Autonomous system (Internet)

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An **autonomous system** (**AS**) is a collection of connected [Internet Protocol](https://en.wikipedia.org/wiki/Internet_protocol_address) (IP) [routing](https://en.wikipedia.org/wiki/Routing) prefixes under the control of one or more network operators on behalf of a single administrative entity or domain that presents a common, clearly defined routing policy to the internet.[[1]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-1)

Originally the definition required control by a single entity, typically an [Internet service provider](https://en.wikipedia.org/wiki/Internet_service_provider) (ISP) or a very large organization with independent connections to multiple networks, that adhered to a single and clearly defined routing policy, as originally defined in RFC 1771.[[2]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-2) The newer definition in [RFC 1930](https://tools.ietf.org/html/rfc1930) came into use because multiple organizations can run [Border Gateway Protocol](https://en.wikipedia.org/wiki/Border_Gateway_Protocol) (BGP) using private AS numbers to an [ISP](https://en.wikipedia.org/wiki/ISP) that connects all those organizations to the internet. Even though there may be multiple autonomous systems supported by the ISP, the internet only sees the routing policy of the ISP. That ISP must have an officially registered **autonomous system number** (**ASN**).

A unique ASN is allocated to each AS for use in BGP routing. ASNs are important because the ASN uniquely identifies each network on the Internet.

Until 2007, AS numbers were defined as 16-bit integers, which allowed for a maximum of 65,536 assignments. [RFC 4893](https://tools.ietf.org/html/rfc4893) introduced 32-bit AS numbers, which the [Internet Assigned Numbers Authority](https://en.wikipedia.org/wiki/Internet_Assigned_Numbers_Authority) (IANA) has begun to allocate to [regional Internet registry](https://en.wikipedia.org/wiki/Regional_Internet_registry) (RIRs), although this proposed standard has now been replaced by [RFC 6793](https://tools.ietf.org/html/rfc6793). These numbers are written preferably as simple integers (in a notation sometimes referred to as "asplain") ranging from 0 to 4,294,967,295 ([hexadecimal](https://en.wikipedia.org/wiki/Hexadecimal) 0xFFFF FFFF), or in the form called "asdot" which looks like *x.y*, where *x* and *y* are 16-bit numbers. Numbers of the form *0.y* are exactly the old 16-bit AS numbers. The accepted textual representation of autonomous system numbers is defined in [RFC 5396](https://tools.ietf.org/html/rfc5396) as "asplain".[[3]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-3) The special 16-bit ASN 23456 ("AS\_TRANS")[[4]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-4) was assigned by IANA as a placeholder for 32-bit ASN values for the case when 32-bit-ASN capable routers ("new BGP speakers") send BGP messages to routers with older BGP software ("old BGP speakers") which do not understand the new 32-bit ASNs.[[5]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-5)

The first and last ASNs of the original 16-bit integers (0 and 65,535) and the last ASN of the 32-bit numbers (4,294,967,295) are reserved and should not be used by operators. ASNs 64,496 to 64,511 of the original 16-bit range and 65,536 to 65,551 of the 32-bit range are reserved for use in documentation by [RFC 5398](https://tools.ietf.org/html/rfc5398). ASNs 64,512 to 65,534 of the original 16-bit AS range, and 4,200,000,000 to 4,294,967,294 of the 32-bit range are reserved for Private Use by [RFC 6996](https://tools.ietf.org/html/rfc6996), meaning they can be used internally but should not be announced to the global Internet. All other ASNs are subject to assignment by IANA.

The number of unique autonomous networks in the routing system of the Internet exceeded 5,000 in 1999, 30,000 in late 2008, 35,000 in mid-2010, 42,000 in late 2012, 54,000 in mid-2016 and 60,000 in early 2018.[[6]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-6)

The number of allocated ASNs exceeded 92,000 as of August 2019.[[7]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-7)



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Assignment[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=1)]

AS numbers are assigned in blocks by [Internet Assigned Numbers Authority](https://en.wikipedia.org/wiki/Internet_Assigned_Numbers_Authority) (IANA) to [regional Internet registries](https://en.wikipedia.org/wiki/Regional_Internet_registry) (RIRs). The appropriate RIR then assigns ASNs to entities within its designated area from the block assigned by IANA. Entities wishing to receive an ASN must complete the application process of their RIR, LIR or upstream service provider[[8]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-8)[[9]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-9) and be approved before being assigned an ASN. Current IANA ASN assignments to RIRs can be found on the IANA website.[[10]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-iana-10)

There are other sources for more specific data:

* [APNIC](https://en.wikipedia.org/wiki/APNIC): <https://ftp.apnic.net/stats/apnic/>
* [RIPE NCC](https://en.wikipedia.org/wiki/RIPE_NCC): <https://ftp.ripe.net/ripe/stats/>
* [AFRINIC](https://en.wikipedia.org/wiki/AFRINIC): <https://ftp.afrinic.net/pub/stats/afrinic/>
* [ARIN](https://en.wikipedia.org/wiki/ARIN): <https://ftp.arin.net/pub/stats/arin/>
* [LACNIC](https://en.wikipedia.org/wiki/LACNIC): <https://ftp.lacnic.net/pub/stats/lacnic/>

ASN Table[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=2)]

A complete table of 16-bits and 32-bits ASN available:[[10]](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_note-iana-10)

| **Number** | **Bits** | **Description** | **Reference** |
| --- | --- | --- | --- |
| 0 | 16 | Reserved | RFC1930, RFC7607 |
| 1 - 23455 | 16 | Public ASNs |  |
| 23456 | 16 | Reserved for AS Pool Transition | RFC6793 |
| 23457 - 64495 | 16 | Public ASNs |  |
| 64496 - 64511 | 16 | Reserved for use in documentation/sample code | RFC5398 |
| 64512 - 65534 | 16 | Reserved for private use | RFC1930, RFC6996 |
| 65535 | 16 | Reserved | RFC7300 |
| 65536 - 65551 | 32 | Reserved for use in documentation and sample code | RFC4893, RFC5398 |
| 65552 - 131071 | 32 | Reserved |  |
| 131072 - 4199999999 | 32 | Public 32-bit ASNs |  |
| 4200000000 - 4294967294 | 32 | Reserved for private use | RFC6996 |
| 4294967295 | 32 | Reserved | RFC7300 |

Types[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=3)]

Autonomous systems (AS) can be grouped into four categories, depending on their connectivity and operating policy.

1. [*multihomed*](https://en.wikipedia.org/wiki/Multihoming): An AS that maintains connections to more than one other AS. This allows the AS to remain connected to the internet in the event of a complete failure of one of their connections. However, unlike a transit AS, this type of AS would not allow traffic from one AS to pass through on its way to another AS.
2. [*stub*](https://en.wikipedia.org/wiki/Stub_network): An AS that is connected to only one other AS. This may be an apparent waste of an AS number if the network's routing policy is the same as its upstream AS's. However, the stub AS may have [peering](https://en.wikipedia.org/wiki/Peering) with other autonomous systems that is not reflected in public [route-view servers](https://en.wikipedia.org/wiki/Looking_Glass_server). Specific examples include private interconnections in the financial and transportation sectors.
3. [*transit*](https://en.wikipedia.org/wiki/Internet_transit): An AS that provides connections through itself to other networks. That is, network A can use network B, the transit AS, to connect to network C. If one AS is an ISP for another, then it is considered a transit AS.[[*clarification needed*](https://en.wikipedia.org/wiki/Wikipedia:Please_clarify)]
4. [*Internet Exchange Point*](https://en.wikipedia.org/wiki/Internet_Exchange_Point) (IX or IXP): A physical infrastructure through which ISPs or [content delivery networks](https://en.wikipedia.org/wiki/Content_delivery_network) (CDNs) exchange internet traffic between their networks (autonomous systems). IXP ASNs are usually transparent.[[*clarification needed*](https://en.wikipedia.org/wiki/Wikipedia:Please_clarify)]

See also[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=4)]

* [Administrative distance](https://en.wikipedia.org/wiki/Administrative_distance)
* [INOC-DBA](https://en.wikipedia.org/wiki/INOC-DBA) — a hotline communications system between the network operations centers of major Autonomous Systems
* [Internet Routing Registry](https://en.wikipedia.org/wiki/Internet_Routing_Registry)
* [PeeringDB](https://en.wikipedia.org/wiki/PeeringDB) - a freely available web-based database of networks that are interested in peering
* [Routing Assets Database](https://en.wikipedia.org/wiki/Routing_Assets_Database) (RADB)

References[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=5)]

* 1. [**^**](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_ref-1) *Hawkinson, John; Bates, Tony (March 1996).*[*Guidelines for creation, selection, and registration of an Autonomous System (AS)*](https://tools.ietf.org/html/rfc1930#section-3)*.*[*IETF*](https://en.wikipedia.org/wiki/Internet_Engineering_Task_Force)*. sec. 3.*[*doi*](https://en.wikipedia.org/wiki/Doi_(identifier))*:*[*10.17487/RFC1930*](https://doi.org/10.17487%2FRFC1930)*.*[*RFC*](https://en.wikipedia.org/wiki/RFC_(identifier))[*1930*](https://tools.ietf.org/html/rfc1930)*. Retrieved 2018-12-31.*
  2. [**^**](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_ref-2) *Rekhter, Yakov; Li, Tony (March 1995).*[*A Border Gateway Protocol 4 (BGP-4)*](https://tools.ietf.org/html/rfc1771)*.*[*IETF*](https://en.wikipedia.org/wiki/Internet_Engineering_Task_Force)*.*[*doi*](https://en.wikipedia.org/wiki/Doi_(identifier))*:*[*10.17487/RFC1771*](https://doi.org/10.17487%2FRFC1771)*.*[*RFC*](https://en.wikipedia.org/wiki/RFC_(identifier))[*1771*](https://tools.ietf.org/html/rfc1771)*. Retrieved 2018-12-31.* (obsoleted by [RFC](https://en.wikipedia.org/wiki/RFC_(identifier)) [4271](https://tools.ietf.org/html/rfc4271))
  3. [**^**](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_ref-3) *Huston, Geoff; Michaelson, George (December 2008).*[*Textual Representation of Autonomous System (AS) Numbers*](https://tools.ietf.org/html/rfc5396)*.*[*IETF*](https://en.wikipedia.org/wiki/Internet_Engineering_Task_Force)*.*[*doi*](https://en.wikipedia.org/wiki/Doi_(identifier))*:*[*10.17487/RFC5396*](https://doi.org/10.17487%2FRFC5396)*.*[*RFC*](https://en.wikipedia.org/wiki/RFC_(identifier))[*5396*](https://tools.ietf.org/html/rfc5396)*. Retrieved 2018-12-31.*
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  10. ^ [Jump up to:***a***](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_ref-iana_10-0) [***b***](https://en.wikipedia.org/wiki/Autonomous_system_(Internet)#cite_ref-iana_10-1) [*"Autonomous System (AS) Numbers"*](https://www.iana.org/assignments/as-numbers/as-numbers.xhtml)*. IANA.org. 2018-12-07. Retrieved 2018-12-31.*

External links[[edit](https://en.wikipedia.org/w/index.php?title=Autonomous_system_(Internet)&action=edit&section=6)]

* [RIPEstat](https://stat.ripe.net/) — Internet Measurements and Analysis
* [Merit](https://www.radb.net/) [RADb](https://en.wikipedia.org/wiki/Routing_Assets_Database)
* [Hurricane Electric BGP Toolkit](https://bgp.he.net/)
* [PeeringDB](https://en.wikipedia.org/wiki/PeeringDB) <https://www.peeringdb.com/>
* [Robtex: Various kinds of research of IP numbers, Domain names, ASN, etc](https://www.robtex.com/)
* [astraceroute, an AS traceroute utility (part of netsniff-ng)](http://www.netsniff-ng.org/)
* [ASN FAQ](https://www.apnic.net/get-ip/faqs/asn/)
* [CIDR and ASN assignment report](https://www.cidr-report.org/as2.0/)
* [Partial List of Autonomous system numbers](http://www.bgplookingglass.com/list-of-autonomous-system-numbers)
* [Lookin'STAT Graph: number of Autonomous systems online](https://stat.lookinglass.org/)

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