

Assessing the Feasibility of Using Microsoft[®] NetMeeting[™] in Distance Education

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Abstract ^¾ One of the weaknesses of most Web-based distance education systems is the lack of adequate, synchronous, interaction between instructor and students. An easy and inexpensive solution to this problem can be obtained by using an off-the-shelf collaboration tool.

In this paper we examine one of those tools, Microsoft NetMeeting. NetMeeting's main technical features, pros and cons are presented and its suitability for educational applications is evaluated. Based on the collected facts, a recommendation for the decision-maker is presented at the end of the article.

Index Terms ^¾ Web-based education, distance learning, collaboration tools, conferencing.

I. INTRODUCTION

One of the most criticized aspects of distance education (both conventional as well as Web-based) is the lack of synchronous, real-time, "live" interaction between instructor and students. Many experts claim that the majority of online courses available today on the Web do little more than converting the course contents into HTML pages interleaved with a few quizzes and some other features that do not effectively contribute to the process of learning [11]. They claim that this model inherits most of the disadvantages of the traditional, predominantly unidirectional, lecture format and none of its advantages, such as the ability of raising questions or interacting with teammates while working on a common project.

There are several ways to overcome the limitations of HTML-based asynchronous distance learning. One of the easiest and less expensive ones is to add a conferencing facility by using a commercial (off-the-shelf) collaboration tool, such as White Pine's CU-SeeMe, PictureTel's LiveShare Plus, or Microsoft NetMeeting, among many others. These tools usually provide highly interactive, synchronous, bi- or multidirectional features, e.g. audio and video conferencing, and multipoint data conferencing using tools such as chat rooms, shared clipboard, whiteboard, and file transfer capabilities.

In this paper we assess the usefulness and suitability of a specific tool, Microsoft NetMeeting, for the purposes of distance education. We start by describing the product's main features, we comment on some of its pros and cons, and devote some attention to its software development kit. We then discuss specifically how could this product be used for distance education, supplementing our opinions with a few examples. We conclude with a summary of our findings and a clear recommendation to the decision-maker reader.

II. DESCRIPTION OF THE PRODUCT

Microsoft NetMeeting can be described as a collaboration tool that combines voice and data communications, video, real-time application sharing, file transfer, a full-featured shared whiteboard, and text based chat [21].

NetMeeting is targeted at home users, as well as small and large organizations and claims to allow users to "take full advantage of the global reach of the Internet or corporate intranet for real-time communications and collaboration." [1] Connecting to other NetMeeting users is made easy with the Microsoft Internet Locator Server (ILS), enabling participants to call each other from a dynamic directory within NetMeeting or from a Web page. Connections can also be established by calling the other party's IP address. While connected on the Internet or corporate intranet, participants can communicate with audio and video, work together on virtually any 32-bit Windows-based application, exchange or mark-up graphics on an electronic whiteboard, transfer files, or use the text-based chat program.

In its first release, NetMeeting 1.0 basically offered Internet telephony and multipoint data conferencing (based on the International Telecommunications Union (ITU) T.120 standard [2] [3]) capabilities.

NetMeeting 2.0 was the next major release of this multimedia communications client. Building on NetMeeting 1.0 audio and data conferencing capabilities, NetMeeting 2.0 integrated a number of new features, as well as improved functionality and user interface enhancements.

The newest version, 2.1, available for Windows NT 4.0, Windows 95, and packaged as part of Windows 98, is designed to support new technology featured in Windows 98, including DirectX 5, universal serial bus (USB) video cameras, and the new video device driver model. NetMeeting 2.1 includes the following enhancements [1]:

- Enhanced interoperability with new H.323 devices, including gateways and Multipoint Conferencing Units (MCUs).
- Support for Windows 98 application sharing.
- DirectX 5 support. DirectX is a set of technologies that enable faster access to hardware in Windows. Installing the DirectSound component of DirectX 5 on a computer (with a compatible audio device) significantly reduces the latency of sending or receiving audio over the Internet using NetMeeting, from a typical average delay of 590 milliseconds end-to-end to 160 milliseconds.

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- Outlook bar, providing easy access to frequently used NetMeeting functions, including Directory, Speed Dial, Current Call, and History.

Some of the most prominent features of NetMeeting 2.1 are [1]:

- **Internet phone/H.323 standards-based audio support:** real-time, point-to-point audio conferencing over the Internet or corporate intranet. Half-duplex and full-duplex audio support for real-time conversations, automatic microphone sensitivity level setting, and microphone muting, which lets users control the audio signal sent during a call. This audio conferencing supports network TCP/IP connections. Support for the H.323 protocol [12] [13] enables interoperability between NetMeeting and other H.323-compatible audio clients. The H.323 protocol supports the ITU G.711 and G.723 audio standards and Internet Engineering Task Force (IETF) RTP and RTCP specifications for controlling audio flow to improve voice quality (Fig. 1). On MMX-enabled computers, NetMeeting uses the MMX-enabled audio codecs to improve performance for audio compression and decompression algorithms. This will result in lower CPU use and improved audio quality during a call.
- **H.323 standards-based video conferencing** including the following features:
 - (a) Participants can switch audio and video to another person during a meeting. This feature makes it easy for users to communicate with many different people.
 - (b) During a meeting, participants can remotely adjust the video image quality, balancing the need for higher quality or faster performance.
 - (c) Users can dynamically change the size of the video window to reduce or enlarge the image being sent to another person.
 - (d) In the NetMeeting main window, the video preview and receive windows are integrated on the Current Call window.
 - (e) Users can view these video windows from Current Call, or drag them to a different location on the desktop.
 - (f) Users can choose whether or not to transmit video immediately when a call starts. Also, they can pause or resume sending or receiving video by pressing a button in the video window frame.
 - (g) NetMeeting automatically balances the performance and quality of video during a meeting based on the speed of the network connection, providing the highest quality, lowest bandwidth video capabilities.
 - (h) Administrators can control access to video features using NetMeeting custom settings.
 - (i) On MMX-enabled computers, NetMeeting uses the MMX-enabled video codecs to improved performance for video compression and decompression algorithms.
 - (j) Support for H.323 conference servers and gateways (currently being developed by leading vendors) will enable NetMeeting users to participate in meetings with multiple audio and video connections.
 - (k) H.323 standard-based video technology is also compliant with the H.261 [14] and H.263 [15] video codecs.

- **Intelligent Audio/Video Stream Control**, which automatically balances the load for network bandwidth, CPU use, and memory use. This intelligent stream control ensures that audio, video, and data are prioritized properly, so that NetMeeting maintains high-quality audio while transmitting and receiving data and video during a call.
- **Multipoint data conferencing:** Two or more users can communicate and collaborate as a group in real time. Participants can share applications, exchange information through a shared clipboard, transfer files, collaborate on a shared whiteboard, and use a text-based chat feature. Also, support for the T.120 data conferencing standard enables interoperability with other T.120-based products and services. The multipoint data conferencing features are listed in table I.

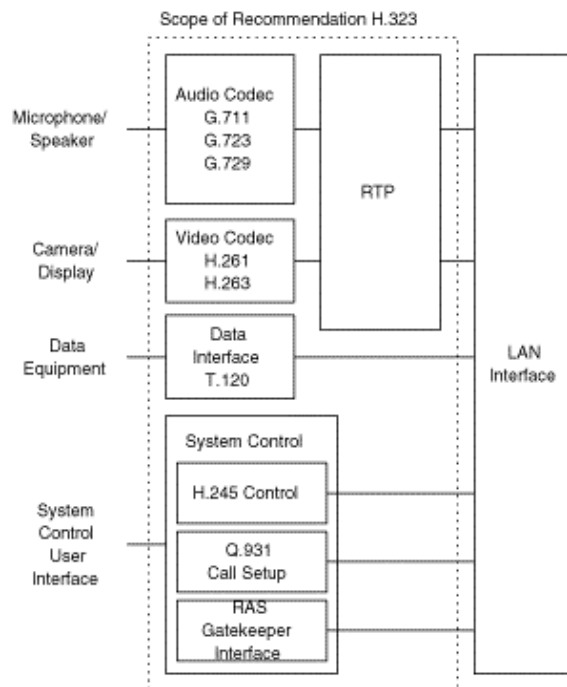


Fig. 1. The scope of Recommendation H.323 and related protocols, recommendations, and standards.

NetMeeting provides a broad support of international standards, to ensure interoperability among solutions from different vendors. NetMeeting 2.1 supports the following industry standards that the ITU or IETF have ratified or proposed:

- **T.120.** ITU set of protocols for transport-independent, multipoint data conferencing. This standard also integrates with H.320 [16] and H.324 [17] protocols.
- **H.323.** ITU set of protocols for audio, video, and data conferencing over TCP/IP networks. This standard includes RTP and RTCP and integrates with T.120, H.261, H.263, G.711, and G.723 protocols.
- **RTP/RTCP** [18]. IETF packet format for sending real-time information across the Internet.
- **LDAP** [19]. IETF set of protocols for directory access.

TABLE I
MULTIPOINT DATA CONFERENCING FEATURES

Application sharing	A user can share a program running on one computer with other participants in the conference. Participants can review the same data or information, and see the actions as the person sharing the application works on the program.
Shared clipboard	The shared clipboard enables a user to exchange its contents with other participants in a conference using familiar cut, copy, and paste operations.
File transfer	Users can send a file in the background to one or all of the conference participants. When one user drags a file into the main window, the file is automatically sent to each person in the conference, who can then accept or decline receipt. This file transfer capability is fully compliant with the T.127 standard.
Whiteboard	Multiple users can simultaneously collaborate using the whiteboard to review, create, and update graphic information. The whiteboard is object-oriented (as opposed to pixel-oriented), enabling participants to manipulate the contents by clicking and dragging with the mouse. In addition, they can use a remote pointer or highlighting tool to point out specific contents or sections of shared pages.
Chat	A user can type text messages to share common ideas or topics with other conference participants, or record meeting notes and action items as part of a collaborative process. Also, participants in a conference can use chat to communicate in the absence of audio support.

III. NET MEETING PROS AND CONS

The following *pros* and *cons* are compiled based on data from comparative reviews, threaded discussions, relevant Web pages and the authors' experience using NetMeeting in their classes.

Pros

- NetMeeting users can talk, send video, type text and share applications all at the same time [21].

- The main tool as well as its Software Development Kit (SDK) and Resource Kit (for Network Administrators) are free and can be downloaded from Microsoft Web site [9].
- NetMeeting is continuously being improved and its basic architecture is being widely supported.
- NetMeeting can be expanded / integrated with other applications using the SDK.
- Broad support of international standards for easy interoperability with solutions from different vendors.
- NetMeeting provides a good degree of privacy during a call (using the "do not disturb" option).
- NetMeeting supports application sharing in multiparty calls. Any collaborating participant can assume mouse control and work in the shared application while others watch. Application sharing has proven to be NetMeeting's "killer feature" [21].

Cons

- NetMeeting's audio and video features work only between two participants, so a three-way call cannot be established.
- NetMeeting is very CPU intensive and requires a powerful machine, especially for audio and video conferencing. The recommended hardware includes a Pentium-MMX 200 MHz or better, at least 32 MB of RAM, 40 MB of free disk space, and good quality peripherals (sound card, video card, microphone or headset, camera, and modem) [21].
- Audio pauses, delays, and momentary loss of full-duplex capabilities are frequent. Moreover, delays, variable latency (jitter) and uneven packet transmission rates (common to any IP-based transmission) may cause deterioration of audio, video, and whiteboard actions.
- Video frame size is too small and frame rate is too low to make video communication a fully enjoyable experience.
- Problems using NetMeeting in intranets protected by firewalls have been reported [7]. Directions of how to get around with this problem can be found at [8] and in chapter 11 of [21].
- NetMeeting has shown security leaks, which can pose great risk to users' data and privacy. An example of a recent and well-known problem in this category is the so-called "Speed Dial" issue [4].
- NetMeeting 2.1 contains a useful whiteboard module that does not comply with T.126, the object-exchange standard under T.120. However, Databeam has produced a tool called MeetingTools [10], which installs on top of NetMeeting and enhances NetMeeting calls. With MeetingTools, NetMeeting users can drive "massive-point" conferences, where hundreds of simultaneous users view the activity from their Web browsers.
- NetMeeting setup is time-consuming and non-technical users can easily get frustrated.
- NetMeeting can be seen as part of the Microsoft monopolizing strategy, and its seamless integration with other Microsoft products (particularly Internet Explorer, Outlook, Windows Explorer, and Exchange) is contro-

versial. Along the same reasoning, one may wonder how long will the product still be offered free of charge.

IV. DEVELOPING CUSTOMIZED APPLICATIONS WITH TAPI 3.0 AND NETMEETING SDK

NetMeeting capabilities can be expanded and/or integrated with other applications using C, C++, or Visual Basic and a set of APIs available in the NetMeeting Software Development Kit (SDK). For the specific case of distance learning, software developers can use the NetMeeting Component Object Model (COM) interfaces to create an application that enables students and teachers to work together in shared documents. The teacher and students can interact in the shared whiteboard, and students can use the chat feature to communicate with the teachers and among themselves. This enables a wide spectrum of possibilities, from the creation of proprietary conferencing-aware applications designed to teach students about a specific subject, to the scenario in which a teacher walks students through information in a shared application.

A peer-to-peer newsgroup is available to help developers interact with other users of the SDK [20].

V. USING NET MEETING IN DISTANCE EDUCATION

The use of NetMeeting as a tool for synchronous distance education is feasible and many schools and universities are experimenting with it (see next section). Despite the fact that it was not created specifically for this purpose, its powerful audio, video, and text communication features and its sharing capabilities make NetMeeting a good choice for a tool that supports the implementation of the Computer-Supported Collaborative Learning (CSCL) concept.

Some of the possible answers to the question "What can you do with Microsoft NetMeeting in education?" are [5]:

- **Chats:** Students from many locations can meet for a moderated (or open) text-based chat. Or, they can draw on a whiteboard visible to all participants.
- **Virtual Field Trips:** Students can visit remote locations and ask questions by audio, video or e-mail in real time; they can receive a guided tour or conduct an interview.
- **Collaboration:** While working together on a class project, students can share video, audio or both with other classrooms. They can also take turns sharing control of an application between two or more locations to build upon others' ideas in real time.

VI. EXAMPLES OF USING NETMEETING IN HIGHER EDUCATION

San Diego State University (San Diego, CA) [22]

In the spring of 1997, Dr. Ilya Zaslavsky, an assistant professor of geography on leave from Western Michigan University (WMU) taught a class remotely from San Diego, California, with Microsoft NetMeeting.

In his evaluation of the students' performance, Dr. Zaslavsky concluded that lab assignments, midterms, and finals showed virtually no difference in results compared with the previous year, under the traditional format. A survey at the

end of the course has shown that thirty percent of the students used the chat window, 83 percent used the white board to exchange graphics, and 57 percent collaborated in shared applications. Of the 30 students surveyed over the two semesters, all but three indicated that they were satisfied with the accomplishments.

University of Georgia at Athens' College of Veterinary Medicine [5]

After consultation with Rhonda Toon, the regional coordinator for Gordon Georgia Youth Science and Technology Center, the college decided to set up Internet sites created around a specific "story," such as horse surgery or animal diabetes, along with video conferencing to stimulate interest in veterinary careers. Through this program, which is still a work in progress, middle school students in three classrooms will have the opportunity to explore the Web site (and, by extension, the facilities). Using NetMeeting, the students will be able to question graduate students and faculty directly.

University of California, Irvine (UCI) [6]

The Graduate School of Management (GSM) at the University of California, Irvine (UCI), started using NetMeeting in August '96. The objective at that time was to permit a professor at a conference in Chicago, a teaching assistant in Irvine, and a group of eight MDs in the Health Care EMBA program to go through a review session via the Internet. The students used NetMeeting's chat features to ask questions; the professor or TA answered using a combination of NetMeeting's whiteboard and chat.

By May of '97, UCI added real-time collaboration features to class support Web pages on the School's intranet. Using a mixture of Active Server Pages and ActiveX controls, students could join one another in a real-time meeting, initiate a study group session, or work together on a paper directly from the Web. Students were accustomed to downloading assignments and posting questions on the intranet site; NetMeeting now allowed them to collaborate in real time from the same site.

Since then, UCI has been working on combining the real time audio component from Windows NT Server NetShow Services, allowing up to 30 students to hear a professor live while looking at what she is drawing on a white board, and allowing them to ask questions back via text. The School is also working on logging these sessions to their MS SQL server, allowing a student to "replay" a live meeting, with audio, white board drawings and text questions replayed in order.

Florida Atlantic University (Boca Raton, FL)

NetMeeting has been used by the authors to implement the concept of *Virtual Office Hours* (VOH). The one-to-one interaction typical of office hours meetings can be easily extended to distant students using NetMeeting. The level of interaction (text only, one- or two-way audio, one- or two-way video) is limited only by the students' side hardware and networking capabilities. Experiments are under way to evaluate the effectiveness of this approach from both students' and instructor's perspective.

VII. SUMMARY AND RECOMMENDATIONS

Microsoft NetMeeting is a mature, feature-rich collaboration tool, whose characteristics might very well suit its use in education. It is offered free of charge and can work satisfactorily in a variety of hardware / software / network configurations. Moreover, its capabilities can be expanded and integrated with other applications.

Preliminary reports of use of NetMeeting in education show positive results and a promising future. After having evaluated NetMeeting we conclude that NetMeeting definitely can be used as a tool for Computer-Supported Collaborative Learning (CSCL) in addition to Web-based virtual classrooms.

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