A platform for validating and demonstrating R&D results

AC094-EXPERT:

A Platform for Validating and Demonstrating R&D Results

The Experimental Platform for Engineering and Trials ("EXPERT") Project is one of the largest in the EU ACTS 4th Framework Program. It comprises 35 partners (network operators, manufacturers and universities) with a total budget of 21 million Euro. It began in October 1995 and its contract runs until the end of November 1999.

The collection of broadband facilities (Fig. 1) offered by EXPERT (applications, terminal equipment, ten different ATM switches, signaling capabilities and network inter-

MARTIN POTTS, BERN

working units) is unique in the ACTS Program. Indeed, such a supported platform offering open access for tests and

demonstrations is unique in all of Europe.

The main areas of work performed within the project are:
– Support and Enhancement of the EXPERT Platform
– Signaling (ITU-T and ATM Fomm) and Service-Related Control
– TMN and Resource Management
– Integrated Traffic Control
– Network Performance Evaluation Tools
– Teleconferencing Platforms

Work Items in the Project and Achievements

Support and Enhancement of the EXPERT Platform

As the title suggests, this activity has two main functions:
– To support the testbed equipment and users of the testbed [1], [21], [25]
– To enhance the testbed with new equipment, mainly with an APON access system, and an Integrated Services Switch [2], [14], [15], [17], [24], [26], [27], [28].

Due to its comprehensive facilities, a major role of the EXPERT platform is the support of the ACTS program. This is done by the hosting other ACTS projects in order that they can fulfil their objec-
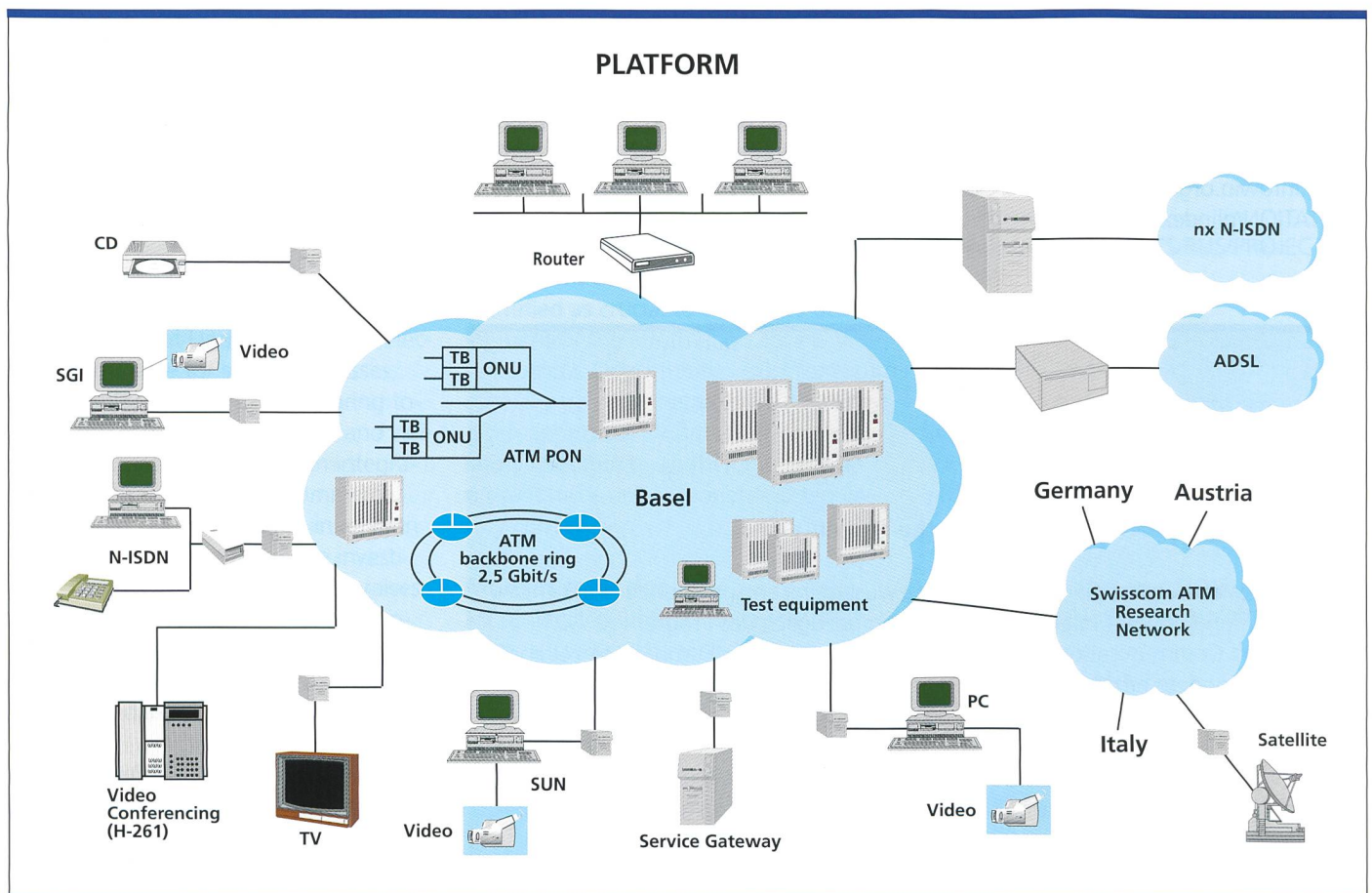

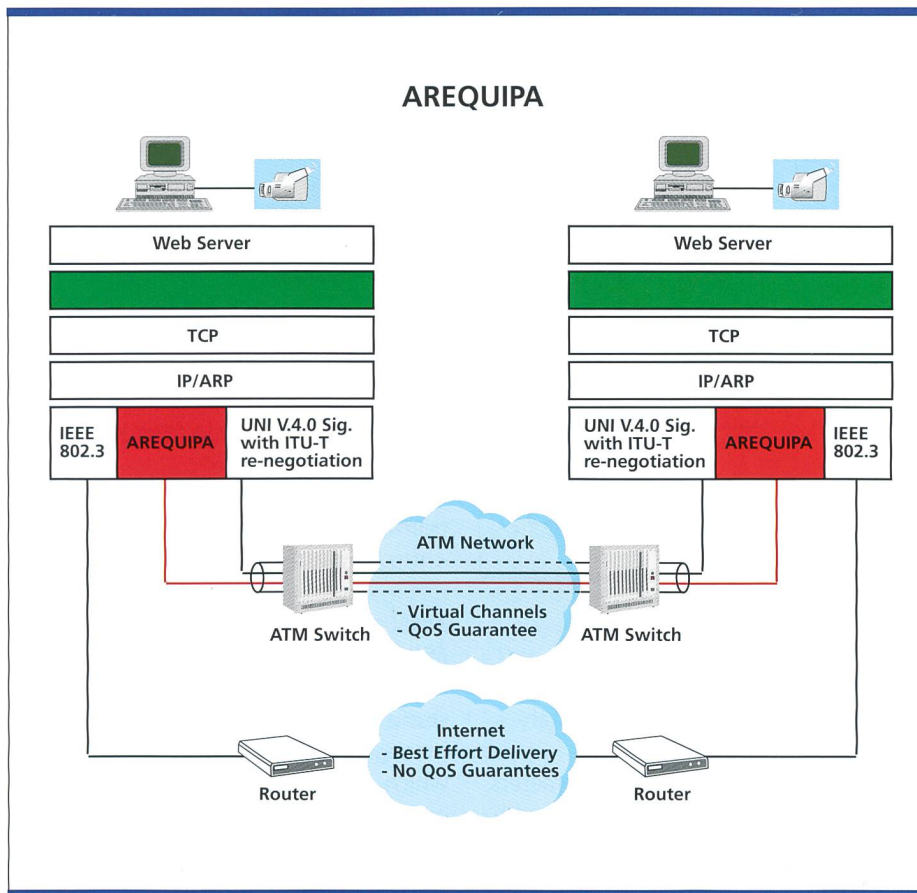*Fig. 1. The EXPERT Platform in Basel.*

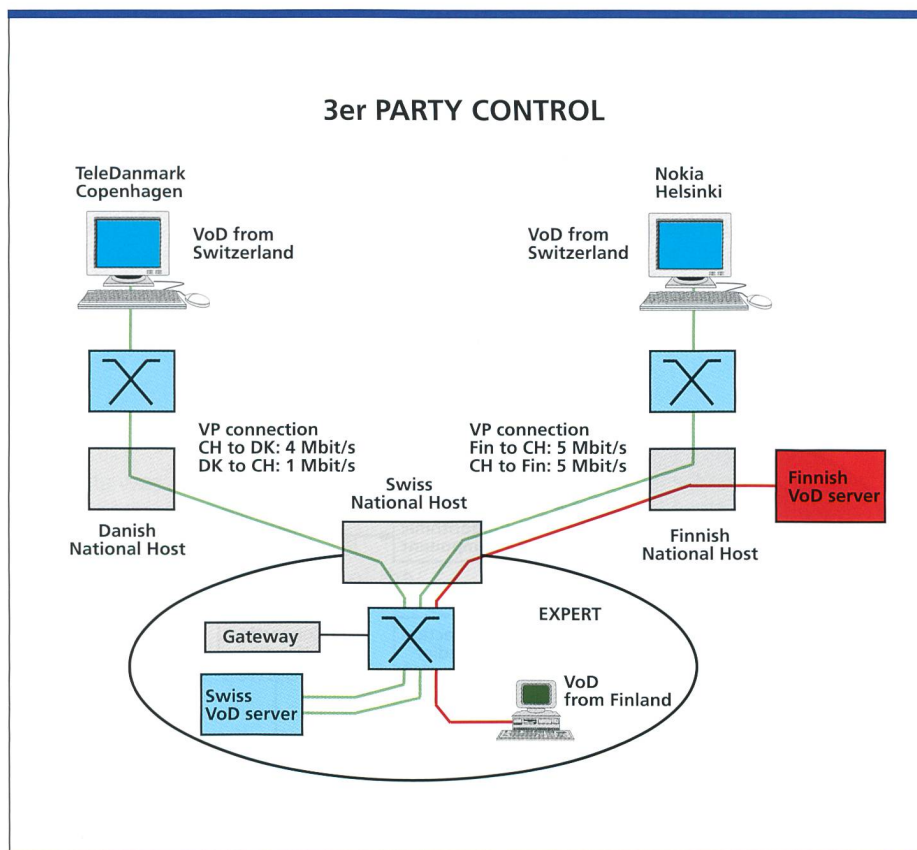Fig. 2. AREQUIPA (rfc 2170) IP with guaranteed QoS.

Fig. 3. Service-Related Control.

tives (e.g. in the fields of UTMS – in conjunction with the University hospital in Basel – accounting and signaling for ATM, interoperability between services nodes and access network from different vendors, tele-learning, monitoring of tests over the Internet and TMN aspects; particularly for network availability). Specific ACTS projects which EXPERT has supported recently include:

– NICE: EXPERT had a major role in a high-profile event organized by the NICE project in 1997. This linked an ACTS conference in Madeira with the Global Networking 1997 Conference in Calgary, and distributed the proceedings to approximately 20 further sites throughout Europe including many CEE states. EXPERT enabled a number of remote application demonstrations and an intercontinental panel discussion. For 1998, the organization of two similar events (Global-360 events) has been incorporated within the EXPERT project (see the work on «Teleconferencing Platforms» below).

– CA$hMAN: EXPERT is the main platform for CA$hMAN's ATM accounting measurements. Joint demonstrations were made at the 1997 Technical Audit, a National Host Forum meeting, the Second IDC Conference, and the "Global Networking 1997" Conference.

– BONAPARTE: EXPERT and BONAPARTE are working on a joint development of the VB5.1 interface between access networks and service nodes.

– REFORM: EXPERT provides the platform for REFORM's network availability tests. These mainly concern the reservation of spare bandwidth for critical connections and the re-routing onto these paths when a failure occurs. A successful public demonstration was made in January 1998.

– W⁴ATT: W⁴ATT uses EXPERT as the source for their system, which allows certain parameters from tests running on broadband testbeds to be monitored at distant locations (e.g. for use in university courses) via the Web.

– EXODUS: EXPERT is providing the location for the inter-working between a terrestrial and mobile broadband network, and facilities for testing and integration.

– DIVINE: DIVINE has developed a video-conferencing system, which can be operated between terminals connected to ISDN, ATM and IP networks. EXPERT is using a DIVINE system for evaluation purposes.
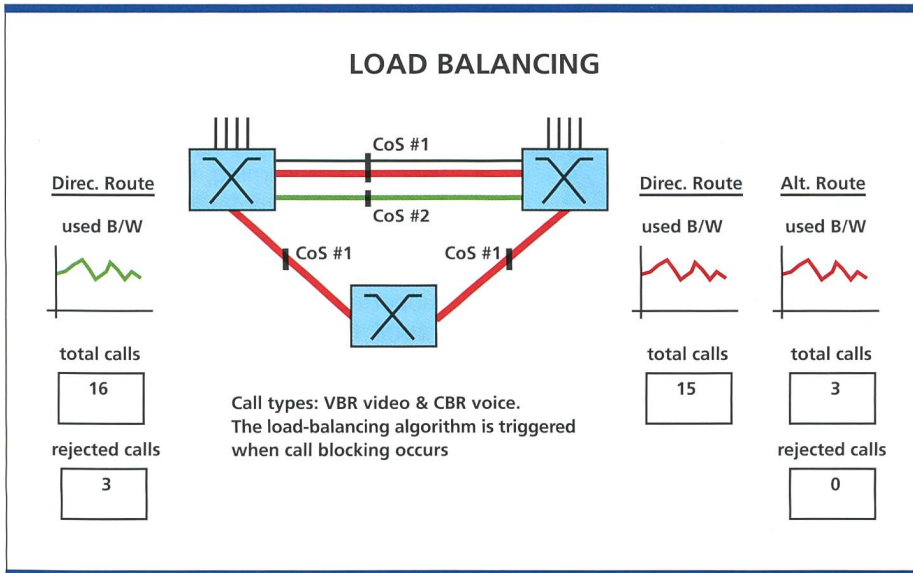
Fig. 4. Dynamic load balancing.

– COPERNICUS 579: EXPERT traffic generation and analysis capabilities are being used to perform practical experiments with Connection Admission Control algorithms, designed by the COST project of COPERNICUS 579.
In addition, EXPERT regularly used European ATM connections from the JAMES project and was a member of their three Special Interest Groups (Performance Measurements, ATM and the Internet, Multimedia over ATM) and the JAMES User Forum.
The EXPERT project also has a close association (and is co-located) with the Swiss national host. International connections outside of Switzerland were previously provided by JAMES. Now that the JAMES project has terminated, other means have to be found. Satellites are becoming increasingly interesting in this respect. EXPERT also has collaboration agreements with the CANARIE[1] Program in Canada and with manufacturers outside the consortium (particularly ATM Systems, CISCO, Olicom, and Wandel & Goltermann) who have provided equipment for use by EXPERT in return for the opportunity to conduct experiments on the platform and have access to measurement results.

Signaling (ITU-Tand ATM Forum) and Service-Related Control [03], [08], [11], [18]
Partners working on this activity have developed and validated two new features

from the ITU-T Q.2931 signaling standard, namely:
– In-call modification of QoS parameters (peak bandwidth), in conjunction with obtaining an IETF rfc (2170) for the AREQUIPA[2] protocol.
– Service-related control (third-party control).
The in-call modification feature allows the parameters of a call to be modified while the call is in progress (i.e. without having to clear down and re-establish the connection). The third party control feature enables an entity within the network to make a connection between two end points rather than the connec-

tion having to be made by one of the parties in the call. A particular use for this function can be to provide a retrieval service for customers without the customers needing to know where the source is located.
Partners working in this area also wrote a paper summarizing the position of the project regarding the co-existence of IP and ATM. This paper has been widely referenced, most recently in the popular German-language computer publication "ct–magazin für computer technik" (issue 11/98) in the article "Der Kamf um die öffentlichen Netze".
A position paper can be downloaded from the EXPERT Web site at <http://www.elec.qmw.ac uk/expert/>.

TMN and Resource Management [4], [5], [6], [9], [10], [13], [19]
Partners working in this area have studied and implemented resource management and routing algorithms, which allow the number of accepted connections to be maximized and the network resources to be optimized. The framework comprises a medium-term[3] strategy for re-allocating bandwidth to VP's, according to (dynamic) loading. As a by-product of this work, it was necessary to develop a mechanism to generate calls on a variety of different ATM switches. These at the time dind not support signaling, nor did the test equipment support the generation of traffic sequences using signaling.

---

[1] CANARIE. Canadian Network for the Advancement of Research Industry and Education.

[2] AREQUIPA: Application Requested QoS for IP over ATM.

[3] This procedure may be triggered (for example) once per hour.
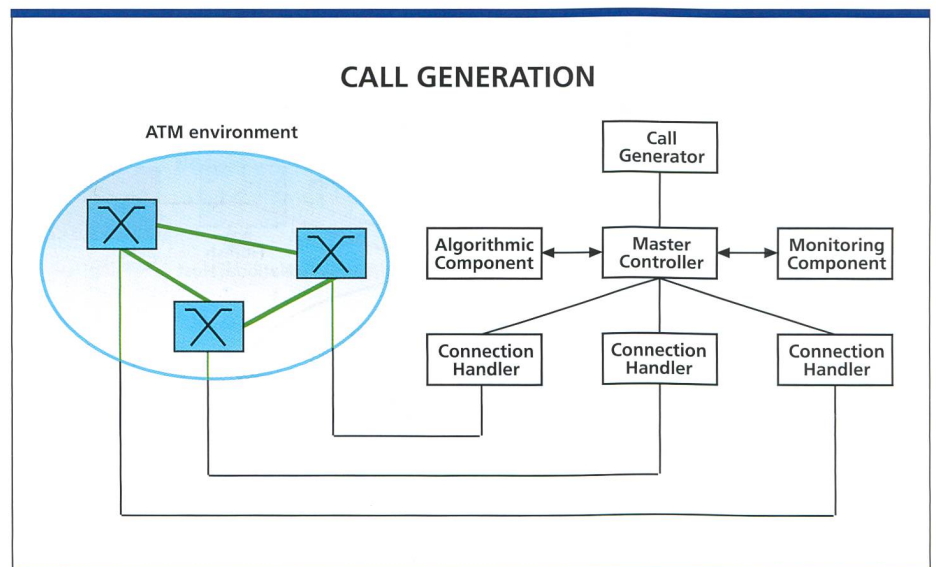
Fig. 5. Generic call generation.

References

Public Deliverables available via the project Web pages
<www.elec.qmw.ac.uk/expert/>

[1] Deliverable 01:   Report on External Liaisons and Dependencies, 1995
[2] Deliverable 02:   Specification of New Access Equipment and the VB Inter-
face, 1996
[3] Deliverable 03:   Specification of ATM Forum and ITU-T CS2.1 Signaling
Functions, 1996
[4] Deliverable 04:   Initial Specification of Bandwidth Management, 1996
[5] Deliverable 05a: Description of TMN Functionality (for routing strategies),
1996
[6] Deliverable 05b: Identification of TMN Enhancements (for routing strate-
gies), 1996
[7] Deliverable 06:   Specification of an Integrated Traffic Control Architecture,
1996
[8] Deliverable 07:   Specification of Service-Related Control Requirements,
1996
[9] Deliverable 08a: Interim Report on Bandwidth and Routing Trials, 1996
[10] Deliverable 08b: Further Report on Bandwidth and Routing Trials, 1997
[11] Deliverable 09:   Implementation of ATM Forum & ITU-T CS2.1 Signaling
Software, 1997
[12] Deliverable 10:   First Results from Trials of Optimized Traffic Control, 1997
[13] Deliverable 12:   Implementation and Integration of TMN Enhancements,
1997
[14] Deliverable 13a: VB5.1 Implementation, 1997
[15] Deliverable 13b: Final VB5.1 Implementation and SN/AN Inter-working,
1998
[16] Deliverable 15:   Definition of Optimum Traffic Control Parameters and
Results of Trials, 1997
[17] Deliverable 16:   Prototype Integrated Services Switch, 1997
[18] Deliverable 18:   Report on the Trials of Service Related Control, 1998
[19] Deliverable 19:   Evaluation of the Bandwidth and Routing Strategies, 1998
[20] Deliverable 20:   Evaluation of Optimum Traffic Control Architecture, 1998
[21] Deliverable 21:   Status oft he Platform, 1998
[22] Deliverable DN1:   Operations Report for the 3rd International Distributed
Conference, 1998
[23] Deliverable DN2:   Operations Report for the Information Society Technolo-
gies Conference, 1998
[24] Deliverable DV3:   B-BCCP Simulations and Experiment Definitions, 1998
[25] Deliverable 22:   Report of Trials made using the EXPERT Platform, 1998
Due in 1999:
[26] Deliverable DV4:   Implementation of AN Enhancements
[27] Deliverable DV5:   Implementation of SN Enhancements
[28] Deliverable DV6:   VB5.2 Experiments Evaluation

A scheme was devised based on adap-
ting a general-purpose call generation
algorithm to the specific manual
connection commands of each of the
switch types.

Integrated Traffic Control [7], [12], [16], [20]

Partners working on this topic have stu-
died and implemented schemes for con-
trolling traffic at the ingress of a net-
work in order to ensure that user QoS
requirements can be guaranteed, especi-
ally in a mixed-traffic environment [7],

[12], [16]. Typical scenarios included the
ability to guarantee CBR and rt-VBR QoS
in the presence of non-rt-VBR backgro-
und traffic, and the investigation of TCP
throughput when used over the UBR
and ABR service classes. The project was
one of the first to obtain ABR-capable
terminal adapters. This work resulted in
validated Connection Admission Control
schemes and recommendations for
handling TCP traffic in an ATM network.
A brief "engineering guide" summari-
zing the results is currently being compi-
led. Results in the area of multiplexing

gain that can be achieved by shaping
bursty sources are being quoted by com-
mercial companies.

Network Performance Evaluation Tool

The task to develop this tool was added
to the project in July 1996 (based on an
existing non-ATM network-planning tool
from one of the partners), and a first ver-
sion is already available for use. The tool
is an extension to normal network plan-
ning tools in that it allows the designed
network to be simulated, using models
for sources, switches, multiplexers and
links, and validated against measure-
ments made on real equipment from
EXPERT [16], [20]. In addition, special
procedures (simplifying the models and
use of variance reduction) were develo-
ped to minimize the simulation time,
which can otherwise be very extensive
for large networks. First users are offered
an attractive package (low licensing fees
and free support from the manufactu-
rers) to try out the current version.

Teleconferencing Platforms [22], [23]

This is a major new activity added to EX-
PERT in May 1998 to cover the world-
wide live distribution of two large EU
conferences in 1998.
– The Third International Distributed
Conference IDC), centered on the Lis-
bon EXPO98 exhibition in Lisbon (Sept.
25 – 28)
– The Information Society Technology
(IST) Conference in Vienna, which will
launch the EU 5th Framework Program
(Nov. 30 – Dec. 2).
EXPERT is responsible for establishing a
global ATM network to distribute impor-
tant presentations from these events and
toallow remote sites to input presentati-
ons and demonstrations. Furthermore, it
will interact with the main host site in or-
der to ask questions. Included in these
responsibilities are technical enhance-
ments to the ISABEL videoconferencing
application (e.g. porting to PC's and Li-
nux) and handling sponsorship arrange-
ments and links with TV companies, and
the operation of a separate program ma-
nagement environment running parallel
to the host conferences. Remote sites in-
clude locations in Central and Eastern
Europe, Canada, and Japan. In view of
the absence of the JAMES project, many
of the connections are being provided
via satellite and the MBONE, thereby
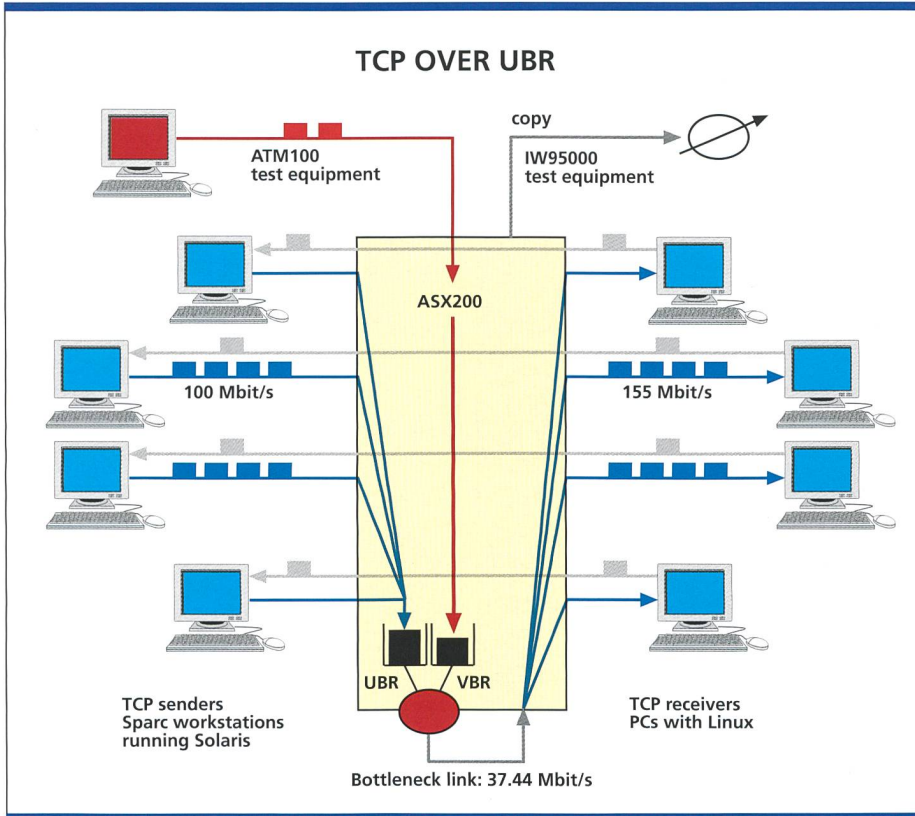bringing new challenges to an already

TCP OVER UBR

Fig. 6. Experiments of TCP over UBR.

Martin Potts *obtained a B.Sc. degree from Salford University (UK) in 1971. He has worked previously for Plessey (now part of the Siemens group), British Telecom and Ascom. He is now the owner of Martel GmbH based in Bern, which specializes in the management of international telecommunication projects. He is also currently the manager of the EU/ACTS EXPERT project in Basel, which operates one of the largest broadband testbeds in Europe. This testbed is used in joint experiments and demonstrations with other such platforms throughout Europe and in Canada and Japan. The platform works closely with the Communications Research Center in Ottawa on tele-educational "Virtual Classroom" events within the framework of a G8/GIBN project.*
He is the chair of the ACTSProgram consensus-building "Chain Group": Network Level Interoperability and Management, and of the "Chain": Global Network Interoperability. Martin Potts also chairs the group of new ACTS projects investigating innovative solutions for providing QoS over the Internet.

complex scenario. The network scenario for the first of these events (IDC) is shown in Fig. 8.

Apart from its innovative technical work, EXPERT is also very active in so-called "horizontal" activities for the general benefit and promotion of the ACTS Program as a whole.

As was mentioned earlier, through its work on "Teleconferencing Platforms" EXPERT is responsible for enabling the distribution of two high-profile EU events. EXPERT is not only providing a platform for application demonstrations, but also is acting as an important site for the physical interconnectivity between Eastern and Western Europe.

As part of the ongoing participation in the G7/GIBN "Virtual Classroom" project, EXPERT collaborates with the Canadian "BADLAB" (Broadband Application Demonstration Laboratory) testbed (from the CANARIE Program), and is using this application framework as the basis for an investigation of a new "Premium IP" service with QoS guarantees. EXPERT also provides much information for dissemination, through the following ACTS projects:
– INFOWIN (several references to EXPERT can be found in the "ATM Trials in Europe" booklet).

– ACTSLINE (providing information on the experiences from ACTS trials).
EXPERT plays a major role in the ACTS consensus-forming process and in producing concise, authoritative messages from the ACTS Program (in the form of guidelines). EXPERT holds the chairmanship in both the NI Chain Group and the Chain NIG. Global Network Interoperability and partners have initiated three

new NI Guidelines, which will be published in 1999:
– NIG-G3: Internet and ATM Co-existence.
– NIG-G4: Network Interoperability Issues from ACTStests.
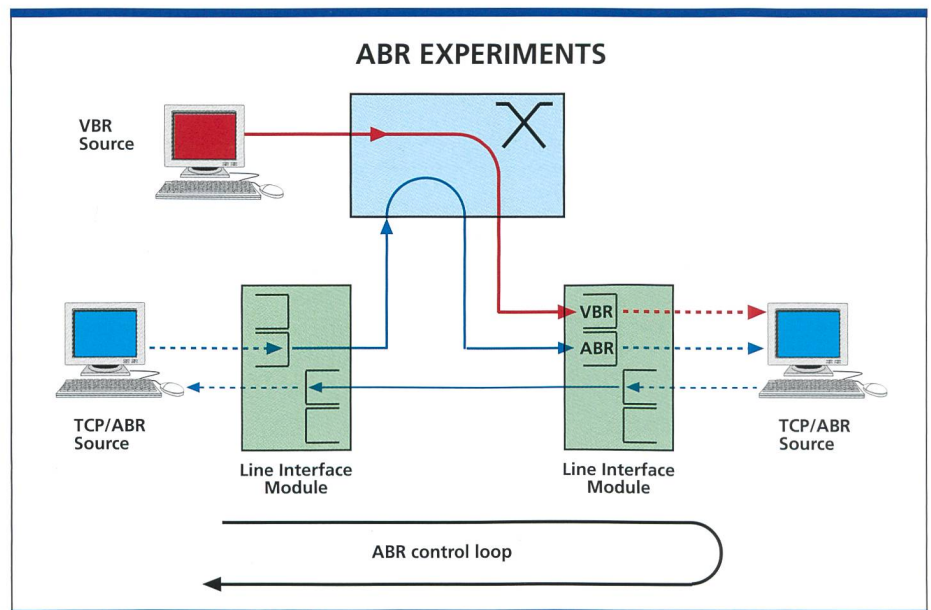
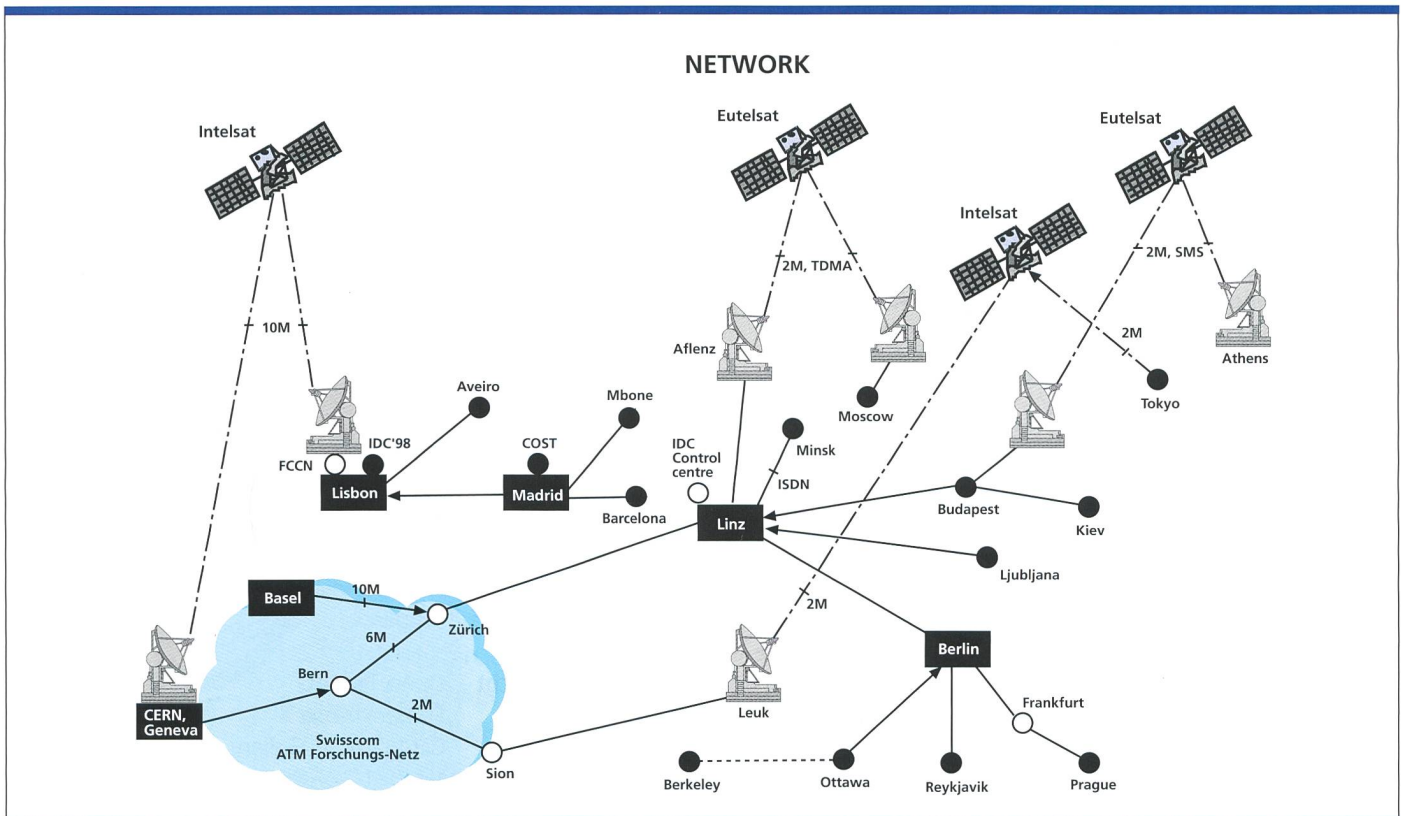## ABR EXPERIMENTS

Fig. 7. Experiments of TCP over ABR.

Fig. 8. The Network Scenario for the IDC '98 Conference (host site Lisbon) (links are 4 Mbit/s ATM, except where indicated otherwise).

– NIG-G7: Open Broadband Access Interface: The rationale for VB5 Systems.
The EXPERT project is a focus point for collaborative R&D work in Switzerland and is well known within the ACTS Program. Its profile is being raised further through the following synergies:
– The three main telecommunications-oriented programs of the EU (ACTS, ESPRIT and Telematics) will merge under the 5th Framework Program (1999 – 2003).
– The scope of the EXPERT platform is being broadened to include a greater emphasis on the demonstration of futuristic applications (while remaining available as an R&D platform). It will be re-named the MultiComLab.
– All Swiss telecommunications manufacturers, operators and universities are being invited to participate in the management, operation and support of the new MultiComLab (Previously, this role was performed by only Swisscom and Ascom).

Acknowledgements

4

Zusammenfassung

AC094-EXPERT

Das Projekt «EXPERT» (Experimental Platform for Engineering Research and Trials) ist eines der grössten Projekte im vierten Rahmenprogramm der EU. Es umfasst 35 Partner (Netzbetreiber, Hersteller und Universitäten) und hat einen Gesamtwert von 21 Mio. Euro. Es begann im Oktober 1995 und hat einen Vertrag bis Ende November 1999. Die Palette von Breitbandeinrichtungen, die von EXPERT angeboten wird (Anwendungen, Terminal-Ausrüstung, 10 verschiedene ATM-Switches, Signalisierungsfähigkeiten und Netz-Anpassungseinrichtungen) ist im Programm ACTS einzigartig. Eine solche unterstützte Plattform, die offenen Zugang zu Versuchen und Vorführungen bietet, ist in ganz Europa tatsächlich einmalig.
Die Hauptgebiete der im Rahmen des Projekts ausgeführten Arbeit sind:
– Unterstützung und Verbesserung der Plattform EXPERT
– Signalisierung (ITU-T und ATM Fomm) und dienstbezogene Steuerung
– TMN- und Ressourcen-Management
– Integrierte Verkehrssteuerung
– Netzleistungsbewertungs-Werkzeug
– Telekonferenz-Plattformen