


What can be learned from the NAT experience?



Lixia Zhang
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Warning: The data here is incomplete

The comments are potentially biased and wrong wrong

Timeline

- Recognition of address shortage problem: ??
- (I*) Planned actions
 - Short term
 - CIDR
 - Long term: IPng effort
- NAT?

Jan 1993

- Paper: "Extending the IP Internet Through Address Reuse"
 - By Paul Tsuchiya, published in Computer Comm. Review
 - Paul got the idea from Van Jacobson

March 1994: RFC1597

- "Address Allocation for Private Internets" (informational)
 - Later evolved to RFC1918 (BCP)
8. Conclusion: *"With the described scheme many large enterprises will need only a relatively small block of addresses from the globally unique IP address space. The Internet at large benefits through conservation of globally unique address space which will effectively lengthen the lifetime of the IP address space. The enterprises benefit from the increased flexibility provided by a relatively large private address space."*

May 1994: RFC1631

- NAT technical description (informational, individual sub.)
- "Indeed, many (if not most) hosts never communicate outside of their stub domain. Because of this, only a subset of the IP addresses inside a stub domain, need be translated into IP addresses that are globally unique when outside communications is required.
- "NAT may be a good short term solution to the address depletion and scaling problems. This is *because it requires very few changes and can be installed incrementally*. NAT has several negative characteristics that make it inappropriate as a long term solution, and may make it inappropriate even as a short term solution."

Other protocols being developed at the time

- IPsec (Security Architecture for the Internet Protocol, RFC1825): August 1995
- SAP: RFC2974, October 2000
 - The development started several years earlier
- SIP: RFC2543: March 1999; RFC3261, June 2002

Note:

- The above were developed *at the same time* as NAT was rolling out in wild
- All based on the original IP model (globally unique addresses) !!

Reactions to the rise of NAT?

- June 1995: RFC1814 "Unique Addresses are Good" (info)
 - This RFC was discussed and agreed by IAB (Jan 95 minutes)
- Feb 1996: RFC1918 Address Allocation for Private Internets (BCP)
 - by vendors+operators
 - not through I* channel?

What IAB was doing at the time

Very busy

- Early days of ISOC
- Commercialization of the Internet
- routing in multiprovider Internet
- IP over ATM
- Interserv
- Workshop on "information infrastructure"
- (re)form IRTF
- and many other things

Assessment of NAT's architectural implications

- November 2000: RFC2993 "Architectural Implications of NAT" (info, individual)
- January 2001: RFC3027 "Protocol Complications with the IP Network Address Translator" (info, individual)
- More came out later ...

Why NAT became so popular

- Trigger point: Address shortage
- The advantage from "*owning*" a large block of IP address
 - No renumbering
 - Easy multihoming
 - Perceived "security"
 -

Why IETF missed the opportunity

to standardize NAT:

- Wanting to stay with architectural correctness?
- Did not pay attention to
 - The *real* issue (IP address shortage for new comers) ?
 - Look, the I* member employers most unlikely suffering from this problem at the time
 - the advantages NAT brings to end users?

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(quoted from ietf mailing list)

- "I am not on the NAT mailing list; nor do I attend NAT working group meetings. I consider NATs to be architecturally unsound and that the IETF and IESG should in no way endorse their use or development.
- "All of the energy and money being spent on NATs could and should be spent to begin the migration to IPv6 instead. It is my hope now that Windows 2000 supports IPSec that enough pressure will be applied to halt the deployment of NATs."

Why did not pay early attention to NAT problems?

- Human tend to be near-sighted
 - Did not foresee the scope of Internet explosion?
- Did not appreciate the fact that immediate problems/need tend to overwrite long term concerns
- Entirely incorrect estimate on the difficulties in designing+rolling out a new IP
 - Off by orders of magnitude

The cost of the mistake

Because the architecture does not consider NAT's existence,

- Every protocol now has to worry about NAT traversal
- And has to traverse NATs of 2 dozens different NAT flavors

What should and can be done now?

- The debate/confusing is still going today
 - Would it be helpful to make a statement about NAT now, to at least get the community synchronized in understanding the issue? (not in practicing NAT, which people will do different things)
- NAT will be with us forever
 - Would it still be helpful to develop a standard, even if it is too late?

What can be learned?

- (not reachable?) foresee the future
 - Pragmatic need override any "architectural correctness"
- Foresee and architect for the Internet growth needs
- Watch out architectural implications of "new practices"
- Solution development: (*VERY personal view*) looking back, IP6 should have picked a backward compatible solution to ease new IP rollout
- ***IP Address affects everything***
 - *How many people are following the PPML discussions*