Recommendations on real-time group communication and collaboration services in support of international projects for

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Final
22 december 2005

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1 Introduction

TERENA asked SURFnet to conduct a survey and study into available group-collaboration solutions such as voice, video and data collaboration tools for supporting trans-European projects like GN2 and EGEE, and give recommendations to TERENA on how such services can be provided to these groups, including how to (re)use existing services available in the member community.
This report is the result of that survey and study.

1.1 Approach and reading guide

A desktop study on available real-time group communication and collaboration systems was performed. Based on the starting points a number of systems have been chosen. Practically all systems were tested. They are described by their high level characteristics in chapter 2.

Based on the writers' experience and taking into account the (functional) characteristics of the systems a decision process for deciding which system is used best in which situation is described in chapter 3. This can be used by international projects to determine what type of system and service is needed.

Based on the data collated by TF-VVC and previous taskforces, which is being updated with the help of the owners of these resources, an overview is given of services already offered by TERENA member NRENs in chapter 4.

1.2 Starting points

The recommendations given below are based on a number of starting points:

- There is a legacy consisting of participants that already have conferencing and/or collaborating hardware and software, and they want to be able to keep on using it. This leads to the point of interoperability. Therefore interoperability is mentioned with each option discussed later on.
- There is a heterogeneous user group and user environment. In paragraphs 1.3 and 1.4 the target user profile and user environment are described. The chosen systems will have to run with those users and in those environments.
- We can't force people to use certain tools. That is, there will be advice to use certain tools to connect to available or newly setup services, but in case of standards based systems we can't force users to buy certain brands or types. For proprietary systems it is clear that the described software has to be used, but we cannot tell the user what PC, camera or other hardware to use.
- We want to support standards and interoperable systems as much as possible.
- On the network side: we expect all participants to have a high bandwidth connection offering at least several megabits per second.
- The report does not give recommendations on the underlying network infrastructures. Common network elements and characteristics like firewall and NAT traversal or limited available bandwidth can cause problems using the recommended systems. These are not dealt with here. Network problems are supposed to be dealt with by the user organization.

1.3 Target user profile

The initial users are researchers (mostly involved in computer-, network- and telecommunications technology, and theoretical and applied science, such as high energy physics and astronomy) and employees of NRENs and research institutes. They can be described as trained in the use of computers and networks. They know about state of the art technology and expect this to be available for them as tools to support their work. Most do not mind installing the needed software (and/or hardware) themselves and take some time to get to know and tweak the tools, but the learning curve should not be steep. User-friendliness is required but not everything has to be foolproof and fully automated. Group collaboration systems are not viewed as hostile or impossible to work with but are considered a tool of which the operation shouldn't interfere with the work or meeting at hand. Because of their knowledge of existing technology they often do expect high quality audio and video in group communication sessions. In most educational scenarios audio is key, video is sometimes required. However, there will also be scenarios where video quality is very important. Most are very experienced email users and share documents by email, take them to the meeting (on paper or on their laptop) and have knowledge of the applications they use and produce their documents with. Presenting slides or documents or having a discussion based on presentation material are the most common activities. Application sharing is required. Usually this means advanced whiteboarding or the sharing of dedicated applications that are not widely available to every participant. Collaborative document editing is considered a welcome feature.

Preferably the chosen systems can also be used by alternative user groups: educators, students and administrative staff of higher education and research institutes and NRENs. They require more user-friendly systems, both in setup and configuration and in use. Many of them have not seen or worked with real-time communication systems before, are not familiar with new communication means, and therefore don't expect high quality audio and video. Audio should be comparable to the telephone system and is key, followed by the requirement for data sharing. Using video is an option in most scenarios (but often no requirement). In some scenarios however, video is important and needs to be close to TV quality.

1.4 User environment

The environments in which the systems are used are universities, research institutes and offices of national research network organizations. These can be classified as network-wise well connected, technical-savvy environments, in which up to date PCs, workstation and peripheral computer equipment is available or can be acquired. Also computer appliances are not strange to this environment. Compared to business environments they have many more different kinds of PCs and workstations and operation systems. Maintenance and user support is usually done in-house, by colleagues of the intended users or is contracted from specialized groups providing these services to the total user group (e.g. for the VC service by the NREN).

Collaboration in these environments is a multiple kingdom problem, meaning there is no one administrative domain all users belong to. They are users from different organizations, connected by different networks. The only common characteristic is access to an IP network.
This leads to the requirement to use interoperable software and hardware working over different domains. We therefore exclude collaboration products developed for closed business environments or requiring a centrally managed directory/communication manager, such as office backend systems or PABX oriented products.

1.5 Caveat

The recommendation of system(s) to be used and even the criteria on how to consider/order/judge them often lead to 'holy war'-type of discussions between the developers and supporters of the different systems. However, the recommendations are based on observations by the authors who can be considered experts in the field with 5 and 8 years of experience in both using the different systems as well as setting up and running services based on them. Objectivity and practical considerations have been the major starting points when writing the recommendations.

For a comprehensive overview of terms and abbreviations, see http://www.terena.nl/library/IPTELEPHONYCOOKBOOK/chapters/Glossary.pdf

2 Overview of available systems

Group collaboration is a hot topic in the IT industry. Updates for existing systems become available every day, and every day the integration of different systems become tighter. In research labs even more advanced systems are being developed. It is therefore impossible to give a complete overview of all available software and hardware, let alone to keep it up to date. However, based on the profile of the intended users and knowledge of the existing user environments, we can focus on a selection of systems after categorizing them. Further on, high level (functional) descriptions of the selected solutions are given.

We focus on group communication systems and describe if and how collaboration, such as document sharing and application sharing, is possible. We do not consider non-real-time collaboration suites, often called Groupware or CSCW (computer supported collaborative work). Nor do we include collaborative management tools that facilitate and manage offline group activities. Examples include electronic calendars (also called time management software) — schedule events and automatically notify and remind group members; project management systems — schedule, track, and chart the steps in a project as it is being completed; workflow systems — collaborative management of tasks and documents within a knowledge-based business process; knowledge management systems — collect, organize, manage, and share various forms of information; and social software systems — organize social relations of groups.
See http://en.wikipedia.org/wiki/Category:Groupware

We focus on standards-based systems. We do not describe proprietary solutions that are to be used within one controlled environment (e.g. central user registration), such as Windows/MSN Messenger in combination with Live Communication Server or IBM/Lotus Notes/Domino. Nor do we describe systems with limited functionality, such as Skype, that can only handle audio and video, but no collaboration.

2.1 Systems to consider

Based on the above characteristics and observations the following systems/technology have been selected. Each one is described by high level characteristics. For more detail on the systems/technology, please see the URLs provided.

2.1.1 H.323 based audio- and videoconferencing

http://en.wikipedia.org/wiki/H.323
http://www.packetizer.com/conf/
http://www.h323forum.org/
H.323 is the videoconferencing protocol standard set by the ITU. It is the oldest standard supporting video in this overview and many products are available, both hardware and software. See the URLs above for more information on the standard. As an example, some of the well-known vendors/freeware are mentioned below. Not only video, but also older VoIP implementations are based on H.323. We group all these systems under the title: H.323 based audio- and videoconferencing.
Required for group communication is:

- For each participant: an *H.323 client* officially called an end point. This can be a hardware codec (coder/decoder), available from Polycom, Tandberg, Sony, Aethra, VCON and others, or software, like Polycom PVX, VCON Meetingpoint, France Telecom eConf, Gnomemeeting (freeware) and other

freeware clients of which most are voice only. Hardware codecs have cameras built in or attached, as well as microphones. They are available as desktop system, or as room system supporting a group of people in a small conference room. Some even have dedicated monitors attached to them. Others need a TV, projector or computer monitor attached. Software clients are only available as desktop application and need a connected camera (webcam or video grabber card + camera) and audio (headset or microphone/speaker/soundcard combo). They use the workstations monitor as display device.

- For group meetings: an *MCU (multipoint control unit)*. This is the central switch all participants are connected to and that manages, and mixes all audio and video. Hardware and software MCUs are available from Polycom, Tandberg, RADVision, Codian, openMCU (freeware). MCUs are available in different capacity or number of simultaneously connected end points. MCUs can be 'cascaded' (connected) to allow a larger group to communicate. MCUs differ in functionality such as switching modes (all video of all participants present, only video of last speaker but all audio mixed, locked audio/video of the presenter, etc.), possibility to invite (instead of dial-in), etc.;
- If one wants to use telephone number-like aliases (instead of IP numbers) or control who will be able to connect, at least one *gatekeeper* is needed. Gatekeepers are available from Polycom, Tandberg, RADVision, VCON, GnuGK (freeware). The clients can register with their aliases at the gatekeeper that can set up the call. For worldwide connectivity a connection to ViDeNet/GDS is recommended. ViDeNet/GDS is an international network of gatekeepers built and maintained by higher education that links thousands of gatekeepers around the world, which makes dialling a VC system or a conference at an MCU as easy as dialling a telephone number.
- If regular PSTN phones should be able to join the multipoint call, also an *H.323-PSTN gateway* is needed. These are available from Polycom, Tandberg, RADVision, Codian and Asterisk (freeware) and many other VoIP gateways.
- When the meetings occur regularly and a predefined number of ports have to be available, a *scheduler* is needed. This reserves the ports on the MCUs so they can't be used by other (ongoing) conferences and in combination with a gatekeeper can also lock-out unauthorised parties. There are several commercial products available (mostly by the vendors of MCUs) but also many home-made products, developed by the providers of videoconferencing services (see chapter 4).

Platform support: Most commercial software clients are only available for the MS Windows OS. Most freeware clients are available for all platforms. Software gatekeepers are available for Linux, *nix and *BSD variants. Similarly for PSTN/voice-gateways. All hardware codecs and components have embedded real-time OSs.

User friendliness: Being the oldest computer based application from the list, the vendors have had a long time to improve on their clients and most H.323 clients, MCUs, and schedulers are user-friendly applications or appliances (using remote controls). First time users can operate the clients usually after a brief explanation of the basic functions.

Recent MCUs include the opportunity to choose between different screen layouts and switching modes (showing only the speaker, or show the speaker in a large area and participants in small boxes, or all participants the same size, etc.). The simultaneous display of more participants is called Continuous Presence.

Interoperability: the standard requires H.323 videoconferencing clients and other components to support at least the H.261 video and G.711 audio codec. But clients and MCUs differ widely in the use of additional and better quality codecs, such as H.263 and the newly developed H.264 codec. Sometimes problems still occur

during call setup (codec negotiation) and teardown (mainly with freeware clients) that can give problems at the MCU. Although interoperability has been greatly improved in the last few years, it can't be guaranteed that every client works with every MCU (or other client). For interoperability with other systems, gateways are needed. Some systems based on other standards also have H.323 support built-in, see below.

Security: The associated security protocol for H.323 is H.235. It is however not universally implemented. The latest generation components do support it. Sometimes it is used only for securing registration at the gatekeeper and call setup, while the media streams (audio/video) are not secured/encrypted. Some vendors offer proprietary solutions for encrypting media streams.

Document sharing / application sharing support: The H.323 standard is an umbrella and includes the T.120 Real time data conferencing protocol. The best known T.120 client is Microsoft Netmeeting, which is no longer supported, but still available in all OS versions, up to Windows XP. Netmeeting often is the underlying technology in other conferencing clients. In newer systems H.239 is supported. This allows for 2 data and/or audio and video streams and is mostly used to send documents or presentations next to the audio/video in one call. H.239 (or its proprietary implementations) does not support application sharing. In group-conferences the MCU as well as all clients need to support T.120 or H.239.

2.1.2 SIP based audio- and videoconferencing

http://en.wikipedia.org/wiki/Session_Initiation_Protocol
http://www.sipcenter.com/

The SIP (Session Initiation Protocol) standard is developed in the IETF as an alternative to the H.323 protocol that is often considered too complex and limited. It is now the world's most used protocol for VoIP. Video applications aren't available on a large scale yet, but more become available each month. For a list of available hard- and software see the URLs above. As an example, well-known vendors or freeware implementations are mentioned where relevant below. We group all these systems under the title: SIP based audio- and videoconferencing.

Required for group communication are:

- For each participant, a *SIP client*, called a *User Agent (UA)*. This can be a SIP phone or video conferencing appliance, or a software application. The software UAs require audio (headset or microphone/speaker/soundcard combo) and when used for videoconferencing also a connected camera (webcam or a camera connected to a grabber card). SIP-based videoconferencing clients are Xten Eyebeam, Wave3 Session or eConf. Most available UAs only support audio!
- At least one *Registrar* that accepts requests and maintains user's whereabouts (sometimes a separate Location Server). The registrar is used in combination with a *proxy* that relays call signalling and sometimes also in combination with a SIP redirect server that forwards calls. A well-knows registrar/proxy is the freeware Iptel.org SER server.
- To support more than two communicating users at the same time, in other words group communication, a *Communication Server* is needed. This is the equivalent of a H.323 MCU. Well known Communication Servers are available from Wave3 and RADVision, many other vendors announced SIP support in their products.
- To include regular phones a *SIP-PSTN gateway* (or VoIP gateway) is needed. There are many available, e.g. the freeware Asterisk software gateway.

Platform support: most UAs are available for all platforms (Windows, Linux/*nix/BSD, PDA, MacOS). However, most are voice-only UAs and do not

support video conferencing. Hardware clients/phones have embedded OSs. Registrars are available for Windows 2003 server and Linux.
User friendliness: software UAs are modern software applications which are very user-friendly both in configuration, setup and operation.
Interoperability: Since SIP is relatively new there are still interoperability issues between UAs. This mainly concerns the interoperability of the audio and video codecs used. Interoperability between UA and proxy/registrar is good. Communication Servers tend to only recognize UAs from the same vendor, mainly due to the codec interoperability mentioned above.
Security: SIP supports secure registration (part of the standard). Not many UAs support secure media streams yet.
Document sharing / application sharing support: SIP is used in many Instant Messaging applications, thereby supporting chat. Many SIP UAs and servers support Presence (tracking online and availability status of buddies/participants) which is a great help in setting up conferences. There are many P2P (peer-to-peer) applications based on SIP that support application and document sharing. However, being peer to peer they do not support group collaboration. Several SIP communication servers support application and document sharing.

2.1.3 VRVS

http://www.vrvs.org/

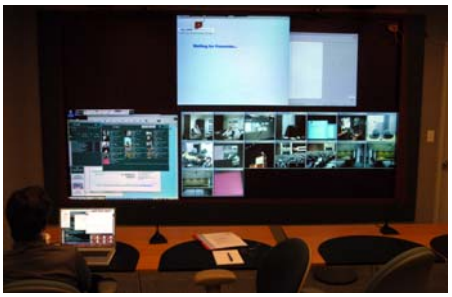
VRVS (Virtual Room Videoconferencing System) is a software based group communication system developed by CalTech. It is very popular in the high-energy and nuclear physics community, but has users all over the world. VRVS consists of (software) clients, distributed communication servers (called reflectors) and distributed application/web servers for scheduling. It is not a person-to-person communication system like H.323 and SIP, but a virtual room based/meet-me-there system. It therefore doesn't need a directory to find other people, but has a directory of available rooms. VRVS requires a one-time registration at the central site (www.vrvs.org) after which the client of choice can be downloaded and meetings can be scheduled. VRVS excels in the scheduling and booking function.
NOTE: In the first half of 2006 the VRVS application will be replaced by **EVO** composed of a Java Client that will run on the client machine, and a Server that is used to provide an intelligent, secure and reliable communication channel between the different entities in the collaboration grid, and some other services (scheduler, directory services). EVO provides several functions including: Instant Messaging (IM); Rich Presence information; reserved and ad-hoc session setup for both multipoint and point to point mode; adaptive videoconferencing and collaboration experience based on local capacity and network connectivity; friendly statistics and real-time information. It promises to cross firewall/NAT and do tunneling to one port for all communication with the system (video, audio, IM, presence, booking, logging,...). It allows for plug-ins. Plug-ins that have been developed are: EVO tools (inspired by Vic/Rat), H.323 plug-in, Video Java Player (play mpeg file, mp3, etc...), Java audio tool and a File sharing plug-in. Work has started on a SIP plug-in.
Required for group communication are:

- For each participant, a *VRVS client* and *web browser*. One can use other videoconferencing applications to take part in a meeting, such as some H.323 codecs. In that case, not all VRVS features are supported. The main VRVS client is based on the old Mbone tools (vic and vat). The desktop client needs a connected camera (webcam or video grabber card + camera) and audio (headset or microphone/speaker/soundcard combination).
- Access to a *reflector*. The reflector is the equivalent of an MCU or SIP communication server and manages all audio/video distribution. There are several freely accessible reflectors set up around the world. For complete

control of the meetings and blocking others from using the services one must set up an own reflector.
- A web browser to book a room through the scheduling and booking system.

Platform support: VRVS clients are available for Windows, PocketPC, Linux, MacOS, SUN Solaris/Unix, SGI Irix and the sources are available for building the client on other OSs. Reflector is available for Linux and *nix variants.
User friendliness: Although it improved in the latest versions, the VRVS videoconferencing client is not considered a user friendly application. Because it is based on the old Mbone tools it opens (too) many windows and control of the application is considered difficult. Special software for screen estate is being developed and probably EVO will also be more user friendly. The VRVS client requires more than average technical knowledge to setup and configure audio and video devices, especially on non-Windows based platforms. The opportunity to see all participants in the meeting simultaneously (continuous presence) as opposed to only the current speaker is well appreciated.
Interoperability: The VRVS videoconferencing client is based on the Mbone tools, and supports multicast connections with other Mbone tools (vic/vat/rat installations). Since many networks do not support multicast, some reflectors act as unicast-to-multicast gateways.
One can use certain H.323 clients (either hardware codecs or software clients) to connect. The H.323 implementation of VRVS (built-in into the reflectors) is strict, resulting in some interoperability problems with H.323 clients and MCUs. Also SIP clients can be used. Again, watch out for video interoperability issues. For non-interactively watching an ongoing conference one can use the QuickTime Player or a Java Media Framework client. VRVS has developed the VRVS-AG Reflector and a specialized web interface that enables end users to connect to any Access Grid (AG, see below) session, in any of the AG virtual venues. The VRVS-AG Reflector provides transparent multicast/unicast switching. End users can participate in AG sessions by using either Mbone (VIC/RAT) tools or H.323 clients from their desktop or laptop. VRVS users send unicast video/audio streams to the corresponding AG Virtual Venue.
Security: Users need to be authenticated (using the OSs authentication options) when accessing the VRVS services. Therefore, all actions are tracked and monitored to prevent abuse of the system. Booking a meeting can be protected by a password so no intruders can listen or watch the discussion. Encrypted media streams are not supported.
Document sharing / application sharing support: VRVS uses VNC as underlying technology for application sharing. It can be started from the VC client. The main VRVS client support whiteboarding and chat since it is based on the Mbone tools. Chat can be done form the VC client.

2.1.4 AccessGrid



http://www.accessgrid.org/
http://agcentral.org/
The Access Grid® (AG) is an ensemble of resources including multimedia large-format displays, presentation tools and interactive environments, and interfaces to Grid middleware and to visualization environments. These resources are used to support group-to-group interactions across the Grid. Originally designed for immersive room-based VC systems there are now several versions, including a one-machine desktop client. The Access Grid is mainly used by researchers participating in Grid projects.
Required for group communication are:
- For each participant, an *AG client*, or *AGnode* (specially designed rooms, with big screens, multiple camera's, echo cancelling hands-free microphone

system, several computers to control display, audio and application sharing). The desktop client needs a connected camera (webcam or video grabber card + camera) and audio (headset or microphone/speaker/soundcard combination). When run for the first time registration is required. During this process a certificate is issued. This can be done by the certificate authority of the community you belong to (such as the Dutch GridPKI) or it can be a 'private' certificate from NCSA.

- Access to a *venue server*. There are several public venue servers available. The user needs a certificate to be able to enter the lobby (central virtual venue) and other venues. The basic network operation mode is based on multicast. If unicast connectivity is required a reflector must be set up.
- Access to the venue scheduler (virtual venue registration system), *AGSchedule*, a central web server run by the NCSA, the National Center for Supercomputing Applications. Registration is required to be able to use it.

Platform support: The AG client (Access Grid Toolkit) runs on Windows XP, MacOS, and Linux and BSD variants.
User friendliness: The desktop video client is based on the Mbone tools and is therefore considered as challenging as the VRVS client. Special software for screen estate is being developed.
Fully equipped and installed by experts, AGnodes (rooms) are very user friendly in that you can walk in and start to talk to others on the big screen(s), the only thing needed is selecting the right venue.
Interoperability: Through the VRVS-AG gateway you can connect VRVS and H.323 clients. Open multicast sessions can be joined using the old Mbone tools. In all cases, not all AG functionality is available.
Security: Access to certain venues is restricted by using specific certificates. In the basic setup the media streams are not secured/encrypted.
Document sharing / application sharing support: AGnodes use VNC for basic application/desktop sharing. Chat/IM is possible through a jabber server component. For advanced application sharing the AG node supports the Globus grid middleware. Several components have been developed as add-ons to the AG toolkit for specialized functions, such as shared movie viewing, sticky notes, shared PDF, Question Tools or the Media Lecture board. For an overview see http://agcentral.org/downloads

Commercial services and software (preconfigured servers), based on the Access Grid Toolkit, are offered by inSORS: http://www.insors.com/
They also provide an AG-H.323 gateway.

2.1.5 Web based integrated suites

This category of system share the fact that they are all browser-based, i.e. run proprietary clients as web browser plugins.

2.1.5.1 Click to Meet

http://www.radvision.com/EnterpriseSolutions/VideoconferencingProducts/ClickToMeet/
Click to Meet from RADVision is based on an H.323 conferencing architecture but taken a couple of steps further.

Required for group communication are:

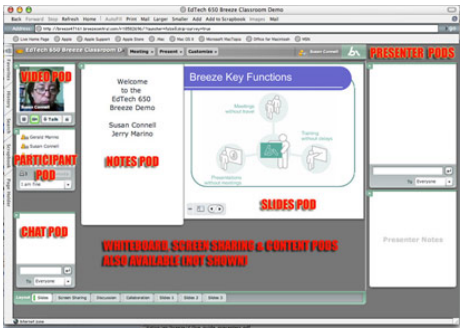
- For each participant, Internet Explorer with the *CtM plug-in* installed. This is automatically installed when accessing a CtM server or venue. The client needs a connected camera (webcam or video grabber card + camera) and audio (headset or microphone/speaker/ soundcard combination).

- A *CtM server*, which in basis is an MCU with a built-in gatekeeper and H.323-SIP gateway, plus additional services.
- If telephones are allowed to participate a VoIP (H.323-PSTN or SIP-PSTN) gateway is necessary.

Platform support: Windows only.
User friendliness: Since all action is within one window/browser and one can pick several layouts the system is considered very practical. Functions are very intuitive and therefore very friendly towards first time users
Interoperability: One can invite H.323 devices/clients and SIP UAs to join the conference, as well as telephones if a gateway is present. There are video codec interoperability problems (see SIP). Clients can also dial-in (CtM gatekeeper can connect to ViDeNet/GDS). CtM integrates with Windows Messenger (for presence and call setup), Live Communications Server (LCS), Outlook (for calendaring/scheduling) and IBM Lotus. Full functionality is only available to users using the CtM plug-in.
Security: One has to log in to join meetings and again to get access to some features (e.g. chairing a meeting). Media stream security will become available in the near future.
Document sharing / application sharing support: The client is a T.120 implementation using Netmeeting underneath and supports document, presentation and application sharing within the browser, as well as collaborative browsing which shows a website to all participants). The server uses encrypted data T.120 (T.123 B). As an option (additional license) conferences can be streamed and viewed by Quicktime, Real or Windows Media player. Another option makes it possible to record sessions to a server and play them back later within another session.

2.1.5.2 Breeze

http://www.macromedia.com/software/breeze/



Breeze is a new group collaboration system. It is based on Macromedia Communication server and Macromedia Flash player (present in almost all browsers on all platforms).
Required for group communication are:

- For each participant, a web browser with the *Macromedia Flash plug-in* installed. The desktop client needs a connected camera (webcam or video grabber card + camera) and audio (headset or microphone/speaker/soundcard combination).
- A *Breeze Communication Server* to set up meeting rooms where participants meet. For additional features additional packages need to be installed.

Platform support: Windows OSs with any browser that supports Flash; MacOS X with Mozilla or Safari browser and Flash player. Linux and Solaris with Mozilla browser and Flash player. Sending audio and video are only available on Windows XP and MacOS X because these can run the latest version of Flash. In older Flash versions it is possible to non-interactively view a session. Breeze Communication Server runs on Windows 2000 server and Windows 2003 server.
User friendliness: the application is very user friendly and has many features. Within the browser the meeting room layout can easily be configured. Features are very intuitive.
Interoperability: Not interoperable with any standard yet. SIP support is announced to be part of the next release. In this case, not all features are supported.
Security: It supports SSL-based end-to-end encryption of all data, voice, and video communication.

Document sharing / application sharing support: with the proper packages on the server, document and application sharing, chat, collaborative browsing and recording and playback/streaming of sessions is supported.

2.1.6 Application based integrated suites

Users of this category of systems have to install a proprietary application on a PC.

2.1.6.1 Marratech

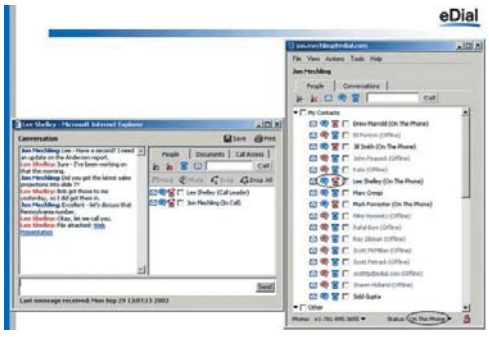
http://www.marratech.com/

Marratech is a spin-off from the Centre for Distance-Spanning Technology (CDT) at Luleå University of Technology, Sweden. Its first systems were based on the old Mbone tools, but have been redesigned / repackaged since.
Required for group communication are:

- For each participant, the *Marratech client*. The desktop client needs a connected camera (webcam or a camera connected to a grabber card) and audio (headset or microphone/speaker/soundcard combo)
- For group meetings: access to a *Marratech virtual office environment* (virtual room). Several public rooms running at Marratech-controlled servers are available. One can install a *Marratech Manager* to set up your own environments. A Manager acts as multicast-unicast reflector.

Platform support: The client is available for Linux, Windows, Mac and Solaris. The Manager runs on Mac, Linux, Windows and Solaris servers.
User friendliness: Marratech rebuilt its system from the ground up, making it a feature-rich, all-in-one-window based system, although the access to the functions is not very intuitive. Downloading, installation, launching and connecting to the proper room can be done by simply clicking on a meeting room link. This needs to be configured through the Manager.
Interoperability: The SIP module enables the Marratech Manager to call out using the SIP protocol. The Manager calls out to a SIP device or SIP to PSTN gateway and mixes the voice into the appropriate ongoing session. H.323 is not supported yet. In all these cases, not all features are supported.
Security: The Marratech solutions high grade, end-to-end encryption (256 bit AES) is turned on by default, protecting authentication, voice, video and whiteboard
Document sharing / application sharing support: built-in. Application sharing, whiteboarding, chat and collaborative browsing is supported within the client, partly based on VNC. One can also record all media (voice, video, whiteboard and chat) and index your recordings so you can easily record your meetings or lectures and play them back later, or send them to others.

2.1.6.2 eDial



eDial started as commercial service provider. It is now an Alcatel division selling the Instant Collaboration System (ICS) and the Advanced Communications Server (ACS). It is a SIP-based system, with Windows Messenger (IM/Presence)-like client with browser-based client for advanced collaboration. It does not (yet) support video communication!
Required for group communication are:

- For each participant, an ICS client. The desktop client needs connected audio

(headset or microphone/speaker/soundcard combination).
- An ACS with enough ports. ACS can act as gateway to PSTN. ACS and ICS support scheduling of conferences.

Platform support: ICS client is available for Windows, Mac OS and Linux. ACS runs on Linux.
User friendliness: as user friendly as Windows Messenger and browser-based application sharing tools discussed above.
Interoperability: With PSTN through PBX and with Windows Messenger and compatible IM clients for instant messaging, through Microsoft Live Communication Server.
Security: secure authentication (registering), HTTPS for web presentations.
Document sharing / application sharing support: application and document sharing, web presentations, chat, instant messaging, presence and collaborative browsing. It supports record and playback of conferences. Again: this covers voice/data conferences only. Video is not supported (yet).

There are many other similar systems, such as Mshow, NetViewer, Dataconnection MeetingPoint, Nortel Multimedia Communications Server. All require a browser and, some proprietary clients. All support audio conferencing, web presentations, some provide video, chat, application sharing, collaborative browsing and voting tools. They are not described because they are not considered complete or user-friendly enough or suitable in other ways for the purpose of this recommendation.

2.1.7 Commercial services

We focus here on dedicated web conferencing services. There are commercial service providers focusing on H.323 services or SIP services and some on proprietary web based services. We consider those offering the combination of voice (PSTN/VoIP) and webpresentation/datasharing.

Some are based on systems/technologies described above. For instance, MeetYou Conferencing (www.meetyou.de) is based on Microsoft Live Communication Server and therefore only supports Windows Messenger (for IM/chat), Office applications and Internet Explorer (for web presentation).
Glance Networks (http://www.glance.net/site/whatis/whatis.asp) is basically a screen sharing service with a telephone conference server: all participants dial in with their phone and all open a specific URL (pointing to the Glance web server) in their browser that shows an uploaded document that needs to be in a certain format. There is a monthly fee for hosting conferences (up to 15 participants).

The best known services are WebEx (http://www.webex.com/) and LiveMeeting (http://main.livemeeting.com/). These are focused on ad hoc meetings (pay per use, per minute) where one user sets up the conference and others connect, as described above. Besides paying per conference you can also buy hosted services (per concurrent port) which are rather expensive. They are browser-based (java applets) collaboration clients that support voice and videoconferencing using a webcam and an audio set next to document sharing. LiveMeeting also has Real-Time Polls, Mood Indicator, Chat, Annotations, Whiteboard, Text Slides and Web Slides, and integrates with Microsoft Office applications. They both use secured (SSL-based) communications.

For an overview see
http://www.networkworld.com/bg/2004/webconferencing/index.jsp
Some, such as Horizon Live and DataConnection MeetingServer can be bought as stand-alone server too, so you can host your own meetings. Prices vary between $15.000 (software only, server machine needed) up to $200.000.

Besides dedicated companies offering services by hosting the conference servers, the companies selling web conferencing servers also sell hosted services. You can rent virtual rooms with Macromedia (Adobe), Marratech or eDial.

2.1.8 Phone/PSTN conferencing

Besides PC based solutions, groups can have decent small meetings using phone conferences. Combined with some of the screen sharing options described below they provide a complete group collaboration environment for a limited number of simultaneous users.

Required for group communication are:

- for each participant: a phone and for data- and application sharing a desktop or laptop PC or a workstation.
- A PBX that can host phone conferences, preferably at one of the participants, or a phone bridge from a commercial service.

Platform support: Every regular phone or VoIP client attached to a PSTN gateway. For data/application sharing a PC or workstation with Windows, MacOS or Linux is needed.

User friendliness: everyone knows how to use a phone, though dial-in instructions need to be clear when people are invited. Additional data/application sharing applications are usually easy to use. Screen sharing quality might not be good enough for some applications.

Interoperability: with other VoIP clients for audio/phone conferencing.

Security: none on the phone conversation, SSL security possible (but not default) on the screen sharing application

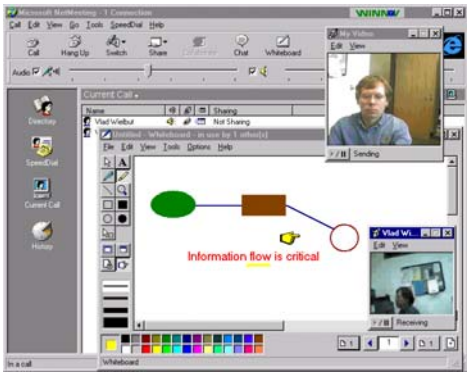
Document sharing / application sharing support: see next paragraph.

2.1.9 Data and application (or Screen) sharing

Since these tools can be used standalone, or in combination with Phone conferencing and most application sharing utilities described in the other paragraphs incorporate them, we think Screen sharing deserves its own paragraph. There are basically two choices:

2.1.9.1 Netmeeting

http://www.microsoft.com/windows/netmeeting/

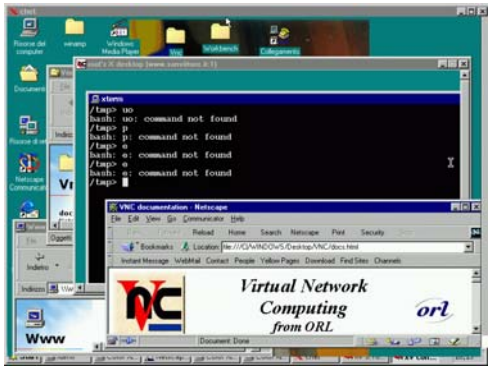


Netmeeting (for every Windows OS from Win95 up to Windows XP, although it is hidden), as an important T.120 implementation, works very well for chatting, whiteboarding, document sending/receiving and desktop/application sharing. One can grant permission to others to take over control of the application. One Netmeeting participant can host a multipoint meeting.

Netmeeting also acts as a (not very well implemented) H.323 client and can therefore also be used as voice conferencing and video conferencing client. Interoperability with other H.323 clients is not guaranteed. It's interoperable with the freeware/Open Source H.323 end point called GnomeMeeting. It's a simple and user friendly application. No security is supported.

Caveat: Netmeeting is no longer supported, and is not really cross-platform.

2.1.9.2 VNC



RealVNC (http://www.realvnc.com/), TightVNC (http://www.tightvnc.com/), UltraVNC (http://ultravnc.sourceforge.net/). All VNC implementations are free, and two are open source. Other versions are available such as OSXvnc (http://www.redstonesoftware.com/vnc.html)
VNC (Virtual Network Computing) software makes it possible to view and fully-interact with one computer from any other computer or mobile device anywhere on the Internet, thereby allowing collaborative (be it, sequential) editing and browsing. VNC software is cross-platform, allowing remote control between different types of computer. For ultimate simplicity, there is even a Java viewer, so that any desktop can be controlled remotely from within a browser without having to install software. VNC is a true screen sharing application. It sends compressed screen images to the listening PCs/workstations that have either a VNC client running or a web-browser with the Java version. It therefore offers unlimited possibilities to share whatever kind of presentation, document, or application.
VNC is available for every imaginable platform, both as 'server' as well as 'clients'. VNC clients and servers are very easy to setup and operate. Most VNC implementations are interoperable. VNC supports security (server and viewer authentication, secure data communication).

2.2 Overview of features

Below you can find a diagram showing the different systems and their support of real time collaboration features. Since most systems can be used with different user terminals, the features in the table below are the 'average' features that you will find on popular hardware or software terminals for this system.

	audio	video	presence	chat	presenting	app sharing	whiteboard	embedded video	session streaming	Ease of installation	Ease of use
H.323 endpoints	V	V							V	-	+
SIP UA's	V	V							V	0	+
VRVS	V	V	V	V	V	V	V			0	-
AG	V	V	V	V	V	V	V			-	0
Click to Meet	V	V	V	V	V	V	V	WMEDIA	V	+	+
Breeze	V	V	V	V	V	V	V	FLASH	V	+	+
Marratech	V	V	V	V	V	V	V		V	0	-
EDial	V		V	V	V	V	V			0	0
Phone	V									+	+
VNC					V	V			V	0	+

V = available
-/0/+ = quality: bad/reasonable/good

Originally, conventional conferencing hardware systems (mostly supporting H.323 and/or SIP) concentrated on video and voice but start to have some form of presentation option on board, though not always compatible even when standards

based. On the other hand, VNC is a good example of a system that was never meant for synchronous communication and it is complementary to H.323 endpoints or SIP UA's. Web based systems usually support most or all features.

2.3 Systems in development

As mentioned in the introduction of this chapter, we cannot take into account all systems in production or in development in research labs. However, we can list important trends and give some examples of development.

The first is the discussion on whether meeting rooms or desktops are the way to go. We see a lot of development towards desktop and even laptop and mobile device support. Small software applications and webcams can be used in real time collaboration between individuals are gaining ground quickly. Mostly these are used for person-to-person communication and collaboration (although the latter is very difficult on smaller screens). On the other hand there is a rather large deployment of room based systems, based on higher quality hardware appliances. These are used for group-to-group meetings and are mostly based on H.323 (or H.320, the ISDN variant). Audio and video are supported, collaborating applications and data sharing are gaining ground. It depends on a specific situation, but we believe the desktop collaboration will be of more use in most cases. As mentioned above one should strive to be interoperable with the legacy systems.

Secondly there is a trend towards integration. Not only audio, video, chat, and data and application sharing in one collaboration environment but the integration of real time collaboration with office tools and other applications. Microsoft integrates, through Live Communications Server, Office (Word, PowerPoint, Excel, Access, Outlook) with H.323 applications and appliances from H.323 vendors, such as Polycom and Tandberg. If you're typing a Word document and want to discuss wording with your colleague you can set up an H.323 videoconference from your Word document.

Above we've looked at real time collaboration applications which support data and application sharing thereby running other applications in a way suitable for collaboration. This is more general than the Microsoft way. However, with the widespread deployment of Microsoft applications and OS on PCs around the world, their strategy might work very well too.

Microsoft likes the ideas of the Access Grid, but developed its own version: ConferenceXP. It has all the real time collaboration features mentioned above and supports multicast videoconferencing and high quality video. As stand-alone group collaboration tool we expect this to be a very popular application in the near future.

Finally there is a trend for some scenarios to go to higher quality. Although hardware codecs do support TV quality there is lots of interest to go to HDTV quality. Not only the new codec (H.264) in H.323 and SIP implementations supports High Definition, but we also see codecs with low latency coming from the TV-world, using MPEG-2, making them suitable for high quality audio and video conferencing. These systems mostly lack data- and application sharing support.

3 Deciding what system to use

This chapter outlines a simple strategy for projects to determine what can be used for their group collaboration.

3.1 Overview of different kind of meetings

The list below gives an overview of the different kind of meetings that can be supported. It describes the several options available to support such a meeting. This can be used as a starting point to make a first choice of a supporting system.

The list has a number of variables:

- the size of the meeting, e.g. up to 20 experienced users versus big audiences
- available equipment/systems, e.g. hardware codec versus phone
- organization: is there one speaker or more, who should interact, etc.

We have taken the most common scenarios and choices for the variables above and come to the following type of meetings and their possible support tools:

1) **project meeting** (small size, available equipment and features from low to high)
    a. phone meeting + documents on 1 web server + mail
    b. H.323 videoconference + MCU + documents on 1 web server + mail
       alternative: SIP videoconference + MCU + documents on 1 web server + mail
    c. Hybrid H.323+SIP videoconference + suitable (hybrid) MCU/Gateway + documents on 1 web server + mail
    d. H.323 videoconference + MCU + documents on 1 web server + mail
       alternative: SIP videoconference + MCU + documents on 1 web server + mail + IM (all use same client/standard)
    e. H.323 videoconference + MCU + documents on 1 web server + mail
       alternative: SIP videoconference + MCU + documents on 1 web server + mail; or Hybrid H.323+SIP videoconference + suitable (hybrid) MCU/Gateway + documents on 1 web server + mail
       + VNC (remote editing + demonstrating applications possible)
       alternative: everything listed above + Netmeeting instead of VNC
    f. web based collaboration (audio/video + IM + collaborative editing/browsing + application sharing)
    g. web based collaboration + some H.323/SIP clients connected, often through and MCU

2) meeting with simultaneous editing
    a. H.323 videoconference (+ MCU) + documents on 1 web server + mail
       alternative: SIP videoconference (+MCU) + documents on 1 web server + mail, or
       H.323/SIP videoconference + suitable MCU/gw + documents on 1 web server + mail
       + VNC (remote editing + demonstrating applications possible) or Netmeeting
    b. web based collaboration (audio/video + IM + collaborative editing/browsing + application sharing)
    c. web based collaboration + some H.323/SIP clients connected, often through MCU

3) **one way presentation** (1 speaker, large audience). NB. The server is needed to stream to large audiences. The feed is coming from a media encoder.
    a. media encoder (+ server) (audio/video) for speaker, player for viewers
    b. media encoder (+ server)+ web server (audio/video + document) for speaker, browser + embedded player for viewers
    c. media encoder (+ server) + VNC (audio/video + documents or applications) server for speaker, VNC client (or web browser) for viewers, or
    media encoder (+ server) + netmeeting for everyone. Speaker controls application, viewers just view (cannot take control).
    d. web based presentation with embedded audio (no feedback possible)
    e. web based collaboration (no feedback allowed)

4) **presentation with feedback** (multiple speakers, large audience)
    a. media encoder (+ server) + VNC (audio/video + documents or applications) server for speaker, VNC client (or web browser) for viewers, or
    media encoder (+ server) + netmeeting for everyone. Speaker controls application, viewers just view (cannot take control).
    b. media encoder (+ server) + VNC (audio/video + documents or applications) server for speaker, VNC client (or web browser) for viewers, or
    media encoder (+ server) + netmeeting for everyone. Speaker controls application, viewers just view (cannot take control)
    + IM
    c. web based collaboration tool (IM, audio/video feedback allowed: e.g. by arm raising, chair selected, token passing)

Other presentation systems (to be used in 3 and 4), e.g. with simultaneous slide presentation, are available as well, but have not been considered here. Our starting point was the availability of (interactive) audio and video.

3.2 Preparing the decision

We have identified a number of steps to take/information to gather before one can decide what system to use.

- Identify which platforms/OSs and web browsers and conferencing clients are available to group members, as well as the availability of Java.
    - Choose the system that is available to the majority. Do not expect people to use a different system easily or eagerly because one or two other participants have no compliant configuration. Try to borrow/lend/rent similar systems for those participants.
- Check if phone services or VC services are available at one of the participant's home institute or NREN.
    - If so, contact them and ask their help. Don't try to set it up yourself.
- Check willingness of participants or their institutes to pay for phone calls.
    - If so, you have a wider range of options, including data sharing with audio by phone meeting.
- Check computer literacy of users and willingness to invest some time in learning (installing, configuring, using) new client/application.
    - If not, choose the simplest form, either phone conferencing (with documents distributed beforehand) or web based conferencing where the client is downloaded and run automatically.
- Is there time for test runs before the project meetings start?

    - Arrange tests: if you do not use phone conferencing, make sure you have at least two test runs. The first will be a lot of: “can you see me?, can you hear me?”, the second will be that again plus extra features (as how to mute the microphone, how to zoom with the camera, etc.). If people attended both test sessions the third session is the first where they can focus on the goal of the meeting instead of on technology. After the fourth meeting people learn to use the technology to their full benefit
- Are participants already used to document sharing (by email or any other way) or is a group support system currently being used?
    - Do not change the way people work dramatically. Introduce audio/video as an add-on. If they do not use any system at all, you can start by using a distribution scheme by email or use the options in the web based collaboration tools. They are considered the easiest.
- Are participants willing to invest in hardware/software?
    - If not, phone conferences and data sharing with available free tools are the only option. If so, depending on the scenario, hardware codecs can be bought for high quality audio and video, or web based collaboration tools for all options.

3.3 Feature checklist

Besides the different type of scenarios there are different requirements for the features one wants to support, such as audio, video, data, etc. Here are some simple questions one must answer before choosing a system.
Audio is considered essential to successful group communication so it is a required feature.

- Is video required or a nice-to-have feature?
    - If required, you need a videoconferencing application, or the chosen web based collaboration system should support videoconferencing. Participants need a webcam or grabber card with attached camera.
- Advanced features (check the feature list of section 2.2 for which systems support the features):
    - Is document/presentation sharing (where one document is shown to all participants and can be discussed by the chair) required or a nice-to-have feature?
    - Is collaborative browsing (follow-me-through-the-web) required or a nice-to-have feature?
    - Is chat/instant messaging required or a nice-to-have feature?
    - Is file sending/receiving within the application required or a nice-to-have feature?
    - Is whiteboarding required or a nice-to-have feature?
    - Is application sharing (running one specific application, e.g. a database program, with access from all participants) required or a nice-to-have feature?
    - Is collaborative editing (sequential or concurrent work in shared document) required or a nice-to-have feature?
- Interactivity
    - Is screen-broadcasting (distributing the main application screen and all events to all participants) sufficient, or should all participants be able to interact with the data?
- Can the same application/system be used by all participants or is a combination of systems necessary?
    - Look for the interoperability options of the available systems.

3.4 Decision tree

After all answers to the questions are collected (about the users, the environments, the features and the scenario), one can use the list below to select a system. The mentioned systems are our recommendations on what to use.

- If the computer literacy is low (and user-friendliness is a strong requirement) you should only look at web based conferencing or -collaboration tools.

- If all participants are required to use the exact same collection of collaboration tools or features, look at web based collaboration systems.

- If phone services are available and all participants know how to use a laptop (or there is a shared PC with projector for local group) you can use phone conference and a data sharing application.

- If the participants have different platforms or systems in place, the best option for getting interoperability without much complications, and user-friendliness and ease of installation is less important, the best option is to use (in this order)
  a) phone conferencing + data sharing through VNC;
  b) VRVS;
  c) Breeze (because not all features are available on all platforms).
  d) Marratech; (more cross platform but less user friendly)
  e) Click to Meet (less cross platform)

- If any of the advanced interactive features (video, chat/IM, doc sending/receiving, whiteboarding, document sharing/web presentation, collaborative editing, collaborative browsing, or application sharing) are required we recommend a (web)collaboration system with data sharing options. The best option is to use a web based collaboration system like Breeze, Click-to-Meet, or use Marratech.

- If any of the above advanced interactive features are important and ease of installation, configuration and use is required and Internet Explorer is used by everyone we recommend only web based conferencing systems, such as Breeze or Click-to-Meet.

For *large scale* use and *interoperability* to existing services it is required that a standardized interface is offered to those that do follow the recommendations above. This interface consists of support for H.323 and the GDS (Global Dialling Scheme and gatekeeper hierarchy) or SIP, and VNC for data collaboration.

Web based collaboration suites are becoming more and more mature. They make it possible to reach a large group of users that do not have to make large investments and have to follow a very short learning curve to enter the communication environment.
We predict they are the main tools to be used within two years, replacing existing services.
At this stage, however, there is no standard to couple the multitude of systems. Some support H.323 and/or SIP for video and voice interaction, other features are not available.
It is recommended to TERENA and NRENs to offer web based suites only if they support H.323 and/or SIP, so participants can join using existing tools, or through existing services, and let TF-VVC actively monitor vendors to create and follow standards to extend interoperability.

3.5 Recommendations on systems to use

Below recommendations are given on which systems to use in which scenario. These are based on systems is available today.

For a small pan-European project meeting with highly skilled and heterogeneous platforms using participants we recommend an H.323 system + VNC for data sharing.

For a small pan-European project meeting with less experienced users (where most use the same platform) we recommend a web based conferencing or –collaboration system, where people that do have the knowledge and equipment can connect to using H.323 or SIP.
For a presentation scenario with one speaker and a large audience we recommend using a streaming system with unicast and multicast streaming. We recommend using Windows Media since it has the widest range of quality formats and there are players for all platforms available.

For a presentation scenario where feedback from possibly all participants is needed we recommend a web based conferencing or -collaboration system.

4 Available services

The TF-VVC webpage http://www.terena.nl/tech/task-forces/tf-vvc/F/vc-services.html lists a number of VC services run by NRENs.
This list was used to contact the owners of the services and ask for updates.
Furthermore known contact persons from VC services or national gatekeepers not listed on the webpage (yet) were contacted.
All updates received will be included in the webpage.

The owners of the services were also asked whether the services will be extended any time soon (what the roadmap of the services was) and whether or not the owners were willing to let the service be used by others not belonging to their user group/constituency and if yes, under what conditions.

Mails were sent to Hungarnet, SURFnet, CARnet, Uninett, HEAnet, FCCN, DFN, FUNET/CSC, RedIRIS, CYNET, GARR, Cineca, Switch, Janet/Ukerna, ARNES, CESNET, BELNET, GRnet, RENATER, LANET, Poznan SCC, UNI-C, KTU (Lithuania), and maintainers of the Swedish national gatekeeper (24 total).
16 responses were received by September 28 [15 usable].

From the interviews it becomes clear that most services are still based on H.323. Some think about support SIP (mainly through new RADVision boxes, or as separate services, such as SER servers). Most SIP services are for voice only.

Almost all are investigating web based conferencing or –collaboration services based on the systems described in par 2.3.5. Timelines for going into operation vary between half a year (Q2 2006) to a year (Q4 2006). All start with small pilots that cannot be used for TERENA project group support.

The services described at TERENAs VC services webpage are all H.323 based, and usually consist of a registration gatekeeper (and a national gatekeeper, both connected to ViDeNet/GDS) and often an MCU that can be scheduled and used by registered users. Almost all have restricted the use to their own clients/constituency (sometimes wider than higher education and research).

There are several conditions under which these services can be used for international research or project groups. The replies (in no particular order) are listed below.

A general condition was that TERENA recognizes/accredits the group.
NB. This was put in the mail as an example, so it was leading the interviewee. All took that as a given, instead of a (new) requirement, and found it reasonable. In private conversation this was confirmed.

[Heanet] to be evaluated on a case by case basis. Usually granted when someone from the community asks to grant collaborators access. Restricted to gateway (dial-in) and MCU.

[SURFnet] if one participant belongs to our constituency, the whole group can use the scheduled MCU and gateway. Others only if we don't have expenses related to it and as long as we have resources available and free. Scheduled conferences by customers always overrule. Well-known H.323 clients need to be used. Registration at FreeLove GK or other GDS connected GK is required, no monitoring service/real-time help can be provided.

[FCCN] to be evaluated on case by case basis. FCCN should be contacted for special configurations (screen layouts, number of ports etc.).

[CARnet] we can allow the use of our resources to any international group (non-profit) as long as we don't have expenses related to it and as long as we have resources free.
[GRnet] available for others with proper registration at RTS webpage http://rts.grnet.gr/
[UKERNA] they may use it as guests of a registered JVCS venue. They can't use it without being involved in a conference which includes a JVCS registered venue. On first-come-first-serve basis. [A perfect example is the new JVCS-OnDemand service: http://www.jvcs.ja.net/ondemand/]
[Belnet] Concerning access to these services to international groups, recognized by TERENA we are open to provide these in case by case way if there is some needs expressed by one of these international groups. But the service is mainly provided to our customers and users.
[NIIF/HUNGARNET] The service is restricted to the Hungarian higher education and research community. However, it is a priority to support the national community. Free capacities could be used for any other international research and higher education purposes. [They already have some experience in supporting international groups] If you plan to ask HUNGARNET officially to support some project we need to create some kind of "usage conditions" document and we also have to do some internal negotiations. For the very first sight: Free capacity can be used on our MCU; Booking service can be provided. I can't tell you anything about costs, it depends on the operational overhead caused by those videoconferences. If e.g. the number of our MCU conferences increases 10x (not likely...) than probably we need some compensation.
[LANET] There are no restrictions to the Latvian higher education and research community! Also I think there is no restrictions to TERENA all users are welcome!
[Uninett] We do not offer any services for VC apart from the GDS/Videnet connection. As for TERENA activities I'm pretty sure if there ever was a need for a VC meeting that it could be arranged free of charge as long as there is free capacity (which there almost always is).
[Cineca - Service provider to Italian HE community] CINECA VC services are not restricted. Our services can also be used by international groups. A user/organization can demand for our services: if resources are available and feasibility conditions are met, we satisfy the request, asking for the payment of a fee. The main factors that are considered for the price policy are:
- if requestor is a Cineca consortium members institution
- if requestor is an academic institution
- if there is a specific agreement/collaboration with CINECA.
We may ask for a pricelist based fee, a cost-recovery fee or a thank you mail (but we generally aim to recover our costs).
[CSC/Funet] We are going to give up our MCU service and move recourses towards VRVS, Access Grid and Gatekeeper service. Our VRVS service (FUNET community) is mainly meant for Finnish academic users. Other users we will be selected case by case. But for example if some TERENA workgroup wants to use FUNET -community, we will give permission for that.
[Switch] (Note: is ahead in deploying web based collaboration systems) Yes, reservations on mcu resources, collaboration sessions and (in the future) streaming channels are restricted to SWITCH community members (as specified above) due to legal and financial reasons. What so ever, there is no restriction for 3rd party users, who would like to join a reserved or generated session by a SWITCH community member.
[DFN] Until end of this year our users have to pay separately for the DFNVC service. Starting with the X-WiN as the successor of the G-WiN at January 2006 we have a bundle for DFNInternet and DFNVC and our users do not have to pay separately for the videoconferencing. It's included in the IP service. Today the service can be used in international groups if one member is customer of

DFNVC. We could extend this to all users of European NRENs if the other countries act accordingly. Such a service has to be symmetrical.
[ARNES] Services are available free for ARNES users, organizations connected to Internet over ARNES and their guests. Profit oriented service is not possible. [For international groups] if resources are available/free.

A special case is SURFnets FreeLove Zone (H.323 service). Here a free gatekeeper registration is possible for anyone (not restricted to higher education and research). The gatekeeper is connected to GDS, so one can dial-out or be dialled by GDS numbers. It also provides up to 9 ports on an MCU for ad hoc meetings in different video/audio qualities. This MCU cannot be scheduled and availability and support are not guaranteed.

SIP for now is only being used as VoIP protocol, some have implemented VoIP networks, but there are no public registrars or proxies. Some provide a gateway to the PSTN.
Three NRENs run a VRVS reflector, two a national reflector for local use (it leaves registration/administration up to the central VRVS site/server, but 'local' rooms can be booked), one public.
FCCN will set up seven AGnodes. CSC/Funet deploys AG too.
Other VRVS sites/reflectors and/or AG venues are left to the institutes of heavy users, e.g. university with HENP researchers.

All other mentioned web conferencing services are being thought about, some in pilot. Some bridge to ClickToMeet sessions at other servers.
[There are lots of complaints about the business models used by the vendors; prices are considered too steep for many NRENs]. With the exception of the following:

- HEAnet hosts a Breeze server that is dedicated for one client;
- There is use of the public Marratech rooms in Portugal;
- Switch has Breeze into production/operation since October;
- SURFnet announced to have Breeze operational in January 2006.

Usage restrictions and conditions for these (new) services will be the same as for the existing (H.323) services.

Only GRnet and Belnet have dedicated IM/presence server, but not integrated with other services. No other dedicated chat/IM services are foreseen.

5 Conclusion

Collaboration environments are rich in features, including audio-, video-, and data conferencing. The web based group collaboration tools promise a workable solution for small and large groups working on different platforms.

We believe that within 2 years these are the tools to use, and many existing services will have been updated.

Although these are the best tools to use, and they have the most advanced features, they may be over-qualified for many collaboration projects. These groups can be helped with good procedures and low-tech tools, such as phone conferences, email and screen sharing applications.

Therefore there should be a scale from low-tech, low-cost, feature-poor tools up to high-tech, feature rich, but often expensive systems, depending on the requirements of the groups. A list of them and recommendations on which to use is given in section 3.

Many groups can be helped by (re)using existing videoconferencing services available at several NRENs. It is recommended that TERENA, after determining the level of service that they want to provide, organizes these services, thereby setting up a procedure by which pan-European groups can use these existing services.

We strongly believe that currently offered services can be used right away and these are the way to go, although some NRENs running them will need to be convinced, and coordination and organizations of distributed services needs to be done.