Zurich Research Laboratory

IPv6

Yesterday, Today and in the coming years

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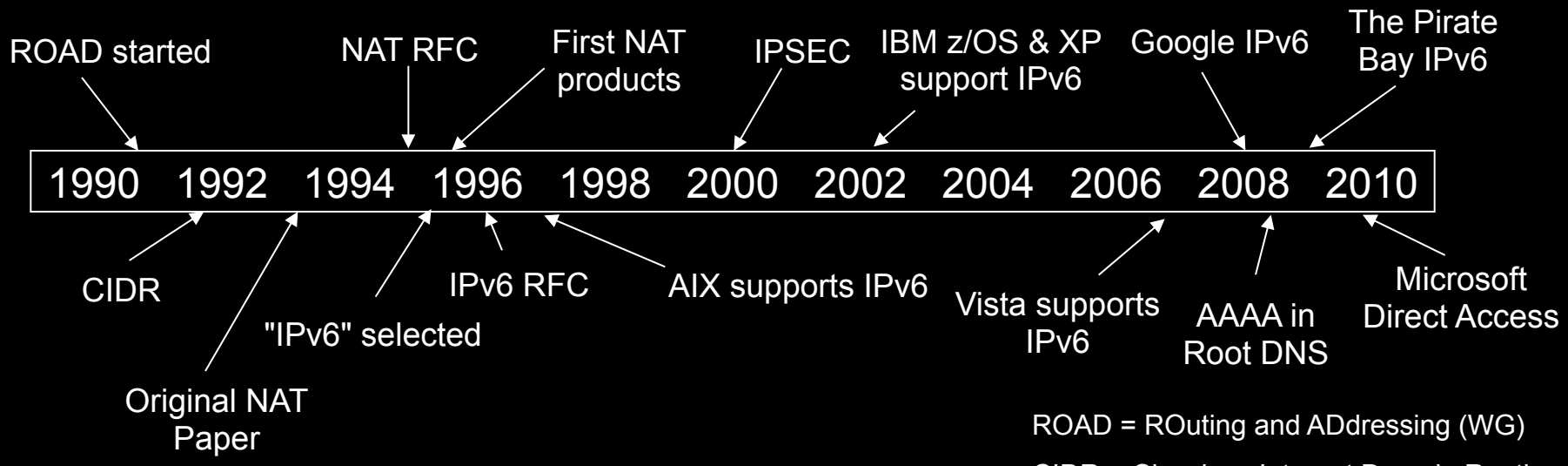
Jeroen Massar
jma@zurich.ibm.com

IPv6 Short history

- IPv6 (Internet Protocol version 6)
  - Also called IPng (Internet Protocol Next Generation)
- No IPv5? (RFC1190 : ST Datagram Mode)
- Biggest and almost the only advantage: way more addresses

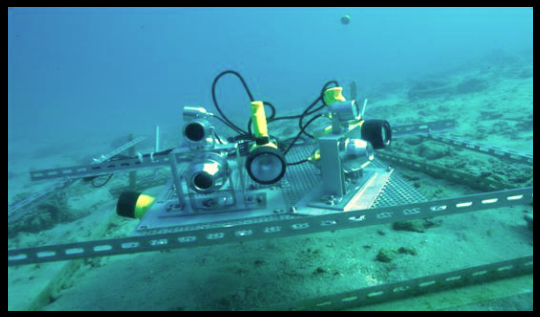


ROAD = ROuting and ADdressing (WG)

CIDR = Classless Internet Domain Routing

NAT = Network Address Translation

IPv6 Toys: Home automation, fridges, sensors, etc

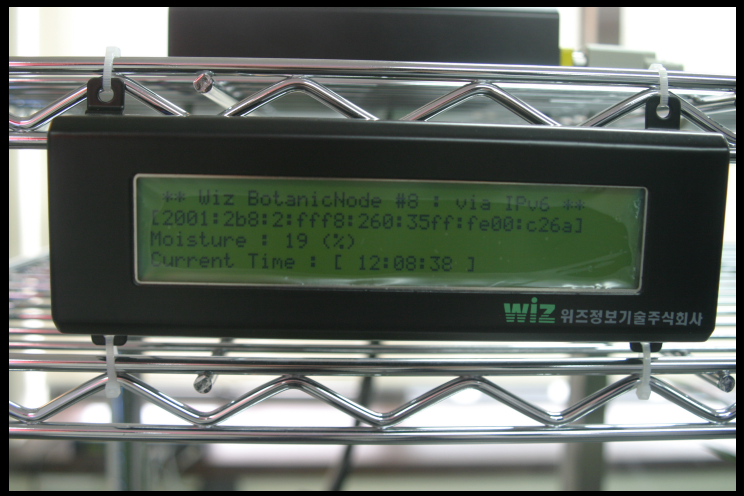


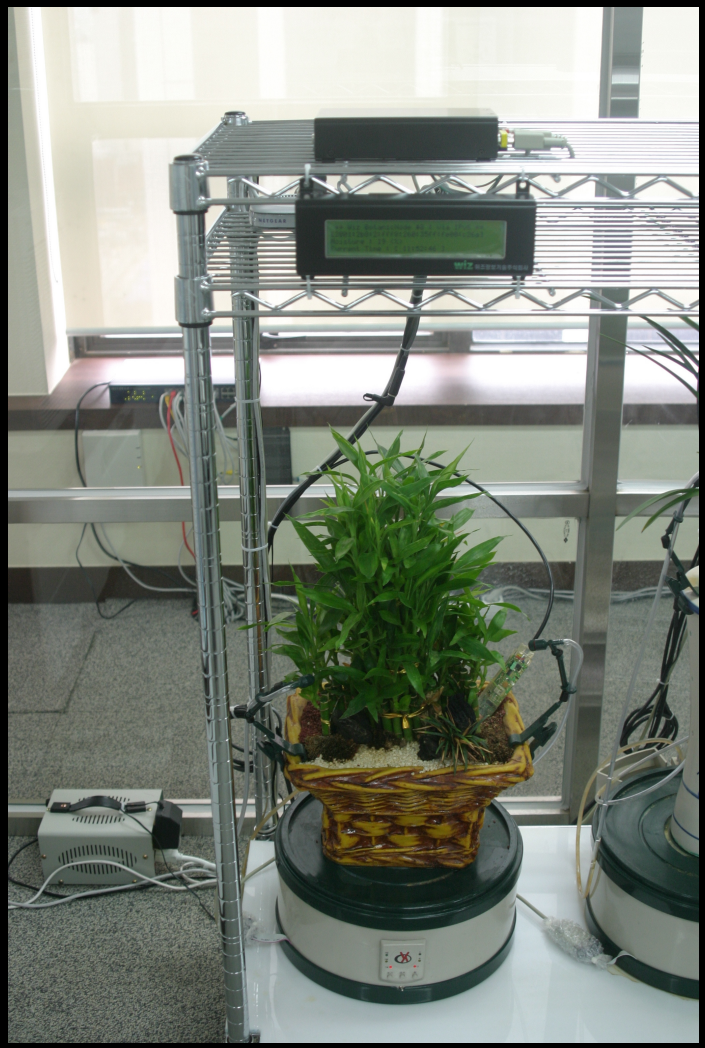
For more:

google(IPv6 toys)

google(IPv6 cool)

IPv6 Toys: $ telnet plant



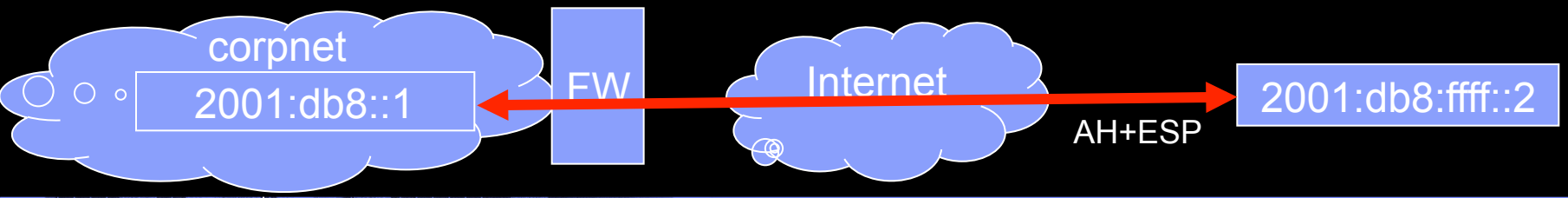


Microsoft Direct Access

- How to do ‘firewalling’ without having to configure prefixes.
- You have your host anywhere, just have IPv6, be that native, proto-41, Teredo, 6to4 or through a Tunnel Broker, could be remote or in the office.
- Sign every packet you sent/receive from your client to the server with an IPSEC-AH.
- Firewall in the middle allows any correctly signed and validated packet, of course only accepting keys that it knows.
- Use IPSEC-ESP to secure packets so that nobody can snoop them.
- Key distribution happens using Active Directory.

- The Direct Access tool allows one to directly access any resources one has at the workplace from any other location on the (inter-)net.

- Same method can be applied to any kind of connection of course.



Problems with IPv6 (and thus fun research for us)

- Broken IPv6 implementations
  - http://v6fix.net
  - "Test" function in AICCU (http://www.sixxs.net/tools/aiccu/) to see what breaks where (coming soon)
- IPv4 will run out before IPv6 is deployed everywhere
  - Carrier Grade NAT (CGN)
  - Tunneling
  - Accessing IPv4 from IPv6 and IPv6 from IPv4
- Routing Table Growth / handling of large amount of prefixes
  - This was already an issue partially in IPv4 but will become a larger problem with IPv6; especially when everybody will wants to do IPv6 PI
  - With IPv6:
    - Every ISP gets at least a /32
    - Every End-site gets a /48 (or /56 for endusers in some regions)
    - ⇒ A single /32 contains 65536 /48's; with 10.000 ISPs, that would be 10.000 * 65536 = 655.360.000 routes when de-aggregated: Way more memory in all routers needed, faster CPUs (due to SPF recalculations) etc

Tunneling

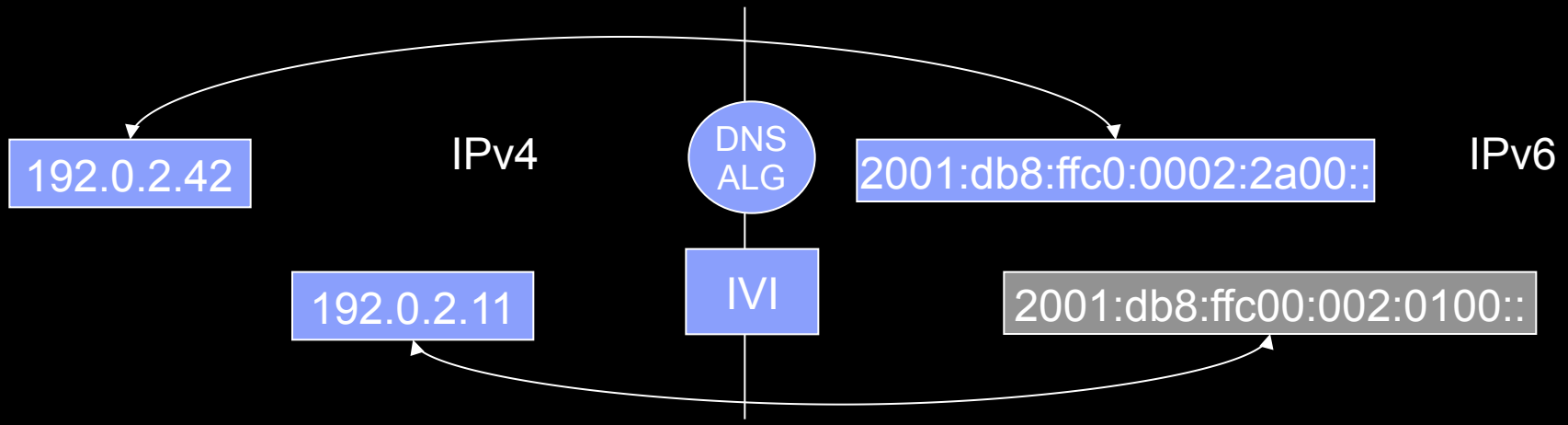
- 6to4 (proto-41 but with anycasted remote IPv4 endpoint, IPv6 address in the form of 2002:aabb:ccdd::/48 based on aa.bb.cc.dd)
- Teredo (as 6to4 doesn't easily cross a NAT box)
- Tunnel Brokers (SixXS / http://www.sixxs.net)
  - proto-41 (IPv6 directly inside IPv4 packet)
  - AYIYA (NAT-aware)
  - TSP (NAT-aware)
- L2TPv3 (used in softwires IETF WG for standardization for this)

Solving IPv4 to IPv6 and back: IVI

Prefix-specific and Stateless Address Mapping (IVI) for IPv4/IPv6 Coexistence and Transition (draft-xli-behave-ivi)

Xing Li, Maoke Chen, Congxiao Bao, Hong Zhang and Jianping Wu

- Name trick: Roman Numerals: IV = 4, VI = 6 => IVI = 46
- Allows IPv4 to connect to IPv6 and IPv6 to connect to IPv4
- Semi-refresh/combination of NAT-PT and SIIT
- Per-ISP prefix (eg 2001:db8:ff*aa*:*bbcc*:*dd*::)
- DNS ALG which fakes AAAA or A record when needed



Routing Research Group

IRTF RRG (http://www.irtf.org/charter?gtype=rg&group=rrg)

- Proposed steps (draft-zhang-evolution):
  - Phase 1: Reduce FIB size
    - ISP internally aggregates e.g. 213.0.0.0/8
  - Phase 2: Reducing Multi-AS Virtual Aggregation Overhead
    - ISP's cooperate and forward directly between aggregators
  - Phase 3: Reducing RIB Size
    - Separate the Aggregated network from the real one, avoiding every router to know about the full table
  - Phase 4: Insulating the Core from Edge Churns
    - Avoiding flapping causing them to generate routing updates
- Current proposals:
  - LISP (Location/ID Separation Protocol) draft-farinacci-lisp
  - APT (A Practical Transit Mapping Service) draft-jen-apt
  - VA (Virtual Aggregation)

Comments and/or questions?

Please submit your applications and ideas to the **IPv6 Application Contest 2009** with a top prize of 10.000 EUR!

http://www.ipv6council.de/

References

- IETF – The Internet Engineering Task Force
  http://www.ietf.org
- IRTF – The Internet Research Task Force
  http://www.irtf.org
- IVI
  http://www.ivi2.org
- Patrick Fältström's IETF photo site
- SixXS - IPv6 Deployment & Tunnel Broker
  http://www.sixxs.net