System Administration

Week 02, Segment 1
Storage Models and Disks

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Parkinson's Law

Disks are always full. It is futile to try to get more disk space.

Data expands to fill any void.

Core Concepts

- basic disk concepts
- basic filesystem concepts
- file systems

Core Concepts

- basic disk concepts
  - storage models
- basic filesystem concepts
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
- basic filesystem concepts
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
- basic filesystem concepts
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
  - partitions
- basic filesystem concepts
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
  - partitions
- basic filesystem concepts
  - RAID
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
  - partitions
- basic filesystem concepts
  - RAID
  - logical volume management
- file systems

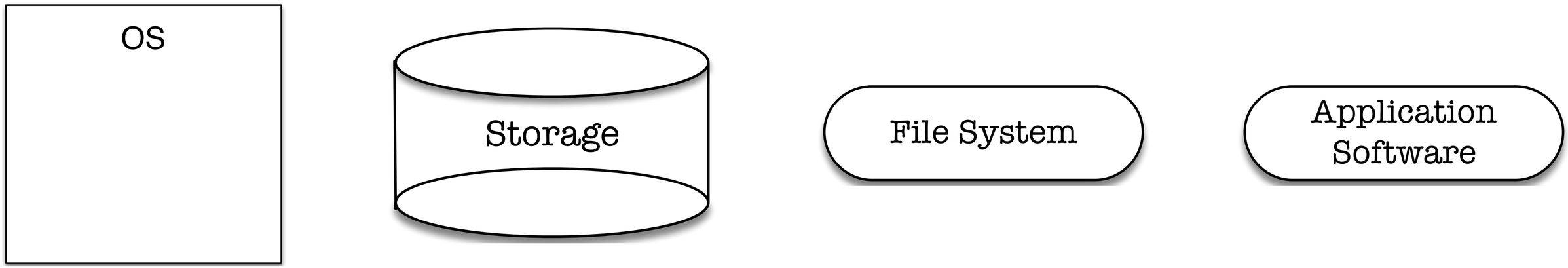
Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
  - partitions
- basic filesystem concepts
  - RAID
  - logical volume management
  - device formatting
- file systems

Core Concepts

- basic disk concepts
  - storage models
  - disk interfaces
  - physical disk structure
  - partitions
- basic filesystem concepts
  - RAID
  - logical volume management
  - device formatting
- file systems (next week)

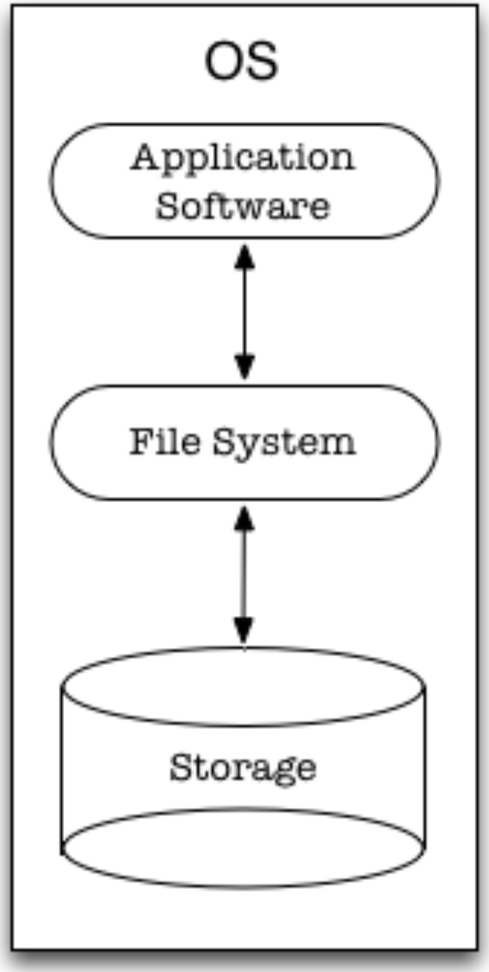
Storage Models



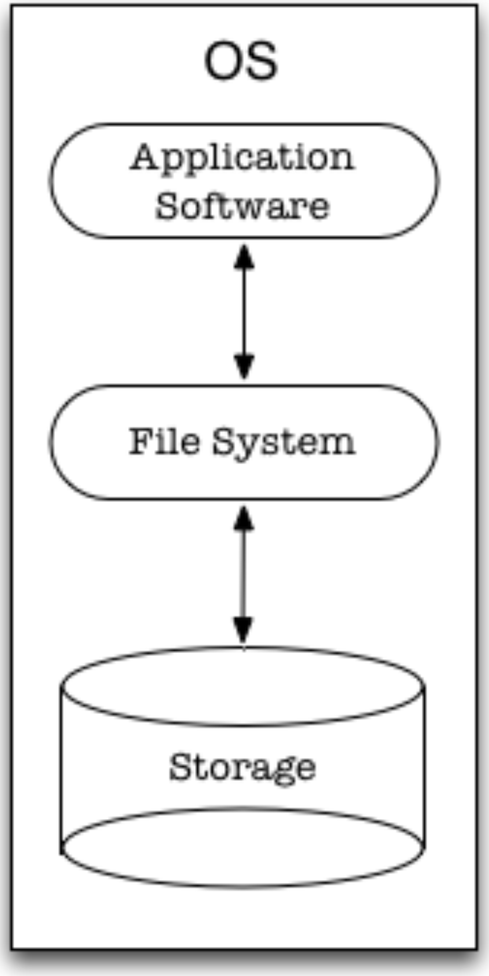
Direct Attached Storage (DAS)

Terminal — 94×24

```
laptop$ df -hi
Filesystem      Size   Used  Avail Capacity iused      ifree %iused  Mounted on
/dev/disk1s1   466Gi   10Gi   18Gi    37%  488222 4881964658    0%   /
devfs          191Ki  191Ki    0Bi   100%     662          0  100%   /dev
/dev/disk1s5   466Gi  430Gi   18Gi    96% 3456869 4878996011    0%   /System/Volumes/Data
/dev/disk1s4   466Gi  6.0Gi   18Gi    25%       6 4882452874    0%   /private/var/vm
map auto_home    0Bi    0Bi    0Bi   100%       0          0  100%   /System/Volumes/Data/home
/dev/disk1s3   466Gi  504Mi   18Gi     3%      50 4882452830    0%   /Volumes/Recovery
laptop$
```

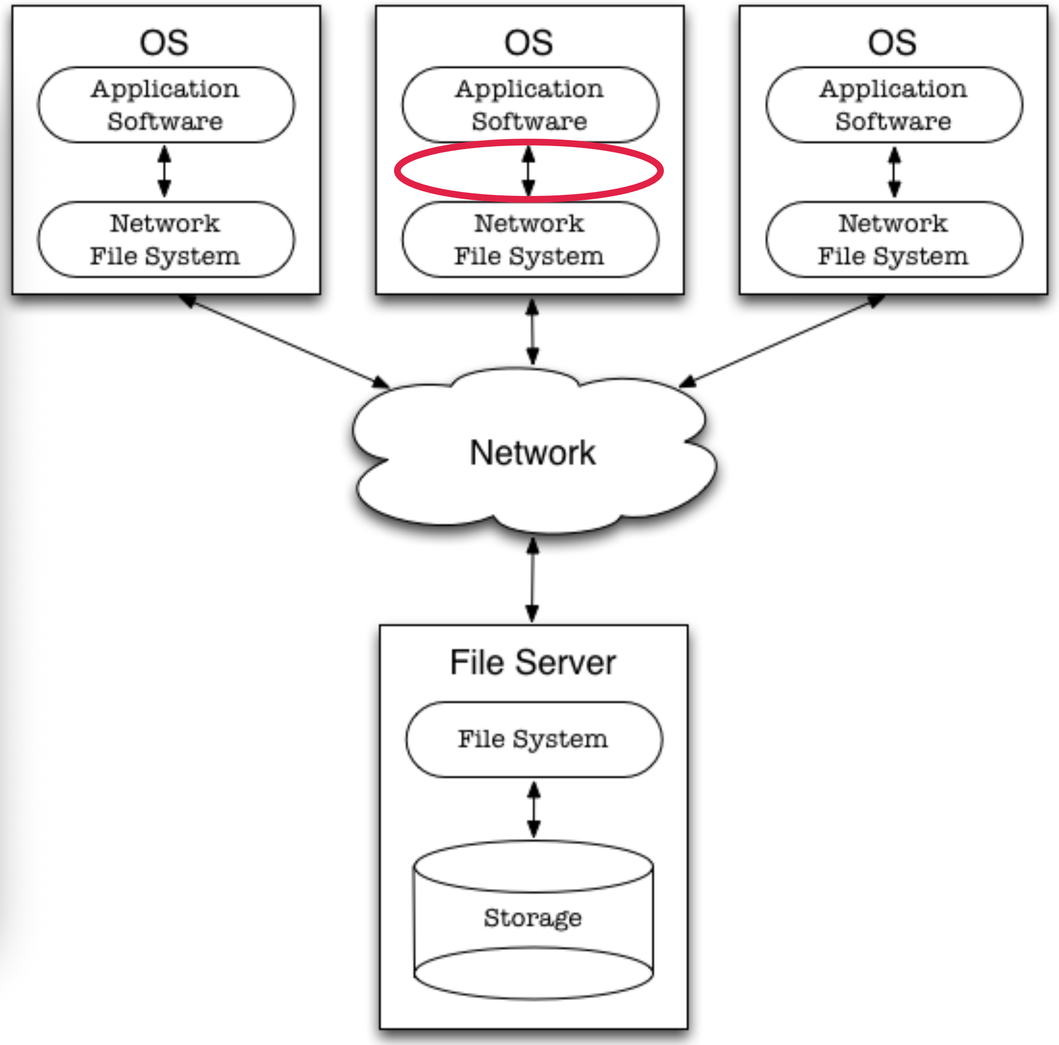


Direct Attached Storage (DAS)



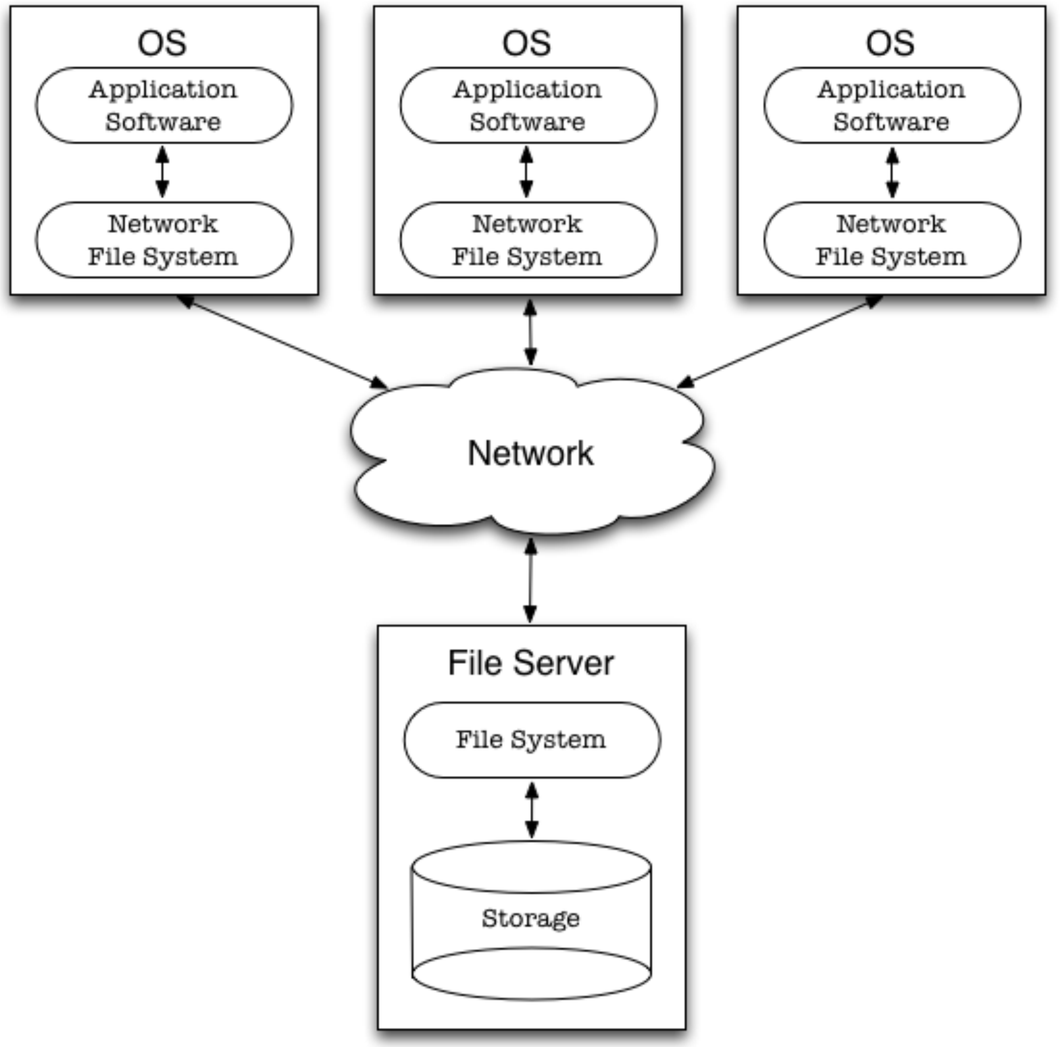
Network Attached Storage (NAS)

```
Terminal — 80×24
laptop$ ssh stevens
eva$ df -hiT /home/$(whoami)
Filesystem                                                  Type Inodes IUsed I
Free IUse% Mounted on
kronos.srcit.stevens-tech.edu:/xraid0-1/export/home/jschauma nfs    150M   47K
150M    1% /home/jschauma
eva$ df -hT /home/$(whoami)
Filesystem                                                  Type  Size  Used Av
ail Use% Mounted on
kronos.srcit.stevens-tech.edu:/xraid0-1/export/home/jschauma nfs   100G   26G
75G  26% /home/jschauma
eva$
```



Network Attached Storage (NAS)

https://www.netmeister.org/blog/spectacular-file-system-confusion.html



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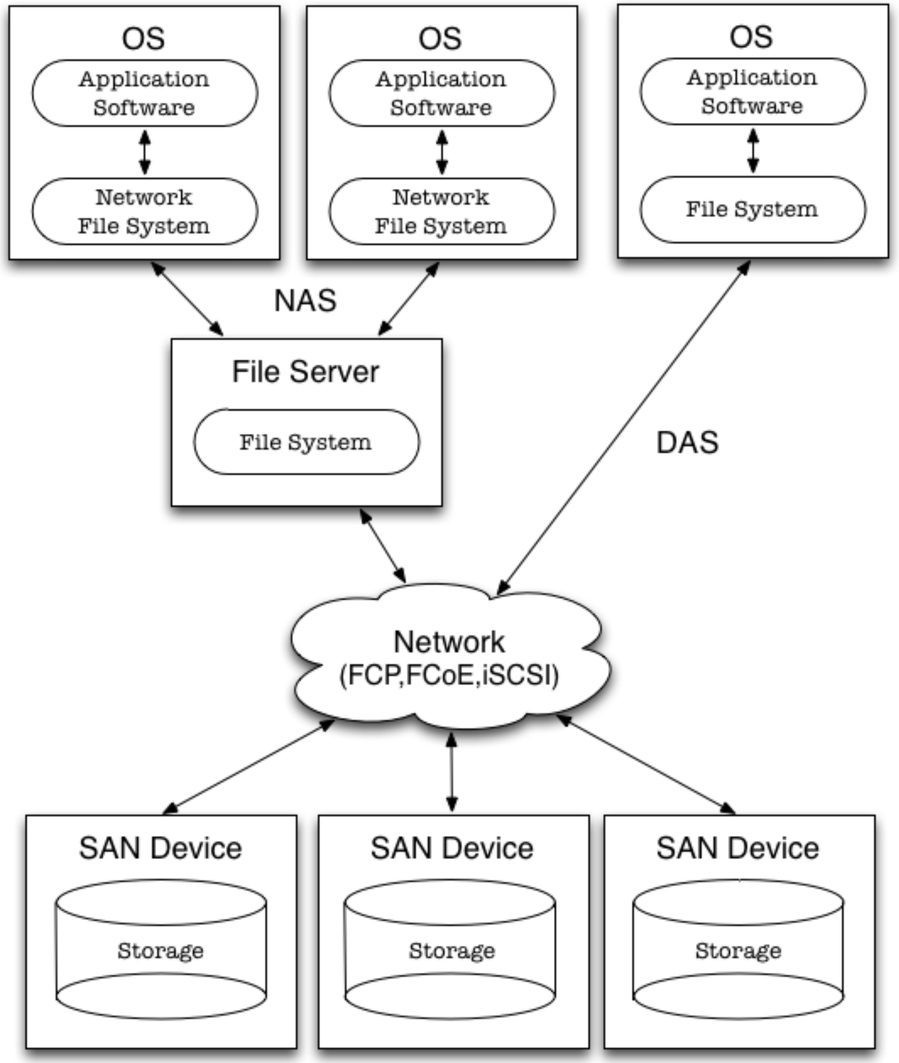
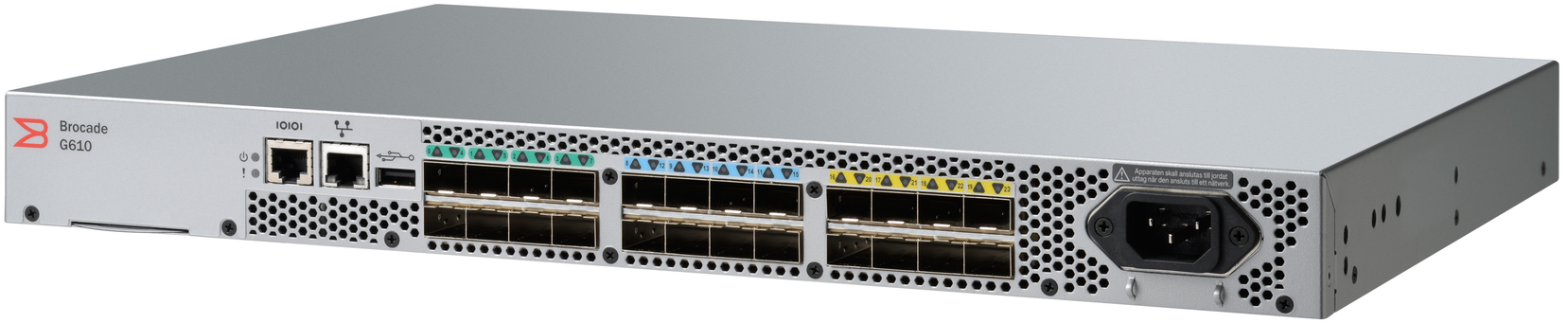
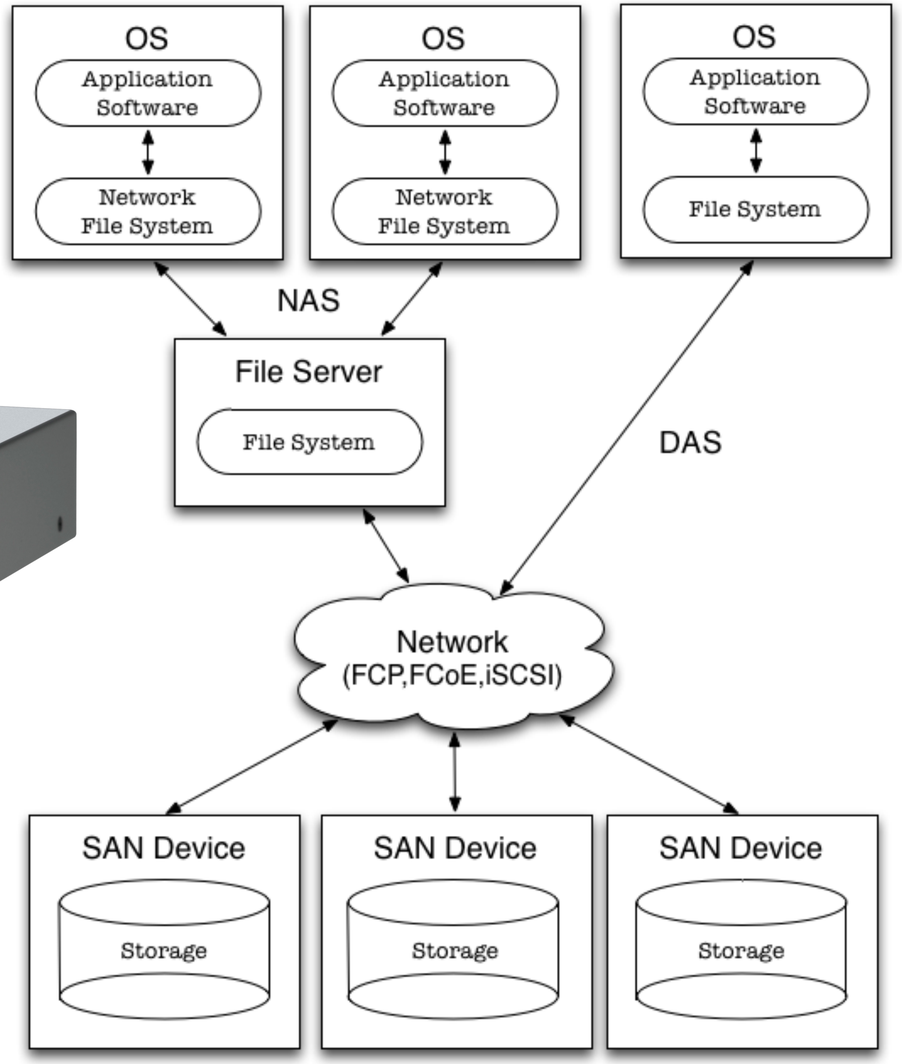
Storage Area Network (SAN)



Storage Area Network (SAN)



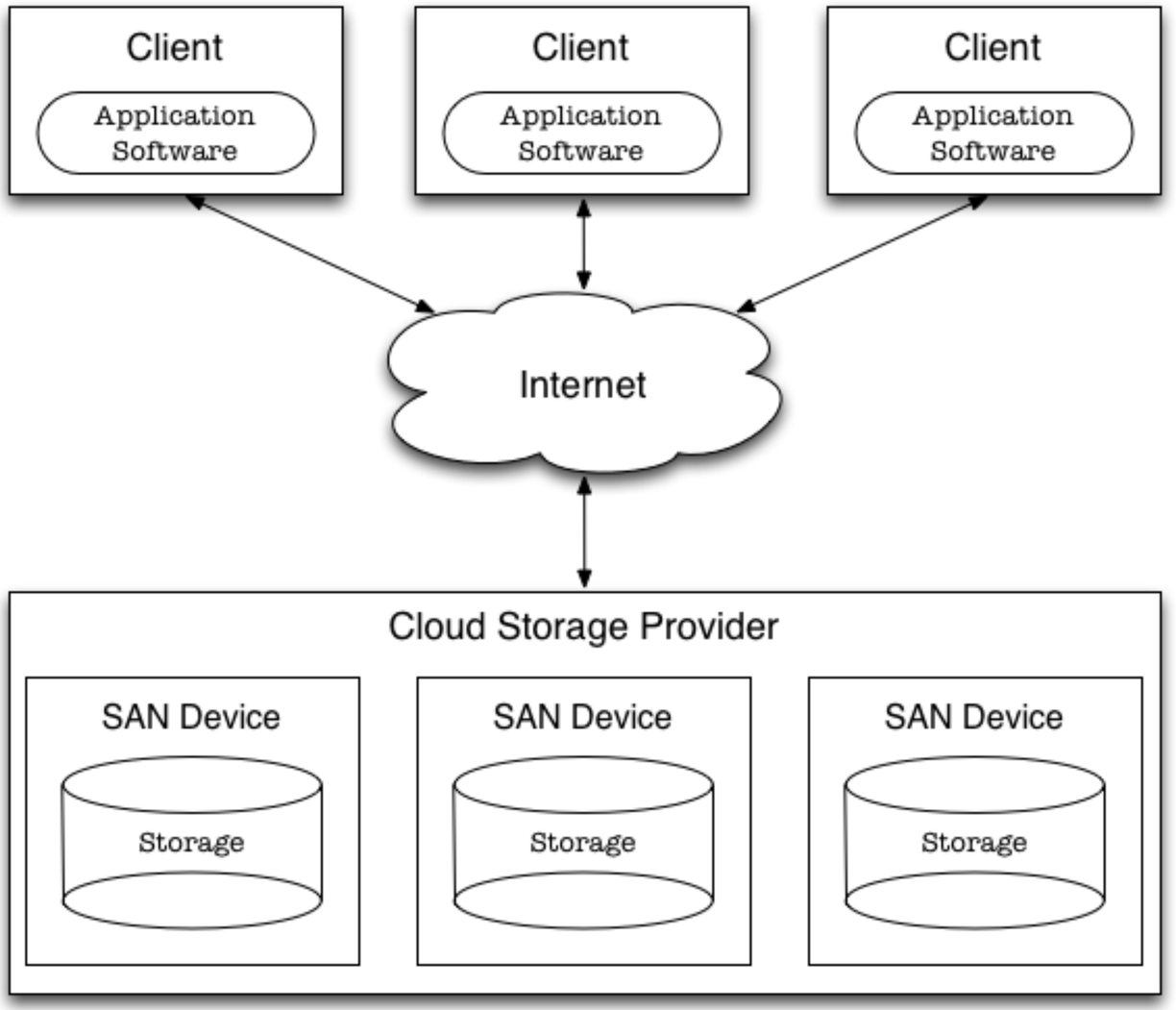


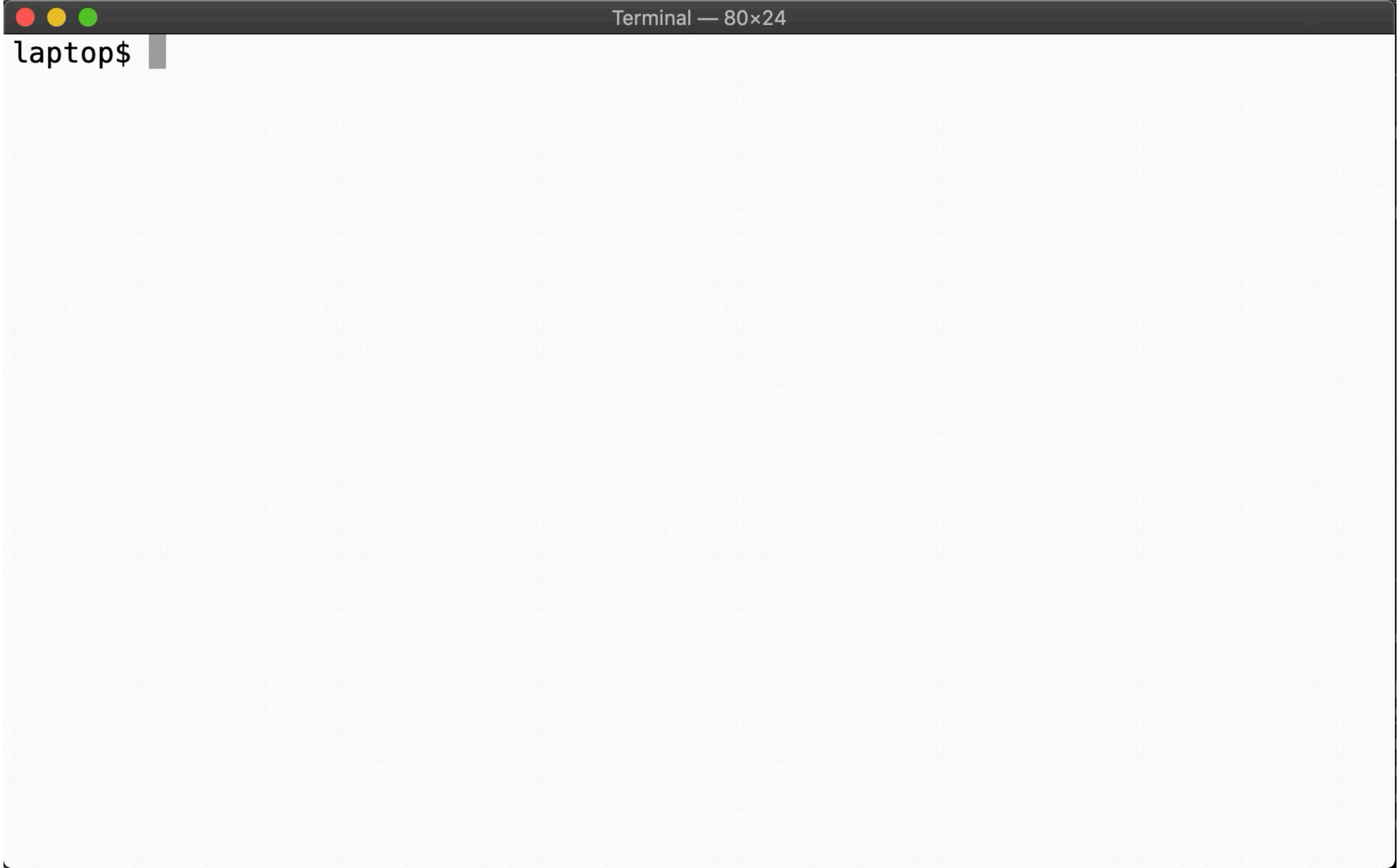
Cloud Storage

Cloud Storage Models:

- “file level” (e.g., Dropbox, GDrive, iCloud)
- “object level” (e.g., AWS S3)
- “block level” (e.g., AWS EBS)

Storage Area Network (SAN)




Terminal — 80×24
laptop$

Summary

Storage Models:

- Direct Attached Storage (DAS)
- Network Attached Storage (NAS)
- Storage Area Network (SAN)
- Cloud Storage (☁️)

Concepts:

- block-level access
- file-level access

Implications:

- There's physical storage *somewhere*.
- Physical and logical location has direct implications on security below the filesystem level.
- Dozens of protocols can be used to combine the different models.

Next up:

- disk interfaces and protocols

Recommended Exercises

Research, contrast, and compare public cloud storage providers. What models do they offer? What do they use internally to support their offerings?

Identify at least three distinct security concerns in each of the storage models we discussed. Outline in detail how an attacker might exploit such weaknesses and how a System Administrator might prevent or counter each attack.

Play around with EBS volumes:

https://stevens.netmeister.org/615/filesystems-exercise.html

Links

File Systems and Storage Models:

https://www.netmeister.org/book/04-file-systems.pdf

Wikipedia:

https://en.wikipedia.org/wiki/Direct-attached_storage

https://en.wikipedia.org/wiki/Network-attached_storage

https://en.wikipedia.org/wiki/Storage_area_network