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Shribman et al.

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(54) **SYSTEM PROVIDING FASTER AND MORE EFFICIENT DATA COMMUNICATION**

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This patent is subject to a terminal disclaimer.

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CPC ... H04L 67/42; H04L 41/046; H04L 67/1002; H04L 67/1023; H04L 67/1063; H04L 67/108; H04L 67/22

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(56) **References Cited**

U.S. PATENT DOCUMENTS

3,922,494 A 11/1975 Cooper et al.
4,347,827 A 9/1982 Lo Cascio

(Continued)

FOREIGN PATENT DOCUMENTS

CN 101075242 A 11/2007
CN 101179389 A 5/2008

(Continued)

OTHER PUBLICATIONS

Octoparse Blog: "Top 20 Web Crawling Tools to Scrape the Websites Quickly", Aug. 23, 2019 (15 pages).

(Continued)

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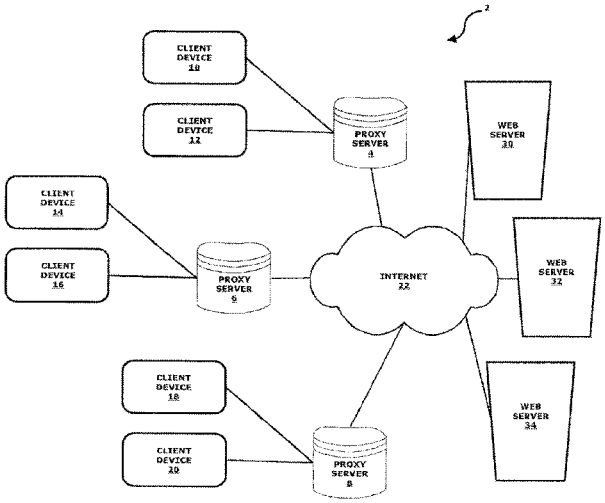
(57) **ABSTRACT**

A system designed for increasing network communication speed for users, while lowering network congestion for content owners and ISPs. The system employs network elements including an acceleration server, clients, agents, and peers, where communication requests generated by applications are intercepted by the client on the same machine. The IP address of the server in the communication request is transmitted to the acceleration server, which provides a list of agents to use for this IP address. The communication request is sent to the agents. One or more of the agents respond with a list of peers that have previously seen some or all of the content which is the response to this request (after checking whether this data is still valid). The client then downloads the data from these peers in parts and in parallel, thereby speeding up the Web transfer, releasing congestion from the Web by fetching the information from multiple sources, and relieving traffic from Web servers by offloading the data transfers from them to nearby peers.

30 Claims, 15 Drawing Sheets



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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,855,894 A 8/1989 Asahi
4,937,781 A 6/1990 Lee et al.
5,519,693 A 5/1996 Galuszka
5,577,243 A 11/1996 Sherwood et al.
5,734,829 A 3/1998 Robinson
5,758,195 A 5/1998 Balmer
5,826,014 A 10/1998 Coley
5,974,566 A 10/1999 Ault
6,012,083 A * 1/2000 Savitzky G06F 40/221 709/202
6,012,090 A 1/2000 Chung
6,061,278 A 5/2000 Kato et al.
6,134,584 A 10/2000 Chang
6,154,782 A 11/2000 Kawaguchi
6,185,625 B1 2/2001 Tso
6,240,444 B1 5/2001 Fin
6,266,704 B1 7/2001 Reed
6,173,330 B1 9/2001 Guo et al.
6,311,216 B1 10/2001 Smith
6,389,422 B1 5/2002 Doi
6,389,462 B1 5/2002 Cohen
6,421,733 B1 7/2002 Tso
6,466,470 B1 10/2002 Chang
6,513,061 B1 1/2003 Ebata
6,519,693 B1 2/2003 Debey
6,665,715 B1 12/2003 Houri
6,687,732 B1 2/2004 Bector
6,701,374 B2 3/2004 Gupta
6,785,705 B1 8/2004 Kocherlakota
6,792,461 B1 9/2004 Hericourt
6,795,848 B1 9/2004 Border et al.
6,842,463 B1 1/2005 Drwiega
6,868,453 B1 3/2005 Watanabe
6,895,011 B1 5/2005 Lassers
6,961,783 B1 11/2005 Cook
7,007,228 B1 2/2006 Carro
7,047,315 B1 5/2006 Srivastava
7,080,158 B1 7/2006 Squire
7,009,927 B2 8/2006 Cudd
7,120,666 B2 10/2006 McCanne et al.
7,139,579 B2 11/2006 Hatano
7,203,741 B2 4/2007 Marco et al.
7,234,059 B1 6/2007 Beaver
7,543,018 B2 6/2009 Appelman
7,558,942 B1 7/2009 Chen et al.
7,620,703 B1 11/2009 Shteyn
7,673,048 B1 3/2010 O'Toole
7,702,784 B2 4/2010 Berstis
7,706,362 B1 4/2010 Senthilnathan
7,719,971 B1 5/2010 Issa
7,742,485 B2 6/2010 Zhang
7,751,628 B1 7/2010 Reisman
7,783,777 B1 8/2010 Pabla
7,788,378 B2 8/2010 Rao
7,805,517 B2 9/2010 Shim
7,818,430 B2 10/2010 Zuckerman
7,831,720 B1 11/2010 Noureddine
7,860,988 B2 12/2010 Aoki
7,865,585 B2 * 1/2011 Samuels H04L 67/28 709/223
7,877,511 B1 1/2011 Berger
7,890,547 B2 2/2011 Hotti
7,890,624 B2 2/2011 Bivens
7,894,431 B2 2/2011 Goring
7,929,429 B2 4/2011 Bornstein
7,970,835 B2 6/2011 St. Jacques
7,984,110 B1 7/2011 Raman
8,135,912 B2 3/2012 Shribman et al.
8,156,275 B2 4/2012 de Cesare
8,171,101 B2 5/2012 Gladwin et al.
8,306,022 B1 11/2012 Cranor
8,375,434 B2 2/2013 Cottrell
8,464,350 B2 6/2013 Kanevsky
8,479,251 B2 7/2013 Feinleib et al.
8,499,059 B2 7/2013 Stoyanov
8,516,084 B1 8/2013 Grieve
8,527,631 B1 9/2013 Liang
8,533,628 B2 9/2013 Rohrabaugh
8,577,724 B1 11/2013 Gandhi
8,595,786 B2 11/2013 Choi
8,627,422 B2 1/2014 Hawkes
8,639,630 B2 1/2014 Fomenko et al.
8,769,035 B2 1/2014 Resch et al.
8,655,985 B2 2/2014 De
8,719,430 B2 5/2014 Ackere
8,719,505 B2 6/2014 Shribman et al.
8,832,179 B2 9/2014 Owen et al.
8,838,811 B2 9/2014 Chen
8,935,798 B1 1/2015 Smith
9,201,808 B2 1/2015 Shribman et al.
8,972,602 B2 3/2015 Mithyantha
8,990,357 B2 3/2015 Graham-Cumming
8,996,856 B2 3/2015 Amit
9,015,335 B1 4/2015 Gigliotti
9,059,938 B1 6/2015 Strand
9,100,320 B2 8/2015 Hsy
9,122,554 B2 9/2015 Callaghan
9,154,557 B2 10/2015 Lev-Ran
9,177,157 B2 11/2015 Binder
9,237,210 B2 1/2016 Liu
9,253,164 B2 2/2016 Gouge
9,313,100 B1 4/2016 Jenkins
9,374,244 B1 6/2016 Brandwine
9,418,243 B2 8/2016 Bauer
9,444,903 B2 9/2016 Nuaimi
9,584,529 B2 2/2017 Su
9,705,959 B1 7/2017 Strand
9,742,866 B2 8/2017 Shribman
9,979,674 B1 5/2018 Kumar
9,990,295 B2 6/2018 Shribman et al.
10,182,466 B2 1/2019 Nirantar
10,277,711 B2 4/2019 Shribman
10,361,911 B2 7/2019 Brandwine
10,404,791 B2 9/2019 Puri
10,410,244 B2 9/2019 Toval
10,484,337 B2 11/2019 Subbarayan
10,484,510 B2 11/2019 Shribman
10,560,509 B2 2/2020 Lo
10,594,660 B2 3/2020 Smith
10,637,956 B1 4/2020 Juravicius
10,645,654 B1 5/2020 Backholm
10,650,166 B1 5/2020 Sundberg
2001/0011312 A1 8/2001 Chu
2001/0033583 A1 10/2001 Rabenko et al.
2001/0054020 A1 12/2001 Barth
2002/0007413 A1 * 1/2002 Garcia-Luna-Aceves H04L 29/12594 709/229
2002/0026517 A1 2/2002 Watson
2002/0065930 A1 5/2002 Rhodes

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0069241 A1 6/2002 Narlikar et al.
2002/0073232 A1 6/2002 Hong
2002/0091760 A1 7/2002 Rozen
2002/0103823 A1 8/2002 Jackson
2002/0112036 A1 8/2002 Bohannon
2002/0120874 A1 8/2002 Shu et al.
2002/0123895 A1 9/2002 Potekhin
2002/0133621 A1 9/2002 Marco et al.
2002/0194183 A1 12/2002 Yoakum
2002/0194292 A1 12/2002 King
2003/0009518 A1 1/2003 Harrow et al.
2003/0009583 A1 1/2003 Chan et al.
2003/0018705 A1 1/2003 Chen
2003/0018834 A1 1/2003 Eilers
2003/0074403 A1 4/2003 Harrow et al.
2003/0095520 A1 5/2003 Aalbers
2003/0097408 A1* 5/2003 Kageyama H04L 12/1818 709/205
2003/0115364 A1 6/2003 Li et al.
2003/0163413 A1 8/2003 Wiczkowski
2003/0174648 A1 9/2003 Wang et al.
2003/0187925 A1 10/2003 Inala
2003/0200307 A1 10/2003 Raju et al.
2003/0204602 A1 10/2003 Hudson
2003/0210694 A1 11/2003 Jayaraman et al.
2003/0229718 A1 12/2003 Tock
2003/0229785 A1 12/2003 Daseke
2004/0044731 A1 3/2004 Chen
2004/0054748 A1 3/2004 Ackaouy
2004/0068579 A1 4/2004 Marmigere
2004/0088646 A1 5/2004 Yeager et al.
2004/0107242 A1 6/2004 Vert et al.
2004/0117455 A1 6/2004 Kaminsky
2004/0133692 A1 7/2004 Blanchet
2004/0212490 A1 10/2004 Fredericks
2004/0221207 A1 11/2004 Yokota
2004/0230593 A1 11/2004 Rudin
2004/0236962 A1 11/2004 Wong
2004/0254907 A1 12/2004 Crow et al.
2004/0263479 A1 12/2004 Shkolnikov
2004/0264506 A1 12/2004 Furukawa
2005/0015552 A1 1/2005 So et al.
2005/0022236 A1 1/2005 Ito et al.
2005/0027782 A1 2/2005 Jalan
2005/0050097 A1 3/2005 Yeh
2005/0060542 A1 3/2005 Risan
2005/0096753 A1 5/2005 Arling
2005/0097441 A1 5/2005 Herbach
2005/0108244 A1 5/2005 Riise
2005/0108551 A1 5/2005 Toomey
2005/0165903 A1 7/2005 Doan
2005/0228964 A1 10/2005 Sechrest et al.
2005/0235044 A1 10/2005 Tazuma
2006/0015545 A1 1/2006 Ezra
2006/0036755 A1 2/2006 Abdullah
2006/0039352 A1 2/2006 Karstens
2006/0047844 A1 3/2006 Deng
2006/0059091 A1 3/2006 Wang
2006/0075114 A1 4/2006 Panasyuk
2006/0155995 A1 7/2006 Torvinen
2006/0184647 A1 8/2006 Dixit
2006/0212542 A1 9/2006 Fang
2006/0212584 A1* 9/2006 Yu G06F 16/9574 709/227
2006/0224687 A1 10/2006 Popkin
2006/0242318 A1 10/2006 Nettle
2006/0259728 A1 11/2006 Chandrasekaran et al.
2006/0271438 A1 11/2006 Shotland
2006/0280191 A1 12/2006 Nishida
2007/0011674 A1 1/2007 Joo
2007/0047452 A1 3/2007 Lohr
2007/0050522 A1 3/2007 Grove
2007/0061440 A1 3/2007 Sundaram
2007/0073878 A1 3/2007 Issa
2007/0088821 A1 4/2007 Sankuratripati
2007/0100839 A1 5/2007 Kim
2007/0142036 A1 6/2007 Wikman
2007/0156855 A1 7/2007 Johnson
2007/0171921 A1 7/2007 Wookey
2007/0174246 A1 7/2007 Sigurdsson
2007/0180111 A1 8/2007 Chmaytelli
2007/0226810 A1 9/2007 Hotti
2007/0239655 A1 10/2007 Agetsuma et al.
2007/0283026 A1 12/2007 Lohmar
2008/0008089 A1 1/2008 Bornstein et al.
2008/0010365 A1 1/2008 Schneider
2008/0025506 A1 1/2008 Muraoka
2008/0037536 A1 2/2008 Padmanabhan
2008/0052156 A1 2/2008 Brenner
2008/0071925 A1 3/2008 Leighton
2008/0098101 A1 4/2008 Black
2008/0109446 A1 5/2008 Xin
2008/0120427 A1 5/2008 Ramanathan
2008/0125123 A1 5/2008 Dorenbosch et al.
2008/0134258 A1 6/2008 Goose et al.
2008/0162700 A1 7/2008 Aborn
2008/0196098 A1 8/2008 Cottrell
2008/0201438 A1 8/2008 Mandre
2008/0209028 A1 8/2008 Kurup
2008/0214152 A1 9/2008 Ramer
2008/0222244 A1 9/2008 Huang
2008/0222267 A1* 9/2008 Horn H04L 67/1008 709/217
2008/0222291 A1 9/2008 Weller et al.
2008/0225710 A1 9/2008 Raja
2008/0228537 A1 9/2008 Monfried
2008/0235391 A1 9/2008 Painter et al.
2008/0235623 A1 9/2008 Li
2008/0235746 A1 9/2008 Peters
2008/0086730 A1 10/2008 Vertes
2008/0243735 A1 10/2008 Rish
2008/0256175 A1 10/2008 Lee
2008/0263180 A1 10/2008 Hurst
2008/0282112 A1 11/2008 Bailey
2008/0320151 A1 12/2008 McCanne
2009/0010426 A1 1/2009 Redmond
2009/0037529 A1 2/2009 Armon-Kest
2009/0037977 A1 2/2009 Gai
2009/0055749 A1 2/2009 Chatterjee
2009/0070489 A1 3/2009 Lu
2009/0077233 A1 3/2009 Kurebayashi
2009/0136219 A1 5/2009 Kikugawa
2009/0138538 A1 5/2009 Klein
2009/0150534 A1 6/2009 Miller
2009/0150930 A1 6/2009 Sherwin
2009/0161554 A1 6/2009 Agarwal
2009/0177761 A1 7/2009 Meyer
2009/0182843 A1 7/2009 Hluchyj
2009/0193498 A1 7/2009 Agarwal
2009/0199000 A1 8/2009 Hsu
2009/0216887 A1 8/2009 Hertle
2009/0217122 A1 8/2009 Yokokawa et al.
2009/0217351 A1 8/2009 Burch
2009/0232003 A1 9/2009 Vasseur
2009/0234970 A1 9/2009 Sun
2009/0248793 A1 10/2009 Jacobsson
2009/0262724 A1 10/2009 Suzuki
2009/0279559 A1 11/2009 Wong et al.
2009/0292816 A1 11/2009 Etchegoyen
2009/0300208 A1 12/2009 Lepeska
2009/0313318 A1 12/2009 Dye
2009/0319502 A1 12/2009 Chalouhi et al.
2009/0327489 A1 12/2009 Swildens
2010/0031183 A1 2/2010 Kang
2010/0036954 A1 2/2010 Sakata
2010/0042724 A1 2/2010 Jeon
2010/0066808 A1 3/2010 Tucker et al.
2010/0067703 A1 3/2010 Candelore
2010/0085977 A1 4/2010 Khalid et al.
2010/0094970 A1 4/2010 Zuckerman et al.
2010/0100952 A1 4/2010 Sample
2010/0125675 A1 5/2010 Richardson
2010/0115063 A1 6/2010 Gladwin et al.
2010/0145925 A1 6/2010 Flinta

(56) **References Cited**

U.S. PATENT DOCUMENTS

2010/0154044 A1 6/2010 Manku
2010/0161752 A1 6/2010 Collet
2010/0161756 A1 6/2010 Lewis
2010/0161760 A1 6/2010 Maloo
2010/0161799 A1 6/2010 Maloo
2010/0162126 A1 6/2010 Donaldson
2010/0180082 A1 7/2010 Sebastian
2010/0235438 A1 9/2010 Narayanan et al.
2010/0235473 A1 9/2010 Koren
2010/0262650 A1 10/2010 Chauhan
2010/0293555 A1 11/2010 Vepsalainen
2010/0322237 A1 12/2010 Raja
2010/0329270 A1 12/2010 Asati et al.
2011/0007665 A1 1/2011 Dinur
2011/0022582 A1 1/2011 Unnikrishnan
2011/0023125 A1 1/2011 Kim
2011/0035503 A1 2/2011 Zaid
2011/0066924 A1 3/2011 Dorso
2011/0087733 A1 4/2011 Shribman
2011/0117938 A1 5/2011 Pyo
2011/0128911 A1 6/2011 Shaheen
2011/0154477 A1 6/2011 Parla
2011/0173345 A1 7/2011 Knox
2011/0264809 A1 10/2011 Koster
2011/0282997 A1 11/2011 Prince
2011/0314347 A1 12/2011 Nakano et al.
2012/0023212 A1 1/2012 Roth
2012/0036220 A1 2/2012 Dare
2012/0096116 A1 4/2012 Mislove
2012/0099566 A1 4/2012 Laine et al.
2012/0124173 A1 5/2012 De et al.
2012/0124239 A1 5/2012 Shribman et al.
2012/0136926 A1 5/2012 Dillon
2012/0144047 A1 6/2012 Armstrong
2012/0164980 A1 6/2012 Phan
2012/0166582 A1 6/2012 Binder
2012/0185947 A1 7/2012 Phillips
2012/0198524 A1 8/2012 Celebisoy
2012/0239811 A1 9/2012 Kohli
2012/0246273 A1 9/2012 Bornstein
2012/0254370 A1 10/2012 Bacher
2012/0254456 A1 10/2012 Zubair et al.
2012/0264520 A1 10/2012 Marsland
2012/0290717 A1 11/2012 Luna
2012/0297041 A1 11/2012 Momchilov
2012/0323674 A1 12/2012 Simmons
2013/0007031 A1 1/2013 Makino
2013/0007232 A1 1/2013 Wang
2013/0007253 A1 1/2013 Li
2013/0019258 A1 1/2013 Bhatia
2013/0046817 A1 2/2013 Isbister
2013/0047020 A1 2/2013 Hershko
2013/0064370 A1 3/2013 Gouge
2013/0067086 A1 3/2013 Hershko
2013/0072233 A1 3/2013 Sandholm
2013/0080498 A1 3/2013 Desilva
2013/0080575 A1 3/2013 Prince
2013/0081129 A1 3/2013 Niemelä
2013/0083800 A1 4/2013 Bounine
2013/0117413 A1 5/2013 Kaneko
2013/0145017 A1 6/2013 Luna
2013/0151709 A1 6/2013 Luna
2013/0157699 A1 6/2013 Talwar
2013/0166768 A1 6/2013 Gouache et al.
2013/0167045 A1 6/2013 Xu
2013/0171964 A1 7/2013 Bhatia
2013/0173756 A1 7/2013 Luna
2013/0201316 A1 8/2013 Binder et al.
2013/0212462 A1 8/2013 Athas
2013/0219281 A1 8/2013 Trevelyan
2013/0219458 A1 8/2013 Ramanathan
2013/0263280 A1 10/2013 Cote et al.
2013/0268357 A1 10/2013 Heath
2013/0272519 A1 10/2013 Huang
2013/0304796 A1 11/2013 Jackowski
2013/0326607 A1 12/2013 Feng
2013/0339477 A1 12/2013 Majeti
2014/0013001 A1 1/2014 Cox
2014/0078462 A1 3/2014 Abreu
2014/0082260 A1 3/2014 Oh et al.
2014/0189802 A1 7/2014 Montgomery
2014/0199044 A1 7/2014 Gupta
2014/0201323 A1 7/2014 Fall
2014/0222974 A1 8/2014 Liu
2014/0244778 A1 8/2014 Wyatt
2014/0258465 A1 9/2014 Li
2014/0301334 A1 10/2014 Labranche et al.
2014/0310709 A1 10/2014 Nirantar
2014/0337308 A1 11/2014 De Francisci Morales
2014/0359081 A1 12/2014 Van Deventer
2014/0372627 A1 12/2014 Axelrod
2014/0376403 A1 12/2014 Shao
2015/0006615 A1 1/2015 Wainner
2015/0016261 A1 1/2015 Backholm
2015/0026239 A1 1/2015 Hofmann
2015/0026341 A1 1/2015 Blacka
2015/0032803 A1 1/2015 Graham-Cumming
2015/0033001 A1 1/2015 Ivanov
2015/0036485 A1 2/2015 Poulson
2015/0039674 A1 2/2015 Agarwal
2015/0067819 A1 3/2015 Shribman et al.
2015/0135302 A1 5/2015 Cohen
2015/0149431 A1 5/2015 Trevelyan
2015/0172324 A1 6/2015 Calme
2015/0172406 A1 6/2015 Hansen
2015/0189401 A1 7/2015 Yi
2015/0206176 A1 7/2015 Toval
2015/0206197 A1 7/2015 Toval
2015/0244839 A1 8/2015 Horn
2015/0268905 A1 9/2015 Chakirov
2015/0295988 A1 10/2015 Goodwin
2015/0317218 A1 11/2015 Verde
2015/0341812 A1 11/2015 Dion
2015/0347118 A1 12/2015 Yeung
2015/0350362 A1 12/2015 Pollack
2015/0358648 A1 12/2015 Limberg
2015/0372972 A1 12/2015 Kennedy
2016/0021430 A1 1/2016 LaBosco et al.
2016/0035019 A1 2/2016 Rosner
2016/0077547 A1 3/2016 Aimone
2016/0098049 A1 4/2016 Fan
2016/0105530 A1 4/2016 Shribman
2016/0140405 A1 5/2016 Graumann
2016/0170814 A1 6/2016 Li
2016/0188657 A1 6/2016 Montana
2016/0205028 A1 7/2016 Luna
2016/0241664 A1 8/2016 Xia
2016/0294956 A1 10/2016 Fix
2016/0323409 A1 11/2016 Kölhi
2016/0337464 A1 11/2016 Eriksson
2016/0352628 A1 12/2016 Tirumaleswar et al.
2016/0366233 A1 12/2016 Le
2017/0041416 A1 2/2017 Zhou
2017/0155654 A1 6/2017 Burke
2017/0221092 A1 8/2017 Toval
2017/0230434 A1 8/2017 Wang
2017/0250861 A1 8/2017 Gheorghe
2017/0272316 A1 9/2017 Johnson
2017/0374566 A1 12/2017 Backholm
2018/0020324 A1 1/2018 Beauford
2018/0034766 A1 2/2018 Chiba
2018/0042067 A1 2/2018 Nirantar
2018/0063228 A1 3/2018 Deen
2018/0077624 A1 3/2018 Jung
2018/0131668 A1 5/2018 Prince
2018/0167336 A1 6/2018 Lawrence
2018/0213060 A1 7/2018 Koonce
2018/0225387 A1 8/2018 Pang
2018/0227210 A1 8/2018 Cosgrove
2018/0262388 A1 9/2018 Johnson
2018/0349354 A1 12/2018 Gonzalez
2018/0367560 A1 12/2018 Mahaffey
2018/0375896 A1 12/2018 Wang
2018/0375952 A1 12/2018 Knecht

(56) **References Cited**

U.S. PATENT DOCUMENTS

2019/0033845	A1	1/2019	Cella
2019/0037047	A1	1/2019	Shribman
2019/0050164	A1	2/2019	Kotian
2019/0059083	A1	2/2019	Backholm
2019/0068740	A1	2/2019	Graham-Cumming
2019/0098518	A1	3/2019	Luna
2019/0110173	A1	4/2019	Collier
2019/0138560	A1	5/2019	Holloway
2019/0155665	A1	5/2019	Bott
2019/0166520	A1	5/2019	Luna
2019/0171474	A1	6/2019	Malboubi
2019/0174449	A1	6/2019	Shan
2019/0180316	A1	6/2019	Toval
2019/0182034	A1	6/2019	McCarthy et al.
2019/0199611	A1	6/2019	Kotadia
2019/0238510	A1	8/2019	Li
2019/0260859	A1	8/2019	Patil
2019/0372878	A1	12/2019	Chakra
2019/0373083	A1	12/2019	Nucci
2019/0379766	A1	12/2019	Decenzo
2019/0387430	A1	12/2019	Ingerman
2020/0007494	A1	1/2020	Prince
2020/0159622	A1	5/2020	Chakravarthy Chintagunta
2020/0162432	A1	5/2020	Ludin
2020/0169536	A1	5/2020	Santelia
2020/0184035	A1	6/2020	Santelia
2020/0186614	A1	6/2020	Luna
2020/0259893	A1	8/2020	James
2020/0287867	A1	9/2020	Knecht

FOREIGN PATENT DOCUMENTS

CN	102314348		1/2012
EP	0948176	A2	10/1999
EP	1672826		6/2006
EP	2597869	A1	5/2013
EP	2597869	A1	5/2015
EP	2922275	B1	3/2016
GB	2418108	A	3/2006
JP	H11-355302		12/1999
JP	2007280388		10/2007
KR	1020090097034		9/2009
RU	2343536	C2	10/2009
WO	2000/018078	A1	3/2000
WO	2004094980		11/2004
WO	2004094980	A2	11/2004
WO	2007/136665		11/2007
WO	2010090562	A1	8/2010
WO	2010090562	A1	12/2010
WO	2011068784	A1	9/2011
WO	2015034752	A1	3/2015
WO	2015/157646		10/2015
WO	2016181383		11/2016
WO	2019/043687		3/2019

OTHER PUBLICATIONS

"Keep Alive"—Imperva, 2019 https://www.imperva.com/learn/performance/keep-alive (2019) (3 pages).
Third party observation filed on Jun. 21, 2019 in PCT Application No. PCT/IL2018/050910 (7 pages).
IETF named: IPv6 Tunnel Broker, Apr. 1999—First uploaded document submitted with third party observation dated Jun. 21, 2019 (13 pages).
RFC 3053 (Jan. 2001) named: IPv6 Tunnel Broker—Secod uploaded document submitted with third party observation dated Jun. 21, 2019 (13 pages).
Li et at, "Toward the Identification of Anonymous Web Proxies", University of Cambridge & University of Genoa, Apr. 3, 2009 (2 pages).
"Anonymizing Proxies: What They Are and Who They Work"—Enterprise Services Mar. 2013 (Year: 2012) (2 pages).
Selected pages from the website proxifier.com as of Feb. 2008 (15 pages).
Proxychains source code (Oct. 20, 2004) (53 pages).
RFC 1918, Address Allocation for Private Internets, Feb. 1996 (9 pages).
RFC 2131, Dynamic Host Configuration Protocol, Mar. 1997 (45 pages).
RFC 4388, Dynamic Host Configuration Protocol (DHCP) Leasequery, Feb. 2006 (27 pages).
R. Fielding et al, RFC 2616: Hypertext Transfer Protocol—HTTP/1.1, Jun. 1999, retrieved from the Internet http://rcf-editor.org [retrieved Apr. 15, 2002] (114 pages).
"On the Leakage of Personally Identifiable Information via Online Social Networks"—Wills et al, AT&T, Apr. 2009 http://www2.research.att.com/~bala/papers/wosn09.pdf.
Notice of Preliminary Rejection in KR Application No. 10-2012-7011711 dated Jul. 15, 2016.
Kei Suzuki, a study on Cooperative Peer Selection Method in P2P Video Delivery, vol. 109, No. 37, IEICE Technical Report, the Institute of Electronics, Information and Communication Engineers, May 14, 2009.
Berners-Lee et al., RFC 1945, Hypertext Transfer Protocol, HTTP/1.0 (May 1996) (60 pages).
Leech et al., RFC 1928, Socks Protocol, Version 5 (Internet Engineering Task Force, Network Working Group, Mar. 1996) (9 pages).
Wessels, "Squid: The Definitive Guide," ISBN-10: 9780596001629, ISBN-13: 978-0596001629, O'Reilly Media; 1st Ed. (Jan. 1, 2004) (468 pages).
VIP72.com home page as of 2013 from Wayback Machine (3 pages).
Loutonen et al., "World-Wide Web proxies," Computer Networks and ISDN Systems 27, 147-154 (Elsevier Science B. V.) (1994) (8 pages).
Cooper et al., RFC 3040, Internet Web Replication and Caching Taxonomy (Jan. 2001) (32 pages).
ISO/IEC 23009-1:2012(E), MPEG-DASH standard, Jan. 5, 2012 (133 pages).
ProxyList.net, as captured by the Wayback Machine (web.archive.org), on Jul. 17, 2011 (1 page).
Printout of VIP72 Youtube web page at https://www.youtube.com/watch?v=L0Hct2kSnn4, retrieved Nov. 21, 2019 (1 page).
VIP72 Scene Images extracted from VIP72.com/nvpnnet, MPEG-4 video recording of "nVPN.net | Double your Safety and use Socks5+nVpn", accessed from https://www.youtube.com/watch?v=L0Hct2kSnn4, published Sep. 11, 2011 (221 pages).
Certification dated Nov. 8, 2019 of Anjali Shresta of Google, Proof of Date for VIP72 Youtube web page and video (4 pages).
Michael K. Reiter and Aviel D. Rubin, "Crowds: Anonymity for Web Transactions", ACM Transactions on Information and System Security, Nov. 1998 (27 pages).
Rennhard, Marc, "MorphMix—A Peer-to-Peer based System for Anonymous Internet Access", 2004 (307 pages).
Ari Luotonen, "Web Proxy Servers," ISBN-10: 0136806120, ISBN-13: 978-0136806127, Prentice Hall; 1st Ed. 1998 (452 pages).
RFC 760, DOD Standard Internet Protocol, Jan. 1980 (46 pages).
RFC 2547, BGP/MPLS VPNs, Mar. 1999 (25 pages).
RFC 1180, A TCP/IP Tutorial, Jan. 1991 (28 pages).
RFC 1122, Requirements for Internet Hosts—Communication Layers, Oct. 1989 (116 pages).
Andrei Popescu, Google, Inc, Geolocation API Specification, W3C Working Draft Dec. 22, 2008 (8 pages).
Andrei Popescu, Google, Inc, Geolocation API Specification, W3C Recommendation Oct. 24, 2013 (10 pages).
Yong Wang, et al., Towards Street-Level Client-Independent IP Geolocation, 2011 (14 pages).
William R. Stanek, Introducing Microsoft Windows Vista 81, 2006 (9 pages).
IETF RFC 2460 "Internet Protocol, Version 6 (IPv6)", Dec. 1998 (39 pages).
IETF RFC 793 "Protocol Specification", Sep. 1981 (90 pages).
IETF RFC 1349 "Type of Service in the Internet Protocol Suite", Jul. 1992 (28 pages).

(56) **References Cited**

OTHER PUBLICATIONS

IEEE Std 802-2001, IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture, Feb. 7, 2002 (47 pages).
Scott Lowe, Use Resource Monitor to monitor network performance—TechRepublic, Jul. 29, 2011 (11 pages).
Greg Shultz, Windows Vista's Task Manager: The harder-to-detect changes—TechRepublic, Feb. 21, 2007 (16 pages).
Gavin Gear, Windows 8 Task Manager In-Depth, Jun. 6, 2013 (32 pages).
IETF RFC 2914, "Congestion Control Principles", Sep. 2000 (17 pages).
IETF RFC 4026, "Provider Provisioned Virtual Private Network (VPN) Terminology", Mar. 2005 (20 pages).
Screen captures from YouTube video clip entitle "nVpn.net | Double your Safety and use Socks5 + nVpn" 38 pages, last accessed Nov. 20, 2018 <https://www.youtube.com/watch?v=L0Hct2kSnn4>.
Screen captures from YouTube video clip entitle "Andromeda" 47 pages, publicly known and available as of at least 2011 <https://www.youtube.com/watch?v=yRRYpFLbKNU>.
Spyeye, https://www.symantec.com/security-center/writeup/2010-020216-0135-9; http://securesql.info/riskyclouds/spyeye-user-manual; known as of at least 2010 (13 pages).
Screen captures from YouTube video clip entitle "Change Your Country IP Address & Location with Easy Hide IP Software" 9 pages, publicly known and available as of at least 2011, <https://www.youtube.com/watch?v=ulwkf1sOfdA and https://www.youtube.com/watch?v=iFEMT-o9DTc>.
CoralCDN ("CoralCDN"), https://pdos.csail.mit.edu/6.824/papers/freedman-coral.pdf (14 Pages).
European Search Report for EP 14182547.1, dated Jul. 30, 2015.
R. Fielding et al, RFC 2616: Hypertext Transfer Protocol—HTTP/1.1, Jun. 1999, retrieved from the Internet http://rcf-editor.org [retrieved Apr. 15, 2002].
"Slice Embedding Solutions for Distributed Service Architectures"—Esposito et al., Boston University, Computer Science Dept., Oct. 2011 http://www.cs.bu.edu/techreports/pdf/2011-025-slice-embedding.pdf.
International Search Report of PCT/US2010/034072 dated Jul. 1, 2010.
YouTube video clip entitled "nVpn.net | Double your Safety and use Socks5 + nVpn" <https://www.youtube.com/watch?v=L0Hct2kSnn4>.
YouTube video clip entitled "Andromeda" <https://www.youtube.com/watch?v=yRRYpFLbKNU>.
YouTube video clip entitled "Change Your Country IP Address & Location with Easy Hide IP Software" <https://www.youtube.com/watch?v=ulwkf1sOfdA and https://www.youtube.com/watch?v=iFEMT-o9DTc>.
Kei Suzuki, a study on Cooperative Peer Selection Method in P2P Video Delivery, vol. 109, No. 37, IEICE Technical Engineers Report, The Institute of Electronics, Information and Communication, May 14, 2009.
Kozierok, The TCP/IP Guide—TCP Connection Preparation, Apr. 6, 2005 (3 pages).
Jovovic, Turning your HD TV into an Android SmartTV is easier than you think!, Feb. 26, 2013 (3 pages).
Allen, A Software Developer's Guide to HTTP Part III—Connections, Jan. 26, 2012 (10 pages).
Google Scholar: MorphMix citation in Alessandro Acquisti, et al., Digital Privacy: Theory, Technologies, and Practices (2007) (2 pages).
RFC 959, File Transfer Protocol (FTP), Oct. 1985 (69 pages).
RFC 821, Jonathan B. Postel, Simple Mail Transfer Protocol, Aug. 1982 (70 pages).
RFC 918, Post Office Protocol, Oct. 1984 (5 pages).
RFC 937, Post Office Protocol—Version 2, Feb. 1985 (24 pages).
Roger Dingledine et al., "The Free Haven Project: Distributed Anonymous Storage Service", Dec. 17, 2000 (23 pages).
Michael Freedman et al., "Tarzan: A Peer-to-Peer Anonymizing Network Layer", Nov. 18-22, 2002 (14 pages).
RFC 791, Darpa Internet Program Protocol Specification, Sep. 1981 (49 pages).
RFC 1034, "Domain Names—Concepts and Facilities", Nov. 1987 (55 pages).
RFC 1035, "Domain Names—Implementation and Specification", Nov. 1987 (54 pages).
RFC 1939, Post Office Protocol—Version 3, May 1996 (23 pages).
RFC 2187, "Application of Internet Cache Protocol (ICP), version 2", Sep. 1997 (24 pages).
Duane Wessels, "ICP and the Squid Web Cache", Aug. 13, 1997 (25 pages).
RFC 1738, "Uniform Resource Locators (URL)", Dec. 1994 (25 pages).
European Search Report of EP 20195075 dated Nov. 13, 2020.
David Gourley et al., "HTTP-The-Definitive-Guide", O'Reilly Media, Inc. Sep. 27, 2002 (658 pages).
Floss Manuals, "Circumvention Tools", Free Software Foundation Inc., May 31, 2021 (240 pages).
David Fifield et al., "Blocking resistant communication through domain fronting", Proceeding on Privacy Enhanching Technologies 2015, May 15, 2015 (19 pages).
Wang Qiyan et al., "CensorSpoofer: Asymmetric Communication with IP Spoofing for ensorship-Resistant Web Browsing", Mar. 9, 2012 (16 pages).
Authors Alain Durand (IMAG) et al., "IPv6 Tunnel Broker <draft-ietf-ngtrans-broker-00.txt>", Internet Society (ISOC), Apr. 2, 1999 (14 pages).
Sophie Gastellier-Prevost et al., "Defeating pharming attacks at the client-side", Network and System Security (NSS), Sep. 6, 2011 (8 pages).
Bharat K et al. "Mirror, Mirror on the Web: a study of host pairs with replicated content", Computer Networks, Amsterdam, vol. 31, No. 11-16, May 17, 1999 (12 pages).
European Search Report of EP 20190259 dated Dec. 16, 2020.
European Search Report of EP 20195090 dated Dec. 8, 2020.
RFC 3022, Traditional IP Network Address Translator (Traditional NAT), Jan. 2001 (16 pages).
RFC 2068, Hypertext Transfer Protocol—HTTP/1.1, Jan. 1997 (162 pages).
RFC 1919, Classical versus Transparent IP Proxies, Mar. 1996 (35 pages).
HAProxy Reference Manual, Version 1.2.18, Willy Tarreau, May 25, 2008 (40 pages).
HAProxy Architecture Guide, Version 1.2.18, Willy Tarreau, May 25, 2008 (23 pages).
RFC 2663 entitled: "IP Network Address Translator (NAT) Terminology and Considerations", Aug. 1999 (30 pages).
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/140,749.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/140,785.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/214,433.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/214,451.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/214,476.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/214,496.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/292,363.
Third-party submission under 37 CFR 1.290 filed on Jul. 22, 2019 and entered in U.S. Appl. No. 16/292,364.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/292,374.
Third-party submission under 37 CFR 1.290 filed on Jul. 23, 2019 and entered in U.S. Appl. No. 16/292,382.
Third-party submission under 37 CFR 1.290 filed on Jul. 25, 2019 and entered in U.S. Appl. No. 16/365,250.
Third-party submission under 37 CFR 1.290 filed on Jul. 25, 2019 and entered in U.S. Appl. No. 16/365,315.

(56) **References Cited**

OTHER PUBLICATIONS

"Slice Embedding Solutions for Distributed Service Architectures"—Esposito et al., Boston University, Feb. 12, 2011 http://www.cs.bu.edu/techreports/pdf/2011-025-slice-embedding.pdf (Year 2011) (16 pages).
RFC 3143, Known HTTP Proxy/Caching Problems, Jun. 2001 (32 pages).
International Search Report issued in PCT Application No. PCT/US2010/051881 dated Dec. 9, 2010.
Supplementary European Search Report issued in EP Application No. 10822724 dated Apr. 24, 2013.
Roger Dingledine, Nick Mathewon, and Paul Syverson, Tor: The Second-Generation Onion Router, in Proceedings of the 13th conference on USENIX Security Symposium, vol. 13, 2004 (17 pages).
Goldschlag D.M., Reed M.G., Syverson P.F., Hiding Routing Information, Lecture Notes in Computer Science, vol. 1174, Springer, Berlin, Heidelberg, 1996 (14 pages).
Schneier, Anonymity and Tor Network, Schneier on Security Sep. 20, 2007, https://www.schneier.com/blog/archives/2007/09...html, p. 1-22, accessed Apr. 26, 2020 (22 pages).
Reed M.G., Syverson P.F. Goldschlag D.M., Protocols Using Anonymous Connections: Mobile applications, Lecture Notes in Computer Science, vol. 1361, Springer, Berlin, Heidelberg, 1997 (11 pages).
Nick Mathewon, and Roger Dingledine, Location Diversity in Anonymity Networks, In Proceedings of the 2004 ACM workshop on Privacy in the electronic society. Association for Computing Machinery, New York, NY, USA 66-67 (11 pages).
Mathew Edman and Paul Syverson, As-Awareness in Tor Path Selection, in Proceedings of the 16th ACM conference on Computer and Communication Security (CCS 09). Association for Computing Machinery, New York, NY, USA 380-389 (10 pages).
Banerjee, Priyanka, Anonymous Routing in Wireless Networks: Onion Routing, Team Project Report 2007, p. 1-16 (16 pages).
McCoy D., Bauer K., Grunwald D., Kohno T., Sicker D., Shining Light in Dark Places: Understandings the Tor Network, Lecture Notes in Computer Science, vol. 5134, Springer, Berlin, Heidelberg, 2008 (14 pages).
Harry Newton, Newton's Telecom Dictionary, Mar. 2004, CNP Books, p. 182, 183, 433, 434, 435, 437, 665, 737 (10 pages).
Chakravarty et al., Identifying Proxy Nodes in a Tor Anonymization Circuit, 2008, IEEE International Conference on Signal Image Technology and Internet Based Systems, Bali, 2008, pp. 633-639 (7 pages).
Orfali et al., Client/Server Survival Guide, 3rd ed., John Wiley and Sons Inc. 1999, p. 15 (3 pages).
Reed M.G., Syverson P.F., Goldschlag D.M., Proxies for Anonymous Routing, in Proceedings 12th Annual Computer Security Applications Conference, 1996, pp. 95-104 (10 pages).
Michael J. Freedman, Princeton University, "Experiences with CoralCDN: a five-year operational view", Proceeding NSDI'10 Proceedings of the 7th USENIX conference on Networked systems design and implementation San Jose, California—Apr. 28-30, 2010 (17 pages).
"The BitTorrent Protocol Specification", Website: https://web.archive.org/web/20120513011037/http:/www.bittorrent.org/beps/bep_0003.html describing BitTorrent dated Jan. 10, 2008 downloaded using web archive on Aug. 16, 2019 (6 pages).
"BitTorrent", Website: https://en.wikipedia.org/w/index.php?title=BitTorrent&oldid=530466721 describing BitTorrent dated Dec. 30, 2012 downloaded using Wikipedia on Aug. 16, 2019 (9 pages).
"VIP Socks/VPN Service", Website: http://vip72.com:80/?drgn=1 describing VIP72 proxy service dated Jan. 2010 downloaded using VIP Technologies webpage on Aug. 16, 2019 (3 pages).
"Welcome to Easy Hide IP", Website: https://web.archive.org/web/20130702093456/http://www.easy-hide-ip.com:80/describing Easy Hide IP dated Jun. 26, 2007 downloaded using web archive on Aug. 16, 2019 (2 pages).
"You make it fun; we'll make it run", Website: https://web.archive.org/web/20130726050810/https://www.coralcdn.org describing CoralCDN dated Jan. 25, 2005 downloaded using web archive on Aug. 16, 2019 (2 pages).
"Net Transport", Website: http://www.xi-soft.com/default.htm describing Net Transport Overview dated 2005 downloaded using Net Transport webpage on Aug. 16, 2019 (2 pages).
Net Transport—Develop History, Website: http://www.xi-soft.com/download.htm describing Net Transport Download dated 2005 downloaded using Net Transport webpage on Aug. 16, 2019 (10 pages).
Net Transport FAQ, Website: http://www.xi-soft.com/faq.htm describing Net Transport FAQ dated 2005 downloaded using Net Transport webpage on Aug. 16, 2019 (4 pages).
Net Transport News, Website: http://www.xi-soft.com/news.htm describing Net Transport News dated 2005 downloaded using Net Transport webpage on Aug. 16, 2019 (5 pages).
Reed et al, "Anonymous Connections and Onion Routing", Naval Research Laboratory, Mar. 1998 https://www.onion-router.net/Publications/JSAC-1998.pdf (Year: 1998).
RFC 2186, Internet Cache Protocol (ICP), version 2, Sep. 1997 (9 pages).

* cited by examiner

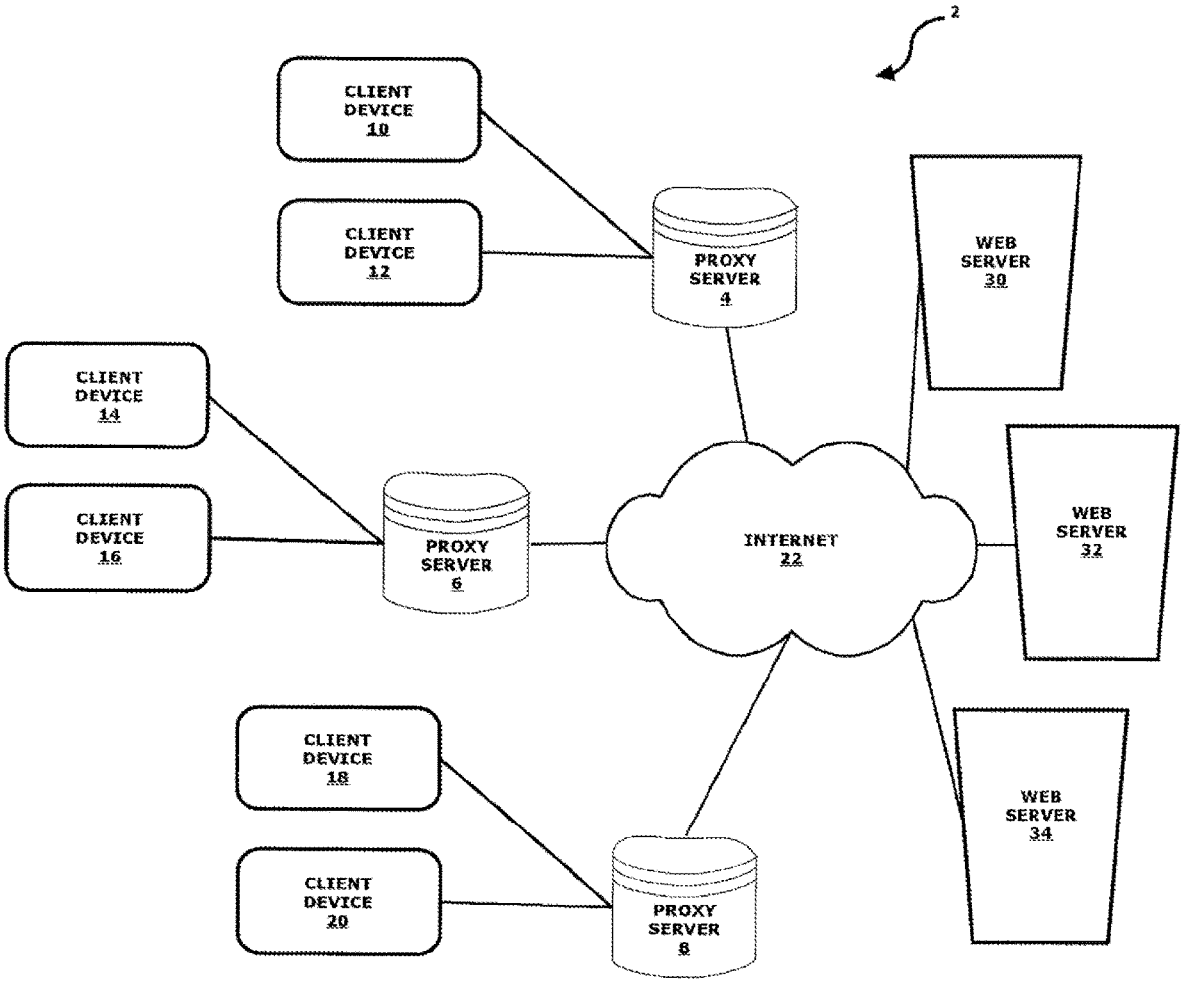
2
CLIENT DEVICE 10
CLIENT DEVICE 12
PROXY SERVER 4
WEB SERVER 30
CLIENT DEVICE 14
CLIENT DEVICE 16
PROXY SERVER 6
INTERNET 22
WEB SERVER 32
CLIENT DEVICE 18
CLIENT DEVICE 20
PROXY SERVER 8
WEB SERVER 34

FIG. 1

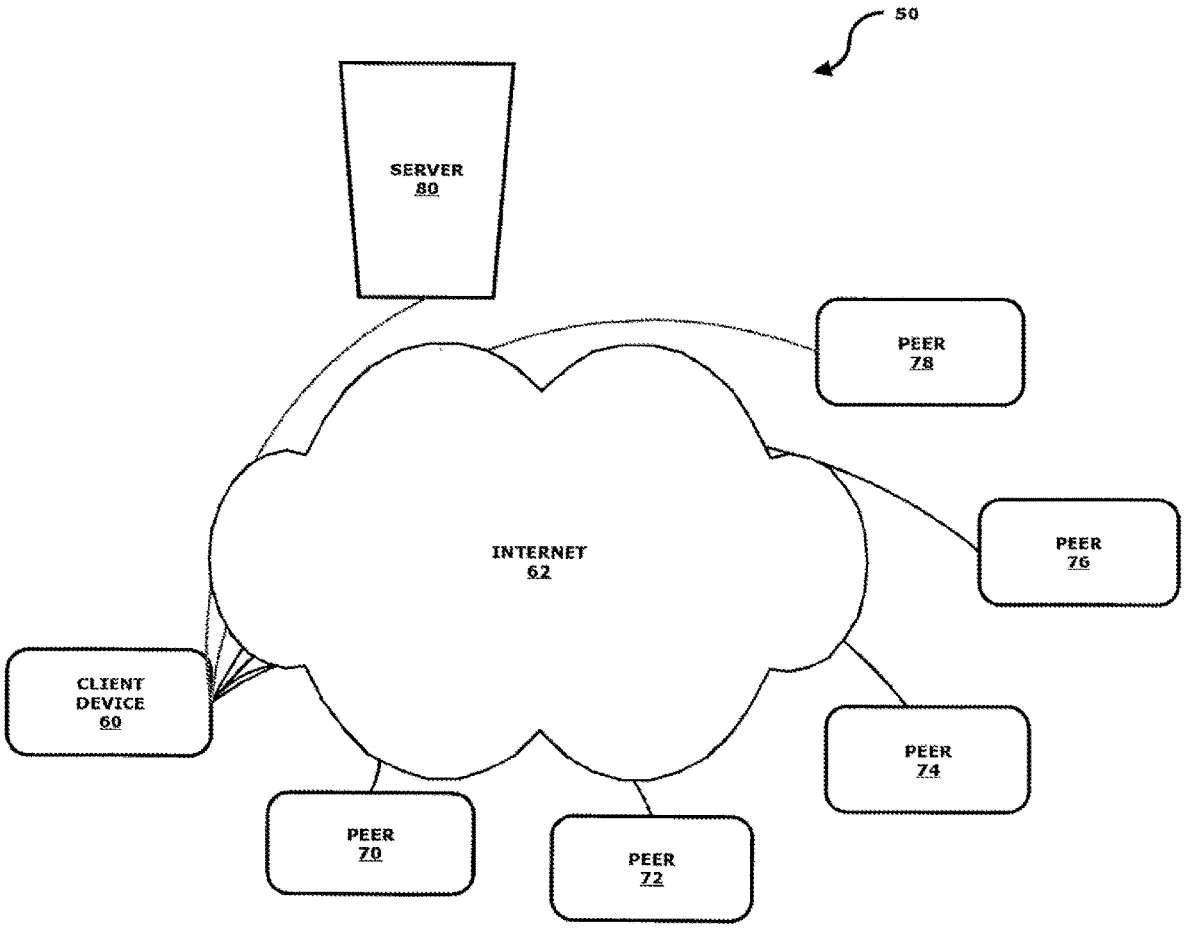
50
SERVER
80
PEER
78
INTERNET
62
PEER
76
CLIENT
DEVICE
60
PEER
74
PEER
70
PEER
72

FIG. 2

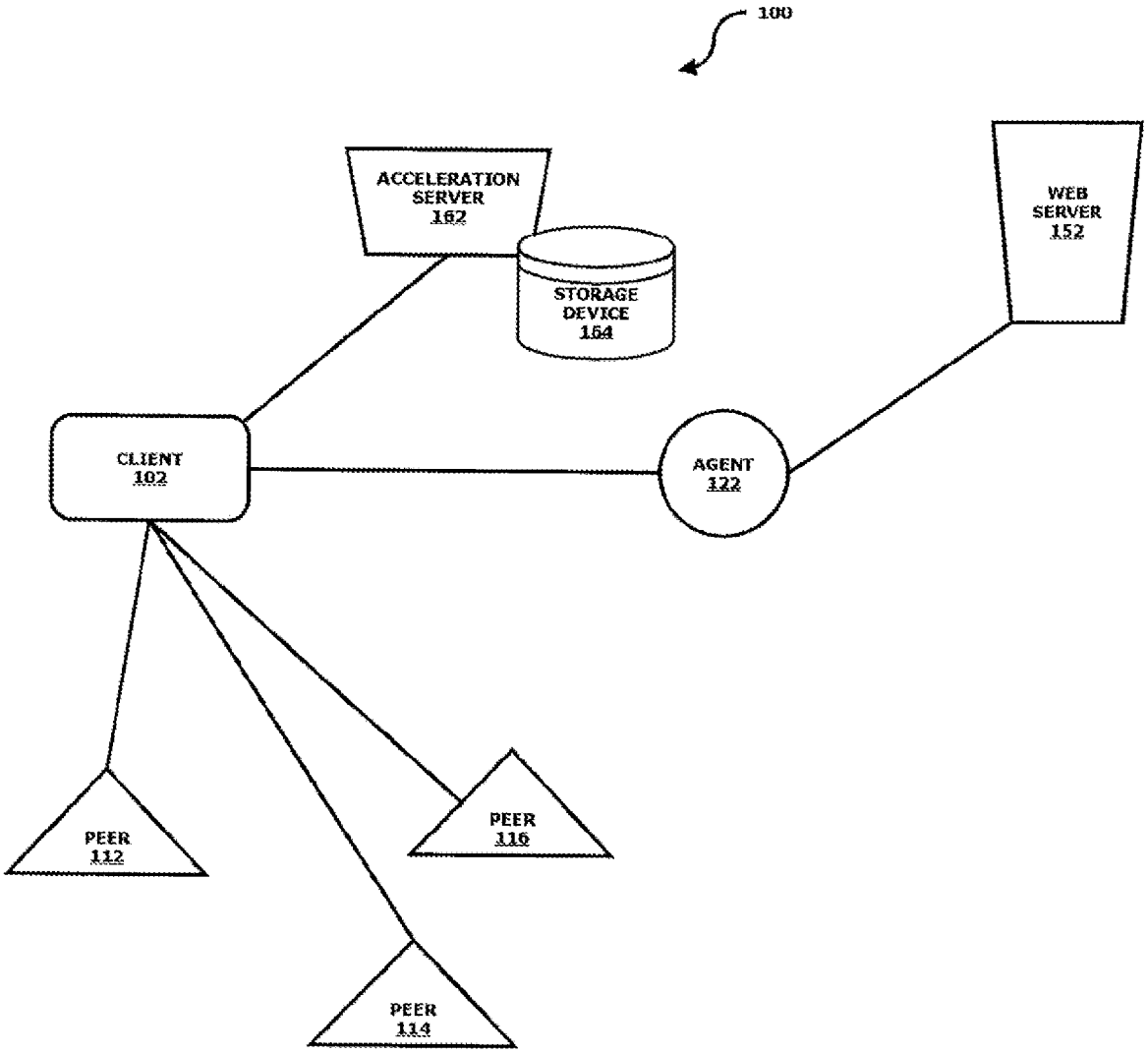
100
ACCELERATION SERVER 162
STORAGE DEVICE 164
WEB SERVER 152
CLIENT 102
AGENT 122
PEER 112
PEER 116
PEER 114

FIG. 3

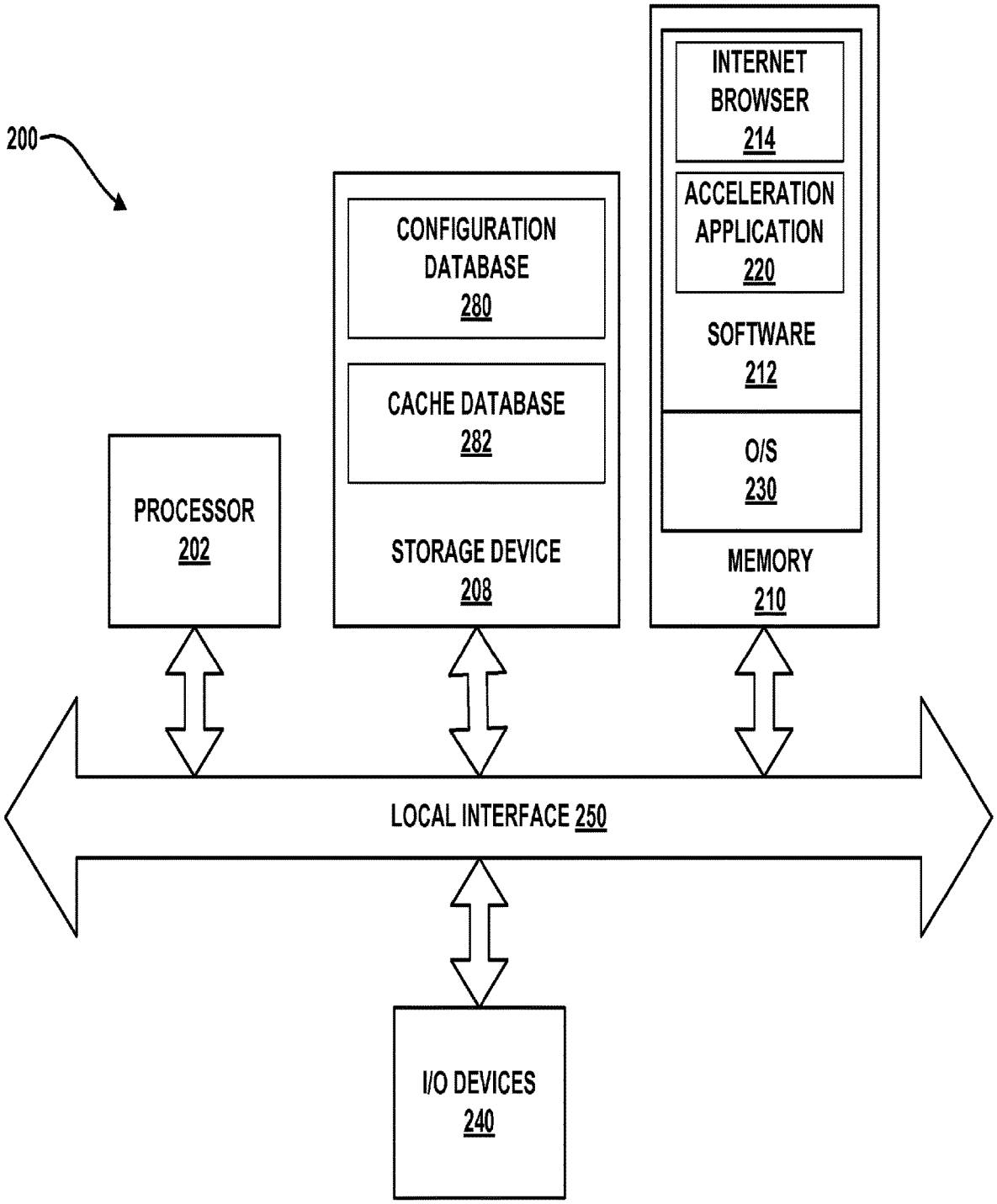
200
INTERNET BROWSER 214
ACCELERATION APPLICATION 220
SOFTWARE 212
O/S 230
MEMORY 210
CONFIGURATION DATABASE 280
CACHE DATABASE 282
STORAGE DEVICE 208
PROCESSOR 202
LOCAL INTERFACE 250
I/O DEVICES 240

FIG. 4

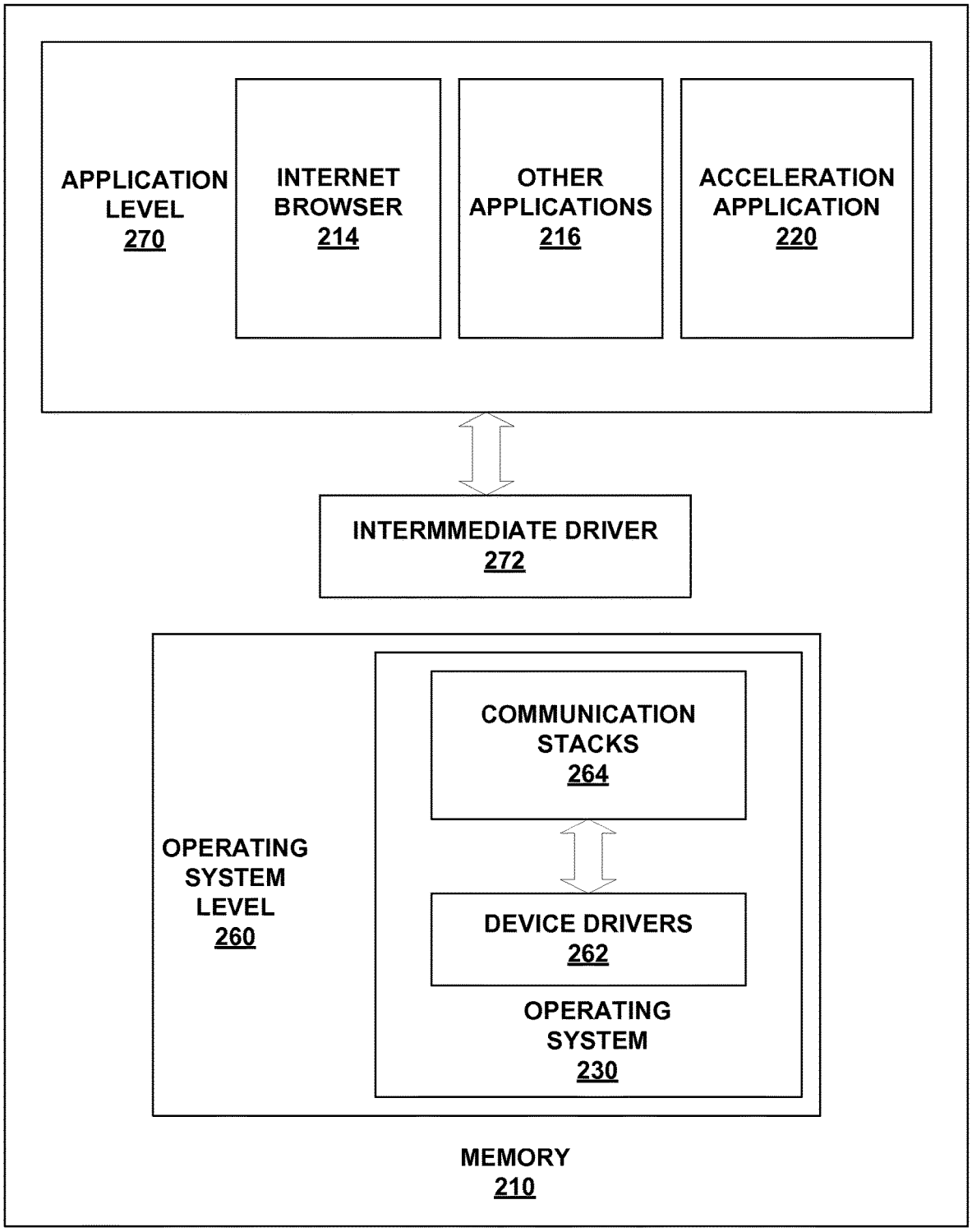
APPLICATION LEVEL 270
INTERNET BROWSER 214
OTHER APPLICATIONS 216
ACCELERATION APPLICATION 220
INTERMMEDIATE DRIVER 272
OPERATING SYSTEM LEVEL 260
COMMUNICATION STACKS 264
DEVICE DRIVERS 262
OPERATING SYSTEM 230
MEMORY 210

FIG. 5

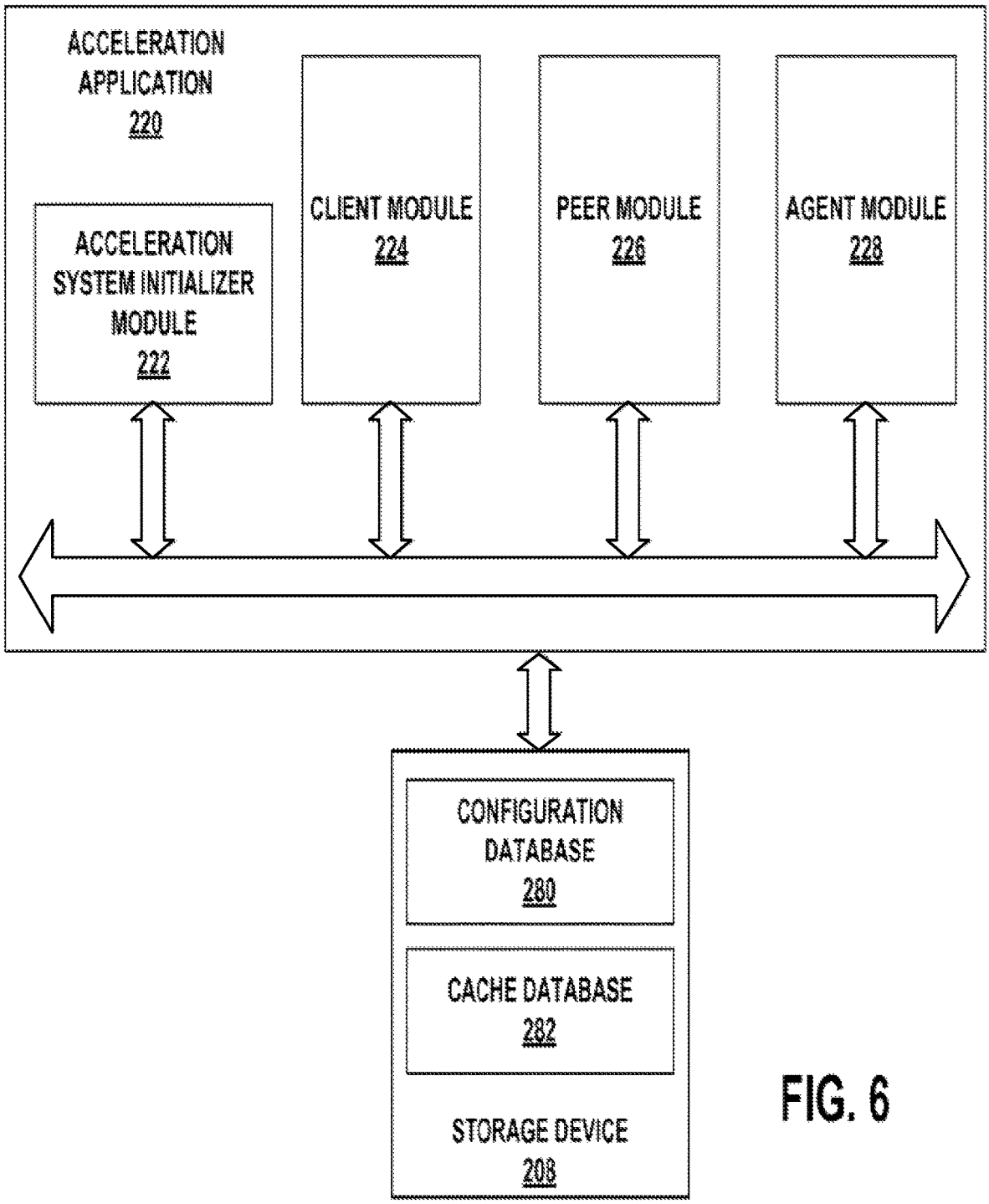
ACCELERATION APPLICATION 220
ACCELERATION SYSTEM INITIALIZER MODULE 222
CLIENT MODULE 224
PEER MODULE 226
AGENT MODULE 228
CONFIGURATION DATABASE 280
CACHE DATABASE 282
STORAGE DEVICE 208

FIG. 6

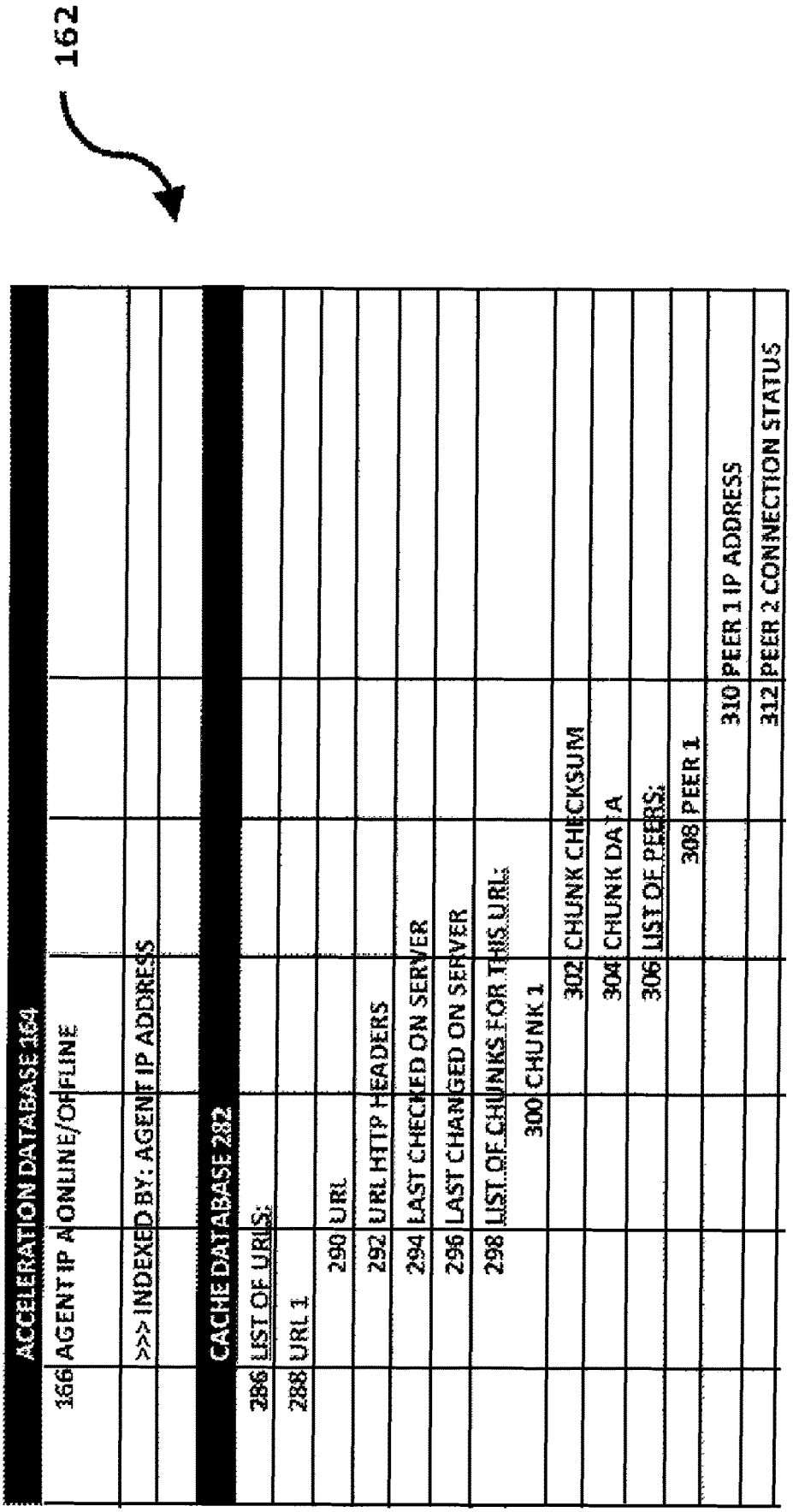
162
ACCELERATION DATABASE 164
166 AGENT IP ADDRESS ONLINE/OFFLINE
>>> INDEXED BY: AGENT IP ADDRESS
CACHE DATABASE 282
286 LIST OF URLS:
288 URL 1
290 URL
292 URL HTTP HEADERS
294 LAST CHECKED ON SERVER
296 LAST CHANGED ON SERVER
298 LIST OF CHUNKS FOR THIS URL:
300 CHUNK 1
302 CHUNK CHECKSUM
304 CHUNK DATA
306 LIST OF PEERS:
308 PEER 1
310 PEER 1 IP ADDRESS
312 PEER 2 CONNECTION STATUS

FIG. 7

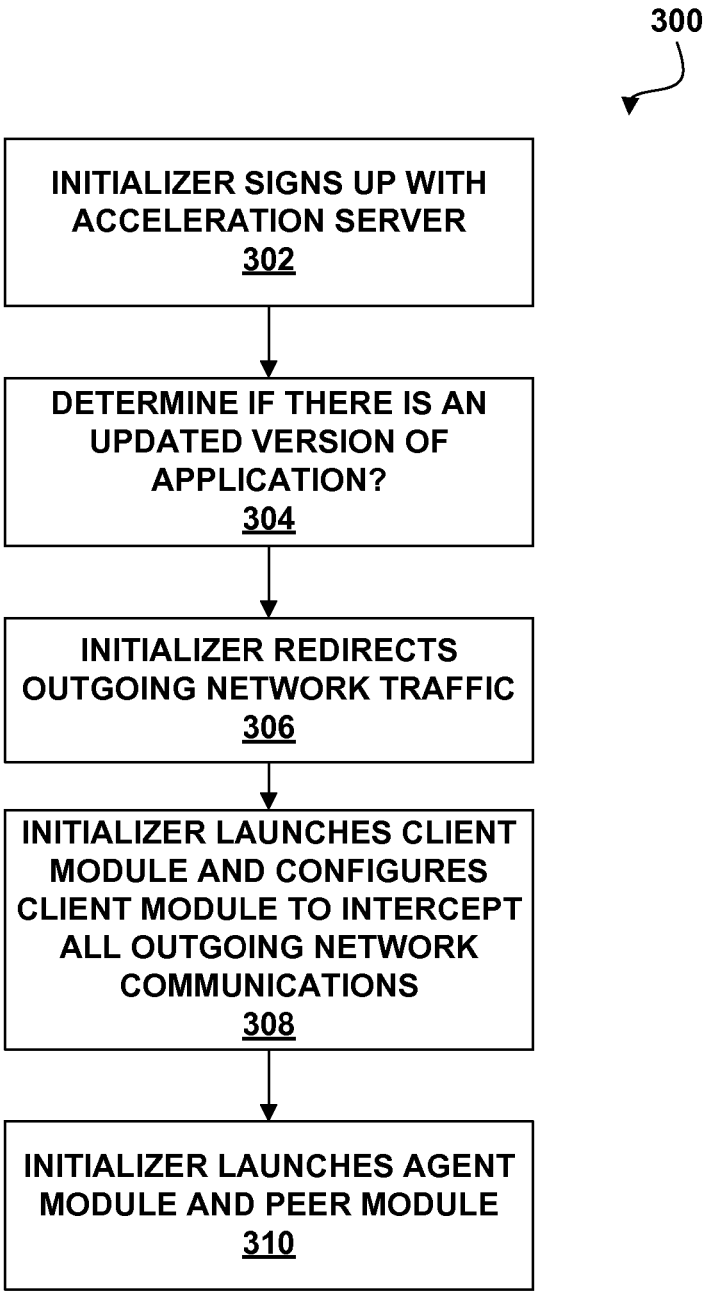
300
INITIALIZER SIGNS UP WITH ACCELERATION SERVER
302
DETERMINE IF THERE IS AN UPDATED VERSION OF APPLICATION?
304
INITIALIZER REDIRECTS OUTGOING NETWORK TRAFFIC
306
INITIALIZER LAUNCHES CLIENT MODULE AND CONFIGURES CLIENT MODULE TO INTERCEPT ALL OUTGOING NETWORK COMMUNICATIONS
308
INITIALIZER LAUNCHES AGENT MODULE AND PEER MODULE
310

FIG. 8

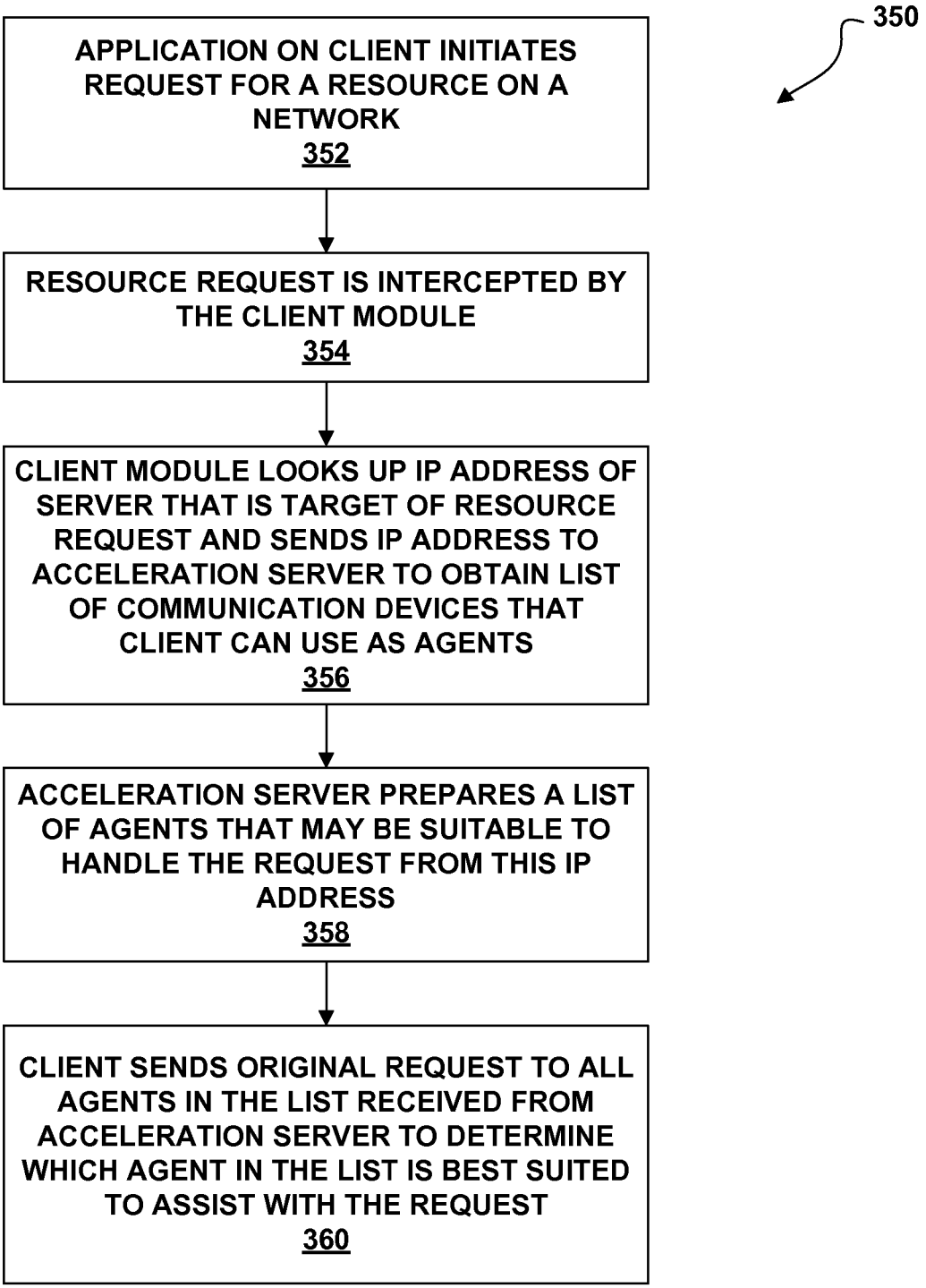
350
APPLICATION ON CLIENT INITIATES REQUEST FOR A RESOURCE ON A NETWORK
352
RESOURCE REQUEST IS INTERCEPTED BY THE CLIENT MODULE
354
CLIENT MODULE LOOKS UP IP ADDRESS OF SERVER THAT IS TARGET OF RESOURCE REQUEST AND SENDS IP ADDRESS TO ACCELERATION SERVER TO OBTAIN LIST OF COMMUNICATION DEVICES THAT CLIENT CAN USE AS AGENTS
356
ACCELERATION SERVER PREPARES A LIST OF AGENTS THAT MAY BE SUITABLE TO HANDLE THE REQUEST FROM THIS IP ADDRESS
358
CLIENT SENDS ORIGINAL REQUEST TO ALL AGENTS IN THE LIST RECEIVED FROM ACCELERATION SERVER TO DETERMINE WHICH AGENT IN THE LIST IS BEST SUITED TO ASSIST WITH THE REQUEST
360

FIG. 9

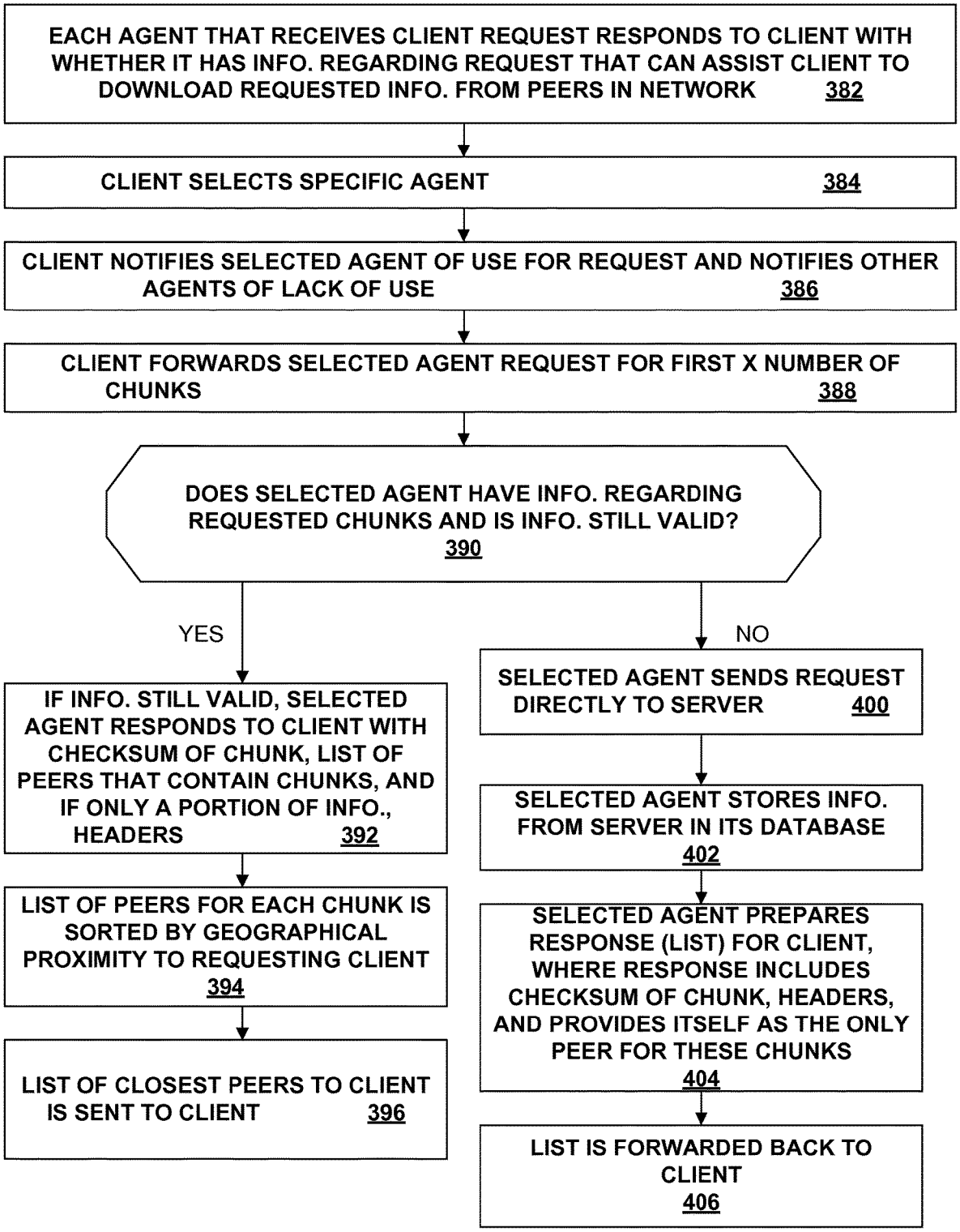
EACH AGENT THAT RECEIVES CLIENT REQUEST RESPONDS TO CLIENT WITH WHETHER IT HAS INFO. REGARDING REQUEST THAT CAN ASSIST CLIENT TO DOWNLOAD REQUESTED INFO. FROM PEERS IN NETWORK 382
CLIENT SELECTS SPECIFIC AGENT 384
CLIENT NOTIFIES SELECTED AGENT OF USE FOR REQUEST AND NOTIFIES OTHER AGENTS OF LACK OF USE 386
CLIENT FORWARDS SELECTED AGENT REQUEST FOR FIRST X NUMBER OF CHUNKS 388
DOES SELECTED AGENT HAVE INFO. REGARDING REQUESTED CHUNKS AND IS INFO. STILL VALID? 390
YES
NO
IF INFO. STILL VALID, SELECTED AGENT RESPONDS TO CLIENT WITH CHECKSUM OF CHUNK, LIST OF PEERS THAT CONTAIN CHUNKS, AND IF ONLY A PORTION OF INFO., HEADERS 392
LIST OF PEERS FOR EACH CHUNK IS SORTED BY GEOGRAPHICAL PROXIMITY TO REQUESTING CLIENT 394
LIST OF CLOSEST PEERS TO CLIENT IS SENT TO CLIENT 396
SELECTED AGENT SENDS REQUEST DIRECTLY TO SERVER 400
SELECTED AGENT STORES INFO. FROM SERVER IN ITS DATABASE 402
SELECTED AGENT PREPARES RESPONSE (LIST) FOR CLIENT, WHERE RESPONSE INCLUDES CHECKSUM OF CHUNK, HEADERS, AND PROVIDES ITSELF AS THE ONLY PEER FOR THESE CHUNKS 404
LIST IS FORWARDED BACK TO CLIENT 406

FIG. 10

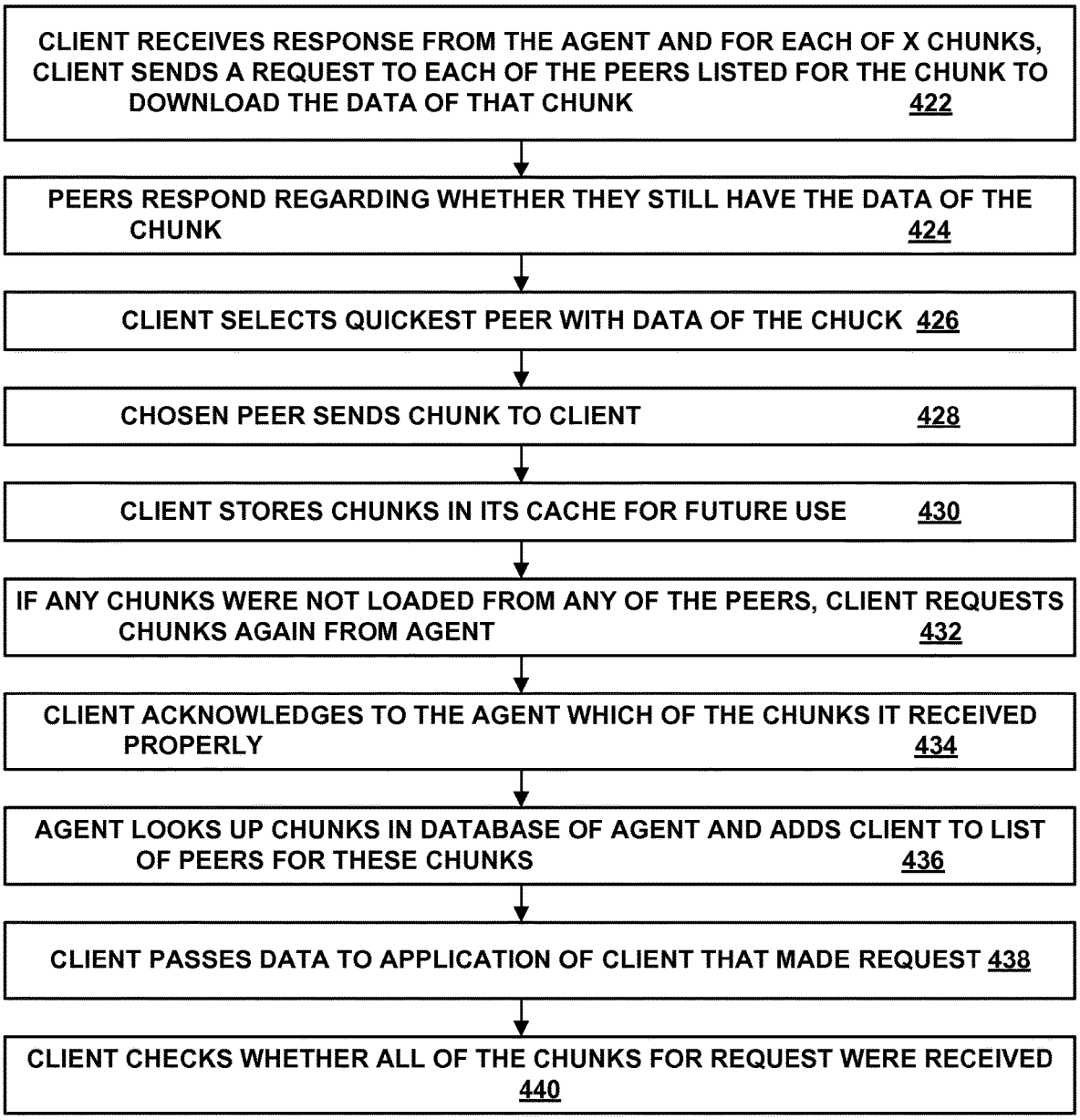
CLIENT RECEIVES RESPONSE FROM THE AGENT AND FOR EACH OF X CHUNKS, CLIENT SENDS A REQUEST TO EACH OF THE PEERS LISTED FOR THE CHUNK TO DOWNLOAD THE DATA OF THAT CHUNK 422
PEERS RESPOND REGARDING WHETHER THEY STILL HAVE THE DATA OF THE CHUNK 424
CLIENT SELECTS QUICKEST PEER WITH DATA OF THE CHUCK 426
CHOSEN PEER SENDS CHUNK TO CLIENT 428
CLIENT STORES CHUNKS IN ITS CACHE FOR FUTURE USE 430
IF ANY CHUNKS WERE NOT LOADED FROM ANY OF THE PEERS, CLIENT REQUESTS CHUNKS AGAIN FROM AGENT 432
CLIENT ACKNOWLEDGES TO THE AGENT WHICH OF THE CHUNKS IT RECEIVED PROPERLY 434
AGENT LOOKS UP CHUNKS IN DATABASE OF AGENT AND ADDS CLIENT TO LIST OF PEERS FOR THESE CHUNKS 436
CLIENT PASSES DATA TO APPLICATION OF CLIENT THAT MADE REQUEST 438
CLIENT CHECKS WHETHER ALL OF THE CHUNKS FOR REQUEST WERE RECEIVED 440

FIG. 11

420

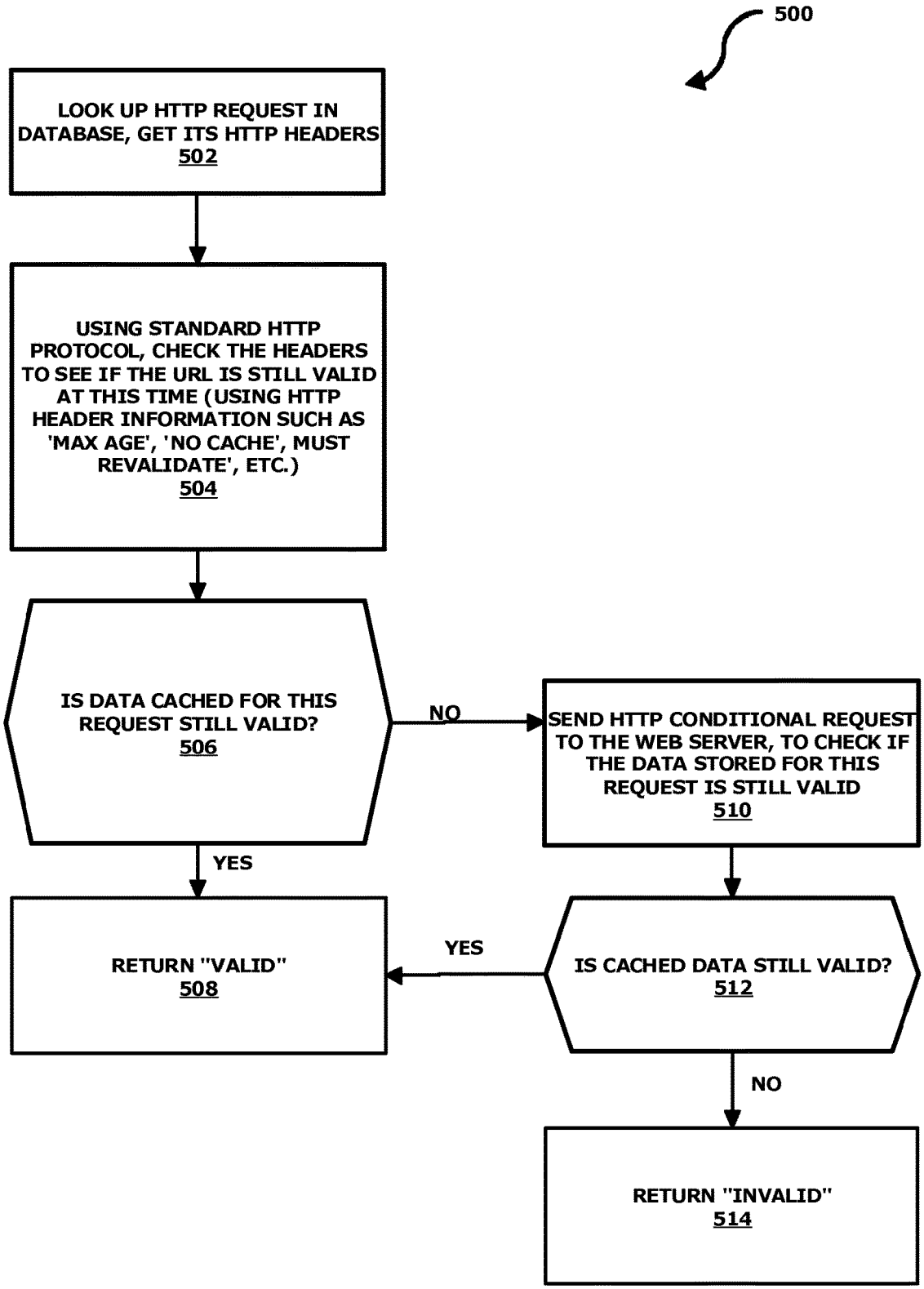
500
LOOK UP HTTP REQUEST IN DATABASE, GET ITS HTTP HEADERS
502
USING STANDARD HTTP PROTOCOL, CHECK THE HEADERS TO SEE IF THE URL IS STILL VALID AT THIS TIME (USING HTTP HEADER INFORMATION SUCH AS 'MAX AGE', 'NO CACHE', MUST REVALIDATE', ETC.)
504
IS DATA CACHED FOR THIS REQUEST STILL VALID?
506
NO
SEND HTTP CONDITIONAL REQUEST TO THE WEB SERVER, TO CHECK IF THE DATA STORED FOR THIS REQUEST IS STILL VALID
510
YES
RETURN "VALID"
508
YES
IS CACHED DATA STILL VALID?
512
NO
RETURN "INVALID"
514

FIG. 12

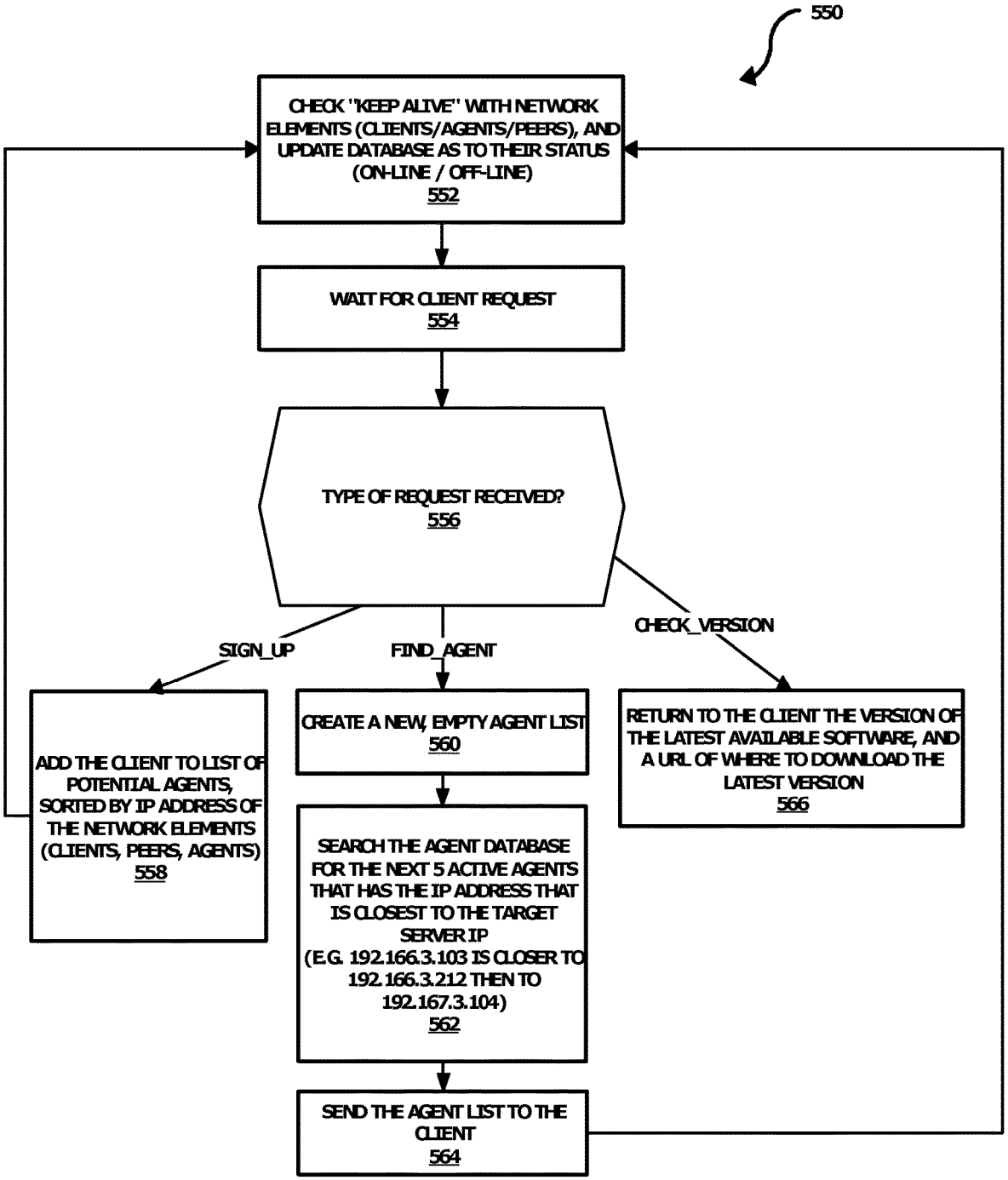
550
CHECK "KEEP ALIVE" WITH NETWORK ELEMENTS (CLIENTS/AGENTS/PEERS), AND UPDATE DATABASE AS TO THEIR STATUS (ON-LINE / OFF-LINE)
552
WAIT FOR CLIENT REQUEST
554
TYPE OF REQUEST RECEIVED?
556
SIGN_UP
FIND_AGENT
CHECK_VERSION
ADD THE CLIENT TO LIST OF POTENTIAL AGENTS, SORTED BY IP ADDRESS OF THE NETWORK ELEMENTS (CLIENTS, PEERS, AGENTS)
558
CREATE A NEW, EMPTY AGENT LIST
560
SEARCH THE AGENT DATABASE FOR THE NEXT 5 ACTIVE AGENTS THAT HAS THE IP ADDRESS THAT IS CLOSEST TO THE TARGET SERVER IP (E.G. 192.166.3.103 IS CLOSER TO 192.166.3.212 THEN TO 192.167.3.104)
562
SEND THE AGENT LIST TO THE CLIENT
564
RETURN TO THE CLIENT THE VERSION OF THE LATEST AVAILABLE SOFTWARE, AND A URL OF WHERE TO DOWNLOAD THE LATEST VERSION
566

FIG. 13

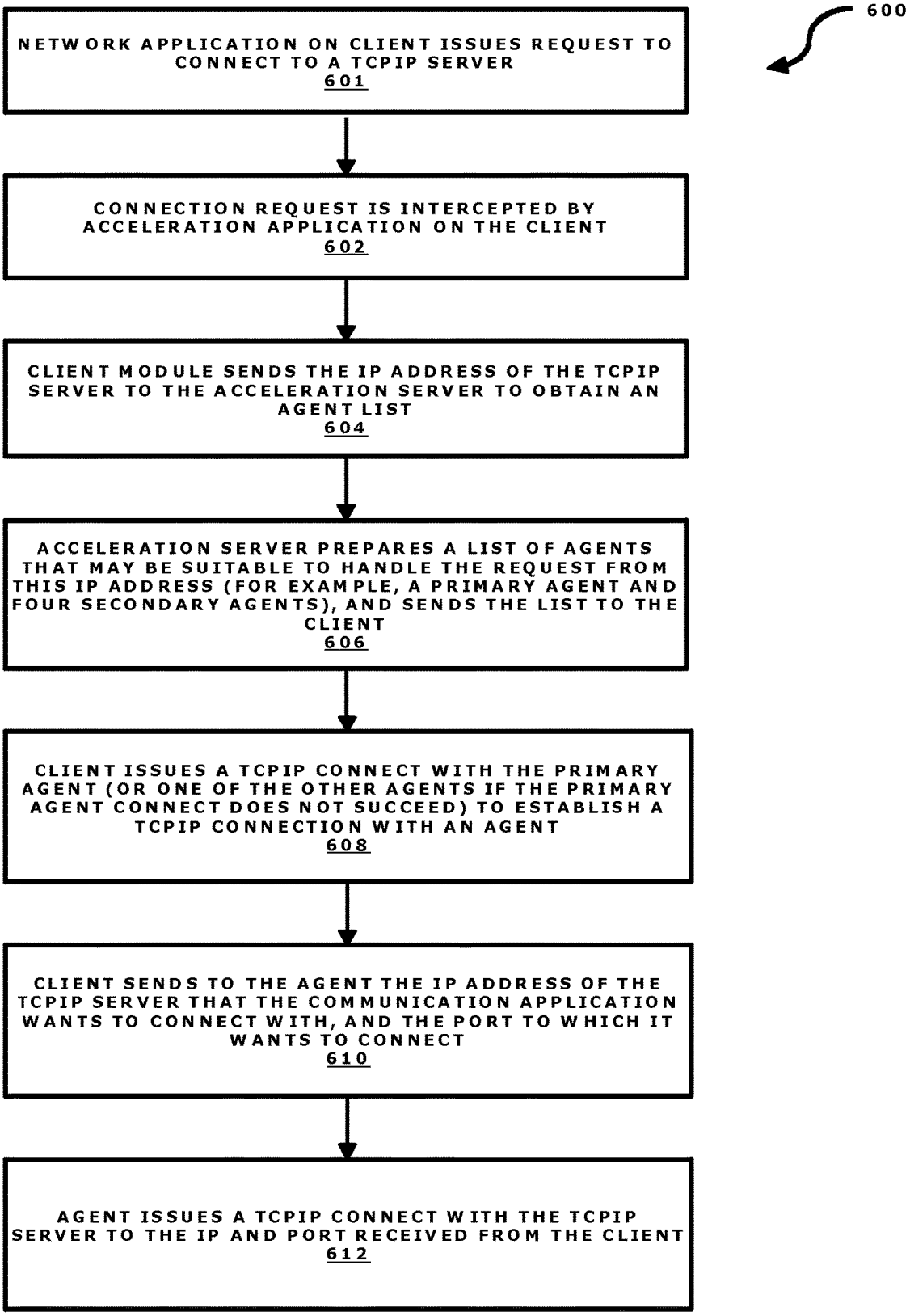
600
NETWORK APPLICATION ON CLIENT ISSUES REQUEST TO CONNECT TO A TCPIP SERVER
601
CONNECTION REQUEST IS INTERCEPTED BY ACCELERATION APPLICATION ON THE CLIENT
602
CLIENT MODULE SENDS THE IP ADDRESS OF THE TCPIP SERVER TO THE ACCELERATION SERVER TO OBTAIN AN AGENT LIST
604
ACCELERATION SERVER PREPARES A LIST OF AGENTS THAT MAY BE SUITABLE TO HANDLE THE REQUEST FROM THIS IP ADDRESS (FOR EXAMPLE, A PRIMARY AGENT AND FOUR SECONDARY AGENTS), AND SENDS THE LIST TO THE CLIENT
606
CLIENT ISSUES A TCPIP CONNECT WITH THE PRIMARY AGENT (OR ONE OF THE OTHER AGENTS IF THE PRIMARY AGENT CONNECT DOES NOT SUCCEED) TO ESTABLISH A TCPIP CONNECTION WITH AN AGENT
608
CLIENT SENDS TO THE AGENT THE IP ADDRESS OF THE TCPIP SERVER THAT THE COMMUNICATION APPLICATION WANTS TO CONNECT WITH, AND THE PORT TO WHICH IT WANTS TO CONNECT
610
AGENT ISSUES A TCPIP CONNECT WITH THE TCPIP SERVER TO THE IP AND PORT RECEIVED FROM THE CLIENT
612

FIG. 14

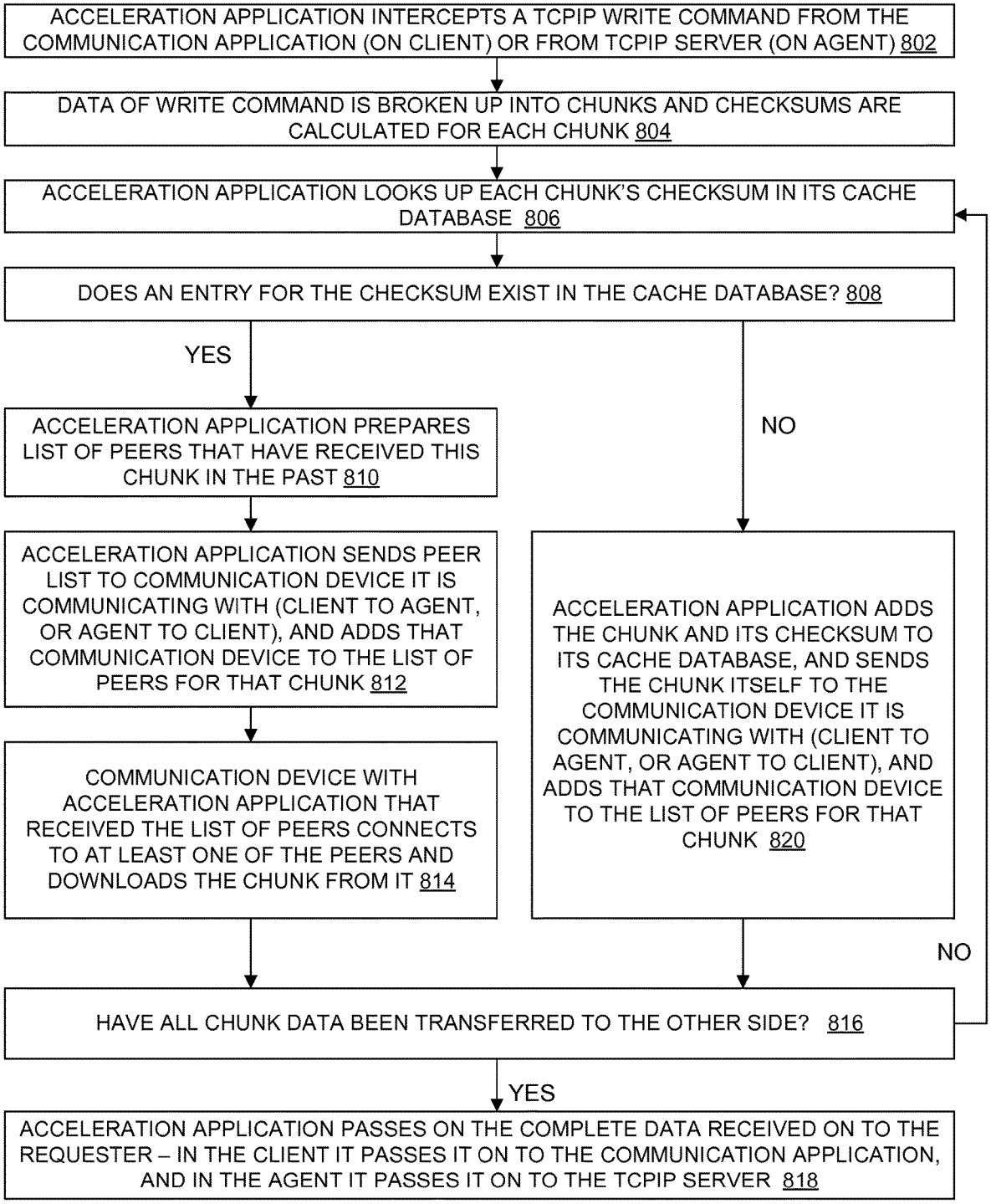
ACCELERATION APPLICATION INTERCEPTS A TCPIP WRITE COMMAND FROM THE COMMUNICATION APPLICATION (ON CLIENT) OR FROM TCPIP SERVER (ON AGENT) 802
DATA OF WRITE COMMAND IS BROKEN UP INTO CHUNKS AND CHECKSUMS ARE CALCULATED FOR EACH CHUNK 804
ACCELERATION APPLICATION LOOKS UP EACH CHUNK'S CHECKSUM IN ITS CACHE DATABASE 806
DOES AN ENTRY FOR THE CHECKSUM EXIST IN THE CACHE DATABASE? 808
YES
NO
ACCELERATION APPLICATION PREPARES LIST OF PEERS THAT HAVE RECEIVED THIS CHUNK IN THE PAST 810
ACCELERATION APPLICATION SENDS PEER LIST TO COMMUNICATION DEVICE IT IS COMMUNICATING WITH (CLIENT TO AGENT, OR AGENT TO CLIENT), AND ADDS THAT COMMUNICATION DEVICE TO THE LIST OF PEERS FOR THAT CHUNK 812
COMMUNICATION DEVICE WITH ACCELERATION APPLICATION THAT RECEIVED THE LIST OF PEERS CONNECTS TO AT LEAST ONE OF THE PEERS AND DOWNLOADS THE CHUNK FROM IT 814
ACCELERATION APPLICATION ADDS THE CHUNK AND ITS CHECKSUM TO ITS CACHE DATABASE, AND SENDS THE CHUNK ITSELF TO THE COMMUNICATION DEVICE IT IS COMMUNICATING WITH (CLIENT TO AGENT, OR AGENT TO CLIENT), AND ADDS THAT COMMUNICATION DEVICE TO THE LIST OF PEERS FOR THAT CHUNK 820
NO
HAVE ALL CHUNK DATA BEEN TRANSFERRED TO THE OTHER SIDE? 816
YES
ACCELERATION APPLICATION PASSES ON THE COMPLETE DATA RECEIVED ON TO THE REQUESTER – IN THE CLIENT IT PASSES IT ON TO THE COMMUNICATION APPLICATION, AND IN THE AGENT IT PASSES IT ON TO THE TCPIP SERVER 818
800

FIG. 15

SYSTEM PROVIDING FASTER AND MORE EFFICIENT DATA COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation application of U.S. non-provisional patent application Ser. No. 14/025,109, filed Sep. 12, 2013, which is a divisional application of U.S. non-provisional patent application entitled "SYSTEM AND METHOD FOR PROVIDING FASTER AND MORE EFFICIENT DATA COMMUNICATION" having Ser. No. 12/836,059, filed Jul. 14, 2010 and issued as U.S. Pat. No. 8,560,604 on Oct. 15, 2013, and claims priority to U.S. provisional patent application entitled "SYSTEM AND METHOD FOR REDUCING INTERNET CONGESTION," having Ser. No. 61/249,624, filed Oct. 8, 2009, which are hereby incorporated herein by reference in their entirety.

FIELD OF THE INVENTION

The present invention is related to Internet communication, and more particularly, to improving data communication speed and bandwidth efficiency on the Internet.

BACKGROUND OF THE INVENTION

There are several trends in network and Internet usage, which tremendously increase the bandwidth that is being used on the Internet. One such trend is that more and more video is being viewed on demand on the Internet. Such viewing includes the viewing of both large and short video clips. In addition, regular shows and full-featured films may be viewed on the Internet. Another trend that is increasing the traffic on the Internet is that Web sites (such as shopping portals, news portals, and social networks) are becoming global, meaning that the Web sites are serving people in many diverse places on the globe, and thus the data is traversing over longer stretches of the Internet, increasing the congestion.

The increase in bandwidth consumption has created several major problems, a few of which are described below:

The problem for users—the current Internet bandwidth is not sufficient, and thus the effective 'speed' experienced by users is slow;

The problem for content owners—the tremendous amount of data being viewed by users is costing large amounts of money in hosting and bandwidth costs; and

The problem for Internet Service Providers (ISPs)—the growth in Internet traffic is requiring the ISPs to increase the infrastructure costs (communication lines, routers, etc.) at tremendous financial expense.

The need for a new method of data transfer that is fast for the consumer, cheap for the content distributor and does not require infrastructure investment for ISPs, has become a major issue which is yet unsolved.

There have been many attempts at making the Internet faster for the consumer and cheaper for the broadcaster. Each such attempt is lacking in some aspect to become a widespread, practical solution, or is a partial solution in that it solves only a subset of the major problems associated with the increase in Internet traffic. Most of the previous solutions require billions of dollars in capital investment for a comprehensive solution. Many of these attempts are lacking in that much of the content on the Internet has become dynamically created per the user and the session of the user (this is

what used to be called the "Web2.0" trend). This may be seen on the Amazon Web site and the Salesforce Web site, for example, where most of the page views on these Web sites is tailored to the viewer, and is thus different for any two viewers. This dynamic information makes it impossible for most of the solutions offered to date to store the content and provide it to others seeking similar content.

One solution that has been in use is called a "proxy". FIG. **1** is a schematic diagram providing an example of use of a proxy within a network **2**. A proxy, or proxy server **4**, **6**, **8** is a device that is placed between one or more clients, illustrated in FIG. **1** as client devices **10**, **12**, **14**, **16**, **18**, **20**, that request data, via the Internet **22**, and a Web server or Web servers **30**, **32**, **34** from which they are requesting the data. The proxy server **4**, **6**, **8** requests the data from the Web servers **30**, **32**, **34** on their behalf, and caches the responses from the Web servers **30**, **32**, **34**, to provide to other client devices that make similar requests. If the proxy server **4**, **6**, **8** is geographically close enough to the client devices **10**, **12**, **14**, **16**, **18**, **20**, and if the storage and bandwidth of the proxy server **4**, **6**, **8** are large enough, the proxy server **4**, **6**, **8** will speed up the requests for the client devices **10**, **12**, **14**, **16**, **18**, **20** that it is serving.

It should be noted, however, that to provide a comprehensive solution for Internet surfing, the proxy servers of FIG. **1** would need to be deployed at every point around the world where the Internet is being consumed, and the storage size of the proxy servers at each location would need to be near the size of all the data stored anywhere on the Internet. The abovementioned would lead to massive costs that are impractical. In addition, these proxy solutions cannot deal well with dynamic data that is prevalent now on the Web.

There have been commercial companies, such as Akamai, that have deployed such proxies locally around the world, and that are serving a select small group of sites on the Internet. If all sites on the Web were to be solved with such a solution, the capital investment would be in the range of billions of dollars. In addition, this type of solution does not handle dynamic content.

To create large distribution systems without the large hardware costs involved with a proxy solution, "peer-to-peer file sharing" solutions have been introduced, such as, for example, BitTorrent. FIG. **2** is a schematic diagram providing an example of a peer-to-peer file transfer network **50**. In the network **50**, files are stored on computers of consumers, referred to herein as client devices **60**. Each consumer can serve up data to other consumers, via the Internet **62**, thus taking the load of serving off of the distributors and saving them the associated costs, and providing the consumer multiple points from which to download the data, referred to herein as peers **70**, **72**, **74**, **76**, **78**, thus increasing the speed of the download. However, each such peer-to-peer solution must have some sort of index by which to find the required data. In typical peer-to-peer file sharing systems, because the index is on a server **80**, or distributed among several servers, the number of files available in the system is not very large (otherwise, the server costs would be very large, or the lookup time would be very long).

The peer-to-peer file sharing solution is acceptable in file sharing systems, because there are not that many media files that are of interest to the mass (probably in the order of magnitude of millions of movies and songs that are of interest). Storing and maintaining an index of millions of entries is practical technically and economically. However, if this system were to be used to serve the hundreds of billions of files that are available on the Internet of today, the cost of storing and maintaining such an index would be

again in the billions of dollars. In addition, these types of peer-to-peer file sharing systems are not able to deal with dynamic HTTP data.

In conclusion, a system does not exist that enables fast transmission of most of the data on the Internet, that does not incur tremendous costs, and/or that provides only a very partial solution to the problem of Internet traffic congestion. Thus, a heretofore unaddressed need exists in the industry to address the aforementioned deficiencies and inadequacies.

SUMMARY OF THE INVENTION

The present system and method provides for faster and more efficient data communication within a communication network. Briefly described, in architecture, one embodiment of the system, among others, can be implemented as follows. A network is provided for accelerating data communication, wherein the network contains: at least one client communication device for originating a data request for obtaining the data from a data server; at least one agent communication device which is assigned to the data server for receiving the data request from the client communication device, wherein the agent keeps track of which client communication devices have received responses to data requests from the assigned data server; at least one peer communication device for storing portions of data received in response to the data request by the at least one client communication device, wherein the portions of data may be transmitted to the at least one client communication device upon request by the client communication device; and at least one acceleration server for deciding which agent communication device is to be assigned to which data server and providing this information to the at least one client communication device.

The present system and method also provides a communication device within a network, wherein the communication device contains: a memory; and a processor configured by the memory to perform the steps of: originating a data request for obtaining data from a data server; being assigned to a data server, referred to as an assigned data server; receiving a data request from a separate device within the network, and keeping track of which client communication devices within the network have received responses to data requests from the assigned data server; and storing portions of data received in response to the originated data request, wherein the portions of data may be transmitted to communication device upon request by the communication device.

Other systems, methods, features, and advantages of the present invention will be or become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features, and advantages be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Many aspects of the invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a schematic diagram providing a prior art example of use of a proxy within a network.

FIG. **2** is a schematic diagram providing a prior art example of a peer-to-peer file transfer network.

FIG. **3** is a schematic diagram providing an example of a communication network in accordance with the present invention.

FIG. **4** is a schematic diagram further illustrating a communication device of the communication network of FIG. **3**.

FIG. **5** is a schematic diagram further illustrating the memory of FIG. **4**.

FIG. **6** is a schematic diagram further illustrating elements of the acceleration application of FIG. **5**, as well as communication paths of the acceleration application.

FIG. **7** is a chart further illustrating two of the main databases utilized within the communication network.

FIG. **8** is a flowchart illustrating operation of the acceleration system initializer module.

FIG. **9** is a flowchart further illustrating communication between different elements of the communication network.

FIG. **10** is a flowchart continuing the flowchart of FIG. **9** and focused on agent response to the HTTP request.

FIG. **11** is a flowchart continuing the flowchart of FIG. **10**, which illustrates actions taken upon receipt of the list of peers, or single peer listing, from the agent.

FIG. **12** is a flowchart illustrating steps taken by an agent, client, or peer to determine whether a certain HTTP request is still valid.

FIG. **13** is a flowchart outlining operation of the acceleration server.

FIG. **14** is a flowchart further illustrating TCPIP acceleration in accordance with an alternative embodiment of the invention.

FIG. **15** is a flowchart further illustrating TCPIP acceleration in accordance with an alternative embodiment of the invention, detailing the communication between the client and the TCPIP server (read and write commands) after the connect phase has completed successfully.

DETAILED DESCRIPTION

The present system and method provides for faster and more efficient data communication within a communication network. An example of such a communication network **100** is provided by the schematic diagram of FIG. **3**. The network **100** of FIG. **3** contains multiple communication devices. Due to functionality provided by software stored within each communication device, which may be the same in each communication device, each communication device may serve as a client, peer, or agent, depending upon requirements of the network **100**, as is described in detail herein. It should be noted that a detailed description of a communication device is provided with regard to the description of FIG. **4**.

Returning to FIG. **3**, the exemplary embodiment of the network **100** illustrates that one of the communication devices is functioning as a client **102**. The client **102** is capable of communication with one or more peers **112**, **114**, **116** and one or more agents **122**. For exemplary purposes, the network contains three peers and one agent, although it is noted that a client can communicate with any number of agents and peers.

The communication network **100** also contains a Web server **152**. The Web server **152** is the server from which the client **102** is requesting information and may be, for example, a typical HTTP server, such as those being used to deliver content on any of the many such servers on the Internet. It should be noted that the server **152** is not limited

to being an HTTP server. In fact, if a different communication protocol is used within the communication network, the server may be a server capable of handling a different protocol. It should also be noted that while the present description refers to the use of HTTP, the present invention may relate to any other communication protocol and HTTP is not intended to be a limitation to the present invention.

The communication network **100** further contains an acceleration server **162** having an acceleration server storage device **164**. As is described in more detail herein, the acceleration server storage device **164** has contained therein an acceleration server database. The acceleration server database stores Internet protocol (IP) addresses of communication devices within the communication network **100** having acceleration software stored therein. Specifically, the acceleration server database contains stored therein a list of communication devices having acceleration software stored therein that are currently online within the communication network **100**. For each such agent, the acceleration server assigns a list of IP addresses.

In the communication network **100** of FIG. **3**, the application in the client **102** is requesting information from the Web server **152**, which is why the software within the communication device designated this communication device to work as a client. In addition, since the agent **122** receives the request from the client **102** as the communication device closest to the Web server **152**, functionality of the agent **122**, as provided by the software of the agent **122**, designates this communication device to work as an agent. It should be noted, that in accordance with an alternative embodiment of the invention, the agent need not be the communication device that is closest to the Web server. Instead, a different communication device may be selected to be the agent.

Since the peers **112**, **114**, **116** contain at least portions of the information sought by the client **102** from the Web server **152**, functionality of the peers **112**, **114**, **116**, as provided by the software of the peers **112**, **114**, **116**, designates these communication devices to work as peers. It should be noted that the process of designating clients, agents, and peers is described in detail herein. It should also be noted that the number of clients, agents, peers, acceleration servers, Web servers, and other components of the communication network **100** may differ from the number illustrated by FIG. **3**. In fact, the number of clients, agents, peers, acceleration servers, Web servers, and other components of the communication network **100** are not intended to be limited by the current description.

Prior to describing functionality performed within a communication network **100**, the following further describes a communication device **200**, in accordance with a first exemplary embodiment of the invention. FIG. **4** is a schematic diagram further illustrating a communication device **200** of the communication network **100**, which contains general components of a computer. As previously mentioned, it should be noted that the communication device **200** of FIG. **4** may serve as a client, agent, or peer.

Generally, in terms of hardware architecture, as shown in FIG. **4**, the communication device **200** includes a processor **202**, memory **210**, at least one storage device **208**, and one or more input and/or output (I/O) devices **240** (or peripherals) that are communicatively coupled via a local interface **250**. The local interface **250** can be, for example but not limited to, one or more buses or other wired or wireless connections, as is known in the art. The local interface **250** may have additional elements, which are omitted for simplicity, such as controllers, buffers (caches), drivers, repeaters, and receivers, to enable communications. Further, the local interface **250** may include address, control, and/or data connections to enable appropriate communications among the aforementioned components.

The processor **202** is a hardware device for executing software, particularly that stored in the memory **210**. The processor **52** can be any custom made or commercially available processor, a central processing unit (CPU), an auxiliary processor among several processors associated with the communication device **200**, a semiconductor based microprocessor (in the form of a microchip or chip set), a macroprocessor, or generally any device for executing software instructions.

The memory **210**, which is further illustrated and described by the description of FIG. **5**, can include any one or combination of volatile memory elements (e.g., random access memory (RAM, such as DRAM, SRAM, SDRAM, etc.)) and nonvolatile memory elements (e.g., ROM, hard drive, tape, CDROM, etc.). Moreover, the memory **210** may incorporate electronic, magnetic, optical, and/or other types of storage media. Note that the memory **210** can have a distributed architecture, where various components are situated remote from one another, but can be accessed by the processor **202**.

The software **212** located within the memory **210** may include one or more separate programs, each of which contains an ordered listing of executable instructions for implementing logical functions of the communication device **200**, as described below. In the example of FIG. **4**, the software **212** in the memory **210** at least contains an acceleration application **220** and an Internet browser **214**. In addition, the memory **210** may contain an operating system (O/S) **230**. The operating system **230** essentially controls the execution of computer programs and provides scheduling, input-output control, file and data management, memory management, and communication control and related services. It should be noted that, in addition to the acceleration application **220**, Internet browser **214**, and operating system **230**, the memory **210** may contain other software applications.

While the present description refers to a request from the client originating from an Internet browser, the present invention is not limited to requests originating from Internet browsers. Instead, a request may originate from an email program or any other program that would be used to request data that is stored on a Web server, or other server holding data that is requested by the client device.

Functionality of the communication device **200** may be provided by a source program, executable program (object code), script, or any other entity containing a set of instructions to be performed. When a source program, then the program needs to be translated via a compiler, assembler, interpreter, or the like, which may or may not be included within the memory **210**, so as to operate properly in connection with the operating system **230**. Furthermore, functionality of the communication device **200** can be written as (a) an object oriented programming language, which has classes of data and methods, or (b) a procedure programming language, which has routines, subroutines, and/or functions.

The I/O devices **240** may include input devices, for example but not limited to, a keyboard, mouse, scanner, microphone, etc. Furthermore, the I/O devices **240** may also include output devices, for example but not limited to, a printer, display, etc. Finally, the I/O devices **240** may further include devices that communicate via both inputs and outputs, for instance but not limited to, a modulator/demodu-

lator (modem; for accessing another device, system, or network), a radio frequency (RF) or other transceiver, a telephonic interface, a bridge, a router, etc.

When the communication device **200** is in operation, the processor **202** is configured to execute the software **212** stored within the memory **210**, to communicate data to and from the memory **210**, and to generally control operations of the communication device **200** pursuant to the software **212**. The software **212** and the O/S **230**, in whole or in part, but typically the latter, are read by the processor **202**, perhaps buffered within the processor **202**, and then executed.

When functionality of the communication device **200** is implemented in software, as is shown in FIG. **4**, it should be noted that the functionality can be stored on any computer readable medium for use by or in connection with any computer related system or method. In the context of this document, a computer readable medium is an electronic, magnetic, optical, or other physical device or means that can contain or store a computer program for use by or in connection with a computer related system or method. The functionality of the communication device **200** can be embodied in any computer-readable medium for use by or in connection with an instruction execution system, apparatus, or device, such as a computer-based system, processor-containing system, or other system that can fetch the instructions from the instruction execution system, apparatus, or device and execute the instructions. In the context of this document, a "computer-readable medium" can be any means that can store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device.

The computer readable medium can be, for example but not limited to, an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, device, or propagation medium. More specific examples (a non-exhaustive list) of the computer-readable medium would include the following: an electrical connection (electronic) having one or more wires, a portable computer diskette (magnetic), a random access memory (RAM) (electronic), a read-only memory (ROM) (electronic), an erasable programmable read-only memory (EPROM, EEPROM, or Flash memory) (electronic), an optical fiber (optical), and a portable compact disc read-only memory (CDROM) (optical). Note that the computer-readable medium could even be paper or another suitable medium upon which the program is printed, as the program can be electronically captured, via for instance optical scanning of the paper or other medium, then compiled, interpreted or otherwise processed in a suitable manner if necessary, and then stored in a computer memory.

In an alternative embodiment, where the functionality of the communication device **200** is implemented in hardware, the functionality can be implemented with any or a combination of the following technologies, which are each well known in the art: a discrete logic circuit(s) having logic gates for implementing logic functions upon data signals, an application specific integrated circuit (ASIC) having appropriate combinational logic gates, a programmable gate array (s) (PGA), a field programmable gate array (FPGA), etc.

The at least one storage device **208** of the communication device **200** may be one of many different categories of storage device. As is described in more detail herein, the storage device **208** may include a configuration database **280** and a cache database **282**. Alternatively, the configuration database **280** and cache database **282** may be located on different storage devices that are in communication with the communication device **200**. The description that follows assumes that the configuration database **280** and cache database **282** are located on the same storage device, however, it should be noted that the present invention is not intended to be limited to this configuration.

The configuration database **280** stores configuration data that is common to all elements of the communication network **100** and is used to provide set up and synchronization information to different modules of the acceleration application **220** stored within the memory **210**, as is described in further detail herein. The cache database **282** stores responses to HTTP requests that the communication device **200** has dispatched, either for its own consumption or on behalf of other elements of the communication network **100**. As is explained in additional detail herein, the responses to HTTP requests are stored within the cache database **282** for future use by this communication device **200**, or for other communication devices within the communication network **100** that need to retrieve this information and will use this communication device as either a peer or an agent.

In addition to the abovementioned, as is explained in further detail herein, the cache database **282** has stored therein a list of URLs that the communication device is aware of (i.e., has seen requests for). For each URL, the cache database **282** has stored therein the URL itself, HTTP headers returned by the Web Server for this URL, when the last time was that the contents of this URL was loaded directly from the Web Server, when the contents of the URL had last changed on the Web Server, as well as a list of chunks that contain the contents of this URL, and the chunks of data themselves. Chunks in the present description are defined as equally sized pieces of data that together form the whole content of the URL. It should be noted that while the present description provides for chunks being equally sized pieces of data, in accordance with an alternative embodiment of the invention, the chunks may instead be of different size.

FIG. **5** is a schematic diagram further illustrating the memory **210** of FIG. **4**. As shown by FIG. **5**, the memory **210** may be separated into two basic levels, namely, an operating system level **260** and an application level **270**. The operating system level **260** contains the operating system **230**, wherein the operating system **230** further contains at least one device driver **262** and at least one communication stack **264**. The device drivers **262** are software modules that are responsible for the basic operating commands for various hardware devices of the communication device **200**, such as the processor **202**, the storage device **208** and the I/O devices **240**. In addition, the communication stacks **264** provide applications of the communication device **200** with a means of communicating within the network **100** by implementing various standard communication protocols.

The application level **270** includes any application that is running on the communication device **200**. As a result, the application level **270** includes the Internet browser **214**, which is used to view information that is located on remote Web servers, the acceleration application **220**, as described in more detail below, and any other applications **216** stored on the communication device **200**.

As is explained in additional detail below, the acceleration application **220** intercepts the requests being made by applications of the communication device (client) that use the Internet, in order to modify the requests and route the requests through the communication network. There are various methods that may be used to intercept such requests. One such method is to create an intermediate driver **272**, which is also located within the memory **210**, that attaches

itself to all communication applications, intercepts outgoing requests of the communication applications of the communication device **200**, such as the Internet browser **214**, and routes the requests to the acceleration application **220**. Once the acceleration application **220** modifies the requests, routes the requests to other system elements on the communication network **100**, and receives replies from other system elements of the communication network **100**, the acceleration application **220** returns the replies to the intermediate driver **272**, which provides the replies back to the requesting communication application.

FIG. **6** is a schematic diagram further illustrating elements of the acceleration application **220**, as well as communication paths of the acceleration application **220**. The acceleration application **220** contains an acceleration system initializer module **222**, which is called when the acceleration application **220** is started. The acceleration system initializer module **222** is capable of initializing all elements of the communication device **200** The acceleration application **220** also contains three separate modules that run in parallel, namely, a client module **224**, a peer module **226**, and an agent module **228**, each of which comes into play according to the specific role that the communication device **200** is partaking in the communication network **100** at a given time. The role of each module is further described herein.

The client module **224** provides functionality required when the communication device **200** is requesting information from the Web server **152**, such as, for example, but not limited to, Web pages, data, video, or audio. The client module **224** causes the communication device **200** having the client module **224** therein to intercept the information request and pass the information request on to other elements of the communication network **100**, such as, servers, agents or peers. This process is further described in detail herein.

The peer module **226** provides functionality required by the communication device **200** when answering other clients within the communication network **100** and providing the other clients with information that they request, which this communication device **200**, having this peer module **226** therein, has already downloaded at a separate time. This process is further described in detail herein.

The agent module **228** provides functionality required when other communication devices of the communication network **100** acting as clients query this communication device **200**, having this agent module **228** therein, as an agent, to obtain a list of peers within the communication network **100** that contain requested information. This process is further described in detail herein.

The acceleration application **220** interacts with both the configuration database **280** and the cache database **282** of the storage device **208**. As previously mentioned herein, the configuration database **280** stores configuration data that may be common to all communication devices of the communication network **100** and is used to provide setup and synchronization information to different modules **222**, **224**, **226**, **228** of the acceleration application **220** stored within the memory **210**.

The cache database **282** stores responses to information requests, such as, for example, HTTP requests, that the communication device **200** has dispatched, either for its own consumption or on behalf of other elements of the communication network **100**. The responses to HTTP requests are stored within the cache database **282** for future use by this communication device **200**, or for other communication devices within the communication network **100** that need to retrieve this same information and will use this communication device **200** as either a peer or an agent. This process is described in detail herein.

Information stored within the cache database **282** may include any information associated with a request sent by the client. As an example, such information may include, metadata and actual requested data. For example, for an HTTP request for a video, the metadata may include the version of the Web server answering the request from the client and the data would be the requested video itself. In a situation where there is no more room for storage in the cache database, the software of the associated communication device may cause the communication device to erase previous data stored in order to clear room for the new data to store in the cache database. As an example, such previous data may include data that is most likely not to be used again. Such data may be old data or data that is known to no longer be valid. The communication device may choose to erase the least relevant data, according to any of several methods that are well known in the art.

FIG. **7** is a chart further illustrating two of the main databases utilized within the communication network **100**, namely, the acceleration server database **164** and the cache database **282**. As previously mentioned, the acceleration server database **164** stores IP addresses of communication devices located within the communication network **100**, which have acceleration software stored therein. Specifically, the acceleration server database **164** contains stored therein a list of communication devices having acceleration software stored therein that are currently online within the communication network **100**. The acceleration server assigns a list of IP addresses to each communication device functioning as an agent. Each communication device will be the agent for any Web servers whose IP address is in the range 'owned' by that communication device. As an example, when a first ever communication device goes online, namely, the first communication device as described herein having the acceleration application **220** therein, the acceleration server assigns all IP addresses in the world to this communication device, and this communication device will be the agent for any Web server. When a second communication device goes online it will share the IP address list with the first communication device, so that each of the communication devices will be responsible for a different part of the world wide web servers.

The cache database **282** of the communication device **200** has stored therein a list of URLs **286** of which the communication device **200** is aware. The communication device **200** becomes aware of a URL each time that the communication device **200** receives a request for information located at a specific URL. As shown by FIG. **7**, for each URL **288** within the list of URLs **286**, the cache database **282** stores: the URL itself **290**; HTTP headers **292** returned by the Web Server **152** for this URL; when the last time **294** was that the contents of this URL were loaded directly from the Web Server **152**; when the contents of the URL last changed **296** on the Web Server **152**; and a list of chunks **298** that contain the contents of this URL, and the content of the chunk. As previously mentioned, chunks, in the present description, are defined as equally sized pieces of data that together form the entire content of the URL, namely, the entire content whose location is described by the URL. As a non-limiting example, a chunk size of, for example, 16 KB can be used, so that any HTTP response will be split up into chunks of 16 KB. In accordance with an alternative embodiment of the invention, if the last chunk of the response is not

large enough to fill the designated chunk size, such as 16 KB for the present example, the remaining portion of the chunk will be left empty.

For each such chunk **300**, the cache database **282** includes the checksum of the chunk **302**, the data of the chunk **304** itself, and a list of peers **306** that most likely have the data for this chunk. As is described in additional detail herein, the data for the chunk may be used by other clients within the communication network **100** when other communication devices of the communication network **100** serve as peers to the clients, from which to download the chunk data.

For each chunk, a checksum is calculated and stored along side of the chunk itself. The checksum may be calculated in any of numerous ways known to those in the art. The purpose of having the checksum is to be able to identify data uniquely, whereas the checksum is the "key" to the data, where the data is the chunk. As an example, a client may want to load the contents of a URL, resulting in the agent that is servicing this request sending the checksums of the chunks to the client, along with the peers that store these chunks. It is to be noted that there could be a different peer for every different chunk. The client then communicates with each such peer, and provides the checksum of the chunk that it would like the peer to transmit back to the client. The peer looks up the checksum (the key) in its cache database, and provides back the chunk (data) that corresponds to this checksum (the key). As shown by FIG. **7**, for each peer **308** within the list of peers **306**, the cache database **282** includes the peer IP address **310**, as well as the connection status **312** of the peer, which represents whether the peer **308** is online or not.

In accordance with one embodiment of the invention, the cache database **282** may be indexed by URL and by Checksum. Having the cache database indexed in this manner is beneficial due to the following reason. When the agent is using the cache database, the agent receives a request from a client for the URL that the client is looking for. In such a case the agent needs the cache database to be indexed by the URL, to assist in finding a list of corresponding peers that have the chunks of this URL. When the peers are using this cache database, the peers obtain a request from the client for a particular checksum, and the peers need the database to be indexed by the checksum so that they can quickly find the correct chunk. Of course, as would be understood by one having ordinary skill in the art, the cache database may instead be indexed in any other manner.

Having described components of the communication network **100**, the following further describes how such components interact and individually function. FIG. **8** is a flowchart **300** illustrating operation of the acceleration system initializer module **222** (hereafter referred to as the initializer **222** for purposes of brevity). It should be noted that any process descriptions or blocks in flowcharts should be understood as representing modules, segments, portions of code, or steps that include one or more instructions for implementing specific logical functions in the process, and alternative implementations are included within the scope of the present invention in which functions may be executed out of order from that shown or discussed, including substantially concurrently or in reverse order, depending on the functionality involved, as would be understood by those reasonably skilled in the art of the present invention.

The initializer **222** is the first element of the communication device **200** to operate as the communication device **200** starts up (block **302**). As the initializer **222** starts, it first communicates with the acceleration server **162** to sign up with the acceleration server **162**. This is performed by providing the acceleration server **162** with the hostname, and all IP addresses and media access control (MAC) addresses of the interfaces on the communication device **200** having the initializer **222** thereon.

In accordance with an alternative embodiment of the invention, as shown by block **304**, the initializer **222** checks with the acceleration server **162** whether a more updated version of the acceleration application software is available. This may be performed by any one of many known methods, such as, but not limited to, by providing the version number of the acceleration application software to the acceleration server **162**. The message received back from the acceleration server **162** indicates whether there is a newer version of the acceleration application software or not. If a newer version of the acceleration application software exists, the initializer **222** downloads the latest version of the acceleration application software from the acceleration server **162**, or from a different location, and installs the latest version on the communication device **200**. In addition to the abovementioned, the initializer **222** may also schedule additional version checks for every set period of time thereafter. As an example, the initializer **222** may check for system updates every two days.

As shown by block **306**, the initializer **222** then redirects outgoing network traffic from the communication device **200** to flow through the acceleration application **162**. As previously mentioned, one way to redirect the outgoing network traffic is to insert an intermediate driver **212** that intercepts and redirects the traffic. It should be noted that there are many other ways to implement this redirection, which are well known to those having ordinary skill in the art.

As shown by block **308**, the initializer **222** then launches the client module **224** of the communication device **200**, and configures the client module **224** of the communication device **200** to intercept to all outgoing network communications of the communication device **200** and route the outgoing network communications to the client module **224**, from the intermediate driver **272** or other routing method implemented. This is performed so that the client module **224** is able to receive all network traffic coming from the network applications, modify the network traffic if necessary, and re-route the traffic. As is known by those having ordinary skill in the art, in order to re-route the traffic, the traffic needs to be modified, as an example, to change the destination of requests.

As shown by block **310**, the initializer **222** then launches the agent module **228** and the peer module **226** to run on the communication device **200**. The agent module **228** and peer module **226** listen on pre-determined ports of the communication device **200**, so that incoming network traffic on these ports gets routed to the agent module **228** and peer module **226**. As is explained in further detail herein, the abovementioned enables the communication device **200** to function as an agent and as a peer for other communication devices within the communication network **100**, as needed.

FIG. **9** is a flowchart **350** further illustrating communication between different elements of the communication network **100**, in accordance with the present system and method for providing faster and more efficient data communication.

As shown by block **352**, an application running on the client **200** initiates a request for a resource on a network. Such a request may be, for example, "GET http://www.aol-.com/index.html HTTP/1.1". The request may come from an Internet browser **214** located on the client **200**, where the Internet browser **214** is loading a page from the Internet, an

application that wants to download information from the Internet, fetch or send email, or any other network communication request.

Through the intermediate driver **272**, or other such mechanism as may be implemented that is re-routing the communication to the client module **224** of the client **200**, the resource request is intercepted by the client module **224** that is running on the client **200** (block **354**). The client module **224** then looks up the IP address of the server **152** that is the target of the resource request (e.g., the IP address of the Web server that is the host of www.aol.com in the example above), and sends this IP address to the acceleration server **162** (block **356**) in order to obtain a list of communication devices that the client **200** can use as agents (hereafter referred to as agents). It should be noted that the process of performing an IP lookup for a server is known by one having ordinary skill in the art, and therefore is not described further herein.

In response to receiving the IP address of the server **152**, the acceleration server **162** prepares a list of agents that may be suitable to handle the request from this IP address (block **358**). The size of the list can differ based on implementation. For exemplary purposes, the following provides an example where a list of five agents is prepared by the acceleration server **162**. The list of agents is created by the acceleration server **162** by finding the communication devices of the communication network **100** that are currently online, and whose IP address is numerically close to the IP of the destination Web server **152**. A further description of the abovementioned process is described here in.

As shown by block **360**, the client module **224** then sends the original request (e.g., "GET http://www.aol.com/index-.html HTTP/1.1") to all the agents in the list received from the acceleration server **162** in order to find out which of the agents in the list is best suited to be the one agent that will assist with this request.

It should be noted that, in accordance with an alternative embodiment of the invention, the communication device **200** may be connected to a device that is actually requesting data. In such an alternative embodiment, the communication device would be a modular device connected to a requesting device, where the requesting device, such as, for example, a personal data assistant (PDA) or other device, would request data, and the communication device connected thereto, either through a physical connection, wireless connection, or any other connection, would receive the data request and function as described herein. In addition, as previously mentioned, it should be noted that the HTTP request may be replaced by any request for resources on the Web.

FIG. **10** is a flowchart continuing the flowchart **380** of FIG. **9** and focused on agent response to the request. As shown by block **382**, upon receiving the request from the client **200**, each agent that received the request from the client responds to the client **200** with whether it has information regarding the request, which can help the client to download the requested information from peers in the network. Specifically, each agent responds with whether the agent has seen a previous request for this resource that has been fulfilled. In such a case, the agent may then provide the client with the list of peers and checksums of the chunks that each of them have.

As shown by block **384**, the client then decides which of the agents in the list to use as its agent for this particular information request. To determine which agent in the list to use as its agent for the particular information request, the client may consider multiple factors, such as, for example, factoring the speed of the reply by each agent and whether that agent does or does not have the information required. There are multiple ways to implement this agent selection, one practical way being to start a timer of a small window of time, such as, for example, 5 ms, after receiving the first response from the agents, and after the small window, choosing from the list of agents that responded, the agent that has the information about the request, or in the case that none of the agents responded, to choose the first agent from the list received from the acceleration server **162**.

As shown by block **386**, after selecting an agent, the client notifies the selected agent that it is going to use it for this request, and notifies the other agents that they will not be used for this request. The client then sends the selected agent a request for the first five chunks of data of the original information request (block **388**). By specifying to the selected agent the requested chunks by their order in the full response, the client receives the peer list and checksums of the requested chunks from the selected agent. As an example, for the first five chunks the client will ask the selected agent for chunks one through five, and for the fourth batch of five chunks the client will ask the agent for chunks sixteen through twenty. As previously mentioned, additional or fewer chunks may be requested at a single time.

As shown by block **390**, after receiving the request from the client, the selected agent determines whether it has information regarding the requested chunks of data by looking up the request in its cache database and determining if the selected agent has stored therein information regarding peers of the communication network that have stored the requested data of the request, or whether the selected agent itself has the requested data of the request stored in its memory. In addition to determining if the selected agent contains an entry for this request in its database, the selected agent may also determine if this information is still valid. Specifically, the selected agent determines whether the data that is stored within the memory of the selected agent or the memory of the peers, still mirrors the information that would have been received from the server itself for this request. A further description of the process utilized by the selected agent to determine if the information is still valid, is described in detail herein.

As shown by block **392**, if the information (requested data of the request) exists and is still valid, then the agent prepares a response to the client, which includes for each of the chunks: (i) the checksum of the chunk; (ii) a list of peers that according to the database of the selected agent contains these chunks; and (iii) if these are the first five chunks of the information, then the selected agent also provides the specific protocol's headers that would have been received from the server, had the initial request from the client been made directly to the server.

As shown by block **394**, the list of peers for each chunk is sorted by geographical proximity to the requesting client. In accordance with the present example, only the five closest peers are kept in the list for every chunk, and the rest of the peers are discarded from this list. As shown by block **396**, the prepared response, namely, the list of closest peers, is sent back to the client. It should be noted that, if this were the last set of chunks to be provided for this request, then it would be beneficial to include information about this to the client.

If the selected agent discovers that it does not have information about this request, or if the selected agent discovers that the information it has is no longer valid, the selected agent needs to load the information directly from the server in order to be able to provide an answer to the requesting client. As shown by block **400**, the selected agent

then sends the request directly to the server. The selected agent then stores the information it receives from the server (both the headers of the request, as well as chunks of the response itself) in its database, for this particular response to the client, as well as for future use to other clients that may request this data (block **402**). The selected agent then prepares a response (list) for the client, where the response includes the protocol headers (if these are the first five chunks), and the checksums of the five chunks, and provides itself as the only peer for these chunks (block **404**). This list is then sent back to the client (block **406**).

FIG. **11** is a flowchart **420** continuing the flowchart of FIG. **10**, which illustrates actions taken upon receipt of the list of peers, or single peer listing, from the agent. As shown by block **422**, the client receives the response from the agent (including the list of chunks and their corresponding data, including peers and other information previously mentioned) and, for each of the five chunks, the client sends a request to each of the peers listed for the chunk to download the chunk. The chunk request that the client sends to each of the peers is the checksum of the data that the client seeks to receive, which is the key (identifier) of the chunk.

As shown by block **424**, the peers then respond regarding whether they still have the data of the chunk. As an example, some of the peers may not currently be online, some may be online but may have discarded the relevant information, and some may still have the relevant information, namely, the chunk. As shown by block **426**, the client then selects the quickest peer that responds with a positive answer regarding the requested information, the client lets that peer know that it is chosen to provide the client with the chunk, and the client notifies the other peers that they are not chosen.

As shown by block **428**, the chosen peer then sends the chunk to the client. It should be noted that if no peers answer the request of the client, the client goes back to the agent noting that the peers were all negative, and the agent either provides a list of 5 other agents, if they exist, or the agent goes on to download the information directly from the Web server as happens in the case where no peers exist as described above.

The client then stores the chunks in its cache for future use (block **430**), when the client may need to provide the chunks to a requesting communication device when acting as a peer for another client that is looking for the same information. As shown by block **432**, if some of the chunks were not loaded from any of the peers, the client requests the chunks again from the agent in a next round of requests, flagging these chunks as chunks that were not loadable from the client list of peers. In this situation, the agent will load the data directly from the server and provide it back to the client.

The client then acknowledges to the agent which of the chunks it received properly (block **434**). The agent then looks up these chunks in the database of the agent, and adds the client to the list of peers for these chunks, specifically, since this client is now storing these chunks, and can provide these chunks to other clients that turn to it as a peer (block **436**).

As shown by block **438**, the client then passes the data on to the Web browser or other application of the client that made the original request, for it to use as it had originally intended. The client then checks whether all of the chunks for this request were received (block **440**), by checking the flag set by the agent. Specifically, when the agent is providing the list of the last **5** chunks, the agent includes that information as part of its reply to the client, which is referred to herein as a flag. This information is what enables the client to know that all information has been received for a particular resource request.

If the last received chunks were not the last chunks for this request, the processing flow of the client continues by returning to the functionality of block **384** of FIG. **10**, but instead sending the chosen agent a request for the next five chunks of data of the original information request. Alternatively, if all chunks for this request were received, the request is complete, and the flow starts again at block **352** of FIG. **9**.

FIG. **12** is a flowchart **500** illustrating steps taken by an agent, client, or peer to determine whether a certain HTTP request is still valid. Specifically, the following provides an example of how the agent, client, or peer can determine whether particular data that is stored within the memory of the agent, or the memory of a peer or client, still mirrors the information that is currently on the Web server. As shown by block **502**, the HTTP request is looked up in the cache database of the agent, client or peer that is checking the validity of the HTTP request. As an example, the HTTP protocol, defined by RFC 2616, outlines specific methods that Web servers can define within the HTTP headers signifying the validity of certain data, such as, but not limited to, by using HTTP header information such as "max age" to indicate how long this data may be cached before becoming invalid, "no cache" to indicate that the data may never be cached, and using other information.

As shown by block **504**, these standard methods of validation are tested on the HTTP request information in question. As shown by block **506**, a determination is made whether the requested information that is stored is valid or not. If the requested information is valid, a "VALID" response is returned (block **508**). Alternatively, if the requested information is not valid, an HTTP conditional request is sent to the relevant Web server, to determine if the data stored for this request is still valid (block **510**). If the data stored for this request is still valid, a "VALID" response is returned (block **508**). Alternatively, if the data stored for this request is not valid, an "INVALID" response is returned (block **514**). It should be noted, that the abovementioned description with regard to FIG. **12** is an explanation of how to check if HTTP information is still valid. There are similar methods of determining validity for any other protocol, which may be utilized, and which those having ordinary skill in the art would appreciate and understand.

FIG. **13** is a flowchart **550** outlining operation of the acceleration server, whose main responsibility in the present system and method is to provide clients with information regarding which agents serve which requests, and to keep the network elements all up to date with the latest software updates. As shown by block **552**, the acceleration server sends "keep alive" signals to the network elements, and keeps track within its database as to which network elements are online. As shown by block **554**, the acceleration server continues to wait for a client request and continues to determine if one is received.

Once a request is received, the acceleration server tests the type of request received (block **556**). If the client request is to sign up the client within the network, an event that happens every time that the client starts running on its host machine, then that client is added to the list of agents stored on the acceleration server, sorted by the IP address of the client (block **558**).

If the request is to find an agent to use for a particular request, the acceleration server creates a new agent list, which is empty (block **560**). The acceleration server then

searches the agent database for the next 5 active agents whose IP address is closest to the IP address of the server who is targeted in the request (block **562**). In this context, 192.166.3.103 is closer to 192.166.3.212 than to 192.167.3.104. The acceleration server then sends this agent list to the client (block **564**).

If instead, the request is to check the version of the latest acceleration software then the acceleration server sends that network element (client, peer or agent) the version number of the latest existing acceleration software version, and a URL from where to download the new version, for the case that the element needs to upgrade to the new version (block **566**).

While the abovementioned example is focused on HTTP requests for data, as previously mentioned, other protocol requests are equally capable of being handled by the present system and method. As an example, in separate embodiments the acceleration method described may accelerate any communication protocol at any OSI layer (SMTP, DNS, UDP, ETHERNET, etc.). In the following alternative embodiment, it is illustrated how the acceleration method may accelerate TCPIP. As is known by those having ordinary skill in the art, TCPIP is a relatively low-level protocol, as opposed to HTTP, which is a high level protocol. For purposes of illustration of TCPIP communication, reference may be made to FIG. **3**, wherein the Web server is a TCPIP server.

In TCPIP there are three communication commands that are of particular interest, namely, connect, write, and read. Connect is a command issued by an application in the communication device that is initiating the communication to instruct the TCPIP stack to connect to a remote communication device. The connect message includes the IP address of the communication device, and the port number to connect to. An application uses the write command to instruct the TCPIP stack to send a message (i.e., data) to a communication device to which it is connected. In addition, an application uses the read command to ask the TCPIP stack to provide the message that was sent from the remote communication device to which it is connected. A communication session typically exists of a connect, followed by a read and write on both sides.

FIG. **14** is a flowchart **600** further illustrating TCPIP acceleration in accordance with this alternative embodiment of the invention. As shown by blocks **601** and **602** when an application of the communication device makes a request to the communications stack to connect with the TCPIP server, that communication is intercepted by the acceleration application.

To find an agent, upon receiving that connect message from the communication device application, which includes the IP address of the TCPIP server and the port to connect to, the acceleration application in the client makes a request to the acceleration server to find out who the agent for the communication with the TCPIP server is. This step is performed in a similar manner to that described with regard to the main HTTP embodiment of the invention (block **604**). As shown by block **606**, the server then provides the client with a list of agents, for example, a primary agent and four others.

To establish a connection, as shown by block **608**, the client issues a TCPIP connect with the primary agent or one of the other agents if the primary agent does not succeed, to create a connection with the agent. The client then sends to the agent the IP address of the TCPIP server and connection port that were provided by the communication device application (block **610**). As shown by block **612**, that agent in turn issues a TCPIP connect to the TCPIP server to the port it received from the client, to create a connection with the agent.

FIG. **15** is a flowchart **800** further illustrating TCPIP acceleration in accordance with this alternative embodiment of the invention, detailing the communication between the client and the TCPIP server (read and write commands) after the connect phase has completed successfully.

As shown by block **802**, if the network application within the client wants to send a message to the TCPIP server, the network application within the client writes the message to the TCPIP stack in the operating system of the client. This WRITE command is received by the acceleration application of the client and handled in the manner described below. If the TCPIP server wants to send a message to the client, the TCPIP server writes the message to the TCPIP stack of TCPIP operating system, on the connection to the agent, since this agent is where the server received the original connection. This WRITE command is received by the acceleration application of the agent and handled in the manner described below.

When the acceleration application of the client receives a message from the network application of the client to be sent to the agent, or when the acceleration application of the agent receives a message from the connection to the TCPIP server that is to be sent to the client, the acceleration application proceeds to send the message to the communication device on the other side. For instance, if the client has intercepted the message from the communication application, the client sends the message to the agent, and if it is the agent that intercepted the message from the connection to the TCPIP server, such as the TCPIP server sending a message that is intended for the communication with client, the agent sends the message to the client in the following manner:

As shown by block **804**, the acceleration application breaks up the content of the message to chunks and calculates the corresponding checksums, in the same manner as in the main embodiment described herein. The acceleration application then looks up each checksum in its cache database (block **806**). As shown by block **808**, the acceleration application checks if the checksum exists in the cache database. Hit does, then, as shown by block **810**, the acceleration application prepares a list of peers that have already received the chunk of the checksum in the past (if any), and adds the communication device of the other side to the list of communication devices that have received this chunk (adds it to the peer list of the checksum in its database), to be provided to other communication devices requesting this information in the future. As shown by block **812**, the list of peers is sent to the receiving communication device, which, as shown by block **814** retrieves the chunks from the peers in the list received, in the same manner as in the main embodiment.

If the checksum does not exist within the cache database of the sending communication device then, as shown by block **820**, the acceleration application adds the checksum and chunk to its cache database, sends the chunk to the communication device on the other side, and adds the other communication device to the list of peers for that checksum in its database.

As shown by block **816**, a determination is then made as to whether all chunks have been received. If all chunks have not been received, the process continues on again from block **806**.

Once all data has been received, as shown by block **818**, the acceleration application passes the data on to the

requester. Specifically, in the client, the acceleration application passes on the complete data to the communication application, and in the agent, the acceleration application passes on the complete data to the requesting TCPIP server.

It should be emphasized that the above-described embodiments of the present invention are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiments of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of this disclosure and the present invention and protected by the following claims.

The invention claimed is:

1. A method for fetching, by a first device, a first web-page that is identified by a first Uniform Resource Locator (URL) and is stored in a first web server and a second web-page that is identified by a second URL and is stored in a second web server, for use with a second device that stores a group of Internet Protocol (IP) addresses, each of the IP addresses is associated with a respective geographical location, the method comprising:

identifying, at the first device, the first URL and a first geographical location that is associated with at least one of the IP addresses in the group;

sending, by the first device to the second device, the first URL and the first geographical location;

receiving, by the first device from the second device, the first web-page, in response to the sending of the first URL and the first geographical location;

identifying, at the first device, the second URL and a second geographical location that is associated with at least one of the IP addresses in the group;

sending, by the first device to the second device, the second URL and the second geographical location; and

receiving, by the first device from the second device, the second web-page, in response to the sending of the second URL and the second geographical location.

2. The method according to claim **1**, further comprising selecting, by the second device, a first IP address from the group that is associated with the first geographical location in response to the receiving of the first geographical location; and selecting, by the second device, a second IP address from the group that is associated with the second geographical location in response to the receiving of the second geographical location.

3. The method according to claim **2**, for use with a third device addressed in the Internet using the first IP address, and for use with a fourth device addressed in the Internet using the second IP address, the method further comprising:

sending, by the second device, the first URL to the third device in response to the selecting of the first IP address; and

sending, by the second device, the second URL to the fourth device in response to the selecting of the second IP address.

4. The method according to claim **3**, further comprising:

receiving, by the third device from the second device, the first URL;

sending, by the third device to the first web server the first URL in response to the receiving of the first URL;

receiving, by the third device from the first web server the first web-page in response to the sending of the first URL;

sending, by the third device to the second device, the first web-page in response to the receiving of the first web-page;

receiving, by the fourth device from the second device, the second URL;

sending, by the fourth device to the second web server the second URL in response to the receiving of the second URL;

receiving, by the fourth device from the second web server the second web-page in response to the sending of the second URL; and

sending, by the fourth device to the second device, the second web-page in response to the receiving of the second web-page.

5. The method according to claim **4**, further comprising:

sending, by the second device to the first device, the first web-page in response to the receiving of the first web-page; and

sending, by the second device to the first device, the second web-page in response to the receiving of the second web-page.

6. The method according to claim **2**, further comprising fetching, by the second device in response to the selecting of the first IP address, the first web-page from the first web server using the first IP address; and fetching, by the second device in response to the selecting of the second IP address, the second web-page from the second web server using the second IP address.

7. The method according to claim **6**, wherein the fetching of the first web-page uses the first IP address as a source address, and wherein the fetching of the second web-page uses the second IP address as a source address.

8. The method according to claim **1**, for use with a plurality of devices, wherein each one of the devices out of the plurality of devices is addressable in the Internet using an IP address from the group.

9. The method according to claim **8**, further comprising communicating, by the second device, with each one of the devices out of the plurality of devices by using the respective IP address from the group.

10. The method according to claim **9**, wherein the communicating comprising:

sending, a 'keep alive' message; and

waiting for a response to the 'keep alive' message.

11. The method according to claim **10**, further comprising responsive to not receiving a response to the 'keep alive' message, removing the IP address of the non-responsive device from the group.

12. The method according to claim **10**, wherein the sending of the 'keep alive' message comprises periodically sending the 'keep alive' message.

13. The method according to claim **9**, further comprising receiving a 'keep alive' message, by the second device, from each one of the devices out of the plurality of devices.

14. The method according to claim **1**, wherein the first device is addressed over the Internet using a first Internet Protocol (IP) address, and the method further comprising storing, in the second device, the first IP address.

15. The method according to claim **14**, further comprising responsive to the receiving of the first URL from the first device, adding the IP address of the first device to the group of IP addresses.

16. The method according to claim **1**, wherein the first device comprises a client device.

17. The method according to claim **16**, further comprising executing, by the first device, an application, and wherein the identifying in part of, or in response to, the executing.

18. The method according to claim **1**, wherein the second device comprises a server device.

19. The method according to claim **18**, further comprising storing, operating, or using, by the second device, a server operating system.

20. The method according to claim **1**, further comprising fetching, by the second device, the first web-page from the first web server in response to receiving the first URL from the first device; and fetching, by the second device, the second web-page from the second web server in response to receiving the second URL from the first device.

21. The method according to claim **20**, wherein the fetching of the first web-page uses the first geographical location and the fetching of the second web-page uses the second geographical location.

22. The method according to claim **1**, wherein each of the IP addresses in the group is associated with a respective device that is identified over the Internet using a respective IP address.

23. The method according to claim **1**, wherein each of the IP addresses in the group is associated with a respective client device that is identified over the Internet using the respective IP address and is currently online.

24. The method according to claim **1**, further comprising establishing, by the second device, a Transmission Control Protocol (TCP) connection with each of the devices in the group.

25. The method according to claim **1**, wherein the second device is a Transmission Control Protocol/Internet Protocol (TCP/IP) server that communicates over the Internet with the first device using TCP/IP protocol or connection.

26. The method according to claim **1**, wherein the first and second devices communicate with each other over the Internet according to UDP, DNS, TCP, FTP, POP #, SMTP, or SQL standard.

27. The method according to claim **1**, further comprising causing the second device to fetch the first web-page from the first web server.

28. The method according to claim **1**, for use with a software application stored in the second device that is associated with a first version number, and wherein the method further comprising sending, by the second device to the first device, a message that comprises the first version number of the software application; and sending, by the second device to the first device, the software application.

29. The method according to claim **1**, wherein the first web server comprises a web server that is a Hypertext Transfer Protocol (HTTP) server responding to HTTP requests, wherein the first device comprises a client device, and wherein the first and second geographical locations are the same geographical location.

30. The method according to claim **1**, wherein the first web-page comprises audio content, video content, or any combination thereof.

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