



Traffic delivery evolution in the Internet  
ENOG 4 – Moscow – 23<sup>rd</sup> October 2012

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Director Network Architecture  
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way-back machine

# Web 1998



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Friday, December 11, 1998

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# Web 1998



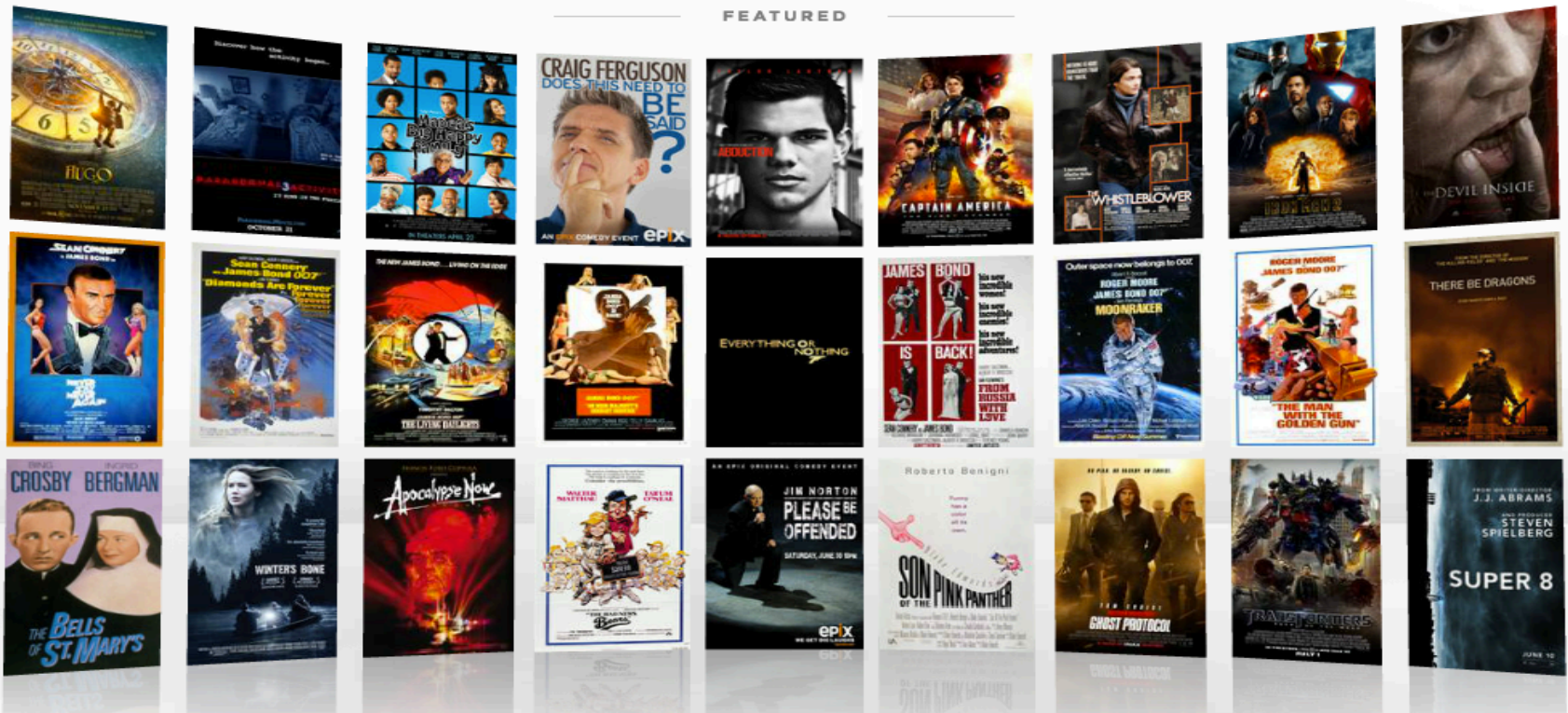
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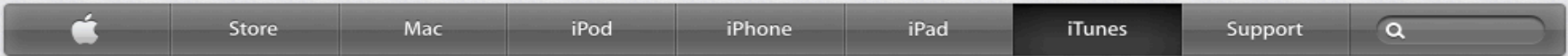
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# So what's the difference?



- 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



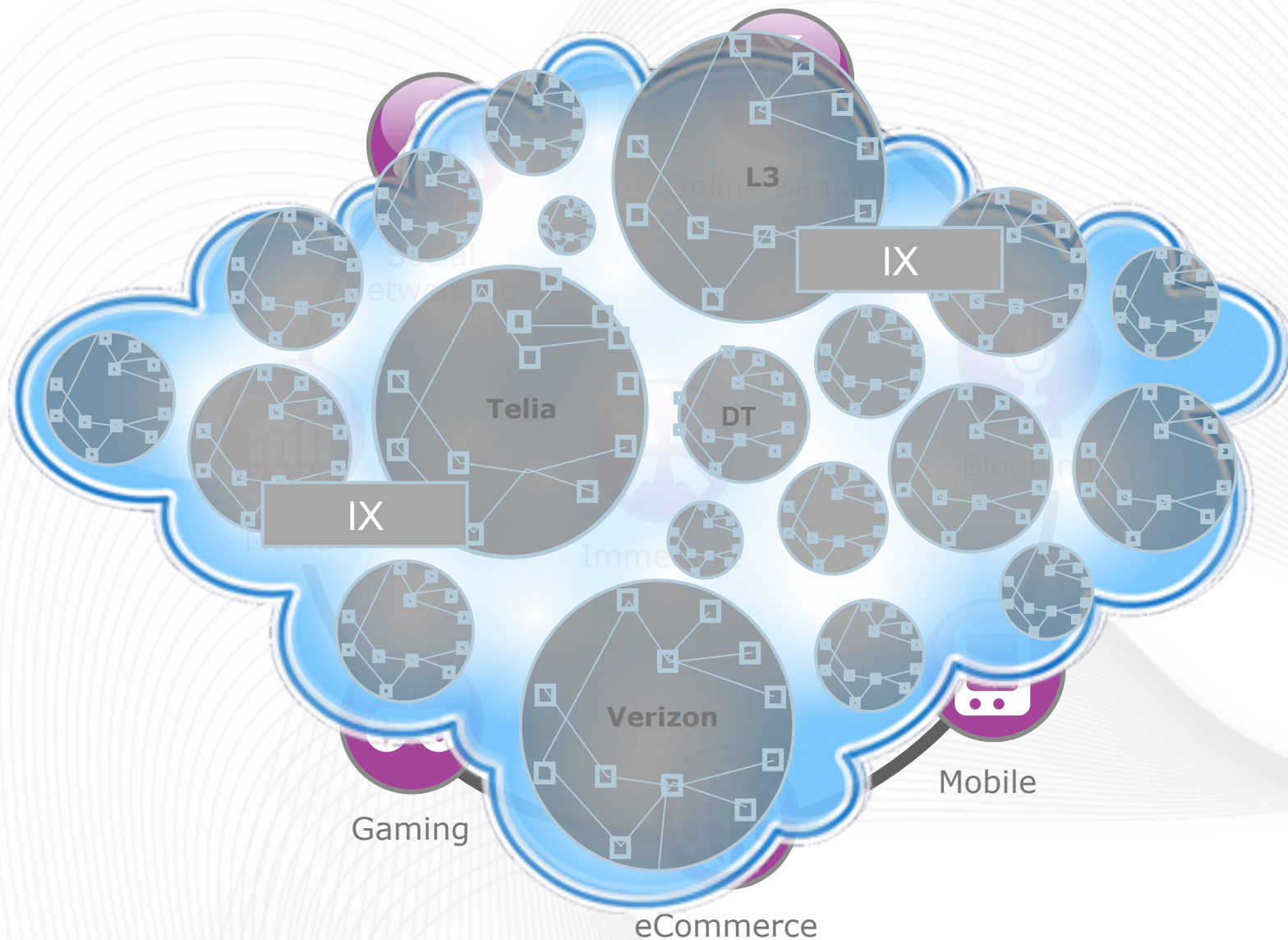
# Trends 2012



# 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

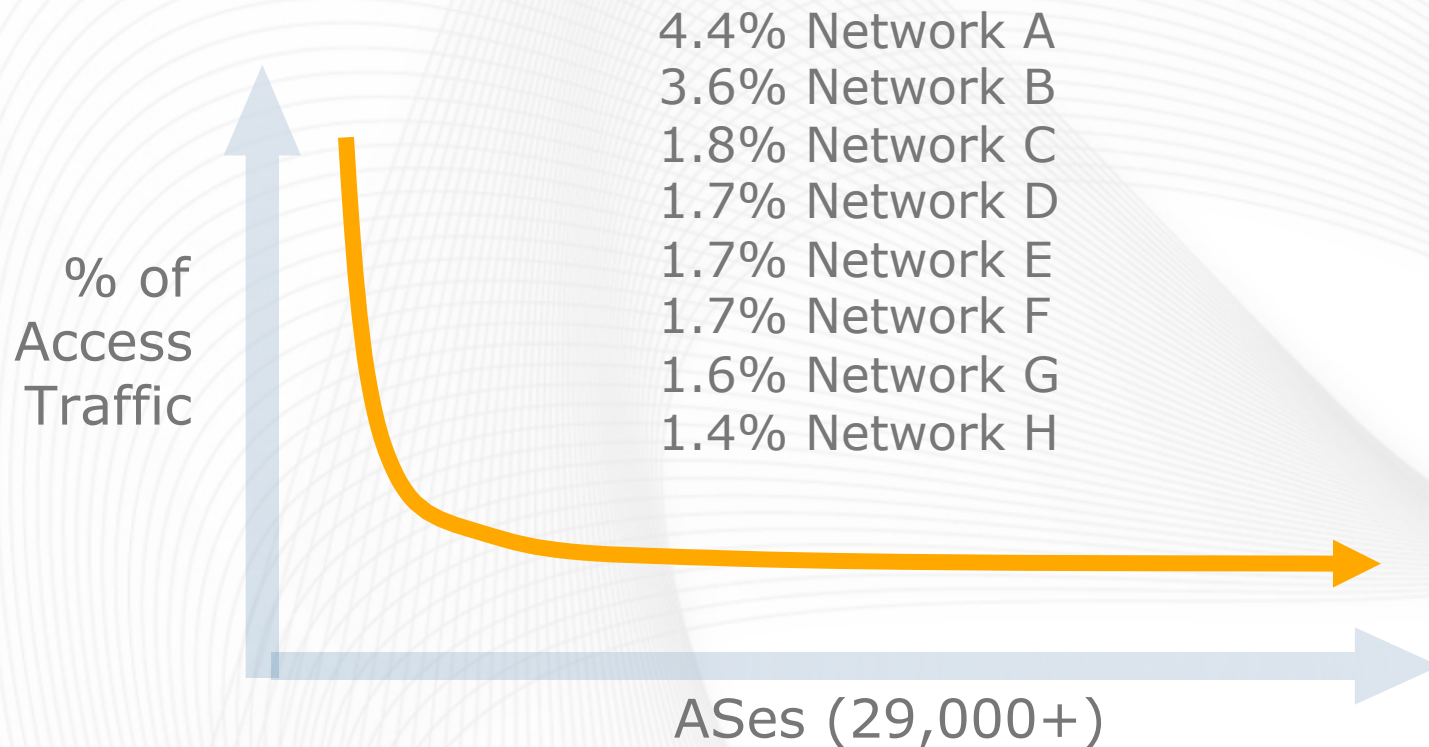


- Content Distribution Networks solve the centralization problem by *distributing content*.
- Greater distribution means greater performance and reliability

# The Edge is Highly Distributed

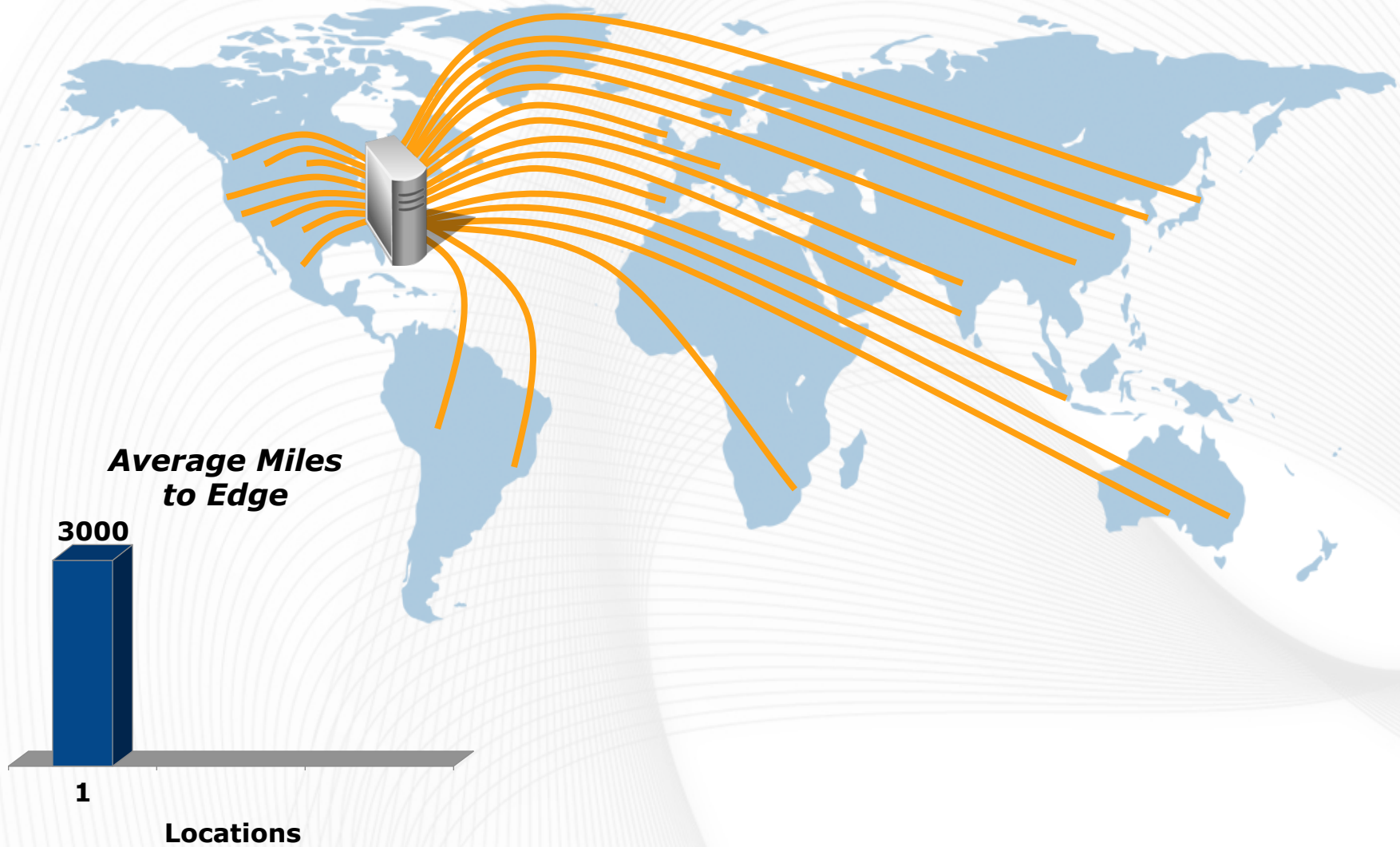


- No one Autonomous System has more than 4.4% of the access traffic.
- The top 50 ASes add up to only 48%.

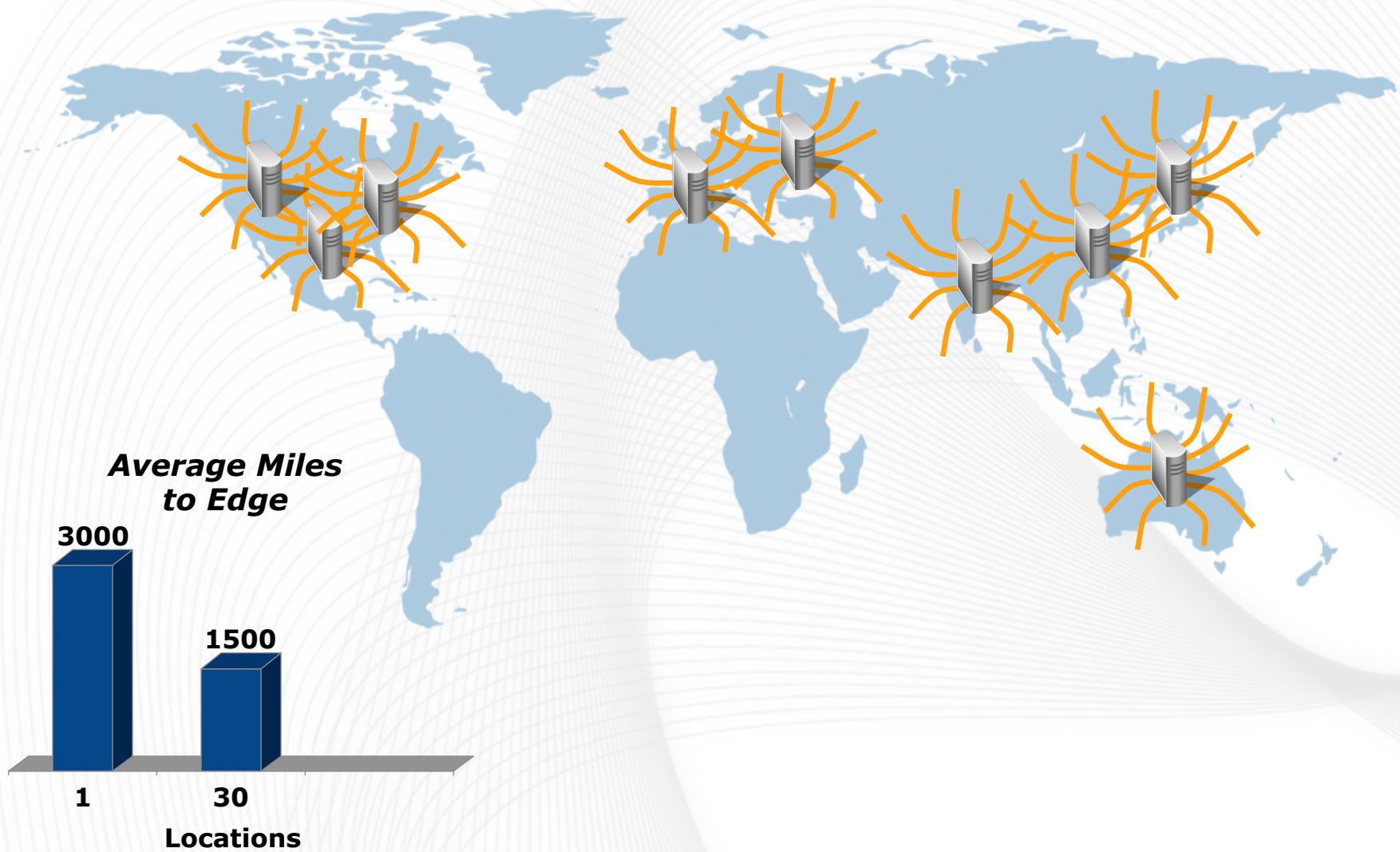




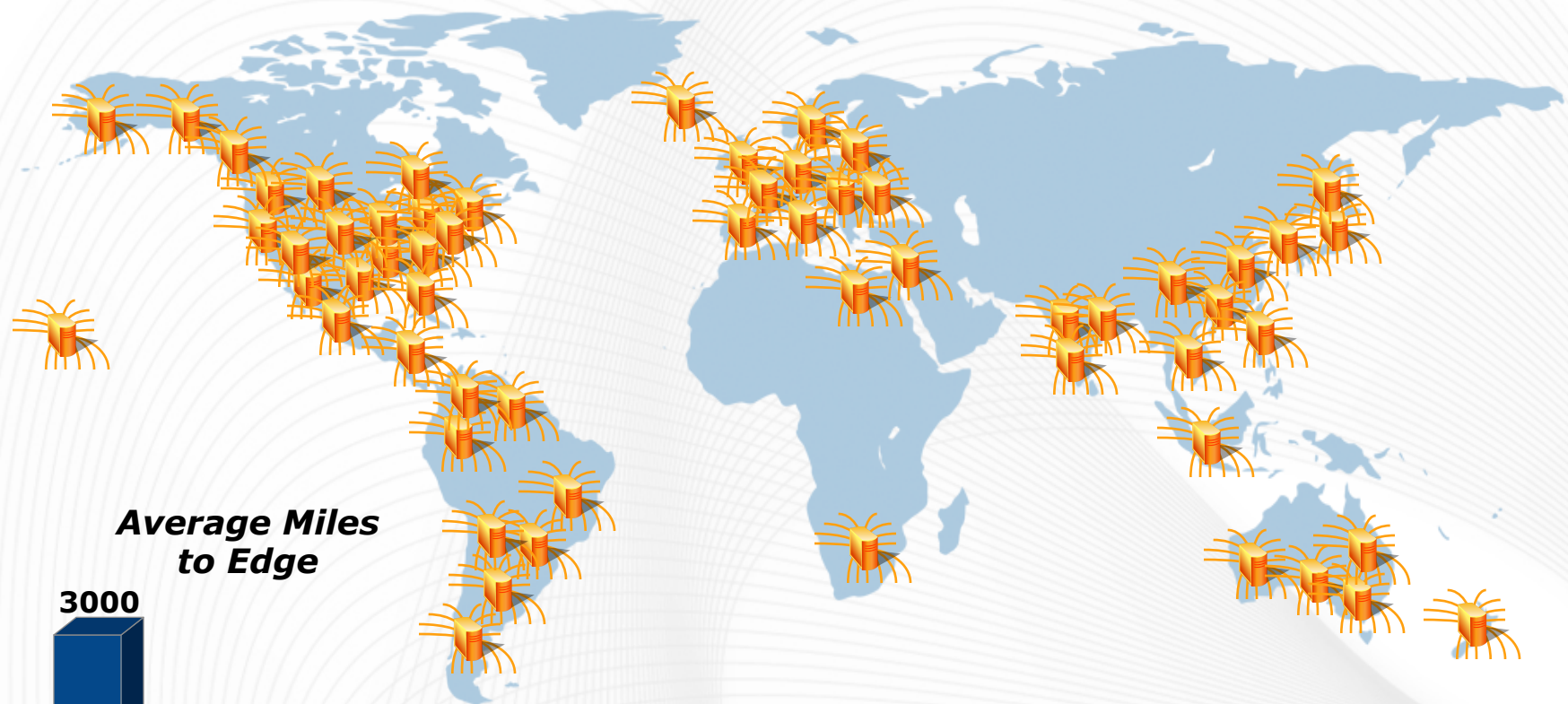
# Edge Proximity From 1 Location



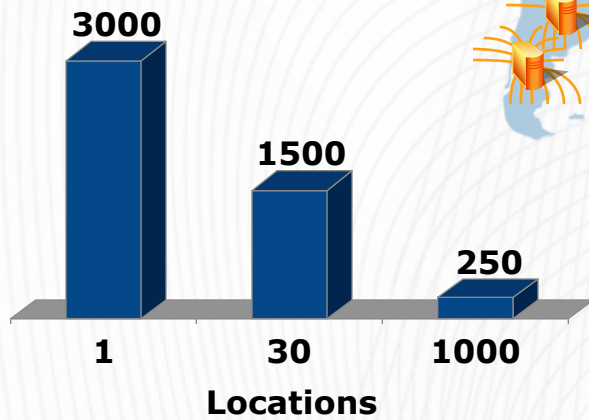
# Edge Proximity From 30 Locations



# Edge Proximity From 1000 Locations



**Average Miles to Edge**





# 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



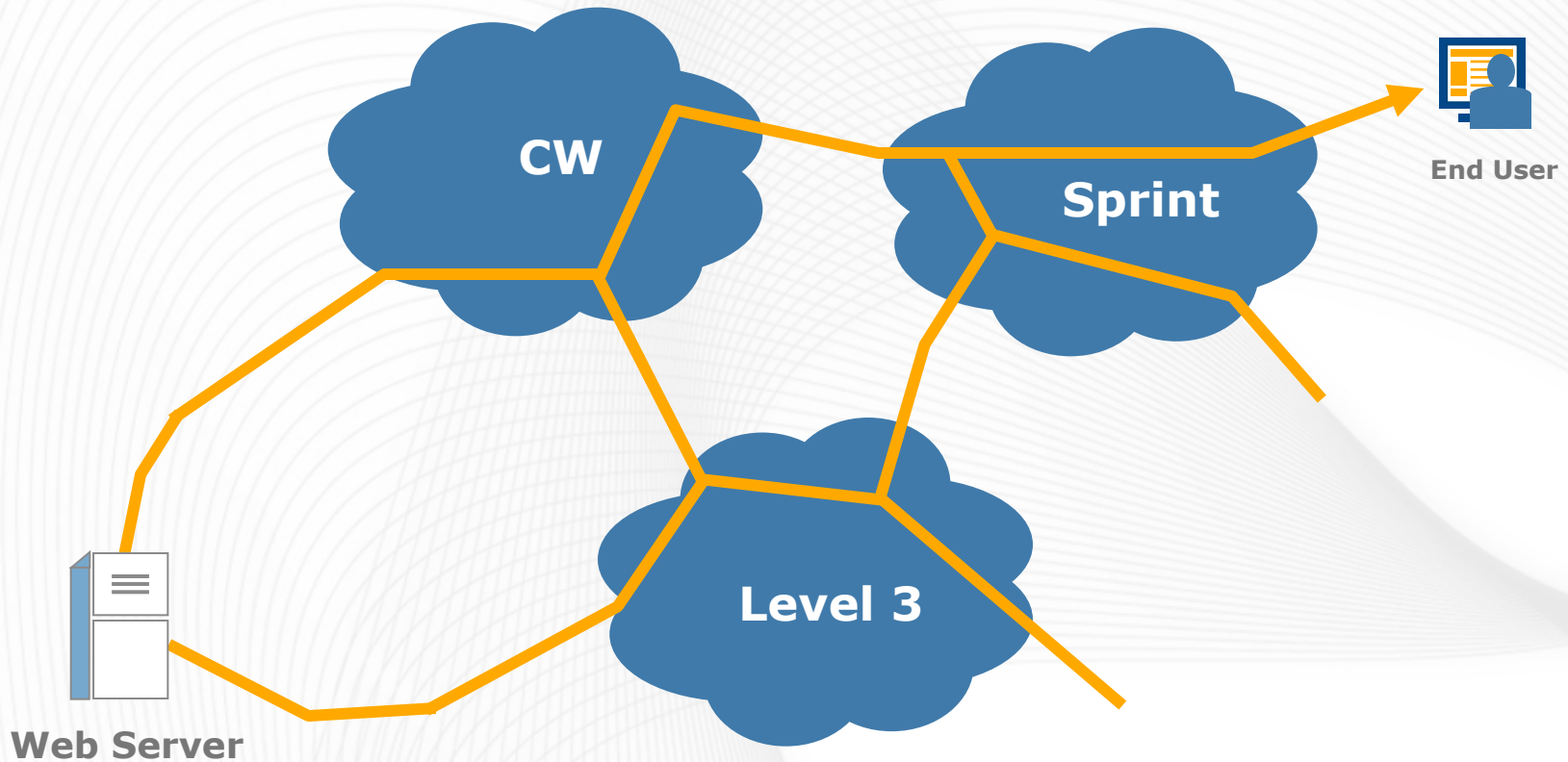
# The Problems with Peering



- 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

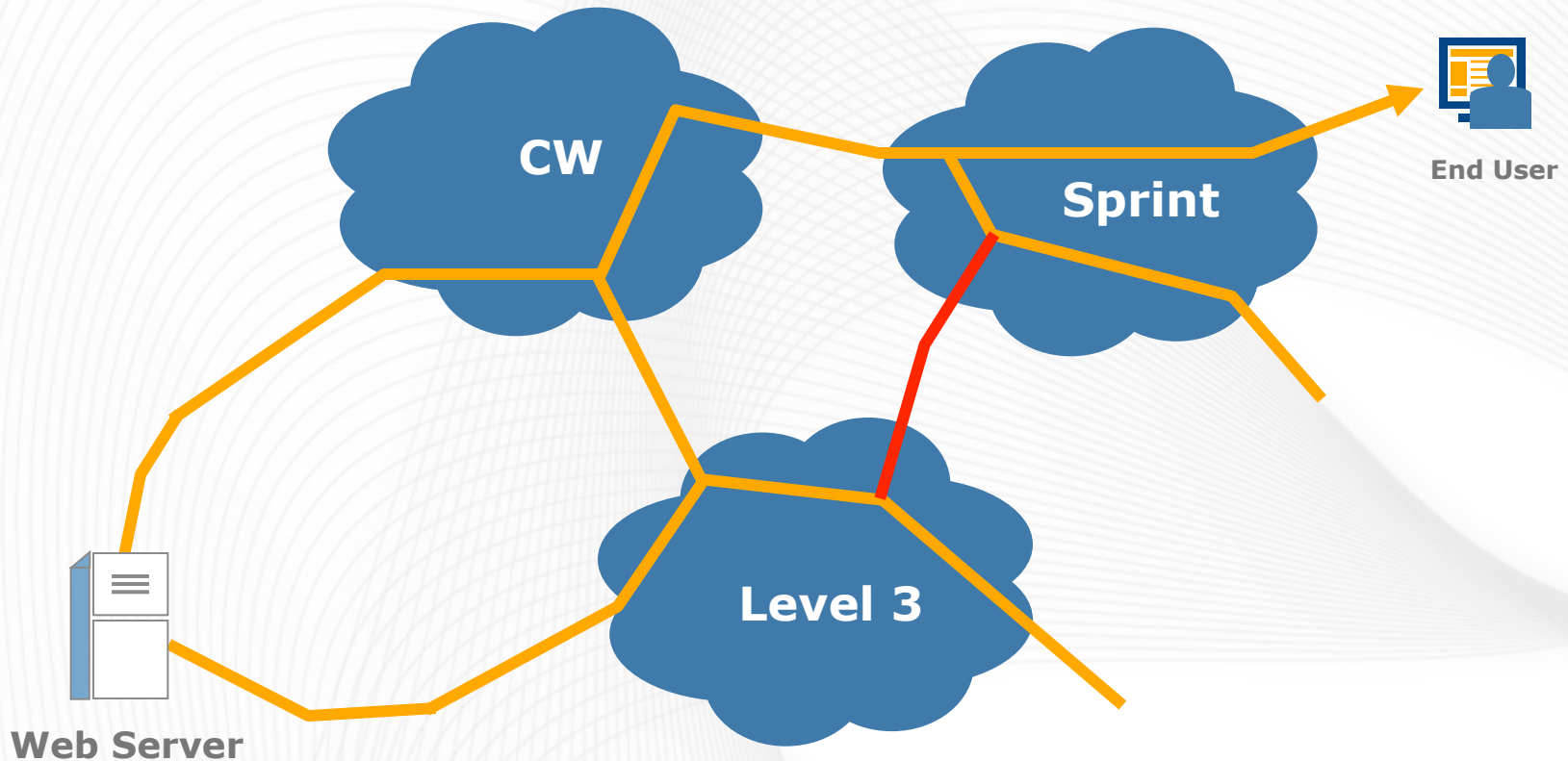
# Normal traffic flow

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



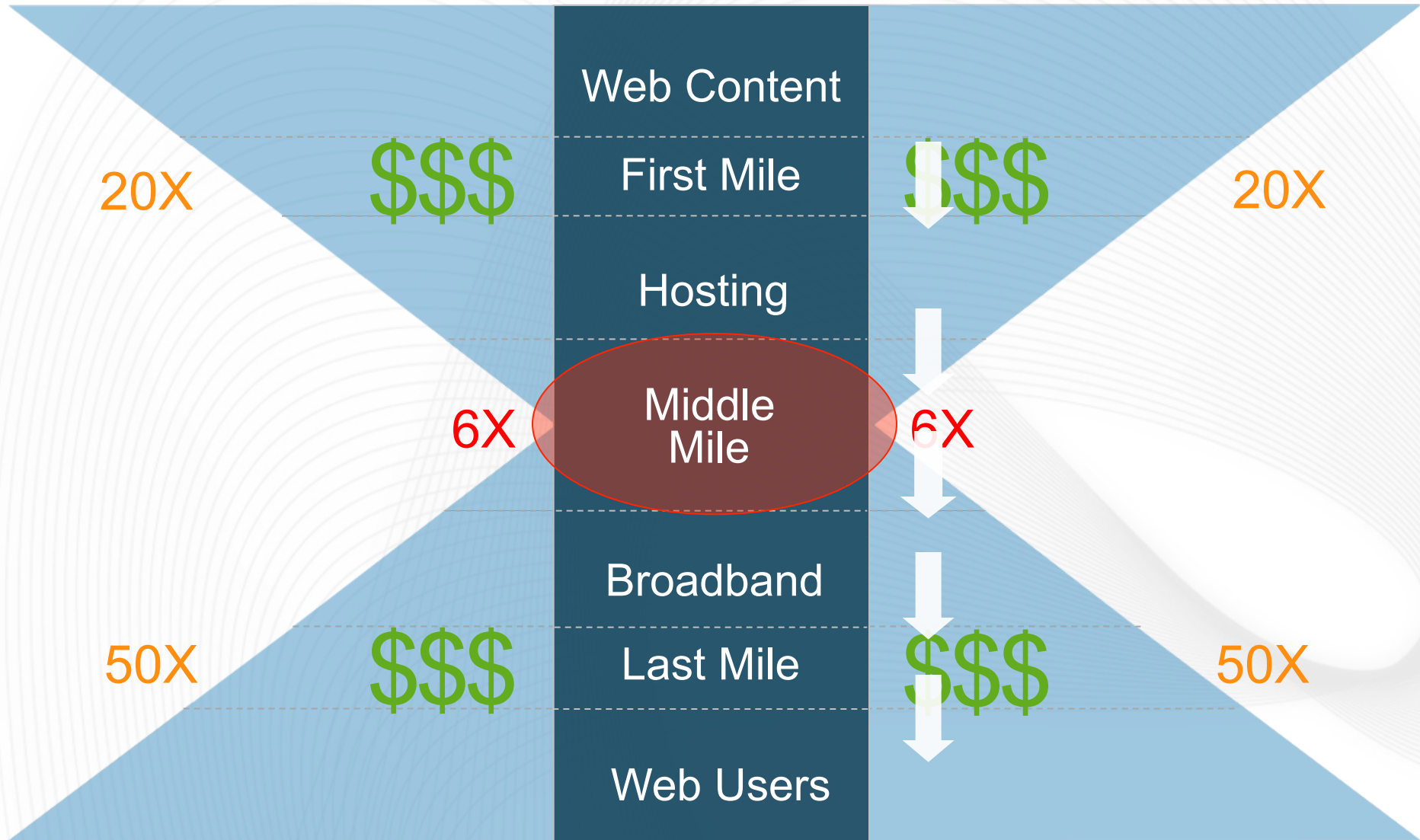
# Normal traffic flow

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

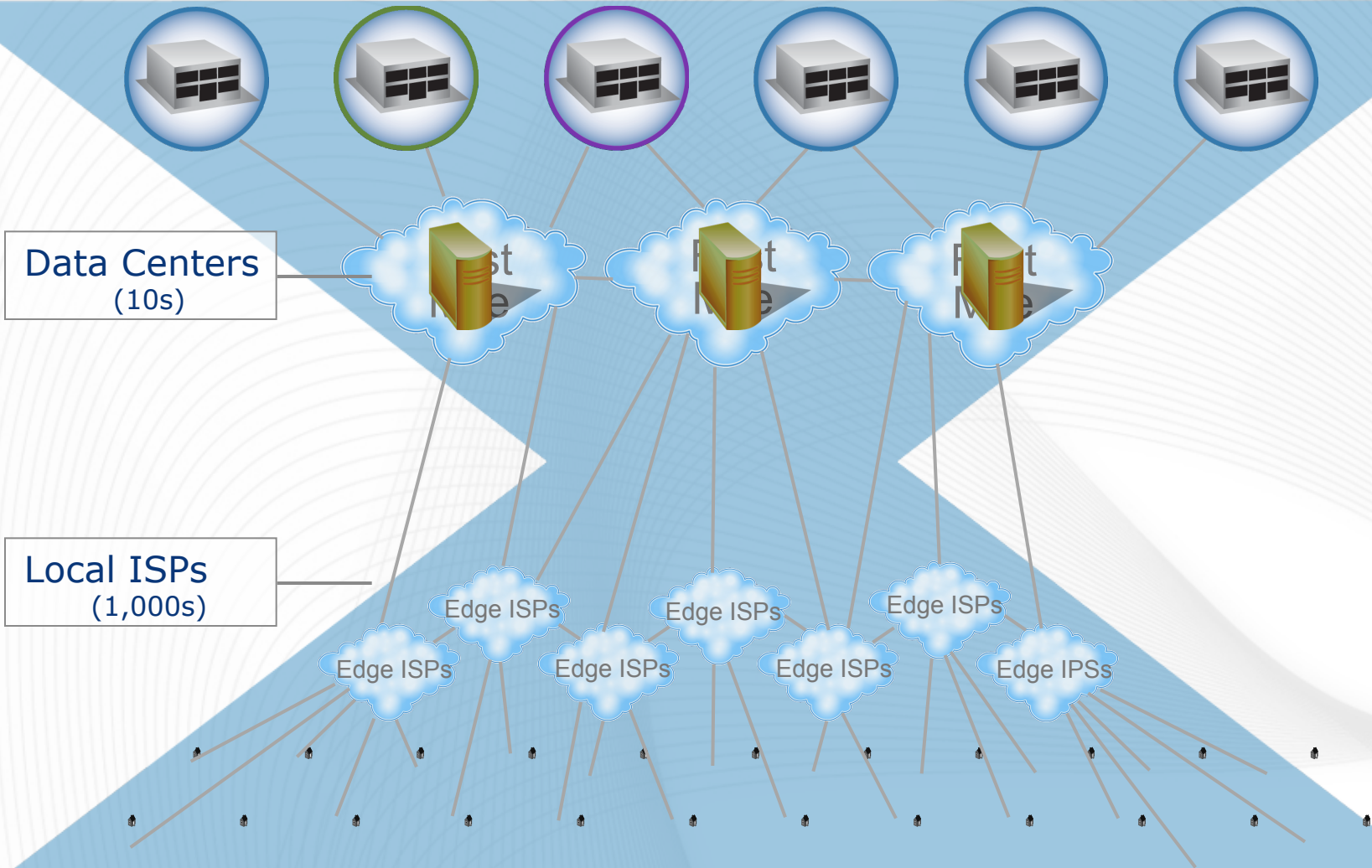




# Infrastructure *Bottleneck*



# The Big Data Center Approach to Content Delivery

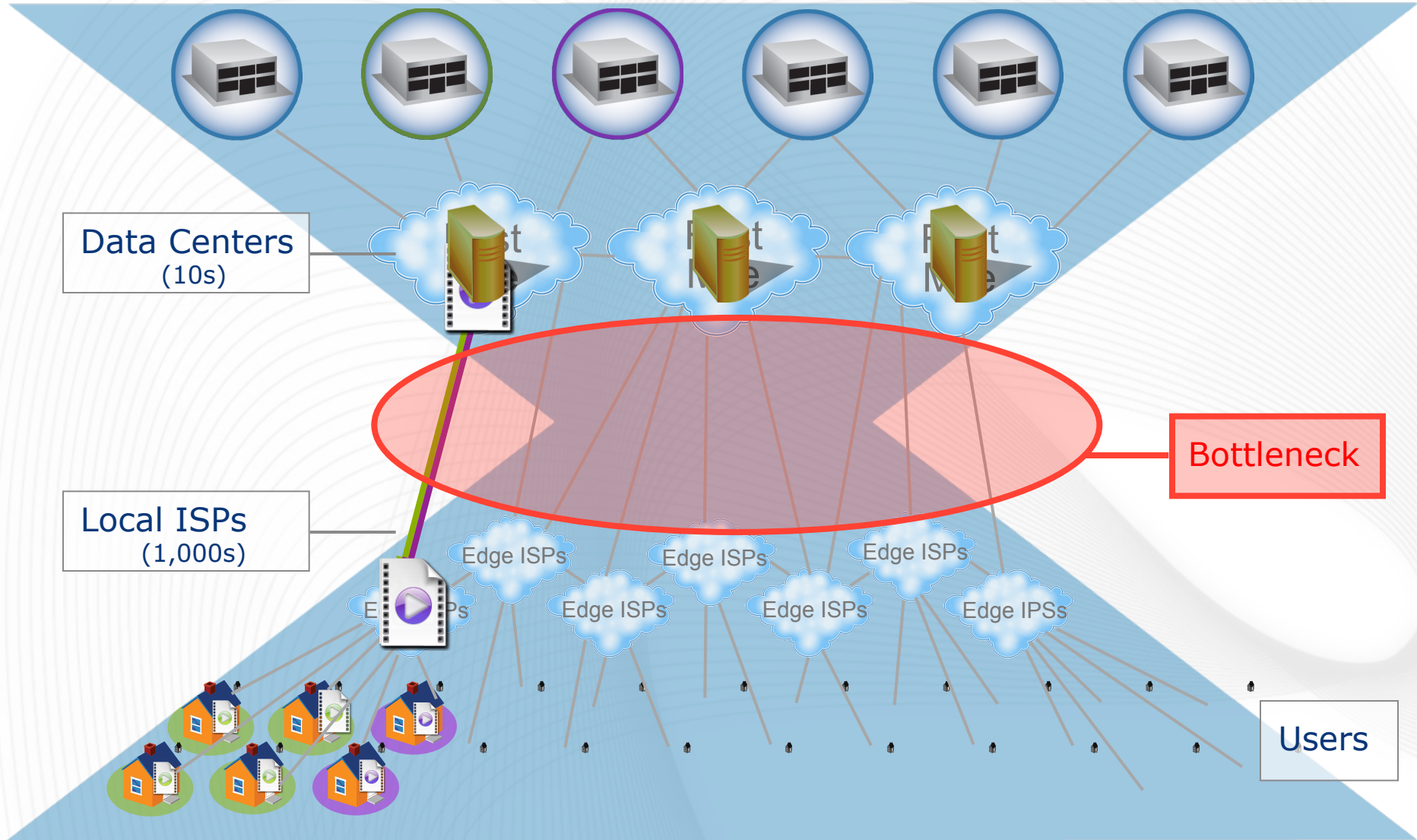


# The Big Data Center Approach to Content Delivery



## Problem 1

Data centers are on the wrong side of the bottleneck



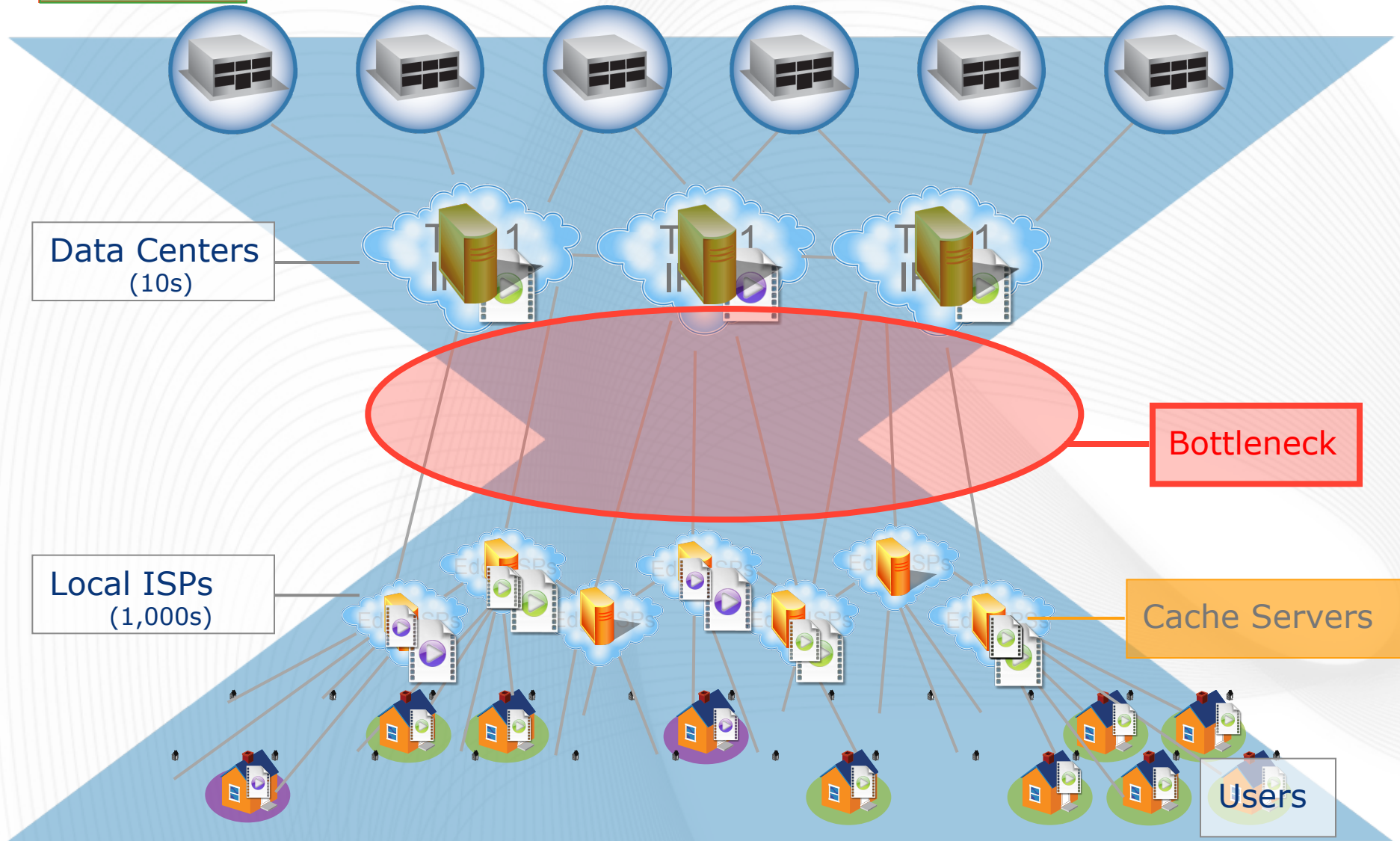


# The Big Data Center Approach to Content Delivery



**Solution 1**

Data centers 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

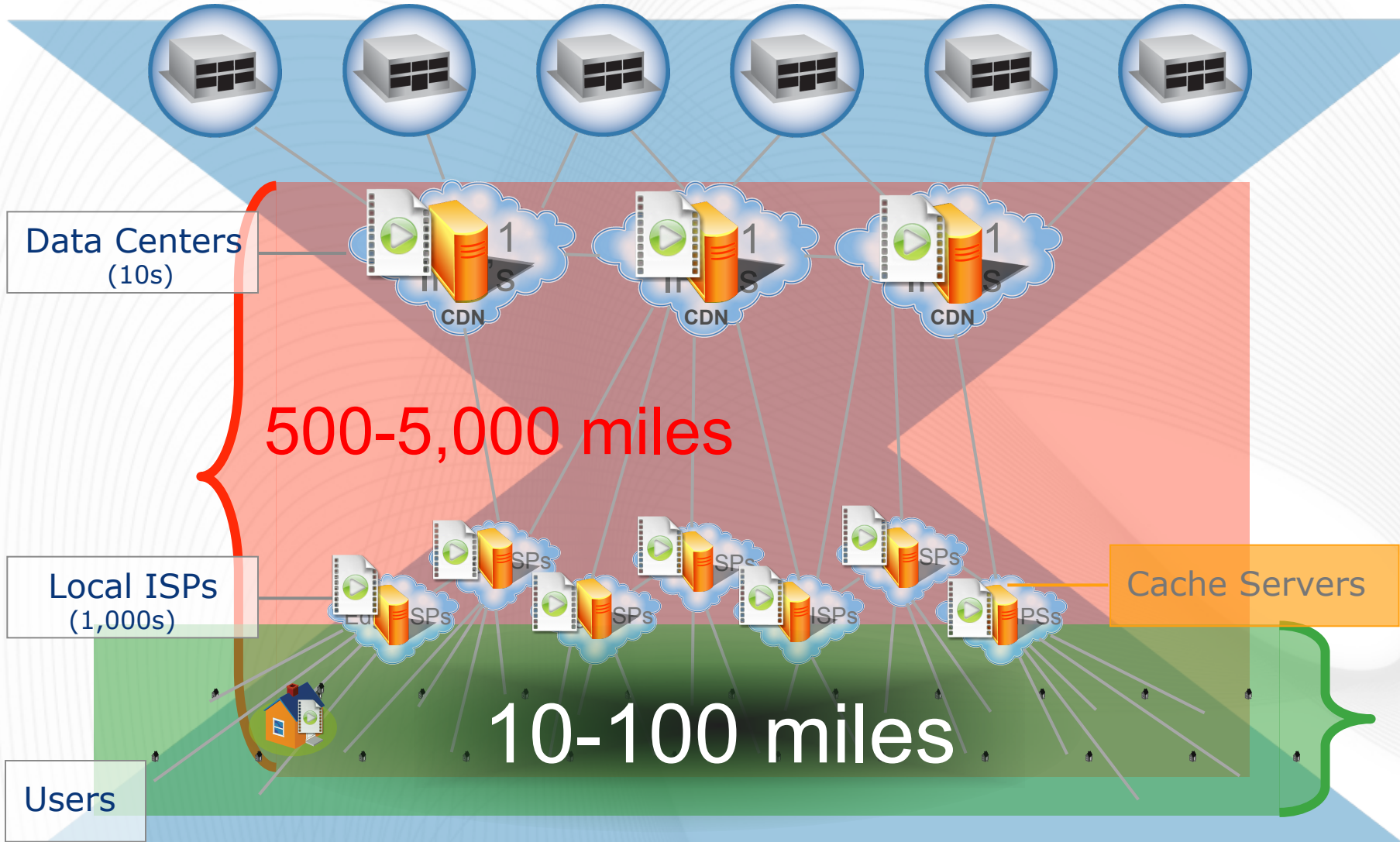


# The Big Data Center Approach to Content Delivery



**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?



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