Traffic delivery evolution in the Internet
ENOG 4 – Moscow – 23rd October 2012

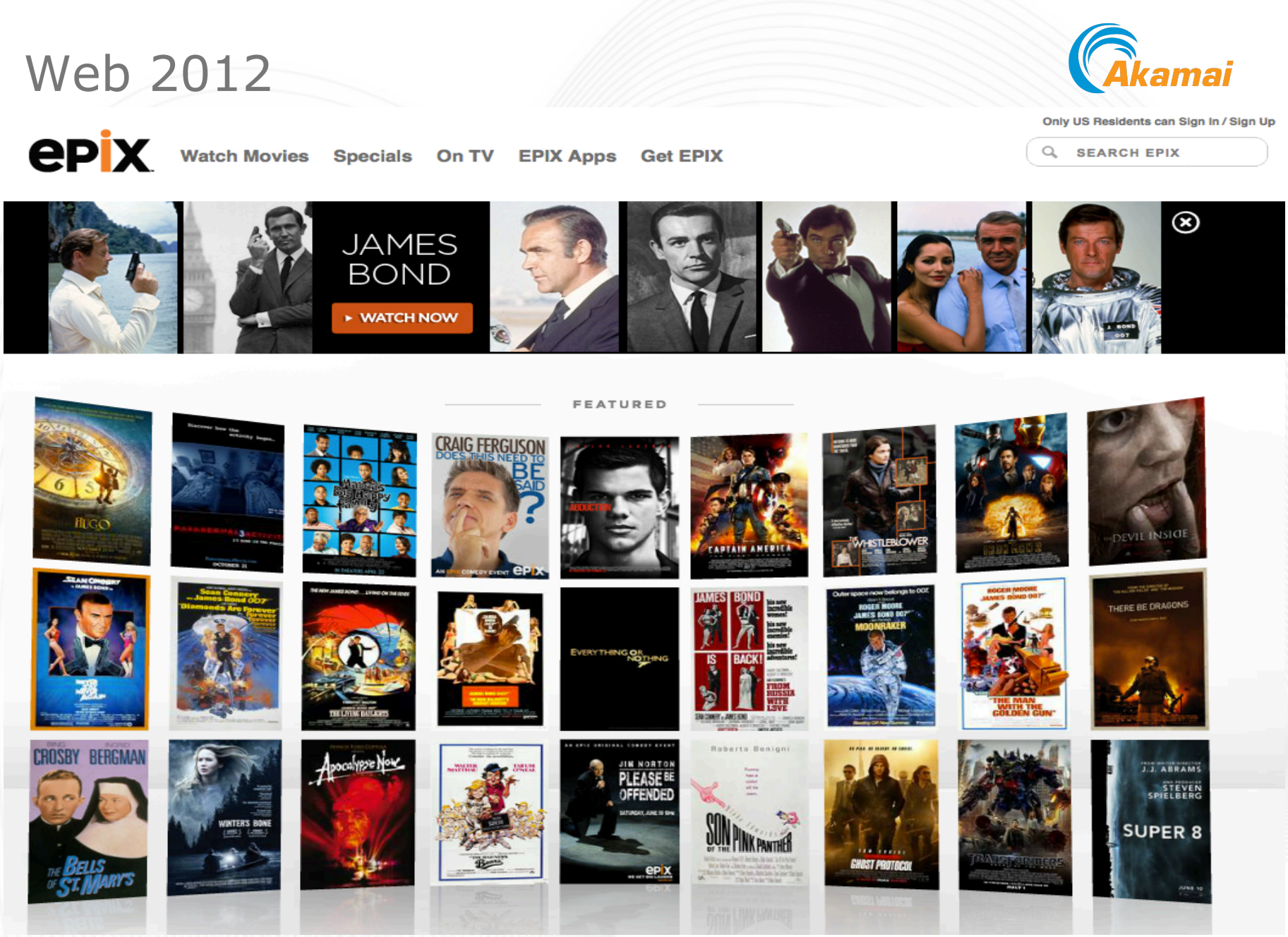
Christian Kaufmann
Director Network Architecture
Akamai Technologies, Inc.

way-back machine

Web 1998

Web 1998

Web 2012



Akamai

Store | Mac | iPod | iPhone | iPad | iTunes | Support

iTunes

What is iTunes | What's on iTunes | iTunes Charts | How To | Download iTunes

Entertain all the possibilities.

With iTunes in the Cloud, the music, apps, and books you purchase automatically appear on all your devices. Or you can download only the stuff you want — including movies and TV shows — to just the devices you want.[1] It's all part of iCloud and iTunes 10.7.

iTunes 10.7
For Mac + PC

Free Download

iTunes 10.7
With iCloud, everything you've bought on iTunes is now on every device you love.

So what's the difference?

- Lots of "high definition" content being pushed to end users
  - Read "large files"
- Can the Internet scale to support this?

  -> Short answer: NO

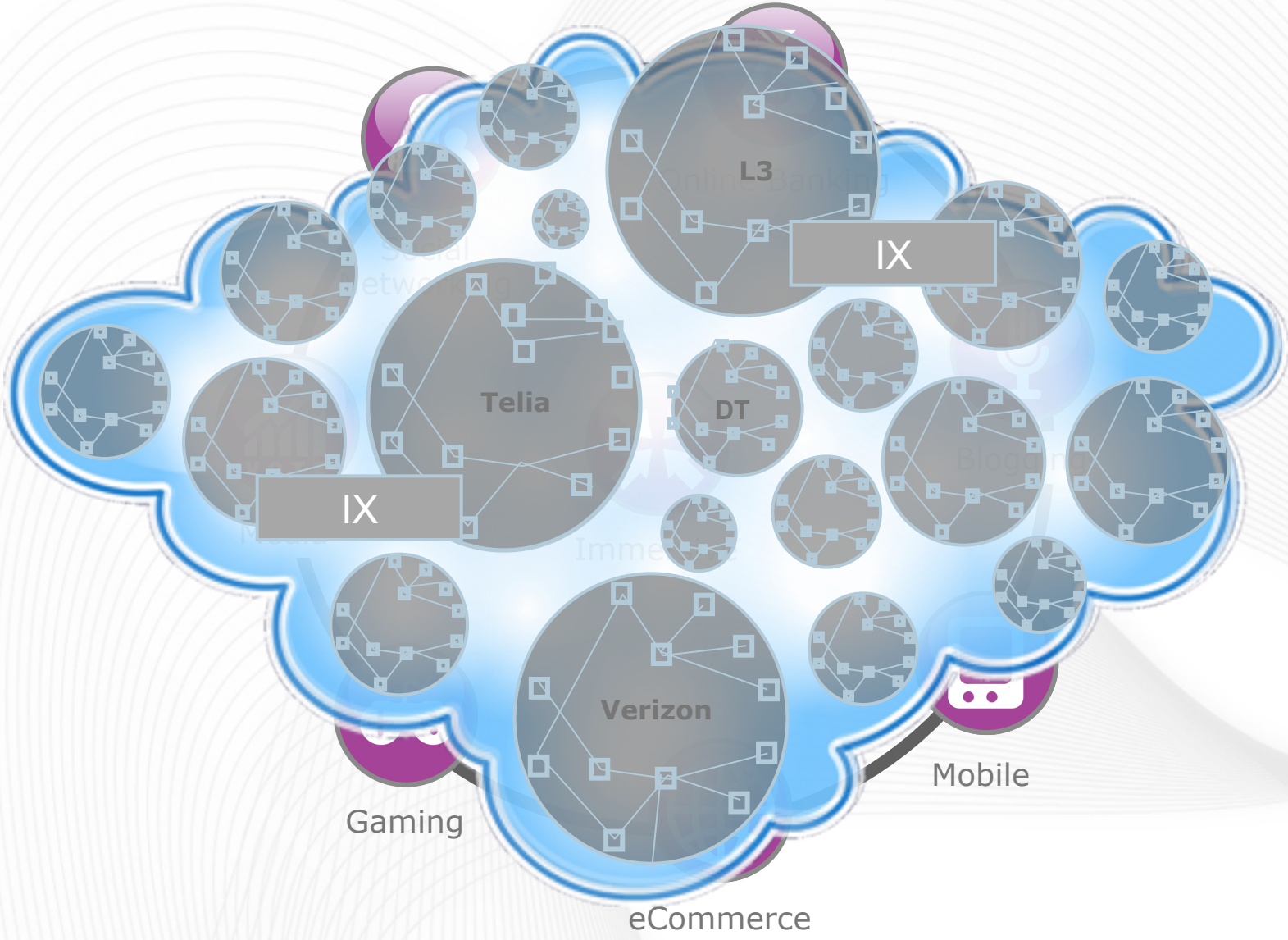
Key Issues

- Problems with a centralized approach, especially for large media files
- Problems with Peering
- Problems with routing protocols
- Inter AS Multicast not really existent
- QoS not really existent and consistent

Trends 2012

Simple on the outside …

… complicated on the inside



The Centralization Bottleneck

- Centralized sites create an inherent bottleneck and target for attackers
- Worldwide user population = huge infrastructure problem
- Not scalable
- Long latency between server and end-user

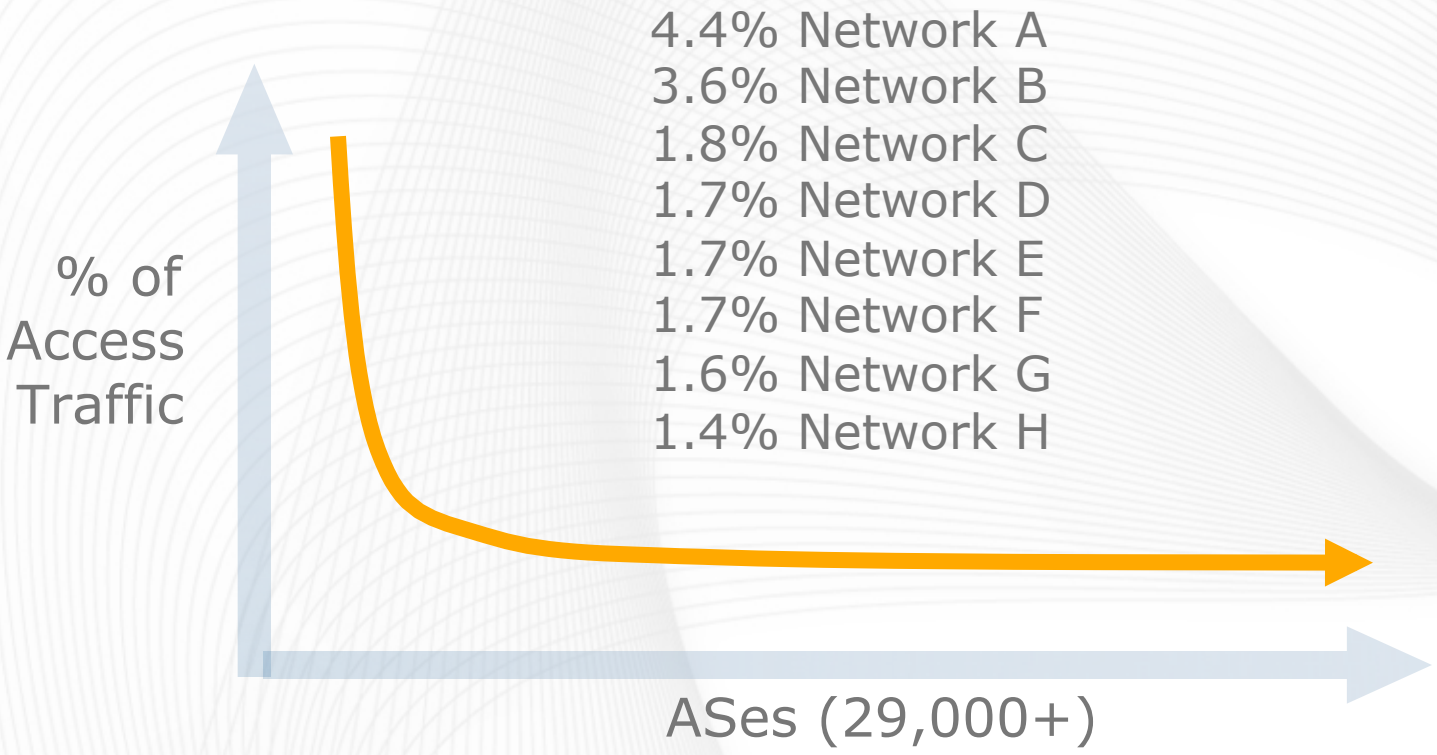
The Centralization Bottleneck

- Content Distribution Networks solve the centralization problem by *distributing content*.

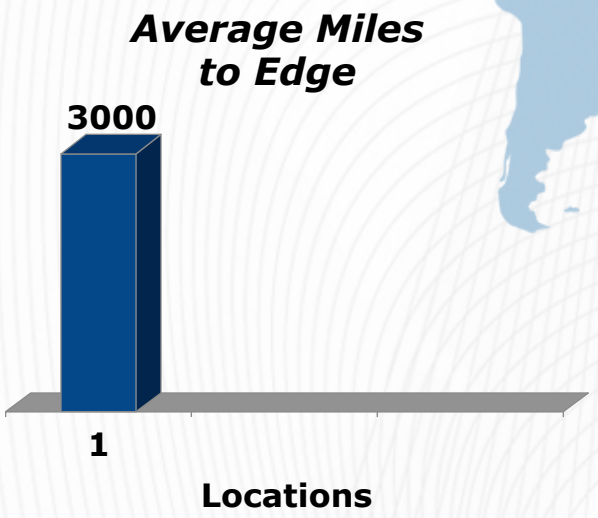
- Greater distribution means greater performance and reliability

The Edge is Highly Distributed

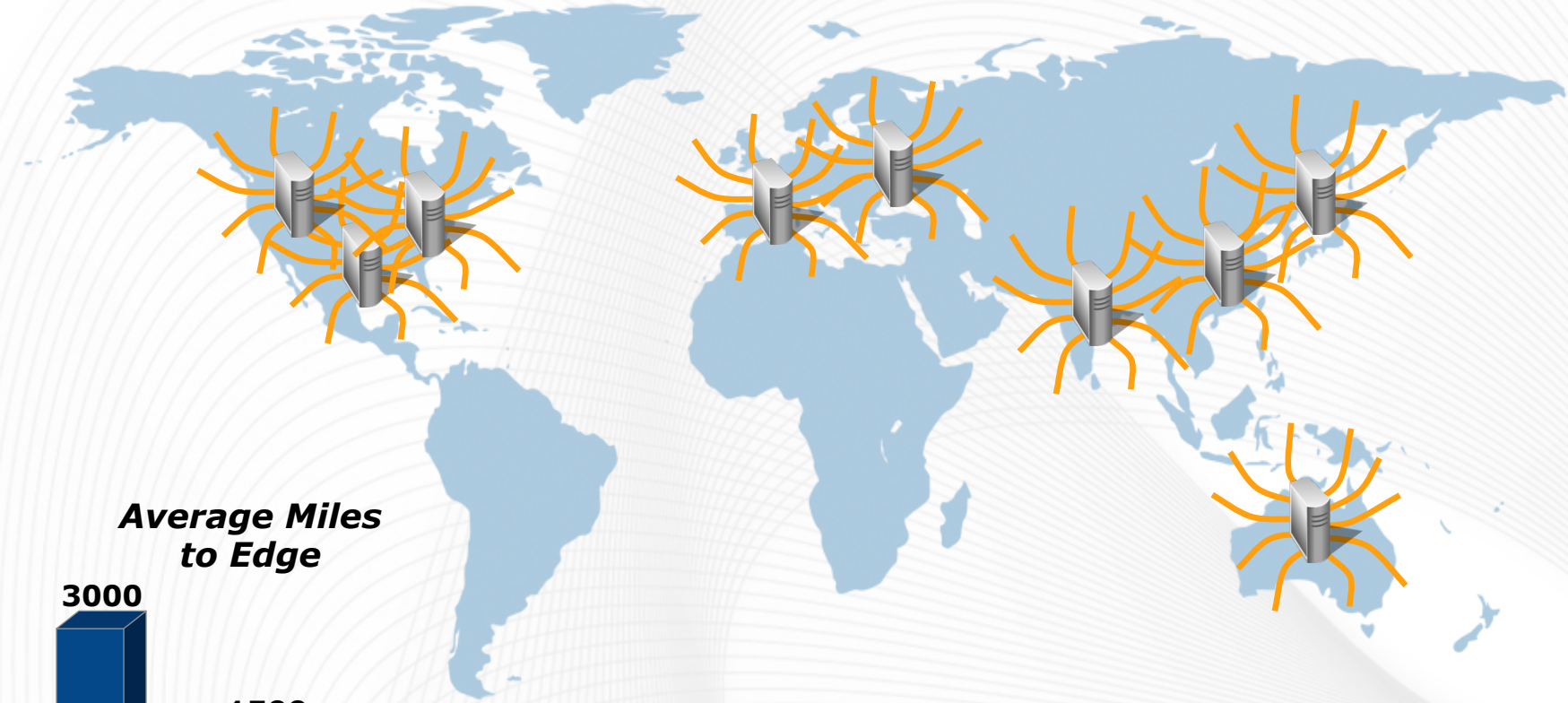
- No one Autonomous System has more than 4.4% of the access traffic.
- The top 50 ASes add up to only 48%.

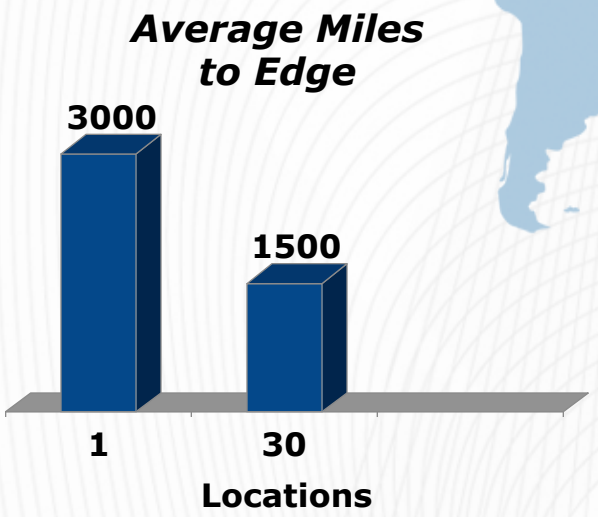


Edge Proximity From 1 Location

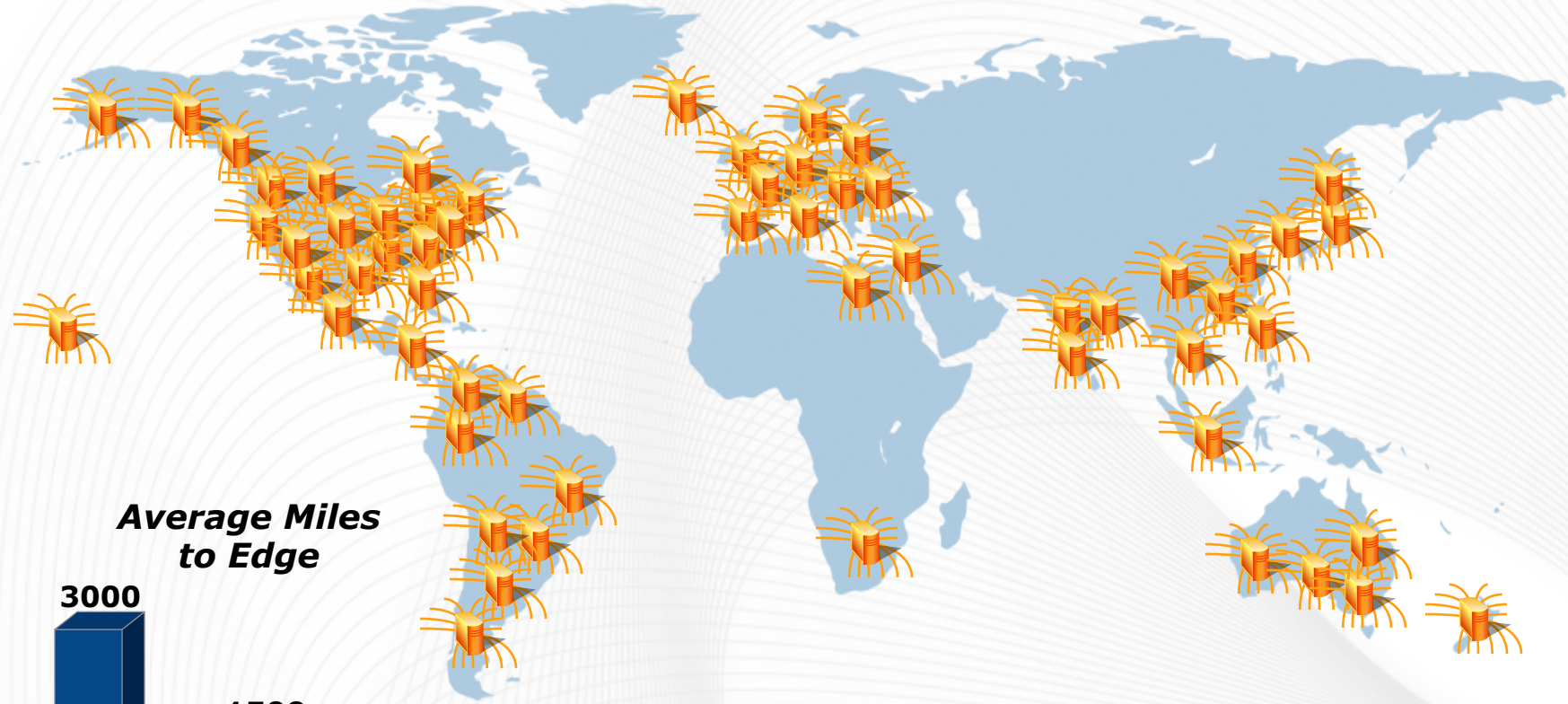


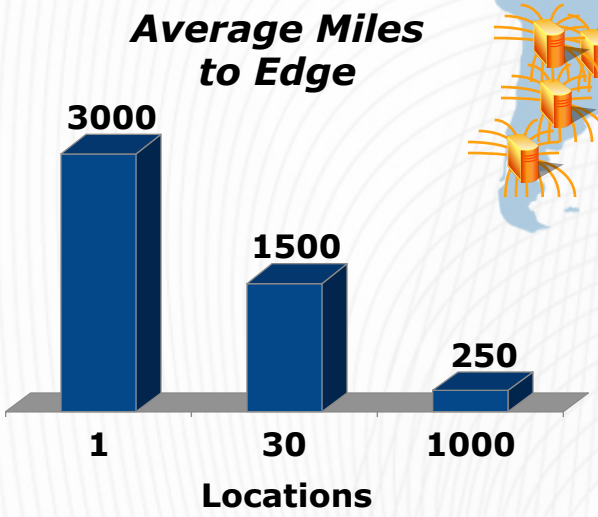
Edge Proximity From 30 Locations





Edge Proximity From 1000 Locations





Does Latency Matter for Large File Downloads?

…who cares if the latency to download a 2-hour DVD is 10ms or 100ms?

The Fat-file Paradox:

Latency Limits Throughput…

…and throughput limits the time to download large files (e.g., 4 GB DVDs)

	Distance from Server to User	Network Latency	Packet Loss	Throughput	Download Time
Akamai	Local <100 mi.	1.6 ms	0.6%	44 Mbs	12.2 min.
Big Data Center Approach	Regional 500-1000 mi.	16 ms	0.7%	4 Mbs	2.2 hrs.
	Cross Continent <3,000 mi.	48 ms.	1.0%	1 Mbs	8.16 hrs.
	Different Continent <6,000 mi.	96 ms.	1.4%	0.4 Mbs	20 hrs.

Centralized Approach with "Big Data Centers"

Clusters of Web servers in large data centers at the core of the Internet

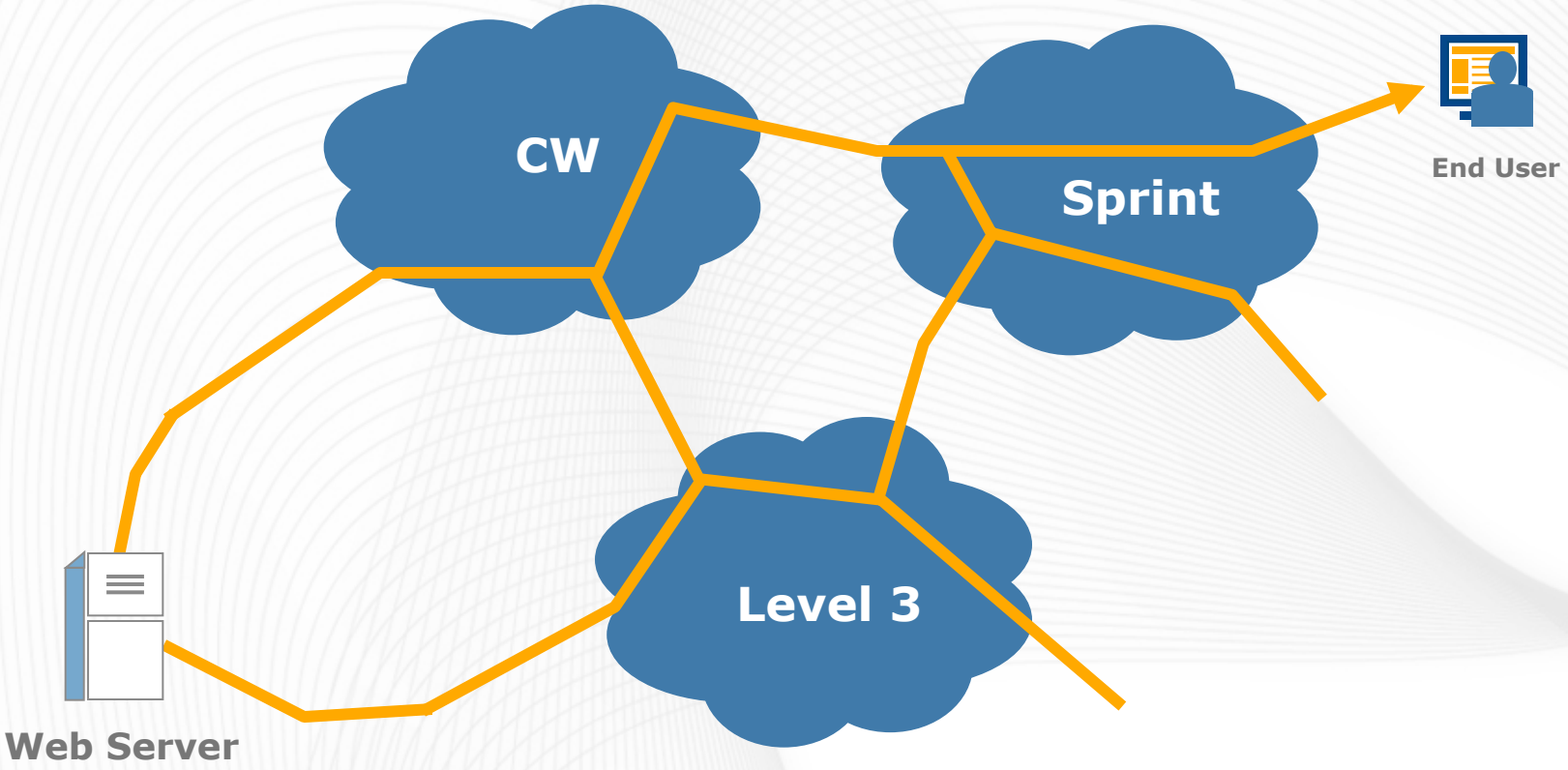
- Tens of data centers
- Transit provided by large backbone ISPs

The Problems with Peering

- Economic considerations limit peering capacity – results in congestion and poor performance
- Routing algorithms (BGP) ignore congestion
- BGP ignores latency
- Data used to determine routes is subject to intentional inaccuracies and human error

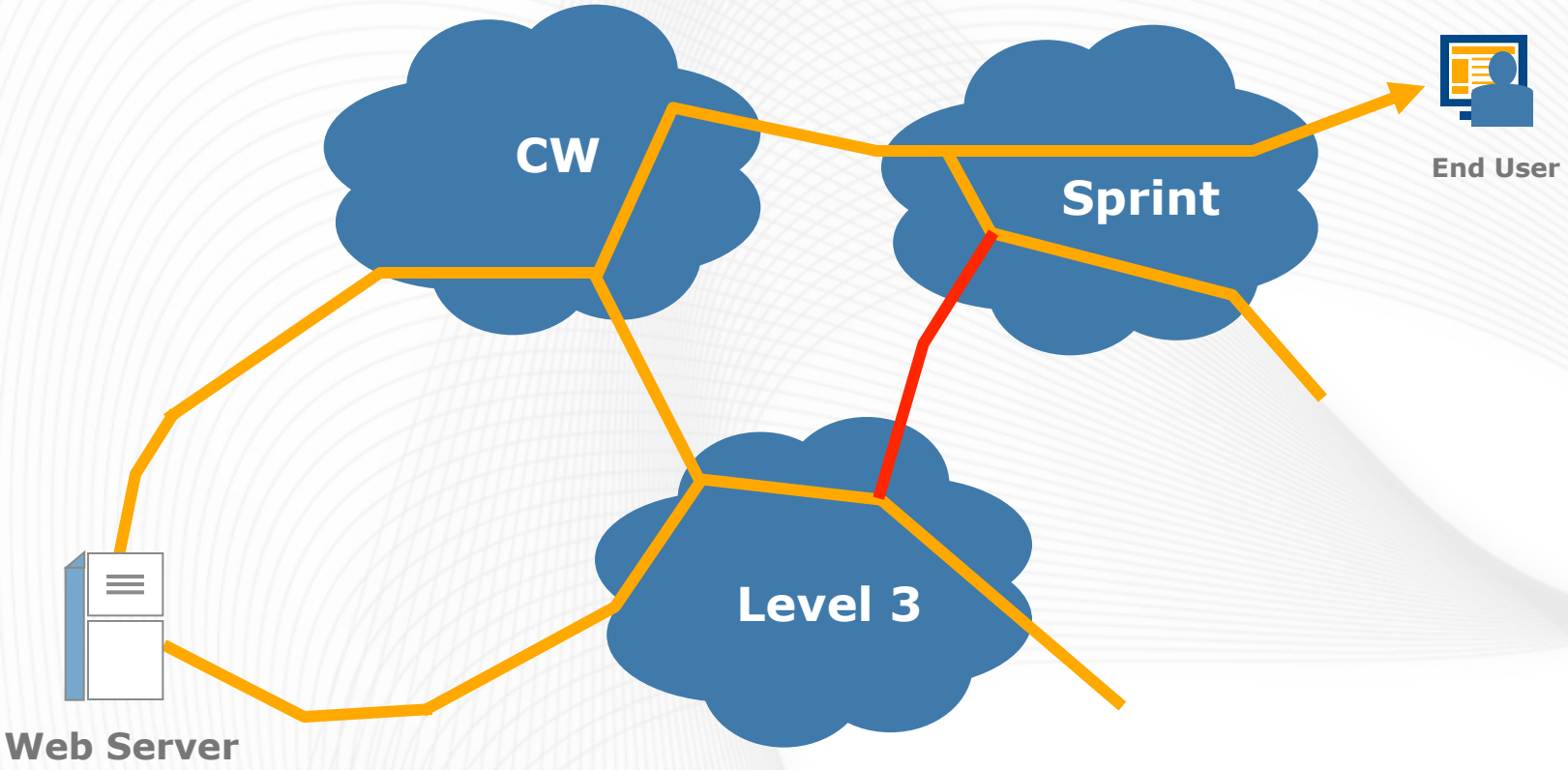
Normal traffic flow

BGP picks the “best” route and *all* packets flow over that path

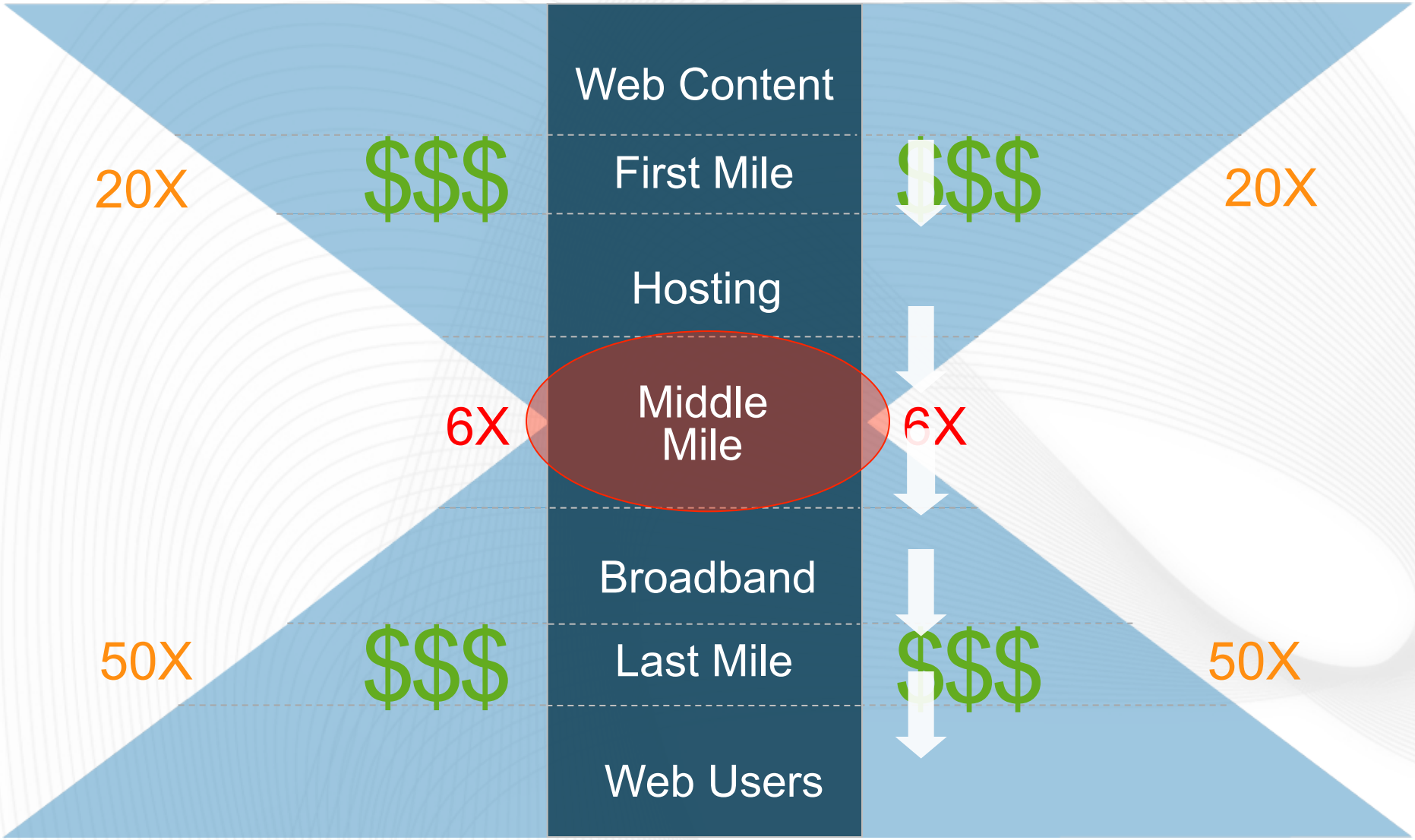


Normal traffic flow

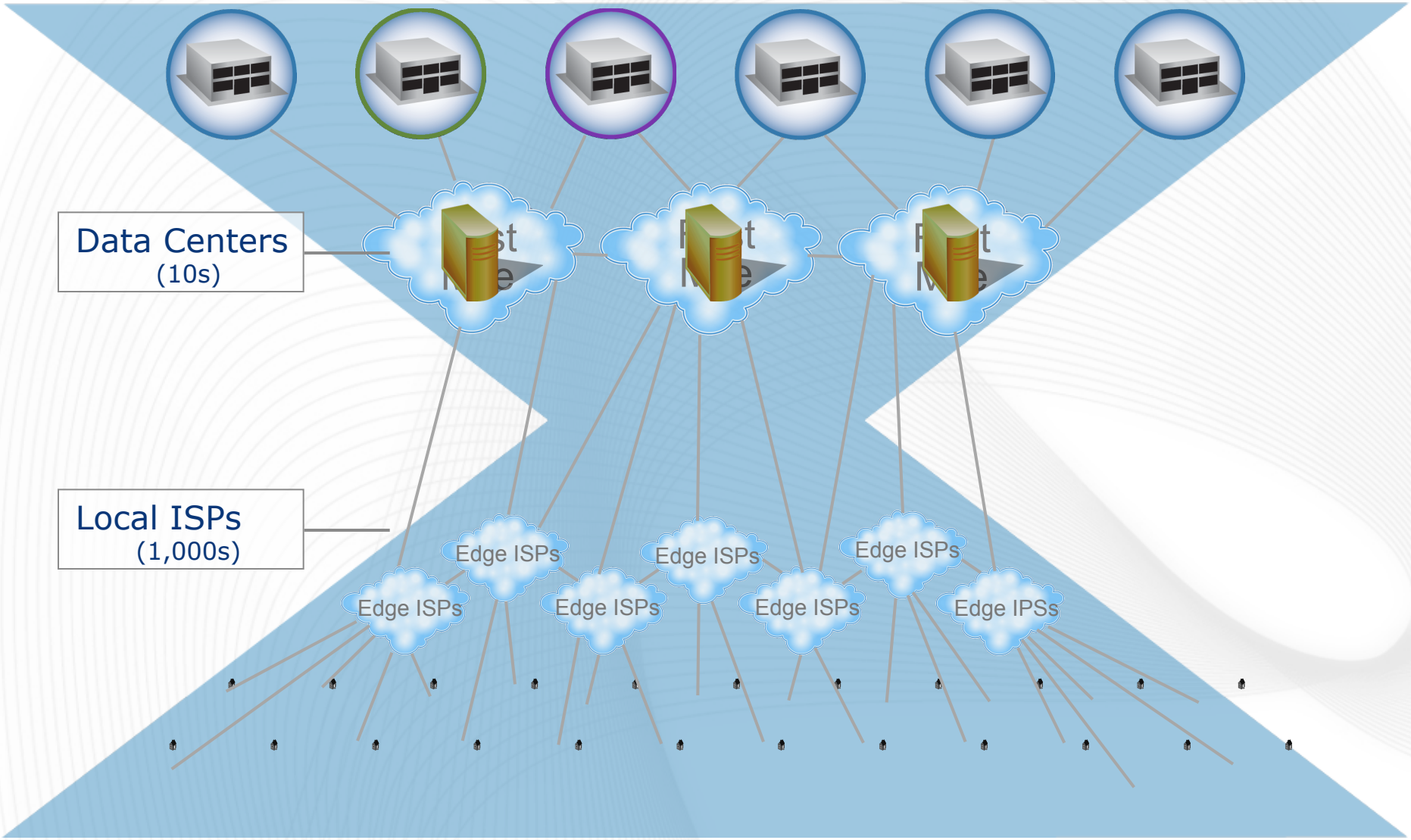
If there is congestion on a link, BGP will continue to send packets down that link



Infrastructure Bottlenecks

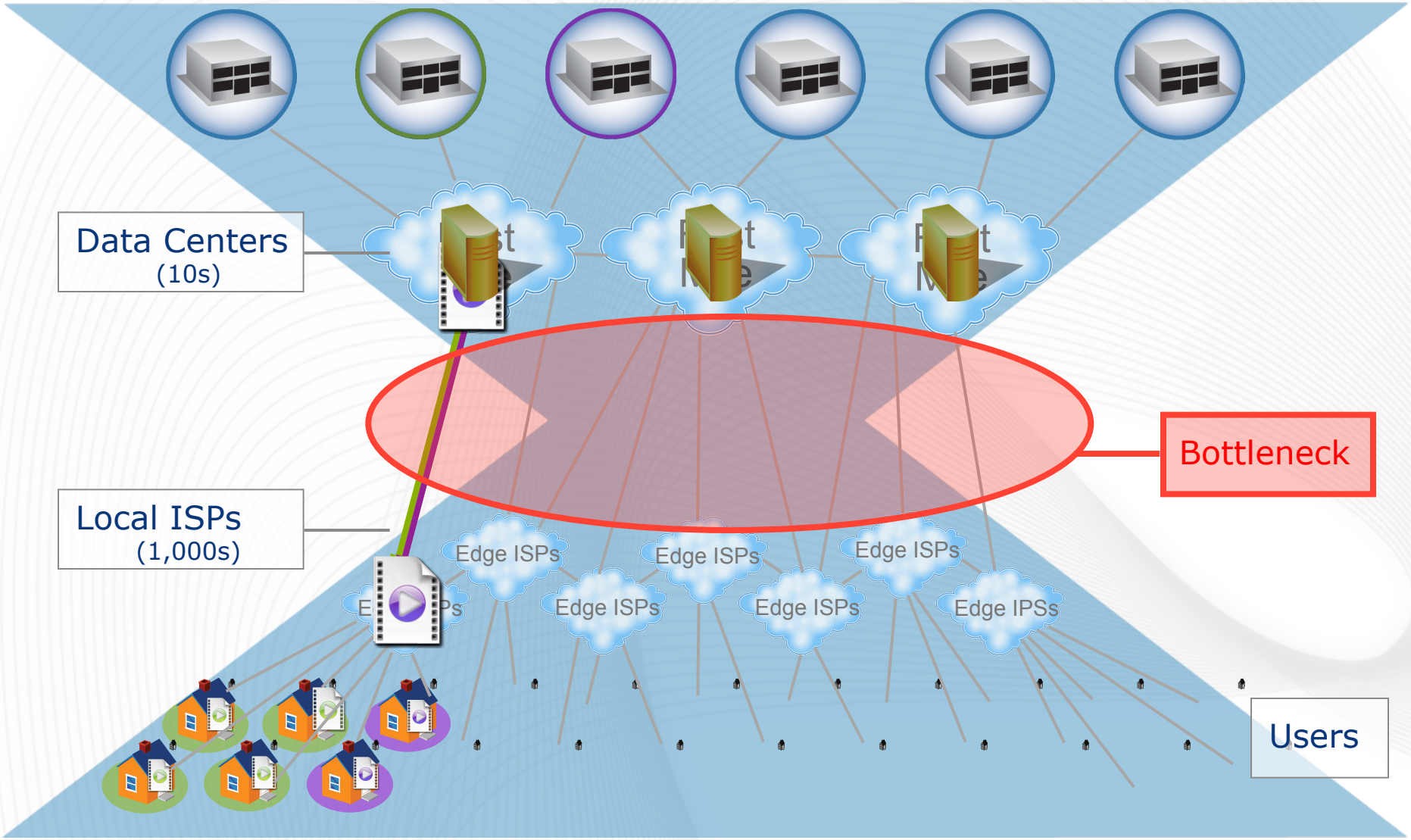


The Big Data Center Approach to Content Delivery



The Big Data Center Approach to Content Delivery

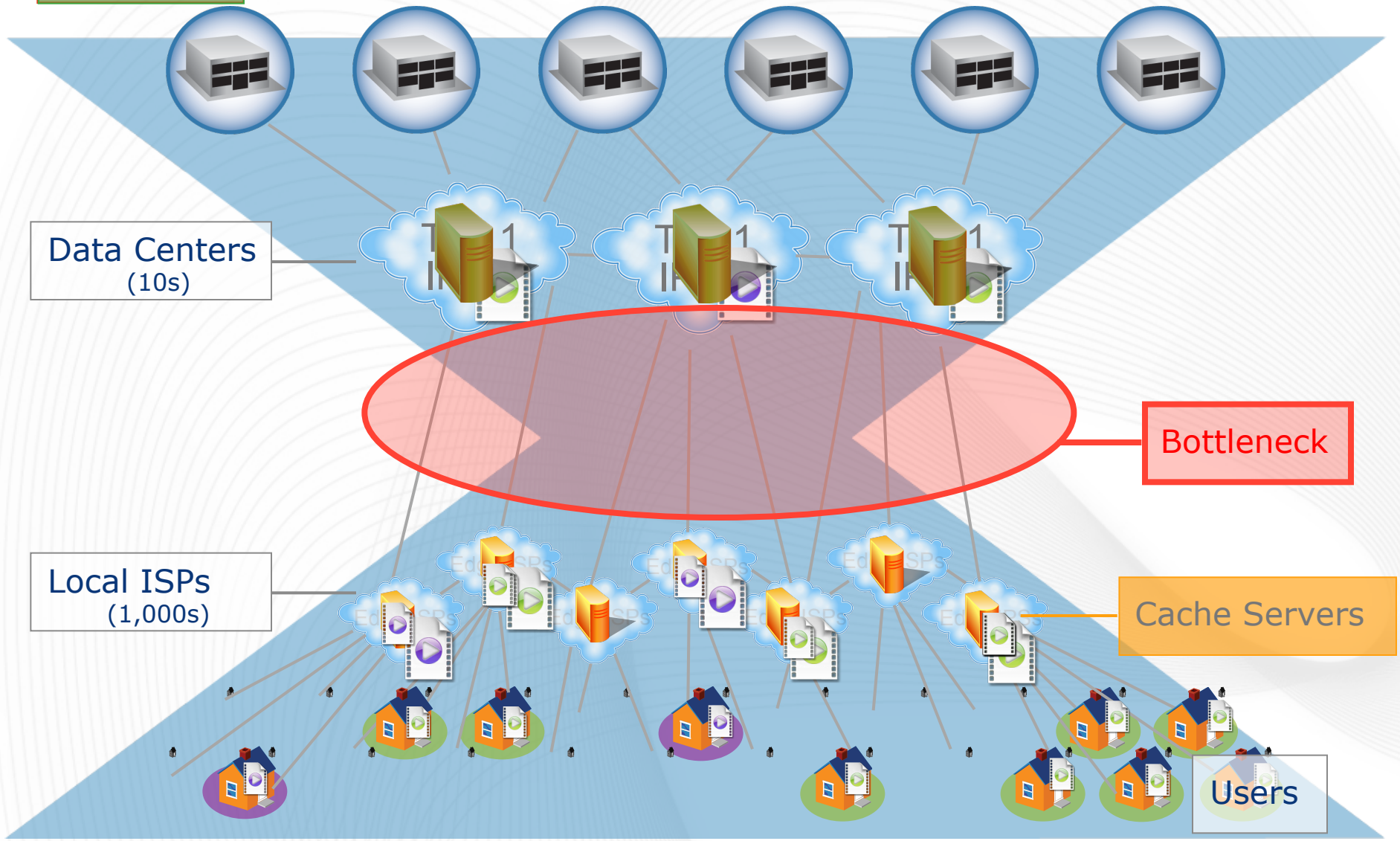
Problem 1 Data centers are on the wrong side of the bottleneck



The Big Data Center Approach to Content Delivery

Solution 1

Caching servers are on the wrong side of the bottleneck



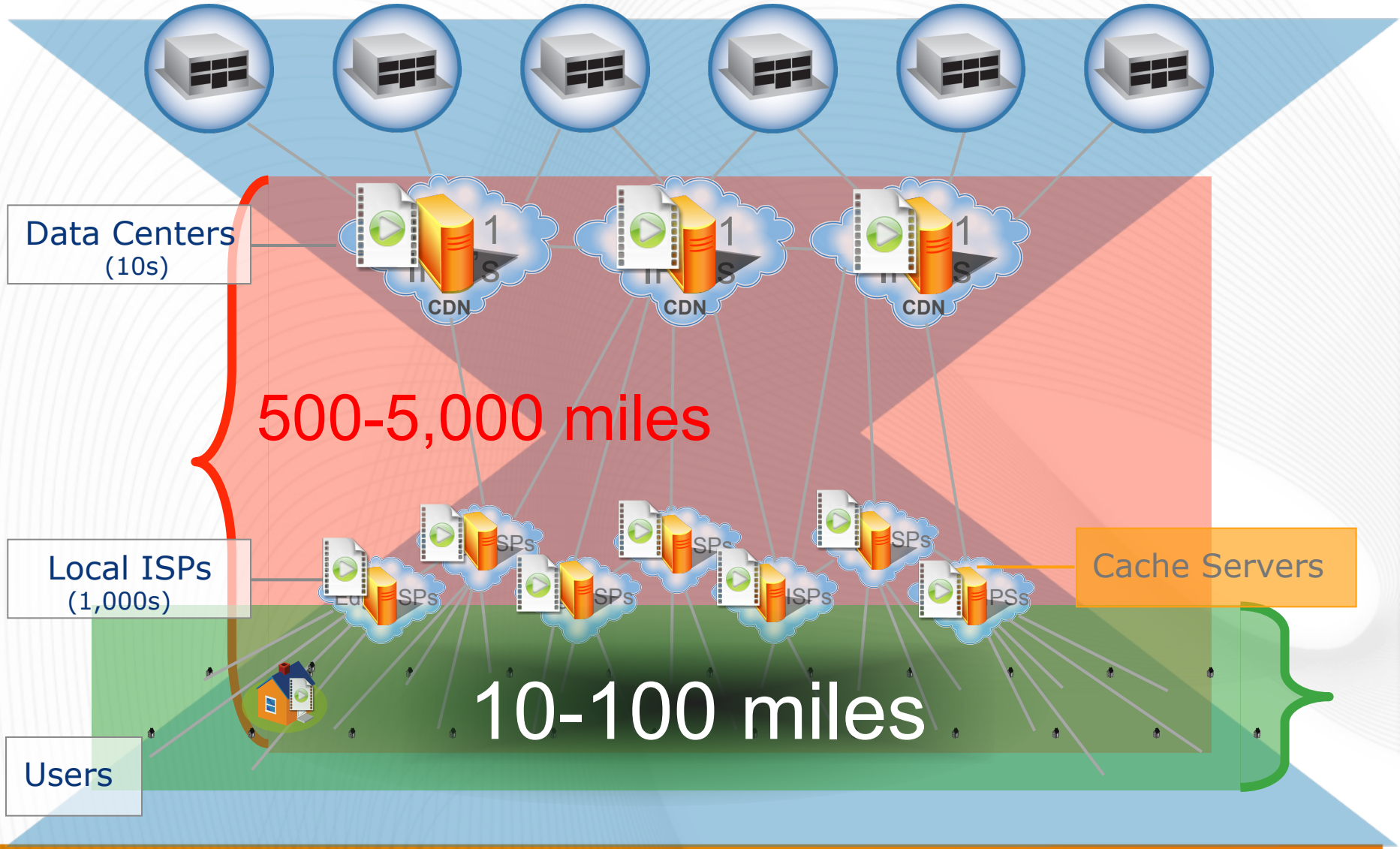
The Big Data Center Approach to Content Delivery

Problem 2 Data centers are far from end users

The Big Data Center Approach to Content Delivery

Solution 2

Data centers are far from end users



The Akamai System

The world's largest on-demand, distributed computing platform delivers all forms of Web content and applications for over 130,000 domains.

The Akamai EdgePlatform:

120,000+ Servers	1928 POPs	1069 Networks	660+ Cities	83 Countries

Resulting in traffic of:

13 Tbps peak traffic
100+ petabytes / day
1,468+ billion hits / day
560+ million unique clients IPs / day

Conclusion: How to deliver HD traffic in the future?

- Overlay CDN networks are state of the Art
  - Akamai, Google, Netflix, using on-net servers
- Protocols like Multicast and QoS are not the solution
- CDN Interconnects and Federations are not the solution either
- Peer to peer networks - unclear so far
- Waiting for the next big idea☺

Questions?

- ck@akamai.com