Video conferencing solution for a nationwide company

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Introduction

Video conferencing is getting more and more popular nowadays. The conferencing and video technology has done a high progress in solving resolution and transmission problems during the last few years as well as the prices for video conferencing equipment has been propped down. All these effects make it interesting to invest money in a video conferencing system, rather than paying for flight ticket for central meetings.

Looking at the given situation, where a company has branches in Newcastle, Glasgow, Birmingham as well as in Manchester and where the headquarter is even further down south in London, the travel costs for a central meeting has to be taken in account:

Costs for travelling by train from branch to headquarter with ¨Standard Open Return¨ tickets can be described as:

Branch	*Costs for train ticket*	*Duration (both ways)*
Newcastle	£ 152.00	6 hours
Glasgow	£ 175.00	12 hours
Birmingham	£ 137.00	3 hours
Manchester	£ 150.00	6 hours
Sum	£ 614.00	27 hours

These prices are per person (second class) per meeting. Just imaging how many hours the employees spent to come to and return from a meeting in London, time in where they aren¨t able to work.

Nevertheless there are still problems connected with having a ¨perfect¨ video conferencing system. What is the latest high cost intensive system worth, when the transmission of the video, sound and data isn¨t fluent or getting interrupted during a conference? You may prefer spending money for flight tickets, rather than buying a company wide video conferencing system. So let us take a closer look into the set up of a videoconference system.

Description of situation

I am a self-employed IT consultant specialized in multimedia and videoconference (VC) systems. A former colleague of mine at university, which is now working at Nestle Plc. UK, has the responsibility to set-up a company wide videoconferencing system. This system has to be able to deal with basic as well as advanced multimedia content. He, Elliot Downy, remembers that I am working as specialist in this area and asked me for this reason to develop a suitable VC solution.

My company decided to accept the inquiry and sent me to Nestle Plc UK for an interview with my old colleague, in which I have to gain more information about the customer and the requirements.

My report, which I made after the meeting with Mr Downy, contains following information:

- The name of the company is Nestle Plc. UK. The subject of the business is the production of chocolate for the UK market.
- Nestle Plc has over 10 years good experiences with its IT supplier IBM and its business partner. Taking this fact in account, they have chosen to give the IBM Global Service Division the go ahead for drawing up a supply and service plan.
- Nestle Plc uses IBM computer on a client /server basis. The main server is located in the headquarter in London. Every branch has its own servers, which are sufficient to run the video conferencing system.
- In the branches a room for a video conferencing system is located in the main working area available and has sufficient places for group videoconferences or for needed demonstrations.
- Nestle has branches in Newcastle, Glasgow, Manchester and Birmingham, which have to be connected by the VC environment. Nestle's headquarter is located in London.

This assignment would be the offer to Nestle Plc UK, who has to decide to sign the contract for the installation of the video conferencing system or not.

Technical equipment

Available equipment:
In every branch following equipment is available for the implementation of the video conferencing system:

- Client/Server structure, which supports the use of videoconference
- IBM AS400 server
- Ethernet 100Base5 network
- Company wide groupware program Lotus Notes connected to a Domino Server.
- Meeting room with Ethernet connected to company LAN.
- Internet and Intranet connection.
- High capable cupper based network.

The London Nestle headquarter has following equipment available:

- Client/Server structure, which supports the use of videoconference
- IBM RS6000 server
- Gigabit Ethernet backbone network
- Ethernet 100Base5 network
- Redundant 100Base5 network
- Plans for introduction of ATM network, when available
- Fibre-class based network backbone

- Lotus Notes as groupware program. The Lotus Domino server is located in the headquarter.
- Meeting room with network access.
- Internet and Intranet connection.
- Back-up system and software
- Security soft- and hardware

Needed equipment:
Following equipment is not available or need to be upgraded to support the video conferencing system:

- Video cameras
- Video conferencing software

Local Area Network Types

Every branch and the headquarter of Nestle Plc. needs a Local Area Network for there daily business. Two LAN standards are available for this purpose

Ethernet (IEE802.3)
Three main different types of Ethernet network are available for the use in a Local Area Network (LAN). Ethernet LANs are organised as star or bus networks.

10Basex – Ethernet
10BaseX-Ethernet allows following different implantations:

- 10Base2: Thin Ethernet, cable category 2, max. segment length is 185 m
- 10Base5: Thick Ethernet, cable category 5, max. segment length is 500 m
- 10BaseT: Unshielded twisted pair Ethernet, max. segment length is 100 m
- 10BaseFL: Fibre optics cable, max. segment length is 2000m

All this variants allow a data rate of only 10 Mbps, which is not enough for a multimedia network system. You should also bear in mind the network is not only used for the VC, but also for daily business. The company or branch wide network has to cope with traffic generated by multimedia applications as well as other business applications used at Nestle Plc, therefore I recommend to migrate to 100Base5 Ethernet where not yet implemented.

100Base – Ethernet
100BaseX-Ethernet allows following different implantations:

- 100BaseTX: Cat 5 UTP[1] cable or type 1 or 2 STP[2] cable with a max. segment length of 100 m
- 100BaseFX: 62.5- or 125-micron multi-mode fibre optic cable with a max. segment length of 400 m
- 100BaseT4: Cat 3, 4 or 5 UTP cable with a max. segment length of 100 m

[1] UTP: Unshielded twisted Pair
[2] STP: Shielded Twisted Pair

- 100VG-AnyLan: Cat 3 or 5 UTP cable with a max. segment length of 100 to 150 m

100Base5 is nowadays a standard in networking in most companies. It offers a data rate of 100 Mbps, which is suitable for all purposes of multimedia networking and conferencing. Also from the point of cost effectiveness, 100Base5 networks are the choice for all network administrators and designers. A high number of affordable accessories are available for this network type. Therefore I would strongly advise Nestle Plc. to upgrade to this network configuration, where it is not yet implemented.

Gigabit Ethernet

As an extension of the IEEE 802.3 Ethernet standard, Gigabit Ethernet allows a data rate of 1000Mbps (1 Gbps). This enormous data rate is very useful in Ethernet backbones. ANSI X3T11 fibre optic cabling channels are used for this architecture. An implementation as company or branch wide main network wouldn't be necessary, because this data rate is up-to-now just needed in network backbones and the costs for an overall Gigabit Ethernet network would blow the company's budget. Videoconferencing is a killer-application for a network but it doesn't need a data rate of 1Gbps.
As Nestle Plc. is already using a Gigabit Ethernet backbone, no recommendation for such an implementation is needed.

Token Ring network

Token Ring networks are organised in rings, where a token runs through the network and manages the traffic. The data rate is limited to 4 Mbps or 16 Mbps. Cisco offers a 100 MB Token Ring solution, which I heard for the first time. As far as this limitation in data rate is concerned, I can't recommend using a Token Ring network for multimedia network purposes.

Telecommunication Technologies

To connect the branches among one another and with the headquarter different telecommunication technologies are available. The normal analogue telephone line is absolutely not suitable to allow video conferencing, so that other technologies have to be taken in account.

ISDN

ISDN is standing for Integrated Services Digital Network, which "involves the digitalisation of the telephone network, which permits voice, data, text, graphics, music, video and other source materials to be transmitted over existing telephone." Applications include " . high-speed file transfer and video conferencing" [Cisco 1999a]. ISDN is described in 3 layers: Layer 1 describes the ISDN-Frame, Layer 2 is responsible for the traffic control and Layer 3 handles the ISDN signalling.

Two different services are available:

- *Basic Rate Interfaces (BRI):*

2 B-Channels for data transmission: 2 x 64 kbps = 128 kbps
1 D-Channel[3] for control and signal information: 16 kbps
With framing control and other overhead the total bit rate rises to 192 kbps.
The BRI is specified under the ITU-T standard I.430

- *Primary Rate Interface (PRI):*
  33 B-Channels for data transmission: 32 x 64 kbps = 2.048 Mbps
  1 D-Channel for control and signal information: 64 kbps
  The PRI is specified under the ITU-T standard I.431

The PRI allows low quality multimedia VC and should be taken in account for the Nestle Plc. VC system for spontaneous conferencing and as well as backup solution in case of non-availability of the Leased Line.

Leased Line

The Leased Line concept works on the way that a company rents a line for telecommunication purposes from a telecommunication company. Most common are T1 and T3 lines, which offer a 10 Mbits or 100 Mbits leased line, which are dedicated just for the company, who rents that line. All data traffic (voice, text, Internet) can be handled through it. This concept guaranties the tenant full availability of the offered services.

BT has different offers (Ignite, MegaStream, KiloStream, etc.) for leased line customers, so that I would advise Nestle Plc. to get in contact with their network service provider to check different possibilities to connect the branches with the headquarter.

XDSL

Digital Subscriber Line (DSL) is ". a modem technology that uses existing twisted-pair telephone lines to transport high-bandwidth data, such as multimedia and video .."[Cisco 1999b]. Different variants of this technology are developed (ADSL, SDSL, HDSL, RADSL and VDSL), from which ASDL and VDSL are the ones with actual development. Network service providers use XDSL to serve customers on the "last mile", which means that customers have XDSL directly from there home and not just from the local exchange loop.

ADSL - Asymmetric Digital Subscriber Line

ADSL allows more bandwidth in the downstream than in the upstream. Using ADSL customers are always online, so that the dial-up process is eliminated. This always on access mode makes it ideal for video-on-demand, video conferencing and large file transfer. The users aren't tied to timeslots, where the connection is on. Files can be transferred before a meeting or VC at any time.
The data rate ranges between 1.5 to 8.0 Mbps as downstream and 16 to 640 kbps in full duplex mode. The data rate of European E1 ASDL modem can stated as 2.048 Mbps. ADSL is reflected in the T1.413 ETSI (European Technical Standards Institute) standard.

[3] The D-Channel can support transmission of user data under certain circumstances

VDSL - Very-High-Data-Rate Digital Subscriber Line
The VDSL is an enhanced DSL-technology with a downstream rate between 51 and 55 Mbps and an upstream rate of 1.6 to 2.3 Mbps using fibre optic cabling to reach these rates. VSDL is still in experimental stage, so that it will not influence our decision to use it in a VC system.

XDSL is a very new possibility to transmit high bandwidth data. It has the capacity to replace the Leased Line connection. It is not widespread in the UK these days. Germany has started an ASDL offensive and offers different types of ASDL solutions to its customers. An initiative named "ASDL-now" wants to make ADSL popular in the UK, but the prices are to high to makes ADSL affordable for everybody. BT also offer ADSL solutions, but the availability to use it for our VC solution is not given yet, so that we can't use this technique at the moment.

I strongly recommend Nestle Plc watching the development of the spreading of this interesting innovative technology. It may be soon an alternative to the leased-line-concept.

ATM
The Asynchronous Transfer Mode allows sending data, voice, video and frame-relay-data in real-time modus. The data rate varies between 1.5 to 622 Mbps. ATM uses a broadband ISDN protocol, which is defined in layers corresponding to the layer 1 and 2 of the ISO/OSI-model. It is used in high-capacity LANs or between educational bodies like universities.

This restriction in the availability of ATM doesn't allow us to use it for our VC system. As well the price for implementation would blow our budget.

Cable modem
Cable modems send data with a data rate up-to 500 kbps over the Cable-TV-Network. Because of the lack of known resources about availability in the United Kingdom, this technique will not be further discussed.

Audio Compression

Audio data in a videoconference is a very important form of information, especially in multicultural conference, where it is crucial for the success of the meeting and negotiated papers. For that reason audio and voice compression has to be handle with care.

In the field of compression two techniques are available: Lossless compression and lossy compression. Lossless compression is used in data compression to ensure that no data gets lost. I will say more about this technique later under data conferencing.

Audio compression uses lossy compression. We understand lossy compression as a technique where redundant information gets lost during compression. This can be done well with audio data, because not every bit is necessary to understand the meaning of a spoken text.

For our VC solution we assume following figures:

A channel capacity of

ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
128 kbps	2048 kbps	10000 kbps	8000 kbps

These values are the max. values, which we only would get when no one else uses the same line to the same time.

Assuming following audio files:

Sound clip:	CD-quality
Duration:	85 sec.
Bandwidth:	22 kHz
Sampling rate:	44.1 kHz
Resolution:	16 bit per sample
Total bit rate:	16 * 44.1 kbps = 705.6 kbps
Data volume:	59,976 kbits / file

Voice:	Telephone quality
Duration:	15 sec.
Bandwidth:	3.1 kHz
Sampling rate:	8 kHz
Resolution:	8 bit per sample
Total bit rate:	8 * 8 kbps = 64 kbps
Data volume:	960 kbits / file

The transmission of the files would take using

Files	ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
Sound clip	468.5 sec	29.28 sec	5.9 sec	7.5 sec
Voice	7.5 sec	0.5 sec	0.1 sec	0.1 sec

It is obviously that we have to find a way to speed-up the transmission of the sound files, especially the sound clip. Bear in mind that these transmission times are not realistic, because we would never have the transmission line solely for us alone. The lines are used by all employees in the company, except the ISDN (which is a dial-up line) line, so that the transmission time increases.

What compression techniques are available to address this problem?

Shorten

Shorten is a freeware programme, developed at the Cambridge University (UK), which uses the Huffmann Code to compress waveform files (PCM encode audio files). The signal is split in 128 or 256 samples and 4 functions are built (original function, 1st, 2nd and 3rd derivation of function). From each function the variant is calculated. The functions with the smallest variants will be compressed with the Huffman Coding.

This compression needs a high amount of calculation during compression and decompression, which makes it not very useful for our VC system.

DPCM
Differential Pulse Code Modulation (DPCM) uses Pulse Code Modulation. The first signal is fully recorded, whereas the following pulses will be recorded as the difference from the original one. Using this method, the amount of recorded data falls. The bit rate drops and the transmission time goes also down.

This method allows compression of audio signals without a high calculation process and may be used in our VC system.

ADPCM
Adaptive DPCM uses also Pulse Code Modulation. The difference is that it records just the difference between the original signal and the following signals. As well as in the DPCM the bit rate falls significant and the data volume gets less high so that the signal transmission is faster.

This method should be considered as a compression technique in connection with the implementation of VC system.

-Law
The –law transformation is one of the fundamental technique of audio compression and is recommended by the CCITT in C711. The transformation is done by a logarithm process, which will lead to a compression rate of 2:1 at a 16 bits per sample file.

The –law coding doesn't have a high calculation process and adaptation in streaming mode is possible. This compression would be useful for compressing the voice signal in a VC system.

Dumb circuiting
Dumb circuiting encodes only signals over a specified level of volume. This technique decreases the amount of data in a certain degree and doesn't have a high a demand in calculation processing. This makes it ideal to use in VC system.

MPEG
MPEG (Moving Picture Expert Group) is nowadays the most popular way to compress audio signals. The most up-to-date version is MPEG4, which is not yet widespread used. With MPEG data high data compression rates are possible without loosing the CD quality. The most audio file sharing systems, like Napster or Gnutella, uses this compression algorithm in the version 3.

MPEG contains 3 layers, which have difference responsibilities. To explain the compression algorithm behind it would go beyond the scope of this assignment.

MPEG needs a high processing capability during encoding and less capacity during decoding. In a VC system a real time MPEG coding is not a useful implement because of this fact, but it can be used before a conference to encode data, which can then be send to the participants of the conference.

Video Compression

Video uses as well as audio compression the lossy compression technique, because not all frames need to be compressed. If some (redundant) information gets lost during compression, the result is still recognisable by the user.

Video streaming is really the killer-application for the Internet, because the amount generated data, is multiple times higher as audio data. I want to give one example

Assuming following values

Video film:
Duration: 65 sec.
Colour depth: 8-bits
Resolution: 320 x 240 pixel (= 76.800 pixels)
Frame rate: 15 frames per second

The bandwidth for 1 sec. is:
15 x 76.800 x 8 bits = 9,216,000 bps = 9,216 kbps

For the whole film the bandwidth is:
9,216 kbps x 65 sec = 599,040 kbits = 599.04 Mbits

Assuming the same Channel capacity as in ¨Audio Compression¨ of

ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
128 kbps	2048 kbps	10000 kbps	8000 kbps

The transmission of the files would take using

Files	ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
Video clip	4,680 sec	292.5 sec	59.9 sec	74.9 sec

It is obviously that we have to find a way to speed-up the transmission of the video file, because uncompressed use of video data is not possible. Bear in mind that these transmission times are not realistic, because we would never have the transmission line solely for us alone. The lines are used by all employees in the company, except the ISDN (which is a dial-up line) line, so that the transmission time increases.

What compression techniques are available to compress video data?

Two compression ways could be stated:

- Inter-frame compression: "Inter-frame compression uses a system of key and delta frames to eliminate redundant information between frames. Key frames store the an entire frame, while data or difference, frames record only inter-frame changes." [Ozer 1995]
- Intra-frame compression: "Intra-frame compression is performed solely with reference to information within a frame. It's performed on pixels in delta frames that remain after inter-frame compression, and on key frames.".[Ozer 1995]

I want to concentrate myself on the intra-frame compression and describe some of these techniques:

RLE - Run Length Encoding

RLE is an extremely inefficient mechanism and therefore will not be described.

JPEG – Joint Photographic Experts Group

JPEG is recognised as a standard for intra-frame compression by the CCITT and ISO and is used for still images. The compression works in three steps. The first step, also known as encoding mode, divides the picture into 8 x 8bits blocks and converts the colours and pixels into frequency of colour-shifts and the amount of colour change (amplitudes). These values are categorised by frequency and average in the second step. The original values get lost. In the third step, after quantization, a further compression using an RLE algorithm is taking place.

JPEG uses a simple algorithm, which makes it very fast. JPEG is used as intra-frame techniques in MPEG and can be used in VC systems. The range of compression could be given as 15:1 up-to 25:1.

VQ - Vector Quantification

Like JPEG, VQ divides the image into 8 x 8 bits block, but uses a recursive or multistep algorithm. This makes the compression intensive and slow, so that this algorithm is not so ideal for videoconferencing.

Wavelets

Wavelets are using different steps for compressing video data. First the frame is filtered with a high-pass and a low-pass filter to gather low-frequency/high-amplitude and high-frequency/low-amplitude information. This step will be carried out several times until the picture is completely encoded, before this information will be compressed with an algorithm that is similar to the one from JPEG. The final process is the Lossless compression using Huffmann Encoding.

Wavelets compression is a fast way of compressing intra-frame data, which makes it interesting for the use in a multimedia VC solution.

FC - Fractal Compression

Fractal Compression starts as well as JPEG or VQ with a splitting of the image into blocks. Similar to VQ the blocks are compared to find similar ones, but it doesn't store this information. FC converts it into equations for recreation of the image.

This compression is resolution-independent, which has the advantage of the possibility of zooming the image to any resolution. It is also fast and simple so that is used by Iterated Systems for fractal video codecs.

MPEG – Moving Picture Expert Group

MPEG can also be used for video compression and is used in some PictureTel videoconference products. A description to this compression mode can be found in the chapter "Audio Compression".

There are four different MPEG Standard specified with their corresponding application and Data rate. The range of compression could be given as 100:1 up-to 200:1.

Standard	Application Domain	Data Rate
MPEG-1	320x240 full motion video for multimedia and TV broadcast	1.5Mbps for VCR-quality video output
MPEG-2	720X480 full motion video for TV broadcast and video on demand	4-10 Mbps for broadcast quality output
MPEG-3 (no longer used)	High definition TV broadcast	5-20Mbps HDTV quality output
MPEG-4	Video telephony and interactive multimedia with small frames and slow refreshing rate	9-40 kbps for video telephony

[Amin 2001]

H.261 - px64

H.261 leads to compression rates between 100:1 and 2000:1, using intra- and inter-frame compression. As in JPEG and VQ the image is divided in blocks of 8 to 8 bits and encoded with movement detection, discrete cosine transformation (DCT), quantization and Huffmann encoding.

The application of this standard is in non-frequently change of images in use over ISDN. All web cam and videoconferencing tools support this standard.

Data Conferencing

Not only video and audio data will be transmitted during a videoconference. Also text data and presentation written in PowerPoint or Freelance Graphics may be sent to the

participants. So we have to take a look on this type of data and how we can compress them.

Assuming a maximum channel capacity of

ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
128 kbps	2048 kbps	10000 kbps	8000 kbps

The transmission of a 12 Mbytes (= 96 Mbits) presentation file would take using

Files	ISDN (BRI)	ISDN (PRI)	Leased Line (T1)	ADSL
Presentation	768 sec	48 sec	9.8 sec	12.3 sec

It is obviously that we have to find a way to speed-up the transmission of the presentation file. Bear in mind that these transmission times are not realistic, because we would never have the transmission line solely for us alone.

We can˝t use lossy compression to compress data files, because loosing bits in presentations or bit-files in general would lead to corrupt files. This problem takes us to lossless compression. Using this technique every bit in a file will be compress and no bit will eliminated. Popular products to do this compression are WinZip or Pkzip.

Packed Decimal, Relative Encoding, Character Suppression and Huffmann Coding are used for lossless compression. Huffmann Coding is the most commonly used one, so that I will concentrate myself on this algorithm.

Huffmann Coding, as a form of statistical encoding, is based on the frequency of characters. The higher the frequency the shorter the corresponding bit code. This algorithm works especially well with high volume data. Early developed, this coding method is still commonly used.

As far as data conferencing is concerned, we should discuss the need of transmitting (large) data files during a videoconference. Obviously it is useful and often necessary to transfer a file in a point-to-point VC between 2 participants, but for larger files still use other ways of file sharing (e.g. email, ftp-server, etc). It takes awful long to transmit a file during a VC using Netmeeting or another VC program. Large files can be transmitted over night, stocked centrally in an Information Warehouse or in groupware environment. I will discuss this strategy in the chapter ˝Conference set up and control˝.

In this chapter I want to bring shortly the critical view on video and audio data to your attention. Is it really needed and useful to see the participants of a VC all the time as a video stream? Wouldn˝t it be enough to have a still image of the person how is talking? Does the company need to send the video of the new advertisement during the conference? Wouldn˝t it be more productive to send the data out before a meeting? Think just a moment about these questions - and about your answers!

Video and audio streams are not the critical factor in a VC. The presentations, charts, numbers and figures as well as the spoken words are important for the success of a meeting like the discussion of the way of the business in the next quarter.

It would be more helpful for all participants to think about data delivery before the conference. Still images and good voice sound quality contribute more to a satisfied feeling of all conference members.

You may argue that the technique is so far developed and your company spends an enormous amount of money for its telecommunication, that video and audio streams should be used.

May I answer to this with another question? Have you ever been in a conference where you just understood half of the sound and could only see the half of the presentation clearly? This didn't make you happy, did it?

I hope, I convinced you to look now with a different point of view on a videoconferencing solution.

Conference set up and control

In this chapter, I want to make recommendations for the conference set up and control. I want to split my recommendation in two sections: One for group videoconferences in special equipped rooms and another one for person-to-person (1:1) conferences.

Group videoconference:

- Conference set up:

I found out during my meeting with Mr Downy from Nestle Plc. that every branch has a meeting room for around 25 people. These rooms are equipped with 100Base5 Ethernet connection to the local LAN. All members are using new IBM ThinkPads (600 Series), which are connected to an extern monitor at the employee's workplace if needed. This fact shows the possibility of great mobility. Every participant can take his notebook with him or her, so that the local data is always available and no media breach happens (i.e. no printed the presentation material is needed: cost efficient).

The only hardware, which has to be bought, is a VC system.
PictureTel, a company specialised in video conferencing systems, offer following products for group videoconference:

Venue 2000 – Model 30	Venue 2000 – Model 50	600 Series	900 Series

The corresponding data sheets are attached in the appendix. I would recommend a model from the 900 Series (950 or 970).

- Conference control

In every group videoconference the team leader has the responsibility to control the use of the system and to lead the conference. He or she has to be aware of some social issues during such a videoconference.
On the technical part, the conference software controls the VC.
The system and the room are booked electronically over the groupware Lotus Notes.

Person-to-person videoconference:

- Configuration set up:

All Nestle employees involved in the set up of a VC solution are equipped with a Notebook, which supports conference solutions. Questioning Mr Downy, I come to following recommendation:
Not every employee will be equipped with a web cam. For a group of 20 people 2 web cams will be available. Assuming that in every branch 2 groups and in the headquarter 5 groups will need this equipment, 26 web cam will be ordered. From own experience I recommend the use of Philips Vesta Pro Web Cams. They deliver high quality pictures, are easy to connect over USB, support the H261 video standard and are available for around £ 45.00 each (£1170 for all 26 web cams).

- Conference control

During a spontaneous 1:1 conference each participant has to take care that the conference is kept under control. This form of conferencing requires a high amount of self-discipline.
On the technical part, the conference software controls the VC.
Conferences, where no web cam is needed, can be started on demand (spontaneously) by each group member. The technical equipment can be obtained from the person, who is in charge of maintaining the web cams.

Communication Software

To start a videoconference we need as well software to run the conference. Different software, partly free of charge (e.g. MSN Messager, Netmeeting etc.), are available on the market. Nestle Plc. is currently using Lotus Notes R5 as their groupware program. Therefore I recommend using software that works together with this tool.

Lotus Sametime runs integrated in the Lotus Notes / Domino environment, which means it uses the functions of Notes during a videoconference. Sametime offers following advantages

- Compatibility to Lotus Notes
- Groupware functions available in VC (calendar, email etc.)
- Whiteboard available
- Channel switch without program switch possible (Voice <--> email <--> whiteboard)
- Up to 100 participants in one conference (no peer-to-peer conferencing)
- Supports application sharing
- Chat function
- Possibility to leave opposite participant a message, when he is not available
- Individual VC possible: VC on demand

- Participant can be asked, if he is free for VC
- Coded in Java (except client) runs on all OS
- SDK[4] for individual adaptation to own needs available
- Awareness: other participant is free. I can disturb him / her. Status option.
- Secure: Password to log-in …
- Server based (good administration)

Using Lotus Notes I would recommend further:

- Sending of presentation material before VC (over night)
- Bundle up of data stream: Server to server and then split to group member to reduce the bandwidth of the WAN.
- Central storage of meeting proposals on Domino server
- Sending link to data: Only the employee, who needs data, downloads it. This reduces sending redundant data.
- Organise meetings in Lotus Notes: Group diary function (less time consuming)
- If needed, place Domino server with frequently used data in all branches
- Set up a dedicated Domino server for multimedia data, when dealing with an increasing workload of such data.

Let me say something shortly about using a multimedia conference system in connection with chatting. A discussion over a VC system using TCP/IP version 4 is not possible, because the latency is over 1.0 second. This latency, time until data signal arrives at destination, is too high for a real-time discussion. The new IP version 6 will minimise the latency to under 0.5 second, where real-time discussion may be possible. An excellent paper for the latency aspect is the paper [Baldi 2000], to which I want to refer at this point.

Standards

Following standards came up in connection with videoconferencing.

T.120

T.120 is "A standard for audio graphics exchange. While H.320 does provide a basic means of graphics transfer, T. 120 will support higher resolutions, pointing and annotation. Users can share and manipulate information much as they would employ if they were in the same room though they are working over distance and using a PC platform. T. 120 will allow audio bridge manufacturers to add graphics to their products in support of a wide range of applications." [Videoconference 2001]

H.320

A recommendation of the ITU-T based on Discrete Cosine Transform, CCM and motion compensation techniques. It can be a video system's sole compression method or supplementary algorithm, used instead of a proprietary algorithm when two dissimilar codecs have needed to interoperate. H.320 includes a number of individual

[4] Software Development Kit

recommendations for coding, framing, signalling and establishing connections. It also includes three audio algorithms, G.721, G.722 and G.728. [Videoconference 2001]

H.323
Protocol, developed from the ITU, is used to allow the interoperation of applications from different manufactures. It allows their communication in package-oriented networks. They are working platform, program and network independent.

H.281
Protocol, which allows a far-end camera control [PictureTel 2000]

H.243
Protocol, which deals with multipoint control. Zooms to the person, who is talking with the highest volume. [PictureTel 2000]

Conclusion

I want to deal shortly with social issues in my conclusion. After solving all technical difficulties and problems, we have to take care about social topics arising during or after the implementation of a videoconferencing system. All of these issues have to be addressed.

Jerry Martin stated some social issues in his paper ¨Desktop Videoconferencing – First Steps¨ [Martin 1997]:

- ¨There are times when no one talks and everybody is just looking at each other.¨ Martin recommends that the moderator should direct the discussion to one person or restart the point of the discussion.
- ¨Occasionally multiple people start talking at the same time¨. Here should in according to Martin recognise one person and the other ones in order.
- ¨Some people may dominate the session¨. The moderator may need to break in to keep the conference on track.
- ¨… Individuals do not contribute.¨ For bigger groups may this be acceptable, but in smaller ones the moderator should encourage all participants to contribute, describes Martin.
- ¨It is helpful to direct questions or ask for input from specific individuals in the group.¨ to minimise gaps during a conference
- ¨People are not familiar with videoconferencing and feel free to interrupt while you are involved with a conference¨. If you have an individual conference, it may helps to state (outside your door) clearly you are in a VC and don¨t want to be disturbed. Close also your phone during the conference, recommends Martin.

When a company takes care of all this social issues, the videoconference system will be a tool, which helps to increase your meeting effectiveness and saves also money and time.

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