

Prefixes and Autonomous Systems

BGP for networks who peer: Part 1

Wolfgang Tremmel
wolfgang.tremmel@de-cix.net



IP Prefixes

IPv4 Addresses

10.3.8.17

IPv4 Addresses

10.3.8.0/22

IPv4 Prefixes

10.3.8.0/22

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0

- IPv4 and IPv6 addresses have a network and a host part
- A **prefix** is just the network part + the **length** of the network part
- Important:
 - The boundary between network and host can be anywhere!

Characteristics of Prefixes: IPv4

10.3.8.0/22

Prefix-Length: 0-32

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0

Notation:

- 4 Numbers 0-255
- Separated by "."
- a "/", followed by

Host-part all zero

32 Bits long

IPv6 Addresses

2003:de:274f:400:226:b0ff:fed8:3d8a

IPv6 Addresses

2003:de:274f:400:204:b0ff:fed8:3d8a

Characteristics of Prefixes: IPv6

2003:de:274f:400::/64

Prefix-Length: 0-128

Notation:

- 4 digit hex numbers (0-9,a-f)
- Separated by ":"
- "::" = fill up with zeros

Host-part all zero

128 Bits long

IP Adresses and Prefixes

Prefix or Not?

	IPv4	IPv6
Length	32 Bit	128 Bit
	0-32 Prefix Length	0-128 Prefix Length
Notation	4 Numbers, 0-255	8 Numbers, 0-ffff
Separator	.	:
Prefix: Host part	all zero	
Address: Host part	not all zero / not all one	
Example (Prefix)	198.51.100.0/24	2001:db8:4f30::/48



198.51.100.0/24



2001:db8:5669::/48



192.0.2.8/27

0000 1000

Host part not zero!



203.0.113.99/32



198.51.100.0/16

Host part not zero!

What is an Autonomous System?

And why do I need one?



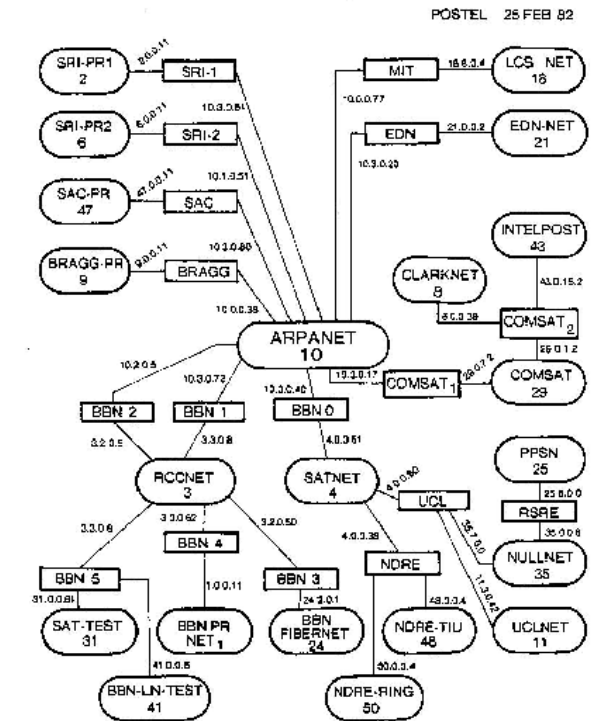
Wolfgang Tremmel
academy@de-cix.net

A brief history of the Internet

According to the Internet Hall of Fame

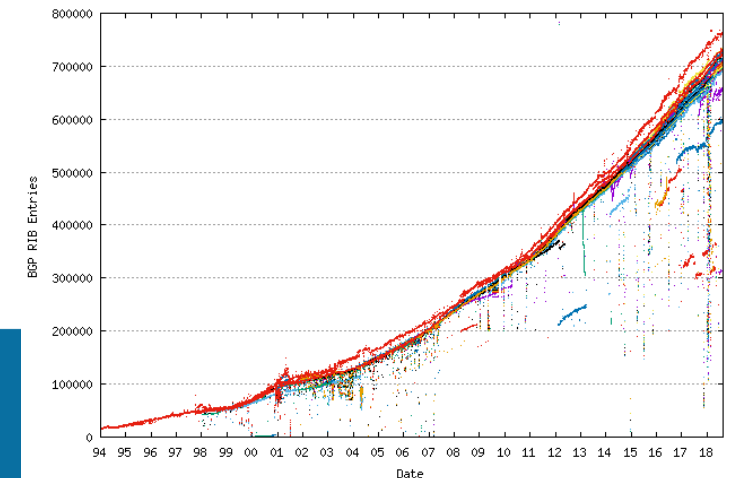
- 1982 – Arpanet (successor of Internet)
- 1982: RFC827 defines Exterior Gateway Protocol:

"Autonomous systems will be assigned 16-bit identification numbers (in much the same ways as network and protocol numbers are now assigned)"



Some years later...

- January 2025: There are 77890 active ASs
(source: http://bgp.he.net/report/prefixes#_networks)
- In 2001, planning to extend AS numbers to 4 bytes began
- This was finalized as a RFC (standard) in May 2007 (see [RFC6793](#))
- Today, 4-byte AS number are assigned
 - They are supported by all modern routers
 - You can no longer request a 2-byte AS number
 - There is also no reason for requesting one



What is an Autonomous System?

Simple Definition

- A group of IP prefixes
 - But to route or announce them, you need hardware
 - A router (or multiple routers)
 - This router speaks BGP (to its neighbors)
 - And has an ***Autonomous System Number*** configured
- Another new term: **Autonomous System Number (ASN)**

Formal Definition (RFC1930):

"An AS is a connected group of one or more IP prefixes run by one or more network operators which has a SINGLE and CLEARLY DEFINED routing policy."



Router

I am **AS196610**, DE-CIX Academy, and I announce prefix
2a02:c50:db8::/48

Autonomous System Number

or AS Number or ASN

- Initially 16bit (0...65535) they are now 32bit long (0..."a lot")
- AS numbers are globally unique
- Unique means, somebody has to administrate them
- This is the IANA (Internet Assigned Numbers Authority)
 - But they have delegated that task to the 5 RIRs (Regional Internet Registries)
- So in Europe: Become a member of the RIPE NCC and request one

*"An AS has a **globally unique** number (sometimes referred to as an **ASN**, or Autonomous System Number) associated with it; this number is used in both the exchange of exterior routing information (between neighboring ASes), and as an **identifier of the AS** itself." ([RFC1930](#))*



Regional Internet Registries (RIRs)

- Talking about everything what RIRs do would be beyond the scope of this training
- So, let's focus on AS numbers
- And for now, let's focus on Europe
- The RIR responsible for Europe, Russia and the Middle East is the RIPE NCC
- RIPE means Réseaux IP Européens – the founders wanted a French name
- NCC means Network Coordination Center
- RIPE is not the same as RIPE NCC, see the website for the difference.
- Back to how to get an AS number ...



Getting an AS number from RIPE NCC: The easy way

- Just become a customer
 - You have to be a legal entity
 - Fill out the forms
 - Pay the sign-up fee (and annual fee)
- Request your AS number
 - You have to be/want to be multi-homed (peering counts!)
 - [RIPE Academy](#) offers lots of online / offline trainings to help you get started.



Getting an AS number without becoming a RIPE NCC member

- You can also get an AS from someone who already is a RIPE NCC member
- This is called a "sponsoring LIR"
- Basically they request the AS from RIPE NCC for you
- ... and may charge you for this

Now I have an AS – how can I route my IP prefix?

- Hmm, this depends where you have your IP space from
- In general, IPv4 prefixes of /24 or larger are routable via BGP
- In IPv6 you can route /48 or larger
- If you have just become a new RIPE NCC member, you can also request IP space
- ~~→ As there is not much IPv4 left, you get a /22 once (and not more)~~
- IPv4 is out! No more IPv4 addresses (except by transfers)**
 - Yes - new RIPE NCC members can still request a /24 via the waitinglist
 - But plenty of IPv6 available...
- To check whether your current space is routable from your new AS, the best way is to check with whom you got that IP space from

in 2023: \$50 per IPv4 address

What is an Autonomous System good for?

	If you have an AS	Without an AS
Redundancy	You can have multiple upstream ISPs and Peering	You only can have one upstream ISP
Control	You have full control over your outgoing traffic	Your upstream ISP controls your traffic
Cost	You can optimize your traffic for cost	You just pay your upstream ISP
Peering	You can setup your own peering policy and have full control	Your upstream ISP makes all decisions

Thank you!



DE-CIX Management GmbH | Lindleyst. 12 | 60314 Frankfurt | Germany
Phone + 49 69 1730 902 0 | sales@de-cix.net | www.de-cix.net

Links and further reading

Links visited during the webinar

→ RFCs

RFCs are Internet standards issued by the [Internet Engineering Task Force \(IETF\)](#)

- [RFC4632](#): Classless Inter-domain routing (CIDR)
- [RFC4291](#): IPv6 addressing architecture
- [RFC827](#): Exterior Gateway Architecture (EGP) (historical, obsolete)
- [RFC1930](#): Guidelines for creation, selection, and registration of an Autonomous System (AS)
- [RFC6793](#): BGP Support for Four-Octet Autonomous System (AS) Number Space

→ AS Numbers

- Giving AS numbers to the RIRs: [iana.org](#)
- Requesting an AS number, links for:
 - [ARIN](#)
 - [Lacnic](#)
 - [APNIC](#)
 - [RIPE NCC](#)
 - [Afrinic](#)