

# Tying It All Together



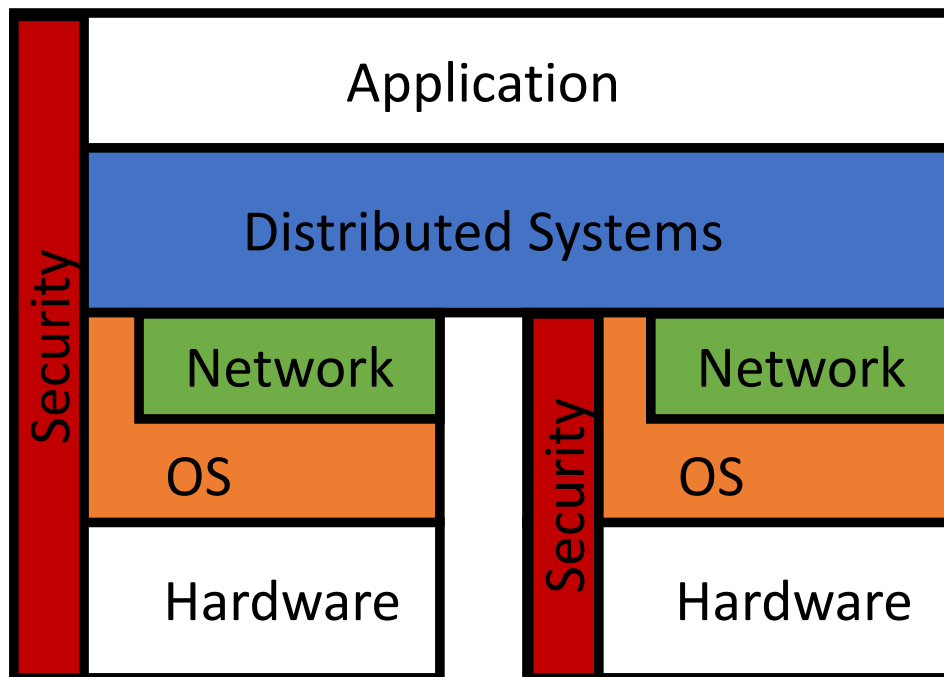
COS 316: Principles of Computer System Design  
Lecture 23

Amit Levy & Wyatt Lloyd

# High Level Topics Covered

- Systems
- Naming
- Caching
- Layering
- 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?

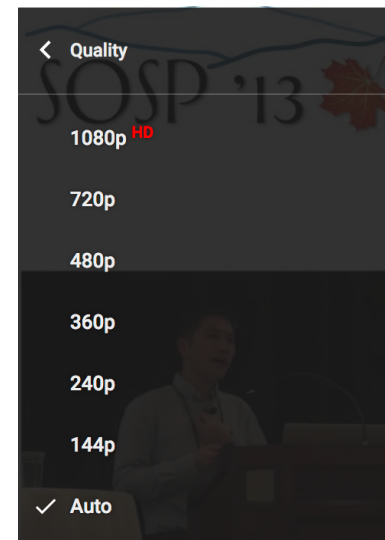
## 4) Web server forwards segments to distributed file system

- 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



## 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

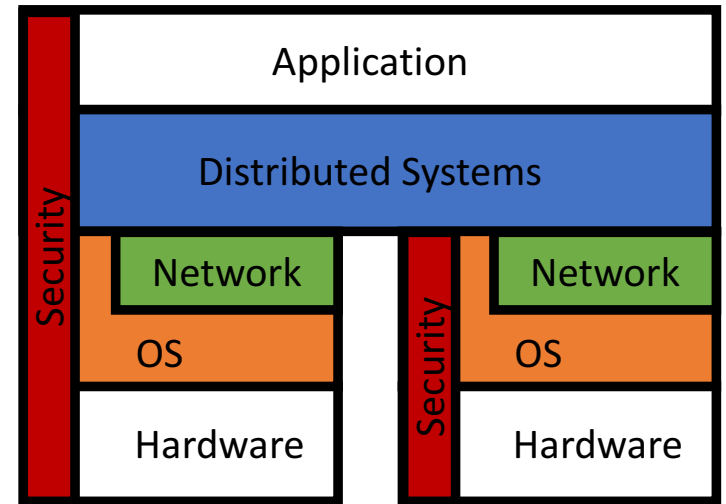
- Host name -> IP address
- Global IP routing
- TCP connection
- Sockets interface
- Request routing to handler on web server
- Is user authorized to view video?
  - Assignment 6 – Access Control!
- Web server sends request to in-memory cache for video segment metadata
  - Assignment 3 – Caching!

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

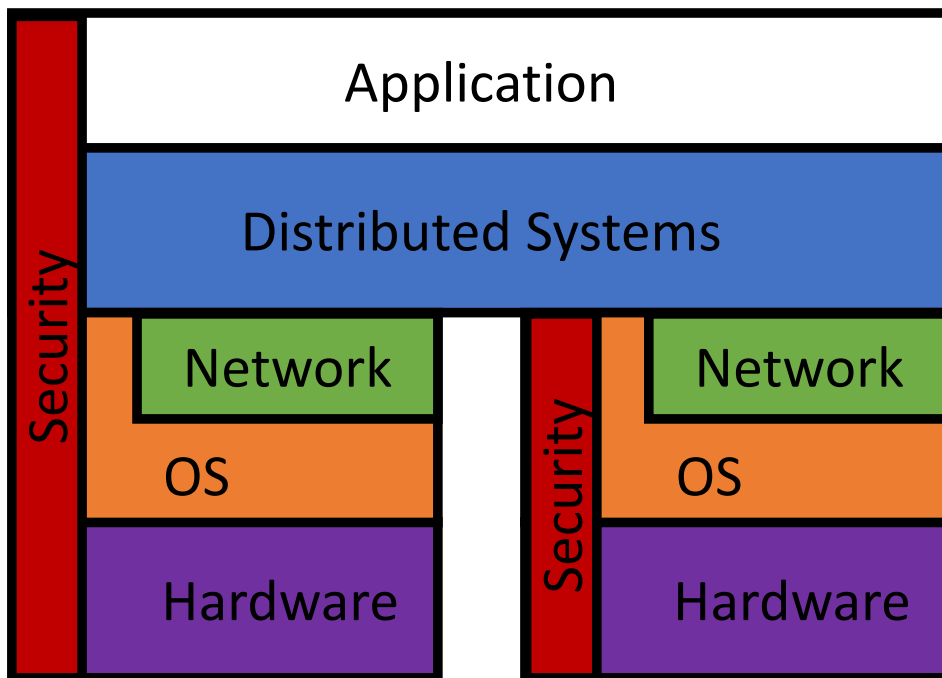
- Adaptive BitRate (ABR) algorithm request video segments
- Video segment requests via Content Distribution Network
- CDNs cache popular video segments

# Systems!

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

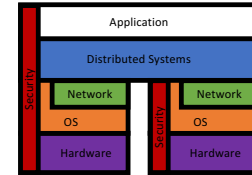


# Systems You Can Learn More About



- Application
- Distributed Systems
- Networking
- Operating Systems
- Security
- Hardware

# Systems You Can Learn More About



- Application COS 333 (Most semesters, “systems”)
- Distributed Systems COS 418 (Spring 2021 – w/ me 😊 )
- Networking COS 461 (Fall typically)
- Operating Systems COS 318 (Fall typically – parallel to 418)
- Security COS 432 (Spring 2021, most semesters, “applications”)
- Hardware
  - Processors COS/ELE 375 (Spring 2021)
  - Logic Design COS 306 / ELE 206



# Monday's Class

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

