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Experiences with the FashionNet project - Distributed multimedia services for the fashion & textile industries

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Abstract

This paper describes the experiences gained during the FashionNet project, and presents some of the results obtained during a series of end-user trials. FashionNet is one of a series of projects funded by the European Commission that concerns the interconnection of broadband applications and networks which are distributed over an International area. The network infrastructure used was the ATM MoU Pilot network across Europe, which interconnects number of local ATM networks at sites throughout Europe. FashionNet is specifically aimed at how the distributed use of multimedia applications may be used within the European Fashion and Textile Industries. Trial scenarios typical of distributed multimedia usage in the Industries were conducted. The experiences gained providing an ATM service to support the applications and trials, both at local and at international network levels is described.

Keywords
ATM, Broadband LAN/WAN, Multimedia, Network Performance

Management of Multimedia Networks and Services R. Boutaba & A. Hafid (Eds.)

1 INTRODUCTION

It is now recognised that one of the factors that will aid the deployment of Asynchronous Transfer Mode (ATM) in the wide area will be the take-up of Broadband services across a wide range of Industry sectors, rather than on any one "killer application" (ACTS, 1994).. The FashionNet/Temin (project B3004) is one of a series of projects carried out under the Trans-European Network for the Integration of Broadband Communications (TEN-IBC) programme (TEN, 1993), funded by the European Commission DGXIII. The programme concerns the interconnection of broadband applications and networks which are distributed over an International area. FashionNet/Temin (Temin = Trans-European Marketing Intelligence Network) project is specifically aimed at the distributed use of broadband applications such as multimedia, within the European Fashion Industry. The project demonstrates the benefits to the industry, which may be achieved through the use of broadband applications such as multimedia databases, video conferencing and Computer Supported Collaborated Working (CSCW) tools.

In order to achieve this a series of trials were designed and implemented which reflected typical scenarios within the Fashion Industry where the use of distributed multimedia would be beneficial. The project ran in three phases, from September 1994 until January 1997 and during this period a series of trials was conducted. The trials were undertaken by a range of potential end users in the Industry, and this included both fashion design students, and commercial designers. The main objectives were to assess the performance of the applications running over an international ATM network, and evaluate the likely impact of the introduction of such new services through a subjective analysis of end users' experiences. Specifically, the investigations focused on the minimum bandwidth requirements and the network usage patterns obtained for each type of scenario; also investigated was the impact of any constraints imposed by the network (such as bandwidth limitation and latency) upon the HCI and usability aspects of the distributed multimedia services.

2 INTERCONNECTING THE TRIAL SITES

The applications used were distributed across a number of university sites that included Queen's University Belfast (QUB) and Trinity College Dublin (TCD), and research establishments including ADETTI in Lisbon, and IAO in Stuttgart. The sites were interconnected through the European Pilot ATM MoU network that connects to each EU member state (MoU, 1994). National access to this network is obtained through a country's broadband host network. The ATM Pilot network (now known as JAMES) was implemented by a collaboration (Memorandum of Understanding) initially among sixteen national telecommunications operators throughout Europe. The Pilot provides the

opportunity for both Operators and End Users across Europe, to deploy, evaluate and develop Asynchronous Transfer Mode (ATM) technology. There is at least one international node in each member country, the network has full logical connectivity at the virtual path level and currently supports PDH 34 Mbps (E3) and SDH 155 Mbps (STM-1) links. A number of benchmark services have been chosen to run over ATM; SMDS/CBDS, Frame Relay, CBR Circuit Emulation and in most countries, 'Virtual Path Bearer Service' that provides ATM to customer premises.

Figure 1 shows the participant sites along with the interconnecting network. All the trial sites have direct ATM connections through their country's broadband infrastructure to the ATM Pilot Network. Currently there are no switched ATM services offered over the ATM pilot network at the trans-Eruopean level, and semi-permenant CBR path connections were negotiated with each of the national operators networks, and with the JAMES consortium for access to the ATM pilot network. Note that in some cases the international links have to go through third party national networks. for example the Lisbon connection to the other sites is achieved via the Spanish access node to the ATM pilot network in Madrid.

The Queen's University Belfast (QUB) site consists of a local ATM network which was used to host an extended series of user trials. QUB is currently one of the nodes on the SuperJANET network (the UK academic backbone network for broadband services) with ATM services, as such it was chosen as the main trial site in the UK and Ireland. A local ATM network was established and a number of scenarios which are typical of broadband application usage in the Fashion industry were trialed. In addition, a number the other sites were able to connect to the QUB ATM network and remotely access some of the applications.

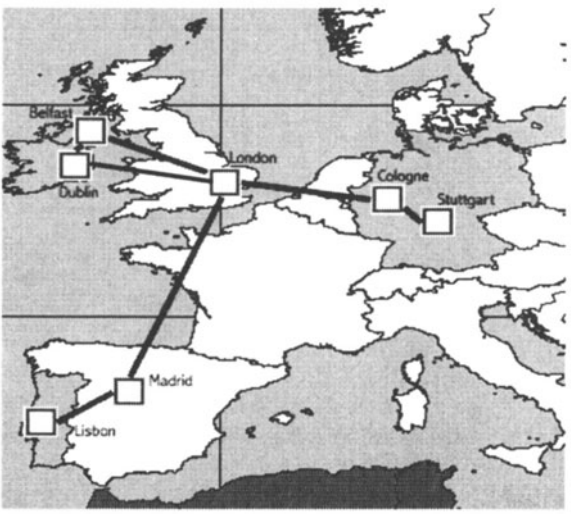

Figure 1 - FashionNet sites and interconnecting network

The experimental network at Queen's University consists of two Fore Systems ASX 200 ATM switches which are connected to a remote ASX 100 series switch (which interconnects up to 12 Silicon Graphics workstations as part of another TEN-IBC project, E = MC^2), the local network accesses the campus ATM switch (a General Datacom DV2) which thus provides 34 Mbps access to the UK SuperJANET network, and hence to the ATM pilot Network crossconnect in London (provided by BT). All connections between switches, and from switches to workstations and other equipment is via 100 Mbps TAXI or 155 Mbps OC3 interfaces. Most of the platforms are multihomedic, that is, they are visible on two sub networks : the ATM domain and an Ethernet domain. Both domains have individual IP addresses. This allows remote access from other sites with Internet connections. The majority of applications which are resident on these platforms communicate using either TCP/IP over ATM (AAL3/4 or AAL5), or native ATM. Figure 2 shows the local network at Queen's University.

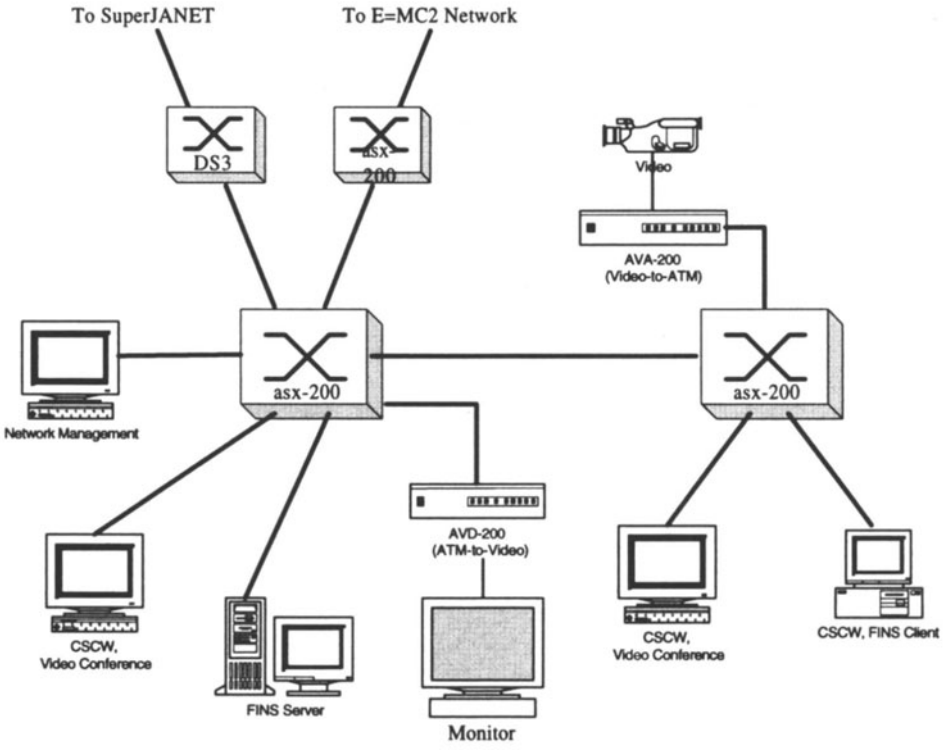

Figure 2 - Local ATM Network at QUB

3 BROADBAND APPLICATIONS

A number of applications were used throughout the trials and these reflected typical broadband services which would be required in an integrated environment. The applications used by FashioNet/Temin can be classified into three generic types : Multimedia database, shared working, audio/video conferencing. Additionally, a network management tool and associated monitoring and test equipment were also employed for trial configuration and monitoring purposes. The specific applications used were :

(i) *FINS*: a multimedia client server database. FINS (Fashion Information Network System) is a multimedia database produced by Nottingham-Trent University (Gray, 1995), it consists of a database comprising various forms of information relevant to fashion designers, marketing and sales. Such information includes the catalogues and addresses of suppliers, pattern and style sheets, as well as archived video clips of fashion events.

FINS uses PC-based platforms, which have both ATM and Ethernet interfaces. The ATM connections use LAN emulation protocols via AAL3/4 and AAL5. The server is multihomedic, allowing client access from either ATM networks (local or international), or from remote sites with Internet access. Remote access to the server has been demonstrated via clients at TCD, IAO, and ADETTI in Lisbon. Currently, access to the server is via clients running the Network File Sharing system (NFS) under the Windows NT operating system. However previous tests have successfully proved local access via Novel Netware using the IPX protocol. There were however, interoperability issues whenever remote clients need to access the server and this protocol is used (IP "tunnelling" for IPX is required which increases the overhead on the protocols). FINS usage has been examined in an extensive period of user trials and both the user responses (HCI, usefulness etc.) and the loading the application imparts upon the network, have been examined.

(ii) *Scribble:* this is a proprietary CSCW based application developed by ADETTI and TCD (Scribble, 1995) which resides on PC platforms. The application provides shared whiteboard services for use between fashion designers, and for design reviews. Using Scribble, designers may manipulate and review designs and other images obtained from FINS in a collaborative manner. Scribble employs ATM VBR connections (AAL3/4 and AAL5) carrying TCP/IP.

(iii) *ShowMe:* A Sun platform based audio/video conferencing system with shared whiteboard and application sharing capabilities. This package has essentially the same CSCW functionality as Scribble but operates in an integrated environment. As such, ShowMe was the main conferencing and annotation

application used during the trials. The ATM connections are AAL3/4 and AAL5 carrying TCP/IP.

(iv) *Video & Audio over ATM:* This is a dedicated video and audio system to transmit both raw and compressed video and audio over the ATM network. The connections are native ATM and the video and audio can be sent to either Sun workstations or via hardware decode, to monitor displays. Currently, only JPEG compression is supported due to the requirement for in-frame editing, which is difficult using inter-frame compression techniques such as MPEG.

(v) *HP Openview/ Foreview*: This is the network management and monitoring tool employed. For each trial scenario the network usage was monitored and recorded. Using HP Openview, it was also possible to remotely manage and monitor applications, equipment and end-connections at the other sites.

4 TRIAL SCENARIOS

Trials involving end users from the Fashion and Textiles Industries were developed in order to simulate a number of typical scenarios which are representative of how multimedia applications may be used in the design, marketing, and product review processes within the Fashion and Textiles environments. The scenarios defined were :

(i) Database usage in the Company
The FINS database provides on-line information which greatly reduces the lead times for new fashion collections, and for sourcing existing and new suppliers. The communications requirements are for a point-to-point retrieval service between the FINS server and one or more clients. Information retrieved may be purely text-based (e.g. supplier details), or it may contain high quality graphics (e.g. product catalogues), or video and audio clips. The end users here were concerned with the Design, Retail and Marketing sectors.

(ii) Expanding the Company's Range of Products
In order to enlarge a product range it is necessary to perform some market research in order to identify new trends, and also to extract photo-quality material from suppliers. The set-up for this scenario is essentially the same as for (i) with the exception that additional information can be inserted into the FINS database. The end users here were concerned with the Design sector.

(iii) Initial Design Brief
This scenario requires point-to-point synchronous working between two or more designers. Designs are shared between whiteboards using ShowMe and Scribble.

In addition, some audio visual dialogue (video conferencing) is required. The end users here were concerned with the Design sector.

(iv) Broadcast Presentation

A lot of users (e.g. sales managers) at different locations require to view pre-defined presentations of various screen images. The users are able to zoom into the screens but are not able to modify the sequence of presentation. The communications requirements of this scenario are for point-to-multipoint connections, synchronously working with a server. Applications used include Scribble, FINS, and an audio connection (ShowMe was used for this). A Broadcast service from one node to all others was also required. The end users here were concerned with the Sales, Design, Marketing and Management sectors.

(v) Store & Forward Collection Details

This scenario simply involves the rapid transfer of bulk information (e.g. screen images) to remote locations. The communication requirements are for point-to-point asynchronous operation, using file transfer and email. The end users here were concerned with the Sales, Design, Marketing and Management sectors.

(vi) Market Intelligence & Collaborative Design

This scenario is essentially the integration of all the previous. The scenario effectively becomes a support environment for the design, sales and marketing functions of a company. Furthermore, these functions may be geographically distributed. Applications used to support the range of tasks involved are as before. The communications requirements are for point-to-point and point-to-multipoint connections across all sites, however the majority of trails were performed across pairs of sites. Remote sites connected to these as individual participants for selected trials. Synchronous working across all sites was also required.

The trial scenarios and the evaluation methodologies were developed by the University of Derby, UK (BRIS, 1995) and the IAO Fraunhoffer Institute for HCI in Stuttgart. The specification and implementation details were undertaken by QUB, ADETTI and TCD.

In order to conduct trails across four international sites with (in many cases) end users who were not very computer literate, and within a specified timescale, an approach was employed to roll out the trails, which attempted to reduce the likelihood of system breakdowns due to incompatibilities between applications, and user systems, and across networks. This involved the decision early on in the project, to standardise as much equipment as possible, and replicate this at each site. The trials were then deployed in a phased manner: QUB and ADETTI were chosen as sites for local trials where the end users could become familiar with the applications, and the scenarios and trial monitoring could be refined. Initial point-to-point connection tests between each of the four sites were then undertaken to

validate the quality of the international links. It was found that the Availability and quality of the ATM Pilot network links was generally very good. The tests showed the measured end-to-end packet loss (using UDP over ATM) to be less than 1% across any link. During this phase, the majority of problems encountered concerned access to the ATM Pilot network via the broadband host network in each country. This involved negotiating specific routes between the end user sites and the ATM Pilot Network access point; initial problems involved inconsistencies in the ATM cell traffic policing policies used by each Public Network Operator (PNO), which tended to reduce the overall Peak Cell Rate (PCR) to that of the PNO with the strictest policy, and to increase the end-to-end latency during some of the trails.

After the initial tests were completed, the actual end users' scenario trails were undertaken. These were scheduled over three monthly periods. Semi-Permenant Virtual Circuit (PVC) connections were used (the ATM Pilot network does not currently support switched ATM connection services) and the sites performed the collaborating trials with each other in alternating pairs. The reasons for this were twofold. Firstly, the majority of the scenarios required only one other international connection with multiple local end users residing at the local sites. Secondly, the ATM Pilot network does not support multicasting ATM services. Although this is feasible on the network, it is not currently offered as a service. In order to allow simultaneous multiple connections, the project overcame this problem by creating an extended virtual LAN architecture over existing dual PVC links at each site. Routing between paths was then performed at the IP level.

5 TRIAL RESULTS

5.1 Local Trial Results

Figure 3 shows the peak cell rate obtained for each multimedia component during a two-way local trial. Traffic was monitored by inserting an ATM line analyser between an end user workstation and a local ATM switch. The graph therefore shows the total one-way measured traffic for each media component. The graph shows that basic graphic annotations (e.g. mouse & pen movements, text, object annotation) require very little bandwidth compared with voice, video and file transfers.Voice (64 kbps) and compressed video services are combined. The file transfer involved downloading a colour catalogue photograph of approximately 1 Mbyte. It may be observed that at 30 frames per second the average cell rate is about 4000 cells per second (cps), with peaks of about 7500 cps, the nature of this profile is very much dependent on the movement within the camera. Note however, the impact of performing a file transfer during a video conference; peak cell rates of approximately 11000 cps are obtained. It should be noted that during the local trials, the ATM switch was configured with the same traffic policing values as for international links.

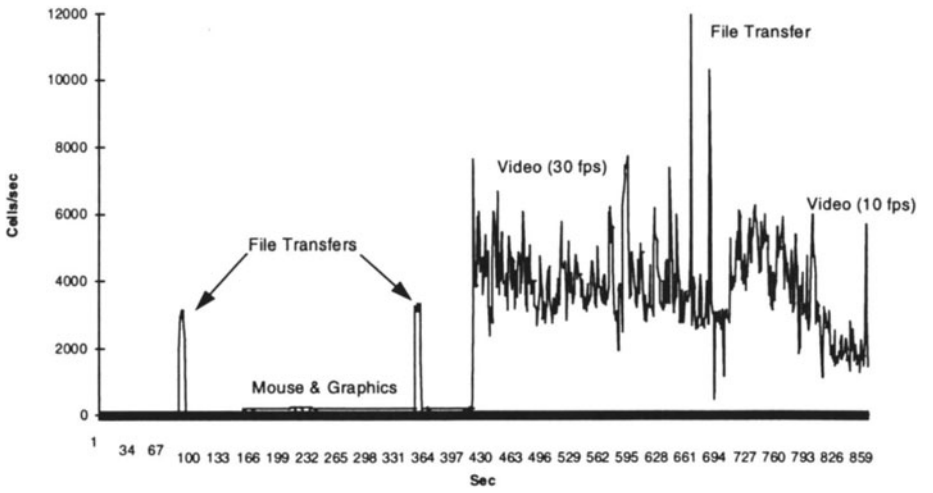

Figure 3 - Typical Peak Cell Rates for each Multimedia Component

5.2 Results for each Application

FINS - The max. data rate achieved for FINS is whenever a graphics file is loaded from a remote hard disk, this was measured between 170 kbps and 280 kbps (approximately 750 cps).

Scribble - The average data rate for the scribble session was around 300 cps. A large and a small image were pasted into Scribble. These resulted in bursts of around 2800 and 1100 cps.

ShowMe Video, Audio and Whiteboard - Full quality colour video (30 frames per second, high picture quality and high number of colours) resulted in a network load of around 4000 cps. The video rate varied according to the movements on the screen:

Rapid Movements - 3.3 Mbps
Average Movements - 2.0 Mbps
No Movements - 1.3 Mbps

Similarly, the Whiteboard data rate varied according to the movements :

General background/ No activity - 1 kbps
Intense mouse movements - 20 kbps

From the measurements made, each application was classified into a specific service type: Voice, Video and Data. The occupancy of each service type was then found to be:

Voice - 64 kbps	*3.1%*
Video - 1.3 Mbps to 3.3 Mbps (average 2 Mbps)	*96 %*
Data - 1 kbps to 280 kbps (average 20 kbps)	*0.8%*

5.3 International Link - Basic Measurements

A number of basic measurements were made across the links to each site. These included network latency, errors rates and availability of the service.
(i) Network Latency - The average round trip times for a (64 byte) ping (using Classical IP with no encapsulation) between QUB and the other sites were:
TCD (Dublin) - 48 ms IAO (Stuttgart) - 73 ms ADETTI (Lisbon) - 71 ms
(ii) Measured error rates - The measured lost (UDP) packets across any link was less than 1.5%; unfortunately there are no cell loss figures available for the same links.
(iii) Availability of Service - Generally the service provided by the ATM Pilot network was very reliable. The measured error rates show the link quality was good, and the link availability was also extremely high. Apart from initial set-up problems, there was only one occasion during the trials when the ATM Pilot Network was unavailable.

5.4 Selected Results from Fashion Design Scenarios

During the end user trials the network traffic was monitored and this information was used in the evaluation phase. Each design scenario was conducted over approximately one hour, and the network traffic was logged. The typical results below show the traffic transmitted between QUB and other sites.

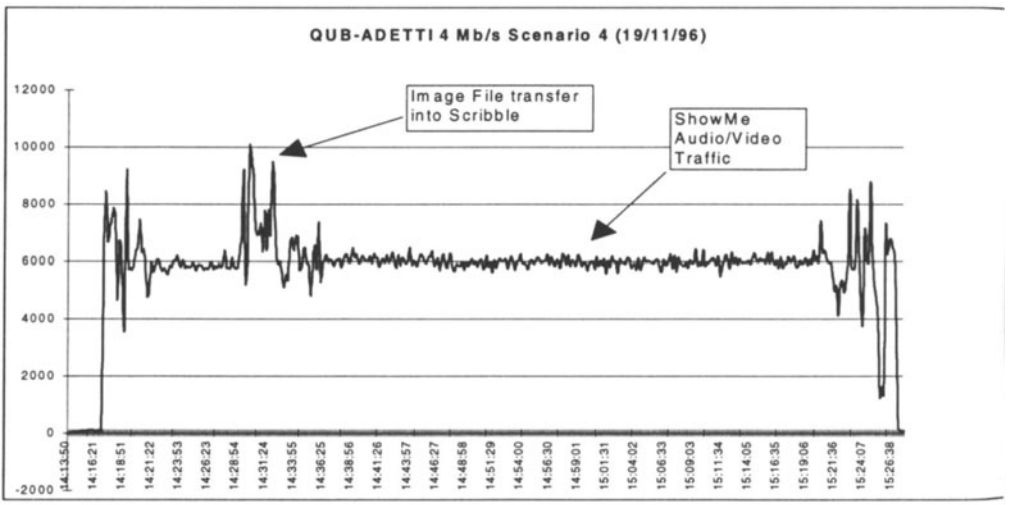

Figure 4 - Network Traffic during End User Trial (Audio/Video/CSCW)

Figure 4 shows the traffic load offered during a typical end user trial - Design Scenario No. 6. In this scenario the end users are involved in a video conference

throughout the session, this is shown by the underlying background traffic of 6000 cps (or 2.3 Mbps). In this scenario, the users have to access the FINS database, source a number of garments, fibre manufacturers and other relevant information, and paste the graphic images into the shared Scribble whiteboard where joint annotation takes place. The peaks in the graph represent the end users loading images into Scribble. It may be observed that this results in bursts of approximately 10000 cps (or 3.84 Mbps) for the composite traffic. This particular design scenario trial was performed whenever the maximum available bandwidth was restricted to 4 Mbps by setting the rate control on the NIC cards in the end users' workstations, and by setting the Usage Parameter Control (UPC) at the local switches (PCR= 30000 cps, SCR= 21600 cps, MBS= 100 cells, CDVT= 10mSec). In this case the composite traffic is seen to conform to the traffic policy (i.e. the PCR is less that 30000 cps), and no cells were dropped at the switch. Note that SCR values were held constant throughout the SuperJANET and ATM Pilot Network sections of the connection.

Figure 5 shows the network traffic observed during a typical multi-party collaborative video conference. For this session three the trial sites were interconnected (ADETTI, QUB & TCD) by the ATM Pilot network to form a Virtual LAN. This was achieved by setting the IP routing tables in each attached workstation. The graph shows the increase in traffic presented to the network whenever a third user is added to the conference.

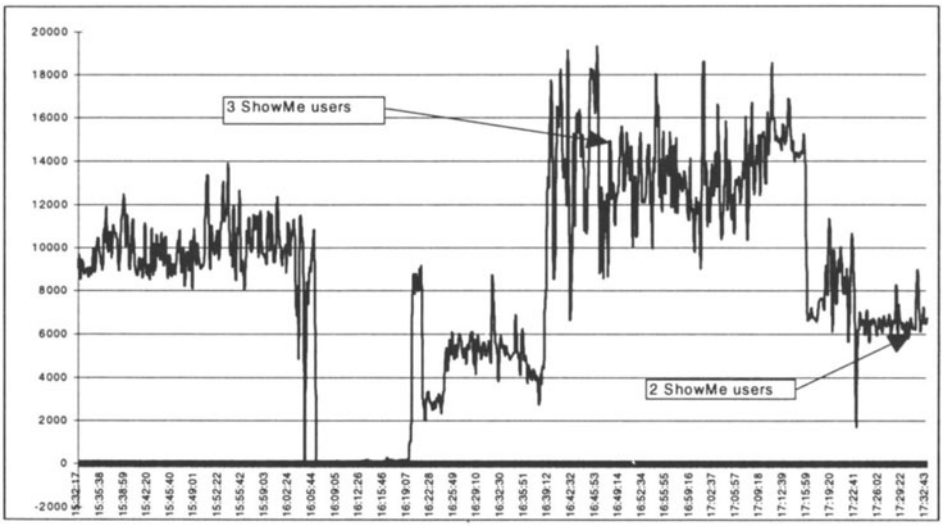

Figure 5 - Multi-Party Collaborative Video Conference

5.5 User Response Analysis

The Evaluation methodologies were developed by the University of Derby and this partner was also responsible for analysis of the end user data. A number of different evaluation methodologies were used to determine the users response to the system. The HCI and usability of each application was evaluated independently in the best possible condition (e.g. using Queen's local ATM network) (Ravden, 1989) and a cost/benefits analysis (Eason, 1995) conducted. The design scenarios were also tested in the same way. Breakdown analysis (Urqu, 1993) was conducted and network event data recorded. This provided a baseline for comparison with the actual trials.

Each scenario was repeated many times in both the local and international network trials over an extended period. The scenarios were run under different bandwidth conditions in order to establish minimum requirements and every scenario trial instance was evaluated for HCI, usability, breakdowns, and cost/benefits. Running each scenario many times allowed certain usage patterns to be determined.

The aim of the local trials was to test impact of the local ATM network and to get some idea of how well the equipment would perform under real-life conditions. To perform these local trials we invited 8 Fashion designers/Fashion students to come to QUB and perform various typical design scenarios using the equipment. The designers were broken into 4 groups (labelled A,B,C,D) and after a day's training on the network were asked to perform 4 different design scenarios. One of the major objectives of the trials was to implement bandwidth limitation on the links in order to emulate the conditions which will exist when using a standard bandwidth connection such as an E1 pipe (2 Mbps), E2 (8 Mbps) or E3 (34 Mbps). With bandwidth limitation, any bandwidth can be emulated up to the allocated maximum bandwidth of the channel. This allowed us to examine what effect the bandwidth of the connection between two remote designers would have on the usability of the equipment. To do this we defined 4 speeds (1 Mbps, 2 Mbps, 4 Mbps and 8 Mbps) over which these trials would run. The local trials at QUB were therefore scheduled to follow the plan shown:

	Speed of Connection			
	1Mbps	*2Mbps*	*4 Mbps*	*8 Mbps*
Scenario 1	A	C	D	B
Scenario 2	C	A	B	D
Scenario 3	C	B	A	D
Scenario 4	B	C	D	A

where A,B,C and D are the design groups. In the scenario allocation, group A gets progressively better speed of connection, group B gets progressively slower whilst C and D are either always high or always low.

5.6 International Trials

Once the applications and the network had been tested via the local trials a series of international trials were then conducted to test the viability of using the equipment to connect together geographically remote fashion designers. In order to do this professional fashion designers were invited to come to QUB to use the equipment to work collaboratively with fashion designers in TCD, ADETTI, and IAO. Again each designer was trained on the equipment and then asked to perform 4 different design scenarios at 4 different speeds of connection to check the usability at each speed. A total of 37 International trials were carried out from QUB during this period.

A detailed breakdown of the users' responses to the trials is provided in (B3004, 1997), however some of the results pertinent to the provision of broadband multimedia services are presented here. As expected, the users' responses to the system degraded as the bandwidth made available was decreased. Below 2 Mbps it was necessary to reduce the frame rate to 4 frames per second the system became effectively unusable; however there was little noticeable improvement in the users' responses as the bandwidth was increased from 4 Mbps to 8 Mbps. Unsurprisingly, video consumed the most bandwidth, however the analyses showed that voice quality has much greater influence on the users' perception system performance. Another important result was the strong desire to have all the applications integrated on one platform; the users found that using a separate workstation for video conferencing and collaborative working, and a PC for database retrieval was confusing. However it is felt that this problem would be resolved should a fully commercial service be initiated. The overall analysis showed that a mean bandwidth of 4 Mbps (in each direction), with Peak Cell Rate setting at greater than 15000 cps provided an adequate level of service, however users would probably accommodate something closer to 2 Mbps channels if the voice quality could be guaranteed and all the applications were presented in an integrated form on one platform.

One of the most interesting results obtained from the trials was the trend identified during long term usage of the multimedia database (FINS). Once familiarised with the system, the end users tended to concentrate more on the actual tasks in-hand such as database searches and less on the more visual components of the package such a video clips. The results shown in figure 6 correlate well with the findings of another TEN-IBC project "Mediator" (MED, 1995). This project was focused on the use of multimedia by journalists within the Newspaper Industry.

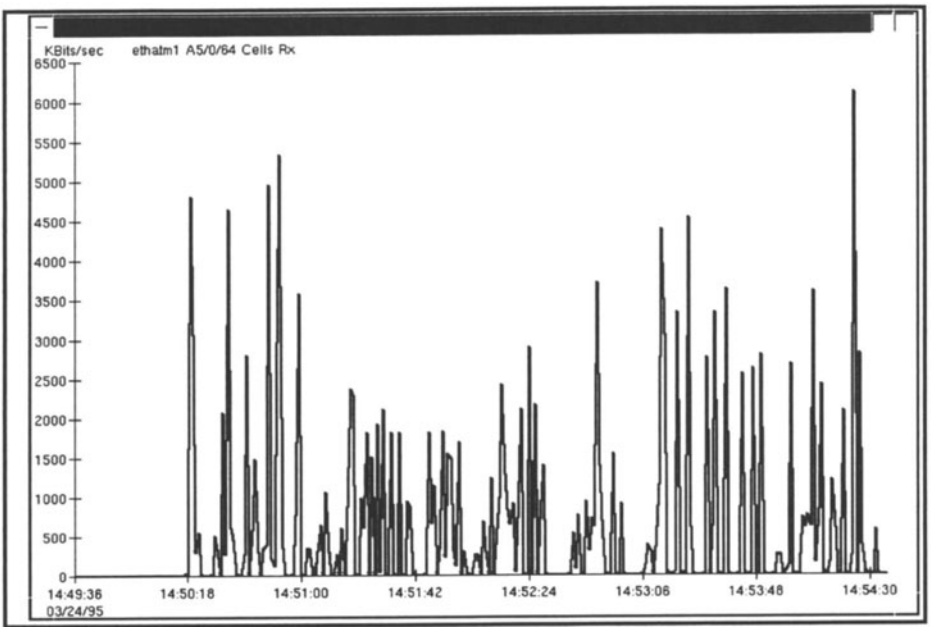

Figure 6 - Intensive FINS browsing

Evaluation of the end users' response to the trials also identified the requirement for a single network connection carrying all the multimedia component parts as one transparent service to as single integrated platform. Users tended to become confused whenever applications were presented simultaneously to them, but across more then one platform (e.g. FINS on a PC, video conference on a workstation). It is felt that the rapid integration of many of these types of packages will soon remove this issue (Adam, 1994). Another important result was the effectiveness of audio and video in removing issues such cultural differences and attitudes to new technology. It was generally felt among the end users that visual links to the collaborating partners engendered each partner to the overall task in a manner not achievable with audio-only and text-only interfaces. This also agrees well with findings from long-term teleconferencing experiments (Beadle, 1995). Additionally, the on-going analysis of the end users during the trials also identified two further requirements. These were (i) the need for an input mechanism to collaborative design other than a mouse (e.g. a pressure sensitive graphics tablet), and (ii) the provision of a high quality input/ output device for scanning in existing design ideas/material etc., and for printing copies of newly created designs. The later series of trails incorporated these features.

6 CONCLUSIONS

This paper has described the implementation of an experimental network architecture which has been developed during the FashionNet project. The projects has demonstrated the feasibility of delivering of broadband services to the European Fashion and Textiles Industries. Experimental trials have been undertaken with end users in these industries, and these have involved the interconnection of a number of local ATM networks at a trans-European level. This has been achieved through the use of the ATM Pilot Network and with the experimental broadband "host" networks in each member state. The Network architecture has now been established, and can be used as a testbed to implement distributed multimedia applications over a high speed network, both locally, and over international distances. The trials have indicated that the communications services provided by the network are generally acceptable to users in these industries. While reliability of the international ATM network was good, establishing consistent international connectivity is however, still problematic. This is due in part to the administrative procedures in the ATM Pilot Network; in this respect, a switched ATM service would be beneficial.

All the services which ran over the international network used IP over ATM as this was the one protocol that all the applications could use. However it is recognised that this is not the optimum solution, particularly for voice and video services. It was recommended that such services are integrated and provided to end users on a single platform with a native ATM connection. This would allow customisation of the individual service components (voice, video, data etc.) in order to achieve the optimum performance for a particular network connection.

In addition to establishing a series of technical trials, the FashionNet project has resulted in the formation of a "Business Interest Group" which consists of a number of end user companies in the Fashion and Textiles Industries, as well as service providers and application developers. It is intended that the project will continue through this group, by the introduction of further trials targeted at specific Industry sectors.

7 ACKNOWLEDGEMENTS

FashionNet/Temin (project B3004) was one of a series of projects carried out under the Trans-European Network, funded by the European Commission DGXIII. The project ran in three phases between October 1994 until January 1997. For further information regarding the project the reader is referred to (B3004, 1997). Much of this information is available via the Internet server:- http://dougal.derby.ac.uk/fnet/

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9 BIOGRAPHY

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