Tying It All Together

COS 316: Principles of Computer System Design

Lecture 22

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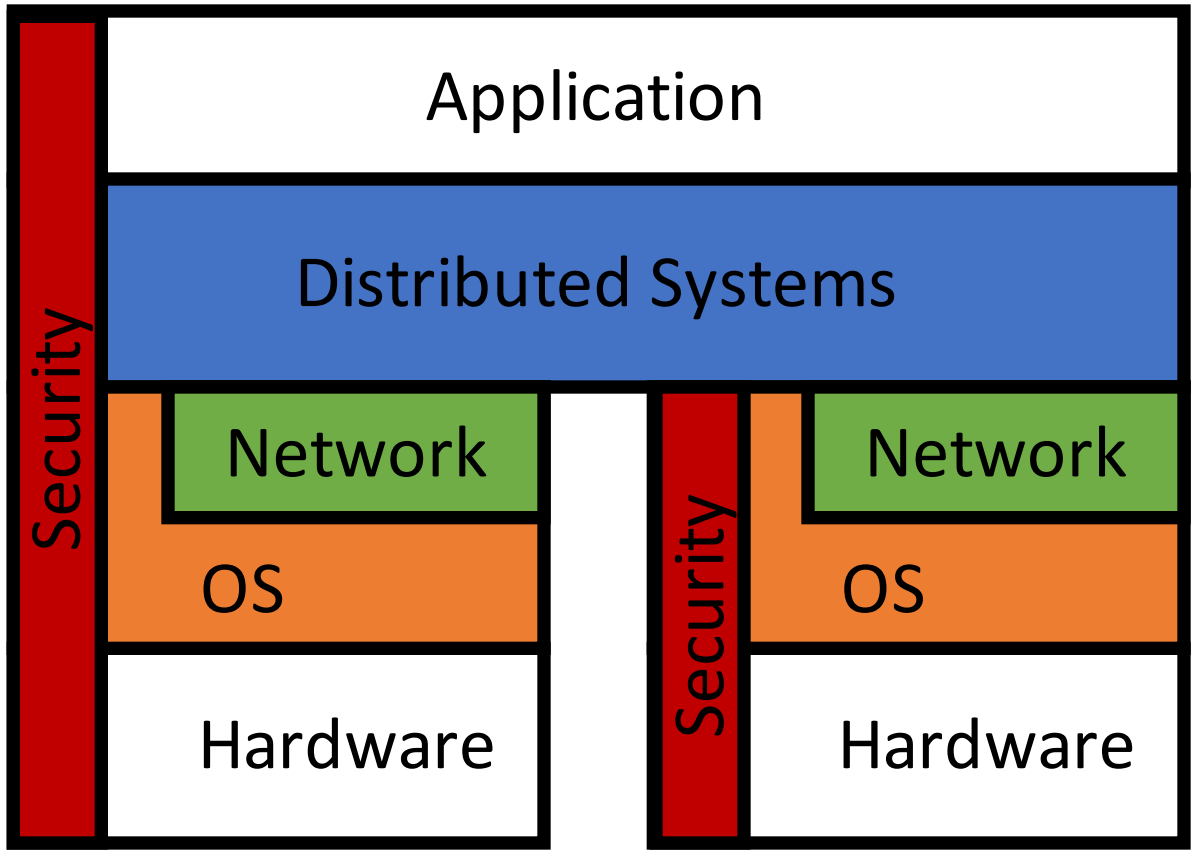
High Level Topics Covered

- Systems
- Naming
- Caching
- Layering
- Resource allocation
- Concurrency
- Access control

Types of Systems We Covered



- Distributed Systems
- Networking
- Operating Systems
- Security

A “Simple” Example – Streaming Video

1. Record video on phone
2. Video sent over Internet to service
3. Web server receives video segments
4. Web server forwards segments to distributed file system
5. Web server initiates video processing
6. Video processing produces streamable versions
7. Video now streamable – shared w/ other users
8. User’s app fetches file with metadata about video segments
9. User’s app runs ABR algorithm to download video segments via CDN

1) Record video on phone

- Does app have access to video device?
- Interface to video device via OS
- Interface to storage via OS

2) Video sent over Internet to the service

- Host name -> IP address (e.g., youtube.com -> 172.217.10.14)
  - Naming!
- Global IP routing to 172.217.10.14
  - Layering!
- Sent over a TCP connection to a remote web server
  - Send whole video, error detection, congestion control, flow control
- Applications use socket interface
  - Assignment 1!

3) Web server receives video segments

- Use request routing logic to runs handler for video segments
  - Assignment 2

- Is user authorized to create new videos?

4) Web server forwards segments to distributed file system

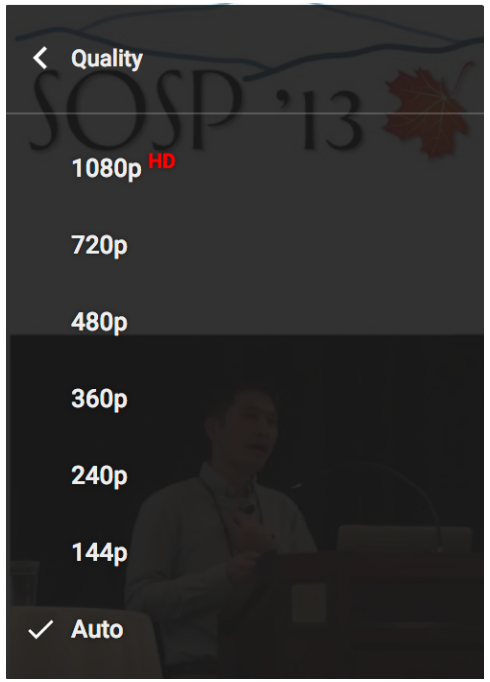
- Durability of video segments

- Distributed file system – looks (kinda) like a unix file system
  - On different machines, accessed over network, running on top of local unix file system

- Aside: video segment metadata
  - Bug: eventual consistency vs. linearizability
  - Video upload application assumed a failed upload
  - … could continue via an alternate server

5) Web server initiates video processing

- Validate video, fix audio alignment, …
- Produce many different bitrates
- Compress video segments
- Generate thumbnails
- …



- Processing done by a distributed system

6) Video processing in action

- Many machines processing different segments of video in parallel
  - Concurrency!

- Durably store resulting video segments

7) Video now shareable with others

- Publish information about video segments to database
  - Assignment 4 – Object Relational Mapper
  - Assignment 5 – Connection pool

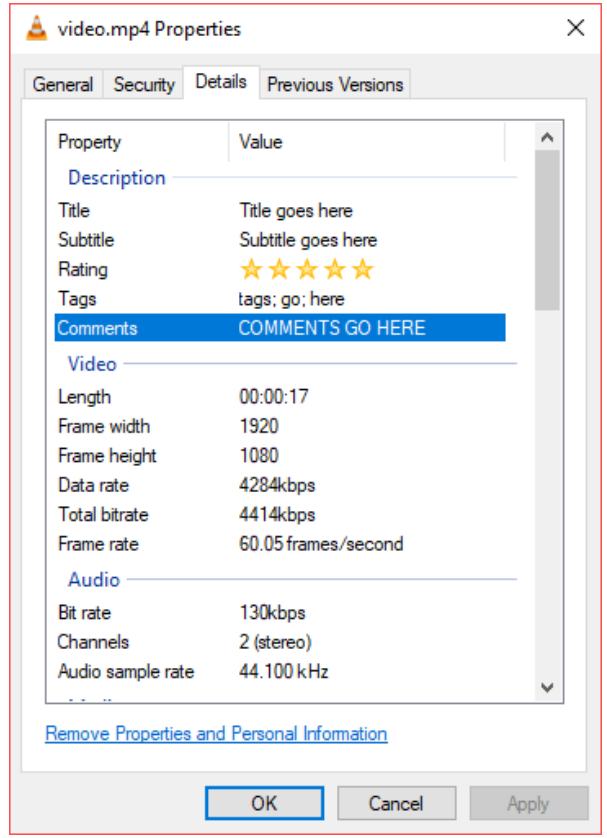
- Push information about video to other indexing systems
  - e.g., newsfeed on Facebook
  - e.g., subscribers on YouTube

8) User's app fetches file with metadata about video segments

- Host name -> IP address
- Global IP routing
- TCP connection
- Sockets interface
- Request routing to handler on web server

- Is user authorized to view video?
  - Access Control!

- Web server sends request to in-memory cache for video segment metadata
  - Assignment 3 – Caching!

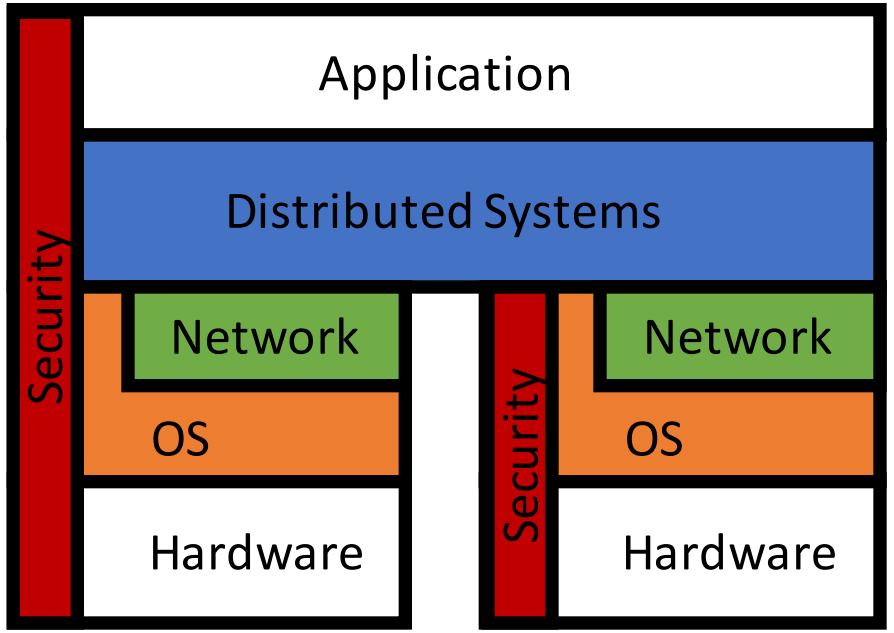


9) User’s app runs ABR algorithm to download video segments via CDN

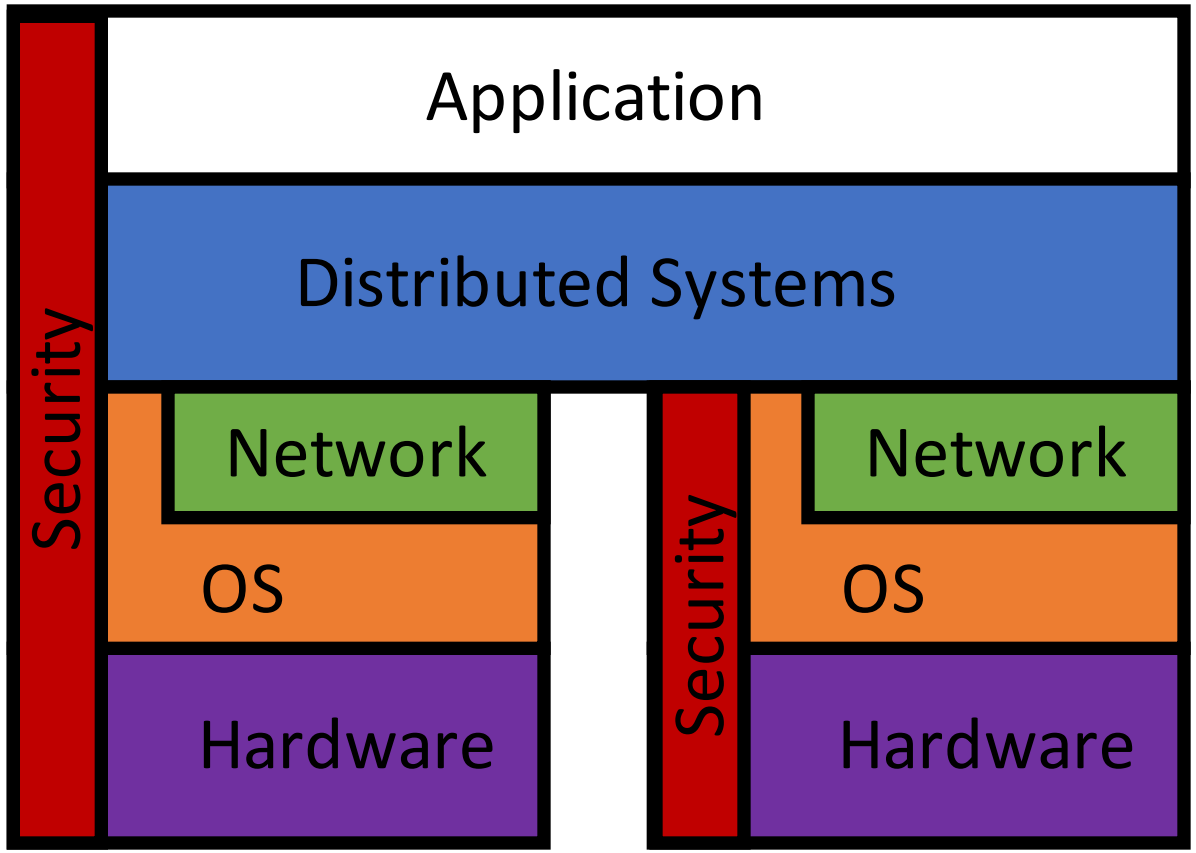
- Adaptive BitRate (ABR) algorithm request video segments
- Video segment requests via Content Distribution Network
- CDNs cache popular video segments

Systems!

- Systems abstract underlying resources
- Systems are **everywhere**
- Systems are challenging and interesting and cool
- This class was about systems



Systems You Can Learn More About



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- Networking
- Operating Systems
- Security
- Hardware

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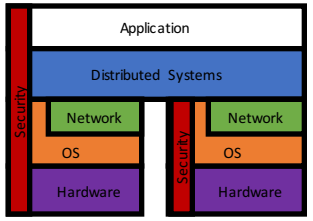

- Applications — COS 333 (Every semester)
- Distributed Systems — COS 418 (Last: Fall 2022)
- Networking — COS 461 (Spring 2023)
- Operating Systems — COS 318 (Last: Fall 2021)
- Security — COS 432 (Spring 2023)
- Hardware
  - Processors — COS/ECE 375 (Last: Fall 2022)
  - Logic Design — COS 306 / ECE 206 (Last: Fall 2022)

Thursday's Class

- Ask us anything
- Topics from class
- Topics outside of class (related to systems)