



Content Delivery Summit

May 2013

# Netflix Content Delivery

- Brief History
- Open Connect
- Common misconceptions

# Netflix

- Launched streaming service in January of 2007
- More than 36 million members
- 40 countries
- More than 1 billion hours per month
- 33% of downstream internet traffic in the US during peak hours
- Multiple terabits per second

# The First Evolution of Netflix Content Delivery

- Built our own 5 POP domestic CDN for launch in 2007
- Original CDN used anycast for geolocation and had all content in each pop
- Successfully scaled to hundreds of gigabits
- Decided to move to 3<sup>rd</sup>-party CDNs in 2008/2009 for two reasons
  - CDN pricing came into line with transit
  - We realized the value of autonomous, intelligent clients coupled with simple HTTP delivery

# The Evolution of Netflix Clients

- We created our own adaptive bitrate algorithms to adapt to changes in throughput
- We created our own CDN selection algorithms to adapt to changing network conditions
  - Overloaded links
  - Overloaded servers
  - Errors
- The “control plane” (Netflix services running in AWS) increased in sophistication over time
  - Authentication/Device Registration
  - Content selection/Dynamic user interfaces
  - Content routing

# The Second Evolution of Netflix Content Delivery

- Mid-2011 – we realized our scale warranted a dedicated solution to maximize network efficiency
- We created Open Connect, a Netflix-specific, specialized content delivery system – launched June 2012
- Open Connect is provided at no cost to ISPs
- Open Connect is the most efficient way to deliver Netflix content to ISP subscribers

# Open Connect

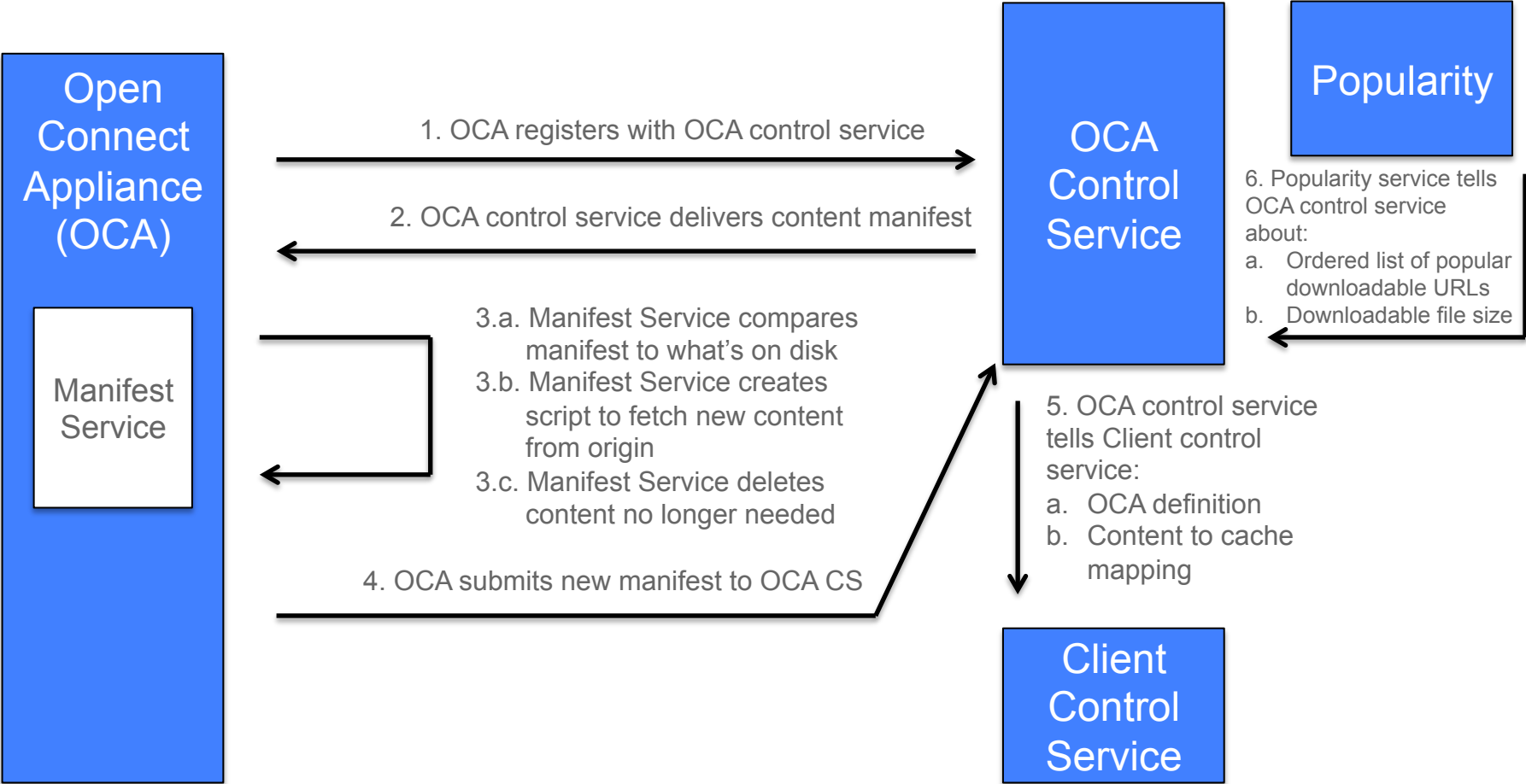
- Known set of users + known set of content = simplified content delivery
- Combines ISP routing information with Netflix content routing to create a robust, extensible layer 3-7 routing engine
- Owning server + client logic allows us to optimize streaming performance
- Proactive caching

# Advantages of Proactive Caching

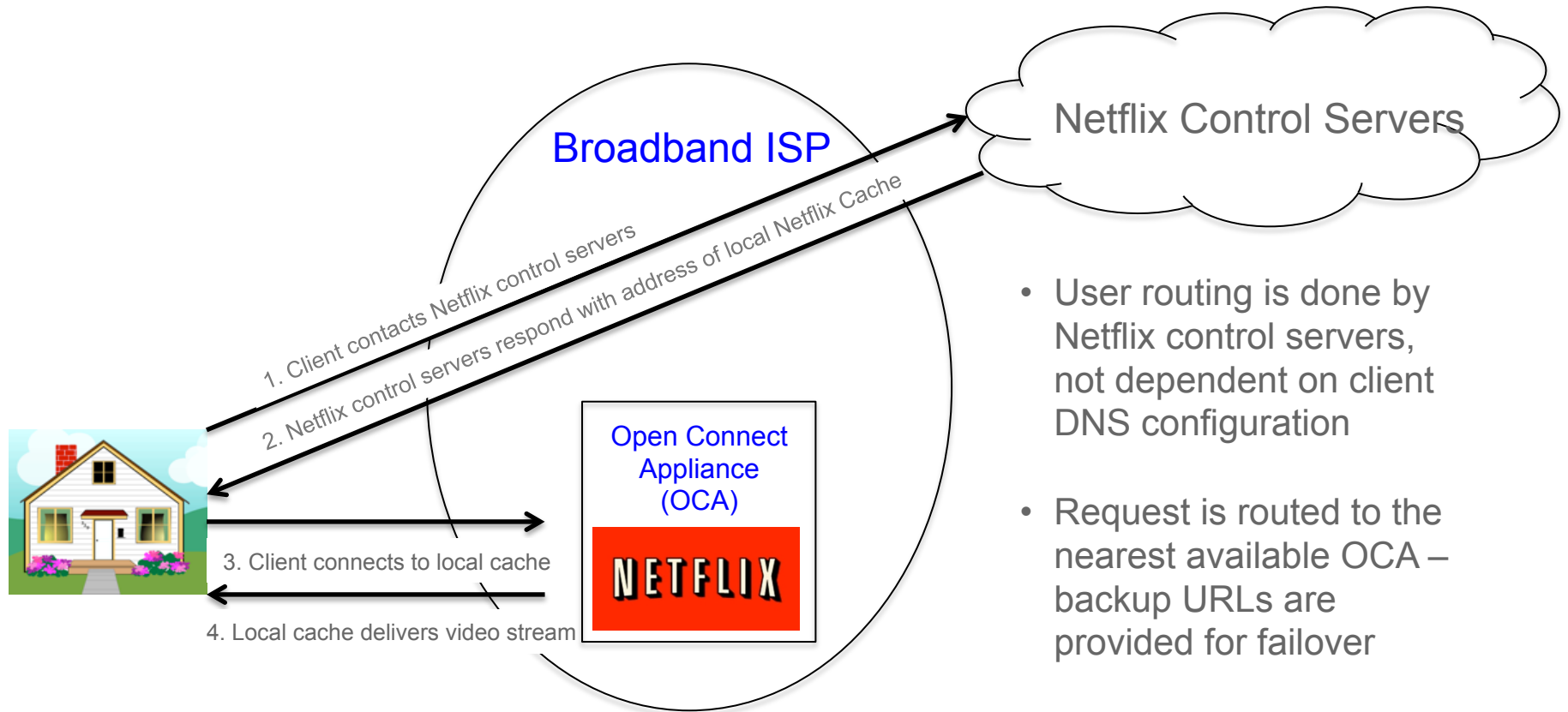
- Off-peak pre-population of content within ISP networks
  - Dramatically reduces upstream network utilization at peak times (75-100%)
  - Removes the need for ISPs to scale transport / IX links for Netflix traffic
- Central popularity calculation is more accurate than a cache or proxy trying to guess popularity based on requests it sees
- Appliances are simple web servers that know how to store files and report on health, 100% utilized and optimized for throughput



# Content Flow – Open Connect Appliance (OCA)



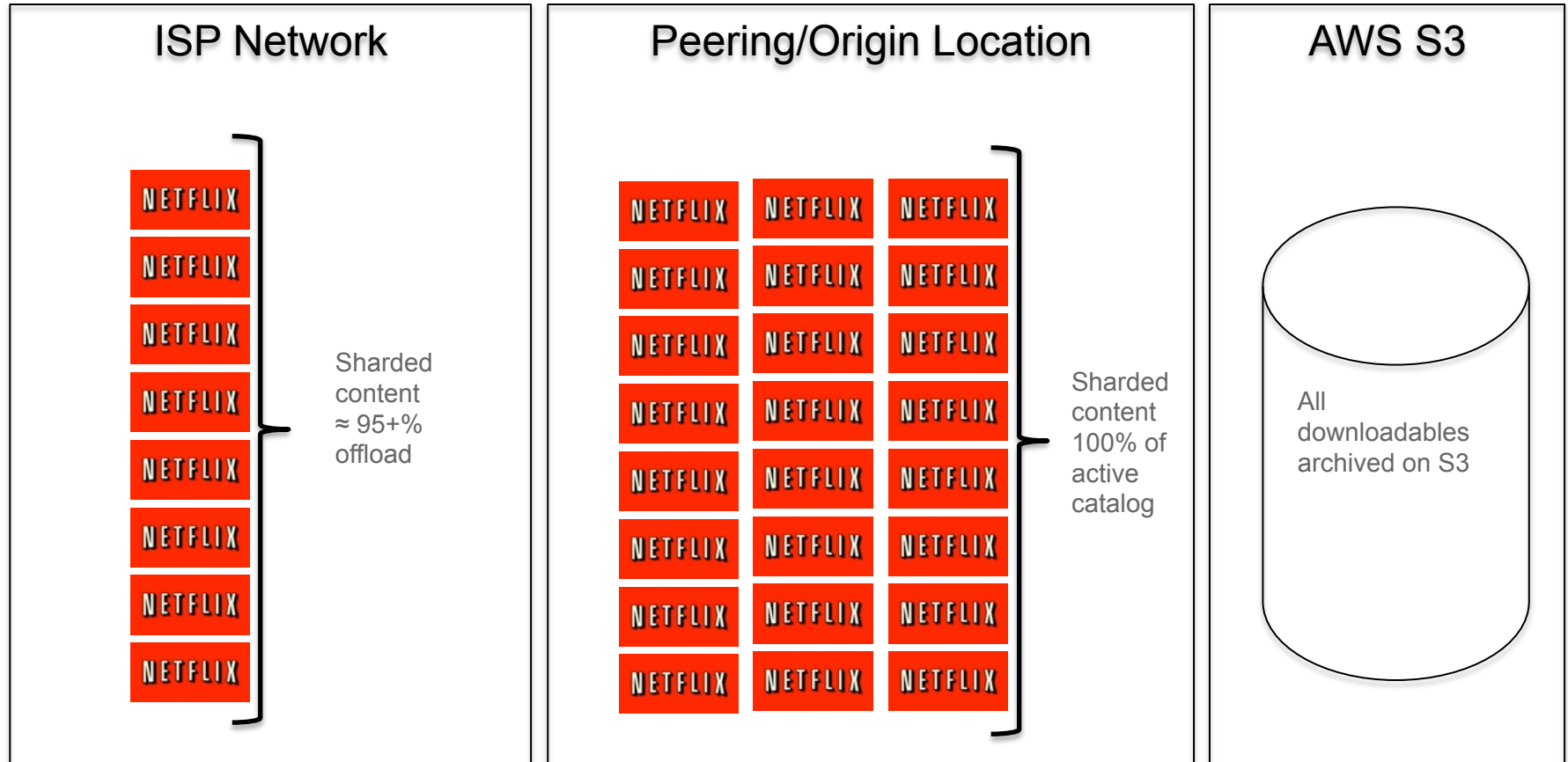
# Directing Clients to Caches



- User routing is done by Netflix control servers, not dependent on client DNS configuration
- Request is routed to the nearest available OCA – backup URLs are provided for failover
- ISP controls client to OCA mapping/clustering/failover via BGP

# Three Tier Architecture

Cache hardware is identical in each tier – different manifests create different roles



# Open Connect Servers

- Purpose-Built hardware and software
- Low power, high density
  - >12Gb/s, 4U, 500W for basic Open Connect Appliance
  - 1 tpbs/rack at densest locations
- Open Source Software
  - BSD
  - nginx
  - BIRD (BGP)
- Open Hardware Spec

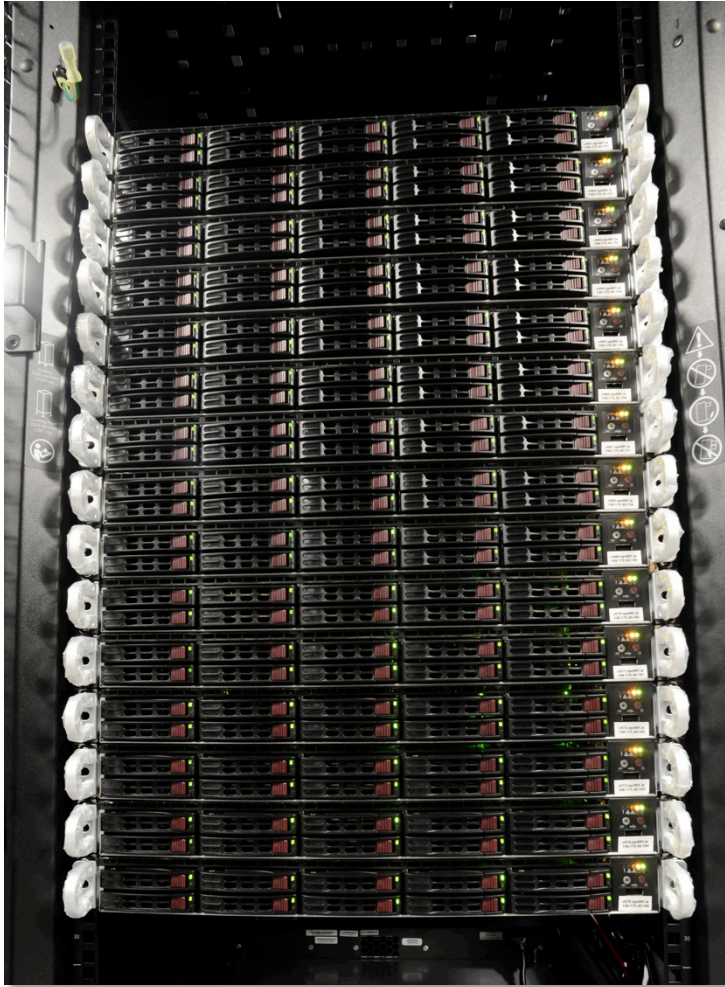


# Open Connect Appliances – Spinning Drives



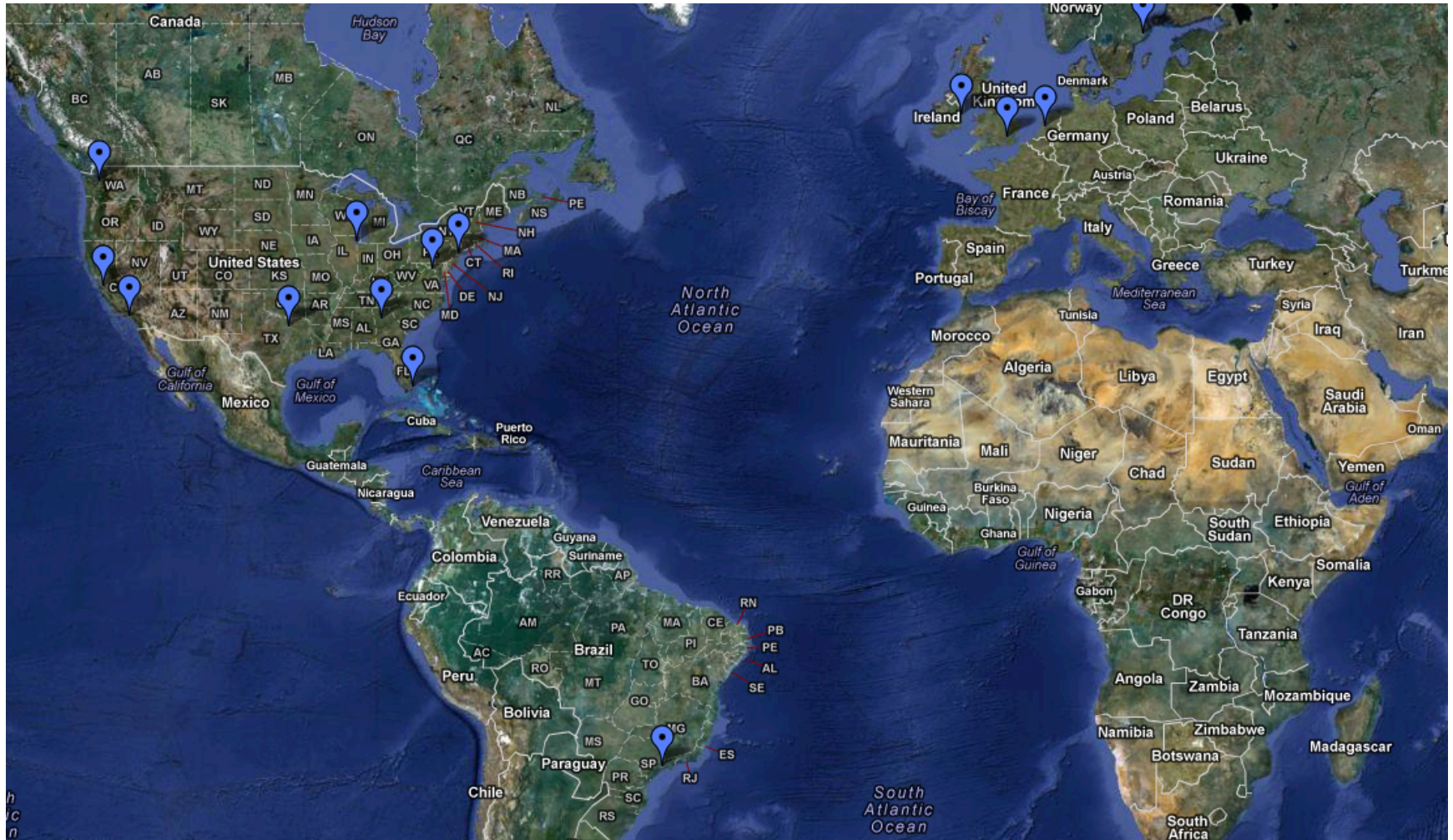


# Open Connect Appliances – Flash Drives





## 21 Global Pops



# Advantages to ISP Partners

- Open Connect is free and easy to implement
  - We work with ISPs to plan deployment
  - We provide servers free of charge
  - Open Connect offload gives back 33% of upstream capacity
- Partners are able to deliver a valued service their subscribers at higher quality with reduced cost
- Working with Open Connect allows ISPs to market a differentially better service than their competitors who do not
  - SuperHD, 3D
  - Fewer interruptions



# Common Misconceptions about OTT Delivery

- Internet-based delivery can never scale to current cable viewership levels
- Internet-based delivery is less efficient
- Internet-based delivery offers inferior picture quality

# Scaling OTT Delivery

- Middle-mile and long haul bandwidth don't need to scale to make Netflix work (we don't use the “internet backbone”)
- Current last-mile bandwidth is more than sufficient for SuperHD streams
  - When we started, our max stream was equal to or greater than most people's max bandwidth
  - Now, our max stream is less than 1/3 of most people's max bandwidth

# OTT Advantages

- IP delivery supports what users want – rich content recommendation, selection and playback on their schedule
- IP delivery allows for rapid iteration/ improved quality – we can re-encode our entire catalog in a couple of weeks – vs years for fixed standards
- Since inception, we've been on a great trend of delivering higher quality streams at lower bitrates, and we expect that trend to continue

# OTT Audio/Visual Quality

- We currently serve SuperHD, 3D, HD – 1080p, 5.1
- We'll be first with UltraHD delivery
- Current global library of transcoded files >3 petabytes

# Other Alternatives

- Proxies – we've seen many instances of poor Netflix performance caused by proxies
  - Play delay
  - Rebuffers
  - Low bitrates
  - Proxies require constant reverse engineering to keep up with changes to the Netflix service
  - Multiple cases of “bad” proxies breaking the service
- Internal ISP CDN / Virtual Machine
  - Not optimized for Netflix (we use 100% of hardware resources on Open Connect boxes)
  - Insufficient storage (we shard content across hundreds of terabytes of storage)
  - Impractical for Netflix to integrate with hundreds of different internal CDNs

# Questions?

<http://openconnect.netflix.com>

