US009077630B2

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

(10) **Patent No.: US 9,077,630 B2**
(45) **Date of Patent: Jul. 7, 2015**

(54) **DISTRIBUTED IMPLEMENTATION OF DYNAMIC WIRELESS TRAFFIC POLICY**

(75) Inventors: **Ari Backholm**, Los Altos, CA (US); **Michael Luna**, San Jose, CA (US)

(73) Assignee: **Seven Networks, Inc.**, San Carlos, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1002 days.

(21) Appl. No.: **13/178,675**

(22) Filed: **Jul. 8, 2011**

(65) **Prior Publication Data**

US 2012/0023236 A1 Jan. 26, 2012

Related U.S. Application Data

(60) Provisional application No. 61/367,871, filed on Jul. 26, 2010, provisional application No. 61/367,870, filed on Jul. 26, 2010, provisional application No. 61/408,858, filed on Nov. 1, 2010, provisional

(Continued)

(51) **Int. Cl.**

G06F 15/173	(2006.01)
H04L 12/24	(2006.01)
H04L 12/813	(2013.01)
H04L 12/26	(2006.01)
H04L 29/08	(2006.01)

(Continued)

(52) **U.S. Cl.**

CPC ***H04L 41/0893*** (2013.01); *H04L 47/22* (2013.01); *H04L 47/35* (2013.01); *H04L 47/14* (2013.01); ***H04L 47/20*** (2013.01); *H04L 47/2408* (2013.01); ***H04L 43/10*** (2013.01); ***H04L 67/2833*** (2013.01); ***H04L 67/42*** (2013.01)

(58) **Field of Classification Search**

CPC H04L 47/14; H04L 47/20; H04L 47/22; H04L 47/35; H04L 47/2408

USPC 709/223, 224, 226

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

222,458	A	12/1879	Connolly et al.
447,918	A	3/1891	Strowger

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0772327	A2	5/1997
EP	1278390	A1	1/2003

(Continued)

OTHER PUBLICATIONS

Examination report from CAIPO for Application No. CA 2806548 mailed Jul. 21, 2014.

(Continued)

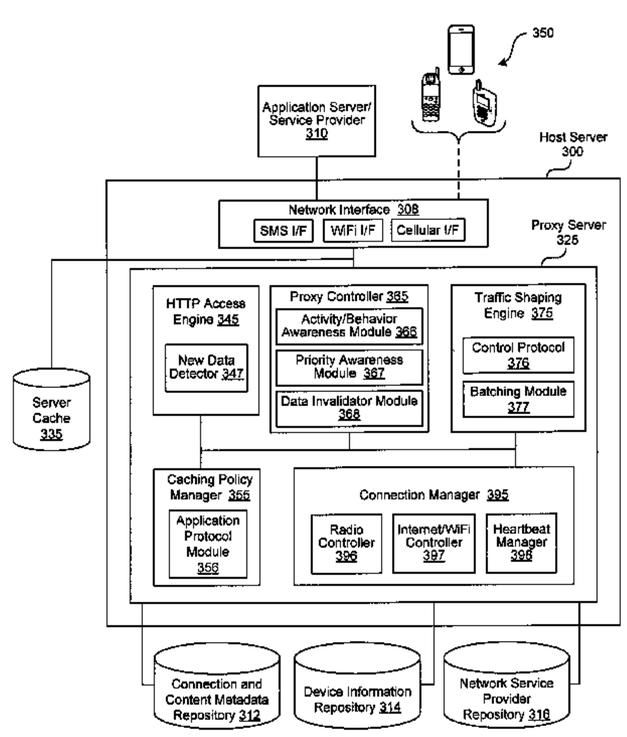
Primary Examiner — Waseem Ashraf

(74) *Attorney, Agent, or Firm* — NKK Patent Law, PLLC

(57) **ABSTRACT**

Systems and methods for distributed implementation of dynamic wireless traffic policy are disclosed. In one aspect, embodiments of the present disclosure include a system for optimizing resources in a mobile network having a local proxy on a mobile device to aggregate client-side parameters and a proxy server to aggregate server-side parameters. The local proxy and the proxy server can each communicate the client-side parameters and the server-side parameters, respectively, to the other component, to formulate a policy for traffic control in the mobile network between the mobile device and the server. The policy can be jointly implemented by the local proxy and the proxy server and dynamically adjusted in real-time.

30 Claims, 11 Drawing Sheets



Related U.S. Application Data

application No. 61/408,839, filed on Nov. 1, 2010, provisional application No. 61/408,829, filed on Nov. 1, 2010, provisional application No. 61/408,846, filed on Nov. 1, 2010, provisional application No. 61/408,854, filed on Nov. 1, 2010, provisional application No. 61/408,826, filed on Nov. 1, 2010, provisional application No. 61/408,820, filed on Nov. 1, 2010, provisional application No. 61/416,020, filed on Nov. 22, 2010, provisional application No. 61/416,033, filed on Nov. 22, 2010, provisional application No. 61/430,828, filed on Jan. 7, 2011.

(51) **Int. Cl.**

H04L 29/06	(2006.01)
H04L 12/815	(2013.01)
H04L 12/801	(2013.01)
H04L 12/851	(2013.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,200,770	A	4/1980	Hellman et al.
4,255,796	A	3/1981	Gabbe et al.
4,276,597	A	6/1981	Dissly et al.
4,531,020	A	7/1985	Wechselberger et al.
4,807,182	A	2/1989	Queen
4,831,582	A	5/1989	Miller et al.
4,875,159	A	10/1989	Cary et al.
4,897,781	A	1/1990	Chang et al.
4,972,457	A	11/1990	O'Sullivan
5,008,853	A	4/1991	Bly et al.
5,159,624	A	10/1992	Makita
5,220,657	A	6/1993	Bly et al.
5,263,157	A	11/1993	Janis
5,283,856	A	2/1994	Gross et al.
5,357,431	A	10/1994	Nakada et al.
5,384,892	A	1/1995	Strong
5,386,564	A	1/1995	Shearer et al.
5,392,390	A	2/1995	Crozier
5,434,994	A	7/1995	Shaheen et al.
5,436,960	A	7/1995	Campana, Jr. et al.
5,438,611	A	8/1995	Campana, Jr. et al.
5,479,472	A	12/1995	Campana, Jr. et al.
5,487,100	A	1/1996	Kane
5,491,703	A	2/1996	Barnaby et al.
5,493,692	A	2/1996	Theimer et al.
5,519,606	A	5/1996	Frid-Nielsen et al.
5,555,376	A	9/1996	Theimer et al.
5,559,800	A	9/1996	Mousseau et al.
5,572,571	A	11/1996	Shirai
5,572,643	A	11/1996	Judson
5,574,859	A	11/1996	Yeh
5,581,749	A	12/1996	Hossain et al.
5,600,834	A	2/1997	Howard
5,603,054	A	2/1997	Theimer et al.
5,604,788	A	2/1997	Tett
5,613,012	A	3/1997	Hoffman et al.
5,619,507	A	4/1997	Tsuda
5,619,648	A	4/1997	Canale et al.
5,623,601	A	4/1997	Vu
5,625,670	A	4/1997	Campana, Jr. et al.
5,625,815	A	4/1997	Maier et al.
5,627,658	A	5/1997	Connors et al.
5,630,081	A	5/1997	Rybicki et al.
5,631,946	A	5/1997	Campana, Jr. et al.
5,632,018	A	5/1997	Otorii
5,634,053	A	5/1997	Noble et al.
5,647,002	A	7/1997	Brunson
5,652,884	A	7/1997	Palevich
5,664,207	A	9/1997	Crumpler et al.
5,666,530	A	9/1997	Clark et al.
5,666,553	A	9/1997	Crozier
5,680,542	A	10/1997	Mulchandani et al.
5,682,524	A	10/1997	Freund et al.
5,684,990	A	11/1997	Boothby
5,689,654	A	11/1997	Kikinis et al.
5,692,039	A	11/1997	Brankley et al.
5,696,903	A	12/1997	Mahany
5,701,423	A	12/1997	Crozier
5,701,469	A	12/1997	Brandli et al.
5,704,029	A	12/1997	Wright, Jr.
5,706,211	A	1/1998	Beletic et al.
5,706,502	A	1/1998	Foley et al.
5,706,507	A	1/1998	Schloss
5,710,918	A	1/1998	Lagarde et al.
5,713,019	A	1/1998	Keaten
5,715,403	A	2/1998	Stefik
5,717,925	A	2/1998	Harper et al.
5,721,908	A	2/1998	Lagarde et al.
5,721,914	A	2/1998	DeVries
5,727,202	A	3/1998	Kucala
5,729,549	A	3/1998	Kostreski et al.
5,729,704	A	3/1998	Stone et al.
5,729,735	A	3/1998	Meyering
5,742,905	A	4/1998	Pepe et al.
5,745,360	A	4/1998	Leone et al.
5,752,186	A	5/1998	Malackowski et al.
5,752,246	A	5/1998	Rogers et al.
5,754,938	A	5/1998	Herz et al.
5,757,916	A	5/1998	MacDoran et al.
5,758,088	A	5/1998	Bezaire et al.
5,758,150	A	5/1998	Bell et al.
5,758,322	A	5/1998	Rongley
5,758,354	A	5/1998	Huang et al.
5,758,355	A	5/1998	Buchanan
5,765,171	A	6/1998	Gehani et al.
5,778,346	A	7/1998	Frid-Nielsen et al.
5,778,361	A	7/1998	Nanjo et al.
5,781,614	A	7/1998	Brunson
5,781,901	A	7/1998	Kuzma
5,781,906	A	7/1998	Aggarwal et al.
5,787,430	A	7/1998	Doeringer et al.
5,787,441	A	7/1998	Beckhardt
5,790,425	A	8/1998	Wagle
5,790,790	A	8/1998	Smith et al.
5,790,974	A	8/1998	Tognazzini
5,793,413	A	8/1998	Hylton et al.
5,794,210	A	8/1998	Goldhaber et al.
5,799,318	A	8/1998	Cardinal et al.
5,802,312	A	9/1998	Lazaridis et al.
5,802,454	A	9/1998	Goshay et al.
5,802,518	A	9/1998	Karaev et al.
5,802,524	A	9/1998	Flowers et al.
5,806,074	A	9/1998	Souder et al.
5,809,242	A	9/1998	Shaw et al.
5,809,415	A	9/1998	Rossmann
5,818,437	A	10/1998	Grover et al.
5,819,172	A	10/1998	Campana, Jr. et al.
5,819,274	A	10/1998	Jackson, Jr.
5,819,284	A	10/1998	Farber et al.
5,822,324	A	10/1998	Kostresti et al.
5,822,747	A	10/1998	Graefe et al.
5,826,269	A	10/1998	Hussey
5,831,664	A	11/1998	Wharton et al.
5,832,483	A	11/1998	Barker
5,832,489	A	11/1998	Kucala
5,832,500	A	11/1998	Burrows
5,835,087	A	11/1998	Herz et al.
5,835,722	A	11/1998	Bradshaw et al.
5,838,252	A	11/1998	Kikinis
5,838,768	A	11/1998	Sumar et al.
5,838,973	A	11/1998	Carpenter-Smith et al.
5,845,278	A	12/1998	Kirsch et al.
5,852,775	A	12/1998	Hidary
5,852,820	A	12/1998	Burrows
5,857,201	A	1/1999	Wright, Jr. et al.
5,862,223	A	1/1999	Walker et al.
5,867,665	A	2/1999	Butman et al.
5,867,817	A	2/1999	Catallo et al.
5,870,759	A	2/1999	Bauer et al.
5,884,323	A	3/1999	Hawkins et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,889,845 A 3/1999 Staples et al.
5,890,147 A 3/1999 Peltonen et al.
5,892,909 A 4/1999 Grasso et al.
5,898,780 A 4/1999 Liu et al.
5,898,917 A 4/1999 Batni et al.
5,903,723 A 5/1999 Beck et al.
5,907,618 A 5/1999 Gennaro et al.
5,909,689 A 6/1999 Van Ryzin
5,913,032 A 6/1999 Schwartz et al.
5,924,096 A 7/1999 Draper et al.
5,928,325 A 7/1999 Shaughnessy et al.
5,928,329 A 7/1999 Clark et al.
5,937,161 A 8/1999 Mulligan et al.
5,940,813 A 8/1999 Hutchings
5,943,676 A 8/1999 Boothby
5,948,066 A 9/1999 Whalen et al.
5,951,636 A 9/1999 Zerber
5,960,394 A 9/1999 Gould et al.
5,960,406 A 9/1999 Rasansky et al.
5,961,590 A 10/1999 Mendez et al.
5,963,642 A 10/1999 Goldstein
5,964,833 A 10/1999 Kikinis
5,968,131 A 10/1999 Mendez et al.
5,974,238 A 10/1999 Chase, Jr.
5,974,327 A 10/1999 Agrawal et al.
5,978,837 A 11/1999 Foladare et al.
5,978,933 A 11/1999 Wyld et al.
5,987,440 A 11/1999 O'Neil et al.
6,000,000 A 12/1999 Hawkins et al.
6,003,070 A 12/1999 Frantz
6,006,274 A 12/1999 Hawkins et al.
6,016,478 A 1/2000 Zhang et al.
6,016,520 A 1/2000 Facq et al.
6,018,762 A 1/2000 Brunson et al.
6,023,700 A 2/2000 Owens et al.
6,023,708 A 2/2000 Mendez et al.
6,029,238 A 2/2000 Furukawa
6,034,621 A 3/2000 Kaufman
6,035,104 A 3/2000 Zahariev
6,044,372 A 3/2000 Rothfus et al.
6,044,381 A 3/2000 Boothby et al.
6,047,051 A 4/2000 Ginzboorg et al.
6,047,327 A 4/2000 Tso et al.
6,052,563 A 4/2000 Macko
6,052,735 A 4/2000 Ulrich et al.
6,057,855 A 5/2000 Barkans
6,065,055 A 5/2000 Hughes et al.
6,073,138 A 6/2000 de l'Etraz et al.
6,073,142 A 6/2000 Geiger et al.
6,073,165 A 6/2000 Narasimhan et al.
6,085,166 A 7/2000 Beckhardt et al.
6,085,192 A 7/2000 Mendez et al.
6,088,677 A 7/2000 Spurgeon
6,101,320 A 8/2000 Schuetze et al.
6,101,480 A 8/2000 Conmy et al.
6,101,531 A 8/2000 Eggleston et al.
6,112,181 A 8/2000 Shear et al.
6,119,014 A 9/2000 Alperovich et al.
6,119,171 A 9/2000 Alkhatib
6,125,369 A 9/2000 Wu et al.
6,125,388 A 9/2000 Reisman
6,128,627 A 10/2000 Mattis et al.
6,130,898 A 10/2000 Kostreski et al.
6,131,096 A 10/2000 Ng et al.
6,131,116 A 10/2000 Riggins et al.
6,134,432 A 10/2000 Holmes et al.
6,138,013 A 10/2000 Blanchard et al.
6,138,124 A 10/2000 Beckhardt
6,138,128 A 10/2000 Perkowitz et al.
6,138,146 A 10/2000 Moon et al.
6,141,664 A 10/2000 Boothby
6,151,606 A 11/2000 Mendez
6,157,630 A 12/2000 Adler et al.
6,161,140 A 12/2000 Moriya
6,167,379 A 12/2000 Dean et al.
6,167,435 A 12/2000 Druckenmiller et al.
6,170,014 B1 1/2001 Darago et al.
6,173,312 B1 1/2001 Atarashi et al.
6,173,446 B1 1/2001 Khan et al.
6,175,831 B1 1/2001 Weinreich et al.
6,178,419 B1 1/2001 Legh-Smith et al.
6,181,935 B1 1/2001 Gossman et al.
6,185,184 B1 2/2001 Mattaway et al.
6,195,533 B1 2/2001 Tkatch et al.
6,198,696 B1 3/2001 Korpi et al.
6,198,922 B1 3/2001 Baynham
6,201,469 B1 3/2001 Balch et al.
6,202,085 B1 3/2001 Benson et al.
6,205,448 B1 3/2001 Kruglikov et al.
6,212,529 B1 4/2001 Boothby et al.
6,219,694 B1 4/2001 Lazaridis et al.
6,221,877 B1 4/2001 Aronov et al.
6,223,187 B1 4/2001 Boothby et al.
6,226,686 B1 5/2001 Rothschild et al.
6,233,341 B1 5/2001 Riggins
6,243,705 B1 6/2001 Kucala
6,246,875 B1 6/2001 Seazholtz et al.
6,247,135 B1 6/2001 Feague
6,249,808 B1 6/2001 Seshadri
6,256,666 B1 7/2001 Singhal
6,263,201 B1 7/2001 Hashimoto et al.
6,263,340 B1 7/2001 Green
6,269,369 B1 7/2001 Robertson
6,272,545 B1 8/2001 Flanagin et al.
6,275,850 B1 8/2001 Beyda et al.
6,275,858 B1 8/2001 Bates et al.
6,289,212 B1 9/2001 Stein et al.
6,289,214 B1 9/2001 Backstrom
6,292,904 B1 9/2001 Broomhall et al.
6,295,541 B1 9/2001 Bodnar et al.
6,300,947 B1 10/2001 Kanevsky
6,304,881 B1 10/2001 Halim et al.
6,308,201 B1 10/2001 Pivowar et al.
6,317,594 B1 11/2001 Gossman et al.
6,320,943 B1 11/2001 Borland
6,324,541 B1 11/2001 de l'Etraz et al.
6,324,542 B1 11/2001 Wright, Jr. et al.
6,324,544 B1 11/2001 Alam et al.
6,324,587 B1 11/2001 Trenbeath et al.
6,327,586 B1 12/2001 Kisiel
6,336,117 B1 1/2002 Massarani
6,336,138 B1 1/2002 Caswell et al.
6,351,767 B1 2/2002 Batchelder et al.
6,356,937 B1 3/2002 Montville et al.
6,363,051 B1 3/2002 Eslambolchi et al.
6,363,352 B1 3/2002 Dailey et al.
6,370,566 B2 4/2002 Discolo et al.
6,377,810 B1 4/2002 Geiger et al.
6,380,959 B1 4/2002 Wang et al.
6,389,422 B1 5/2002 Doi et al.
6,389,455 B1 5/2002 Fuisz
6,389,457 B2 5/2002 Lazaridis et al.
6,397,057 B1 5/2002 Malackowski et al.
6,397,230 B1 5/2002 Carmel et al.
6,401,104 B1 6/2002 LaRue et al.
6,401,112 B1 6/2002 Boyer et al.
6,401,113 B2 6/2002 Lazaridis et al.
6,405,197 B2 6/2002 Gilmour
6,411,696 B1 6/2002 Iverson et al.
6,415,031 B1 7/2002 Colligan et al.
6,418,308 B1 7/2002 Heinonen et al.
6,421,669 B1 7/2002 Gilmour et al.
6,421,781 B1 7/2002 Fox et al.
6,430,602 B1 8/2002 Kay et al.
6,438,585 B2 8/2002 Mousseau et al.
6,438,612 B1 8/2002 Ylonen et al.
6,442,589 B1 8/2002 Takahashi et al.
6,442,637 B1 8/2002 Hawkins et al.
6,446,118 B1 9/2002 Gottlieb
6,463,463 B1 10/2002 Godfrey et al.
6,463,464 B1 10/2002 Lazaridis et al.
6,487,557 B1 11/2002 Nagatomo
6,487,560 B1 11/2002 LaRue et al.
6,490,353 B1 12/2002 Tan

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,496,802 B1 12/2002 van Zoest et al.
6,499,054 B1 12/2002 Hesselink et al.
6,505,214 B1 1/2003 Sherman et al.
6,516,327 B1 2/2003 Zondervan et al.
6,526,433 B1 2/2003 Chang et al.
6,526,506 B1 2/2003 Lewis
6,529,908 B1 3/2003 Piett et al.
6,532,446 B1 3/2003 King
6,535,892 B1 3/2003 LaRue et al.
6,546,005 B1 4/2003 Berkley et al.
6,549,939 B1 4/2003 Ford et al.
6,556,217 B1 4/2003 Mäkipää et al.
6,593,944 B1 7/2003 Nicolas et al.
6,601,026 B2 7/2003 Appelt et al.
6,615,253 B1 9/2003 Bowman-Amuah
6,618,710 B1 9/2003 Zondervan et al.
6,621,892 B1 9/2003 Banister et al.
6,625,621 B2 9/2003 Tan et al.
6,636,482 B2 10/2003 Cloonan et al.
6,639,693 B1 10/2003 Ejiri et al.
6,640,097 B2 10/2003 Corrigan et al.
6,640,244 B1 10/2003 Bowman-Amuah
6,640,249 B1 10/2003 Bowman-Amuah
6,643,650 B1 11/2003 Slaughter et al.
6,643,688 B1 11/2003 Fuisz
6,647,384 B2 11/2003 Gilmour
6,650,890 B1 11/2003 Irlam et al.
6,662,016 B1 12/2003 Buckham et al.
6,668,046 B1 12/2003 Albal
6,671,695 B2 12/2003 McFadden
6,671,700 B1 12/2003 Creemer et al.
6,671,702 B2 12/2003 Kruglikov et al.
6,671,757 B1 12/2003 Multer et al.
6,694,336 B1 2/2004 Multer et al.
6,697,807 B2 2/2004 McGeachie
6,701,378 B1 3/2004 Gilhuly et al.
6,707,801 B2 3/2004 Hsu
6,708,221 B1 3/2004 Mendez et al.
6,714,965 B2 3/2004 Kakuta et al.
6,721,787 B1 4/2004 Hiscock
6,727,917 B1 4/2004 Chew et al.
6,728,530 B1 4/2004 Heinonen et al.
6,728,786 B2 4/2004 Hawkins et al.
6,732,101 B1 5/2004 Cook
6,732,158 B1 5/2004 Hesselink et al.
6,735,591 B2 5/2004 Khan
6,741,232 B1 5/2004 Siedlikowski et al.
6,741,855 B1 5/2004 Martin et al.
6,742,015 B1 5/2004 Bowman-Amuah
6,742,059 B1 5/2004 Todd et al.
6,745,024 B1 6/2004 DeJaco et al.
6,745,326 B1 6/2004 Wary
6,756,882 B2 6/2004 Benes et al.
6,757,362 B1 6/2004 Cooper et al.
6,757,696 B2 6/2004 Multer et al.
6,757,708 B1 6/2004 Craig et al.
6,760,916 B2 7/2004 Holtz et al.
6,771,294 B1 8/2004 Pulli et al.
6,775,362 B1 8/2004 Ransom
6,779,019 B1 8/2004 Mousseau et al.
6,782,409 B1 8/2004 Yoshida
6,785,868 B1 8/2004 Raff
6,785,906 B1 8/2004 Gaughan et al.
6,799,190 B1 9/2004 Boothby
6,804,707 B1 10/2004 Ronning
6,816,849 B1 11/2004 Halt, Jr.
6,820,088 B1 11/2004 Hind et al.
6,820,204 B1 11/2004 Desai et al.
6,829,487 B2 12/2004 Eiden et al.
6,834,195 B2 12/2004 Brandenberg et al.
6,847,974 B2 1/2005 Wachtel
6,850,757 B2 2/2005 Watanabe et al.
6,859,212 B2 2/2005 Kumar et al.
6,867,774 B1 3/2005 Halmshaw et al.
6,868,447 B1 3/2005 Slaughter et al.
6,871,220 B1 3/2005 Rajan et al.
6,871,236 B2 3/2005 Fishman et al.
6,873,688 B1 3/2005 Aarnio
6,874,017 B1 3/2005 Inoue et al.
6,879,985 B2 4/2005 Deguchi et al.
6,886,030 B1 4/2005 Easterbrook et al.
6,892,070 B2 5/2005 Warrier et al.
6,892,196 B1 5/2005 Hughes
6,895,394 B1 5/2005 Kremer et al.
6,895,558 B1 5/2005 Loveland
6,898,427 B1 5/2005 Griffith et al.
6,922,547 B2 7/2005 O'Neill et al.
6,922,721 B1 7/2005 Minborg et al.
6,925,477 B1 8/2005 Champagne et al.
6,931,529 B2 8/2005 Kunzinger
6,938,079 B1 8/2005 Anderson et al.
6,944,447 B2 9/2005 Portman et al.
6,944,662 B2 9/2005 Devine et al.
6,947,770 B2 9/2005 Rydbeck
6,957,397 B1 10/2005 Hawkins et al.
6,965,917 B1 11/2005 Aloni et al.
6,966,058 B2 11/2005 Earl et al.
6,968,175 B2 11/2005 Raivisto et al.
6,970,879 B1 11/2005 Gilmour
6,972,682 B2 12/2005 Lareau et al.
6,973,299 B2 12/2005 Apfel
6,981,041 B2 12/2005 Araujo et al.
6,981,047 B2 12/2005 Hanson et al.
6,985,933 B1 1/2006 Singhal et al.
6,985,983 B2 1/2006 Pellegrino et al.
6,986,061 B1 1/2006 Kunzinger
6,987,734 B2 1/2006 Hundemer
6,990,472 B2 1/2006 Rosenhaft et al.
6,993,326 B2 1/2006 Link, II et al.
6,993,327 B2 1/2006 Mathis
6,996,627 B1 2/2006 Carden
6,999,753 B2 2/2006 Beckmann et al.
7,020,685 B1 3/2006 Chen et al.
7,024,491 B1 4/2006 Hanmann et al.
7,026,984 B1 4/2006 Thandu et al.
7,032,242 B1 4/2006 Grabelsky et al.
7,035,630 B2 4/2006 Knowles
7,046,993 B2 5/2006 Haaramo et al.
7,047,202 B2 5/2006 Jaipuria et al.
7,062,024 B2 6/2006 Kreckel et al.
7,069,308 B2 6/2006 Abrams
7,072,678 B2 7/2006 Allison
7,079,499 B1 7/2006 Akhtar et al.
7,080,371 B1 7/2006 Arnaiz et al.
7,082,316 B2 7/2006 Eiden et al.
7,085,365 B2 8/2006 Kauppinen
7,096,030 B2 8/2006 Huomo
7,100,821 B2 9/2006 Rasti
7,103,432 B2 9/2006 Drader et al.
7,120,692 B2 10/2006 Hesselink et al.
7,120,928 B2 10/2006 Sheth et al.
7,130,839 B2 10/2006 Boreham et al.
7,136,645 B2 11/2006 Hanson et al.
7,139,555 B2 11/2006 Apfel
7,139,565 B2 11/2006 Fiatal et al.
7,140,549 B2 11/2006 de Jong
7,146,645 B1 12/2006 Hellsten et al.
7,149,780 B2 12/2006 Quine et al.
7,149,789 B2 12/2006 Slivka et al.
7,149,959 B1 12/2006 Jones et al.
7,162,241 B2 1/2007 Kim et al.
7,165,727 B2 1/2007 de Jong
7,172,118 B2 2/2007 Urken
7,181,228 B2 2/2007 Boesch
7,184,790 B2 2/2007 Dorenbosch et al.
7,185,362 B2 2/2007 Hawkes et al.
7,194,273 B2 3/2007 Vaudreuil
7,200,390 B1 4/2007 Henager et al.
7,203,733 B1 4/2007 Bern
7,206,806 B2 4/2007 Pineau
7,209,757 B2 4/2007 Naghian et al.
7,210,121 B2 4/2007 Xia et al.
7,219,139 B2 5/2007 Martin et al.
7,219,222 B1 5/2007 Durbin et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

7,224,957 B2 5/2007 Spector
7,231,206 B2 6/2007 Cudak et al.
7,233,795 B1 6/2007 Ryden
7,234,111 B2 6/2007 Chu et al.
7,239,877 B2 7/2007 Corneille et al.
7,240,095 B1 7/2007 Lewis
7,242,680 B2 7/2007 Gallant
7,245,926 B2 7/2007 Liao et al.
7,257,391 B2 8/2007 Burgess et al.
7,257,639 B1 8/2007 Li et al.
7,259,666 B1 8/2007 Hermsmeyer et al.
7,260,552 B2 8/2007 Riera Jorba et al.
7,260,590 B1 8/2007 Williams
7,260,651 B2 8/2007 Parrella, Sr. et al.
7,272,830 B2 9/2007 de Jong
7,277,408 B2 10/2007 Sorsa
7,284,664 B1 10/2007 Ivchenko et al.
7,289,792 B1 10/2007 Turunen
7,289,964 B1 10/2007 Bowman-Amuah
7,289,971 B1 10/2007 O'Neil et al.
7,293,107 B1 11/2007 Hanson et al.
7,295,853 B2 11/2007 Jin et al.
7,296,155 B1 11/2007 Trostle et al.
7,305,252 B2 12/2007 Britt et al.
7,305,700 B2 12/2007 Boynton et al.
7,310,350 B1 12/2007 Shao et al.
7,310,729 B2 12/2007 Gordon et al.
7,324,473 B2 1/2008 Corneille et al.
7,349,871 B2 3/2008 Labrou et al.
7,353,274 B1 4/2008 Rouhi et al.
7,359,720 B2 4/2008 Hartmaier et al.
7,373,386 B2 5/2008 Gardner et al.
7,374,099 B2 5/2008 de Jong
7,376,701 B2 5/2008 Bhargava et al.
7,382,879 B1 6/2008 Miller
7,388,950 B2 6/2008 Elsey et al.
7,389,412 B2 6/2008 Sharma et al.
7,392,483 B2 6/2008 Wong et al.
7,395,329 B1 7/2008 Holt et al.
7,398,271 B1 7/2008 Borkovsky et al.
7,430,609 B2 9/2008 Brown et al.
7,441,271 B2 10/2008 Fiatal et al.
7,443,847 B1 10/2008 Albert et al.
7,461,071 B2 12/2008 Fitzpatrick et al.
7,465,231 B2 12/2008 Lewin et al.
7,469,125 B2 12/2008 Nurmi
7,483,036 B2 1/2009 Moore
7,499,537 B2 3/2009 Elsey et al.
7,502,615 B2 3/2009 Wilhoite et al.
7,519,042 B2 4/2009 Gorday et al.
7,532,571 B1 5/2009 Price et al.
7,539,665 B2 5/2009 Mendez
7,548,947 B2 6/2009 Kasriel et al.
7,548,969 B2 6/2009 Tripp et al.
7,551,900 B2 6/2009 Kang et al.
7,567,575 B2 7/2009 Chen et al.
7,574,208 B2 8/2009 Hanson et al.
7,575,171 B2 8/2009 Lev
7,584,294 B2 9/2009 Plamondon
7,587,482 B2 9/2009 Henderson et al.
7,587,608 B2 9/2009 Haller et al.
7,593,714 B2 9/2009 Schultz et al.
7,596,608 B2 9/2009 Alexander et al.
7,596,791 B2 9/2009 Wei et al.
7,613,792 B2 11/2009 Zervas et al.
7,630,986 B1 12/2009 Herz et al.
7,634,558 B1 12/2009 Mangal et al.
7,643,818 B2 1/2010 Backholm et al.
7,644,166 B2 1/2010 Appelman et al.
7,650,416 B2 1/2010 Wu et al.
7,672,291 B2 3/2010 Wang
7,672,439 B2 3/2010 Appelman et al.
7,680,281 B2 3/2010 Fiatal et al.
7,684,346 B2 3/2010 Valli
7,689,664 B2 3/2010 Karlberg
7,693,555 B2 4/2010 Srinivasan et al.
7,693,944 B2 4/2010 Appelman et al.
7,694,008 B2 4/2010 Chang et al.
7,706,781 B2 4/2010 Backholm et al.
7,707,573 B1 4/2010 Marmaros et al.
7,752,633 B1 7/2010 Fleming
7,757,956 B2 7/2010 Koenck et al.
7,769,395 B2 8/2010 Fiatal et al.
7,769,400 B2 8/2010 Backholm et al.
7,769,805 B1 8/2010 Barnes et al.
7,778,792 B2 8/2010 Huang et al.
7,783,757 B2 8/2010 Plamondon
7,796,742 B1 9/2010 Sutaria et al.
7,797,064 B2 9/2010 Loomis et al.
7,809,818 B2 10/2010 Plamondon
7,827,055 B1 11/2010 Snodgrass et al.
7,827,597 B2 11/2010 Boynton et al.
7,853,563 B2 12/2010 Alvarado et al.
7,877,703 B1 1/2011 Fleming
7,881,745 B1 2/2011 Rao et al.
7,899,996 B1 3/2011 Levin-Michael
7,908,656 B1 3/2011 Mu
7,917,468 B2 3/2011 Ariel et al.
7,917,505 B2 3/2011 van Gent et al.
7,921,167 B2 4/2011 Shroff et al.
7,930,416 B2 4/2011 Miller et al.
7,933,929 B1 4/2011 McClendon et al.
7,937,091 B2 5/2011 Roman et al.
7,970,860 B2 6/2011 Kline et al.
7,996,487 B2 8/2011 Snyder
8,005,891 B2 8/2011 Knowles et al.
8,010,082 B2 8/2011 Sutaria et al.
8,032,409 B1 10/2011 Mikurak
8,064,583 B1 11/2011 Sutaria et al.
8,069,166 B2 11/2011 Alvarado et al.
8,078,158 B2 12/2011 Backholm
8,107,921 B2 1/2012 Fiatal
8,116,214 B2 2/2012 Backholm et al.
8,127,342 B2 2/2012 Boynton et al.
8,166,164 B1 4/2012 Luna et al.
8,190,701 B2 5/2012 Luna et al.
8,194,680 B1 6/2012 Brandwine et al.
8,204,953 B2 6/2012 Luna et al.
8,209,709 B2 6/2012 Fleming
8,260,852 B1 9/2012 Cselle
8,291,076 B2 10/2012 Luna et al.
8,504,680 B1 * 8/2013 Hernacki et al. 709/224
8,584,234 B1 11/2013 Sobel et al.
2001/0009025 A1 7/2001 Ahonen
2001/0010046 A1 7/2001 Muyres et al.
2001/0013069 A1 8/2001 Shah
2001/0023414 A1 9/2001 Kumar et al.
2001/0032254 A1 10/2001 Hawkins
2001/0034225 A1 10/2001 Gupte et al.
2001/0034244 A1 10/2001 Calder et al.
2001/0037453 A1 11/2001 Mitty et al.
2001/0039191 A1 11/2001 Maierhofer
2001/0041566 A1 11/2001 Xanthos et al.
2001/0042009 A1 11/2001 Montague
2001/0042099 A1 11/2001 Peng
2001/0043148 A1 11/2001 Stewart
2001/0052052 A1 12/2001 Peng
2001/0053687 A1 12/2001 Sivula
2002/0002478 A1 1/2002 Swart et al.
2002/0002591 A1 1/2002 Ketola
2002/0007303 A1 1/2002 Brookler et al.
2002/0013727 A1 1/2002 Lee
2002/0019225 A1 2/2002 Miyashita
2002/0019812 A1 2/2002 Board et al.
2002/0035556 A1 3/2002 Shah et al.
2002/0035617 A1 3/2002 Lynch et al.
2002/0038253 A1 3/2002 Seaman et al.
2002/0042875 A1 4/2002 Shukla
2002/0049828 A1 4/2002 Pekarek-Kostka
2002/0053078 A1 5/2002 Holtz et al.
2002/0055351 A1 5/2002 Elsey et al.
2002/0059201 A1 5/2002 Work
2002/0059457 A1 * 5/2002 Ballard et al. 709/246
2002/0068559 A1 6/2002 Sharma et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0073207	A1	6/2002	Widger et al.	
2002/0077077	A1	6/2002	Rezvani et al.	
2002/0077084	A1	6/2002	Zellner et al.	
2002/0078384	A1	6/2002	Hippelainen	
2002/0087549	A1	7/2002	Mostafa	
2002/0087679	A1	7/2002	Pulley et al.	
2002/0087883	A1	7/2002	Wohlgemuth et al.	
2002/0089542	A1	7/2002	Imamura	
2002/0091921	A1	7/2002	Kunzinger	
2002/0095319	A1	7/2002	Swart et al.	
2002/0095328	A1	7/2002	Swart et al.	
2002/0095391	A1	7/2002	Swart et al.	
2002/0095399	A1	7/2002	Devine et al.	
2002/0098855	A1	7/2002	Hartmaier et al.	
2002/0099613	A1	7/2002	Swart et al.	
2002/0099809	A1	7/2002	Lee	
2002/0101975	A1	8/2002	Tiburtius et al.	
2002/0103934	A1	8/2002	Fishman et al.	
2002/0107944	A1	8/2002	Bai et al.	
2002/0107985	A1	8/2002	Hwang et al.	
2002/0116499	A1	8/2002	Enns et al.	
2002/0116501	A1	8/2002	Ho et al.	
2002/0120388	A1	8/2002	Bullock	
2002/0120766	A1	8/2002	Okajima et al.	
2002/0120779	A1	8/2002	Teeple et al.	
2002/0126701	A1	9/2002	Requena	
2002/0133504	A1	9/2002	Vlahos et al.	
2002/0144109	A1	10/2002	Benantar et al.	
2002/0146129	A1	10/2002	Kaplan	
2002/0152379	A1	10/2002	Gefwert et al.	
2002/0155848	A1	10/2002	Suryanarayana	
2002/0156839	A1	10/2002	Peterson et al.	
2002/0158908	A1	10/2002	Vaajala et al.	
2002/0161587	A1	10/2002	Pitts, III et al.	
2002/0161925	A1	10/2002	Munger et al.	
2002/0161928	A1	10/2002	Ndili	
2002/0164977	A1	11/2002	Link, II et al.	
2002/0167484	A1	11/2002	Hatanaka et al.	
2002/0174189	A1	11/2002	Peng	
2002/0186848	A1	12/2002	Shaik	
2002/0188940	A1	12/2002	Breckner et al.	
2002/0193094	A1	12/2002	Lawless et al.	
2002/0194209	A1	12/2002	Bolosky et al.	
2002/0198027	A1	12/2002	Rydbeck	
2003/0005151	A1	1/2003	Ullman et al.	
2003/0014491	A1	1/2003	Horvitz et al.	
2003/0022662	A1	1/2003	Mittal	
2003/0023692	A1	1/2003	Moroo	
2003/0023975	A1	1/2003	Schrader et al.	
2003/0028430	A1	2/2003	Zimmerman	
2003/0028441	A1	2/2003	Barsness et al.	
2003/0046433	A1	3/2003	Luzzatti et al.	
2003/0046586	A1	3/2003	Bheemarasetti et al.	
2003/0046587	A1	3/2003	Bheemarasetti et al.	
2003/0050041	A1	3/2003	Wu	
2003/0051142	A1	3/2003	Hidalgo et al.	
2003/0053463	A1*	3/2003	Vikberg et al.	370/395.1
2003/0054810	A1	3/2003	Chen et al.	
2003/0055882	A1*	3/2003	Kawamura	709/203
2003/0056096	A1	3/2003	Albert et al.	
2003/0060188	A1	3/2003	Gidron et al.	
2003/0063120	A1	4/2003	Wong et al.	
2003/0065738	A1	4/2003	Yang et al.	
2003/0065739	A1	4/2003	Shnier	
2003/0065802	A1	4/2003	Vitikainen et al.	
2003/0070061	A1	4/2003	Wong et al.	
2003/0072451	A1	4/2003	Pimentel et al.	
2003/0078880	A1	4/2003	Alley et al.	
2003/0084165	A1	5/2003	Kjellberg et al.	
2003/0088629	A1	5/2003	Berkowitz et al.	
2003/0093691	A1	5/2003	Simon et al.	
2003/0097381	A1	5/2003	Detweiler et al.	
2003/0100321	A1	5/2003	Rao et al.	
2003/0100326	A1	5/2003	Grube et al.	
2003/0117432	A1	6/2003	Kautto-Kiovula et al.	
2003/0120685	A1	6/2003	Duncombe et al.	
2003/0125023	A1	7/2003	Fishler	
2003/0126216	A1	7/2003	Avila et al.	
2003/0130984	A1	7/2003	Quinlan et al.	
2003/0145038	A1	7/2003	Bin Tariq et al.	
2003/0146934	A1	8/2003	Bailey et al.	
2003/0153338	A1	8/2003	Herz et al.	
2003/0154212	A1	8/2003	Schirmer et al.	
2003/0156146	A1	8/2003	Suomela et al.	
2003/0157947	A1	8/2003	Fiatal et al.	
2003/0169262	A1	9/2003	Lavelle et al.	
2003/0172112	A1*	9/2003	Vignaud	709/203
2003/0177281	A1	9/2003	McQuillan et al.	
2003/0182431	A1	9/2003	Sturniolo et al.	
2003/0187984	A1	10/2003	Banavar et al.	
2003/0204605	A1	10/2003	Hudson et al.	
2003/0208529	A1	11/2003	Pendyala et al.	
2003/0208559	A1	11/2003	Velline et al.	
2003/0210666	A1	11/2003	Trossen et al.	
2003/0211845	A1	11/2003	Lohtia et al.	
2003/0217098	A1	11/2003	Bobde et al.	
2003/0217142	A1	11/2003	Bobde et al.	
2003/0223554	A1	12/2003	Zhang	
2003/0227487	A1	12/2003	Hugh	
2003/0227745	A1	12/2003	Khoo	
2003/0235308	A1	12/2003	Boynton et al.	
2003/0236857	A1	12/2003	Takase et al.	
2003/0236981	A1	12/2003	Marmigere et al.	
2004/0002324	A1	1/2004	Juntunen et al.	
2004/0006630	A1	1/2004	Friend et al.	
2004/0015504	A1	1/2004	Ahad et al.	
2004/0024795	A1	2/2004	Hind et al.	
2004/0024892	A1	2/2004	Creswell et al.	
2004/0027326	A1	2/2004	Hays et al.	
2004/0027375	A1	2/2004	Ellis et al.	
2004/0027378	A1	2/2004	Hays et al.	
2004/0043770	A1	3/2004	Amit et al.	
2004/0049579	A1	3/2004	Ims et al.	
2004/0049599	A1	3/2004	Friend et al.	
2004/0051715	A1	3/2004	Brokenshire et al.	
2004/0054739	A1	3/2004	Friend et al.	
2004/0064445	A1	4/2004	Pfleging et al.	
2004/0064488	A1	4/2004	Sinha	
2004/0068579	A1	4/2004	Marmigere et al.	
2004/0068698	A1	4/2004	Wu et al.	
2004/0073476	A1	4/2004	Donahue et al.	
2004/0073651	A1	4/2004	Beaulieu et al.	
2004/0075675	A1	4/2004	Raivisto et al.	
2004/0075695	A1	4/2004	Chew et al.	
2004/0078814	A1	4/2004	Allen	
2004/0080515	A1	4/2004	Hagiwara	
2004/0082346	A1	4/2004	Skytt et al.	
2004/0098625	A1	5/2004	Lagadec et al.	
2004/0103147	A1	5/2004	Flesher et al.	
2004/0107319	A1	6/2004	D'Orto et al.	
2004/0110497	A1	6/2004	Little	
2004/0120323	A1	6/2004	Viikari et al.	
2004/0123095	A1	6/2004	Marshall	
2004/0123304	A1	6/2004	Black et al.	
2004/0127214	A1	7/2004	Reddy et al.	
2004/0128375	A1	7/2004	Rockwell	
2004/0133626	A1	7/2004	Herrero et al.	
2004/0141011	A1	7/2004	Smethers et al.	
2004/0147248	A1	7/2004	Will	
2004/0147262	A1	7/2004	Lescuyer et al.	
2004/0148375	A1	7/2004	Levett et al.	
2004/0158611	A1	8/2004	Daniell et al.	
2004/0167966	A1	8/2004	Lee et al.	
2004/0170257	A1	9/2004	Gross et al.	
2004/0172481	A1	9/2004	Engstrom	
2004/0176128	A1	9/2004	Grabelsky et al.	
2004/0177369	A1	9/2004	Akins, III	
2004/0179513	A1	9/2004	Smith et al.	
2004/0181550	A1	9/2004	Warsta et al.	
2004/0184475	A1	9/2004	Meier	
2004/0186902	A1	9/2004	Stewart	
2004/0189610	A1	9/2004	Friend	
2004/0199497	A1	10/2004	Timmons	
2004/0199582	A1	10/2004	Kucharewski et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2004/0199663 A1 10/2004 Horvitz et al.
2004/0205248 A1 10/2004 Little et al.
2004/0205330 A1 10/2004 Godfrey et al.
2004/0209602 A1 10/2004 Joyce et al.
2004/0210639 A1 10/2004 Ben-Yoseph et al.
2004/0219932 A1* 11/2004 Verteuil 455/456.2
2004/0219940 A1 11/2004 Kong et al.
2004/0230619 A1 11/2004 Blanco et al.
2004/0233930 A1 11/2004 Colby, Jr.
2004/0236792 A1 11/2004 Celik
2004/0242209 A1 12/2004 Kruis et al.
2004/0252816 A1 12/2004 Nicolas
2004/0255126 A1 12/2004 Reith
2004/0258231 A1 12/2004 Elsey et al.
2004/0259535 A1 12/2004 Elsey et al.
2004/0259537 A1 12/2004 Ackley
2004/0260948 A1 12/2004 Miyata et al.
2004/0264396 A1 12/2004 Ginzburg et al.
2004/0266364 A1 12/2004 Nguyen et al.
2004/0268148 A1 12/2004 Karjala et al.
2005/0002501 A1 1/2005 Elsey et al.
2005/0002508 A1 1/2005 Elsey et al.
2005/0002509 A1 1/2005 Elsey et al.
2005/0002510 A1 1/2005 Elsey et al.
2005/0010694 A1 1/2005 Ma et al.
2005/0015432 A1 1/2005 Cohen
2005/0021750 A1 1/2005 Abrams
2005/0022000 A1 1/2005 Inomata et al.
2005/0022182 A1 1/2005 Mittal
2005/0027591 A9 2/2005 Gailey et al.
2005/0027716 A1 2/2005 Apfel
2005/0027869 A1 2/2005 Johnson
2005/0033812 A1 2/2005 McCarthy et al.
2005/0033926 A1 2/2005 Dumont
2005/0037741 A1 2/2005 Gilbert
2005/0038707 A1 2/2005 Roever et al.
2005/0038724 A1 2/2005 Roever et al.
2005/0038863 A1 2/2005 Onyon et al.
2005/0041793 A1 2/2005 Fulton et al.
2005/0044144 A1 2/2005 Malik et al.
2005/0055578 A1 3/2005 Wright et al.
2005/0063544 A1 3/2005 Uusitalo et al.
2005/0071489 A1 3/2005 Parupudi et al.
2005/0071674 A1 3/2005 Chou et al.
2005/0073982 A1 4/2005 Corneille et al.
2005/0076136 A1 4/2005 Cho et al.
2005/0076241 A1 4/2005 Appelman
2005/0086540 A1 4/2005 Gunter et al.
2005/0094625 A1 5/2005 Bouat
2005/0097225 A1 5/2005 Glatt et al.
2005/0097570 A1 5/2005 Bomers
2005/0101307 A1 5/2005 Brugge et al.
2005/0102257 A1 5/2005 Onyon et al.
2005/0102328 A1 5/2005 Ring et al.
2005/0102351 A1 5/2005 Jiang et al.
2005/0108427 A1 5/2005 Datta
2005/0117606 A1 6/2005 Kim
2005/0120082 A1 6/2005 Hesselink et al.
2005/0120084 A1 6/2005 Hu et al.
2005/0120181 A1 6/2005 Arunagirinathan et al.
2005/0122333 A1 6/2005 Sumanaweera et al.
2005/0124332 A1 6/2005 Clark et al.
2005/0138111 A1 6/2005 Aton et al.
2005/0138176 A1 6/2005 Singh et al.
2005/0144219 A1 6/2005 Terada
2005/0147130 A1 7/2005 Hurwitz et al.
2005/0154698 A1 7/2005 Ikezawa et al.
2005/0154796 A1 7/2005 Forsyth
2005/0154836 A1 7/2005 Steely et al.
2005/0155027 A1 7/2005 Wei
2005/0164703 A1 7/2005 Huynh
2005/0164721 A1 7/2005 Eric Yeh et al.
2005/0165909 A1 7/2005 Cromer et al.
2005/0170776 A1 8/2005 Siorpaes
2005/0183143 A1 8/2005 Anderholm et al.
2005/0188038 A1 8/2005 Yabe
2005/0193036 A1 9/2005 Phillips et al.
2005/0193096 A1 9/2005 Yu et al.
2005/0198170 A1 9/2005 LeMay et al.
2005/0203966 A1 9/2005 Labrou et al.
2005/0210104 A1 9/2005 Torvinen
2005/0210125 A1 9/2005 Li
2005/0222891 A1 10/2005 Chan et al.
2005/0228812 A1 10/2005 Hansmann et al.
2005/0232295 A1 10/2005 Young
2005/0234860 A1 10/2005 Roever et al.
2005/0235214 A1 10/2005 Shimizu et al.
2005/0246139 A1 11/2005 Rivenbark et al.
2005/0248526 A1 11/2005 Twerdahl et al.
2005/0251555 A1 11/2005 Little, II
2005/0254443 A1 11/2005 Campbell et al.
2005/0262220 A1 11/2005 Ecklund et al.
2005/0273804 A1 12/2005 Preisman
2005/0278307 A1 12/2005 Battagin et al.
2005/0278641 A1 12/2005 Mansour et al.
2005/0278647 A1 12/2005 Leavitt et al.
2005/0288006 A1 12/2005 Apfel
2006/0012672 A1 1/2006 Schrader et al.
2006/0020525 A1 1/2006 Borelli et al.
2006/0020580 A1 1/2006 Dettinger et al.
2006/0020804 A1 1/2006 Schleifer et al.
2006/0020947 A1 1/2006 Hallamaa et al.
2006/0021023 A1 1/2006 Stewart et al.
2006/0022048 A1 2/2006 Johnson
2006/0026580 A1 2/2006 Cabillic et al.
2006/0029062 A1 2/2006 Rao et al.
2006/0029063 A1 2/2006 Rao et al.
2006/0029064 A1 2/2006 Rao et al.
2006/0031114 A1 2/2006 Zommers
2006/0031300 A1 2/2006 Kock et al.
2006/0031365 A1 2/2006 Kay et al.
2006/0031428 A1 2/2006 Wikman
2006/0031785 A1 2/2006 Raciborski
2006/0037071 A1 2/2006 Rao et al.
2006/0046686 A1 3/2006 Hawkins et al.
2006/0047844 A1 3/2006 Deng
2006/0048061 A1 3/2006 Forlenza et al.
2006/0052091 A1 3/2006 Onyon et al.
2006/0052137 A1 3/2006 Randall et al.
2006/0059239 A1* 3/2006 Kouznetsov et al. 709/206
2006/0059495 A1 3/2006 Spector
2006/0063544 A1 3/2006 Zhao et al.
2006/0069686 A1 3/2006 Beyda et al.
2006/0069687 A1 3/2006 Cui et al.
2006/0069715 A1 3/2006 Vayssiere
2006/0069742 A1 3/2006 Segre
2006/0069746 A1 3/2006 Davis et al.
2006/0073810 A1 4/2006 Pyhalammi et al.
2006/0074951 A1 4/2006 Beier et al.
2006/0075028 A1 4/2006 Zager et al.
2006/0084410 A1 4/2006 Sutaria et al.
2006/0085503 A1 4/2006 Stoye et al.
2006/0093026 A1 5/2006 Montojo et al.
2006/0093135 A1 5/2006 Fiatal et al.
2006/0095768 A1* 5/2006 Hoshino et al. 713/168
2006/0095969 A1 5/2006 Portolani et al.
2006/0099969 A1 5/2006 Staton et al.
2006/0099970 A1 5/2006 Morgan et al.
2006/0112177 A1 5/2006 Barkley et al.
2006/0123042 A1 6/2006 Xie et al.
2006/0132495 A1 6/2006 Anderson
2006/0141962 A1 6/2006 Forbes et al.
2006/0143464 A1 6/2006 Ananthanarayanan et al.
2006/0149591 A1 7/2006 Hanf et al.
2006/0149843 A1 7/2006 Rhoads et al.
2006/0149970 A1 7/2006 Imazu
2006/0155822 A1 7/2006 Yang et al.
2006/0161621 A1 7/2006 Rosenberg
2006/0165060 A1* 7/2006 Dua 370/352
2006/0165226 A1 7/2006 Ernst et al.
2006/0167969 A1 7/2006 Andreev et al.
2006/0168043 A1 7/2006 Eisenberger et al.
2006/0168164 A1 7/2006 Lemson
2006/0179410 A1 8/2006 Deeds

(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0188864 A1 8/2006 Shah
2006/0190428 A1 8/2006 Jung et al.
2006/0190569 A1 8/2006 Neil et al.
2006/0190984 A1 8/2006 Heard et al.
2006/0192014 A1 8/2006 Hamilton et al.
2006/0195570 A1 8/2006 Zellner et al.
2006/0209842 A1 9/2006 Creamer et al.
2006/0212531 A1 9/2006 Kikkawa et al.
2006/0224629 A1 10/2006 Alexander et al.
2006/0230394 A1 10/2006 Forth et al.
2006/0240804 A1 10/2006 Backholm et al.
2006/0240805 A1 10/2006 Backholm et al.
2006/0242137 A1 10/2006 Shah et al.
2006/0242210 A1 10/2006 Ring et al.
2006/0242320 A1 10/2006 Nettle et al.
2006/0242607 A1 10/2006 Hudson
2006/0252435 A1 11/2006 Henderson et al.
2006/0253456 A1 11/2006 Pacholec et al.
2006/0253605 A1 11/2006 Sundarrajan et al.
2006/0259923 A1 11/2006 Chiu
2006/0265595 A1 11/2006 Scottodiluzio
2006/0271884 A1 11/2006 Hurst
2006/0277265 A1 12/2006 Backholm et al.
2006/0277271 A1 12/2006 Morse et al.
2006/0294071 A1 12/2006 Weare et al.
2006/0294223 A1 12/2006 Glasgow et al.
2007/0005738 A1 1/2007 Alexion-Tiernan et al.
2007/0006317 A1 1/2007 Asami et al.
2007/0011367 A1 1/2007 Scott et al.
2007/0019610 A1 1/2007 Backholm et al.
2007/0022118 A1 1/2007 Layne
2007/0027775 A1 2/2007 Hwang
2007/0027832 A1 2/2007 Fiatal et al.
2007/0027886 A1 2/2007 Gent et al.
2007/0027917 A1 2/2007 Ariel et al.
2007/0027920 A1 2/2007 Alvarado et al.
2007/0027921 A1 2/2007 Alvarado et al.
2007/0027930 A1 2/2007 Alvarado et al.
2007/0033531 A1 2/2007 Marsh
2007/0038567 A1 2/2007 Allaire et al.
2007/0038931 A1 2/2007 Allaire et al.
2007/0044041 A1 2/2007 Beynon et al.
2007/0049258 A1 3/2007 Thibeault
2007/0060196 A1 3/2007 Sharma
2007/0061393 A1 3/2007 Moore
2007/0067147 A1 3/2007 Huang
2007/0067381 A1 3/2007 Grant et al.
2007/0067424 A1 3/2007 Raciborski et al.
2007/0070931 A1 3/2007 Lewis et al.
2007/0072617 A1 3/2007 Lewis et al.
2007/0078857 A1 4/2007 Punaganti et al.
2007/0078964 A1 4/2007 East et al.
2007/0088790 A1* 4/2007 Shenfield et al. 709/206
2007/0088852 A1 4/2007 Levkovitz
2007/0105627 A1 5/2007 Campbell
2007/0111764 A1 5/2007 Park et al.
2007/0116223 A1 5/2007 Burke et al.
2007/0118620 A1 5/2007 Cartmell et al.
2007/0123214 A1 5/2007 Mock
2007/0130108 A1 6/2007 Simpson et al.
2007/0130217 A1 6/2007 Linyard et al.
2007/0140193 A1 6/2007 Dosa et al.
2007/0147317 A1 6/2007 Smith et al.
2007/0147411 A1 6/2007 Bijwaard et al.
2007/0150881 A1 6/2007 Khawand et al.
2007/0156824 A1 7/2007 Thompson
2007/0156842 A1 7/2007 Vermeulen et al.
2007/0162514 A1 7/2007 Civetta et al.
2007/0167178 A1 7/2007 Al-Harbi
2007/0174433 A1 7/2007 Mendez et al.
2007/0175998 A1 8/2007 Lev
2007/0198698 A1 8/2007 Boyd et al.
2007/0220080 A1 9/2007 Humphrey
2007/0220099 A1 9/2007 Di Giorgio et al.
2007/0233855 A1 10/2007 Brown et al.
2007/0237318 A1 10/2007 McGary
2007/0245010 A1 10/2007 Arn et al.
2007/0249365 A1 10/2007 Jendbro
2007/0250591 A1 10/2007 Milic-Frayling et al.
2007/0254631 A1 11/2007 Spooner
2007/0255848 A1 11/2007 Sewall et al.
2007/0264993 A1 11/2007 Hughes
2007/0267492 A1 11/2007 Maclaine Pont
2007/0276925 A1 11/2007 LaJoie et al.
2007/0276926 A1 11/2007 LaJoie et al.
2007/0288469 A1 12/2007 Shenfield
2007/0290787 A1 12/2007 Fiatal et al.
2007/0293207 A1 12/2007 Guedalia et al.
2007/0293238 A1 12/2007 Fiatal et al.
2007/0293958 A1 12/2007 Stehle et al.
2007/0294295 A1 12/2007 Finkelstein et al.
2007/0294763 A1 12/2007 Udezue et al.
2007/0296701 A1 12/2007 Pope et al.
2007/0299918 A1 12/2007 Roberts
2008/0001717 A1 1/2008 Fiatal
2008/0008095 A1 1/2008 Gilfix
2008/0009344 A1 1/2008 Graham et al.
2008/0016236 A1 1/2008 Beverly et al.
2008/0032718 A1 2/2008 Suresh
2008/0034031 A1 2/2008 Weisbrot et al.
2008/0037787 A1 2/2008 Boynton et al.
2008/0059308 A1 3/2008 Gerken
2008/0059398 A1 3/2008 Tsutsui
2008/0061142 A1 3/2008 Howcroft et al.
2008/0068519 A1 3/2008 Adler et al.
2008/0077506 A1 3/2008 Rampell et al.
2008/0077571 A1 3/2008 Harris et al.
2008/0085719 A1 4/2008 Kuchibhotla et al.
2008/0085724 A1 4/2008 Cormier et al.
2008/0086379 A1 4/2008 Dion et al.
2008/0086773 A1 4/2008 Tuvell et al.
2008/0091773 A1 4/2008 Hameen-Anttila
2008/0103877 A1 5/2008 Gerken
2008/0104666 A1 5/2008 Dillaway
2008/0108298 A1 5/2008 Selen et al.
2008/0114881 A1 5/2008 Lee et al.
2008/0125225 A1 5/2008 Lazaridis et al.
2008/0130663 A1 6/2008 Fridman et al.
2008/0133326 A1 6/2008 Goncalves et al.
2008/0133641 A1 6/2008 Gent et al.
2008/0133708 A1 6/2008 Alvarado et al.
2008/0133729 A1* 6/2008 Fridman et al. 709/223
2008/0134292 A1 6/2008 Ariel et al.
2008/0140665 A1 6/2008 Ariel et al.
2008/0151817 A1 6/2008 Fitchett et al.
2008/0154870 A1 6/2008 Evermann et al.
2008/0155613 A1 6/2008 Benya et al.
2008/0163318 A1 7/2008 Chen et al.
2008/0166999 A1 7/2008 Guedalia et al.
2008/0167019 A1 7/2008 Guedalia et al.
2008/0168145 A1 7/2008 Wilson
2008/0178294 A1 7/2008 Hu et al.
2008/0183800 A1 7/2008 Herzog et al.
2008/0192820 A1 8/2008 Brooks et al.
2008/0198995 A1 8/2008 McGary et al.
2008/0201362 A1 8/2008 Multer et al.
2008/0201751 A1 8/2008 Ahmed et al.
2008/0204921 A1* 8/2008 Takahashi et al. 360/71
2008/0207182 A1 8/2008 Maharajh et al.
2008/0209491 A1 8/2008 Hasek
2008/0214148 A1 9/2008 Ramer et al.
2008/0216094 A1 9/2008 Anderson et al.
2008/0220797 A1 9/2008 Meiby et al.
2008/0232290 A1 9/2008 Elzur et al.
2008/0233983 A1 9/2008 Park et al.
2008/0242370 A1 10/2008 Lando et al.
2008/0263170 A1 10/2008 Caron et al.
2008/0270379 A1 10/2008 Ramakrishna
2008/0273498 A1 11/2008 Jalil et al.
2008/0281798 A1 11/2008 Chatterjee et al.
2008/0288659 A1 11/2008 Hasha et al.
2008/0298386 A1 12/2008 Fiatal
2008/0299956 A1 12/2008 Bailey et al.
2008/0301231 A1 12/2008 Mehta et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2008/0301300 A1 12/2008 Toub
2008/0307035 A1 12/2008 Burckart et al.
2008/0307219 A1* 12/2008 Karandikar 713/153
2008/0313282 A1 12/2008 Warila et al.
2009/0010204 A1 1/2009 Pratt, Jr. et al.
2009/0010259 A1 1/2009 Sirotkin
2009/0012841 A1 1/2009 Saft et al.
2009/0016526 A1 1/2009 Fiatal et al.
2009/0019485 A1 1/2009 Ellis et al.
2009/0019532 A1 1/2009 Jacobsen et al.
2009/0024794 A1 1/2009 Iyer et al.
2009/0031006 A1 1/2009 Johnson
2009/0052372 A1 2/2009 Durazzo et al.
2009/0054034 A1 2/2009 Backholm et al.
2009/0055353 A1 2/2009 Meema
2009/0059950 A1 3/2009 Gao et al.
2009/0063647 A1 3/2009 Backholm et al.
2009/0075683 A1 3/2009 Backholm et al.
2009/0077263 A1 3/2009 Koganti et al.
2009/0077277 A1* 3/2009 Vidal et al. 710/46
2009/0077326 A1 3/2009 Motohashi
2009/0094317 A1 4/2009 Venkitaraman
2009/0100416 A1 4/2009 Brown et al.
2009/0110179 A1 4/2009 Elsey et al.
2009/0119266 A1 5/2009 Fitzpatrick et al.
2009/0125523 A1 5/2009 Fitzpatrick et al.
2009/0144359 A1* 6/2009 Karlsen et al. 709/203
2009/0144632 A1 6/2009 Mendez
2009/0147008 A1 6/2009 Do et al.
2009/0149203 A1 6/2009 Backholm et al.
2009/0156178 A1 6/2009 Elsey et al.
2009/0157792 A1 6/2009 Fiatal
2009/0164433 A1 6/2009 R et al.
2009/0164560 A1 6/2009 Fiatal
2009/0172565 A1 7/2009 Jackson et al.
2009/0181641 A1 7/2009 Fiatal
2009/0182500 A1 7/2009 Dicke
2009/0187939 A1 7/2009 Lajoie
2009/0191903 A1 7/2009 Fiatal
2009/0193130 A1 7/2009 Fiatal
2009/0193338 A1 7/2009 Fiatal
2009/0215504 A1 8/2009 Lando
2009/0221326 A1 9/2009 Roussel et al.
2009/0228545 A1 9/2009 Mendez et al.
2009/0234861 A1 9/2009 Ramer et al.
2009/0241180 A1 9/2009 Fiatal
2009/0248670 A1 10/2009 Fiatal
2009/0248696 A1 10/2009 Rowles et al.
2009/0248794 A1 10/2009 Helms et al.
2009/0248878 A1 10/2009 Tran et al.
2009/0252136 A1 10/2009 Mahany et al.
2009/0254589 A1 10/2009 Nair et al.
2009/0254971 A1 10/2009 Herz et al.
2009/0264138 A1 10/2009 Kang et al.
2009/0282125 A1 11/2009 Jeide et al.
2009/0286531 A1 11/2009 Bhatt et al.
2009/0287750 A1 11/2009 Banavar et al.
2009/0299817 A1 12/2009 Fok et al.
2009/0307133 A1 12/2009 Holloway et al.
2009/0318171 A1 12/2009 Backholm et al.
2009/0323678 A1 12/2009 Wang
2009/0325565 A1 12/2009 Backholm
2009/0327390 A1 12/2009 Tran et al.
2010/0042691 A1* 2/2010 Maguire 709/206
2010/0049872 A1 2/2010 Roskind
2010/0057924 A1 3/2010 Rauber et al.
2010/0069127 A1 3/2010 Fiennes
2010/0077035 A1 3/2010 Li et al.
2010/0077083 A1 3/2010 Tran et al.
2010/0083255 A1 4/2010 Bane et al.
2010/0087167 A1 4/2010 Tsurutome et al.
2010/0087184 A1* 4/2010 Stoev et al. 455/422.1
2010/0088722 A1 4/2010 Jiang
2010/0093273 A1 4/2010 Hohl
2010/0115050 A1 5/2010 Sultenfuss et al.
2010/0118190 A1 5/2010 Salfati et al.
2010/0131593 A1 5/2010 Kihara et al.
2010/0131617 A1 5/2010 Osborne et al.
2010/0146107 A1 6/2010 Fiatal
2010/0149975 A1 6/2010 Tripathi et al.
2010/0174735 A1 7/2010 Fiatal
2010/0174939 A1 7/2010 Vexler
2010/0186011 A1 7/2010 Magenheimer
2010/0207870 A1 8/2010 Cho
2010/0211651 A1 8/2010 Guedalia et al.
2010/0214984 A1 8/2010 Cho et al.
2010/0227594 A1 9/2010 De Vries
2010/0228863 A1 9/2010 Kawauchi
2010/0229096 A1 9/2010 Maiocco et al.
2010/0238915 A1 9/2010 Cayla et al.
2010/0250695 A1* 9/2010 Shenfield et al. 709/206
2010/0250706 A1 9/2010 Burckart et al.
2010/0250986 A1 9/2010 Black et al.
2010/0268757 A1 10/2010 Fisher
2010/0274922 A1* 10/2010 Reavely 709/238
2010/0274983 A1 10/2010 Murphy et al.
2010/0279662 A1 11/2010 Kuusinen et al.
2010/0293335 A1* 11/2010 Muthiah et al. 711/133
2010/0299223 A1 11/2010 Crouch
2010/0313018 A1 12/2010 Jorgensen
2010/0319054 A1 12/2010 Mehta et al.
2010/0322124 A1 12/2010 Luoma et al.
2010/0325306 A1 12/2010 Vimpari et al.
2011/0016195 A1* 1/2011 Kaplan et al. 709/219
2011/0019627 A1* 1/2011 Krishnaswamy et al. 370/329
2011/0028129 A1 2/2011 Hutchison et al.
2011/0040718 A1 2/2011 Tendjoukian et al.
2011/0065424 A1 3/2011 Estevez et al.
2011/0066646 A1 3/2011 Danado et al.
2011/0099363 A1 4/2011 Boynton et al.
2011/0113109 A1 5/2011 LeVasseur et al.
2011/0119134 A1 5/2011 Zivkovic et al.
2011/0126060 A1 5/2011 Grube et al.
2011/0138102 A1 6/2011 Glikson et al.
2011/0138402 A1 6/2011 Fleming
2011/0153728 A1* 6/2011 Einarsson et al. 709/203
2011/0153937 A1 6/2011 Annamalaisami et al.
2011/0158239 A1 6/2011 Mohaban
2011/0165889 A1 7/2011 Fiatal et al.
2011/0179138 A1 7/2011 Van Geest et al.
2011/0179377 A1 7/2011 Fleming
2011/0182220 A1 7/2011 Black et al.
2011/0184827 A1 7/2011 Hubert
2011/0185355 A1 7/2011 Chawla et al.
2011/0190014 A1 8/2011 Fiatal
2011/0191474 A1 8/2011 Fiatal
2011/0201304 A1 8/2011 Sutaria et al.
2011/0207436 A1 8/2011 van Gent et al.
2011/0208810 A1 8/2011 Li et al.
2011/0213800 A1 9/2011 Saros et al.
2011/0213898 A1 9/2011 Fiatal et al.
2011/0214182 A1 9/2011 Adams et al.
2011/0238772 A1 9/2011 Fiatal
2011/0246950 A1 10/2011 Luna et al.
2011/0252088 A1 10/2011 Fiatal
2011/0264622 A1 10/2011 Vargas et al.
2011/0264731 A1 10/2011 Knowles et al.
2011/0264905 A1* 10/2011 Ovsiannikov 713/151
2011/0294463 A1 12/2011 Fiatal
2011/0294464 A1 12/2011 Fiatal
2011/0296050 A1 12/2011 Cherukuri
2011/0296120 A1 12/2011 Khan
2011/0296415 A1 12/2011 Khan et al.
2011/0302154 A1 12/2011 Snyder
2011/0319071 A1* 12/2011 Beppler et al. 455/424
2012/0005276 A1* 1/2012 Guo et al. 709/206
2012/0008536 A1 1/2012 Tervahauta et al.
2012/0022980 A1 1/2012 Angelone
2012/0023190 A1 1/2012 Backholm et al.
2012/0023226 A1 1/2012 Petersen et al.
2012/0023236 A1 1/2012 Backholm et al.
2012/0030280 A1 2/2012 Wang et al.
2012/0030750 A1 2/2012 Bhargara et al.
2012/0054386 A1 3/2012 Hanes

(56) **References Cited**

U.S. PATENT DOCUMENTS

2012/0072910	A1	3/2012	Martin et al.	
2012/0077482	A1	3/2012	Backholm	
2012/0078996	A1	3/2012	Shah	
2012/0096092	A1	4/2012	Davidge et al.	
2012/0108225	A1	5/2012	Luna et al.	
2012/0110109	A1	5/2012	Luna et al.	
2012/0110110	A1	5/2012	Luna et al.	
2012/0110111	A1	5/2012	Luna et al.	
2012/0110112	A1	5/2012	Luna et al.	
2012/0110118	A1	5/2012	Luna et al.	
2012/0110171	A1	5/2012	Luna et al.	
2012/0110173	A1	5/2012	Luna et al.	
2012/0110174	A1	5/2012	Wootton et al.	
2012/0110275	A1	5/2012	Ganti et al.	
2012/0130973	A1	5/2012	Tamm et al.	
2012/0131095	A1	5/2012	Luna et al.	
2012/0131184	A1	5/2012	Luna et al.	
2012/0135726	A1	5/2012	Luna et al.	
2012/0140750	A1	6/2012	Yan et al.	
2012/0149352	A1	6/2012	Backholm et al.	
2012/0151044	A1	6/2012	Luna et al.	
2012/0157170	A1	6/2012	Backholm et al.	
2012/0158837	A1	6/2012	Kaul	
2012/0158908	A1	6/2012	Luna et al.	
2012/0170496	A1	7/2012	Yang et al.	
2012/0173616	A1	7/2012	Luna et al.	
2012/0174220	A1	7/2012	Rodriguez	
2012/0176968	A1	7/2012	Luna	
2012/0178414	A1	7/2012	Fiatal	
2012/0179801	A1	7/2012	Luna et al.	
2012/0185597	A1	7/2012	Luna	
2012/0185918	A1	7/2012	Backholm et al.	
2012/0210121	A1	8/2012	Boynton et al.	
2012/0226767	A1	9/2012	Luna et al.	
2012/0227059	A1	9/2012	Fleming	
2012/0246333	A1	9/2012	Fiatal	
2013/0064120	A1 *	3/2013	Bodog et al.	370/252

FOREIGN PATENT DOCUMENTS

EP	1422899	A1	5/2004
EP	1466261	A1	10/2004
EP	1466435	A1	10/2004
EP	1482702	A1	12/2004
EP	1815634	A1	8/2007
EP	1815652	A1	8/2007
EP	1817883	A1	8/2007
FI	117152	B	6/2006
FI	118288	B	9/2007
FI	119581	B	12/2008
JP	4154233	A	5/1992
JP	10-336372	A	12/1998
JP	2001-218185	A	8/2001
JP	2001-350718	A	12/2001
JP	2001-356973	A	12/2001
JP	2005-515664	T	5/2005
JP	2009-207177	A	9/2009
JP	4386732	B2	10/2009
JP	2010239366	A	10/2010
KR	2001-0018568	A	3/2001
KR	2006-0068186	A	6/2006
KR	2007-0071858	A1	7/2007
KR	10-0765238	B1	10/2007
KR	2007-0102091	A1	10/2007
KR	2007-0117874	A	12/2007
KR	2009-0077515	A	7/2009
KR	2010-0064605	A	6/2010
WO	WO 97/41661	A2	11/1997
WO	WO 98/24257	A1	6/1998
WO	WO 98/58322	A2	12/1998
WO	WO 01/30130	A2	5/2001
WO	WO 03/007570	A1	1/2003
WO	WO 03/058483	A1	7/2003
WO	WO 03/058879	A1	7/2003
WO	WO 03/065701	A1	8/2003
WO	WO 03/098890	A1	11/2003
WO	WO 2004/017591	A2	2/2004
WO	WO 2004/045171	A1	5/2004
WO	WO 2005/015925	A2	2/2005
WO	WO 2005/020108	A1	3/2005
WO	WO 2006/045005	A1	4/2006
WO	WO 2006/045102	A2	4/2006
WO	WO 2006/053952	A1	5/2006
WO	WO 2006/053954	A1	5/2006
WO	WO 2006/058967	A1	6/2006
WO	WO 2007/015725	A2	2/2007
WO	WO 2007/015726	A1	2/2007
WO	WO 2007/149526	A2	12/2007
WO	WO 2007/149540	A2	12/2007
WO	WO 2008/061042	A2	5/2008
WO	WO 2011/126889	A2	10/2011
WO	WO 2012/018430	A1	2/2012
WO	WO 2012/018431	A1	2/2012
WO	WO 2012/018477	A2	2/2012
WO	WO 2012/018479	A2	2/2012
WO	WO 2012/018556	A2	2/2012
WO	WO 2012/024030	A2	2/2012
WO	WO 2012/060995	A2	5/2012
WO	WO 2012/060996	A2	5/2012
WO	WO 2012/060997	A2	5/2012
WO	WO 2012/061430	A2	5/2012
WO	WO 2012/061433	A2	5/2012
WO	WO 2012/061437	A1	5/2012
WO	WO 2012/071283	A1	5/2012
WO	WO 2012/071384	A2	5/2012
WO	WO 2012/094675	A2	7/2012

OTHER PUBLICATIONS

Eronen, "TCP Wake-Up: Reducing Keep-Alive Traffic in Mobile IPv4 and Ipsec NAT Traversal," NRC-TR-2008-002, Nokia, 10 pages, Jan. 31, 2008.

International Application No. PCT/US2011/044974, International Search Report, 15 pages, Jun. 1, 2012.

International Application No. PCT/US2011/056474, International Search Report & Written Opinion, 9 pages, May 4, 2012.

International Application No. PCT/US2011/056476, International Search Report & Written Opinion, 12 pages, May 24, 2012.

International Application No. PCT/US2011/056478, International Search Report & Written Opinion, 11 pages, May 31, 2012.

International Application No. PCT/US2011/058840, International Search Report & Written Opinion, 10 pages, Apr. 26, 2012.

International Application No. PCT/US2011/058843, International Search Report & Written Opinion, 11 pages, May 16, 2012.

International Application No. PCT/US2011/058848, International Search Report & Written Opinion, 10 pages, Apr. 10, 2012.

International Application No. PCT/US2011/061512, International Search Report, 10 pages, May 10, 2012.

International Application No. PCT/US2011/061795, International Search Report & Written Opinion, 10 pages, Jul. 31, 2012.

International Application No. PCT/US2012/021459, International Search Report & Written Opinion, 10 pages, Jun. 1, 2012.

International Application No. PCT/US2012/022121, International Search Report & Written Opinion, 11 pages, May 14, 2012.

Newton, Harry, "Newton's Telecom Dictionary," 20th Edition, pp. 67, 127, 542, Mar. 2004.

Seven Networks, Inc., "Seven Optimizing the Mobile Ecosystem," www.seven.com/products.traffic_optimization.php, 1 page, May 29, 2012.

Wikipedia, Definition for "General Packet Radio Service," 7 pages, downloaded on May 31, 2012.

International Application No. PCT/US2012/020669, International Search Report & Written Opinion, 10 pages, Sep. 12, 2012.

Examination report from UKIPO for Application No. GB 1400632.4 mailed Feb. 19, 2014.

Allchin, James Edward, "An Architecture for Reliable Decentralized Systems," Ph.D. Thesis, Georgia Institute of Technology, 185 pages, Sep. 1983.

Android Developers, "Date," 10 pages, Oct. 27, 2011.

(56) **References Cited**

OTHER PUBLICATIONS

Augun, Audrey, "Integrating Lotus Notes With Enterprise Data," Lotus Notes Advisory, pp. 22-25, Jul.-Aug. 1996.
Balaban, Bob, "This Is Not Your Father's Basic: LotusScript in Notes Release 4," The View, vol. 1, Issue 5, 32 pages, Nov.-Dec. 1995.
Bedell, Doug, "Meeting Your New Best Friends Six Degrees Widens Your Contacts in Exchange for Sampling Web Sites," The Dallas Morning News, 4 pages, Oct. 27, 1998.
Bergman, Lawrence D. et al., "Programming-By-Demonstration for Behavior-Based User Interface Customization," IBM Research Report, RC23116, 5 pages, Feb. 20, 2004.
B'Far, Reza et al., "Designing Effective User Interfaces for Wireless Devices," Publication Unknown, 14 pages, Published prior to Feb. 23, 2006.
Blaney, Jeff, "You Can Take It With You—An Introduction to Mobile Computing With Notes R4," The View, vol. 2, Issue 1, 14 pages, Jan.-Feb. 1996.
Braden, R., "Requirements for Internet Hosts—Application and Support," RFC 1123, 80 pages, Oct. 1989.
Brown, Kevin et al., "Mastering Lotus Notes®," Sybex Inc., 996 pages, 1995.
"Chapter: About NotesPump," Publication Unknown, 480 pages, Published prior to Jan. 8, 2003.
"Chapter 13-1—Anatomy of a Note ID," Publication Unknown, 8 pages, Published prior to Jan. 8, 2003.
Cole, Barb et al., "Lotus Airs Notes-To-Database Integration Tool," Network World, 2 pages, Oct. 2, 1995.
"CR 3483 to Release 8 TS 25.331, Rev. 2," 3GPP TSG-RAN2 Meeting #64, Prague, Czech Republic, 11 pages, Nov. 10-14, 2008.
"CR 4100 to Release 8 TS 25.331, Rev. 1," 3GPP TSG-RAN WG2 Meeting #69, San Francisco, U.S., 6 pages, Feb. 22-26, 2010.
Dahl, Andrew, "Lotus Notes® 4 Administrator's Survival Guide," Sams Publishing, 64 pages, 1996.
Decker, Stefan et al., "The Social Semantic Desktop," Digital Enterprise Research Institute, DERI Technical Report May 2, 2004, 7 pages, May 2004.
Elz, R. et al., "Clarifications to the DNS Specification," RFC 2181, 12 pages, Jul. 1997.
European Patent Application No. EP 03705704.9, Supplementary European Search Report, 4 pages, Jun. 9, 2010.
European Patent Application No. EP 03707338.4, Supplementary European Search Report, 2 pages, Apr. 18, 2011.
European Patent Application No. EP 05815115.0, Supplementary European Search Report, 7 pages, Nov. 17, 2011.
Falkner, Mike, "How to Plan, Develop, and Implement Lotus Notes® in Your Organization," John Wiley & Sons, Inc., 539 pages, 1996.
Freeland, Pat et al., "Lotus Notes 3-3.1 for Dummies™," IDG Books Worldwide, 389 pages, 1994.
Frenkel, Garry, "Pumping for Info: Notes and Database Integration," Network Computing, 10 pages, May 1, 1996.
Gameline, Advertisement, 1 page, 1982.
Gewirtz, David, "Lotus Notes 3 Revealed!," Prima Publishing, 261 pages, 1994.
Grous, Paul J., "Creating and Managing a Web Site With Lotus Internotes Web Publisher," The View, vol. 1, Issue 4, 20 pages, Sep.-Oct. 1995.
GSM Association, "Network Efficiency Task Force Fast Dormancy Best Practices," V1.0, 21 pages, May 26, 2010.
Haas, Zygmunt J. et al., "Mobile-TCP: An Asymmetric Transport Protocol Design for Mobile Systems," IEEE, pp. 1054-1058, 1997.
Haas, Zygmunt J. et al., "The Design and Performance of Mobile TCP for Wireless Networks," Journal of High Speed Networks, vol. 10, pp. 187-207, 2001.
Hajdu, Kalman et al., "Lotus Notes Release 4 in a Multiplatform Environment," IBM Corporation, 173 pages, Feb. 1996.
Hardy, Ed, "Microsoft Proposes Two New Thumb-Driven User Interfaces," Brighthand Consulting, Inc., 2 pages, 2003.
IBM Corporation, "The Architecture of Lotus Notes," White Paper No. 114654, 26 pages, May 31, 1995.
IBM Corporation, "The History of Notes and Domino," Lotus Developer Domain, 11 pages, Sep. 29, 2003.
ImTOO, "ImTOO iPod Movie Converter," 3 pages, Nov. 9, 2005.
IntelliLink Corporation, "IntelliLink® for Windows User's Guide," Version 3.0, 167 pages, 1994.
International Application No. PCT/US2003/000618, International Search Report, 1 page, Apr. 4, 2003.
International Application No. PCT/US2003/000624, International Search Report, 2 pages, May 13, 2003.
International Application No. PCT/US2005/037702, International Preliminary Examination Report, 6 pages, Nov. 20, 2007.
International Application No. PCT/US2005/037702, International Search Report, 1 page, Nov. 5, 2007.
International Application No. PCT/US2005/037702, Written Opinion, 6 pages, Nov. 5, 2007.
International Application No. PCT/US2005/038135, International Search Report, 2 pages, Aug. 8, 2008.
International Application No. PCT/US2005/038135, Written Opinion, 8 pages, Aug. 8, 2008.
International Application No. PCT/US2005/038135, International Preliminary Report on Patentability, 9 pages, Oct. 31, 2011.
International Application No. PCT/FI2005/050424, International Search Report, 4 pages, Mar. 2, 2006.
International Application No. PCT/FI2005/050426, International Search Report, 3 pages, Mar. 1, 2006.
International Application No. PCT/FI2005/050441, International Search Report, 3 pages, Mar. 1, 2006.
International Application No. PCT/US2006/023426, International Search Report, 1 page, Feb. 21, 2007.
International Application No. PCT/US2006/023427, International Search Report, 1 page, Oct. 12, 2006.
International Application No. PCT/US2007/014462, International Search Report, 1 page, Jul. 2, 2008.
International Application No. PCT/US2007/014497, International Search Report, 1 page, Aug. 25, 2008.
International Application No. PCT/US2011/030534, International Search Report, 10 pages, Dec. 29, 2011.
International Application No. PCT/US2011/037932, International Search Report, 9 pages, Jan. 2, 2012.
International Application No. PCT/US2011/037943, International Search Report, 11 pages, Jan. 2, 2012.
International Application No. PCT/US2011/043322, International Search Report, 9 pages, Feb. 9, 2012.
International Application No. PCT/US2011/043328, International Search Report, 12 pages, Feb. 27, 2012.
International Application No. PCT/US2011/043409, International Search Report, 11 pages, Feb. 9, 2012.
Japanese Patent Application No. 2003-558726, Office Action, 2 pages, Jun. 10, 2008.
Karlson, Amy K. et al., "AppLens and LaunchTile: Two Designs for One-Handed Thumb Use on Small Devices," Proceedings of CHI 2005, 10 pages, Apr. 2-7, 2005.
Kent, S. et al., "Security Architecture for the Internet Protocol," RFC 2401, The Internet Society, 62 pages, Nov. 1998.
Kleinberg, Jon, "The Small-World Phenomenon: An Algorithmic Perspective," Cornell Computer Science Technical Report 99-1776, 14 pages, Oct. 1999.
Koeppel, Dan, "GUIs Just Want to Have Fun," Wired Magazine, Issue 8.10, 12 pages, Oct. 2000.
Kornblith, Polly Russell, "Lotus Notes Answers: Certified Tech Support," Covers Release 3, McGraw-Hill, Inc., 326 pages, 1994.
Kreisle, Bill, "Teach Yourself . . . Lotus Notes 4," MIS Press, 464 pages, 1996.
Lamb, John P. et al., "Lotus Notes Network Design," McGraw-Hill, 278 pages, 1996.
Londergan, Stephen et al., "Lotus Notes® Release 4 for Dummies®," IDG Books Worldwide, 229 pages, 1996.
Lotus Development Corporation, "Firewall Security Overview and How Firewalls Relate to Lotus Notes," Lotus Notes Knowledge Base, 9 pages, May 22, 1996.
Lotus Development Corporation, "How to Set Up 'Firewall' Protection for a Notes Domain," Lotus Notes Knowledge Base, 2 pages, Nov. 6, 1995.

(56) **References Cited**

OTHER PUBLICATIONS

Lotus Development Corporation, "Lotus Announces Lotus NotesPump 1.0," Lotus Notes Knowledge Base, 6 pages, Oct. 31, 1995.
Lotus Development Corporation, "Lotus Inside Notes—The Architecture of Notes and the Domino Server," 207 pages, 2000.
Lotus Development Corporation, "Lotus NotesPump 1.0 Q & A," Lotus Notes Knowledge Base, 3 pages, Oct. 31, 1995.
Lotus Development Corporation, "Lotus NotesPump: Database Integration for Lotus Notes," Lotus Notes Knowledge Base, 5 pages, Oct. 31, 1995.
Lotus Development Corporation, "Lotus Notes Administration," Release 3.3, 20 pages, 1995.
Lotus Development Corporation, "Lotus Notes Administrator's Guide," Release 4, 499 pages, 1995.
Lotus Development Corporation, "Lotus Notes Administrator's Guide—Server for NetWare, OS-2, and Unix," Release 3.1, 509 pages, 1994.
Lotus Development Corporation, "Lotus Notes Administrator's Guide—Server for Windows," Release 3.1, 345 pages, 1994.
Lotus Development Corporation, "Lotus Notes Application Developer's Guide," Release 4, 475 pages, 1995.
Lotus Development Corporation, "Lotus Notes Customer Service Application Guide," Release 3.1, 46 pages, 1994.
Lotus Development Corporation, "Lotus Notes Customer Support Guide," 33 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Customer Support Guide—North American Guide," Release 4.1, 51 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Database Manager's Guide," Release 4, 115 pages, 1995.
Lotus Development Corporation, "Lotus Notes Deployment Guide," Release 4, 104 pages, 1995.
Lotus Development Corporation, "Lotus Notes for Windows, OS-2, and Macintosh," Release 3.3, 89 pages, 1995.
Lotus Development Corporation, "Lotus Notes Getting Started With Application Development," Release 3.1, 151 pages, 1994.
Lotus Development Corporation, "Lotus Notes Install Guide for Servers," Release 4, 68 pages, 1996.
Lotus Development Corporation, "Lotus Notes Install Guide for Workstations," Release 4, 28 pages, 1995.
Lotus Development Corporation, "Lotus Notes Install Guide for Workstations," Release 4.1, 67 pages, 1996.
Lotus Development Corporation, "Lotus Notes Install Guide for Workstations," Release 4.5, 81 pages, 1996.
Lotus Development Corporation, "Lotus Notes Internet Cookbook for Notes Release 3," 21 pages, Jan. 16, 1996.
Lotus Development Corporation, "Lotus Notes Internet Cookbook for Notes Release 4," 35 pages, Feb. 14, 1996.
Lotus Development Corporation, "Lotus Notes Internotes Web Navigator Administrator's Guide," Release 4, 60 pages, 1995.
Lotus Development Corporation, "Lotus Notes Internotes Web Navigator User's Guide," Release 4, 56 pages, 1995.
Lotus Development Corporation, "Lotus Notes Internotes Web Publisher Guide," Release 4, 122 pages, 1996.
Lotus Development Corporation, "Lotus Notes LotusScript Classes for Notes," Release 4, 6 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Migration Guide," Release 4, 110 pages, 1996.
Lotus Development Corporation, "Lotus Notes Network Configuration Guide," Release 4.5, 121 pages, 1996.
Lotus Development Corporation, "Lotus Notes Network Driver Documentation," Release 3.1, 100 pages, 1994.
Lotus Development Corporation, "Lotus Notes Programmer's Guide—Part 1," Release 4, 614 pages, 1995.
Lotus Development Corporation, "Lotus Notes Programmer's Guide—Part 2," Release 4, 462 pages, 1995.
Lotus Development Corporation, "Lotus Notes Quick Reference for Application Developers," Release 3, 6 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Quick Reference for Macintosh," Release 3, 6 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Quick Reference for SmartIcons," Release 3.1, 4 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Quick Reference for Windows and Presentation Manager," Release 3, 6 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "Lotus Notes Release Notes," Release 4, 139 pages, 1995.
Lotus Development Corporation, "Lotus Notes Release Notes," Release 4.1, 197 pages, 1996.
Lotus Development Corporation, "Lotus Notes Server for Windows," Release 3.3, 7 pages, 1994.
Lotus Development Corporation, "Lotus Notes Server Up and Running!," Release 4, 13 pages, 1996.
Lotus Development Corporation, "Lotus Notes Site and Systems Planning Guide," Release 3.1, 169 pages, 1994.
Lotus Development Corporation, "Lotus Notes Start Here—Workstation Install for Windows, OS-2 and Macintosh," Release 3.3, 47 pages, 1995.
Lotus Development Corporation, "Lotus Notes Step by Step—A Beginner's Guide to Lotus Notes," Release 4, 179 pages, 1995.
Lotus Development Corporation, "Lotus Notes Step by Step—A Beginner's Guide to Lotus Notes," Release 4.1, 167 pages, 1996.
Lotus Development Corporation, "Lotus Software Agreement," 8 pages, Published prior to Jan. 8, 2003.
Lotus Development Corporation, "What Is the Notes Replicator?," Lotus Notes Knowledge Base, 8 pages, Jul. 5, 1995.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Jun. 1995.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Aug. 1995.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Oct. 1995.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Dec. 1995.
"Lotus Notes Advisor," Advisor Publications Inc., 63 pages, Jan.-Feb. 1996.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Apr. 1996.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Jun. 1996.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Aug. 1996.
"Lotus Notes Advisor," Advisor Publications Inc., 55 pages, Oct. 1996.
"Lotus Notes Advisor," Advisor Publications Inc., 63 pages, Dec. 1996.
"Lotus Notes—Notes Administration Help," Screen Shots, 17 pages, Published prior to Jan. 8, 2003.
MacGregor, Rob et al., "The Domino Defense: Security in Lotus Notes and the Internet," IBM Corporation, 183 pages, Dec. 1997.
Maltz, David A. et al., "MSOCKS: An Architecture for Transport Layer Mobility," IEEE, pp. 1037-1045, 1998.
Marmel, Elaine, "Easy Lotus® Notes Release 4.0," Que Corporation, 237 pages, 1996.
Mason, Luke, "Windows XP: New GUI Design Shows Skin Is In," TechRepublic, 4 pages, Apr. 4, 2001.
McMullen, Melanie, "Network Remote Access and Mobile Computing," Miller Freeman Inc., 226 pages, 1994.
Microsoft, Definition of "Access," Microsoft Computer Dictionary, Fifth Edition, 2 pages, May 1, 2002.
Microsoft, Definition of "Synchronization," Microsoft Computer Dictionary, Fifth Edition, 2 pages, May 1, 2002.
Milgram, Stanley, "The Small-World Problem," Psychology Today, vol. 2, pp. 60-67, 1967.
Miller, Victor S., "Use of Elliptic Curves in Cryptography," Advances in Cryptology—CRYPTO '85 Proceedings, vol. 218, pp. 417-426, 1985.
Mockapetris, P., "Domain Names—Concepts and Facilities," RFC 1034, 43 pages, Nov. 1987.
Mockapetris, P., "Domain Names—Implementation and Specification," RFC 1035, 43 pages, Nov. 1987.

(56) **References Cited**

OTHER PUBLICATIONS

Myers, Brad A. et al., "Extending the Windows Desktop Interface With Connected Handheld Computers," WSS'00 Proceedings of the 4th Conference on USENIX Windows Systems Symposium, vol. 4, 10 pages, 2000.
Myers, Brad A. et al., "User Interfaces That Span Hand-Held and Fixed Devices," CHI'2001 Workshop on Distributed and Disappearing User Interfaces in Ubiquitous Computer, 4 pages, 2001.
National Institute of Standards and Technology, "Advanced Encryption Standard (AES)," Federal Information Processing Standards Publication 197, 52 pages, Nov. 26, 2001.
National Institute of Standards and Technology, "Secure Hash Standard," Federal Information Processing Standards Publication 180-2, 83 pages, Aug. 1, 2002.
Netscape Communications Corporation, "Netscape Mail Server Administrator's Guide," Version 2.0, 172 pages, 1996.
Netscape Communications Corporation, "Netscape Mail Server Installation Guide," Version 2.0 for Unix, 62 pages, 1996.
Netscape Communications Corporation, "Netscape Mail Server User's Guide," Version 2.0, 35 pages, 1996.
Netscape Communications Corporation, "Netscape News Server Administrator's Guide for Windows NT," Version 2.0, 119 pages, 1996.
Niederée, Claudia et al., "A Multi-Dimensional, Unified User Model for Cross-System Personalization," Proceedings of the AVI 2004 Workshop on Environments for Personalized Information Access, 11 pages, 2004.
Nokia, "Developer Platforms," 3 games, 2005.
"NotesPump 1.0 Release Notes," Publication Unknown, 8 pages, Published prior to Jan. 8, 2003.
Opyt, Barbara et al., "Use the Internet as Your Lotus Notes WAN," Lotus Notes Advisor, pp. 17-20, Nov.-Dec. 1996.
Ortiz, C. Enrique, "An Introduction to the Symbian OS™ Platform for Palm OS® Developers," Metrowerks Corp., 21 pages, 2002.
"Overview—What Is Lotus NotesPump?," Publication Unknown, 88 pages, Published prior to Jan. 8, 2003.
Perez, Sarah, "Onavo's Data-Compressing Mobile App Raises $10 Million Series B From Horizons, Motorola Ventures," 2 pages, Jan. 24, 2012.
Phillips, Joshua et al., "Modeling the Intelligence Analysis Process for Intelligent User Agent Development," Research and Practice in Human Resource Management, vol. 9, No. 1, pp. 59-73, 2001.
Pyle, Hugh, "The Architecture of Lotus Notes," Lotus Notes Advisor, Premiere Issue, pp. 18-27, 1995.
Pyle, Lisa, "A Jump Start to the Top Ten R3-To-R4 Migration Considerations," The View, vol. 1, Issue 5, 22 pages, Nov.-Dec. 1995.
Qualcomm Incorporated, "Managing Background Data Traffic in Mobile Devices," 16 pages, Jan. 2012.
Qualcomm, "System Parameter Recommendations to Optimize PS Data User Experience and UE Battery Life," 80-W1112-1, Revision B, 9 pages, Mar. 2007.
Ringel, Meredith et al., "iStuff: A Scalable Architecture for Lightweight, Wireless Devices for Ubicomp User Interfaces," Proceedings of UbiComp 2002, 2 pages, 2002.
Shafran, Andrew Bryce, "Easy Lotus Notes® for Windows™," Que Corporation, 199 pages, 1994.
Signorini, Eugene, "SEVEN's Service-Based Wireless Solutions Enable Enterprises to Untether E-Mail," Wireless/Mobile Enterprise & Commerce, 16 pages, Oct. 2004.
Swedeen, Bret et al., "Under the Microscope—Domino Replication," LDD Today, 8 pages, Oct. 1, 1998.
Tamura, Randall A., "Lotus® Notes™ 4 Unleashed," Sams Publishing, 928 pages, 1996.
U.S. Appl. No. 60/663,463, File History, 113 pages, Mar. 18, 2005.
Vivacqua, Adriana et al., "Profiling and Matchmaking Strategies in Support of Opportunistic Collaboration," CoopIS/DOA/ODBASE 2003, LNCS 2888, pp. 162-177, 2003.
Wainwright, Andrew, "Secrets to Running Lotus Notes: The Decisions No One Tells You How to Make," IBM Corporation, 193 pages, Oct. 1996.
Wilcox, Adam A., "PC Learning Labs Teaches Lotus Notes 3.0," Ziff-Davis Press, 381 pages, 1993.
Wong, Harry, "Casahl's Replic-Action: Delivering True Notes—DBMS Integration," The View, vol. 2, Issue 1, pp. 33-50, Jan.-Feb. 1996.
Non-Final Office Action mailed Apr. 15, 2015 for U.S. Appl. No. 13/547,001.

* cited by examiner

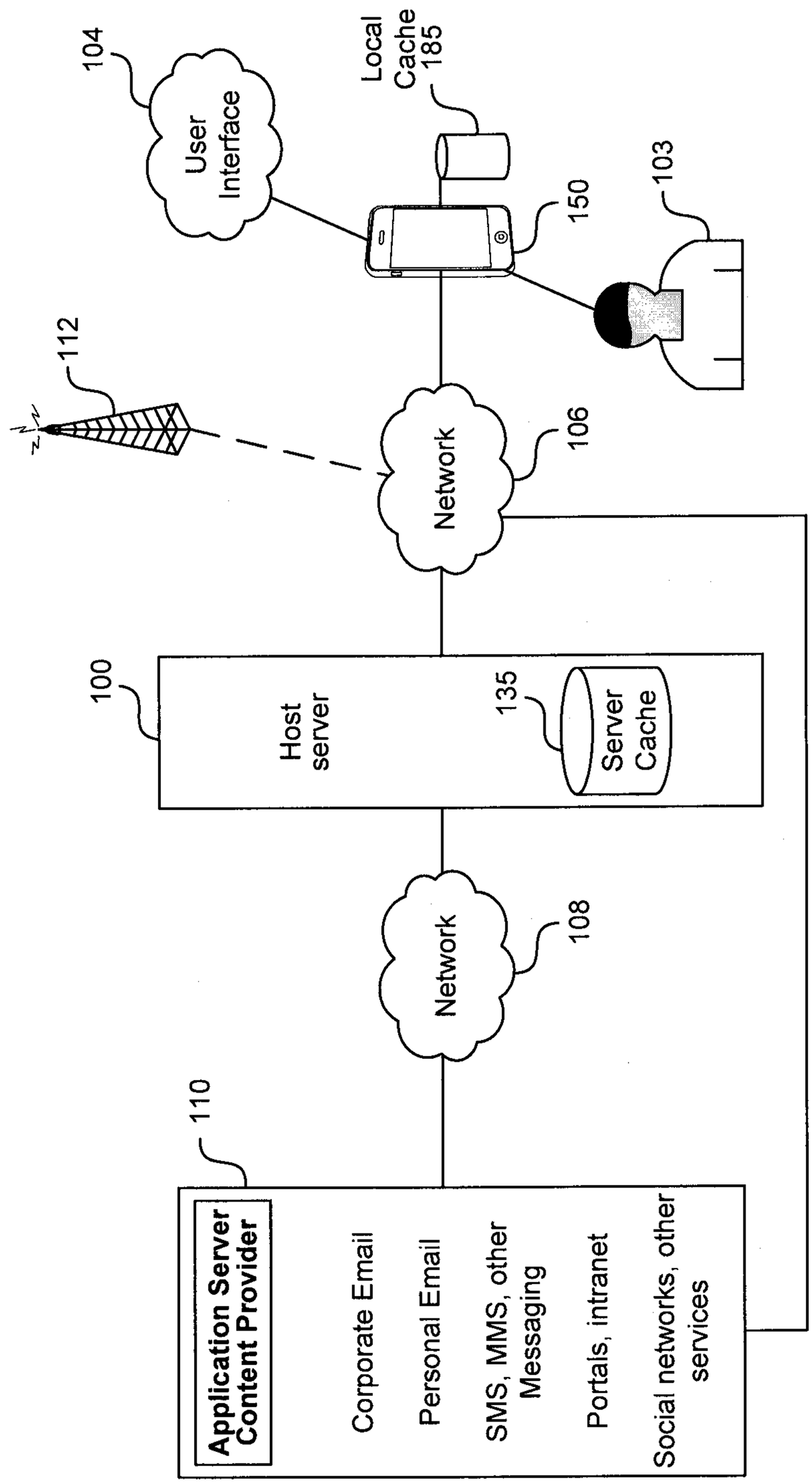

104
User Interface
Local Cache 185
150
103
112
Network
106
100
Host server
135
Server Cache
Network
108
110
Application Server Content Provider
Corporate Email
Personal Email
SMS, MMS, other Messaging
Portals, intranet
Social networks, other services

FIG. 1A

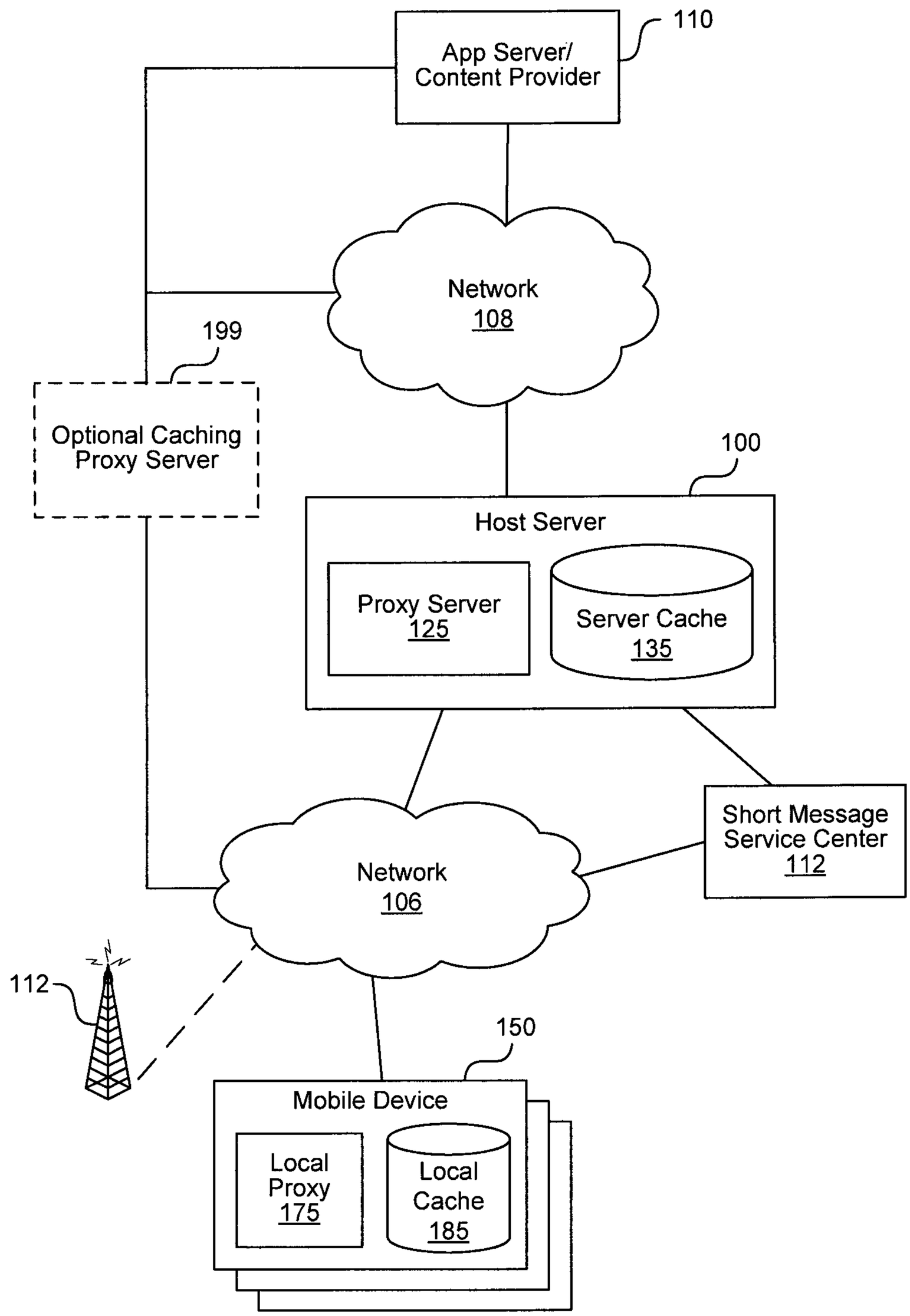

App Server/
Content Provider
110
Network
108
199
Optional Caching
Proxy Server
100
Host Server
Proxy Server
125
Server Cache
135
Short Message
Service Center
112
Network
106
112
150
Mobile Device
Local
Proxy
175
Local
Cache
185

FIG. 1B

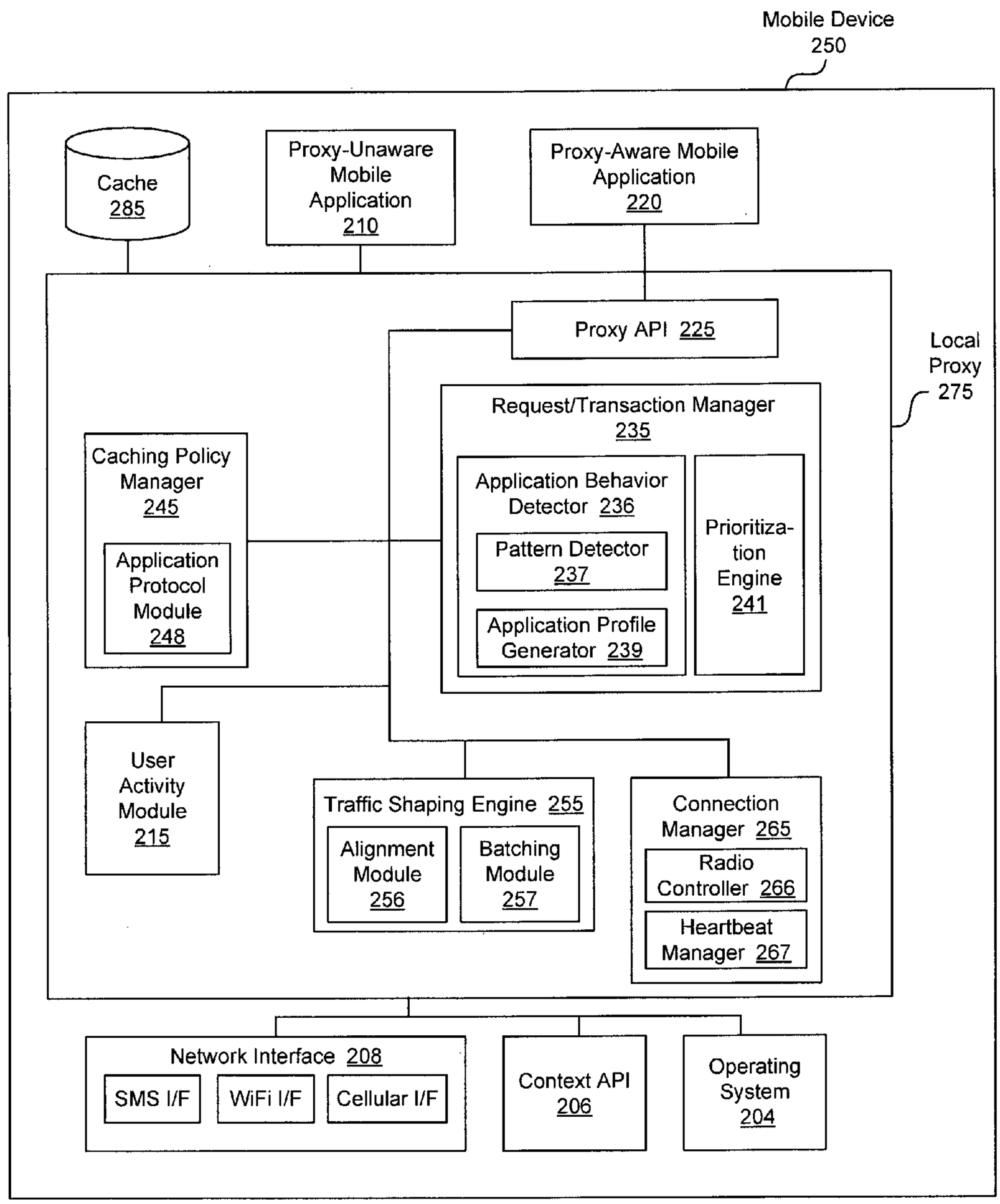

Mobile Device
250
Cache
285
Proxy-Unaware
Mobile
Application
210
Proxy-Aware Mobile
Application
220
Proxy API 225
Local
Proxy
275
Request/Transaction Manager
235
Application Behavior
Detector 236
Pattern Detector
237
Application Profile
Generator 239
Prioritiza-
tion
Engine
241
Caching Policy
Manager
245
Application
Protocol
Module
248
User
Activity
Module
215
Traffic Shaping Engine 255
Alignment
Module
256
Batching
Module
257
Connection
Manager 265
Radio
Controller 266
Heartbeat
Manager 267
Network Interface 208
SMS I/F
WiFi I/F
Cellular I/F
Context API
206
Operating
System
204

FIG. 2A

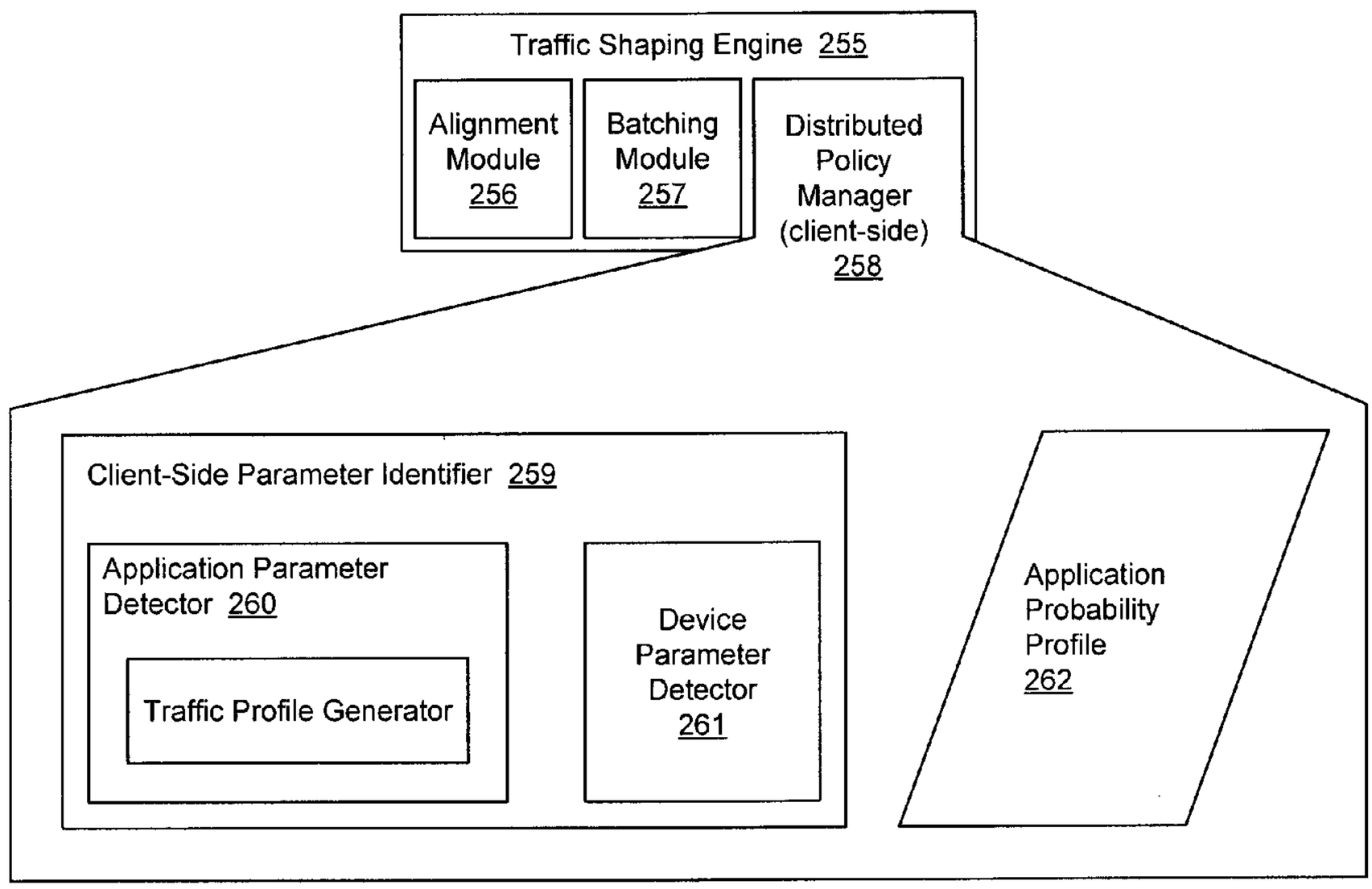

Traffic Shaping Engine 255
Alignment Module 256
Batching Module 257
Distributed Policy Manager (client-side) 258
Client-Side Parameter Identifier 259
Application Parameter Detector 260
Traffic Profile Generator
Device Parameter Detector 261
Application Probability Profile 262

FIG. 2B

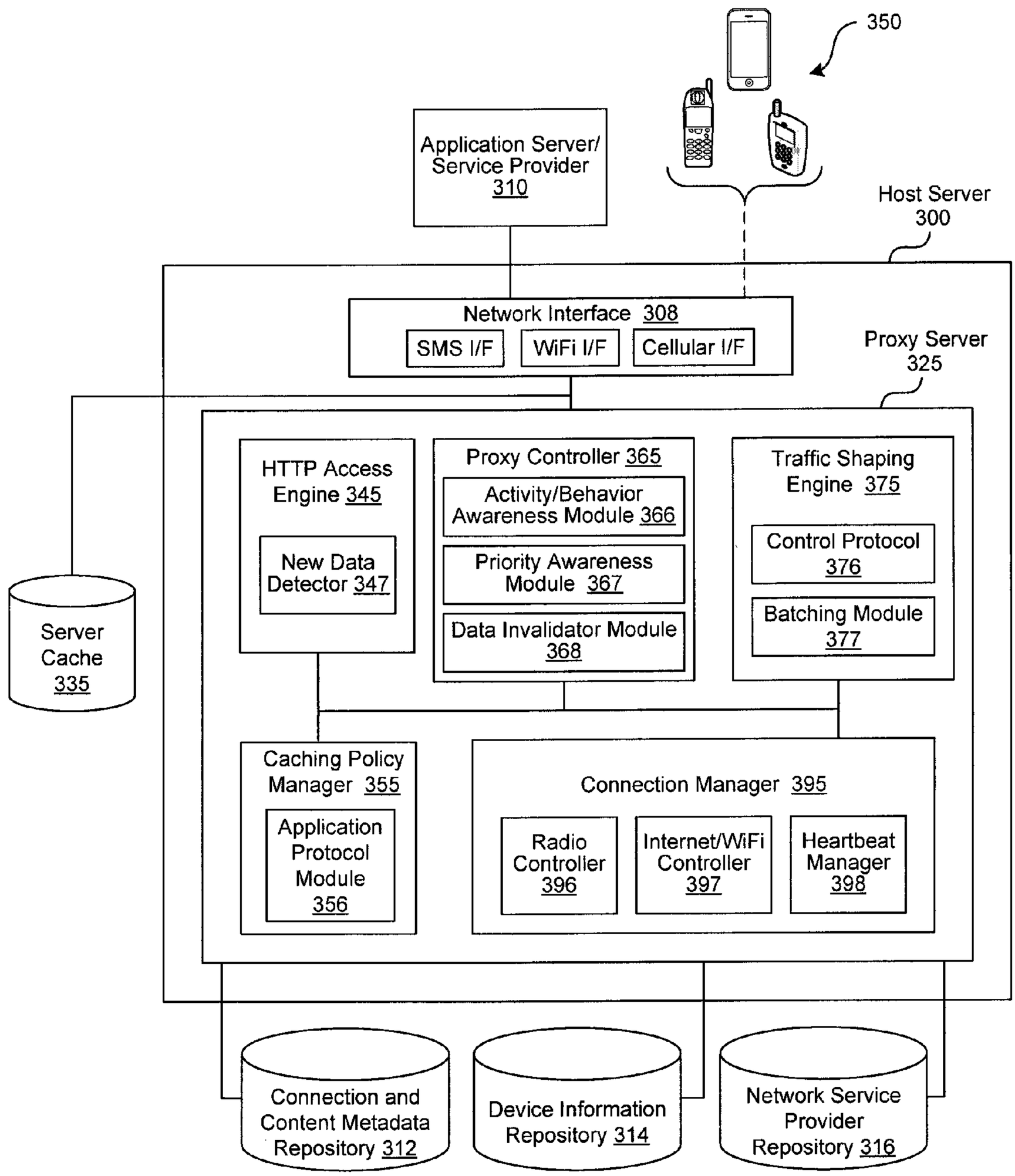

350
Application Server/ Service Provider 310
Host Server 300
Network Interface 308
SMS I/F
WiFi I/F
Cellular I/F
Proxy Server 325
HTTP Access Engine 345
New Data Detector 347
Proxy Controller 365
Activity/Behavior Awareness Module 366
Priority Awareness Module 367
Data Invalidator Module 368
Traffic Shaping Engine 375
Control Protocol 376
Batching Module 377
Server Cache 335
Caching Policy Manager 355
Application Protocol Module 356
Connection Manager 395
Radio Controller 396
Internet/WiFi Controller 397
Heartbeat Manager 398
Connection and Content Metadata Repository 312
Device Information Repository 314
Network Service Provider Repository 316

FIG. 3A

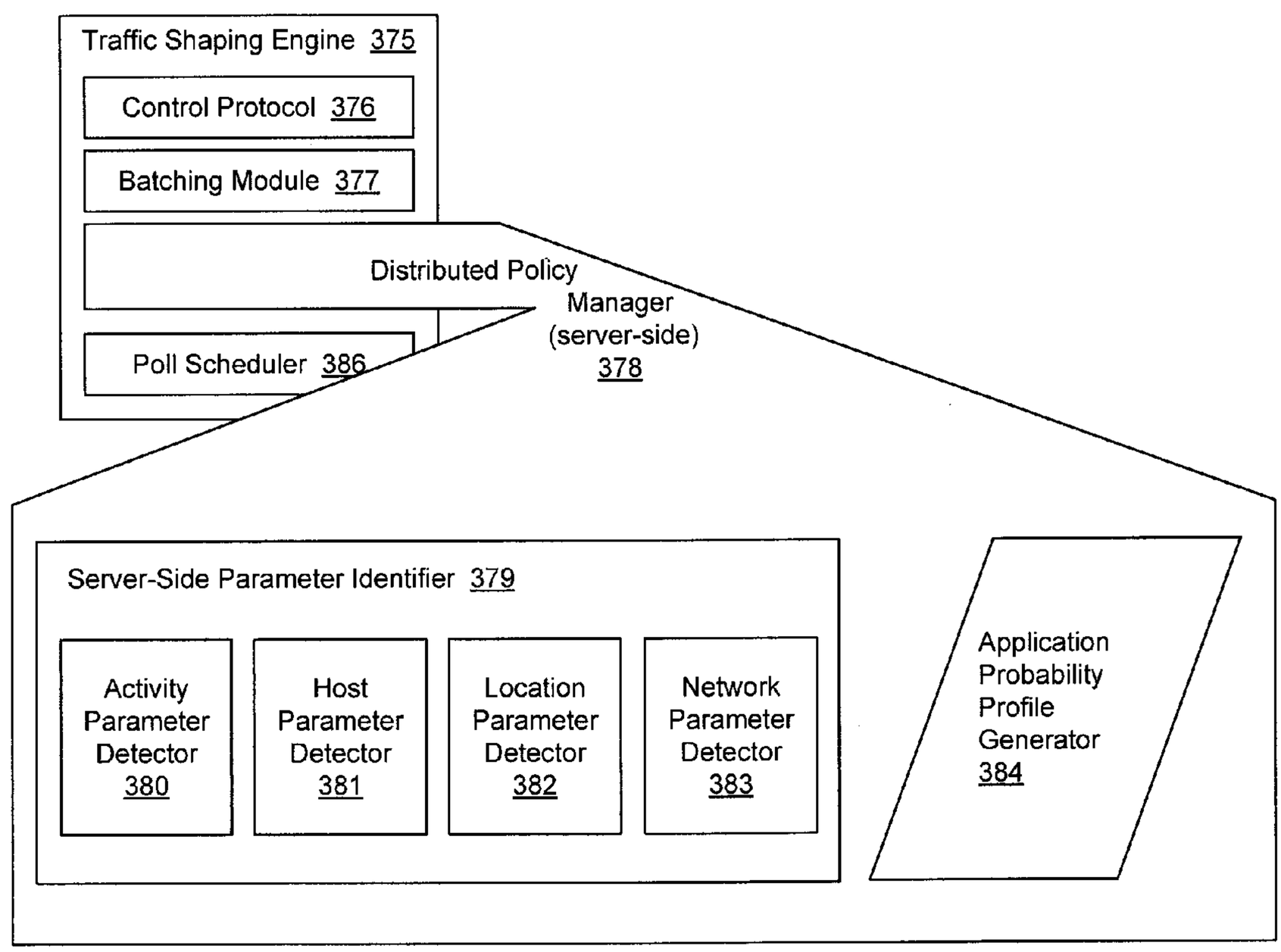

Traffic Shaping Engine 375
Control Protocol 376
Batching Module 377
Distributed Policy Manager (server-side) 378
Poll Scheduler 386
Server-Side Parameter Identifier 379
Activity Parameter Detector 380
Host Parameter Detector 381
Location Parameter Detector 382
Network Parameter Detector 383
Application Probability Profile Generator 384

FIG. 3B

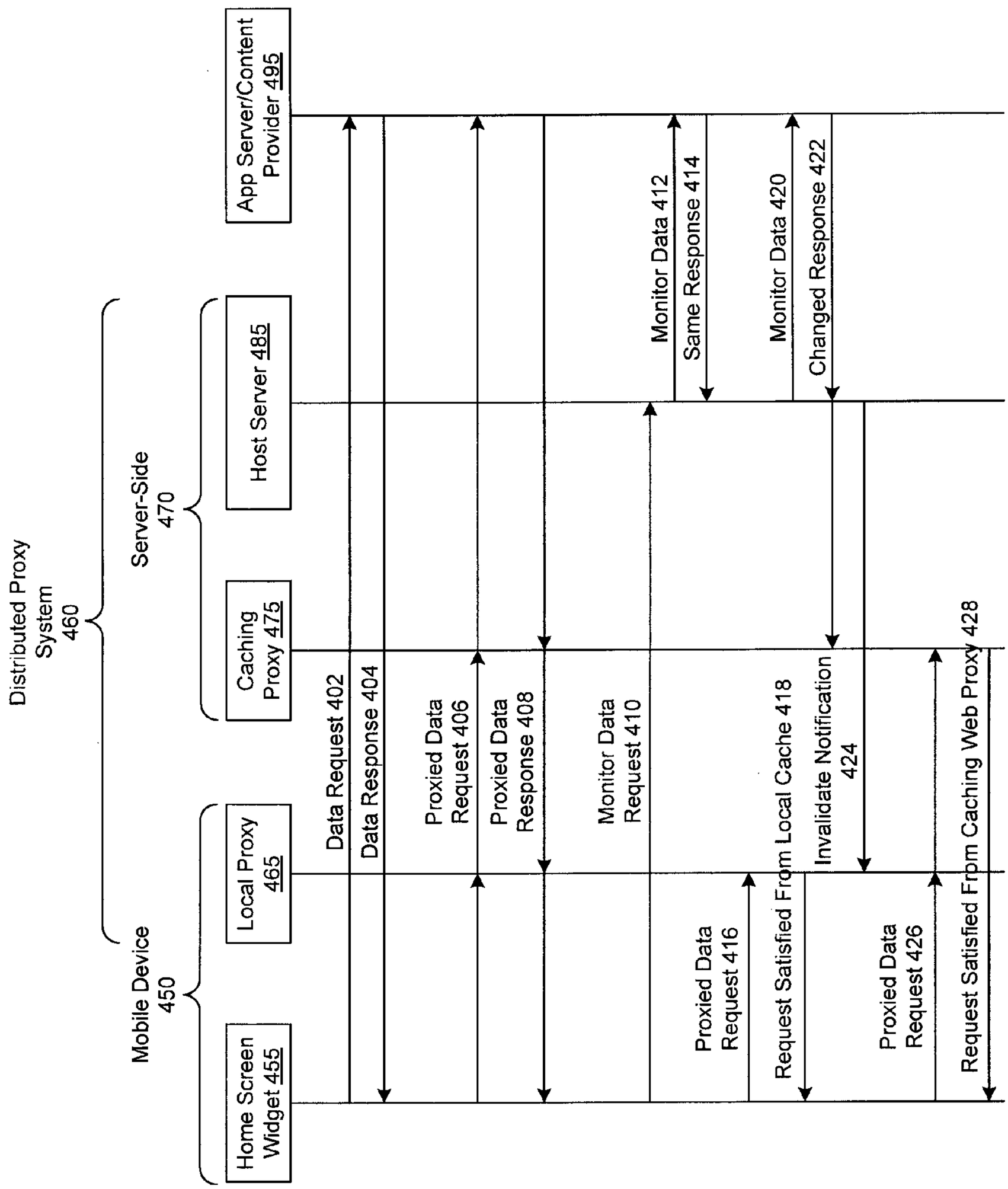

Distributed Proxy System 460
Mobile Device 450
Server-Side 470
Home Screen Widget 455
Local Proxy 465
Caching Proxy 475
Host Server 485
App Server/Content Provider 495
Data Request 402
Data Response 404
Proxied Data Request 406
Proxied Data Response 408
Monitor Data Request 410
Monitor Data 412
Same Response 414
Proxied Data Request 416
Request Satisfied From Local Cache 418
Monitor Data 420
Changed Response 422
Invalidate Notification 424
Proxied Data Request 426
Request Satisfied From Caching Web Proxy 428

FIG. 4

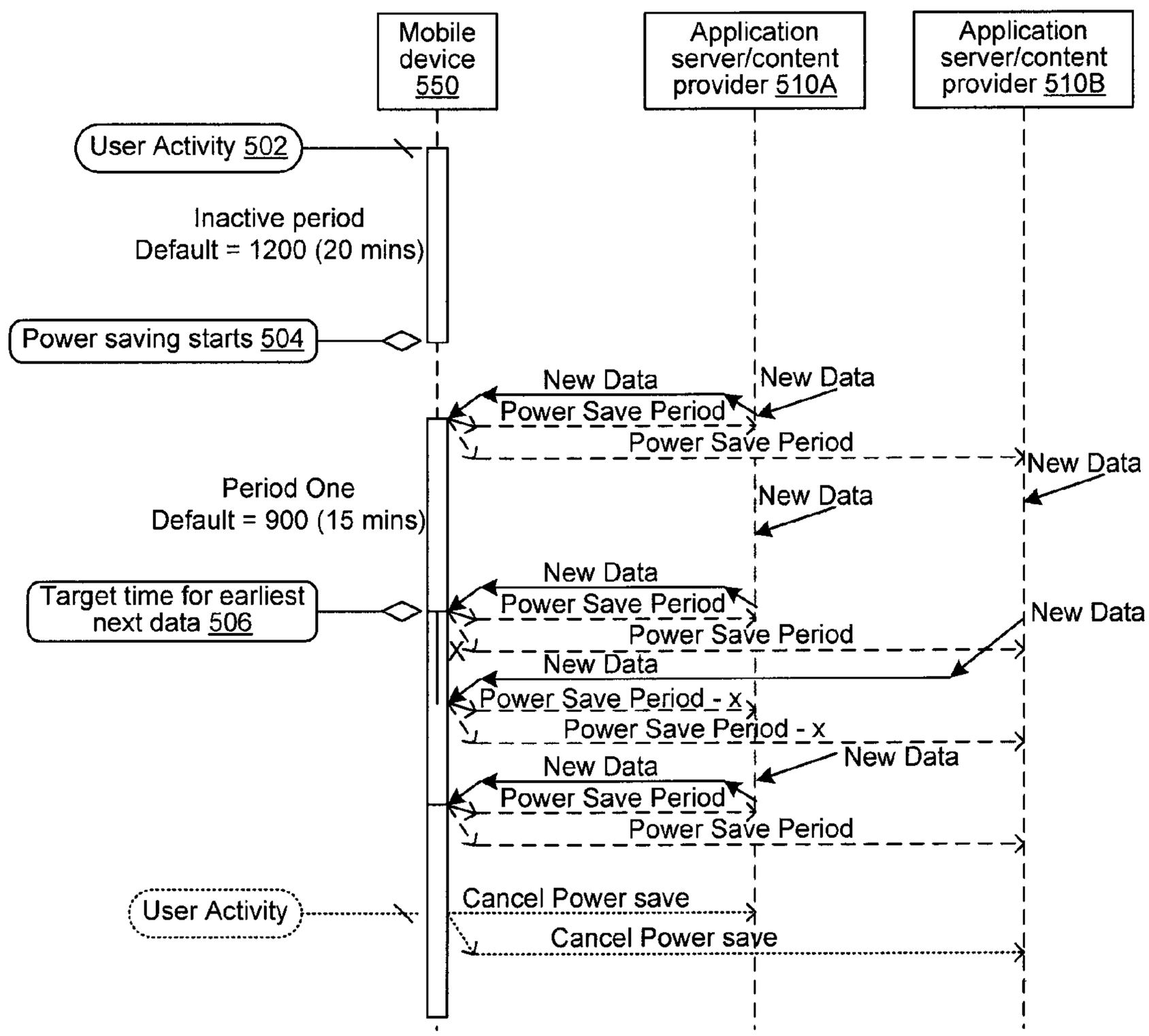

Mobile device 550
Application server/content provider 510A
Application server/content provider 510B
User Activity 502
Inactive period
Default = 1200 (20 mins)
Power saving starts 504
New Data
Power Save Period
Period One
Default = 900 (15 mins)
Target time for earliest next data 506
Power Save Period - x
User Activity
Cancel Power save

FIG. 5

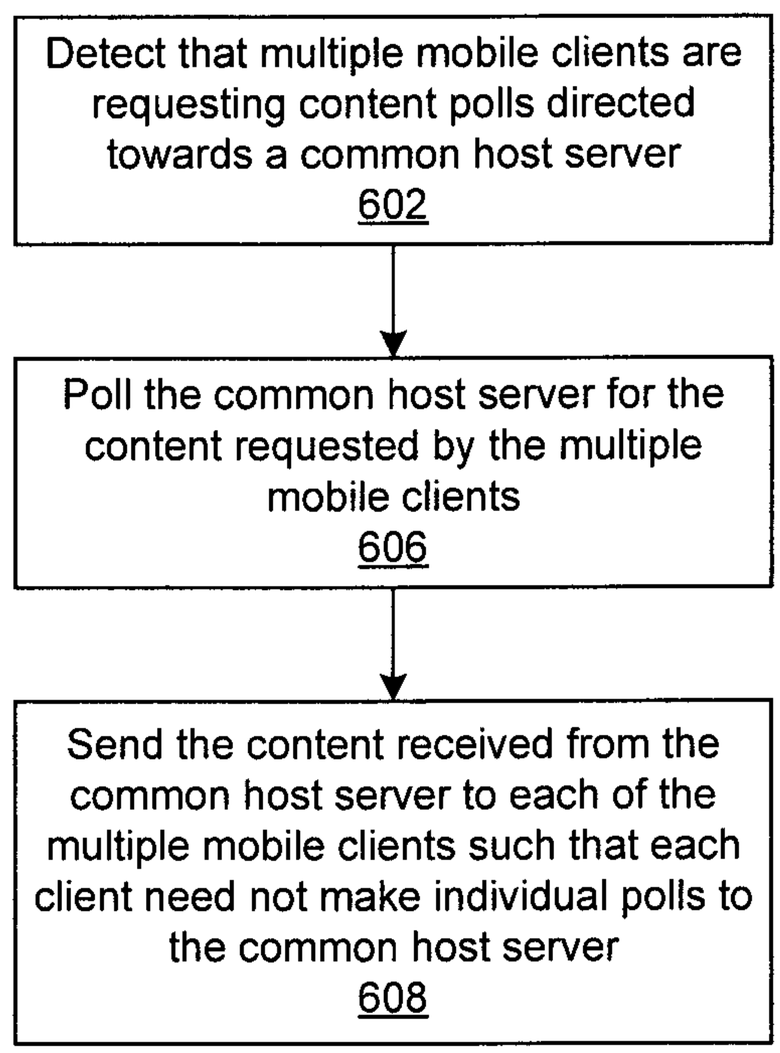

Detect that multiple mobile clients are requesting content polls directed towards a common host server
602
Poll the common host server for the content requested by the multiple mobile clients
606
Send the content received from the common host server to each of the multiple mobile clients such that each client need not make individual polls to the common host server
608

FIG. 6

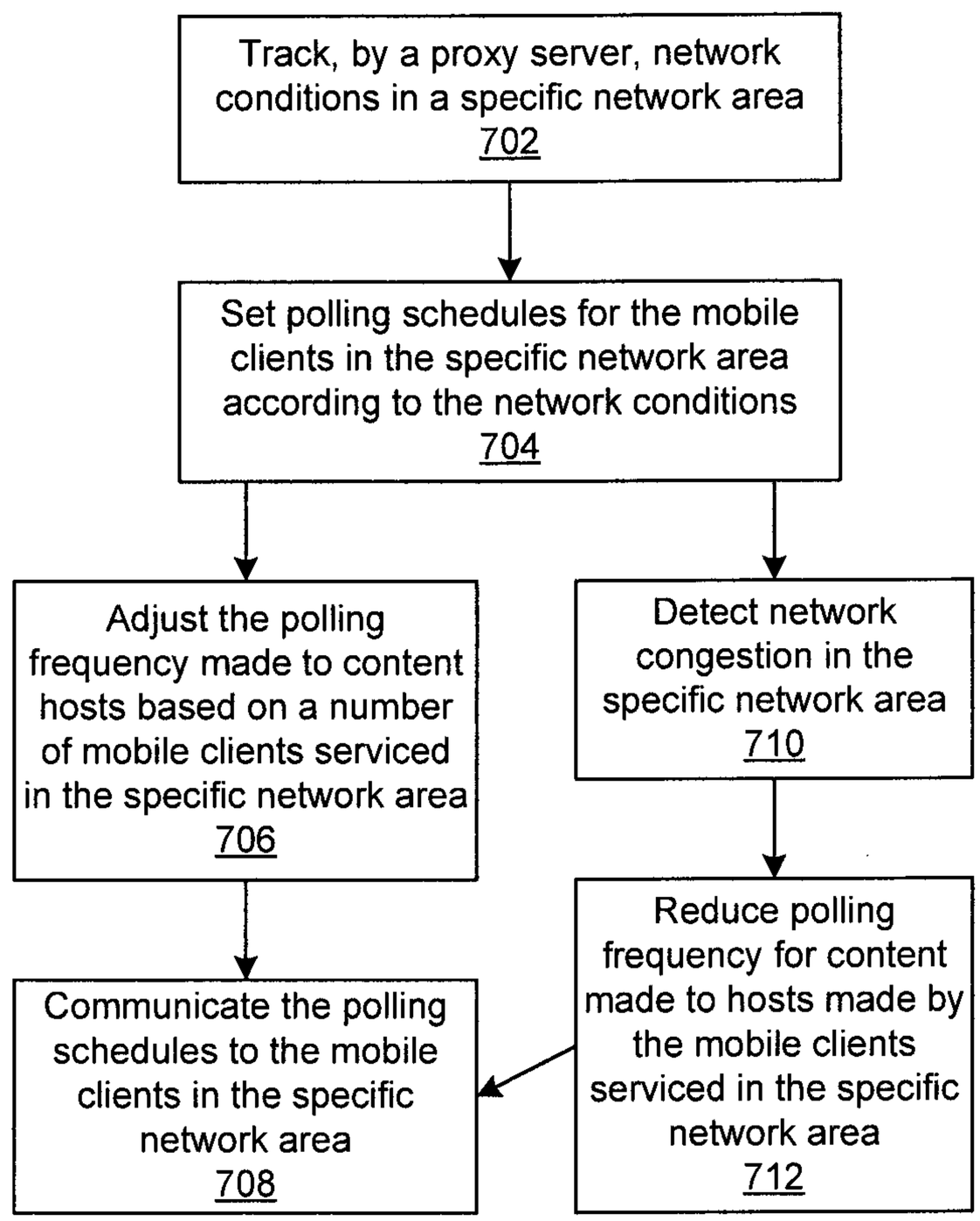

Track, by a proxy server, network conditions in a specific network area 702
Set polling schedules for the mobile clients in the specific network area according to the network conditions 704
Adjust the polling frequency made to content hosts based on a number of mobile clients serviced in the specific network area 706
Detect network congestion in the specific network area 710
Communicate the polling schedules to the mobile clients in the specific network area 708
Reduce polling frequency for content made to hosts made by the mobile clients serviced in the specific network area 712

FIG. 7

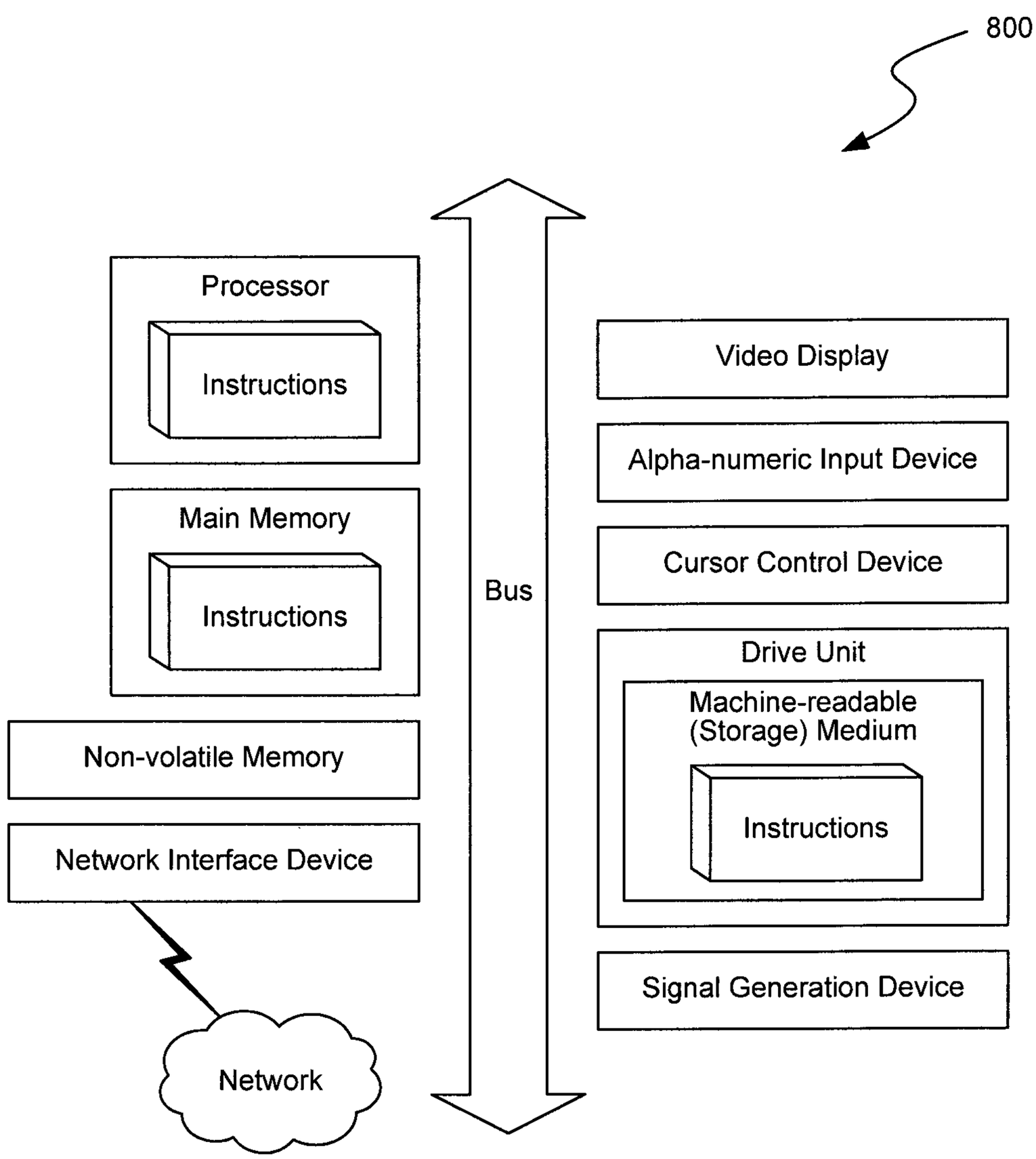

800
Processor
Instructions
Main Memory
Instructions
Non-volatile Memory
Network Interface Device
Network
Bus
Video Display
Alpha-numeric Input Device
Cursor Control Device
Drive Unit
Machine-readable
(Storage) Medium
Instructions
Signal Generation Device

FIG. 8

DISTRIBUTED IMPLEMENTATION OF DYNAMIC WIRELESS TRAFFIC POLICY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 61/367,871 entitled "CONSERVING POWER CONSUMPTION IN APPLICATIONS WITH NETWORK INITIATED DATA TRANSFER FUNCTIONALITY", which was filed on Jul. 26, 2010, U.S. Provisional Patent Application No. 61/367,870 entitled "MANAGING AND IMPROVING NETWORK RESOURCE UTILIZATION, PERFORMANCE AND OPTIMIZING TRAFFIC IN WIRE LINE AND WIRELESS NETWORKS WITH MOBILE CLIENTS", which was filed on Jul. 26, 2010, U.S. Provisional Patent Application No. 61/408,858 entitled "CROSS APPLICATION TRAFFIC COORDINATION", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,839 entitled "ACTIVITY SESSION AS METHOD OF OPTIMIZING NETWORK RESOURCE USE", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,829 entitled "DISTRIBUTED POLICY MANAGEMENT", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,846 entitled "INTELLIGENT CACHE MANAGEMENT IN CONGESTED WIRELESS NETWORKS", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,854 entitled "INTELLIGENT MANAGEMENT OF NON-CACHEABLE CONTENT IN WIRELESS NETWORKS", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,826 entitled "ONE WAY INTELLIGENT HEARTBEAT", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/408,820 entitled "TRAFFIC CATEGORIZATION AND POLICY DRIVING RADIO STATE", which was filed on Nov. 1, 2010, U.S. Provisional Patent Application No. 61/416,020 entitled "ALIGNING BURSTS FROM SERVER TO CLIENT", which was filed on Nov. 22, 2010, U.S. Provisional Patent Application No. 61/416,033 entitled "POLLING INTERVAL FUNCTIONS", which was filed on Nov. 22, 2010, U.S. Provisional Patent Application No. 61/430,828 entitled "DOMAIN NAME SYSTEM WITH NETWORK TRAFFIC HARMONIZATION", which was filed on Jan. 7, 2011, the contents of which are all incorporated by reference herein.

BACKGROUND

When WCDMA was specified, there was little attention to requirements posed by applications whose functions are based on actions initiated by the network, in contrast to functions initiated by the user or by the device. Such applications include, for example, push email, instant messaging, visual voicemail and voice and video telephony, and others. Such applications typically require an always-on IP connection and frequent transmit of small bits of data. WCDMA networks are designed and optimized for high-throughput of large amounts of data, not for applications that require frequent, but low-throughput and/or small amounts of data. Each transaction puts the mobile device radio in a high power mode for considerable length of time—typically between 15-30 seconds. As the high power mode can consume as much as 100× the power as an idle mode, these network-initiated applications quickly drain battery in WCDMA networks. The issue has been exacerbated by the rapid increase of popularity of applications with network-initiated functionalities, such as push email.

Lack of proper support has prompted a number of vendors to provide documents to guide their operator partners and independent software vendors to configure their networks and applications to perform better in WCDMA networks. This guidance focuses on: configuring networks to go to stay on high-power radio mode as short as possible and making periodic keep alive messages that are used to maintain an always-on TCP/IP connection as infrequent as possible. Such solutions typically assume lack of coordination between the user, the application and the network.

Furthermore, in general, mobile application usage is sporadic in nature. For example, there can be periods of user inactivity (e.g., during working hours or when the user is sleeping) followed by periods of multiple application usage, such as where a user is updating their Facebook status, sending a Tweet, checking their email, and using other applications to get an update of their online information. This doesn't mean, however, that the mobile device is inactive during user inactivity: the device may be actively downloading new content such as advertisements, polling for email, and receiving push notifications for activities on the Internet, thus utilizing occupying network bandwidth and consuming device power even when the user is not interacting with the mobile device or otherwise expecting data.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A illustrates an example diagram of a system where a host server facilitates management of traffic between client devices and an application server or content provider in a wireless network for resource conservation.

FIG. **1**B illustrates an example diagram of a proxy and cache system distributed between the host server and device which facilitates network traffic management between a device and an application server/content provider for resource conservation.

FIG. **2**A depicts a block diagram illustrating an example of client-side components in a distributed proxy and cache system residing on a mobile device that manages traffic in a wireless network for resource conservation.

FIG. **2**B depicts a block diagram illustrating another example of the traffic shaping engine having a distributed policy manager in the local proxy on the client-side of the distributed proxy system shown in the example of FIG. **2**A.

FIG. **3**A depicts a block diagram illustrating an example of server-side components in a distributed proxy and cache system that manages traffic in a wireless network for resource conservation.

FIG. **3**B depicts a block diagram illustrating another example of the traffic shaping engine as further including a distributed policy manager in the proxy server shown in the example of FIG. **3**A.

FIG. **4** depicts a diagram showing how data requests from a mobile device to an application server/content provider in a wireless network can be coordinated by a distributed proxy system in a manner such that network and battery resources are conserved through using content caching and monitoring performed by the distributed proxy system.

FIG. **5** depicts a diagram showing one example process for implementing a hybrid IP and SMS power saving mode on a mobile device using a distributed proxy and cache system (e.g., such as the distributed system shown in the example of FIG. **1**B).

FIG. **6** depicts a flow chart illustrating an example process for using a single server poll to satisfy multiple mobile client requests.

FIG. **7** depicts an example of process for poll schedule management and adjustment for mobile devices in a specific network area based on network conditions and congestion.

FIG. **8** shows a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

DETAILED DESCRIPTION

The following description and drawings are illustrative and are not to be construed as limiting. Numerous specific details are described to provide a thorough understanding of the disclosure. However, in certain instances, well-known or conventional details are not described in order to avoid obscuring the description. References to one or an embodiment in the present disclosure can be, but not necessarily are, references to the same embodiment; and, such references mean at least one of the embodiments.

Reference in this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the disclosure. The appearances of the phrase "in one embodiment" in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Moreover, various features are described which may be exhibited by some embodiments and not by others. Similarly, various requirements are described which may be requirements for some embodiments but not other embodiments.

The terms used in this specification generally have their ordinary meanings in the art, within the context of the disclosure, and in the specific context where each term is used. Certain terms that are used to describe the disclosure are discussed below, or elsewhere in the specification, to provide additional guidance to the practitioner regarding the description of the disclosure. For convenience, certain terms may be highlighted, for example using italics and/or quotation marks. The use of highlighting has no influence on the scope and meaning of a term; the scope and meaning of a term is the same, in the same context, whether or not it is highlighted. It will be appreciated that same thing can be said in more than one way.

Consequently, alternative language and synonyms may be used for any one or more of the terms discussed herein, nor is any special significance to be placed upon whether or not a term is elaborated or discussed herein. Synonyms for certain terms are provided. A recital of one or more synonyms does not exclude the use of other synonyms. The use of examples anywhere in this specification including examples of any terms discussed herein is illustrative only, and is not intended to further limit the scope and meaning of the disclosure or of any exemplified term. Likewise, the disclosure is not limited to various embodiments given in this specification.

Without intent to limit the scope of the disclosure, examples of instruments, apparatus, methods and their related results according to the embodiments of the present disclosure are given below. Note that titles or subtitles may be used in the examples for convenience of a reader, which in no way should limit the scope of the disclosure. Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure pertains. In the case of conflict, the present document, including definitions will control.

The massive growth in mobile data, largely resulting from mass of smart phones and tablets, has introduced new challenges to mobile network operators in the way that the surge in data is managed and supported the surge in data. With total spending near exceeding billions of dollars on network improvements alone, operators are working hard to make their networks faster, smarter and more efficient. Most of the existing solutions on the market to improve network performance deal with only one aspect of the problem—increasing the size and scope of the networks.

As mobile media explodes and end-users turn to their portable devices to view and share videos, music, and applications, the pressure for bigger, faster networks has grown. Although increasing the size/scope of physical networks addresses the need for 'bigger pipes' to transport more data, it does not take into account the type of data being shared. For example, bandwidth addresses mobile video applications, but fails to take into account the vast array of other mobile applications and end-user behavior. Many factors contribute to the massive growth in data including more sophisticated devices, end-user behavior, and advanced mobile applications—all contributing to an enormous amount of data traffic.

Device manufacturers are also experiencing increased challenges as a result of this trend. With increasingly sophisticated devices, challenges with limited battery life are driven by end-users accessing multiple applications simultaneously and devices constantly accessing the network. Smart phones and the 'always on', chatty mobile applications receive frequent updates and regularly poll the network. These constant requests cause the device battery to drain rapidly. Some approaches seek to address this issue by rapidly disconnecting from the network once updates are sent or received. While fast dormancy succeeds in improving battery life, it puts a heavy load on mobile networks.

The frequent and constant connections and disconnections increase the amount of signaling traffic, which lowers the performance of the network overall again placing additional pressure on the mobile network operators and forcing additional capital investment to increase bandwidth and network access. Although more sophisticated versions of fast dormancy have been developed to address the device battery and network congestion issues, these solutions fail to take into account all the elements that are contributing to the mobile data tsunami.

There are multiple factors that contribute to the proliferation of data. Some of these factors include, for example: the end-user, mobile devices, mobile applications, mobile services, and the network. As mobile devices evolve, so do the various associated elements, for example, availability, applications, services, user behavior, location-changing the way the mobile network interacts or needs to be interacting with the device and the application.

One embodiment of the disclosed technology includes, a system that optimizes multiple aspects of the connection with wired and wireless networks and devices through a comprehensive view of device and application activity including: loading, current application needs on a device, controlling the type of access (push vs. pull or hybrid), location, concentration of users in a single area, time of day, how often the user interacts with the application, content or device, and using this information to shape traffic to a cooperative client/server or simultaneously mobile devices without a cooperative client. Because the disclosed server is not tied to any specific network provider it has visibility into the network performance across all service providers. This enables optimizations to be applied to devices regardless of the operator or service provider, thereby enhancing the user experience and

managing network utilization while roaming. Bandwidth has been considered a major issue in wireless networks today. More and more research has been done related to the need for additional bandwidth to solve access problems—many of the performance enhancing solutions and next generation standards, such as those commonly referred to as 4G, namely LTE, 4G, and WiMAX are focused on providing increased bandwidth. Although partially addressed by the standards a key problem that remains is lack of bandwidth on the signaling channel more so than the data channel.

Embodiments of the disclosed technology includes, for example, alignment of requests from multiple applications to minimize the need for several polling requests; leverage specific content types to determine how to proxy/manage a connection/content; and apply specific heuristics associated with device, user behavioral patterns (how often they interact with the device/application) and/or network parameters.

Embodiments of the present technology can further include, moving recurring HTTP polls performed by various widgets, RSS readers, etc., to remote network node (e.g., Network operation center (NOC)), thus considerably lowering device battery/power consumption, radio channel signaling, and bandwidth usage. Additionally, the offloading can be performed transparently so that existing applications do not need to be changed.

In some embodiments, this can be implemented using a local proxy on the mobile device which automatically detects recurring requests for the same content (RSS feed, Widget data set) that matches a specific rule (e.g. happens every 15 minutes). The local proxy can automatically cache the content on the mobile device while delegating the polling to the server (e.g., a proxy server operated as an element of a communications network). The server can then notify the mobile/client proxy if the content changes, and if content has not changed (or not changed sufficiently, or in an identified manner or amount) the mobile proxy provides the latest version in its cache to the user (without need to utilize the radio at all). This way the mobile device (e.g., a mobile phone, smart phone, etc.) does not need to open up (e.g., thus powering on the radio) or use a data connection if the request is for content that is monitored and that has been not flagged as new/changed.

The logic for automatically adding content sources/application servers (e.g., including URLs/content) to be monitored can also check for various factors like how often the content is the same, how often the same request is made (is there a fixed interval/pattern?), which application is requesting the data, etc. Similar rules to decide between using the cache and request the data from the original source may also be implemented and executed by the local proxy and/or server.

For example, when the request comes at an unscheduled/unexpected time (user initiated check), or after every (n) consecutive times the response has been provided from the cache, etc., or if the application is running in the background vs. in a more interactive mode of the foreground. As more and more mobile applications base their features on resources available in the network, this becomes increasingly important. In addition, the disclosed technology allows elimination of unnecessary chatter from the network, benefiting the operators trying to optimize the wireless spectrum usage.

Embodiments of the present disclosure further include systems and methods for distributed implementation of dynamic wireless traffic policy. The described technology provides an end-to-end solution that addresses the contributing factors and elements in whole, for operators and devices manufacturers to successfully support both the shift in mobile devices and the surge in data.

Distributed Policy Management

Embodiments of the present disclosure allow a local proxy (e.g., local proxy **175** or **275** in the examples of FIG. **1**B and FIG. **2**A respectively) in the mobile device (e.g., device **150** in FIG. **1**A-B) and the proxy server (e.g., proxy server **125** or **325** in the examples of FIG. **1**B and FIG. **3**A respectively), the components that are on each side of the network hop (e.g., the wireless network **106** of FIG. **1**A-B) to share information to optimize the traffic (e.g., the transfer of traffic such as messages or data) in this network hop. As examples, the local proxy and/or the proxy server can generate, monitor, or transfer one or more of the network and operational parameters (or information about such characteristics) described below in order to implement, optimize, adjust, or refine policy:

(1) Client-Side Parameters/Functions

a. Application parameters
   i. Applications installed in the device
   ii. Application status: foreground state (e.g., in foreground, not in foreground)
   iii. Application traffic profile (polling rates, protocols used, amount of data; background activities vs. user interactions)

b. Activity within the portfolio of applications installed on the device (to enable coordination of activity between applications, e.g., delay/accelerate content transfer for certain applications)

c. Device parameters
   i. User activity status (for example, as determined through backlight state, motion detector, light sensor, cursor activity, etc.)
   ii. Network availability, network strength (to avoid excessive reconnect attempts when network strength is low, for example)
   iii. Current radio state of each wireless radio (Bluetooth, Wifi, cellular, etc.)

d. Sending the traffic profile to the server as an adjunct (piggybacking) on payload data; if no payload is sent, upload profile every (X) hours; also, use the profile upload to send usage statistics that the server can use for analytics and reporting purposes.

(2) Server-Side Parameters/Functions

a. Location of the device (based on infrastructure data, GPS, etc.)

b. Other devices presently in the same general location (in congested areas, may use to slow down traffic or ask devices to switch to alternative bearers or carriers), the activity profiles of other users

c. Content changes at the content host(s)

d. Final decisions regarding the profile based on input from multiple devices

In operation, implementations of the disclosed technology can include a local proxy on a mobile device and/or a proxy server on a remote host server monitoring operations, collecting status information, parameters, or data and communicating that information or data between the local proxy and proxy server in order to formulate, optimize, enhance, or dynamically update and refine, a policy for management of the traffic communicated over the network (cellular or others).

Some examples of use cases and implementation of the technology as described as follows:

1) Local proxy (e.g., local proxy **175** or **275** in the examples of FIG. **1**B and FIG. **2**A respectively) on a mobile device detects the applications installed in the device and the respective polling frequencies which can be communicated to the proxy server (e.g., proxy server **125** or **325** in the examples of FIG. **1**B and FIG. **3**A respectively) on a host server (e.g., the

host server **100** or **300**). The proxy server can determine whether other mobile devices are making similar requests (within a certain time frame, for example) and can combine the content polls (for the host servers) to serve multiple mobile devices simultaneously;

(2) When the proxy server determines that mobile devices sharing the same network cell (or other network area) are failing to connect to a wireless network (e.g., for longer than a specified time period), or another measure of network congestion or operational difficulties, such as initiating multiple connection attempts, or the server detects throughput rates lower than a threshold amount (e.g., the average rate or another rate), the proxy server can reduce the polling frequency for content changes for all application servers/content providers (e.g., app server/provider **110** in FIG. **1**A-**1**B) that are being polled for all or some of the mobile devices.

Note that additional criteria may be employed. For example, mobile devices with specific data plans may be allowed to operate differently than others) in the affected cell or other network area, for either all applications or for applications matching a specific criteria (e.g. where application profile is "background" or "low priority");

a. Additional criteria may be employed: for example, traffic shaping can be implemented based on whether the proxy server observes either a certain number of mobile devices in the same cell or other network area, or otherwise (for example, through integration with the network infrastructure) is made aware that the mobile devices that it is monitoring and managing includes more than a certain portion of mobile devices in the same network cell.

b. The proxy server can communicate to (the local proxies of) the mobile devices in the affected area to reduce the frequency of reconnection attempts and present user(s) with connection failures even without attempting the connection in order to conserve signaling bandwidth.

c. The proxy server communicate specific schedule for polling to local proxies or mobile devices—for example by communicating a different schedule to different devices, to avoid congestion.

(3) A local proxy can detect and identify the applications installed in the device and the respective polling frequencies. The local proxy can communicate this information to the proxy server. The proxy server can observe the frequency of how often polls of application servers/content providers finds new/changed data (e.g., how frequently the content at the source changes) and can create a probability profile for the application (e.g., as an indicator to predict whether an upcoming poll is likely to find new data). Using criteria that is either predetermined or based on a request from the proxy server, the local proxy may not retrieve the new content to its cache from the proxy server immediately when the server signals content change on the application server/content provider, but instead combines multiple polls to be performed simultaneously.

a. The local proxy can accelerate the timing of a poll for an application, for example, if poll for another application is about to happen because there is new data, and the probability for finding new data for the application in question is higher than a certain percentage; the proxy server can adjust this percentage based on network considerations such as congestion or other operational difficulties as described in (2) above. The local proxy can communicate to the proxy server that such an accelerated poll happened so that the proxy server can skip the next poll.

b. The local proxy can delay a poll for an application even if the proxy server has signaled new data availability, for example, if another application is about to poll within a certain time frame (server may adjust this based on (2) above) and the probability to find new data for this second application is higher than a threshold percentage; the server can also adjust this percentage based on congestion considerations as in (2) above.

FIG. **1**A illustrates an example diagram of a system where a host server **100** facilitates management of traffic between client devices **102** and an application server or content provider **110** in a wireless network for resource conservation.

The client devices **102**A-D can be any system and/or device, and/or any combination of devices/systems that is able to establish a connection, including wired, wireless, cellular connections with another device, a server and/or other systems such as host server **100** and/or application server/content provider **110**. Client devices **102** will typically include a display and/or other output functionalities to present information and data exchanged between among the devices **102** and/or the host server **100** and/or application server/content provider **110**.

For example, the client devices **102** can include mobile, hand held or portable devices or non-portable devices and can be any of, but not limited to, a server desktop, a desktop computer, a computer cluster, or portable devices including, a notebook, a laptop computer, a handheld computer, a palmtop computer, a mobile phone, a cell phone, a smart phone, a PDA, a Blackberry device, a Palm device, a handheld tablet (e.g. an iPad or any other tablet), a hand held console, a hand held gaming device or console, any SuperPhone such as the iPhone, and/or any other portable, mobile, hand held devices, etc. In one embodiment, the client devices **102**, host server **100**, and app server **110** are coupled via a network **106** and/or a network **108**. In some embodiments, the devices **102** and host server **100** may be directly connected to one another.

The input mechanism on client devices **102** can include touch screen keypad (including single touch, multi-touch, gesture sensing in 2D or 3D, etc.), a physical keypad, a mouse, a pointer, a track pad, motion detector (e.g., including 1-axis, 2-axis, 3-axis accelerometer, etc.), a light sensor, capacitance sensor, resistance sensor, temperature sensor, proximity sensor, a piezoelectric device, device orientation detector (e.g., electronic compass, tilt sensor, rotation sensor, gyroscope, accelerometer), or a combination of the above.

Signals received or detected indicating user activity at client devices **102** through one or more of the above input mechanism, or others, can be used in the disclosed technology in acquiring context awareness at the client device **102**. Context awareness at client devices **102** generally includes, by way of example but not limitation, client device **102** operation or state acknowledgement, management, user activity/behavior/interaction awareness, detection, sensing, tracking, trending, and/or application (e.g., mobile applications) type, behavior, activity, operating state, etc.

Context awareness in the present disclosure also includes knowledge and detection of network side contextual data and can include network information such as network capacity, bandwidth, traffic, type of network/connectivity, and/or any other operational state data. Network side contextual data can be received from and/or queried from network service providers (e.g., cell provider **112** and/or Internet service providers) of the network **106** and/or network **108** (e.g., by the host server and/or devices **102**). In addition to application context awareness as determined from the client **102** side, the application context awareness may also be received from or

obtained/queried from the respective application/service providers **110** (by the host **100** and/or client devices **102**).

The host server **100** can use, for example, contextual information obtained for client devices **102**, networks **106**/**108**, applications (e.g., mobile applications), application server/provider **110**, or any combination of the above, to manage the traffic in the system to satisfy data needs of the client devices **102** (e.g., to satisfy application or any other request including HTTP request). In one embodiment, the traffic is managed by the host server **100** to satisfy data requests made in response to explicit or non-explicit user **103** requests and/or device/application maintenance tasks. The traffic can be managed such that network consumption, for example, use of the cellular network is conserved for effective and efficient bandwidth utilization. In addition, the host server **100** can manage and coordinate such traffic in the system such that use of device **102** side resources (e.g., including but not limited to battery power consumption, radio use, processor/memory use) are optimized with a general philosophy for resource conservation while still optimizing performance and user experience.

For example, in context of battery conservation, the device **150** can observe user activity (for example, by observing user keystrokes, backlight status, or other signals via one or more input mechanisms, etc.) and alters device **102** behaviors. The device **150** can also request the host server **100** to alter the behavior for network resource consumption based on user activity or behavior.

In one embodiment, the traffic management for resource conservation is performed using a distributed system between the host server **100** and client device **102**. The distributed system can include proxy server and cache components on the server **100** side and on the client **102** side, for example, as shown by the server cache **135** on the server **100** side and the local cache **150** on the client **102** side.

Functions and techniques disclosed for context aware traffic management for resource conservation in networks (e.g., network **106** and/or **108**) and devices **102**, reside in a distributed proxy and cache system. The proxy and cache system can be distributed between, and reside on, a given client device **102** in part or in whole and/or host server **100** in part or in whole. The distributed proxy and cache system are illustrated with further reference to the example diagram shown in FIG. **1**B. Functions and techniques performed by the proxy and cache components in the client device **102**, the host server **100**, and the related components therein are described, respectively, in detail with further reference to the examples of FIG. **2**-**3**.

In one embodiment, client devices **102** communicate with the host server **100** and/or the application server **110** over network **106**, which can be a cellular network. To facilitate overall traffic management between devices **102** and various application servers/content providers **110** to implement network (bandwidth utilization) and device resource (e.g., battery consumption), the host server **100** can communicate with the application server/providers **110** over the network **108**, which can include the Internet.

In general, the networks **106** and/or **108**, over which the client devices **102**, the host server **100**, and/or application server **110** communicate, may be a cellular network, a telephonic network, an open network, such as the Internet, or a private network, such as an intranet and/or the extranet, or any combination thereof. For example, the Internet can provide file transfer, remote log in, email, news, RSS, cloud-based services, instant messaging, visual voicemail, push mail, VoIP, and other services through any known or convenient protocol, such as, but is not limited to the TCP/IP protocol, UDP, HTTP, DNS, Open System Interconnections (OSI), FTP, UPnP, iSCSI, NSF, ISDN, PDH, RS-232, SDH, SONET, etc.

The networks **106** and/or **108** can be any collection of distinct networks operating wholly or partially in conjunction to provide connectivity to the client devices **102** and the host server **100** and may appear as one or more networks to the serviced systems and devices. In one embodiment, communications to and from the client devices **102** can be achieved by, an open network, such as the Internet, or a private network, such as an intranet and/or the extranet. In one embodiment, communications can be achieved by a secure communications protocol, such as secure sockets layer (SSL), or transport layer security (TLS).

In addition, communications can be achieved via one or more networks, such as, but are not limited to, one or more of WiMax, a Local Area Network (LAN), Wireless Local Area Network (WLAN), a Personal area network (PAN), a Campus area network (CAN), a Metropolitan area network (MAN), a Wide area network (WAN), a Wireless wide area network (WWAN), enabled with technologies such as, by way of example, Global System for Mobile Communications (GSM), Personal Communications Service (PCS), Digital Advanced Mobile Phone Service (D-Amps), Bluetooth, Wi-Fi, Fixed Wireless Data, 2G, 2.5G, 3G, 4G, IMT-Advanced, pre-4G, 3G LTE, 3GPP LTE, LTE Advanced, mobile WiMax, WiMax 2, WirelessMAN-Advanced networks, enhanced data rates for GSM evolution (EDGE), General packet radio service (GPRS), enhanced GPRS, iBurst, UMTS, HSPDA, HSUPA, HSPA, UMTS-TDD, 1xRTT, EV-DO, messaging protocols such as, TCP/IP, SMS, MMS, extensible messaging and presence protocol (XMPP), real time messaging protocol (RTMP), instant messaging and presence protocol (IMPP), instant messaging, USSD, IRC, or any other wireless data networks or messaging protocols.

FIG. **1**B illustrates an example diagram of a proxy and cache system distributed between the host server **100** and device **150** which facilitates network traffic management between the device **150** and an application server/content provider **100** (e.g., a source server) for resource conservation.

The distributed proxy and cache system can include, for example, the proxy server **125** (e.g., remote proxy) and the server cache, **135** components on the server side. The server-side proxy **125** and cache **135** can, as illustrated, reside internal to the host server **100**. In addition, the proxy server **125** and cache **135** on the server-side can be partially or wholly external to the host server **100** and in communication via one or more of the networks **106** and **108**. For example, the proxy server **125** may be external to the host server and the server cache **135** may be maintained at the host server **100**. Alternatively, the proxy server **125** may be within the host server **100** while the server cache is external to the host server **100**. In addition, each of the proxy server **125** and the cache **135** may be partially internal to the host server **100** and partially external to the host server **100**.

The distributed system can also, include, in one embodiment, client-side components, including by way of example but not limitation, a local proxy **175** (e.g., a mobile client on a mobile device) and/or a local cache **185**, which can, as illustrated, reside internal to the device **150** (e.g., a mobile device).

In addition, the client-side proxy **175** and local cache **185** can be partially or wholly external to the device **150** and in communication via one or more of the networks **106** and **108**. For example, the local proxy **175** may be external to the device **150** and the local cache **185** may be maintained at the device **150**. Alternatively, the local proxy **175** may be within

the device **150** while the local cache **185** is external to the device **150**. In addition, each of the proxy **175** and the cache **185** may be partially internal to the host server **100** and partially external to the host server **100**.

In one embodiment, the distributed system can include an optional caching proxy server **199**. The caching proxy server **199** can be a component which is operated by the application server/content provider **110**, the host server **100**, or a network service provider **112**, and or any combination of the above to facilitate network traffic management for network and device resource conservation. Proxy server **199** can be used, for example, for caching content to be provided to the device **150**, for example, from one or more of, the application server/provider **110**, host server **100**, and/or a network service provider **112**. Content caching can also be entirely or partially performed by the remote proxy **125** to satisfy application requests or other data requests at the device **150**.

In context aware traffic management and optimization for resource conservation in a network (e.g., cellular or other wireless networks), characteristics of user activity/behavior and/or application behavior at a mobile device **150** can be tracked by the local proxy **175** and communicated, over the network **106** to the proxy server **125** component in the host server **100**, for example, as connection metadata. The proxy server **125** which in turn is coupled to the application server/provider **110** provides content and data to satisfy requests made at the device **150**.

In addition, the local proxy **175** can identify and retrieve mobile device properties including, one or more of, battery level, network that the device is registered on, radio state, whether the mobile device is being used (e.g., interacted with by a user). In some instances, the local proxy **175** can delay, expedite (prefetch), and/or modify data prior to transmission to the proxy server **125**, when appropriate, as will be further detailed with references to the description associated with the examples of FIG. **2-3**.

The local database **185** can be included in the local proxy **175** or coupled to the proxy **175** and can be queried for a locally stored response to the data request prior to the data request being forwarded on to the proxy server **125**. Locally cached responses can be used by the local proxy **175** to satisfy certain application requests of the mobile device **150**, by retrieving cached content stored in the cache storage **185**, when the cached content is still valid.

Similarly, the proxy server **125** of the host server **100** can also delay, expedite, or modify data from the local proxy prior to transmission to the content sources (e.g., the app server/content provider **110**). In addition, the proxy server **125** uses device properties and connection metadata to generate rules for satisfying request of applications on the mobile device **150**. The proxy server **125** can gather real time traffic information about requests of applications for later use in optimizing similar connections with the mobile device **150** or other mobile devices.

In general, the local proxy **175** and the proxy server **125** are transparent to the multiple applications executing on the mobile device. The local proxy **175** is generally transparent to the operating system or platform of the mobile device and may or may not be specific to device manufacturers. In some instances, the local proxy **175** is optionally customizable in part or in whole to be device specific. In some embodiments, the local proxy **175** may be bundled into a wireless model, into a firewall, and/or a router.

In one embodiment, the host server **100** can in some instances, utilize the store and forward functions of a short message service center (SMSC) **112**, such as that provided by the network service provider **112**, in communicating with the device **150** in achieving network traffic management. As will be further described with reference to the example of FIG. **3**, the host server **100** can forward content or HTTP responses to the SMSC **112** such that it is automatically forwarded to the device **150** if available, and for subsequent forwarding if the device **150** is not currently available.

In general, the disclosed distributed proxy and cache system allows optimization of network usage, for example, by serving requests from the local cache **185**, the local proxy **175** reduces the number of requests that need to be satisfied over the network **106**. Further, the local proxy **175** and the proxy server **125** may filter irrelevant data from the communicated data. In addition, the local proxy **175** and the proxy server **125** can also accumulate low priority data and send it in batches to avoid the protocol overhead of sending individual data fragments. The local proxy **175** and the proxy server **125** can also compress or transcode the traffic, reducing the amount of data sent over the network **106** and/or **108**. The signaling traffic in the network **106** and/or **108** can be reduced, as the networks are now used less often and the network traffic can be synchronized among individual applications.

With respect to the battery life of the mobile device **150**, by serving application or content requests from the local cache **185**, the local proxy **175** can reduce the number of times the radio module is powered up. The local proxy **175** and the proxy server **125** can work in conjunction to accumulate low priority data and send it in batches to reduce the number of times and/or amount of time when the radio is powered up. The local proxy **175** can synchronize the network use by performing the batched data transfer for all connections simultaneously.

FIG. **2**A depicts a block diagram illustrating an example of client-side components in a distributed proxy and cache system residing on a device **250** that manages traffic in a wireless network for resource conservation.

The device **250**, which can be a portable or mobile device, such as a portable phone, generally includes, for example, a network interface **208**, an operating system **204**, a context API **206**, and mobile applications which may be proxy unaware **210** or proxy aware **220**. Note that the device **250** is specifically illustrated in the example of FIG. **2** as a mobile device, such is not a limitation and that device **250** may be any portable/mobile or non-portable device able to receive, transmit signals to satisfy data requests over a network including wired or wireless networks (e.g., WiFi, cellular, Bluetooth, etc.).

The network interface **208** can be a networking module that enables the device **250** to mediate data in a network with an entity that is external to the host server **250**, through any known and/or convenient communications protocol supported by the host and the external entity. The network interface **208** can include one or more of a network adaptor card, a wireless network interface card (e.g., SMS interface, WiFi interface, interfaces for various generations of mobile communication standards including but not limited to 2G, 3G, 3.5G, 4G, LTE, etc.), Bluetooth, or whether or not the connection is via a router, an access point, a wireless router, a switch, a multilayer switch, a protocol converter, a gateway, a bridge, bridge router, a hub, a digital media receiver, and/or a repeater.

Device **250** can further include, client-side components of the distributed proxy and cache system which can include, a local proxy **275** (e.g., a mobile client of a mobile device) and a cache **285**. In one embodiment, the local proxy **275** includes a user activity module **215**, a proxy API **225**, a request/transaction manager **235**, a caching policy manager **245**, a traffic shaping engine **255**, and/or a connection manager **265**.

The traffic shaping engine **255** may further include an alignment module **256** and/or a batching module **257**, the connection manager **265** may further include a radio controller **266**. The request/transaction manager **235** can further include an application behavior detector **236** and/or a prioritization engine **238**, the application behavior detector **236** may further include a pattern detector **237** and/or and application profile generator **238**. Additional or less components/modules/engines can be included in the local proxy **275** and each illustrated component.

As used herein and as used with the description of any other applicable components shown in the figures accompanying the present disclosure, a "module," "a manager," a "handler," a "detector," an "interface," an "identifier," or an "engine" can include a general purpose, dedicated or shared processor and, typically, firmware or software modules that are executed by the processor. Depending upon implementation-specific or other considerations, the module, manager, handler, detector, interface, identifier, or engine can be centralized or its functionality distributed. The module, manager, handler, detector, interface, identifier, or engine can include general or special purpose hardware, firmware, or software embodied in a machine-readable or computer-readable (storage) medium for execution by the processor.

As used herein, a computer-readable medium or computer-readable storage medium is intended to include all mediums that are statutory (e.g., in the United States, under 35 U.S.C. 101), rather than mediums that are non-statutory in nature to the extent that the exclusion is necessary for a claim that includes the computer-readable (storage) medium to be valid. Some examples of such known statutory machine-readable or computer-readable (storage) mediums include hardware (e.g., registers, random access memory (RAM), non-volatile (NV) storage, to name a few), and can more generally include software, hardware, or a combination of hardware and software.

In one embodiment, a portion of the distributed proxy and cache system for network traffic management resides in or is in communication with device **250**, including local proxy **275** (mobile client) and/or cache **285**. The local proxy **275** can provide an interface on the device **150** for users to access device applications and services including email, IM, voice mail, visual voicemail, feeds, Internet, other applications, etc.

The proxy **275** is generally application independent and can be used by applications (e.g., both proxy aware and proxy-unaware mobile applications **210** and **220**) to open TCP connections to a remote server (e.g., the server **100** in the examples of FIG. **1**A-**1**B and/or server proxy **125**/**325** shown in the examples of FIG. **1**B and FIG. **3**). In some instances, the local proxy **275** includes a proxy API **225** which can be optionally used to interface with proxy-aware applications **220** (or mobile applications on a mobile device).

The applications **210** and **220** can generally include any user application, widgets, software, HTTP-based application, web browsers, video or other multimedia streaming or downloading application, video games, social network applications, email clients, RSS management applications, application stores, document management applications, productivity enhancement applications, etc. The applications can be provided with the device OS, by the device manufacturer, by the network service provider, downloaded by the user, or provided by others.

One embodiment of the local proxy **275** includes or is coupled to a context API **206**, as shown. The context API **206** may be a part of the operating system **204** or device platform or independent of the operating system **204**, as illustrated. The operating system **204** can include any operating system including but not limited to, any previous, current, and/or future versions/releases of, Windows Mobile, iOS, Android, Symbian, Palm OS, Brew MP, Java 2 Micro Edition (J2ME), Blackberry, etc.

The context API **206** may be a plug-in to the operating system **204** or a particular client application on the device **250**. The context API **206** can detect signals indicative of user or device activity, for example, sensing motion, gesture, device location, changes in device location, device backlight, keystrokes, clicks, activated touch screen, mouse click or detection of other pointer devices. The context API **206** can be coupled to input devices or sensors on the device **250** to identify these signals. Such signals can generally include input received in response to explicit user input at an input device/mechanism at the device **250** and/or collected from ambient signals/contextual cues detected at or in the vicinity of the device **250** (e.g., light, motion, piezoelectric, etc.).

In one embodiment, the user activity module **215** interacts with the context API **206** to identify, determine, infer, detect, compute, predict, and/or anticipate, characteristics of user activity on the device **250**. Various inputs collected by the context API **206** can be aggregated by the user activity module **215** to generate a profile for characteristics of user activity. Such a profile can be generated by the module **215** with various temporal characteristics. For instance, user activity profile can be generated in real-time for a given instant to provide a view of what the user is doing or not doing at a given time (e.g., defined by a time window, in the last minute, in the last 30 seconds, etc.), a user activity profile can also be generated for a 'session' defined by an application or web page that describes the characteristics of user behavior with respect to a specific task they are engaged in on the device **250**, or for a specific time period (e.g., for the last 2 hours, for the last 5 hours).

Additionally, characteristic profiles can be generated by the user activity module **215** to depict a historical trend for user activity and behavior (e.g. 1 week, 1 mo, 2 mo, etc.). Such historical profiles can also be used to deduce trends of user behavior, for example, access frequency at different times of day, trends for certain days of the week (weekends or week days), user activity trends based on location data (e.g., IP address, GPS, or cell tower coordinate data) or changes in location data (e.g., user activity based on user location, or user activity based on whether the user is on the go, or traveling outside a home region, etc.) to obtain user activity characteristics.

In one embodiment, user activity module **215** can detect and track user activity with respect to applications, documents, files, windows, icons, and folders on the device **250**. For example, the user activity module **215** can detect when an application or window (e.g., a web browser) has been exited, closed, minimized, maximized, opened, moved into the foreground, or into the background, multimedia content playback, etc.

In one embodiment, characteristics of the user activity on the device **250** can be used to locally adjust behavior of the device (e.g., mobile device) to optimize its resource consumption such as battery/power consumption and more generally, consumption of other device resources including memory, storage, and processing power. In one embodiment, the use of a radio on a device can be adjusted based on characteristics of user behavior (e.g., by the radio controller **266** of the connection manager **265**) coupled to the user activity module **215**. For example, the radio controller **266** can turn the radio on or off, based on characteristics of the user activity on the device **250**. In addition, the radio controller **266** can adjust the power mode of the radio (e.g., to be in

a higher power mode or lower power mode) depending on characteristics of user activity.

In one embodiment, characteristics of the user activity on device **250** can also be used to cause another device (e.g., other computers, a mobile device, or a non-portable device) or server (e.g., host server **100** and **300** in the examples of FIG. **1**A-B and FIG. **3**) which can communicate (e.g., via a cellular or other network) with the device **250** to modify its communication frequency with the device **250**. The local proxy **275** can use the characteristics information of user behavior determined by the user activity module **215** to instruct the remote device as to how to modulate its communication frequency (e.g., decreasing communication frequency, such as data push frequency if the user is idle, requesting that the remote device notify the device **250** if new data, changed, data, or data of a certain level of importance becomes available, etc.).

In one embodiment, the user activity module **215** can, in response to determining that user activity characteristics indicate that a user is active after a period of inactivity, request that a remote device (e.g., server host server **100** and **300** in the examples of FIG. **1**A-B and FIG. **3**) send the data that was buffered as a result of the previously decreased communication frequency.

In addition, or in alternative, the local proxy **275** can communicate the characteristics of user activity at the device **250** to the remote device (e.g., host server **100** and **300** in the examples of FIG. **1**A-B and FIG. **3**) and the remote device determines how to alter its own communication frequency with the device **250** for network resource conservation and conservation of device **250** resources.

One embodiment of the local proxy **275** further includes a request/transaction manager **235**, which can detect, identify, intercept, process, manage, data requests initiated on the device **250**, for example, by applications **210** and/or **220**, and/or directly/indirectly by a user request. The request/transaction manager **235** can determine how and when to process a given request or transaction, or a set of requests/transactions, based on transaction characteristics.

The request/transaction manager **235** can prioritize requests or transactions made by applications and/or users at the device **250**, for example by the prioritization engine **238**. Importance or priority of requests/transactions can be determined by the manager **235** by applying a rule set, for example, according to time sensitivity of the transaction, time sensitivity of the content in the transaction, time criticality of the transaction, time criticality of the data transmitted in the transaction, and/or time criticality or importance of an application making the request.

In addition, transaction characteristics can also depend on whether the transaction was a result of user-interaction or other user initiated action on the device (e.g., user interaction with a mobile application). In general, a time critical transaction can include a transaction resulting from a user-initiated data transfer, and can be prioritized as such. Transaction characteristics can also depend on the amount of data that will be transferred or is anticipated to be transferred as a result of the request/requested transaction. For example, the connection manager **265**, can adjust the radio mode (e.g., high power or low power mode via the radio controller **266**) based on the amount of data that will need to be transferred.

In addition, the radio controller **266**/connection manager **265** can adjust the radio power mode (high or low) based on time criticality/sensitivity of the transaction. The radio controller **266** can trigger the use of high power radio mode when a time-critical transaction (e.g., a transaction resulting from a user-initiated data transfer, an application running in the foreground, any other event meeting a certain criteria) is initiated or detected.

In general, the priorities can be set in default, for example, based on device platform, device manufacturer, operating system, etc. Priorities can alternatively or in additionally be set by the particular application; for example, the Facebook mobile application can set its own priorities for various transactions (e.g., a status update can be of higher priority than an add friend request or a poke request, a message send request can be of higher priority than a message delete request, for example), an email client or IM chat client may have its own configurations for priority. The prioritization engine **238** may include set of rules for assigning priority.

The priority engine **238** can also track network provider limitations or specifications on application or transaction priority in determining an overall priority status for a request/transaction. Furthermore, priority can in part or in whole be determined by user preferences, either explicit or implicit. A user, can in general, set priorities at different tiers, such as, specific priorities for sessions, or types, or applications (e.g., a browsing session, a gaming session, versus an IM chat session, the user may set a gaming session to always have higher priority than an IM chat session, which may have higher priority than web-browsing session). A user can set application-specific priorities, (e.g., a user may set Facebook related transactions to have a higher priority than LinkedIn related transactions), for specific transaction types (e.g., for all send message requests across all applications to have higher priority than message delete requests, for all calendar-related events to have a high priority, etc.), and/or for specific folders.

The priority engine **238** can track and resolve conflicts in priorities set by different entities. For example, manual settings specified by the user may take precedence over device OS settings, network provider parameters/limitations (e.g., set in default for a network service area, geographic locale, set for a specific time of day, or set based on service/fee type) may limit any user-specified settings and/or application-set priorities. In some instances, a manual sync request received from a user can override some, most, or all priority settings in that the requested synchronization is performed when requested, regardless of the individually assigned priority or an overall priority ranking for the requested action.

Priority can be specified and tracked internally in any known and/or convenient manner, including but not limited to, a binary representation, a multi-valued representation, a graded representation and all are considered to be within the scope of the disclosed technology.

TABLE I

Change (initiated on device)	Priority	Change (initiated on server)	Priority
Send email	High	Receive email	High
Delete email	Low	Edit email	Often not possible to sync (Low if possible)
(Un)read email	Low		
Move message	Low		
Read more	High		
Down load attachment	High	New email in deleted items	Low
New Calendar event	High	Delete an email	Low
Edit/change Calendar event	High	(Un)Read an email	Low
		Move messages	Low
Add a contact	High	Any calendar change	High
Edit a contact	High	Any contact change	High
Search contacts	High	Wipe/lock device	High
Change a setting	High	Settings change	High

TABLE I-continued

Change (initiated on device)	Priority	Change (initiated on server)	Priority
Manual send/receive	High	Any folder change	High
IM status change	Medium	Connector restart	High (if no changes nothing is sent)
Auction outbid or change notification	High		
Weather Updates	Low	Social Network Status Updates	Medium
		Sever Weather Alerts	High
		News Updates	Low

Table I above shows, for illustration purposes, some examples of transactions with examples of assigned priorities in a binary representation scheme. Additional assignments are possible for additional types of events, requests, transactions, and as previously described, priority assignments can be made at more or less granular levels, e.g., at the session level or at the application level, etc.

As shown by way of example in the above table, in general, lower priority requests/transactions can include, updating message status as being read, unread, deleting of messages, deletion of contacts; higher priority requests/transactions, can in some instances include, status updates, new IM chat message, new email, calendar event update/cancellation/deletion, an event in a mobile gaming session, or other entertainment related events, a purchase confirmation through a web purchase or online, request to load additional or download content, contact book related events, a transaction to change a device setting, location-aware or location-based events/transactions, or any other events/request/transactions initiated by a user or where the user is known to be, expected to be, or suspected to be waiting for a response, etc.

Inbox pruning events (e.g., email, or any other types of messages), are generally considered low priority and absent other impending events, generally will not trigger use of the radio on the device **250**. Specifically, pruning events to remove old email or other content can be 'piggy backed' with other communications if the radio is not otherwise on, at the time of a scheduled pruning event. For example, if the user has preferences set to 'keep messages for 7 days old,' then instead of powering on the device radio to initiate a message delete from the device **250** the moment that the message has exceeded 7 days old, the message is deleted when the radio is powered on next. If the radio is already on, then pruning may occur as regularly scheduled.

The request/transaction manager **235**, can use the priorities for requests (e.g., by the prioritization engine **238**) to manage outgoing traffic from the device **250** for resource optimization (e.g., to utilize the device radio more efficiently for battery conservation). For example, transactions/requests below a certain priority ranking may not trigger use of the radio on the device **250** if the radio is not already switched on, as controlled by the connection manager **265**. In contrast, the radio controller **266** can turn on the radio such a request can be sent when a request for a transaction is detected to be over a certain priority level.

In one embodiment, priority assignments (such as that determined by the local proxy **275** or another device/entity) can be used cause a remote device to modify its communication with the frequency with the mobile device. For example, the remote device can be configured to send notifications to the device **250** when data of higher importance is available to be sent to the mobile device.

In one embodiment, transaction priority can be used in conjunction with characteristics of user activity in shaping or managing traffic, for example, by the traffic shaping engine **255**. For example, the traffic shaping engine **255** can, in response to detecting that a user is dormant or inactive, wait to send low priority transactions from the device **250**, for a period of time. In addition, the traffic shaping engine **255** can allow multiple low priority transactions to accumulate for batch transferring from the device **250** (e.g., via the batching module **257**). In one embodiment, the priorities can be set, configured, or readjusted by a user. For example, content depicted in Table I in the same or similar form can be accessible in a user interface on the device **250** and for example, used by the user to adjust or view the priorities.

The batching module **257** can initiate batch transfer based on certain criteria. For example, batch transfer (e.g., of multiple occurrences of events, some of which occurred at different instances in time) may occur after a certain number of low priority events have been detected, or after an amount of time elapsed after the first of the low priority event was initiated. In addition, the batching module **257** can initiate batch transfer of the cumulated low priority events when a higher priority event is initiated or detected at the device **250**. Batch transfer can otherwise be initiated when radio use is triggered for another reason (e.g., to receive data from a remote device such as host server **100** or **300**). In one embodiment, an impending pruning event (pruning of an inbox), or any other low priority events, can be executed when a batch transfer occurs.

In general, the batching capability can be disabled or enabled at the event/transaction level, application level, or session level, based on any one or combination of the following: user configuration, device limitations/settings, manufacturer specification, network provider parameters/limitations, platform specific limitations/settings, device OS settings, etc. In one embodiment, batch transfer can be initiated when an application/window/file is closed out, exited, or moved into the background; users can optionally be prompted before initiating a batch transfer; users can also manually trigger batch transfers.

In one embodiment, the local proxy **275** locally adjusts radio use on the device **250** by caching data in the cache **285**. When requests or transactions from the device **250** can be satisfied by content stored in the cache **285**, the radio controller **266** need not activate the radio to send the request to a remote entity (e.g., the host server **100**, **300**, as shown in FIG. **1** and FIG. **3** or a content provider/application server such as the server/provider **110** shown in the examples of FIG. **1**A and FIG. **1**B). As such, the local proxy **275** can use the local cache **285** and the cache policy manager **245** to locally store data for satisfying data requests to eliminate or reduce the use of the device radio for conservation of network resources and device battery consumption.

In leveraging the local cache, once the request/transaction manager **225** intercepts a data request by an application on the device **250**, the local repository **285** can be queried to determine if there is any locally stored response, and also determine whether the response is valid. When a valid response is available in the local cache **285**, the response can be provided to the application on the device **250** without the device **250** needing to access the cellular network.

If a valid response is not available, the local proxy **275** can query a remote proxy (e.g., the server proxy **325** of FIG. **3**) to determine whether a remotely stored response is valid. If so, the remotely stored response (e.g., which may be stored on the server cache **135** or optional caching server **199** shown in the example of FIG. **1**B) can be provided to the mobile device,

possibly without the mobile device **250** needing to access the cellular network, thus relieving consumption of network resources.

If a valid cache response is not available, or if cache responses are unavailable for the intercepted data request, the local proxy **275**, for example, the caching policy manager **245**, can send the data request to a remote proxy (e.g., server proxy **325** of FIG. **3**) which forwards the data request to a content source (e.g., application server/content provider **110** of FIG. **1**) and a response from the content source can be provided through the remote proxy, as will be further described in the description associated with the example host server **300** of FIG. **3**. The cache policy manager **245** can manage or process requests that use a variety of protocols, including but not limited to HTTP, HTTPS, IMAP, POP, SMTP and/or ActiveSync. The caching policy manager **245** can locally store responses for data requests in the local database **285** as cache entries, for subsequent use in satisfying same or similar data requests. The manager **245** can request that the remote proxy monitor responses for the data request, and the remote proxy can notify the device **250** when an unexpected response to the data request is detected. In such an event, the cache policy manager **245** can erase or replace the locally stored response(s) on the device **250** when notified of the unexpected response (e.g., new data, changed data, additional data, etc.) to the data request. In one embodiment, the caching policy manager **245** is able to detect or identify the protocol used for a specific request, including but not limited to HTTP, HTTPS, IMAP, POP, SMTP and/or ActiveSync. In one embodiment, application specific handlers (e.g., via the application protocol module **246** of the manager **245**) on the local proxy **275** allows for optimization of any protocol that can be port mapped to a handler in the distributed proxy (e.g., port mapped on the proxy server **325** in the example of FIG. **3**).

In one embodiment, the local proxy **275** notifies the remote proxy such that the remote proxy can monitor responses received for the data request from the content source for changed results prior to returning the result to the device **250**, for example, when the data request to the content source has yielded same results to be returned to the mobile device. In general, the local proxy **275** can simulate application server responses for applications on the device **250**, using locally cached content. This can prevent utilization of the cellular network for transactions where new/changed data is not available, thus freeing up network resources and preventing network congestion.

In one embodiment, the local proxy **275** includes an application behavior detector **236** to track, detect, observe, monitor, applications (e.g., proxy aware and/or unaware applications **210** and **220**) accessed or installed on the device **250**. Application behaviors, or patterns in detected behaviors (e.g., via the pattern detector **237**) of one or more applications accessed on the device **250** can be used by the local proxy **275** to optimize traffic in a wireless network needed to satisfy the data needs of these applications.

For example, based on detected behavior of multiple applications, the traffic shaping engine **255** can align content requests made by at least some of the applications over the network (wireless network) (e.g., via the alignment module **256**). The alignment module can delay or expedite some earlier received requests to achieve alignment. When requests are aligned, the traffic shaping engine **255** can utilize the connection manager to poll over the network to satisfy application data requests. Content requests for multiple applications can be aligned based on behavior patterns or rules/settings including, for example, content types requested by the multiple applications (audio, video, text, etc.), mobile device parameters, and/or network parameters/traffic conditions, network service provider constraints/specifications, etc.

In one embodiment, the pattern detector **237** can detect recurrences in application requests made by the multiple applications, for example, by tracking patterns in application behavior. A tracked pattern can include, detecting that certain applications, as a background process, poll an application server regularly, at certain times of day, on certain days of the week, periodically in a predictable fashion, with a certain frequency, with a certain frequency in response to a certain type of event, in response to a certain type user query, frequency that requested content is the same, frequency with which a same request is made, interval between requests, applications making a request, or any combination of the above, for example.

Such recurrences can be used by traffic shaping engine **255** to offload polling of content from a content source (e.g., from an application server/content provider **110** of FIG. **1**) that would result from the application requests that would be performed at the mobile device **250** to be performed instead, by a proxy server (e.g., proxy server **125** of FIG. **1**B or proxy server **325** of FIG. **3**) remote from the device **250**. Traffic engine **255** can decide to offload the polling when the recurrences match a rule. For example, there are multiple occurrences or requests for the same resource that have exactly the same content, or returned value, or based on detection of repeatable time periods between requests and responses such as a resource that is requested at specific times during the day. The offloading of the polling can decrease the amount of bandwidth consumption needed by the mobile device **250** to establish a wireless (cellular) connection with the content source for repetitive content polls.

As a result of the offloading of the polling, locally cached content stored in the local cache **285** can be provided to satisfy data requests at the device **250**, when content change is not detected in the polling of the content sources. As such, when data has not changed, application data needs can be satisfied without needing to enable radio use or occupying cellular bandwidth in a wireless network. When data has changed and/or new data has been received, the remote entity to which polling is offloaded, can notify the device **250**. The remote entity may be the host server **300** as shown in the example of FIG. **3**.

In one embodiment, the local proxy **275** can mitigate the need/use of periodic keep-alive messages (heartbeat messages) to maintain TCP/IP connections, which can consume significant amounts of power thus having detrimental impacts on mobile device battery life. The connection manager **265** in the local proxy (e.g., the heartbeat manager **267**) can detect, identify, and intercept any or all heartbeat (keep-alive) messages being sent from applications.

The heartbeat manager **267** can prevent any or all of these heartbeat messages from being sent over the cellular, or other network, and instead rely on the server component of the distributed proxy system (e.g., shown in FIG. **1**B) to generate the and send the heartbeat messages to maintain a connection with the backend (e.g., app server/provider **110** in the example of FIG. **1**).

The local proxy **275** generally represents any one or a portion of the functions described for the individual managers, modules, and/or engines. The local proxy **275** and device **250** can include additional or less components; more or less functions can be included, in whole or in part, without deviating from the novel art of the disclosure.

FIG. **2**B depicts a block diagram illustrating another example of the traffic shaping engine **255** having a distributed policy manager **258** in the local proxy on the client-side of the distributed proxy system shown in the example of FIG. **2**A.

As described in FIG. **2**A, the traffic shaping engine **255** is able to manipulate, arrange, batch, combine, forward, delay, prioritize, or de-prioritize traffic at the mobile device **250** (e.g., including traffic originating from applications and/or services at the mobile device **250**). In one embodiment, the traffic shaping engine **255** additionally includes a client-side distributed policy manager **258** which can aggregate client-side parameters in formulating and/or implementing a policy for traffic control in the mobile network servicing the mobile device **250**. In one embodiment, the client-side parameters include application parameters and device parameters. Thus, the policy manager **258** can obtain and analyze parameters for all applications running or active on the device, as well as parameters for all hardware components and elements of the device.

For example, the client-side application parameters can include an indication or identification of applications installed on the device **250**. Application parameters can also include polling frequency of the application, state of the application including background operation, foreground operation, inactive, or active. Furthermore, application traffic parameters such as, by way of example but not limitation, polling rate, protocol used, amount of data, and interaction with other applications can be determined. In general, application parameters can be detected, identified, tracked, monitored, adjusted, updated, modified, or revised by the application parameter detector **260**. By using various application parameters, the traffic profile generator can generate a traffic profile for a given application.

In general, application parameters can be identified, monitored, updated, and tracked for multiple applications on the mobile device **250** on a per-application basis. In addition, application parameters can be user configurable or user editable. For example, the user can view all system detected and configured parameters and adjust each parameter as desired.

Device parameters can include generally user-related information, device-related information, and/or network-related information. Some device parameters can include by way of example, but not limitation, user activity status indicating whether the user is active or inactive (e.g., back light, motion sensor, etc.), whether the device is active or inactive, network availability, network strength, network congestion, radio state of each wireless radio on the mobile device, including one or more of, Bluetooth, WiFi, and cellular radios, the on/off or active/inactive state of various hardware components on the device, or the state/reading of any sensor (e.g., touch, gesture, proximity, light, motion, capacitance, resistance, piezoelectric, temperature, etc.) on the device.

Device parameters can be determined, tracked, identified, detected, updated, revised, monitored by, for example, the device parameter detector **261** in the client-side policy manager **258**. In addition, some or all of the device parameters may be supplied by the remote host (e.g., host **100** of FIGS. **1**A/**1**B, the proxy server **325** of host server **300** in the example of FIG. **3**A). For example, network-related parameters such as, network availability, network strength, network congestion, or any other network related operational difficulties may be detected by the remote host or other remote third party and communicated to the device parameter detector **261**.

In general, client-side parameters for each application can be system-identified (e.g., by the identifier **259** in the local proxy), all user-identified (e.g., specified via an on-screen widget provided by the local proxy), or a combination of system identified and user identified parameters. The user can specify whether an application is to be configured with parameters detected by the proxy, or whether an application is to be configured with parameters specified by the user, or a combination of both. The user can specify (e.g., through a user interface on the mobile device **250** itself or through another device interface), each individual parameter for an application or modify individual parameters after the system has detected and provided a value. Overall, while some application and device parameters are disclosed herein, the system may of course obtain and analyze other parameters.

In some instances, parameter profiles can be generated to be applied automatically to certain groupings of applications (e.g., groupings based on system-determined or user-determine priority, time sensitivity, importance, device preference, operator settings or preference, user-liking, etc.), initially when an application is first installed, or by default until the user requests that application-specific parameters be determined and applied (e.g., by the identifier **259** and/or by the user). Parameter profiles can be used to initiate some level of high-level traffic optimization before the system has had time to perform application or event specific optimization such that overhead time can be reduced for the user, device, and network operator to begin to experience benefits of traffic and resource consumption optimization.

In one embodiment, such parameter profiles with default settings can be provided by another entity (an entity external to the local proxy **275**) and can include, the host server (e.g., the proxy server **325** of server **300** shown in the example of FIG. **3**). The parameter profiles with predetermined settings may be automatically pushed from the proxy **325** or provided upon request (e.g., either by the local proxy **275** and/or by the mobile device user). Since the host server **300** or the proxy server **325** on the host server services, monitors, tracks, or otherwise corresponds/communicates

In some instances, the mobile device **250** may be accessed by multiple users (e.g. sharing the same user account or using separate accounts on the same device). For example, several family members may share one device, or several corporate users may share a corporate phone, such as a loaner device. Therefore, application parameters may be tracked on a per-user basis for each application on the mobile device, in cases where separate user accounts are used and also in cases where a single account is shared by multiple users. For example, the parameter identifier **259** can provide user interfaces prompting each user to specify application or device parameters or to specify preferences for system configuration or user configuration. Each user can also utilize user interfaces, widgets, or an application on the device **250**, or another device to specify their own settings for application and/or device parameters.

Any or all of the client-side parameters as described above can be used to formulate application probability profiles **262** for some or all applications on device **250**. An application probability profile can specify, for instance, using poll frequency of an application, an indication of how frequently polls of the application results in new data to be received which allows a prediction of the likelihood or probability that a subsequent poll will find new or changed data.

Specifically, the local proxy **275** can use the client-side parameters to determine the frequency with which polling by an application yields new data and can create a probability profile for the application using the determined frequency. Such probability profiles **262** can then be used by the traffic shaping engine **255** to determine how to handle and satisfy particular data request initiated at the mobile device. For example, the probability profile can be used (e.g., by the caching policy manager **245** shown in the example of FIG.

2A) to determine whether to respond to an application poll using a local cache on the mobile device.

If the probability for a request generated by an application indicates a lower than threshold probability of finding new data at the app server/content host (e.g., server/provider **110** of FIGS. **1**A/**1**B) the local proxy **275** may decide to satisfy the request with a previously cached response to this request instead of allowing the data request to go over the cellular network and/or to turn on an otherwise off radio. Application probability profiles can be used by the local proxy **275** to formulate a policy for traffic control at the mobile device, between the mobile device **275**, the host server (e.g. server **100**/**300**, and app server/provider **110**).

The traffic policy can be formulated based on the probability profiles and can factor in additional criteria such as device state, user state, and/or network state. For example, a traffic policy can indicate that for an application or data request with a given probability of finding new data, the request is to be forwarded over the air given certain network conditions (e.g., as identified by network parameters: not congested or otherwise without identified operational difficulties). The decision in a traffic policy as to whether a request with a certain level of probability is to be forwarded over the cellular network can also be based on whether the user is active and/or whether the application is in the foreground (as identified by the application and/or device parameters), for example.

For example, the traffic shaping engine **255** can decide as part of a traffic policy to delay a poll for an application even if the server has signaled new data availability, if another application is about to poll and/or if the probability to find new data for this second application is higher than a threshold. This decision can include an additional criteria defined in the traffic policy such that network conditions (e.g., operational difficulties) are considered.

Note that the traffic policy can be formulated by the traffic shaping engine **255** using alignment and/or batching processes, as described in FIG. **2**A. The traffic policy can also be jointly formulated with the remote server (e.g., server **100** or **300**), and be adjustable dynamically, on-demand, automatically, based on certain triggers, or based on user request, or other types of user explicit and implicit triggers. In general, implementation of the policy can be performed solely by the local proxy **275** or jointly with the remote server (e.g., proxy server **175**, or **375** on the hosts **100** or **300** respectively).

Note that when the traffic policy is formulated in conjunction with a remote server, or in some instances, solely by the remote server (e.g., server **100** or **300**), additional parameters can be aggregated and used in defining such policies. For example, server-side parameters which can be detected and aggregated can be used in formulating traffic policies or further refining already-defined traffic policies, as will be further discussed in description associated with the example of FIG. **3**B.

FIG. **3**A depicts a block diagram illustrating an example of server-side components in a distributed proxy and cache system residing on a host server **300** that manages traffic in a wireless network for resource conservation.

The host server **300** generally includes, for example, a network interface **308** and/or one or more repositories **312**, **314**, **316**. Note that server **300** may be any portable/mobile or non-portable device, server, cluster of computers and/or other types of processing units (e.g., any number of a machine shown in the example of FIG. **11**) able to receive, transmit signals to satisfy data requests over a network including any wired or wireless networks (e.g., WiFi, cellular, Bluetooth, etc.).

The network interface **308** can include networking module (s) or devices(s) that enable the server **300** to mediate data in a network with an entity that is external to the host server **300**, through any known and/or convenient communications protocol supported by the host and the external entity. Specifically, the network interface **308** allows the server **308** to communicate with multiple devices including mobile phone devices **350**, and/or one or more application servers/content providers **310**.

The host server **300** can store information about connections (e.g., network characteristics, conditions, types of connections, etc.) with devices in the connection metadata repository **312**. Additionally, any information about third party application or content providers can also be stored in **312**. The host server **300** can store information about devices (e.g., hardware capability, properties, device settings, device language, network capability, manufacturer, device model, OS, OS version, etc.) in the device information repository **314**. Additionally, the host server **300** can store information about network providers and the various network service areas in the network service provider repository **316**.

The communication enabled by **308** allows for simultaneous connections (e.g., including cellular connections) with devices **350** and/or connections (e.g., including wired/wireless, HTTP, Internet connections, LAN, Wifi, etc.) with content servers/providers **310**, to manage the traffic between devices **350** and content providers **310**, for optimizing network resource utilization and/or to conserver power (battery) consumption on the serviced devices **350**. The host server **300** can communicate with mobile devices **350** serviced by different network service providers and/or in the same/different network service areas. The host server **300** can operate and is compatible with devices **350** with varying types or levels of mobile capabilities, including by way of example but not limitation, 1G, 2G, 2G transitional (2.5G, 2.75G), 3G (IMT-2000), 3G transitional (3.5G, 3.75G, 3.9G), 4G (IMT-advanced), etc.

In general, the network interface **308** can include one or more of a network adaptor card, a wireless network interface card (e.g., SMS interface, WiFi interface, interfaces for various generations of mobile communication standards including but not limited to 2G, 3G, 3.5G, 4G type networks such as, LTE, WiMAX, etc.), Bluetooth, WiFi, or any other network whether or not connected via a router, an access point, a wireless router, a switch, a multilayer switch, a protocol converter, a gateway, a bridge, bridge router, a hub, a digital media receiver, and/or a repeater.

The host server **300** can further include, server-side components of the distributed proxy and cache system which can include, a proxy server **325** and a server cache **335**. In one embodiment, the server proxy **325** can include an HTTP access engine **345**, a caching policy manager **355**, a proxy controller **365**, a traffic shaping engine **375**, a new data detector **386**, and/or a connection manager **395**.

The HTTP access engine **345** may further include a heartbeat manager **346**, the proxy controller **365** may further include a data invalidator module **366**, the traffic shaping engine **375** may further include a control protocol **276** and a batching module **377**. Additional or less components/modules/engines can be included in the proxy server **325** and each illustrated component.

As used herein, a "module," "a manager," a "handler," a "detector," an "interface," a "controller," or an "engine" includes a general purpose, dedicated or shared processor and, typically, firmware or software modules that are executed by the processor. Depending upon implementation-specific or other considerations, the module, manager, han-

dler, or engine can be centralized or its functionality distributed. The module, manager, handler, or engine can include general or special purpose hardware, firmware, or software embodied in a computer-readable (storage) medium for execution by the processor. As used herein, a computer-readable medium or computer-readable storage medium is intended to include all mediums that are statutory (e.g., in the United States, under 35 U.S.C. 101), and to specifically exclude all mediums that are non-statutory in nature to the extent that the exclusion is necessary for a claim that includes the computer-readable (storage) medium to be valid. Known statutory computer-readable mediums include hardware (e.g., registers, random access memory (RAM), non-volatile (NV) storage, to name a few), but may or may not be limited to hardware.

In the example of a device (e.g., mobile device **350**) making an application or content request to an app server or content provider **310**, the request may be intercepted and routed to the proxy server **325**, which is coupled to the device **350** and the provider **310**. Specifically, the proxy server is able to communicate with the local proxy (e.g., proxy **175** and **275** of the examples of FIG. **1** and FIG. **2** respectively) of the device **350**, the local proxy forwards the data request to the proxy server **325** for, in some instances, further processing, and if needed, for transmission to the content server **310** for a response to the data request.

In such a configuration, the host **300**, or the proxy server **325** in the host server **300** can utilize intelligent information provided by the local proxy in adjusting its communication with the device in such a manner that optimizes use of network and device resources. For example, the proxy server **325** can identify characteristics of user activity on the device **350** to modify its communication frequency. The characteristics of user activity can be determined by, for example, the activity/behavior awareness module **366** in the proxy controller **365**, via information collected by the local proxy on the device **350**.

In one embodiment, communication frequency can be controlled by the connection manager **396** of the proxy server **325**, for example, to adjust push frequency of content or updates to the device **350**. For instance, push frequency can be decreased by the connection manager **396** when characteristics of the user activity indicate that the user is inactive. In one embodiment, when the characteristics of the user activity indicate that the user is subsequently active after a period of inactivity, the connection manager **396** can adjust the communication frequency with the device **350** to send data that was buffered as a result of decreased communication frequency, to the device **350**.

In addition, the proxy server **325** includes priority awareness of various requests, transactions, sessions, applications, and/or specific events. Such awareness can be determined by the local proxy on the device **350** and provided to the proxy server **325**. The priority awareness module **367** of the proxy server **325** can generally assess the priority (e.g., including time-criticality, time-sensitivity, etc.) of various events or applications; additionally, the priority awareness module **367** can track priorities determined by local proxies of devices **350**.

In one embodiment, through priority awareness, the connection manager **395** can further modify communication frequency (e.g., use or radio as controlled by the radio controller **396**) of the server **300** with the devices **350**. For example, the server **300** can notify the device **350**, thus requesting use of the radio if it is not already in use, when data or updates of an importance/priority level which meets a criteria becomes available to be sent.

In one embodiment, the proxy server **325** can detect multiple occurrences of events (e.g., transactions, content, data received from server/provider **310**) and allow the events to accumulate for batch transfer to device **350**. Batch transfer can be cumulated and transfer of events can be delayed based on priority awareness and/or user activity/application behavior awareness, as tracked by modules **366** and/or **367**. For example, batch transfer of multiple events (of a lower priority) to the device **350** can be initiated by the batching module **377** when an event of a higher priority (meeting a threshold or criteria) is detected at the server **300**. In addition, batch transfer from the server **300** can be triggered when the server receives data from the device **350**, indicating that the device radio is already in use and is thus on. In one embodiment, the proxy server **324** can order the each messages/packets in a batch for transmission based on event/transaction priority, such that higher priority content can be sent first, in case connection is lost or the battery dies, etc.

In one embodiment, the server **300** caches data (e.g., as managed by the caching policy manager **355**) such that communication frequency over a network (e.g., cellular network) with the device **350** can be modified (e.g., decreased). The data can be cached, for example in the server cache **335**, for subsequent retrieval or batch sending to the device **350** to potentially decrease the need to turn on the device **350** radio. The server cache **335** can be partially or wholly internal to the host server **300**, although in the example of FIG. **3**, it is shown as being external to the host **300**. In some instances, the server cache **335** may be the same as and/or integrated in part or in whole with another cache managed by another entity (e.g., the optional caching proxy server **199** shown in the example of FIG. **1**B), such as being managed by an application server/content provider **110**, a network service provider, or another third party.

In one embodiment, content caching is performed locally on the device **350** with the assistance of host server **300**. For example, proxy server **325** in the host server **300** can query the application server/provider **310** with requests and monitor changes in responses. When changed or new responses are detected (e.g., by the new data detector **347**), the proxy server **325** can notify the mobile device **350**, such that the local proxy on the device **350** can make the decision to invalidate (e.g., indicated as out-dated) the relevant cache entries stored as any responses in its local cache. Alternatively, the data invalidator module **368** can automatically instruct the local proxy of the device **350** to invalidate certain cached data, based on received responses from the application server/provider **310**. The cached data is marked as invalid, and can get replaced or deleted when new content is received from the content server **310**.

Note that data change can be detected by the detector **347** in one or more ways. For example, the server/provider **310** can notify the host server **300** upon a change. The change can also be detected at the host server **300** in response to a direct poll of the source server/provider **310**. In some instances, the proxy server **325** can in addition, pre-load the local cache on the device **350** with the new/updated data. This can be performed when the host server **300** detects that the radio on the mobile device is already in use, or when the server **300** has additional content/data to be sent to the device **350**.

One or more the above mechanisms can be implemented simultaneously or adjusted/configured based on application (e.g., different policies for different servers/providers **310**). In some instances, the source provider/server **310** may notify the host **300** for certain types of events (e.g., events meeting a priority threshold level). In addition, the provider/server **310**

may be configured to notify the host **300** at specific time intervals, regardless of event priority.

In one embodiment, the proxy server **325** of the host **300** can monitor/track responses received for the data request from the content source for changed results prior to returning the result to the mobile device, such monitoring may be suitable when data request to the content source has yielded same results to be returned to the mobile device, thus preventing network/power consumption from being used when no new/changes are made to a particular requested. The local proxy of the device **350** can instruct the proxy server **325** to perform such monitoring or the proxy server **325** can automatically initiate such a process upon receiving a certain number of the same responses (e.g., or a number of the same responses in a period of time) for a particular request.

In one embodiment, the server **300**, for example, through the activity/behavior awareness module **366**, is able to identify or detect user activity, at a device that is separate from the mobile device **350**. For example, the module **366** may detect that a user's message inbox (e.g., email or types of inbox) is being accessed. This can indicate that the user is interacting with his/her application using a device other than the mobile device **350** and may not need frequent updates, if at all.

The server **300**, in this instance, can thus decrease the frequency with which new or updated content is sent to the mobile device **350**, or eliminate all communication for as long as the user is detected to be using another device for access. Such frequency decrease may be application specific (e.g., for the application with which the user is interacting with on another device), or it may be a general frequency decrease (e.g., since the user is detected to be interacting with one server or one application via another device, he/she could also use it to access other services) to the mobile device **350**.

In one embodiment, the host server **300** is able to poll content sources **310** on behalf of devices **350** to conserve power or battery consumption on devices **350**. For example, certain applications on the mobile device **350** can poll its respective server **310** in a predictable recurring fashion. Such recurrence or other types of application behaviors can be tracked by the activity/behavior module **366** in the proxy controller **365**. The host server **300** can thus poll content sources **310** for applications on the mobile device **350**, that would otherwise be performed by the device **350** through a wireless (e.g., including cellular connectivity). The host server can poll the sources **310** for new or changed data by way of the HTTP access engine **345** to establish HTTP connection or by way of radio controller **396** to connect to the source **310** over the cellular network. When new or changed data is detected, the new data detector can notify the device **350** that such data is available and/or provide the new/changed data to the device **350**.

In one embodiment, the connection manager **395** determines that the mobile device **350** is unavailable (e.g., the radio is turned off) and utilizes SMS to transmit content to the device **350**, for instance via the SMSC shown in the example of FIG. **1**B. SMS is used to transmit invalidation messages, batches of invalidation messages, or even content in the case the content is small enough to fit into just a few (usually one or two) SMS messages. This avoids the need to access the radio channel to send overhead information. The host server **300** can use SMS for certain transactions or responses having a priority level above a threshold or otherwise meeting a criteria. The server **300** can also utilize SMS as an out-of-band trigger to maintain or wake-up an IP connection as an alternative to maintaining an always-on IP connection.

In one embodiment, the connection manager **395** in the proxy server **325** (e.g., the heartbeat manager **398**) can generate and/or transmit heartbeat messages on behalf of connected devices **350**, to maintain a backend connection with a provider **310** for applications running on devices **350**.

For example, in the distributed proxy system, local cache on the device **350** can prevent any or all heartbeat messages needed to maintain TCP/IP connections required for applications, from being sent over the cellular, or other network, and instead rely on the proxy server **325** on the host server **300** to generate and/or send the heartbeat messages to maintain a connection with the backend (e.g., app server/provider **110** in the example of FIG. **1**). The proxy server can generate the keep-alive (heartbeat) messages independent of the operations of the local proxy on the mobile device.

The repositories **312**, **314**, and/or **316** can additionally store software, descriptive data, images, system information, drivers, and/or any other data item utilized by other components of the host server **300** and/or any other servers for operation. The repositories may be managed by a database management system (DBMS), for example but not limited to, Oracle, DB2, Microsoft Access, Microsoft SQL Server, PostgreSQL, MySQL, FileMaker, etc.

The repositories can be implemented via object-oriented technology and/or via text files, and can be managed by a distributed database management system, an object-oriented database management system (OODBMS) (e.g., ConceptBase, FastDB Main Memory Database Management System, JDOInstruments, ObjectDB, etc.), an object-relational database management system (ORDBMS) (e.g., Informix, OpenLink Virtuoso, VMDS, etc.), a file system, and/or any other convenient or known database management package.

FIG. **3**B depicts a block diagram illustrating another example of the traffic shaping engine **375** as further including a distributed policy manager **378** in the proxy server **325** shown in the example of FIG. **3**A.

As described in FIG. **3**A, the traffic shaping engine **375** is able to manipulate, arrange, batch, combine, forward, delay, prioritize, or de-prioritize traffic at the host server **300** (e.g., including traffic originating from or destined to applications and/or services at the mobile device **250** and/or traffic originating from or destined to an app server/provider **110**). In one embodiment, the traffic shaping engine **255** additionally includes a server-side distributed policy manager **378** which can aggregate server-side parameters in formulating and/or implementing a policy for traffic control in the mobile network servicing the mobile device **250**. In one embodiment, the server-side parameters include network parameters, activity parameters for multiple devices and/or users, location parameters (as determined from triangulation, GPS, or other means), and can be detected, identified, tracked, monitored, adjusted, updated, modified, or revised by the components (e.g., the activity parameter detector **308**, host parameter detector **381**, location parameter detector **382**, and/or the network parameter detector **383**) in the server-side parameter identifier **379**, for example.

As discussed for the client-side parameters, the server-side parameters or use of server side parameters may be user configurable, on a device-by-device basis, and/or application-by-application (service-by-service) basis. Use and aggregation of such parameters may be enabled or disabled by the user or other parties, such as the device manufacturer, network operator, application/service provider, etc.

Using various server-side parameters (with or without consideration of the client-side parameter), the application probability profile generator **384** can generate application probability profiles, as discussed in FIG. **2**B. The traffic shaping engine **375** can use the application probability profiles to generate, define, update, revise, formulate, or modify traffic

policies across one or more of multiple dimensions (e.g., user, application, network operator, device OS, etc.). In addition or in alternate, the local proxies of respective mobile clients create traffic profiles (e.g., including application probability profiles and traffic policies) of applications installed on the mobile clients and transfer the traffic profiles to the proxy server for use in managing network resources in the wireless network, for example, across multiple mobile devices and/or networks and/or network operators.

For example, traffic policies can be formulated by the traffic shaping engine **375** on the server side for a given application on a given device, a given application across multiple devices, a given application for a given user, or a given application for devices on a given wireless network, or a given application given a particular operating system, etc. The application probability profile generator **384** can also generate a traffic profile for a given user or a given device, or a given operating system, or a given network that can be application-independent or application-dependent. Such policies can factor into any of the client-side parameters such as those aggregated by the local proxy **275**.

In one embodiment, the server **300** or the proxy server **325** in the host server **300** can detect that multiple mobile clients are requesting content polls directed towards a common host server (e.g., application server **110**), for example, within a certain timeframe. The traffic shaping engine **375** can formulate a policy such that the common host server is polled once for all such common requests directed towards the same server and occurring within a specified time frame. The traffic policy may further be formulated such that the received response or data/content is sent to each of the request multiple mobile clients such that each client need not make individual polls to the common host server.

In another example, traffic policies are formulated by the traffic shaping engine **375** based on network conditions. For example, the network parameter detector **385** in the proxy server **325** can track network conditions in a specific network area or multiple network areas, for a single network operator, or multiple network operators. Network congestion can be detected based on, by way of example but not limitation, failure of mobile clients in the specific network area to be able to connect to the wireless network, reported by a network operator or a user.

In one embodiment, the traffic shaping engine **375** sets polling schedules for the mobile clients in a specific network area according to the network conditions, or for mobile clients serviced by a specific network operator, for example. Polling schedules can be adjusted or modified by blocking polls from reaching the wireless network or from the intended destination (e.g., content host or host server). The blocking can be performed by the local proxy and/or the proxy server. In addition, the traffic shaping engine **375** can adjust the polling frequency made to content hosts (e.g., application server/content provider **110**) based on a number of mobile clients serviced in the specific network area (e.g. to promote user experience, mitigate the chances of experiencing slowness/delays, prevent traffic congestion or to prevent further congestion), for example, if the network congestion reaches a threshold level.

In one embodiment, the traffic shaping engine **375** can communicating the polling schedules to the mobile clients in the specific network area. The polling schedules can include instructions for the mobile clients to poll on different schedules so as to avoid congestion. The schedules may be application dependent or application independent, or destination server dependent or independent. In another example, the proxy server **375** detects network congestion in a specific area, and can modify some or all traffic policies to reduce polling frequency for content made to hosts made by all or some of the mobile clients serviced in the specific network area where congestion is detected. The applications for which poll frequency is reduced may meet a certain criterion, for example, the application may be a low priority application, or an application running in the background as opposed to the foreground.

The traffic policies modified in this situation may further depend on device, application provider, or network operator specifications. For example, the network operator may allow certain subscribers (e.g., those with premier or higher tier service plans, or otherwise higher paying customers) to access the network with priority when the network is congested.

FIG. **4** depicts a diagram showing how data requests from a mobile device **450** to an application server/content provider **496** in a wireless network can be coordinated by a distributed proxy system **460** in a manner such that network and battery resources are conserved through using content caching and monitoring performed by the distributed proxy system **460**.

In satisfying application or client requests on a mobile device **450** without the distributed proxy system **460**, the mobile device **450**, or the software widget executing on the device **450** performs a data request **402** (e.g., an HTTP GET, POST, or other request) directly to the application server **495** and receives a response **404** directly from the server/provider **495**. If the data has been updated, the widget on the mobile device **450** can refreshes itself to reflect the update and waits for small period of time and initiates another data request to the server/provider **495**.

In one embodiment, the requesting client or software widget **455** on the device **450** can utilize the distributed proxy system **460** in handling the data request made to server/provider **495**. In general, the distributed proxy system **460** can include a local proxy **465** (which is typically considered a client-side component of the system **460** and can reside on the mobile device **450**), a caching proxy (**475**, considered a server-side component **470** of the system **460** and can reside on the host server **485** or be wholly or partially external to the host server **485**), a host server **485**. The local proxy **465** can be connected to the proxy **475** and host server **485** via any network or combination of networks.

When the distributed proxy system **460** is used for data/application requests, the widget **455** can perform the data request **406** via the local proxy **465**. The local proxy **465**, can intercept the requests made by device applications, and can identify the connection type of the request (e.g., an HTTP get request or other types of requests). The local proxy **465** can then query the local cache for any previous information about the request (e.g., to determine whether a locally stored response is available and/or still valid). If a locally stored response is not available or if there is an invalid response stored, the local proxy **465** can update or store information about the request, the time it was made, and any additional data, in the local cache. The information can be updated for use in potentially satisfying subsequent requests.

The local proxy **465** can then send the request to the host server **485** and the server **485** can perform the request **406** and returns the results in response **408**. The local proxy **465** can store the result and in addition, information about the result and returns the result to the requesting widget **455**.

In one embodiment, if the same request has occurred multiple times (within a certain time period) and it has often yielded same results, the local proxy **465** can notify **410** the server **485** that the request should be monitored (e.g., steps

412 and 414) for result changes prior to returning a result to the local proxy 465 or requesting widget 455.

In one embodiment, if a request is marked for monitoring, the local proxy 465 can now store the results into the local cache. Now, when the data request 416, for which a locally response is available, is made by the widget 455 and intercepted at the local proxy 465, the proxy 465 can return the response 418 from the local cache without needing to establish a connection communication over the wireless network.

In addition, the server proxy performs the requests marked for monitoring 420 to determine whether the response 422 for the given request has changed. In general, the host server 485 can perform this monitoring independently of the widget 455 or local proxy 465 operations. Whenever an unexpected response 422 is received for a request, the server 485 can notify the local proxy 465 that the response has changed (e.g., the invalidate notification in step 424) and that the locally stored response on the client should be erased or replaced with a new response.

In this case, a subsequent data request 426 by the widget 455 from the device 450 results in the data being returned from host server 485 (e.g., via the caching proxy 475). Thus, through utilizing the distributed proxy system 460 the wireless (cellular) network is intelligently used when the content/data for the widget or software application 455 on the mobile device 450 has actually changed. As such, the traffic needed to check for the changes to application data is not performed over the wireless (cellular) network. This reduces the amount of generated network traffic and shortens the total time and the number of times the radio module is powered up on the mobile device 450, thus reducing battery consumption, and in addition, frees up network bandwidth.

FIG. 5 depicts a diagram showing one example process for implementing a hybrid IP and SMS power saving mode on a mobile device 550 using a distributed proxy and cache system (e.g., such as the distributed system shown in the example of FIG. 1B).

In step 502, the local proxy (e.g., proxy 175 in the example of FIG. 1B) monitors the device for user activity. When the user is determined to be active, server push is active. For example, always-on-push IP connection can be maintained and if available, SMS triggers can be immediately sent to the mobile device 550 as it becomes available.

In process 504, after the user has been detected to be inactive or idle over a period of time (e.g., the example is shown for a period of inactivity of 20 min.), the local proxy can adjust the device to go into the power saving mode. In the power saving mode, when the local proxy receives a message or a correspondence from a remote proxy (e.g., the server proxy 135 in the example of FIG. 1B) on the server-side of the distributed proxy and cache system, the local proxy can respond with a call indicating that the device 550 is currently in power save mode (e.g., via a power save remote procedure call). In some instances, the local proxy can take the opportunity to notify multiple accounts or providers (e.g., 510A, and 510B) of the current power save status (e.g., timed to use the same radio power-on event).

In one embodiment, the response from the local proxy can include a time (e.g., the power save period) indicating to the remote proxy (e.g., server proxy 135) and/or the app server/providers 510A/B when the device 550 is next able to receive changes or additional data. A default power savings period can be set by the local proxy.

In one embodiment, if new, change, or different data or event is received before the end of any one power saving period, then the wait period communicated to the servers 510A/B can be the existing period, rather than an incremented time period. In response, the remote proxy server, upon receipt of power save notification from the device 550, can stop sending changes (data or SMSs) for the period of time requested (the wait period). At the end of the wait period, any notifications received can be acted upon and changes sent to the device 550, for example, as a single batched event or as individual events. If no notifications come in, then push can be resumed with the data or an SMS being sent to the device 550. The proxy server can time the poll or data collect event to optimize batch sending content to the mobile device 550 to increase the chance that the client will receive data at the next radio power on event.

Note that the wait period can be updated in operation in real time to accommodate operating conditions. For example, the local proxy can adjust the wait period on the fly to accommodate the different delays that occur in the system.

Detection of user activity 512 at the device 550 causes the power save mode to be exited. When the device 550 exits power save mode, it can begin to receive any changes associated with any pending notifications. If a power saving period has expired, then no power save cancel call may be needed as the proxy server will already be in traditional push operation mode.

In one embodiment, power save mode is not applied when the device 550 is plugged into a charger. This setting can be reconfigured or adjusted by the user or another party. In general, the power save mode can be turned on and off, for example, by the user via a user interface on device 550. In general, timing of power events to receive data can be synced with any power save calls to optimize radio use.

FIG. 6 depicts a flow chart illustrating an example process for using a single server poll to satisfy multiple mobile client requests.

In process 602, it is detected (e.g., by a host server 100 or 300 or proxy server 325 in the host 300) that multiple mobile clients are requesting content polls directed towards a common host server (e.g., an application server/content provider 110). In process 604, the common host server is polled for the content requested by the multiple mobile clients. The common host server can be polled just once, or a few instances but less than the total number of mobile clients that actually requested the content polls to preemptively prevent duplicate traffic from being sent over the wireless network since content polls occurring at or approximately the same time would likely yield the same response having same content.

Thus, in process 608, the content received from the common host server is sent to each of the multiple mobile clients such that each client need not make individual polls to the common host server, to conserve network resources. This approach may be taken for polls occurring at the same time or substantially at the same time, or occurring within a predetermined or customized time interval. The timing interval can range anywhere from 1-10 ms., to seconds, to minutes, hours, or days, weeks, etc. and can depend on the server being polled, the polling application, network conditions (in real time or historical conditions), the network operator, the user behavior/preference, device OS, subscription level (tier of service) with the wireless carrier, sponsorship of a given application service provider/content host, etc.

FIG. 7 depicts an example of process for poll schedule management and adjustment for mobile devices in a specific network area based on network conditions and congestion.

In process 702, network conditions in a specific network area are tracked (e.g., by the proxy server 325 of the host 300). Information regarding network conditions may also be provided by other parties, including reported by a wireless device

user, reported by local proxies on mobile devices, network operators, application/service providers/content hosts, or other third parties.

In process **704**, polling schedules are set or specified for the mobile clients or devices in the specific network area according to the network conditions. In one embodiment, the setting the polling schedules includes adjusting the polling frequency made to content hosts. The polling frequency made to the content hosts can be, for example, adjusted by blocking at least some polls from the mobile clients from reaching the wireless network. In process **706**, the polling frequency made to content hosts can be adjusted based on a number of mobile clients serviced in the specific network area. The poll frequencies can be specified in poll schedules and can be communicated to the mobile clients in the specific network area, in process **708**.

The poll schedules can be received by local proxies on the mobile devices and implemented/managed by the local proxies. Alternatively, the poll schedules may be locally generated by local proxies, based on network information received from the proxy server, or other sources. In one embodiment, the proxy server also adjusts content delivery schedule to the mobile clients from content hosts. For example, in the event of detection of network congestion in process **710** (e.g., either locally or determined from another source), polling frequency for content made to hosts made by the mobile clients serviced in the specific network area can be reduced in process **712**. This reduction can be specified in traffic policies specified by the local proxy, the proxy server, or a combination of the two. Network congestion is determined based on reduced data transfer speeds in the wireless network, higher retransmission rates on lower level protocols, and/or failure to connect.

FIG. **8** shows a diagrammatic representation of a machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

In alternative embodiments, the machine operates as a standalone device or may be connected (e.g., networked) to other machines. In a networked deployment, the machine may operate in the capacity of a server or a client machine in a client-server network environment, or as a peer machine in a peer-to-peer (or distributed) network environment.

The machine may be a server computer, a client computer, a personal computer (PC), a user device, a tablet PC, a laptop computer, a set-top box (STB), a personal digital assistant (PDA), a cellular telephone, an iPhone, an iPad, a Blackberry, a processor, a telephone, a web appliance, a network router, switch or bridge, a console, a hand-held console, a (hand-held) gaming device, a music player, any portable, mobile, hand-held device, or any machine capable of executing a set of instructions (sequential or otherwise) that specify actions to be taken by that machine.

While the machine-readable medium or machine-readable storage medium is shown in an exemplary embodiment to be a single medium, the term "machine-readable medium" and "machine-readable storage medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term "machine-readable medium" and "machine-readable storage medium" shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the presently disclosed technique and innovation.

In general, the routines executed to implement the embodiments of the disclosure, may be implemented as part of an operating system or a specific application, component, program, object, module or sequence of instructions referred to as "computer programs." The computer programs typically comprise one or more instructions set at various times in various memory and storage devices in a computer, and that, when read and executed by one or more processing units or processors in a computer, cause the computer to perform operations to execute elements involving the various aspects of the disclosure.

Moreover, while embodiments have been described in the context of fully functioning computers and computer systems, those skilled in the art will appreciate that the various embodiments are capable of being distributed as a program product in a variety of forms, and that the disclosure applies equally regardless of the particular type of machine or computer-readable media used to actually effect the distribution.

Further examples of machine-readable storage media, machine-readable media, or computer-readable (storage) media include but are not limited to recordable type media such as volatile and non-volatile memory devices, floppy and other removable disks, hard disk drives, optical disks (e.g., Compact Disk Read-Only Memory (CD ROMS), Digital Versatile Disks, (DVDs), etc.), among others, and transmission type media such as digital and analog communication links.

Unless the context clearly requires otherwise, throughout the description and the claims, the words "comprise," "comprising," and the like are to be construed in an inclusive sense, as opposed to an exclusive or exhaustive sense; that is to say, in the sense of "including, but not limited to." As used herein, the terms "connected," "coupled," or any variant thereof, means any connection or coupling, either direct or indirect, between two or more elements; the coupling of connection between the elements can be physical, logical, or a combination thereof. Additionally, the words "herein," "above," "below," and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. Where the context permits, words in the above Detailed Description using the singular or plural number may also include the plural or singular number respectively. The word "or," in reference to a list of two or more items, covers all of the following interpretations of the word: any of the items in the list, all of the items in the list, and any combination of the items in the list.

The above detailed description of embodiments of the disclosure is not intended to be exhaustive or to limit the teachings to the precise form disclosed above. While specific embodiments of, and examples for, the disclosure are described above for illustrative purposes, various equivalent modifications are possible within the scope of the disclosure, as those skilled in the relevant art will recognize. For example, while processes or blocks are presented in a given order, alternative embodiments may perform routines having steps, or employ systems having blocks, in a different order, and some processes or blocks may be deleted, moved, added, subdivided, combined, and/or modified to provide alternative or subcombinations. Each of these processes or blocks may be implemented in a variety of different ways. Also, while processes or blocks are at times shown as being performed in series, these processes or blocks may instead be performed in parallel, or may be performed at different times. Further any specific numbers noted herein are only examples: alternative implementations may employ differing values or ranges.

The teachings of the disclosure provided herein can be applied to other systems, not necessarily the system described

above. The elements and acts of the various embodiments described above can be combined to provide further embodiments.

Any patents and applications and other references noted above, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the disclosure can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further embodiments of the disclosure.

These and other changes can be made to the disclosure in light of the above Detailed Description. While the above description describes certain embodiments of the disclosure, and describes the best mode contemplated, no matter how detailed the above appears in text, the teachings can be practiced in many ways. Details of the system may vary considerably in its implementation details, while still being encompassed by the subject matter disclosed herein. As noted above, particular terminology used when describing certain features or aspects of the disclosure should not be taken to imply that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the disclosure with which that terminology is associated. In general, the terms used in the following claims should not be construed to limit the disclosure to the specific embodiments disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the disclosure encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the disclosure under the claims.

While certain aspects of the disclosure are presented below in certain claim forms, the inventors contemplate the various aspects of the disclosure in any number of claim forms. For example, while only one aspect of the disclosure is recited as a means-plus-function claim under 35 U.S.C. §112, ¶6, other aspects may likewise be embodied as a means-plus-function claim, or in other forms, such as being embodied in a computer-readable medium. (Any claims intended to be treated under 35 U.S.C. §112, ¶6 will begin with the words "means for".) Accordingly, the applicant reserves the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the disclosure.

What is claimed is:

1. A system for optimizing resources in a mobile network, the system comprising:

a mobile device having a local proxy to aggregate client-side parameters, the client-side parameters including user activity status indicating whether the user is active or inactive;

a proxy server to aggregate server-side parameters, the proxy server being coupled to the mobile device and being wirelessly coupled to a server with which the mobile device interacts, the proxy server being able to wirelessly communicate with the local proxy;

wherein the local proxy and the proxy server each communicate the client-side parameters and the server-side parameters, respectively, to the other component, to formulate a policy for traffic control in the mobile network between the mobile device and the server based on both of the client-side parameters and the server-side parameters;

wherein the policy is jointly implemented by the local proxy and the proxy server and dynamically adjustable in real-time based on continued communication between the local proxy and the proxy server;

wherein the local proxy and the proxy server each communicate the client-side parameters and server-side parameters before a first formulation of a traffic policy;

wherein the client-side parameters include identification of an application installed on the mobile device and polling frequency of the application;

wherein the proxy server uses the client-side parameters to determine frequency with which polling by the application yields new data and creates a probability profile for the application using the determined frequency; and

wherein the local proxy uses the probability profile to determine whether to respond to an application poll using a local cache on the mobile device.

2. A system for optimizing resources in a mobile network, the system comprising:

a mobile device having a local proxy to aggregate client-side parameters;

a proxy server to aggregate server-side parameters, the proxy server being coupled to the mobile device and being wirelessly coupled to a server with which the mobile device interacts, the proxy server being able to wirelessly communicate with the local proxy;

wherein the local proxy and the proxy server each communicate the client-side parameters and the server-side parameters, respectively, to the other component, to formulate a policy for traffic control in the mobile network between the mobile device and the server based on both of the client-side parameters and the server-side parameters;

wherein the policy is jointly implemented by the local proxy and the proxy server and dynamically adjustable in real-time based on continued communication between the local proxy and the proxy server;

wherein the local proxy and the proxy server each communicate the client-side parameters and server-side parameters before a first formulation of a traffic policy;

wherein the client-side parameters include identification of an application installed on the mobile device and polling frequency of the application;

wherein the proxy server uses the client-side parameters to determine frequency with which polling by the application yields new data and creates a probability profile for the application using the determined frequency; and

wherein the local proxy uses the probability profile to determine whether to respond to an application poll using a local cache on the mobile device.

3. The system of claim **2**, wherein the client-side parameters include application parameters.

4. The system of claim **3**, wherein the application parameters include state of the application including background operation, foreground operation, inactive, or active.

5. The system of claim **3**, wherein the application parameters include application traffic parameters including one or more of protocol used, amount of data, and interaction with other applications.

6. The system of claim **2**, wherein the client-side parameters include device parameters.

7. The system of claim **6**, wherein the device parameters include user activity status indicating whether the user is active or inactive.

8. The system of claim **6**, wherein the device parameters include one or more of, network availability, network strength or network congestion.

9. The system of claim **6**, wherein the device parameters include radio state of each wireless radio on the mobile device, including one or more of, Bluetooth, WiFi, and cellular radios.

10. The system of claim **2**, wherein the server-side parameters include network parameters.

11. The system of claim **2**, wherein the server-side parameters include activity parameters for other devices or users.

12. The system of claim **2**, wherein the server-side parameters include content host parameters which indicate whether new content is available.

13. The system of claim **2**, wherein the server-side parameters include location parameters determined from triangulation and/or GPS.

14. The system of claim **8**, wherein the network congestion is reported by a network operator.

15. A method for optimizing resources in a mobile network, the method comprising:

aggregating client-side parameters by a local proxy on a mobile device;

communicating the client-side parameters to a proxy server and receiving server-side parameters from the proxy server to formulate a policy for traffic control in the mobile network between the mobile device and a server based on both of the client-side parameters and the server-side parameters;

wherein the server-side parameters are aggregated by the proxy server;

wherein the proxy server is coupled to the mobile device and is wirelessly coupled to the server with which the mobile device interacts, the proxy server being able to wirelessly communicate with the local proxy;

wherein, the policy is jointly implemented by the local proxy and the proxy server and dynamically adjustable in real-time based on continued communication between the local proxy and the proxy server;

wherein the local proxy and the proxy server each communicate the client-side parameters and server-side parameters before a first formulation of a traffic policy;

wherein the client-side parameters include identification of an application installed on the mobile device and polling frequency of the application;

wherein the proxy server uses the client-side parameters to determine frequency with which polling by the application yields new data and creates a probability profile for the application using the determined frequency; and

wherein the local proxy uses the probability profile to determine whether to respond to an application poll using a local cache on the mobile device.

16. The method of claim **15**, wherein the client-side parameters include application parameters.

17. The method of claim **16**, wherein the application parameters include state of the application including background operation, foreground operation, inactive, or active.

18. The method of claim **16**, wherein the application parameters include application traffic parameters, including one or more of protocol used, amount of data, and interaction with other applications.

19. The method of claim **16**, wherein the client-side parameters include device parameters.

20. The method of claim **19**, wherein the device parameters include user activity status indicating whether the user is active or inactive.

21. The method of claim **19**, wherein the device parameters include one or more of network availability, network strength and network congestion.

22. The method of claim **20**, wherein the device parameters include radio state of each wireless radio on the mobile device, including one or more of Bluetooth, WiFi, and cellular radios.

23. The method of claim **15**, wherein the server-side parameters include network parameters.

24. The method of claim **15**, wherein the server-side parameters include activity parameters for other devices or users.

25. The method of claim **15**, wherein the server-side parameters include content host parameters which indicate whether new content is available.

26. The method of claim **25**, wherein the server-side parameters include location parameters determined from triangulation and/or GPS.

27. A non-transitory machine-readable storage medium having stored thereon instructions which when executed by a processor performs a method of optimizing resources in a mobile network, the method, comprising:

aggregating client-side parameters by a local proxy on a mobile device; and

communicating the client-side parameters to a proxy server and receiving server-side parameters from the proxy server to formulate a policy for traffic control in the mobile network between the mobile device and a server based on both of the client-side parameters and the server-side parameters;

wherein the server-side parameters are aggregated by the proxy server;

wherein the proxy server is coupled to the mobile device and is wirelessly coupled to the server with which the mobile device interacts, the proxy server being able to wirelessly communicate with the local proxy;

wherein the policy is jointly implemented by the local proxy and the proxy server and dynamically adjustable in real-time based on continued communication between the local proxy and the proxy server;

wherein the local proxy and the proxy server each communicate the client-side parameters and server-side parameters before a first formulation of a traffic policy;

wherein the client-side parameters include identification of an application installed on the mobile device and polling frequency of the application;

wherein the proxy server uses the client-side parameters to determine frequency with which polling by the application yields new data and creates a probability profile for the application using the determined frequency; and

wherein the local proxy uses the probability profile to determine whether to respond to an application poll using a local cache on the mobile device.

28. The medium of claim **27**, wherein the client-side parameters include application parameters.

29. The medium of claim **28**, wherein the application parameters include state of the application including background operation, foreground operation, inactive, or active.

30. The medium of claim **28**, wherein the application parameters include application traffic parameters including one or more of protocol used, amount of data, and interaction with other applications.

* * * * *