PTO/SB/16 (11-95)
Approved for use through 01/31/98. OMB 0651-0037
Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

JC585 U.S. PTO
06/08/98

Docket Number	040000-164	Type a plus sign (+) inside this box →	+

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TITLE OF THE INVENTION (280 characters max)

APPLICATION AND COMMUNICATION PLATFORM FOR CONNECTIVITY BASED SERVICES

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ENCLOSED APPLICATION PARTS *(check all that apply)*

[X] Specification *Number of Pages* 14
[X] Drawing(s) *Number of Sheets* 5
[ ] Small Entity Statement
[X] Other (specify) Four (4) pages of claims and a One-Page Abstract

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

[X] A check or money order is enclosed to cover the Provisional filing fees
[X] The Commissioner is hereby authorized to charge any deficiency in filing fees or credit any overpayment to Deposit Account Number 02-4800. This paper is submitted in triplicate.

PROVISIONAL FILING FEE AMOUNT(S): $ [ ] $75.00; $ [X] $150.00

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

[X] No.
[ ] Yes, the name of the U S. Government agency and the Government contract number are

Respectfully submitted,

SIGNATURE Steven M. duBois Date June 8, 1998

TYPED or PRINTED NAME Steven M. duBois Registration No. 35,023 *(if appropriate)*

[X] Additional inventors are being named on separately numbered sheets attached hereto

(10/97)

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Ljungberg	Johan		
Andersson	Jörgen		

(10/97)

APPLICATION AND COMMUNICATION PLATFORM FOR CONNECTIVITY BASED SERVICES

BACKGROUND

The present invention generally relates to information and communication systems and, more particularly, to systems and methods for providing an open and horizontal platform to distribute and operate connectivity based services.

Recently, many advances have been made in the areas of information and communication technologies. For example, computers, and in particular personal computers, have radically changed the way in which information is manipulated and stored. Moreover, microprocessors are being incorporated into more and more products and are controlling an ever increasing number of processes in the modern world. It is not unusual today to find microprocessors controlling household appliances, automobile operations, manufacturing processes, etc. At the same time, communication systems continue to expand and develop. For example, in the last decade commercial wireless communication systems have become widely popular for personal communication services. Data communication services have also rapidly expanded, among which the advent of the Internet is particularly notable.

Those skilled in the arts of information and communication technologies frequently view these areas as rapidly becoming one, integrated technology rather than two separate areas of research and development. As devices which process and manipulate data become further integrated with devices which communicate data, the potential to use such integrated technologies expands their applicability. For example, Applicants believe that in the near future the number and availability of connectivity based services, i.e., services which monitor or control the operation of remote devices, will rapidly increase.

For example, one form of connectivity based service might entail a utility providing a service to remotely monitor and control the operation of remote devices which consume electricity. Other potential applications for connectivity based services include industrial equipment monitoring and control, building automation, safety and

security of both commercial and residential environments, Internet access and electronic commerce, telephony services and mobile applications. However, to date, no integrated solution exists for handling the installation, maintenance, operation control and billing for such connectivity based services.

In fact, today's communication tools can be described as belonging to a spectrum between those devices which have dedicated functionality and connections to those devices which are multifunctional and may have many communication connections to different input/output devices. An example of some of these communication tools is illustrated in Figure 1. Therein, at the dedicated end of the spectrum, one might consider today's modems or electricity meters. These devices have certain positive characteristics which include security of information transfer, reliability, ease of maintenance and relatively low cost. However, dedicated communication devices also tend to have the drawbacks that they possess little intelligence or memory, are not very flexible, typically have a single dedicated communication channel and provide a limited communication interface for end users.

At the other end of the spectrum, today's personal computers provide a wide variety of information and communication services to the end user. These types of devices have the advantages of being relatively flexible and intelligent, having significant memories, possessing the capability to add new applications as they arise and multiple communication interfaces. However, in contrast to the dedicated communication devices, multifunctional communication tools suffer from poor reliability, are relatively expensive, are difficult to maintain and support and typically require sophisticated user interaction in order to perform their desired functions and/or add new functionality.

Accordingly, it would be desirable to provide a new platform to support the arrival of the anticipated plethora of connectivity based services which Applicants expect to be created in the wake of the evolution of the information and communication technologies. Such a platform should have as many of the positive characteristics of both dedicated and multifunctional conventional communication tools as possible with as few of the drawbacks.

SUMMARY

These and other drawbacks and limitations of conventional information and communication systems are overcome according to the present invention wherein a platform for connectivity based services is provided. The platform facilitates the development, implementation, operation and maintenance of services in an integrated manner so that the interface between different services providers and the end user is transparent to both. Each service may comprise a set of functionalities and logic which are implemented in software as an application. The application may be distributed among various pieces of equipment which are geographically separated. Implemented in the software are functions designed to monitor, control and otherwise interact with remote devices in a manner which can be easily monitored by the service provide, the end user, and, potentially, other intermediary operators.

Platforms according to the present invention are dedicated and scalable so that many different types of services can be implemented efficiently using the same platform. Platforms according to the present invention are preferably open platforms to allow for the development of service applications by third party developers. Moreover, standard communication protocols and programming languages may be used in order to facilitate such service software application development. In addition to being open platforms, platforms according to the present invention are intended to be horizontal in nature so that a plurality of service providers can share the same platform infrastructure. While sharing the same infrastructure, the service applications can be modularized so that from the perspective of the service providers, platforms according to the present invention will appear as if they were dedicated to their respective services.

Connectivity based service platforms according to the present invention are preferably operated and maintained by a business entity rather than the end user or subscriber in order to provide ease of maintenance and support with respect to the end user and promote security and reliability of the services which are deemed to be significant characteristics of service platforms according to the present invention. The business entity which performs the operation and maintenance of the service platforms may be different from the entity which actually provides the service which is being

subscribed to by the end user. The end user may be an individual, a residence, a business or any other type of entity.

Connectivity based service platforms according to the present invention are intended to be generic in many ways in order to support different types of services and different types of equipment which provide those services. For example, multiple types of access solutions are envisioned according to the present invention including those involving local area networks and external networks. Various types of terminals may be used to link with platforms according to the present invention to obtain information about an implemented service or about results associated with such service. Interaction with the implemented service is separated from implementation of the service itself. Given the wide variety of communication devices available today, and a desire to support these various devices as terminals which may access platforms according to the present invention, various types of output are supported including different types of display sizes.

According to exemplary embodiments of the present invention, service gateway equipment can be connected to a local area network through which the service may be implemented. By providing, as part of the platform, such service gateway equipment, services can be personalized and adapted to individual users or entities. Moreover, by localizing some of the functionality of each service proximate the remote devices which are controlled or monitored to actually implement the service (i.e, in the dedicatd platform servers), bandwidth associated with each communication link used to implement the service can be controlled in an efficient manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing objects, features and advantages of the present invention will be more readily understood upon reading the following detailed description in conjunction with the drawings in which:

Figure 1 is a diagram of certain existing communication tools along with their positive and negative attributes;

Figure 2 illustrates an exemplary embodiment of the present invention depicting the architecture associated with a service platform;

Figure 3 depicts various potential service providers and connectivity based services;

Figure 4 illustrates a mobile embodiment of an exemplary embodiment of the present invention; and

Figure 5 depicts another mobile embodiment of the present invention.

DETAILED DESCRIPTION

Figure 2 depicts an exemplary embodiment of the present invention which provides a platform for connectivity based services associated with residential use. Those skilled in the art will, of course, appreciate that this example is merely illustrative in many senses and that service platforms according to the present invention are equally applicable to business and other uses, some of which will be described below. As seen in Figure 2, a local area network 10 can be provided in a residence for communicating with and controlling a plurality of sensors and appliances therein. Those depicted include a thermostat 12, a clothes washing/drying facility 14, a coffee maker 16, and a telephone 18. Again, these particular sensors and appliances are depicted merely as examples and a plethora other types of remote devices will be readily apparent to those skilled in the art.

Also attached to the local area network 10 associated with a residence may be one or more local clients 20. These clients may, for example, include a personal computer or a home base station associated with a localized cellular radiocommunication system. Service platforms according to the present invention are intended to operate in conjunction with any type of local area network (LAN) including, for example, those based on Ethernet, IR, short distance wireless radio, CEBus, Lonworks, X10 or any other communication protocols. Also connected to local area network 10 is a service platform server 22. According to exemplary embodiments of the present invention, the service platform server 22 is preferably directly connected to the local area network 10, e.g., by Ethernet cable, rather than

through a modem or other gateway connection. The service platform server 22 interacts with local area network 10 and remote devices connected thereto, e.g., devices 12-18 to implement connectivity based services according to the present invention. Although it may be physically closer to local area network 10 than the network operator's equipment 24, service platform server 22 may be logically considered as a node associated with the network operator rather than the local area network since the service platform server 22 is preferably not open to control or commands from the local area network 10, e.g., using local client 20. Instead, for reasons that will be discussed in more detail below, control, maintenance and operation of service platform server 22 is performed by the network operator.

Service platform server 22 may have loaded thereon all or part of a software application or applications which are used to implement one or more connectivity based services which have been requested and/or subscribed for by the end user, in this case the residential user. For example, service platform server 22 may include software which performs services that interact with one or more of the remote devices 12-18, e.g., an environmental control service which interacts with thermostat 12, a laundry service which interacts with device 14, a coffee service which interacts with device 16 or telephony services which interact with device 18. Service platform server 22 could also contain software which, at least in part, implements a service which interacts with the local client(s) 20 of local area network 10.

Connected to the service platform server 22 is equipment 24 associated with the network operator. This equipment may include one or more servers, i.e., relatively powerful computers operating in conjunction with one or more secondary storage devices. According to exemplary embodiments of the present invention, Applicants envision that a network operator will be responsible for the maintenance and operation of the service platform servers 22 associated with various end users. Like today's internet service providers (ISPs), which act as intermediaries between personal computer users and the Internet, network operators according to the present invention may act as intermediaries between service providers and the end users of those services. Various corporate entities may function as network operators according to the present

invention, including, for example, utilities, communication companies, etc. The connection between the network operator server 24 and the service platform server 22 may be wire-based or wireless.

In any event, the network operator will be connected to a plurality of service provider's equipment 34 via some communication network, e.g., the Internet 26. The server provider's equipment 34 which may include, for example, other computer systems or servers, may be the initial repository for software used to implement connectivity based services according to the present invention. Exemplary techniques in which these services are implemented upon request are described below. Also represented in Figure 2 are examples of remote clients 28 and 30 which may be used to interact with implemented services. For example, a service user/subscriber may operate one of the terminals 28 and 30 to obtain information associated with the operation of the service or change operating parameters associated with the service, e.g., monitoring results of the thermostat device 12 or changing temperature settings. Some remote terminal devices, such as device 28 may be connected to the Internet via intermediary communication networks. For example, if the remote terminal is a mobile phone used in a cellular network, then the intermediary communication network might be, for example, a GSM cellular radio communication system 32.

Since the output devices associated with various remote terminals may differ in either the type of output available or the amount of information which can be output at any given time, e.g., the size of the display, the capability to tailor information received from implemented services to the terminal device being used can be provided. For example, a remote device 28 having a relatively small display may receive information in a first format tailored to that display while the same request generated by a remote terminal 30 having a larger display may result in different information and/or format being presented. Object-oriented programming techniques designed to provide, among other things, these different types of outputs may be found in International Patent Application WO 9623267 to Hans Thorsen, published on August 1, 1996, the disclosure of which is incorporated here by reference.

Having briefly described an exemplary architecture by which connectivity based services can be supported according to the present invention, an example will now be provided to illustrate how these services can be implemented using distributed processing techniques. Suppose that an end user associated with local area network 10 contacts service provider #1 which has advertised a service designed to monitor household temperatures and control heating and cooling equipment connected to a local area network to implement a residential user's desired temperature patterns at various times of day, days of the year, etc. This service provider also touts this connectivity based service as being remotely monitorable and adjustable by the residential user using remote terminals. The residential user may enter into an agreement with service provide 1 in any conventional manner, e.g., by mail or over the telephone, to subscribe to this service.

Once the residential user has been confirmed as a subscriber, then service provider #1 will inform the network operator 24 responsible for maintaining and controlling that residential user's service platform server 22. The service can be implemented in various ways depending upon where the software currently resides which is used to implement the service. If, for example, this environmental service offered by service provider #1 is commonly requested by residential users, then the portion of the software used to implement this service which would normally reside on the service platform server 22 may have already been preloaded thereon, in which case network operator 24 may simply activate that software by way of a command signal to service platform server 22. Otherwise, network operator 24 may download all or part of the software associated with that service to the service platform server 22 whereupon the service platform server can run the newly loaded software to control thermostat 12 and other remote devices which are associated with the environmental service for that residential user which are connected to local area network 10.

If a service is brand new, or infrequently requested, the network operator 24 may need to receive some portions of the application software from the service provider #1 via Internet 26. Having received the associated software, the network operator can then download some or all of that software to service platform server 22. As mentioned

earlier, Applicants envision that implementation of connectivity based services according to the present invention may take advantage of distributed processing techniques whereby a service may be implemented using software operating on two or more of the servers or processors associated with the architecture illustrated in Figure 2.

For example, a first portion of software associated with the environmental service described above may reside permanently on the service provider #1's equipment 34. A second portion of the software used to implement environment control in the end user's residence may reside on the network operator's equipment 24. Likewise, a third portion of the software used to implement this service may reside on service platform server 22. The distribution of software used to implement any particular service will, of course, depend upon the nature of the service, the nature of the software, and the bandwidth associated with various information transfer needed to implement the desired service. For example, for services which implement a relatively rapid feedback control loop, it may be desirable to provide most or all of the software associated with the feedback control loop directly on service platform server 22 so that the high data rate/bandwidth communication associated with this portion of the service is confined to communication between the geographically local service platform server 22 and local network 10 rather than the possibly more distantly located service provider's equipment 34 or network operator's equipment 24. Rather than being distributed over all three pieces of equipment, those skilled in the art will appreciate that software can be distributed over just the network operator's server 24 and service platform server 22 or just the service provider's equipment 34 and the service platform server 22, or any other combination of processors that is deemed desirable.

Moreover, it is envisioned that in addition to the functionality which is directly associated with the implementation of a particular service, e.g., turning on an air conditioning unit or a heater in connection with an environmental control service, other software modules or applications may be designed solely to maintain that service. For example, to maintain and control an environmental service, the network operator's server 24 may contain other software modules which monitor the service platform's

server 22's implementation of the environmental control software. This may include, for example, software which records the frequency with which remote device 12 is operated or adjusted or diagnostic software which monitors the various components, e.g., the server 22 itself, the local area network 10 and the remote device 12, which are needed to implement the service software stored, at least in part, on service platform server 22. The capability and responsibility of network operator 24 to handle maintenance and control of the service implementation is intended to provide enhanced security, reliability and ease of use to the end user of connectivity based services according to the present invention.

As mentioned earlier, service platforms according to the present invention are intended to appear dedicated to each service provider, but in fact reuse infrastructure to support multiple connectivity based services supported by different service providers. Thus, to extend the foregoing example, the residential user having local area network 10 may also request from service provider #2 certain telephony services which are used to operate, control and monitor telephone 18. Upon subscription to this service in the same manner described above, network operator 24 would once again load, if necessary, the necessary software portion onto service platform server 22 for implementing the desired and requested telephony services. Service platform server 22 would then, multitask software applications which implement the environmental control service and the telephony services for interacting with remote devices 12 and 18. Thus, the present invention is seen to be extendible to activate, maintain and control a plurality of connectivity based services on a single service platform server 22 so that this infrastructure can be cost effective.

The service subscriber or end user associated with local area network 10 can interface with the requested services via, for example, remote terminals 28 or 30 in order to obtain information associated with those services from remote locations. For example, if the subscriber wishes to obtain information about the environmental control service and how it is performing or about his/her telephony services, such information could be accessed remotely and displayed or otherwise output (e.g, voice output) via remote terminals 28 or 30. Although the end user or subscriber has access to this

information via remote or local terminals, the end user is preferably not able to control the operation of service platform server 22.

The foregoing exemplary embodiment provides only a limited, yet illustrative example of the different types of service providers and connectivity based services which can be implemented using techniques according to the present invention. For example, as conceptually illustrated in Figure 3, open service platforms according to the present invention may be used to integrate many independent service providers to further exploit efficiencies associated with using this same communication and information processing infrastructure. As seen in the figure, potential service providers include power utilities, telecommunication operators, security companies, insurance companies, banks, appliance manufacturers and others. These or other service providers may make available services which can be added to the service platform which include, for example, utility management services, safety and security services, communication services, telemetry services, home automation services, information services and entertainment services.

Moreover, application of service platforms according to the present invention is clearly not limited to residential applications but may also include provision of services to business or other entities. For example, a service platform server could be provided to provide service support for an entire office building or an industrial plant. Additionally, service platform servers according to the present invention are not limited to fixed applications. Applicants anticipate that connectivity based services will be equally desired by mobile users in much the same way that communication services are desired today. This concept is illustrated in Figure 4 wherein a vehicle is depicted having both a service platform server 22 as well as a local client 40 which may be an auto PC, standard personal digital assistant (PDA) or any type of terminal device. The vehicle will be also contain a wire or wireless LAN (not shown) by which various remote devices within the vehicle may be monitored and/or controlled. The platform server 22 may also include communication equipment for communicating with the network operator's equipment wirelessly and, optionally, a global positioning system (GPS) receiver which may be used to provide the platform server 22 with information

regarding the vehicle's current location. Integration of connectivity based services with mobile environments will enable mobile users to have access to offboard, dynamic information sources. Moreover, services which have been implemented for that user at his/her residence can follow the user to his/her vehicle providing a seamless integration of connectivity based services. Using the GPS receiver, the services can be adapted to the location of the vehicle, e.g., which location may trigger the update of information or other remote device functionality. Since the vehicle depicted in Figure 4 may travel over great distances, it is possible that the service platform server 22 mounted therein may be wireless connected to different operators to support services in connection therewith.

Figure 5 depicts an exemplary embodiment of the present invention which provides one exemplary application of a mobile service platform server in connection with the trucking industry. Therein the truck (not illustrated) has a service platform server mounted thereon in which various service software client packages have been loaded, denoted by reference numerals 50-53. For example, this particular truck may be employed in the service of two different freight companies which coordinate their individual activities using service equipment 55 and 56, respectively. When the truck is employed at any given time by a respective freight management service, the applicable client 50 or 51 runs to coordinate and communicate information between the appropriate service equipment and the truck. For example, when the truck is in the employ of the FMS 1, client 50 may be run on service platform server 22 to provide that particular trucking company with information regarding the current location of the truck and its anticipated arrival time at a delivery sight. Similarly, the end vehicle terminal 58 may provide the truck driver with information regarding subsequent deliveries/ pick-ups and other information provided by the one or more of the clients 50-53 which are running at any given time on the service platform server 22. Freight broker and yellow page service providers 59 and 60 are provided as other examples of services which may be implemented on service platform server 22 for a trucking implementation of service platforms according to the present inveniton.

It will be noted that the exemplary embodiment of Figure 5 provides for direct connectivity between a communication system, e.g., the Internet 62 and the service platform server 22. Although frequently it will be desirable to interpose an intermediary network operator, there may be certain embodiments of the present invention where the network operator and the associated equipment may be eliminated.

Several examples of specific services envisioned by Applicants have also been mentioned, although those skilled in the art will appreciate that numerous connectivity based services will likely emerge. For example, utility companies are likely candidates for implementing connectivity based services including automated meter reading, real time pricing (wherein the price per kilowatt-hour may vary based on demand), automated load control (wherein a subscriber acquires a server that varies the amount and type of electricity consumption on a household-wide or individual load basis based on, for example, the real time price of electricity, time of day and/or other parameters).

Additionally, Applicants consider secure implementation of these connectivity based services to be important to achieving subscriber satisfaction and acceptance of platforms according to the present invention. Since various service providers, network providers and, possibly, end users, will share infrastructure, it is important that information and communication associated with each implemented connectivity based service be secure. As mentioned earlier, Applicants envision a preferred embodiment of the present invention to allow only the network operator (and not the subscriber) to have control access to the service platform server, which, in part, provides for a more secure platform than if the subscriber was able to control this server. Moreover, Applicants envision widespread usage of other security techniques including data encryption, various authorization and identity verification techniques, etc. to be provided so that the implementation, monitoring and billing associated with these services is robustly defended against intrusion and manipulation.

While the present invention has been described using the foregoing exemplary embodiments, these embodiments are intended to be illustrative in all respects, rather than restrictive of the present invention. Thus, the scope of the present invention is instead set forth by the appended claims and encompasses any and all equivalents and modifications embraced thereby.

WHAT IS CLAIMED IS:

1. A system for controlling operation of a service comprising:

at least one remote device associated with said service;

a local area network connected to said at least one remote device;

service gateway equipment connected to said local area network;

network operator's equipment connected to said service gateway equipment for selectively loading a first portion of software associated with said service onto said service gateway equipment; and

service provider's equipment connected to said network operator's equipment via a communication link for providing said at least said first portion of software to said network operator equipment;

wherein said service gateway equipment runs said first portion of software to interact with said at least one remote device.

2. The system of claim 1, wherein said communication link is the Internet.

3. The system of claim 1, wherein said at least one remote device includes a sensor.

4. The system of claim 3, wherein said at least one remote device is a thermostat and said at first portion of software runs to operate said thermostat and control temperature.

5. The system of claim 1, wherein control and maintenance of said service gateway equipment is performed by said network operator's equipment.

6. The system of claim 5, wherein said service provider's equipment loads a second portion of software associated with said service into said network operator's equipment, said second portion of software including control and maintenance

instructions for supervising said service gateway equipment's implementation of said service.

7. The system of claim 1, wherein said at least one remote device includes a transducer.

8. The system of claim 1, wherein said at least one remote device includes a processor.

9. The system of claim 1, wherein said at least one remote device includes an electricity meter and said service is automated meter reading.

10. The system of claim 1, wherein said at least one remote device includes an electricity meter and said service is real time electricity pricing.

11. The system of claim 1, wherein said at least one remote device includes an electricity meter and said service is automated electricity load control.

12. The system of claim 1, further comprising:

a client device connected to said system for allowing a subscriber of said service to interact therewith.

13. The system of claim 12, wherein said client device is directly connected to said local area network.

14. The system of claim 12, wherein said client device is connected to said system via a radiocommunication system.

15. A method for providing at least one utility service to a user comprising the steps of:

providing at least one remote device associated with a first utility service;

providing a local area network connected to said device;

connecting a service platform server to said local area network;

selectively loading software associated with said first utility service onto said service platform server from a first service provider's equipment; and

operating said first utility service to control said at least one remote device using said loaded software.

16. The method of claim 15, wherein said step of connecting further comprises the step of:

directly connecting said service platform server to said local area network using a cable or wire.

17. The method of claim 15, wherein said service platform server is dedicated to operating services.

18. The method of claim 15, further comprising the steps of:

selectively loading software associated with a second utility service onto said service platform service from a second service provider's equipment; and

operating said second utility service to control said at least one remote device.

19. The method of claim 18, wherein said first utility service is automated meter reading and said at least one remote device is an electricity meter.

20. The method of claim 18, wherein said second utility service is automated load control and said at least one remote device is an electricity meter.

21. The method of claim 15, wherein said step of operating further comprises the steps of:

distributing software associated with said first utility service across processors in addition to said service platform server; and

running said distributed software to operate said first utility service.

22. The system of claim 12, wherein said client has a display and an output of information associated with said service is adjusted based on a size of said display.

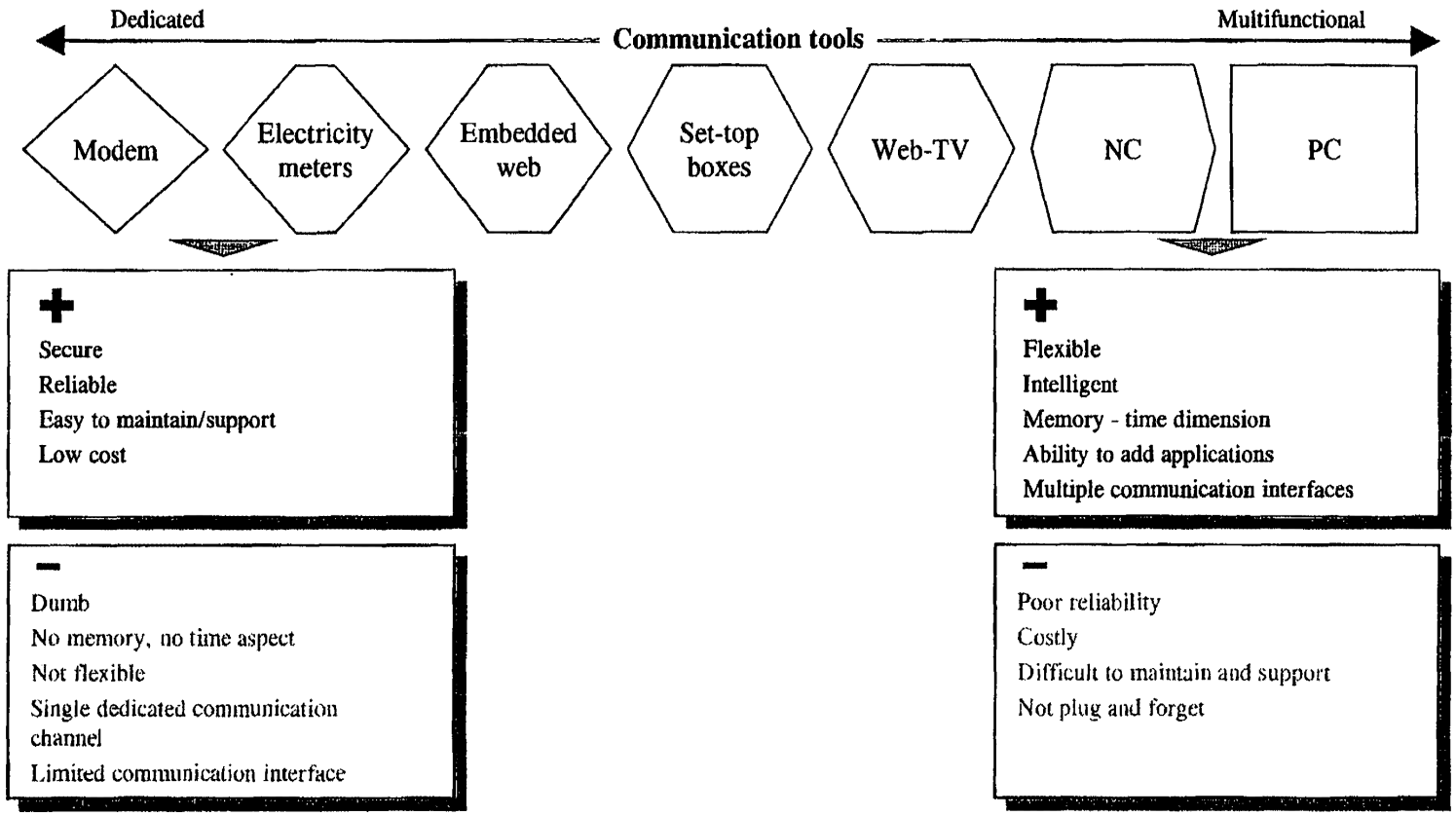
Dedicated
Communication tools
Multifunctional
Modem
Electricity meters
Embedded web
Set-top boxes
Web-TV
NC
PC
+
Secure
Reliable
Easy to maintain/support
Low cost
−
Dumb
No memory, no time aspect
Not flexible
Single dedicated communication channel
Limited communication interface
+
Flexible
Intelligent
Memory - time dimension
Ability to add applications
Multiple communication interfaces
−
Poor reliability
Costly
Difficult to maintain and support
Not plug and forget

Figure 1

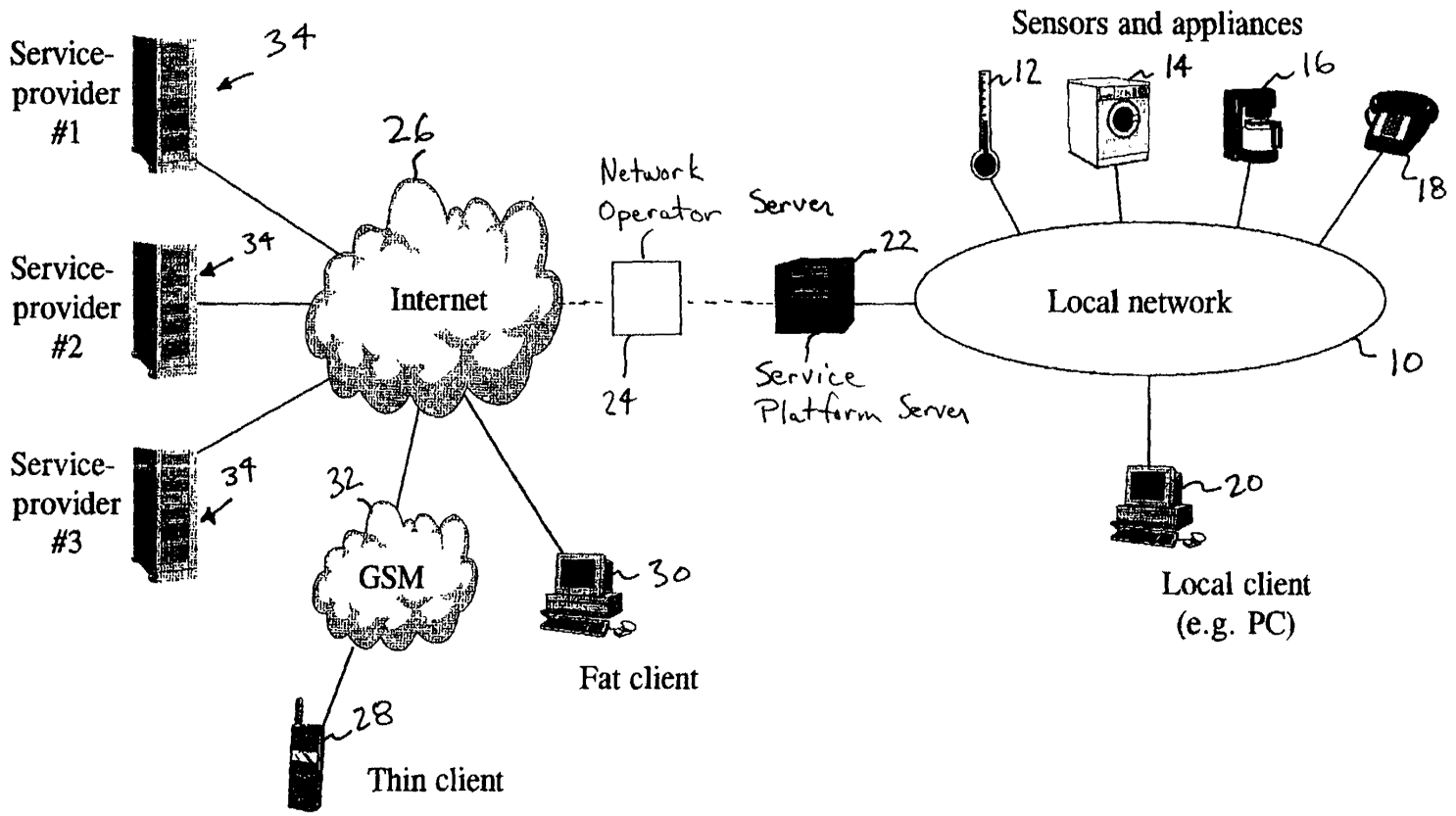
Service-provider #1
Service-provider #2
Service-provider #3
34
34
34
26
Internet
32
GSM
28
Thin client
30
Fat client
Network Operator Server
24
22
Service Platform Server
Sensors and appliances
12
14
16
18
Local network
10
20
Local client (e.g. PC)

Figure 2

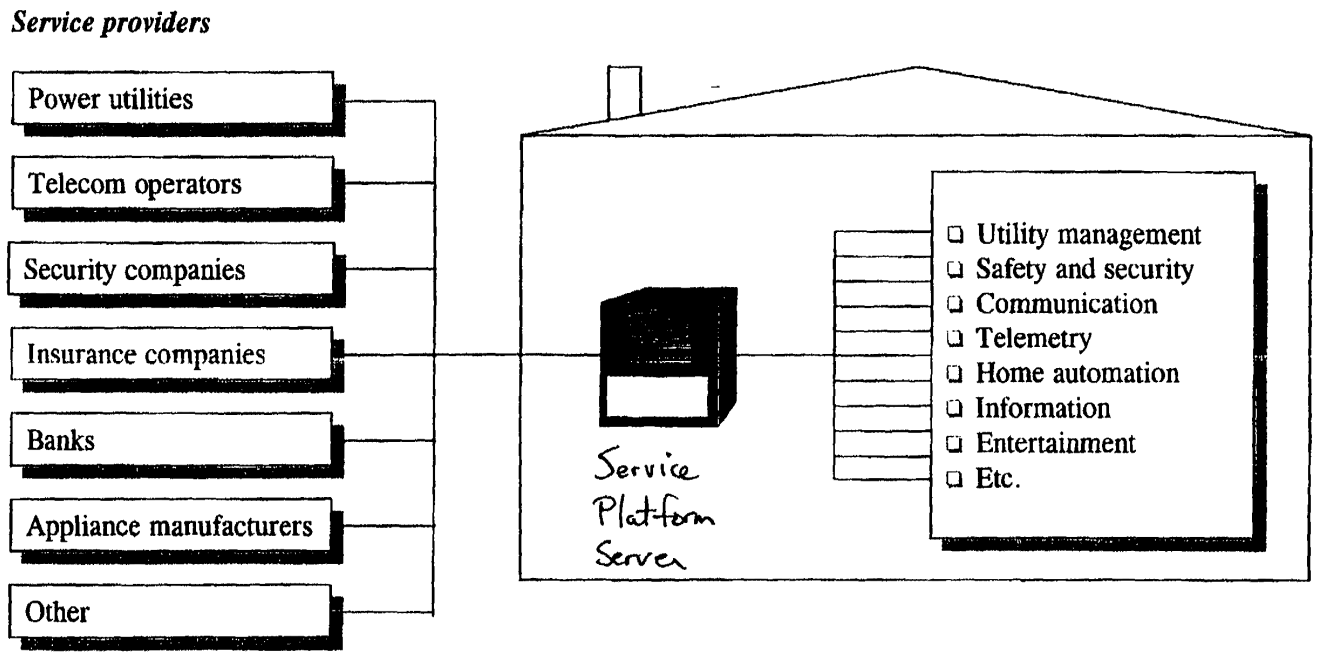
Service providers
Power utilities
Telecom operators
Security companies
Insurance companies
Banks
Appliance manufacturers
Other
Service Platform Server
Utility management
Safety and security
Communication
Telemetry
Home automation
Information
Entertainment
Etc.

Figure 3

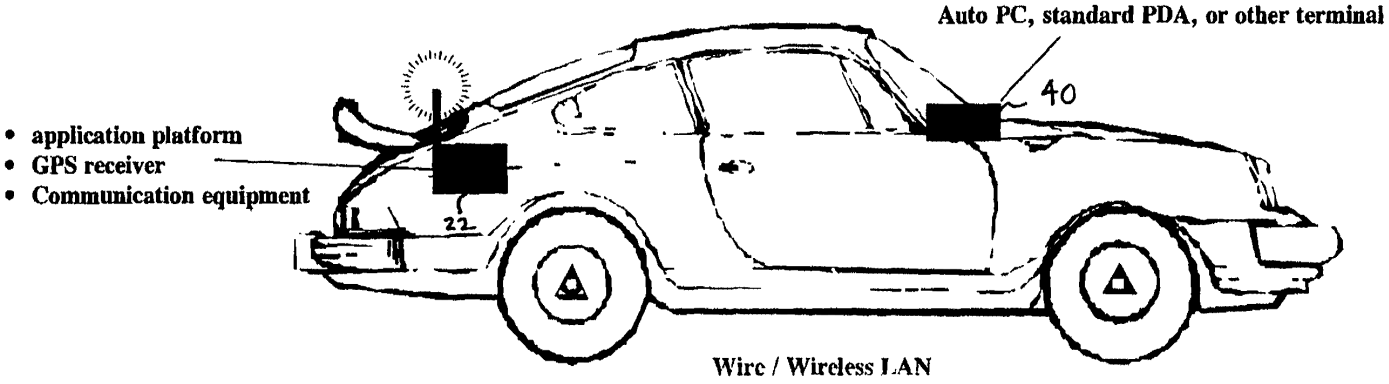
Auto PC, standard PDA, or other terminal
40
• application platform
• GPS receiver
• Communication equipment
22
Wire / Wireless LAN

Figure 4

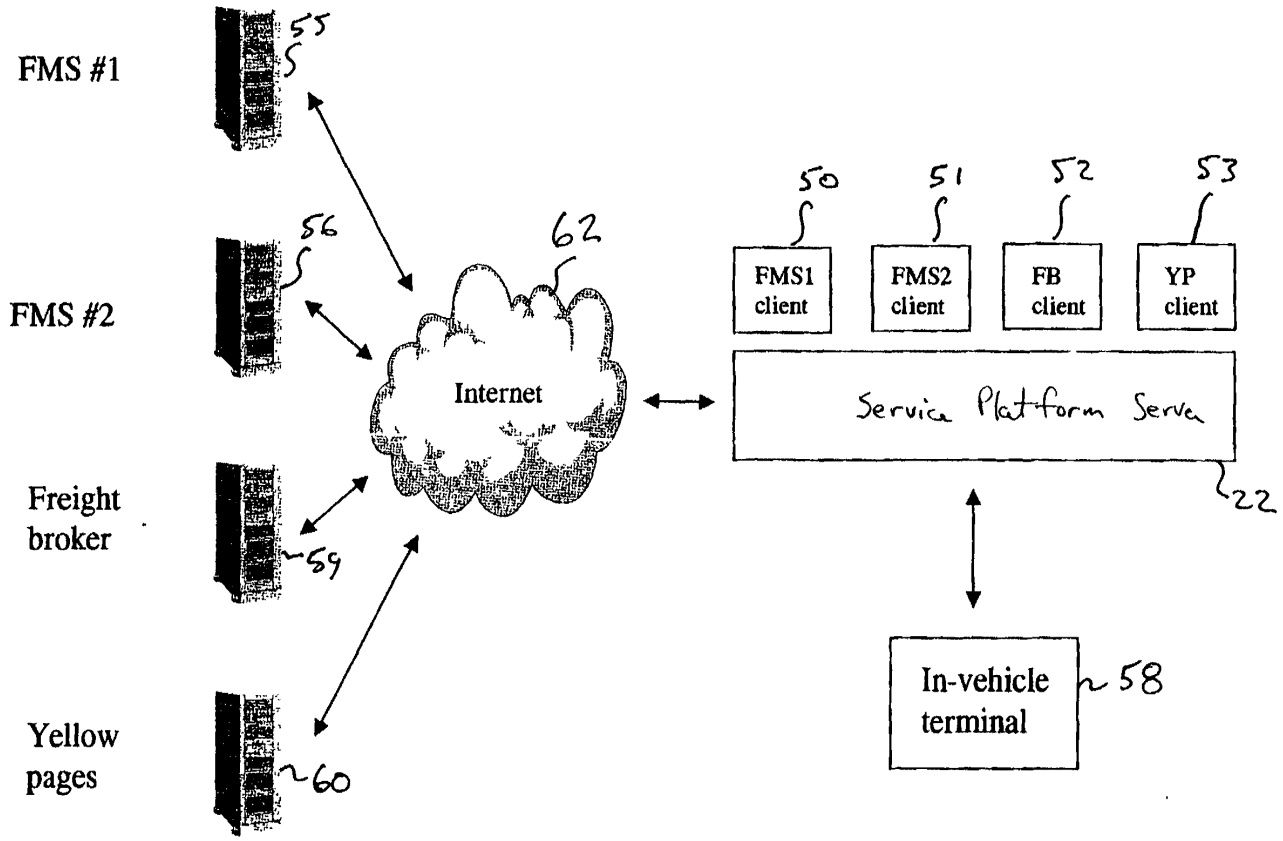
FMS #1
55
FMS #2
56
Freight broker
59
Yellow pages
60
62
Internet
50
51
52
53
FMS1 client
FMS2 client
FB client
YP client
Service Platform Server
22
In-vehicle terminal
58

Figure 5

ABSTRACT OF THE DISCLOSURE

Open, horizontal service platforms are described. Service providers can, via network operators, load software associated with a service onto a dedicated, service platform server. The service platform server is connected, via a LAN, to one or more remote devices (e.g., sensors, transducers, processors, etc.). The functionality associated with the service can be distributed among two or more of the entities involved in the architecture. The distributed software operates and/or monitors these remote devices to implement the subscribed service.