결정할 수 있다(단계 S530).
- <54> 만약, 입력 가상 포트 타입이 에지 가상 포트인 경우, 도메인 VSI 내의 모든 도메인 가상 포트에게만 플로딩을 수행한다(단계 S540).
- <55> 만약, 입력 가상 포트 타입이 도메인 가상 포트인 경우, 도메인 VSI 내의 모든 에지 가상 포트에게만 플로딩을 수행한다(단계 S550).
- <56> 도 6a 및 도6b는 본 발명의 실시예에 따른 도메인 VSI에서의 플로딩을 나타낸 개념도이다.
- <57> 도 6a 및 도6b를 참조하면, 입력 가상 포트 타입이 에지 가상 포트라면 에지 가상 포트로는 플로딩을 수행하지 않고 도메인 가상 포트로만 플로딩을 수행할 수 있다. 반대로 입력 가상 포트 타입이 도메인 가상 포트일 때는 같은 타입인 도메인

가상 포트로는 플로딩하지 않고 에지 가상 포트로만 플로딩할 수 있다. 이러한 변형 플로딩 규칙은 플로딩에 의한 포워딩 루프(forwarding loop) 생성을 방지하기 위해 사용될 수 있다.

<58> 전술한 바와 같은 본 발명의 실시예에 따른 멀티 도메인 네트워크 가상화 방법을 사용함으로써 L3 터널로 구성하는 오버레이 기반 네트워크 가상화 방법의 확장을 제공할 수 있다. 즉, 풀-메쉬 L3 오버레이 터널 방식으로 만들 수 있는 적정 규모의 네트워크 가상화 도메인을 복수개 생성하고, 각 도메인마다 도메인 터널 종단점(Domain Tunnel End Point)을 두고, 도메인 터널 종단점간의 풀-메쉬 연결을 수행하는 것 만으로 다수의 도메인을 통합한 대규모의 하나의 네트워크 가상화 도메인을 생성할 수 있다. 이를 통해 네트워크 가상화 도메인에 필요한 터널의 수를 크게 줄여 대규모의 네트워크 가상화 도메인을 구축할 수 있다.

<59> 이상 실시예를 참조하여 설명하였지만, 해당 기술 분야의 숙련된 당업자는 하기의 특허 청구의 범위에 기재된 본 발명의 사상 및 영역으로부터 벗어나지 않는 범위 내에서 본 발명을 다양하게 수정 및 변경시킬 수 있음을 이해할 수 있을 것이다.

【특허 청구범위】

【청구항 1】

네트워크 가상화 장치에 있어서,

가상 네트워크의 터널 종단점 정보를 수집하고, 상기 수집한 터널 종단점 정보를 바탕으로 각 터널 종단점과 터널을 연결하는 터널 관리부;

터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하여 도메인 VSI(virtual switching instance)로 전달하는 터널 패킷 종단부;

상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 스위칭을 수행하여 터널 패킷 생성부로 전달하는 도메인 VSI; 및

상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 터널 패킷 생성부를 포함하는 것을 특징으로 하는 네트워크 가상화 장치.

【청구항 2】

제1항에 있어서,

상기 도메인 VSI는, 상기 L2 스위칭 수행 시,

상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 SA(source address) 정보를 획득하고,

상기 L2 스위칭을 할 수 있도록 처리된 패킷의 L2 DA(destination address)

정보가 이미 러닝된 유니캐스트 주소인지 여부를 판단하며,

상기 L2 DA 정보가 이미 러닝된 유니캐스트 주소가 아니거나 멀티캐스트 또는 브로드캐스트를 지시하는 경우, 입력 가상 포트 타입을 기반으로 한 플로딩을 수행하되,

상기 플로딩은 상기 입력 가상 포트 타입이 에지 가상 포트인 경우, 상기 도메인 VSI 내의 모든 도메인 가상 포트에게만 수행되고, 상기 입력 가상 포트 타입이 도메인 가상 포트인 경우, 상기 도메인 VSI 내의 모든 에지 가상 포트에게만 수행되는 것을 특징으로 하는 네트워크 가상화 장치.

【청구항 3】

제2항에 있어서,

상기 도메인 VSI는, 상기 L2 스위칭 수행 시,

상기 L2 DA 정보가 이미 러닝된 유니캐스트 주소인 경우, 상기 유니캐스트 주소에 대응되는 목적지 가상 포트에 상기 L2 스위칭을 할 수 있도록 처리된 패킷을 전달하고, 상기 목적지 가상 포트로부터 상기 패킷의 목적지 터널 종단점의 L3 주소를 획득하는 것을 특징으로 하는 네트워크 가상화 장치.

【청구항 4】

제1항에 있어서,

상기 터널 패킷 종단부는,

수신한 상기 터널 패킷의 터널 헤더로부터 상기 터널 패킷의 VNID 및 송신 터널 종단점의 L3 주소 정보를 획득하고,

상기 터널 패킷을 L2 스위칭을 할 수 있도록 패킷을 처리하며,

상기 송신 터널 종단점과 연계된 가상포트를 통해 상기 VNID에 대응되는 도메인 VSI에 상기 L2 스위칭을 할 수 있도록 처리된 패킷을 전달하는 것을 특징으로 하는 네트워크 가상화 장치.

【청구항 5】

제1항에 있어서,

상기 터널 패킷 생성부는,

상기 L2 스위칭을 수행한 패킷에 대해, 상기 도메인 VSI에 대응되는 VNID를 포함하는 VN 헤더(Virtual Network Header)와 상기 L2 스위칭을 수행한 패킷의 목적지 가상 포트로부터 획득한 목적지 터널 종단점 L3 주소를 바탕으로 L3 터널 헤더를 생성하고, 상기 VN 헤더와 상기 L3 터널 헤더를 상기 L2 스위칭을 수행한 패킷에 결합하여 전송하는 것을 특징으로 하는 네트워크 가상화 장치.

【청구항 6】

제1항에 있어서,

망 전체의 네트워크 가상화를 관리하는 네트워크 가상화 관리부(network virtualization manager)로부터 가상 네트워크의 VNID(Virtual Network ID)를 수신하여 그에 대응하는 도메인 VSI(Domain Virtual Switching Instance)를 생성하는 도메인 VSI 관리부를 더 포함하는 것을 특징으로 하는 네트워크 가상화 장치,

【청구항 7】

네트워크 가상화 장치의 동작 방법에 있어서,
가상 네트워크의 터널 종단점 정보를 수집하고, 상기 수집한 터널 종단점 정보를 바탕으로 각 터널 종단점과 터널을 연결하는 단계;
터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하는 단계;
상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 스위칭을 수행하는 단계; 및
상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 단계를 수행하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 8】

제7항에 있어서,
상기 L2 스위칭 수행하는 단계는,

상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 SA(source address) 정보를 획득하는 단계;

상기 L2 스위칭을 할 수 있도록 처리된 패킷의 L2 DA(destination address) 정보가 이미 러닝된 유니캐스트 주소인지 여부를 판단하는 단계; 및

상기 L2 DA 정보가 이미 러닝된 유니캐스트 주소가 아니거나 멀티캐스트 또는 브로드캐스트를 지시하는 경우, 입력 가상 포트 타입을 기반으로 한 플로딩을 수행하되,

상기 플로딩은 상기 입력 가상 포트 타입이 에지 가상 포트인 경우, 도메인 VSI 내의 모든 도메인 가상 포트에게만 수행되고, 상기 입력 가상 포트 타입이 도메인 가상 포트인 경우, 상기 도메인 VSI 내의 모든 에지 가상 포트에게만 수행되는 단계를 포함하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 9】

제8항에 있어서,

상기 L2 스위칭을 할 수 있도록 처리된 패킷의 상기 L2 DA(destination address) 정보가 이미 러닝된 유니캐스트 주소인지 여부를 판단하는 단계에서,

상기 L2 DA 정보가 이미 러닝된 유니캐스트 주소인 경우, 상기 유니캐스트 주소에 대응되는 목적지 가상 포트에 상기 L2 스위칭을 할 수 있도록 처리된 패킷을 전달하고, 상기 목적지 가상 포트로부터 상기 패킷의 목적지 터널 종단점의 L3

주소를 획득하는 단계를 더 포함하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 10】

제7항에 있어서,

상기 터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하는 단계는,

수신한 상기 터널 패킷의 터널 헤더로부터 상기 터널 패킷의 VNID 및 송신 터널 종단점의 L3 주소 정보를 획득하는 단계;

상기 터널 패킷을 L2 스위칭을 할 수 있도록 패킷을 처리하는 단계; 및

상기 송신 터널 종단점과 연계된 가상포트를 통해 상기 VNID에 대응되는 도메인 VSI에 상기 L2 스위칭을 할 수 있도록 처리된 패킷을 전달하는 단계를 포함하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 11】

제7항에 있어서,

상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 단계는,

상기 L2 스위칭을 수행한 패킷에 대해, 도메인 VSI에 대응되는 VNID를 포함

하는 VN 헤더(Virtual Network Header)와 상기 L2 스위칭을 수행한 패킷의 목적지 가상 포트로부터 획득한 목적지 터널 종단점 L3 주소를 바탕으로 L3 터널 헤더를 생성하는 단계; 및

상기 VN 헤더와 상기 L3 터널 헤더를 상기 L2 스위칭을 수행한 패킷에 결합하여 전송하는 단계를 포함하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 12】

제7항에 있어서,

가상 네트워크의 터널 종단점 정보를 수집하고, 상기 수집한 터널 종단점 정보를 바탕으로 각 터널 종단점과 터널을 연결하는 단계 전에,

망 전체의 네트워크 가상화를 관리하는 네트워크 가상화 관리부(network virtualization manager)로부터 가상 네트워크의 VNID(Virtual Network ID)를 수신하여 그에 대응하는 도메인 VSI(Domain Virtual Switching Instance)를 생성하는 단계를 더 포함하는 것을 특징으로 하는 네트워크 가상화 장치의 동작 방법.

【청구항 13】

네트워크 가상화 방법에 있어서,

도메인 터널 종단점과 적어도 하나 이상의 에지 터널 종단점으로 구성된 네트워크 가상 도메인을 적어도 두 개 이상 생성하는 단계; 및

상기 각 네트워크 가상 도메인의 도메인 터널 종단점 간에 L3 터널을 이용하여 풀-메쉬(full-mesh)로 연결하는 단계를 포함하고,

상기 도메인 터널 종단점과 상기 적어도 하나 이상의 에지 터널 종단점은 L3 터널을 기반으로 연결되는 것을 특징으로 하는 네트워크 가상화 방법.

【청구항 14】

제13항에 있어서,

상기 도메인 터널 종단점은,

에지 터널 종단점 및 다른 도메인 터널 종단점들에서 수신한 패킷의 터널 헤더를 제거하는 단계;

상기 수신한 패킷이 속한 가상 네트워크 별로 생성된 가상 스위치에서 오리지널 패킷의 L2 헤더기반 L2 스위칭을 수행하는 단계; 및

목적지 호스트가 속한 터널 종단점 방향으로 연결된 터널을 찾아 상기 오리지널 패킷을 다시 터널링하여 전송하는 단계를 수행하는 것을 특징으로 하는 네트워크 가상화 방법.

【요약서】

【요약】

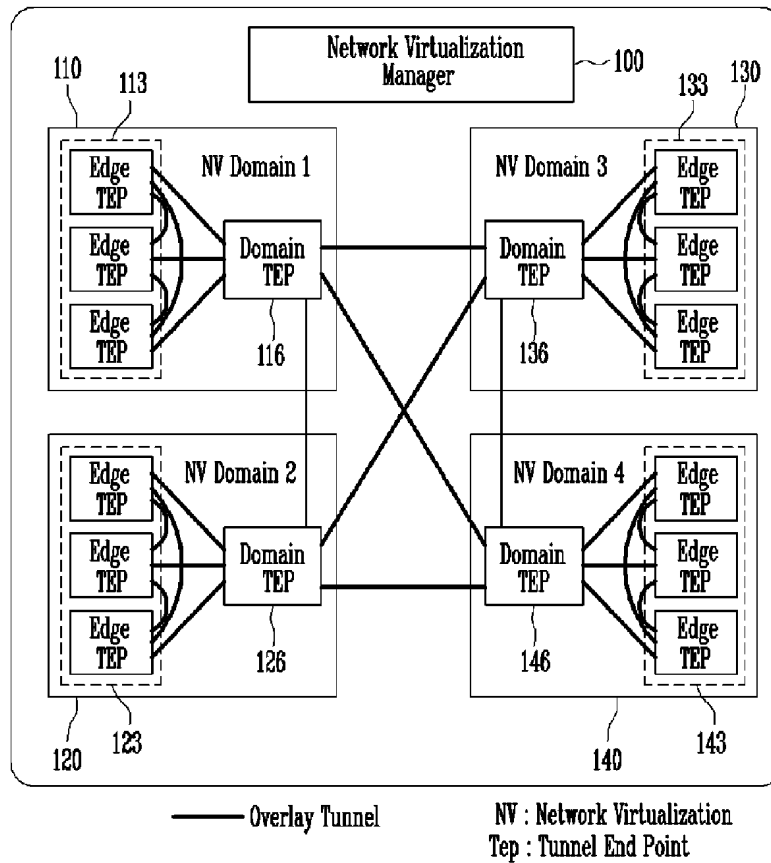
네트워크 가상화 방법 및 장치가 개시되어 있다. 본 발명의 실시예에 따른 네트워크 가상화 장치는, 가상 네트워크의 터널 종단점 정보를 수집하고, 상기 수집한 터널 종단점 정보를 바탕으로 각 터널 종단점과 터널을 연결하는 터널 관리부, 터널 패킷을 수신하여 L2 스위칭을 할 수 있도록 패킷을 처리하여 도메인 VSI(virtual switching instance)로 전달하는 터널 패킷 종단부, 상기 L2 스위칭을 할 수 있도록 처리된 패킷에 대하여 L2 스위칭을 수행하여 터널 패킷 생성부로 전달하는 도메인 VSI 및 상기 L2 스위칭을 수행한 패킷에 대하여 터널 헤더를 추가하여 새로운 터널 패킷을 생성하고, 상기 새로운 터널 패킷을 전송하는 터널 패킷 생성부를 포함하는 것을 특징으로 한다.

【대표도】

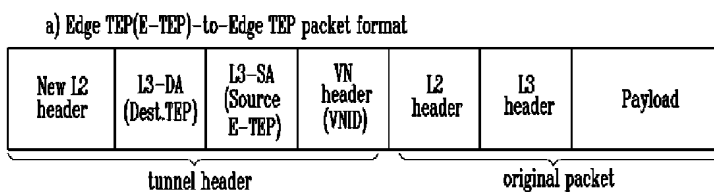
도 3

【도면】

【도 1】

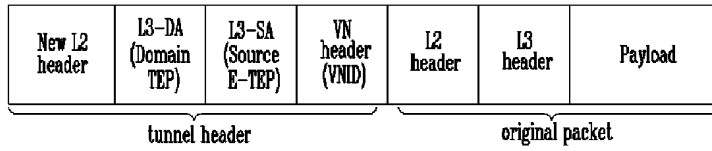


【도 2a】



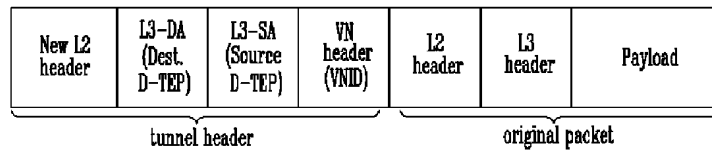
【 도 2b 】

b) Edge TEP-to-Domain TEP(D-TEP) packet format

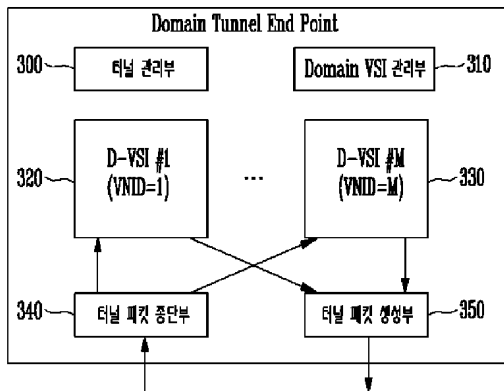


【 도 2c 】

c) Domain TEP - to - Edge TEP packet format

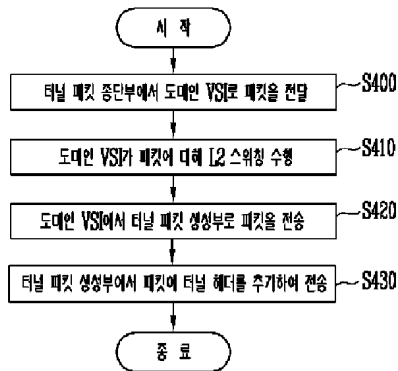


【 도 3 】

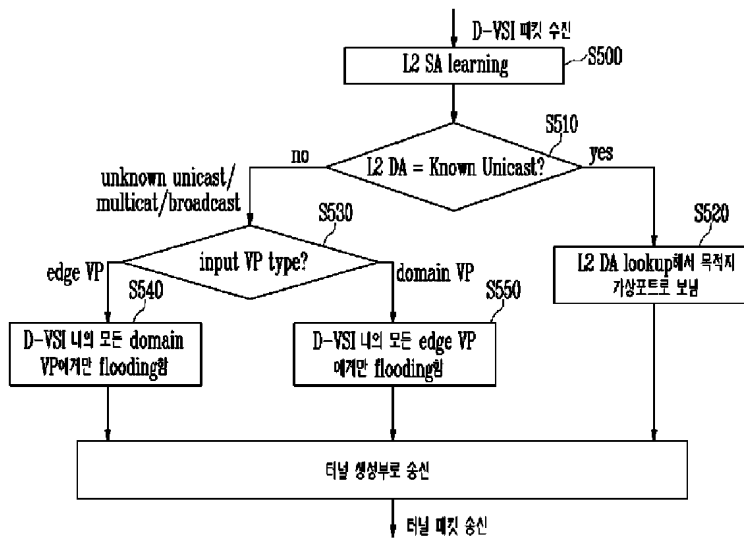


D-VSI = Domain Virtual Switching Instance
VNID = Virtual Network ID

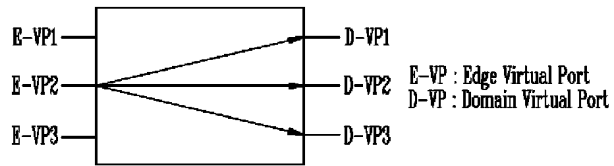
【도 4】



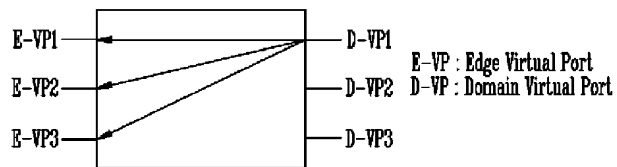
【도 5】



【도 6a】



【도 6b】





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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
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224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

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Publication No.US-2015-0188728-A1

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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.

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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.

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



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528
26530 7590 03/07/2017 LADAS & PARRY LLP 224 SOUTH MICHIGAN AVENUE SUITE 1600 CHICAGO, IL 60604			EXAMINER HAN, CLEMENCE S	
			ART UNIT	PAPER NUMBER
			2414	
			NOTIFICATION DATE	DELIVERY MODE
			03/07/2017	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

Office Action Summary	Application No. 14/583,303	Applicant(s) BYUN, SUNG HYUK	
	Examiner CLEMENCE HAN	Art Unit 2414	AIA (First Inventor to File) Status Yes

-- 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 2 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 12/26/2014.
☐ 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) 1-14 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) ____ is/are rejected.
- 8) ☐ Claim(s) ____ is/are objected to.
- 9) ☒ Claim(s) 1-14 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 ____ 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: ____. |

Election/Restrictions

1. Restriction to one of the following inventions is required under 35 U.S.C. 121:
 - I. Claims 1-12, drawn to generating a new tunnel packet, see Figure 5.
 - II. Claims 13 and 14, drawn to generating network virtualization domains, see Figure 1.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as subcombinations disclosed as usable together in a single combination. The subcombinations are distinct if they do not overlap in scope and are not obvious variants, and if it is shown that at least one subcombination is separately usable. In the instant case, subcombination I has separate utility such as generating a new tunnel packet and subcombination II has separate utility such as generating network virtualization domains. See MPEP § 806.05(d).

The examiner has required restriction between subcombinations usable together. Where applicant elects a subcombination and claims thereto are subsequently found allowable, any claim(s) depending from or otherwise requiring all the limitations of the allowable subcombination will be examined for patentability in accordance with 37 CFR 1.104. See MPEP § 821.04(a). Applicant is advised that if any claim presented in a continuation or divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application.

Restriction for examination purposes as indicated is proper because all these inventions listed in this action are independent or distinct for the reasons given above and there would be a serious search and/or examination burden if restriction were not required because at least the following reason(s) apply:

The inventions require a different field of search.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of an invention to be examined even though the requirement may be traversed (37 CFR 1.143) and (ii) identification of the claims encompassing the elected invention.

The election of an invention may be made with or without traverse. To reserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the restriction requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable upon the elected invention.

Should applicant traverse on the ground that the inventions are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the inventions to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable

over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CLEMENCE HAN whose telephone number is (571)272-3158. The examiner can normally be reached on Monday-Friday 8-4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edan Orgad can be reached on (571) 272-7884. 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.

/CLEMENCE HAN/
Primary Examiner, Art Unit 2414

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application:	Sung Hyuk BYUN	}	Art Unit: 2414
		}	
Serial No:	14/583,303	}	Ex.: Han, Clemence S.
		}	
Filed:	December 26, 2014	}	
		}	
For:	METHOD AND APPARATUS FOR NETWORK VISUALIZATION		

RESPONSE TO RESTRICTION REQUIREMENT

The Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

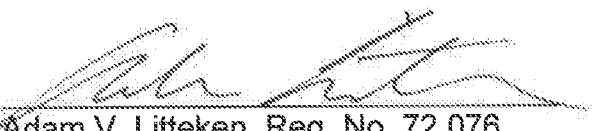
In the office action dated March 7, 2017, setting a two-month shortened statutory period for a reply ending on May 7, 2017, the pending claims 1-14 were restricted as follows:

- Group I:** Claims 1-12 drawn to generating a new tunnel packet; and
Group II: Claims 13 and 14, drawn to generating network visualization domains.

Applicant hereby elects **Group 1, Claims 1-12**, drawn to generating a new tunnel packet. Applicant retains the right to present the non-elected in a divisional application. No fee is believed to be required with this amendment, but, if this is not the case, please charge the requisite fee (or credit any overpayment) to Deposit Account No. 12-0400.

Respectfully submitted,

Dated: May 5, 2017


Adam V. Litteken, Reg. No. 72,076
Ladas & Parry
224 South Michigan Avenue
Chicago, Illinois 60604
(312) 427-1300

Electronic Acknowledgement Receipt

EFS ID:	29132153
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Adam Vincent Litteken/Lauren Coppinger
Filer Authorized By:	Adam Vincent Litteken
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	05-MAY-2017
Filing Date:	26-DEC-2014
Time Stamp:	16:59:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Response to Election / Restriction Filed	71729-RR.pdf	62414	no	1
			dd90b175fad1e17041a4b0a37f104c01f13c320f		

Warnings:

Information:	
Total Files Size (in bytes):	62414
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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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528
26530 7590 08/14/2017 LADAS & PARRY LLP 224 SOUTH MICHIGAN AVENUE SUITE 1600 CHICAGO, IL 60604			EXAMINER HAN, CLEMENCE S	
			ART UNIT	PAPER NUMBER
			2414	
			NOTIFICATION DATE	DELIVERY MODE
			08/14/2017	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

Office Action Summary	Application No. 14/583,303	Applicant(s) BYUN, SUNG HYUK	
	Examiner CLEMENCE HAN	Art Unit 2414	AIA (First Inventor to File) Status Yes

-- 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 05/05/2017.
☐ 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) 1-14 is/are pending in the application.
5a) Of the above claim(s) 13 and 14 is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 1-10 is/are rejected.
- 8) ☒ Claim(s) 11 and 12 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 ____ 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)
- 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date ____.
- 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 4) ☐ Other: ____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

5. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Objections

6. Claim 2 is objected to because of the following informalities: There is a missing comma or semicolon after “the processed packet” in line 3. Appropriate correction is required.

7. Claim 5 is objected to because of the following informalities: An acronym, VNID, is used without its definition. Appropriate correction is required.

8. Claim 8 is objected to because of the following informalities: There is a double comma after “broadcast address” in line 9. Appropriate correction is required.

9. Claim 11 is objected to because of the following informalities: An acronym, VNID, is used without its definition. Appropriate correction is required.

Claim Rejections - 35 USC § 112

10. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 2-6 and 8-10 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and

distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

12. Claim 2 recites the limitation "the type" in line 6. There is insufficient antecedent basis for this limitation in the claim.

13. Claim 2 recites the limitation "the input virtual port" in line 6. There is insufficient antecedent basis for this limitation in the claim.

14. Regarding claim 4, the phrase "a tunnel header" in line 3 renders the claim indefinite because it is unclear whether the same domain VSI cited in claim 1 or not.

15. Regarding claim 4, the phrase "a domain VSI" in line 6 renders the claim indefinite because it is unclear whether the same domain VSI cited in claim 1 or not.

16. Regarding claim 5, the phrase "a domain VSI" in line 4 renders the claim indefinite because it is unclear whether the same domain VSI cited in claim 1 or not.

17. Regarding claim 6, the phrase "a domain VSI" in line 4 renders the claim indefinite because it is unclear whether the same domain VSI cited in claim 1 or not.

18. Claim 8 recites the limitation "the type" in line 7. There is insufficient antecedent basis for this limitation in the claim.

19. Claim 8 recites the limitation "the input virtual port" in line 7. There is insufficient antecedent basis for this limitation in the claim.

20. Claim 8 recites the limitation "the domain VSI" in line 10. There is insufficient antecedent basis for this limitation in the claim.

21. Regarding claim 10, the phrase "a tunnel header" in line 5 renders the claim indefinite because it is unclear whether the same domain VSI cited in claim 1 or not.

Double Patenting

22. 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 conflicting claims 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); *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 nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined 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/patent/patents-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 www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

23. Claims 1, 4, 7 and 10 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 2 of copending Application No. 14/822,994. Although the claims at issue are not identical, they are not patentably distinct from each other because the application's claims merely broaden the scope of the copending application's claims by not claiming some claim elements (i.e. VNID management unit).

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

Claim 1 of Instant Application	Claim 1 of 14/822,994
A network virtualization apparatus comprising: a tunnel manager configured to collect tunnel end point information	A proxy tunnel end point apparatus comprising: a tunnel management unit configured to generate a tunnel to be

within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected;	connected to each of a plurality of tunnel end point units of a plurality of node units that include a first node unit and second node unit;
	a VNID management unit configured to generate a VSI (Virtual Switching Instance) for each VNID (Virtual Network Identifier), which is set for each virtual network;
a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance);	a tunnel packet end point unit configured to receive a packet through the tunnel connected to a first tunnel end point unit of the first node unit and to terminate the tunnel, extract VNID information from a tunnel header of the packet, and transmit the terminated L2 packet to the VSI corresponding to the VNID;
the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the packet to a tunnel packet generator; and	a VSI unit having a virtual port corresponding to each terminated tunnel in the tunnel packet end point unit, and configured to perform L2 switching on the terminated L2 packet transmitted from the

	tunnel packet end point unit and to transmit the L2 packet to a destination virtual port; and
the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet.	a tunnel packet generation unit configured to transmit the packet to a second tunnel end point unit of the second node unit that is a destination of transmission, based on destination virtual port information at the VSI.

Claim Rejections - 35 USC § 102

24. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

25. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(a)(2) the claimed invention was described in a patent issued under section 151, or in an application for patent published or deemed published under section 122(b), in which the patent or application, as the case may be, names another inventor and was effectively filed before the effective filing date of the claimed invention.

26. Claim(s) 1 and 7 is/are rejected under 35 U.S.C. 102(a)(2) as being anticipated by Davie et al. (US Pub. 2015/0100704).

Regarding claims 1 and 7, Davie teaches a network virtualization apparatus comprising: a tunnel manager configured to collect tunnel end point information within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected [0132]; a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance) [0135], [0139]; the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the packet to a tunnel packet generator [0135], [0139]; and the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet [0135], [0139].

Allowable Subject Matter

27. Claims 2, 3, 5, 6, 8 and 9 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

28. Claims 4 and 10 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims and the terminal disclaimer is timely filed to overcome the rejection based on nonstatutory double patenting, set forth in this Office action..

29. Claims 11 and 12 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CLEMENCE HAN whose telephone number is (571)272-3158. The examiner can normally be reached on Monday-Friday 8-4.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edan Orgad can be reached on (571) 272-7884. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/CLEMENCE HAN/
Primary Examiner, Art Unit 2414

Notice of References Cited	Application/Control No. 14/583,303		Applicant(s)/Patent Under Reexamination BYUN, SUNG HYUK	
	Examiner CLEMENCE HAN		Art Unit 2414	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-2010/0208615 A1	08-2010	Soon; Yee Ming	H04L12/462	370/254
*	B	US-2010/0309894 A1	12-2010	Csaszar; Andras	H04L12/4641	370/338
*	C	US-2014/0269702 A1	09-2014	Moreno; Victor Manuel	H04L45/64	370/390
*	D	US-2014/0355419 A1	12-2014	PILLAI; KIRAN SASIDHARAN	H04L41/0654	370/225
*	E	US-2015/0100704 A1	04-2015	Davie; Bruce	H04L45/14	709/238
*	F	US-9,686,180 B2	06-2017	Chu; Kit Chiu	H04L45/28	1/1
	G	US-				
	H	US-				
	I	US-				
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	K	US-				
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*		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.



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BIB DATA SHEET

CONFIRMATION NO. 1528

SERIAL NUMBER 14/583,303	FILING or 371(c) DATE 12/26/2014 RULE	CLASS 370	GROUP ART UNIT 2414	ATTORNEY DOCKET NO. CU-71729 AVL		
APPLICANTS ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE, Daejeon, KOREA, REPUBLIC OF; INVENTORS Sung Hyuk BYUN, Daejeon, KOREA, REPUBLIC OF; ** CONTINUING DATA ***** ** FOREIGN APPLICATIONS ***** REPUBLIC OF KOREA 10-2013-0165299 12/27/2013 REPUBLIC OF KOREA 10-2014-0136067 10/08/2014 ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** ** SMALL ENTITY ** 01/14/2015						
Foreign Priority claimed ☒ Yes ☐ No 35 USC 119(a-d) conditions met ☒ Yes ☐ No Verified and Acknowledged <u>/CLEMENCE S HAN/</u> Examiner's Signature		☐ Met after Allowance Initials	STATE OR COUNTRY KOREA, REPUBLIC OF	SHEETS DRAWINGS 4	TOTAL CLAIMS 14	INDEPENDENT CLAIMS 3
ADDRESS LADAS & PARRY LLP 224 SOUTH MICHIGAN AVENUE SUITE 1600 CHICAGO, IL 60604 UNITED STATES						
TITLE METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION						
FILING FEE RECEIVED 730	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			

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/05a (51-10)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		14583303	
	Filing Date		2014-12-26	
	First Named Inventor	Sung Hyuk BYUN		
	Art Unit			
	Examiner Name			
	Attorney Docket Number		CU-71729	

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	8223770	B2	2012-07-17	Wray et al.	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20130294231	A1	2013-11-07	Nodir et al.	
	2	20130343385	A1	2013-12-26	Benny et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	1020130126833	KR	A	2013-11-21	ETRI		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	14583303
Filing Date	2014-12-26
First Named Inventor	Sung Hyuk BYUN
Art Unit	
Examiner Name	
Attorney Docket Number	CU-71729

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/CLEMENCE S HAN/	Date Considered	08/05/2017
--------------------	------------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.18 if possible. * Applicant is to place a check mark here if English language translation is attached.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4782	tunnel adj2 ("end point" endpoint)	US-PGPUB; USPAT	OR	ON	2017/08/05 11:07
L2	28	virtual adj switch\$4 adj instance and 1	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
L3	17	2 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
L4	13	2 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
L5	19	3 4	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
L6	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/05 11:18
L7	6	(US-20150100704-\$ or US-20140355419-\$ or US-20140269702-\$ or US-20100309894-\$ or US-20100208615-\$).did. or (US-9686180-\$).did.	US-PGPUB; USPAT	OR	ON	2017/08/05 11:18
L8	6	6 7	US-PGPUB; USPAT	OR	ON	2017/08/05 11:18
L9	6	("layer 2" l2 ethernet "layer-2") and 8	US-PGPUB; USPAT	OR	ON	2017/08/05 11:19
S1	3	("20130294231" "20130343385" "8223770").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:17
S2	17	sung with hyuk with byun.in.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:18
S3	4	("20070097968" "20130322453" "20150263862" "20150365313").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:30
S4	421	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S5	212	S4 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S6	152	S4 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S7	255	S5 S6	US-PGPUB;	OR	ON	2017/08/04 21:38

			USPAT			
S8	0	vnid and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S9	182	(id identifier) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S10	5353	(H04L12/4633 or H04L45/66).cpc.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S11	61	S7 and S10	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S12	43	tunnel with (end endpoint) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 22:02
S13	26	tunnel with ("end point" endpoint) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 22:02
S14	3	tunnel with ("end point" endpoint) and S3	US-PGPUB; USPAT	OR	ON	2017/08/04 22:08
S15	2	tunnel with ("end point" endpoint) with "l2 switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:10
S16	234	tunnel with ("end point" endpoint) with "switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S17	172	S16 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S18	119	S16 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S19	209	S17 S18	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S20	163	virtual and S19	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S21	38	vxlan and S19	US-PGPUB; USPAT	OR	ON	2017/08/04 22:12
S22	3	(US-20140269702-\$ or US-20150100704-\$).did. or (US-9686180-\$).did.	US-PGPUB; USPAT	OR	ON	2017/08/04 22:19
S23	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S24	4	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S25	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:20
S26	6	S22 S23 S24 S25	US-PGPUB; USPAT	OR	ON	2017/08/04 22:20

8/ 5/ 2017 12:11:00 PM

C:\Users\chan\Documents\EAST\Workspaces\14583303.wsp

Search Notes 	Application/Control No. 14583303	Applicant(s)/Patent Under Reexamination BYUN, SUNG HYUK
	Examiner CLEMENCE HAN	Art Unit 2414

CPC- SEARCHED		
Symbol	Date	Examiner
(H04L12/4633 or H04L45/66).cpc.	8/5/2017	ch

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
inventor search	8/5/2017	ch
(H04L12/4633 or H04L45/66).cpc. see Search History printout	8/5/2017	ch
see Search History printout	8/5/2017	ch

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

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/583,303	Filing Date 12/26/2014	☐ To be Mailed
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ENTITY: ☐ LARGE ☒ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

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), (j), 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

AMENDMENT	(Column 1)	(Column 2)	(Column 3)	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
	10/17/2017	CLAIMS REMAINING AFTER AMENDMENT					
	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X \$40 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X \$210 =	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

AMENDMENT	(Column 1)	(Column 2)	(Column 3)	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)
		CLAIMS REMAINING AFTER AMENDMENT					
	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
ANGELA s. WHITE

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application:	Sung Hyuk BYUN	]	Art Unit: 2414
		]	
Serial No:	14/583,303	]	Ex.: Han, Clemence S.
		]	
Filed:	December 26, 2014	]	
		]	
For:	METHOD AND APPARATUS FOR NETWORK VISUALIZATION		

AMENDMENT UNDER 37 CFR 1.111

Mail Stop Amendment

The Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

In response to the non-final office action dated August 14, 2017, setting a 3-month shortened statutory period for reply ending on November 14, 2017, the Applicant submits the following responsive amendment in the above-identified application. The Applicant hereby authorizes the Commissioner to charge any deficiency of fees and credit any overpayments to Deposit Account Number 12-0400.

Amendments to the Claims are reflected in the listing of claims, which begins on page 2 of this paper.

Remarks begin on page 9 of this paper.

AMENDMENTS TO THE CLAIMS

The listing of claims presented below will replace all prior versions and listings of claims in the application.

Listing of claims:

1. (Original) A network virtualization apparatus comprising:

a tunnel manager configured to collect tunnel end point information within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected;

a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance);

the domain VSI configured to perform the L2 switching on the processed packet , and to transmit the packet to a tunnel packet generator; and

the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet.

2. **(Currently amended)** The apparatus according to claim 1,
wherein the domain VSI, when perform the L2 switching,
obtains L2 SA (source address) information for the processed packet,
determines whether or not L2 DA (destination address) information of the
processed packet is a unicast address already learned, and
performs a flooding based on ~~[[the]]~~ a type of ~~[[the]]~~ an input virtual port, when

the L2 DA information is not already learned unicast address, or is multicast or broadcast address;

wherein the flooding is performed on only domain virtual ports within the domain VSI, when the type of the input virtual port being an edge virtual port, and the flooding is performed on only edge virtual ports within the domain VSI when the type of the input virtual port being a domain virtual port.

3. (Original) The apparatus according to claim 2,
wherein, the domain VSI, when performing the L2 switching,
in response to the L2 DA information being a unicast address already learned, transmits the processed packet to a destination virtual port corresponding to the unicast address, and obtains an L3 address of a destination tunnel end point of the packet from the destination virtual port.

4. (Currently amended) The apparatus according to claim 1,
wherein the tunnel packet end point obtains a VNID (Virtual Network ID) of the tunnel packet and L3 address information of a sending tunnel end point from **[[a]] the** tunnel header of the tunnel packet,
processes the tunnel packet such that the L2 switching may be performed, and transmits the processed packet to **[[a]] the** domain VSI corresponding to the VNID through a virtual port associated with the sending tunnel end point.

5. (Currently amended) The apparatus according to claim 1,

wherein the tunnel packet generator is configured, for the packet for which the L2 switching has been performed, to generate a VN header (virtual network header) including a VNID (Virtual Network ID) corresponding to **[[a]] the** domain VSI and a L3 tunnel header based on a destination tunnel end point L3 address obtained from a destination virtual port of the packet for which the L2 switching has been performed, and to combine the VN header and the L3 tunnel header with the processed packet for which the L2 switching has been performed, and transmit the same.

6. **(Currently amended)** The apparatus according to claim 1,
further comprising a domain VSI manager configured to receive a VNID (virtual network ID) of a virtual network from a network virtualization manager that manages network virtualization of an entire network, and to generate **[[a]] the** domain VSI (domain virtual switching instance) corresponding thereto.

7. **(Currently amended)** An operating method of a network virtualization apparatus, the method comprising:

collecting tunnel end point information within a network virtualization domain,
and connecting each tunnel end point with a tunnel based on the tunnel end point information collected;

receiving a tunnel packet and processing the packet such that a L2 switching may be performed;

performing the L2 switching on the processed packet; **[[and]]**

adding a tunnel header to the packet for which the L2 switching has been

performed to generate a new tunnel packet, and transmitting the new tunnel packet;

and

connecting tunnel end points within the network virtualization domain to other tunnel end points within another network virtualization network domain with a unicast tunnel using the new tunnel packet.

8. (Currently amended) The method according to claim 7,
wherein the performing the L2 switching comprises:
obtaining L2 SA (source address) information for the processed packet such that the L2 switching may be performed;
determining whether or not L2 DA (destination address) information of the processed packet is a unicast address already learned; and
performing a flooding based on ~~[[the]]~~ a type of ~~[[the]]~~ a input virtual port, when the L2 DA information is not the unicast address already learned, or indicates multicast or broadcast address,~~[[,]]~~
wherein the flooding is performed on only domain virtual ports within ~~[[the]]~~ a domain VSI when the type of the input virtual port being an edge virtual port, and the flooding is performed on only edge virtual ports within the domain VSI when the type of the input virtual port being a domain virtual port.

9. (Original) The method according to claim 8,
wherein the determining whether or not the L2 DA (destination address) information of the processed packet is a unicast address already learned further

comprises:

in response to the L2 DA information being the unicast address already learned, transmitting the processed packet to a destination virtual port corresponding to the unicast address, and obtaining the L3 address of destination tunnel end point of the packet from the destination virtual port.

10. **(Currently amended)** The method according to claim 7, wherein the receiving the tunnel packet and processing the packet such that the L2 switching may be performed comprises:

obtaining a VNID (Virtual Network ID) of the tunnel packet and L3 address information of a sending tunnel end point from **[[a]] the** tunnel header of the tunnel packet;

processing the tunnel packet such that the L2 switching may be performed; and transmitting the processed packet to **[[a]] the** domain VSI corresponding to the VNID through a virtual port associated with the sending tunnel end point.

11. **(Currently amended)** The method according to claim 7, wherein the adding a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and transmitting the new tunnel packet comprises:

generating, for the packet for which the L2 switching has been performed, a VN header (Virtual Network Header) including a VNID (Virtual Network ID) corresponding to a domain VSI, and an L3 tunnel header based on a destination tunnel end point L3

address obtained from a destination virtual port of the packet for which the L2 switching has been performed; and

combining the VN header and the L3 tunnel header with the packet for which the L2 switching has been performed, and transmitting the same.

12. (Original) The method according to claim 7,
prior to collecting tunnel end points information within a network, and connecting each tunnel end point with a tunnel based on the tunnel end point information collected,
further comprising receiving a VNID (Virtual Network ID) of the virtual network from a network virtualization manager that manages network virtualization of an entire network and generating a domain VSI (Domain Virtual Switching Instance) corresponding thereto.

13-14. (Canceled)

15. (New) A network virtualization apparatus comprising:
a tunnel manager configured to collect tunnel end point information within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected;
a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance);
the domain VSI configured to perform the L2 switching on the processed packet , and to transmit the packet to a tunnel packet generator; and

the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new unicast tunnel packet, and to transmit the new unicast tunnel packet.

REMARKS

The office action mailed on August 14, 2017, has been reviewed and carefully considered. Reconsideration is respectfully requested.

Status of Claims

Claims 1-14 are now pending in the present application; among them, claims 1, 7, and 13 are independent claims. Claims 13-14 were withdrawn in the previous office action response. Claims 2, 4-8, and 10-11 have been amended. Withdrawn claims 13-14 have been canceled without prejudice. Support can be found at least on paragraph [0026] of the specification. Accordingly, no new matter has been added.

As an initial matter, claims 1-6 have not substantively been amended with regard to patentability. The Applicant notes that MPEP 706.07(a) states that "where the examiner introduces a new ground of rejection that is neither necessitated by applicant's amendment of the claims, nor based on information submitted in an information disclosure statement" a second office action shall not be made final. Therefore, the next office action cannot be made final if any one of claims 1-6 is rejected on new grounds.

Claim Objections and Rejections - 35 U.S.C. § 112

In the office action (page 2), claims 2, 5, 8, and 11 stand objected to because of informalities. In the office action (page 2), claims 2-6 and 8-10 stand rejected under 35 U.S.C. § 112(b) as being indefinite.

The Applicant has amended claims 2, 4-6, and 8-11 to overcome the rejections. Withdrawal of the objections and rejections is respectfully requested.

Double Patenting Rejection

In the office action (page 5), claims 1, 4, 7, and 10 stand provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 2 of copending Application No. 14/822,994.

The Applicant respectfully submits that a terminal disclaimer has been submitted with this response. Withdrawal of the rejection is respectfully requested.

Claim Rejections - 35 U.S.C. §102

In the office action (page 7), claims 1 and 7 stand rejected under 35 U.S.C. §102(a)(2) as being anticipated by U.S. Patent No. 2015/0100704 of Davie *et al.* (Davie).

Regarding claim 1, the Applicant respectfully submits that Davie does not disclose at least “the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet” limitation.

The Examiner asserts that in paragraphs [0135] and [0139] of Davie discloses the claim limitation above. The Applicant respectfully disagrees. Davie discloses a managing software and hardware forwarding elements to define virtual networks. In the data plane of the virtual networks, tunnels are used to extend the virtual network overlay among the hypervisors and third party devices. A variety of tunneling encapsulations may be used (VXLAN, STT, GRE, etc.) [0132] The tunneling encapsulations VXLAN are used when forwarding packets to virtual switch instances. [0135] However, Davie does not disclose that “the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed” because Davie’s encapsulation is performed before the packet is forwarded to the virtual switch instances. Also, Davie does not disclose “generat[ing] a new tunnel packet” either. Rather, Davie switches and classifies virtual interfaces to machine associated information such as port information. [0123], [0125]-[0126]. Accordingly, Davie does not disclose at least “the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a unicast tunnel packet, and to transmit the unicast tunnel packet” limitation. Thus, claim 1 is allowable. Claims 2-6 are also allowable at least by virtue of their dependencies and for their additional features.

Regarding amended claim 7, the Applicant respectfully submits that Davie does not disclose at least the “connecting tunnel end points within the network virtualization domain to other tunnel end points within another network virtualization network domain

with a unicast tunnel using the new tunnel packet" limitation. Accordingly, amended claim 7 is allowable. Claims 8-12 are also allowable at least by virtue of their dependencies and for their additional features.

Allowable Subject Matter

In the office action (page 8), claims 2-6 and 8-12 would be allowable if rewritten to overcome the rejections under 35 U.S.C. 112(b). The Applicant thanks the Examiner for acknowledging the allowable subject matter with respect to claims 2-6 and 8-12.

New Claim

Claim 15 has been added. Support can be found at least on paragraph [0026] of the specification. Claim 15 is also allowable at least for the same reasoning as claim 1 and additional features reciting the "to generate a new unicast tunnel packet, and to transmit the new unicast tunnel packet" limitation.

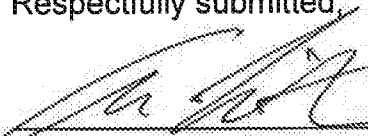
Conclusion

For at least the foregoing reasons, all pending claims are in condition for allowance. Accordingly, the Applicant respectfully requests reconsideration and withdrawal of the rejections.

This amendment is considered to be responsive to all points raised in the office action. The Applicant reserves the right to pursue the original claims and other claims in this and other applications. Should the Examiner have any remaining questions or concerns, the Examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

Dated: October 17, 2017


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224 South Michigan Avenue, Suite 1600
Chicago, Illinois 60604
(312) 427-1300

Electronic Patent Application Fee Transmittal

Application Number:	14583303			
Filing Date:	26-Dec-2014			
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION			
First Named Inventor/Applicant Name:	Sung Hyuk BYUN			
Filer:	Adam Vincent Litteken/Sangik Bae			
Attorney Docket Number:	CU-71729 AVL			
Filed as Small 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:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	2814	1	160	160
Total in USD (\$)				160

Electronic Acknowledgement Receipt

EFS ID:	30677327
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Adam Vincent Litteken/Sangik Bae
Filer Authorized By:	Adam Vincent Litteken
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	17-OCT-2017
Filing Date:	26-DEC-2014
Time Stamp:	13:20:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 160
RAM confirmation Number	101717INTEFSW00014432120400
Deposit Account	120400
Authorized User	ADAM LITTEKEN

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37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
 37 CFR 1.20 (Post Issuance fees)
 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	Terminal Disclaimer Filed	2017-10-17_Terminal_Disclaimer.pdf	94371	no	1
			c8445587c9325a5f88ab3d805da2a73ce001b71c		

Warnings:

Information:

2	Amendment/Req. Reconsideration-After Non-Final Reject	2017-10-17_Filed_OA_Response.pdf	448163	no	11
			f6cae64cc33e405954a566ed297c4105ca349a7c		

Warnings:

Information:

3	Fee Worksheet (SB06)	fee-info.pdf	30498	no	2
			3bc59e6c1cd6c2a3c8ad1b603986eba946bd8010		

Warnings:

Information:

Total Files Size (in bytes):			573032
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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.

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**TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING
REJECTION OVER A PENDING "REFERENCE" APPLICATION**Docket Number (Optional)
CU-71729

In re Application of: Sung Hyuk BYUN

Application No.: 14/583,303

Filed: December 26, 2014

For: METHOD AND APPARATUS FOR NETWORK VISUALIZATION

The applicant, ELEC. & TELECOMM. RESEARCH INST. (ETRI), 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 any patent granted on pending reference Application Number 14/622,994 filed, August 11, 2015, as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

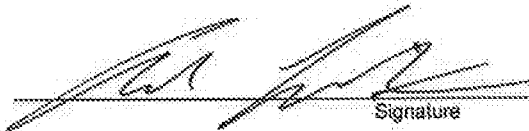
In making the above disclaimer, the applicant does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that: any such patent granted on the pending reference application 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 shortened by any terminal disclaimer filed prior to its grant.

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. 72,076



October 17, 2017

Date

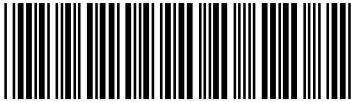
Adam V. Litteken
Typed or printed namePatent Attorney
Title312.427.1300
Telephone Number

- ☒ Terminal disclaimer fee under 37 CFR 1.20(d) is 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.

Application Number 	Application/Control No. 14/583,303	Applicant(s)/Patent under Reexamination BYUN, SUNG HYUK	
Document Code - DISQ		Internal Document – DO NOT MAIL	

TERMINAL DISCLAIMER	☐ APPROVED	☒ DISAPPROVED
Date Filed : 17 October, 2017	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
<u>/CRYSTAL QUEEN/</u> Technology Center: <u>PLRC</u> Telephone: _____ The terminal disclaimer identifies a party who is not the applicant (only for applications filed on or after September 16, 2012; See FP 14.26.10): <u>Below is what needs to be done to correct the defects:</u> <u>For cases filed on/after 9/16/12, 37 CFR 1.321 specifies that the applicant can disclaim, and the terminal disclaimer must specify the extent of the applicant's ownership.</u> <u>A request under 37 CFR 1.46(c) to change the applicant needs to be filed, which is (1) a request, signed by a 1.33(b) party, (2) a corrected ADS (37 CFR 1.76(c)) that identifies the "new" applicant in the applicant information, and is underlined since it is new, and (3) a 3.73(c) statement showing chain of title to the new applicant. Along with the § 1.46(c) request we need a POA that gives power to the attorney who is signing the TD, along with another copy of the TD, unless they file a TD that is signed by the applicant.</u> <u>NOTE: applicant name must match exactly how it is on the ADS.</u> <u>The TD must be re-filed; no new fees are due.</u>



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528
26530 7590 11/03/2017 LADAS & PARRY LLP 224 SOUTH MICHIGAN AVENUE SUITE 1600 CHICAGO, IL 60604			EXAMINER HAN, CLEMENCE S	
			ART UNIT	PAPER NUMBER
			2414	
			NOTIFICATION DATE	DELIVERY MODE
			11/03/2017	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

ChicagoUSPTO@ladas.net

Office Action Summary	Application No. 14/583,303	Applicant(s) BYUN, SUNG HYUK	
	Examiner CLEMENCE HAN	Art Unit 2414	AIA (First Inventor to File) Status Yes

-- 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 10/17/2017.
☐ 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) 1-12 and 15 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) 1,4,7,10 and 15 is/are rejected.
- 8) ☒ Claim(s) 2,3,5,6,8,9,11 and 12 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 ____ 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, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Arguments

2. Applicant's arguments filed 10/17/2017 have been fully considered but they are not persuasive because the terminal disclaimer filed is disapproved.

The terminal disclaimer identifies a party who is not the applicant (only for applications filed on or after September 16, 2012: See FP 14.26.10):

Below is what needs to be done to correct the defects:

For cases filed on/after 9/16/12, 37 CFR 1.321 specifies that the applicant can disclaim, and the terminal disclaimer must specify the extent of the applicant's ownership.

A request under 37 CFR 1.46(c) to change the applicant needs to be filed, which is (1) a request, signed by a 1.33(b) party, (2) a corrected ADS (37 CFR 1.76(c)) that identifies the "new" applicant in the applicant information, and is underlined since it is new, and (3) a 3.73(c) statement showing chain of title to the new applicant. Along with the § 1.46(c) request we need a POA that gives power to the attorney who is signing the TD, along with another copy of the TD, unless they file a TD that is signed by the applicant.

The TD must be re-filed: no new fees are due.

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 conflicting claims 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); *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 nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined 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/patent/patents-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 www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

2. Claims 1, 4, 7, 10 and 15 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1 and 2 of copending Application No. 14/822,994. Although the claims at issue are not identical, they are not patentably distinct from each other because the application's claims merely broaden the scope of the copending application's claims by not claiming some claim elements (i.e. VNID management unit).

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

Claim 1 of Instant Application	Claim 1 of 14/822,994
A network virtualization apparatus comprising: a tunnel manager configured to collect tunnel end point information	A proxy tunnel end point apparatus comprising: a tunnel management unit configured to generate a tunnel to be

within a network, and to connect each tunnel end point with a tunnel based on the tunnel end point information collected;	connected to each of a plurality of tunnel end point units of a plurality of node units that include a first node unit and second node unit;
	a VNID management unit configured to generate a VSI (Virtual Switching Instance) for each VNID (Virtual Network Identifier), which is set for each virtual network;
a tunnel packet end point configured to receive a tunnel packet and process the packet such that an L2 switching may be performed, and to transmit the packet to a domain VSI (virtual switching instance);	a tunnel packet end point unit configured to receive a packet through the tunnel connected to a first tunnel end point unit of the first node unit and to terminate the tunnel, extract VNID information from a tunnel header of the packet, and transmit the terminated L2 packet to the VSI corresponding to the VNID;
the domain VSI configured to perform the L2 switching on the processed packet, and to transmit the packet to a tunnel packet generator; and	a VSI unit having a virtual port corresponding to each terminated tunnel in the tunnel packet end point unit, and configured to perform L2 switching on the terminated L2 packet transmitted from the

	tunnel packet end point unit and to transmit the L2 packet to a destination virtual port; and
the tunnel packet generator configured to add a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet.	a tunnel packet generation unit configured to transmit the packet to a second tunnel end point unit of the second node unit that is a destination of transmission, based on destination virtual port information at the VSI.

Allowable Subject Matter

3. Claims 1, 4, 7, 10 and 15 would be allowable if the terminal disclaimer is timely filed to overcome the rejection based on nonstatutory double patenting, set forth in this Office action.
4. Claims 2, 3, 5, 6, 8, 9, 11 and 12 objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.
5. The following is a statement of reasons for the indication of allowable subject matter: The prior art in the record (in particular, US Pub. 2015/0100704 to Davie et al. (hereinafter "Davie")) does not disclose, with respect to claim 1, the virtual switching instance performing the L2 switching on the processed packet and transmitting the packet to the tunnel packet generator and the tunnel packet generator adding a tunnel

header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet as claimed. Rather, Davie teaches encapsulating packet and forwarding the encapsulated packet to the virtual switching instance [0135]. The same reasoning applies to claims 7 and 15 *mutatis mutandis*.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CLEMENCE HAN whose telephone number is (571)272-3158. The examiner can normally be reached on Monday-Friday 8-4.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edan Orgad can be reached on (571) 272-7884. 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.

/CLEMENCE HAN/
Primary Examiner, Art Unit 2414

Search Notes 	Application/Control No. 14583303	Applicant(s)/Patent Under Reexamination BYUN, SUNG HYUK
	Examiner CLEMENCE HAN	Art Unit 2414

CPC- SEARCHED		
Symbol	Date	Examiner
(H04L12/4633 or H04L45/66).cpc.	8/5/2017	ch

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
inventor search	8/5/2017	ch
(H04L12/4633 or H04L45/66).cpc. see Search History printout	8/5/2017	ch
see Search History printout	8/5/2017	ch
see Search History printout	10/30/2017	ch

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

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	437	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2017/10/30 11:19
L3	59	tunnel with packet with generator	US-PGPUB; USPAT	OR	ON	2017/10/30 11:22
L4	435	tunnel with packet with unicast	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
L5	5522	tunnel with packet with encapsulat\$4	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
L6	5727	3 4 5	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
L7	45	1 and 6	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
L8	33	7 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
L9	20	7 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:24
L10	35	8 9	US-PGPUB; USPAT	OR	ON	2017/10/30 11:24
L11	254	("L2" ethernet) adj2 switch\$4 and 1	US-PGPUB; USPAT	OR	ON	2017/10/30 11:31
L12	90	11 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
L13	49	11 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
L14	98	12 13	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
L15	18	10 and 14	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
S1	3	("20130294231" "20130343385" "8223770").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:17
S2	17	sung with hyuk with byun.in.	US-PGPUB;	OR	ON	2017/08/04 21:18

			USPAT			
S3	4	("20070097968" "20130322453" "20150263862" "20150365313").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:30
S4	421	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S5	212	S4 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S6	152	S4 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S7	255	S5 S6	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S8	0	vnid and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S9	182	(id identifier) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S10	5353	(H04L12/4633 or H04L45/66).qpc.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S11	61	S7 and S10	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S12	43	tunnel with (end endpoint) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 22:02
S13	26	tunnel with ("end point" endpoint) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 22:02
S14	3	tunnel with ("end point" endpoint) and S3	US-PGPUB; USPAT	OR	ON	2017/08/04 22:08
S15	2	tunnel with ("end point" endpoint) with "l2 switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:10
S16	234	tunnel with ("end point" endpoint) with "switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S17	172	S16 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S18	119	S16 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S19	209	S17 S18	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S20	163	virtual and S19	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S21	38	vxlan and S19	US-PGPUB;	OR	ON	2017/08/04 22:12

			USPAT			
S22	3	(US-20140269702-\$ or US-20150100704-\$).did. or (US-9686180-\$).did.	US-PGPUB; USPAT	OR	ON	2017/08/04 22:19
S23	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S24	4	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S25	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:20
S26	6	S22 S23 S24 S25	US-PGPUB; USPAT	OR	ON	2017/08/04 22:20
S27	4782	tunnel adj2 ("end point" endpoint)	US-PGPUB; USPAT	OR	ON	2017/08/05 11:07
S28	28	virtual adj switch\$4 adj instance and S27	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S29	17	S28 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S30	13	S28 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S31	19	S29 S30	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S32	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/05 11:18
S33	6	(US-20150100704-\$ or US-20140355419-\$ or US-20140269702-\$ or US-20100309894-\$ or US-20100208615-\$).did. or (US-9686180-\$).did.	US-PGPUB; USPAT	OR	ON	2017/08/05 11:18
S34	6	S32 S33	US-PGPUB; USPAT	OR	ON	2017/08/05 11:18
S35	6	("layer 2" S28 ethernet "layer-2") and S34	US-PGPUB; USPAT	OR	ON	2017/08/05 11:19

10/ 30/ 2017 11:44:13 AM
C:\ Users\ chan\ Documents\ EAST\ Workspaces\ 14583303.wsp

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/25 U.S. Patent and Trademark Office Department of Commerce
Electronic Petition Request	TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION	
Application Number	14583303	
Filing Date	26-Dec-2014	
First Named Inventor	Sung Hyuk BYUN	
Attorney Docket Number	CU-71729 AVL	
Title of Invention	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION	
☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action		
☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.		
Owner	Percent Interest	
ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE	100%	
The owner(s) of percent interest listed above 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 any patent granted on pending reference Application Number(s)		
14822994 filed on 08/11/2015 as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and any patent granted on the reference application 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 owner does not disclaim the terminal part of any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that any such patent granted on the pending reference application: 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 shortened by any terminal disclaimer filed prior to its grant.		
☐ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.		

- ☒ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

- ☒ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application
- Registration Number 72076
- ☐ A sole inventor
- ☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application
- ☐ A joint inventor; all of whom are signing this request

Signature	/Adam V. Litteken/
Name	Adam V. Litteken

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Doc Code: DISQ.E.FILE

Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 14583303

Filing Date: 26-Dec-2014

Applicant/Patent under Reexamination: BYUN

Electronic Terminal Disclaimer filed on November 20, 2017

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	30998129
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Adam Vincent Litteken/Sangik Bae
Filer Authorized By:	Adam Vincent Litteken
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	20-NOV-2017
Filing Date:	26-DEC-2014
Time Stamp:	13:56:00
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	32731	no	2
			7a2c41cfc2e245dffcb8dccb22965d37d6bd7795		

Warnings:

Information:	
Total Files Size (in bytes):	32731
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.	



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

NOTICE OF ALLOWANCE AND FEE(S) DUE

26530 7590 03/20/2018
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

EXAMINER

HAN, CLEMENCE S

ART UNIT

PAPER NUMBER

2414

DATE MAILED: 03/20/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528

TITLE OF INVENTION: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$500	\$0	\$0	\$500	06/20/2018

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)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

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.

26530 7590 03/20/2018
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

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.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528

TITLE OF INVENTION: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$500	\$0	\$0	\$500	06/20/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
HAN, CLEMENCE S	2414	370-254000

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 _____
 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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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL	1528

EXAMINER	
HAN, CLEMENCE S	

ART UNIT	PAPER NUMBER
2414	

DATE MAILED: 03/20/2018

26530 7590 03/20/2018
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

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. 14/583,303	Applicant(s) BYUN, SUNG HYUK	
	Examiner CLEMENCE HAN	Art Unit 2414	AIA (First Inventor to File) Status Yes

-- 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 TD received on 11/20/2017 and claim set received on 10/17/2017.
☐ 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 1-12 and 15 now renumbered as 1-13 in order. 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) | 5. ☐ Examiner's Amendment/Comment |
| 2. ☐ Information Disclosure Statements (PTO/SB/08),
Paper No./Mail Date ____ | 6. ☒ Examiner's Statement of Reasons for Allowance |
| 3. ☐ Examiner's Comment Regarding Requirement for Deposit
of Biological Material | 7. ☐ Other ____. |
| 4. ☐ Interview Summary (PTO-413),
Paper No./Mail Date ____. | |

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DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

2. The following is an examiner's statement of reasons for allowance: The prior art in the record (in particular, US Pub. 2015/0100704 to Davie et al. (hereinafter "Davie")) does not disclose, with respect to claim 1, the virtual switching instance performing the L2 switching on the processed packet and transmitting the packet to the tunnel packet generator and the tunnel packet generator adding a tunnel header to the packet for which the L2 switching has been performed to generate a new tunnel packet, and to transmit the new tunnel packet as claimed. Rather, Davie teaches encapsulating packet and forwarding the encapsulated packet to the virtual switching instance [0135]. The same reasoning applies to claims 7 and 15 mutatis mutandis. Accordingly, claims 1-12 and 15 are allowed.

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 CLEMENCE HAN whose telephone number is (571)272-3158. The examiner can normally be reached on Monday-Friday 8-4.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edan Orgad can be reached on (571) 272-7884. 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.

/CLEMENCE HAN/
Primary Examiner, Art Unit 2414

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	5324	tunnel adj2 ("end point" endpoint)	US-PGPUB; USPAT	OR	ON	2018/02/16 17:00
L3	32	virtual adj switch\$4 adj instance and L2	US-PGPUB; USPAT	OR	ON	2018/02/16 17:00
L4	470	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2018/02/16 17:00
S1	3	("20130294231" "20130343385" "8223770").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:17
S2	17	sung with hyuk with byun.in.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:18
S3	4	("20070097968" "20130322453" "20150263862" "20150365313").PN.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:30
S4	421	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S5	212	S4 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S6	152	S4 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S7	255	S5 S6	US-PGPUB; USPAT	OR	ON	2017/08/04 21:38
S8	0	vnid and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S9	182	(id idenifier) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 21:39
S10	5353	(H04L12/4633 or H04L45/66).cpc.	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S11	61	S7 and S10	US-PGPUB; USPAT	OR	ON	2017/08/04 21:40
S12	43	tunnel with (end endpoint) and S7	US-PGPUB; USPAT	OR	ON	2017/08/04 22:02
S13	26	tunnel with ("end point" endpoint) and S7	US-PGPUB;	OR	ON	2017/08/04 22:02

			USPAT			
S14	3	tunnel with ("end point" endpoint) and S3	US-PGPUB; USPAT	OR	ON	2017/08/04 22:08
S15	2	tunnel with ("end point" endpoint) with "l2 switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:10
S16	234	tunnel with ("end point" endpoint) with "switching"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S17	172	S16 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S18	119	S16 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S19	209	S17 S18	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S20	163	virtual and S19	US-PGPUB; USPAT	OR	ON	2017/08/04 22:11
S21	38	vxlan and S19	US-PGPUB; USPAT	OR	ON	2017/08/04 22:12
S22	3	(US-20140269702-\$ or US-20150100704-\$).did. or (US-9686180-\$).did.	US-PGPUB; USPAT	OR	ON	2017/08/04 22:19
S23	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S24	4	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:19
S25	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100208615-\$).did.	US-PGPUB	OR	ON	2017/08/04 22:20
S26	6	S22 S23 S24 S25	US-PGPUB; USPAT	OR	ON	2017/08/04 22:20
S27	4782	tunnel adj2 ("end point" endpoint)	US-PGPUB; USPAT	OR	ON	2017/08/05 11:07
S28	28	virtual adj switch\$4 adj instance and S27	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S29	17	S28 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S30	13	S28 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S31	19	S29 S30	US-PGPUB; USPAT	OR	ON	2017/08/05 11:08
S32	3	(US-20150100704-\$ or US-20140355419-\$ or US-20100309894-\$).did.	US-PGPUB	OR	ON	2017/08/05 11:18
S33	6	(US-20150100704-\$ or US-20140355419-\$ or	US-	OR	ON	2017/08/05

		US-20140269702-\$ or US-20100309894-\$ or US-20100208615-\$).did. or (US-9686180-\$).did.	PGPUB; USPAT			11:18
S34	6	S32 S33	US-PGPUB; USPAT	OR	ON	2017/08/05 11:18
S35	6	("layer 2" S28 ethernet "layer-2") and S34	US-PGPUB; USPAT	OR	ON	2017/08/05 11:19
S36	437	virtual adj switch\$4 adj instance	US-PGPUB; USPAT	OR	ON	2017/10/30 11:19
S37	59	tunnel with packet with generator	US-PGPUB; USPAT	OR	ON	2017/10/30 11:22
S38	435	tunnel with packet with unicast	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
S39	5522	tunnel with packet with encapsulat\$4	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
S40	5727	S37 S38 S39	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
S41	45	S36 and S40	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
S42	33	S41 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:23
S43	20	S41 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:24
S44	35	S42 S43	US-PGPUB; USPAT	OR	ON	2017/10/30 11:24
S45	254	("L2" ethernet) adj2 switch\$4 and S36	US-PGPUB; USPAT	OR	ON	2017/10/30 11:31
S46	90	S45 and @ad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
S47	49	S45 and @rlad<"20131227"	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
S48	98	S46 S47	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32
S49	18	S44 and S48	US-PGPUB; USPAT	OR	ON	2017/10/30 11:32

2/16/2018 5:45:06 PM

C:\Users\chan\Documents\EAST\Workspaces\14583303.wsp

Search Notes 	Application/Control No. 14583303	Applicant(s)/Patent Under Reexamination BYUN, SUNG HYUK
	Examiner CLEMENCE HAN	Art Unit 2414

CPC- SEARCHED		
Symbol	Date	Examiner
(H04L12/4633 or H04L45/66).cpc.	8/5/2017	ch

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
inventor search	8/5/2017	ch
(H04L12/4633 or H04L45/66).cpc. see Search History printout	8/5/2017	ch
see Search History printout	8/5/2017	ch
see Search History printout	10/30/2017	ch
see Search History printout	2/16/2018	ch

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
	see Interference Search printout	2/16/2018	ch

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EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	30	(virtual adj switch\$4 adj instance).clm.	USPAT	OR	ON	2018/02/16 16:55
S50	29	(virtual adj switch\$4 adj instance).clm.	USPAT	OR	ON	2017/10/30 11:19

2/ 16/ 2018 5:45:15 PM
C:\ Users\ chan\ Documents\ EAST\ Workspaces\ 14583303.wsp

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 when 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 (s) 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)

26530 7590 03/20/2018
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

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.

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.

Adam V. Litteken (Depositor's name)
 (Signature)
 June 11, 2018 (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	12/26/2014	Sung Hyun BYUN	CU-71729 AVL	1528

TITLE OF INVENTION: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	\$500	\$0	\$0	\$500	06/20/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
HAN, CLEMENCE S	2414	370-254000

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 3 registered patent attorneys or agents. If no name is listed, no name will be printed.

1. LADAS & PARRY LLP

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)

ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE Daejeon, Rep. of Korea

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 \$500
☐ 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 12-0400 (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 1.29 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____
 Typed or printed name Adam V. Litteken

Date June 11, 2018
 Registration No. 72076

Electronic Patent Application Fee Transmittal

Application Number:	14583303			
Filing Date:	26-Dec-2014			
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION			
First Named Inventor/Applicant Name:	Sung Hyuk BYUN			
Filer:	Adam Vincent Litteken/Daniel Schwartz			
Attorney Docket Number:	CU-71729 AVL			
Filed as Small 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:				
UTILITY APPL ISSUE FEE	2501	1	500	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				500

Electronic Acknowledgement Receipt

EFS ID:	32864424
Application Number:	14583303
International Application Number:	
Confirmation Number:	1528
Title of Invention:	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION
First Named Inventor/Applicant Name:	Sung Hyuk BYUN
Customer Number:	26530
Filer:	Adam Vincent Litteken/Daniel Schwartz
Filer Authorized By:	Adam Vincent Litteken
Attorney Docket Number:	CU-71729 AVL
Receipt Date:	11-JUN-2018
Filing Date:	26-DEC-2014
Time Stamp:	17:18:20
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 500
RAM confirmation Number	061218INTEFSW00005135120400
Deposit Account	120400
Authorized User	Daniel Schwartz

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

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
37 CFR 1.20 (Post Issuance fees)
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	Issue Fee Payment (PTO-85B)	2018-06-11_CU-71729_issue_fee_transmittal.pdf	145203	no	1
			40a5408f19ee1da9c857332588191faf6381dd9c		

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30673	no	2
			f2d0741d0eebf9891d45260d07c651815bc54f5e		

Warnings:

Information:

Total Files Size (in bytes):	175876
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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.



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 NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/583,303	07/10/2018	10020961	CU-71729 AVL	1528

26530 7590 06/20/2018
LADAS & PARRY LLP
224 SOUTH MICHIGAN AVENUE
SUITE 1600
CHICAGO, IL 60604

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 571 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):

Sung Hyuk BYUN, Daejeon, KOREA, REPUBLIC OF;
ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE, Daejeon, KOREA, REPUBLIC OF;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:

Docket No.: 432-0350

Sung Hyuk BYUN et al.

Confirmation No.: 1528

Patent No.: 10,020,961

Group Art Unit: 2414

Issued: July 10, 2018

Examiner: CLEMENCE S HAN

For: **METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION**

Commissioner for Patents
P.O. BOX 1450
Alexandria, VA 22313-1450

**NOTIFICATION OF LOSS OF ENTITLEMENT TO SMALL ENTITY
STATUS**

Sir:

It is respectfully requested that the status of this patent be changed from small entity to large entity. Small entity status was established in this application in good faith upon filing of this application. It has now been discovered that this application is no longer entitled to small entity status.

Prompt and favorable consideration of this submission is respectfully requested.

Respectfully Submitted,

/Steve H. Lam/

Steve H. Lam
Reg. No. 72,721

PARATUS LAW GROUP, PLLC
1765 Greensboro Station Place
Suite 320
Tysons Corner, Virginia 22102
Tel: 571-313-7556
Fax: 703-935-8473
SHL/SWL
Date: January 22, 2025

UNITED STATES
PATENT AND TRADEMARK OFFICEP.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov**ELECTRONIC ACKNOWLEDGEMENT RECEIPT**APPLICATION #
14/583,303RECEIPT DATE / TIME
01/22/2025 01:37:04 PM Z ETATTORNEY DOCKET #
CU-71729 AVL**Title of Invention**

METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION

Application InformationAPPLICATION TYPE Utility - Nonprovisional Application
under 35 USC 111(a)

PATENT # 10020961

CONFIRMATION # 1528

FILED BY HYE RAN HAN

PATENT CENTER # 68862330

FILING DATE 12/26/2014

CUSTOMER # 26530

FIRST NAMED
INVENTOR Sung Hyuk BYUNCORRESPONDENCE
ADDRESS -

AUTHORIZED BY Lenny Jiang

Documents**TOTAL DOCUMENTS: 3**

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
01_432- 0350_Request_to_Change_ Entity_Status.pdf	1	Notification of loss of entitlement to small entity status	14 KB
02_432- 0350_3.73c_Statement.pdf	3	Assignee showing of ownership per 37 CFR 3.73	133 KB
03_432- 0339_et_al._Executed_POA. pdf	3	Power of Attorney	2822 KB

Digest

DOCUMENT MESSAGE DIGEST(SHA-512)

01_432- 0350_Request_to_Change_Enti ty_Status.pdf	0A8A603BE8F51187180DB2E96F8A9BA15F26B631EB5304F8B EFA6A5A7F59AACCF18D8F8DF997C910DF31091E50805EE70 05D2DCFEA475039C46C50DA0825C46E
02_432- 0350_3.73c_Statement.pdf	48A57DE3961EF5C4DC726F2CA58E19FF8904081DBAB4497D EB485B48D89DA500D37C5AA5155478A591E4A56A0C262D195 60D74CDF75D8A0E53D20CEBAE370E0C
03_432- 0339_et_al._Executed_POA.pd f	F7C927D9EF99CE096311A79C38776112174A53F4591E13C119 151547CCD89D93582B73B9BB54B04E1A0C4C408745D311792 BFE1FEA87743FC7D4671670873D99

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 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.

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.

STATEMENT UNDER 37 CFR 3.73(c)First Named Inventor/Patent Owner: Sung Hyuk BYUNApplication No./Patent No.: 10,020,961Filed/Issue Date: July 10, 2018Titled: METHOD AND APPARATUS FOR NETWORK VIRTUALIZATIONELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE, a Research Institute

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

- A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached*.
- B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: BYUN, Sung Hyuk To: ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

The document was recorded in the United States Patent and Trademark Office at

Reel 034586, Frame 0574, or for which a copy thereof is attached*.2. From: BYUN, Sung Hyuk To: ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

The document was recorded in the United States Patent and Trademark Office at

Reel 034767, Frame 0471, or for which a copy thereof is attached*.

[Page 1 of 2]

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0031. Public burden for this form is estimated to average 12 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. 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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached*.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).☐ *As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Steve H. Lam/

Signature

Steve H. Lam

Printed or Typed Name

January 22, 2025

Date

72,721

Title or Registration 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. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013). <https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf>

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PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS	Patent Number	Identified in the Appendix
	Issue Date	Identified in the Appendix
	First Named Inventor	Identified in the Appendix
	Title	Identified in the Appendix
	Attorney Docket No.	Identified in the Appendix

I hereby revoke all previous powers of attorney given in the 21 patents identified in the Appendix.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the Customer Number identified in the box at right as my/our attorney(s) or agent(s) with respect to the 21 patents identified in the Appendix, and to transact all business in the United States Patent and Trademark Office connected therewith:

145742

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

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OR

☐ Firm or
Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the:

☐ Applicant.

OR

☒ Patent owner.☒ Statement under 37 CFR 3.73(c) (Form PTO/AIA/96) submitted herewith or filed on _____.**SIGNATURE of Applicant or Patent Owner**

Signature

Jang Sik Choi

Date

January 20th, 2025

Name

Jang Sik Choi

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Title and Company

Director of ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

NOTE: Signatures of all the applicants or patent owners of the entire interest or their representative(s) are required. If more than one signature is required, submit multiple forms, check the box below, and identify the total number of forms submitted in the blank below.

☒ A total of 1 forms are submitted.

An Appendix listing 21 patents, spanning two pages, begins on the next page.

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 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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APPENDIX

No.	Patent No.	Issue Date	First Named Inventor	Title	Attorney Docket No.
1	8,689,085	April 1, 2014	Jong-Yoon SHIN	METHOD AND APPARATUS FOR TRANSMITTING DATA IN OPTICAL TRANSPORT NETWORK	432-0339
2	8,638,807	January 28, 2014	Dae Ub KIM	METHOD FOR MANAGING ETHERNET RING NETWORK OF VLAN-BASED BRIDGE	432-0340
3	9,030,925	May 12, 2015	Tae Sik Cheung	METHOD AND APPARATUS FOR SHARED MESH PROTECTION SWITCHING	432-0341
4	8,780,887	July 15, 2014	Sun Cheul KIM	METHOD OF NETWORK-BASED COMMUNICATION IN VIRTUAL NETWORK ENVIRONMENT	432-0342
5	8,788,846	July 22, 2014	Jong Youl PARK	CLOUD COMPUTING SYSTEM AND CLOUD SERVER MANAGING METHOD THEREOF	432-0343
6	9,319,241	April 19, 2016	Sachoon KANG	FLOW-BASED PACKET TRANSPORT DEVICE AND PACKET MANAGEMENT METHOD THEREOF	432-0344
7	9,313,101	April 12, 2016	SANG WAN KIM	METHOD OF CONTROLLING TRAFFIC BY TIME-BASED POLICY	432-0345
8	9,112,934	August 18, 2015	Tai-Won UM	APPARATUS AND METHOD FOR CONFIGURING ON-DEMAND CONTENT DELIVERING OVERLAY NETWORK	432-0346
9	9,621,469	April 11, 2017	Kang-Il CHOI	APPARATUS AND METHOD FOR MANAGING FLOW IN SERVER VIRTUALIZATION ENVIRONMENT, AND METHOD FOR APPLYING QOS	432-0347
10	9,136,968	September 15, 2015	Han-Hyub LEE	TIME AND WAVELENGTH DIVISION MULTIPLEXING - PASSIVE OPTICAL NETWORK (TWDM-PON) SYSTEM AND COMMUNICATION LINK METHOD THEREOF	432-0348
11	9,577,924	February 21, 2017	Nam-Seok KO	SDN-BASED NETWORK DEVICE WITH EXTENDED FUNCTION AND METHOD OF PROCESSING PACKET IN THE SAME DEVICE	432-0349
12	10,020,961	July 10, 2018	Sung Hyuk BYUN	METHOD AND APPARATUS FOR NETWORK VIRTUALIZATION	432-0350
13	9,825,710	November 21, 2017	Hark YOO	METHOD AND SYSTEM FOR DETERMINING AND CONTROLLING POWER OF OPTICAL TRANSMITTER OF OPTICAL NETWORK UNIT FOR TIME AND WAVELENGTH DIVISION MULTIPLEXING PASSIVE OPTICAL NETWORK	432-0351
14	10,248,433	April 2, 2019	Sung Won BYON	NETWORK MANAGEMENT APPARATUS AND METHOD FOR REMOTELY CONTROLLING STATE OF IT DEVICE	432-0352
15	11,088,774	August 10, 2021	Han Hyub LEE	METHOD AND APPARATUS FOR WAVELENGTH ALLOCATION FOR BIDIRECTIONAL OPTICAL ACCESS	432-0353
16	8,781,323	July 15, 2014	Yool KWON	PACKET TRANSPORT LAYER PASSIVE OPTICAL NETWORK (PTL-PON) PROVIDING SYSTEM AND METHOD	432-0365

Revocation of Power of Attorney with a New Power of Attorney and Change of Correspondence Address
Owner of Patents: ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE

No.	Patent No.	Issue Date	First Named Inventor	Title	Attorney Docket No.
17	9,197,351	November 24, 2015	Kyeong-Hwan DOO	METHOD OF SELECTING WAVELENGTH OF OPTICAL NETWORK UNIT IN PASSIVE OPTICAL NETWORK	432-0366
18	9,806,939	October 31, 2017	Dae Ub KIM	METHOD AND APPARATUS FOR LINEAR PROTECTION SWITCHING	432-0367
19	9,507,625	November 29, 2016	Byung Yun LEE	APPARATUS AND METHOD FOR GENERATING SOFTWARE DEFINED NETWORK (SDN)-BASED VIRTUAL NETWORK ACCORDING TO USER DEMAND	432-0368
20	10,827,240	November 3, 2020	Hwan Seok CHUNG	COOPERATIVE DYNAMIC BANDWIDTH ALLOCATION METHOD IN MOBILE NETWORK WITH OPTICAL NETWORK, AND DEVICE OF PERFORMING THE COOPERATIVE DYNAMIC BANDWIDTH ALLOCATION METHOD	432-0369
21	11,233,572	January 25, 2022	Han Hyub LEE	SLICE CONNECTION METHOD OF OPTICAL ACCESS NETWORK AND OPTICAL ACCESS NETWORK SYSTEM FOR SLICE CONNECTION	432-0370



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL

CONFIRMATION NO. 1528

POWER OF ATTORNEY NOTICE



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NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/22/2025.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

/mtekle michael/



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/583,303	12/26/2014	Sung Hyuk BYUN	CU-71729 AVL

CONFIRMATION NO. 1528

POA ACCEPTANCE LETTER



OC00000084279342

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Date Mailed: 02/12/2025

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/22/2025.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

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