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(54) **SOFTWARE DEFINED NETWORKING PIPE FOR NETWORK TRAFFIC INSPECTION**

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2011/0286324 A1 * 11/2011 Bellagamba H04L 41/0677
370/219

2012/0210416 A1 * 8/2012 Mihelich H04L 63/0218
726/11

2013/0291088 A1 * 10/2013 Shieh H04L 63/0218
726/11

2014/0133360 A1 * 5/2014 Chiueh H04L 41/12
370/256

2014/0211807 A1 * 7/2014 Takenaka H04L 45/74
370/392

2015/0124629 A1 * 5/2015 Pani H04L 12/4679
370/248

2015/0163150 A1 * 6/2015 Beheshti-Zavareh . H04L 45/121
370/400

2015/0222491 A1 * 8/2015 Clark H04L 45/48
370/256

2015/0236900 A1 * 8/2015 Chung H04L 69/02
709/221

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G06F 21/00 (2013.01)
H04L 29/06 (2006.01)

(52) **U.S. Cl.**
CPC **H04L 63/02** (2013.01); **H04L 63/0245**
(2013.01)

(58) **Field of Classification Search**
CPC H04L 63/02; H04L 63/0245
See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS

6,697,806 B1 * 2/2004 Cook G06F 21/31

6,751,219 B1 * 6/2004 Lipp H04L 49/201
370/390

8,339,959 B1 * 12/2012 Moisan H04L 63/0236
370/235

2003/0021230 A1 * 1/2003 Kuo H04L 47/10
370/230

2006/0036780 A1 * 2/2006 Dernis G06F 13/4282
710/36

2009/0249472 A1 * 10/2009 Litvin H04L 63/0263
726/14

2009/0300353 A1 * 12/2009 Hart H04L 63/1416
713/168

2010/0269171 A1 * 10/2010 Raz G06F 17/00
726/13

2010/0278180 A1 * 11/2010 Ma H04L 49/354
370/392

OTHER PUBLICATIONS

OpenFlow—Wikipedia, the free encyclopedia, 3 sheets [retrieved on Nov. 15, 2013], retrieved from the internet: <http://en.wikipedia.org/wiki/OpenFlow>.

ONF—Open Networking Foundation, White Paper, Software-Defined Networking: The New Form Norm for Networks, Apr. 13, 2012, pp. 1-12.

* cited by examiner

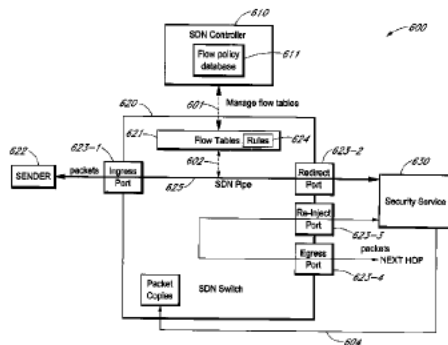
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(57) **ABSTRACT**

A software defined networking (SDN) computer network includes an SDN controller and an SDN switch. The SDN controller inserts flow rules in a flow table of the SDN switch to create an SDN pipe between a sender component and a security component. A broadcast function of the SDN switch to the ports that form the SDN pipe may be disabled. The SDN pipe allows outgoing packets sent by the sender component to be received by the security component. The security component inspects the outgoing packets for compliance with security policies and allows the outgoing packets to be forwarded to their destination when the outgoing packets pass inspection. The SDN controller may also insert a flow rule in the flow table of the SDN switch to bypass inspection of specified packets.

17 Claims, 8 Drawing Sheets



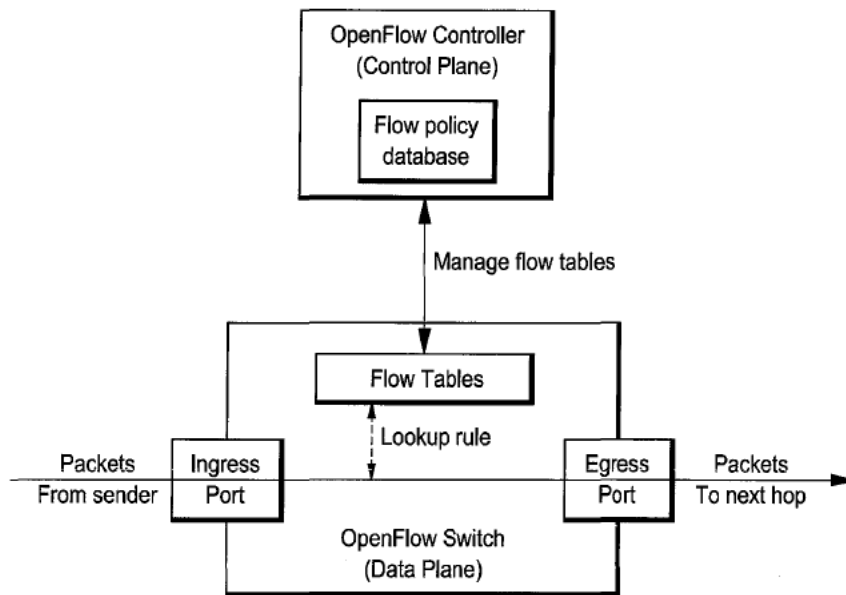


FIG. 1
(PRIOR ART)

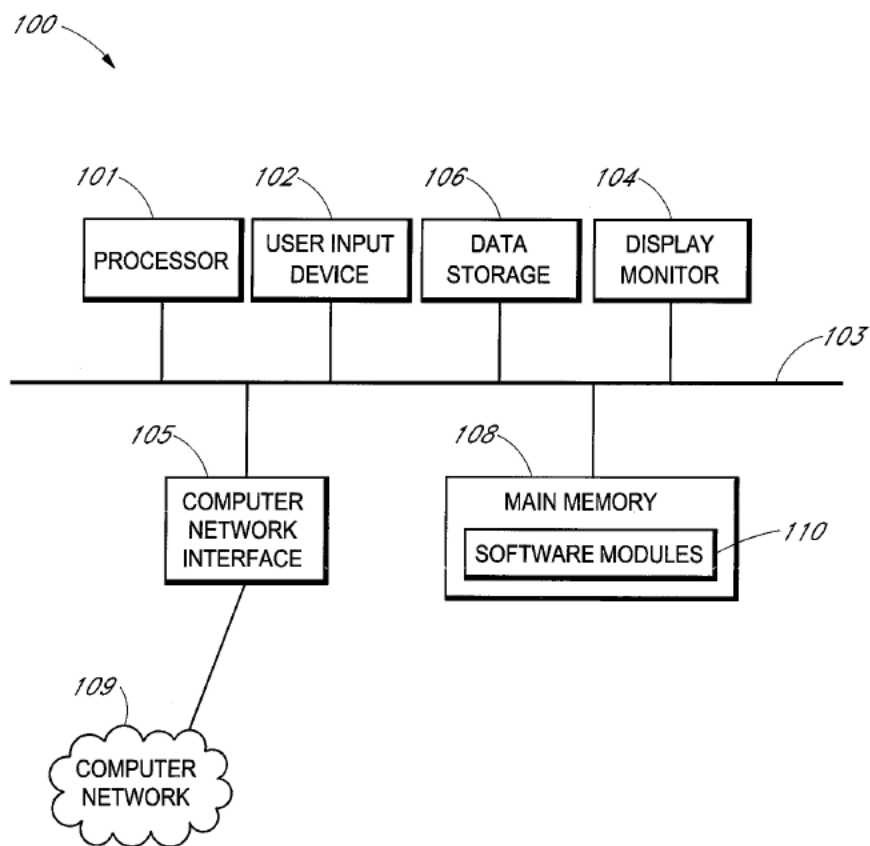


FIG. 2

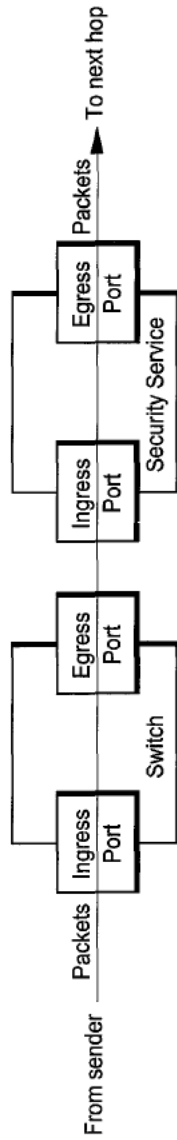


FIG. 3

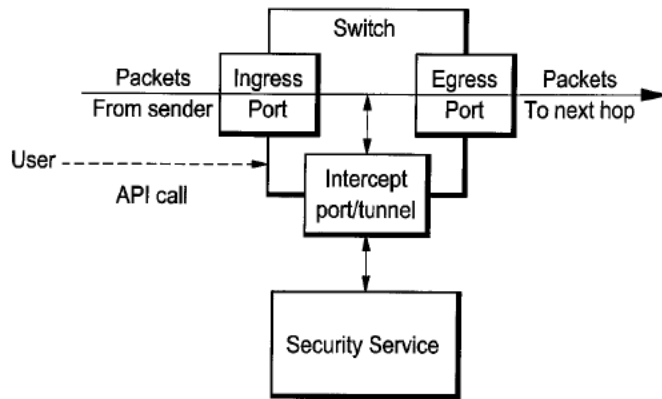


FIG. 4

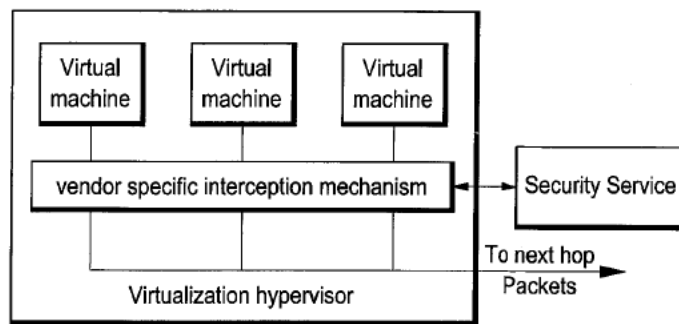


FIG. 5

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