The Future of the Networked World:

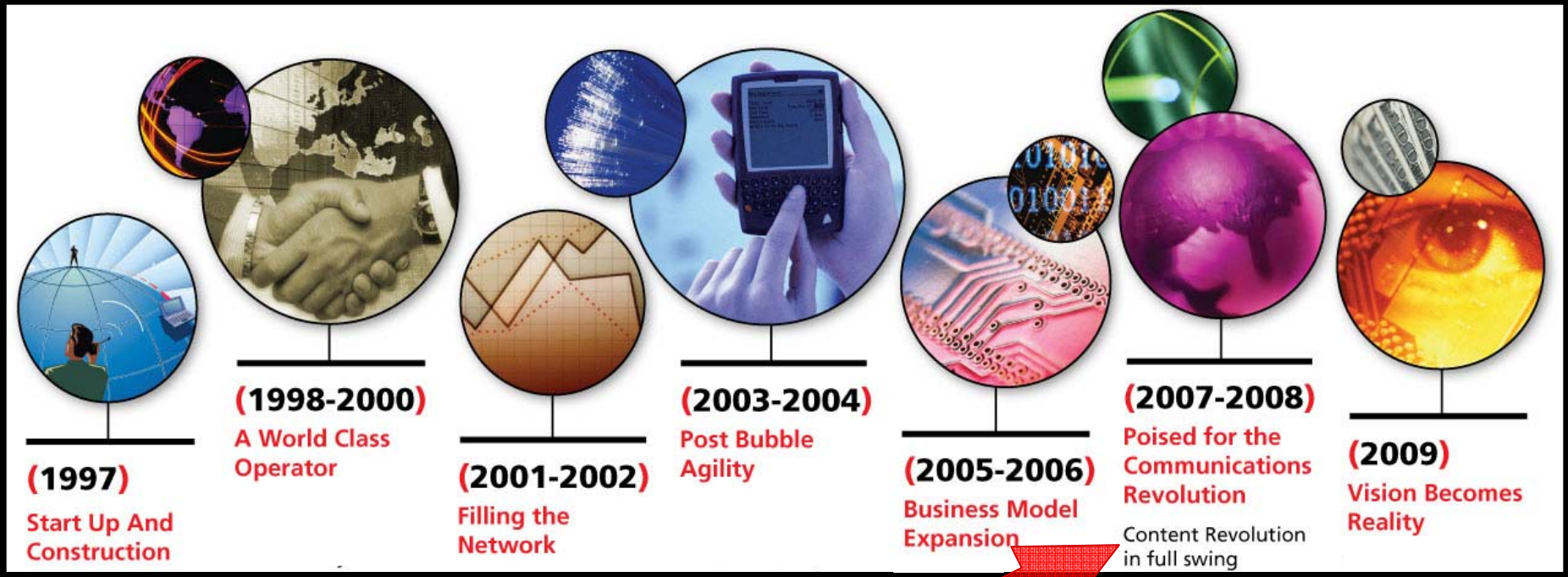
Are you ready for high quality video delivery?

Andrew Haynes
Director, European Product Delivery

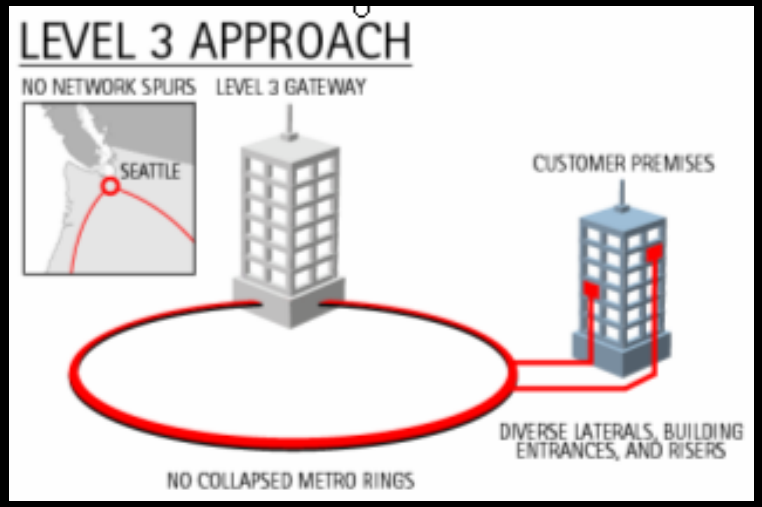
PLNOG 3
Kraków, September 2009

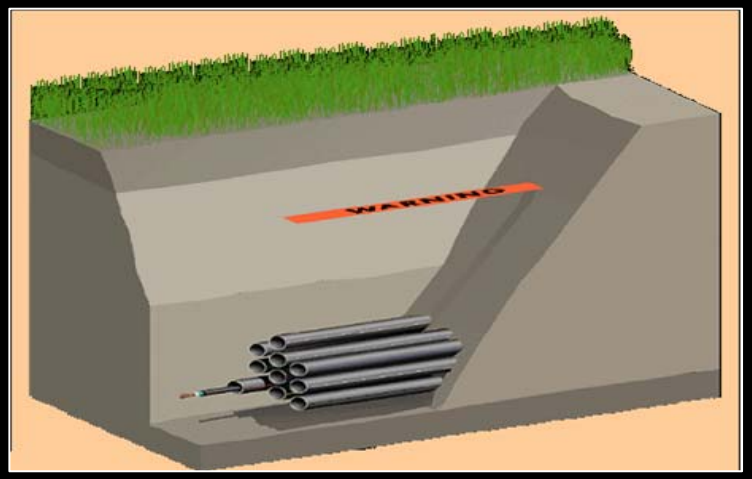
The Level 3 Story

The core of the networked world



Level 3 Network Diversity





- Service quality is only as good as the underlying diversity
- Level 3 is committed to network diversity
  - Diverse or triverse laterals
  - Minimal network spurs or collapsed rings
  - Physical and electronic diversity options
  - Dual gateway designs provide even greater network redundancy e.g. Vienna, Warsaw, Milan
  - Buried, terrestrial network with few fiber cuts
  - Multiple fiber conduits

Exceptional Global Connectivity

Level 3 continues to be the world's most connected ISP

Renesys® "Customer Base" Rankings (June 15, 2009)

North America	
Rank	Service Provider
1	Level 3 Communications
2	Global Crossing
3	Sprint
4	AT&T
5	Verizon/MCI
6	Savvis
7	Cogent
8	Teleglobe/TATA
9	Qwest
10	XO

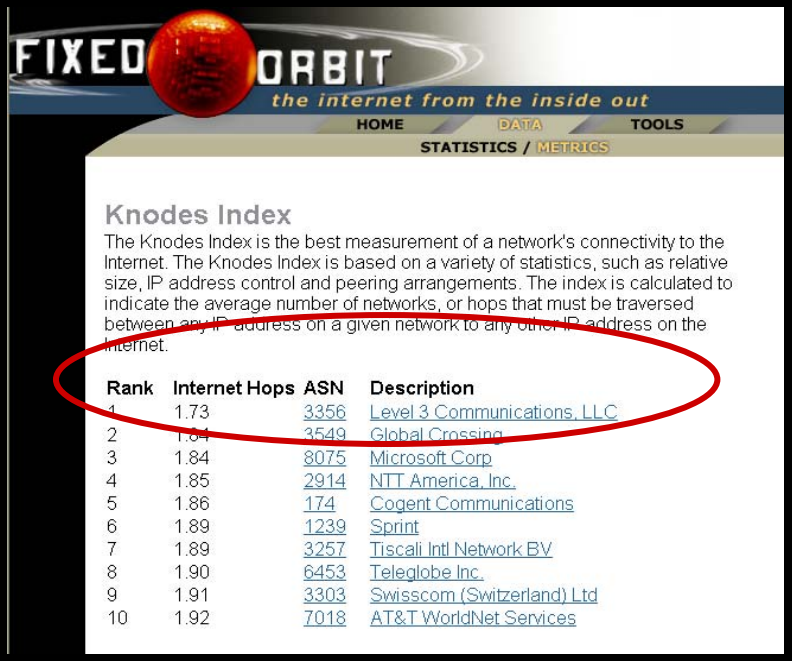
Europe	
Rank	Service Provider
1	Level 3 Communications
2	Sprint
3	TeliaSonera
4	Global Crossing
5	Tiscali
6	Deutsche Telekom
7	Teleglobe/TATA
8	Verizon/MCI
9	Cogent
10	France Telecom

Asia	
Rank	Service Provider
1	Level 3 Communications
2	Sprint
3	NTT
4	Global Crossing
5	China Telecom
6	TeliaSonera
7	Savvis
8	KDDI
9	AT&T
10	Verizon/MCI

Date:15/06/2009

About Renesys and Backbone Customer Base:
Renesys (www.renesys.com) is an independent network intelligence company who's tools provide service providers a real-time view of the global Internet. Renesys measures "Customer Base" as a means of ranking providers who are responsible for meeting the Internet transit needs of large customer networks within a given market.

Fewest AS Hops


FIXED ORBIT

the internet from the inside out

HOME DATA TOOLS

STATISTICS / METRICS

Knodes Index

The Knodes Index is the best measurement of a network's connectivity to the Internet. The Knodes Index is based on a variety of statistics, such as relative size, IP address control and peering arrangements. The index is calculated to indicate the average number of networks, or hops that must be traversed between any IP address on a given network to any other IP address on the Internet.

Rank	Internet Hops	ASN	Description
1	1.73	3356	Level 3 Communications, LLC
2	1.84	3549	Global Crossing
3	1.84	8075	Microsoft Corp
4	1.85	2914	NTT America, Inc.
5	1.86	174	Cogent Communications
6	1.89	1239	Sprint
7	1.89	3257	Tiscali Intl Network BV
8	1.90	6453	Teleglobe Inc.
9	1.91	3303	Swisscom (Switzerland) Ltd
10	1.92	7018	AT&T WorldNet Services

Source: http://www.fixedorbit.com/metrics.htm – updated: 15/06/2009

Fewest hops

Level 3 customers reach global Internet destinations in an average of **1.73 hops , fewer than any other provider**

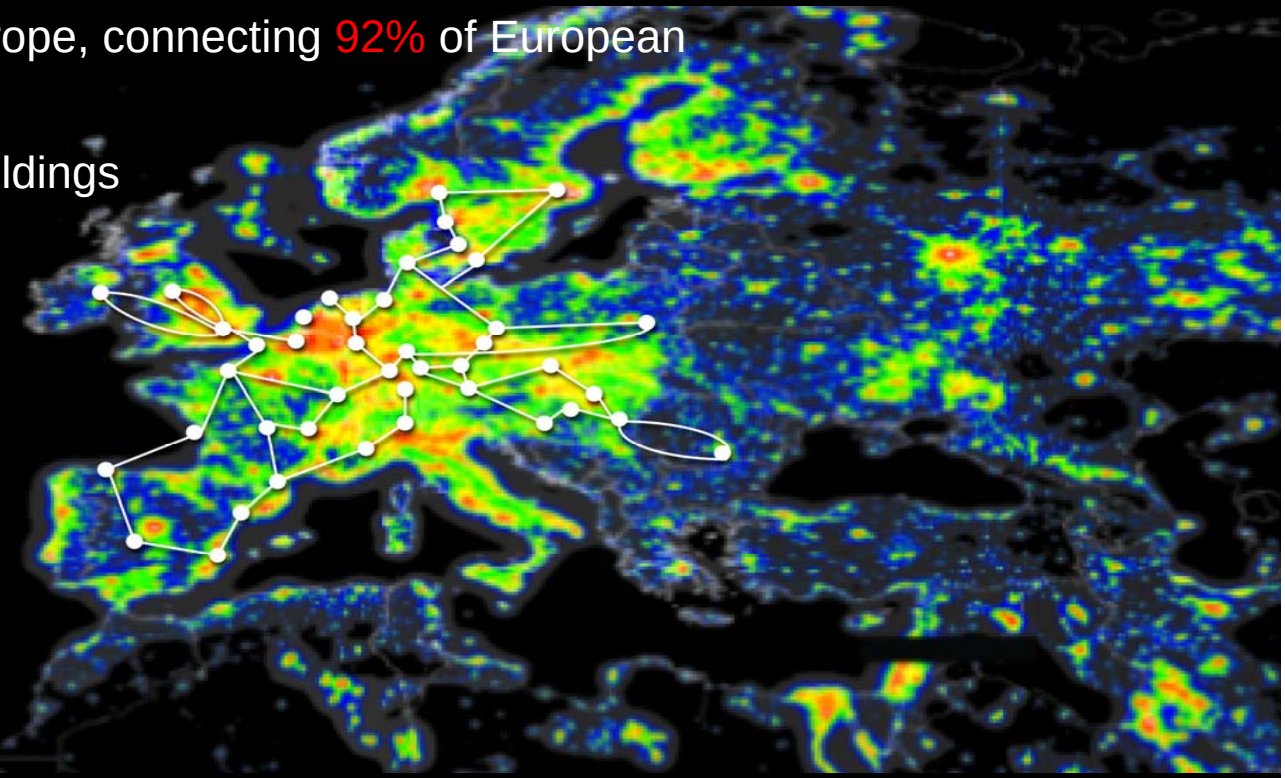
Extensive Connectivity to an extraordinary community of on-net customers and peers

The Internet user has a better, faster experience

- 19 of the top 20 telecom carriers
- 9 of the top 10 largest telecom providers in Europe
- 9 of the top 10 largest U.S. ISP's
- 9 of the top 10 largest U.S. Cable MSOs
- 4 of the top 5 U.S. wireless service providers
- 8 out of top 10 most popular Internet destinations

European Presence
Delivering Extensive Reach with Local Connectivity

- In 28 IP PoPs across Europe, connecting 92% of European eyeballs in 1 hop
- More than 280 on-net buildings
- 2.6 Tbps of customer facing port capacity
- 640 Gbps of interfaces with our peers (EU)
- 480 Gbps of TA capacity dedicated to IP
- 65% of our traffic is on-net giving us an unmatched control of our SLAs



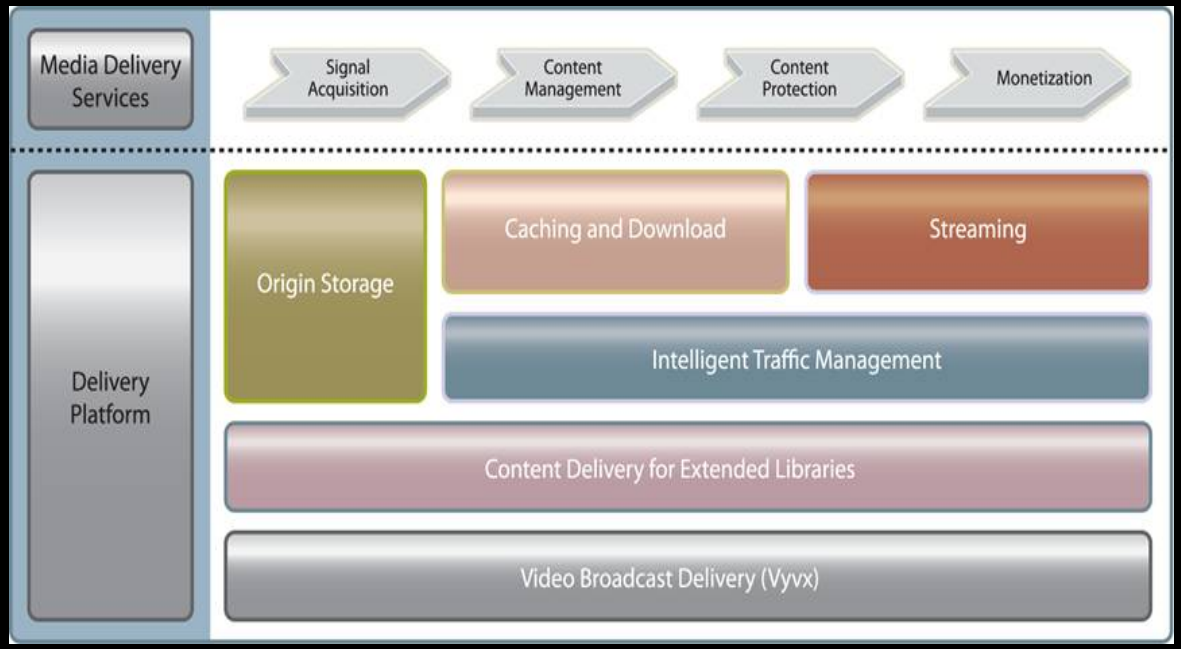
Level 3's Content Delivery Network

Broadcast enabling the Internet

- **Built into Level 3's IP network**
  - HTTP Caching; Move Networks and Microsoft Smooth streaming
  - WMS and FMS Streaming
  - Origin storage and extended library content
- **4,000 servers deployed in 31 strategic locations designed to accommodate the most demanding flash crowd situations**
- **Globally load-balanced and intelligently managed with no reliance on third parties**

- **Benefits to ISPs**
  - Content cached and streamed directly to customers from local sites
  - Enhanced quality of experience for customers

- **Benefits to content providers**
  - Ability to balance between HSIP and CDN as needs change
  - Resilience and redundancy



Extensive Portfolio

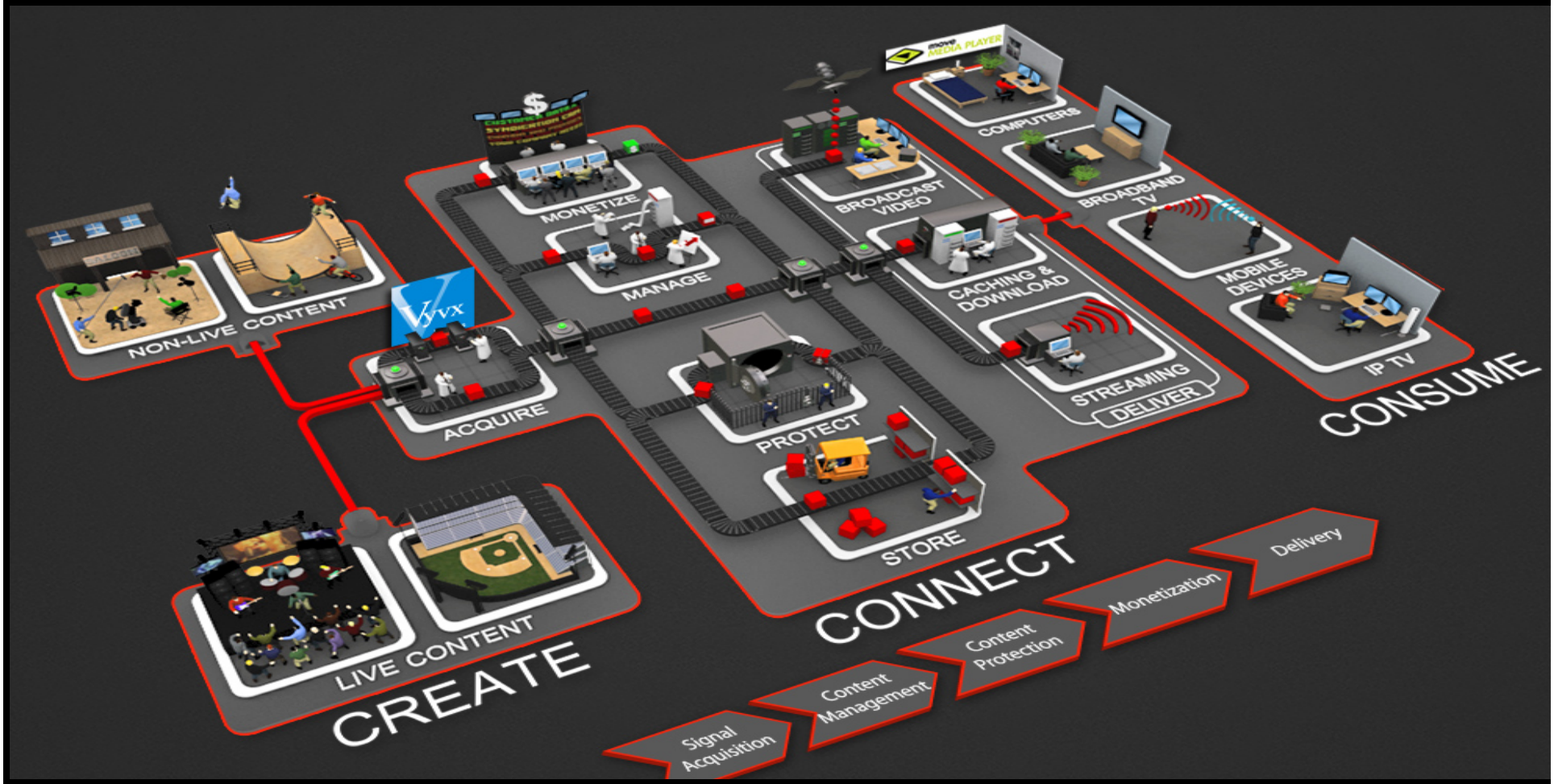
A product suite from layer 0 to 7

Infrastructure	Transport	Data & Ethernet	IP & CDN
Dark Fiber	Private Line	Ethernet Virtual Private Line	HSIP
Colocation	Ethernet PL	Virtual Private LAN Service	CDN
	Wavelengths	IP VPN	Vyvx® Services
	Metro	Managed Ethernet Access	
	Transoceanic		
	Access Solutions		

Level(3)Enabled℠ Portal

Customer Network Planning and Professional Services

From Creation to Consumption



- The Level 3® IP backbone has a global throughput of over 20 Petabytes of traffic per day, which is equivalent to transmitting over 1,000,000 x 20GB movies per day.

Why Level 3?

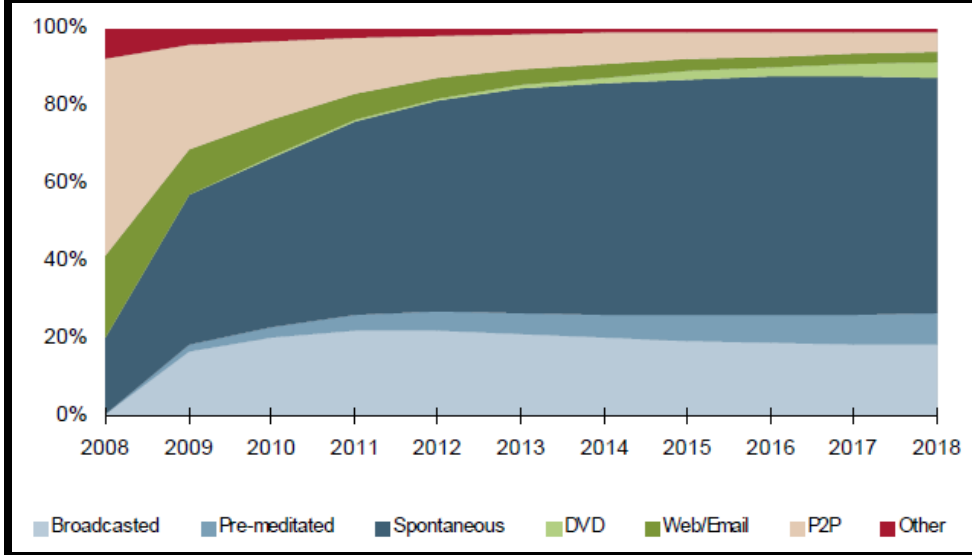
- Unparalleled IP Network reach
- Robust physical and transport network
- Designed for scalability and performance
- Ultra high-speed bandwidth and network interconnections
- Excellence in customer care and quality assurance
- The world's leading IP brand

Fewest AS hops
Level 3 customers reach global Internet destinations in an average of **1.73 hops**

Guaranteed Latency SLA
Europe: **15 ms**
US: **25 ms**
TA: **40 ms**

Exceptional Global Connectivity
Europe: **Number 1**
NA: **Number 1**
Asia: **Number 1**

What are we delivering today?

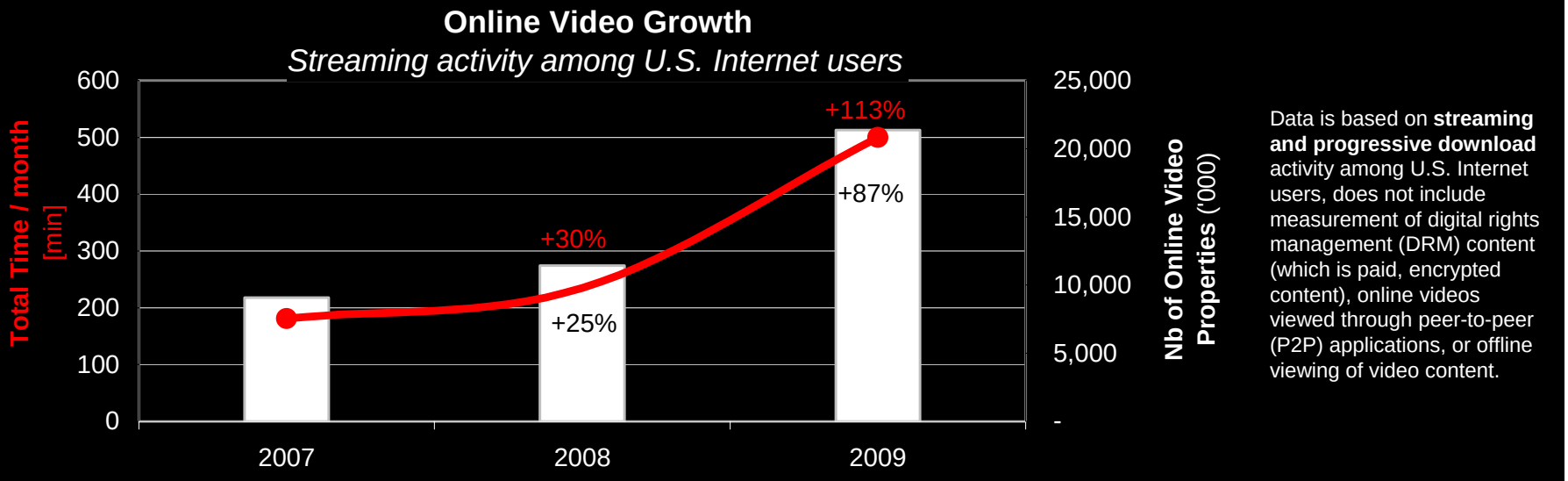


Source: Analysys Mason, Nov 2008

- Video consumption moves online
  - Almost all TV will be on-demand and consumed over IP networks
  - Majority of content to be HD Ready by 2018
  - More pronounced shift to broadcasting linear content over IP
  - Wide range of specialist independent channels, at the expense of existing broadcasters
  - DVD content is downloadable (new DVD rental models)
  - P2P is declining

- Bandwidth composition as a result
  - one minute of medium-quality video equates to around 7-10MB of data
  - Expecting **2Mbps** / broadband line by 2018 (average annual growth 55%)

End users will not wait



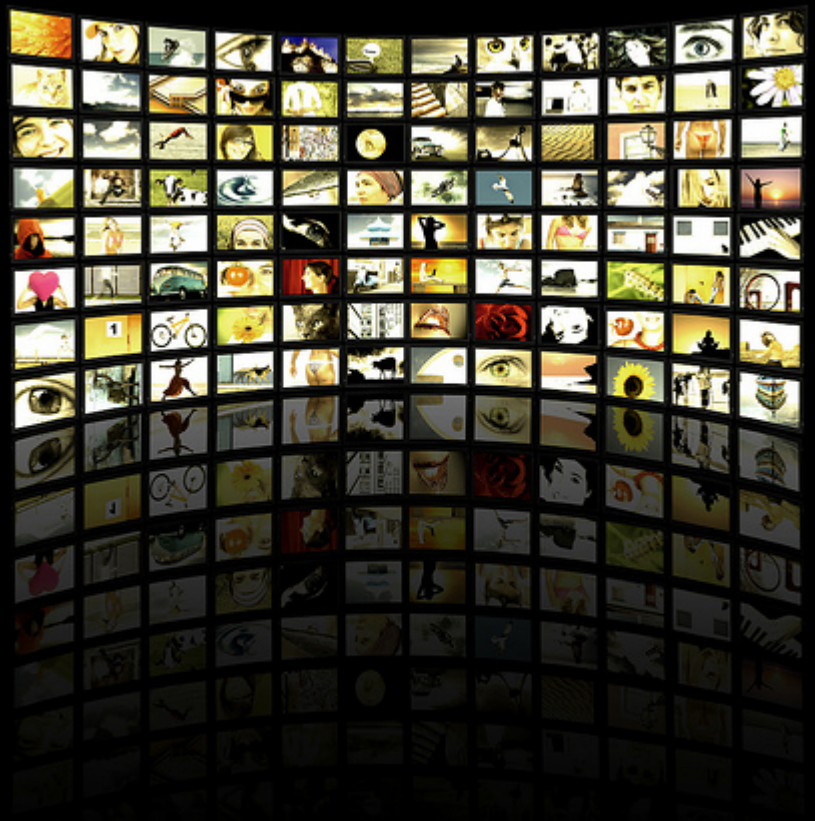
Data is based on **streaming and progressive download** activity among U.S. Internet users, does not include measurement of digital rights management (DRM) content (which is paid, encrypted content), online videos viewed through peer-to-peer (P2P) applications, or offline viewing of video content.

Source: comScore Video Metrix

- The time spent on online video viewing has increased dramatically
  - More than doubled the last year!
- Online Universe – the content available online is expanding at an exponential rate
  - In July 2006 You Tube delivered **100milion** video streams /day
  - Today (3 years later) YouTube video streams Top **1.2 Billion** /day this is an average annual growth of 129% !

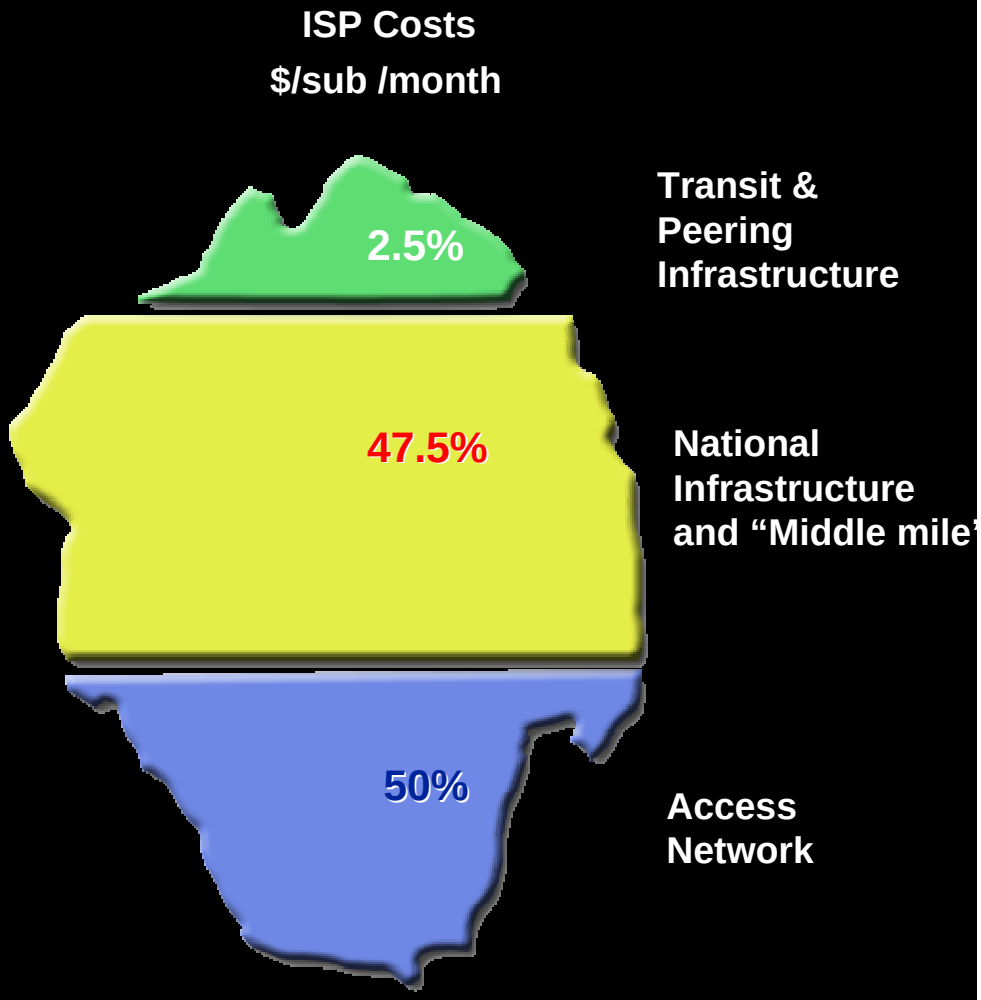
What's down the line

- Joe Lawrence, Principle Network Architect, Level 3 Communications



The Brick Wall

An ISP perspective
- cost of delivery



ISP Architectures

When is an IP Network not an IP Network?

- Traditional “ULL” or Cable architecture
  - Centralised interconnect points
  - Extension cords to content
  - Centralised BRASes
  - Expensive router hops
  - Inefficient transport usage
- Why does growing usage/sub (video) damage this?
  - Unidirectional flows (so in-out infrastructure is wasted)
  - Not from anywhere to anywhere (so why pay for the router hops)

ISP Strategies

Peer it all!

- Many ISPs place almost all of their effort on reducing the percentage of traffic that travels over their transit links – but at what cost?
  - Building an international network
  - Constant political battles over peering
  - Reliance on single interconnect points
  - Hot potato receive (ie you have no control over where you receive the traffic)
    - Hence expensive on infrastructure (router and DWDM hops)
- This misses the point – the costs isn't in the external bandwidth – it's in your networks
- Transit (as well as being very cost effective when compared with the true costs of peering):
  - Lets you control the traffic (via cold potato)
  - Reduces international network management
  - Is less hassle in terms of managing inteconnecting networks

ISP Strategies

Make Content Pay for the network!

- QoS and the fabled walled garden
  - Choke traffic from content sources that won't pay you to "tag" their content
  - Adds cost to your network (and who will pay?)
  - If regular network is fine, why pay (or are your threatening untagged traffic)
  - How will your customers feel about this?

- Slightly subtler… Build a CDN in your network
  - Creates a value added service for content to purchase from the ISP
  - How many ISPs are each content company supposed to buy CDN services from?
  - What exactly does the ISP know about servicing these ultra-high quality conscious customers?
  - What are ISP saying about content that doesn't come from their CDN – is it tagged lower priority?
  - What about the other 20 vertically integrated products that the content customer wants to buy?

ISP Strategies

Why doesn't anyone try these?

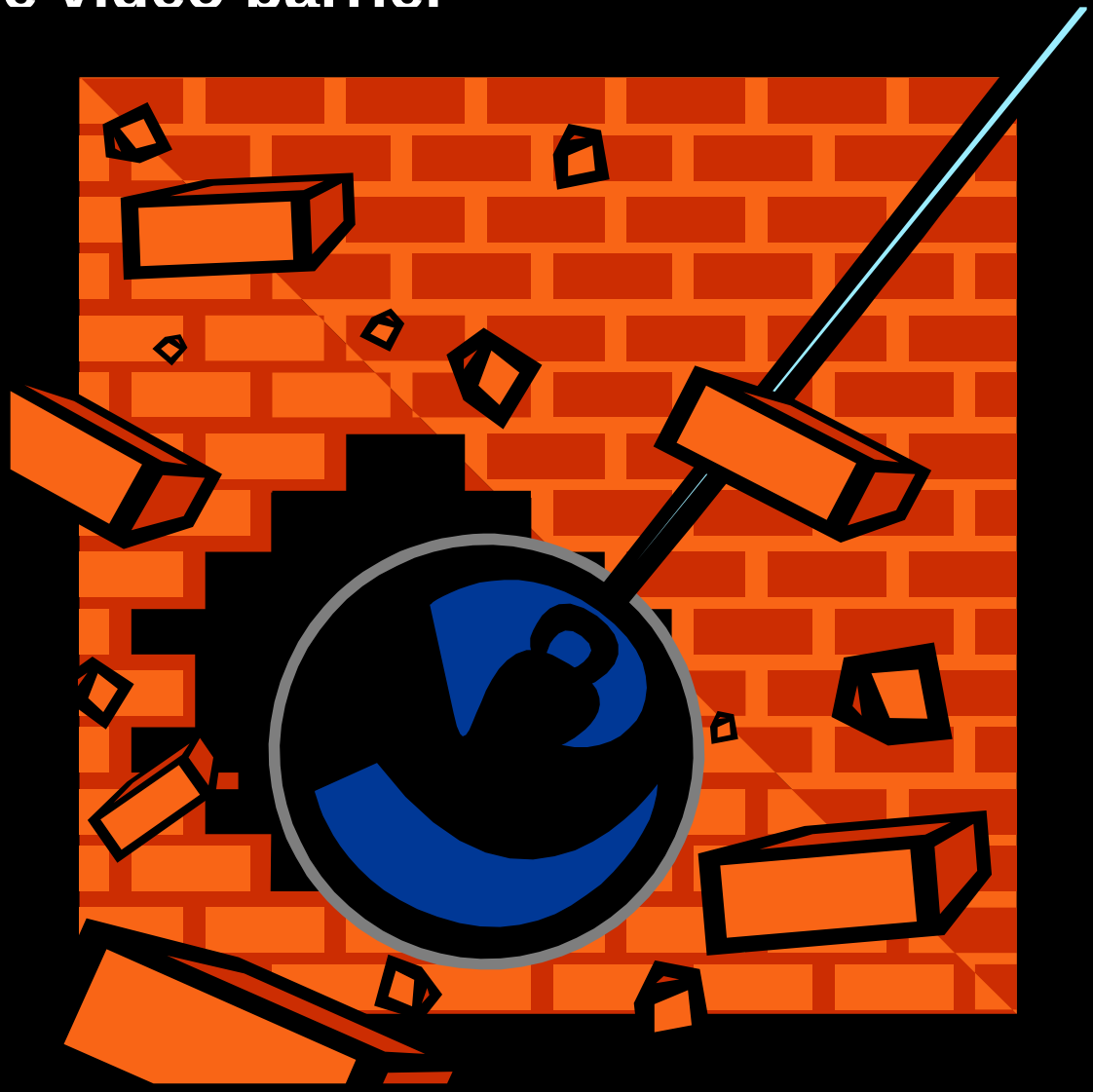
What you can't control

- Eyeballs cause traffic, content doesn't – get over it!
- Growing volumes in an open world (subs won't put up with walled gardens)

What you can control

- Make your network more capable of handling inflows deeper into your network – cold potato your way to happiness!
  - Lower your equipment costs (Tx? definitely IP)
  - Lower your reliance on the incumbent for leased lines
- Work with existing CDNs to allow for caches to be deployed deep in your network (point 1 above being a pre-requisite)

Breaking the video barrier



ISP Strategies: Conclusions

- Sure focus on peering, but that isn't the problem
- Want to build your own CDN? Really?
- QoS your way to pointlessness (and cost you won't recover)

Or…

- Design your network to take feeds locally
- Work with interconnecting parties to lower the number of equipment hops each bit in your network makes
- If the problem is cost, complexity isn't likely to be the solution
- Don't convince yourself someone else should pay for your problem – they won't

Are YOU ready?

- The content tsunami is real and is already happening
- Only those ‘wholesale’ providers who can provide a full suite of solutions will be in a position to service the needs of broadcasters and content companies as service and technical needs become more complicated
- ISPs will continue to face a barrage of content to manage and those who embrace simplicity and partner with those who can help, will provide the quality of service their customers are paying for
- Solutions at the margin are as good as they go, but can only do so much
- ISPs should focus on key competencies (marketing, service provision and support) to keep a lead in a highly competitive market

Thank You

For more details please contact:
andrew.haynes@level3.com