Welcome to the Internet

BGP, ASNs and decentralisation

https://www.youtube.com/watch?v=k1BneeJTDcU
Welcome to the Internet - Bo Burnham (from “Inside")

Baltic Honeybadger 2025 - Riga - August 9-10 - Michel ‘ketominer’ L.

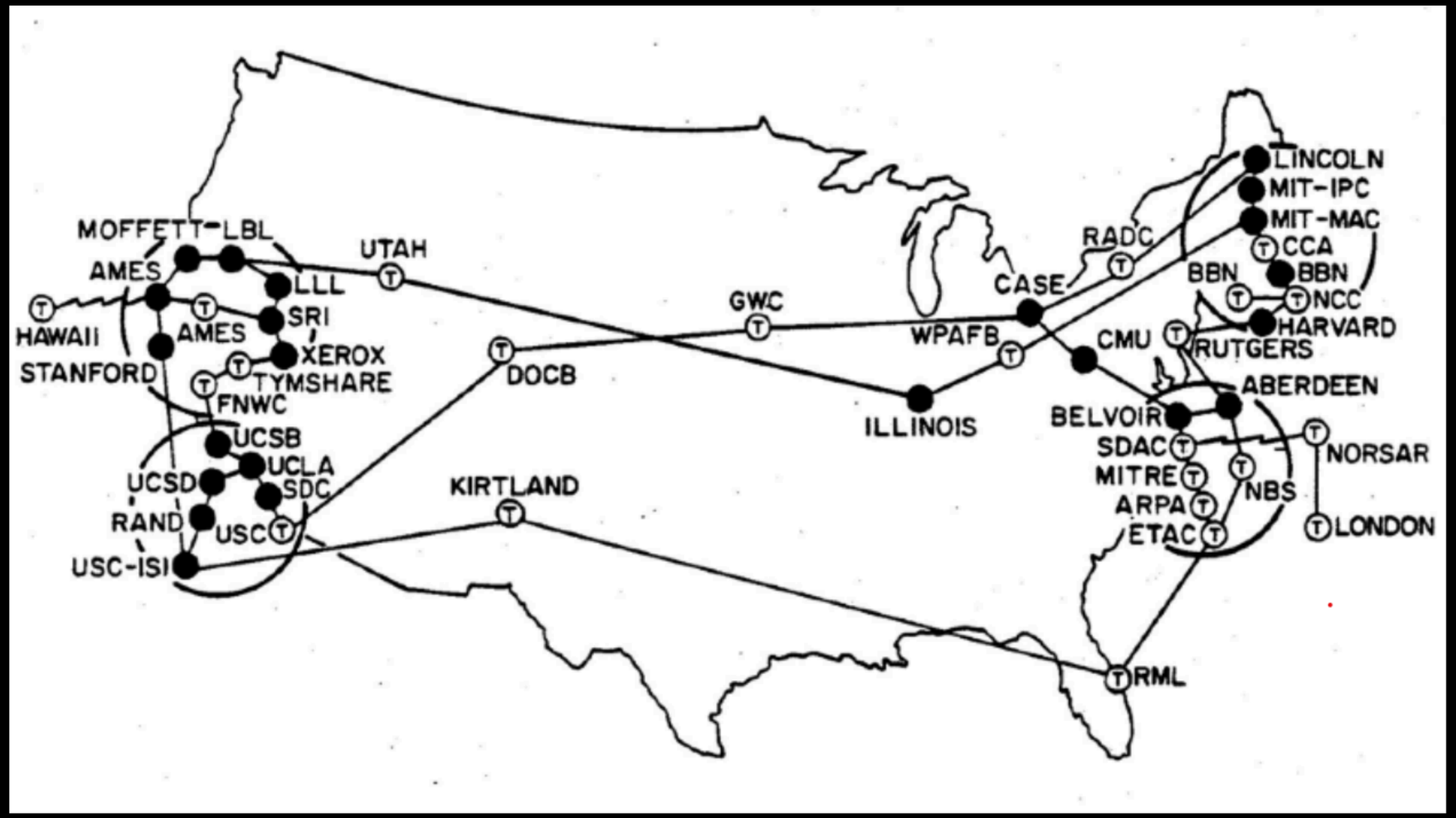
What I do


nodl


VPS - Domain Names
NoKYC - BTC Only


FIBER • METAL
CODE • BTC • MEAT

How it started



Physical map of ARPANET - 1970s

How it started - what made it possible

- 1983: whole network switches to TCP/IP (transition plan https://www.rfc-editor.org/rfc/rfc801.txt)
- 1986: NSFNET connects major universities with a 56kbps backbone
- 1988: finished upgrade to T-1 (1.5 Mbps)
- 1991-1995: progressively open to commercial traffic and phase-out of the old NSFNET backbone
- Now: 100 000+ independent networks interconnected

How it’s going

There is no single view

- https://as2914.net/ (as seen by NTT)
- https://www.pacnog.org/pacnog17/presentations/MappingTheInternet.pdf (as mapped by the NSRC and the University of Oregon)
- As seen by one of my routers (2 days apart):


```
admin@br01-lf1:~$ show ip route | wc -l
989956
admin@br01-lf1:~$ show ipv6 route | wc -l
218608
```

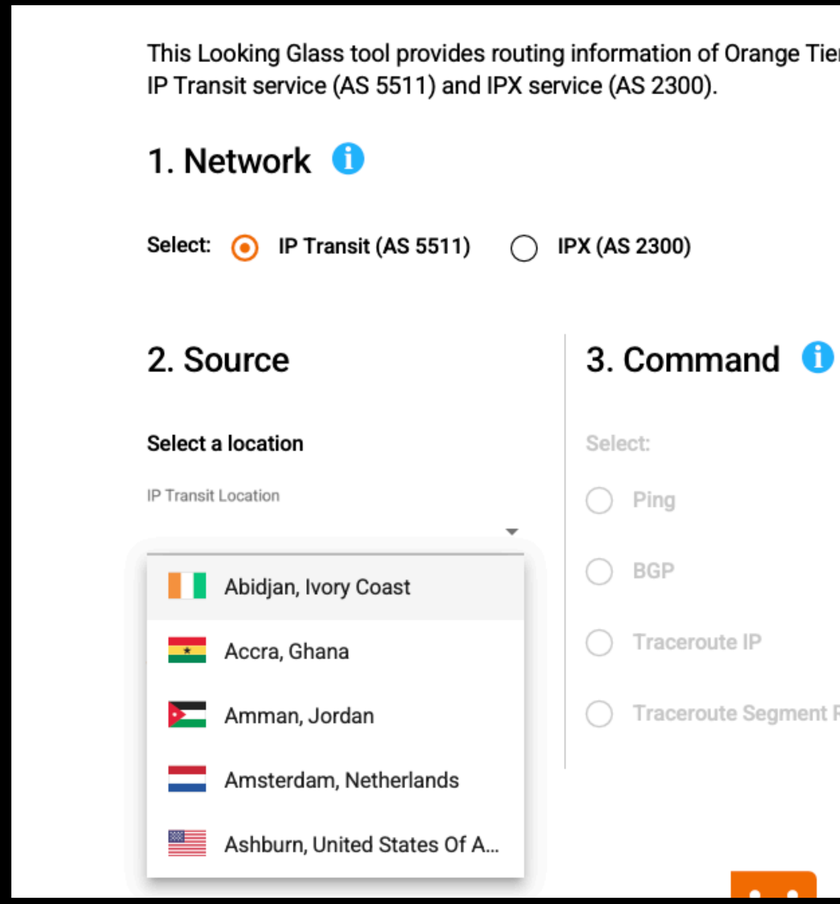
```
admin@br01-lf1:~$ show ip route | wc -l
990009
admin@br01-lf1:~$ show ipv6 route | wc -l
218063
```

BGP and ASNs

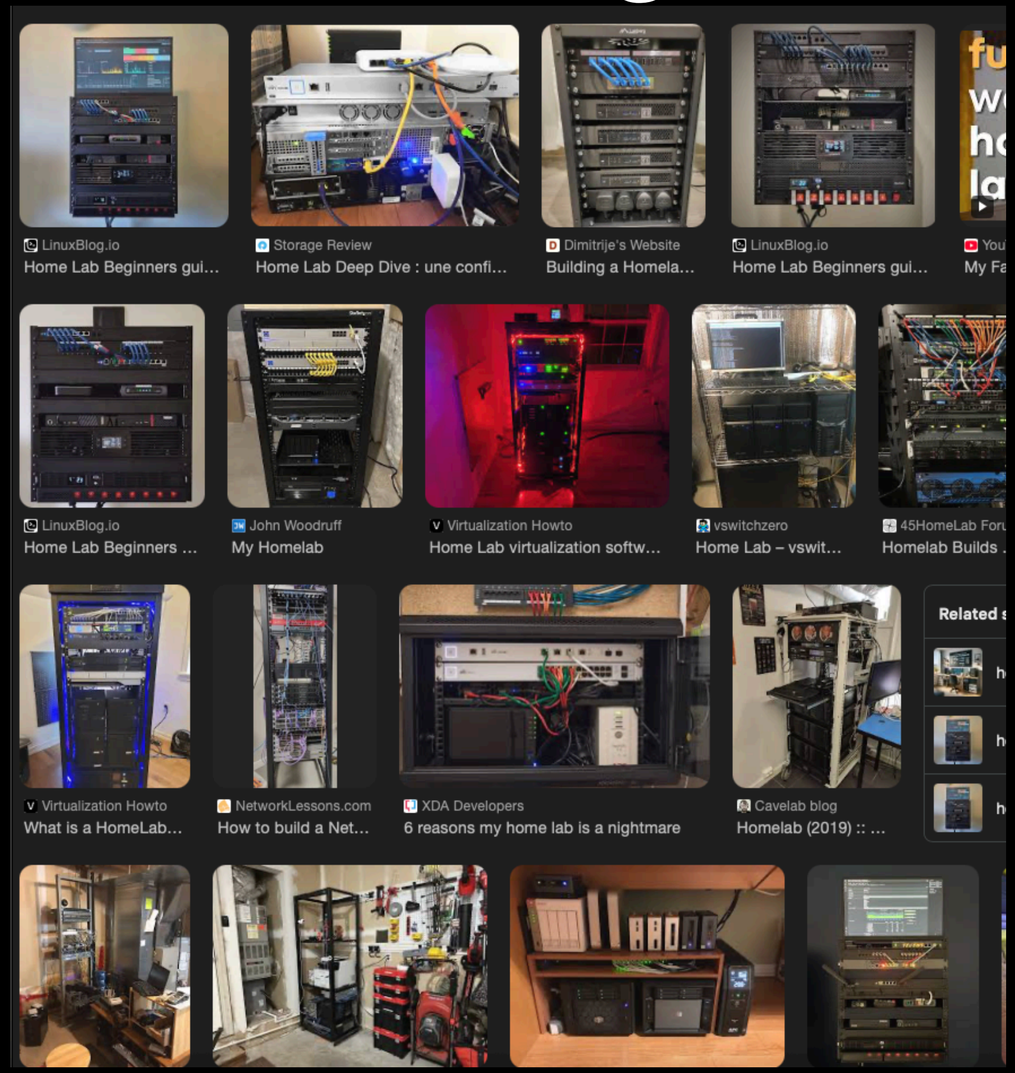
- RFC1771 - could as well be called “the Internet RFC” - https://datatracker.ietf.org/doc/html/rfc1771
- March 1995 - Defines AS, BGP4, …
- Pretty much nothing changed
- AS: “The classic definition of an Autonomous System is a set of routers under a single technical administration, using an interior gateway protocol and common metrics to route packets within the AS, and using an exterior gateway protocol to route packets to other ASs.”
- 1 ASN = 1 “ISP” = 1 participant in the global Internet

Go explore

- Access directly routers (through a website a.k.a. “looking glass”) or via telnet: http://traceroute.org/ - used daily to troubleshoot issues, check reachability, …
- Web view of the Internet as seen from Hurricane Electric (wanabee Tier-1): https://bgp.he.net/
- Type ASN + Looking glass in a search engine - ex: AS5511 Looking Glass: https://looking-glass.opentransit.net/
- Many big players make looking glass public because it’s a proof of their interconnections and helps troubleshooting
- Learn on a small scale simulated Internet: https://dn42.eu/ (it has all the features of the real one!)

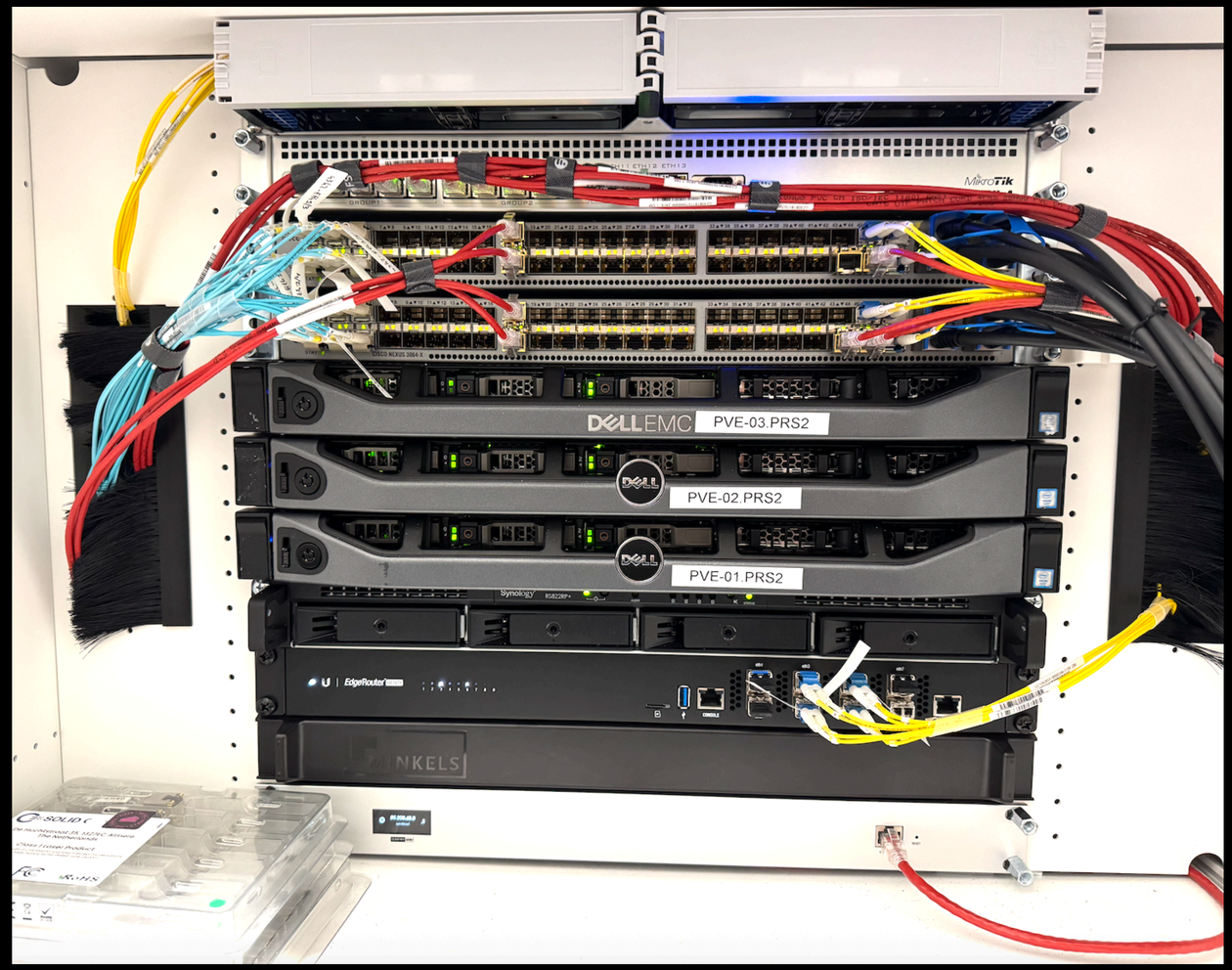


“Self-hosting”



Single power source, usually single attachement to “the Internet”, etc.
- connected TO the Internet -

or



Redundant power with N+N UPS, ASN, multiple IP subnets and upstreams, connections to IXPs, etc
- part OF the Internet -

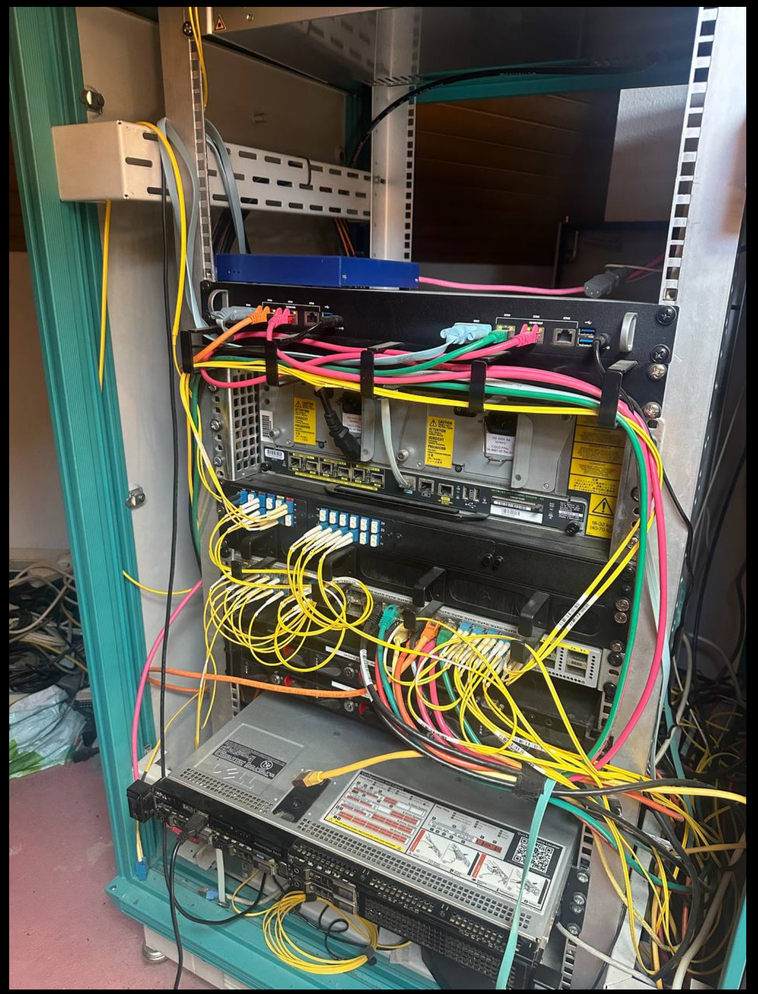
Meet half way

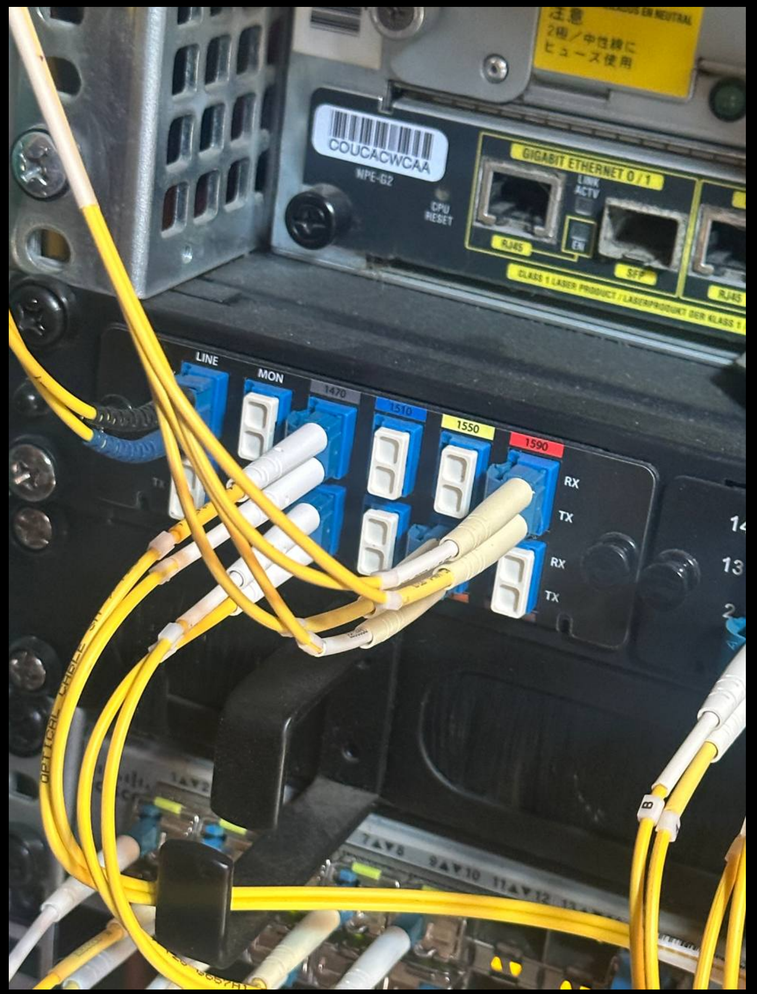
- Optimisations for the “home-lab” hosting:
  - get an ISP proposing fixed IPv4 (hint: starlink (business plans) is one!)
  - get UPS, generator, etc.
- If you live in a (european) city, you can go further
  - get dedicated (or else) fiber(s) to one or several datacenters
  - get an ASN + IPv6 block (comes with RIPE membership - 1000 Eur sign-up + 1800 Eur yearly + 50 Eur yearly for ASN)
  - get an IPv4 block (/24 minimum for BGP) - 8-12kEur right now / or wait list (3 years?)
  - use existing DSL/FTTH for OOBM (very important!)
- Or you can simulate this with VPNs into a couple of friendly ISPs that will provide BGP to you

Personal ISP/ASN

- You don’t have to be a legal entity
- Many of RIPE NCC members are private individuals
- ex. https://bgp.he.net/AS35360#_asinfo - directly connected to 1000+ other ASNs… from home
- ex. https://bgp.he.net/AS44097 - less peers but has 100 Gbps fiber at home :)
- ~3000 new ASNs each year!
- Keep in mind: it still mainly happens in IRL events, mailing lists, handshake agreements

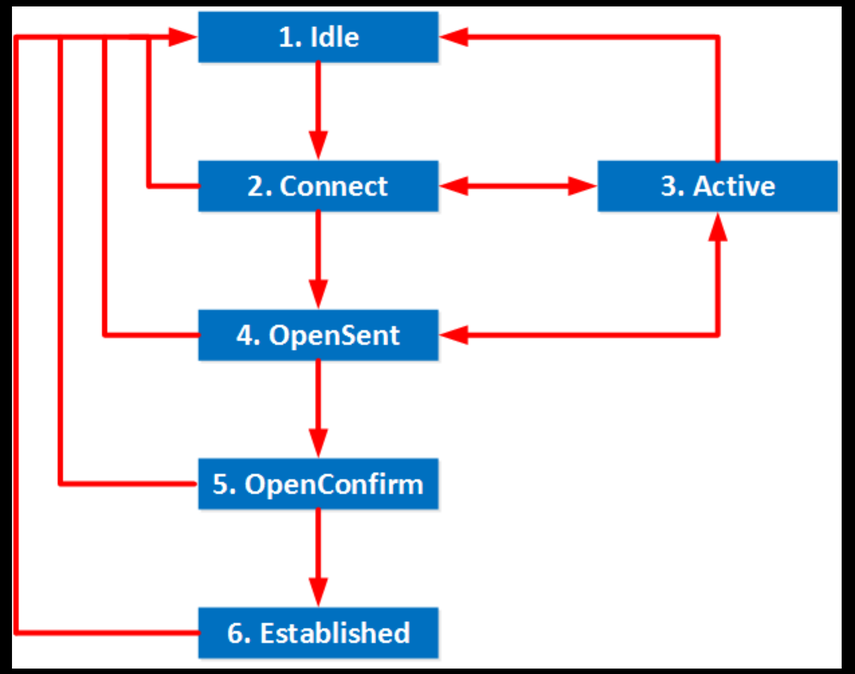
Personal ISP/ASN (AS35360)

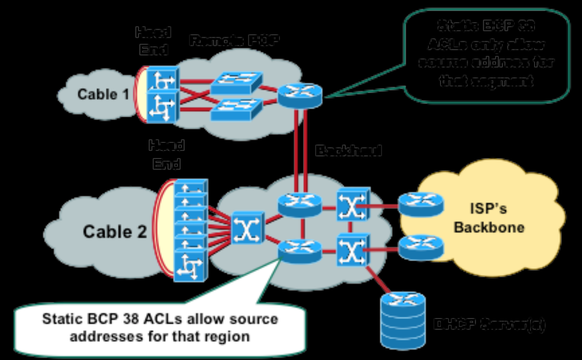




so… BGP

- “Hi AS B, I’m AS A and I have these routes”
- State machine for connection
- First send all known routes, then UPDATEs
- Simple, based on trust…
- and fragile
- RPKI: cool on paper - ~30% prefixes signed, but only ~15% check
- BGPSEC: who uses that?
- BCPs, MANRS…





Peerings

- Full (a.k.a. Transit) - gives you a “full view” of the Internet
  - you want multiple of this (re: there is no single view - esp. for IPv6)
- IXPs
  - big “switches” with 100s to 1000s ASNs attached, Route Servers and/or direct sessions
- PNIs
  - if (traffic) big enough, direct interconnect with other ASN (free or paid)

Incidents

- Some malicious, some fuckups (occam’s razor applies)
- Pakistan telecom tried to block Youtube but instead accounced their routes to the whole world, effectively taking down Youtube for (almost) everybody (and DDoSing themselves)
- Indosat announced 417 038 routes - interception attempt? doubtful given the size of their network - probably IGP to EGP leak
- Level 3 (tier-1 !!!) propagated routes announced by their customer, Telekom Malaysia effectively taking down a big chunk of the Internet for all their downstreams
- Facebook locking themselves out of their building (access control was on the same network) - quickly helped by other ASNs to restore

Notable incident affecting “crypto”

- In April 2018, an ISP in Columbus, Ohio (or one of their customers) announced subnets beloging to Amazon’s Route 53 (DNS) service - Amazon peers (such as HE) blindly repeated this resulting in redirectiong MyEtherWallet users to a malicious version
- https://www.thousandeyes.com/blog/amazon-route-53-dns-and-bgp-hijack
- Read more: https://en.wikipedia.org/wiki/BGP_hijacking
- Scarcity of IPv4 doesn’t help - rent agreements, etc…

Take aways

- No single point of control
- No accountability but Trust through Reputation - also Naming and Shaming!
- Engineer based community (and a small one!)
- NANOG, FRnOG, etc…
- Mostly acting in the best interest of their users
- work in progress: https://manrs.org/ (Mutually Agreed Norms for Routing Security)
- Bogons…
- Don’t let all this scare you!

Opinions (from someone running multiple ASNs for 20+ years)

- Bitcoin runs on top of the Internet (at least for now)
- A system built on top of another system requires understanding of the underlying system
- Some initiatives (asmap) go in the right direction
- Participate in the decentralisation by running your own AS ($$)
  - there are actors in the community who already do!
- We haven’t touched the fun parts yet: traffic engineering, etc.

- I can help!

One more thing…

- August 11th 2025, first “nodl day” (btcpayserver wink wink)
- https://day.nodl.eu (register for free)
- Come chill with us, see some guest talks, discover the future of nodl
- 11am for coffee

Q&A and Contact info

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