November 21, 2016

BoR (16) 232

Internet Interconnection

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AT&T

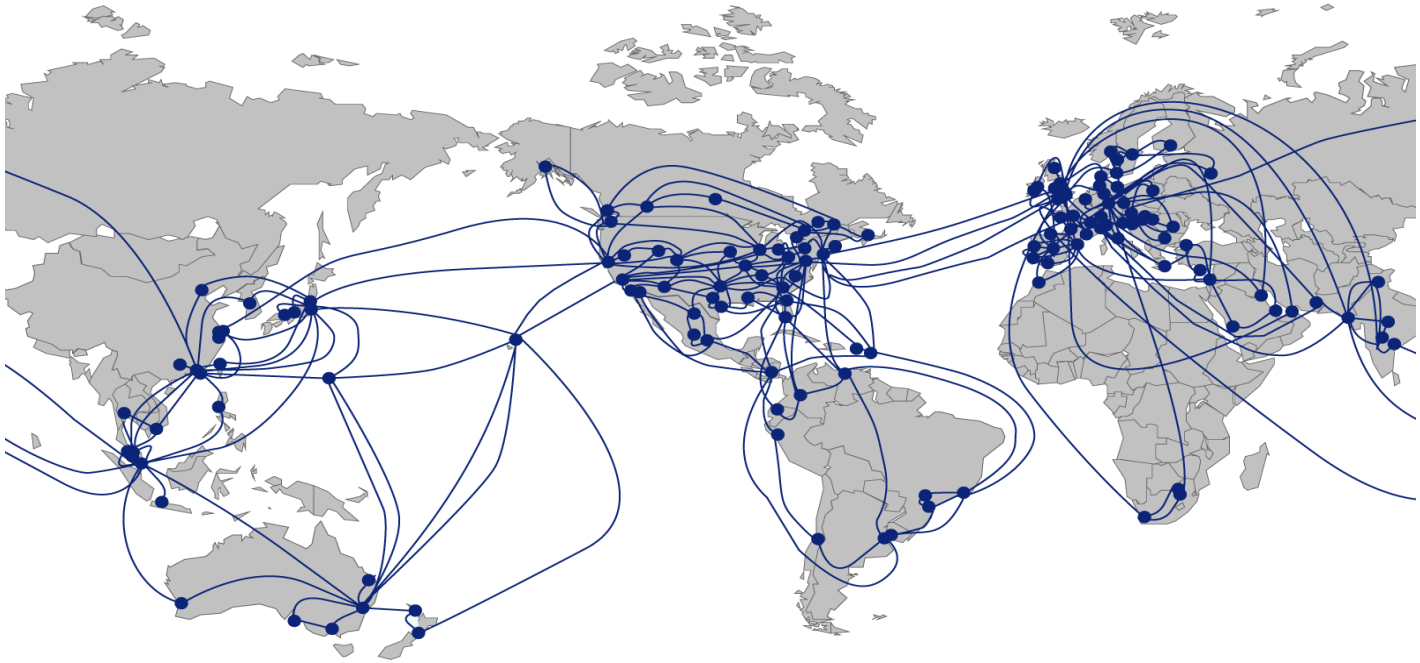
Since 2011 - AT&T's Perspective

– AT&T's Global Network

– Internet Traffic Trends

– Interconnection Trends

– Regulatory Policy



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AT&T's Global Network

– AT&T's global IP network is **multi-purpose**:
  - **Fixed ISP** for ~16 million subscribers.
  - **Mobile ISP** for ~144 million subscribers.
  - Supplier of **corporate VPNs.**
  - Supplier of **website hosting** services.
  - **Carrier's carrier** for other fixed and mobile ISPs.
  - Supplier of **voice** services.

The AT&T Global Network carries more than **125.9 Petabytes of Data Traffic** on an Average Business Day

– Providing these services requires AT&T to interconnect with other IP networks in **large-scale** fashion.
  - The **same physical facilities** and interconnections may be used to support different services that may be separated only logically.
  - To handle 126 Petabytes/day requires **thousands** of 10Gbps–equivalent interconnections.
  - Via **peering**, **on-net only** or **transit** interconnections.

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Internet Traffic Trends

- **Continued growth** in Internet traffic.
- Biggest growth driver **- video, video, video** …
  - **Busy-hour** traffic is **growing** much **faster** than average-hour traffic.
  - Over **half** of all busy-hour traffic is from **two providers** – Netflix and Google (YouTube).
- **Mobile broadband** consumption is growing at a faster rate than fixed. However, fixed broadband consumption is still far greater than mobile.
- Large content providers are **deploying their own CDNs** as a more efficient means of delivering video.
- Industry continues to accommodate growth on **commercial terms.**
- **Transit** service remains highly competitive and **prices continue to decline.**
- **CDN service** is also highly competitive and **prices are declining.**

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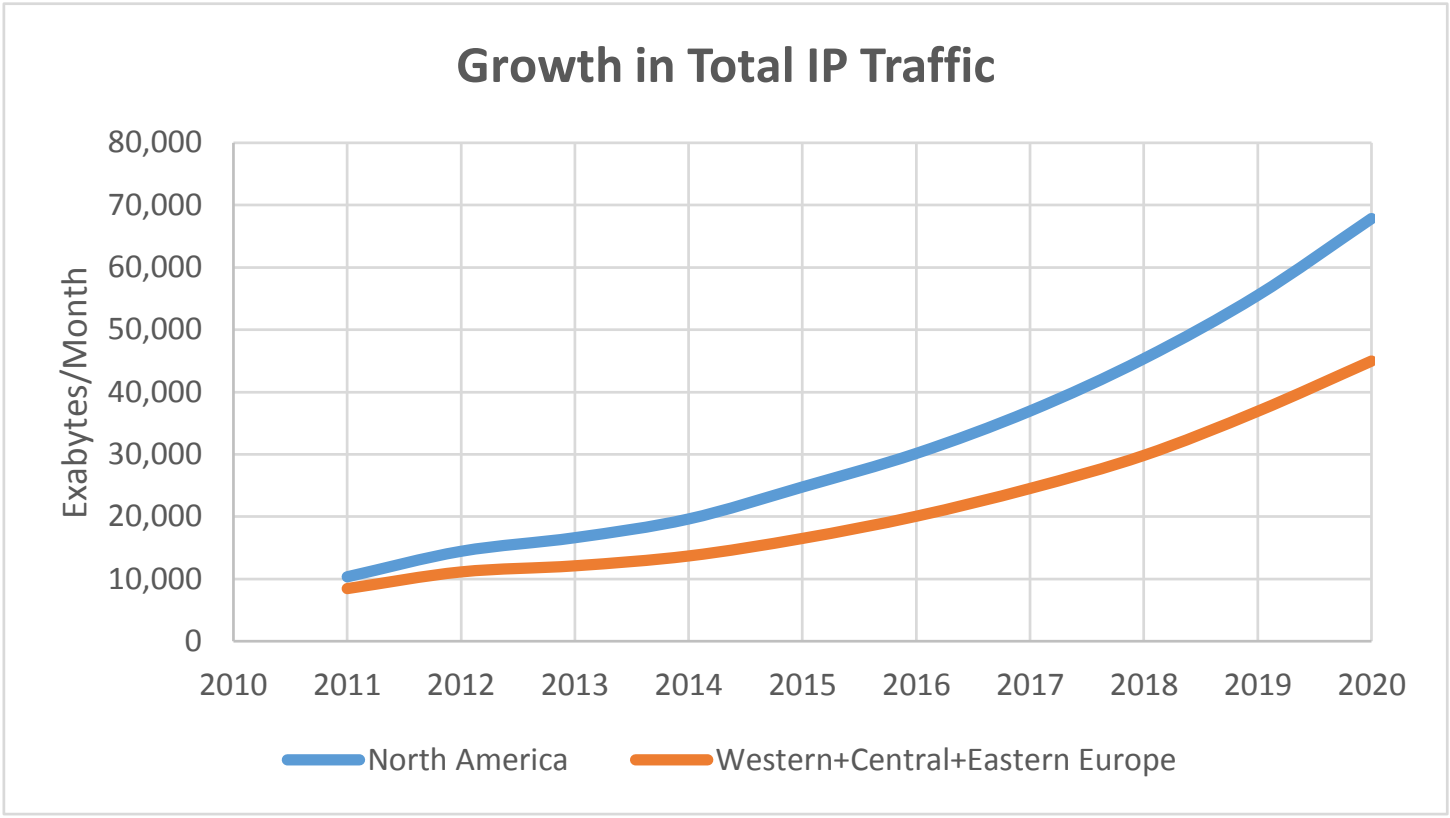
Internet Traffic Continues to Grow



Source: Cisco VNI Report

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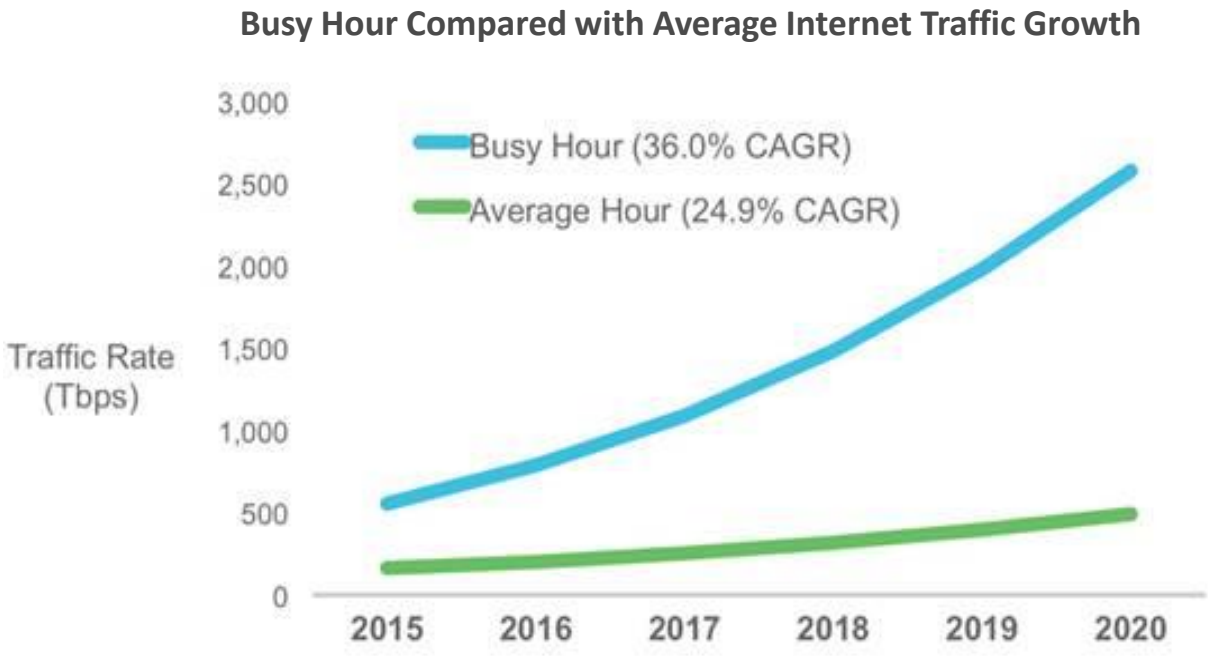
Busy-Hour Traffic is Growing 50% Faster Than Average-Hour Traffic

- This growth is driven largely by video viewing during **evening "prime time"**
- Network capacity requirements and costs **scale** with busy-hour demand, not average-hour



Source: Cisco VNI Global IP Traffic Forecast, 2015–2020

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Busy-Hour is Dominated by Video

Top 10 Peak Period Applications – North America, Fixed

Upstream		Downstream		Aggregate	
BitTorrent	18.37%	Netflix	35.15%	Netflix	32.72%
YouTube	13.13%	YouTube	17.53%	YouTube	17.31%
Netflix	10.33%	Amazon Video	4.26%	HTTP - OTHER	4.14%
SSL - OTHER	8.55%	HTTP - OTHER	4.19%	Amazon Video	3.96%
Google Cloud	6.98%	iTunes	2.91%	SSL - OTHER	3.12%
iCloud	5.98%	Hulu	2.68%	BitTorrent	2.85%
HTTP - OTHER	3.70%	SSL - OTHER	2.53%	iTunes	2.67%
Facebook	3.04%	Xbox One Games Download	2.18%	Hulu	2.47%
FaceTime	2.50%	Facebook	1.89%	Xbox One Games Download	2.15%
Skype	1.75%	BitTorrent	1.73%	Facebook	2.01%
	69.32%		74.33%		72.72%

Source: Sandvine 2016 Global Internet Phenomena

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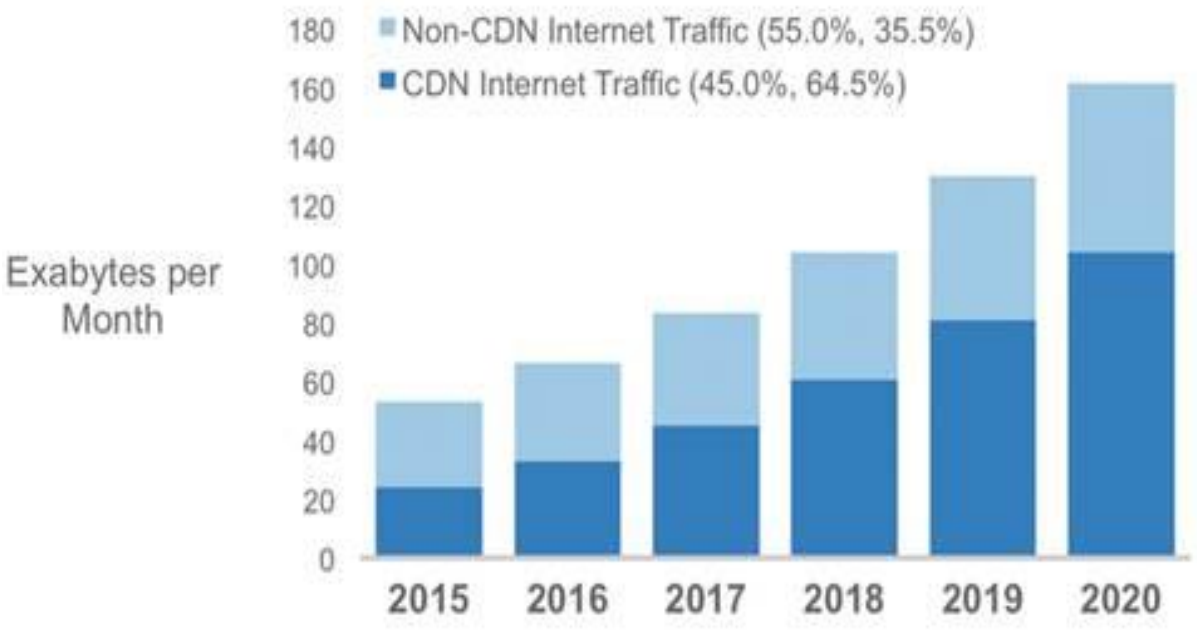
Video is Driving Traffic Delivery Via CDNs

- It is **more efficient** for most streaming video traffic to be delivered to the viewer's ISP by a CDN than via unicast across-the-Internet transport. As a result:
  - Content providers with large volumes of video traffic have deployed their **own CDNs.**
  - Demand for **on-net only** interconnection is increasing rapidly.

Global Content Delivery Network Internet Traffic, 2015 and 2020



Source: Cisco VNI Global IP Traffic Forecast, 2015–2020

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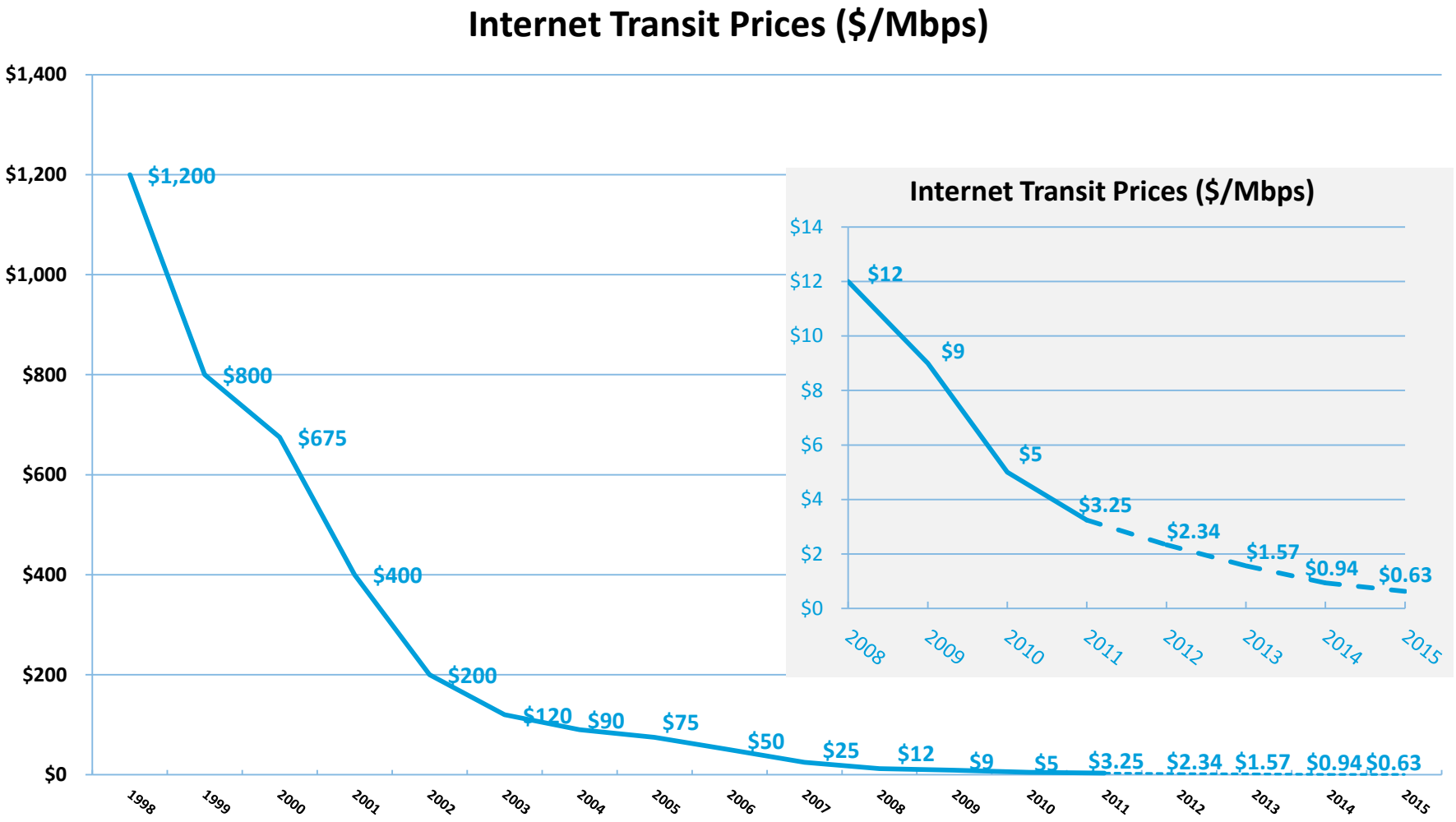
Competition is Driving Lower Transit Prices



Source: drpeering.net

The Interconnection Ecosystem Has Proven to be Resilient and Adaptable

- Networks and interconnection arrangements continue to be **rapidly augmented** to accommodate growth.
- New peering and on-net only agreements are being struck in order to accommodate evolving demands **economically** and **flexibly**.
- **Competition** for transit business is thriving.
- Competition **among CDNs** is also thriving – In 2015, video CDN prices declined 20% and are expected to decrease 20-25% in 2016 – *Dan Rayburn, cdnpricing.com*
- Peering and on-net only connections will move from 10Gbps to **100Gbps.**
- Interconnection **pricing** has followed **costs**, which depend on:
  - **Volume** and time **pattern** of traffic.
  - Required **length of haul** (i.e., hot-potato/best-exit versus best-entrance).
  - **On-net** or **off-net** carriage.
  - **Location** of interconnection.

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Regulatory Policy

For the first time, the FCC, in their 2015 **Open Internet Order,** proposes to apply "light touch" regulation to "Internet traffic exchange."

> "… we lack the background in practices addressing Internet traffic exchange. For this, we adopt a case-by-case approach, which will provide the Commission with greater experience. Thus, we will continue to monitor traffic exchange and development in this market."

– The FCC found Internet traffic exchange to be a part of Broadband Internet Access Service.

This **may threaten the dynamism** with which commercial interconnection has been able to adapt to rapidly evolving market needs.

– Regulation is **unnecessary** as the industry has repeatedly been able to resolve interconnection related issues on voluntary commercial terms. The market is working.

– Because the Open Internet rules impose obligations **asymmetrically** only on ISPs serving eyeballs and not to backbone ISPs and content and application providers:

- **Hold-ups** will likely arise.
- May encourage **rent seeking.**
- Dynamism will be **suppressed.**

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