



US010097452B2

(12) **United States Patent**
Lefebvre et al.

(10) **Patent No.:** **US 10,097,452 B2**
(45) **Date of Patent:** **Oct. 9, 2018**

(54) **CHAINING OF INLINE SERVICES USING SOFTWARE DEFINED NETWORKING**

(75) Inventors: **Geoffrey Lefebvre**, Montreal (CA);
Erik Rubow, San Jose, CA (US); **Ravi Manghirmalani**, San Jose, CA (US)

(73) Assignee: **Telefonaktiebolaget LM Ericsson (publ)**, Stockholm (SE)

8,284,664	B1 *	10/2012	Aybay et al.	370/235
2005/0289244	A1	12/2005	Sahu et al.	
2009/0259810	A1	10/2009	Baden et al.	
2010/0290485	A1	11/2010	Martini et al.	
2010/0303083	A1 *	12/2010	Belanger et al.	370/401
2011/0055845	A1	3/2011	Nandagopal et al.	
2012/0163180	A1 *	6/2012	Goel	370/238
2012/0281540	A1 *	11/2012	Khan et al.	370/241

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 684 days.

EP	1387553	A1	2/2004
EP	2226970	A1	9/2010
WO	2012/047885	A1	4/2012

(21) Appl. No.: **13/556,456**

(22) Filed: **Jul. 24, 2012**

(65) **Prior Publication Data**
US 2013/0272305 A1 Oct. 17, 2013

Related U.S. Application Data

(60) Provisional application No. 61/624,823, filed on Apr. 16, 2012.

(51) **Int. Cl.**
H04L 12/721 (2013.01)
H04L 12/851 (2013.01)
H04L 12/725 (2013.01)

(52) **U.S. Cl.**
CPC **H04L 45/38** (2013.01); **H04L 45/302** (2013.01); **H04L 45/306** (2013.01); **H04L 47/24** (2013.01)

(58) **Field of Classification Search**
CPC .. H04L 12/56; H04L 12/5689-12/5692; H04L 12/5695-12/5696; H04L 47/24-47/2491; H04L 63/1408-63/1425; H04L 63/306
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,860,100	B2	12/2010	Khalid et al.
8,170,038	B2	5/2012	Belanger et al.

24 Claims, 9 Drawing Sheets

OTHER PUBLICATIONS

International Search Report for PCT/IB2013/053017 dated Sep. 30, 2013; 4 pages.
Openflow 1.1 in Hardware: "I was wrong (again)"; Apr. 29, 2011; 3 pages.
"A 100 Gig Openflow 1.1 Switch"; Powerpoint slide downloaded from the Internet on Apr. 16, 2013; 1 page.
Li, Erran et al.: Mosaic: Policy Homomorphic Network Extension; May 13, 2010; 15 pages.

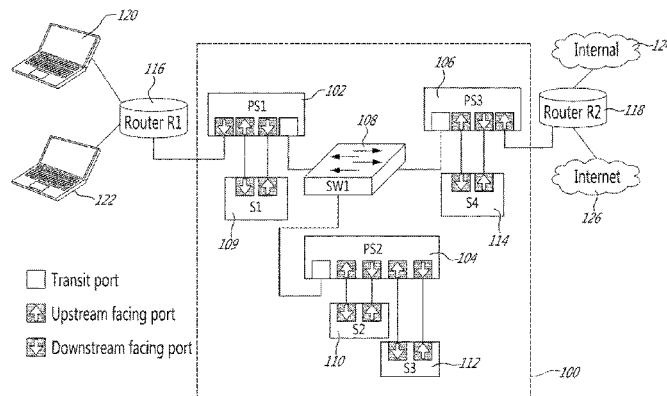
* cited by examiner

Primary Examiner — Eric A Myers

(74) *Attorney, Agent, or Firm* — Ericsson Inc.

(57) **ABSTRACT**

A system and method for steering traffic through a set of services is provided. A service path or chain is assigned to a received packet based on a classification of the packet. A position and/or a direction of the traffic in the service path can be determined based on the previous service performed on the traffic. A next destination for the traffic can be assigned in accordance with the assigned service chain and determined position and direction information.



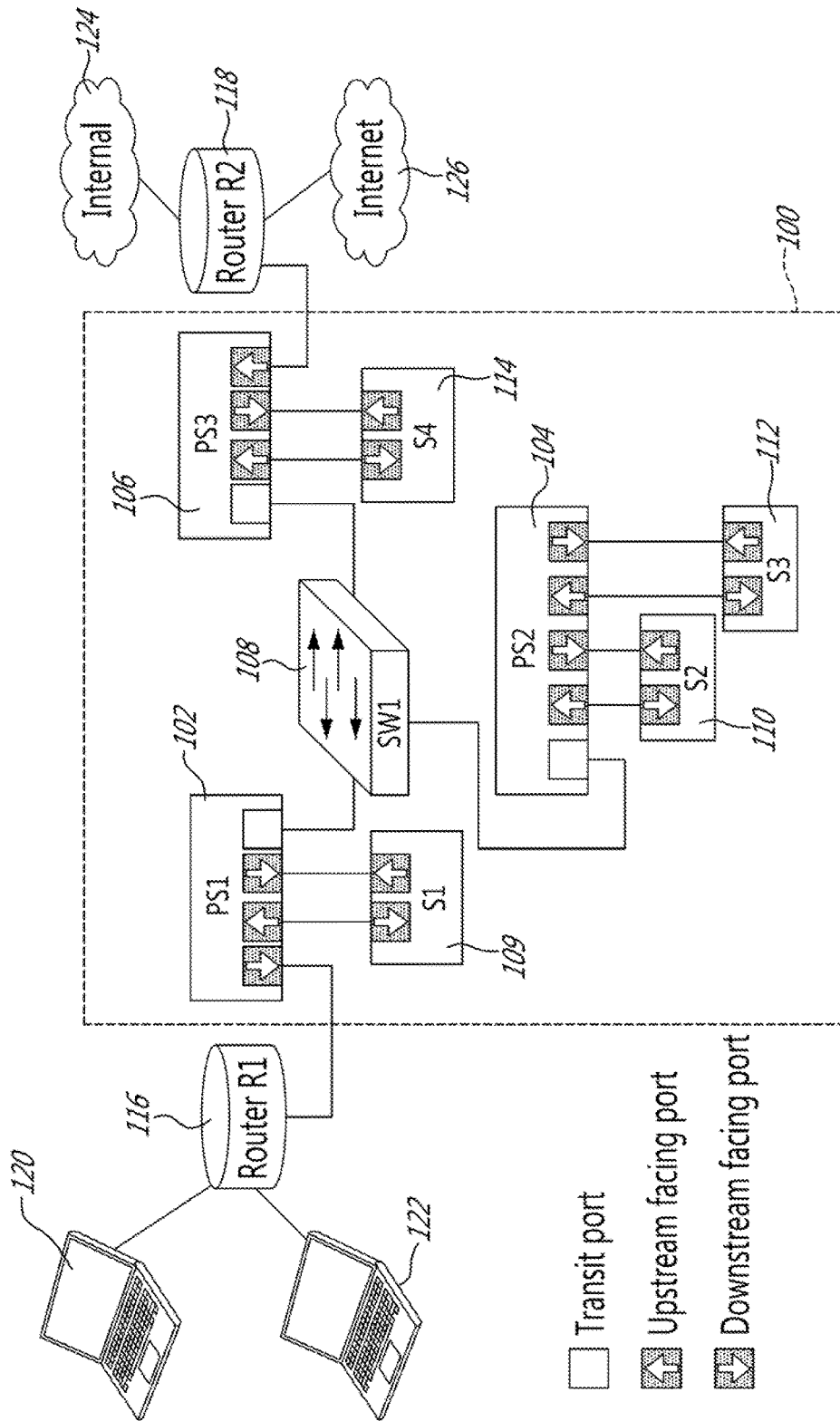


FIG. 1

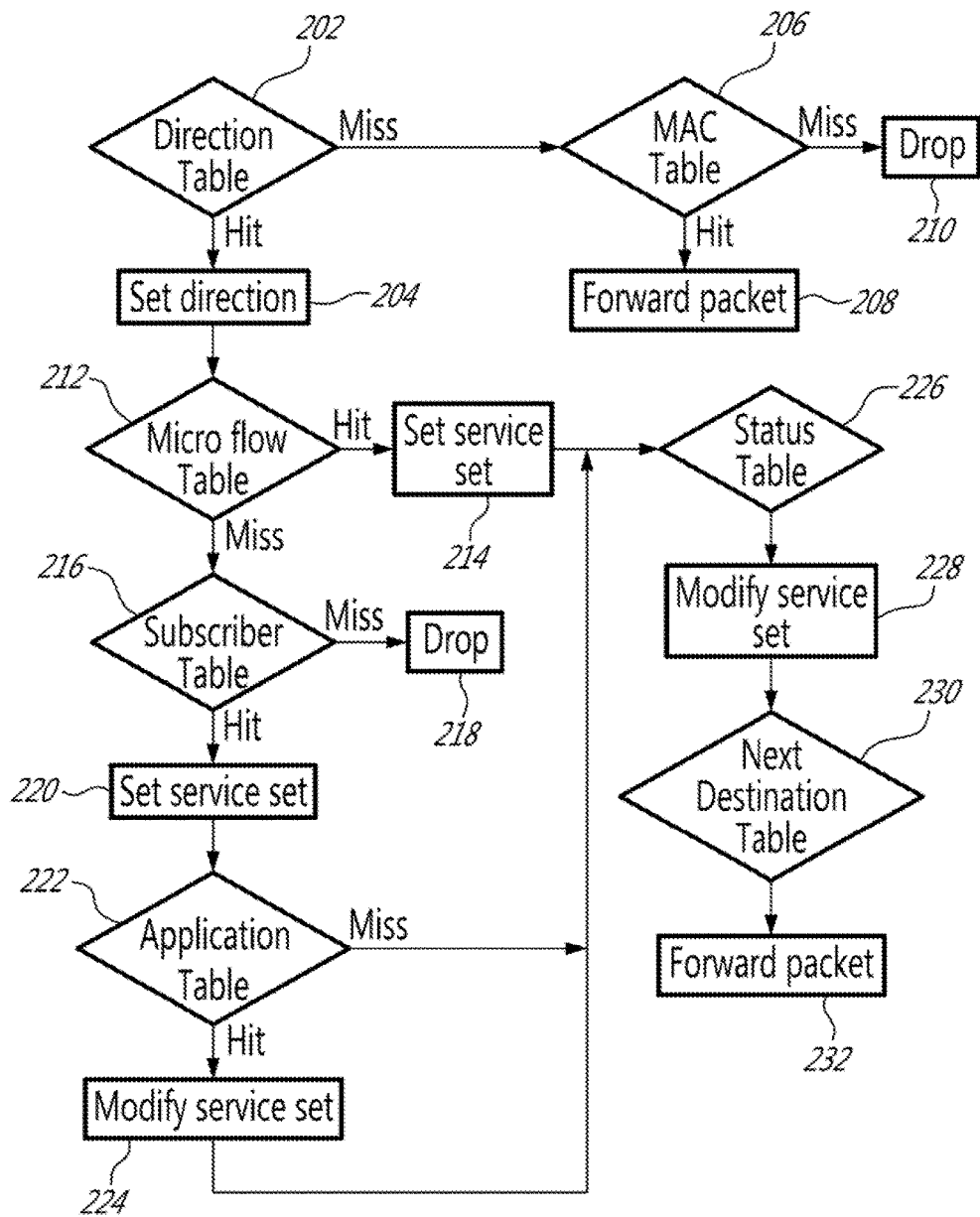


FIG. 2

Configuration Data ³⁰⁰

Subscriber	IP Address	Services up	Services down		
Bob	1.2.3.4/32	{S1,S3}	{S1,S3}		
Joe	1.2.3.5/32	{S2,S3}	{S3,S4}		
Service	Down-facing MAC	Up-facing MAC			
S1	00:00:00:00:0A:51	00:00:00:00:0B:51			
S2	00:00:00:00:0A:52	00:00:00:00:0B:52			
S3	00:00:00:00:0A:53	00:00:00:00:0B:53			
S4	00:00:00:00:0A:54	00:00:00:00:0B:54			
Router	Type	MAC			
R1	upstream	00:00:00:00:00:01			
R2	downstream	00:00:00:00:00:02			
Application	IP Address	Protocol	Port	Up	Down
Special site	4.3.2.1/32	TCP	80	+S2,-S3	-S3
Internal stuff	3.2.1.0/24	*	*	-S1	-S1
Direction	Global Service Order				
Up	S2 -> S1 -> S3 -> S4				
Down	S2 -> S3 -> S4 -> S1				
Perimeter Switch	Port	MAC			
PS2	0	00:00:00:00:F2:00			
PS2	1	00:00:00:00:F2:01			
PS2	2	00:00:00:00:F2:02			
PS2	3	00:00:00:00:F2:03			
PS2	4	00:00:00:00:F2:04			

FIG. 3

Direction Table ⁴¹⁰

⁴¹² Ingress Port	^{412b} Action
^{412'} 1	dir = down
^{412''} 2	dir = up
^{412'''} 3	dir = down
^{412''''} 4	dir = up

FIG. 4a

MAC Table ⁴²⁰

⁴²² Destination MAC Address	^{422b} Action
00:00:00:00:0A:52	set smac = 00:00:00:00:F2:01 output on port 1
00:00:00:00:0B:52	set smac = 00:00:00:00:F2:02 output on port 2
00:00:00:00:0A:53	set smac = 00:00:00:00:F2:03 output on port 3
00:00:00:00:0B:53	set smac = 00:00:00:00:F2:04 output on port 4

FIG. 4b

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.