Special Topics: Virtualization

CS 5007: Systems

Adrienne Slaughter

Northeastern University

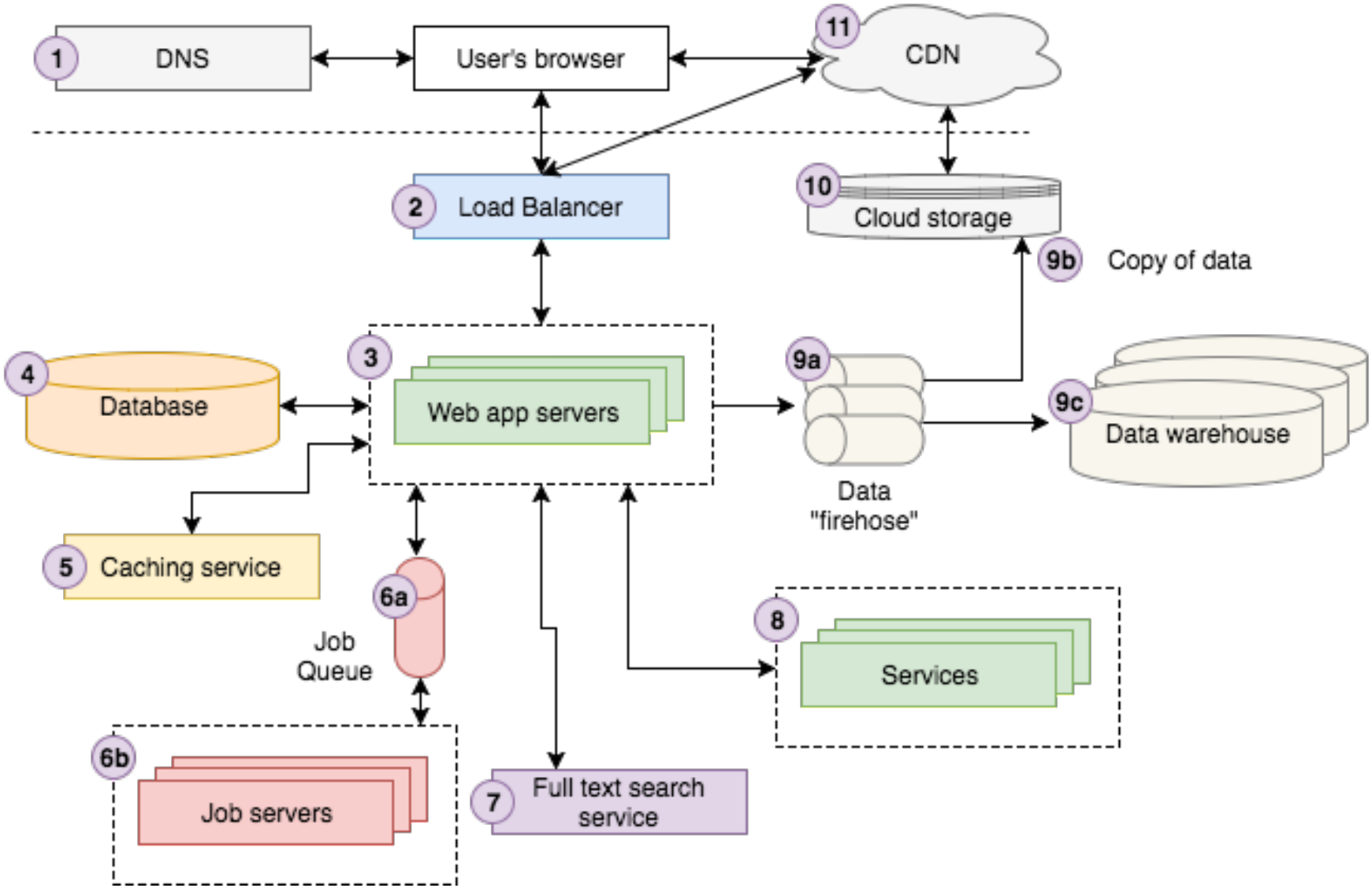
August 16, 2018

1. Web Application Architecture

2. Virtualization

Outline/Agenda

- Structure of a Web Application
- Virtualization
  - Virtual Machines (virtual box)
  - Containers (Docker, Kubernetes)


1
DNS
User's browser
11
CDN
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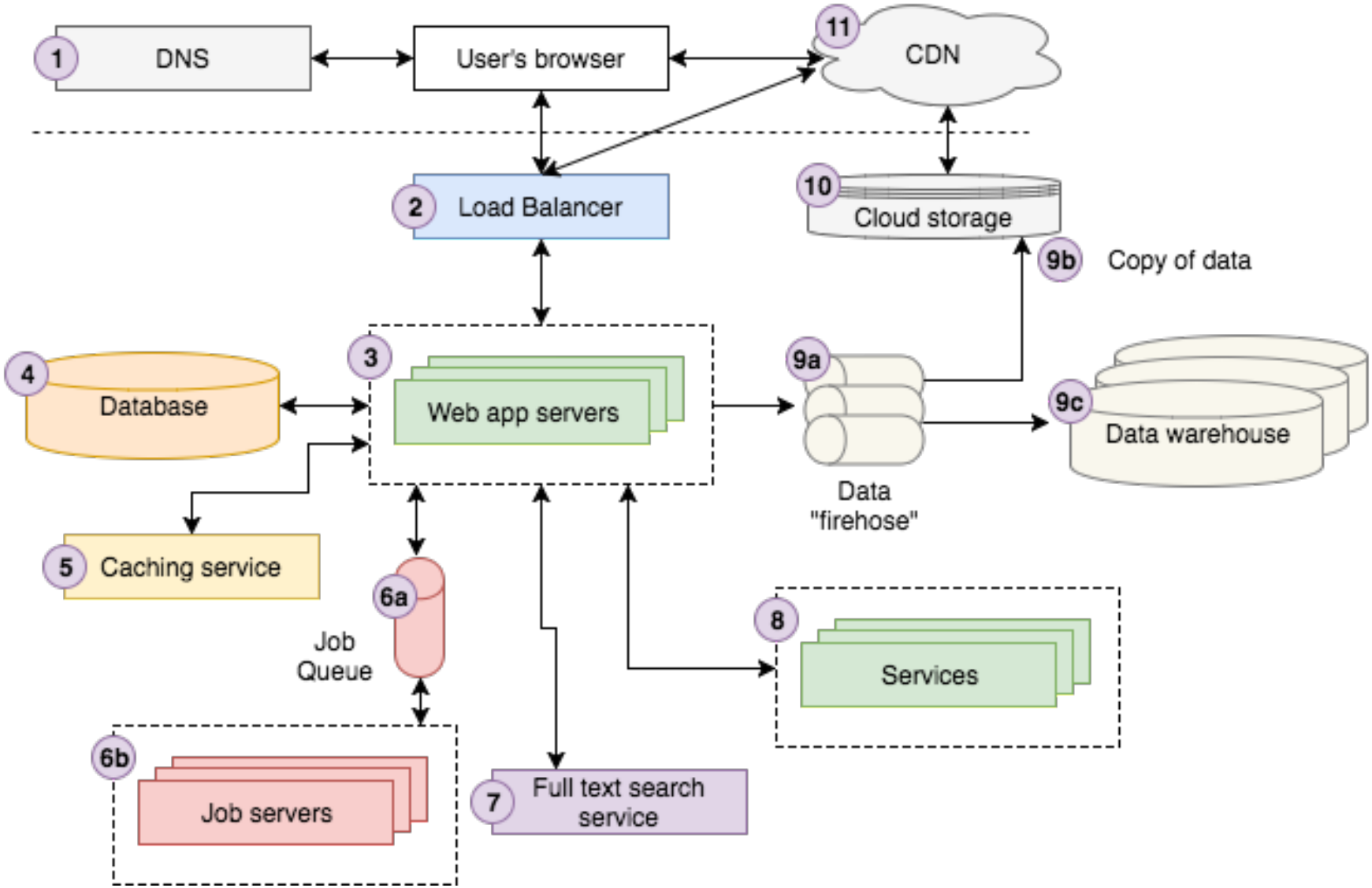
Load Balancer
10
Cloud storage
9b
Copy of data
4
Database
3
Web app servers
9a
9c
Data warehouse
Data
"firehose"
5
Caching service
6a
Job
Queue
8
Services
6b
Job servers
7
Full text search
service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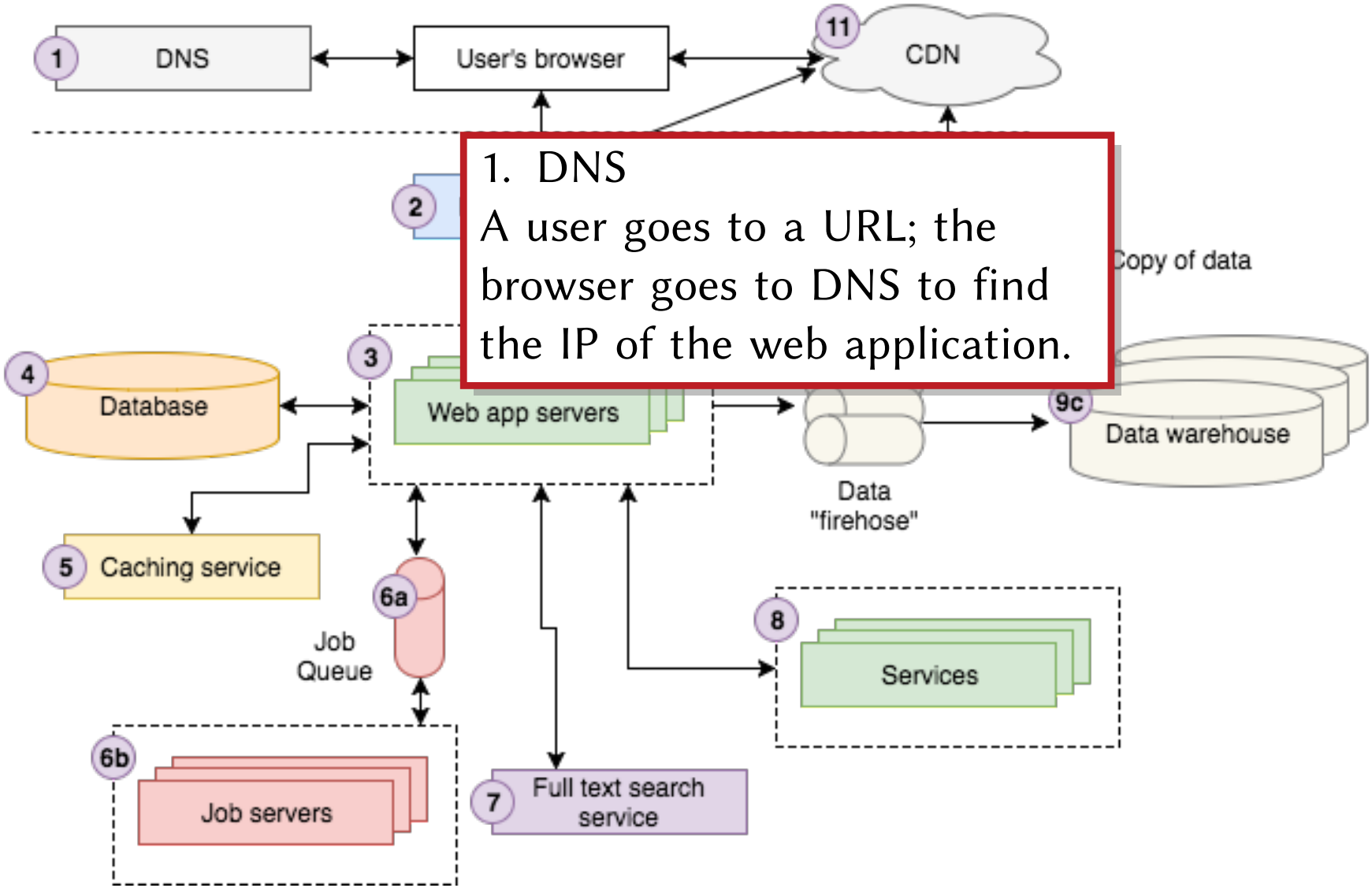
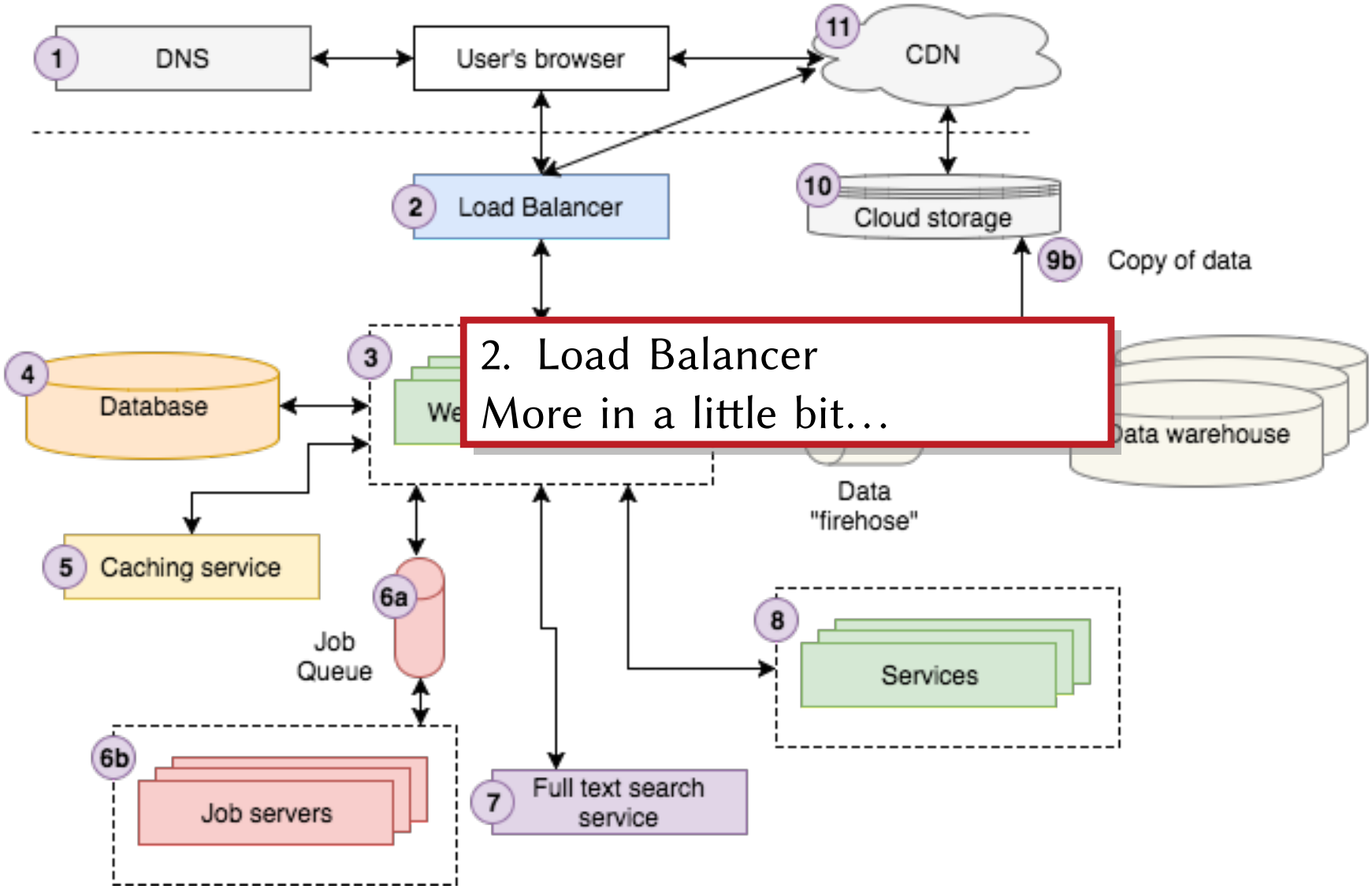


1. DNS
A user goes to a URL; the browser goes to DNS to find the IP of the web application.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More in a little bit...
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Data warehouse
Data "firehose"
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Job Queue
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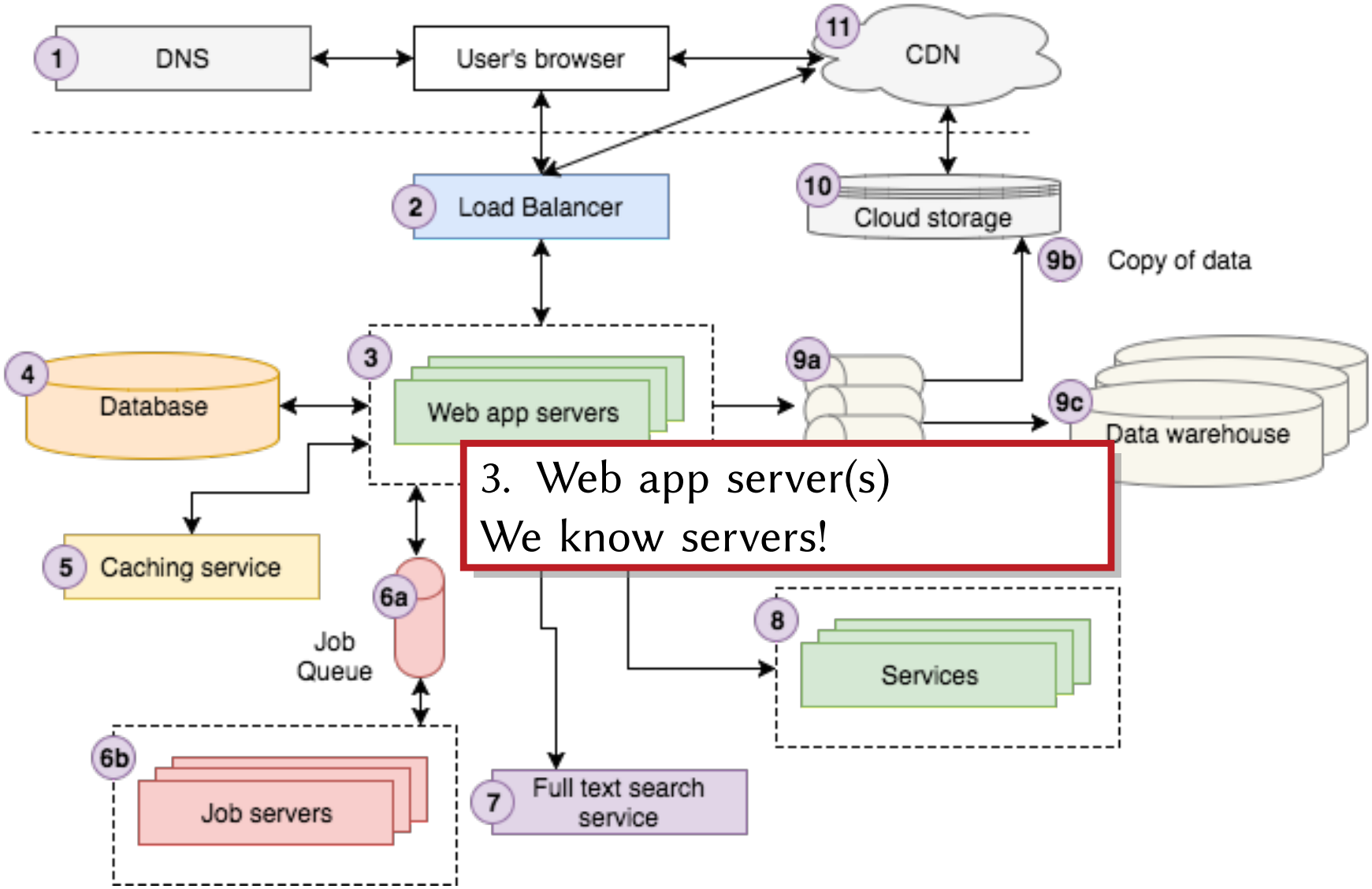
Job servers
7 Full text search service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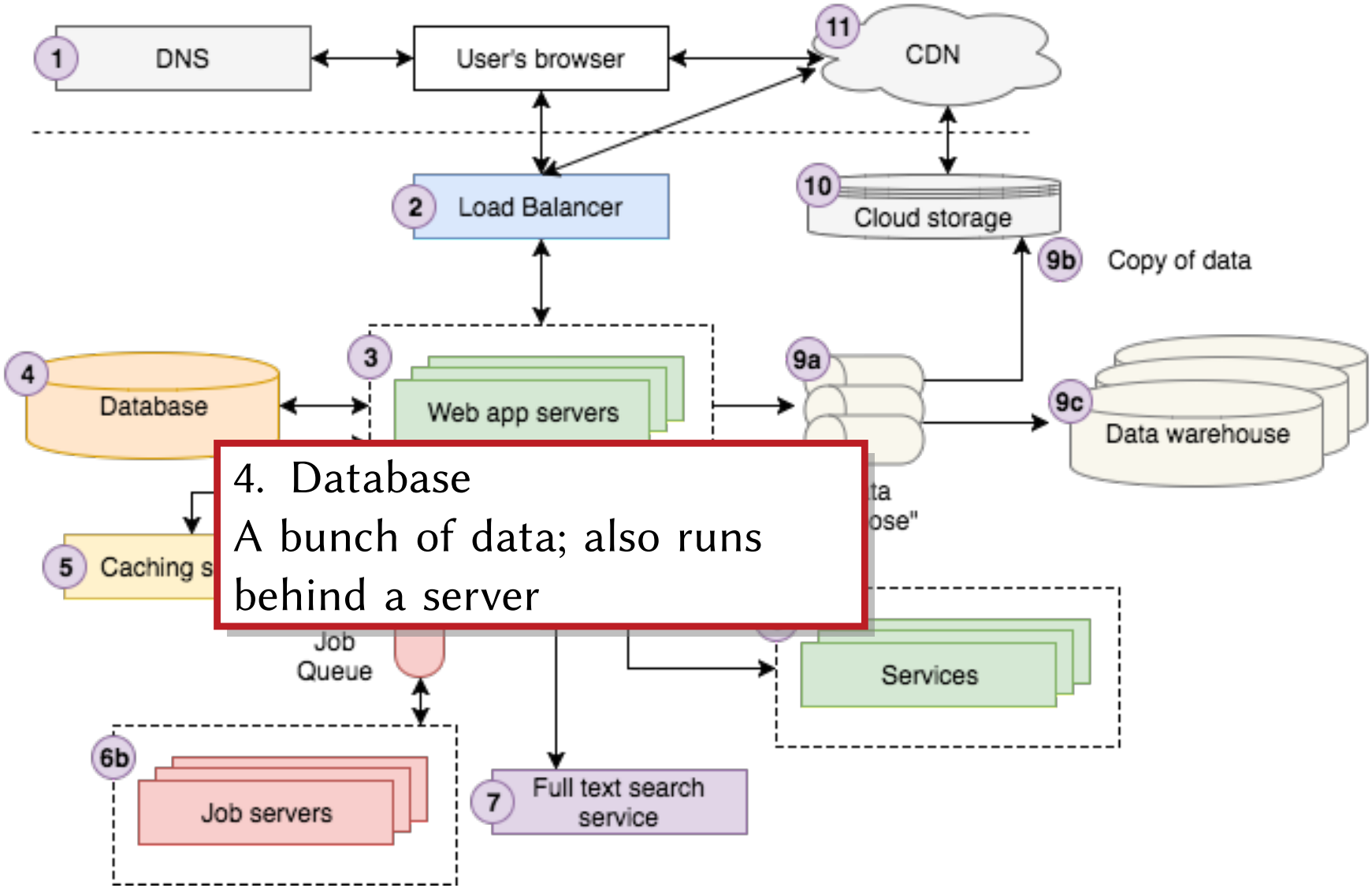
9c Data warehouse
3. Web app server(s)
We know servers!
5 Caching service
6a
Job Queue
8
Services
6b
Job servers
7 Full text search service

3. Web app server(s)

We know what servers are!
A web app server:

- Accepts connections from clients (browsers)
- Pulls data together into an HTML page
- Returns an HTML page to the client/browser/user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Data warehouse
4. Database
A bunch of data; also runs behind a server
5
Caching s
Job Queue
Services
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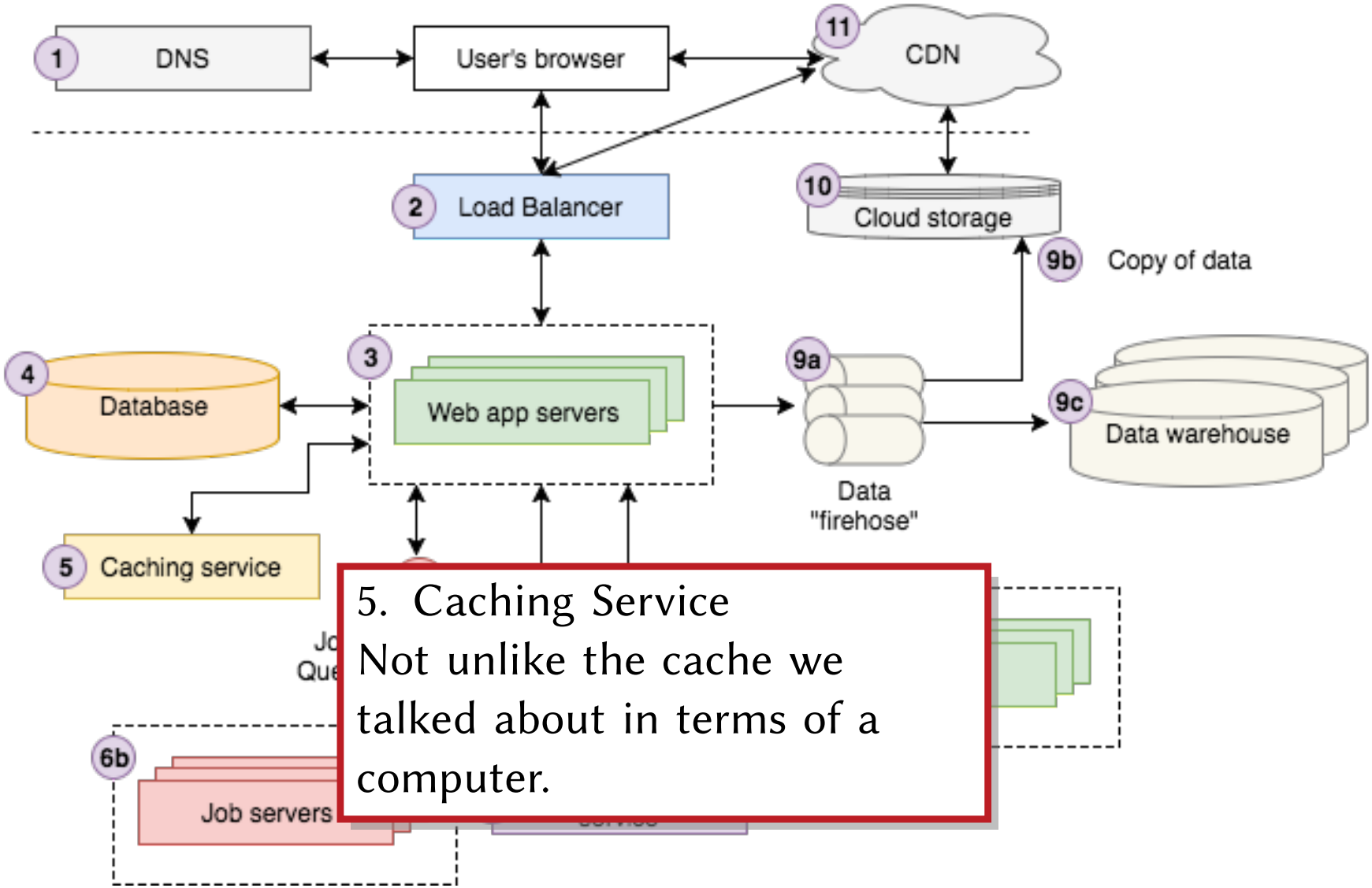
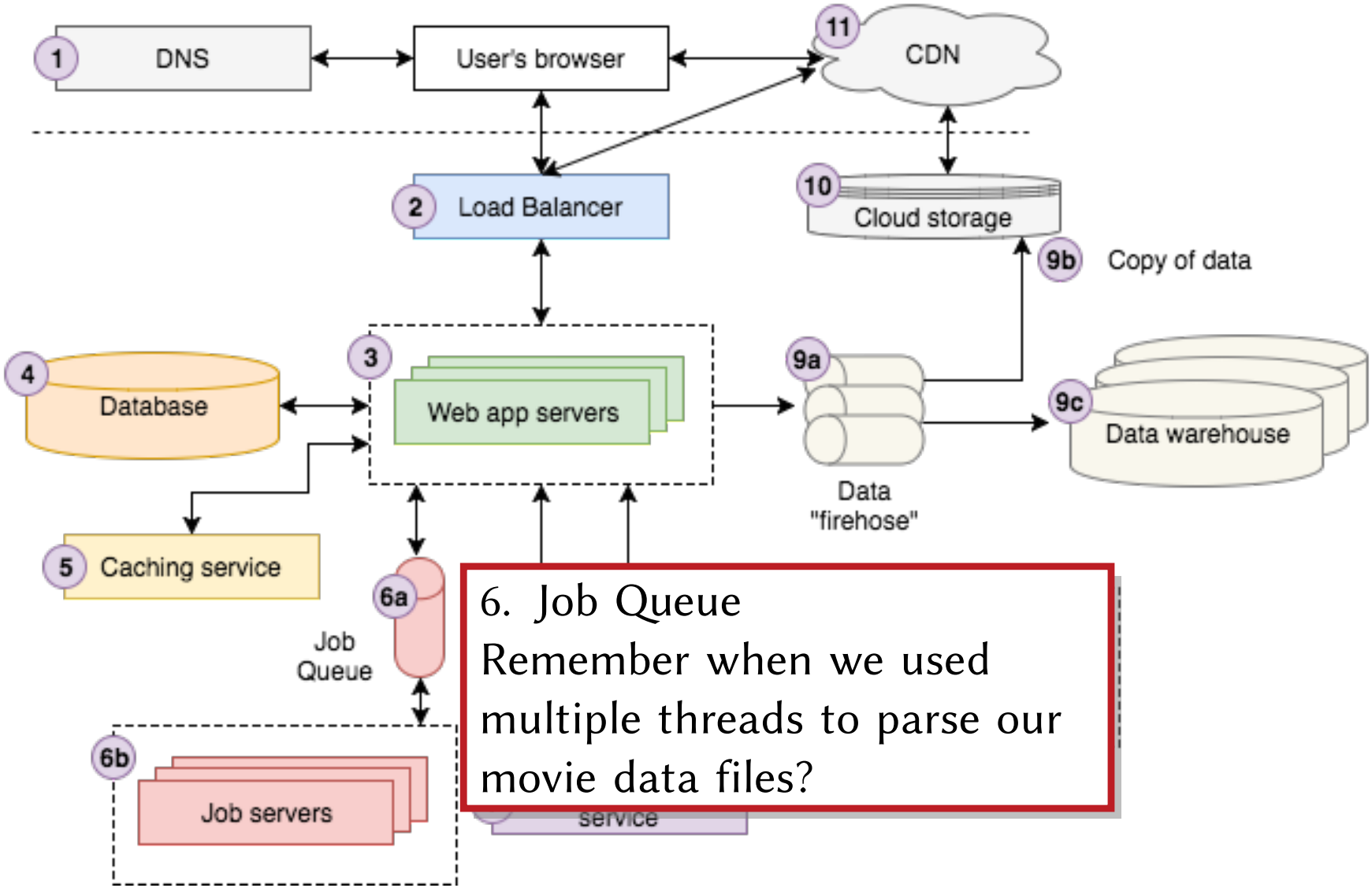
Job servers
7
Full text search service

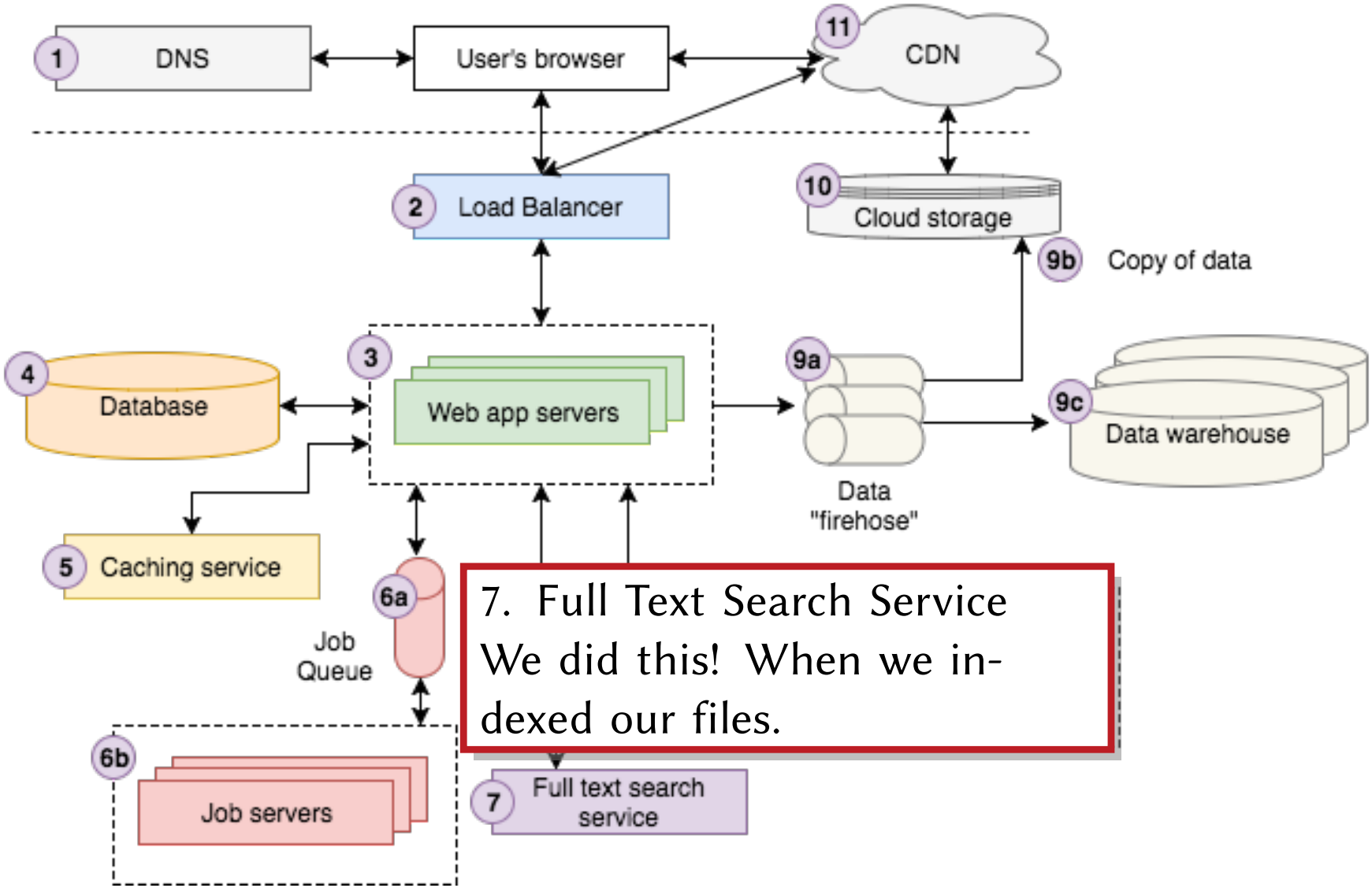


5. Caching Service
Not unlike the cache we talked about in terms of a computer.



6. Job Queue

Remember when we used multiple threads to parse our movie data files?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Data "firehose"
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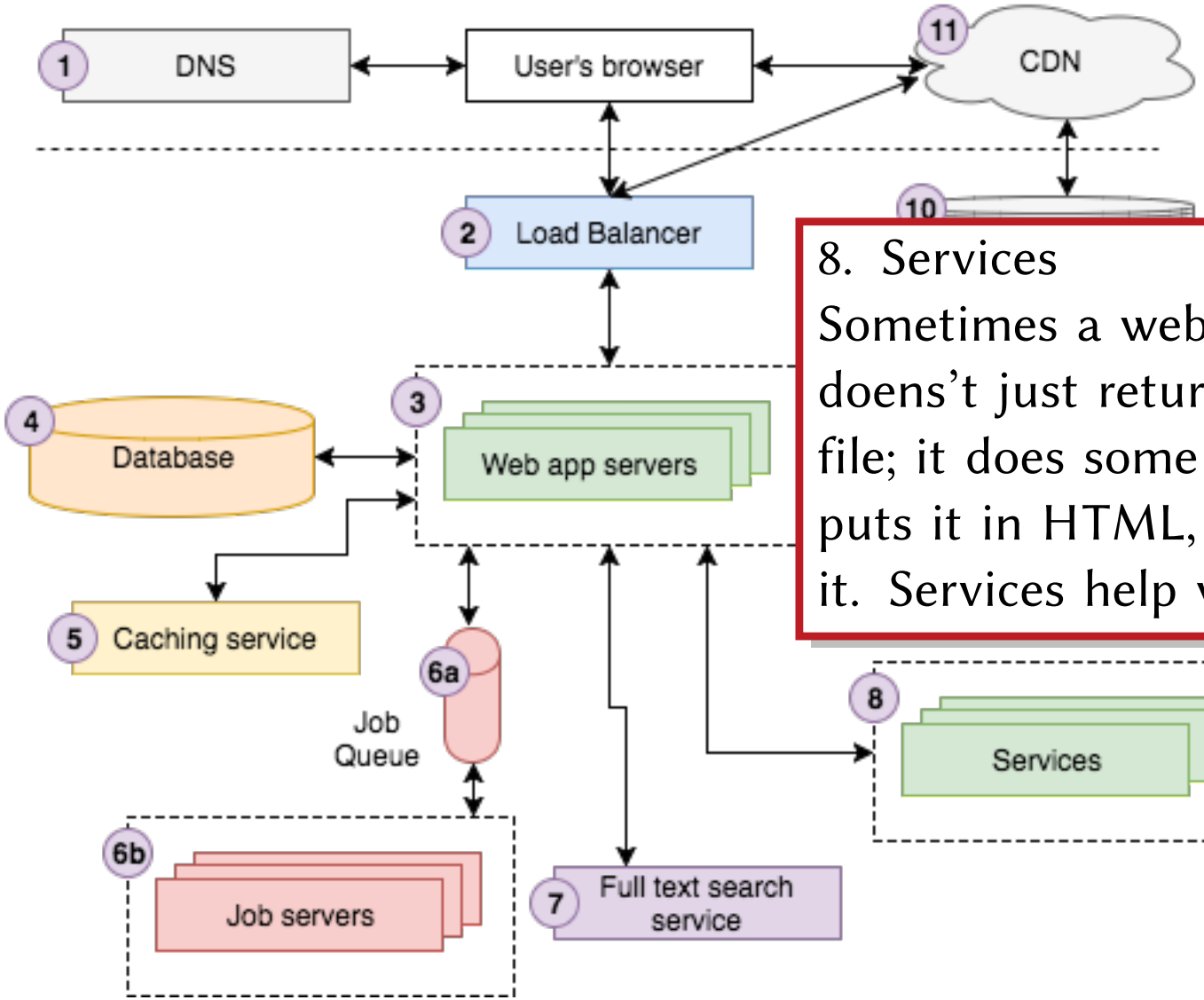
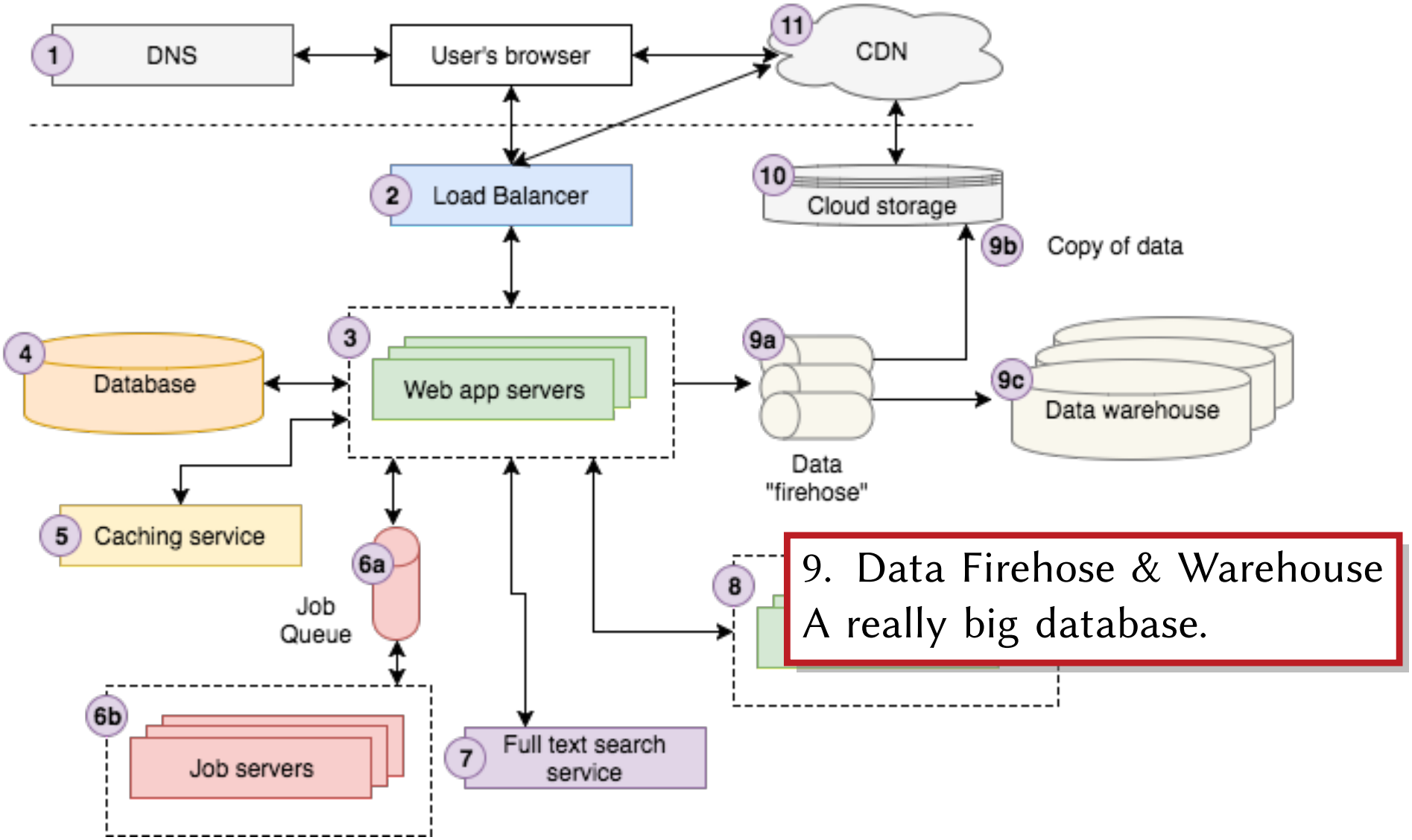
Job Queue
7. Full Text Search Service
We did this! When we indexed our files.
6b
Job servers
7 Full text search service



8. Services

Sometimes a web application doens't just return a single file; it does some calculations, puts it in HTML, then returns it. Services help with that.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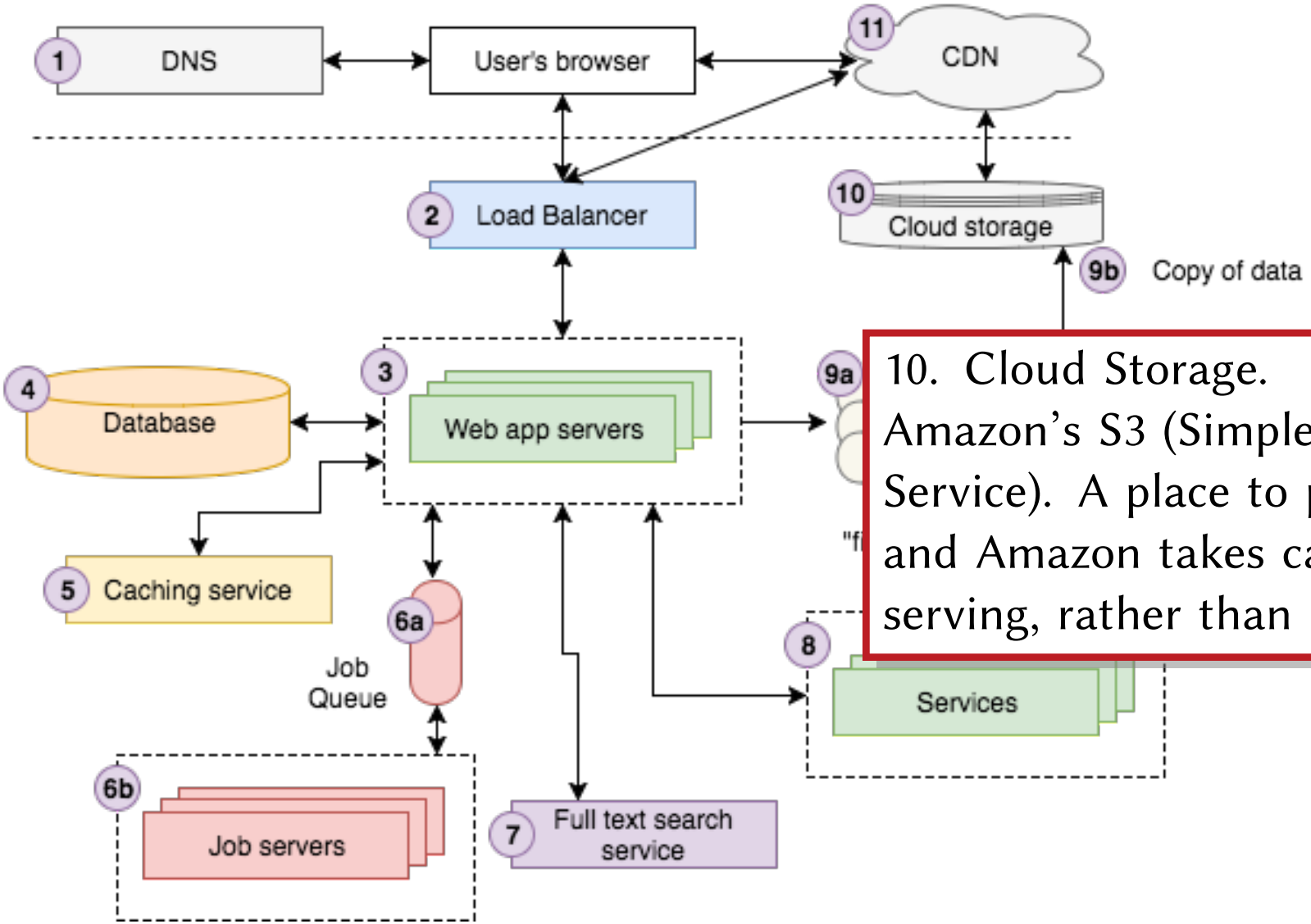
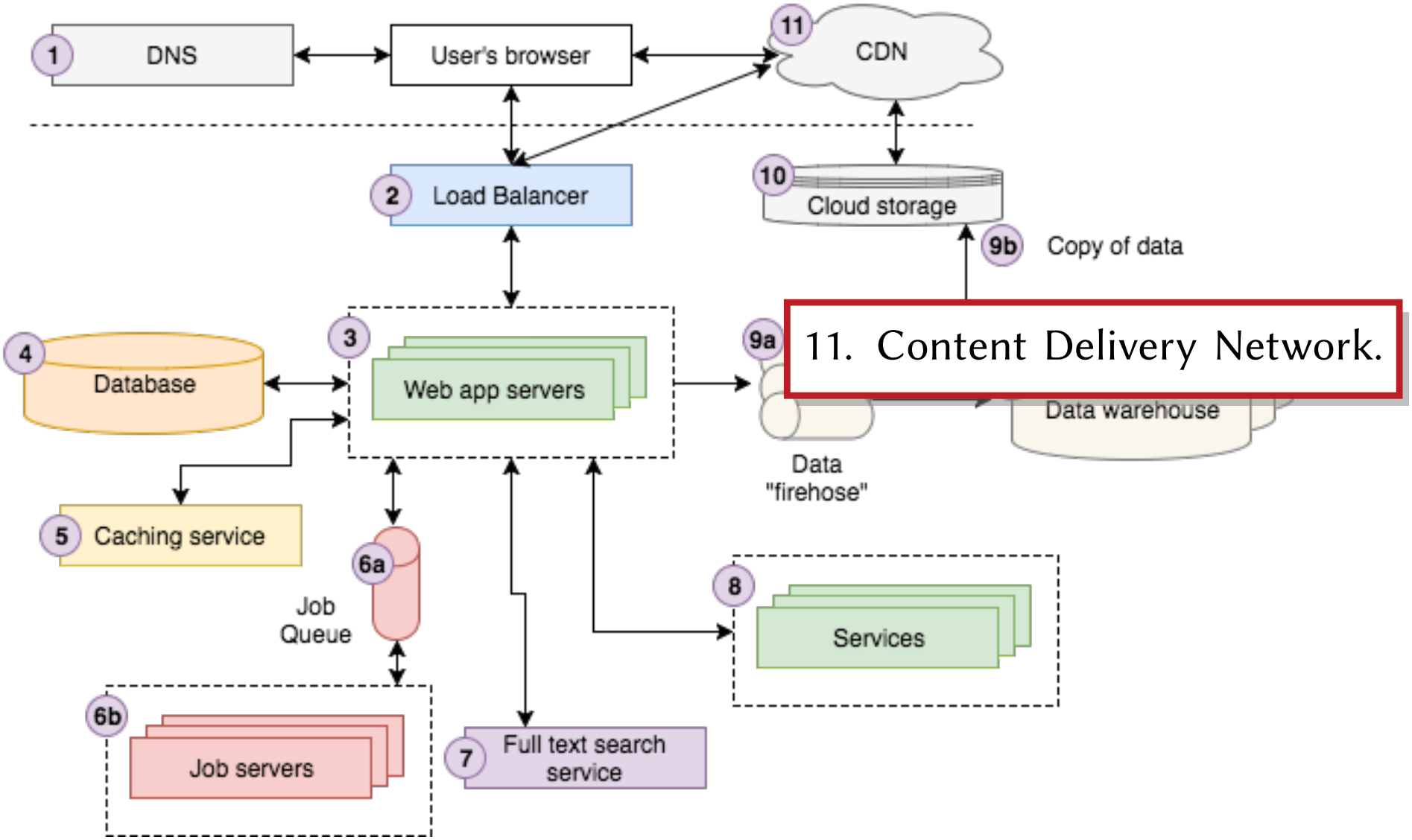
9. Data Firehose & Warehouse
A really big database.
6b Job servers
7 Full text search service



10. Cloud Storage.
Amazon's S3 (Simple Storage Service). A place to put files, and Amazon takes care of the serving, rather than us.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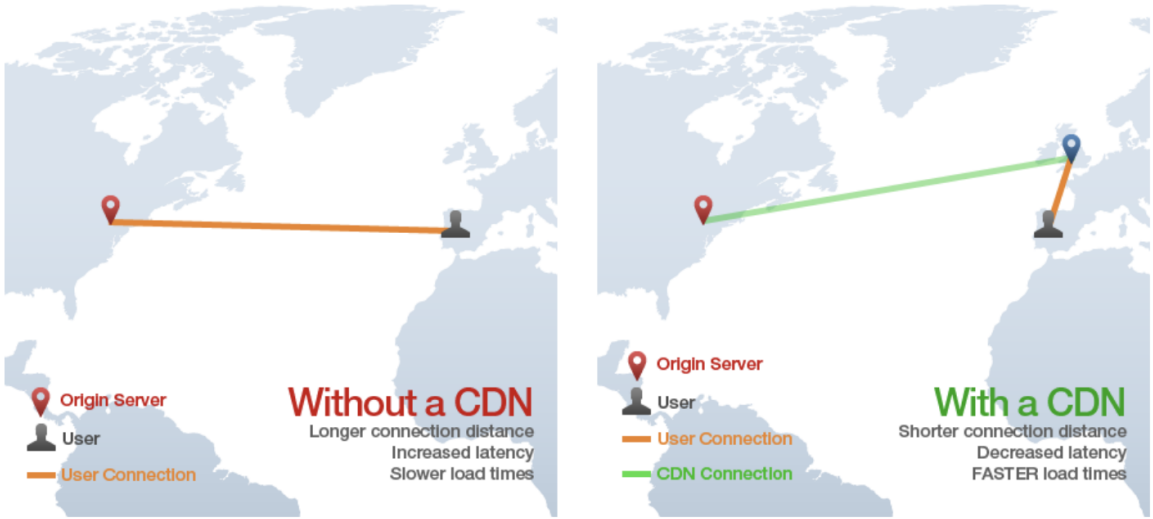
Content Delivery Network



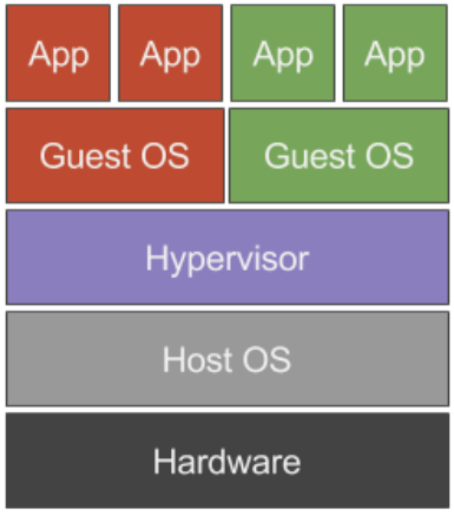
Section 2

Virtualization

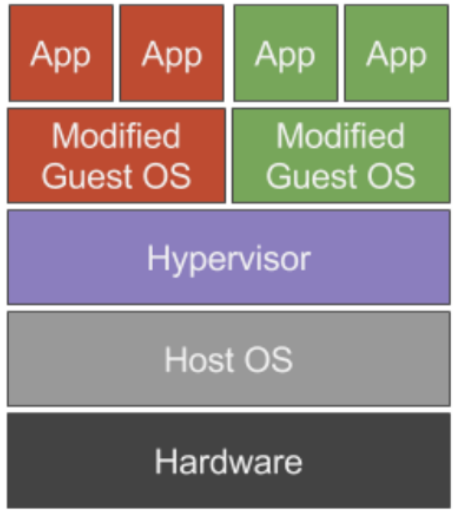
What is Virtualization?

"the art and science of making the function of an object or resource simulated or emulated in software identical to that of the corresponding physically realized object"

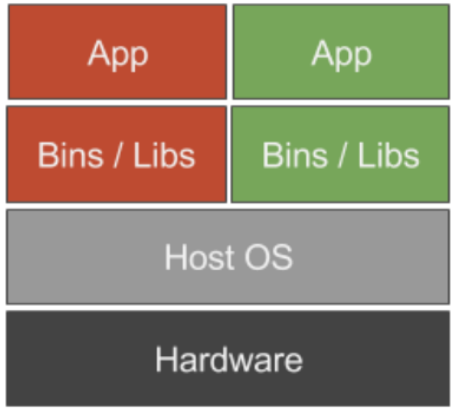
- use abstraction to make software act like hardware



Full Virtualization



Paravirtualization



OS Level virtualization

Hypervisor

- a.k.a Virtual Machine Monitor, or VMM

Hypervisor

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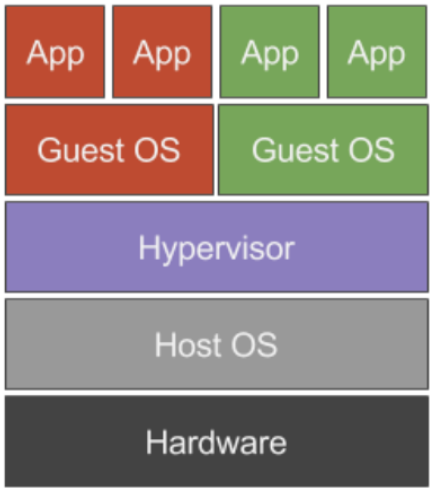
- an "API" that provides access to the hardware level for virtual machines

Full Virtualization



Full Virtualization

- Example: VMware ESX

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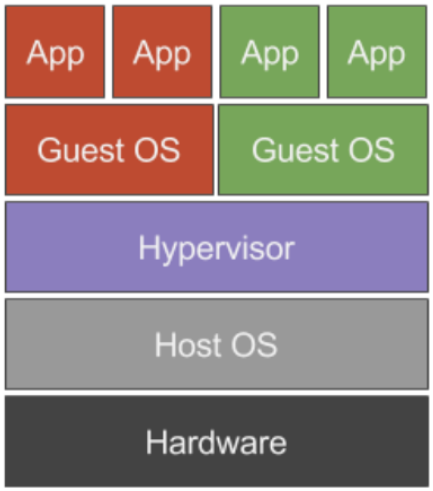

Full Virtualization

- Example: VMware ESX
- Runs a full version of the OS in a VM

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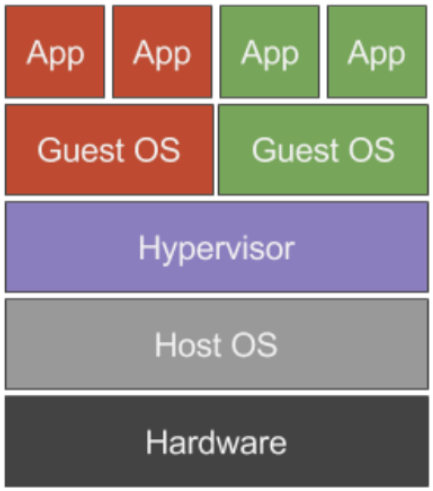

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- Each one thinks it's on a dedicated server, with a fraction of resources

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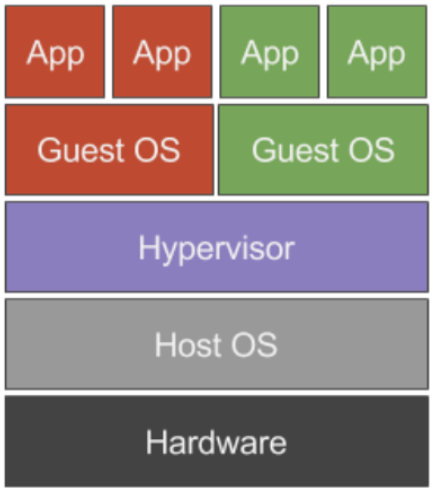

Full Virtualization

- Example: VMware ESX
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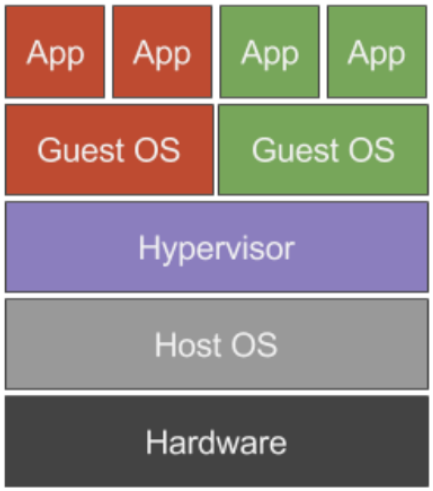
- Runs unmodified code– don't have to do something special with your code to make it run

Full Virtualization



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- System calls are captured by the Host OS and passed on to the hardware

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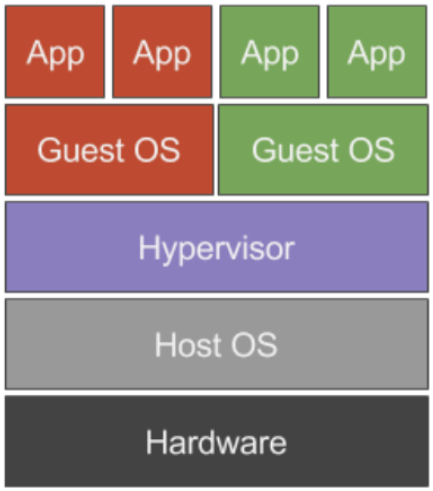

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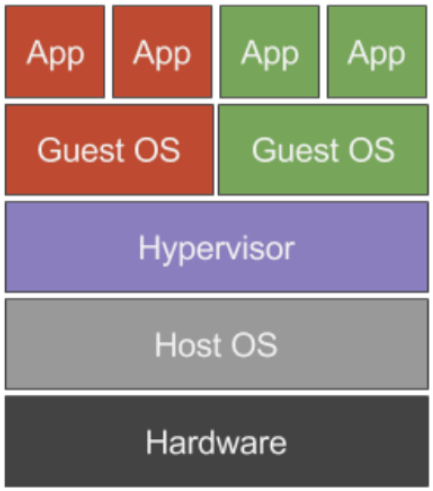
- Large startup costs (slow to start!)

Full Virtualization



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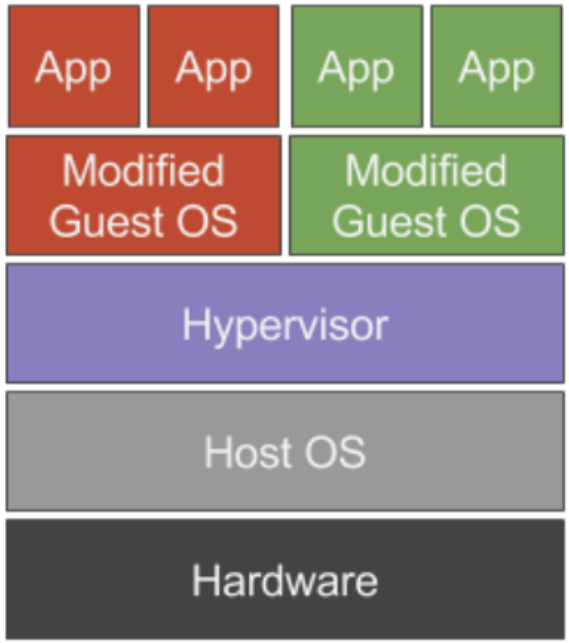
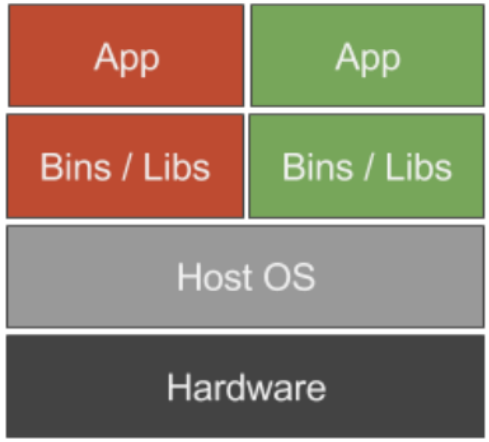
Hybrid/Para-virtualization



Paravirtualization

- the OS running on the virtual machine has a modified Kernel that accesses system resources using a Hypervisor Call rather than a System Call
- Requires a modified OS– not the original OS

OS Level Virtualization



OS Level virtualization

- Example: Docker
- Applications run on the host OS, in a sandboxed environment
- Apps need to be repackaged
- Faster startup
- Less-strict isolation between resources