

A Multimedia Call Centre on the Internet

Chai Kiat Yeo, Siu Cheung Hui, *Ing Yann Soon

School of Computer Engineering
*School of Electrical & Electronics Engineering
Nanyang Technological University
Nanyang Avenue
S 639798
Republic of Singapore

Abstract

The proliferation of the Internet and the web has changed the way people interact and conduct business. Video and audio communications have become prevalent. It is expected that the advance in technology will revolutionise the way call centres are set up and run. Multimedia call centres will gradually replace the traditional help-desks ones based on telephony to provide better customer service and to cater to the emerging e-commerce market. This paper proposes a system architecture to support multimedia call centre. The architecture is able to support video, audio and collaborative tools such as whiteboard, chat, file sharing, co-filling of forms and co-browsing of web sites. The architecture is browser-based and no installation of any specific software or hardware is required on the client machines. Organisations can easily customise the system to suit the needs of the services to be provided by the call centres.

Keywords: Multimedia, call centre, Internet, collaborative tools, e-commerce

1. INTRODUCTION

Internet has indeed created a revolution. People all over the world are using the Internet not only for information retrieval, but also for telephony and videoconferencing purposes. Multimedia call centre has now become technically feasible. As the global economy has created more competition for businesses, companies need to provide more personalised service to their global customers to better poise themselves for the global knowledge based economy. Multimedia call centre is an inexpensive yet personalised and attractive alternative to setting up customer service centres all over the world. Moreover, the development of electronic commerce over the Internet has further underscored the need for personalised interaction between web-surfers and company personnel.

A multimedia call centre over the Internet must therefore be able to establish a multimedia connection between web surfers and the call centre with as much ease as Internet-surfing. A user who wishes to establish real time communication with the call center does not need to install any software or configure any system. The user merely clicks a button at the call centre web site to achieve a multimedia connection. Any required communication software should be automatically installed into the user system without user intervention. The question is how and what are the strategies needed in order to implement such a multimedia call centre (MCC) using existing technology and available resources.

This paper proposes a system architecture for such a MCC. ActiveX [1] technology is adopted in this architecture so that multimedia connections can be established between the clients and the MCC agents without the need for users to set up the necessary resources. The proposed architecture is able to support video, audio and a host of collaborative tools to cater to the different types of services to be rendered by the call centre. Section 2 provides an overview of the MCC and its functionalities while section 3 details its architecture design. Its implementation is described in section 4 and the benefits and performance of such a system are described in section 5. Section 6 concludes the paper.

2. OVERVIEW

The basic components of the MCC are illustrated in Figure 1. The call centre essentially comprises the following:

- a web server to host its web pages
- a call route server to manage the setting up of communication links between clients and available agents

- a database to maintain the IP addresses of clients and agents
- multimedia PCs for the agents

The concept of the MCC as shown in Figure 1 is, therefore, to make use of the Internet as the communication medium. Clients do not need to install similar video and audio conferencing tools or any other tools at both the client PC and the agent PC. Clients only require full duplex sound card, video camera and the web browser to call the MCC. The establishment of the communication links will be handled by the call centre. A client who does not have video camera can still connect to the call centre with audio and one-way video communications.

A client requests for communication by simply clicking a button on the call centre web page. Once a connection request is detected, the server will initiate the communication process. The call centre achieves the initiation process by listening for user request at a specific port. When such a request arrives, the call route server is responsible for routing the call request to a free agent within the call centre's local area network. Each client and agent is identified by their unique IP address. The IP addresses, once captured by the server, will be stored in the database. The IP addresses are used by the server to establish the communication link between the client and the agent. The two host computers will then exchange their multimedia capabilities after which data, audio or video communications can ensue.

The MCC features the following functionalities:

- Voice communication
- Video communication
- Real time chat
- Whiteboard
- Co-browsing of web pages

- Sharing of files
- Transfer of files
- Assisted form filling

These features are shown in Figure 2 which is the Graphics User Interface on the

client browser when a connection to the MCC is requested. The icons represent audio, video, whiteboard, documents sharing, real time chat, file transfer and co-browsing of web pages respectively in order of occurrence from left to right in Figure 2.

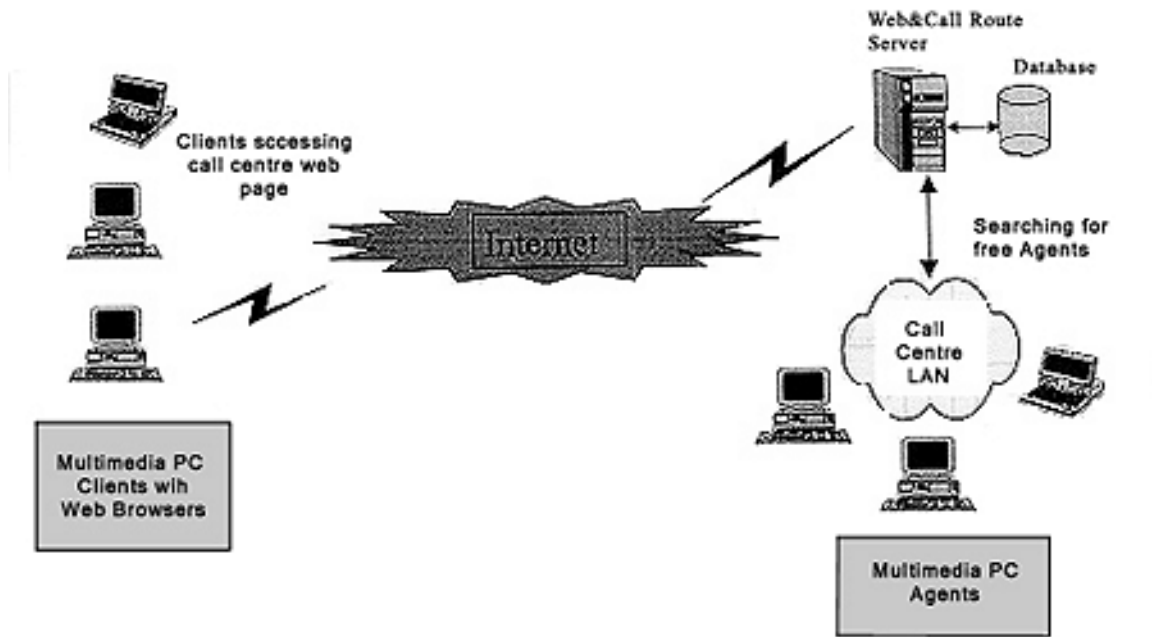


Figure 1 Overview of Multimedia Call Centre

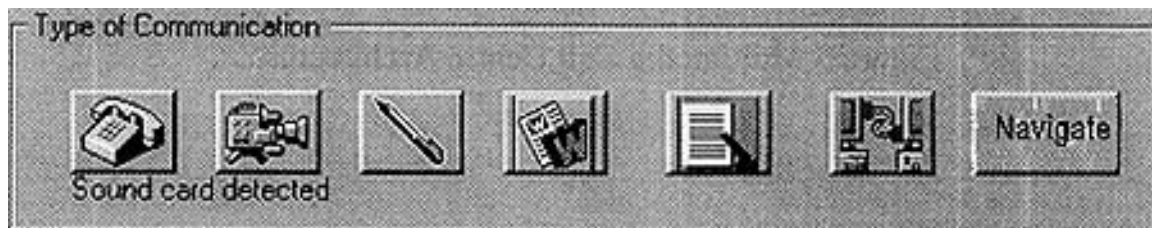
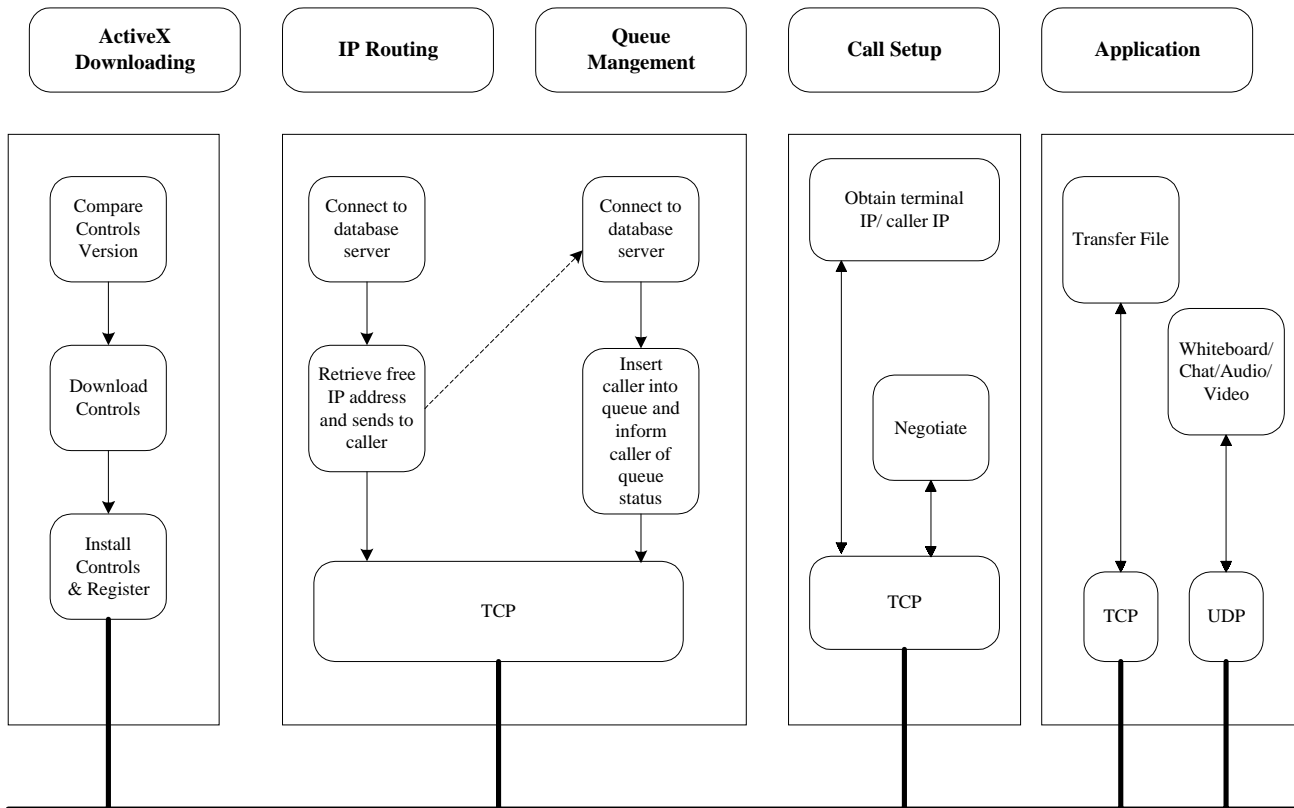


Figure 2 Communication Services Selectable by Client



3. SYSTEM ARCHITECTURE

Figure 3 shows the system architecture of the MCC. The architecture consists of the following five entities:

- *ActiveX Control Download.* Downloads controls from the call centre web site into the client system and installs the controls into the system registry.
- *IP Routing.* Routes the client's request for connection to an available call centre agent.
- *Queue Management.* Manages the client queue when no call centre agents are available to service the client.
- *Call Setup.* Sets up the communication link between the client PC and the call centre agent PC using Internet as the transport mechanism.
- *Application Support.* Activates the respective modules to support the collaborative tools selected by the client such as video, audio, whiteboard, chat, document sharing etc.

4. SYSTEM IMPLEMENTATION

The MCC makes use of a Windows NT server. The application for the call center agent is written in Visual C++ [2] while the graphics user interface is developed using Visual Basic. Javascripts [3] is used in the implementation of the ActiveX controls setting in the HTML files.

The software modules required to implement the MCC architecture shown in

Figure 2 are described as follows:

- A call route server to assist the set up of peer to peer connection
- A registry in the form of a database for storing the call centre agent's and the client's IP addresses to facilitate setup of communication.
- An agent terminal program at the call centre to communicate with the server for the setup of connection to caller.
- An ActiveX control to communicate with the route server for setting up peer to peer connection.
- Collaborative tools to provide a fully featured call centre architecture
- Multimedia modules for audio and video communication

4.1 Route Server

The route server constantly listens for client requests at a specific port. Upon receipt of a request, new sockets [4] are created for the connections and the original socket will continue to listen for additional client request. The server will search for a free agent from the registry database and send the request to the agent. The entries in the registry database reflect the current status of the active agents. The route server also monitors the status of the agents in order to maintain the registry up-to-date. Agent terminals will keep the route server informed when they enter or leave the call centre.

4.2 Registry

The registry is essentially an Access [5] database used to maintain the list of IP addresses of all call centre agents and the clients as well as the status of the agents and the clients. The database server for the registry will monitor the agent terminal in

the call centre LAN, such that when a terminal becomes online, the terminal will inform the server and register itself as being available. This is achieved by setting up a client application on the agent terminal, such that upon logon, the client application will be activated and will send the terminal IP to the server, which will then register the terminal in the list. The registry also maintains the list of clients who are put on the queue awaiting for service from the first available agent.

As the MCC is designed to be easily customised for different services, different agent terminals can be configured to cater to differentiated services. The service categories of the different agent terminals are

also maintained in the registry. Figure 4 shows an example of the information captured in the registry database.

4.3 Agent Terminal Program

This is the application program running on the agent terminal. It allows agent to log into the MCC system and register itself in the registry. The agent can select the category of his service and once the terminal is linked to the MCC, the agent is ready to service client request assigned by the route server. An example of the graphics interface for the agent is shown in Fig. 5.

The screenshot shows a window titled 'Server' with two tables. The first table, 'Call Centre Terminal', lists terminal details. The second table, 'Queue', shows pending requests.

Call Centre Terminal			
IP Address	Status	Categories	CallIP
155.63.7.122	busy	HR	125.63.3.1
155.63.7.124	free	Sales	0.0.0.0
155.63.7.144	free	Technical	0.0.0.0

Queue		
CallIP	Request	Quantity
155.64.1.2	HR	1
155.63.8.174	HR	2
155.4.1.2	Enquiry	1

Figure 4 Example of information captured in the Registry



Figure 5 Example of the Category of Services provided by the Call Centre Agent (Agent Registration Page)

4.4 ActiveX Controls

ActiveX controls are developed and placed in the call centre web-site, so that client can achieve videoconferencing capability without manual installation of any software. However, these controls still need to be installed and registered in the client system. To simplify the distribution of the control to clients, these controls, placed at the call centre web-site will be automatically downloaded and installed onto the client system when the client request for communication with the call centre. They only need to be installed once in the client system, and will be upgraded with new version of the ActiveX controls when necessary. The controls are responsible for voice and video communications, execution of collaborative tools.

4.5 Collaborative Tools

The following modules support the various collaborative tools:

Real Time Chat. Real time chat allows client to be able to communicate with the agent even if the client does not have multimedia support for voice and video. Chat data exchange is effected using UDP [6] protocol. Use of UDP simplifies the communication process as no prior connection needs to be set up before data exchange can take place. It therefore provides more real-time transfer but with no guarantee of successful delivery at the destination.

Whiteboard. Whiteboard allows connected parties to illustrate their ideas. It therefore emulates the process of a face to face discussion whereby parties can sketch and illustrate their ideas. This tool is especially useful for cyber meeting when words cannot clearly convey the problem

or solution. White boarding is thus an important adjunct for videoconferencing. The whiteboard program is a Visual Basic freeware which has been developed into the ActiveX environment.

File Transfer. File transfer supports transfer of files between the two parties using TCP [6] protocol. It is implemented as a simple packet by packet transfer of the files with acknowledgement from the receiver to the sender.

Co-browsing Web Pages. This module enables the client to co-navigate web pages with the call centre agent. In this way, the call centre agent can guide the client in the surfing of the web pages. This is accomplished through the use of an ActiveX control to manage the navigation process at the agent terminal and to capture the URL of the web pages in real-time.

Assisted Form-Filling. This module is an extension of co-browsing of web pages whereby the call centre agent can assist the client in filling up the forms on the web pages. The client can see and verify that the information is correct.

Document Sharing. Sharing of Microsoft documents and spreadsheets between client and call centre agents are supported through Microsoft OLE container.

4.6 Multimedia Tools

As seen from Figure 3, TCP protocol is being used in the setting up of the communication link between the client and the call centre agent. This allows a logical path to be established between the involved parties and ensure the successful delivery of control messages between the

communicating entities. However, in the application entity, UDP protocol is being

employed. UDP is used in the delivery of video and audio [7,8] to ensure real time display and play back of audio and video packets. UDP also simplifies the communication process as no path needs to be set up for the exchange of the data. Data are sent but with no guarantee of arrival at the destination.

4.7 Support for Customisation

Dynamic request setting has been provided for in the call centre implementation to allow for customisation of the MCC to cater to the different service applications. The request type available,

such as technical support, sales, human resource etc (see Figure 5) can be dynamically added using Javascripts. The ActiveX control is developed such that the request type is a combo box which allows Javascripts to interact with the ActiveX controls. This facilitates web administrator to customise and set the range of request types to suit their needs. These methods of the ActiveX control have been made public in the development so that they can be accessed by the scripting language in the editing of the HTML file.

Figure 6 shows the MCC in operation with video communication and whiteboard feature used.

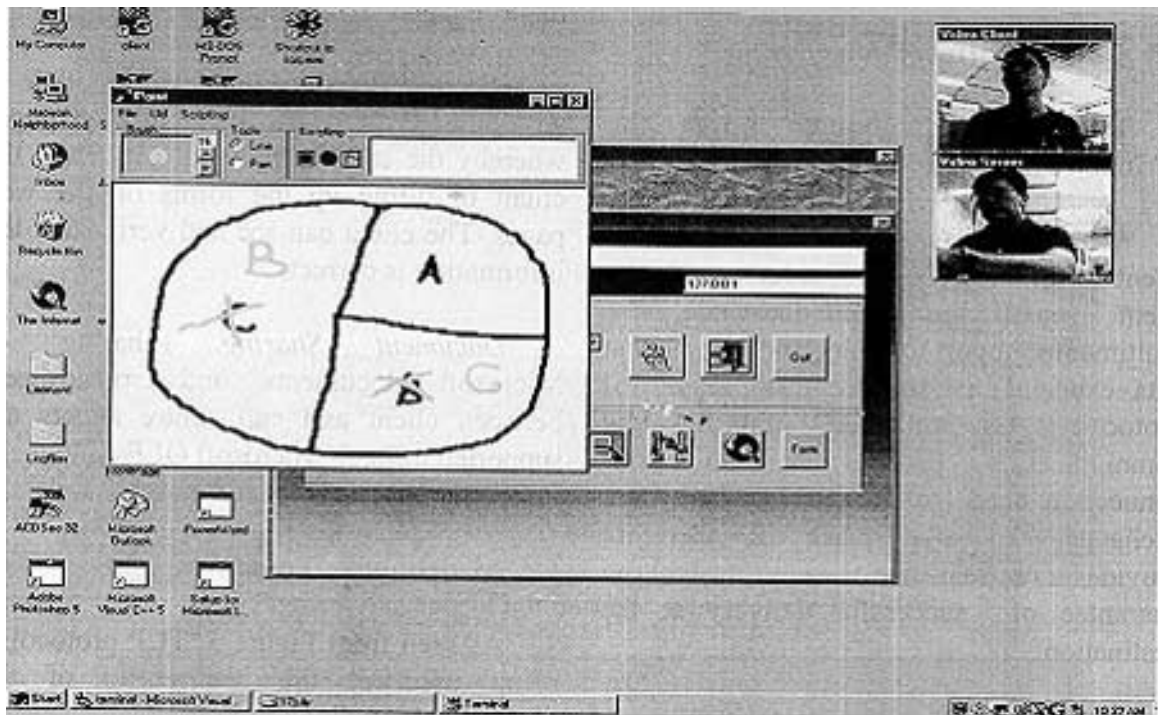


Figure 6 Screen Snapshot of the MCC. In Operation

5. EVALUATION

Multimedia Call Centre on the Internet allows customers visiting a company's web-site to establish a face-to-face interaction with a live agent of a company using their own browser and multi-media PC. Users can have real-time, on-line conversations with call center service representatives to clarify any outstanding issues, and then continue with their web travels.

5.1 Benefits to Organisation

The MCC on Internet solution not only allows both clients and potential clients to reach the call centre, but also facilitates the conduct of business over the Internet. It:

- Enhances customer service and increases satisfaction with great convenience to customers.
- Provides a more service-oriented and personalized environment to conduct electronic commerce.
- Allows consumers to contact the call centre in real-time, right at the moment of heightened interest.
- Generates revenue from the web site.
- Increases interaction and allows for two-way communications.
- Reduces the clients' hesitation in making purchase via credit card over the Internet as they can verify with the agents readily.
- Matches each customer's needs to the expert agent best qualified to meet these needs.
- Expands the range of products and services offered by sharing staff and expertise among locations.
- Controls cost by pooling agent resources and delivering more services without adding staff at all locations.

5.2 Applications

Besides being used for customer support services which are the main functions of existing PSTN call centres, the MCC's applications can be extended to many other applications. The following are just some of the possible applications:

- *E-commerce*
With a click of a button on the web page, buyers can now initiate a videoconferencing session with the online shop, allowing buyers to enquire about the products they are interested in. In this way, a form of human touch is provided for E-commerce.
- *Distance Learning*
Students from several geographic locations can now be linked to a teacher for interaction. This includes the visual and voice communication, interchanging of teaching materials, assignment, and remotely showing documents, images and data.
- *Remote Monitoring, Diagnosis and Troubleshooting*
In this application, a workplace or a piece of equipment can be under monitoring, such that whenever something goes wrong, the technical staff will be alerted immediately and action can be taken by communicating with the staff at the site to rectify the problem. Moreover, experts can be called on-line and remotely offer advice to on-site service and maintenance personnel to help them to diagnose problems or troubleshoot faulty equipment [9].

5.3 Comparison

To further highlight the merits of the proposed multimedia call centre, a

comparison is performed among the MCC and existing multimedia call centres. The two systems used are Internet Call Centre (ICC) by CentreVu [10] and Video Multimedia Call Centre (VMCC) by Lucent Technologies [11].

The ICC allows clients to access the call centre via the Internet using multimedia PC and the browser. However it only provides data and voice communication without video. Agents are linked via the Private Branch Exchange (PBX) to provide audio services to clients. Java applet is used to minimise the need for clients to set up any software for accessing the call centre.

The VMCC is not Internet based but it provides video, audio as well as data communication. It is installed on multimedia PC or kiosk in selected locations and these are linked to the help-desks which are based on PSTN. Hence it has limited client coverage as clients can only access it via the specific machines.

Six factors are used to evaluate the performance of the three systems. They are:

- *Ubiquity of Client Access.* This evaluates how accessible the call centre is from the clients. As MCC and ICC are both Internet based, accessibility is excellent as any client machines with Internet access can connect to the call centres. As for VMCC, as mentioned above, client access is limited to the specific locations where the PCs and kiosks are sited.
- *Heterogeneity of Client Machines.* This factor looks at the types of client machines used to access the call centre. MCC is constrained in this aspect as it is based on Microsoft Technology and hence requires client

machines to run the Microsoft operating system. Nevertheless, given the prevalence of PCs installed with the Microsoft windows and NT operating systems, this operating system constraint of MCC cannot be considered a major limitation. ICC, which is based on Java applets, can support heterogeneous platform and hence has advantage over MCC in this respect. VMCC requires specific machines installed with the application in order to run; hence it is the most limited in terms of heterogeneity of client platforms.

- *Service Capability.* MCC is excellent in this aspect as it provides the complete range of services from audio, to video to collaborative tools. ICC is limited as it does not provide video while VMCC has very limited collaborative tools although it has video, audio capabilities.
- *Communication Channel.* All systems make use of current technology with the MCC being more advanced using Internet and LAN while ICC integrates the Internet with PBX. VMCC does not use Internet for its communication.
- *Software Installation by Clients.* This factor measures how easy it is for client to install the necessary software in order to use the call centre. MCC and ICC do not require manual installation by clients as they automatically load the software using ActiveX controls and Java applets respectively. VMCC requires staff to load the application on the designated machines.
- *Speed of Client Software.* In comparison with the proposed MCC,

which makes use of ActiveX controls, ICC is slower as Java applet has to be interpreted while the ActiveX controls are compiled codes. The speed of downloading of the Java Applet and the ActiveX controls are both relatively fast, but the advantage is that the ActiveX controls for the MCC need to be downloaded only once for installation

into the client local machine. As for ICC, the Java applets have to be loaded every time the call centre is accessed. VMCC only requires the application to be loaded once on the designated machines.

Table 1 summarises the comparison results between the proposed MCC, the ICC and the VMCC.

Table 1 Summary of Comparison

	Multimedia Call Centre on Internet	Centre Vu Internet Call Centre	Video Multimedia Call Centre
Ubiquity of client Assess	Excellent. Uses Internet	Excellent. Uses Internet.	Limited to dedicated Of PC or kiosks.
Heterogeneity of Client machines	Constrained. Clients Need Microsoft OS.	Excellent, Heterogeneous client Systems supported by Java applets.	Limited to dedicated PCs or kiosks.
Service capability	Excellent with video, Audio, data and Collaborative tools.	Limited with audio And data	Very good with video, audio and data.
Communication Channel	Internet and LAN.	Internet and PBX.	Telephone line and PSTN network.
Software installation by clients	Automatically using ActiveX controls.	Automatically using Java applets.	Manually installed by Call centre staff.
Speed of client Software	Fast as controls need To be installed once and are compiled codes.	Slow as Java applets Needs to be installed at every access and are interpreted codes.	Fast as applications are loaded once and are compiled

6. CONCLUSION

This paper presents a multimedia call centre which is capable of supporting real-time audio and video communications over the Internet. The system is enhanced by collaborative features such as document sharing, co-browsing, whiteboard and real time chat. Clients can easily access the system without the need to manually install the necessary software. Another advantage is the significantly lower cost structure of the Internet voice and video communication. This is especially so for international access as international PSTN toll charges to access PSTN call centres are very expensive for the clients. Furthermore, the call centre is distributed in nature such that the call centre agents can be located in a number of places around the world. The agents can register themselves into the centralised registry and be ready to service any call requests from all over the world. The MCC provides an inexpensive, ubiquitous and personalised environment for the provision of call centre services and will certainly add substantial value to businesses in particular those delving in e-commerce. Other applications include remote diagnosis and distance learning.

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