US007043225B1

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

(10) **Patent No.: US 7,043,225 B1**
(45) **Date of Patent: May 9, 2006**

(54) **METHOD AND SYSTEM FOR BROKERING BANDWIDTH IN A WIRELESS COMMUNICATIONS NETWORK**

(75) Inventors: **Pulin R. Patel**, McKinney, TX (US); **Raghuram Krovvidi**, Irving, TX (US); **Ojas T. Choksi**, Plano, TX (US); **Achal R. Patel**, McKinney, TX (US); **Kenneth W. Davidson**, Plano, TX (US); **Mohammad R. Ali**, Plano, TX (US)

(73) Assignee: **Cisco Technology, Inc.**, San Jose, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/513,592**

(22) Filed: **Feb. 25, 2000**

(51) **Int. Cl.**
H04M 11/00 (2006.01)
H04Q 7/20 (2006.01)

(52) **U.S. Cl.** **455/405**; 455/406; 455/404.2; 455/456.1; 455/456.2; 455/456.6

(58) **Field of Classification Search** 455/405, 455/406, 452, 456, 67.1, 404.2, 456.1, 456.2, 455/456.6; 370/468, 351–352, 401, 328, 370/465

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,301,359	A	4/1994	Van den Heuvel et al.	455/56.1
5,581,802	A *	12/1996	Erickson et al.	455/33.1
5,594,947	A *	1/1997	Grube et al.	455/54.2
5,666,356	A	9/1997	Fleming et al.	370/328
5,862,490	A *	1/1999	Sasuta et al.	455/525
5,961,569	A *	10/1999	Craport et al.	701/200
5,987,326	A	11/1999	Tiedemann, Jr. et al.	455/442
6,021,309	A	2/2000	Sherman et al.	455/12.1
6,064,972	A *	5/2000	Jankowitz et al.	705/7
6,101,379	A *	8/2000	Rahman et al.	455/406
6,151,309	A	11/2000	Busuioc et al.	370/328
6,289,005	B1	9/2001	Katz	370/328
6,304,562	B1	10/2001	Kim et al.	370/332
6,324,185	B1	11/2001	Budhraja	370/468
6,327,254	B1	12/2001	Chuah	370/328
6,347,224	B1	2/2002	Smyth et al.	455/406
6,424,646	B1 *	7/2002	Gerszberg et al.	370/352
6,618,594	B1 *	9/2003	Myers et al.	455/457

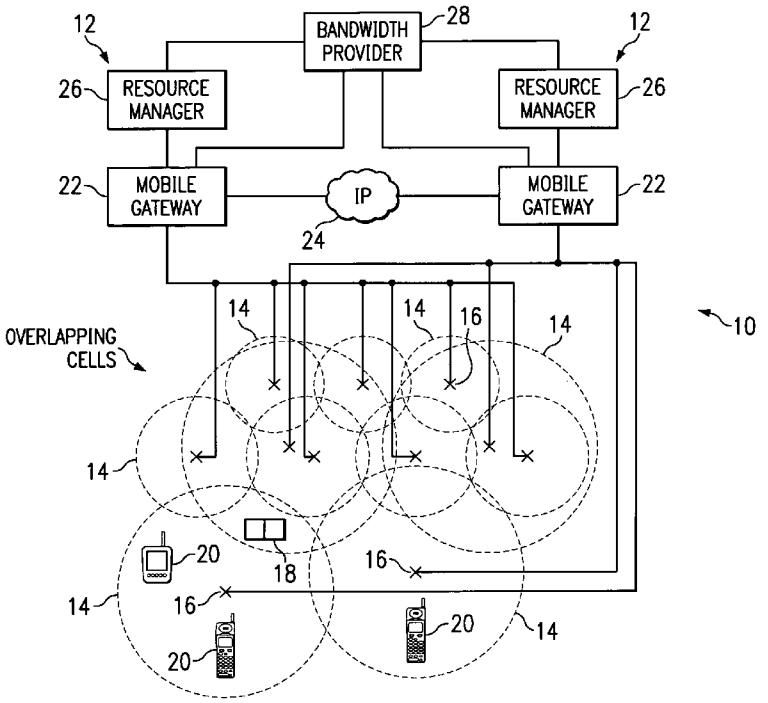
* cited by examiner

Primary Examiner—Marceau Milord
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A method and system for brokering bandwidth in a wireless communications network includes receiving a request for a wireless service at a geographic region. An availability of the wireless service is determined at the geographic region. A response to the request is generated based on the availability of the wireless service. The response includes one or more terms for the wireless service.

55 Claims, 3 Drawing Sheets



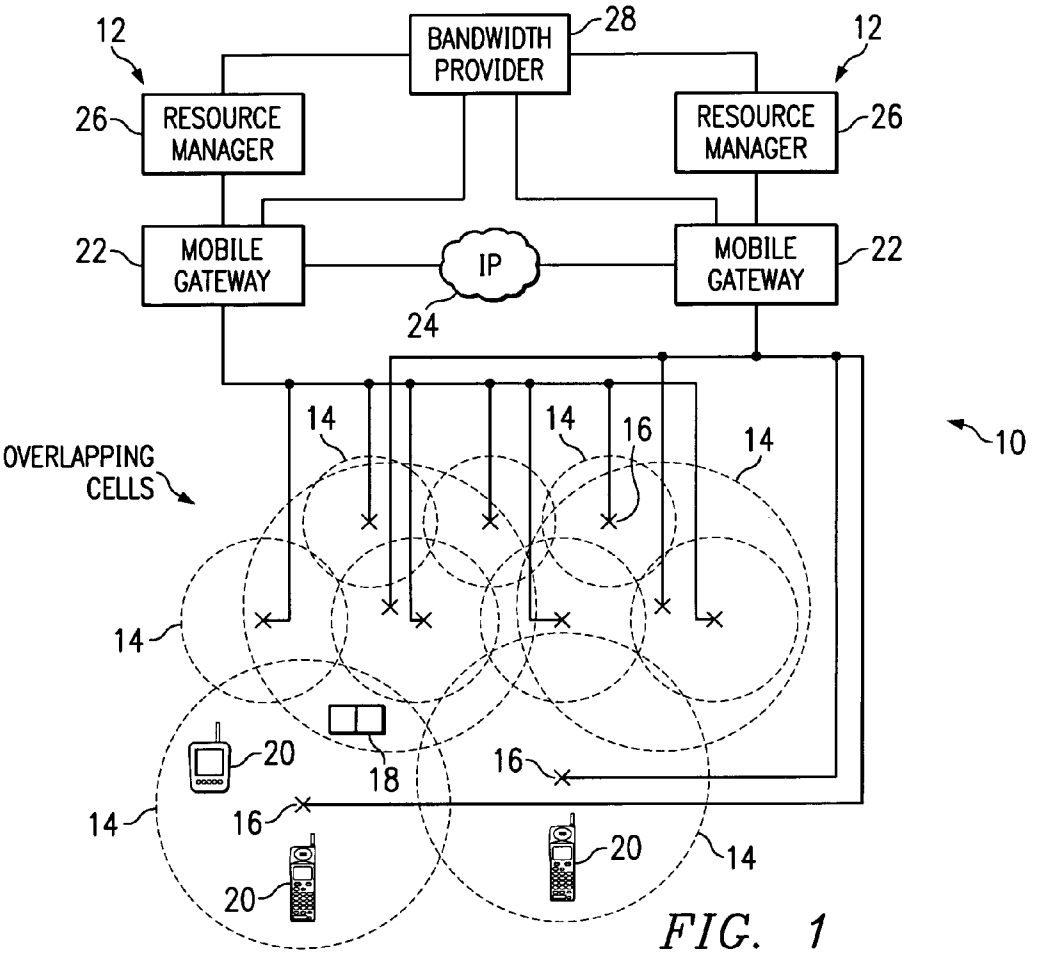

BANDWIDTH PROVIDER
28
12
12
RESOURCE MANAGER
26
RESOURCE MANAGER
26
MOBILE GATEWAY
22
IP
24
MOBILE GATEWAY
22
10
OVERLAPPING CELLS
14
14
16
14
14
20
18
16
14
16
20
14
20

FIG. 1

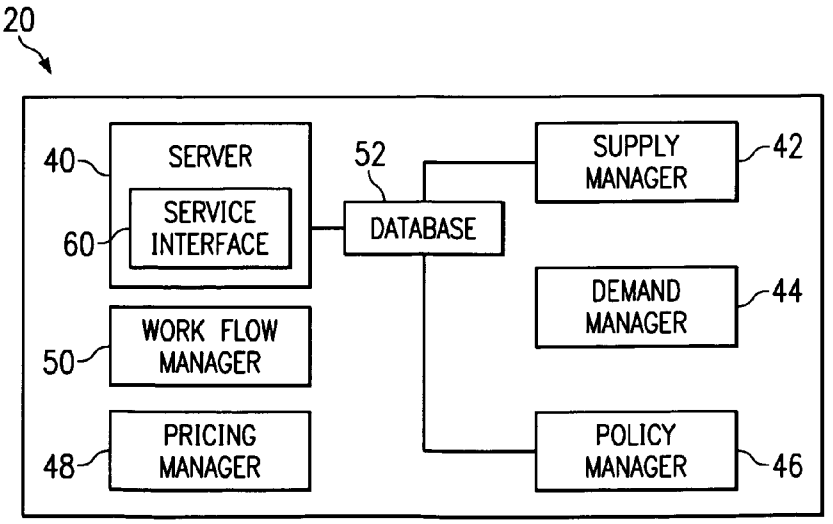

20
40
SERVER
60
SERVICE INTERFACE
52
DATABASE
SUPPLY MANAGER
42
DEMAND MANAGER
44
50
WORK FLOW MANAGER
48
PRICING MANAGER
POLICY MANAGER
46

FIG. 3

FIG. 2

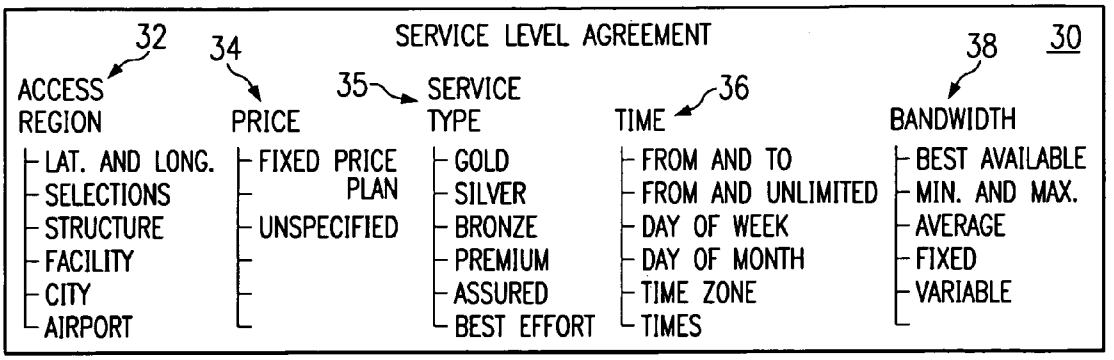
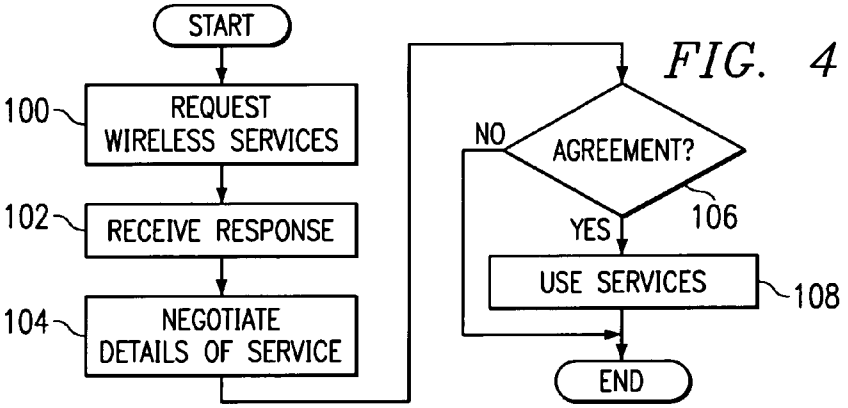


FIG. 4



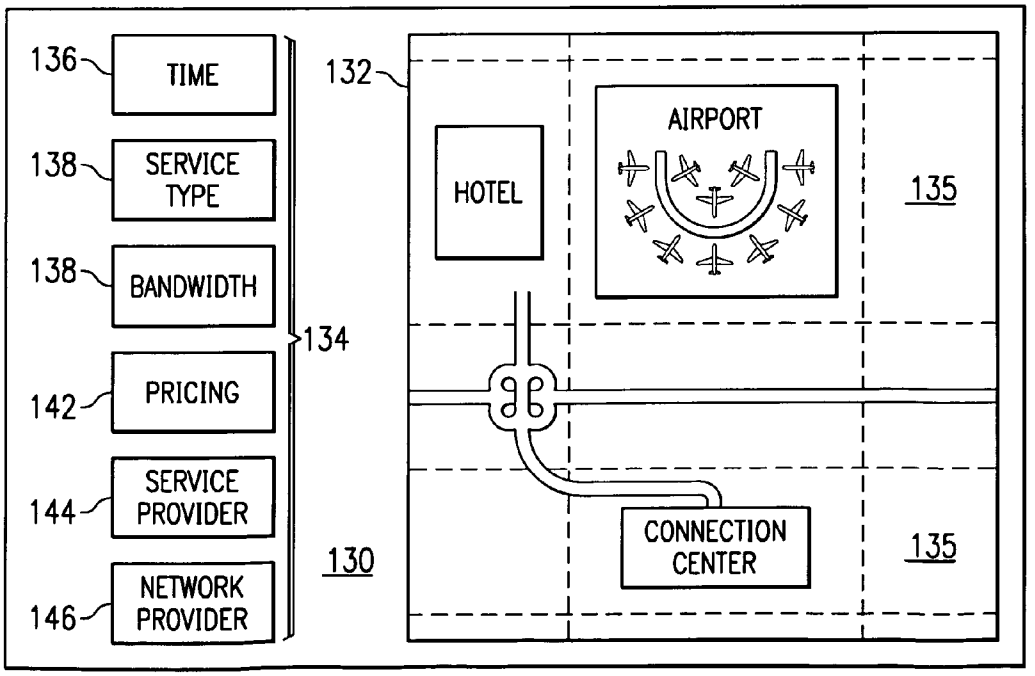


FIG. 5

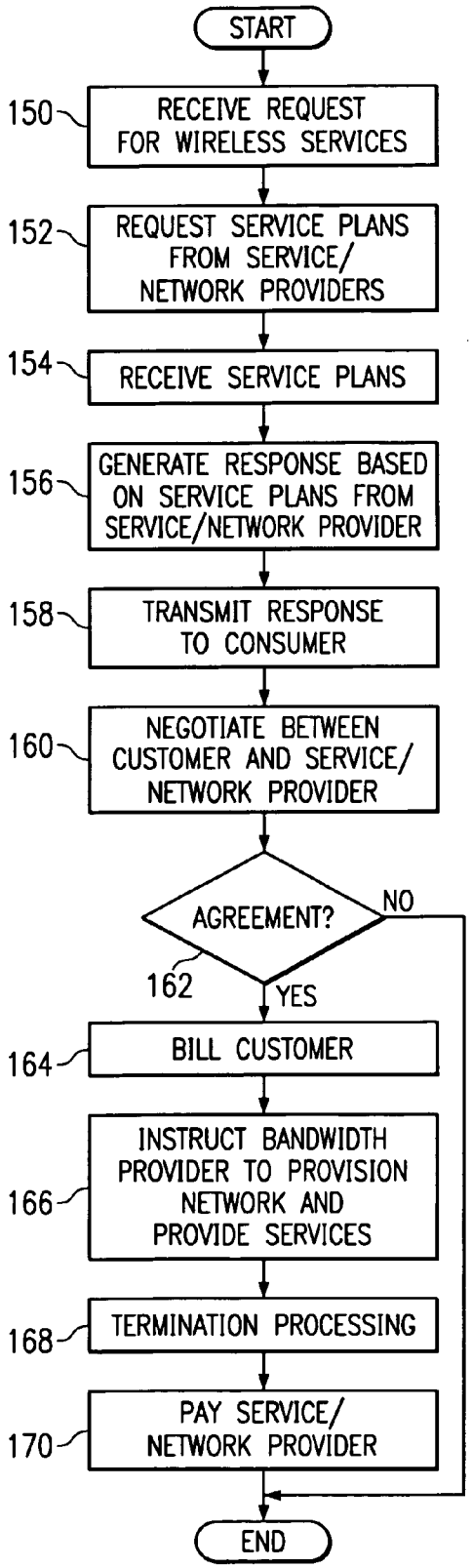

START
150
RECEIVE REQUEST FOR WIRELESS SERVICES
152
REQUEST SERVICE PLANS FROM SERVICE/ NETWORK PROVIDERS
154
RECEIVE SERVICE PLANS
156
GENERATE RESPONSE BASED ON SERVICE PLANS FROM SERVICE/NETWORK PROVIDER
158
TRANSMIT RESPONSE TO CONSUMER
160
NEGOTIATE BETWEEN CUSTOMER AND SERVICE/ NETWORK PROVIDER
AGREEMENT?
162
NO
YES
164
BILL CUSTOMER
166
INSTRUCT BANDWIDTH PROVIDER TO PROVISION NETWORK AND PROVIDE SERVICES
168
TERMINATION PROCESSING
170
PAY SERVICE/ NETWORK PROVIDER
END

FIG. 6

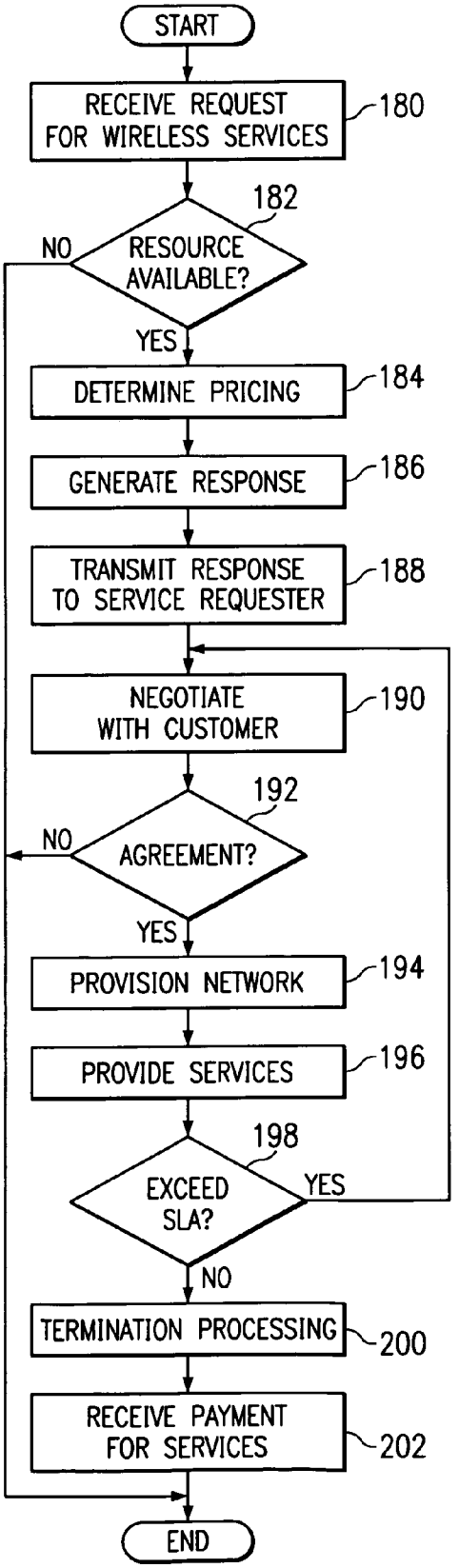

START
RECEIVE REQUEST FOR WIRELESS SERVICES
180
182
RESOURCE AVAILABLE?
NO
YES
DETERMINE PRICING
184
GENERATE RESPONSE
186
TRANSMIT RESPONSE TO SERVICE REQUESTER
188
NEGOTIATE WITH CUSTOMER
190
192
AGREEMENT?
NO
YES
PROVISION NETWORK
194
PROVIDE SERVICES
196
198
EXCEED SLA?
YES
NO
TERMINATION PROCESSING
200
RECEIVE PAYMENT FOR SERVICES
202
END

FIG. 7

METHOD AND SYSTEM FOR BROKERING BANDWIDTH IN A WIRELESS COMMUNICATIONS NETWORK

RELATED APPLICATIONS

This application is related to U.S. patent application Ser. No. 09/513,912 entitled "Method and System for Queuing Traffic in a Wireless Communications Network," U.S. patent application Ser. No. 09/513,913 entitled "Method and System for Managing Transmission Resources in a Wireless Communications Network," U.S. patent application Ser. No. 09/513,914 entitled "Wireless Router and Method for Processing Traffic in a Wireless Communications Network," and U.S. patent application Ser. No. 09/513,090 entitled "Method and System for Configuring Wireless Routers and Networks," all filed on Feb. 25, 2000 and incorporated herein by reference.

TECHNICAL FIELD OF THE INVENTION

The present invention relates generally to the field of wireless communications, and more particularly to a method and system for brokering bandwidth in a wireless communications network.

BACKGROUND OF THE INVENTION

Wireline Internet protocol (IP) networks have traditionally supported a best effort delivery of all traffic. To support enhanced services, multiple types, or classes, of services have been established and assigned certain quality of service (QoS) parameters that manage queues for each service type. The QoS parameters include delay, jitter, error rates, and throughput. The QoS parameters can be provisioned on a per IP connection or per flow basis through mechanisms such as resource reservation protocol (RSVP) or can be provisioned on aggregate flows which are classified into service classes. Internet service providers (ISPs) can utilize the service classes, their associated QoS behavior and QoS provisioning to provide tiered service offerings to their business and consumer consumers.

The IP QoS architecture provides tools for marking IP flows, controlling and shaping the traffic of various IP flows, and managing various IP queues in order to ensure QoS behavior for each class of service. Queue management algorithms include head-drop, tail-drop, first in first out (FIFO) and random early detect (RED). The queue management may be on individual microflows or on aggregate flows which are treated with similar QoS behavior.

Recent proposals for the IP QoS architecture include supporting bandwidth brokers that control and allocate Internet or other network bandwidth. The bandwidth brokers can be programmed with an organization's policies, current allocation traffic, and new requests for allocations. The bandwidth brokers manage the allocations of bandwidth within their network domain and communicate with bandwidth brokers of other network domains to negotiate QoS parameters.

Wireless communications networks use the IP QoS architecture to support transmission of data and/or voice traffic between mobile devices and a wireline network. Typically, wireless consumers sign-up for wireless telephony and data services in a defined coverage area at a specified QoS policy and price. Once outside the coverage area, the wireless services may not be available to a consumer or may only be

available at an unknown price and QoS policy. This limits true mobility of the devices within a wide geographic area.

SUMMARY OF THE INVENTION

The present invention provides a method and system for brokering bandwidth in a wireless communications network that substantially eliminate or reduce problems and disadvantages associated with previous methods and systems. In particular, wireless bandwidth in a region is brokered to consumers for specified periods of time at agreed upon terms. This allows discreet segments of bandwidth to be commercialized and bandwidth use in the network to be maximized.

In accordance with one embodiment of the present invention, a method for brokering resources of a wireless communications network includes receiving a request for a wireless service at a geographic region. The availability of the wireless service at the geographic region is determined. A response to the request is generated based on the availability of the wireless service. The response includes one or more terms for providing the wireless service.

More specifically, in accordance with a particular embodiment of the present invention, the request may identify a time, a bandwidth, a type of service, and/or a price for the wireless service. In this embodiment, the availability of the wireless service is determined at the geographic region at the specified time, bandwidth, type and/or price. Terms in the response may include additional or different time, price, type of service and/or bandwidth terms for the wireless service. The terms may be negotiated between a consumer or agent for the consumer and a bandwidth provider such as a network or service provider or agent for the network or service provider.

Technical advantages of the present invention include providing a method and system for brokering bandwidth in a wireless communications network. In particular, wireless resources are brokered on a geographic location, time including date or dates and time of day or days, bandwidth, type of service and/or price basis. As a result, discrete segments of bandwidth may be commercialized to maximize bandwidth use in each area of the wireless network.

Another technical advantage of the present invention includes providing a method and system for consumers to obtain wireless resources. In particular, consumers may specify resource location, price, QoS policy and other parameters to bandwidth providers including service providers, network providers and bandwidth brokers, shop between providers and negotiate service parameters. Thus, consumers can narrowly specify the services they are interested in and limit the price they are willing to pay for the services.

Yet another technical advantage of the present invention includes providing a method and system for consumers to obtain temporary wireless resources outside their normal coverage area. In particular, wireless resources may be directly or indirectly negotiated with and reserved from a service provider at a remote geographic location. Thus, a mobile user may be assured adequate wireless resources when he or she travels to the geographic location. The wireless resources may be reserved from a service provider, bandwidth broker, travel or other agent, or directly from the network provider and may be reserved through the Internet or other network, a kiosk or other terminal, a phone line, a handset by data input, voice or other commands.

Yet another technical advantage of the present invention includes providing an Internet gateway for brokering and

negotiating wireless transmission resources between users and service providers. In particular, a web site is provided at which consumers may specify a location, time, bandwidth, type of service and/or pricing of desired services and submit request for services. In this way, consumers may easily request and negotiate with network providers, service providers and bandwidth brokers for wireless services.

Still another technical advantage of the present invention includes providing a method and system for bandwidth providers to broker available bandwidth to consumers. In particular, network providers, service providers, and bandwidth brokers may advertise and display available bandwidth for purchase by consumers. Bandwidth may be prepackaged in plans that specify all parameters to eliminate negotiations and facilitate purchase by consumers. Based on supply and demand, available bandwidth may be auctioned between consumers or consumer requests auctioned between bandwidth providers. Moreover, unsolicited advertisements may be sent to consumers to inform them of the available bandwidth. In this way, bandwidth usage within a network is maximized.

Other technical advantages of the present invention will be readily apparent to one skilled in the art from the following figures, description, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and its advantages, reference is now made to the following description taken in conjunction with accompanying drawings, wherein like reference numerals represent like parts, in which:

FIG. **1** is a block diagram illustrating a wireless communications network in accordance with one embodiment of the present invention;

FIG. **2** is a block diagram illustrating wireless service terms in accordance with one embodiment of the present invention;

FIG. **3** is a block diagram illustrating details of the resource manager of FIG. **1** in accordance with one embodiment of the present invention;

FIG. **4** is a flow diagram illustrating a user method for obtaining wireless resources in accordance with one embodiment of the present invention;

FIG. **5** is a screen diagram illustrating a user interface for obtaining wireless resources in accordance with one embodiment of the present invention;

FIG. **6** is a flow diagram illustrating a method for brokering wireless services of a plurality of service providers to consumers in accordance with one embodiment of the present invention; and

FIG. **7** is a flow diagram illustrating a service provider method for providing wireless resources to consumers in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates a wireless network **10** in accordance with one embodiment of the present invention. In this embodiment, the wireless network **10** comprises a plurality of overlapping cellular networks **12** in which terrestrial and mobile wireless transmission originates in geographically delimited cells. It will be understood that the present invention may be used in connection with satellite and other suitable types of wireless and other dynamic bandwidth networks.

Referring to FIG. **1**, the cellular networks **12** each cover a contiguous area that is broken down into a series of overlapping cells **14**. Each cell **14** has a base station, or server, **16** and may be subdivided into a plurality of geo-location areas **18**. The geo-location areas **18** are each a defined area in which bandwidth may be allocated to mobile devices **20**. The geo-location areas **18** may have a resolution greater than, less than, or equal to cell size. In a particular embodiment, the geo-location areas **18** are substantially square in shape to form a contiguous grid over the coverage area. Thus, the geo-locations **18** may be shared by one or more cells **14**. Further information regarding the geo-location areas and allocation of bandwidth in the areas is described in co-owned U.S. patent application Ser. No. 09/466,308, filed Dec. 17, 1999, entitled "Method and System for Allocating Bandwidth in a Wireless Communications Network," which is hereby incorporated by reference.

Servers **16** provide a radio frequency (RF) link for mobile devices **20** in a corresponding cell **14**. The wireless RF link to the mobile devices **20** in the cell **14** may be based on established standards such as IS-54 (TDMA), IS-95 (CDMA), GMS and AMPS, 802.11 based WLAN, or new upcoming standards such as CDMA 2000 and W-CDMA or proprietary terrestrial or mobile radio interfaces. The mobile devices **20** may be cell phones, data phones, data devices, portable computers, or any other suitable devices capable of communicating information over a wireless link.

Due to the nature of the RF airlink, the interference generated by the usage of various mobile devices **20** is inter-dependent. That is, the interference generated by the usage of a mobile device **20** including transmitting and receiving signals is not only dependent on its geo-location, but is also dependent on the geo-location of surrounding mobile devices **20** and the usage of those devices. Thus, each cellular network **12** is an inherently interference-limited network with bandwidth usage in a particular location impacting the interference in specific areas of the neighborhood. In the complete spectrum sharing systems such as CDMA and W-CDMA, bandwidth usage in a particular area directly impacts the bandwidth available at different locations in the neighborhood.

The servers **16** each have a defined bandwidth with which to communicate with the mobile devices **20** in the corresponding cell **14**. The bandwidth is used by the server **16** and the mobile devices **20** to communicate voice and data information. The supported bandwidth is a function of various factors such as frequency reuse, carrier to interface ratio, bit-energy to noise ratio, effective bit-rate per connection and the like. The bandwidth available to allocate to certain flows is geo-location dependent, and time dependent based on current usage of other flows in the geo-neighborhood.

The servers **16** in each cellular network **12** are connected to one or more mobile gateways **22** that allocate bandwidth within the cellular network **12**, route traffic, and track the location of the mobile devices **20** in the cells **14**. The mobile gateways **22** may group, allocate, and control traffic and transmission resources as described in co-owned U.S. patent applications entitled "Method and System for Queuing Traffic in a Wireless Communications Network" and "Method and System for Managing Transmission Resources in a Wireless Communications Network," both previously incorporated by reference. The position of a mobile device **20** may be determined using network-assist, global position systems (GPS) and RF fingerprinting. Preferably, the positioning technique provides fast and accurate information

with respect to the location of the mobile device **20** to minimize acquisition time for position information. As mobile users move from cell **14** to cell **14** within a cellular network **12**, a hand-off operation between servers **16** is performed by the mobile gateway **22**.

The mobile gateways **22** in each cellular network **12** provide connectivity from the wireless portion of the cellular network **12** to a wireline portion **24** of the wireless network **10** via circuit switched and packet switched wireless data protocols. The wireline portion **24** may be the Internet, intranet, extranet, or other suitable local or wide area network. For the Internet, the mobile gateways **22** provide an access, or entry point for all transport control protocol/Internet protocol (TCP/IP) data connections to the wireless portion of the network **12**. Each mobile gateway **22** may serve one or more servers **16** include the RF front-end and other functionality of the servers **16**, and/or may be wireless routers as described in co-owned U.S. patent application entitled "Wireless Router and Method for Processing Traffic in a Wireless Communications Network," previously incorporated by reference. In the later case, the wireless router may be self-configuring as described in co-owned U.S. patent application entitled "Method and System for Configuring Wireless Router and Network," also previously incorporated by reference. Bandwidth allocation and other functionality of the mobile gateways **22** may instead be implemented by a mobile switching center (MSC), data interworking function (IWF) devices, and other suitable network devices without departing from the scope of the present invention.

In each cellular network **12**, a service level agreement (SLA), or resource manager **26** manages bandwidth and other suitable network resources of the network provider. As described in more detail below, the resource manager **26** receives requests for wireless services from a consumer, service provider, bandwidth broker or other requester, determines resource availability based on the request, generates a response based on resource availability, and sends the response to the requester. The request and reply may each be an offer to accept or provide services, an acceptance of an offer, or a partial offer to accept or provide services including both specified and open terms. Based on the request and the response, additional negotiations may occur between the resource manager **26** and the requester in order to agree on terms at which the wireless service will be provided. The agreed upon terms define a SLA and may specify a wireless region, price, time, type of service, bandwidth and other suitable conditions of service. The SLA will be checked and enforced/ensured by the network elements during use of the wireless service as packets are transmitted over the cellular network **12**.

In a particular embodiment, the resource manager **26** is a distributed server component with separate or shared instances. In this embodiment, a customer premise equipment (CPE) may install the resource manager **26** locally or lease/share an instance installed at a server premise equipment (SPE) data center location. Thus, the SPE will maintain a local installation of the resource manager **26**. The relationship between the SPE and CPE resource managers **26** may be one-to-many or many-to-many.

One or more bandwidth providers **28** communicate with the resource managers **26** of the cellular networks **12** and/or mobile gateways **22** within the cellular networks **12** to intelligently broker bandwidth and other suitable wireless resources of the network providers to third parties based on time and space considerations such as geo-location of the demand and supply within the networks **12**. The bandwidth providers may be a service provider such as an Internet Service Provider (ISP) or a bandwidth broker. The bandwidth broker may broker bandwidth of a service provider in addition to that of a network provider. As described in more detail below, the bandwidth providers **28** may receive requests for wireless services directly from consumers and broadcast the request to network providers capable of providing the specified wireless services. The bandwidth provider **28** receives, analyzes and/or evaluates responses from the different network providers to generate a consumer response. The consumer response may include an offer to provide wireless services at specified terms, several offers from several different network providers for evaluation and selection by the consumer, or one or more partial offers with open terms to be negotiated with the consumer. The bandwidth provider **28** may also negotiate with network providers on behalf of consumers or facilitate negotiations between consumers and network providers. After an agreement has been reached, the bandwidth provider **28** may process billing, termination and other suitable transactions regarding the wireless services.

FIG. **2** illustrates wireless service terms for a service level agreement (SLA) **30** in accordance with one embodiment of the present invention. In this embodiment, the SLA **30** includes access region parameters **32**, price parameters **34**, service type parameters **35**, time parameters **36**, and bandwidth parameters **38**. The access region parameters **32** include latitude and longitude, selections, structures, facilities, cities, airports, and any other suitable area that can be identified for provision of wireless services. The price parameters **34** include fixed price, variable price, price plans, discounts, and other suitable pricing strategies. The service type parameters **35** include different class or quality of service (QoS) types such as gold, silver, bronze, premium, assured, and best efforts. The time parameters **36** include a from and to time for services, if from an unlimited time for services, a day of the week and/or month for services, a time zone and any other suitable times at which wireless services may be provisioned. The bandwidth parameters **38** include best available, a minimum and maximum, an average, fixed, variable, or other suitable level of bandwidth.

FIG. **3** illustrates details of the resource manager **26** in accordance with one embodiment of the present invention. In this embodiment, the resource manager **26** is implemented as a centralized system for controlling bandwidth within a cellular network **12**. It will be understood that functionality of the resource manager **26** may be suitably distributed within the cellular network **12**.

Referring to FIG. **3**, the resource manager **26** includes a server **40**, a supply manager **42**, a demand manager **44**, a pricing manager **46**, a policy manager **48**, and a work flow manager **50**. A database **52** is shared by the server **40** and the managers **42**, **44**, **46**, **48** and **50**. Each of the server and managers **40**, **42**, **44**, **46**, **48** and **50** may be implemented in hardware, software stored in a computer-readable medium, a combination of hardware and software or any other computer processable medium having hardwired or programmed instructions. The hardware may comprise a field programmable gate array (FPGA) programmed to perform some or all of the functionality of the resource manager **26**, an application specific integrated circuit (ASIC) designed to perform some or all of the functionality of the resource manager **26** and/or a general purpose processor programmed by software instructions to perform some or all the functionality of the resource manager **26**.

The server **40** includes a service interface **60** through which consumers, including their agents, and bandwidth

providers **28** may request wireless services in the cellular network **12**. As described in more detail below, the service interface **60** is a web or other Internet site, a destination e-mail or electronic data interchange (EDI) site, an automated call attendant line, a voice activated instruction line, a fax line, an operator entry device, or other suitable device through which consumers and bandwidth provider **28** may request wireless services. The service interface **60** allows consumers and bandwidth provider **28** to specify geographic access regions, price, bandwidth, type of service and/or other suitable parameters for wireless services. The service interface **60** also communicates responses to requests back to the service requester and allows for negotiations between the service requester and bandwidth provider **28**. After terms for wireless services have been agreed to with or for a customer, the server **40** stores the SLA for the service in the database **52**.

The supply manager **42** maintains current and expected available supply information and/or maps for the cellular network **12**. The demand manager **44** maintains current and expected demand information and/or maps for the cellular network **12**. The pricing manager **46** maintains pricing information and/or maps for the cellular network **12**. The supply, demand, and pricing maps are dynamic and may be location and time dependent. The dynamic supply, demand, and pricing maps may be stored in the database **52** and updated by their respective managers **42**, **44** and **46**.

The policy manager **48** provisions policies in the mobile gateways **22** based on an SLA with a consumer or bandwidth provider **28**. In particular, the policy manager **48** communicates with the mobile gateways **22** to provision services in the cellular network **12**. The work flow manager **50** controls the service interface **60** and business process within the resource manager **26**. The work flow manager **50** may operate in real time or non-real time. In addition, each stage of the work flow may be synchronous or asynchronous.

In operation, requests for wireless services may be received by the resource manager **26** electronically via an EDI, graphical user interface (GUI) of an Internet or other suitable site, GUI, voice or vision activated, pen stroke, key stroke or touch screen interface of a cell phone, PDA or other mobile device, or by automated telephony systems in which consumers and bandwidth providers **28** may select access regions and other parameters for wireless services. Requests may also be received by an operator keying in information from a caller, a fax, e-mail or other suitable notification. Each request may include mandatory and/or optional parameters that will be used by the resource manager **26** to determine resource availability. In one embodiment, the mandatory parameters may include the wireless access region for the wireless service. The region may be a large geographic region such as a city, a facility such as an airport, convention center, hotel, or a specific geo-location area **16**. Additional parameters may include rate/pricing plans, a time window or start time, required bandwidth, and/or type of service.

In the CPE/SPE embodiment, manual requests for wireless services may be re-keyed by an operator via a GUI on the SPE resource manager **26**. Electronic requests are received by the CPE resource manager **26** and forwarded to the corresponding SPE resource manager **26**. The SPE resource manager **26** performs validation on the request by checking the content for well formedness and validity.

In a particular embodiment, the request may be a request for information on available wireless services, a request for reservation of future wireless services, a request for immediate wireless services, or a confirmation request. Depending on the type of the request, the resource manager **26** will check for available resources and return a response based on the availability of resources. For inquiry type requests, the resource manager **26** returns information about availability and pricing of wireless services. For reservation types of requests, the resource manager **26** returns a successful or unsuccessful reservation along with availability and pricing information. In case of unsuccessful reservation results, the resource manager **26** may return alternatives available for bandwidth and pricing. After returning the result, the resource manager **26** stores the request and flags for confirmation. The request will also be flagged for a specific expiry period. If confirmation is received after the expiry period, the request will be invalidated.

For instant request types, the resource manager **26** returns an acceptance or decline response along with information about availability and pricing of wireless resources. For confirmation requests, the resource manager **26** checks if the confirmation falls within the expiry period range. If the confirmation period has expired, a reservation expired response will be returned to the requester. If the confirmation is made within the expiry period range, the resource manager **26** will confirm provision of the wireless service.

FIG. **4** is a flow chart illustrating a user method for obtaining wireless services in accordance with one embodiment of the present invention. The method begins at step **100** in which a potential consumer requests wireless services from a bandwidth provider **28** or other intermediate agent. As previously described, the request may be submitted manually by calling an operator, sending a fax, or sending an e-mail to the wireless service provider or intermediary, or electronically by sending an EDI message accessing an Internet site and entering parameters specifying the wireless services or from any other graphical, voice, vision, key stroke, pen stroke, or other interface through which request may be submitted or offers reviewed or requested. The consumer request may be automated to be generated in response to activation of a mobile device **20** outside of a predefined coverage area or within a predefined coverage area or type of coverage area. Thus, for example, a car phone may upon activation automatically determine that it is outside a normal coverage area and request information on available bandwidth or generate request for bandwidth based on predefined pricing, service type and/or bandwidth parameters. Parameters may be mandatory or optional and may include a coverage region, rates/pricing plans, time, bandwidth, and types of service.

Proceeding to step **102**, the potential consumer receives a response from the bandwidth provider **28**. The consumer may accept a service plan offered in the response or may negotiate details of the wireless service with the bandwidth provider **28** at step **104**. Thus, if a consumer cannot obtain a requested level of wireless resources at a specified price, the consumer may choose to accept a lower level of resources at the specified price or pay an offered price for the specified level of wireless resources.

Proceeding to decisional step **106**, if an agreement is reached with a bandwidth provider, the Yes branch leads to step **108** in which the consumer may use the agreed upon wireless services. The wireless services may be requested in real-time for immediate use or requested for use at a specified future time. During use of the wireless service, the mobile device **20** may track and/or display charges based on the SLA **30**. Thus, if the consumer is travelling to a remote geographic location, the consumer may first reserve wireless resources at that location to be assured of adequate coverage while at that location. Returning to decisional step **106**, if no

agreement is reached, the No branch of decisional step **106** leads to the end of the process. Thus, consumers may determine ahead of time the cost of wireless services and decide whether or not to proceed with the services based on the cost.

For automatically generated requests, a mobile device may have one or more sets of defined parameters with which it can negotiate for wireless services. Thus, for example, a mobile device may automatically negotiate and agree to wireless services that fall within specified pricing, service type and/or bandwidth parameters for all calls, automatically negotiate and agree to wireless services falling within a second set of parameters for calls to or from identified individuals or business, and require user approval for wireless services above or below specified pricing, service type and/or bandwidth parameters. Further still, wireless services above ceiling parameters may be automatically rejected by the mobile device **20**. For emergency calls, the mobile device may accept any available bandwidth regardless of pricing, service level and/or bandwidth parameters.

FIG. **5** illustrates details of the service interface **60** in accordance with one embodiment of the present invention. In this embodiment, the service interface **60** is a graphical user interface **130** accessible by consumers and bandwidth providers **28** over the Internet or other suitable network or on the mobile device handset. The graphical user interface **130** allows consumers to easily request and negotiate with bandwidth providers **28** for wireless services. The geographical interface may instead be implemented in the mobile device **20**. Other suitable interfaces for the mobile or other device include keystroke, pen stroke, touch screen, voice activated and vision activated.

Referring to FIG. **5**, the graphical user interface **130** includes an interactive map **132** by which wireless access regions for a wireless service may be specified and a plurality of parameter buttons **134** by which additional parameters for the wireless service may be specified. The interactive map **132** may display wireless access regions **135** overlayed on a map of the physical terrain. The wireless access regions may correspond to a geo-location area, portion of a cell site, one or more cell sites, a physical structure such as an airport, complex, or building or any other suitable region in which bandwidth can be allocated. The service requester may zoom in and zoom out on the map to target specific wireless access regions **135**. The service requester may then select displayed access regions for provision of wireless services. The service requester may also draw a wireless access region free form, select a center region and radius of operation or otherwise suitably specify a region in which wireless services are being requested.

The parameter buttons **134** allow the service requester to specify time, service type, bandwidth, and pricing parameters for the wireless service at the identified geographic location. In particular, the time button **136** allows the service requester to enter a time window or a start time for wireless services. In the latter case, wireless services may terminate upon notice from the consumer or termination of a call. The service type button **138** allows the service requester to specify a class of service to be provided. The bandwidth button **140** allows the service requester to specify bandwidth requirements for the service. The pricing button **142** allows the service requester to specify pricing information for the service. The service provider button **144** allows the service requester to specify a preferred service provider, such as an ISP. The network provider button **146** allows the service requester to specify a preferred network provider. Thus, a service requester may specify one or more of the parameters for service using the graphical interface **130**. Information entered into the graphical interface **130** is used to generate a request for transmission and evaluation by bandwidth providers. Responses from bandwidth providers may be displayed to the service requester in the graphical interface **130**. In addition, the service requester may negotiate parameters through the graphical interface **130** with bandwidth providers.

In another embodiment, available wireless resources in a cellular network **12** may be displayed in a graphical user interface **130** for purchase by consumers. In this embodiment, wireless service plans including predefined location, time, service type, bandwidth and/or pricing information may be displayed for selection by consumers. Thus, bandwidth providers **28** may periodically advertise available bandwidth and packaged service plans to facilitate purchase by consumers. If demand exceeds supply, available resources may be auctioned between consumers over the Internet or other medium. In addition, unsolicited advertisements may be sent to consumers to advertise available service plans and/or packages.

Consumers may also request wireless resources and/or receive advertisement and offers for wireless resources through a handset. In this embodiment, consumers may select packages, specify and negotiate terms through a voice-activated interface, call-attended interface, or operator. Thus, services for a device can be obtained directly through the device without need to access a computer or other device.

FIG. **6** is a flow diagram illustrating a method for brokering wireless services of a plurality of network (or service) providers in accordance with one embodiment of the present invention. The method begins at step **150** in which a request for wireless services is received by the bandwidth provider **28**. The request may be received at the graphical user interface **130** or any other suitable interface through which a consumer may specify parameters for the wireless service.

Next, at step **152**, the bandwidth provider **28** requests service plans from network providers covering an access region identified by the request for wireless services. The identified location may be a specific location, such as an airport, convention center, or hotel, or may be a larger geographic region such as a city or portion of a city.

Proceeding to step **154**, the bandwidth provider **28** receives service plans from network providers capable of providing the requested wireless service or a modification of the requested wireless service. At step **156**, the bandwidth provider **28** generates a response based on the service plans from the network providers. The response may include the lowest priced plan that includes all parameters specified by the consumer, a number of plans for evaluation and selection by the consumer, or an aggregation of different portions of service plans from different network providers to best meet the parameters specified by the user.

At step **158**, a response is transmitted to the consumer for evaluation, negotiation, and/or acceptance. At step **160**, the bandwidth provider **28** handles negotiations between the consumer and the network provider. During these negotiations, location, time, type, bandwidth, pricing and other suitable parameters of the wireless service may be negotiated, discussed and agreed to between the consumer and the network provider.

Proceeding to decisional step **162**, if an agreement cannot be reached through negotiations, the No branch leads to the end of the process and no agreement is reached. Wireless services may nevertheless be provided in accordance with preexisting SLAs. Thus, a consumer will be able to deter-

mine ahead of time the price and limits of wireless services and may choose to accept or reject the conditions at which the service will be provided. If an agreement is reached, an SLA is generated and the Yes branch of decisional step **162** leads to step **164**. At step **164**, the consumer is billed by the bandwidth provider **28**. Next, at step **166**, the bandwidth provider **28** instructs the network provider to provision the cellular network **12** to provide the agreed upon services. After the services have been used by the consumer, the bandwidth provider **28** performs termination processing at step **168**. At step **170**, the bandwidth provider **28** forwards payment to the network provider for services rendered. Step **170** leads to the end of the process by which bandwidth providers **28** provide wireless services to consumers. In this way, discrete segments of bandwidth may be commercialized to maximize bandwidth use in each area of a wireless network.

FIG. **7** is a flow diagram illustrating a network (or service) provider method for providing wireless services to consumers in accordance with one embodiment of the present invention. The method begins at step **180** in which the request for wireless services is received by the resource manager **26**. As previously described, the request may be received directly from a consumer or from a bandwidth provider **28**.

Proceeding to decisional **182**, the resource manager **26** determines resource availability based on the request. Resource availability may include whether wireless service is available at a specified geographic location or approximate geographic location, at a specified time, at a specified service type, at a specified bandwidth and/or at a specified price.

If wireless resources for the request are not available, the No branch of decisional step **182** leads to the end of the process. In this case, the service provider does not have the additional bandwidth to sell and is not overextended by agreeing to provide services for which resources are not available. Alternatively, if some bandwidth is available, the bandwidth provider may offer that bandwidth in reply to the request and negotiate terms for that bandwidth. If sufficient resources are available or substantially sufficient resources are available, the Yes branch of decisional step **182** leads to step **184**. At step **184**, the resource manager **26** determines pricing from the pricing manager **48**. At step **186**, the resource manager **26** generates a response based on resource availability and pricing information. The response may include additional and/or altered terms to the request. At step **188**, the response is transmitted to the service requester.

At step **190**, the network provider may negotiate with the service requester to finalize terms at which the wireless services will be provided. If an agreement is not reached, the No branch of decisional step **192** leads to the end of the process. In this case, no agreement could be reached and accordingly wireless services will be provided only in accordance with any pre-existing SLAs. Thus, the consumer may determine ahead of time the cost of wireless services and decide whether to proceed with the services based on the cost. If an agreement is reached, the Yes branch of decisional step **192** leads to step **194**. At step **194**, the resource manager **26** generates and stores the SLA for provisioning of the services. As previously described, the services are provisioned in the mobile gateways **22** upon activation of the consumer's mobile device **20**.

Next, at step **196**, services are provided in accordance with the SLA between the consumer and the bandwidth provider. At decisional step **198**, if the consumer leaves the agreed upon access region, exceeds the agreed upon time or otherwise is outside the agreed upon terms for the wireless services, the Yes branch returns to step **190** in which terms for the wireless service may be dynamically renegotiated and a new SLA generated and stored as previously described. If use of the wireless services does not exceed the SLA, then upon completion of the wireless service, the No branch of decisional step **198** leads to step **200**. Termination processing is performed at step **200**. At step **202**, payment for the provided services is received directly from the consumer or from a bandwidth provider **28** through which the services were sold. Step **202** leads to the end of the process in which the network provider is able to determine resource availability and to sell bandwidth to consumers and other bandwidth providers **28** at specified conditions.

Although the present invention has been described with several embodiments, various changes and modifications may be suggested to one skilled in the art. It is intended that the present invention encompass such changes and modifications as fall within the scope of the appended claims.

What is claimed is:

1. A method for brokering resources of a wireless communications network, comprising:

providing a service interface allowing a user of a remote communications device to select one or more geographic regions for which the user desires wireless service coverage for the remote communications device;

receiving at a centralized brokerage manager via the service interface a request from the user for a wireless service at a particular geographic region selected by the user via the service interface;

selectively determining an availability of the wireless service for at least two service providers available at the selected geographic region based on the request;

generating a first response to the request based on the availability of the wireless service at the selected geographic region, the first response including one or more terms for the wireless service including at least one option between the at least two service providers;

communicating the first response to the remote communications device; and

receiving a second response to the first response, the second response selecting at least one of the at least two service providers to provide the wireless service.

2. The method of claim **1**, further comprising:

the request identifying a time for the wireless service; and

determining the availability of the wireless service at the selected geographic region at the time.

3. The method of claim **1**, further comprising:

the request identifying a bandwidth for the wireless service; and

determining the availability of the wireless service at the selected geographic region for the bandwidth.

4. The method of claim **1**, further comprising:

the request identifying a type of service for the wireless service; and

determining the availability of the wireless service at the selected geographic region for the type of service.

5. The method of claim **1**, further comprising:

the request identifying a price for the wireless service; and

determining the availability of the wireless service at the selected geographic region at the price.

6. The method of claim **1**, further comprising:

the request identifying a network provider for the wireless service; and

determining the availability of the wireless service at the selected geographic region from the network provider.

7. The method of claim 1, further comprising:

the request identifying a service provider for the wireless service; and

determining the availability of the wireless service at the selected geographic region from the service provider.

8. The method of claim 1, the terms in the response comprising a time for the wireless service.

9. The method of claim 1, the terms in the response comprising a price for the wireless service.

10. The method of claim 1, the terms in the response comprising a type of service for the wireless service.

11. The method of claim 1, the terms in the response comprising a bandwidth for the wireless service.

12. The method of claim 1, the terms and the response comprising a network provider for the wireless service.

13. The method of claim 1, the terms and the response comprising a service provider for the wireless service.

14. The method of claim 1, the response comprising an offer for the wireless service, further comprising providing the wireless service in response to acceptance of the terms by a user.

15. The method of claim 1, further comprising:

broadcasting the request to a plurality of network providers each having a wireless access network covering at least part of the selected geographic region;

receiving a service plan from at least one of the network providers, the service plan based on an availability of the wireless service at the selected geographic region in the wireless access network of the network provider; and

generating the response based on service plans from the network providers.

16. The method of claim 1, wherein providing the service interface comprises providing an Internet site including a graphical user interface configured to receive the user's request for the wireless service at the selected geographic region.

17. The method of claim 16, the graphical user interface configured to receive a plurality of service criteria, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

18. The method of claim 16, the graphical user interface further comprising a graphical map displaying geographic areas for selection of the geographic region for which the user desires wireless service coverage for the remote communications device.

19. The method of claim 1, wherein providing the service interface comprises providing a graphical user interface on a mobile device, the graphical user interface configured to receive the request for the wireless service at the selected geographic region.

20. The method of claim 19, the graphical user interface configured to receive a plurality of service criteria, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

21. The method of claim 19, the graphical user interface further comprising a graphical map displaying graphic areas for selection of the geographic region for which the user desires wireless service coverage for the remote communications device.

22. The method of claim 1, wherein providing the service interface comprises providing a telephony site including voice activated commands configured to receive the request for the wireless service at the selected geographic region.

23. The method of claim 22, the telephony site configured to verbally receive a plurality of service criteria, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

24. The method of claim 1, further comprising negotiating at least one of a plurality of service criteria for the wireless service with the user requesting the wireless service, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

25. The method of claim 24, the service criteria comprising at least one of a network provider and a service provider.

26. A system for brokering resources of a wireless communications network, comprising:

computer implementable instructions encoded in at least one computer processable medium; and

the instructions operable upon processing to provide a service interface allowing a user of a remote communications device to select one or more geographic regions for which the user desires wireless service coverage for the remote communications device, receive via the service interface a request from the user for a wireless service at a particular geographic region selected by the user via the service interface, selectively determine an availability of the wireless service for at least two service providers available at the selected geographic region based on the request, generate a first response to the request based on the availability of the wireless service at the selected geographic region, the first response including one or more terms for the wireless service including at least one option between the service providers, communicate the first response to the remote communications device, and receive a second response to the first response, the second response selecting at least one of the at least two service providers to provide the wireless service.

27. The system of claim 26, wherein the computer implementable instructions comprise software stored on a computer-readable medium.

28. The system of claim 26, wherein the request identifies a time for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region at the time.

29. The system of claim 26, wherein the request identifies a bandwidth for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region for the bandwidth.

30. The system of claim 26, wherein the request identifies a type of service for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region for the type of service.

31. The system of claim 26, wherein the request identifies a price for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region at the price.

32. The system of claim 26, wherein the request identifies a network provider for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region from the network provider.

33. The system of claim 26, wherein the request identifies a service provider for the wireless service, the instructions operable upon processing to determine the availability of the wireless service at the selected geographic region from the service provider.

34. The system of claim **26**, the terms in the response comprising a time for the wireless service.

35. The system of claim **26**, the terms in the response comprising a price for the wireless service.

36. The system of claim **26**, the terms in the response comprising a type of service for the wireless service.

37. The system of claim **26**, the terms in the response comprising a bandwidth for the wireless service.

38. The system of claim **26**, the terms and the response comprising a network provider for the wireless service.

39. The system of claim **26**, the terms in the response comprising a service provider for the wireless service.

40. The system of claim **26**, the response comprising an offer for the wireless service, the instructions operable upon processing to provide the wireless service in response to acceptance of the terms by a user.

41. The system of claim **26**, the instructions operable upon processing to broadcast the request to a plurality of network providers each having a wireless access network covering at least part of the selected geographic region, to receive a service plan from at least one of the network providers, the service plan based on an availability of the wireless service at the selected geographic region in the wireless access network of the network provider, and to generate the response based on service plans from the network providers.

42. The system of claim **26**, wherein providing the service interface comprises providing an Internet site including a graphical user interface configured to receive the user's request for the wireless service at the selected geographic region.

43. The system of claim **42**, the graphical user interface configured to receive a plurality of service criteria, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

44. The system of claim **42**, the graphical user interface further comprising a graphical map displaying geographic areas for selection of the geographic region for which the user desires wireless service coverage for the remote communications device.

45. The system of claim **26**, wherein providing the service interface comprises providing a graphical user interface at a mobile device, the graphical user interface configured to receive the request for the wireless service at the selected geographic region.

46. The system of claim **45**, the graphical user interface configured to receive a plurality of service criteria, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

47. The system of claim **45**, the graphical user interface further comprising a graphical map displaying geographic areas for selection of the geographic region for which the user desires wireless service coverage for the remote communications device.

48. The system of claim **26**, wherein providing the service interface comprises providing a telephony site including voice activated commands configured to receive the request for the wireless service at the selected geographic region.

49. The system of claim **26**, the instructions operable upon processing to negotiate at least one of a plurality of service criteria for the wireless service with the user requesting the wireless service, the service criteria comprising a geographic region, a price, a type of service, a bandwidth, and a time for the wireless service.

50. The system of claim **49**, wherein the service criteria comprises at least one of a network provider and a service provider.

51. An interface for a mobile communication device operable to use wireless services in connection with a wireless communications network, comprising:

computer implementable instructions encoded in at least one computer processable medium; and

the instructions operable upon processing to provide a user interface configured to receive from a user of a remote communications device a plurality of service criteria for generating a request for wireless services at a geographic region, the service criteria comprising a geographic region for which the user desires wireless service coverage, a price, a type of service, a bandwidth, and a time for the wireless service, wherein the instructions are further operable upon processing to cause the request to be communicated to a centralized brokerage manager, wherein the user interface is further operable to display a response to the request comprising available wireless services and terms for the available wireless services at the geographic region selected by the user via the user interface, wherein the available wireless services are determined at the centralized brokerage device based on the service criteria and the terms include at least one option between at least two service providers of the requested wireless services, and wherein the user interface is further operable to receive a selection of at least one of the at least two service providers to provide the wireless service at the geographic region selected by the user via the user interface.

52. The system of claim **51**, the service criteria further comprising at least one of a network provider and a service provider.

53. The system of claim **51**, wherein the user interface is a graphical user interface.

54. The system of claim **53**, the graphical user interface operable to display a graphical map illustrating geographic areas for selection of the geographic region for which the user desires wireless service coverage for the remote communications device.

55. The system of claim **51**, wherein the user interface is a voice activated interface.

* * * * *