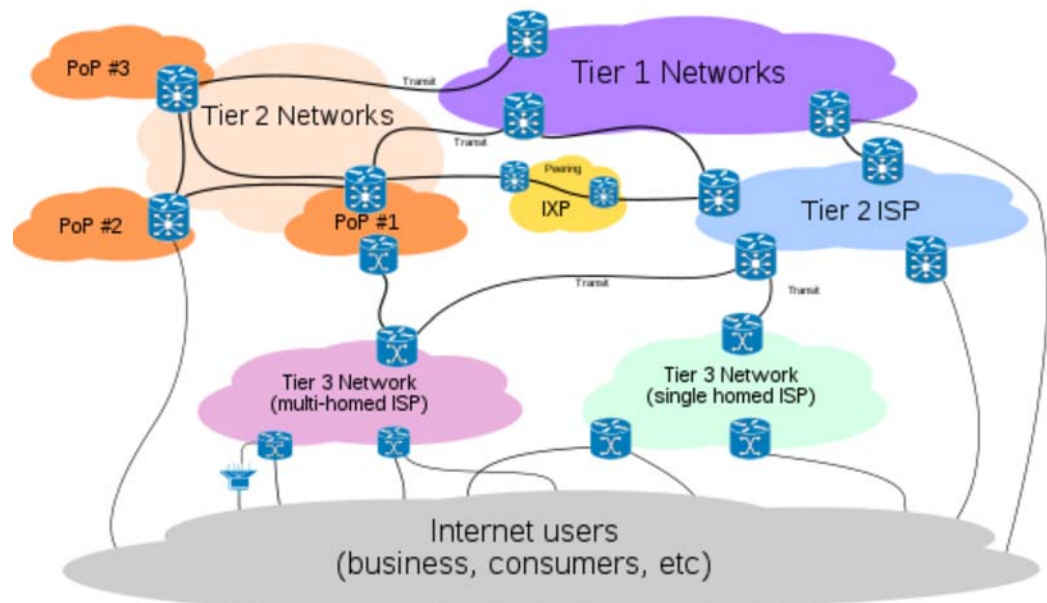# Tier 1 network

A **Tier 1 network** is an Internet Protocol (IP) network that can reach every other network on the Internet solely via settlement-free interconnection (also known as settlement-free peering).[1][2] Tier 1 networks can exchange traffic with other Tier 1 networks without having to pay any fees for the exchange of traffic in either direction,[3] while some Tier 2 networks and all Tier 3 networks must pay to transmit traffic on other networks.[3]

Relationship between the various tiers of Internet providers

There is no authority that defines tiers of networks participating in the Internet.[1] The most common and well-accepted definition of a Tier 1 network is a network that can reach every other network on the Internet without purchasing IP transit or paying for peering.[2] By this definition, a Tier 1 network must be a transit-free network (purchases no transit) that peers for free with every other Tier 1 network and can reach all major networks on the Internet. Not all transit-free networks are Tier 1 networks, as it is possible to become transit-free by paying for peering, and it is also possible to be transit-free without being able to reach all major networks on the Internet.

The most widely quoted source for identifying Tier 1 networks is published by Renesys Corporation,[4] but the base information to prove the claim is publicly accessible from many locations, such as the RIPE RIS database,[5] the Oregon Route Views servers, Packet Clearing House, and others.

It can be difficult to determine whether a network is paying for peering or transit, as these business agreements are rarely public information, or are covered under a non-disclosure agreement. The Internet peering community is roughly the set of peering coordinators present at the Internet exchange points on more than one continent. The subset representing Tier 1 networks is collectively understood in a loose sense, but not published as such.

Common definitions of Tier 2 and Tier 3 networks:

- Tier 2 network: A network that peers for free with some networks, but still purchases IP transit or pays for peering to reach at least some portion of the Internet.
- Tier 3 network: A network that solely purchases transit/peering from other networks to participate in the Internet.

Contents

History

The original Internet backbone was the ARPANET when it provided the routing between most participating networks. The development of the British JANET (1984) and U.S. NSFNET (1985) infrastructure programs to serve their nations' higher education communities, regardless of discipline,[6] resulted in 1989 with the NSFNet backbone. The Internet could be defined as the collection of all networks connected and able to interchange Internet Protocol datagrams with this backbone. Such was the weight of the NSFNET program and its funding ($200 million from 1986 to 1995) - and the quality of the protocols themselves - that by 1990 when the ARPANET itself was finally decommissioned, TCP/IP had supplanted or marginalized most other wide-area computer network protocols worldwide.

When the Internet was opened to the commercial markets, multiple for-profit Internet backbone and access providers emerged. The network routing architecture then became decentralized and attained a need for exterior routing protocols, in particular the Border Gateway Protocol emerged. New Tier 1 ISPs and their peering agreements supplanted the government-sponsored NSFNet, a program that was officially terminated on April 30, 1995.[6] The NSFnet-supplied regional networks then sought to buy national-scale Internet connectivity from these now numerous, private, long-haul networks.

Routing through peering

A bilateral private peering agreement typically involves a direct physical link between two partners. Traffic from one network to the other is then primarily routed through that direct link.

A Tier 1 network may have various such links to other Tier 1 networks. Peering is founded on the principle of equality of traffic between the partners and as such disagreements may arise between partners in which usually one of the partners unilaterally disconnects the link in order to force the other into a payment scheme. Such disruptive de-peering has happened several times during the first decade of the 21st century. When this involves large-scale networks involving many millions of customers this may effectively partition a part of the Internet involving those carriers, especially if they decide to disallow routing through alternate routes. This is not largely a technical issue but a commercial matter in which a financial dispute is fought out using the other party's customers as hostages to obtain a better negotiating position. In the worst case, single-homed customers of each network will not be able to reach the other network at all. The de-peering party then hopes that the other network's customers will be hurt more by the decision than its own customers which may eventually conclude the negotiations in its favor.[7][8] Lower tier ISPs and other parties not involved in the dispute may be unaffected by such a partition as there exist

typically multiple routes onto the same network. The disputes referenced have also typically involved transit-free peering in which one player only exchanged data with the other that involved each other's networks—there was no data transiting *through* the other's network destined for other parts of the Internet. By the strict definition of peering and the strict definition of a Tier 1 network, a Tier 1 network only peers with other Tier 1 networks and has no transit routes going anywhere. More practically speaking, Tier 1 networks *serve* as transit networks for lower tier networks and only peer with other Tier 1 networks that offer the same services on an adequate scale—effectively being "peers" in the truest sense of the word.[9]

More appropriately then, peering means the exchange of an equitable and fair amount of data-miles between two networks, agreements of which do not preclude any pay-for-transit contracts to exist between the very same parties. On the subject of routing, settlement-free peering involves conditions disallowing the abuse of the other's network by sending it traffic not destined for that network (i.e. intended for transit). Transit agreements however would typically cater for just such outbound packets. Tier 1 providers are more central to the Internet backbone and would only purchase transit from other Tier 1 providers, while selling transit to providers of all tiers. Given their huge networks, Tier 1 providers do not participate in public Internet Exchanges but rather sell transit services to such participants.

In the most logical definition, a Tier 1 provider will never pay for transit because the set of all Tier 1 providers sells transit to all of the lower tier providers everywhere, and because

> (a) all Tier 1 providers peer with every other Tier 1 provider globally and,

> (b) the peering agreement allows *access* to all of the transit customers, this means that

> (c) the Tier 1 network contains all hosts everywhere that are connected to the global Internet.

As such, by the peering agreement, all the customers of any Tier 1 provider already have access to all the customers of all the other Tier 1 providers without the Tier 1 provider itself having to pay transit costs to the other networks. Effectively, the actual transit costs incurred by provider A on behalf of provider B are logically identical to the transit costs incurred by provider B on behalf of provider A -- hence there not being any payment required.

List of Tier 1 networks

These networks are universally recognized as Tier 1 networks, because they can reach the entire internet (IPv4 and IPv6) via settlement free peering. The CAIDA AS Rank is a rank of importance on the internet.[10]

Name	Headquarters	AS number	CAIDA AS Rank[10]	Fiber Route Miles	Fiber Route km	Peering Policy
AT&T[11]	United States	7018	23	410,000	660,000[12]	AT&T Peering policy (http://www.corp.att.com/peering/)
CenturyLink (formerly Level 3)[13][14]	United States	3356	1	750,000	885,139[15][16]	North America (http://www.centurylink.com/legal/peering_na.html); International (http://www.centurylink.com/legal/peering_int.html) Level 3 Peering Policy (http://www.level3.com/~/media/files/brochures/en_dataserv_br_secureinternetservices.pdf/en/legal/ip-traffic-exchange-policy/)
CenturyLink (formerly Level 3 formerly Global Crossing)[13][14]	United States	3549	12	750,000	885,139[15][16]	North America (http://www.centurylink.com/legal/peering_na.html); International (http://www.centurylink.com/legal/peering_int.html) Level 3 Peering Policy (http://www.level3.com/~/media/files/brochures/en_dataserv_br_secureinternetservices.pdf/en/legal/ip-traffic-exchange-policy/)
Deutsche Telekom Global Carrier[17]	Germany	3320	20	155,343	250,000[18]	DTAG Peering Details (https://www.peeringdb.com/asn/3320)
GTT Communications, Inc.	United States	3257	3	144,738	232,934[19][20]	GTT Peering Policy (http://www.gtt.net/peering/)
KPN International[21]	Netherlands	286	35	75,000	120,000[22]	KPN Peering Policy (https://as286.net/AS286-routing-policy.html)
Liberty Global[23][24]	United Kingdom[25]	6830	31	500,000	800,000[26]	Peering Principles (https://www.libertyglobal.com/operations/business-services/global-peering-principles/)
NTT Communications (America) (formerly Verio)[27]	Japan	2914	5	?	?	North America (http://www.us.ntt.net/support/policy/routing.cfm)

Name	Headquarters	AS number	CAIDA AS Rank[10]	Fiber Route Miles	Fiber Route km	Peering Policy
Orange (OpenTransit)[28]	France	5511	18	?	?	OTI peering policy (https://www.peeringdb.com/asn/5511)
PCCW Global	Hong Kong	3491	9	?	?	Peering policy (https://www.peeringdb.com/asn/3491)
Sprint (SoftBank Group)[29]	Japan	1239	27	26,000	42,000[30]	Peering policy (https://www.peeringdb.com/asn/1239)
Tata Communications (formerly Teleglobe)[31]	India	6453	6	435,000	700,000[32]	Peering Policy (https://www.peeringdb.com/asn/6453)
Telecom Italia Sparkle (Seabone)[33]	Italy	6762	8	347,967	560,000	Peering Policy (https://www.peeringdb.com/asn/6762)
Telxius (https://telxius.com/) (Subsidiary of Telefónica)[34]	Spain	12956	14	40,000	65,000[35]	Peering Policy (https://telxius.com/wp-content/uploads/2017/08/Peering-policy-Telxius.pdf)
Telia Carrier[36]	Sweden	1299	2	40,000	65,000[37]	TeliaSonera International Carrier Global Peering Policy (https://web.archive.org/web/20160817032814/http://www.teliacarrier.com/dms/teliasoneraic/Documents/tsic-pp-010.pdf)
Verizon Enterprise Solutions (formerly UUNET)[42]	United States	701	22	500,000	805,000[43]	Verizon UUNET Peering policy 701, 702, 703 (http://www.verizonenterprise.com/terms/peering/)
Zayo Group (formerly AboveNet)[44]	United States	6461	10	122,000	196,339[45]	Zayo Peering Policy (http://www.zayo.com/wp-content/uploads/2017/02/ZayoPeeringPolicy.pdf)

While most of these Tier 1 providers offer global coverage (based on the published network map on their respective public websites), there are some which are restricted geographically. However these do offer global coverage for mobiles and IP-VPN type services which are unrelated to being a Tier 1 provider.

A 2008 report shows Internet traffic relying less on U.S. networks than previously.[46]

Regional Tier 1 networks

A common point of contention regarding Tier 1 networks is the concept of a *regional Tier 1* network. A regional Tier 1 network is a network which is not transit free globally, but which maintains many of the classic behaviors and motivations of a Tier 1 network within a specific region.

A typical scenario for this characteristic involves a network that was the incumbent telecommunications company

in a specific country or region, usually tied to some level of government-supported monopoly. Within their specific countries or regions of origin, these networks maintain peering policies which mimic those of Tier 1 networks (such as lack of openness to new peering relationships and having existing peering with every other major network in that region). However, this network may then extend to another country, region, or continent outside of its core region of operations, where it may purchase transit or peer openly like a Tier 2 network.

A commonly cited example of these behaviors involves the incumbent carriers within Australia, who will not peer with new networks in Australia under any circumstances, but who will extend their networks to the United States and peer openly with many networks. Less extreme examples of much less restrictive peering requirements being set for regions in which a network peers, but does not sell services or have a significant market share, are relatively common among many networks, not just regional Tier 1 networks.

While the classification *regional Tier 1* holds some merit for understanding the peering motivations of such a network within different regions, these networks do not meet the requirements of a true global Tier 1 because they are not transit free globally.[47]

Other major networks

This is a list of networks that are often considered and close to the status of Tier 1, because they can reach the majority (80%+) of the internet via settlement free peering. However, routes to one or more Tier 1 are missing or paid. Therefore they are technically Tier 2 and practically something in between.

Name	Headquarters	AS Number	CAIDA AS Rank[10]	Reason
Comcast	United States	7922	25	Network limited to the US; Purchases transit from Tata/AS6453, otherwise full reach via peering
Cogent Communications[48]	United States	174	4	IPv6: No routes to Google/AS15169 nor Hurricane Electric/AS6939.[49][50]
Hurricane Electric[51]	United States	6939	7	IPv4: Purchases transit from Telia/AS1299 to reach NTT/AS2914, Cogent/AS174, Tata/AS6453 and GTT/AS3257[52] IPv6: No routes to Cogent/AS174.[53][54]
Vodafone (formerly Cable and Wireless)	United Kingdom	1273	11	Purchases transit from Telia Carrier/AS1299 to reach AT&T/AS7018. [55]
Verizon Enterprise Solutions (formerly XO Communications)[60]	United States	2828	33	IPv6: Purchases transit from Sprint/AS1239 to reach Vodafone (CW)/AS1273 and Telecom Italia Sparkle (Seabone).

See also

- Interconnect agreement
- Internet exchange point
- List of Internet exchange points

References

1. Winther, Mark (May 2006). "Tier1 ISPs: What They Are and Why They Are Important" (http://www.us.ntt.net/downloads/papers/IDC_Tier1_ISPs.pdf) (PDF). *NTT America Corporate*.

2. "How the 'Net works: an introduction to peering and transit: Page 4" (https://arstechnica.com/guides/other/peering-and-transit.ars/4). 2008-09-02. Retrieved 2008-11-04. "Tier 1 networks are those networks that don't pay any other network for transit yet still can reach all networks connected to the internet."

3. "Definition of: Tier 1 network" (https://www.pcmag.com/encyclopedia/term/60763/tier-1-network). *pcmag.com*. Retrieved 2018-08-10.

4. http://renesys.com/ Renesys Corporation

5. RIPE RIS database (http://www.ripe.net/ris/)

6. "Brief History of the Internet" (https://www.internetsociety.org/internet/history-internet/brief-history-internet/). *Internet Society*. Retrieved 2019-01-22.

7. "You can't get there from here" (http://www.renesys.com/2008/03/you-cant-get-there-from-here-1/). 2008-03-17. Retrieved 2014-05-11. "Cogent and Telia are having a lover's quarrel and, as a result, the Internet is partitioned. That means customers of Cogent and Telia cannot necessarily reach one another."

8. " 'Peering' Into AOL-MSN Outage" (http://www.internetnews.com/dev-news/article.php/3073411). 2003-09-05. Retrieved 2014-05-11. "Some industry watchers believe the problem shows signs of dispute over peering agreements -- deals between Internet service providers to create a direct link to route each other's packets rather than pay a third-party network service provider for transport."

9. "Level 3 IP traffic exchange policy" (http://www.level3.com/en/legal/ip-traffic-exchange-policy/). Retrieved 2014-05-11. "Must provide paid Internet transit services to at least 500 unique transit networks utilizing BGP on a global basis."

10. CAIDA AS ranking (http://as-rank.caida.org/)

11. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=7018). 2016-09-01. Retrieved 2016-09-01.

12. http://www.att.com/gen/general?pid=7462

13. "CenturyLink completes acquisition of Level 3" (http://news.centurylink.com/2017-11-01-CenturyLink-completes-acquisition-of-Level-3). *MediaRoom*. Retrieved 2019-01-22.

14. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=209). 2016-09-01. Retrieved 2016-09-01.

15. Inc, CenturyLink. "CenturyLink completes largest deployment of G.fast technology in North America" (https://www.prnewswire.com/news-releases/centurylink-completes-largest-deployment-of-gfast-technology-in-north-america-300325687.html). *www.prnewswire.com*. Retrieved 2019-01-22.

16. http://www.level3.com/~/media/files/brochures/en_dataserv_br_secureinternetservices.pdf

17. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=3320). 2016-09-01. Retrieved 2016-09-01.

18. "Internet and Contents" (https://globalcarrier.telekom.com/business-areas/internet-content).

19. https://www.gtt.net/wp-content/uploads/2017/02/GTT-Investor-Presentation-February-2017.pdf

20. "GTT Buys Interoute for $2.3 Billion to Gain Europe Fiber Network" (https://www.bloombergquint.com/business/gtt-buys-interoute-for-2-3-billion-to-gain-europe-fiber-network). *BloombergQuint*. Retrieved 2019-02-05.

21. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=286). 2016-09-01. Retrieved 2016-09-01.

22. http://www.kpn-international.com/network

23. "AS6830 IPv4 route propagation" (http://bgp.he.net/AS6830#_graph4). 2016-11-09. Retrieved 2016-11-09.

24. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=6830). 2016-11-15. Retrieved 2016-11-15.

25. http://www.libertyglobal.com/about-us-contact-us.aspx

26. "Liberty Global | largest international cable company" (https://web.archive.org/web/20170809184226 /http://www.libertyglobal.com/index.html). *www.libertyglobal.com*. Archived from the original (http://w ww.libertyglobal.com/index.html) on 2017-08-09. Retrieved 15 August 2017.

27. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=2914). 2016-09-01. Retrieved 2016-09-01.

28. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=5511). 2016-09-01. Retrieved 2016-09-01.

29. "Sprint and SoftBank Announce Completion of Merger | Sprint Newsroom" (https://newsroom.sprint.c om/sprint-and-softbank-announce-completion-of-merger.htm). *newsroom.sprint.com*. Retrieved 2019-01-22.

30. https://www.sprint.com/business/resources/fts2001/rrg/section2.doc

31. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=6453). 2016-09-01. Retrieved 2016-09-01.

32. http://www.tatacommunications.com/glance/our-network

33. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=6762). 2016-09-01. Retrieved 2016-09-01.

34. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=12956&data-selec ted-id=26). 2016-09-01. Retrieved 2016-09-01.

35. http://telxius.com/wp-content/uploads/2016/12/Fichas_Telxius_Capacity-Services.pdf

36. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=1299). 2016-09-01. Retrieved 2016-09-01.

37. "Telia Carrier" (http://www.teliacarrier.com/About-us.html). *Telia Carrier*. Retrieved 2019-01-22.

38. http://www.fiercetelecom.com/telecom/after-delay-verizon-wraps-1-8b-xo-acquisition-deepens-metro- fiber-density-45-markets

39. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=701). 2016-09-01. Retrieved 2016-09-01.

40. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=702). 2016-07-30. Retrieved 2016-07-30.

41. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=703). 2016-07-30. Retrieved 2016-07-30.

42. [38][39][40][41]

43. "When you need quality, reliability and a global presence, trust Verizon Partner Solutions for all of your VOICE SERVICES requirements" (https://www22.verizon.com/wholesale/productguide/voice_s ervices/when-you-need-quality-reliability-and-a-global-presence-trust-verizon-global-wholesale-for-al l-of-your-voice-services-requirements.html). *www22.verizon.com*. Retrieved 2019-01-22.

44. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=6461). 2016-09-01. Retrieved 2016-09-01.

45. "Network Solutions Provider - Dark Fiber Network | Zayo Group, LLC" (https://www.zayo.com/service s/dark-fiber/). *Zayo Group*. Retrieved 2019-01-22.

46. Markoff, John (2008-08-30). "Internet Traffic Begins to Bypass the US" (https://www.nytimes.com/20 08/08/30/business/30pipes.html?pagewanted=all). *New York Times*.

47. "Who are the Tier 1 ISPs?" (https://drpeering.net/FAQ/Who-are-the-Tier-1-ISPs.php). *drpeering.net*. Retrieved 2019-05-22.

48. "Caida" (http://as-rank.caida.org/). *caida.org*. Retrieved 1 February 2018.

49. "Cogent - Google - HE Fun" (http://mailman.nanog.org/pipermail/nanog/2016-March/084611.html). 2016-03-09.

50. "No connectivity to Cogent IPv6 network" (https://www.sixxs.net/tickets/?msg=tickets-8635922). *www.sixxs.net*. Retrieved 5 February 2017.

51. "Caida" (http://as-rank.caida.org/). *caida.org*. Retrieved 1 February 2018.

52. "AS6939 Hurricane Electric LLC - bgp.he.net" (https://bgp.he.net/AS6939#_graph4). Retrieved 2019-12-20.

53. "Peering Disputes Migrate to IPv6" (http://www.datacenterknowledge.com/archives/2009/10/22/peering-disputes-migrate-to-ipv6/).

54. "IPv6 internet broken, cogent/hurricane not peering" (https://mailman.nanog.org/pipermail/nanog/2009-October/014017.html).

55. "AS1273 Cable and Wireless Worldwide plc - bgp.he.net" (https://bgp.he.net/AS1273#_graph4). *bgp.he.net*. Retrieved 2019-11-03.

56. http://www.fiercetelecom.com/telecom/after-delay-verizon-wraps-1-8b-xo-acquisition-deepens-metro-fiber-density-45-markets

57. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=701). 2016-09-01. Retrieved 2016-09-01.

58. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=702). 2016-07-30. Retrieved 2016-07-30.

59. "CAIDA AS Rank" (http://as-rank.caida.org/?mode0=as-info&mode1=as-table&as=703). 2016-07-30. Retrieved 2016-07-30.

60. [56][57][58][59]

Retrieved from "https://en.wikipedia.org/w/index.php?title=Tier_1_network&oldid=940314232"

This page was last edited on 11 February 2020, at 20:12 (UTC).