

# How Netflix Works

## CS144

### 2019

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A world map composed of small squares, with the word 'netflix' in red and 'everywhere' in white.

# #netflix everywhere

No ads | Uninterrupted entertainment | All episodes at once

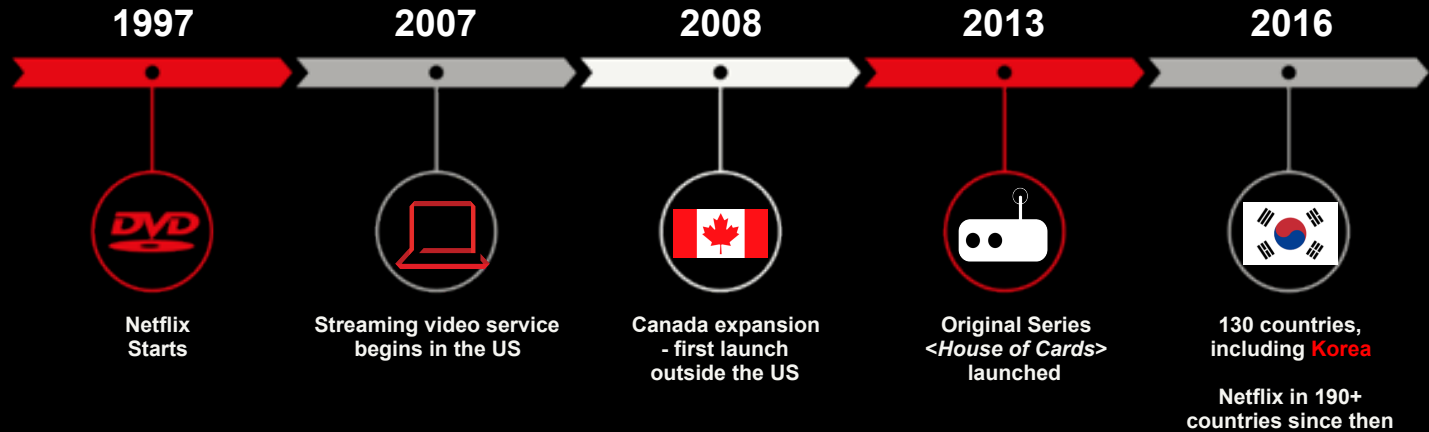


The background of the advertisement features a dark, moody scene with a laptop and a tablet. The word 'NETFLIX' is printed in a large, red, sans-serif font on the screens of both devices. The laptop is in the upper left, and the tablet is in the lower right, both angled towards the viewer. The overall lighting is low, creating a sophisticated and tech-oriented atmosphere.

원하는 시간에  
원하는 방식으로  
원하는 장소에서 시청

Watch When You Want.  
How You Want.  
Where You Want.

# The Netflix journey





What about today?



A satellite view of Earth at night, showing the curvature of the planet and the glowing lights of cities and continents. The text is overlaid on this image.

More Than  
**190 Countries**

Over **151 Million**  
Paid Memberships

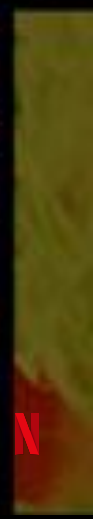
**60+% from**  
Outside of the U.S.

1,700+ 넷플릭스 지원 기기 Different types of devices



518M+ 글로벌 회원이 넷플릭스를 시청하는 기기 Unique devices globally









Bringing **great stories** from  
around the world to audiences  
the world over.

A low-angle shot of a person with dark hair, wearing a brown jacket and a backpack, looking up at a very tall, modern apartment building with many windows. The sky is blue with some clouds.

# How Do We Deliver a Great **Netflix** **Experience** to Everyone?

# What makes a great streaming



- Start quickly
- Great quality
- No interruptions



# Diverse networks and devices

3G

LTE

5G

Cable

Satellite

Fibre

Wi-Fi

4K

HDR

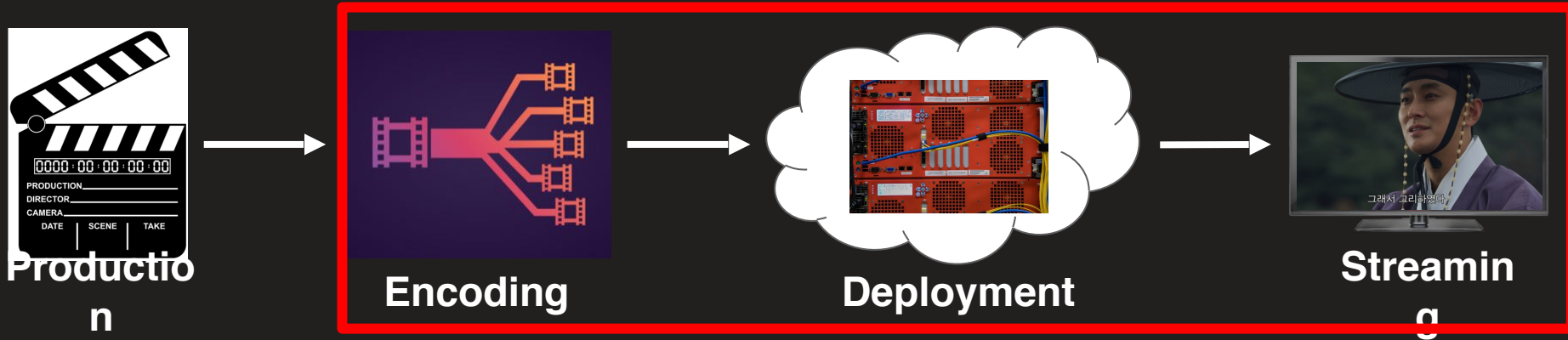
HD

SD



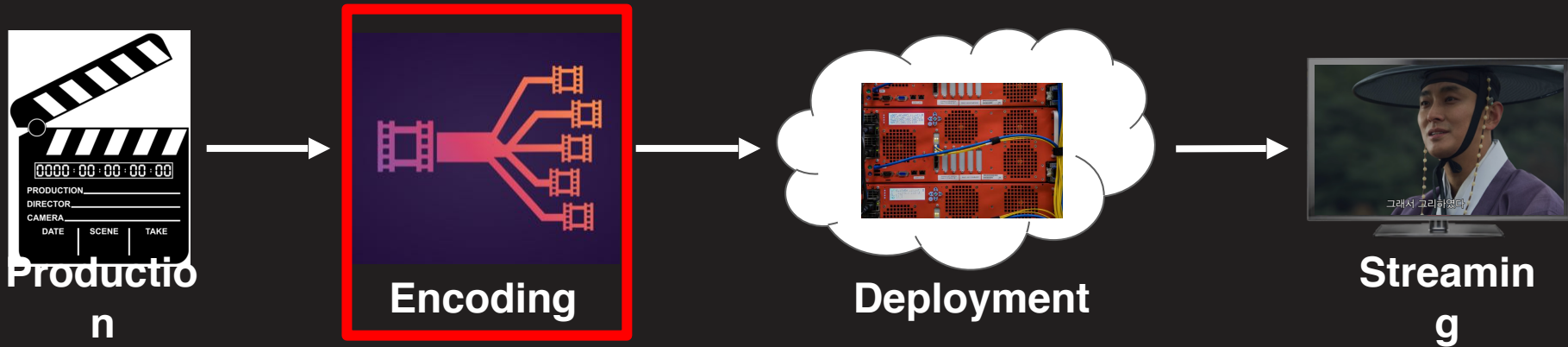


# The building blocks of the Netflix streaming experience



All of these are continually optimized to improve user experience

# The building blocks of the Netflix streaming experience



# 통합 인코딩 방식 적용

One-size-fits-all encoding

1050kbps 스탠다드 화질(SD)

Standard Definition (SD) at 1050 kbps



2011년

2012

2013

2014

2015

2016

2017

2018

# 타이틀 별 인코딩 방식 구분

Per-title encoding



640 kbps



710 kbps



910 kbps

2011

2012

2013

2014

2015년

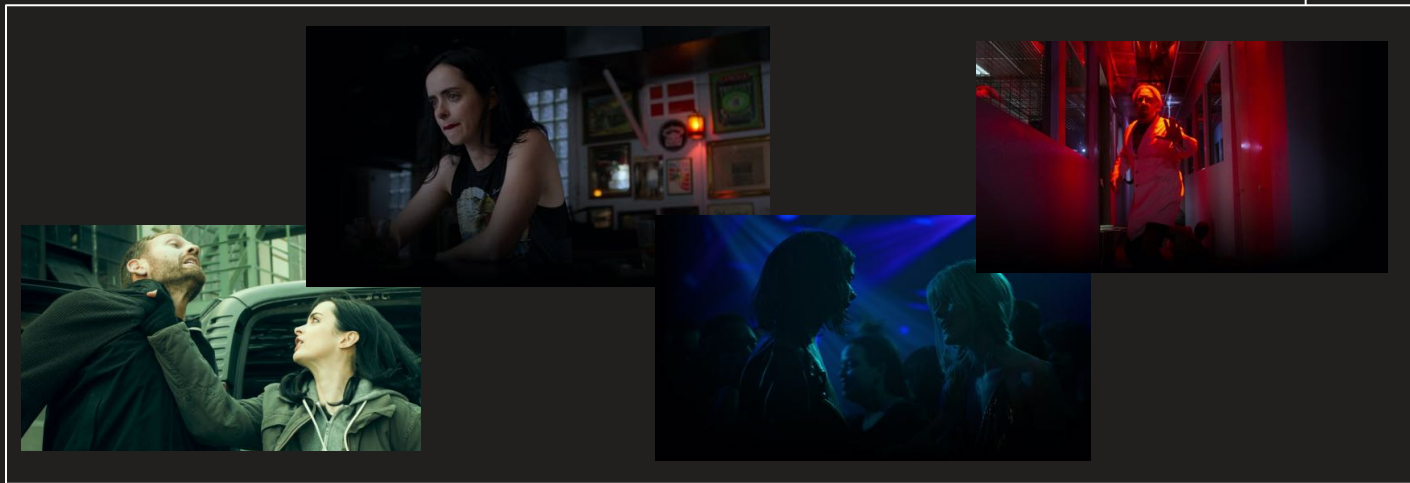
2016

2017

2018

# 장면당 인코딩 구분

Per-shot encoding



2011

2012

2013

2014

2015

2016

2017

2018년



## 장면에 가장 최적화된 인코딩 방식 선택

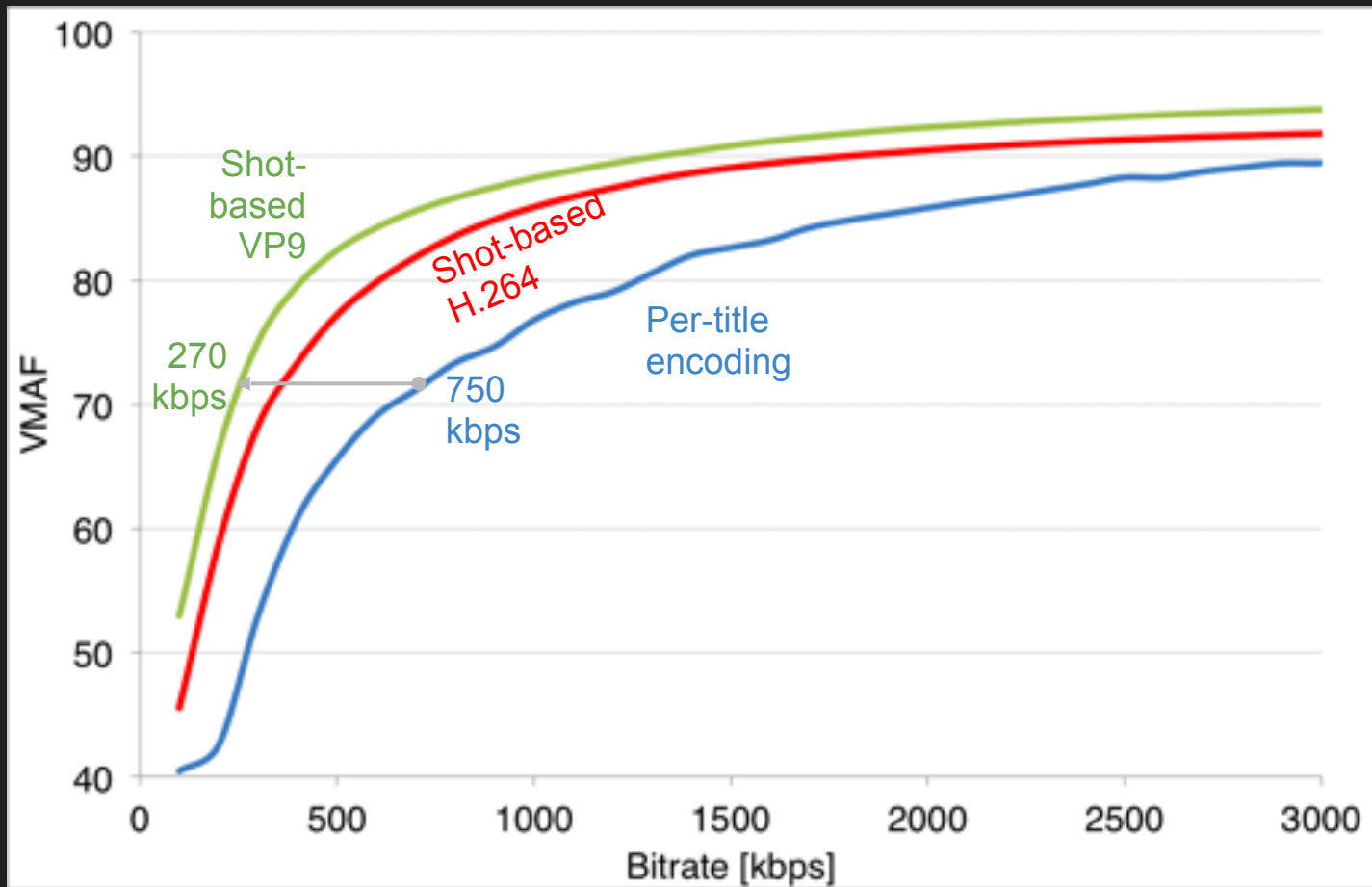
Select the best encoding recipe **per-shot**

## 최상의 화질을 위한 비트 할당

Allocate the bits optimally to achieve the best overall quality

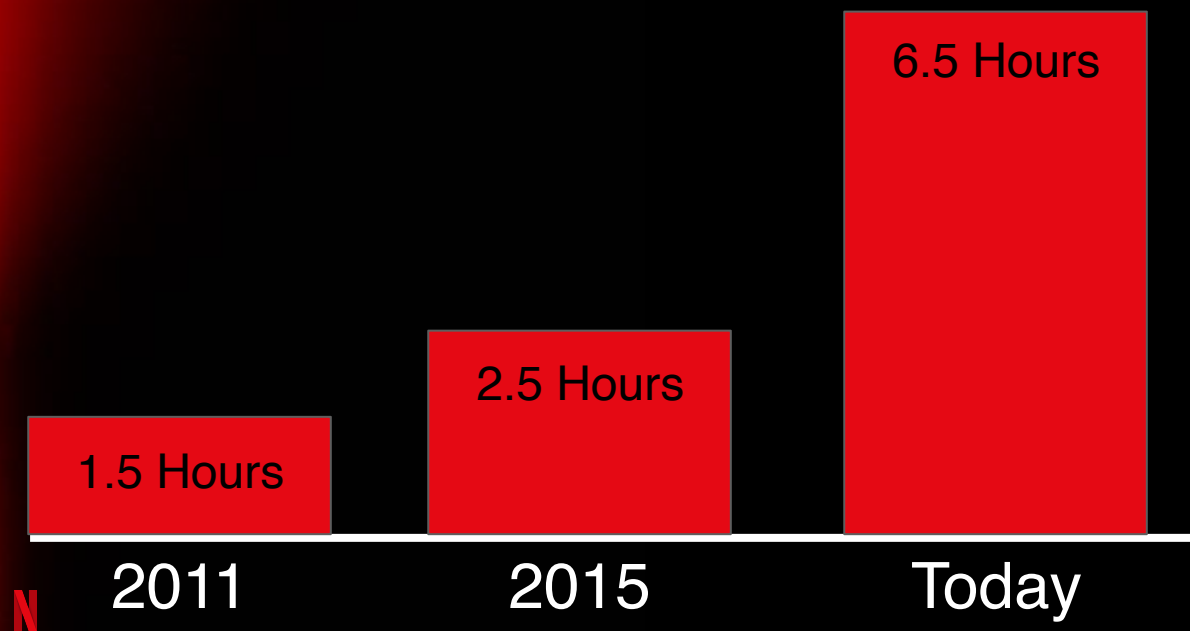
## 화질은 같은 수준으로, 대역폭 사용은 64% 절감!

64% less bandwidth for the same quality



64% less bits for the same quality

# Hours of Netflix content in 1GB of data



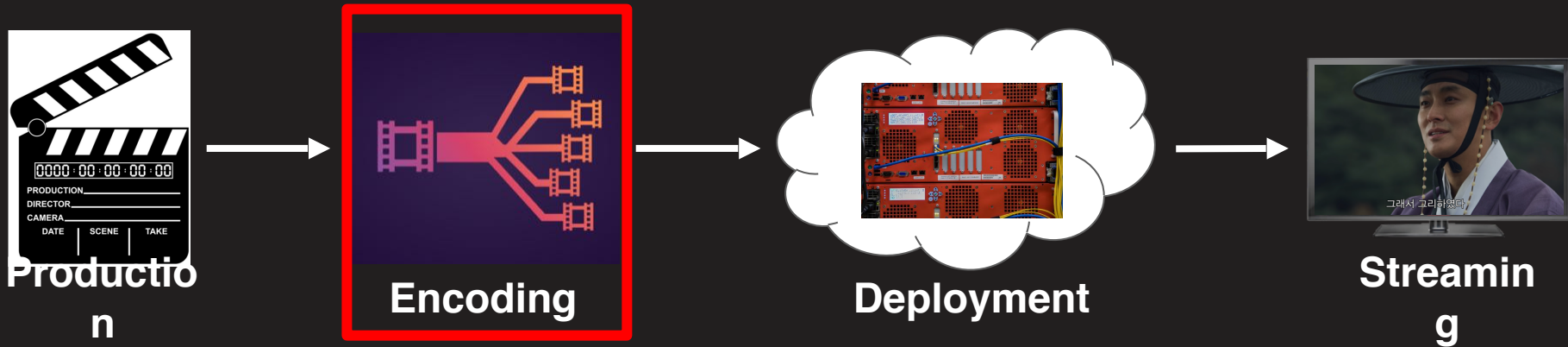
8 episodes !



Coming soon ...



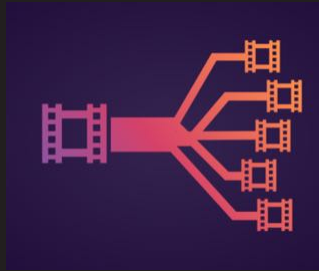
# The building blocks of the Netflix streaming experience



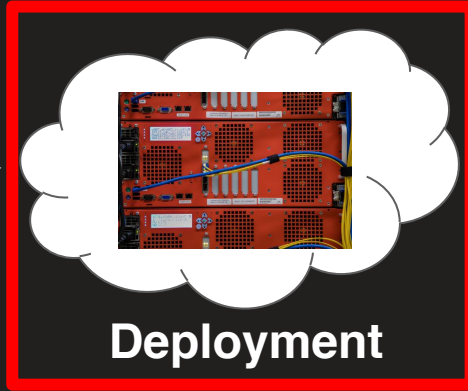
# The building blocks of the Netflix streaming experience



Production  
n



Encoding



Deployment



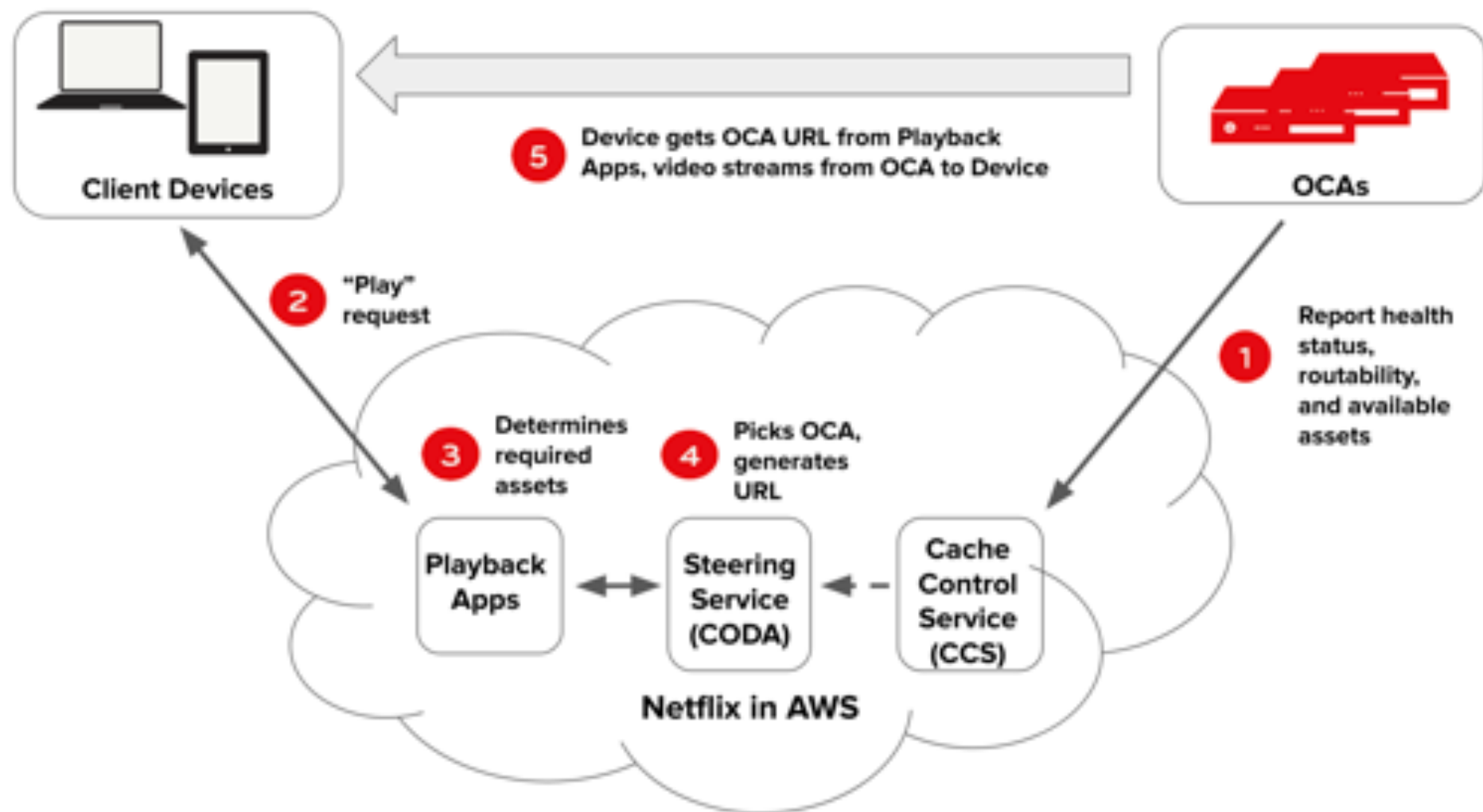
Streaming  
g

# Global Netflix Delivery Architecture



**NETFLIX**

**Open Connect**

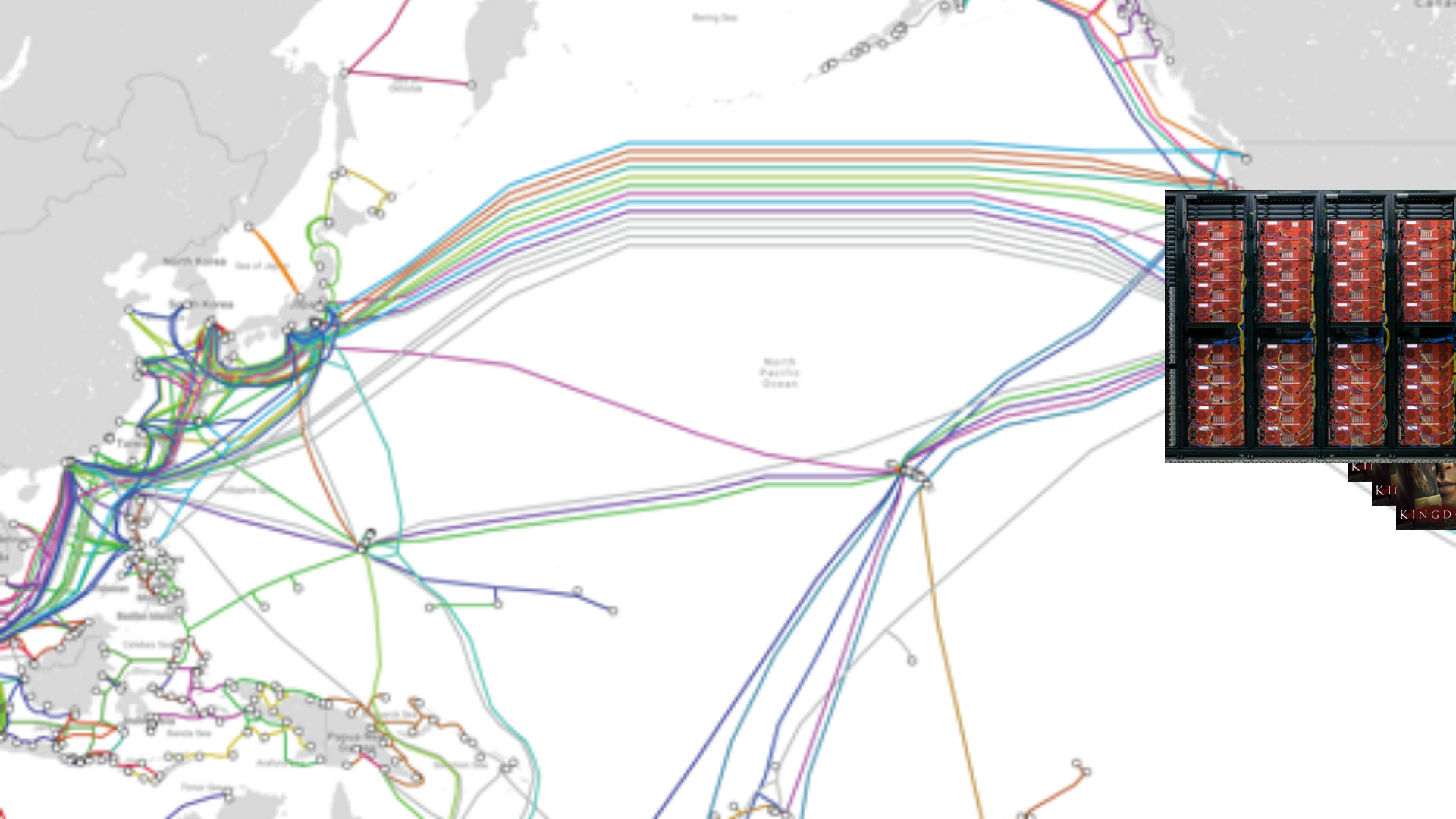


## servers (OCA)

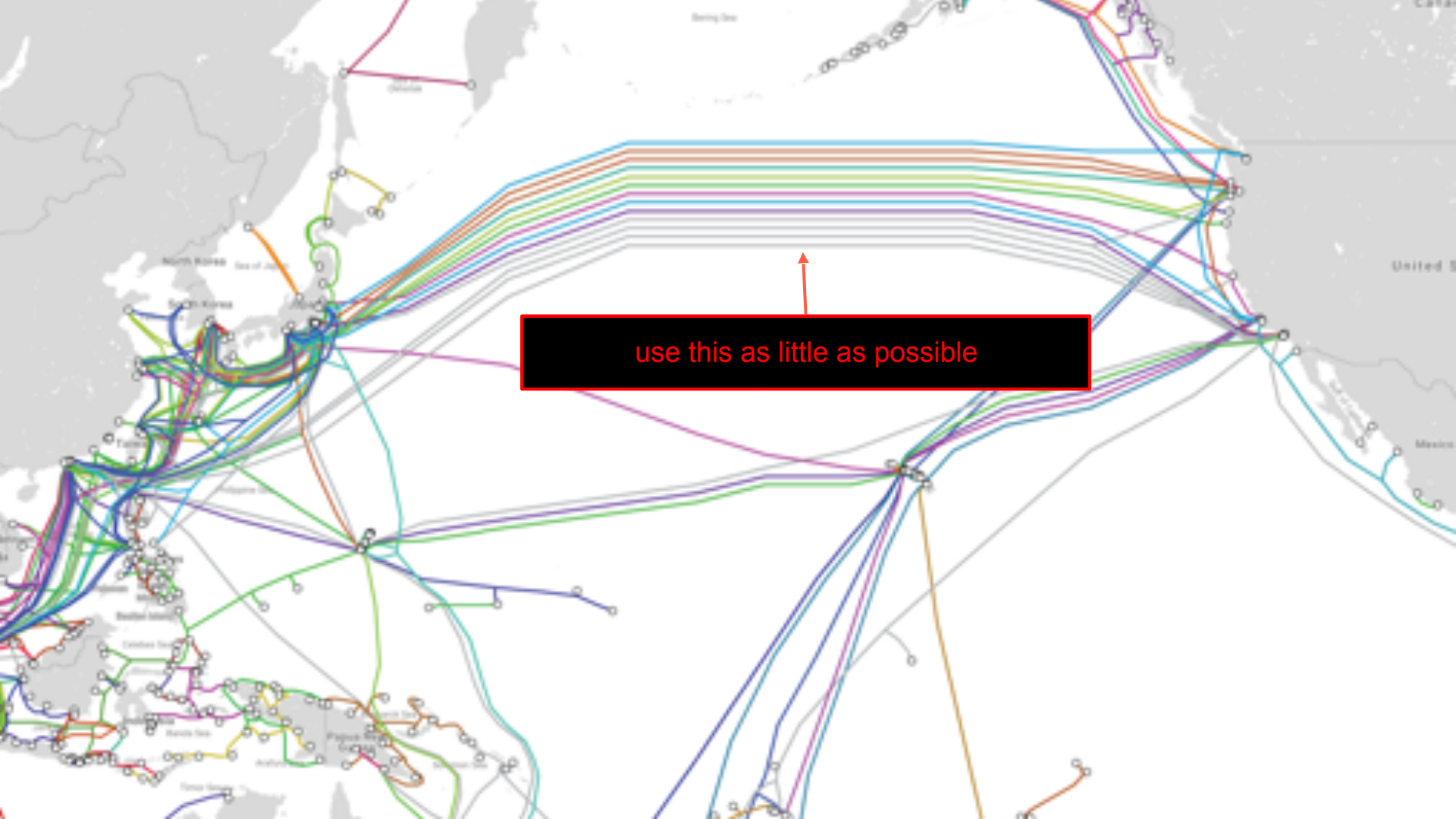


## networks









use this as little as possible





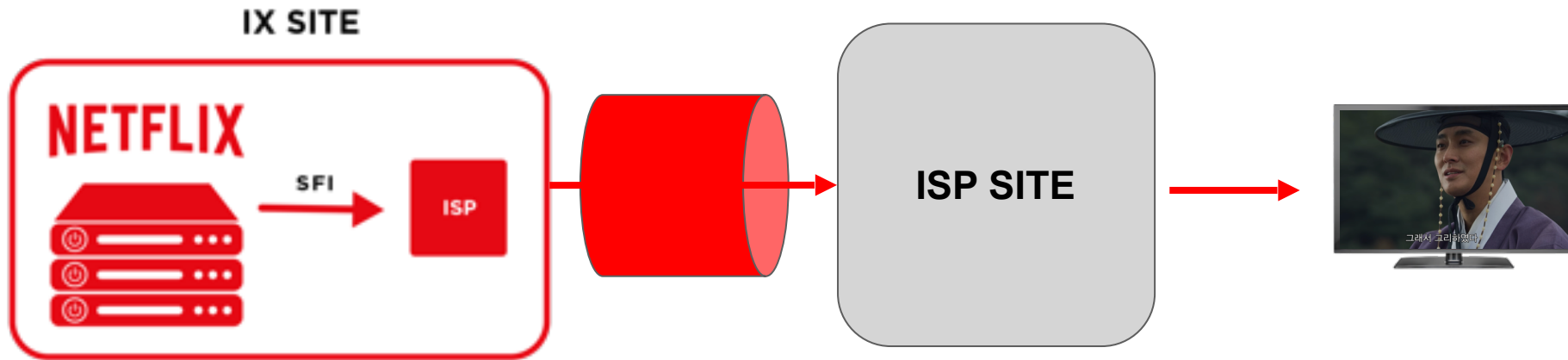


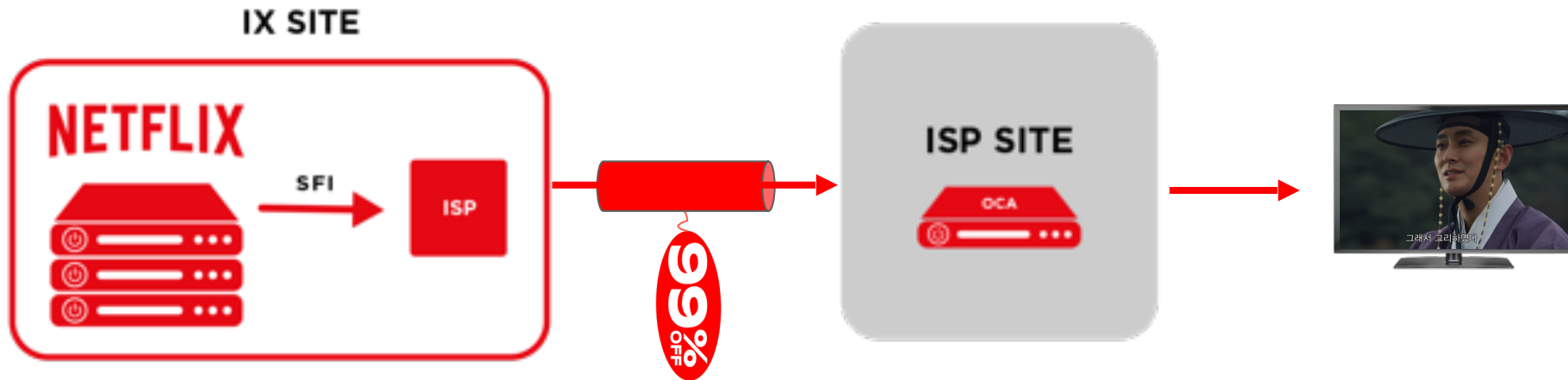
Order of 100 globally



Order of 10,000 globally



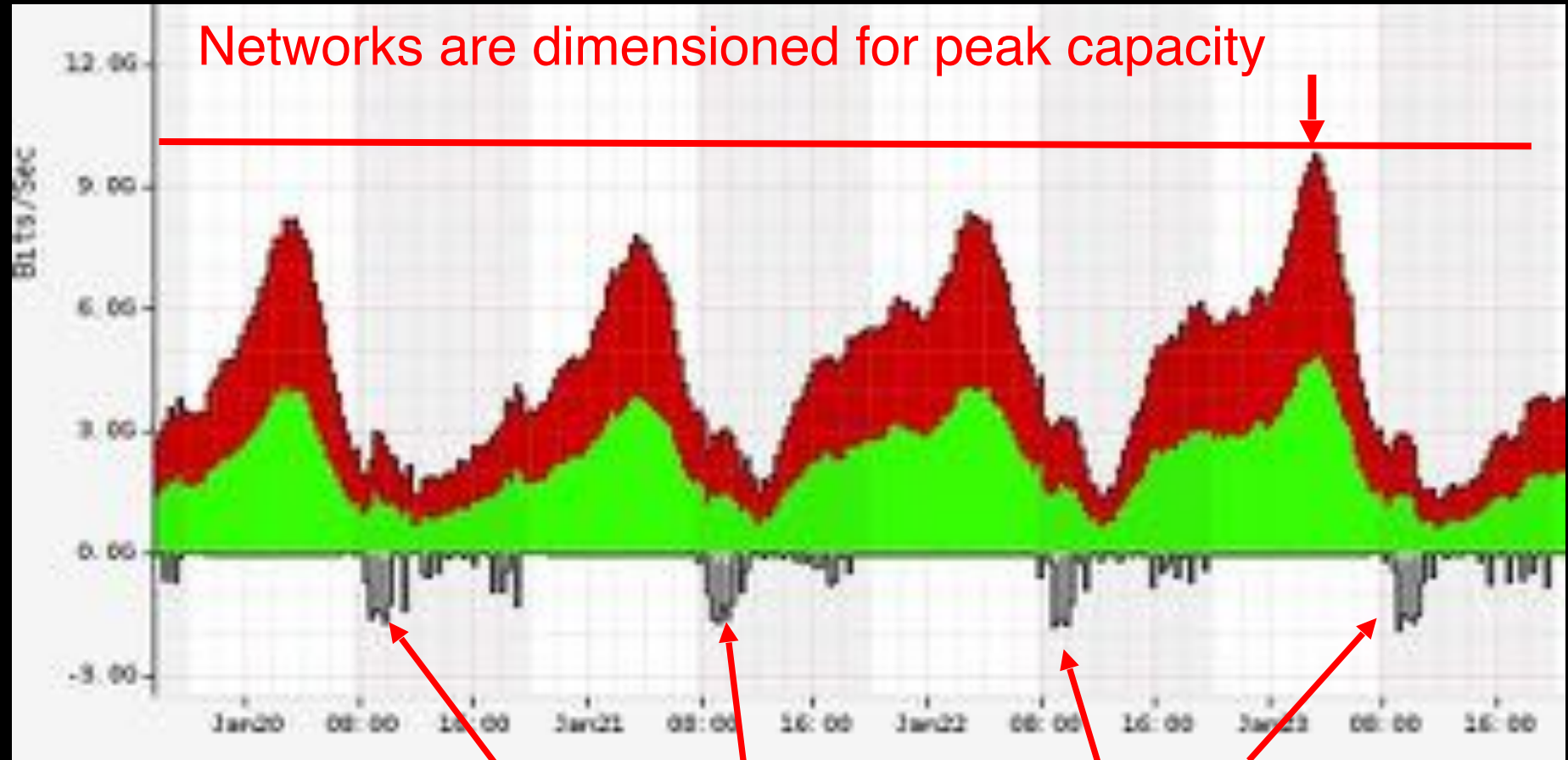






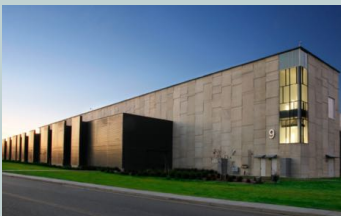
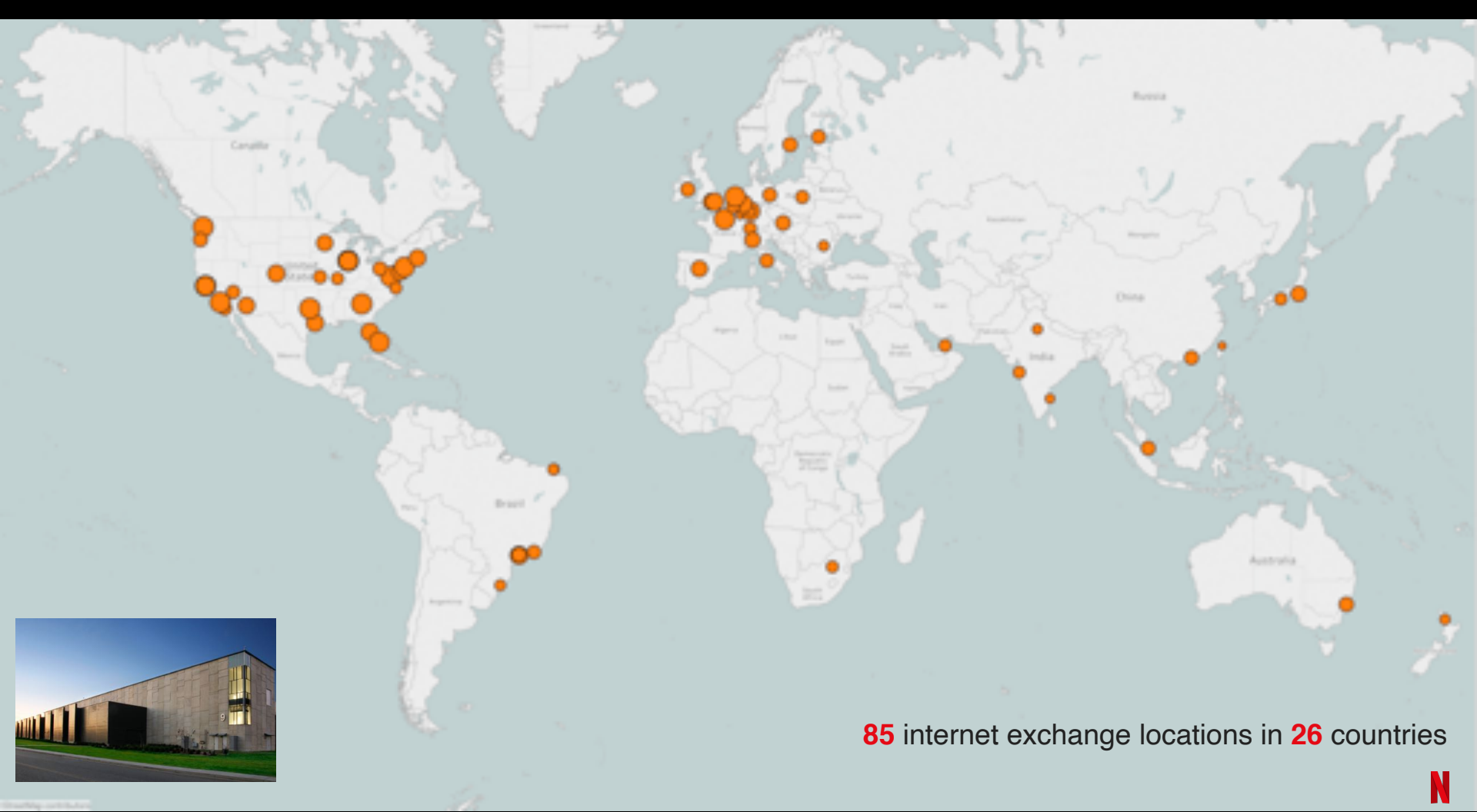
caches fill while you sleep

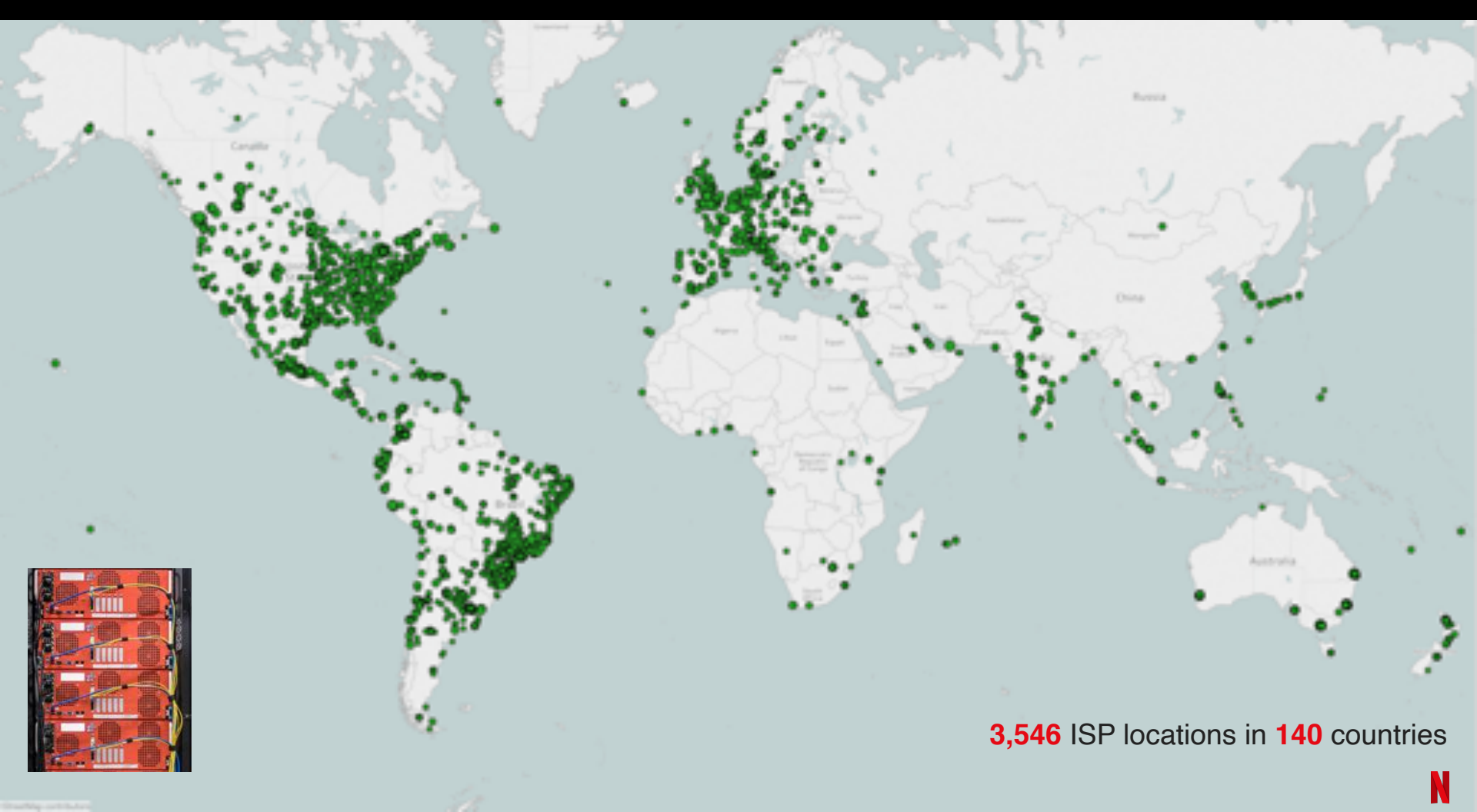
Networks are dimensioned for peak capacity



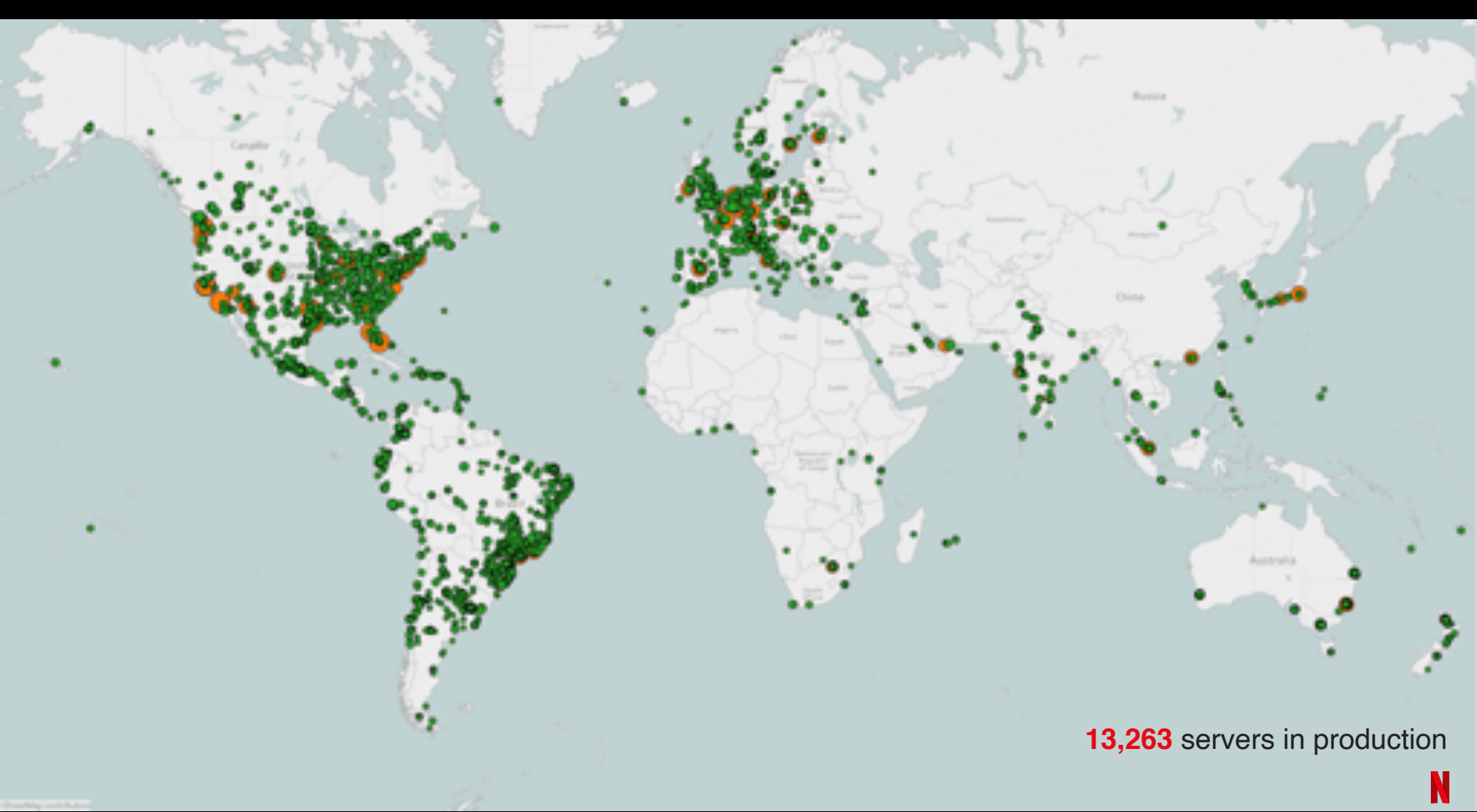
Off-peak cache fill means no need for additional





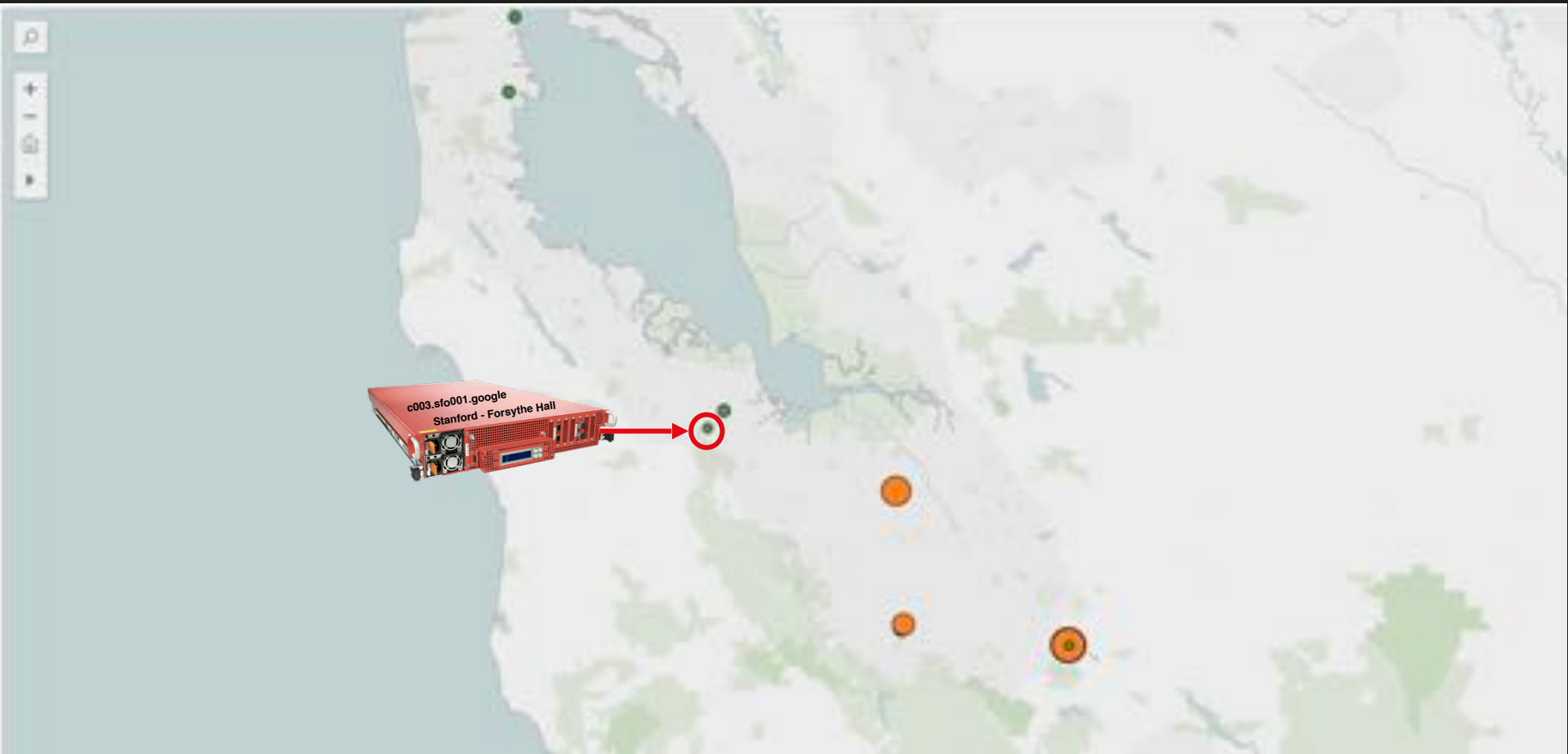




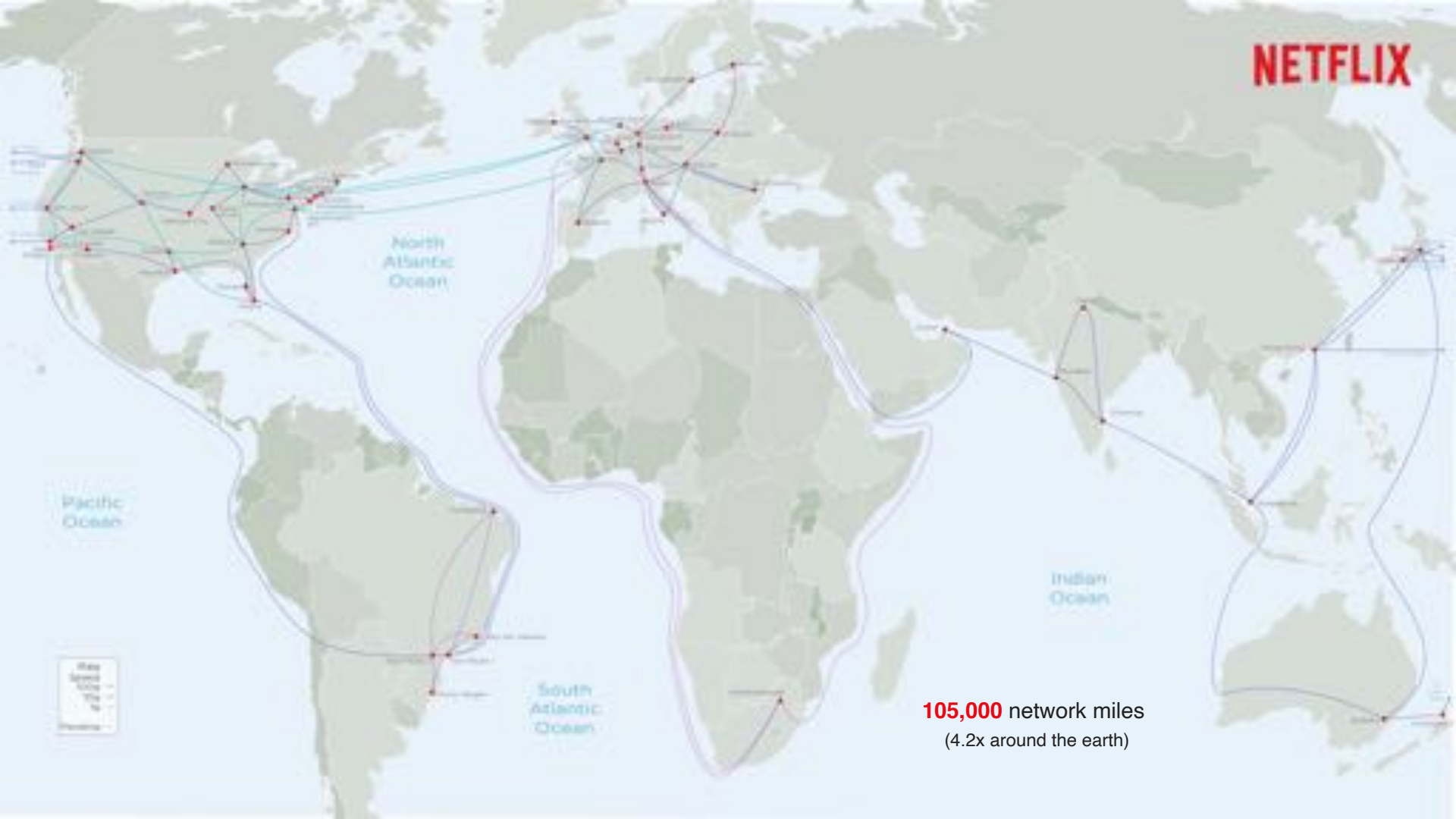


13,263 servers in production



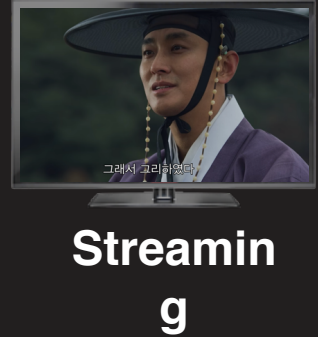
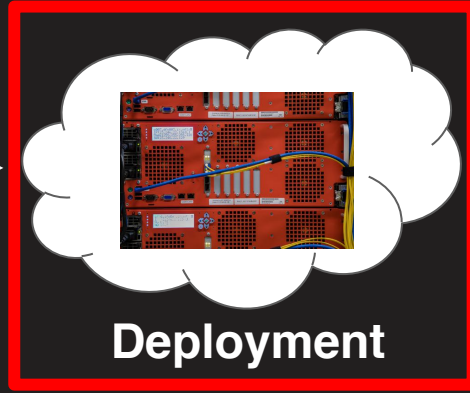
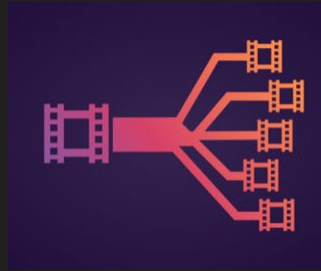


# NETFLIX

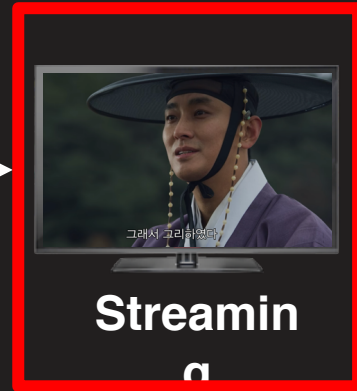
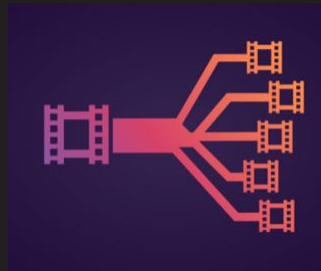


**105,000** network miles  
(4.2x around the earth)

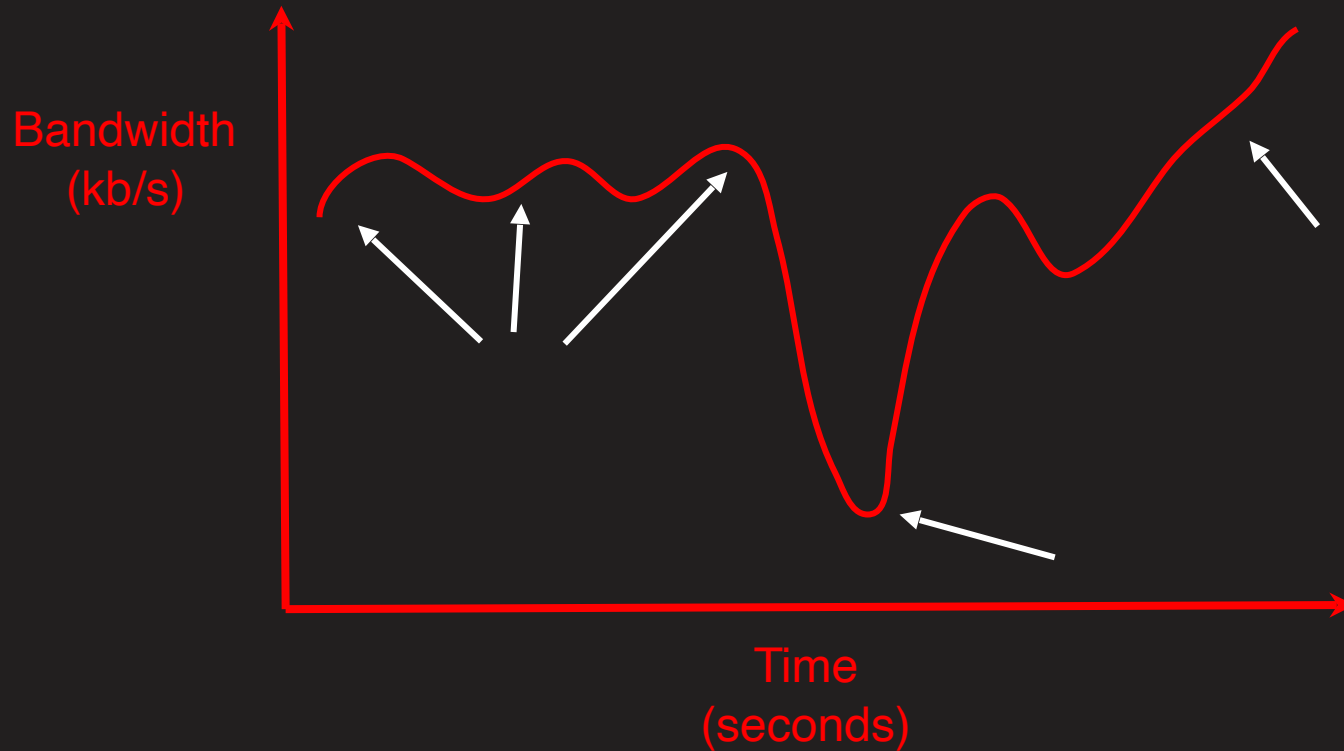
# The building blocks of the Netflix streaming experience



# The building blocks of the Netflix streaming experience



# Network conditions change



playdelay

adaptive  
streaming  
engine

video quality

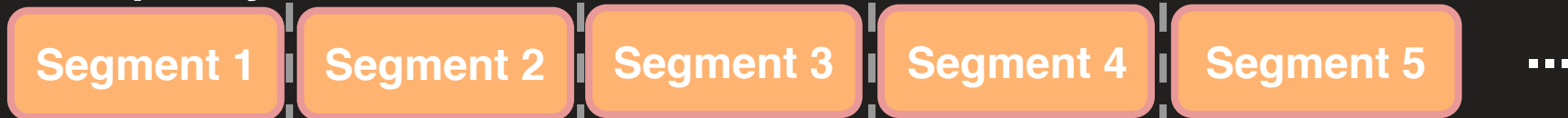
rebuffer risk

# Adapt video quality based on changing conditions

High quality



Mid quality

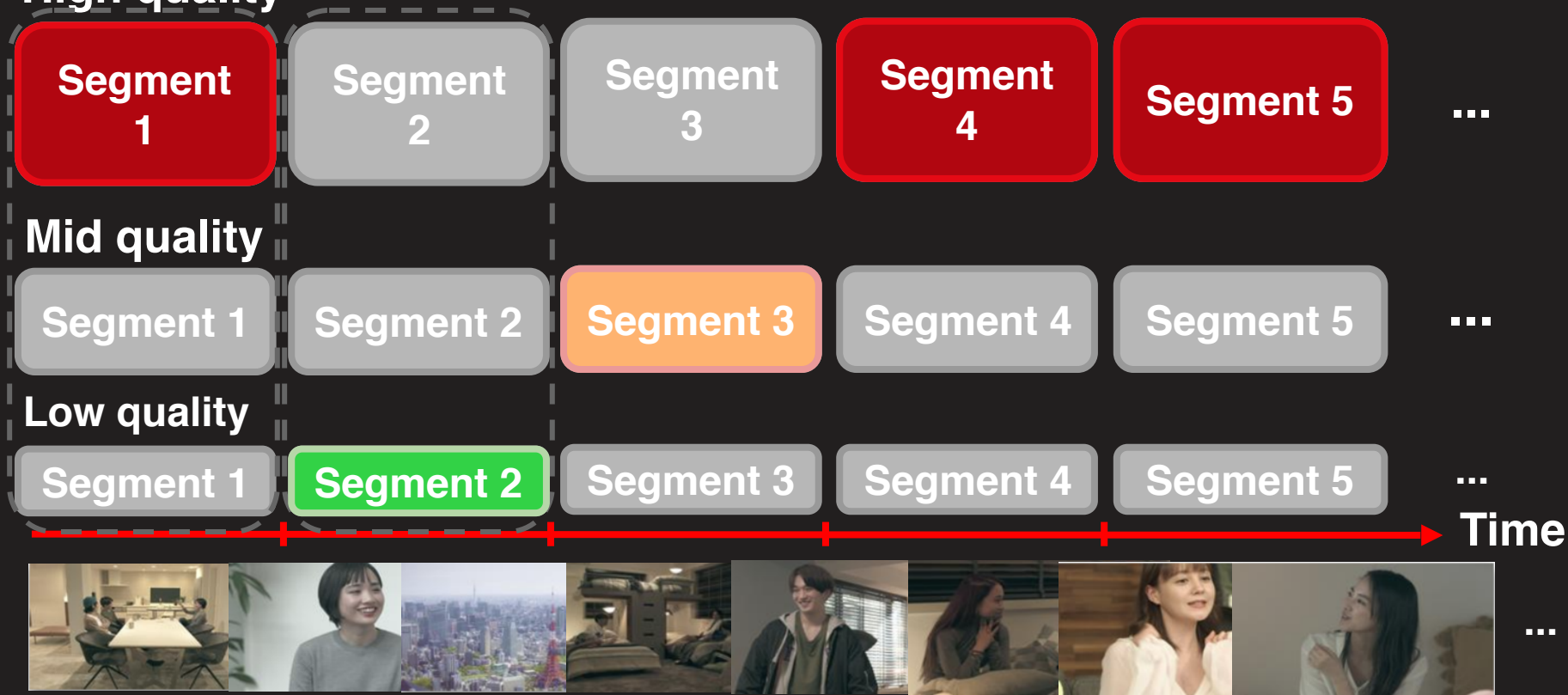


Low quality





# Adapt video quality based on changing conditions



# Adapt video quality based on changing conditions

## Resulting experience



**tips and tricks**



Ctrl+Alt+Shift+D

Version: 6.0012.638.011  
Eid: NFDCH-MC-ETZVTXGXUCT3YUMFJAN9HPPPCWSP  
PBCID: 6.NJRWUgweyP6fTgoXZ41-4J0SSJu7\_Jby6188G0  
UserAgent: Mozilla/5.0 (Macintosh; Intel Mac OS X 10\_14\_0) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/72.0.3626.109 Safari/537.36

MovieId: 80212130  
TrackingId: 13752289  
Xid: 15510496084593 (15510496084593)  
Position: 121.433  
Duration: 3672.000  
Volume: 100%

Player state: Normal  
Buffering state: Normal  
Rendering state: Playing

Playing bitrate (av): 96.2260 (1280x720)  
 Playing/Buffering vmaf: 91/91  
 Buffering bitrate (av): 96 / 2260  
 Buffer size in Bytes (av): 3167688 / 63528369  
 Buffer size in Bytes: 66696037  
 Buffer size in Seconds (av): 246.951 / 226.915  
 Current CDN (av): c032.sco005.ix.nflvideo.net, id: 48030 / c032.sco005.ix.nflvideo.net, id: 48030

Audio Track: en, Id: A:1:1:2,en:1, Channels: 2.0, Codec: audio/mpeg,codecs=mp4a.40.2  
Video Track: Codec: video/mpeg,codecs=avc1.640028 (avc)  
Timed Text Track: en, Profile: stpl-srt, Id: T:1:0:1,en:1,1

FrameRate: 23.977  
Current Dropped Frames: 0  
Total Frames: 1335  
Total Dropped Frames: 5  
Total Corrupted Frames: undefined  
Total Frame Delay: undefined  
Main Thread stallwac: DISABLED  
VideoDialog: readyState=4,currentTime=121.579334,gbRate=1,audioBuffered=48.000,audioRanges=96,128-144,127999,video=24,024,videoRanges=116,116-140,139999,duration=1672.1920,exp=1551092817000,keyStatus=unusable

Throughput: 163835 kbps

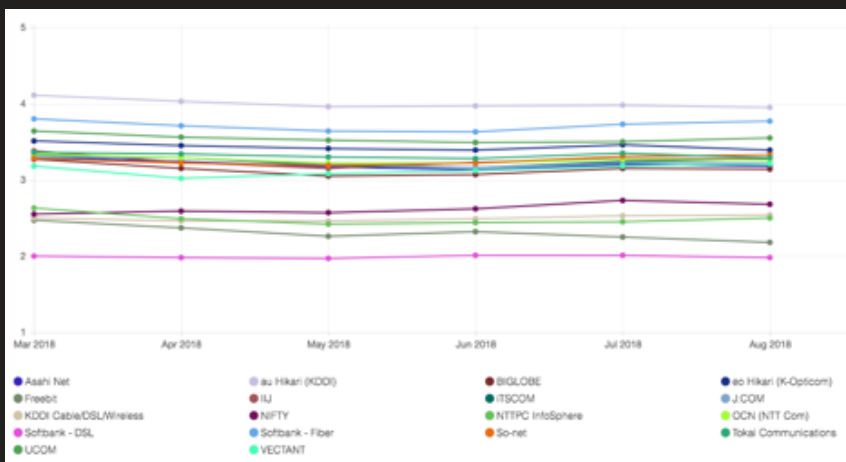
[illegible]

# NETFLIX ISP SPEED INDEX

ENTER LOCATION

Enter country or region

OR SELECT FROM THE MAP BELOW



EXPAND YOUR REGION FOR A PERFORMANCE OVERVIEW

EUROPE - MIDDLE EAST - AFRICA



AMERICAS



ASIA-PACIFIC



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fast.com



questions?





A dark silhouette of an elephant is the central focus. On its back sits a small industrial factory with two tall smokestacks. Thick smoke billows from the stacks into the dark, hazy background. A small human figure is walking to the right, holding a rope that is attached to the elephant's trunk. The overall scene is a metaphor for the environmental impact of industry.

고맙습니다!  
Thank you!