Distributed Video Systems
Chapter 1
Introduction

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Preface

- Target Audience
  - Assumes engineering background;
  - No prior knowledge on multimedia and video technologies required.
- Outline
  - Chapter 1: Introduction
  - Chapter 2: Video Coding Technologies
  - Chapter 3: Storage Technologies
  - Chapter 4: Network Technologies
  - Chapter 5: Applications

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- 1.2 Video-on-Demand Systems
- 1.3 Types of Video Services
- 1.4 Types of Service Models
- 1.5 Major Challenges

1.1 Distributed Video Systems

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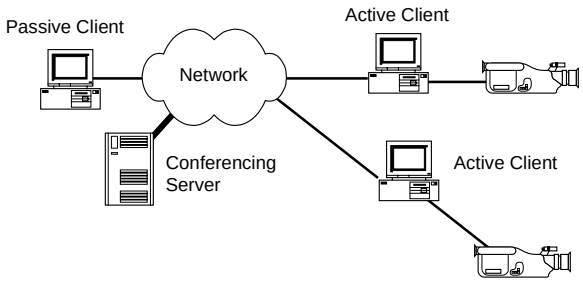
- General System Overview
  - Video Conferencing Systems



1.1 Distributed Video Systems

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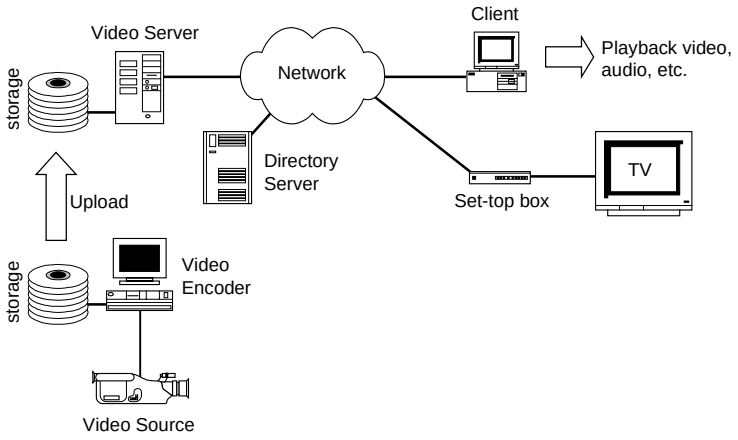
- General System Overview
  - Video-on-Demand (VoD) Systems



1.2 Video-on-Demand Systems

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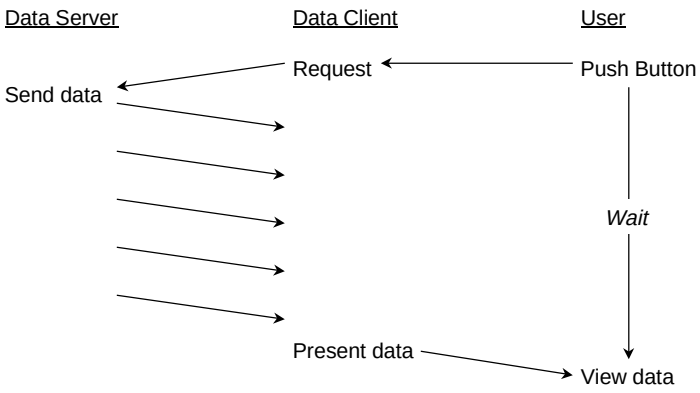
- How is it different from traditional data servers?
  - The Download Model:



1.2 Video-on-Demand Systems

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- How is it different from traditional data servers?
  - The Download Model:
    - Data Transfer Time *T*

      T=Size of data / link speed

      E.g. (a) Download a web page (10KB) through 28.8Kbps modem

      T = 10*8/28.8 = 2.78 seconds

      (b) Download a JPEG image (100KB) using 28.8Kbps modem

      T = 100*8/28.8 = 27.8 seconds

      (c) Download a one-hour MPEG1 video (540MB) using 28.8Kbps modem:

      T = 540*8*1000/28.8 = 41.67 hours!

    - The Problem : Too much data, too little bandwidth!

1.2 Video-on-Demand Systems

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- How is it different from traditional data servers?
  - The Download Model:
    - Why not just use a high-speed network?
      - Say, using 10Mbps Ethernet for an 1-hr MPEG1 video:

        T = 540*8/10 = 7.2 minutes

        Much better, but will you wait 7 minutes to watch a video?
        How about a full-length movie (2 hours)?

      - So how much bandwidth is needed?

        If max waiting time is 10 seconds, then
        C = 540*8/10 = 432 Mbps

      - Hence simply raising bandwidth is not a good solution.

1.2 Video-on-Demand Systems

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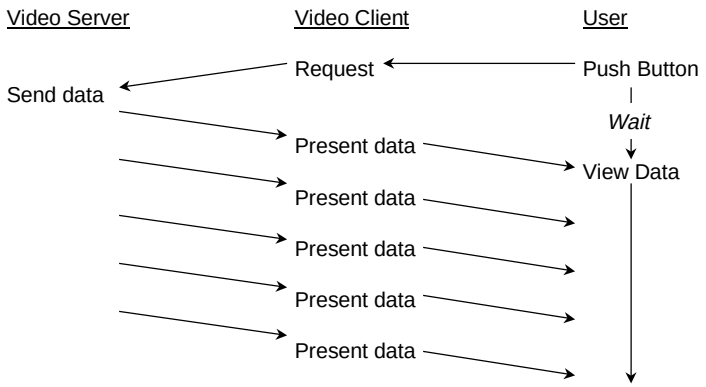
- How is it different from traditional data servers?
  - The Streaming Model:



1.2 Video-on-Demand Systems

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- Requirement for Streaming
  - Data must be progressively decodable & presentable
    - Example: Video, minimum unit is one frame.
    - Counter Example: Program, partial program cannot run.
- Types of Streaming
  - Realtime
    - The data have a pre-determined sequence and time of presentation. For example, video and audio.
  - Non-Realtime
    - The data does not have presentation time requirement. For example, progressive JPEG.

1.3 Types of Video Services

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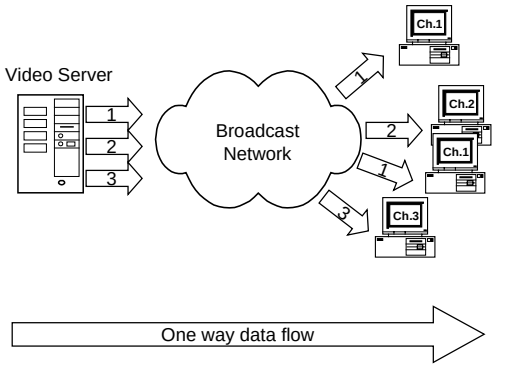
- Broadcast / Multicast Video:



Passive receive, no control except selecting channels.

One channel is needed per movie / programme.

1.3 Types of Video Services

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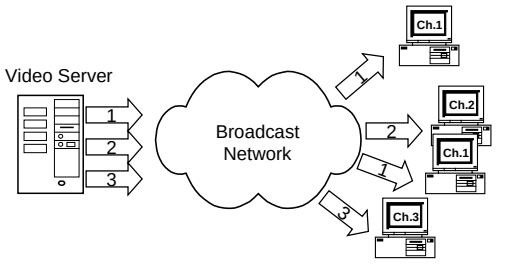
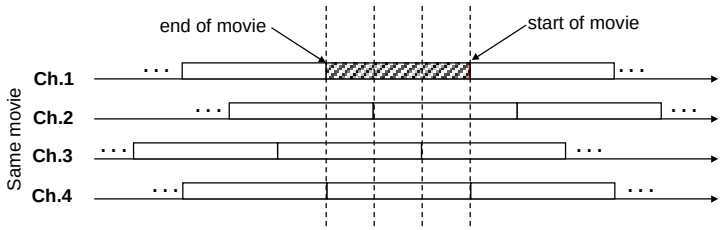
- Near-Video-on-Demand:



Passive receive, limited controls.



1.3 Types of Video Services

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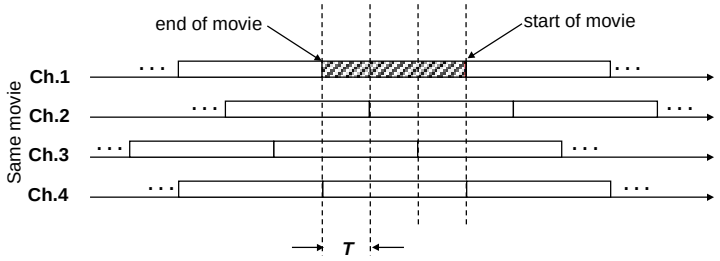
- Near-Video-on-Demand:



If movie length is ***L*** then number of channels needed per movie is: ***N = L / T***

For example, if *L* = 120 minutes, *T* = 10 minutes,
then number of video channels needed N = 120 / 10 = 12 channels.

This also means that in the worst case, the user has to wait 10 minutes
before viewing a movie.

System response time inversely proportional to number of required channels.

1.3 Types of Video Services

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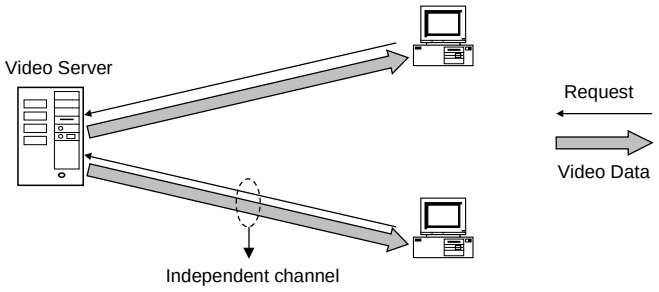
- True Video-on-Demand



- Full interactive controls, like pause/resume, seeking, fast forward, etc.
- One video channel per user required.

1.3 Types of Video Services

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- Comparisons:

	Broadcast Video	Near-Video-on-Demand (Pay-Per-View)	True Video-on-Demand
Select video?	Yes, but limited to a few channels	Yes, but limited to a few programmes	Yes
Select time to watch?	No	Yes (limited to fixed time slots)	Anytime
Interactive?	No	None or very little	VCR-like control
# of Viewers	Unlimited	Unlimited	Limited
Cost / Viewer	Low	Medium	High

1.4 Types of Service Model

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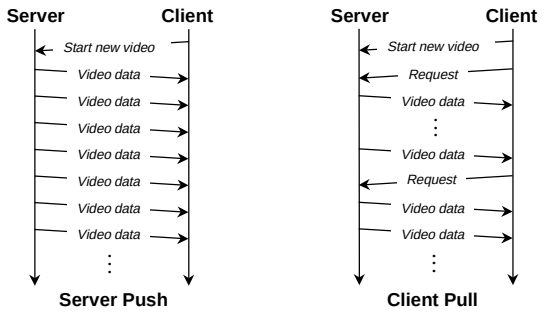
- What?
  - How video data are *scheduled* for delivery from the video server to a video client.
- Types of Service Model
  - Client-Pull v.s. Server Push



1.4 Types of Service Model

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- Client-Pull
  - Advantages
    - Simple server design;
    - Supports any video bit-rate, CBR and VBR;
    - Better tolerance to delay and delay jitter;
  - Disadvantages
    - A backward network channel (upstream) from client to server is necessary;
    - More complicated client machine;
    - May requires more buffering at the client.
  - Common Applications
    - Local Area Networks (LAN) based VoD systems.

1.4 Types of Service Model

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- Server-Push
  - Advantages
    - A backward network channel (upstream) from client to server is not needed (desirable in certain applications like satellite broadcast);
    - May requires less buffering at the client;
    - More predictable performance;
    - Easier to optimize server performance.
  - Disadvantages
    - Requires real-time hardware and software at the server;
    - Difficult to support mixed bit-rate and VBR videos;
    - Less tolerance to delay and delay jitter;
  - Common Applications
    - All kinds of VoD systems, particularly WAN-based and satellite video broadcast.

1.5 Major Challenges

- Volume
  - High-quality digital video requires large amount of capacity in storage and delivery.
- Time Sensitivity
  - Video data must be delivered and presented according to a stringent timing schedule, otherwise the video playback will not be continuous.