اكمل نماذج لوصول بعض الرهائن ويجسرون أنفسهم في "دار السرّ الملكية" في إسبانيا، بينما يلعب أحد العمليين الإجرامي بالشرطة لتنفيذ مخططه.

أفضل الاختيارات لك
What is a Content Delivery Network?

- Originated in the 90s as the consumer internet began to scale around the world.
- Allowed the assets of a website to be cached on servers positioned around the network, closer to users devices.
- Companies like Akamai built systems to aggregate many different websites, typically using DNS tricks and proxy caching.
Why build a CDN?

- Many websites like Netflix have content that is the same for many users.
- Using distributed copies on the network saves infrastructure cost.
- As a bonus, it also improves latency.
- Google (Youtube) and Netflix have many 10+% of consumer internet traffic, so they have the scale to build their own CDNs.
Some goals of the Netflix CDN

● For large scale, focus on
  ○ Simplicity
  ○ Low cost

● Easier to operate for Netflix
  ○ Less development and operations staff

● Easier to show value to ISP partners
  ○ Reduces cost for Netflix and the ISP
Networks are dimensioned for peak capacity

Off-peak cache fill is “free”
Caching methodology

- Media assets are transmitted via HTTPS
- Most CDN are based on http proxy caching
- The Netflix control plane already knows where the client is on the network and what they want to watch
- We **preposition** the files off peak, and only send requests to caches (via the control plane) with the content already present
Proactive caching provides benefits

- Designated off-peak fill “window”
- <5% of Netflix traffic comes from upstream at peak
- Load balancing across servers by distributing popular content
- Most popular content placed on flash drives
- No read/write contention at peak
105,000 network miles
(4.2x around the earth)
servers (OCA)

networks
**flash “offload”**
- most popular content
- 100 gbps per server
- ~91,000 drives in service
- ~100 petabytes
- 7% of storage
- 60% of traffic

**hdd “storage”**
- complete catalog
- 40 gbps per server
- ~169,000 drives in service
- ~1.4 exabytes
- 93% of storage
- 40% of traffic
open connect

Internet architecture
the vast majority of data flows this way (toward the home)

Order of 100 globally

Order of 10,000 globally
quality of experience
Distance (km) from Client to Server vs PrimeTime Rebuffers per Session Hour

![Graph showing the relationship between Distance (km) from Client to Server and PrimeTime Rebuffers per Session Hour over time. The graph includes a red line and a gray line, with data points from 7/1/2016 to 7/1/2018. The x-axis represents time, while the y-axes represent distance and PrimeTime Rebuffers per Session Hour, respectively.](image-url)
adaptive streaming
input rate
(from network)

video buffer
(leaky bucket)

buffer level

output rate
(to screen)
Quality of Experience factors

- Playdelay
- Adaptive streaming engine
- Video quality
- Rebuffer risk
transcoding
64% less bits for the same quality
tips and tricks
Your Internet speed is

![210 Mbps](image)

<table>
<thead>
<tr>
<th>Latency</th>
<th>Upload Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unloaded</td>
<td>Loaded</td>
</tr>
<tr>
<td>18 ms</td>
<td>190 ms</td>
</tr>
</tbody>
</table>

Client: Ben Lomond, US
Server(s): Santa Clara, US

Settings:
- 500MB
- 10MB
Device gets OCA URL from Playback Apps, video streams from OCA to Device

1. Report health status, routability, and available assets

2. "Play" request

3. Determines required assets

4. Picks OCA, generates URL

5. Device gets OCA URL from Playback Apps, video streams from OCA to Device

Client Devices

OCAs

Netflix in AWS

Playback Apps

Steering Service (CODA)

Cache Control Service (CCS)
questions?