Observations of an IT User in Charge of an ATM-MAN

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Beginning 1995, a regional ATM network extending over a 65 km diameter and more than 150 km fiber optic cable was built and operated by a group from the scientific community of the state of Bremen. Also, one complete LAN serving 500 users and some parts of LANs were rebuilt using ATM LAN-E as the base technology. This platform also supplied specific projects with ATM connectivity to locations in Europe and even Canada.

This project, called „Landesbreitbandnetz Bremen" catapulted the regional science and educational community as well as some small and big private enterprises from the era of some 64 or 128 kBit/s Internet access points, used in 1994 (plus one place of point-to-point broadband application piloting, at the AWI) to a general broadband experience in 1996. It was made possible by the financial means of the senators for economy and harbours and the staff of scientific institutions. It is devoted to research and development - mainly at the application level - and to general qualification, and understood as a tool to speed up the economical restructuring of the region, facing the „information age".

Some technical as well as organizational peculiarities cannot be understood without the knowledge of telecommunication law (near monopoly) and public and private funding of research (sparse) in Germany during this time. It was a main undertaking to overcome the legal and financial barriers - however, it succeeded within a year. Then, the core network (as well as the AWI campus LAN) was designed to become operational within 6 to 9 month, to provide broadband IP connectivity to available user equipment and LANs, while opening the possibility for innovative projects.

Consequently, ATM was chosen as the base technology to connect two routers at the main sites (and more , later) via PVCs carrying classical IP. Some sites were connected via ATM LAN-E only, from the start, to economize on routers. The campus network of AWI, which was rebuilt from scratch during the same period, was based nearly exclusively on an ATM backbone and LAN-E. Therefore, ATM signalling was used extensively from the beginning, as opposed to other pilot networks at that time. This somewhat risky concept - considering time and experience constraints - could only be realized by a design involving components from a single manufacturer. Cisco was chosen because early establishment of IP connectivity between existing campus LANs with staff experienced in Cisco products was a main milestone.

Today, the 155 MBit/s network connects about 30 "participants" - ranging from a single workstation with an ATM-NIC in a small firm to complete IP networks including a university campus. External connectivity is by access to the (IP-) science network "B-WiN" and the ATM network of Deutsche Telekom at 34 MBit/s each. Thus, the network serves as a backbone for utility Internet access for most of the regional science and educational institutions as well as a platform for specific R&D projects such as the G7 project SPOCK[2] which deals with distributed engineering in the aerospace industry, and the ACTS project EIES[3] which is to set up a trial communications service between European harbours.

Projects had access to European and transatlantic ATM pilot networks thanks to the JAMES project of the European Commission and the generous help of DeTeBerkom[4] and Rechenzentrum of University of Stuttgart[5]. As soon as February 1996 it was possible to establish Megabit ATM PVCs to Stuttgart and CRC, Ottawa, Canada in order to demonstrate distributed engineering, involving visualization and video conferencing components. Meanwhile, regular sessions have been held with Italian, Dutch, Belgian, Spanish and French participants. However, all but one of the applications used IP (over ATM) only. (The exeption is an experimental HTTP over ATM service)

Considerable effort had to be spent each time when a connection was established for the first time, adapting the configuration of user equipment or even border network switches at each end to the peculiarities of the other partner or intermediate networks.

Even today it is not possible to set up a connection by signalling - which is no surprise, considering that there is no agreed upon numbering plan as yet. However, once established, a guaranteed bandwidth for the end-to-end connections was provided as a minimum advantage over Internet connections.

Some observations - as of autumn 1997 - are:

- Building an ATM LAN-E based local area network with routers, ATM- and Ethernet-switches from a single vendor is - almost - a plug-and-play operation today, given some experience in IP-network operation.
  This was experienced at least on two occasions, when upgrading the MAN backbone ATM switches in autumn of 1996 and exchanging the complete backbone equipment of AWI in autumn of 1997 whithin three hours each (after preparation and experiments in the lab, costing some person-days).
- Under these constraints and given a little experience in ATM, LAN-E even proves useful in extending an emulated LAN to another city, on the fly.
  Plugging an ethernet-switch into an ATM-switch in Bremerhaven, setting the ATM-address of the LAN-E configuration server at the other institution in Bremen and assigning ethernet ports to VLANs took less than 15 minutes.
- It is somewhat harder to integrate workstations and ATM-NICs of different flavours into these emulated LANs as clients.
  This is simply due to the fact, that each vendor of Unix and ATM-NICs has a different way of installing and configuring network interfaces, assingning them to emulated LANs etc. In a project using heterogeneous equipment, distributed over the MAN in different institutions, with minor help from the MAN network managment it was too much overhead for the „users" to keep a LAN-E configuration stable over numerous OS and driver upgrades, during 1996.
- Integration of ATM equipment of a different vendor into the network remains to be a major undertaking.
  Two vendors agreed to set up showcases, involving video conferencing (with LAN-E based control connections) and MPOA, respectively, where two halves of each setup had to be connected over the MAN backbone as a carrier, from Bremerhaven to Bremen. Both were confident to install their demo in a day or two (as shown at the Networld and Interop), but failed. In a real world environment - as compared to the lab - and with real world support staff it may take person-weeks to connect complete ATM networks fully functional (1997)
- The majority of user equipment is not ready to consume multi-Megabit streams
  Since multimedia PCs have just arrived, much of the equipment on older LANs cannot transfer f.e. video data from the network- to the graphics-adapter at those rates. Many PCs even have difficulties to do simple filetransfers at more than 10 MBit/s whithout tweaking drivers - which would cost support at many places. Therefore, in this MAN the bottleneck has moved from the network to the PC, for the first time.
- No native ATM "killer"-application has emerged on desktops.
  The case for ATM to the desktop would be - for example - a video stream, an animation and a file transfer competing for an IP over 100BaseT attachment of a workstation to a switch, as experienced at a virtual (Übersee-)museum demo. Maybe this is a hen-and-egg problem at this time. After all: who else has ATM, at the desktop or the server? Maybe it is wait (for RSVP) and see. However, the question will be similar: who has (will have) RSVP, end-to-end?

Contrary to the beliefs of some in 1995, LAN-E seems to be simple enough to be stable, useful and performing in real world user- and operational environments. Maybe[6] LAN-E and its successors are the killer apps of ATM - if interoperability problems are solved.

This statement is derived from the truism that switching techniques, especially for the majority of ethernet-ready user equipment, are a winner. In contrast to a pure IP-switching environment, LAN-E opens the opportunity to serve some legacy (i.e.: non-IP) systems in the short term and provides an additional layer of administration and control (of security as well as cost) which may be welcome increasingly.

In my opinion the main keys for success in the contest of broadband network technologies are ease of use and quality of service - from the user perspectitive - and „cost of ownership", security and accountability - from the management perspective.

It remains to be seen, if a RSVP, IP-switching and/or big router router strategy can satisfy those key requirements easier, earlier or less costly (on a broad scale, end-to-end) than one based on ATM-switching and MPOA. The problems implementing the former could be as demanding or as simple, but numerous (at the end-points) as those with ATM LAN-E described in the observations on the Landesbreitbandnetz Bremen.

Currently, some project are in the design or implementation phase, which deal f.e. with an extranet for the harbours authorities and some firms involved in services for maritme logistics, with an emphasis on security; broadband satellite services and broadcast, conferencing and surveillance quality video which all require some special kind of quality of service. It seems, that it is easier - with currently evailable equipment and services - to implement these using ATM.

On the other hand, there are projects which f.e. need a close coupling between (compute-) servers, point-to-point. It seems to be easier to implement these using Gigabit-Ethernet. In a MAN environment this would require a transparent optical channel, end-to-end, to avoid uncertainties especially about latency. So in this application it is not Gigabit-Ethernet which challenges ATM but a future all-optical network.

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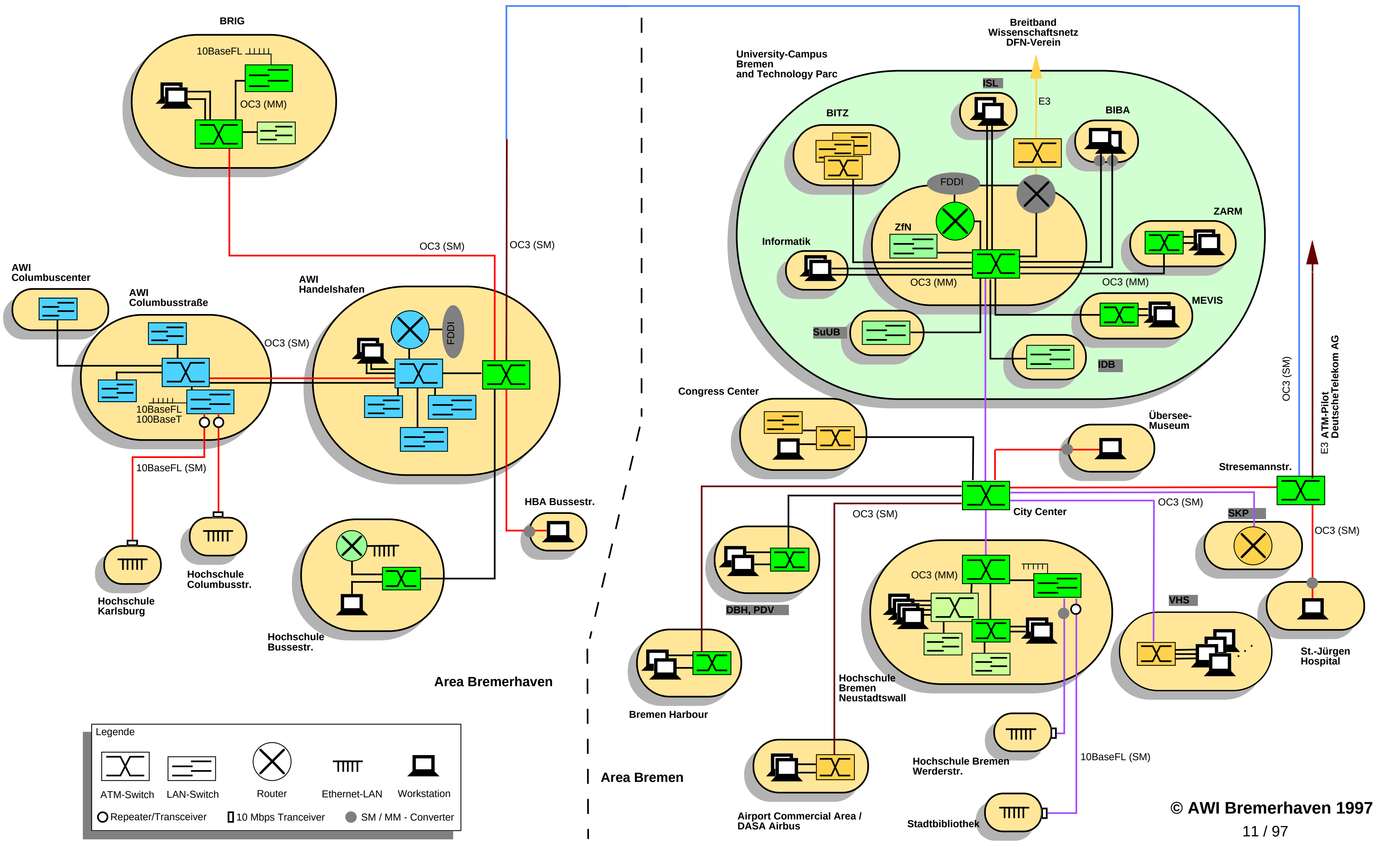
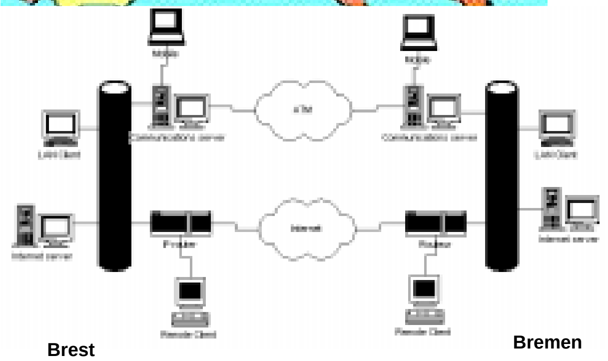
[1] http://www.awi-bremerhaven.de/EDV/Projects/AWI-LBN and references therein
[2] http://www.spock.hs-bremen.de
[3] http://www.isl.org/projects/eies
[4] http://www.deteberkom.de
[5] http://www.uni-stuttgart.de/Rus
[6] Vorhersagen sind schwierig, vor allem, wenn sie die Zukunft betreffen (Niels Bohr)
(Predictions are difficult, especially, if they relate to the future)

Bremisches Landesbreitbandnetz

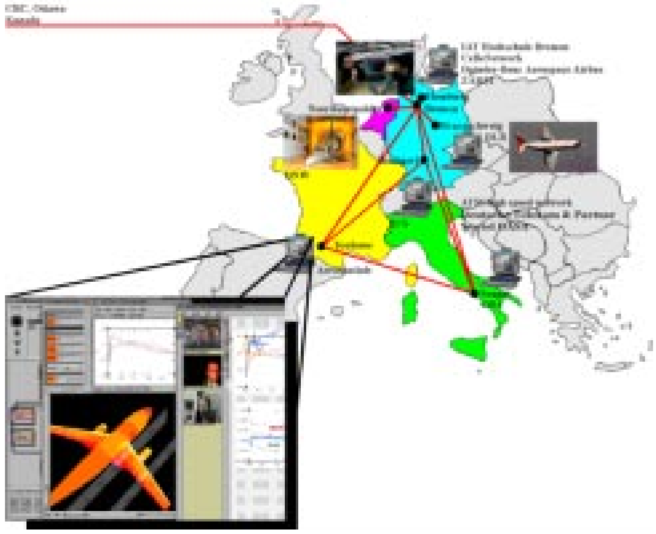


European Information Exchange Service for the Communication between Harbour Areas

http://www.isl.org/projects/eies

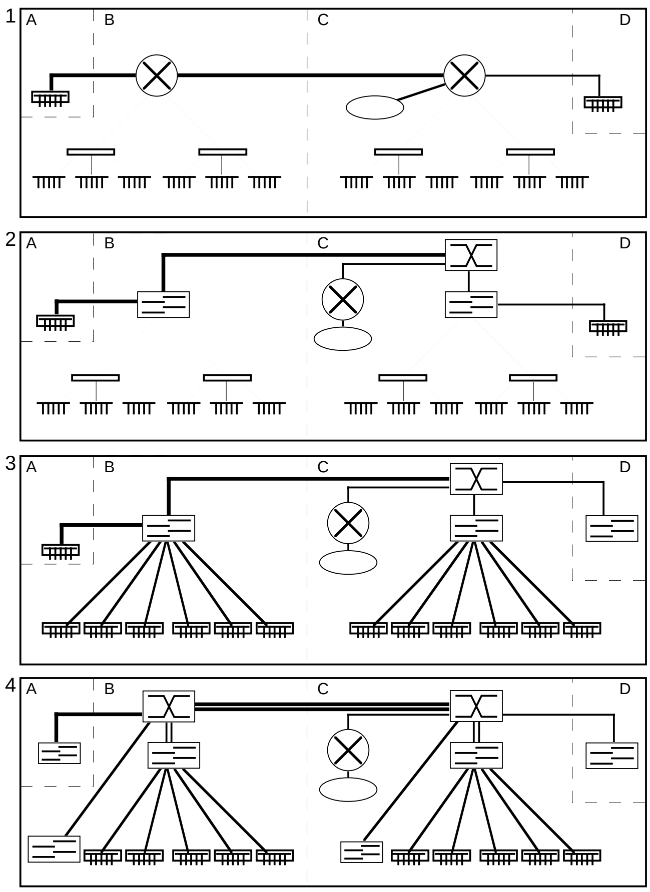


SPOCK



In the project SPOCK it is anticipated to integrate the disciplines of aerodynamic aircraft design: Computational Fluid Dynamics (CFD), Wind Tunnel experiment and Flight Test. This integration is based on the Computer-Supported-Cooperative-Work (CSCW) technology and aims the computerbased collaboration of geographically distributed teams via international ATM high speed networks and cooperation/ communication software.

http://www.spock.hs-bremen.de



Restructuring the AWI Campus LAN

4 Buildings (A - D) - 500 Users - 4 Snapshots (1 - 4)

Snapshot 1 : Jan, 1996
Router, repeater, coax-based network (with FDDI-ring for Crays, etc.) New structured cabling 50% complete

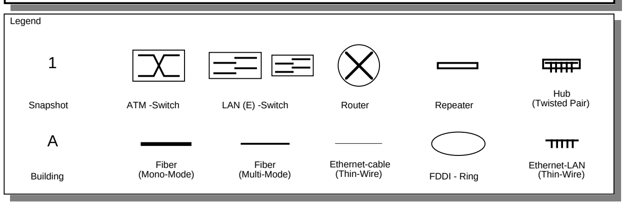
Snapshot 2 : Feb 01, 1996
replace old Routers by switching equipment plus new router „on the stick“ (half a day)

Snapshot 3 : Feb - Sep 1996
install hubs, migrate user equipment from coax, local talk to 10BaseT ethernet, map old physical subnets to VLANs, cabling 100% complete (Jun). Replace „old“ ATM-switch by new model, give an ethernet-switch to high end users (Sep)

Invisible : Begin restructuring VLANs according to departments; apply different routing policies etc.

Snapshot 4 : Oct - Nov 1997
Install redundant ATM backbone, redundant route/switch engines. Migrate servers to 100BaseT. Replace more hubs by ethernet-switches.

http://www.awi-bremerhaven.de/EDV



Determinants of the Bremen MAN

Pre-Liberalization Law

- No competitor of D.Telekom able to provide all necessary lines => lease lines from D.Telekom and 3 public utility companies
- Complicated licensing necessary => let the former telephony department of the public administration run the network officially.

Public finance and (no) sponsoring

- Neither Telekom nor utilities willing to sponsor.
- Senator for science and education out of money, but lets his people do the work
- Lease and equipment plus 1 (one) person to do the „Adidas"-type of netadmin payed for by Senators for economy and harbours

Organization

- Steering headed by senatorial group
- Working groups
  - Technics, netadmin (AWI,University)
  - Aquire projects (officials from senate)
  - Involve SMEs (consultancy firm)

History of the Bremen MAN

1994: AWI and University of Bremen on the German science network (WiN) at 128 kBit/s each.

AWI on the regional testbed (Northern Germany) for the broadband science network (B-WiN).

Talks about an ATM based state network.

Q1,1995: Decision to build „Landesbreitbandnetz", for two year initially. AWI responsible for technical concept and implementation.

Jun 1995: Orders for leased lines and equipment.

Oct 1995: Model network with equipment and short cables in the lab.

Nov 1995: Roll out equipment to final locations Put long distance fibres into operation.

Dec 1995: Workshop at Bremen University. Demonstrate connection to Bremerhaven (100 km of fibre, 4 ATM-switches). Build broadband IP network of scientific institutions.

29 Feb 1996: Official opening. Demonstration of distributed engineering: DASA-Airbus Bremen, University of Stuttgart, BADLAB Canada, AWI.

Apr 1996: Connect to B-WiN at 34 MBit/s

Nov 1996: Replace first generation ATM-switches (Cisco LS100) by second generation (LS1010)

Nov 1997: Decision to operate network 3 more years.

Participants (partial)

Science

- Alfred Wegener Institute
- University of Bremen, esp. Institutes for
  - Informatics
  - Maritime Logistics
  - Applied Industrial Technology
  - Applied Space and Materials Science
  - Medical Visualization
- Hospital
- University Library
- Technical Colleges (Hochschulen)

Education

- Schools
- Adult Evening School
- Public Library

Harbours

- Senatorial office
- Port Authority
- Ports Datacenter

Industry

- DASA Airbus
- Spin Off Centers

Components - Backbone, („Customer"))

ATM Switches:
- Cisco LS1010, LS100 (Nortel, 3Com)

IP Router:
- Cisco 7000 (4700, 7500, Catalyst RSM)

LAN-E Switches:
- Cisco Catalyst 5000, 5500 (3000, 3Com)

Leaf Nodes:
- Sun
- SGI
- IBM-Workstations,
- (Linux-) PCs

NICs:
- Fore
- Sun
- Olicom