IMPLEMENTATION OF ATM-BASED COLLABORATIVE DESIGN

BOB MARTENS and ANDREAS VOIGT
Vienna University of Technology (TU Wien)
Faculty of Architecture, Urban and Regional Planning
Karlsplatz 13, A-1040 Wien, Austria
e-mail: bmartens@email.tuwien.ac.at voigt@ifoer.tuwien.ac.at
phone: ++43/1/58801 ext: 25620; 26821; fax: ++43/1/58801/26899
URL: http://info.tuwien.ac.at/raumsim http://www.ifoer.tuwien.ac.at

Abstract. The following contribution describes research work in progress within the context of the focal field of research and development "Remote Teamwork (RT)" at Vienna University of Technology. Current research work is aiming at the elaboration of suited collaborative remote-working structures for research and project transactions (incl. study projects) - within the context of spatial planning - on the basis of Asynchronous Transfer Mode (ATM, a technology of broad band telecommunications). The generation and manipulation of digital spatial models and their virtual transportation within large distances represent main objectives. The current subjects in architecture, urban and regional planning (e.g. master planning, building-up planning, urban design, interior design) act as test projects to be defined in the course of the research work in their contents and spatial context and to be represented as digital spatial working models. Special attention is given to consolidation, harmonizing and advancement of current single activities in the field of ATM (e.g. facilitation of the access to technology, definition of project partners at the global level, development of originary, planning- and design-relevant software on the basis of native-ATM).

1. Introduction

Based on the current studies to this avail (Martens, Voigt and Linzer, 1996 resp. Voigt and Linzer, 1997) - the present paper first contains an update of the factual and technical frame conditions as well as a description of the ATM-test series performed and of experiences resulting therefrom and finally, after an enumeration of the agenda required and possible fields of application, cooperation at a global level is considered.

The technical-functional challenge concerning "Remote Teamwork" mainly consists of coordinating the actions of all participants in the virtual world and their impact thereon in such a way that all participants receive the view of a singular logical (consistent) world, even though, in reality, the world is being simulated in portions by various computers. Apart from several essentially algorithmic problems the limited bandwidths of long-range computer networks pose the real technological issue (Brutzman et al. 1995). ATM lends itself

extremely well to the realization of RT necessarily being based on high-speed networks. ATM is a broadband telecommunication-technology, which stands for a standardized transmission method having been specifically developed as a common platform for the transmission of language, video and data. ISDN was not considered, as this investment would have also called for a costly MPEG-encoder (necessary for granting larger bandwidths). ISDN thus lends itself only when considering reduced bandwidth requirements.

Advanced spatial planning is not focussed on the technical attractiveness furnished by the ATM-technology, but on the principal specialized fields of application and their impending real benefits for planning work. Based on the above mentioned increase in globalizing and networking regarding planning issues new measures are to be set in the following fields:

1. Support of "teamwork/collaboration" and any involved working and decision situation - namely the topics of communication and mediation - Computer Mediated Communication (CMC); decision supporting in workgroups - Group Decision Support (GDS) - questions e.g. as to directing, coordination and controlling, settlement of conflicts, etc.;
2. Support of modeling and simulation: establishing and structuring of planning data banks - Design Data Base (DDB); interaction with the planning models in real time; Distributed Virtual Reality (DVR); furthermore, issues of coherence and consistency of models etc.

2. Background: Advantages of ATM

The major strongholds of the ATM-technology regarding the demands of an advanced spatial planning can be described as follows:

- Large bandwidth
- Demand driven
- Quality of Service (QOS)
- Standard
- Lan-emulation

Rapid transfer of great quantities of information and data is in close relationship with large bandwith. The high data rate provides for real-time transfer of great data quantities resulting e.g. in multi-media applications and also for the interactive cooperation of several partners or partner-teams via the network. Without this high data rate lively cooperation would not come about

even at short real distances. Adjusting to the requirements and demands of the user, several “channels of communication” such as speech, non-verbal communication, gestures and miming, writing and characters, additional presentation material can be used. Differing priorities can be set according to the varying “channels of communication”, reservation of minimum standards and bandwidths (e.g. audio, video, “data” - model data 2D, 3D, 4D, resp. qualitative data - textures, colors; topological data; metadata, etc.). QOS ensures the availability of information in a specified quality within a specific time limit. ATM featuring the integration of all advantages including QOS results in new forms of interaction, just using the large bandwidth does not seem sufficiently productive. Therefore, an efficient implementation accounting for specific requirements and application possibilities of network bandwidths in combination with the QOS-parameters will prove useful. ATM-records and ATM-equipment are both standardized. The *Lan Emulation Service* makes for the combination of two or more spatially separated *Local Area Networks* or components thereof to a logical network thus lending the impression of a single connected network. By means of this technology the logical separation of two or several groups of users caused by spatial separation of the bunching of network junction points is avoided.

2.1. HARDWARE AND SOFTWARE: ASPECTS OF COMMUNICATION

Every new medium and every new technology is to be “cultivated” in line with the user´s needs and the specific requirements and the individual components to be combined effectively. The characteristic qualities of forms and media of communication are to be regarded in view of the new possibilities offered, priorities in the fields of “channels and periphery of communication” are to be set, new applications are to be developed utilizing the characteristics and strong points of the new technology efficiently. Simple digital reproduction of analogue or local techniques is not deemed to be sufficient. The most important preliminary issues to be tackled are:

1. Classification and selection of data (audio, video, model data, etc.);
2. Data properties and characteristics (e.g.: requirement of constant transfer rate for audio, minimum resolution and contrast of image data, etc.);
3. Requirements concerning transfer and reception of data and information;
4. Instructions: the new technology will call for the development and adaption of instructions for communicating, a new discipline of communication will result.

The components hardware and software as such in terms of their general aspects for communication as a basic requirement of teamwork lend themselves to a “local” and a “remote” consideration:

Table 1. Hardware and Software-Periphery

HARDWARE- PERIPHERY

Local

1. The human being and his “basic equipment” for speaking, moving, acting, gestures, etc.;
2. Additional media such as overhead, flipchart, blackboard, poster, slides, video/film, multimedia, physical models, etc.;
3. (Communication) Space

Remote

1. The human being and his “basic equipment” (cf. above);
2. Additional media (cf. above: these media mutate to e.g the electronic whiteboard or digital images);
3. Virtual space: The media obtain new properties due to data processing and the interaction with models in virtual space
4. Additional devices: Userinterface and recording periphery (audio and video, scanner/2D or 3 D, digital camera, digitizer) for the participants; ATM-hardware (cf. below 3.1) and computers as such.

SOFTWARE – PERIPHERY

Remote

1. Data transfer;
2. Data generation (via CAD, GIS, text editor, etc.);
3. Data visualizing and manipulation (rendering, navigation, relocation, morphing, etc.).

1999 the following working ATM-hardware configuration is made up of:

- Real-world Interfaces
- ATM Interfaces
- ATM-Switch
- General network infrastructure

At present 2 SiliconGraphics Indy Workstations with R5000 processors (96 MB memory) and a SiliconGraphics O2 with 256 MB memory are available. The Indy and O2-Workstations are equipped with Indycam and an A2 Audio Processor. The connection at the ATM-side is granted by three GIA-200 Fore Runner ATM each equipped with a 25MHz i960 offering a transfer rate of 155 Mbit/sec. The ATM-switch at the Vienna University of Technology (LS 2020, 1010, resp.) connects the machines as well as any possible project partners.

2.2. TEST SET

The research project "Remote Teamwork" is work in progress. Essential partial experience has been gained in the course of parts of the projects completed. Ever since the end of 1993 videoconferencing tests have been regularly run. Retrospectively, all attempts as to IT- implementation and particularly concerning ATM are to be regarded as "genuine" pioneering work, as the issue of available bandwiths had already then been a problematic item. Instead of a "drive over IP" switching to ATM represents a meaningful alternative. The software range available, however, was the actual limiting factor, due to which the bandwidth available often could not be made most of.

A possible test set comprises such fields as:

1. Testing the ATM-standards (IP over ATM, native ATM);
2. Testing the existing software to the extent it lends itself as part components of the planning application "Remote Teamwork";
3. Development of new applications making due use of the standards in line with the design requirements (based on above tests and experience).

The ATM- test series at the Vienna University of Technology presently halts at QOS, native ATM so far not having been tested lacking application possibilities (cf. table below).

Table 2. Test Set ATM - Vienna University of Technology 9901/Vgt-RV/BM

Technical possibilitie	**Test to be pe formed**	**Design Rel vancy**	**Remarks**
• Number of participants	Within Vienna University of Technology Austria-wide EU-wide and worldwide	Presentation Teamwork	Establishing virtual LANs
• Large bandwidth	Videoconferencing (VIC)	Presentation	e.g. IP over ATM
	File transfer	Presentation	e.g. Urban spatial models, architectural models
	(local) Interaction with the data model	Presentation, development of variants, spatial impact analysis	e.g Navigation, relocation, morphing
• Quality of service (QOS)	Combination of ”channels of communication”	Presentation, dialogue and interaction	Native ATM Various applications required
• Combination of large bandwidth and QOS	(cf. Tests large bandwidth)	Presentation and development of variants (distributed modeling), spatial impact analysis	Computer-integrated videoconferencing (CIVIC) Various applications required
• Combination of large bandwidth, QOS and planning aspects	Integration of the requirements of planning – various tests in the field distributed virtual reality (DVR)	Interaction, development of variants and spatial impact analysis (shared modeling)	Computer-integrated spatial planning (CISP), development and integration of software

3. Review: ATM-Testseries (1997/98)

The question put over and over again as to “why architects and urban and regional planners concern themselves with High-End-IT at all” is to be examined by means of the three following current case-studies. At the same time the present state of activities as well as respective approaches (focal issues) are to be enumerated. It was basically on account of the requirements arising in the field

of teaching that research activities were carried out in the period 1997/98 under report.

Being a faculty with presently approx. 4000 students of architecture and urban and regional planning (Vienna University of Technology) continuous advancements regarding meaningful teaching methods are to be taken for granted. Due to the Austrian geography with is conurbations (e.g. axes Innsbruck-Salzburg and Linz-Wien-Graz) and its rural regions well-established data networks could be of great avail, also concerning the phenomenon of "exodus from the cities". Constant or vast (tele-) presence in these conurbations would become possible and these regions would not only be "animated"on weekends or in the vacations. This is to be approached in a gentle way, as highly sophisticated expectations might not amount to much in the short run. Dealing with the present methods and processes of telematics might lead to compulsive attitude. Though an alternative exists now, the "quality of the previous" is to be increasingly considered.

3.1. CASE STUDY: VISIONS FOR LECTURE HALL 7 (PROJECT "7.UPGRADE")

URL: http://info.tuwien.ac.at/raumsim/entwerfen/hs_7_ergeb.html

In the summer-term of 1998 a design-program was dedicated to the upgrading and adaptation of present building substance for teaching purposes at the university level, also including new formulations and re-interpretations of the subject matter "lecture". The term "lecture hall" was to be very comprehensive.


Picture 1and 2. Condition in 1998: As to general opinion the present state of the lecture hall fails to meet the requirements of a modern-day teaching environment.

Lecture Hall 7 in the main building of the Vienna University of Technology represents somewhat of a "historical hole reminiscing former days". The university as institutions is constantly changing, building structure, however, does not attempt to match these changes. How is a platform for performing

lecture activities to be designed? How is the exchange of factual information to be granted and to which extent is direct interaction required? Due to the fact that the acting personnel remains the same over longer periods of time also the presentation of many a lecture remains unchanged. E.g. video-recording might make for undreamt of resources for other activities (e.g. video on demand via videoserver. Guest lectures could also be watched at a later point. Thus this design program was aimed at stock-taking of present and future requirements. What are the demands regarding the lecture halls of tomorrow? Both considerations as to infrastructure and particularly regarding multimedia equipment and videoconferencing, resp. were to be dealt with, not, however, belittling the quality of a "live-presentation". The question in as far as an audience is to be "electrified" by video-transmission was left unresolved. The possibility for interaction exists throughout a lecture "taking place in reality" (but does it work out in larger audiences?).

Back to design methodology. The connection of present-day techniques seemed to be of importance from a practical point of view. The participants of the lecture-workshop were to be acquainted with e.g. the videoconferencing-techniques. What was also put to use was the active cooperation in the field of architectural teaching over longer periods of time between Austria's major universities of technology (Graz and Vienna) with their locations at a distance of approx. 200 km. Giving a lecture or a workshop amounts to a day's journey (approx. 4-6 hours depending on the means of transportation chosen only spent on travelling back and forth). Without wanting to fail to meet one's teaching assignments the presence of an "external lecturer" might be considered. E-mail contacts and/or internetchats are possible, but mainly visual entities are criticized particularly in architectural teaching. These items of information can be furnished in e.g. homepages subject to continuous reviewing (provided "old" and "new" is to be identified clearly). The problem of reaction times would also have to be solved and what could prove very wise is the possibility of following-up the procedure of criticizing. What we are dealing with, however, is the 1-to-1-situation. Videoconferencing would provide for the classical principle of "individual training in groups" - still being of utmost popularity throughout architectural teaching at "mass universities". Everyone could benefit from the comments. The 7.upgrade-projects were criticized by e.g. the architect and university teacher Peter Hammerl from Graz who already had performed lecture hall adaptations.

The software-product "Inperson" on SG-computers was available at both sites. Bandwidths were financed weekly at fixed times by the *Austrian National Host / BIT)*. Though the participating students were fascinated by the attendant circumstances in the beginning (picture- and sound quality comparable to live-transmissions from the Apollo-capsule) the enthusiasm did not last long (short

"lifetime" of the media). Fatigue arose quickly with its negative impact on concentration. Reduced sound quality and extremely small visual display sections also added to this. A "filming" of plan representation only was of limited use, transmitting of CAD-working models performed via "whiteboard" proved more meaningful. Directing and moderating is generally required, particularly when several individuals wish to participate in discussions. Compact, remote-control cameras - nowadays reasonably priced - may offer part-solutions to this end. Alternative media (e.g. parallel www-presentations) are to be prepared as a less-than-ideal solution. Stationary videoconferencing equipment should be available ("plug and play").

This, however, was not the first "network-experience" of the axes Graz-Vienna. Already during the project Grawi '97 the implementation possibilities of high-performance network-technology was examined within the exercise activities of the study of architecture (cf. http://info.tuwien.ac.at/ecaade/proc/martens/). Here again this technology was not used completely instead of physical presence but rather to grant continuity throughout the complete term (motto: out of sight - out of thought?!).

3.2. CASE STUDY: ATMTA ´98 (ATM-MEDIA-DAY - AFLENZ/STYRIA)

URL: http://www.heritage.tuwien.ac.at/atmta/

In cooperation with several institutes at the Vienna University of Technology a well-attended media-day at the old provosty at Aflenz (Styria) took place. The state of development and any such perspective of high-performance networks with particular consideration of ATM in teaching and research were examined closely throughout the presentations and discussions. In addition to the papers and discussions the personal acquaintance of partners was of importance for this not "established" network structure.

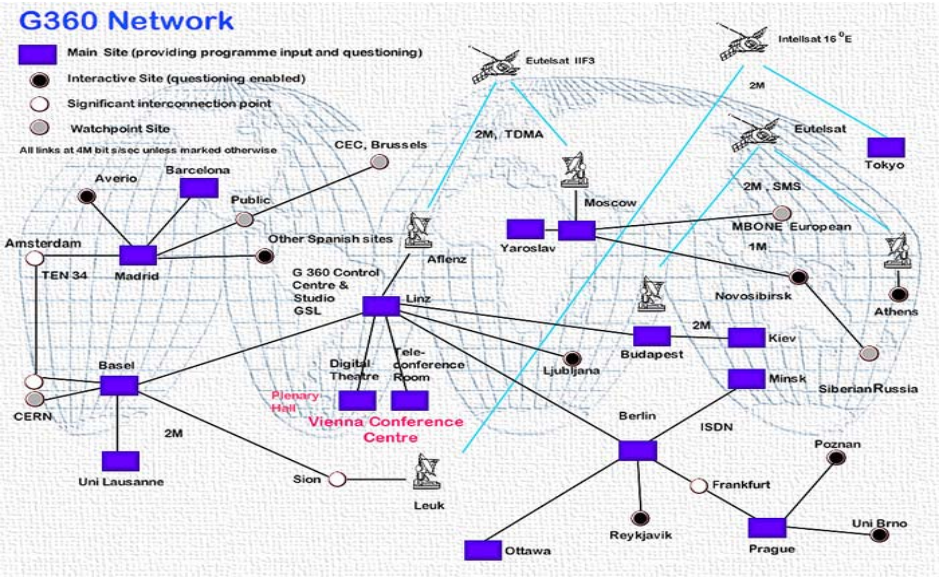
What was remarkable was that high-performance technology based on ATM was installed within a relatively short time - though under great organizational and personal effort - at a not-adapted old provosty (setting-up was supported very effectively at the site); the vicinity to the earth station Aflenz was an essential prerequisite, a directional radio link was installed between the old provosty and the earth station). The software "Inperson" was used with SG-computers, however, did not prove wise, as this software is only suited for local networks. Furthermore, scaling is not possible and available large bandwidths cannot be put to use. Great delays also disturb transmission.

3.3. CASE STUDY: INFORMATION SOCIETY TECHNOLOGIES CONFERENCE

URL: http://www.cordis.lu/ist 98/

Based on the current repeated involvement of the research group behind this specific research, project participation at this international conference being in direct cooperation with the Austrian EU-presidency was encouraged by invitation of the BIT-Austria. In cooperation with the EDP-center of the Vienna University and the ZID of the Johannes Kepler University Linz acting as "broadcasting-intersection" was called for in order to transmit the local discussion to all worldwide participating "sites" and enabling the direct, interactive participation of these sites.

The software product "ISABEL" on SG-O2 was put to use for the first time at this conference having been prepared for weeks in dialogue with the Spanish software-producer for this mission. ISABEL stands for a videoconferencing application based on IP Multicast not only working via ATM but also with other transport media (though with limitations). A special set of algorithms for video- and audio transmissions makes for a particularly fine real-time performance. Several modes not only support the broadcasting as such, but also interactive sessions and showing of slides. ISABEL thus lends itself well as tool suited for lectures and discussions over larger distances.



Picture 3. G360 Network of IST´98

4. Agenda and Discussion

The complexity of the defined field of research and development calls for the concentrated, strategical and efficient cooperation of university research institutions, producers of hardware and software and user groups in planning and planning administration. The following is required:

- Development and availability of a meaningful range of software applications, i.e. contact and exchange of experience with holders and developers of applications.
- Performance of definite tests with partners optimizing of exchange of experience and determination of avoidable problems.
- Setting of possible goals for future development, i.e. applications for planners and decision-makers.
- Know-how regarding extent of utilization, feasibility of solutions developed.

The following roughly structured areas as of 1999 are enumerated as realistic fields of application:

1. Expert-support in critical planning and decision situation (equivalent to medical work: preparation of "operations" on the patient city; establishment of a "design council" - decisions regarding large-scale building projects and/or building projects at strategic or prominent spots of a city or a planning space in general);
2. Continuous work ("follow-up" work) regarding research work and developing projects (e.g. following a conference involving real participation of people).

Presently, the associations ACADIA, CAADRIA, eCAADe and SiGraDI are on the way to establish a close, worldwide, substance-related relationship. The platforms could act as a stimulating testbed for the further advancement of research projects in the context of ATM-technology. A closer substance-related cooperation and integration in the fields of research and teaching might result from an advanced involvement with the respective fields in the individual regions leading to considerable positive synergy-effects within strategic cooperations. The topics to be elaborated might develop from below (incomplete) enumeration of fields of research and development certainly requiring global cooperation:

1. "Sustainable Utilization of Space" – "Spatial Impact Analysis" (including environmental and social compatibility).
2. Forms of Building-up and Settlements for the "3rd millennium" with special attention to "Low-energy Structures".

Glossary

Below an enumeration of important planning-related and EDP-technical terms is furnished:

SPATIAL PLANNING can be defined as permanent evaluating of spatial development possibilities in the context of changing functional and socio-ecological objectives. The required *spatial impact analysis* results in repeated iteration of checking- and developing-procedures throughout the planning process. *Modeling and simulation* have become indispensable in the context of spatial planning and act both on a physio-analogue and virtual-digital level. In order to advance models in progress effectively planning requires a continuous flow of communication, i.e. the transportation of information on planning ideas (e.g. as spatial models) via suitable media mediation.

TEAMWORK has become a basic requirement for spatial planning. Due to the increase of globalization and cross-linkage of problems a globally cross-linked teamwork is called for. Therefore, teamwork over spatial distance has become an essential field of research.

REMOTE TEAMWORK (RT) can be defined as the substance-related cooperation of people over spatial distances in decision-situations. Application of RT is to enhance planning- and modeling processes both in technical and functional terms thus creating a new planning medium. Teamwork requires repetition and combination of creative- and decision-stimulating working situations. All the necessary connective and decision stages of a complete planning process have to be assisted.

ATM can principally transfer every kind of data, two basically different types of utilization are to be mentioned. ATM can on one hand be used without its QOS-parameter, then only making use of the high-speed network, transporting any required other record, e.g. IP, with all the advantages and shortcomings of such a record (including transmission overhead). ATM can, however, on the other hand also be used with its QOS-parameter (native ATM) this enabling the user or the software to distribute the network load according to specific demands. Differing types of contents (e.g audio, video) are transferred at differing priorities (this also resulting in differing transmission speeds) according to requirements and specific demands. Audio-data can result in a higher priority level than video data leading to improved transmission audibility of a lecture during a videoconference, as speech is still transferred in good quality whereas the image might already have faded away.

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