SIMnet - a Collaborative Tool for Metrology in the Americas

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Abstract

The use of video conferencing equipment used with the Internet to facilitate international comparisons and collaborations is described. The system employs standard hardware and software at a number of National Metrology Institutes within the Americas and a special network server to allow audio, video, and data exchange between multiple participants. Sponsored by the Interamerican Metrology System (SIM), the system has been dubbed SIMnet.

1. Introduction

One of the very important activities of the National Metrology Institutes (NMI's) in support of international trade is international cooperation to facilitate and harmonize the compatibility of measurements at an international level. The most important technical aspect of this cooperation involves international comparisons, with an artifact, a traveling standard, circulating between laboratories.

In the past, the traveling standard was usually a highly stable passive device such as a standard capacitor, resistor, or a thermal voltage converter. The process of international comparison took a very long time. In recent years, sophisticated electronic instruments such as multifunction calibrators and digital multimeters have been developed that are stable enough for international comparisons between laboratories. These instruments can be used to verify several electrical quantities simultaneously. Application of computer controlled calibrators and multimeters in comparisons at the highest accuracy level requires very careful operation, common test procedures, computer software and hardware, and good communication between the pilot laboratory and the participating laboratories. This is described in more detail in reference [1].

2. SIMnet

The Interamerican Metrology System (Sistema Interamericana de Metrologia - SIM), working under the aegis of the Organization of American States, consists of five geographical regions NORAMET, CAMET, CARIMET, ANDIMET and SURAMET. For example, NORAMET groups three North American countries, Canada, Mexico and the United States.

One of the main objectives of SIM is to compare the standards of basic metrology in each country in the hemisphere. SIM comparisons support this objective. Recent establishment of SIMnet is another important step towards this purpose.

SIMnet – SIM network, has been set up by the National Institute of Standards and Technology (NIST). Its formal inauguration took place in December 1998. There are several layers of activities in this network. On the most basic level it is a network of computers devoted to videoconferencing and data conferencing through the Internet, facilitating international comparisons. On a more general level, it is a tool to foster and maintain collaboration between metrologists in the NMI's in the Americas, promote exchange of information, standardize test procedures, and share software via SIMnet web page, etc.

At the present time, twelve countries participate in the SIMnet: Argentina, Brazil, Canada, Colombia, Costa Rica, Ecuador, Jamaica, Mexico, Panama, Trinidad and Tobago, Uruguay and the United States.

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3. Hardware

Videoconferencing via the Internet, in the authors' experience, is not yet a fully mature technology and as such is very sensitive to modifications of hardware and settings of software drivers. For these reasons it was very important for the success of this endeavor that the computer hardware was standardized.

The standard SIMNet videoconferencing station is a 400 MHz Pentium II[1] computer, equipped with 128 MB of memory and a 19" video monitor, running Windows NT Operating System.

The selected computer-top video camera is outfitted with a capture card and an internal microphone. The card digitizes and compresses the video and has inputs for S-Video and Composite-Video cameras. It does not require DMA access or SRQ assignment. The camera and the card can capture images up to 750x576 pixels. Every station is equipped with an identical IEEE-488 bus card.

The standardization of the computer hardware has an important advantage in international comparisons, using bus-controlled instruments as traveling standards. The operation of the traveling standard can be verified in the SIMnet laboratory in almost exactly the same conditions as in the pilot laboratory, using the same software and the same IEEE-488 commands. This was difficult previously, as metrologists in each country use different computers, different cards, and different software. For example, in the NRC experience, it was more efficient during the SIM comparison of electrical units to measure the traveling digital multimeter manually, than to set up a special station with an IEEE-488 bus card not previously used at NRC.

The videoconferencing stations were acquired by NIST and distributed on loan to the 11 SIMnet countries mentioned above (similar systems will be provided to the remaining SIM members in the future).

An important part of the SIMnet is a videoconferencing server that allows multiple participants to receive audio and video. The function of the server is to facilitate multipoint videoconferencing and will be briefly discussed below.

4. Software

Several different Internet videoconferencing software packages are available on the market. At the present time SIMnet is using Microsoft NetMeeting [2] which is based on the International Telecommunications Union standard H.323.

[1] Commercial hardware and software is identified in this paper to describe the system. Such identification does not imply recommendation or endorsement by NIST or NRC, nor does it imply that the hardware or software is necessarily the best available for the purpose.

Audio and video communication is the most important feature of the teleconferencing software. In the authors' experience, reliability of the audio can be poor and dependent on the Internet traffic. Best results are obtained by using a headset rather than an external microphone and computer loudspeakers. Quite often, resorting to the telephone produces the only reliable audio communication.

Two video windows are displayed simultaneously on the screen, one sent from the station and a second one received from the other conference participant. Three sizes of video windows are available. A palm-size and freely moveable digital video camera can deliver very good and sharp close-ups. Even small hardware details and instrument connections can be effortlessly examined remotely via Internet.

NetMeeting can be used to connect multiple participants, important for an on-line meeting of experts. Unfortunately, the software allows only two participants to send and receive audio and video. If a third party wants to send or receive, one of the two active participants must manually switch (mouse click) to the third. Simultaneous handling of such a switch becomes unmanageable with several active speakers.

To help solve these problems, another software package (server) was procured to extend the capability of H323 compliant clients. This server requires a 400 MHz dual Pentium II machine to process and send audio and video to as many as 24 participants. All conference participants log-in to the SIMnet server, rather than to one of the participants. The server software detects and distributes the audio and video of the last speaker to all participants. Switching is voice-activated. However with transmission delays, even this system can become unmanageable when two or more participants speak at the same time. So meeting rules and discipline are necessary.

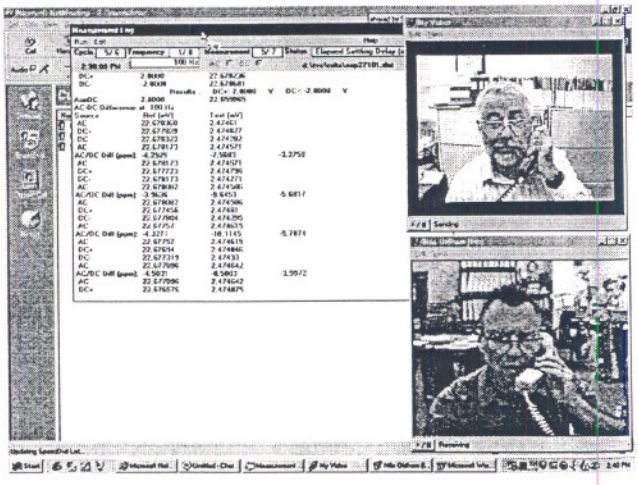

Fig. 1. Authors discussing a test.

Chat, the text communication tool, is practically a standard Internet communication feature. Netmeeting chat can be used to send text information to all participants or to a selected one (in the 'whisper' mode).

The whiteboard is a very versatile graphic communication accessory. It is essentially a shared graphic notebook program. Participants can draw, paste graphs, data, photographs, and pictures from other Windows programs, point, highlight and write on the screen. The whiteboard, which can be many pages long and be prepared in advance of the meeting, can be saved after the meeting, preserving session information.

Application sharing is an extremely useful tool in data conferencing. One of the participants can share with other participants the window of a currently running program. An example of application sharing is shown in Fig. 1. Three stations are participating in the videoconference; one at NIST in Gaithersburg, MD, USA, and two at NRC in Ottawa, Canada. One of the NRC stations, situated in the NRC ac-dc transfer laboratory, is running a test of a NIST-owned traveling standard and shares this application with the two remaining stations. Authors, from their offices, discuss results of the test.

Collaboration is an extension of application sharing; the participants can not only observe the screen of the running application but also take over the mouse and the keyboard of the remote computer. Figure 2 shows the authors collaborating on this paper submission, one day before the deadline.

File transfer between participants is part of the video conferencing software; it does not require any other application. Participants can accept or refuse the transfer.

5. Concluding remarks

The paper presents a short history and features of SIMnet, a network of computers established in support of international metrological collaboration in the Americas. Examples of SIMnet applications were shown. Several others will be discussed at the conference.

The feature not mentioned before is network security. NetMeeting has no internal safety features and does not encrypt the transferred data. Its use may be restricted and audio and video communication slowed down by corporate firewalls. When the corporate firewall or proxy server is set on the highest level of security then no NetMeeting communication outside the corporate network is possible. At present this is the most restricting feature of the software.

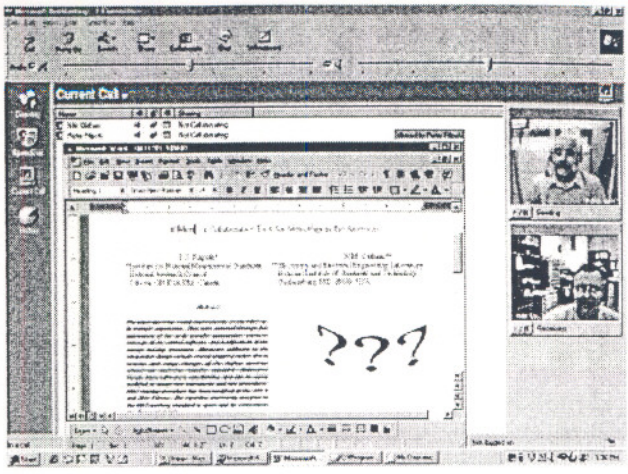

Fig. 2. Authors collaborating on this submission.

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