EX 1001

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(54) **SYSTEM AND METHOD FOR PROVIDING ACCESS CONTROL**

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See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,623,601	A	4/1997	Vu	
5,673,393	A	9/1997	Marshall et al.	
5,706,427	A	1/1998	Tabuki	
5,748,901	A	5/1998	Afek et al.	
5,835,727	A *	11/1998	Wong et al.	709/238
5,878,231	A	3/1999	Baehr et al.	
5,896,499	A *	4/1999	McKelvey	726/11
5,901,148	A	5/1999	Bowen et al.	

(Continued)

FOREIGN PATENT DOCUMENTS

EP 0587522 B1 1/2000

(Continued)

OTHER PUBLICATIONS

Pending U.S. Appl. No. 09/458,602, Pagan et al.

(Continued)

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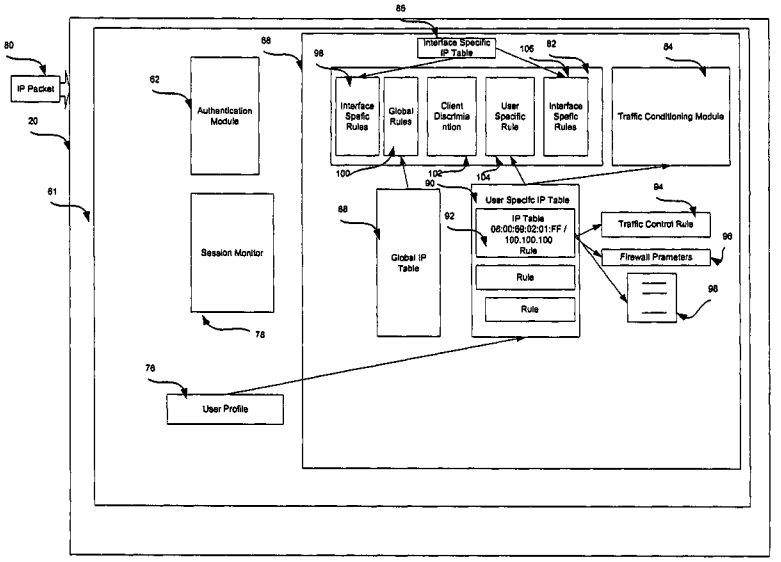
(57) **ABSTRACT**

Embodiments disclosed herein provide systems and methods for provisioning network access for a user in order to provide access control to one or more networks with regard to the user. More particularly, a user may be authenticated and, based on a user profile associated with the authenticated user, provisioning rules may be established for the user such that the user's network access to one or more networks may be controlled based upon the user profile associated with the user. In a network utilized by multiple users, the use of access control based on user profiles associated with the users may prevent any one user or users from accessing one or more networks to the exclusion or detriment of other users because each user may be limited to the network resources provisioned to that user based on the user profile associated with the user.

27 Claims, 8 Drawing Sheets



U.S. PATENT DOCUMENTS

5,936,542	A	8/1999	Kleinrock et al.	
5,953,506	A	9/1999	Kalra et al.	
5,987,134	A	11/1999	Shin et al.	
5,996,013	A	11/1999	Delp et al.	
6,085,241	A	7/2000	Otis	
6,088,451	A	7/2000	He et al.	
6,092,200	A	7/2000	Muniyappa et al.	
6,108,782	A	8/2000	Fletcher et al.	
6,130,892	A	10/2000	Short et al.	
6,131,116	A	10/2000	Riggins et al.	
6,157,953	A	12/2000	Chang et al.	
6,173,331	B1	1/2001	Shimonishi	
6,176,883	B1	1/2001	Holloway et al.	
6,185,567	B1	2/2001	Ratnaraj et al.	
6,194,992	B1	2/2001	Short et al.	
6,199,113	B1	3/2001	Alegre et al.	
6,205,552	B1	3/2001	Fudge	
6,212,558	B1	4/2001	Antur et al.	
6,219,706	B1	4/2001	Fan et al.	
6,226,752	B1 *	5/2001	Gupta et al.	726/9
6,233,607	B1	5/2001	Taylor et al.	
6,243,815	B1	6/2001	Antur et al.	
6,266,774	B1	7/2001	Sampath et al.	
6,275,693	B1	8/2001	Lin et al.	
6,295,294	B1	9/2001	Odlyzko	
6,321,339	B1	11/2001	French et al.	
6,324,648	B1	11/2001	Grantges, Jr.	
6,336,133	B1	1/2002	Morris et al.	
6,404,743	B1	6/2002	Meandzija	
6,421,319	B1	7/2002	Iwasaki	
6,463,474	B1 *	10/2002	Fuh et al.	709/225
6,473,793	B1	10/2002	Dillon et al.	
6,473,801	B1	10/2002	Basel	
6,477,143	B1	11/2002	Ginossar	
6,502,131	B1 *	12/2002	Vaid et al.	709/224
6,502,135	B1	12/2002	Munger et al.	
6,516,417	B1	2/2003	Pegrum et al.	
6,535,879	B1	3/2003	Behera	
6,539,431	B1	3/2003	Sitaraman et al.	
6,631,416	B2 *	10/2003	Bendinelli et al.	709/227
6,636,894	B1 *	10/2003	Short et al.	709/225
6,643,260	B1 *	11/2003	Kloth et al.	370/235
6,678,733	B1	1/2004	Brown et al.	
6,708,212	B2	3/2004	Porras et al.	
6,732,179	B1	5/2004	Brown et al.	
6,735,691	B1	5/2004	Capps et al.	
6,757,740	B1	6/2004	Parekh et al.	
6,763,468	B2 *	7/2004	Gupta et al.	726/2
6,785,252	B1	8/2004	Zimmerman et al.	
6,789,110	B1	9/2004	Short et al.	
6,789,118	B1 *	9/2004	Rao	709/225
6,798,746	B1 *	9/2004	Kloth et al.	370/235
6,804,783	B1 *	10/2004	Wesinger et al.	726/11
6,816,903	B1 *	11/2004	Rakoshitz et al.	709/226
6,823,385	B2	11/2004	McKinnon et al.	
6,834,341	B1 *	12/2004	Bahl et al.	713/156
6,839,759	B2	1/2005	Larson et al.	
6,876,668	B1 *	4/2005	Chawla et al.	370/468
6,907,530	B2	6/2005	Wang	
6,917,622	B2	7/2005	McKinnon et al.	
6,976,089	B2 *	12/2005	Na et al.	709/242
6,996,625	B2	2/2006	Kaplan et al.	
7,013,331	B2	3/2006	Das	
7,085,385	B2	8/2006	Frantz et al.	
7,085,854	B2 *	8/2006	Keane et al.	709/250
7,092,727	B1 *	8/2006	Li et al.	455/466
7,120,934	B2	10/2006	Ishikawa	
7,143,283	B1	11/2006	Chen et al.	
7,143,435	B1 *	11/2006	Droms et al.	726/3
7,146,639	B2	12/2006	Bartal et al.	
7,181,017	B1 *	2/2007	Nagel et al.	380/282
7,181,542	B2 *	2/2007	Tuomenoksa et al.	709/250
7,181,766	B2 *	2/2007	Bendinelli et al.	726/15
7,185,073	B1 *	2/2007	Gai et al.	709/221
7,185,358	B1	2/2007	Schreiber et al.	
7,185,368	B2	2/2007	Copeland, III	
7,188,180	B2	3/2007	Larson et al.	
7,194,554	B1 *	3/2007	Short et al.	709/246
7,257,833	B1 *	8/2007	Parekh et al.	726/1
7,266,754	B2	9/2007	Shah et al.	
7,272,646	B2	9/2007	Cooper et al.	
7,290,288	B2 *	10/2007	Gregg et al.	726/28
7,310,613	B2	12/2007	Briel et al.	
7,316,029	B1 *	1/2008	Parker et al.	726/13
7,324,551	B1 *	1/2008	Stammers	370/468
7,324,947	B2	1/2008	Jordan et al.	
7,325,042	B1	1/2008	Soscia et al.	
7,386,888	B2	6/2008	Liang et al.	
7,406,530	B2	7/2008	Brown et al.	
7,418,504	B2	8/2008	Larson et al.	
7,420,956	B2	9/2008	Karaoguz et al.	
7,444,669	B1 *	10/2008	Bahl et al.	726/3
7,448,075	B2 *	11/2008	Morand et al.	726/7
7,454,792	B2	11/2008	Cantrell et al.	
7,490,151	B2	2/2009	Munger et al.	
7,509,625	B2	3/2009	Johnston et al.	
7,587,512	B2	9/2009	Ta et al.	
7,590,728	B2	9/2009	Tonnesen et al.	
7,610,621	B2	10/2009	Turley et al.	
7,624,438	B2	11/2009	White	
7,665,130	B2	2/2010	Johnston et al.	
2001/0038639	A1	11/2001	McKinnon et al.	
2001/0038640	A1	11/2001	McKinnon et al.	
2001/0038645	A1	11/2001	McKinnon et al.	
2001/0039576	A1	11/2001	Kanada	
2001/0039582	A1	11/2001	McKinnon et al.	
2002/0011218	A1	1/2002	Ford et al.	
2002/0013844	A1	1/2002	Garrett et al.	
2002/0021665	A1	2/2002	Bhagavath et al.	
2002/0023160	A1	2/2002	Garrett et al.	
2002/0023210	A1 *	2/2002	Tuomenoksa et al.	713/161
2002/0026503	A1 *	2/2002	Bendinelli et al.	709/220
2002/0026531	A1 *	2/2002	Keane et al.	709/250
2002/0029260	A1	3/2002	Dobbins et al.	
2002/0029276	A1 *	3/2002	Bendinelli et al.	709/227
2002/0035699	A1	3/2002	Crosbie	
2002/0042883	A1	4/2002	Roux et al.	
2002/0046264	A1	4/2002	Dillon et al.	
2002/0052950	A1	5/2002	Pillai et al.	
2002/0053031	A1 *	5/2002	Bendinelli et al.	713/201
2002/0055968	A1	5/2002	Wishoff et al.	
2002/0056008	A1 *	5/2002	Keane et al.	709/245
2002/0059408	A1	5/2002	Pattabhiraman et al.	
2002/0075844	A1 *	6/2002	Hagen	370/351
2002/0085719	A1	7/2002	Crosbie	
2002/0087713	A1	7/2002	Cunningham	
2002/0090089	A1	7/2002	Branigan	
2002/0091859	A1 *	7/2002	Tuomenoksa et al.	709/245
2002/0091944	A1	7/2002	Anderson et al.	
2002/0099829	A1 *	7/2002	Richards et al.	709/227
2002/0112183	A1	8/2002	Baird, III et al.	
2002/0120741	A1	8/2002	Webb et al.	
2002/0123335	A1	9/2002	Luna et al.	
2002/0124078	A1	9/2002	Conrad	
2002/0124103	A1	9/2002	Maruyama et al.	
2002/0129143	A1	9/2002	McKinnon, III et al.	
2002/0131404	A1	9/2002	Mehta et al.	
2002/0133581	A1	9/2002	Schwartz et al.	
2002/0133586	A1	9/2002	Shanklin et al.	
2002/0133589	A1	9/2002	Gubbi et al.	
2002/0136226	A1	9/2002	Christoffel et al.	
2002/0138631	A1	9/2002	Friedel et al.	
2002/0138762	A1	9/2002	Horne	
2002/0138763	A1	9/2002	Delaney et al.	
2002/0143964	A1	10/2002	Guo et al.	
2002/0152284	A1	10/2002	Cambray et al.	
2002/0162030	A1	10/2002	Brezak et al.	
2002/0164952	A1	11/2002	Singhal et al.	
2002/0165949	A1 *	11/2002	Na et al.	709/223
2002/0165990	A1	11/2002	Singhal et al.	
2002/0169867	A1	11/2002	Mann et al.	
2002/0174227	A1	11/2002	Hartsell et al.	
2002/0178282	A1	11/2002	Mysore et al.	
2002/0199007	A1	12/2002	Clayton et al.	
2003/0041104	A1	2/2003	Wingard et al.	
2003/0043846	A1	3/2003	Purpura et al.	
2003/0046370	A1	3/2003	Courtney	

2003/0055994	A1	3/2003	Herrmann et al.	
2003/0059038	A1	3/2003	Meyerson et al.	
2003/0061506	A1	3/2003	Cooper et al.	
2003/0069955	A1*	4/2003	Gieseke et al.	709/223
2003/0069956	A1	4/2003	Gieske et al.	
2003/0070170	A1	4/2003	Lennon	
2003/0078784	A1	4/2003	Jordan et al.	
2003/0087629	A1	5/2003	Juitt et al.	
2003/0110073	A1	6/2003	Briel et al.	
2003/0115247	A1*	6/2003	Simpson et al.	709/200
2003/0123442	A1	7/2003	Drucker et al.	
2003/0126608	A1	7/2003	Safadi et al.	
2003/0135753	A1	7/2003	Batra et al.	
2003/0149751	A1	8/2003	Bellinger et al.	
2003/0154399	A1	8/2003	Zuk et al.	
2003/0159072	A1	8/2003	Bellinger et al.	
2003/0163603	A1	8/2003	Fry et al.	
2003/0172167	A1	9/2003	Judge et al.	
2003/0177477	A1	9/2003	Fuchs	
2003/0182420	A1*	9/2003	Jones et al.	709/224
2003/0212800	A1*	11/2003	Jones et al.	709/228
2003/0212900	A1	11/2003	Liu et al.	
2003/0217126	A1	11/2003	Polcha et al.	
2004/0015719	A1	1/2004	Lee et al.	
2004/0047356	A1	3/2004	Bauer	
2004/0049586	A1	3/2004	Ocepek et al.	
2004/0064351	A1*	4/2004	Mikurak	705/7
2004/0064560	A1*	4/2004	Zhang et al.	709/226
2004/0064836	A1	4/2004	Ludvig et al.	
2004/0073941	A1	4/2004	Ludvig et al.	
2004/0083295	A1*	4/2004	Amara et al.	709/229
2004/0085906	A1	5/2004	Ohtani et al.	
2004/0093513	A1	5/2004	Cantrell et al.	
2004/0103426	A1	5/2004	Ludvig et al.	
2004/0107290	A1	6/2004	Kaplan et al.	
2004/0122956	A1	6/2004	Myers et al.	
2004/0172557	A1	9/2004	Nakae et al.	
2004/0179822	A1	9/2004	Tsumagari et al.	
2004/0181816	A1	9/2004	Kim et al.	
2004/0199635	A1*	10/2004	Ta et al.	709/226
2004/0210633	A1	10/2004	Brown et al.	
2004/0215957	A1*	10/2004	Moineau et al.	713/153
2004/0268149	A1	12/2004	Aaron	
2004/0268234	A1	12/2004	Sampathkumar et al.	
2005/0021686	A1	1/2005	Jai et al.	
2005/0021975	A1*	1/2005	Liu	713/182
2005/0044350	A1	2/2005	White	
2005/0044422	A1	2/2005	Cantrell et al.	
2005/0066200	A1*	3/2005	Bahl et al.	713/201
2005/0091303	A1	4/2005	Suzuki	
2005/0138358	A1*	6/2005	Bahl et al.	713/155
2005/0138416	A1	6/2005	Qian et al.	
2005/0149721	A1	7/2005	Lu et al.	
2005/0193103	A1	9/2005	Drabik	
2005/0195854	A1	9/2005	Agmon et al.	
2005/0204022	A1	9/2005	Johnston et al.	
2005/0204031	A1	9/2005	Johnston et al.	
2005/0204050	A1	9/2005	Turley et al.	
2005/0204168	A1*	9/2005	Johnston et al.	713/201
2005/0204169	A1	9/2005	Tonnesen	
2005/0204402	A1	9/2005	Turley et al.	
2006/0036723	A1	2/2006	Yip et al.	
2006/0168229	A1	7/2006	Shim et al.	
2006/0168454	A1*	7/2006	Venkatachary et al.	713/182
2006/0173992	A1	8/2006	Weber et al.	
2006/0184618	A1	8/2006	Kurup et al.	
2007/0073718	A1	3/2007	Ramer et al.	
2007/0186113	A1	8/2007	Cuberson et al.	
2007/0208936	A1	9/2007	Robles	
2007/0268878	A1	11/2007	Clements	
2008/0066096	A1	3/2008	Wollmershauser et al.	
2008/0120661	A1	5/2008	Ludvig et al.	
2008/0147840	A1	6/2008	Roelens et al.	
2008/0276305	A1	11/2008	Chan et al.	
2010/0192213	A1	7/2010	Ta et al.	

FOREIGN PATENT DOCUMENTS

WO	WO 0177787	A2	10/2001
WO	WO 0209458	A2	1/2002
WO	WO 02/23825	A1	3/2002
WO	WO 0241587	A3	5/2002
WO	WO 02077820	A1	10/2002
WO	WO 03021890	A1	3/2003
WO	WO 03/098461	A1	5/2003
WO	WO 2004/034229	A2	4/2004
WO	WO 2004/036371	A2	4/2004
WO	WO 2005/020035	A2	3/2005

OTHER PUBLICATIONS

Pending U.S. Appl. No. 09/541,877, Short et al.

Pending U.S. Appl. No. 09/458,569, Short et al.

Pending U.S. Appl. No. 08/816,174, Short et al.

Lingblom, "Granite Develops SMB Stategy", CRN, San Jose, CA, Jun. 23, 2003.

"Boingo Wireless Service Installed At LaGuardia Airport" Copyright 2003 M2Communications Ltd., found at www.findarticles.com, 1 page, printed Dec. 8, 2003.

"West Point Unwired: the Military Academy at West Point Continues to Lead the Way in High-Tech Curriculum with Wireless Classroom Networking" Copyright 2003 M2Communications Ltd., found at www.findarticles.com, 1 page, printed Dec. 8, 2003.

Molta, "Wireless Hotspots Heat Up", Mobile & Wireless Technology feature, pp. 1-8, Copyright 2003 M2Communications Ltd., found at www.networkcomputing.com, printed Dec. 8, 2003.

Jackson, "Wireless at West Point: Officers of the Future Use IT in Class Now, in the Field Later (technology Report)" pp. 1-3, www.gcn.com, Apr. 21, 2003.

Lingblom, "Bluesocket's New Gateway Based on Open Standards—WGX-4000 Switch Wireless Gateway" CRN, Burlington, MA, found at www.crn.channelsupersearch.com, Apr. 21, 2003.

Dornan, "Wireless LANs: Freedom vs. Security?" Network Magazine, pp. 36-39, Jul. 2003.

O'Shea, "PCTEL looks past patent suite toward fusion of Wi-Fi, PC" Telephony.online, pp. 1-2, found at www.telephonyonline.com, Jun. 2, 2003.

O'Shea, "Boingo to Launch Initiative Aimed at Carrier Market" Telephony.online, 1 page, found at www.telephonyonline.com, Mar. 10, 2003.

International Search Report PCT/US03/32268, Oct. 29, 2004.

U.S. Patent Office Official Action issued Jan. 25, 2008 in U.S. Appl. No. 11/076,652, Steven D. Tonnesen, Jan. 25, 2008.

U.S. Patent Office Action issued Apr. 17, 2008, in U.S. Appl. No. 10/687,002, Tuan Ta, 13 pages.

U.S. Patent Office Official Action issued Jul. 13, 2007 in U.S. Appl. No. 10/922,041, Eric White.

U.S. Patent Office Official Action issued Oct. 18, 2007 in U.S. Appl. No. 10/687,002, Tuan Ta.

U.S. Patent Office Official Action issued Oct. 31, 2007 in U.S. Appl. No. 11/078,223, Keith Johnston.

Office Action issued in U.S. Appl. No. 11/076,652 dated Dec. 11, 2008, Tonnesen, 8 pages.

Office Action issued in U.S. Appl. No. 10/687,002 dated Jan. 7, 2009, Ta, 4 pages.

U.S. Patent Office Action issued Jul. 9, 2008, in U.S. Appl. No. 11/076,672, Keith Johnston, 12 pages.

U.S. Appl. No. 09/821,565, Ishikawa.

U.S. Appl. No. 09/881,147, Cooper et al.

U.S. Appl. No. 10/000,396, Copeland.

U.S. Appl. No. 10/072,683, Zuk et al.

U.S. Appl. No. 10/195,326, Lee et al.

U.S. Appl. No. 10/236,402, Bauer.

U.S. Appl. No. 10/291,095, Cantrell et al.

U.S. Appl. No. 10/469,206, Ohtani et al.

U.S. Appl. No. 10/641,494, Valluri.

U.S. Appl. No. 10/643,864, Nakae et al.

U.S. Appl. No. 10/709,423, Lu et al.

U.S. Appl. No. 10/930,392, Cantrell et al.

U.S. Appl. No. 10/930,922, Cantrell et al.

U.S. Appl. No. 10/953,326, Suzuki.

Fan et al, "Distributed Real Time Intrusion Detection System for 3G", 2004, pp. 1566-1570.

Yu et al., "Fuzzy Logic Based Adaptive Congestion Control Scheme for High-Speed Network", Aug. 2004, pp. 389-393.
Hamano et al., A Redirections-Based Defense Mechanism Against Flood-Type Attacks in Large Scale ISP Networks, 2004, pp. 543-547.
Sarolahti, "Congestion Control on Spurious TCP Retransmssion Timeouts," 2003, pp. 682-686.
Estevez-Tapiador et al., "Measuring Normality in HTTP Traffic for Anomaly-Based Intrusion Detection", Jun. 6, 2004, pp. 175-193.
Xing et al., "A Survery of Computer Vulnerability Assessment", Jan. 2004, pp. 1-11.
Wen et al. "Development of a Snort-Based Security Network Management and Real-Time Intrusion Detection System", Feb. 2004, pp. 40-43.
Thottethodi et al., "Exploiting Global Knowledge to Achieve Self-Tuned Congestion Control for K-ary n-cube Networks", Mar. 2004, pp. 257-272.
Trabelsi et al., "Malicious Sniffing Systems Detection Platform", 2004, pp. 201-207.
Guangzhi et al., "A Framework for Network Vulnerability Analysis", 2002, pp. 289-294.
Albuquerque et al., "Network Border Patrol: Preventing Congestion Collapse and Promoting Fairness in the Internet", Feb. 2004, pp. 173-186.
Wirbel, Loring, "Security Stampede Could Flatten IPSec", Jan. 2004, p. 12.
MacLeod, Calum, "Freeing the Shackles with Secure Remote Working", 2003, pp. 66-67.
Fisher, D., "SSL Simplifies VPN Security", Nov. 10, 2003, p. 40.
Conry-Murray, A., "SSL VPNs: Remote Access for the Masses", Oct. 2003, pp. 26-32.
Permeo Supports Microsoft Network Access Protection for Simplified Secure Remote Access; Permeo's Base5 Support for Microsoft Tech. Provides "Zero Touch" Policy Enforcement.
No author, Permeo Drives Out Operational Costs, Simplifies Secure Remote Access, Mar. 28, 2005, pp. NA.
No author, Netilla Lauches SSL VPN for Citrix. (Industry Briefs) (Virtual Private Networks) (Brief Article), Sep. 20, 2004, p. 43.
No author, "Secure Remote Access (Network Security) (VPN Gateway 4400 Series) (Brief Article)", Mar. 1, 2004, p. 50.
International Search Report and Written Opinion for related International Application No. PCT/US04/29249, Dec. 15, 2005.
Stone, David, "Securing Wireless LANs with VPN," May 2006, pp. NA.
Hamzeh, et al., "Point-to-Point Tunneling Protocol—PPTP RFC 2637" Network Working Group, Jul. 1999, pp. 1-54.
Pfleeger, Charles P., Security in Computing, PTR Prentice-Hall, Inc., 1989, Ch. 10.
International Search Report for PCT/US03/32912, Apr. 8, 2004.
Lingblom, "Bluesocket's New Gateway Based on Open Standards—WGX-4000 Switch Wireless Gateway" CRN, Burlington, MA at www.crn.channelsupersearch.com, Apr. 21, 2003.
U.S. Patent Office Action issued Jul. 22, 2008, in U.S. Appl. No. 11/076,652, Steven D. Tonnesen, 8 pages.
Office Action issued in U.S. Appl. No. 11/076,719, dated Sep. 4, 2008, Turley, 7 pages.
U.S. Patent Office Action issued Aug. 13, 2008, in U.S. Appl. No. 11/076,591, Patrick Turley, 10 pages.
SBC Technology Resources, Inc., XNMP-XML Network Management Protocol and Interface, Jul. 19, 2002, pp. 1-9, http://www.ietf.org/proceedings/02jul/slides.
Shim, Choon B., XNMP for IP Telephony Management, Enterprise Networks & Servers, Jun. 2006, pp. 1-7, http://www.enterprisenetworksandservers.com.
Oh et al., Interaction Translation Methods for XML/SNMP Gateway, Jul. 11, 2003, retrieved from . . . http://web-archive.org/web/20030711162412/http://dpnm.postech.ac.kr/papers/DSOM/02/xml-snmp-gateway/xml-snmp-gateway.pdf, pp. 1-5.
Office Action issued in U.S. Appl. No. 11/076,672 dated Feb. 3, 2009, Johnston, 10 pages.
Office Action issued in U.S. Appl. No. 11/076,591 dated Feb. 13, 2009, Turley, 26 pages.
International Preliminary Report on Patentability in PCT/US03/032268 dated Apr. 10, 2005, 3 pages.
International Preliminary Report on Patentability in PCT/US03/032912 dated Apr. 16, 2005, 3 pages.
International Preliminary Report on Patentability and Written Opinion in PCT/US04/029249 dated Feb. 21, 2006, 6 pages.
Office Action issued in U.S. Appl. No. 11/076,719 dated Mar. 17, 2009, 8 pages.
"Netilla Lauches Secure Gateway Appliance Family of Application . . .", PR Newswire, Sep. 13, 2004, Somerset, NJ, 3 pages.
"Fortinet and Aventail Deliver Joint Solution for Clientless Remote . . .", PR Newswire, Jan. 5, 2004, Seattle/Sunnyvale, CA, 3 pages.
"Cisco targets SSL VPN Vendors, adds support for clientless security . . .", Computerworld, vol. 37, No. 46, Nov. 17, 2003, 3 pages.
Office Action issued in U.S. Appl. No. 10/922,041, mailed Dec. 6, 2005, White, 10 pages.
Office Action issued in U.S. Appl. No. 10/922,041, mailed Mar. 30, 2006, White, 18 pages.
Office Action issued in U.S. Appl. No. 10/922,041, mailed Aug. 11, 2006, White, 19 pages.
Office Action issued in U.S. Appl. No. 10/922,041, mailed Jan. 30, 2007, White, 20 pages.
Office Action issued in U.S. Appl. No. 10/687,002, mailed May 2, 2007, Ta, 10 pages.
U.S. Patent and Trademark Office, Office Action issued in U.S. Appl. No. 10/922,041, mailed May 8, 2009, White, 13 Pages.
U.S. Patent and Trademark Office, Office Action issued in U.S. Appl. No. 11/076,672, mailed Jul. 21, 2009, White, 11 Pages.
Crandell et al., "A Secure and Transparent Firewall Web Proxy," Oct. 2003, USENIX, Retrieved from the internet on Jul. 15, 2009: <URL: http://www.usenix.org/event/lisa03/tech/full_papers/crandell/crandell.pdf>.
Sommerlad, "Reverse Proxy Patterns," 2003 Retrieved from the Internet on Jul. 15, 2009: <URL: http://www.modsecurity.org/archive/ReverseProxy-book-1.pdf>.
U.S. Patent and Trademark Office, Notice of Allowability issued in U.S. Appl. No. 11/076,646, mailed Jul. 24, 2009, Johnston et al., 7 pages.
Office Action issued in U.S. Appl. No. 11/076,672, mailed Jan. 7, 2010, 9 pgs.
Office Action issued in U.S. Appl. No. 11/076,591, mailed Feb. 2, 2010, 34 pgs.
Office Action issued in U.S. Appl. No. 11/076,591, mailed Aug. 6, 2009, 29 pages.
Rashti et al, "A Multi-Dimensional Packet Classifier for NP-Based Firewalls," Jan. 2004, retrieved from the internet on Aug. 12, 2009: <URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=1266123&isnumber=28312>.
Office Action for U.S. Appl. No. 11/076,591, mailed Jul. 20, 2010, 33 pgs.
Office Action for U.S. Appl. No. 12/506,140, mailed Sep. 1, 2010, 11 pgs.
Office Action for U.S. Appl. No. 12/579,566, mailed Oct. 6, 2010, 7 pgs.
Web site page entitled "Our Products," downloaded from http://web.archive.org/web/20010815034246/rocksteady.com/product.html and printed Nov. 2, 2010, 1 pg.
Web site page entitled "About RockNET," downloaded from http://web.archive.org/web/20010824234659/rocksteady.com/rocknet.html and printed Nov. 2, 2010, 2 pgs.
Web site page entitled "About RockNOC," downloaded from http://web.archive.org/web/20010825000449/rocksteady.com/rocknoc.html and printed Nov. 2, 2010, 1 pg.
Web site page entitled "Our RockBOX," downloaded from http://web.archive.org/web/20010824233630/rocksteady.com/rockbox.html and printed Nov. 2, 2010, 2 pgs.
Web site page entitled "About RockSteady," downloaded from http://web.archive.org/web/20010825001007/rocksteady.com/techdetails.html and printed Nov. 2, 2010, 2 pgs.
Web site page entitled "Your RockSteady Network," downloaded from http://web.archive.org/web/20010723202022/rocksteady.com/popup.html and printed Nov. 2, 2010, 1 pg.

Discussion of Conceptual Difference Between Cisco IOS Classic and Zone-Based Firewalls, Oct. 2007, 4 pgs., Cisco Systems, Inc., San Jose, CA.
Cisco IOS Firewall Zone-Based Policy Firewall, Release 12.4(6)T, Technical Discussion, Feb. 2006, 77 pgs., Cisco Systems, Inc., San Jose, CA.
Zone-Based Policy Firewall Design and Application Guide, Document ID: 98628, Sep. 13, 2007, 49 pgs., Cisco Systems, Inc., San Jose, CA.
SP Maj, W Makairanondh, D Veal, "An Evaluation of Firewall Configuration Methods," IJSCSNS International Journal of Computer Science and Network Security, vol. 10, No. 8, Aug. 2010, 7 pgs.
Using VPN with Zone-Based Policy Firewall, May 2009, Cisco Systems, Inc., San Jose, CA, 10 pgs.
Cisco IOS Firewall Classic and Zone-Based Virtual Firewall Application Configuration Example, Document ID: 100595, Feb. 12, 2008, 20 pgs., Cisco Systems, Inc., San Jose, CA.
Class-Based Policy Provisioning: Introducing Class-Based Policy Language (CPL), Aug. 2008, 36 pgs., Cisco Systems, Inc., San Jose, CA.
Cisco IOS Zone Based Firewall Example, at http://www.linickx.com/archives/2945/cisco-ios-zon . . ., printed Dec. 7, 2010, 6 pgs., LINICKX.com.
Zone-Based Policy Firewall, Published Feb. 22, 2006, Updated Jun. 19, 2006, 46 pgs., Cisco Systems, Inc., San Jose, CA.
Applying Zone-based Firewall Policies in Cisco Security Manager, Published Mar. 2009, Revised Sep. 2009, 64 pgs., Cisco Systems, Inc., San Jose, CA.
"FreeBSD Handbook, Chapter 30 Firewalls," 2003, found at www.freebsd.org/doc/handbook/firewalls-ipfw.html, printed Dec. 27, 2010, 13 pgs.
Watters, Paul, "Solaris 8 Administrator's Guide. Chapter 4, Network Configuration," O'Reilly & Associates, Inc., Jan. 2002, 17 pgs.
Spitzner, Lance, "Configuring network interface cards; getting your interfaces to talk," Mar. 23, 2004, 4 pgs.
Gite, Vivek, "Redhat/CentOS/Fedora Linux Open Port," Sep. 13, 2007, found at www.cyberciti.biz/faq/howto-rhel-linux-open-port-using-iptables/ printed Jan. 3, 2011, 7 pgs.
Office Action for U.S. Appl. No. 12/617,211, dated Feb. 3, 2011, 14 pgs.
"Managing Firewall Services," User Guide for Cisco Security Manager 3.3.1, Oct. 2009, Ch. 11, 90 pgs., Cisco Systems, Inc., San Jose, CA.
"Cisco Common Classification Policy Language," Cisco Router and Security Device Manager 2.4 User's Guide, Ch. 34, 2007, 32 pgs., Cisco Systems, Inc., San Jose, CA.
Guide to User Documentation for Cisco Security Manager 4.0, Jun. 18, 2010, 6 pgs., Cisco Systems, Inc., San Jose, CA.
Cisco Configuration Professional: Zone-Based Firewall Blocking Peer to Peer Traffic Configuration Example, Document ID: 112237, Updated Dec. 3, 2010, 25 pgs., Cisco Systems, Inc., San Jose, CA.
Tuning Cisco IOS Classic and Zone-Based Policy Firewall Denial-of-Service Protection, 2006, 10 pgs., Cisco Systems, Inc., San Jose, CA.
Holuska, Marty, Using Cisco IOS Firewalls to Implement a Network Security Policy, Fort Hays State University/INT 490, printed Dec. 6, 2010, 5 pgs., at http://quasarint.com/Capstone/zb_policy.php.
Cisco Feature Navigator, Cisco Systems, Inc., San Jose, CA, at http://tools.cisco.com/ITDIT/CFN/Dispatch, printed on Dec. 2, 2010, 4 pgs.
Office Action for U.S. Appl. No. 12/506,140, mailed Feb. 18, 2011, 13 pgs.
Notice of Allowance for U.S. Appl. No. 12,579,566, mailed Mar. 23, 2011, 5 pgs.
Notice of Allowance for U.S. Appl. No. 12/579,566, mailed May 13, 2011, 8 pgs.
Office Action for U.S. Appl. No. 12/617,211, mailed Jul. 19, 2011, 18 pgs.
Office Action for U.S. Appl. No. 12/506,140, mailed Aug. 4, 2011, 18 pgs.
Notice of Allowance for U.S. Appl. No. 12/579,566, mailed Aug. 26, 2011, 9 pgs.
Notice of Allowance issued in U.S. Appl. No. 10/683,317, mailed Nov. 28, 2011, 11 pages.
Notice of Allowance for U.S. Appl. No. 12/617,211, mailed Nov. 10, 2011, 8 pages.
Office Action for U.S. Appl. No. 12/753,390, mailed Dec. 8, 2011, 10 pages.
Notice of Allowance for U.S. Appl. No. 12/617,211, mailed Dec. 12, 2011, 8 pages.

* cited by examiner

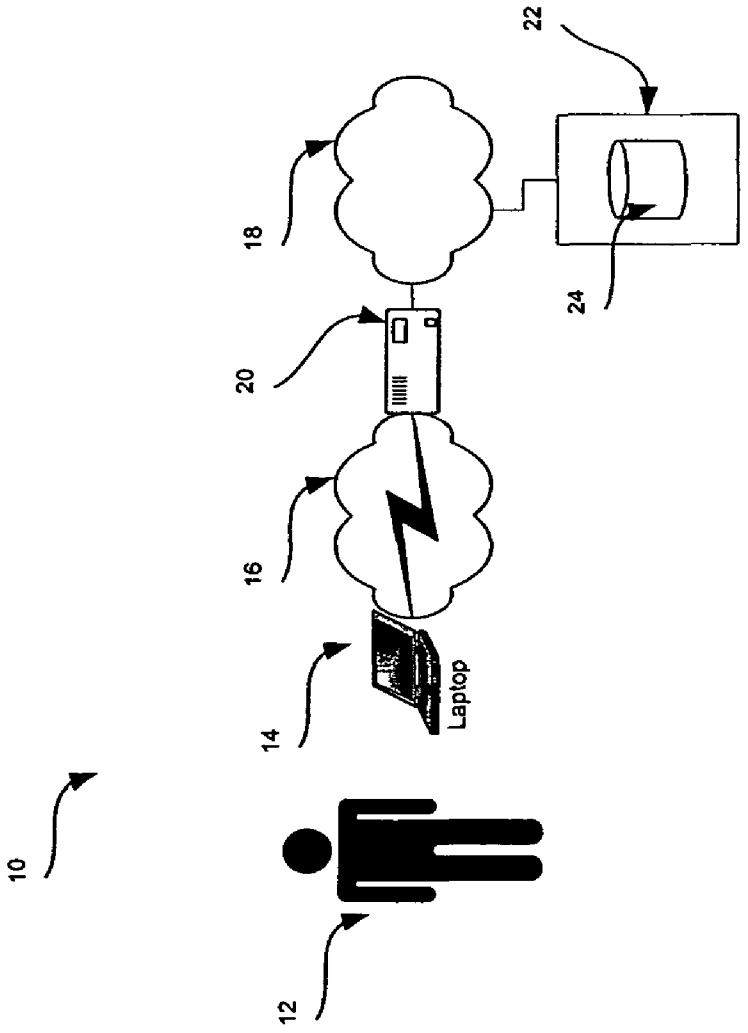
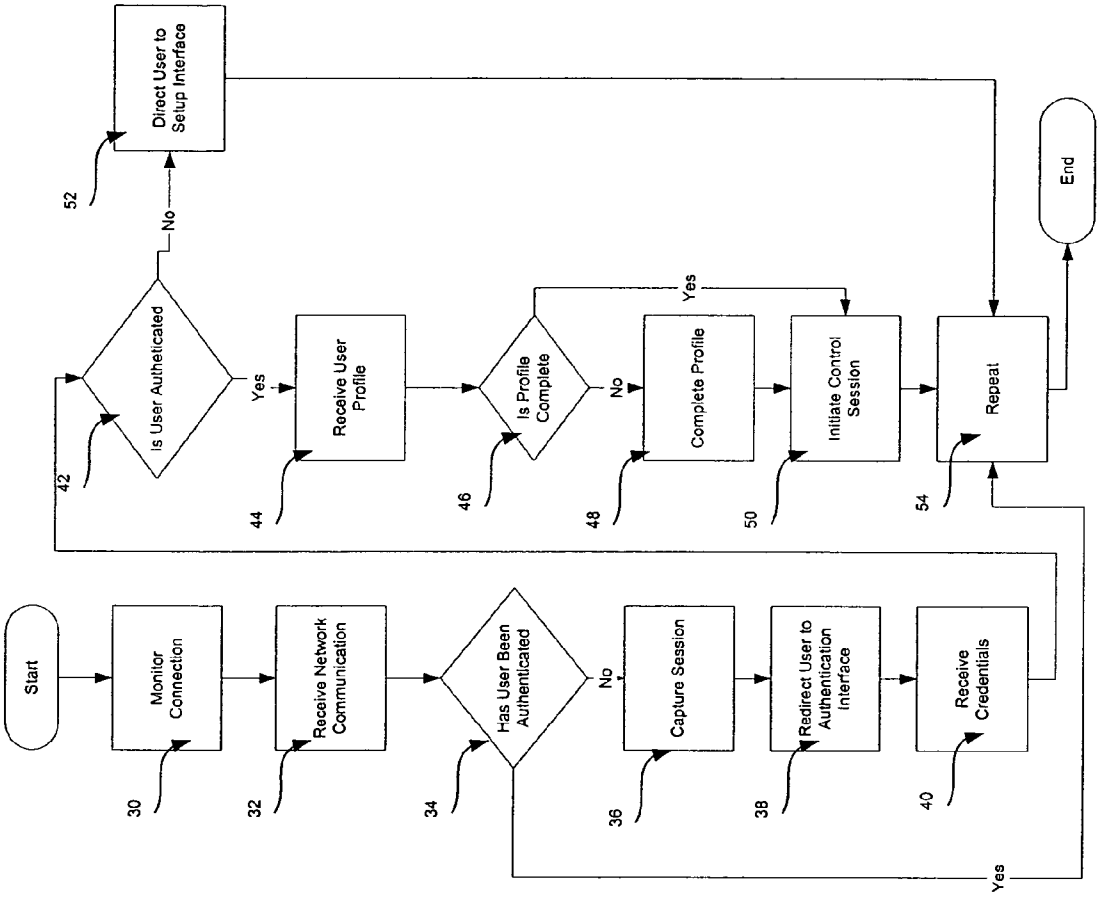


FIG. 1

FIGURE 2



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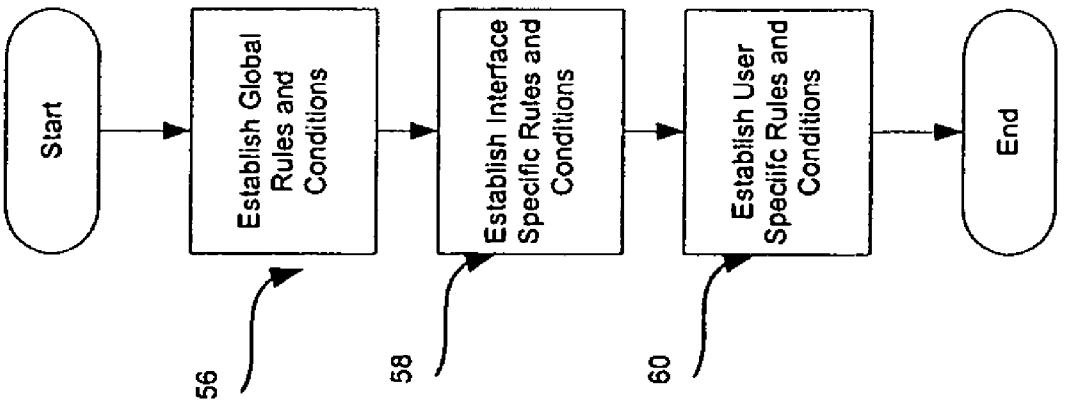

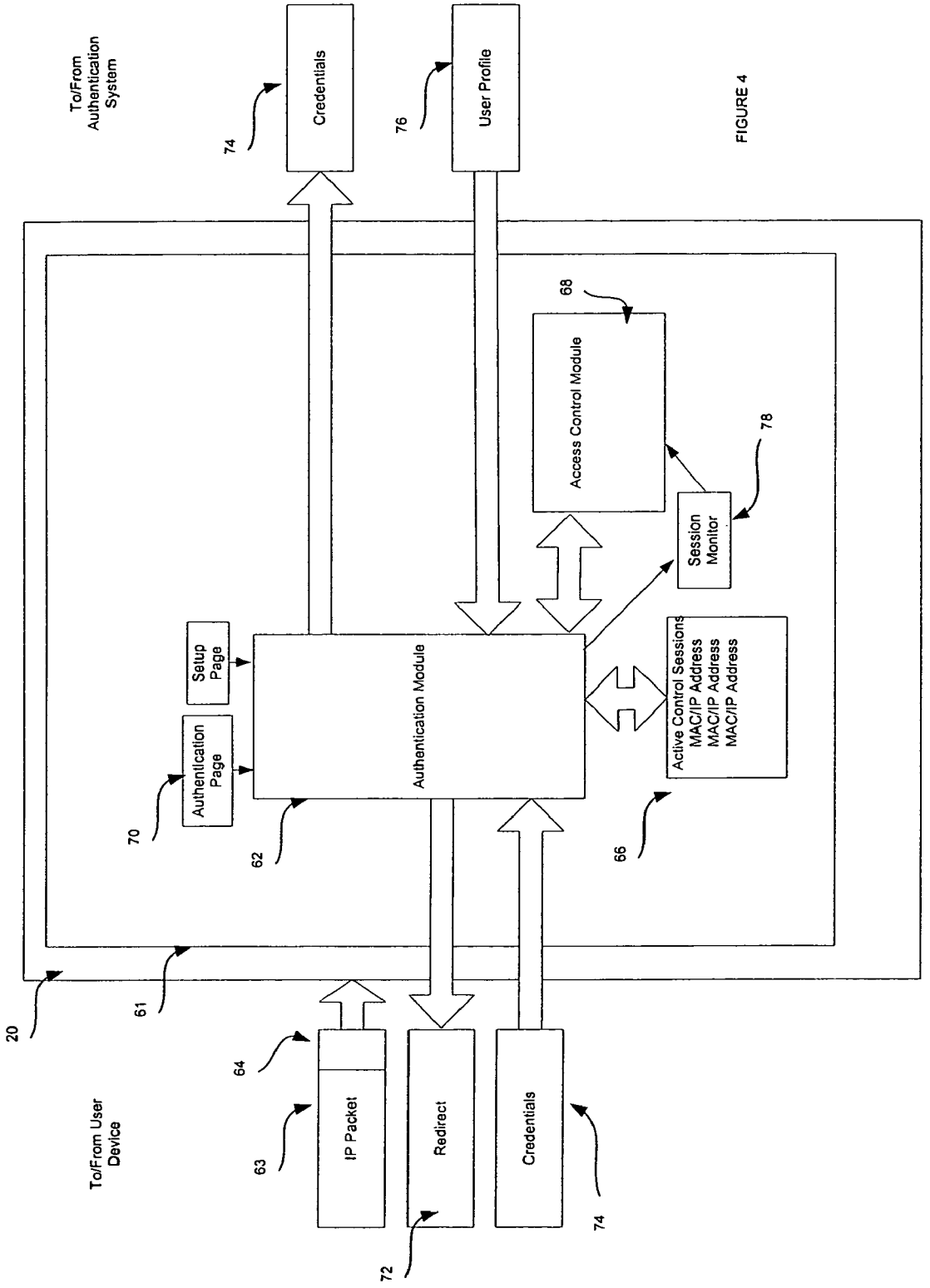

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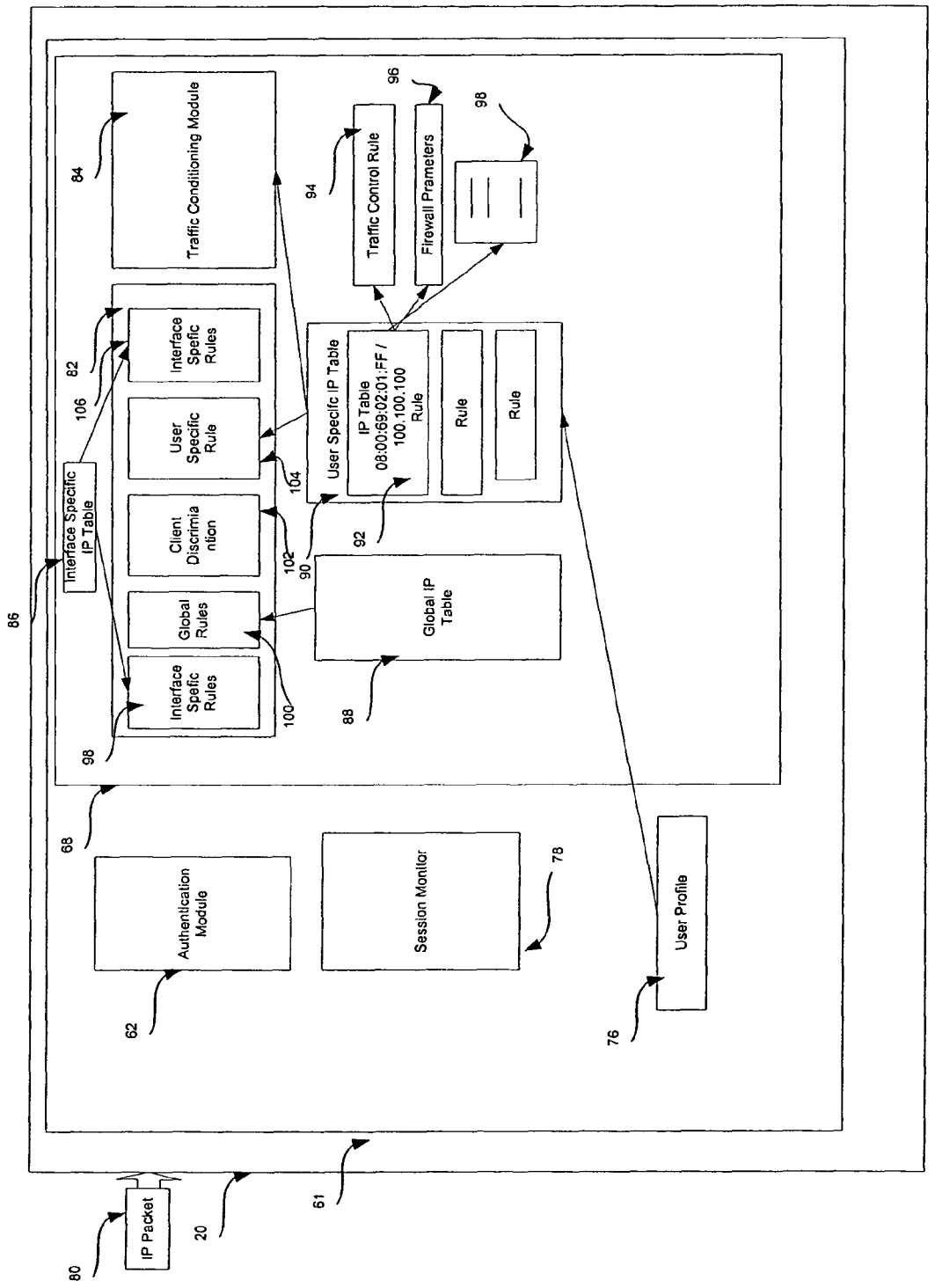


FIGURE 5

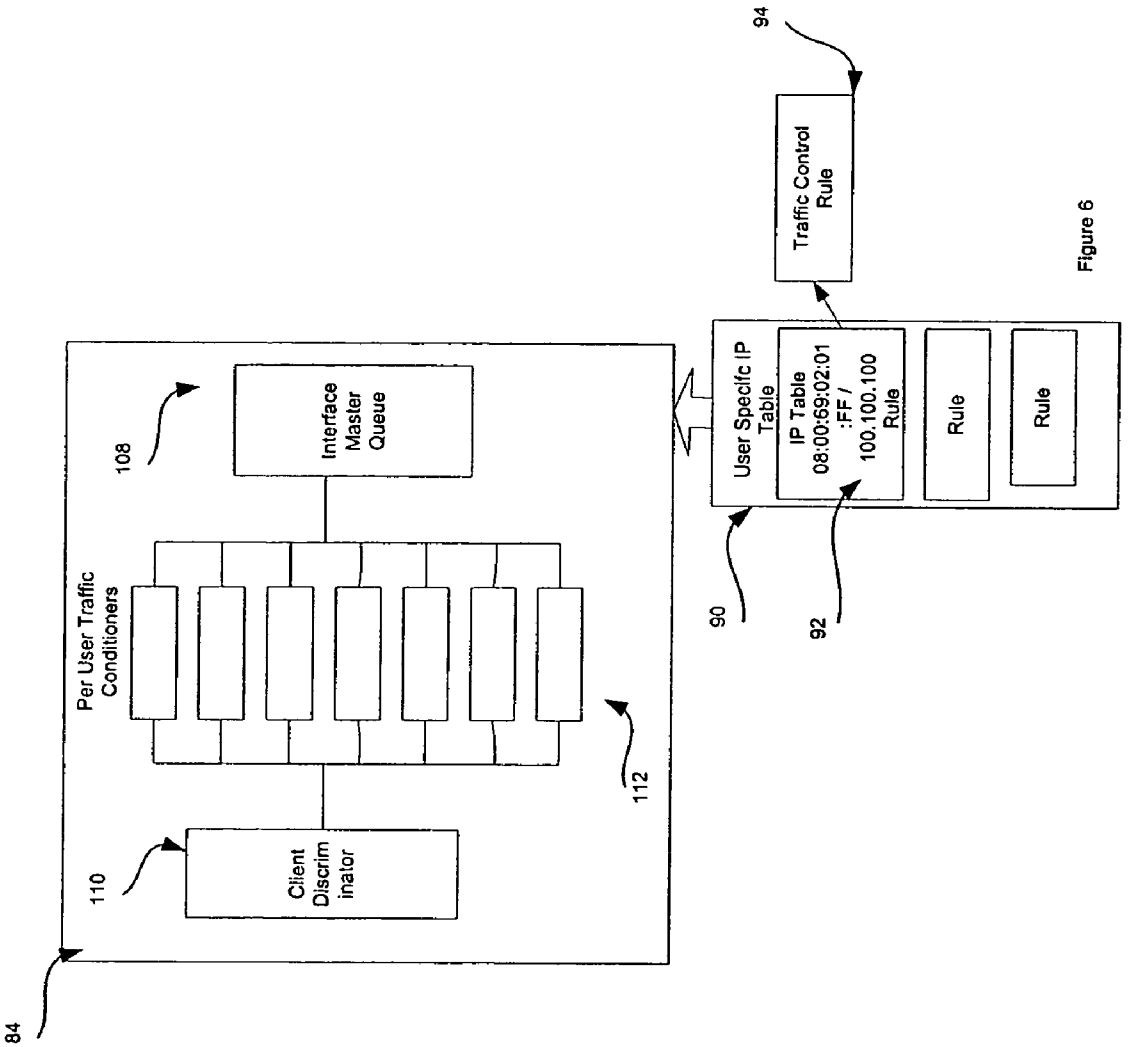


Figure 6

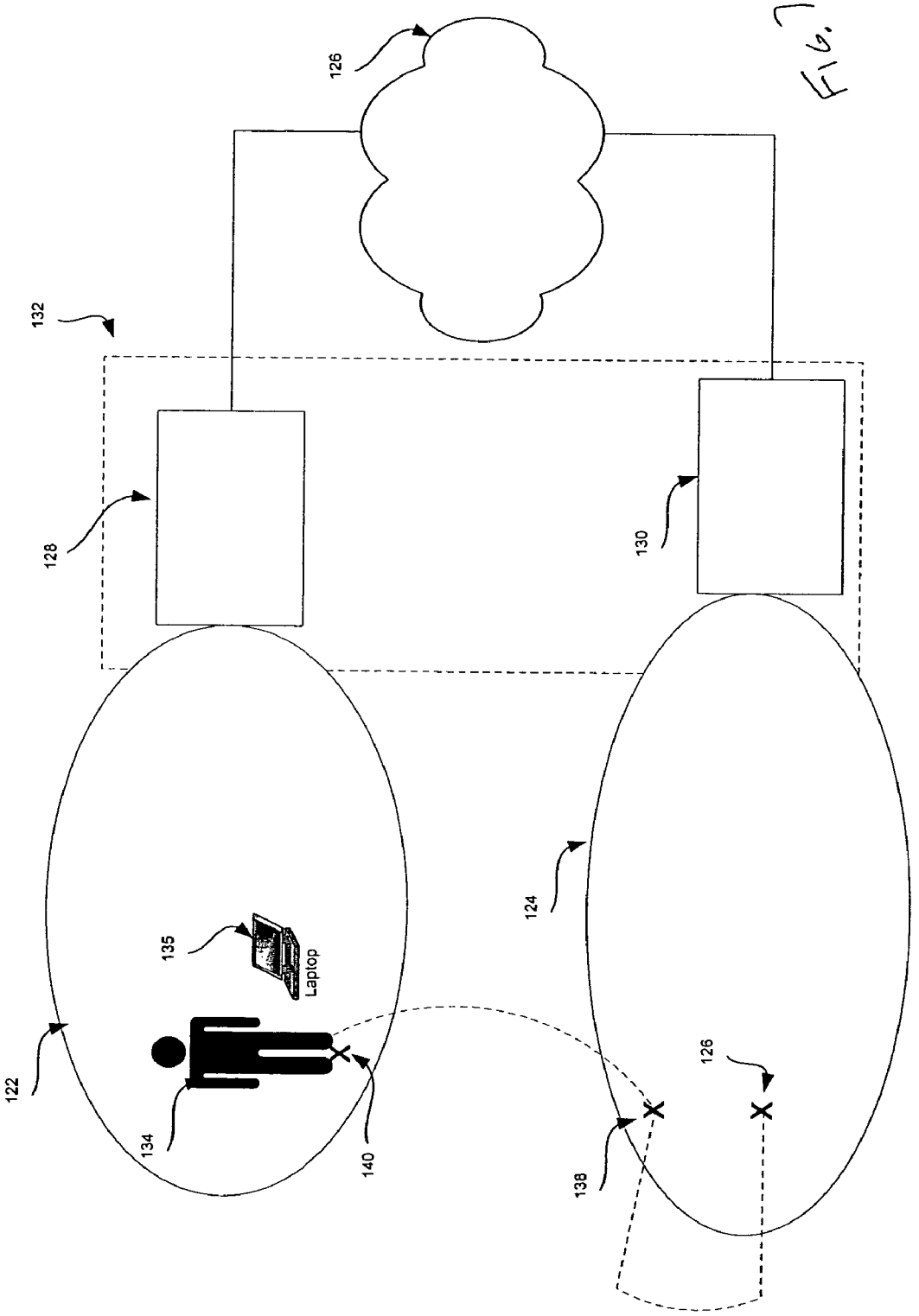
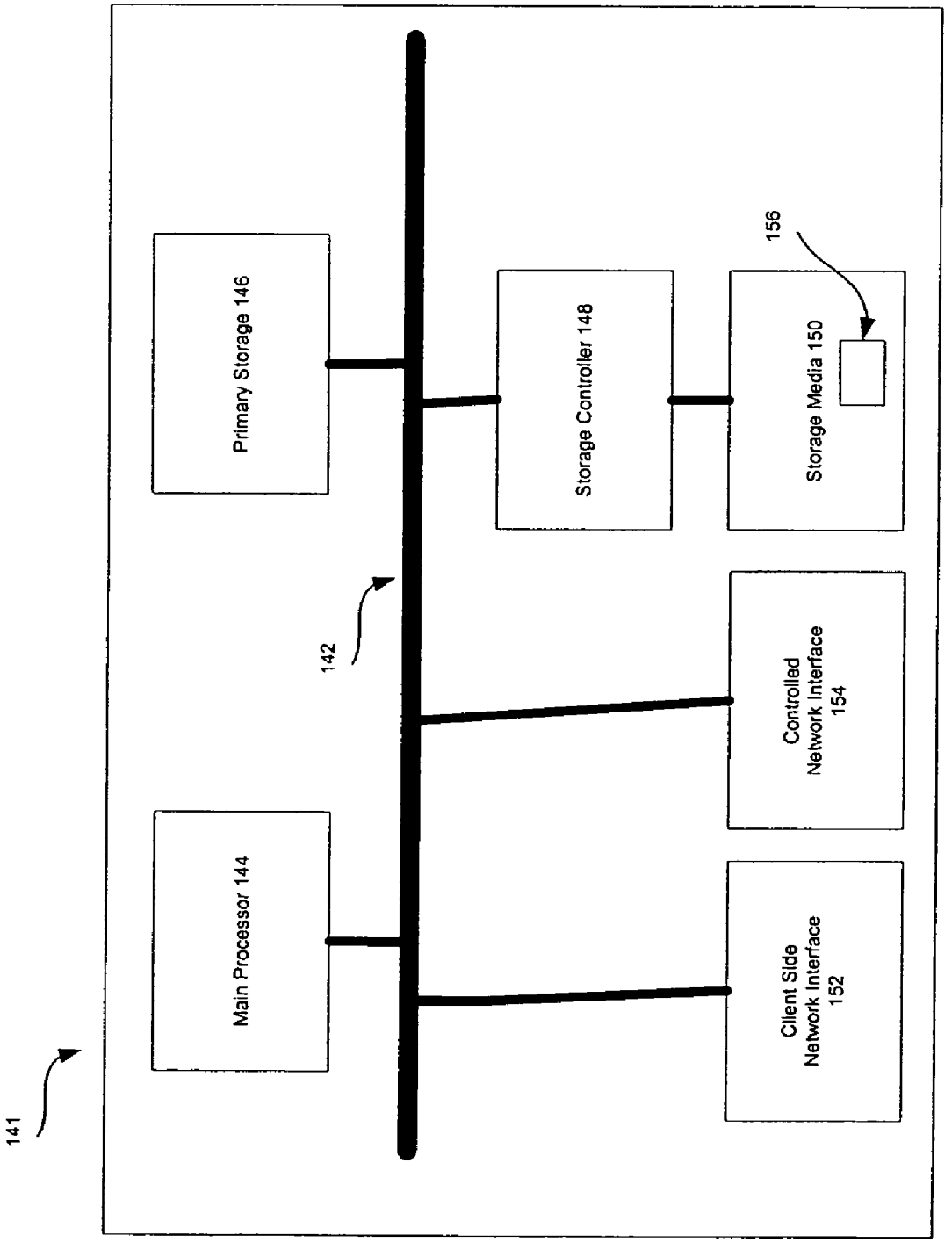


Fig. 7

FIGURE 8



SYSTEM AND METHOD FOR PROVIDING ACCESS CONTROL

RELATED APPLICATIONS

This application claims priority under 35 U.S.C. 119(e) to U.S. Provisional Patent Application No. 60/417,674, entitled "Access Controlled Network Sharing," to Richard MacKinnon and Kelly Looney, filed Oct. 10, 2002, which is hereby fully incorporated by reference herein.

TECHNICAL FIELD OF THE INVENTION

Embodiments of the present invention relate to network access. More particularly, embodiments of the present invention relate to providing access control for a shared network.

BACKGROUND

The communication of data over networks has become an important, if not essential, way for many organizations and individuals to communicate. The Internet is a global network connecting millions of computers using a client-server architecture in which any computer connected to the Internet can potentially receive data from and send data to any other computer connected to the Internet. The Internet provides a variety methods in which to communicate data, one of the most ubiquitous of which is the World Wide Web. Other methods for communicating data over the Internet include e-mail, usenet newsgroups, telnet and FTP.

Users typically access the Internet either through a computer connected to an Internet Service Provider ("ISP") or computer connected to a local area network ("LAN") provided by an organization, which is in turn, connected to the ISP. The ISP provides a point of presence to interface with the Internet backbone.

Routers and switches in the backbone direct data traffic between the various ISPs.

To access a LAN and, in turn, the Internet, many prior art access control systems require a user to connect his or her computer to a wired network (e.g., through an Ethernet port) and enter a user name and password. If the user name and password match a user name and password in an authentication database, the user will be provided access to the network. These systems typically assume that a user is tied to a particular physical port, such as a port in the user's office. Based on this assumption, provisioning of bandwidth to the user occurs by physically provisioning the port to which the user is connected. If the user moves to a different port, the user will typically be provided with the bandwidth provisioned to the new port. Thus, provisioning of bandwidth is done on a per port rather than a per user basis.

General internet access provided via broadband technology (e.g., Digital Subscriber Line, DOCSIS or analog cable modem, or similar technologies) are capable of provisioning bandwidth to a computer premise equipment (CPE) device. CPE provisioning can be dynamic and remotely administered. However, broadband technology adoption is not a single-user and, hence, is not user-specific provisioning.

An increasing number of organizations (e.g., businesses, governmental organizations) wish to provide access to LANs and the Internet to various classes of users (internal users, contractors, customers, visitors). For example, many cafes have public wireless networks to allow patrons to access the Internet, receive email and perform other network activities. While users may be asked to authenticate to use the network, bandwidth is provisioned to the wireless routers, not the individual users. This means that one user connected to a particular router can consume a majority of the bandwidth (e.g., downloading pictures from the Internet), slowing down the wireless network for other users connected to that router.

An additional problem with many current networks, particularly wireless networks, is roaming between subnets. A subnet is a portion of a LAN that has a common address component. One subnet, for example, can cover a particular floor of a building, while another subnet covers another floor. Each subnet can potentially have its own set of internet protocol ("IP") addresses that may or may not overlap with the IP addresses of other subnets. When a user moves from one subnet to another, even if both subnets are part of the same LAN, the user must typically reauthenticate with the network.

This can make physically roaming between subnets frustrating because open network sessions will often be dropped.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide a system and method of providing network access that eliminates, or at least substantially reduces, the shortcomings of prior art network access systems and methods. More particularly, one embodiment of the present invention provides a system of providing network access comprising a processor, a first network interface coupled to the processor, a second network interface coupled to the processor, a storage media accessible by the processor and a set of computer instructions stored on the storage media, executable by the processor. In one embodiment of the present invention, the computer instructions can be executable to receive a network communication over the first network interface from a user using a user device and determine if the network communication is associated with an authenticated user. If the network communication is not associated with an authenticated user, the computer instructions can be executable to direct the user to an authentication interface. The computer instructions can be further executable to receive credentials from the user and authenticate the user based on the credentials. If the user is authenticated, the computer instructions can receive a user profile.

Another embodiment of the present invention can include a system for providing access to a network that comprises a processor, a first network interface coupled to the processor, a second network interface coupled to the processor, a storage media accessible by the processor and a set of computer instructions stored on the storage media. The computer instructions can be executable by the processor to receive a user profile and provision a user with access to a network based on the user profile.

Another embodiment of the present invention includes a set of computer instructions stored on a storage media, executable by a processor to receive a network communication over a first network interface from a user using a user device, determine if the network communication is associated with an authenticated user, if the network communication is not associated with an authenticated user, direct the user to an authentication interface, receive credentials from the user, authenticate the user based on the credentials. If the user is authenticated, the computer instructions can be executed to receive a user profile.

Yet another embodiment of the present invention includes a set of computer instructions stored on the storage media, executable by the processor to receive a user profile and provision a user with access to a network based on the user profile.

Another embodiment of the present invention includes a method comprising receiving a user profile and provisioning a user with access to a network based on the user profile.

Another embodiment of the present invention includes a method comprising receiving a network communication over a first network interface from a user using a user device, determining if the network communication is associated with an authenticated user, if the network communication is not associated with an authenticated user, directing the user to an authentication interface, receiving credentials from the user, authenticating the user based on the credentials, and receiving a user profile if the user is authenticated.

Embodiments of the present invention provide an advantage over current systems and methods of providing access to a network by being able to authenticate a user sending network communications in any number of protocols.

Embodiments of the present invention provide another advantage over current systems and methods of providing access to a network by not requiring propriety client software to authenticate.

Embodiments of the present invention provide yet another advantage over current systems and methods of providing network access by provisioning network access on a per user rather than per port basis.

Embodiments of the present invention provide yet another advantage over current systems and methods of providing network access by supporting the ability of a user to physically roam without requiring reauthentication on different subnets.

BRIEF DESCRIPTION OF THE FIGURES

A more complete understanding of the present invention and the advantages thereof may be acquired by referring to the following description, taken in conjunction with the accompanying drawings in which like reference numbers indicate like features and wherein:

FIG. **1** is a diagrammatic representation of a system for providing network access according to one embodiment of the present invention;

FIG. **2** is a flow chart illustrating one embodiment of a method for providing network access control;

FIG. **3** is a flow chart illustrating one embodiment of provisioning user access to a network;

FIG. **4** is a diagrammatic representation of a software architecture for providing authentication, according to one embodiment of the present invention;

FIG. **5** is a diagrammatic representation of one embodiment of a software system for controlling access to a network for an authenticated user;

FIG. **6** is a diagrammatic representation of traffic conditioning module, according to one embodiment of the present invention;

FIG. **7** is a diagrammatic representation of roaming according to one embodiment of the present invention; and

FIG. **8** is a diagrammatic representation of an example embodiment of a control device.

DETAILED DESCRIPTION

Preferred embodiments of the invention are illustrated in the FIGURES, like numerals being used to refer to like and corresponding parts of the various drawings.

Embodiments of the present invention provide a system and method of network access control. According to one embodiment of the present invention, a control device can sit between a network (e.g., an Internet, a LAN or other network known in the art) and users. The users themselves may be located on a network or subnet or may connect directly to the control device. When a particular user attempts to access the network behind the control device (i.e., the controlled network), the control device can determine if the user has already been authenticated to use the controlled network. If the user has not been authenticated, the control device can direct the user to an authentication interface, such as a web page, and receive a set of credentials from the user. If the user is authorized to use the controlled network, based on the credentials, the control device can provision the user with access to the controlled network based on user specific settings.

FIG. **1** is a diagrammatic representation of a system **10** for providing network access according to one embodiment of the present invention. In system **10**, a user **12**, using a user device **14** on network **16**, can send a network communication that is destined for a device on controlled network **18**. Network **16** and controlled network **18** can be any networks known in the art including, but not limited to, LANs, WANs, the Internet, global communications networks, wireless networks and/or any other communications network known in the art. For the sake of example, network **16** can be a wireless network, such as public wireless network provided to cafe patrons, and controlled network **18** can be the Internet. An access control device **20** ("control device **20**") can receive the network communication and determine if user **12** is authorized to access network **18** and the extent of the user's access. Control device **20** can contact an authentication system **22** to authenticate user **12** against a set of authorized users stored, for example, in authentication database **24**. If user **12** is authenticated, access control device **20** can receive a user profile that includes one or more attributes that govern the user's access to controlled network **18**.

According to one embodiment of the present invention, user device **14** can comprise any computing device known in the art (e.g., desktop, laptop, PDA, mobile phone or any other device capable of network communication) and can be connected to control device **20** in any manner known in the art (e.g., by LAN, wireless network, direct connection or other manner known in the art). In the example of FIG. **1**, user **12** is using a laptop **14** on a public wireless network **16** (e.g., a wireless LAN) to access Internet **18**.

User **12** can send the network communication using a network application running on user device **14** destined for a device on network **18**. The network application can be any publicly available network application (e.g., a web browser, email program, etc.) or proprietary application. For example, user **12** can use an internet browser, such as Netscape Navigator or Microsoft Internet Explorer, to send a request for a web page available over Internet **18**. As would be understood by those of ordinary skill in the art, the web page request is transmitted as an HTTP request in one or more internet protocol ("IP") packets.

Control device **20** can monitor network **16** for network communications originating on network **16** (e.g., for example for IP packets originating on LAN **16**) using any network monitoring technique known in the art. Control device **20** can read the IP packet headers to extract information on the originating user device. As an example, control device **20** can read the packet headers corresponding to the web page request to determine the IP address and MAC address associated with laptop **14**.

Based on the MAC address, IP address or other information that can be extracted from the network communication, control device **20** can determine if user **12** has been authenticated. This can be done, for example, by comparing the MAC address and IP address of user device **14** to MAC addresses

and IP addresses for users that have been authenticated. If the user has not authenticated, control device **20** can direct user **12** to an authentication interface by, for example, redirecting the HTTP request to a login web page that requests user credentials, such as user name and password.

Control device **20** can receive the user credentials and send the credentials to authentication system **22**. Authentication system **22** can compare the credentials to credentials in authentication database **24** to determine if user **12** is permitted access to network **18** and the extent of the user's access. If the credentials are authenticated, authentication system **22** can pass a user profile associated with user **12** to control device **20**.

The user profile can include parameters that determine the extent of a user's access to network **18** and/or services available to that user. For example, the user profile can indicate that a user is permitted certain upload and download data transfer rates, that the user is not permitted to visit particular web sites, or that the user qualifies for virus scanning. In one embodiment of the present invention, the constraints indicated in the user profile can be implemented through one or more applications at control device **20**.

When control device **20** receives a user profile from authentication system **22** (or self authenticates the user), control device **20** can establish a control session for the user, indicating that the user is currently active. Additionally, control device **20** can establish provisioning rules based on the user profile. The provisioning rules can include, for example, firewall rules and traffic constraints that govern the user's access to network **18**. In one embodiment of the present invention, the sessions and provisioning rules can be indexed to a particular user. This can be done, for example, by associating the control session and rules to a key based on the MAC address and/or IP address of laptop and/or user credentials. The use of user credentials as part of an indexing key allows multiple sessions by the same user using different devices (e.g., a user accessing network **18** through a laptop and PDA) to be tied together for, for example, billing purposes.

It should be noted that FIG. **1** is provided by way of example only. In other embodiments of the present invention, control device **20** can control access to multiple networks. For example, if a user requests a web page over a cafes publicly available wireless connection, the user may need to access both additional portions of the cafe's internal LAN (e.g., routers, switches or other network devices) and the Internet. Additionally, it should be noted that authentication, in one embodiment of the present invention, can be performed at control device **20** or be carried out by a separate authentication system.

FIG. **2** is a flow chart illustrating one embodiment of a method for providing network access control at, for example, a control device (e.g., control device **20** of FIG. **1**). At step **30**, the control device can monitor a connection, such as a LAN, across protocol layers (e.g., IP, UPD/IP, TCP/IP and other protocol layers known in the art) for a network communication originating at a user device and, at step **32**, receive a network communication. The network communication can be, for example, an HTTP request, an email message, an FTP request, a telnet request, an instant message, an ICMP message, a SNMP message, a UDP message or other network communication known in the art.

The control device can determine, at step **34**, if a user associated with the network communication has been authenticated. In one embodiment of the present invention, this can be done by comparing an identifier(s) with identifiers previously associated with authenticated users. Any identifier or combination of identifiers known in the art can be used to identify the origins of a network communication. By way of example, but not limitation, the control device can read the headers of IP packets carrying the network communication to extract an originating MAC address and/or an originating IP address associated with the originating user device. The control device can compare the identifier(s) extracted from the IP packet to identifiers for previously authenticated users. If the extracted identifier matches an authenticated user, the control device can control the user's network access as described in conjunction with the example of FIG. **5**. Otherwise, control can pass to step **36**.

If a user has not authenticated, the control device, at step **36**, can capture the user's network application session until the user authenticates. For applications that are latency or session sensitive, such as HTTP or HTTPS communications, the session may be cached or suspended in a manner that does cause the destination application (e.g., web page) to drop the session. For example, if the user enters into a stateful network application session, the control device can detect this, based on information in the IP packets, and maintain the session on behalf of the user until the user has authenticated.

At step **38**, the control device can redirect the user to an authentication interface. By way of example but not limitation, if the network communication is an HTTP request, control device **20** can redirect the HTTP request to an authentication web page hosted by the control device using any HTTP redirection technique known in the art. If the network communication is in another form, such as an email message, the control device can detect, from the IP packets, the protocol (e.g., POP, SMTP or other protocol known in the art) used by the network application (e.g., a mail user agent) and send a message back to the network application with, for example, an embedded link to the authentication interface. In other embodiments of the present invention, the control device can send a protocol-specific message, such as an error message, indicating the authentication state and providing information about further actions necessary on part of the user to authenticate. As an example, if an unauthenticated user initiates a telnet session, the control device can return a telnet error indicating a failed authentication and providing directions to the application interface. Thus, the control device, rather than simply returning "Connect Failed" could return "Connect Failed: Authenticate at http://www.Rocksteady1.com/login// ." In this case, http://www.Rocksteady1.com/login// can be hosted by the control device.

In response to the authentication interface, the user can provide credentials and, at step **40**, the control device can receive them. The credentials can be any credentials known in the art including, but not limited to, user name, password, biometric data (e.g., fingerprint, retina pattern or other biometric information known in the art), smart card credentials, certificates and/or other user or hardware based credentials. In one embodiment of the present invention, the credentials can be received by HTTP Post from a web page based form.

At step **42**, the control device can authenticate the user by initiating a comparison between the received credentials and the credentials for authorized users.

This can be done at the control device, or the control device can authenticate the user by sending the credentials to a backend authentication system (e.g., using HTTP Post). The credentials, in one embodiment of the present invention, can be compared against an authentication database of authorized users to determine if the credentials match credentials in the authentication database. Example authentication technolo-

gies include LDAP, RADIUS, Microsoft Active Directory Service, Tivoli Access Manager, and Cisco TACACS/TACACS+.

If the credentials are not authenticated, control can pass to step **52**. If, on the other hand, the credentials are authenticated, the control device, at step **44**, can receive a user profile from the authentication system or internal data storage (e.g., a database, file or other data storage format known in the art) that contains attributes that govern provisioning of user access to the network. For example, the user profile can contain indicators of the upload and download bandwidth to which the user is entitled, session time limit, whether the control device will perform virus scanning for the user of incoming and/or outgoing IP packets, or other services known in the art. The user profile can also point to additional information that can be used to control network access. For example, the user profile can point to a list of web sites that the particular user is not permitted to visit. In one embodiment of the present invention, the user profile can be received in a canonical format as an HTTP Post from the authentication system to the control device.

According to one embodiment of the present invention, each user profile can have a predefined set of attributes. In some cases, the backend authentication system may not provide values for each of these attributes. Therefore, the control device can determine, at step **46**, if the received user profile is complete, and, if it is not complete can, at step **48**, fill in the missing attribute values with default values, which can be part of the control device's local configuration or may be retrieved by the control device during, for example, its initialization or startup phase. At step **50**, the control device can initiate a control session for the authenticated user. The control session can have a specified time limit, a time out limit and/or other session features known in the art. While the control session is active, the control device can govern a user's access to a network according to the user profile associated with that user and defaults. The control session can be tracked by credentials, IP address, MAC address and/or other identifier. In one embodiment of the present invention, the control session can be tracked based on a combination of user device MAC address and IP address and user provided credentials.

Thus, the control device can determine if the user seeking to use a network is authorized to use the network (step **42**). According to one embodiment of the present invention, if the user is authenticated, the control device receives a user profile (step **44**), fills in any missing parameters in the user profile with defaults (steps **46** and **48**) and initiates a control session for the user (step **50**).

If, however, at step **42**, the user is not authenticated, the control device, at step **52**, can direct the user to a setup interface, such as an account setup web page. At the setup interface, the user can specify credentials, network access and levels of service, payment options and/or other account information. Based on this information, a user profile can be generated and stored in the authentication database. Profiles can also be entered into the authentication database by a systems administrator or in any other manner known in the art.

The control device can, thus, authenticate a user based on a network communication from a network application such as a web browser, ftp client, telnet client, mail user agent or other publicly available or proprietary network application. By supporting publicly available network applications, such as web browsers, embodiments of the present invention allow authentication without requiring that a user install a proprietary network application on the user's user device. If a user can authenticate, the control device can control a user's access to a controlled network based on a user profile and/or default values. If the user can not authenticate, the user can be given an opportunity to establish a user profile. According to one embodiment of the present invention, steps **30**-**54** can be optionally repeated (step **54**) for each new network communication or IP packet detected.

FIG. **3** is a flow chart illustrating one embodiment of provisioning user access to a network at a control device (e.g., control device **20** of FIG. **1**). At step **56**, global rules can be established. Global rules can include rules, such as firewall rules and bandwidth allocations. A firewall rule can include any firewall rule known in the art, such as, for example, that all packets destined for a particular web site will be blocked. A traffic rule can include any globally applicable traffic rule; for example, that the total used bandwidth of control device **20** must not exceed a particular amount. Additionally global rules can include rules such as that every packet is scanned for viruses or subject to some other arbitrarily defined process. At step **58**, interface specific rules can be established. Interface specific rules can specify and arbitrary traffic rule or condition on a per interface basis. For example, an interface specific firewall rule can specify that streaming content will not be permitted over a wireless interface. Global and interface specific rules can be established in any manner, as would be understood by those of ordinary skill in the art.

At step **60**, the control device can establish user specific rules and conditions based on attributes in the user profile. According to one embodiment of the present invention, the control device can map the attributes to any arbitrary rule or traffic condition. By way of example, but not limitation, a user profile can contain attributes to specify upload and download bandwidth allocations for a user, firewall settings, whether the user can use transient VPNS, whether the user can use streaming services or voice over IP services, whether the user should be permitted to perform video teleconferencing, whether the control device should perform virus scanning or worm detection for the user, whether the user can utilize print services, surcharges for services or other settings. On example of supporting transient VPN is described in U.S. Provisional Patent Application No. 60/496,629, entitled "System and Method for Providing a Secure Connection Between Networked Computers," to Eric White, et al., filed Aug. 20, 2003, which is hereby fully incorporated by reference.

In one embodiment of the present invention, rules can be represented in an IP table. As would be understood by those of ordinary skill in the art, IP tables are essentially tables of rules that can be accessed by applications, such as a firewall, to execute the rules.

Rules in the IP table can be associated to a user through any arbitrary identifier. Using the example of FIG. **1**, the IP table rule(s) for user **12** can be bound to user **12** based on the MAC address and IP address of user device **14** and the credentials provided by user **12** for the particular control session.

An IP table rule can reference other rules or parameters for providing user specific provisioning. As an example, the IP table rule can reference websites that a user is not permitted to visit. A firewall application can access the rule to prevent the user from visiting these sites. As another example, the IP table rule for user **12** can reference a traffic rule that dictates that the bandwidth allocated to user **12** is 128 kbps up and 512 kbps down. A traffic control application, such as the Linux based Traffic Control module, can access the traffic control rule through the IP table and enforce the bandwidth allocation.

It should be noted that a user specific rule in an IP table can reference rules or parameters usable by any number of applications or process, such as firewalls, traffic control modules, virus scan applications or other applications known in the art.

For example, a virus scan application can access the IP table rule for a particular user and us parameters referenced by the rule to provide user specific virus scanning. It should be further noted that the use of IP tables to establish user specific rules for user specific provisioning of bandwidth and access control is provided by way of example only, and user specific rules can be implemented in any suitable manner, as would be understood by those of ordinary skill in the art

FIG. **4** is a diagrammatic representation of a software architecture for providing authentication, according to one embodiment of the present invention. The software architecture can be implemented, for example, at control device **20**. According to one embodiment of the present invention, an authentication module **62** of an authentication and control program **61** can monitor a connection, such a network connection for communications from user devices. Control device **20** can receive a network communication in the form of, for example, one or more IP packets **63**, which can represent a network communication from a web browser, a telnet client, a mail user agent or other communication from a network application. In one embodiment of the present invention, the network communication can be directed to control device **20** to access authentication page **70** or to another destination, such as a web server on the Internet.

Authentication module **62** can read the header **64** of IP packet **63** to determine an identifier for the originating user device such as, for example, an originating MAC address and/or IP address. For the sake of example, the MAC address is 08:00:69:02:01:FF and the IP address is 100.100.100. Authentication module **62** can then determine if the IP packet originated at a user device for which a control session is active by comparing information extracted from the header to a list **66** of active control sessions. The active control sessions can be indexed by, for example, MAC address, IP address, a combination of addresses or other identifier(s) associated with the originating user device or user. If a control session is active for the originating user device, the IP packet and header information can be passed to provisioning module **68**. If the IP packet originated at a user device not associated with an active control session, control device **20** can authenticate the user.

According to one embodiment of the present invention, to authenticate the user, control device **20** can redirect the user to an authentication interface, such as authentication web page **70**, by sending a redirect message **72**. Redirect message **72** can be a web page redirect, an error message, an email message with an embedded link to web page **70** or other indication that a user should access the authentication interface.

A user can provide credentials **74** to control device **20** and control device **20** can pass the credentials **74** to an authentication system as, for example, an HTTP Post. If the credentials are authenticated by the authentication system, authentication module **62** can receive a user profile **76** that contains attributes that can govern provisioning of access control for the user. In one embodiment of the present invention, if the user profile is incomplete, authentication module **62** can add default attributes to the profile. Furthermore, if the user is authenticated by the authentication system, session monitor **78** can initiate a new control session if the credentials are authenticated and update the list **66** of active control sessions. It should be noted that in another embodiment of the present invention, authentication can occur internally to control device **20**.

FIG. **5** is a diagrammatic representation of one embodiment of a software system for controlling access to a network for an authenticated user. According to one embodiment of the present invention, an authentication and control program **61** running at control device **20** can receive an IP packet **80** originating from a user device. Authentication module **62** can determine if IP packet **80** is associated with a user that has authenticated, as described in conjunction with FIG. **4**. Continuing with the previous example, and assuming that the user associated with MAC address 08:00:69:02:01:FF and the IP address 100.100.100 authenticated, IP packet **80** can be processed by provisioning module **68**, which can provide user specific provisioning. In the example of FIG. **5**, user specific provisioning can include provisioning of firewall services (e.g., by firewall module **82**), user specific allocation of bandwidth (e.g., by traffic conditioning module **84**). It should be understood, however, that user specific provisioning can include provisioning of additional services known in the art. In one embodiment of the present invention firewall module **82** can be a LINUX based firewall and traffic conditioning module **84** can be the LINUX based Traffic Controller program.

According to one embodiment of the present invention, provisioning module **68** can build a set of IP tables to govern provisioning by firewall module **82** and traffic conditioning module **84**. In the example of FIG. **5**, provisioning module **68** can have IP table **81** for interface specific rules, IP table **88** for global rules and IP table **90** for user specific rules. IP table **90** can contain user specific rules associated with particular users. For example, IP table **90** can contain user rule **92** indexed to MAC address 08:00:69:02:01:FF and the IP address 100.100.100 (i.e., indexed to user **12** on laptop **14**).

Each rule can optionally point to additional rules and parameters. For example user specific rule **92** can point to traffic control rule **94** to govern bandwidth provisioning, firewall parameters **96** to govern firewall settings and file **98** that contains web sites that user **12** is not permitted to access. User specific rule **92** and the associated rules and parameters can be based on user profile **76**. As an example, user profile **76** can specify that user **12** is entitled to 128 kbps up and 512 kbps down.

Provisioning module **68** can establish traffic control rule **94**, accessible by traffic conditioning module **84**, that contains these limitations. Similarly, provisioning module **68** can establish firewall parameters **96** and file **98** based on attributes in user profile **76**.

In the example of FIG. **5**, provisioning module **68** can provide firewall and traffic conditioning services for IP packet **80**. Firewall module **82**, in one embodiment of the present invention, can process IP packet **80** according to several stages. At interface specific stage **98**, firewall module **82** can access interface specific IP table **86** to access rules to be applied to packet **80** based on the type of interface over which packet **80** is received (e.g., wireless, Ethernet, or other interface known in the art).

At global stage **100**, firewall module **82** can apply global firewall rules to packet **80** from global IP table **88**. In general, firewall module **82** can apply global firewall rules to every IP packet that firewall module **82** processes.

At client discrimination stage **102**, firewall module **82** can read the packet header of packet **80** to extract information to associate packet **80** with a user. Continuing with the previous example, if firewall module **82** extracts MAC address 08:00:69:02:01:FF and the IP address 100.100.100, firewall module **82** can associate packet **80** with user specific rule **92**. At user specific rule stage **104**, firewall module **82** can access user specific rule **92** based, for example, on the extracted MAC address and IP address. Based on user specific rule **92**, firewall module **82** can access firewall parameters **94** and restricted web site list **96** and can process packet **80** accordingly. It should be noted that firewall parameters **94** can

include any arbitrary set of parameters that can be used by a firewall to control traffic flow. For example, firewall parameters **94** can specify whether the associated user (e.g., user **12** of FIG. **1**) can use voice over IP applications, video conferencing services, transient VPN applications or other applications.

Finally, at interface specific stage **106**, firewall module **82** can access interface specific IP table **86** and enforce rules corresponding to the interface over which packet **80** will be communicated (e.g., wireless connection, Ethernet connection, or other computer interface known in the art).

In one embodiment of the present invention, traffic conditioning module **84** can also access user specific IP table **90** and locate user specific rule **92**, based for example, on the originating MAC address and IP address.

From user specific rule **92**, traffic conditioning module **84** can locate traffic control rule **94** that specifies a maximum upload bandwidth of 128 kbps. If the user exceeds this bandwidth limitation, traffic conditioning module **84** can queue or drop packet **80**.

Packet flow in the reverse direction can be processed in an analogous manner. For example, a packet arriving from the Internet destined for a user device (e.g., laptop **14** of FIG. **1**) can be examined for IP address and MAC address. Based on these identifiers, user specific traffic control rules and firewall rules can be applied to the packet as governed by user specific rule **92** in IP table **90**. Firewall module **82** can apply global rules based on IP table **88** and interface specific rules based on IP table **86** for both the controlled network and user side interfaces.

In addition to authentication and provisioning, authentication and control program **61** can provide session monitoring. Session monitoring can be performed in any manner known in the art. Session monitor **78** can monitor a control session for session characteristics such as session time, time out, bandwidth utilization and other session characteristics known in the art. In one embodiment of the present invention, session monitor **78** can determine if a user's session is still active by for example, performing port scans and ARP pings, as would be understood by those of skill in the art. If session monitor **78** determines that a control session is timed out (e.g., has been inactive for a predetermined period of time), session monitor can remove the control session from the list of active sessions, returning the user to an unauthenticated state, and delete the user specific rules for the associated user from IP table **90**. Session monitor **78** can also generate records, such as accounting records and session records that can optionally be transmitted to other systems for further processing.

As would understood by those of ordinary skill in the art, authentication and control program **61** can also provide any arbitrary services known in the art, including, but not limited to, web server functions, DHCP client for negotiation with ISPs, DHCP server to assign IP addresses to user computers, kernel based packet filtering and stateful inspection, IP sharing, NATplus, port redirection, information and attack logging, automatic updating, VPN masquerade, remote support an configuration, name server configuration and/or web content filtering.

FIG. **6** is a diagrammatic representation of traffic conditioning module **84**, according to one embodiment of the present invention. Conditioning module **84** can include interface master queue **108**, user discriminator **110** and user specific conditioner **112**. User discriminator **110** can read a packet header to determine the appropriate user specific conditioner to which to send the packet based on for example, the IP address and MAC address of the packet. Bandwidth limits can be enforced based on user specific traffic control rules.

According to one embodiment of the present invention, conditioning module **84** can locate the user specific traffic control rule based from user specific IP table **90**. For example, for a packet having the originating MAC address 08:00:69:02:01:FF and the IP address 100.100.100, traffic conditioning module **84** can access user specific rule **92** and, from user specific rule **92**, user specific traffic control rule **94**. The user specific traffic control rule can be enforced at the corresponding user specific conditioner.

Interface master queue **108** can control the flow of network traffic over a particular interface. It can be configured to send out data at whatever rate is appropriate for the corresponding network connection.

Interface master queue **108** can be feed data by user specific conditioners **112**, each of which can have its own queue to hold packets the conditioner has accepted, but interface master queue **108** is not ready to accept.

For a particular network interface, each user can have an inward (i.e., download) and outward (i.e., upload) bandwidth allowance, based on attributes in the user's user profile. A bandwidth limit is the maximum rate at which a user is permitted to transmit or receive network traffic over a particular interface. User specific traffic conditioners **112** ensure that, if a user exceeds his or her bandwidth allowance, further network traffic in that direction on the network will be queued or dropped until the average data rate fall back within the bandwidth allowance. Thus, traffic conditioning module **84** can regulate bandwidth on a per user basis. In one embodiment, the control device can also dynamically control bandwidth on a per user basis. One embodiment of dynamic bandwidth shaping is discussed in U.S. Provisional Patent Application No. 60/418,968, entitled "System and Method for Dynamic Bandwidth Shaping," to Kerry Clendenning, et al., filed Oct. 16, 2002, which is hereby fully incorporated by reference.

It should be noted that the architectures of FIG. **4**, FIG. **5** and FIG. **6** are provided by way of example only and authentication, session monitoring and provisioning can be implemented using any suitable programming language and/or structure known in the art. In the example of FIG. **5**, provisioning module **68** provides firewall and traffic conditioning based on a set of IP tables. It should be noted, however, that provisioning module **68** can provide additional services on a per user basis, such as virus scanning, worm detection or any other service known in the art. Each of these additional services can access rules and parameters based, for example, on IP table **90**. Moreover, the use of IP tables to index and provide access to rules and parameters for particular services is also provided by way of example. In other embodiments of the present invention, a user profile can be mapped to rules and parameters for various applications in any suitable programming manner known in the art.

Embodiments of the present invention provide advantages over prior art systems and methods of providing access control. One advantage is that embodiments of the control device can detect network communications across a variety of protocols and direct a user to an authentication interface. Another advantage provided by embodiments of the present invention is that provisioning can be done based on a user profile rather than based on a particular port. In other words provisioning of bandwidth and services can be done on a per user rather than per port basis. Additionally, as will be described in conjunction with FIG. **7**, embodiments of the present invention can provide advantages with respect to physical roaming.

FIG. **7** is a diagrammatic representation of roaming according to one embodiment of the present invention. In the example of FIG. **7**, a LAN can have multiple subnets, in this

case two, subnet **122** and subnet **124**. For the sake of example, each subnet can be a wireless subnet.

Each subnet could represent for example subnets on different floors of an office building or subnets in different buildings, etc. Each subnet can be connected to network **126** via control device **128** and control device **130**, respectively. Network **126** can be any network known in the art including a LAN, the Internet, a wireless network a global communications network or any other network known in the art. According to one embodiment of the present invention, control device **128** and control device **130** can be in federation **132**. This means that control device **128** and control device **132** have at least enough information about each other that they can send messages to each other over the LAN and/or over network **126** to exchange session information.

In operation, user **134** using user device **135** (e.g., a laptop or other computing device known in the art) can authenticate with control device **130** at point **136** in subnet **124**. Because user **134** is in subnet **124** at point **136**, user device **135** can be assigned a first IP address, for example 100.100.100. For the sake example, user device can also be associated with MAC address 08:00:69:02:01:FF. The user's active session can be indexed based on the first IP address, the MAC address and the user's credentials. User **134** can then roam outside of subnet **124**, by for example, leaving the range of the wireless routers of subnet **124**. Control device **130** can determine if user **134** is still active on subnet **124** by, for example, ARP pining and/or performing port scans on user device **135** at predetermined intervals.

If control device **130** can not locate user device on subnet **124**, control device **130** can begin a time out timer. If the time out timer reaches a predetermined limit, control device **130** can close the control session, returning user **134** to his or her preauthenticated state. If, however, user **134** returns to subnet **124**, as, for example, determined by the ARP pings and/or port scans, within the time limit, control device **130** can reset the time out timer and keep the control session open. Assume, for the sake of example, that user **134** returns to point **138** in subnet **124** before the session is timed out, so his or her control session remains open. Thus, control device **130** can maintain user **134** in an authenticated state even though user **134** roamed outside of subnet **124**.

User **134** can then roam from point **138** to point **140** with laptop **135**. When user **134** leaves subnet **124**, control device **130** can begin a time out timer for the user's control session. When user **134** enters subnet **122**, laptop **135** can be assigned a new IP address for that subnet, say 101.100.100. If user **134** initiates a network communication destined for network **126** (e.g., a web page request), control device **128** can receive the communication and determine if IP address 101.100.100 and MAC address 08:00:69:02:01:FF correspond to an active control session. In this case, because user **134** authenticated with control device **130**, IP address 101.100.100 and MAC address 08:00:69:02:01:FF will not correspond to an active session on control device **128**. In one embodiment of the present invention, control device **128** can simply initiate a new authentication process.

In another embodiment of the present invention, control device **128** can query other control devices with which it is federated to determine if a user has an active control session. For example, because control device **128** and control device **130** are in federation **132**, control device **128** can query control device **130** to determine if user **134** has an active session. This can be done based, for example, on the MAC address of laptop **135** as laptop **135** will typically retain the same MAC address across subnets.

According to one embodiment of the present invention, control device **128** can send an SNMP message to control device **130** to determine if there is an active session corresponding to the MAC address 08:00:69:02:01:FF. In this case, if the user's control session at control device **130** has not yet timed out, control device **130** can reply to control device **128** with session information and the user profile for user **134**. Control device **128** can establish user based provisioning based on the user profile as if user **134** had authenticated at control device **128**. Thus, user **134** can communicate to network **126** through control device **128** without reauthenticating.

In other embodiments of the present invention, active session information for each control device can be maintained at a centralized system. Control device **128** can, in this embodiment of the present invention, query the centralized system as to whether there are any active session corresponding to MAC address 08:00:69:02:01:FF. In yet another embodiment of the present invention, control device **128** can receive the user profile for user **134** from an authentication system rather than from another control device.

Thus, embodiments of the present invention allow a user to physically roam, either in a wired or wireless environment, by, for example permitting mobile, transient behavior through the use of network access timeouts; and/or coordinating authentications between control devices.

As can be understood from the foregoing, physically moving from one location to another can cause a user device to become disconnected from the network or subnet (e.g., subnet **122** or subnet **124**) for a short period of time. The length of the time the user is not connected can be a function of physically moving from one location to another. Embodiments of the present invention permit a configurable timeout period that allows an authenticated user to become disconnected from a network and then reappear without losing the user's authentication status. In one embodiment of the present invention, this timeout period can be part of the policy of the network service provider (e.g., the entity controlling subnet **122** and subnet **124**) and, as such, is a configurable item in the control devices. The control devices can monitor user network device connection states actively, employing ARP ping techniques and non-obtrusive polling of network application ports to check the connection status of all authenticated users' devices.

A second aspect of physical roaming is when a user not only becomes disconnected from the network, but leaves a subnet arbitrated or monitored by a control device. In this case, once the user attempts any network access by way of a network access port (wired or wireless) at another control device, that control device can solicit feedback from any federation of control devices with which it has joined to determine if this particular user has an active session and should be granted a new session, without the requirement to authenticate. In some embodiments of the present invention, the new control device can dynamically remap the network connections and configuration of a roaming user's user device, in the event that the new control device is configured differently or controls a different subnet. For example, the new control device can remap the IP address of the user device according any IP mapping scheme known in the art.

Control devices can participate in federations, in one embodiment of the present invention, via loosely-coupled SNMP dialogs. In this embodiment of the present invention there is no permanent federation configuration and, instead, control devices can broadcast their authorization status requests dynamically.

Another aspect of roaming can be service roaming. Service roaming can be a function of negotiated usage agreements between internet service providers, resulting in cross-indexed user authentication database and, potentially, resulting surcharges for accessing network resources via service providers other than the primary service provider associated with a user; i.e., assuming network service is funded by an individual, there may be surcharges to access network services via control devices not owned by that service provider.

FIG. **8** is a diagrammatic representation of one embodiment of a control device **141** that can provide access control and authentication. For the purposes of example, control device **141** can comprise a main bus **142**, a main processor **144**, a primary storage medium **146**, a secondary storage controller **148**, a storage media **150**, a user side network interface **152** and a controlled network network interface **154**. The network interfaces can include Ethernet interfaces, fibre channel interfaces, T1 interfaces, wireless interfaces or other network interfaces known in the art. Other devices may be connected to or be part of such a control device include, by way of example, but not limitation, controllers, a display, a mouse, a keyboard, and so forth. Additionally, control device **140** can include additional interfaces to communicate to additional networks using various protocols and can include interfaces for administrative functions.

The main processor **144** communicates with the other components by way of the main bus **142**. This main processor **144** can be a general purpose processor, a limited processor such as an ASIC or microcontroller, or any other instruction execution machine. The primary storage **146** can provide transient memory or storage space for use by programs executing on the main processor **144**. The main processor **144** communicates with the primary storage in any manner known in the art.

The secondary storage controller **148** connects a storage media **150** such as a hard drive, CD-ROM, floppy, tape drive, optical storage medium, memory or other storage device to the main processor **144** by way of the main bus **142**. The main processor **144** communicates with the secondary storage controller **148** by way of the main bus **142**, and the secondary storage controller **148** is used to read and/or write the storage media **150** on behalf of the main processor **144**.

Control device **141** may communicate with other computing devices (e.g., user devices, network servers, etc.) by way of networks using network interfaces (e.g., user side network interface **152** and controlled network network interface **154** or other network interface). Computer instructions running on the main processor may then access other computers across the network in any of the conventional ways, e.g. by executing "protocols" which affect the transmission and reception of protocol data units, packages, etc. over the data transmission network.

In one embodiment of the present invention, storage media **150** can store a set of computer instructions **156** that are executable by processor **144**. During execution, portions of computer instructions **156** and data can be stored in primary storage **146**, as would be understood by those of ordinary skill in the art. Processor **144** can execute computer instructions **156** to authenticate users and/or provide provisioning to users on a per user basis. Computer instructions **156** may be implemented in any programming language known in the art and can be implemented using any suitable architecture.

Additionally, in one embodiment of the present invention, storage media **150** can include a database of user profiles an authentication credentials. In this embodiment of the present invention, instructions **156** can be executable to authenticate the user at control device **141** and receive the user profile from storage media **150**.

Although shown as a standalone device in FIG. **8**, control device **141** may be integrated with and share components with other devices such as routers, servers, hubs or other devices known in the art. Additionally, computer instructions **156** can be distributed across multiple storage media and can be executed by multiple processors. One example of an exemplary control device is the Rock Box or the Rocksteady NSA Server, from Rocksteady Networks, Inc. of Austin, Tex.

While the present invention has been described with reference to particular embodiments, it should be understood that the embodiments are illustrative and that the scope of the invention is not limited to these embodiments. Many variations, modifications, additions and improvements to the embodiments described above are possible. It is contemplated that these variations, modifications, additions and improvements fall within the scope of the invention as detailed in the following claims.

What is claimed is:

1. A method for network access control, comprising:

at a control device, receiving a packet originating from a user device in a first network, wherein the first network is connected to a second network via the control device, and wherein the user device is associated with a user;

processing the packet according to a plurality of stages, including a client discrimination stage and a user specific rule stage;

at the client discrimination stage, extracting information associated with the user device from a header of the packet and associating the packet with user specific traffic control rules and user specific firewall rules; and

at the user specific rule stage, accessing the user specific traffic control rules and user specific firewall rules based on the extracted information associated with the user device and applying the user specific traffic control rules and the user specific firewall rules to the packet as governed by at least one user specific class of service rule associated with the user on the user device in the first network.

2. The method according to claim **1**, wherein the plurality of stages further comprises an interface specific stage, further comprising:

at the interface specific stage, applying interface specific rules to the packet based on a type of a network interface over which the packet is received.

3. The method according to claim **2**, wherein the plurality of stages further comprises a global stage, further comprising:

at the global stage, applying global firewall rules to the packet.

4. The method according to claim **1**, wherein the packet is processed utilizing a provisioning module running on the control device, wherein the provisioning module comprises a first table for interface specific rules, a second table for global rules, and a third table for user specific rules.

5. The method according to claim **1**, wherein the user device is assigned with an Internet Protocol (IP) address in the first network and wherein the at least one user specific rule is associated with the IP address.

6. The method according to claim **5**, wherein the user device is associated with a media access control (MAC) address and wherein the at least one user specific rule is further associated with the MAC address.

7. The method according to claim **1**, wherein the user specific traffic control rules and the user specific firewall rules are established for the user based on a user profile that includes parameters that determine an extent of the user's access to the second network, services available to the user, or a combination thereof.

8. A method according to claim 1, further comprising determining whether the user has authenticated.

9. A method according to claim 8, wherein the user has not authenticated, further comprising:

redirecting the user to a login web page that requests user credentials; and

using the user credentials received from the user to authenticate the user.

10. A computer program product comprising at least one non-transitory computer-readable storage medium storing computer instructions translatable by a processor of a control device to perform:

receiving a packet originating from a user device in a first network, wherein the first network is connected to a second network via the control device, and wherein the user device is associated with a user;

processing the packet according to a plurality of stages, including a client discrimination stage and a user specific rule stage;

at the client discrimination stage, extracting information associated with the user device from a header of the packet and associating the packet with user specific traffic control rules and user specific firewall rules; and

at the user specific rule stage, accessing the user specific traffic control rules and user specific firewall rules based on the extracted information associated with the user device and applying the user specific traffic control rules and the user specific firewall rules to the packet as governed by at least one user specific class of service rule associated with the user on the user device in the first network.

11. The computer program product of claim 10, wherein the plurality of stages further comprises an interface specific stage and wherein the computer instructions are further translatable by the processor to perform:

at the interface specific stage, applying interface specific rules to the packet based on a type of a network interface over which the packet is received.

12. The computer program product of claim 10, wherein the plurality of stages further comprises a global stage and wherein the computer instructions are further translatable by the processor to perform:

at the global stage, applying global firewall rules to the packet.

13. The computer program product of claim 10, wherein the computer instructions are further translatable by the processor to implement a control program on the control device, wherein the control program comprises a provisioning module, wherein the provisioning module comprises a traffic conditioning module for user specific allocation of bandwidth.

14. The computer program product of claim 10, wherein the computer instructions are further translatable by the processor to establish the user specific traffic control rules and the user specific firewall rules for the user based on a user profile that includes parameters that determine an extent of the user's access to the second network, services available to the user, or a combination thereof.

15. The computer program product of claim 10, wherein the computer instructions are further translatable by the processor to determine whether the user has authenticated.

16. The computer program product of claim 15, wherein the user has not authenticated and wherein the computer instructions are further translatable by the processor to perform:

redirecting the user to a login web page that requests user credentials; and

using the user credentials received from the user to authenticate the user.

17. A control device for network access control, comprising:

a processor;

at least one computer-readable storage medium storing computer instructions translatable by the processor to perform:

receiving a packet originating from a user device in a first network, wherein the first network is connected to a second network via the control device, and wherein the user device is associated with a user;

processing the packet according to a plurality of stages, including a client discrimination stage and a user specific rule stage;

at the client discrimination stage, extracting information associated with the user device from a header of the packet and associating the packet with user specific traffic control rules and user specific firewall rules; and

at the user specific rule stage, accessing the user specific traffic control rules and user specific firewall rules based on the extracted information associated with the user device and applying the user specific traffic control rules and the user specific firewall rules to the packet as governed by at least one user specific class of service rule associated with the user on the user device in the first network.

18. The control device of claim 17, wherein the plurality of stages further comprises an interface specific stage and wherein the computer instructions are further translatable by the processor to perform:

at the interface specific stage, applying interface specific rules to the packet based on a type of a network interface over which the packet is received.

19. The control device of claim 17, wherein the plurality of stages further comprises a global stage and wherein the computer instructions are further translatable by the processor to perform:

at the global stage, applying global firewall rules to the packet.

20. The control device of claim 17, wherein the computer instructions are further translatable by the processor to implement a control program on the control device, wherein the control program comprises a provisioning module, wherein the provisioning module comprises a traffic conditioning module for user specific allocation of bandwidth.

21. The control device of claim 20, wherein the traffic conditioning module further comprises an interface master queue for controlling a flow of network traffic over a particular network interface.

22. The control device of claim 20, wherein the provisioning module further comprises a firewall module for associating the packet with the user specific firewall rules.

23. The control device of claim 20, wherein the provisioning module further comprises an authentication module for authenticating the user.

24. The control device of claim 17, wherein the computer instructions are further translatable by the processor to establish the user specific traffic control rules and the user specific firewall rules for the user based on a user profile that includes parameters that determine an extent of the user's access to the second network, services available to the user, or a combination thereof.

25. The control device of claim 17, wherein the computer instructions are further translatable by the processor to determine whether the user has authenticated.

26. The control device of claim 25, wherein the user has not authenticated and wherein the computer instructions are further translatable by the processor to perform:

redirecting the user to a login web page that requests user credentials; and

using the user credentials received from the user to authenticate the user.

27. A control device for network access control, comprising:

a processor;

at least one computer-readable storage medium storing computer instructions translatable by the processor to perform:

receiving a packet originating from a user device in a first network, wherein the first network is connected to a second network via the control device, and wherein the user device is associated with a user;

determining whether the user has authenticated;

if the user has not authenticated:

redirecting the user to a login web page that requests user credentials; and

using the user credentials received from the user to authenticate the user;

processing the packet according to a plurality of stages, including a client discrimination stage and a user specific rule stage;

at the client discrimination stage, extracting information associated with the user device from a header of the packet and associating the packet with user specific traffic control rules and user specific firewall rules; and

at the user specific rule stage, accessing the user specific traffic control rules and user specific firewall rules based on the extracted information associated with the user device and applying the user specific traffic control rules and the user specific firewall rules to the packet as governed by at least one user specific class of service rule associated with the user on the user device in the first network.

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