

Distributed Architecture for Multimedia Information Systems

- Distributed Multimedia Information Services
 - Distributed Architecture for Networked Multimedia Databases
 - Quality & Synchronization Requirements in DMIS
 - Broadband Networking Technology for DMIS
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Distributed Multimedia Information Services

- Workgroup Application Services
 - ◆ SameTime, SamePlace: Group Scheduling, Groupware, etc.
 - ◆ SameTime, AnyPlace: Conferencing, etc.
 - ◆ AnyTime, SamePlace: Workflow, etc.
 - ◆ AnyTime, AnyPlace: Messaging, etc.
- Personal Application Services
 - ◆ Interactive
 - Retrieval: Web HTML retrieval, news-on-demand, movies-on-demand, etc.
 - Transaction: pay-by-view, teleshopping, interactive games, etc.
 - ◆ Distribution
 - Multicast: newspaper distribution, courseware-on-air, etc.
 - Broadcast: teleadvertising, data broadcasting, etc.

Notes:

- The service classifications of both ITU and ATM Forum can be naturally mapped into our multimedia document service taxonomy
 - ITU is based on four classes of services: Conversational, Messaging, Retrieval and Distribution
 - ATM Forum has produced a list of multimedia services: Broadcast Video Services, Videoconferencing Services, Audio-Video and Multimedia Services on Desktop, Audio plus Data Services and Video-on-Demand services.
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Multimedia Workgroup Applications

<p>SameTime, AnyPlace:</p> <ul style="list-style-type: none">● Applications: Conferencing● Examples: Fujitsu Desktop Conferencing	<p>AnyTime, AnyPlace:</p> <ul style="list-style-type: none">● Applications: Messaging● Examples: FirstClass (SoftArc)
<p>SameTime, SamePlace:</p> <ul style="list-style-type: none">● Applications: Group Scheduling● Examples: Meeting Maker XP (On Technology).	<p>AnyTime, SamePlace:</p> <ul style="list-style-type: none">● Applications: Workflow● Examples: Notes (Lotus), LinkWorks (Digital)

Fully document-integrated workgroup applications should support

- Truly multimedia document sharing and communication among working groups
- Fully access to documents at component levels from document management systems for workgroup activities such as sending out messages with retrieved documents or workflowing documents into right persons, etc.

Multimedia Database Systems

Multimedia Conferencing

Types of Conferencing	Characteristics	Products
Sharing WhiteBoards	<ul style="list-style-type: none">+ Allow conferees to view and edit bitmap images as the shared whiteboard+ Most products also include drawing tools that mark up the whiteboard	+ In Vison (In Vision System)
Sharing Screens	+ One or more conferees can view the screen of any other conferees in read-only mode	<ul style="list-style-type: none">+ Vistium (AT&T)+ Desktop Conferencing (Fujitsu)+ Proshare (Intel)
Sharing Applications	+ One conferee can take full control of another conferee's platform, including the ability to launch applications and manipulate files	<ul style="list-style-type: none">+ Vistium (AT&T)+ Desktop Conferencing (Fujitsu)+ Proshare (Intel)

Multimedia Messaging

Types of Messaging	Characteristics	Products
Attached Files	+ Associated files with e-mail	+ Many Products
Smart Boxes	+ Filtering messages, forwarding deleting useless information, or setting up complex rules for routing.	+ BeyondMail(Beyond Corp)
Smart Agents	+ Embedding instructions, compiled codes or scripts in the messaging and sending it to selected points in network. The smart agents are executed automatically once they reach the destinations.	+ Safe-Tcl (Public Domain) + Telescript (General Magic)

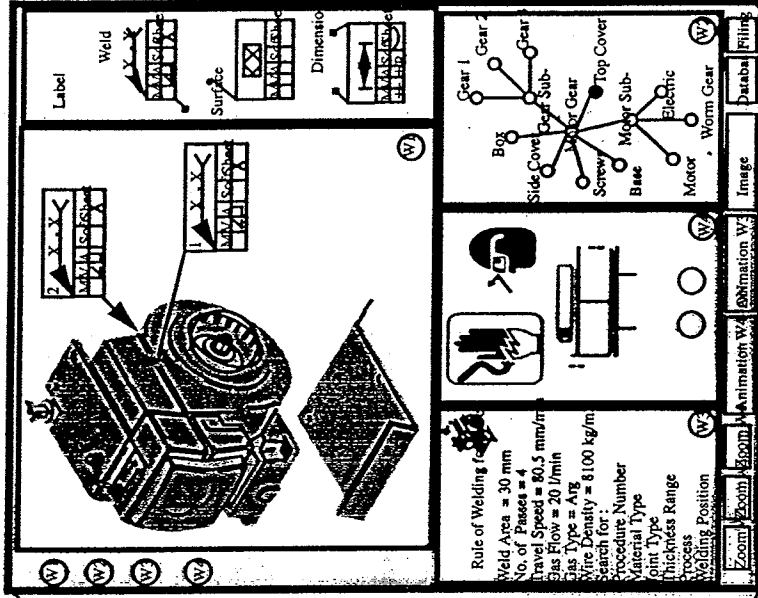
An Example of Workgroup Application

Distributed Manufacturing

Concurrent Engineering
using Computer
Supported Collaborative

Distributed Locations
but Shared Data and
Knowledge:

- Designers
- Manufacturers
- Testers
- Sales



Product Design, Manufacturing and
Testing Data/Knowledgebase

Possible Network Technologies for Multimedia Services

- WAN Architecture/Protocols**
ISDN,
Broadband ISDN (B-ISDN),
Asynchronous Transfer Mode (ATM) (CCITT Standard),
Synchronous Optical Network (SONET, CCITT OC Standard, SDH)
- MAN Architecture/Protocols**
Distributed Queue Dual Bus (DQDB, IEEE Standard)
- LAN Architecture/Protocols**
Fiber Distributed Data Interface (FDDI, IEEE 100 Mbs Standard)
Fast Ethernet (100 Mbits/sec)
Highly Parallel Peripheral Interface (HIPPI)
ATM LAN

Physical Media: Copper, Coax, Fiber, Wireless, Satellite etc

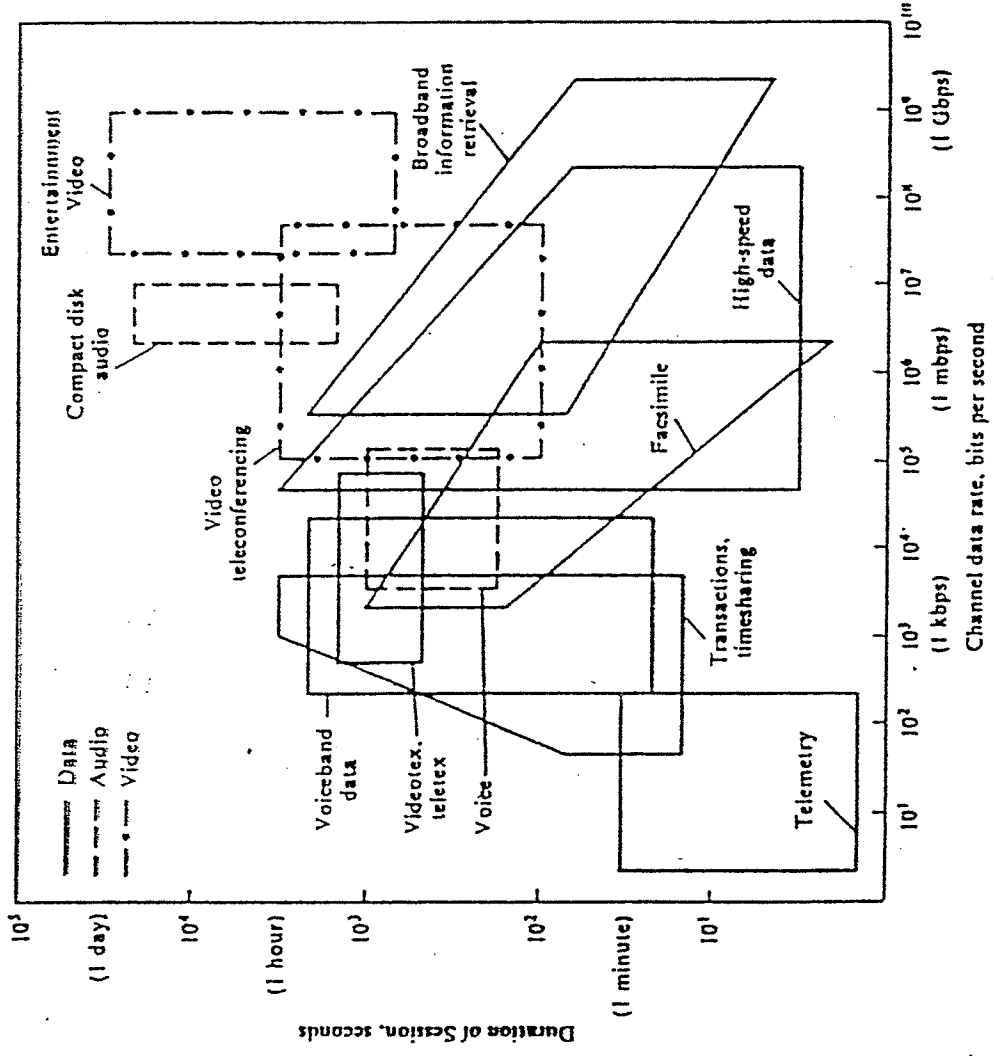


Why Broadband ISDN?

- Increasing demand for high bit rate services, especially image and video services.
- These services require data rate beyond what is deliverable ISDN.
- Evolution of technology to support these services, for example.
 - Optical fiber transmission systems
 - High-speed microelectronic circuits
 - High-quality video monitors & cameras



B-ISDN Requirements



^{UN} Standard Transmission Rates for Compressed Video

Levels of video quality (Adopted by ITU)

Service Quality A:

HDTV 92 – 200 Mbits/sec

Service Quality B:

Digital Component–Coding signal 30/45 – 145 Mbits/sec

Service Quality C:

Digitally coded NTSC, PAL, SECAM for distribution 20 – 45 Mbits/sec

Service Quality D:

Reduced spatial portrayal and movement portrayal 0.384 – 1.92 Mbits/sec

Service Quality E:

Highly–reduced spatial resolution and movement portrayal 64 Kbits/sec



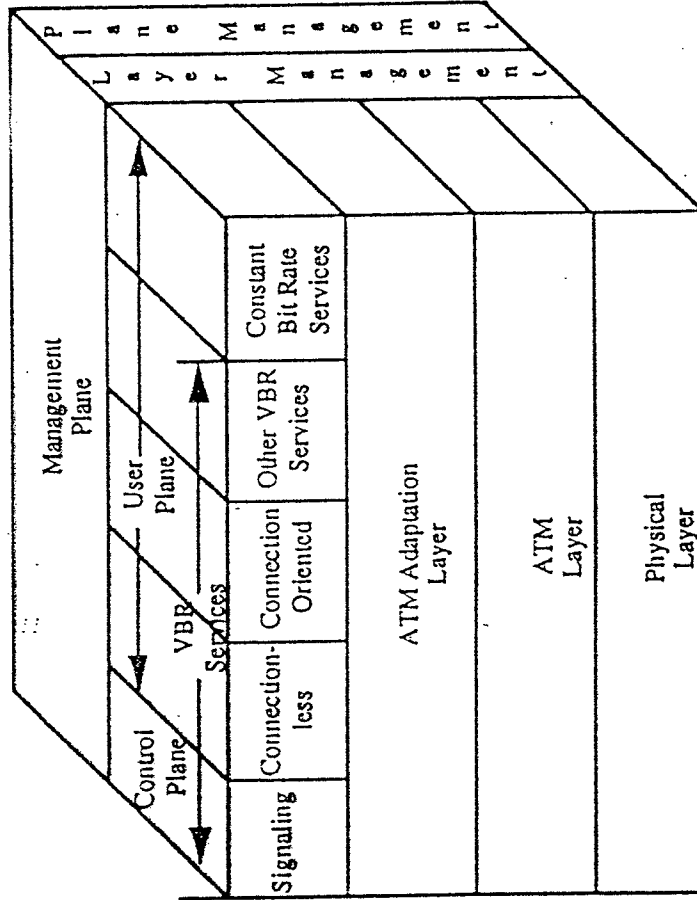
Video Telephony Technology

- Analog Videophone (e.g. AT&T 2500) 9.6 Kbits/sec, proprietary compression
- ISDN Videophones (Intel's Indeo) 56 – 128 Kbits/sec, Px64 / H.261
- Business Conference Rooms (Picturetel) 384 Kbits/sec, Px64 / H.261
- Desktop Conferencing (LAN, FDDI) 1 – 2 Mbits/sec, JPEG / MPEG-1
- Digital NTSC (Video-On-Demand) 3–10 Mbits/sec, MPEG-2
- High Definition Television (HDTV) 15 – 25 Mbits/sec, MPEG-2

Asynchronous Transfer Mode (ATM)

- Fixed cell length (53 bytes) simplifies hardware processing and complexity of buffer and queue management.
- Flexible allocation of bandwidth
- Flexibility in supporting different services
 - Guaranteed and best-effort services
 - Connection-oriented and connectionless services
 - Constant bit rate and variable bit rate services

B-ISDN Protocol Reference Model



B-ISDN Protocol Reference Model

Consists of:

A user plane

A control plane

– Layered structure

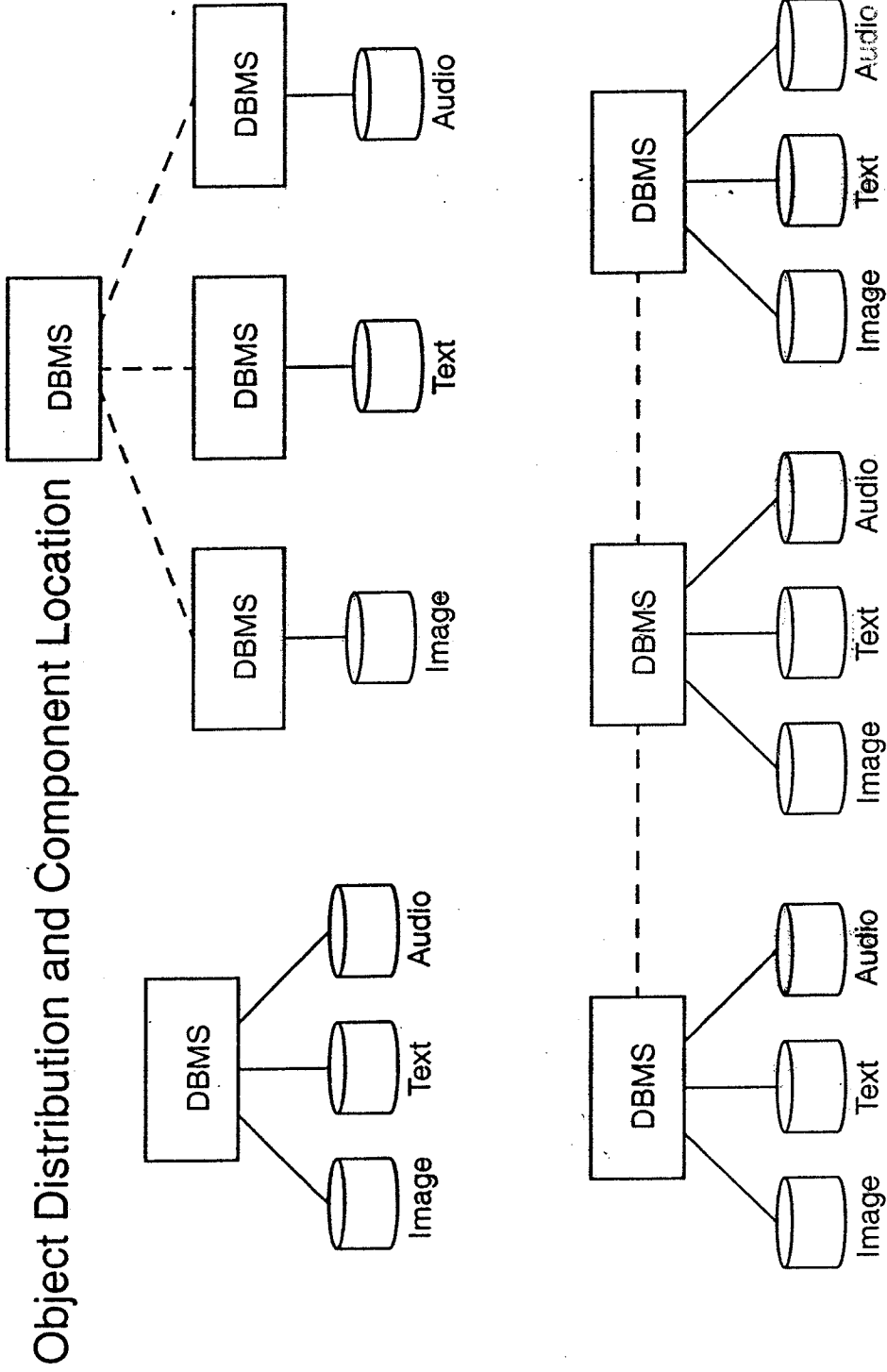
Physical Layer

ATM Layer

ATM Adaptation Layer (AAL)

Layers above the AAL

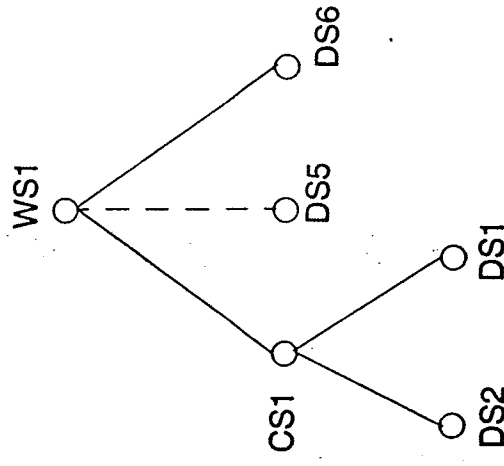
Distributed Architecture for Multimedia Information Systems



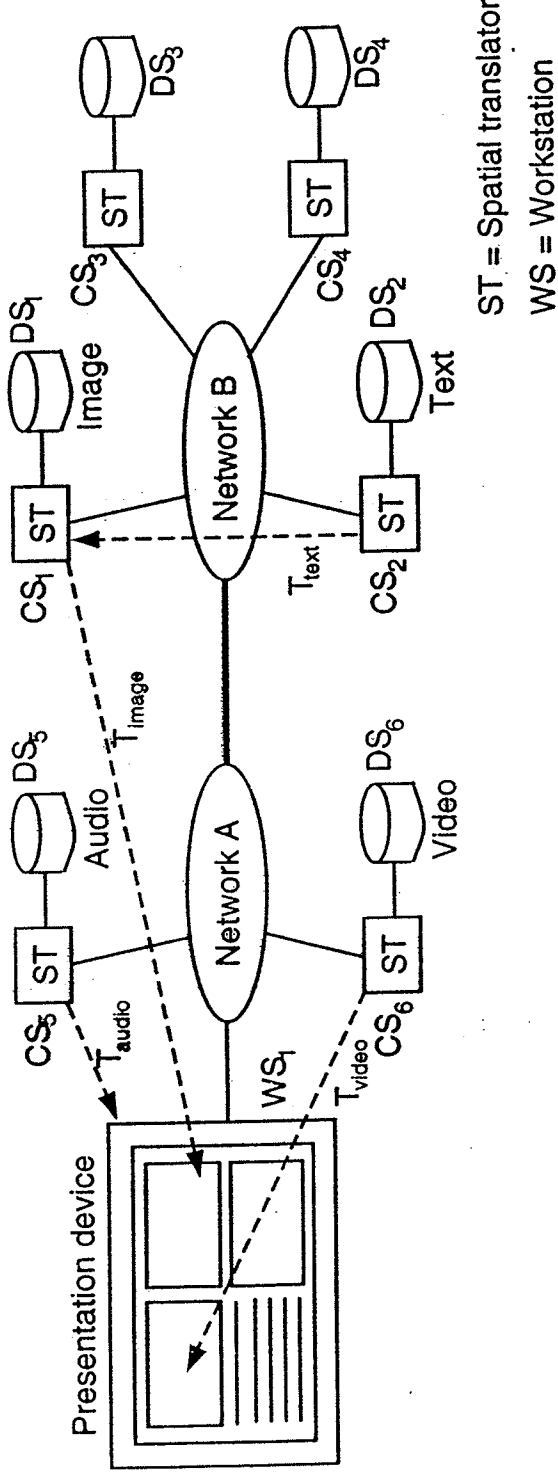
Distributed Object Identification and Composition

- Locating Objects
- Identify Synchronization Requirements
- Setting up Composition Hierarchy
- Networked Browsing

HTTP, JAVA, etc.



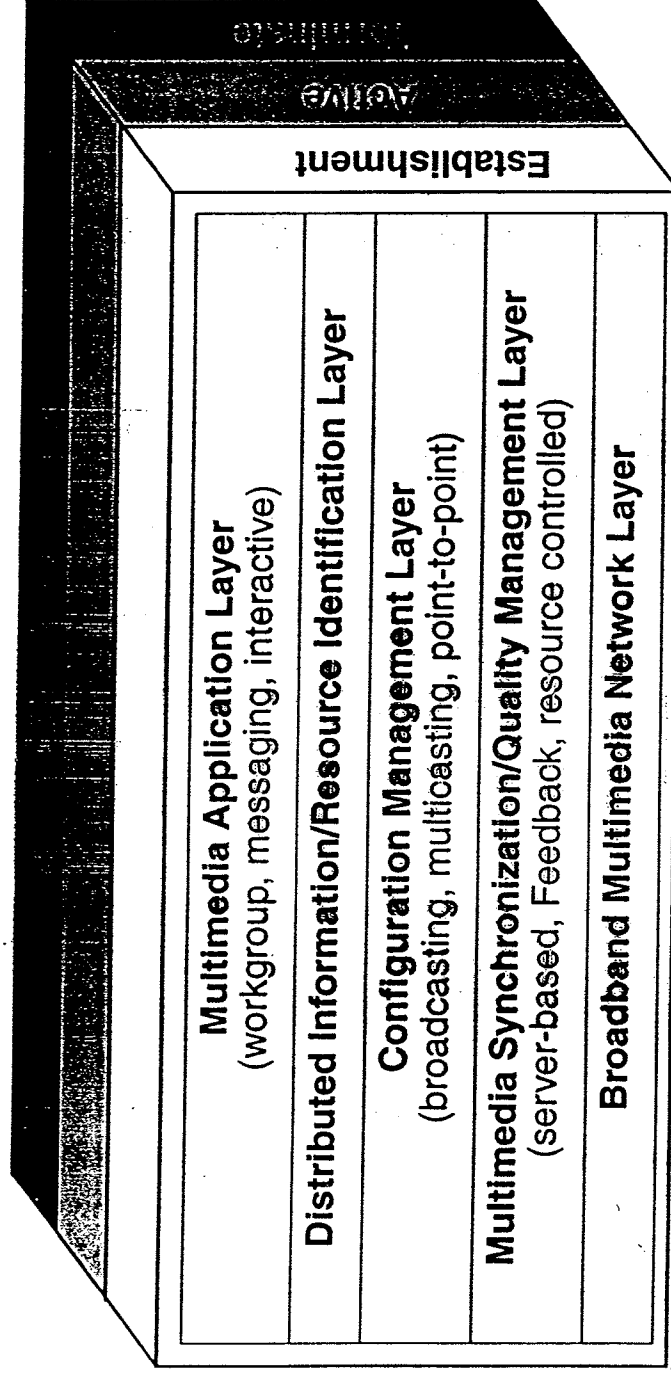
Distributed Object Communication and Composition



- Locating distributed objects (naming, location, access)
- Transparency requirements for heterogeneous data servers
- Distributed object messaging & synchronization
- Inter-server co-ordination

Multimedia Database Systems

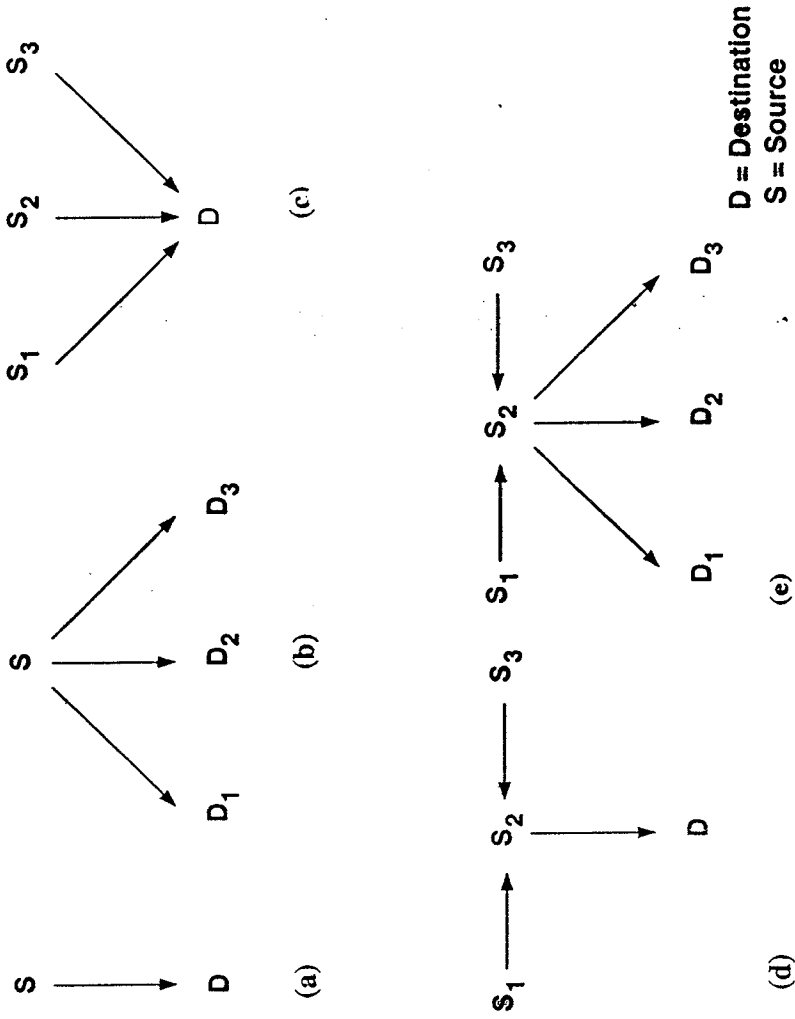
Distributed Architecture for Networked Multimedia Databases



Distributed Configuration Management Layer

Communication Modes

- Broadcasting
- Multicasting
- Point-to-Point



Configuration Management Protocol

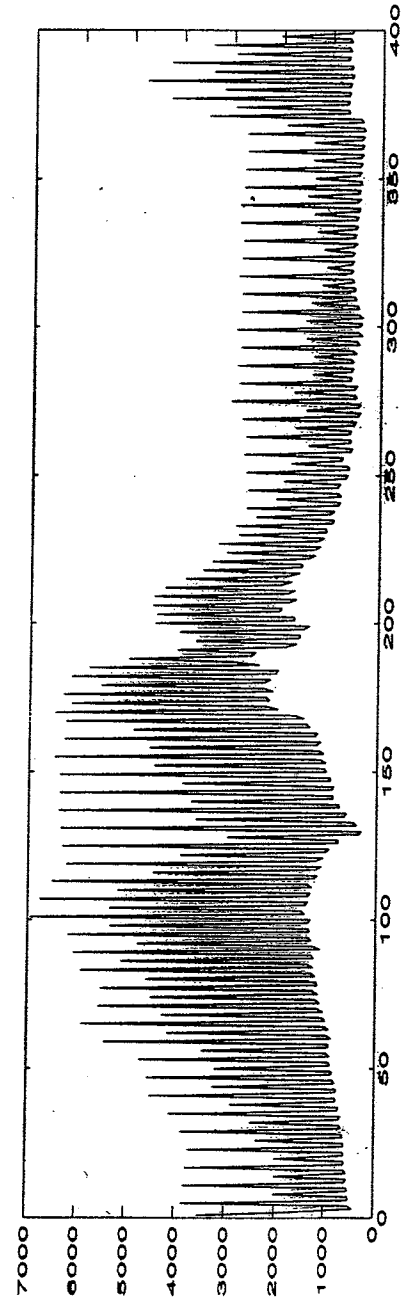
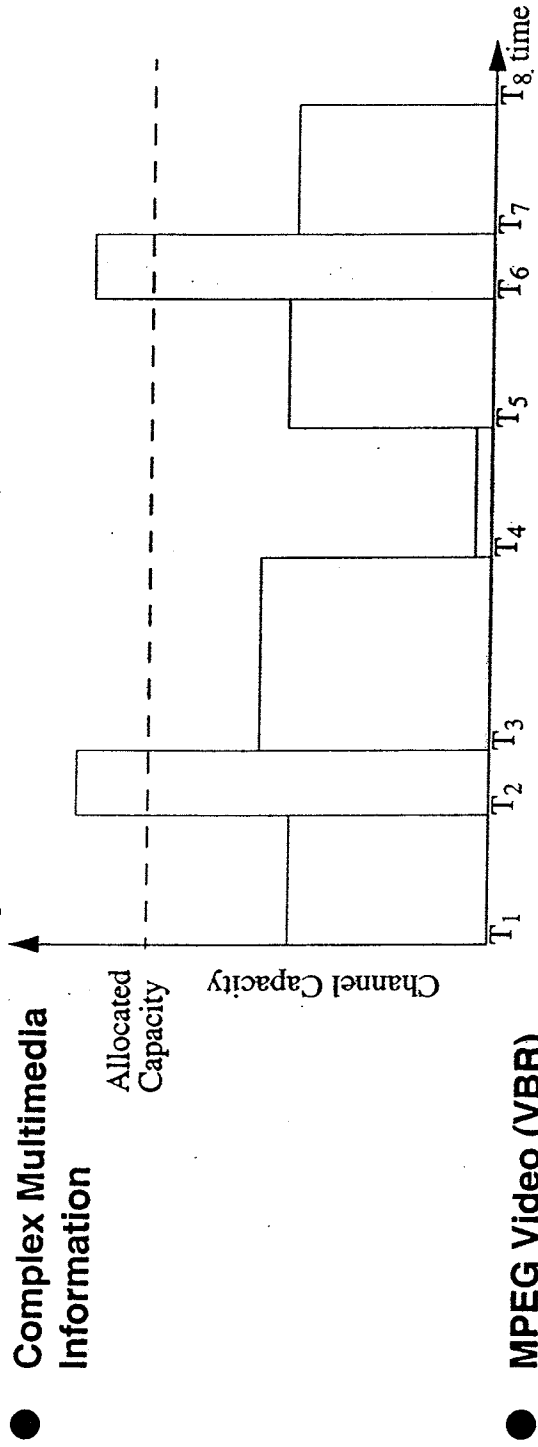
- Floor control protocols
 - Identify suitable composing site
 - Session joining and signing-off protocols in workgroup
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Quality and Synchronization Requirements in DIMS

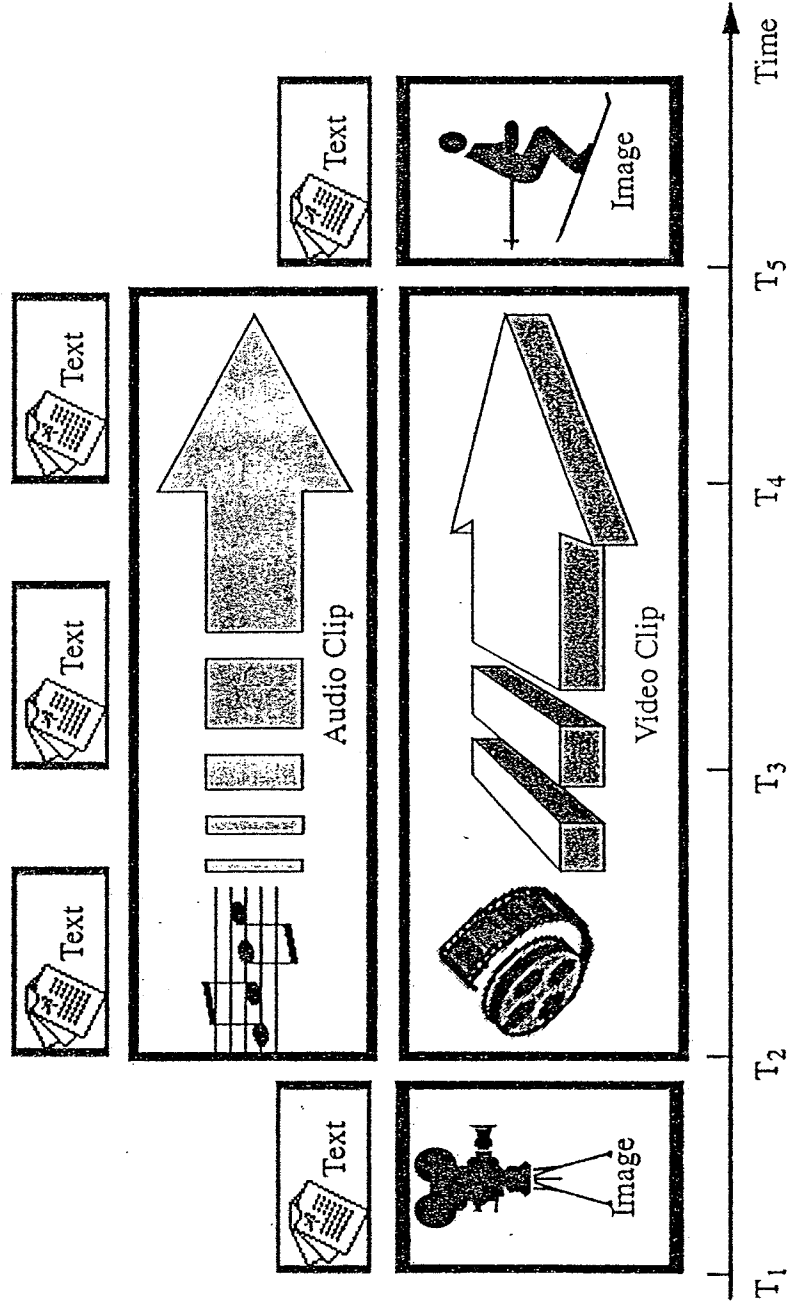
Two Important Problems for Multimedia Document Retrieval

- Networks have random delays
 - ◆ Discontinuity in presentation
- Different media (video, audio, images, text) need different QOS channels
 - ◆ Use multiple virtual channels
 - ◆ Data is out of synch; e.g. Lip synch in audio & video

Traffic Characteristics of Media Streams in a Typical Multimedia Session



Time Line Model of Complex Multimedia Information



Synchronization in Distributed Multimedia Services

Two Important Problems for Multimedia Document Retrieval

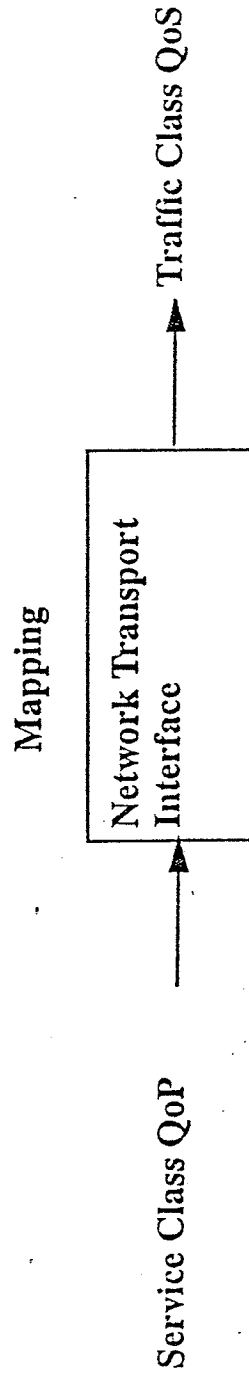
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Merging Multimedia and Telecommunications

- **Multimedia Computing Platforms**
 - ◆ Objective is to support service classes:
 - ◆ Text (reliability)
 - ◆ Images (compression JPEG, resolution, GIF, Raster, Tiff, etc.)
 - ◆ Audio (CD quality, compression)
 - ◆ Video (HDTV, MPEG, H.261, AVI, Quicktime, etc.)
 - ◆ Synchronization
 - ◆ Characterization of services using statistics and QoS

- **Networking Infrastructures**
 - ◆ Traffic Classes with their own statistics and QoS guarantees



Network Resource Management and Quality of Service

Network Resources for Connection Configuration

- Number of channels used
- Capacities of individual channels
- Destination buffering requirement

QOS:

- Guaranteed Network Bandwidth (A View of Circuit Switched Lines)
- Bounded end-to-end delays
- Bounded variations in end-to-end delays (Jitter)
- Reliability Requirements
- Bounds on packet and bit error rates

A Model for Resource Allocation in Broadband Networks

ASYNCHRONOUS TIME SHARING

- Multiclass Network Model
- Resource Sharing (Time, Space)
 - ◆ Communication Bandwidth Allocation
 - ◆ Buffer Management



The Principle of Asynchronous Resource Sharing

Design

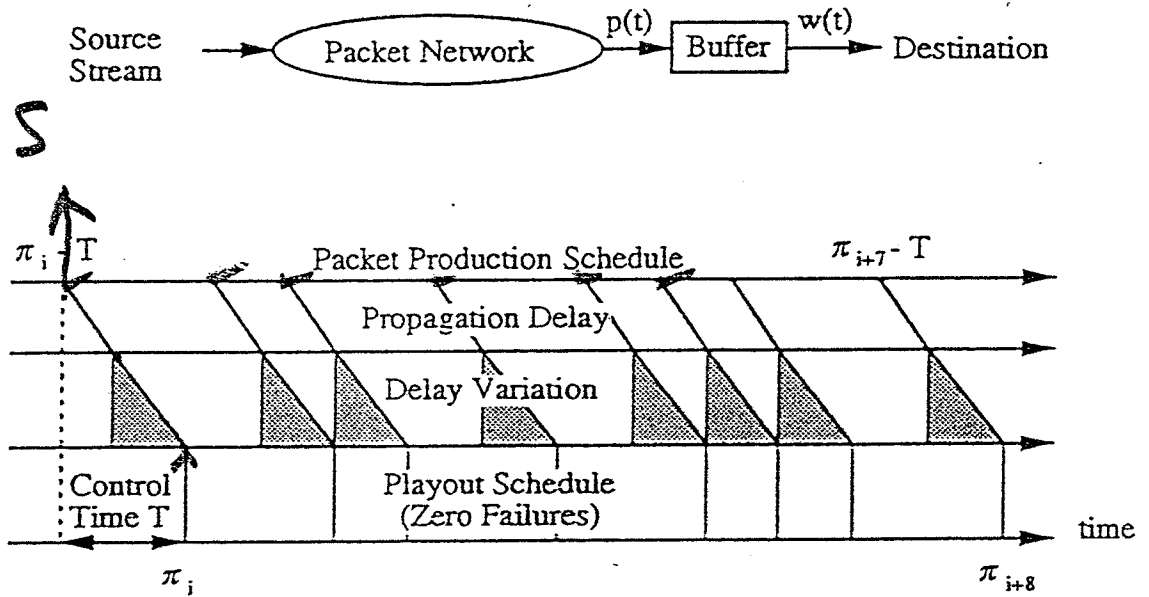
Resource Sharing Mechanism

- ◆ Link Scheduling and Buffer Management
- ◆ Routing
- ◆ Flow Control
- ◆ Admission Control
- ◆ OS Scheduling
- ◆ Memory Management

The Principle of Asynchronous Resource Sharing postulates that the network operating point is achieved through the asynchronous interaction among a set of competing control mechanism designed to support a set of services with QoS guarantees.



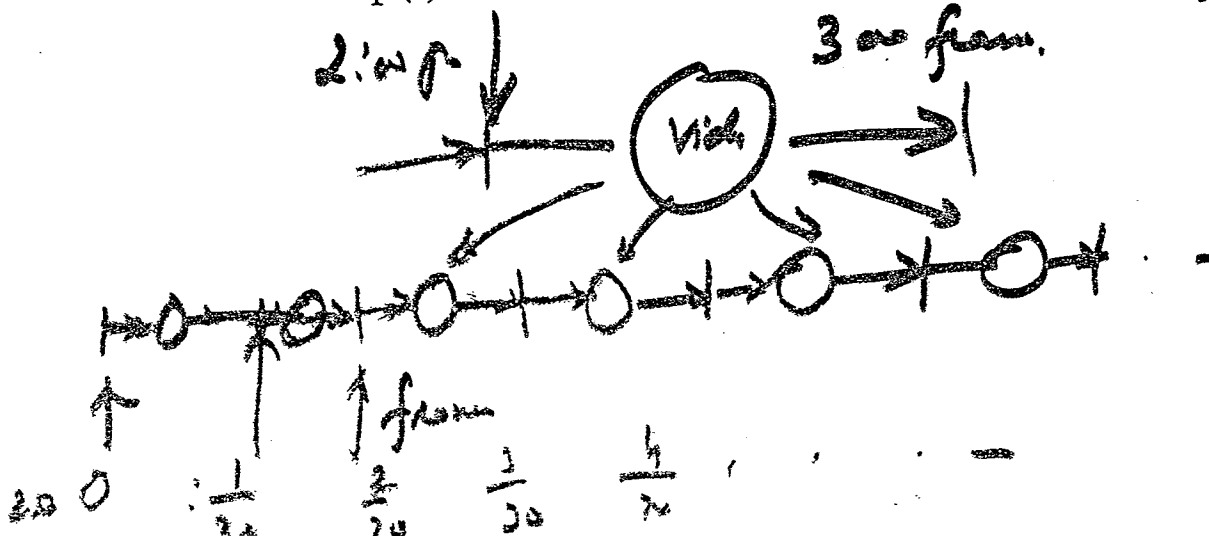
General Scenario for Synchronization



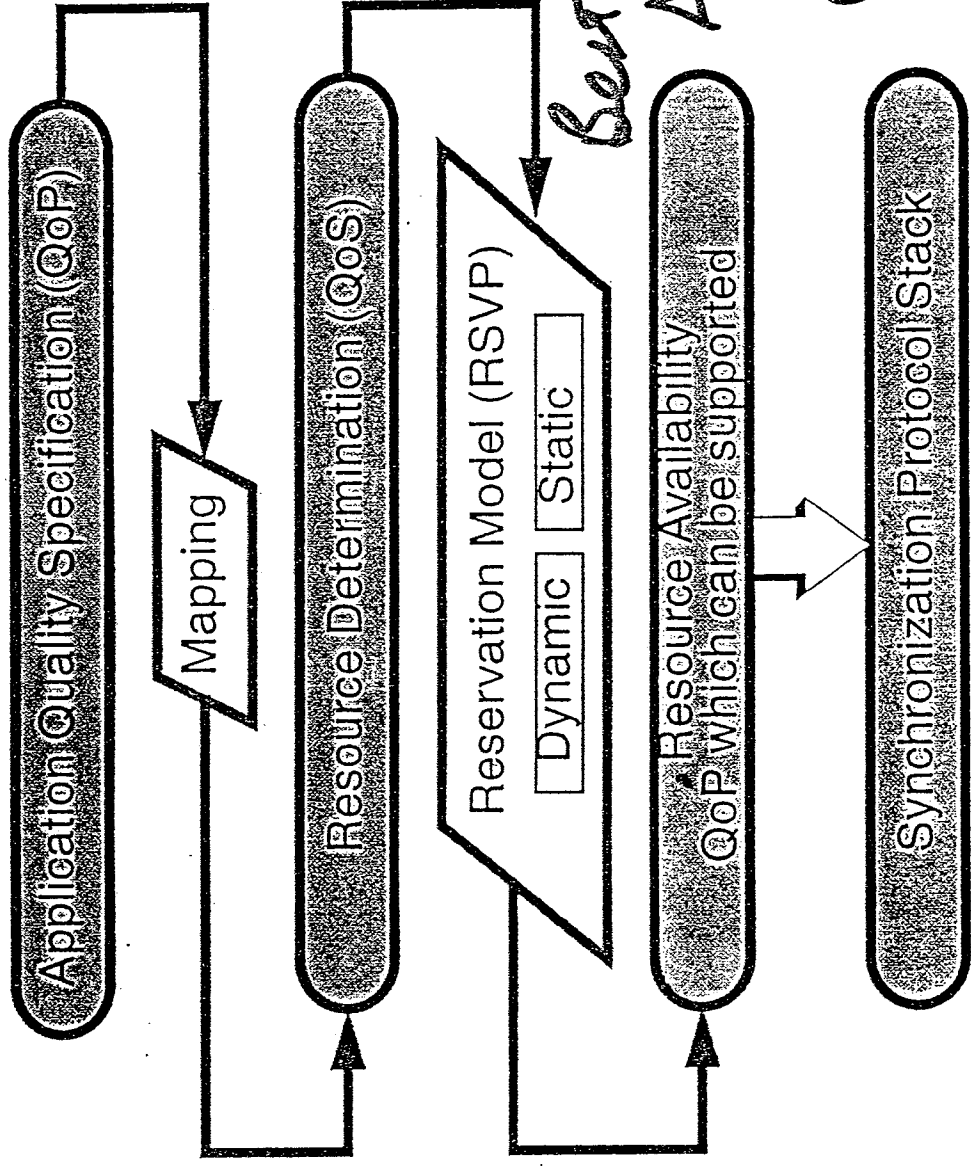
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Atomic Units
for Synchronization:

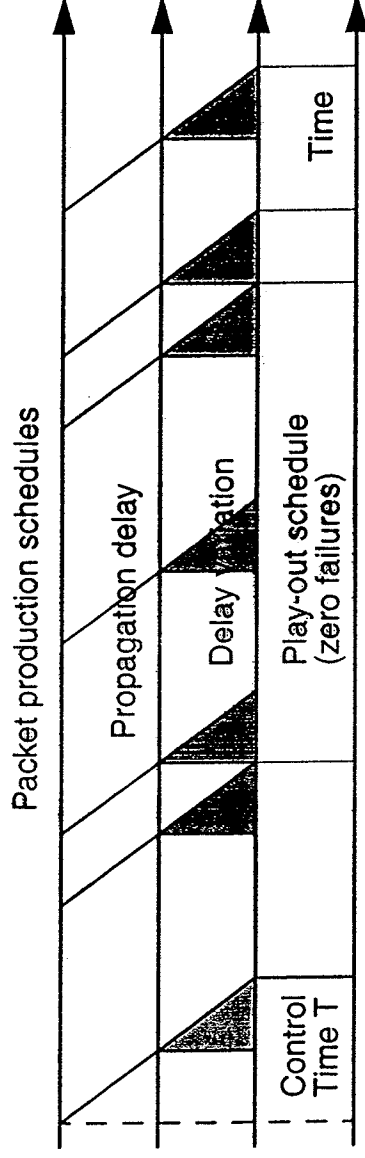
$p(t)$: distribution of random network delay



Quality-Based Resource Determination & Protocol Selection

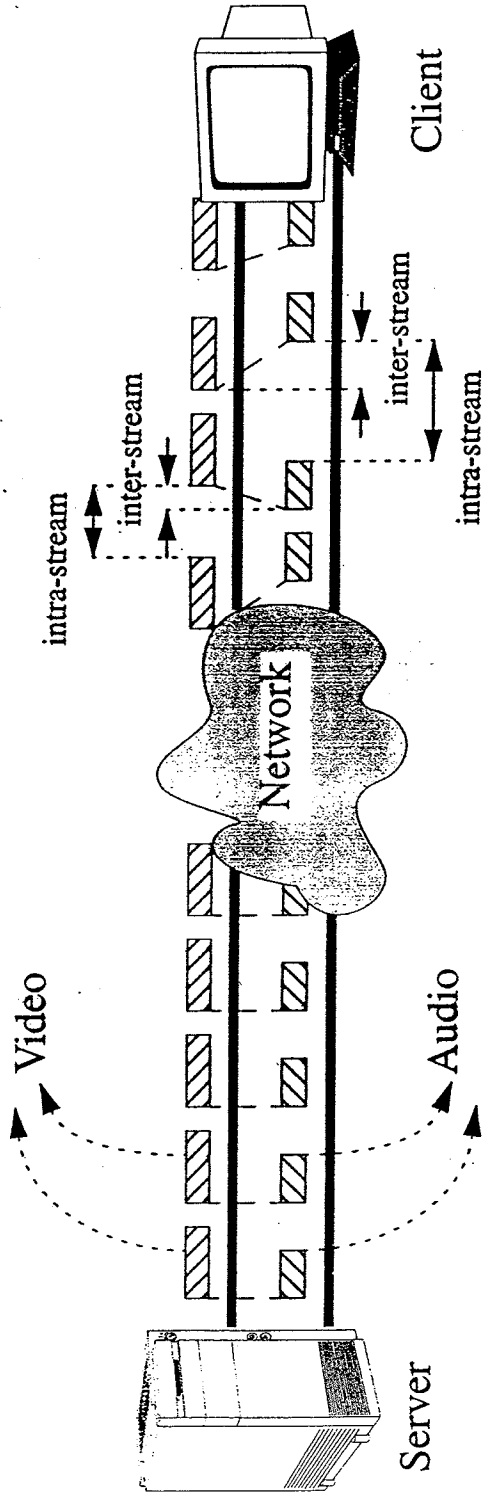


Network Randomness for Stored Multimedia Data



- The effect of network random delays on media streams
 - Prefetching/control time requirements
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Multimedia Synchronization Requirements



- Intra-Stream Synchronization
- Inter-stream Synchronization
- Multicast Synchronization

Quality Requirements for Multimedia Data

Skew

Object	Mode, Application	Delay
video	animation	120 ms
	audio	80 ms
	image	240 ms
	text	500 ms
audio	animation	240 ms
	animation	500 ms
	animation	80 ms
	audio	11 ms
	image	120 ms
	image	500 ms
audio	image	5 ms
	text	500 ms
	pointer	240 ms
	pointer	-500 ms
		+750 ms

Reliability

Object	Reliability
voice	0.98
video	0.90
image	1.0
text	1.0

Configuration Management Protocol

- Floor control protocols
- Identify suitable composing site
- Session joining and signing-off protocols in a workgroup environment



Synchronization Techniques (Inter & Intra Stream)

- Server Based Synchronization
- Synchronization using Feed-back
- Dynamic Network Resource controlled synchronization



