Design and Implementation of a Distributed Telecommunications Supermarket

Rajiv Mathur, Dirk Pesch
Center for Adaptive Wireless Systems
Electronic Engineering
Cork Institute of Technology, Ireland
{rmathur,d pesch}@cit.ie
Phone: +353 214326869, Fax: +353 21 4326625

Ashutosh Mundra, Gaurav Nolkha, Sheelraj Agarwal
Electronics & Communication Engineering
Malaviya National Institute of Technology
Jaipur, India
amundra@ieee.org
Phone: +353 214326869, Fax: +353 21 4326625

Abstract—TelecomSupermart is a ‘Win-Win’ solution for users and providers of communication services. In current communication systems, wired and wireless, subscribers are more or less tied to their service providers by means of long-term contracts - the business model is therefore rigid. In an ideal scenario, users should be free to buy telecommunications services just as they are able to buy other commodities in a super market without being obliged to buy products from a particular company. The service providers should also be able to maximize their revenues by means of intelligent strategies such as dynamic pricing based on demand and supply trends in the market. TelecomSupermart is a novel implementation of an agent-based system for telecommunication service provision. It encompasses the merits of an open and free market and facilitates revenue maximization for service providers while giving the users the choice of selecting a service provider based on their own requirements. The backbone of the TelecomSupermart is a decentralized network of individual service providers offering entrepreneurs and individuals an opportunity to become a listed service provider and offer communications services through the TelecomSupermart.

Keywords – telecommunication supermarket, SIP, agents, service provider

I. WHY USE A MARKET?

The current telecommunication market is rigid in that consumers of telecommunication services are tied to their service providers by means of long-term contracts. The service providers have to spend a large proportion of their revenues in advertising, running in a mad race to attract customers. In an ideal scenario, users should be free to buy telecommunication services just as they are able to buy other commodities in a super market without being obliged to buy products from a particular company. The situation in the telecommunication sector currently is the same as that would be if a customer were forced to buy ONLY from a particular company for at least a year or pay a penalty for breaking the contract! A possible approach to making the telecommunication system more flexible is to introduce telecommunication super markets where users could buy services on a per call basis. In such a market based system, the user will not be tied with a long-term contract, but will be able to dynamically choose the best service provider from a pool of service providers willing to offer services.

This system will have many benefits over the current state of the art –

1. It will introduce more competition in the communications market, thus forcing the service providers to better serve the interests of the users. This is actually in line with the recommendations of telecommunication regulators such as ComReg in Ireland and OFTEL in the UK. OFTEL, the UK telecommunications regulator, for example has stated in a report that ‘the mobile communication market is not yet fully effective, and one of its key objectives is to promote competition’.

2. It will help service providers to stop running in the mad race for acquiring more customers, thus saving a lot of capital in advertising

3. The success of the service provider will be based purely on their own merit in being able to provide good value services

4. There will be an opportunity for service providers to dynamically price their services depending upon the demand and supply. This will present them with the opportunity to increase their network utilization, thus generating more revenue from the network

5. There will be a decoupling between service providers and network operators which will allow operators to dynamically sell their spare capacity to service providers, thus increasing their revenues.

TelecomSupermart is a distributed framework that can provide communication services to its users via a globally distributed network of service providers and network operators. The framework has decentralized control and offers entrepreneurs and individuals to become service providers and network operators and thus generate revenue by providing services to users. The users take advantage of the distributed network of service providers and network operators and benefit from the competition in a telecommunication supermarket by availing of the best prices. Along with merits of open and free market, the novelty of the TelecomSupermart is its decentralized nature that will offer opportunity to any individual to start providing communication services using the TelecomSupermart and generate revenue.
The paper is organized as follows. The next section provides a brief overview of market based frameworks that have been reported in literature. Section III describes the framework of the TelecomSupermart, giving details of the architecture of the TelecomSupermart and discusses the roles of various entities present in the TelecomSupermart. Section IV describes the prototype implementation of TelecomSupermart and Section V concludes the paper.

II. TECHNOLOGY REVIEW

Over the recent past, novel approaches to the management of networks and services in multi-service provider environments have been investigated. Eurescom has developed the EQOS framework as a platform for negotiation and management of QoS and network performance [1]. The Parlay group has developed an Application Programmable Interface (API) to separate the service provider and network operator domains [2]. The API enables the flexibility to build, test and operate applications by the service provider outside the network domain. The Digital Marketplace (DMP) proposed by the University of Strathclyde uses a market-based approach for selecting the service provider on a dynamic basis and thus efficiently managing future cellular networks [3]. The DMP uses a market like framework where the customer is the consumer of communications services provided by one or more service providers. However, existing proposals for market based network and service management have so far been mainly theoretical without much real implementation beyond simulation studies [4][5]. TelecomSupermart is an attempt to implement these theoretical concepts. The focus is on building a distributed, decentralized market based system. Session Initiation Protocol (SIP) will be used to initiate calls from the user end thus providing an end to end. PC to PC calls are made using SIP and while making PC to PSTN call, the user to PSTN gateway connection is done using SIP after which the gateway forwards the call to PSTN through a modem.

III. FRAMEWORK

TelecomSupermart provides a marketplace for trading communication services. Consequently, the proposed framework is based on a reorganized business model. In this context, the different business roles that are involved in the provision and use of telecommunication services are depicted in Figure 1.

![Figure 1: TelecomSupermart]

Figure 1: TelecomSupermart

The customer avails of the services provided by this distributed market based approach after registering its profile and preferences with the TelecomSupermart. The user is then represented in the TelecomSupermart by an intelligent user agent (UA) which negotiates with the service provider agents (SPA) for the provision of communication services. The service provider provides communication services to the user by utilizing the services of the network operator (NO). An intelligent service provider agent represents the service provider in the TelecomSupermart. The network operator is responsible for the actual flow of user data (voice, video). The network operator agent (NOA), representative of network operator in TelecomSupermart, communicates with the service provider agent and they negotiate parameters relating to the price of service provision, QoS etc. Although service providers and network operators are functionally distinct entities there are nevertheless opportunities for network operators to become service providers and vice versa. If a service provider also owns a network then it is also the network operator. The TelecomSupermart allows the opportunity for service providers to dynamically price their services depending upon market trends and thus maximize revenue.

TelecomSupermart has a layered architecture that operates by means of a hierarchy of contracts as shown in Figure 2. This layered framework extends from the application layer down to the communications layer and is therefore capable of forming the backbone of a complete communication
system. The application layer consists of users requesting the application service through their agents. The applications layer is responsible for stating the user’s requirements in subjective terms. The application layer passes this information to the services layer that translates user requirements in service specific terminology and passes it onto the network layer. The network layer translates the service specific terminology into network specific requirements and instructs the communication layer to provide for the data flow by providing a physical connectivity to the user.

IV. PROTOTYPE AND WORKING MODEL

The TelecomSupermart is a self-organizing, dynamic, distributed and decentralized system representing a novel infrastructure for the provision of communication services. It is self-organizing in that service providers can join and leave the TelecomSupermart at their own discretion. It is dynamic since there is inherent support for dynamic pricing of services by service providers. It is decentralized or distributed since TelecomSupermart does not directly control the behavior of service providers and gives service providers the choice to intelligently price services. The strength of the TelecomSupermart lies in its distributed nature that facilitates communication between service providers located across the globe. TelecomSupermart is the digital market place where communication services can be traded. The controlling of prices will be free depending on the demand and supply of the market place. But TelecomSupermart will have its active role in ensuring that service providers, network operators and users stick to their commitment, in order to ensure optimal utilization of resources and Quality of Service provision.

In our prototype implementation of such a distributed telecommunication market place, a user can send the request for a call through his/her user agent to the market place on the click of a button, which in turn will broadcast the request to all the service providers along with the service requirements of the user, which are taken from the user’s profile description in the TelecomSupermart database. On accepting the closed bid from service providers, the marketplace server finds the most suitable bid for the user and provides its user agent the information, which is displayed to the user. Once user accepts the bid, user is connected to the appropriate gateway in order to make call. The whole process is depicted in the control flow diagram shown in Figure 3. The User (represented by the User Agent in the TelecomSupermart) requests telecommunication services as shown by flow 1 in Figure 3. This request is broadcasted to all the service provider agents. The broadcasted request consists of user credentials such as user identity, access password, location and QoS preferences etc. The service providers in turn negotiate with the network operator agents for the provision of telecommunication services to particular location and for the user preferences as shown in flow 2 in Figure 3. The network operator then bids for this particular session negotiated by the user (flow 3). The TelecomSupermart selects the best bid based on user preferences and forwards it to the user agent as shown in flow 4 in Figure 3. If the user chooses to accept the bid, a connection is established.

The adoption of the Session Initiation Protocol (SIP) as the signaling protocol provides the flexibility required to support a range of services as well as flexible routing mechanisms for SIP messages through the use of SIP Via: headers. Figure 4 shows how a session is established through the SIP proxy server located within the TelecomSuperMart.

TelecomSuperMart is the place where service providers will sell their products and control pricing through their service provider agent. User agents will facilitate user to buy the telecom services from the supermarket. This user agent will negotiate with the service providers. User agents and the service provider agents will be the part of the World Wide Web. But in order to provide connectivity to and from the user outside the Internet, gateways provide interconnection with other networks such as the PSTN, ISDN, mobile networks or other data networks. In our prototype implementation we have focused on the implementation of a voice service provision. In this case, the gateways can be installed easily by anyone who has Internet, Phone line and a PC with a spare voice modem. These gateways can be owned by service providers or can render their services to service providers in lieu of payment. This approach achieves a decentralized network of gateways that will give people an opportunity to become service providers and earn money by providing an interconnection between the World Wide Web and circuit switched networks as shown in Figure 1.

In our prototype implementation of the TelecomSupermart, the user and service providers have to follow a standard
procedure. The following step-by-step process describes the procedure.

1. First, the user registers on the web portal of the TelecomSupermart. Once this is done, the user is redirected to the download page where the user can download the user agent. The user agent developed in our implementation is user friendly and allows user to make free PC to PC calls and PC to Phone calls using TelecomSupermart as shown in Figure 5.

2. In order to make a PC to Phone call, the user needs to log into the remote server of TelecomSupermart as shown in Figure 6.

3. After Authentication user specifies its priority and the geographical location where he/she wants to dial, and sends this to the server as shown in Figure 7.

4. The user preferences are broadcasted to the service providers who return closed bids for providing the service. The TelecomSupermart chooses the best bid based on user preferences and informs the user agent. The user is alerted by the user agent about the best bid as shown in Figure 8. Finally, the user is given the option of accepting or rejecting the bid.

5. On getting acceptance from the user, direct connection is made between user and the Network Operator, who will setup the call.

This prototype implementation represents the simplest implementation of the proposed distributed telecommunications supermarket, the TelecomSupermart. It is a first step toward the full implementation of the TelecomSupermart. For example, in the implementation described here, the user and service provider agents do not negotiate. The service provider agents only informs the market provider agent if they will be able to provide the required service and inform the market provider agent of the cost of providing the service. Proper negotiation is being currently implemented using autonomous intelligent agents. Further, the choice of the service provider is being made based on just the cost and does not take into account other factors such as QoS, the service provider promises to provide or the reputation of the service provider. This is also being implemented and the interesting effects of doing this will be represented in a follow on paper.
More sophisticated implementations of the TelecomSupermart are envisaged where a wide variety of QoS parameters will be negotiated by autonomous intelligent agents, more services will be offered and where a sophisticated bidding process based on agent technology can implement any economic bidding and negotiation model.

V. CONCLUSIONS

We have presented a novel architecture for a distributed market based approach to flexible service provision in telecommunication networks and the Internet, the TelecomSupermart. In order to demonstrate the operation of the TelecomSupermart we have presented a prototypical implementation based on a simple voice service provision between a PC and a PC or a PC and the PSTN using SIP signalling. Our proposed model can be implemented in a way that every computer user with Internet access based on DSL or other broadband technologies and a modem connected to a telephone line can become a service provider offering cheap voice calls. Future steps in the further development of the implementation of this model include the provision of other services and further research into agent systems for bidding and negotiation for the market.

REFERENCES


