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## **"Performance Evaluation of Multimedia Systems in the AMUSE-Project"**

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Multimedia, the integration of data, video and sound, is now going to become a totally new area in computer science and will mature to distributed systems and applications. The global objective of the EU-project AMUSE - "Advanced Multimedia Services for Residential Users" - is to carry out experiments in the provision of interactive and distributed multimedia services to real residential users. The participants in AMUSE are several renowned European TC and IT-companies as well as research institutes and universities which will demonstrate and evaluate these services in field trials carried out in different islands.

The main goal of the overall project is the demonstration of the viability of the overall system choices in a real advanced multi-service, multi-service-provider and multi-operator environment and the collection of results to validate user acceptance. This will especially include the user's satisfaction regarding the functionality, the quality and the performance of the offered multimedia services. The acceptance of the multimedia services decisively depends on the performance of the overall system. The integration of the multimedia server in the different network infrastructures is a highly relevant topic for the successful realization of the services. Thus, the end-to-end performance of the overall system will have to be analysed and evaluated.

The performance evaluation of the multimedia server and the overall system will include both performance measurements and performance modelling. The two main objectives of the performance measurements of the multimedia server are the following:

- (1) localising and analysing performance bottlenecks for improving the performance of the server with respect to the performance of the overall system
- (2) generating basic performance data for tuning the server performance and furtheron for performance prediction and modelling purposes.

The performance measurements will be done on two different levels by using standard UNIX-monitoring tools in an automated measuring and evaluating environment:

- The measurements for analysing system bottlenecks will be carried out under realistic conditions in the different trials.
- The generation of basic performance data will be better performed by measurements in a test environment.

An assessment of user behaviour will be performed by means of an automatic monitoring of all relevant user actions within the AMUSE field trials. From this information a detailed service usage profile including information on quantity and media type of data accessed will be evaluated. Both the service and technical related measurements resulting from the field trials will be used for setting up performance models of the delivery system and its specific components. The ultimate goal is to evaluate the performance of the overall system by means of computer simulation with a larger user population and larger geographical extension of the system in order to find bottlenecks and give guidelines for parameter optimization and further improvement of the system.

# Performance Evaluation of Multimedia Systems in the AMUSE Project

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## Overview:

- General overview of the AMUSE project
- Results of Munich trial evaluation
- Performance Modelling and Simulation
- Conclusions and future work



## Overview of the AMUSE project (1):

### **AMUSE:**

Advanced Multimedia Services for Residential Users

Project in the framework of ACTS Programme  
(Advanced Communication Technologies and Services)

### **Project Target:**

setting-up and performing interactive multimedia services trials

- involving real residential users
- taking advantage of state of the art end-to-end ATM infrastructures

**Partners:**        Italtel, I (prime contractor)

Autor, P  
CSELT, I  
Deutsche Telekom, D  
GPT ltd., UK  
IDEA S.C., B  
INESC, P  
NTUA, GR  
Nyherji ltd., IC  
Online Media (Acorn), UK  
Portugal Telecom CET, P  
Post & Telecom Iceland, IC

Siemens AG, D  
Siemens Albis AG, CH  
Siemens Nixdorf AG, D  
Sirti S.p.a., I  
Swiss Telecom PTT, CH  
Telecom Italia S.p.a., I  
University of Iceland, IC  
University of Paderborn, D  
University of Stuttgart, D  
Videotime, I



## Overview of the AMUSE project (2):

### **Approach:**

Trials will run in a number of different islands, characterized by:

- different economic, political and commercial contexts
- different access network technologies and switching systems
- different telecommunication network infrastructures

### **General Objective:**

Providing key players (end-user, service provider, content, and network provider) with some answers on the services and the required infrastructure

### **Achievement:**

Performing several experiments in two distinct categories:

- experiments assessing the service domain
- experiments assessing the technological domain as:
  - \* Interoperability
  - \* Transport aspects
  - \* Control Plane aspects
  - \* Operation and Maintenance aspects
  - \* Performance aspects



## Overview of the AMUSE project (3):

### AMUSE Technical Performance Evaluation Activities:

#### Field Trial Performance Measurements:

- Usage Information for VoD Services
- Usage Information for Internet Access
- Monitoring of Video Server Response on User Actions

#### Laboratory Measurements on Key Delivery System Components:

- Retrieval of Video Data Streams from Hierarchical Storage Architectures
- Video Server Bottleneck Analysis

#### Modelling and Simulation of Delivery System Components:

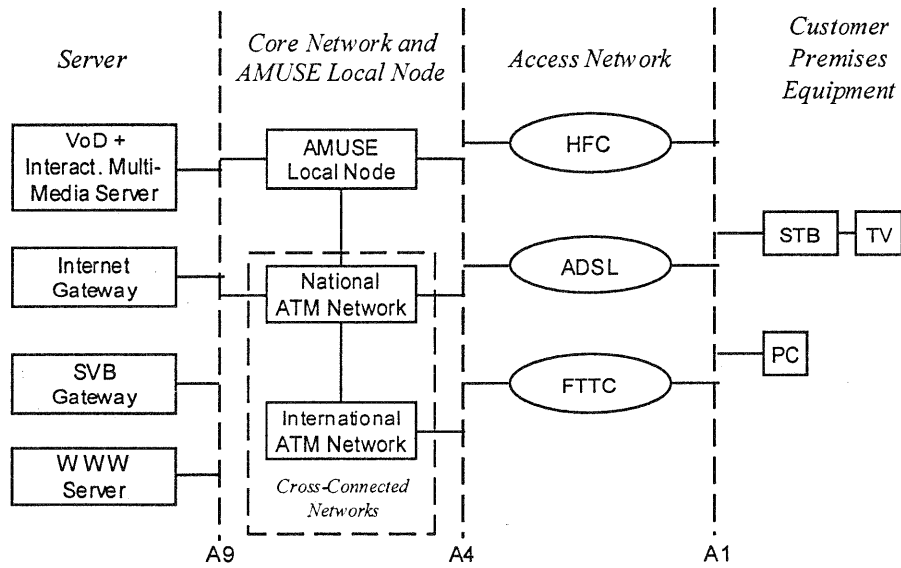
**Goal:** Extension of the results that can be obtained within the Field Trials

- Simulation of Larger User Populations
- Simulation of Alternative Multimedia Network Environments
- Simulation and Optimization of Hierarchical Storage Architectures



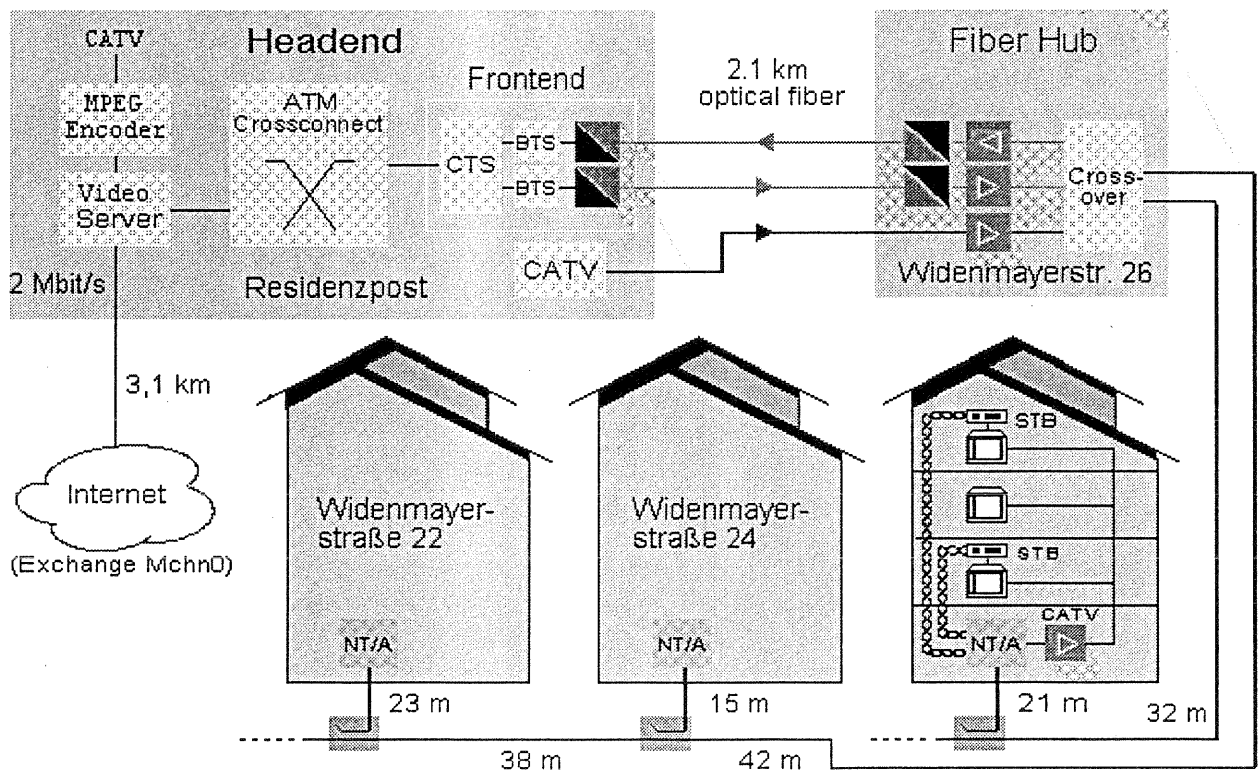
# Overview of the AMUSE project (4):

## General reference configuration:



Apr 2

## AMUSE Munich field trial

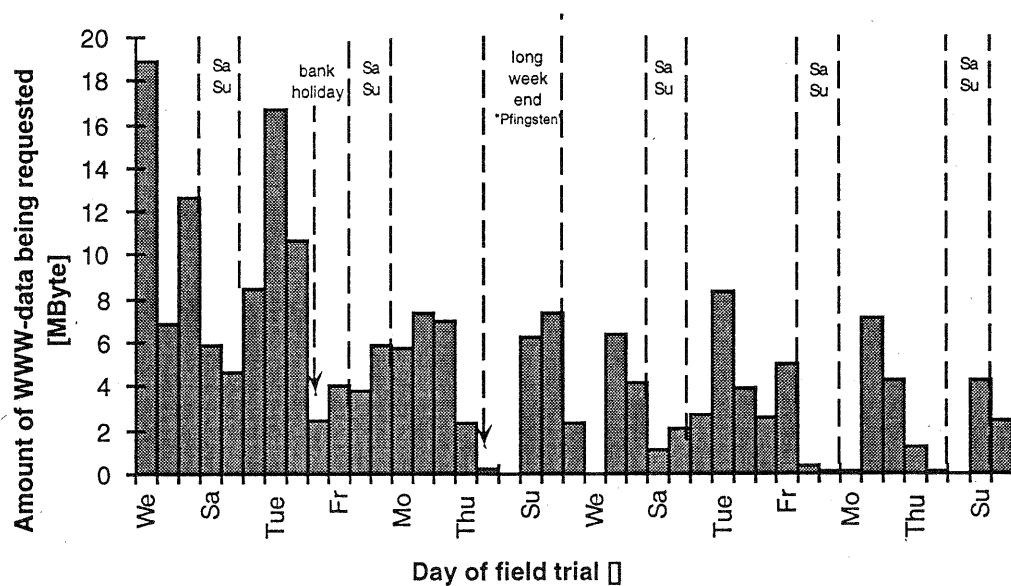


## Preliminary Results of WWW Internet Access (1):

- Logging information created by httpd Server-Daemon

### Amount of WWW data being requested:

- Evaluation interval of 1 day
- 1st day of observation: Wednesday, May 8th 1996
- period of 41 days, until Monday, June 17th 1996



- Higher usage during first days of the trial
- Lower usage during weekend/bank holidays

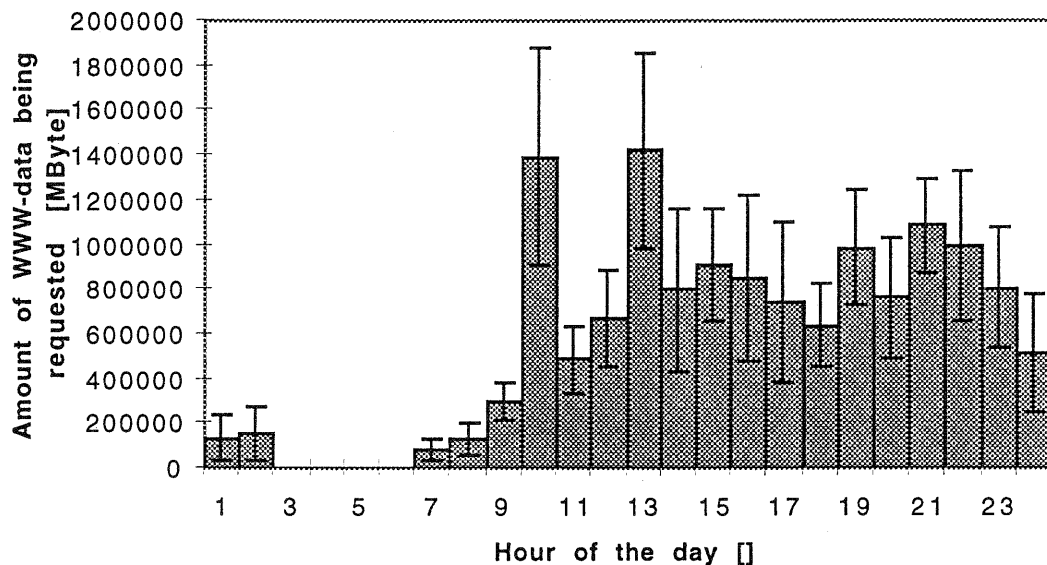




## Preliminary Results of WWW Internet Access (2):

### Amount of WWW data being requested:

- Evaluation interval of 1 hour
- 1st day of observation: Wednesday, May 8th 1996
- Averages taken of 10 consecutive days
- with 90% Confidence Levels



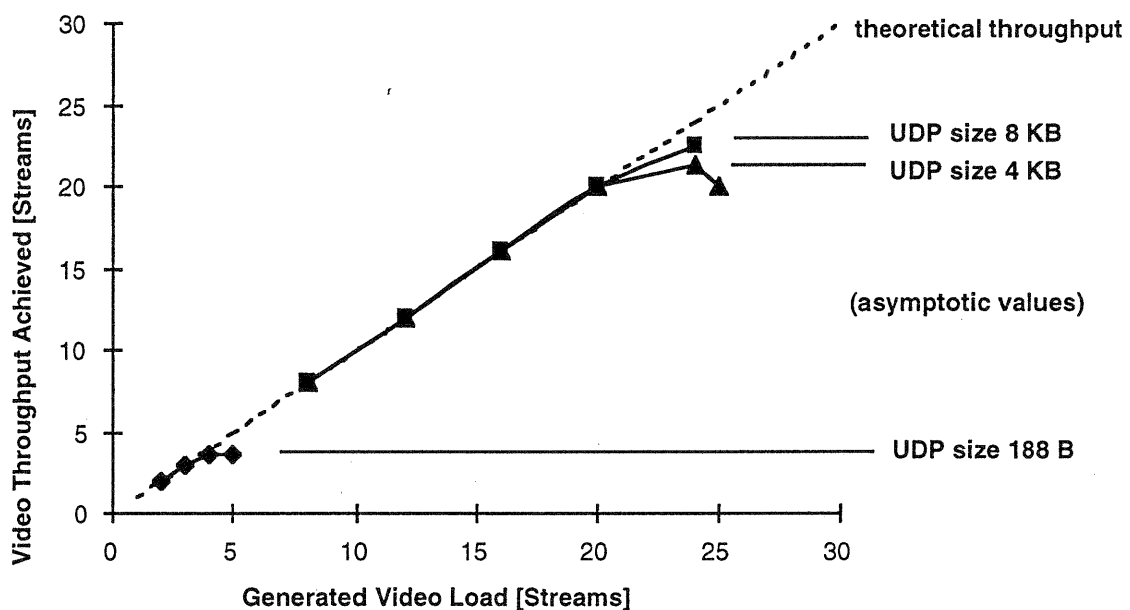
- Never used between 3 and 6 a.m.
- „Service rush-hours“ during the afternoon and night



## Preliminary Results of performance measurements of VoD-Server System:

- Measurements in „private“ test environment
- SNI Media Server RM 400 (mono processor version)
- Video material stored on Disk Array (RAID-system)
- Access to ATM network
- One video stream = 1.5 Mbit/s MPEG-1

VoD throughput vs. # of video streams:

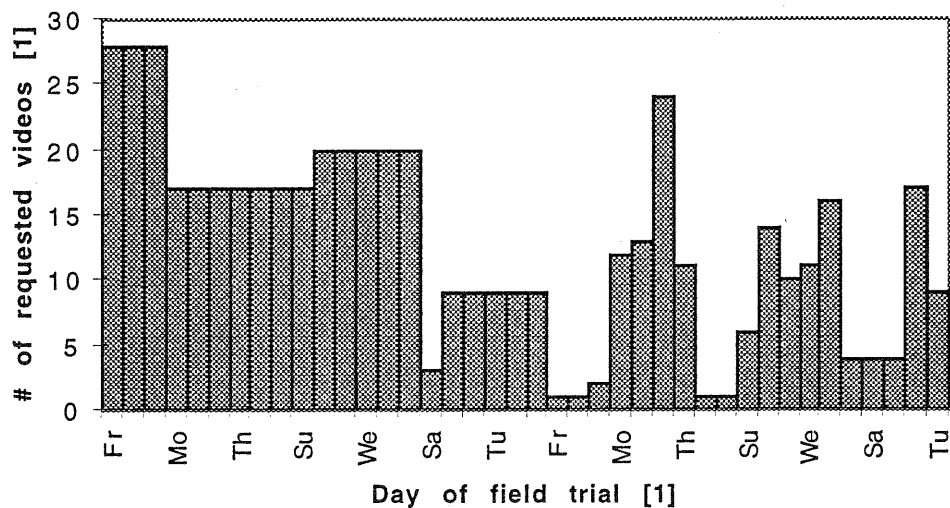


- up to 22 parallel video streams achievable in present system configuration with appropriate UDP datagram size
- CPU loaded below 50 % (for UDP datagram size 8K)
- scalable up to 70 parallel streams in different configurations with more powerful I/O devices



## Preliminary Results of VoD Service Usage:

- Data taken from (preliminary) accounting software
- Evaluation interval of 1 day  
(unfortunately sometimes accumulating for several days)
- 1st day of observation: Friday, May 10th 1996
- period of 40 days, until Tuesday, June 18th 1996

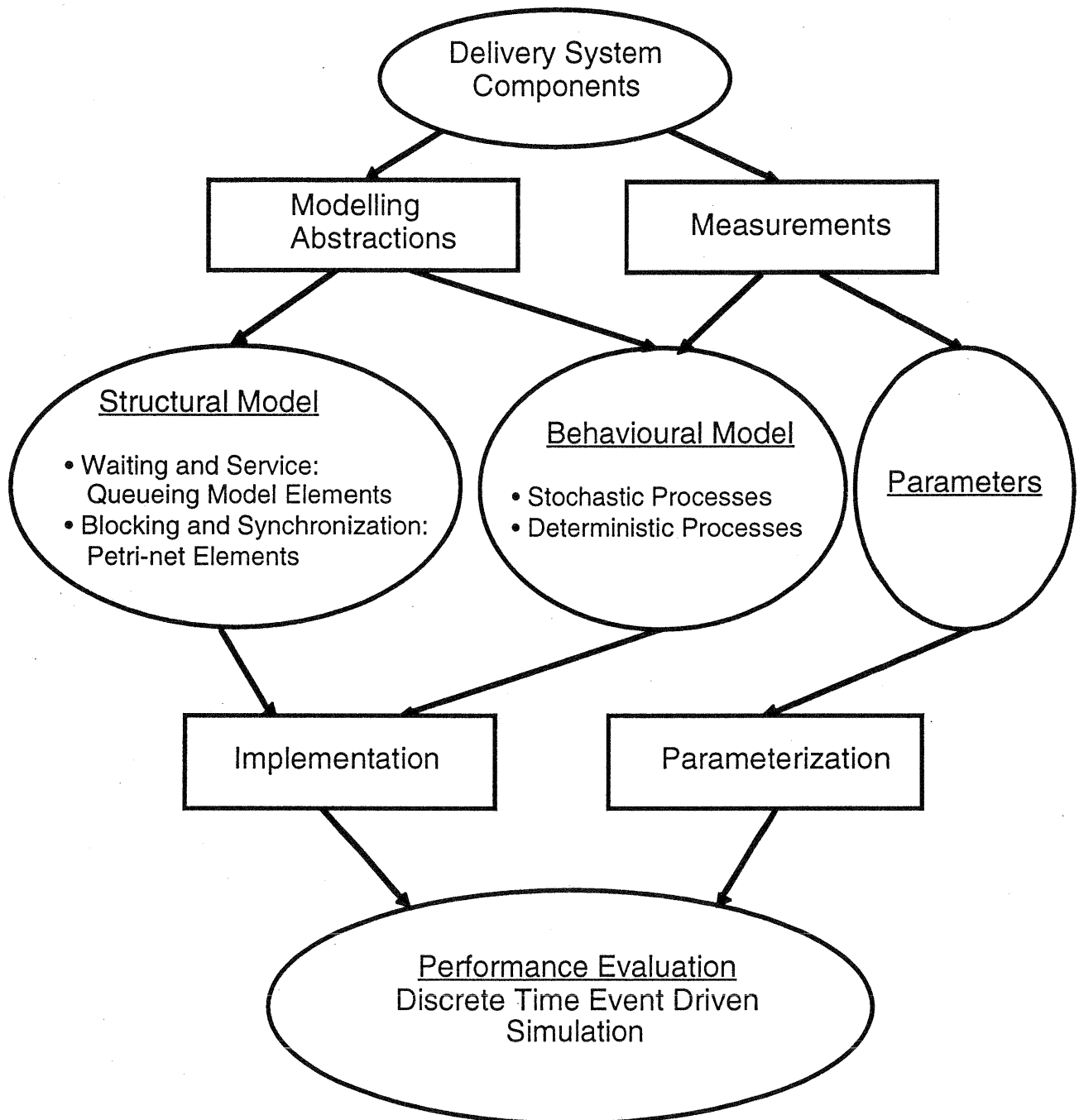


- Higher usage during first days of the trial
- Usage decreasing during the trial
- News on Demand Service at 32 % of all videos being requested by the users
- German news „Heute“, „Heute Journal“, „Bayrische Rundschau“ available for last 7 days



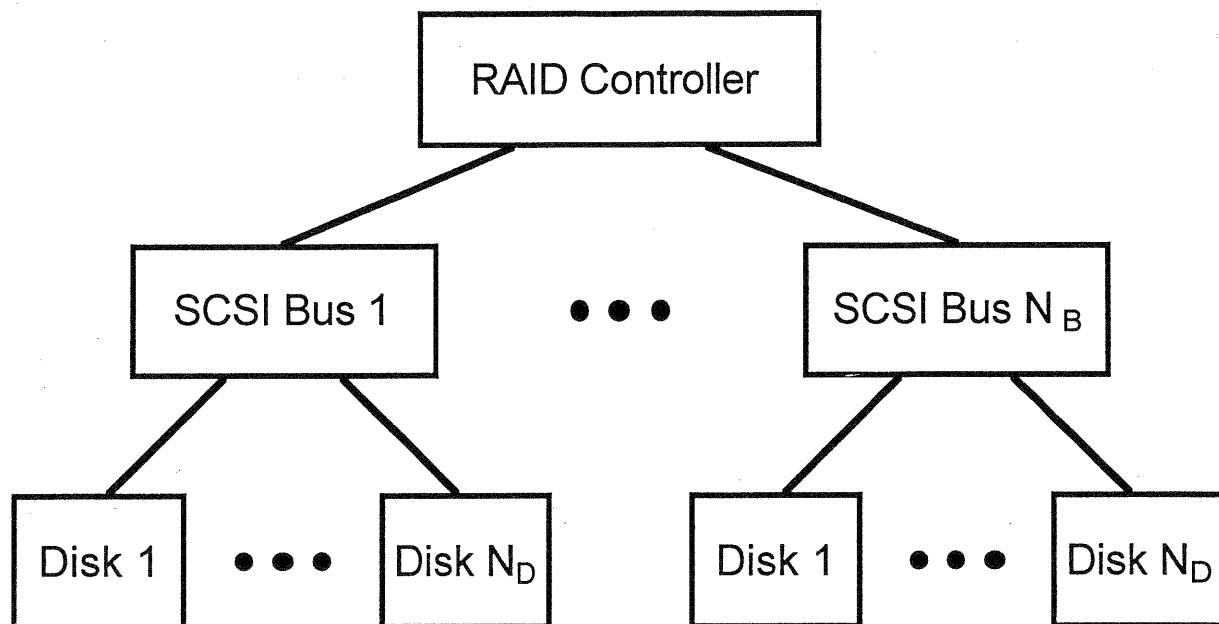
# Performance Modelling and Simulation (1):

## Modelling and Simulation Methodology:



## Performance Modelling and Simulation (2):

### RAID Storage System Model



#### Model Features:

##### RAID Controller:

- RAID Controller Overhead
- RAID Level
- Local Memory Size

##### SCSI Bus:

- Bus Arbitration
- Data and Command Transfer Delays

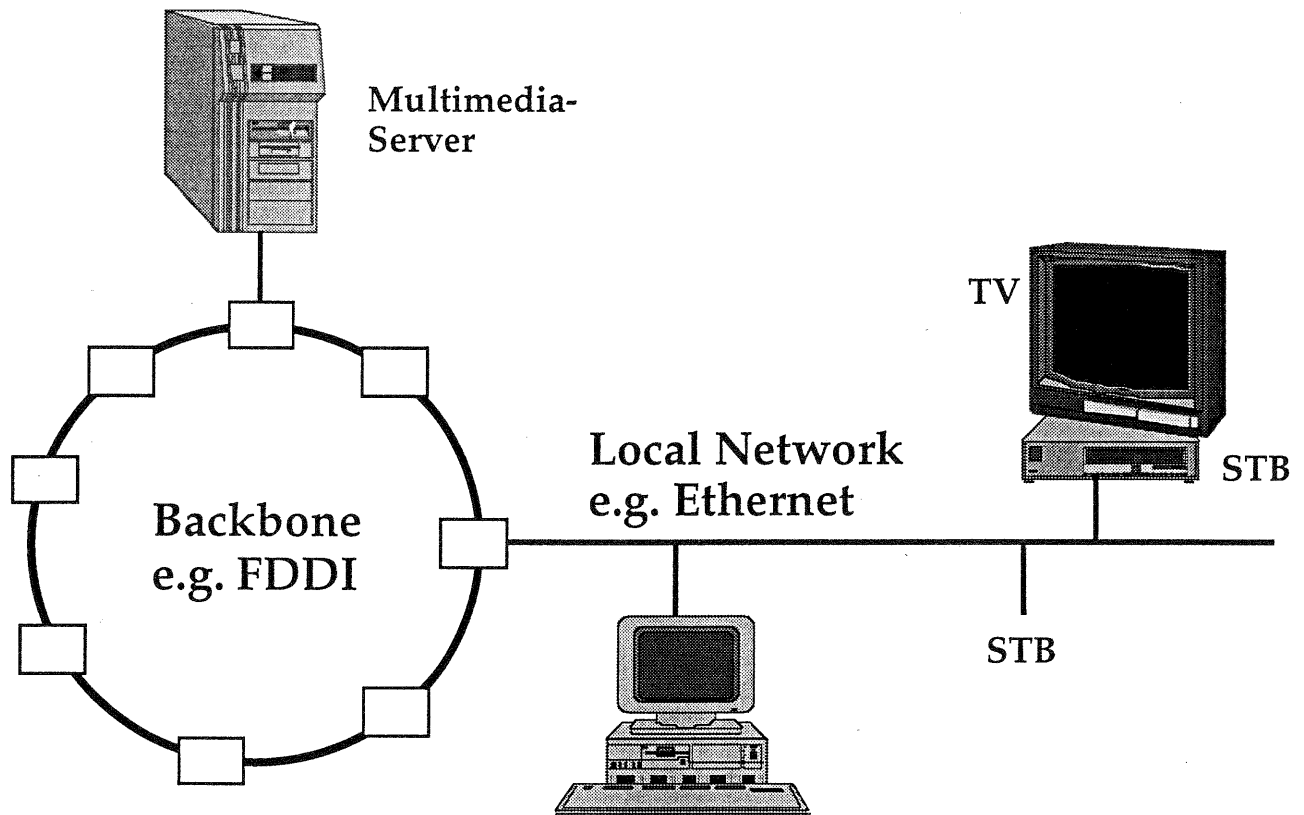
##### Harddisk:

- Disk Controller/Bus Disconnect Overhead
- Head Positioning
- Rotational Latency
- Cache Size/ Cache Strategy
- Zoning



## Performance Modelling and Simulation (3):

Scenario: Multimedia Services in Metropolitan or Campus Networks



- Multimedia Services (like Audio/Video on Demand, information retrieval, ...)
- Campus-like networks (e.g. Universities, industry fairs, metropolitan information system, ...)
- Performance evaluation of system components by means of simulation
- Comparison of different backbone networks (e.g. FDDI, ATM) and different local networks (e.g. (fast) Ethernet)



## Conclusions and future work:

### Conclusions:

- Presentation of first results from Munich trial (WWW-usage, Server performance)
- Plans/Concept for performance evaluation of Multimedia Service provision by simulation

### Future Work:

- Final evaluation of trial measurements/monitoring after finish of the trial
- Analysis of trial results for setting up usage characteristics
  
- Detailed setup of simulation models
- Implementation of simulation programs
- Execution and analysis of simulation

