# IP Multicast E-Meetings through Multipurpose Internet Mail Web Gateway

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**Abstract**— As use of video conferencing and e-meeting systems are often on the Internet and in businesses it becomes immensely important to be able to play its role from any computer at any location. Often this is impossible, since these systems cannot run without special software that are not readily available everywhere or impossible to install for administrative reasons. Locations also lack the necessary network system configuration such as IP multicast. This paper presents a World Wide Web gateway system that allows users to enable its participation using only a standard web browser tools. The design and architecture of the system are described and performance numbers that show the more flexible approach of the system.

## 1 INTRODUCTION

Video conferencing and e-meetings systems are today common place on the Internet in several environments, such as businesses where save money on travel costs or time spent on going to physical meetings. These types of systems are utilize for presentations, meetings and for continuously support to collaboration in a group setting, providing other features such as text messaging, audio and video, and shared collaboration tools. Unfortunately it is not possible to take part in a video conference or an e-meeting session in various locations and occasions for various reasons. Many public access Internet terminals at web cafes, airport terminals or hotels offer only access through a web browser and not allow users to install customized software. In some locations the access through network might not support the mandatory protocols such as IP Multicast. One way to able participate in e-meetings where a wide variety of different locations is connectedby e-meeting sessions to the World Wide Web. The interface must be kept simple and limited to basic web standards such to be able to support as many systems as possible. While this does not enable a full two-way participation as audio and video input are limited it still creates a great benefit to mobile users. This paper presents the architecture and evaluation of a web interface gateway system to emeetings that ables users to take part in an e-meeting session from any place through a standard web Browser. The system is implemented using a commercial e-meeting tool, Marratech Pro.

## 2 RELATED WORK

The WebSmile system is a gateway system for multicast video. It only supports the Motion JPEG codec only not any audio codecs. The system described in this paper uses the same ideas for video display, Apart from not having any Java video player applet. Mediascape provides a similar system for video as WebSmile. In Mediascape users can leave messages to other users through a system known Post-it and it is possible to start a direct video call with other users. NYNEX Portholes is a web based group awareness tool which is used in the MIM web interface, which also provides a web page with video snapshots and activity meters.

Although HTML and HTTP are used for extensions, asynchronous media and plug-ins for synchronous media such as audio and video exist, for example streaming media players and Java applets. In this paper we will try to keep to the original features supported by HTTP and HTML as to get the widest possible support from the variety of web browser installations available.

The e-meeting system provides benefits in the daily work and benefits when out traveling or visiting somewhere. These types of application can not already and easily installed. The Marratech Pro system requires the user to be allowed to install custom software and having the network capacity to receive the full session and includes support for tunneling the traffic through firewalls and NAT network[5]. Special versions that do not exist today would also be necessary on devices. A interfacing web is one solution to the problem of making e-meetings accessible from anywhere from computer connected to the Internet. A interfacing web would also be useful as a light weight tool can be used to get a quick overview of what currently happening in an e-meeting.
A web interface or gateway to an e-meeting session can be deployed or implemented in two different modes:

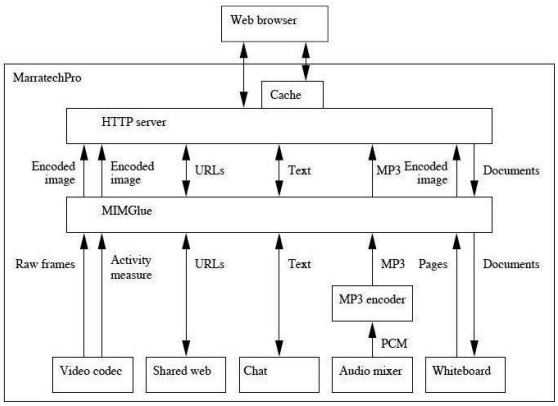


Figure: Architecture

**Public mode** The web interface can run at a central location. All users access the same application making user identification necessary [6]. The MIM web interface can support both of these modes. It is possible to divide uses of the web interface into different levels depending on the participation's amount:

1. Passively viewing an e-meeting now and then to get a sense of group awareness
2. Participate by chat and whiteboard tools and the shared web browser
3. Listen to audio and see live video
4. Send audio and video to see full frame-rate video and the ability to edit whiteboard pages.

In this it support for levels 1-3 are implemented requiring only HTTP and HTML support and an MP3 player. Level 4 requires more advanced browser plug-ins.

### 3.1 Chat

Chat can create problems depending on the gateway if it is running in a public or personal mode. In the personal mode, private and public chat messages pose no problem since there is only one user of the gateway. In the public mode, multiple user can send chat messages from the gateway. If user authentication is done by the gateway the user name can be added to all out going chat messages, make possible to identify the sending user [9]. This is sufficient for public chat messages. The problems with private chat messages are impossible for the gateway to differentiate private messages from the e-meeting session for different users of the gateway onlyif it is part of the session as one unique user [8]. To solve the problem of gateway has to be able to join the session as different users, or the e-meeting software has to be modified to support it. The low-weight solution is to create a convention where an e-meeting user adds the name of the recipient in private chat messages.

### 3.2 Shared whiteboard

The shared whiteboard tool is one of the most complex parts of Marratech Pro. A user can draw text, lines and other geometrical objects, import text and Microsoft PowerPoint and Word documents, etc. Although supporting the full functionality of the tool in a web browser would be impossible without using advanced web tools such as Java script or a Java applet, only displaying the whiteboard pages are much easier. The pages can be rendered as images which are then viewed in the browser. As a form of input, documents such as images or Microsoft Office documents can be uploaded to the gateway and distributed from there to the session.

- **Shared browser**

The user distributes a web page the complete page is downloaded and distributed to all Marratech Pro clients from the local cache by using a reliable multicast protocol. The built in web browser in Marratech Pro displays the original URL in the location field in the GUI and creating the appearance that the page was downloaded from that URL[4]. There are two ways to get access the shared pages from the gateway system: either the browser uses the original URL of the shared page or the browser uses the original URL.

The complete page is sent to reliable multicast to all clients in Marratech Pro because of scalability: by sending the URL which would create a HTTP GET request "explosion",as all clients would simultaneously request to the same web page at the same time. This problem does not occur in the same way for a gateway system; have to manually follow a link to a web page.

- **Audio**

Audio is the most important part of a video conference or an e-meeting, but it is also hard to support with basic web standards, it is a synchronous media that requires continuous streaming. Several audio formats can be streamed over HTTP, such as MPEG-1. MP3 or Windows media or MPEG-1 Layer III is the most well known and widely supported format. Most browsers need programs to play these formats or external plug-ins. A phone gateway such as the Cisco VG248 Analog Phone Gateway products or the System Base Dialgate-2010 could also be used to provide audio support.

### 3.3 VIDEO

Similar to audio video is a continuous and synchronous media, but for video single frames of a video stream can easily be incorporated in a web page. It requires the gateway decodes the video stream and re-encodes frames in an image format that supports the browser. An illusion of a video stream can be achieved by continuously refreshing the image regularly, either by reloading the HTML page that includes the image or by updating the image with push-technologies [6]. The experimental multipart/x-mixed-replace MIME-type [7] can be used to push updates to for example image from the server to the client, but it is not implemented by all browsers.

For supporting full frame-rate, video streaming additional tools is needed. As in WebSmile, a custom Java applet can be used for creating a video player in a web browser. Plug-ins such as the Real Video, Window Media or QuickTime plug-ins all support streaming video. In both cases, the gateway has to re-encode the stream into the new format and stream it over HTTP, untill original format is supported by the player.

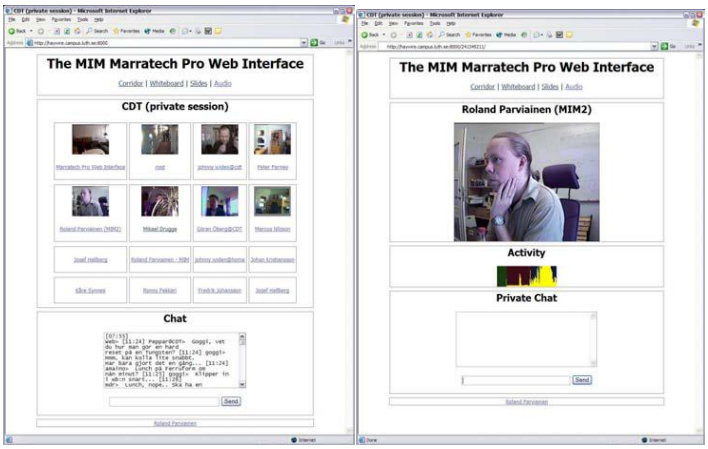
Fortunately, we might not need to support the full frame rate of the live video streams: in the required frame rate for video conferencing is reported as being no more than at least 5 fps. The author states that a frame rate very low as one snapshot in every five minutes can provide group awareness in a work environment.

Implementation

Building on an existing application has some benefits such as:

- Easy access to already decoded video and mixed audio frames. All audio and video codecs are supported by Marratech Pro automatically supported by the web interface.
- Easy access to whiteboard pages as low graphics objects that makes it easy to encode them to various image formats.
- The user has to run one application.
- All input from the web interface to a session always comes from the same origin as if the user would use the normal tool.

On the other side, it also means the gateway always requires the full user interface of Marratech Pro and it can be hard to get access from the Internet if the internal network is separated with proxies and firewalls.



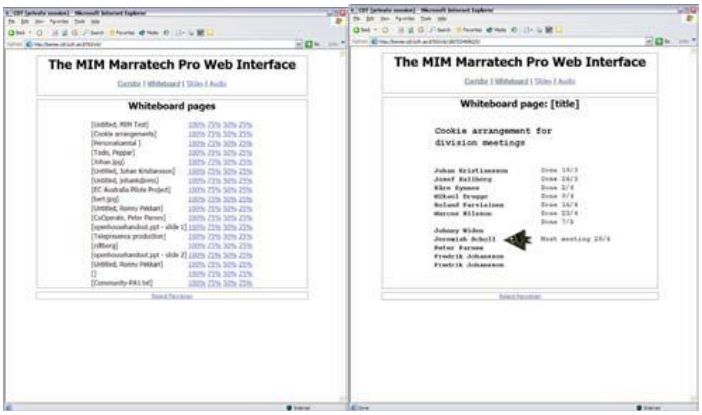




Figure: Simple web interface

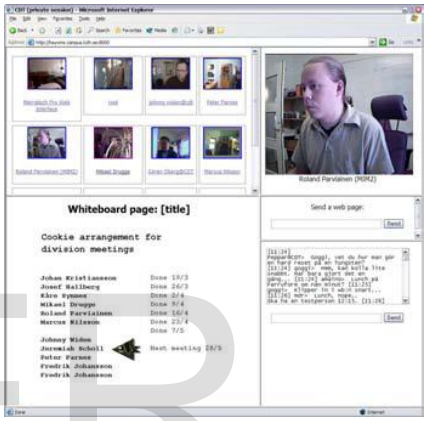



Figure: Advanced web interface

See figure for an overview of the architecture of the system. The MIMGlue component is responsible for communication with the MIM system, the name of the system it originally comes from. All information to and from the HTTP server are handled by this component. When it is said that the HTTP server retrieves information from Marratech Pro it is implied that it goes through the MIMGlue component. The MIMGlue component and the HTTP server both are running in the same Java process as Marratech Pro.

### 3.4 Activity indicators

As seen in figure of simple web interface, an activity indicator is added to the individual user views to make it easier for getting an overview of the recent activity of a user. we cannot rely on the video stream to provide the information when video updates are far apart. Algorithm for detecting activity in video is similar to the one used in NYNEX Portholes. Different activities such as sending audio or chat messages are also added to the indicator in different colors.

### 3.5 Caching

For increase the performance, all requests to the HTTP server

can be cached. Different types of objects such as whiteboard images, video snapshots or HTML pages can have different cache limits [10]. To prevent proxies and web browser from caching,it always changing information HTML <META> tags together with the Pragma: no-cache HTTP/1.0. The header is used to state that the pages should not be cached. The different media have different needs when it comes to caching. The video snapshot often changes the cache should be short while the list of whiteboard pages does not change very often. Therefore it can be cached for much longer, although this is contrary to the performance gains of caching in the HTTP server.

### 3.6 Privacy

The user authentication or identification is required for the Basic Authentication Scheme in HTTP/1.0. If stronger encryption or authentication is needed, HTTPS (HTTP over SSL) would be the obvious choice[5]. The HTTP server is currently used. Unfortunately it does not support HTTPS as of today, but SSL tunneling software such as Stunnel_ can easily be used together with the web interface.

### 3.6 Audio receivers

The evaluation of the minimum delay experienced by a user and the scalability of the system with regards to the maximum number of concurrent listeners.The audio delay is mostly affected by the amount of buffering done by the MP3 player such as the default settings of the Winamp v2.81 MP3 player the end to end delay is around 30 seconds. Using the same player, the minimum allowed settings for HTTP streaming buffer sizes the end to end audio delay was around 4 seconds. It includes the time for encoding to 8Khz 64 kbit/s PCM audio stream in a sender on the same local network, decoding to raw audio at 32 Khz, transmission over RTP, encoding to MP3 and finally download and playout over HTTP. The relatively large delay is caused by several parts: buffering before data is handed of to HTTP clients, MP3 encoder delay, network delay and buffering by the client [5].

Scalability was tested with up to 500 concurrent receivers. The audio delay for a Winamp 2.81 client was still 4s. CPU usage on the server computer roughly doubled from around 20% to 40%, where the bandwidth used was expected close to 1Mbyte/s (500 receivers at 16 Kbit/s). It shows that the limits on the scalability of the number of audio receivers are either the amount of concurrent open sockets or the network bandwidth that the Java virtual machine or operating system can maintain.

### 3.7 Web server performance

All tests were performed with different cache limits, i.e. the time objects in the cache are still considered valid. When the objects are invalid, they are regenerated. Both JPEG and PNG image formats were tested, since some tradeoffs they offer: the PNG encoder is faster than the JPEG encoder but produces larger files in general. The JPEG video images were approximately 10 Kbyte while the PNG video images were approximately 210 Kbyte. For testing the dynamically generated web pages were used: the Corridor page, which is list the users of a session and shows a chat text are and was 4674 bytes large, the Whiteboard page, which list the available shared whiteboard pages was 511 bytes large and the Shared web page, which is the list of currently shared web pages and was 4733 bytes.

This increase in performance with a large cache limit is visible clearly. The large size of the PNG images results in higher bandwidth usage but there is small amount of successful downloads. This number of concurrent download threads has a noticeable effect on the download speed and rate of successful downloads, where the more threads in general reduces the performance of the servers. The beneficial effect levels out after a limit of 1 second. This same performance drop when the number of current download thread increases is also visible.

In both cases, the download time grows linearly as the number of threads increases. The benefit of a short cache limit is clear visible for both HTML pages and images, but as above longer cache limits than 1 second does not enhance the performance in the case of HTML pages.

## 4 Conclusion

In this paper the architecture and development of a novel Internet e-meeting gateway have been presented. The system fulfil a need for users to be able to get in to multicast e-meetings while using limited terminals in needs such as web cafe's and public places and on PC's where the user is restricted to install custom software. It enables users to participate using only a usual web browser and supports a huge variety of different media. We have discussed couple different uses of the system: as a common gateway into one meeting and as a personal gateway to a specific perception of an e-meeting client, and presented an updating on the scalability of the former alternative. Using a flexible template system, the Graphical user interface and the look of the web pages implementing the e-meeting can easily be created, without any need of substantial change in the systems source code. This change to the system shows that the system can accommodate large number of concurrent users if needed.

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