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AN ELECTRONIC ARENA FOR PARTICIPATION IN CONNECTED COMMUNITIES

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Deliverable 6.5.1
An electronic arena for participation in connected communities

ABSTRACT

Task 6.5.1 is concerned with developing the concept of interactive Internet-TV (i2tv) as a basis for medial integration of Internet participants into events taking place at a real physical location. Interaction in real space is combined with actions of Internet participants into a new framework of cultural participation and production, such as distributed participatory theatre and interactive Mixed Reality TV productions. This deliverable discusses two main issues:

- The development of the i2tv system as a technological framework for developing electronic arenas integrating on-line and on-site participation.
- The development of two concrete dramaturgical models for i2tv electronic arenas: 1) Integrated on-site and on-line discussion in a public symposium. This is accompanied by the evaluation of the public trial at the Memoria Futura symposium, 2) A theatrical model in form of a distributed poetry play "Ottos Mops" bringing together an on-site performer and multiple on-line participants in a real-time networked performance based on sound poetry of the famous Austrian poet Ernst Jandl.

The innovative aspect of this approach is the integration of Internet-based multi-user interaction and awareness with broadcast technologies such as Internet streaming and Virtual Studio, and with technologies for mixed reality in shared physical space. This is accompanied with concrete participation models going beyond traditional models of game shows, quizzes, or social chats in 3D space, towards new forms of cultural events for connected communities.

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1. Introduction

In our previous work in the eRENA project, we have developed the concept of the Mixed Reality Stage as new framework of communication realized through interaction of multiple participants in an interconnection of real and virtual space. The Mixed Reality Stage is a model for electronic arenas bringing together several participants in physical space with participants from the Internet, in a combination of shared physical and three-dimensional virtual space. Their interaction creates new forms of social experience, as well as content that is experienced by the physically present audience.

The focus of our work in the third year of the eRENA project are concepts providing adequate channels of participation for remote viewers and participants who cannot experience the immersive situation on-site, but are still actively involved in a collective experience. The challenge is to create a situation in which on-line and on-site participants feel present and involved, while retaining the specifics of both situations (on-line, on-site). Unlike most efforts in staging events with on-line participation that focus on supporting synchronous interaction during the event, we also address asynchronous interaction and the question of making visible the creation of "collective memory" as a result of the connected on-line/on-site event.

For the participants in such electronic arenas the basic condition is that of finding oneself simultaneously „immersed" in the situation and trying to find a reflective distance. Metaphorically, this relates to the understanding of „thinking in doing" as a way to deal with the impossibility to „stop-time", an intrinsic realization of todays media culture.

In addressing these issues we explore models of electronic arenas that look at theatre as organising principle for organising many simultanous and seemingly unrelated inputs, into a synaesthetic experience. The main questions that need to be addressed are: How can understanding the conflicts of „real-time – delay" and „immediacy of involvement – distance for reflection" as intrinsic qualities of the on-line/on-site situation, provide fertile ground for new communication models? How do we create a spatial situation in which both on-line and on-site participants feel present and involved, even if not in the same way ? How do we create a situation that is both theatrically staged and at the same time enables reflective discussion?

To approach these questions we undertake trials based on common cultural models, such as discussion formats extended to integrate on-line/on-site participation and theatrical models based on the basic situation of digital culture where "everybody is a producer". Rather than merely "bridging the distance" we examine the characteristic roles, formats and participation models, intrinsic to a connected on-line/on-site situation. We refer to the underlying integration of cultural models determined by TV on the one hand, and by the Internet on the other, as i2TV: interactive Internet TV.

To support the experiments and realization of such concepts, the i2tv system integrates the passive broadcast model with participatory models of interactive networked environments and medial staging on-site. It combines the technology for networked shared spaces with audioandvideo streaming, 3D environments, Virtual Studio and digital TV. (Chapter 3.3.). On the one hand, this acknowledges the current technical limitations of individual technologies, such as the limitations of Internet broadcast in reaching large-scale audiences compared to that of digital TV. On the other, it reflects the lack of appropriate structures for developing dramaturgical concepts for hypermedia spaces combining different forms of representation and interaction, based on the situation of individual participants: on-site, on-line, or on the move with palmtops and mobiles. As a technological framework, i2tv addresses the need for new cultural spaces exploring the strategies for dealing with the everyday situation of information overload and cultural acceleration brought about by the ever more pervasive Internet and mobile communications.

1.1 Structure of the deliverable

This deliverable is divided into six chapters. The first three chapters introduce the basic idea of our work and provide the context for relating it to other approaches:

- Chapter 1 introduces the motivation for this work and provides an overview of the structure of the deliverable.
- Chapter 2 presents a characterization of different approaches and techniques for realization of electronic arenas, seeking for requirements of an electronic arena integrating on-line participants into events taking place in real physical space. Special attention is given to analyzing participation models demonstrated by different approaches.
- Chapter 3 introduces the fundamental concept of interactive Internet-TV (i2tv) as a form of electronic arena integrating Internet participants into an event at a real physical location. Main issues and requirements for implementing such a concept are presented and accompanied by the discussion of the developed i2tv system that addresses these requirements. This is distinguished from other approaches to electronic arenas, such as broadcasting interaction from collaborative virtual environments and Mixed Reality performance in shared physical space.

This is complemented by two examples of i2tv-based dramaturgical models and stage presentations for an electronic arena: Memoria Futura Symposium integrating on-site and on-line discussion, and the “Ottos Mops” distributed poetry play for on-site performers and on-line participants.

- Chapter 4 describes the i2tv model of an electronic arena integrating on-site and on-line discussion in a public symposium. The i2tv trial at the Memoria Futura Symposium December ’99 at GMD is discussed as an experiment in exploring a

minimal set of requirements needed to integrate on-line participants into the situation on-site. As part of the symposium Internet participants are integrated with the on-site event and digital TV broadcast. Internationally known experts from interactive technologies, TV, media art and theatre take part as on-line participants in the symposium and professional observers of the trial.

- Chapter 5 discusses a theatrical model for an i2tv electronic arena that explores live artistic production integrating on-line participants with participants at a real physical location. The distributed poetry play "Ottos Mops" brings together an on-site performer and multiple on-line participants in a real-time networked performance based on sound poetry of the famous Austrian poet Ernst Jandl (see video deliverable). It involves both on-site audience and on-line viewers through channels for active participation. This concept points to possible approaches for developing participation models for networked scenarios that go beyond traditional models such as game shows, quizzes, or social chats in 3D space. It demonstrates ways for addressing the problems recognized by the approach of Inhabited TV, such as relating the performers and participants from the audience to each other, balancing interaction of different participants through "self-regulation", a pace of interaction suitable for the involvement of the viewers, and forms of interaction allowing individual expression and persistent degree of participation [Benf99]
- Chapter 6 summarizes the main conclusions of our work discussed in this deliverable.

2. Mapping the landscape of electronic arenas

Within the eRENA project, the term electronic arena is used to refer to environments which deploy mixed reality technologies to enable real-time participation in „media-rich" cultural events[1]. Different approaches demonstrating this understanding of electronic arenas include Inhabited TV, Mixed Reality performance and Mixed Reality Stage. In this chapter we provide an overview of these and related approaches to realising electronic arenas as amplification of traditional cultural space by enabling new forms of cultural production and participation, even if not explicitely using Mixed Reality technologies.

This overview provides the context for introducing the concept of *interactive Internet-TV (i2tv)* developed in our own work (Chapter 3). This defines our approach to electronic arenas as integration of on-line participants into events taking place at a real physical location. The cultural model of active participation embodied by the Internet is combined with that of global emphatic experience constructed by TV, and with medial staging in real physical

[1] http://www.nada.kth.se/erena

space. Interaction in real space is combined with actions of Internet participants into a new framework of cultural participation and production, such as distributed participatory theatre and interactive Mixed Reality TV productions.

Fig. 1: Example of i2tv live Mixed Reality production (Chapter 5)

2.1 Approaches to electronic arenas

An electronic arena may be realised in virtual reality where participants share a virtual space or localised in a physical space with augmentation through interactive technology. This section discusses concrete examples of electronic arenas that illustrate different approaches within this broad range of possibilities, such as broadcasting interaction from virtual environments, performances linking real and virtual space and reality shows on TV and Internet. Brief descriptions of individual examples are followed by an analysis of participation models that they demonstrate.

Inhabited Television

Inhabited Television is a form of an electronic arena based on broadcasting interaction from collaborative virtual environments (CVE) on TV and allows online audience to take part in TV shows staged in a virtual world. The action of participants within the virtual world is transmitted to a conventional viewing audience, either as a live event or sometime later as edited highlights. The objective is to produce interaction between participants which is interesting as broadcast content for TV viewers. Two examples in exploring this approach are *Out Of This World* and *Ages of Avatar*. *Out Of This World* [Green99] is a live game show staged in a multi-user virtual world. The participants take part in four collaborative games which produce the broadcast content.

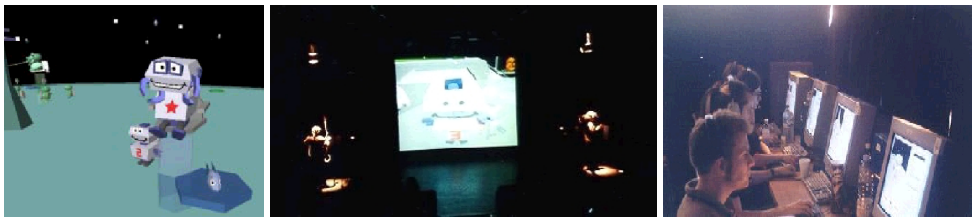

Fig. 2: Inhabited TV example *Out of This World* [Green99]

In Ages of avatar [Benf99] the avatars of the participants move in a series of virtual worlds, which replace the classical stage and represent different phases in an avatar's life. The participants interaction has to result in a show interesting for the viewers. To support this the worlds are designed according to specific themes, like a play space or a place to network with professionals from new media and business communities.

In the first phase a committed on-line community of participants who actively contribute to the development of virtual worlds is formed. In the second phase broadcast material based on this community is developed by involving the participants in a number of evolving stories.

Mixed Reality Stage

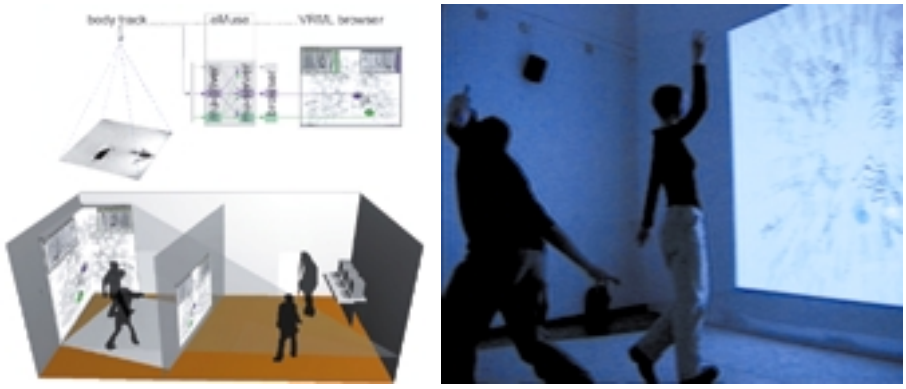

Fig. 3: Mode of interaction in Mixed Reality stage

The Mixed Reality Stage [Strauss99] is based on the following situation: one or several participants in the physical space are simultaneously present in an information space that is made visible only through participants actions in the real space. The virtual space is realised as an interactive field of sounds, which are triggered by users movement and emitted into the physical space. This is shared with an undefined number of further participants on the Internet. The overlapping and integration of these two spatial situations – physical space filled with virtual information space - creates a new reality of perception. The superposition of physical and audio-visual virtual space is perceived as a room furnished with data - a spatially organised information space revealed through users movement and interaction in the

combined real-virtual space. The objective is to create a situation, which brings the participants into mutual play by amplifying their bodily awareness of space and of each other.

A concrete theatrical realisation of the Mixed Reality stage concept is the interactive installation *Murmuring Fields* [Strauss99][Flei00]. *Murmuring Fields* is a mixed reality installation realised as an interactive virtual soundscape triggered by users movement in physical space. This is augmented by a visual representation of the virtual world, showing the position of the participants avatars. The interaction of participants generates a new experience for the participants and content for the audience. The interaction is staged in public space as an interactive situation for casual visitors or in a theatrical setting as a stage for professional performers.

Big Brother

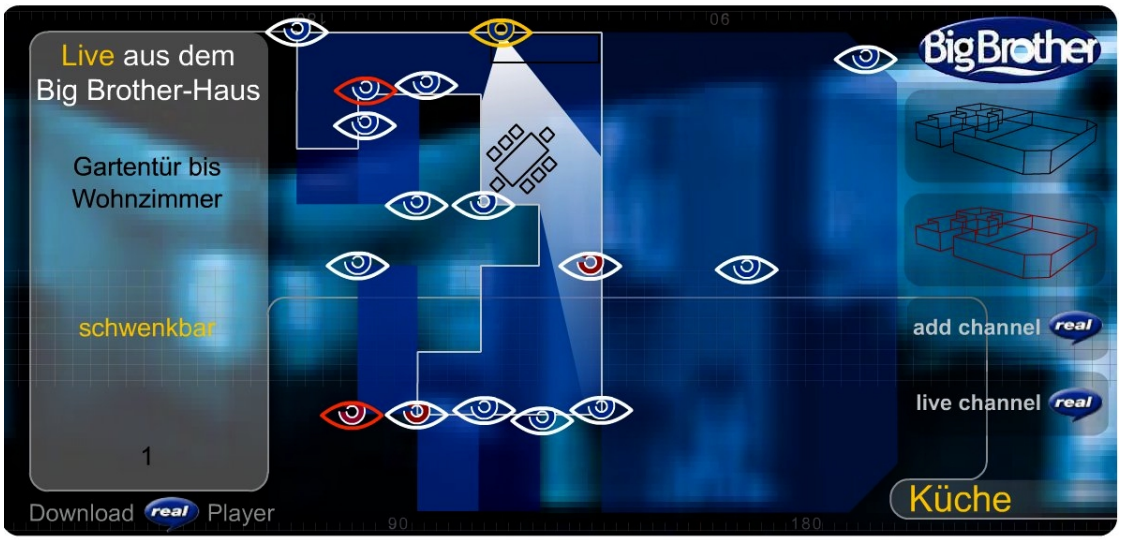

Figure 4: Multiple-camera perspectives; interface in Big Brother

Big Brother[2] is a television and Internet show which was broadcasted in Germany between September 1999 and March 2000. Ten people were selected to live together in a container for a period of time. Their “everyday life” was the content of the television program. The produced content is the result of their interaction, external contacts are not possible. The goal is similar to Inhabited Television: producing interaction between participants that is interesting as broadcast content for TV viewers. The difference is, that the participants in Big Brother are playing on a real stage, not as avatars in a virtual world. The situation staged is a

2 http://www.big-brother.de

simulation of daily life - the participants become actors in a struggle to produce interesting material for selected broadcast in the one-hour evening television transmission. Internet viewers can watch the non-edited broadcast and select between multiple-camera perspectives.

CNN Q&A; Kulturserver and Berlin OpenChannel

Many television transmissions offer the audience the possibility of taking part in the show by putting questions and comments by telephone, fax or Internet. The *Q&A*[3] (Question & Answer) transmission on CNN combines the TV broadcast with an on-line chat. The on-line moderator forwards selected questions to the participants of the transmission and displays them as part of the TV image. Kulturserver[4] offers an interesting combination of Internet streaming and TV broadcast: users can stream their own audio/video program (live performances or pre-produced material) to Kulturserver which feeds it into the Berlin Open Acces cable channel. In this way, individual producers can reach a broad audience, instead of being limited by number of freely available streams on the Internet. The video stream is accompanied by a simultaneous chat of the Internet viewers, which provides a basic form of interaction for the audience. [Kultur00]

Video Only; Ich sehe was, was du nicht siehst

Video Only explores the artistic potential of the virtual studio in producing a TV performance show for the the award ceremony of the international Videokunstpreis 1995. It is realised as a first live distributed virtual studio production. The audience is situated in the studio between the blue box on one side and a video wall on the other one. By turning their seats they can decide which situation they want to watch: the actors in the virtual sets on the wall-high projection area or the life dance performance in the empty blue stage. Today it is possible to actively involve the TV viewers through interaction channels over the Internet. This is demonstrated by the interactive TV show *Ich sehe was, was du nicht siehst!* (I see something that you don't see)[5] which combines live Virtual Studio production and Internet participants. Using a Web browser, children watching the show can create a 3D set for the Virtual Studio based on some predefined elements. The newly created virtual set is sent to the production team of the transmission and can be subsequently embedded into the transmission set during the live broadcast.

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3 http://www.cnn.com/CNNI/Programs/qa/

4 http://www.kulturserver.de/

5 http://ichsehewas.khm.de/

Figure 5: Internet interface and live show “Ich sehe was, was du nicht siehst”

2.2 Participation models

There are distinct ways that can be used to explore the participatory experience in the approaches described above. As noted in [Benf99] the previous research in the field of participation is focused on reflective experience especially in theatre. We recognize three important points for the development of models of participation in electronic arenas.

- Real-time interaction in the event
- Involvement in the creation of content
- Externalization of participants’ experience as “collective memory”

Real-time interaction in the event

In every electronic arena four different roles can be distinguished: on-site participants and on-site audience, on-line participants and on-line viewers. Participation models for electronic arenas have to consider their mutual interdependence and relationships.

Murmuring Fields stages a mixed reality-situation in which the audio-visual world of the installation is invisible until evoked through body movement of on-site participants. Their live action becomes an intrinsic part creating the actual artistic design. In public presentations, the performative situation comes into being almost automatically, with the intrigued on-site visitors becoming the audience of on-site participants [Büsch99]. Interactive installations such as Murmuring Fields require visitors to play a specific role – one visitor effectively executes a performance for the others. [Dug97]

In *Out of this World*, the example of Inhabited Television, there are three different roles: on-site participants, on-line participants and on-site viewers. For most of the time the viewers do not directly interact with the content of the show and as such resemble a traditional TV audience. A limited opportunity for audience interaction occurs towards the end of the show by waving a colored card to choose the best losing-team member. In Ages of Avatar the on-line viewers are also passive except when they contribute to the forum. The main goal of the activity of on-line participants is the creation of material suitable for television broadcast.

Video Only attempts a first step towards involving the passive television audience in a virtual studio production. The basic possibility of interaction by turning the swivel chairs to choose between the television image with actors integrated into the virtual sets, or the live dance performance in the empty blue stage, makes the event more attractive for the physically present audience. The traditional modes of perception are redefined through the motivation of the spectators to physical movement. This resembles to some strategies of active audience engagement in theatre, where the audience is made to move between multiple stages on which the theatre piece is simultaneously performed.

In *Big Brother* the Internet medium is used to realise a typical television mode of interaction: choosing among multiple simultaneous camera perspectives of the simulation of everyday life in the container, corresponds to changing programs and channels on a TV set. The moment of paying attention to the screen (or even not paying attention) determines the interaction [Bry83]. The economic model of pay TV is introduced by having selected cameras available only to subscribed customers. Since the model of interaction between participants in the container is „everyday life“ and is broadcasted on Internet unedited 24 hours a day, the Internet viewers are in effect composing their own movies. By voting per telephone, viewers decide which one of the actors is to be eliminated next. In a way, the viewers posses the actors and play the role of directors.

Involvement in the creation of content

The promise of interactivity is that the experience of cultural production can be something the viewers do rather than something they are given. This complicates the conventional concepts of content in this context. In interactive media the interface shapes the experience of content by defining how one perceives and navigates that same content. This is clearly visible in Inhabited TV where the content is represented by the interaction of on-line participants through chat and movement of their avatars in a shared 3D space experienced on the computer screen. In *Murmuring Fields* the interface defines a sort of landscape -soundscape- consisting of a room furnished with data. Content is created as a result of action and interaction that are initiated through the exchange with the virtual space. But the interaction takes place in real physical space, not in a virtual one, and is not conditioned through the technical dispositions of a noticeable interface. This makes the experience of the space inseparably connected with

body motorics. The media space is employed as a stimulation of bodily experience, not as a replacement of the real space.

The examples described in the previous chapter also demonstrate different possibilities of creating content for television transmissions through audience participation. *Kulturserver* offers the audience the possibility to create the fundamental content of the transmission by relaying the video stream sent by the audience directly to the local Berlin cable TV channel. In *CNN's Q&A* the involvement of the viewers mainly depends on how much the TV transmission addresses the questions and issues brought up in their Internet chat. The viewers influence on the content of the transmission is manifested only indirectly "through the mouths of the others". The principal creators of content in *Big Brother* are the ten on-site participants in the container acting out daily life. As the audience decides who gets eliminated from the show, it has an implicit influence on the content in that the actors are struggling to please it, which largely determines their behavior[6]. The possibility of the viewers to create their own virtual sets for the live show in "Ich sehe was, was du nicht siehst" remains a conceptual possibility as the show has not yet been produced in this way. Similarly to *Q&A* the critical factor for viewers involvement is how much their contributions are embedded into the show, which might prove difficult given that they are basically changing the whole stage setting.

Externalization of the participants experience as "collective memory"

Besides real-time interaction in the event and the involvement of audience in the creation of content, another research issue is developing ways for visualizing the experience of the participants involved an event. This is also a point of departure for addressing the challenge of involving the audience not only for the physically duration of the event but also after its end, as a result of the shared context and experience created by the participation in the event. Sharing this experience is often considered an essential part of understanding interactive communication [Scott96]. The difficult question is how that can be made possible. The merits of information technology for memorising and archiving have been long acknowledged and in *Big Brother* this is demonstrated by the extensive video archive of all scenes of the play in the container, as well as of the editors best-choice selection. This constructs a new kind of audio-visual library set around a particular theme. What is missing is a visualisation of the "movies" effectively composed through Internet viewers selection in watching and browsing through the cameras. Communicative structures like forum or chat accompanying or following the event (*Out of this world*) or the transmission (*Q&A* on CNN, *Kulturserver*) are basic possibilities for creating spaces of active participation in cultural production. *Murmuring Fields* attempts to address this issue from an artistic perspective by making it an intrinsic part of the basic dramaturgical model of the situation: the internal experiences of the participants are externalised through the creation of Mixed Reality space caused by their interdependent actions. All of these examples demonstrate some points of departure for taking on the

6 The spanish version of Big Brother (http://www.granhermano.es) demonstrates this point even more clearly reflecting the dense social fabrics of the spanish society.

challenge of discovering new ways for the development of new communicative structures based on content created through a shared experience.

2.3 Technologies for electronic arenas

Most commonly used technologies in building electronic arenas can be classified into five categories:

- collaborative virtual environments
- mixed-reality environments
- media servers
- video conferencing systems
- Virtual Studio environment

The key concept of collaborative virtual environments (CVEs) can be summarised as that of computer generated spaces in which each participant has his graphical representation and can control his own viewpoint and interact with other participants or various representation of data [Novak99]. Such spaces are usually referred to as shared virtual worlds. Typical example of how deeply CVEs are involved in building electronic arenas are many text based MUDs, textual chat boards as well as 3D graphical virtual worlds systems being used for this purpose. Some of the systems offer more or less an opportunity for the integration with other technologies which enlightens the process of electronic arena development. MASSIVE-2 [MASSIVE96] [Green97], Microsoft Virtual Worlds [Vellon00] and enCore MOO system [enCore00] are good examples of such technologies.

The term mixed reality is commonly used to refer to environments which combine real and virtual objects with visual representation of real and virtual space. The underlying paradigm is that of an information space merging components of physical and digital information, in different degrees of spatiality. The notion of simultaneous presence and communication between multiple participants in such environments is incorporated to a greater or lesser extent as an extension of this basic idea. e-MUSE (Electronic Multi-User Stage Environment) [Strauss99] is an example of a VRML based platform for development of networked mixed-reality environments. It supports several users in a shared environment as a combination of physical and virtual space. Early examples of collaborative augmented reality include the Shared Space system [BillKa99] in which users share virtual objects across a physical table top and Studierstube [Fuhr98], in which virtual objects are also displayed in a physical space between multiple users. Both of these systems utilise see–through head–mounted displays. Systems based on video views of remote scenes are inherently sharable as the video display is usually located in a shared physical space. The approach of tangible bits [Ishii97a] involves the use of graspable physical objects called photo-icons to interact with digital information,

for example moving physical models across a table top in order to access a digital map that is projected onto it.

Media servers are complete hardware/software solutions which enable storing as well as audio/video delivering and live streaming [Peranovic99]. Due to the size of media data and compression standards used for the transmission there must be some client side buffering which is an integral part of these systems [VIDe99]. Therefore it is impossible to avoid delays on the client side (usually 15-30 seconds). Media servers are commonly used in video-on-demand and near video-on-demand applications. Thanks to the implementation of IP multicast and unicast video/audio transmission as well as immediate storage during the live sessions they can also be used in electronic arenas where delay does not play a big role. There are many commercial solutions such as Real Networks Real Server, Apple Quick Time Server, Microsoft Windows Media Services and Oracle Video Server.

Video conferencing systems in their most basic form enable transmission of video and audio back and forth between two or more physically separate locations [SURA99]. Most of them are based on an ITU standard H.323 for video-conferencing over networks that do not guarantee bandwidth, such as the Internet. There are two drawbacks of these systems: they do not support storing of sessions on video servers for playback later and they do not offer an opportunity to broadcast a conference to many users. The second drawback should be overcome by using IP multicast. Both functionalities are currently in development and should be available in several months. Only then could video-conferencing systems become a part of an electronic arena using it as a video/audio delivering environment. Video-conferencing systems can be divided into three categories: software-only (e.g. Microsoft NetMeeting, Whitepine CU-SeeMe); hardware assisted (e.g. Intel Proshare, Armada Cruiser); and room systems (VCON MediaConnect, Intel TeamStation).

The idea of a Virtual Studio originates from attempts to overcome the constraints of traditional chroma-keying. Virtual Studio environment can be described as a set, consisting of three major parts: camera tracking system, real-time rendering system and composition system. This technology offers several advantages compared to a local virtual studio because different equipment can be shared between many studios and productions of different sizes (several cameras) can be supported by appropriate network configuration. These environments have been used in professional TV since several years and can also be used as an environment for an electronic arena combining several distributed video inputs into one joint video output. Good example for of such as system is GMDs 3DK Virtual Studio [3DK][Vonol99][Breit96]. Its basic components are foreground and background generation systems, composition system and interfaces to other studio equipment. A distributed virtual studio results from placing these components on two or more different locations.

Examples of electronic arenas, discussed in the previous chapter, demonstrate the usage of different combination of the described technologies.

Inhabited television concept of electronic arena employs two technologies: collaborative virtual environment and TV. MASSIVE-2 multi-user virtual environment enables up to 15 users to take part in shows such as *Out of This World* [Green99]. It is an environment which requires very fast network connections and can be deployed only on very fast local networks. The connection between MASSIVE-2 system and TV was made through SGI system's normal video output capabilities with standard video options which took the selected video areas and sent it to the mixing desk.

Ages of Avatar exemplifies electronic arena that targets many users connected to Internet at home PCs. It is completely based on the Virtual Worlds system [Vellon00] which is a research platform, originally developed by Microsoft Research, that supports a variety of multi-user multimedia environments for creating online communities. It provides a persisted and distributed object oriented architecture. Some of its design comes from text MUDs like LambdaMOO [Lambda]. Virtual Worlds platform implements object inheritance in order to facilitate the development of new types and objects. The biggest drawback of this system is its platform dependence. The system is limited to MS Windows operating systems on the server side and MS Internet browsers on the client side.

There are several interesting examples of electronic arenas which combine media servers and TV. The *Big Brother* TV/Internet show represents mainly a combination of TV and Internet video/audio streaming. Combination of embedded web pages objects (plug-ins) such as Macromedia Flash and Real Networks streaming technology (Real Server and standalone Real Player) enables Internet "viewers" to choose between multiple-camera perspectives of the broadcast.

CNN's *Q&A* (Questions & Answers) program uses a similar technological concept as the *Big Brother* show. In this case, streaming is made possible by using two mostly used media servers (Microsoft Windows Media Services and Real Networks Real Server). This enables viewers without an opportunity to receive CNN TV signal to watch and hear the programme. At the same time, using email, textual chat, telephone or fax, viewers can interact and set the questions to the moderator or participants of the TV transmission. *Offener Kanal – Kulturserver* project is a very interesting approach in combining several technologies to produce an electronic arena. The idea is usually to make a video/audio stream and send it to the media server which delivers it to different users. In this case video server is situated on the content producer's side and Real Video stream is delivered from the server to the *Offener Kanal* and then from there rebroadcast to the standard analogue cable TV system. Some interaction which is also broadcasted to cable-tv viewers is implemented through text chat. The idea is interesting but the implementation could be simplified if the system used a central media server which could receive and redistribute incoming streams.

The latter three examples (*Big Brother*, *CNN Q&A* and *Offener Kanal*) are similar in concept and include two or more technologies mentioned at the beginning of the overview. *Big Brother* and *Q&A* use even more existing communication channels for interaction improvement (phones, faxes etc) but on the other side this increases complexity of the whole system. This should be considered when constructing an electronic arena.

Using mixed reality technology to construct an electronic arena in real and virtual space is exemplified in the mixed reality performance *Murmuring Fields*. The development of *Murmuring Fields* as an interactive communication space has been accompanied by the development of a system to support its realisation – e-MUSE [Strauss99][vrml99]. e-MUSE is a VRML based platform for networked communication, interface, rendering and display organisation. It is built as a modular system providing independent levels of implementation for interfacing, rendering and displaying the virtual world, for multiple user support and support for attachment of non-standard, full-body interaction interfaces. Because of the ease and flexibility of the underlying architecture, e-MUSE can be seen as an experimental platform for prototyping and trying out new spatial configurations as well as interaction and communication concepts for shared mixed-reality environments.

Good examples for distributed video production are *Video Only* and *Ich sehe was du nicht siehst* projects, both based on the Virtual Studio environment. *Video Only* is completely based on the idea of Virtual Studio while *Ich sehe was, was du nicht siehst* combines a Virtual Studio environment and Internet to provide real-time interaction for viewers.

There are several important features of the ATM network technology which can be used for electronic arenas but two of them bring most benefits [Vonol99]:

- deterministic bandwidth: ability to allocate bandwidth for electronic arena applications and guarantee quality of service regardless of what other applications are running on the network;
- scalability: ATM bandwidth is scalable to meet requirements of expanding application complexity and faster host processors

The network infrastructure is the biggest problem to be solved in constructing electronic arenas. Data transfer over the Internet networks is not reliable because one can never know how fast the connection really is. With ATM classes of service [Peranovic99], divided into five main categories, it is possible to allocate bandwidth for electronic arenas which e.g. consist of high quality streaming or simply use available bit rate for other narrow bandwidth based arenas. On the other side, daily improvement in video and audio compression techniques makes high quality video transmission possible, even on lower bandwidth rates.

3. i2tv - an electronic arena integrating on-line and on-site participants

3.1 Basic concept

i2tv (interactive Internet-TV) is a basis for medial integration of Internet participants into events taking place at a real physical location: a symposium, conference or live artistic production. The challenge is to create a situation in which on-line and on-site participants feel present and involved, while retaining the specifics of both situations (on-line, on-site).

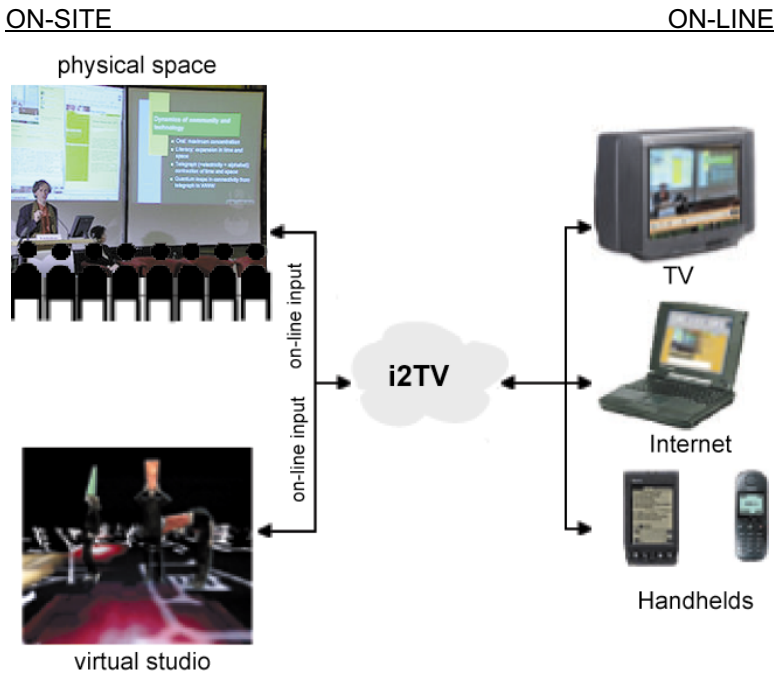

Fig. 6: Typical situation enabled by the i2tv system

The basic questions addressed by this approach are: What is the added value of bringing the two situations, on-line and on-site, together? How can the connected situation fundamentaly change the nature of the experience for all parties involved? What roles can be identified? What new models of cultural production can be developed?

Addressing these questions is the basic difference between i2tv and other approaches such as video conferencing and shared virtual environments. The latter represent two extreme points of a variety of approaches that focus on one basic issue: that of removing the distance between remote participants. Video-conferencing attempts to provide exactly the same channels of presence for the remote participants which they would have if they were

physically present. Shared virtual environments on the other hand, attempt to create a virtual space as a third place where all participants meet.

For our approach, we choose the term “interactive Internet-TV” (i2tv) to refer not only to the integration of related technologies, but to the integration of two different cultural models: that of active participation embodied by the Internet, and that of global emphatic experience constructed by TV. To make this possible, the i2tv system combines the technology for multi-user networked interaction with Internet streaming, virtual environments and digital TV (Chapter 3.3).

In relation to our previous work in developing the concept of the Mixed Reality Stage [Strauss99], i2tv provides the framework for integrating multiple and remote Mixed Reality Stages with each other, and extends this with other forms of medial staging of on-line/on-site participation (Fig. 7). The Mixed Reality Stage is a model of an electronic arena bringing together several participants in a combination of shared physical and shared 3D virtual space. i2tv extends this model by providing adequate channels of participation for remote viewers and participants, who cannot experience the immersive situation on-site, but can still be actively involved in a collective experience.

3.2 On-line/on-site formats: beyond bridging the distance

Connecting the two different situations (on-site, on-line) means creating a meaningful relation between the participants on-line and the live situation in real physical space. The goal is to enable the production of scenarios in which on-line participants become active producers of new content and an integral part of the live situation on-site. This requires relating to each other two different social situations, with its own experiences of space and time, and finding ways for making all parties feel involved, even if not in the same way.

Developing models which integrate multiple on-line participants as active producers of content requires theatrical staging as a strategy for organising many simultaneous inputs. The action in real space needs to be integrated with action and content representation in networked shared space. This requires relating to each other many different layers of representation and interaction in new dramaturgical formats. In exploring and developing such concepts one can draw from lessons and experiences from different fields of the arts: from traditional theatre to participatory performances of the 60’s, to the models of mixed reality stage and mixed reality performance from our previous work.

Understanding the strategies of the theatre becomes a crucial pre-requisite. Since the invention of theatre by the Greeks, theatre separates the spectator from the events on stage. The spectator is no longer actively (acting) integrated into performance practices, but he is looking at models of behaviour in social groups. The stage is no longer, as in oral culture, the

physically supported essence of an organised social group and life-experience, but it is the experimentation of experience, its evaluation and reflection. By the separation of the public from the action the multi-sensorial events on stage became a model and a concept of experience rather than the experience itself. Theatre became the machine of giving meaning. [Leeker99]

The effect of the internalisation of processing life and reality by consuming theatre is that theatre became a way of existing in the world, with an individual, separated internal identity. This model is projected to the world. Derrick de Kerckhove proposes that the discourse which tells us that our life is basically organised in a theatrical way, is an epistemological illumination: we behave like actors and spectators as a basic structure of our existence in literate cultures. [Leeker99]

In digital culture, theatre and performance serve as models and metaphors for the externalisation of the inner world invoked by theatre and the re-integration of man into his environment. The critical point to achieve this is interactivity. This was still missing in the early 1960s, as the technology wasn't there. Todays Mixed Reality Stages and performances on them, seem to be the bodily adaptation of what is behind the screen, in Internet, TV, and computers. But they do this in a theatrical way. [Leeker99]

The premise of the connected situation (on-site/on-line) is to create an occasion in which the participants are simultaneously immersed into the situation and trying to find a reflective distance. The possibilities for creating such a context become graspable by investigating the fundamental nature of the on-line condition, and its relationship to physical presence on-site. The undertaken experiments investigating the on-site/on-line discussion format (Chapter 4) point to the existence of four basic roles stemming from the particular situation from which the participants take part in the event: the actors (on-site participants), the impressed (on-site audience), the commentators (on-line participants), and the analysts (on-line audience).

This raises several important questions: What participation channels are suitable for the nature of these roles ? How are they put in relation ? What is the added value produced by the different modes of participation ? How can the theatrical means be employed in an interactive situation, where participants are actors and spectators at the same time ?

As a point of departure in developing concrete concepts of such electronic arenas, we choose the discussion format as an everday communication model, and theatrical models as an abstraction of this situation. The first deals with integrating on-site/on-line discussion at the *Memoria Futura* Symposium, in December '99 at GMD and is discussed in Chapter 4. The second explores live artistic production integrating on-line participants with participants at a real physical location in the form of a distributed play based on sound poetry by the famous austrian poet Ernst Jandl (Chapter 5).

3.3 The i2tv system

This section discusses main issues and requirements for realising the concept of an electronic arena integrating on-line and on-site participants, introduced in the previous chapter. This is accompanied by the description of how the developed i2tv system supports these requirements.

i2tv is a networked system for integration of Internet participants into events taking place at a real physical location: a symposium, conference or artistic live production. The goal is to make on-line participants active producers of new content and an integral part of the live situation on-site. This requires that the underlying system provides a framework for developing networked scenarios connecting on-site and on-line participation with medial-staging on-site and live TV production.

The technical requirements raised by such a model differ from the requirements of other approaches to developing an electronic arena, such as broadcasting interaction from collaborative virtual environments that focus on representation and interaction of participants in a shared virtual space [Benf99]. They also differ from the requirements of the mixed reality performance approach which focuses on combining interaction of participants in a shared physical space with elements of virtual space [Flei00] [Fein99], as well as from requirements of the approach of broadcasting multiple-camera perspectives of real space interaction to Internet viewers[7].

The following main issues need to be addressed:

- modelling hypermedia structures for on-site/on-line dramaturgical formats,
- broadcasting the live situation on-site to participants on-line,
- presence and interaction of on-site and on-line participants,
- medial staging for organising many simultaneous inputs.
-

This means that the system supporting the realisation of integrated on-site/on-line formats needs to combine the technologies for multi-user interaction and awareness with broadcast technologies such as Internet streaming and digital TV, as well as with technologies for mixed reality in shared physical space. As discussed in the previous chapter (Chapter 2.3) none of the existing system provides support for such combination of requirements.

The next sections discusses how these requirements are addressed by the developed i2tv system.

7 See *Big Brother* example in Chapter 2.1.

3.3.1 Basic structure

i2tv is built as a modular system providing independent levels of implementation for broadcasting the live situation on-site to on-line participants, for supporting presence and interaction of on-line and on-site participants, for different input and display devices, and for medial staging on-site. To realise that, the system combines and extends several existing technologies. It consists of the following parts:

1. MOO server – platform for networked multi-user environments [Curtis94][Lambda],
2. RealServer – platform for streaming video over Internet [Real],
3. e-MUSE – system for multi-user interaction in a combination of shared physical and virtual space [Strauss99],
4. 3DK Virtual Studio – distributed Virtual Studio system [Vonol99][3DK],
5. eMOOSE – interface layer connecting individual elements of the i2tv system.
6. Display and input devices – Web browser, handhelds, free body interfaces.

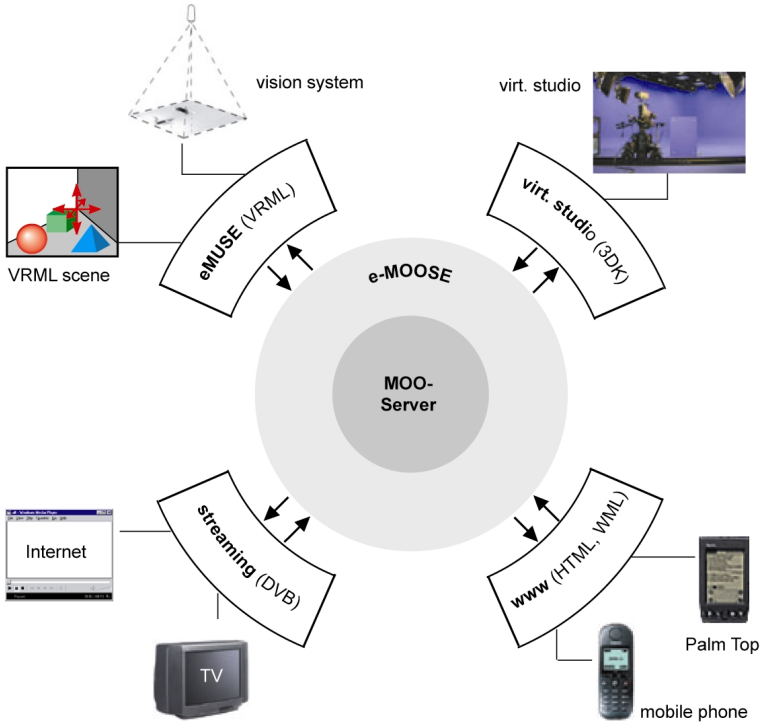

Fig. 7: Basic structure of the i2tv system

The MOO server [Curtis94] provides support for multi-user communication, event propagation, spatial structuring and behaviour scripting support. The related enCore database [enCore00][Haynes98] provides basic functionalities of a shared virtual space with enCore

Xpress as a basic Web interface (text, html). The i2tv system extends the text-based MOO system into a framework for spatial structuring of hypermedia elements. The e-MUSE system is a result of our previous development in the eRENA project [Strauss99]. Integrating it into the i2tv system provides two important functionalities: attachment of various interfaces such as vision systems, electric field sensors and handhelds, and VRML-based virtual spaces combined with multi-user interaction in a shared physical space.

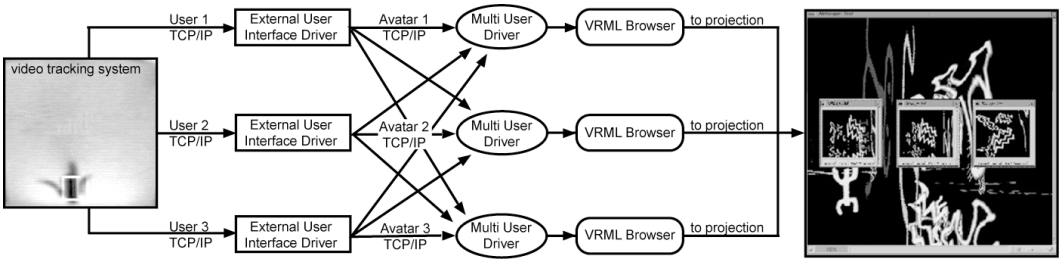

Fig. 8: Structure of e-MUSE system

The 3DK distributed Virtual Studio system [Vonol99][Breit96] enables the composition of video images of a real broadcast camera together with 3D computer generated scenes, as well as the insertion of virtual objects into real scenes, with individual facilities distributed over an ATM network. It is developed by GMDs Institute for Media Communication [3DK].

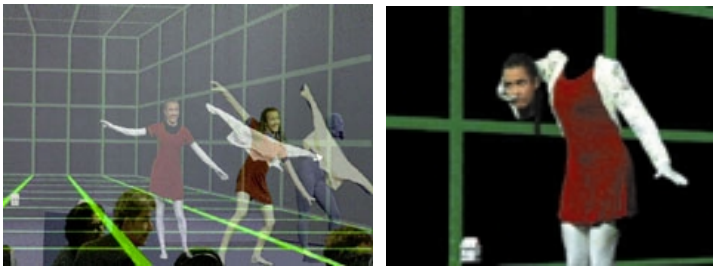

Fig. 9: Compositing real actors with a 3D virtual set using Virtual Studio

e-MOOSE is a java-based interface layer connecting the individual elements of the i2tv system (MOO server, streaming, e-MUSE, 3DK, displays and input devices) into an integrated whole. It consists of a server-side java application and a client-side applet. The e-MOOSE client-side applets communicate with display systems and interfaces to users‘ input devices (Web browser, e-MUSE, Virtual Studio, streaming). The e-MOOSE server-side component communicates with with the MOO server and the e-MOOSE client-side applets of individual users. This enables the creation of a multi-user environment integrating different forms of representation of content, interaction, presence and mutual awareness.

The combination of these individual elements into an integrated architecture addresses the following requirements for an electronic arena:

- real-time interaction,
- media richness,
- large-scale participation,
- mixed reality,
- new forms of participation in cultural events.

Particular attention is also given to the following considerations:

- different layers of presence and interaction based on individual users situation
- incorporation of TV as a display medium addressing large audiences,
- support for media integration with a range of different participation channels.

The described multi-layered architecture enables the combination of different levels of content representation, interaction and communication channels, based on the situation on-site and on-line, and depending on individual users bandwidth and input and display devices. This makes i2tv clearly different from other systems such as 3D shared virtual environments (e.g. MASSIVE [Green96][Green97]), tele-conferencing systems (e.g. SunForum [Isaacs94], MS Flatland [White99]), or web-based distance education systems (e.g. MS Telep [Jancke00]).

3.3.2 Modelling hypermedia structures for on-line/on-site scenarios

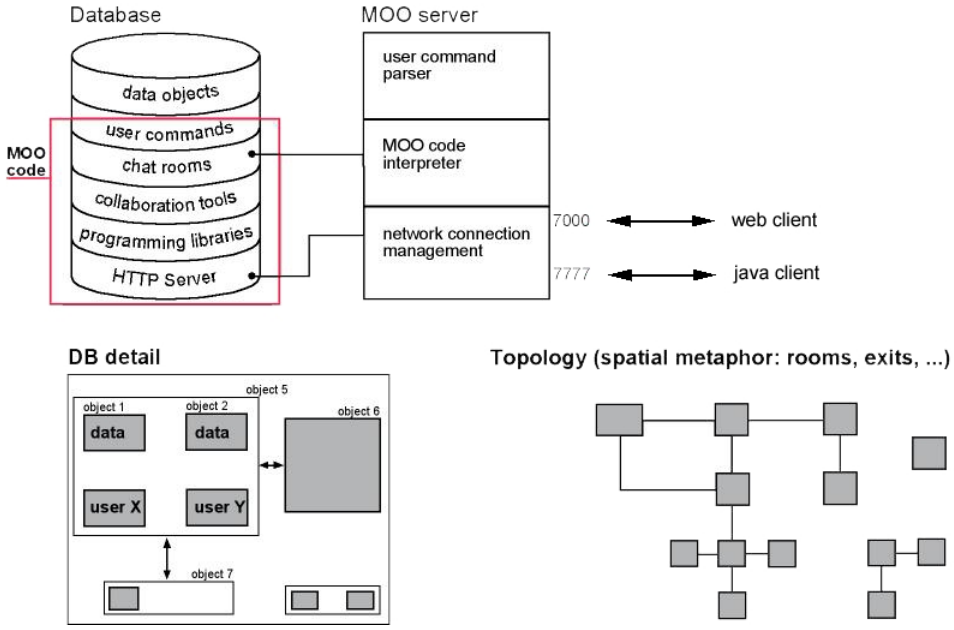

Fig. 10: Structure of the MOO system employed by i2tv

i2tv[8] employs the MOO[9] system as an abstraction layer for generic implementation of a multi-user shared space. The MOO provides a virtual world database, spatial structuring of multi-user awareness and interaction, event propagation and behaviour scripting for up to 300 simultaneous participants [CVW]. MOO objects are used as containers for multi-layered representation of hypermedia content. The elements composing the shared space, the relationships between elements, as well as events and behaviours based on user actions, are modelled as an open structure independent from individual input and output formats and devices. In other words, the MOO is employed, as a generic representation of a shared virtual space, independently of the format of content representation (text, 2D, 3D).

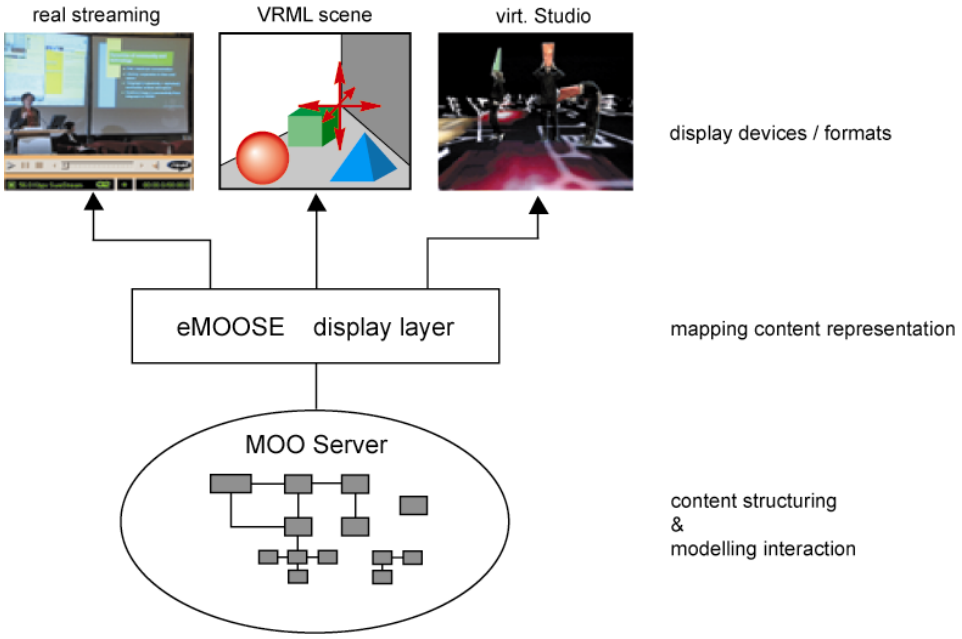

Fig. 11: Different levels of content representation

The shared virtual space of the MOO serves as a universal layer for modelling interactions between on-site and on-line participants and their effect on hypermedial manifestations on-site and on-line. This is fundamentally different to 3D virtual environments which are built on structures describing the rendering of the shared space as the primary element. In contrast, i2tv is implemented as a content structuring framework for organising hypermedia elements.

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8 i2tv system integrates the enCore version of the MOO system (http://lingua.utdallas.edu/encore) consisting of the LambdaMOO server, enCore Database for basic set of functionalities and components of the enCore Xpress interface for basic web connectivity.

9 Originally used for text-based networked virtual environments. Common applications are text-based socialising spaces, role playing and adventure games, and text/HTML on-line collaboration environments.

It builds on a layer describing data structures, interaction models and behaviours. This is completely independent from the layer describing how the content is to be rendered. Such structure allows modelling different forms of representation based on individual user's bandwidth, display and input device.

The real-life spatial metaphor of the MOO (rooms, users, exits, things, users, etc.) [Dieb96] facilitates the modelling of scenarios which relate objects in real space to structures in the virtual space (such as Virtual Studio sets), as well as relating actions in real space to on-line manifestations. The definition of events and behaviours on objects independently from the actual source of action and display, enables modelling interaction concepts for on-site and on-line participants in the same manner.

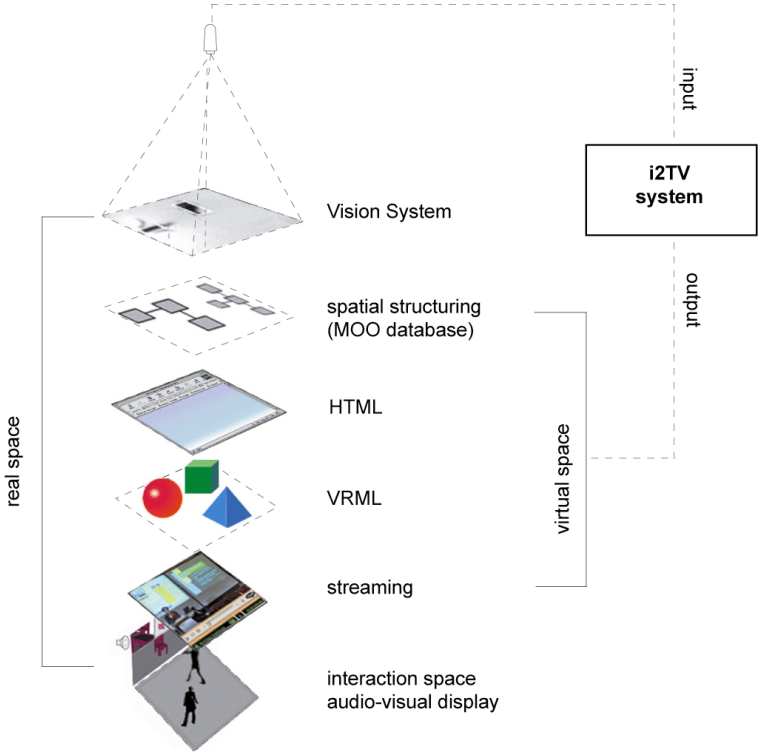

Fig. 12: Linking different forms of real and virtual space in the i2tv system

The mapping of MOO events into events suitable for a given display format (such as VRML, HTML, Streaming or Virtual Studio) as well as the mapping of user inputs from different input devices (such as web-interface, handheld device or Vision System) into a format needed for the MOO event structure, is done by the eMOOSE layer. The designer of the scenario defines the actual mappings: the levels of representation for given content (stored as objects in the MOO database, or as external references), relationships between objects, and manifestations of user's actions mapped across different layers of representation. This is done

through simple eMOOSE configuration scripts and MOO space editors (such as enCore Xpress), without internal modifications of the i2tv system.

3.3.3 Broadcasting the situation on-site to participants on-line

A straightforward way to provide feedback of the situation on-site for on-line participants is video streaming. While technologies such as Real Streaming enable reaching relatively large audiences with relatively low bandwidth requirements, they inevitably introduce 15-20 seconds delay between the live situation on-site and the video stream received by on-line participants. This imposes limitations on the models of interaction between on-line participants and the situation on-site. Real-time streaming solutions without delay typically require bandwidth capacities from 1,5 Mbs upwards. At present, this significantly narrows the reachable audience with this kind of connectivity.

A possible solution is to use Internet as interaction channel, and broadcast on-site situation through TV. This would be a convinient solution as it would not only enable high quality video for the remote participants, but also solve the problem of overcrowding too much information on a computer screen. Current problems with TV broadcast are that analog broadcast is very expensive, and digital TV has not yet achieved significant market penetration. The i2tv system supports both real streaming for Internet , as well as digital TV streams which has been demonstrated in the *Memoria Futura* Symposium public trial (see Chapter 4).

Upcoming digital TV settop boxes often integrate a modem for Internet-based interaction back-channel. This could provide basic (and limited) means of interaction for participants using only digital TV as display and interaction device. In this respect, especially interesting is the upcoming standard for the Multimedia Home Platform.

The current i2tv streaming solution is based on the Real Server. The i2tv system enables the on-site director to choose between multiple cameras as streaming sources, during run-time. The only limitation is the number of available encoders. It also implements an automatical fall-back solution: if the current encoder crashes down, the system automatically switches to the next available encoder, with a minimal loss of image for the viewers.

Since the streaming player runs as part of the i2tv web-interface, it is connected to the underlying MOO networked environment through the eMOOSE interface layer. This enables the implementation of scenarios based on events caused by individual user‘s actions upon the video, such as adding a video annotation, pausing, re-playing or seeking. All these events can be propagated within the i2tv system, and used as triggers for events in other users clients.

This enables the realisation of scenarios such as dynamic shared annotation spaces, shared video awareness, user video activity visualisation etc. It also enables the attachment of meta content to the video stream, stored in a database and synchronised to streamed content based on pre-defined time-markers or external actions (moderator, users).

For high-bandwidth streaming we had employed a DVB (MPEG-2) solution, as a basis for digital satellite broadcast during the *Memoria Futura* Symposium. However, the current lack of appropriate APIs for DVB platforms made it univiable to implement interactive possiblities as part of the satellite broadcast. So the normal i2tv Internet interface was used, with digital TV only as a high-quality, real-time display medium.

3.3.4 Channels of presence, interaction and participation

The i2tv system supports scalable channels for representation of remote users. Depending on available bandwidth and personal choice, the user can choose between live video stream, iconic representation through a photo or a symbolic graphical representation. The video stream from a user webcam is distributed to other users through the real server in the i2tv system. Since i2tv integrates the display of streaming video with the underlying multi-user event model, it is possible to combine events based on actions of individual users with manifestations in the display of incoming streams. For example, quieting down one of the users streams by the moderator, can be automatically propagated to all on-line participants, affecting their display of the specified stream.

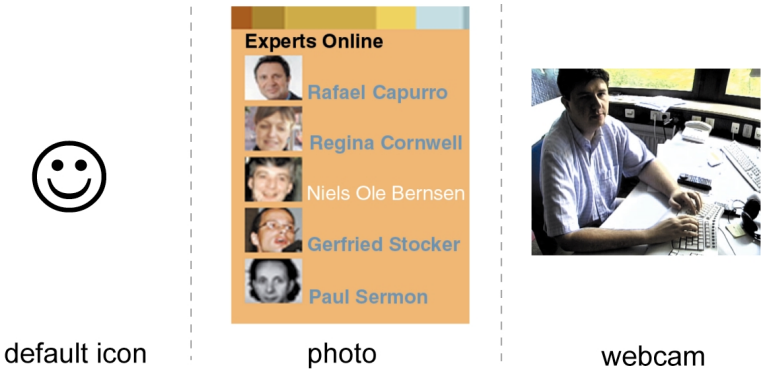

Fig. 13: Modes of user representation (photo, live video, graphical symbol)

However, the display of live video streams as manifestation of presence of on-line participants is largely feasible only on-site with appropriate hardware configurations. The common home PC is likely to experience problems with playing more than two streams, in addition to all other inputs from the event. Additionaly, some studies of on-site/on-line presentation formats with large audiences, have shown that live video as representation of

remote participants is neither very helpful, nor preferred by the on-line users [Jancke00]. They note that remote viewers even preferred anonymous representations in the form of symbolic icons to that of a live video stream. This is likely to vary depending on the role of on-line viewers and participants. In the case of our trial of an integrated on-site/on-line conference format (Chapter 4) the on-line participants actively took part in the situation on-site, and made sure they used the possibility of being represented by photo-icons.

This recognition of the relationship between the roles of individual participants in an on-site/on-line event, and appropriate channels of representation and interaction (Chapter 4.3.1), has determined the available representation and interaction channels in the i2tv system. In order to enable appropriate channels of interaction for different roles of on-line and on-site participants, on-line viewers, and on-site audience the i2tv system supports a range of interaction channels:

- moderated chat (public and private channels),
- streaming audio/video,
- text annotations to live video (video notes),
- 3D content creation in Virtual Studio,
- movement and content creation in shared 3D space.

Text chat has proven the most viable form of action for on-line participants in the context of an integrated on-line/on-site discussion format such as conference or symposia. It is also the only currently possible direct form of interaction for participants using handheld devices such as palmtops or handys. This form of interaction is directly enabled by the MOO system.

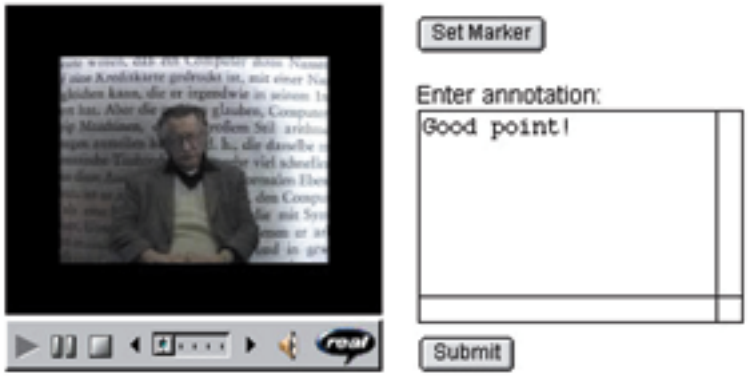

Fig. 14: Video annotations input form

The possibility of annotating the live video stream has been developed in order to provide an appropriate channel of active participation for on-site audience and remote viewers. The audience comments are stored in the i2tv system as annotations to the video stream being recorded. This enables the construction of the archive of the event as a visualisation of

participants experiences in a kind of collective memory space described in Chapter 3.3.6. It is implemented through the connection between the i2tv web interface, the stream player and the MOO system. The eMOOSE client-side applet enables the immediate propagation of new annotations to all participants, through the underlying MOO server.

The relevance of such interaction channel for audience participation is supported by a recent study of video annotations in collaborative video viewing sessions [Barg00] published parallel to our work. Used in a tele-education test setting, the study reports about users using video annotations in the amount comparable to that of taking paper notes. Although, the setting was not that of an real-time event, but of viewing a pre-recorded video, the shared notes situation also was tested in laboratory conditions, where it delivered very positive user feedback. As the annotations were propagated instantaneously to all participants, in some respect it resembled the situation we envisage in a live event. To the best of our knowledge, there have yet been no demonstrations and studies on using video annotations as a participation channel during a live event, as we intend with the i2tv system.

The interaction model of video annotations with creation of memory space provides support both for synchronous interaction during the live event as well as for asynchronous interaction. The latter is usually missing in systems addressing the live on-site/on-line situation.The users can act immediately, in real-time, while the visible manifestations of their actions can be postponed by the moderator. The resulting memory space (Chapter 3.3.6) provides a basis for post-event interaction by allowing subsequent annotations to the already existing memory space of the event.

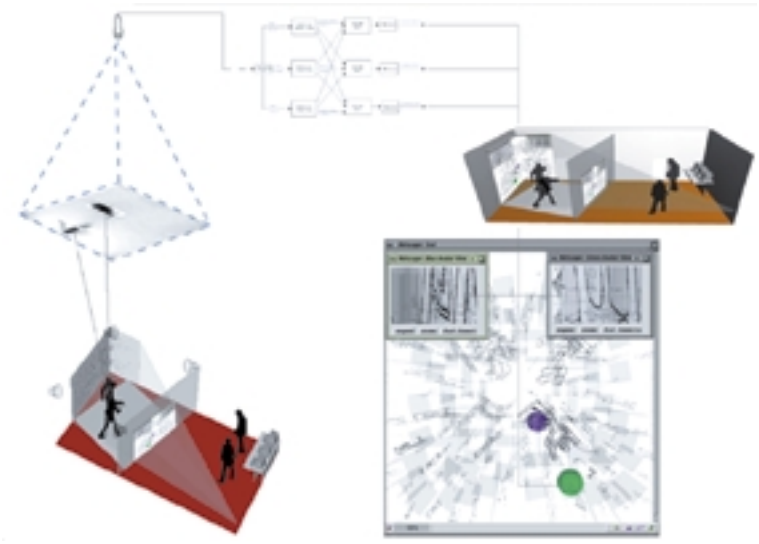

Fig. 15: Movement in physical space mapped to shared 3D space

Movement in shared 3D space is intended for different forms of Mixed Reality performances integrating bodily action in physical space and on-line participation, such as the Mixed

Reality installation Murmuring Fields [Strauss99][Flei00]. This is supported by the e-MUSE module that implements a VRML-based shared space with free-body interfaces.

Perhaps the most interesting aspect is the possibility to combine different interaction channels with each other. Even the simplest text inputs gain a different perspective if visualised as elements of the Virtual Studio setting, as is demonstrated in the „Ottos Mops“ distributed play (Chapter 5). Combining free movement in physical space as the natural form of interaction for on-site participants creates a new layer of the performative situation.

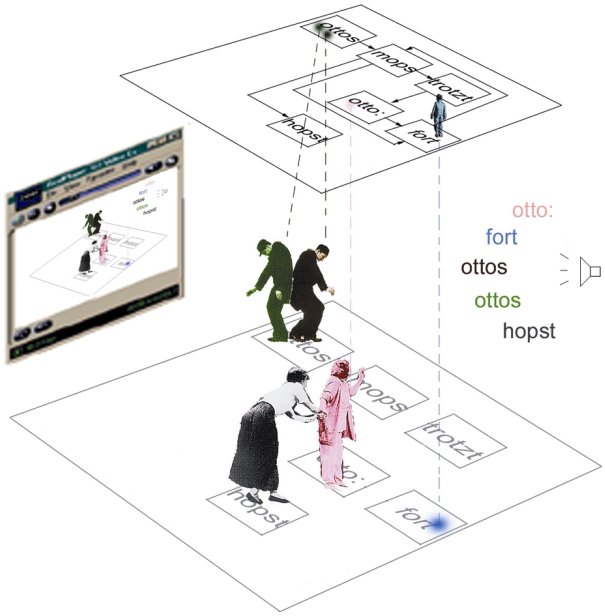

Fig. 16: Combining different channels of interaction and representation

3.3.5 Organising many simultaneous inputs: medial staging

The basic characteristic of integrating on-line participants into an on-site event is the resulting multitude of simultaneous inputs that need to be organised into some kind of integrated whole. One approach to this problem is clustering individual inputs into larger entities, where manifestation is varied based on the number of participants involved in the same kind of action. This is explored by the so-called crowd management techniques which address the problem of large scale participation. These approaches mostly attempt to give some kind of interaction possibility to large audiences. In most scenarios however [Benf99], this is recognised as insufficient and the role of several active participants is differentiated from very limited interaction possibilities of „crowd“ audiences. These active participants are provided with rich interaction possibilities as their purpose is to significantly influence, or even create, the actual content. Already the situation of one on-site performer and a few of such active on-line participants causes a multitude of simultaneous inputs that somehow need to be managed.

Dealing with this situation requires adequate dramaturgical formats that incorporate all the different inputs into an integrated whole. For this, we look at theatrical staging as an organisational principle for many simultaneous information sources (see Chapter 4.3.5). Such models require appropriate technologies for the spatial organisation of audio-visual inputs. The common approach is to have spatially organised projections of 2D or 3D shared spaces (e.g. VRML). We have explored this approach in our previous work by developing the concept of the Mixed Reality Stage [Strauss99].

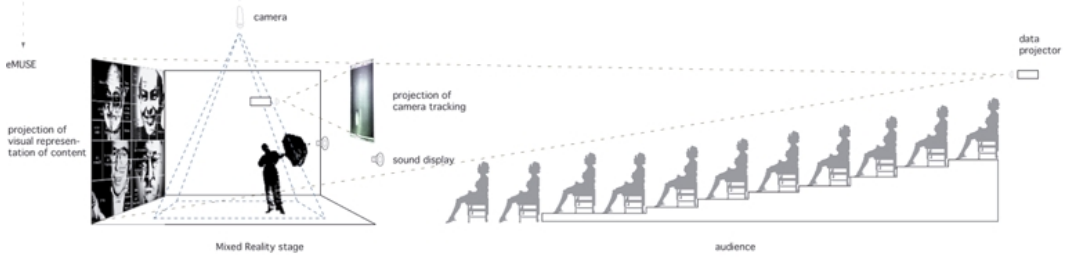

Fig. 17: Example of spatial setup on-site using projection VR [Strauss99]

The problem of this approach is, that due to the lack of real-time holographic displays, it is impossible to visually construct the 3D space within the physical space of the stage. So we had employed the concept of a spatialised interactive soundspace [Strauss99] which provides the immersion, accompanied by visual projections as side elements. Another solution would be to use glasses with see-through personal displays to which stereoscopic images are transmitted from a remote server. However, both of these approaches are difficult to convey to on-line participants and not suitable for broadcast formats.

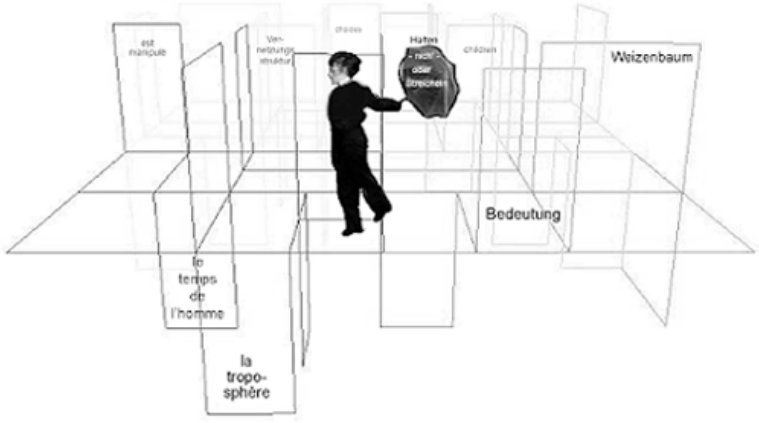

Fig. 18: The principle of interactive soundscape [Strauss99]

A possible approach to deal with this problem is using the Virtual Studio technology as a display environment for the Mixed Reality stage. This is demonstrated by the „Ottos Mops“ distributed play where the virtual stage is used to spatially organise the on-line inputs. The on-site performer is integrated into the virtual stage by using real-time Virtual Studio technology.

The connection of Virtual Studio with actions of Internet participants is made possible by the eMOOSE display layer which connects the multi-user shared space of the MOO with the Virtual Studio. The output of the Virtual Studio is either streamed to Internet audience or broadcasted to TV audience. In this way, the on-line participants can experience the situation of a Mixed Reality Stage created in real-time through their interaction with the participants on-site in the Studio.

Fig. 19: Using Virtual Studio for medial staging of on-line contributions

Another possibility would be to use CAVE-like systems such as GMD's Cyberstage. Due to the limited size of the CAVE (3mx3mx3m) this would provide the advantage of immersive experience only for one on-site performer but only a limited stereoscopic experience for the on-site audience. An experiment in creating a CAVE-based networked performance environment is described in our eRENA deliverable on forms of user representation in electronic arenas [Sengers00].

3.3.6 Visualising the participants experience as "collective memory"

The goal of the i2tv concept and public experiments is not interactive production of content to be broadcasted to passive TV audience (such as in inhabited TV), but the creation of spaces for active participation in cultural production. In this respect, not only synchronous communication and real-time participation, but also asynchronous participation is of critical importance. Supporting asynchronous interaction and integrating it into the creation of content during a particular live situation, becomes an significant issue. The emphasis of this issue is one of the strong distinctions between i2tv and other approaches of electronic arenas (see Chapter 2.1.)

The i2tv system extends the notion of a time-based hypermedia archive to an individualised memory space. The audience on-site and viewers on-line can make annotations to the video stream of the live situation, using their cell phone, palmtop or home PC. This provides a channel for active participation suitable for the role of an on-site audience and on-line viewers. They assume the role of commentators.

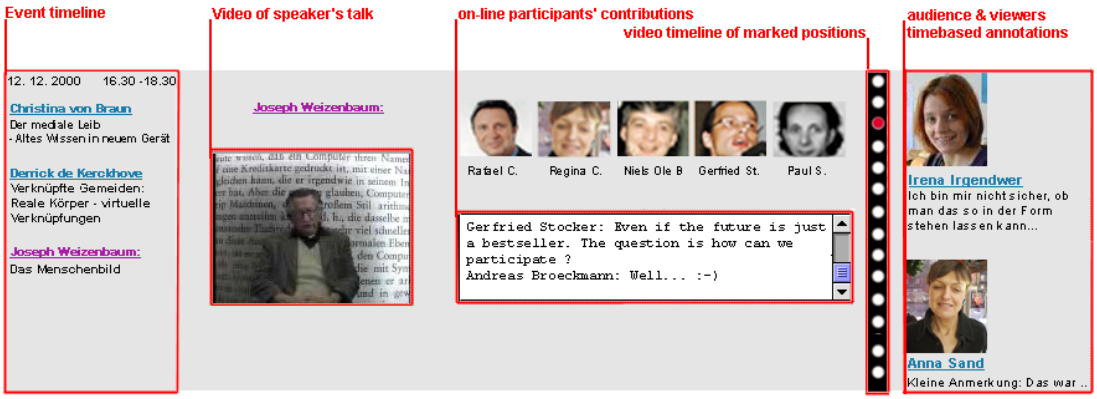

Fig 20: Visualising contributions of participants and audience as personal impressions building up a memory space

The video markers and comments of the viewers are stored in the archive as time-stamped annotations of the video stream transmitted by the i2tv system. The timepoints serve as points of reference for the visualisation of the history of the event. Instead of a linear timeline, the video recording is visualised according to the timepoints set by the viewers actions. They provide the structure onto which all the individual elements of the event are mapped: the recorded video, the contributions of on-line participants, and the comments of on-line viewers and on-site audience.

Putting these individual pieces into relation provides a kind of a mental map of the event, as it is perceived by the participants involved. Instead of an archive, a space of individual memories is built up. This memory space is generated in real-time during the event, not at its end. It can be visualised by the moderators, or looked up by the on-line viewers and participants, at any given point in time.

On the one hand, this allows the participants to experience points of view different from one‘s own, while the event is still in progress. In a way, it can be compared with the liberty of experiencing an arbitrary point of view in 3D virtual space. Even more so, looking through the i2tv memory space means seeing through the eyes of another real person, not a fictitious avatar. On the other hand, the fundamental notion of archive is transformed by capturing the event through the experience of participants involved. Rather than a collection of „objective“ facts captured by the camera or text logs, the hypermedial archive of the event is visualised as a collection of personal impressions. A space of individual memories creates a memory space of collective experience.

4. Memoria Futura Symposium: Integrating on-line/on-site discussion

The goal of the i2tv event at the *Memoria Futura* symposium[10] was to test the first ideas and the prototype system, in the archetypical situation for integrating remote participants: that of an on-line/on-site discussion. The attempt is to empirically address the question: what is the minimal set of requirements needed to integrate on-line participants into the situation on-site ?

Although there have been a number of experiments adding an on-line discussion to the on-site event [Jancke00][Isaacs94][Reki98], they come short of our purpose in several main respects:

- they focus on different situations (such as tele-presentation)
- they don't aim at or achieve little integration of the on-line discussion with the discussion on-site,
- they give little attention to the implications of situational differences of on-line and on-site for the nature of participants roles.

The main questions that this trial addresses are: How does the connected situation change the nature of experience for all parties involved? What are the intrinsic differences of on-line and on-site participation, defined by the absence of physical presence on the one hand, and by available interaction channels on the other? What roles can be identified, as determined by these differences? What new formats of cultural production and participation are inspired and made possible by these differences? Which familiar models from everyday life relate to this situation, that seeks to connect without providing the illusion of removing the distance?

The goal was to gain a deeper understanding of these issues. We wanted to find a better evaluation process of how critical the incorporation of certain technical features in the system really could be (such as audio/video feedback from on-line participants or threedimensional organisation of on-line input). It also served as a point of departure for developing new dramaturgical models for connected events (Chapter 5.). This is why we decided to do the trial in a very early stage in the development of the system, instead of waiting until more sophisticated functionalities were implemented. This decision proved extremely fruitful, as the lessons discussed in this chapter demonstrate.

10 http://imk.gmd.de/mars/cat/memoria

4.1 Basic concept

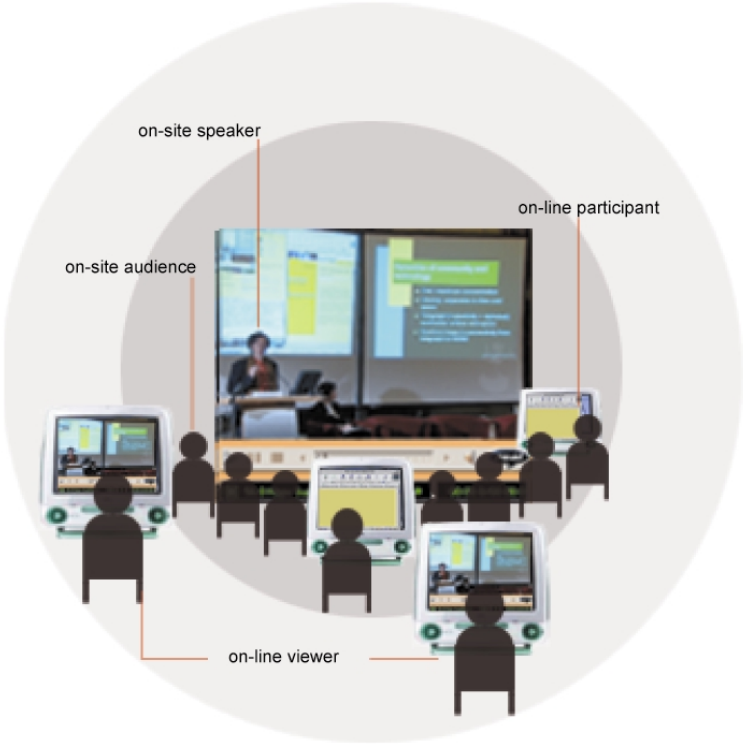

Fig. 21: Layers of participation in the i2tv event at *Memoria Futura* Symposium

The i2TV event at the *Memoria Futura* Symposium focuses on integrating on-line and on-site participation as an extension of the common conference format towards new models for connecting people or communities. A group of invited experts is integrated into the discussion on-site as Internet participants through the i2TV system. Live audio and video from the symposium are streamed to Internet participants. They can intervene into the symposium by means of text.

The Internet view is projected into the real space of the symposium as well. Additionaly, most important questions from the online participants are selected by the on-line moderator and displayed on the fly in large letters. These sentences also appear in the browser window of the online participants providing a feedback of the moderator's actions.

In this way, the on-line and on-site participants are made visible to each other. The audience and the speakers can follow and relate to the communication flow. The interaction level is deliberately kept simple (text) as the goal is to work towards concepts accessible for a broad public.

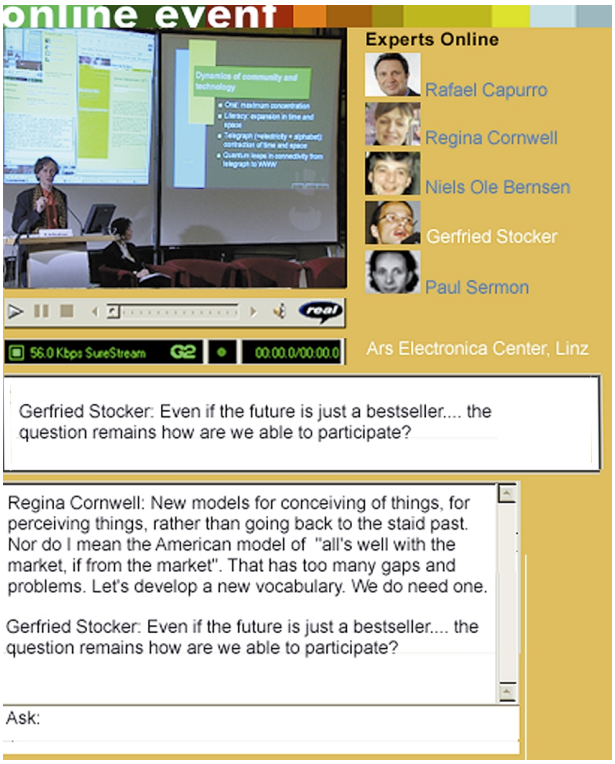

Fig. 22: i2tv interface at Memoria Futura Symposium

This concept focuses on the interaction between on-line participants and the on-site speaker. The on-site audience has no active role, except in the discussion when it can ask a question either to the speaker on-site or the participants on-line. Additionaly, there are the on-line viewers who can only watch and are completely invisible to other participants in the event. These restrictions are consciously made in order to isolate critical parts of the situation: the interaction of on-site speaker and on-line participants on one hand, and the observations of the on-site audience in retaining the passive role. In addition to that, one on-line participant in each session is actually located on-site, in the conference. This enables us to simulate a situation where the members of an on-site audience have active channels of participation, without introducing additional complexity into the situation.

4.2 Implementation

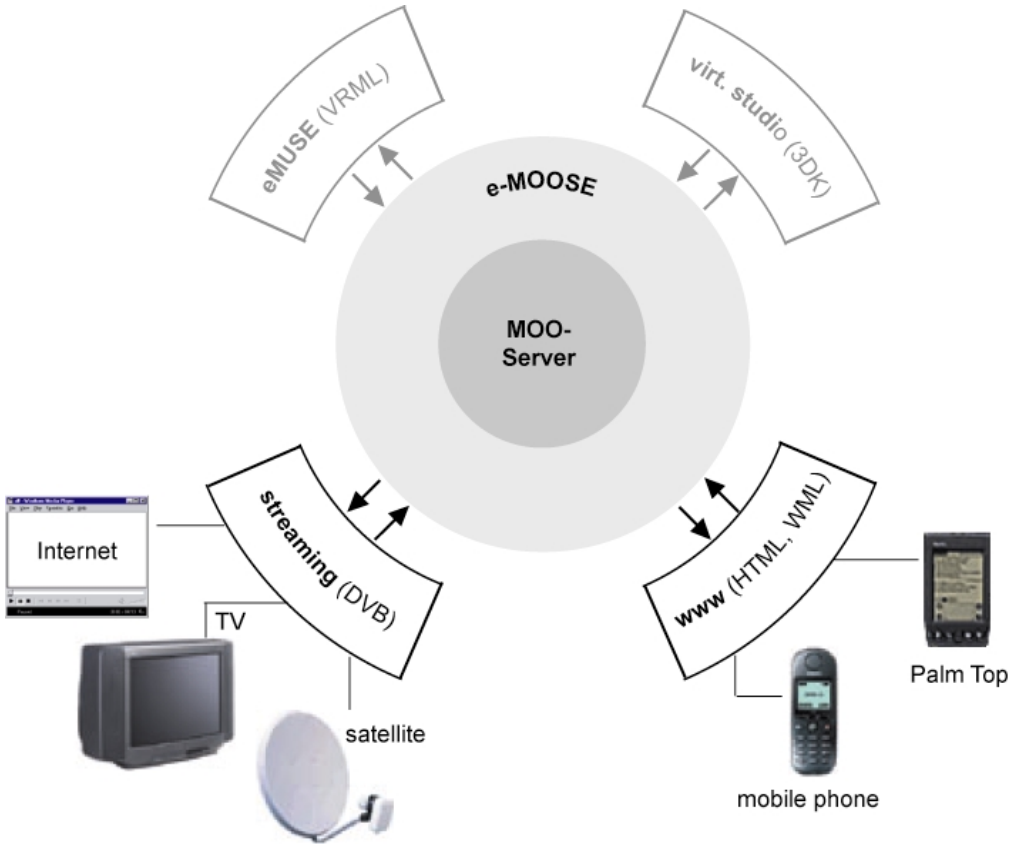

Fig. 23: Prototype i2tv system used in *Memoria Futura* Symposium

This trial combined three basic elements of the i2tv system: the MOO server, Real Server, prototype eMOOSE client and web interface. Additionaly, a DVB streaming solution was used for the satellite broadcast (via EUTELSAT). This enabled the on-line participants to use digital set-top boxes to receive no-delay and high-quality video from the symposium, while interacting through the Internet interface.

4.3 Evaluation of public trial and lessons learned

The symposium “Memoria Futura: Information Technology and Cultural Heritage – A New Perspective ?” took place from December 11-12, 1999 at GMD in Schloss Birlinghoven. There were four thematic sessions consisting of four on-site speakers and five specially invited on-line participants per session. Altogether twenty on-line participants were in the symposium. The on-line participants connected from Germany, Italy, Denmark, Croatia, and the USA. On two occassions, one extra participant located on-site joined the sessions as an

on-line participant as well. Speakers on-site included researchers such as Joseph Weizenbaum, Derrick de Kerckhove and Nadia Thalmann. Researchers and professionals from a wide range of disciplines were invited as on-line participants: from information technology and interactive media to media art, television, theatre, sociology and philosophy. Their affiliations ranged from university and research institutions to independent artists, media industry and television broadcasters[11]. Participants such as Niels Ole Bernsen (co-ordinator of I3 net)and Gerfried Stocker (artistic director of the Ars Electronica Center, Linz, Austria) illustrate the broad range of professions.

Positive feedback from the audience as well as from the speakers and from invited on-line participants confirmed the suitability of the i2TV prototype and the relevance of this approach for researching new forms of communication for a broad audience. The described media integration could point towards new forms of public events as it has awaken great interest among the attendees of the symposium from both science and technology as well as from culture. Inquiries and proposals for cooperation in further work of this kind have been made during and after the symposium.

The most important lessons include understanding the particular roles of on-line and on-site participants and audience, the notion of two social situations, the idea of memory space, and the notion of theatre as organising principle for many simultaneous inputs.

In evaluating the trial we used the method of subjective analysis such as informal interviews with audience and participants, and written evaluations of professional observers which we invited to take part as on-line participants for this special purpose. This was accompanied by objective analysis based on video recording of the event and on log files of on-line participants' contributions. The following discussion summarises the most important lessons we recognised based on this analysis.

4.3.1 Understanding the roles

One of the most important lessons was understanding the specification of roles of all parties involved, as determined by their individual situations of participating in the event. The analysis of the event based on the video recording, the log of on-line sessions and on comments from on-site audience and on-line participants, clearly points to very specific characteristics of the four elements constituting an on-site/on-line event. They can be represented by following roles:

11 For detailed information about the symposium, including a full list of participants and their affiliations, as well as personal feedback, consult the web-site of the symposium at http://imk.gmd.de/mars/cat/memoria.

- on-site speaker: the actor,
- on-site audience: the passivly involved,
- on-line participants: the commentators,
- on-line viewers: the analysts,

The basic characteristic of the situation of the on-site speaker is that of exposure. He is the one standing in front of the audience delivering the talk. At the same time, this puts him in the position of power and control. As a result, the nature of his participation is highly subjective, power and „manipulation". His goal is to lead the audience along his way. Hence the metaphor of an actor, performing a piece.

Being physically present and subject to the speakers verbal action, the on-site audience is the party which is immersed into the situation. Their perception is highly personal and immediate. This immersiveness means a lack of distance for reflection, the only real possiblity of participation being that of emphatic involvement, and immediate reactions rather than reflections. Compared to this, the degree of reflection for on-line viewers is higher. The ability to switch to asynchrone modus opens more space for reflection

The inherent nature of the situation on-line is the feeling of not being exposed, since physically not „being there". This feeling of "safety" (non-exposure) is reinforced by having only symbolic representation through a photo-icon, rather than live video stream. As a result, on-line participants turned out less careful in statements, and more prone to open discussion and critical remarks. On one hand, not being immersed into the situation created by the speaker on-site gave them the power to act reflectively. On the other hand, the awareness of being able to make themselves noticed through active production, resulted in the urge to act, which took away the objective part. Hence, more than "cold" analysis, the logs of the on-line session point to critical questioning of speakers statements.

The Internet viewers are the most uninvolved participants. They are invisible on-site, and consequently distant and cold. They can stop, rewind and replay at will, as well as attend to other things during the event. They do not feel obliged to follow the speakers flow. This puts them in a position to reflect.

These four basic roles, were accompanied by the moderator on-site and one on-line moderator. These roles are discussed in the following section.

4.3.2 Two social situations

Making the on-line discussion visible simultaneously with the talk delivered by the speaker on-site is a straightforward way of visualising activity and contributions of on-line participants. At the same time, it is a rather ineffective way. The audience responses signifies

that it was generally perceived as a good indicator of on-line participants' activity, and hence of their presence, but it didn't convey much more information: it proved tiresome and distracting to read the full text.

Having the selected on-line contributions projected in large letters from time to time by the on-line moderator, was appreciated by the on-site audience. It was received as interesting side comments providing a different point of view to what the speaker was saying, as well as introducing some dynamism into the perception of the speakers presentation. Some comments regarded it simply as "amusing" and therefore actually helping to keep the attention to the speaker's talk, rather than being distracting. Propagating these selections to browsers of on-line participants was regarded as a very welcome feedback, and is reported to have enhanced their sense of involvement in the event.

Most speakers considered projecting these selections during their talk as an unwelcome distraction and asked for it to be shut off until the discussion. But two speakers have been very enthusiastic in getting some active feedback from on-line, and in establishing some kind of communication, without disrupting their talk. Interestingly, it turned out that one of them was considered as having delivered the most exciting talk. During the panel discussion, following a set of few talks, the comments and questions from on-line participants were selected and projected by the on-line moderator at a much higher rate. This was appreciated by the on-line participants who reported high involvement in the event at that time. Both the on-line participants, and the audience on-site considered the on-line moderator as crucial for the integration of on-line participants. However, most important for a succesful integration was the co-operation of the on-line and the on-site moderator.

The existence of two different social situations, the one on-line and the one on-site, is clearly shown by the kind of on-line comments: there are always comments such as personal remarks, jokes or simply technical questions. This requires separate public and private channels for discussion related comments and those necessary for the creation of a social situation on-line. Although this was supported by the system, we had deliberately disabled it for the sake of the simplicity of the on-line interface. Additionaly, the on-line moderator was critical for accompanying the social situation on-line: from explaining technical questions to introducing on-line participants to each other, to answering questions regarding the situation on-site.

The difference of the two situations was additionaly demonstrated by the short attention span of on-line participants. Long talks by the speakers as well as the slow turnaround cycle of subsequent discussion, resulted in the development of a parallel discussion on-line with a life of its own and little relationship to the discussion on-site. This was substantially improved as we had the on-site moderator reduce the time slot for talks to 15 minutes, and as the on-line moderator projected on-line contributions at a higher rate. The delay imposed by the

streaming technology required the on-line participants to mentally adjust to the fact that they would receive the on-site responses to their questions and comments with 15-20 seconds delay. At the same time this also turned into a kind of regulatory mechanism for disciplining the question-answer flow in terms that it prevented the flow "on-line question-speaker answer-on-line remark to speaker answer" by one and the same participant. The majority of on-line participants reported the delay as being disturbing. The situation required a mental adjustment, but it did not jeopardize the involvement of the on-line participants.

4.3.3 The presence paradox and desire for action

The common assumption is that on-line participants in an event taking place at a real physical location, are the disadvantaged party due to their physical absence. The comments of on-line participants and of the on-site audience in this experiment provide a different perspective. Almost unanimously, the on-site audience expressed their impression that on-line participants were clearly treated as more important, due to their active participation during the event. At the same time, the on-line participants loudly complained about not having been given enough attention by the on-line moderator, and generally felt disadvantaged compared to the audience on-site.

These observations point to the realisation that available channels for interaction and active participation are more important than physical presence. Moreover, the lack of such channels for the on-site audience provoked increased activity in competing for attention to ask questions during the discussion. This points to the need for an equilibrium in available channels of participation for all parties involved. These lessons are reflected in the concept of video annotations as a model for non-disruptive audience participation throughout the event (Chapters 3.3.4, 3.3.6).

4.3.4 Is it archive or memories ?

Creating an archive of the event that comprises all individual parts (video, chat, audience questions) proved a difficult task with respect to recreating the time relation between individual elements.

This could have been overcome by a time-synchronised archive through simple timestamping. But even so, it would have provided only partial snapshot of what had happened during the event – namely only visible manifestations of involved participants. But what about the reception by the audience? What traces, personal imprints did the event leave with them? How was it different for the audience on-site, from the audience on-line? The reflections provoked by the symposium were eagerly discussed in the breaks between the sessions, and in our conversations with the audience. But they didn't result as a visible part of the event,

except the ones later on re-told through email comments, or summed up by our team as results of informal interviews in the event evaluation.

In order to overcome these limitations and provide appropriate participation channel for the audience, we have introduced the notions of video notes (Chapter 3.3.3.) and memory space (Chapter 3.3.6.) visualising the participants experience of the event as “collective memory”.

4.3.5 Theatre as organisational principle

The previous discussion of lessons on integrating on-site and on-line participation obviously brings up the question of appropriate organisation of on-line input for the on-site participants. The question of projecting textual discussion can be abstracted to the question of projecting any kind of graphical feedback that directly replicates the activity on-line: be it live audio or video streams or a 3D representation of a shared virtual world. The experiences of Inhabited TV project which implements the latter, show that even 3D does not help if on-line activity (movement or chat in 3D space) is directly replicated on-site. Having an on-line moderator selecting on-line contributions to be brought to particular attention on-site, is not merely a straightforward solution, but a simplification of a greater principle: that of medial staging of on-line participation into the on-site event.

What this relates to is the problem of organising many simultaneous inputs on the same stage, possibly coming in different media formats from different actors (text, audio, video or 3D). We compare this situation to that of a theatrical staging of a piece. Abstracting the situation of a conference, we come to the same model: the actions of multiple actors need to be organised in the same space. The basic difference of having not only physically present actors, but also remote ones, is that instead of physical bodies, only the medial manifestation of remote participants action is present. We look at theatre as a principle for organising simultaneous inputs of many different actors, into an integrated whole.

Theatre can be seen as a hypermedium, in which different forms of reality are put together. Theatre has been a mixed reality since its invention. This place brings together different realities through text, bodies, architecture, sounds, etc. Another example for the status of theatre as a mixed reality is the actors as a person and his role on stage. And at the same time, the dual meaning of stage as fiction or reality.

This hypermedium theatre becomes an intermedium. That is to say, it processes one reality with the other, one media with the other, in order to place boundaries and experimental transgressions between them. Example: How can a text be represented with the body, what is the relation of music and body to text, what is the relation of emotions to gestures and mimicry.

So theatre can be seen as an organiser and controller of mixed reality by intermediation. It does this in two ways:

- by creating paradigmatic boundaries such as role/person, fiction/reality, acting space/public space, with the help of different forms of material and immaterial frames (curtain, extraordinary behaviour of actors and public, proscenium, light etc.)
- by generating models of interrelation between media as forms of representation and the materiality, by the processes of culturally based interpretation (the most significant and obvious interrelation of materiality and representation in theatre is that of body and language).

Through theatre, these external models of the organisation of reality become the internal models of what we think is reality and how we can reproduce it consistently. Theatre creates reality by producing and training psycho-physiological states of mind as forms of existence in the world that can not easily be detected, because we are in it. For example: Being in the world as an actor/spectator leads to an understanding of reality as it is represented in the literate world. [Leeker99]

The metaphor of theatre as organisational principle for many simultanous inputs, immediately points to appropriate dramaturgical models as critical element, rather than merely a sophsticated spatial arrangement of display elements (e.g. projections). Especially interesting seems the postdramatic theatre whose basic intention is to develop strategies for dealing with the fragmentary nature of perception in a situation of simultaneousness of symbols, information overload, and non-hierarchical, ambigous relationships between elements. This realisation enables us to incorporate lessons from our previous work on theatrical models for Mixed Reality in shared physical space, such as the Mixed Reality performance *Murmuring Fields* [Strauss99]. Applying these lessons and theatrical strategies to the development of new models for on-site/on-line formats, is demonstrated by the *Ottos Mops* distributed play that we developed in sequence to this trial (Chapter 5).

5. Theatrical model: „Ottos Mops“ distributed poetry play

„Ottos Mops“ is a model for an electronic arena that explores live artistic production integrating on-line participants with participants at a real physical location. It brings together an on-site performer and multiple on-line participants in a real-time distributed play based on sound poetry (see video deliverable). The on-site audience and on-line viewers are also involved through channels for active participation.

Such theatrical model is an abstraction of the everyday situation in current media culture: the advancement of ever more pervasive Internet and mobile communications. The participants take part in a networked real-time performance and a live Virtual Studio TV production, from a home PC, an Internet Café, or as digital nomads with cell phones and palmtops.

5.1 Basic concept

Poem text:

ottos mops

ottos mops trotzt
otto: fort mops fort
ottos mops hopst fort
otto: soso

otto holt koks
otto holt obst
otto horcht
otto: mops mops
otto hofft

ottos mops klopft
otto: komm mops komm
ottos mops kommt
ottos mops kotzt
otto: ogottogott

Ernst Jandl

Abstracting the situation of on-line/on-site discussion described in the previous chapter leads us to a theatrical model that we realise in the form of a distributed poetry play. In this play, the performer on-site and participants on-line engage in a networked performance based on the sound poetry of the famous austrian poet Ernst Jandl. „Ottos Mops“ is a poem about a guy called Otto and Mops, his dog. Rather than depending on fixed meanings about what Otto and Mops do, the poem functions as combinations of sounds, and can be read in many different ways.

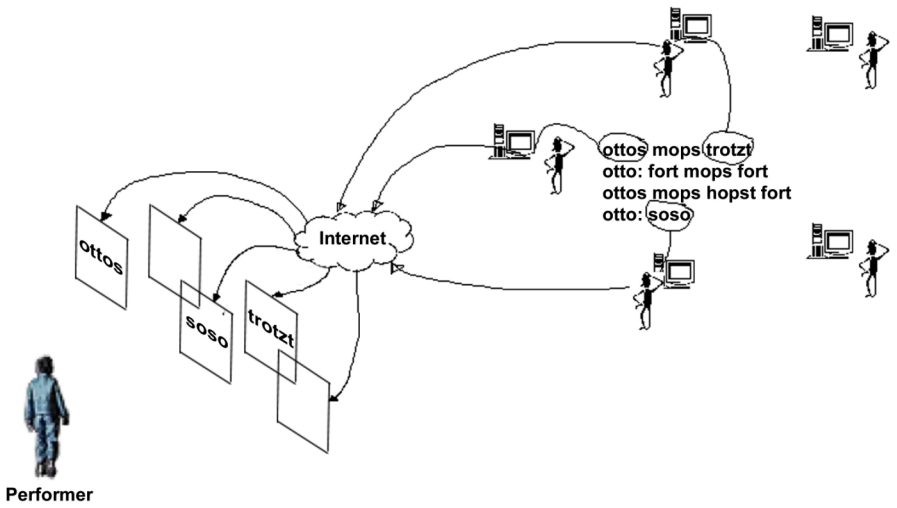

Fig. 24: Basic concept of “Ottos Mops” distributed poetry play

This particular choice makes two points:

- on one hand, we attempt to create a scenario in which on-line participants are an integral part of the situation on-site - they crucially determine the content produced,
- on the other, choosing the particular sound poem as point of departure, we exemplify the kind of open structures suitable for the technique of real-time collaborative collage, employed in this play.

This concept explores the familiar cultural technique of collage or "jam-session" in the context of a performance integrating on-line participants into the event taking place in real physical space. It tries to create a situation in which the interaction between on-site and on-line participants is the fundamental part of generated content. The on-site performer starts the performance by reciting the poem “Ottos Mops”. He is joined by Internet participants who send in pieces of the same poem, according to their own choice. The performance consists both in the actions of the performer as well as in the medial staging of the input from Internet participants. The Internet participants receive the audio-visual feedback of the performance on-site, as well as the visual feedback of each other's actions. They are not only related to the participants on-site, but also to each other.

As the performance develops, the on-site performer engages into improvisations based on the on-line input. On-line participants become active producers of new content and an integral part of the live situation on-site. The on-site performer becomes a kind of an unconscious conductor who binds their contributions in a concerted action.

5.2 Public test of an early prototype

An early prototype of the web-only version of the described realisation of the “Ottos Mops” distributed play has been presented at the European Media Art Festival (EMAF[12]) in May 2000, in Osnabrück, Germany, as part of the Congress “European Digital Visions”. The presentation has been accompanied by a live test in very low-bandwidth conditions with invited on-line participants and intended as a hands on experience for the audience. The goal was to get some feedback from a competent audience and recognise potential conceptual and technological bottlenecks in an early stage of development.

The setting included six on-line participants, on-site audience and the on-site performer replaced by the computerised voice based on text-to-speech synthesis of on-line inputs. One

12 http://www.emaf.de

member of the on-site audience was involved as an active participant on-site with the same interaction channels as Internet participants. Invited on-line participants came from fields such as dramaturgy and theatre, interactive fiction, media art and theory of new media. They connected from Germany, Italy, USA and Australia. The audience was a mixture of artists working with new media, media professionals, new media theorists, and an interested general public. The visual feedback on-site was represented by the projection of an early web-interface that was later developed to the final version described in Chapter 5.3.

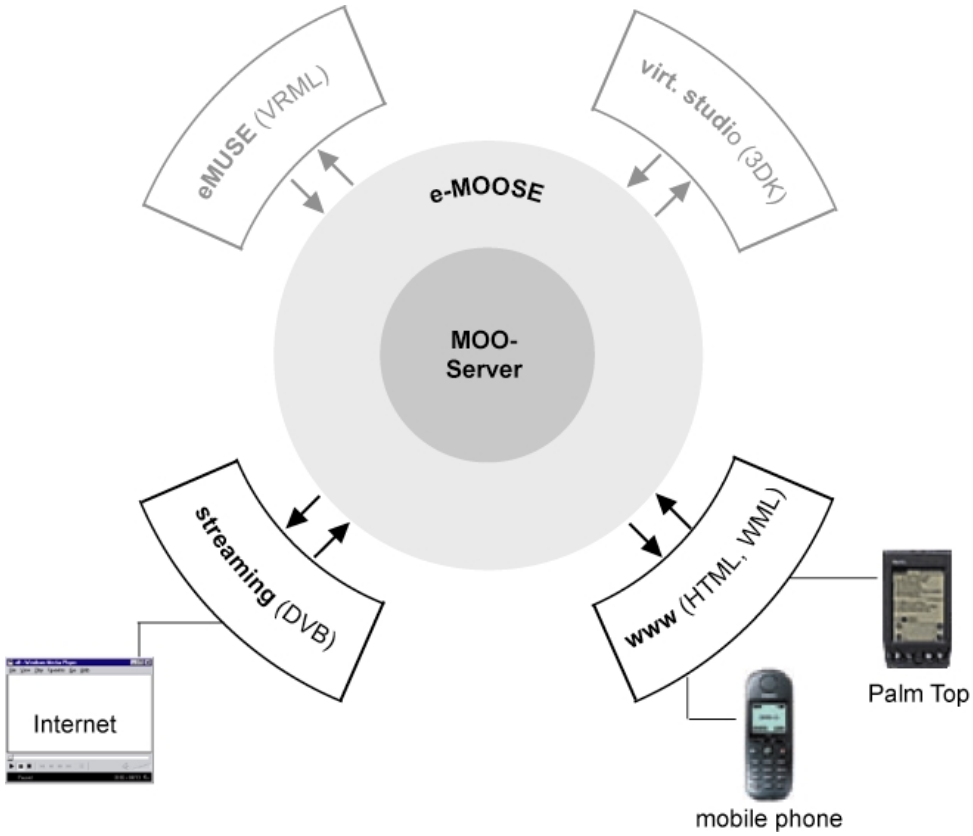

Fig. 25: i2tv configuration used in early implementation of “Ottos Mops” concept

The basic result of the test is that it functioned well for on-line participants but not for the on-site audience, due to technical problems with the limited Internet connection on-site for accomodating the outgoing and feedback video stream alongside multi-user traffic. The following discussion sums up the basic issues raised by this early test.

Technical

The bandwidth of the Internet connection on-site (128kbps) made it difficult / impossible for the system to work as envisaged given the traffic to and from the on-site computers. The available bandwidth was almost entirely eaten up already by the two streams transmitted through it: the stream out to the GMD server, and the feedback stream for the local client, projecting sound and video into the conference room. Nominally 56k streams, these streams effectively amounted to 34k each, which led us to believe the remaining 60kbps would be enough for the HTML traffic generated by user actions. We could have minimised this problem by streaming 28k instead of 56k but with unsufficient sound quality. Concerned with the sound output on-site we chose the better quality, bigger bandwidth solution.

What we overlooked was the fact, that - as a result of participants actions- a number of HTML frames were constantly reloading in the simple web-interface. This became a critical factor under such severely limited bandwidth conditions (unlike the situation at GMD). In effect, the refreshing rate of frames in the client browser window turned out too slow, hence restricting the speed with which the participants could act upon the text (including the two participants on-site). As a result, the words read out aloud by the computer, succeeded each other in a very slow pattern, without any underlying rhythm. The speed of participants actions on-site and of the feedback from actions on-line, needed for the interaction concept to provide satisfactory results wasn't there.

This made it impossible for a kind of word sound collage, created through the actions of on-line participants, to be perceived as such by the audience in the conference room. The succesion of words was simply much to slow. At this point it seemed unproductive to continue the experiment for much longer than a few minutes as the situation was not improving, and we had to keep the time-schedule of the symposium.

Most of the lessons we learned on-site relate to the technological problems noted and the status of the implementation which was a very first prototype. For example, the improvement of the web-interface in order to reduce the reload-rate problem. The urgent completion of the visual interface which was only a sketch to start with in the first place, etc.

Organisational

Even though the time available didn't allow for incorporating on-line participants into it, we should have remembered to at least have an on-line moderator to take care of on-line participants while they were listening to the talks and waiting for the experiment (introducing, helping with technical problems, co-ordinating the experiment on-line). Delivering a presentation and co-ordinating the experiment at the same time also proved too much for one person. A kind of director is needed whose only occupation is the on-line/on-site experiment. Making the experiment part of the presentation, as imposed by the schedule and nature of the occasion (symposium talks), turned out to be very unsuitable for tests with such early prototypes. There simply is no time to workaround errors and problems which are bound to occur. This was a point of doubt in advance, but it seemed a pity to miss the opportunity of the EMAF festival as an excellent public occasion for getting some qualified feedback from both general audience and professional observers.

Conceptual

As the experiment didn't technically work out as planned, it was difficult to distinguish the difficulties related to technological problems, from the ones related to the concept itself. The point of departure was the *Ottos Mops* poem as an open basis for a real-time collage situation, possibly connecting on-line and on-site participation. The on-line participants largely gave positive feedback on the concept itself and reported an interesting experience between themselves, on-line. With respect to described technical difficulties, the reported lack of interaction with on-site was apparent. Some interesting proposals were made as to the further development of the web interface, which were incorporated in the design presented in Chapter 5.3

As a summary of this experience, following main points were recognised: 1) the underlying technology needed to be improved in order to work in such limited bandwidth connections as we had on-site, 2) it was unfeasible to undertake the experiment tied to a presentation, it would have needed a time-slot and situation of its own in order to work on the problems expected when testing such early prototypes, 3) the underlying concept seemed to work fine for on-line but couldn't be tested on-site due to technical difficulties. The final implementation of the distributed play *Ottos Mops* incorporating these concerns is described in the next chapter.

5.3 Implementation

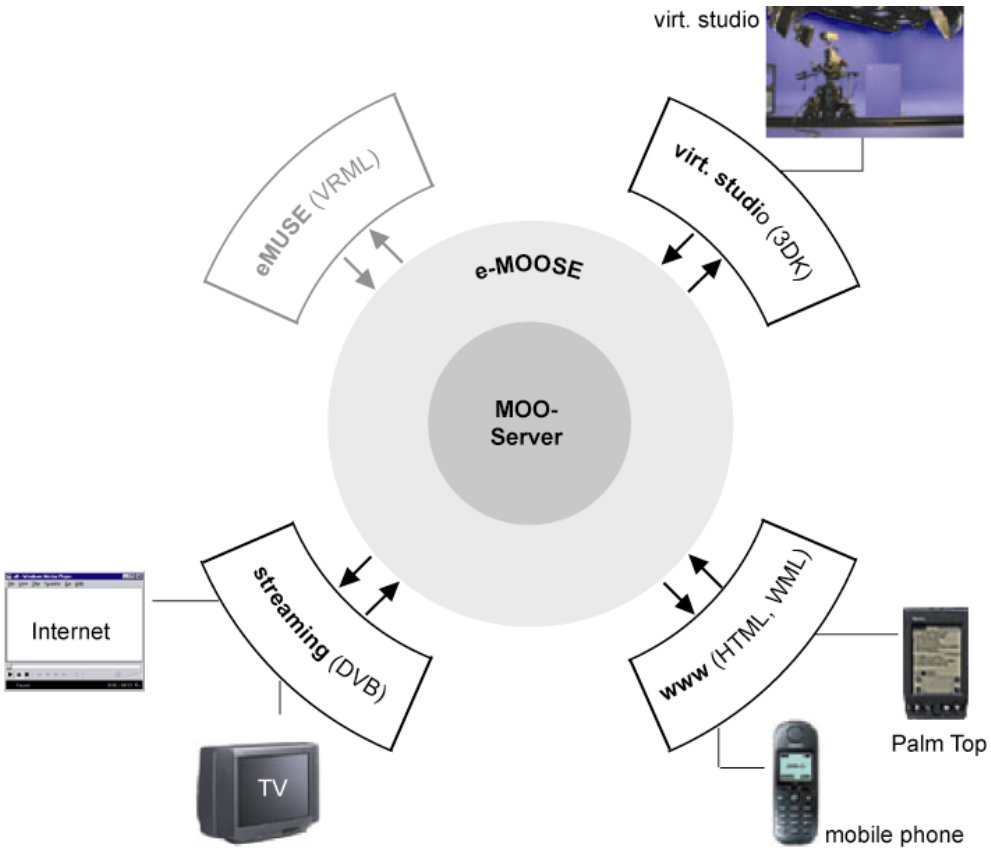

Fig. 26: i2tv implementation of “Ottos Mops” distributed play

The final realisation of *Ottos Mops* distributed play takes advantage of following elements of the i2tv system: the MOO server, real streaming, eMOOSE interface layer, web interface and Virtual Studio (Fig. 26). On-line participants and viewers can take part through the web interface both as interaction and display channel. Or they can watch the TV broadcast from Virtual Studio for high-quality no-delay video, while using the web interface only for interaction. This is possible because the results of their actions are displayed in multiple levels of representation: through web-based media, as 3D set of the Virtual Studio, and through TV broadcast.

The audience on-site experiences the situation of a Virtual Studio enhanced by the projection of the resulting Mixed Reality Stage. They can choose whether to watch the actor in the blue

box, or to watch the composed Mixed Reality Stage on the projection screen, while always hearing the combined auditory display of the actor and on-line inputs.

Fig. 27: Layers of participation in *Ottos Mops* distributed play

Fig. 28: Medial staging in Virtual Studio (as part of live TV broadcast)

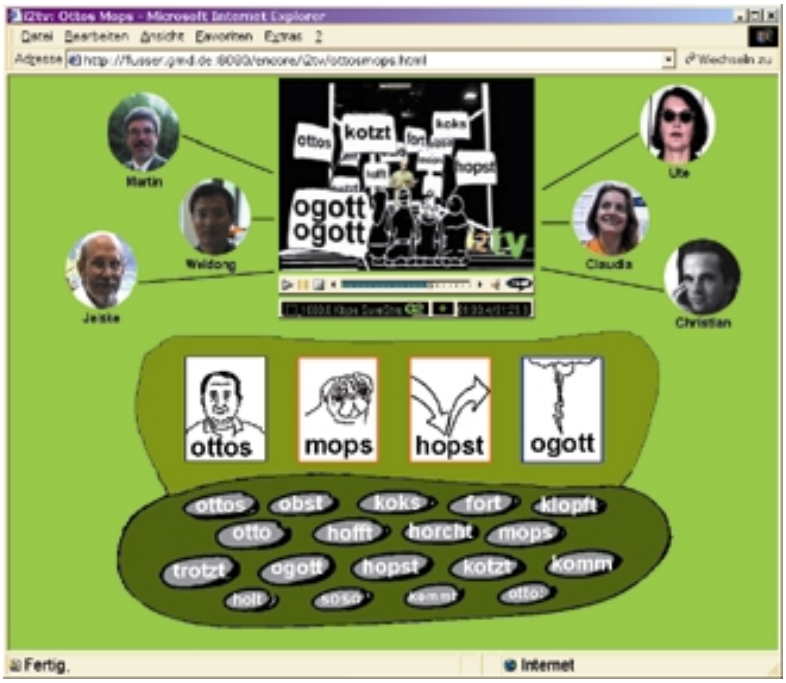

Fig. 29: i2tv interface for Internet participants in Ottos Mops distributed play

In addition to providing real-time input for the performance, on-line participants can also mark points at which they particularly like the currently composed line of the play. This is recorded by the system into a collection of impressions which assumes the form of new poems as personal memories of the event. The on-site audience and on-line viewers can also mark points in the live video stream of the event and annotate them with textual comments, using their mobile phones or palmtops with Internet access[13]. Their markers serve as reference points for visualising the history of the event. In this way, all the parties involved contribute to the creation of new content. The resulting archive of the event is organised in a form of a memory space, built-up by the personal impressions of the participants (Chapter 3.3.6).

5.4 Issues addressed

This model addresses two basic questions of electronic arenas:

[13] At the time of writing the WAP interface for mobile phones and the interface for the Palm Pilot are still in development. On the economical note, current rates for mobile Internet access in Europe make this an expensive solution for the people in the audience, but this can be solved through sponsorship agreements between the event organiser and mobile service providers, for the particular occasion.

- what kind of structures are needed for creating situations in which the interaction of multiple participants produces an aesthetic experience,
- medial staging for organising many simultaneous inputs into a coherent whole.
-

Related work in electronic arenas [Benf99] points out following issues as critical to integrating different layers of participation in an electronic arena:

- structuring interaction,
- establishing engagement between on-site performers and on-line participants,
- actively involving the on-site audience and on-line viewers.

We extend this with the following distinction of elements defining different participation models (Chapter 2.2) :

- Real-time interaction in the event
- Involvement in the creation of content
- Externalisation of participants' experience as "collective memory"

In the following we discuss how the distributed poetry play *Ottos Mops* as a model of an electronic arena integrating on-line participants into an event at a physical location, addresses these issues.

5.4.1 Structuring real-time interaction

As the first step in developing *Ottos Mops*, the question of the material suitable for real-time de-composition and re-combination is addressed. The sound poetry of Ernst Jandl is taken as a starting point that exemplifies an open structure suitable for networked scenarios. It provides a structure which is inherently mutable and re-composable, rather then conditioned by fixed relationships between the elements in order to create an aesthetic experience. This makes it an appropriate basis for the creation of new content through real-time interaction of multiple participants. Involving an on-site performer with the task of binding the on-line contributions in an aesthetic whole demonstrates artistic alternatives to the role of a moderator in traditional approaches.

5.4.2 Establishing engagement and involvement in the creation of new content

Metaphorically, the choice of the poem *Ottos Mops* addresses the notion of "communication" as the discovering of possible meanings, rather than that of "equal interpretation of meaning" by the parties involved in the exchange. The playful element of the poem helps to avoid the need of establishing meaning. It entices playful exploration in discovering alternative constellations of what is recounted by Jandl - "the stories of the story".

Substituting the performer by participants from the on-site audience, extends the situation to a kind of Mixed Reality karaoke. In a way, it provides a first-hand experience of the problem of interactive media: immediacy of involvement vs. distance for reflection. The roles of on-site and on-line participants relate to the specificity of their respective situations. On-site is emphatic, immersed into the situation, "close" to the experience of the poem read as written. On-line is distant, reflective, that which puts apart the predefined structure, helping uncover the inner workings of the poem as "stories that could be told".

5.4.3 Involving the audience and visualising individual experiences as a “collective space”

Providing the possibility of expressing personal experience of the event through the concept of video annotations, demonstrates a non-disruptive channel of active participation for the audience. This simple form of interaction gains another dimension when audience remarks are employed as a time-based structure for mapping out the history of the event. The resulting memory space (Chapter 3.3.6) illustrates a simple but powerful way of making visible a “collective experience”.

5.4.4 A model for interactive narratives

Staging *Ottos Mops* as a distributed play can be understood as creating a situation in which the participants can develop strategies for exploring interactive narratives. This concept points to possible approaches for developing participation models for networked scenarios which go beyond traditional models such as game shows, quizzes, or social chats in 3D space. It demonstrates ways for addressing the problems recognised by the approach of Inhabited TV, such as relating the performers and participants from the audience to each other, balancing interaction of different participants through “self-regulation”, a pace of interaction suitable

for the involvement of the viewers, and forms of interaction allowing individual expression and persistent degree of participation [Benf99]

In doing so, the *Ottos Mops* model of i2tv, demonstrates the fulfillment of all characteristics of an electronic arena as defined in the eRENA project[14]. It involves multiple participants in real-time interaction that is a basis for a new form of a cultural event integrating on-site and remote participants. Realising a live Virtual Studio production allows to visualise a Mixed Reality situation for all parties involved, while reaching large audiences through live TV broadcast. The combination of the passive broadcast model with interactive channels of the i2tv system enables active participation of the audience through the Internet interface (up to 300 simultaneous users). Rather than merely a combination of underlying technologies, the *Ottos Mops* distributed play demonstrates the abstraction of different cultural models from everyday life (TV, Internet) into an artistic production.

6. Conclusions

In this work, we have developed, applied and evaluated the i2tv system as an electronic arena for participation in cultural events for connected communities (Chapter 3). The i2tv system enables the development of scenarios that integrate Internet participants into events at real physical location through the combination of different media and channels for active participation. To this end, it combines networked multi-user interaction and awareness with medial staging on-site and broadcast technologies such as Internet streaming and Virtual Studio (Chapter 3.3). Rather then placing the participants as avatars in a shared virtual world, or creating a mixed reality performance confined to performers and audience in the physical space of the theatre, the i2tv system enables the development of electronic arenas as networked Mixed Reality productions linking physically present and remote participants while retaining the specifics of their respective situations.

The two concrete models of i2tv-enabled electronic arenas demonstrate new forms of participation in cultural events for connected communities. The historical format of participation in public discussion is extended to integrate on-line participants into a networked

14 http://www.nada.kth.se/erena

Mixed Reality agora (Chapter 4). This exemplifies a point of departure for uncovering the intrinsic characteristics of the connected on-line/on-site situation as a fundamentaly new form of cultural experience. The basic question of the added value of the connected situation, and how it can enable new models of cultural participation beyond familiar formats, is addressed by the analysis of participation roles and models uncovered in the public trial at the *Memoria Futura* symposium (Chapter 4.3).

The lessons learned are demonstrated in the sequent development of a theatrical model as a new form of artistic production making on-line participants active producers of new content and an integral part of the situation on-site. This is realised in the form of a distributed play *Ottos Mops* (Chapter 5) based on sound poetry by the famous austrian poet Ernst Jandl. The play demonstrates a participation model based on four roles specific to the connected situation (Chapter 4.3.1): the actor (on-site performer), the passivly involved (on-site audience), the commentators (on-line participants) and the analysts (on-line viewers). The concept of video annotations and the visualisation of participants experience as a space of “collective memory” (Chapter 3.3.6, Chapter 5.2) exemplify non-disruptive channels for active participation of the on-site audience and on-line viewers. The combination of multi-user networked interaction with medial staging on-site and live Virtual Studio TV production, demonstrates the integration of the participatory model of the Internet and the passive broadcast model of TV into a new convergent unit - live Mixed Reality TV production integrating Internet participants with the event in real physical space (Chapter 3.3.5,Chapter 5.2).

The results of this work have been presented at several international forums such as the scientific conference SIGGRAPH (July 2000, New Orleans) and the European Media Art Festival (May 2000, Osnabrück). Positive feedback from participants, audience and professional observers in our trials confirmed the suitability of the i2TV system and the relevance of this approach for researching new forms of communication for a broad audience. The described media integration could point towards new forms of public events as it has received great interest among the attendees of the symposium from both science and technology as well as from culture. With this work on the development of the i2tv system and concrete models of electronic arenas that it enables, we aim at presenting a way of addressing the need for new cultural spaces that explore strategies for dealing with the desire of active social participation in the media culture.

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