IP Next Generation (IPng)

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History

- Why?
  - apparently running out of IP addresses
  - routing table bloat
- August 1990
  - projected exhaustion of Class B space by March 1994
- November 1991
  - Routing and Addressing (ROAD) group formed
- March 1992
  - ROAD report recommended
    - do CIDR
    - issue call for IPng proposals

History, contd.

- July 1992
  - IAB issues "IP version 7"
  - IETF issues call for IPng proposals
- July 1993
  - ipdecide BOF & IESG plenary
    - IESG take on responsibility making IPng recommendation
    - (not “let the market decide”)
- August 1993
  - temporary IETF area formed to consolidate IPng activity
- July 1994
  - IPng recommendation (RFC 1752)

IPng Area

- area directors from other areas
  Scott Bradner & Allison Mankin
- on temporary assignment in addition to regular duties
- existing IPng working groups moved into area

Charge From the IETF Chair

- establish directorate
- keep process public
- understand the available timeframe
- recommend policy changes if warranted
- make a recommendation on the scope of IPng
  - 'just' fix addresses or do more
- develop a clear and concise set of technical requirements
- develop a recommendation on which, if any, of the current proposals should be the next IP

Directorate

J. Allard - Microsoft	<jallard@microsoft.com>
Steve Bellovin - AT&T	<smb@research.att.com>
Jim Bound - Digital	<bound@zk3.dec.com>
Ross Callon - Wellfleet	<rcallon@wellfleet.com>
Brian Carpenter - CERN	<brian.carpenter@cern.ch>
Dave Clark - MIT	<ddc@lcs.mit.edu >
John Curran - NEARNET	<curran@nic.near.net>
Steve Deering - Xerox	<deering@parc.xerox.com>
Dino Farinacci - Cisco	<dino@cisco.com>
Paul Francis - NTT	<francis@slab.ntt.jp>
Eric Fleischmann - Boeing	<ericf@atc.boeing.com>
Mark Knopper - Ameritech	<mak@aads.com>
Greg Minshall - Novell	<minshall@wc.novell.com>
Rob Ullmann - Lotus	<ariel@world.std.com>
Lixia Zhang - Xerox	<lixia@parc.xerox.com>

IPng Proposal Working Groups

- multiple working groups
- open meetings and mailing lists
- different approaches to solve addressing and routing problems
- different views on problems
- optimize different aspects of problems
- not right or wrong
- learned from all efforts

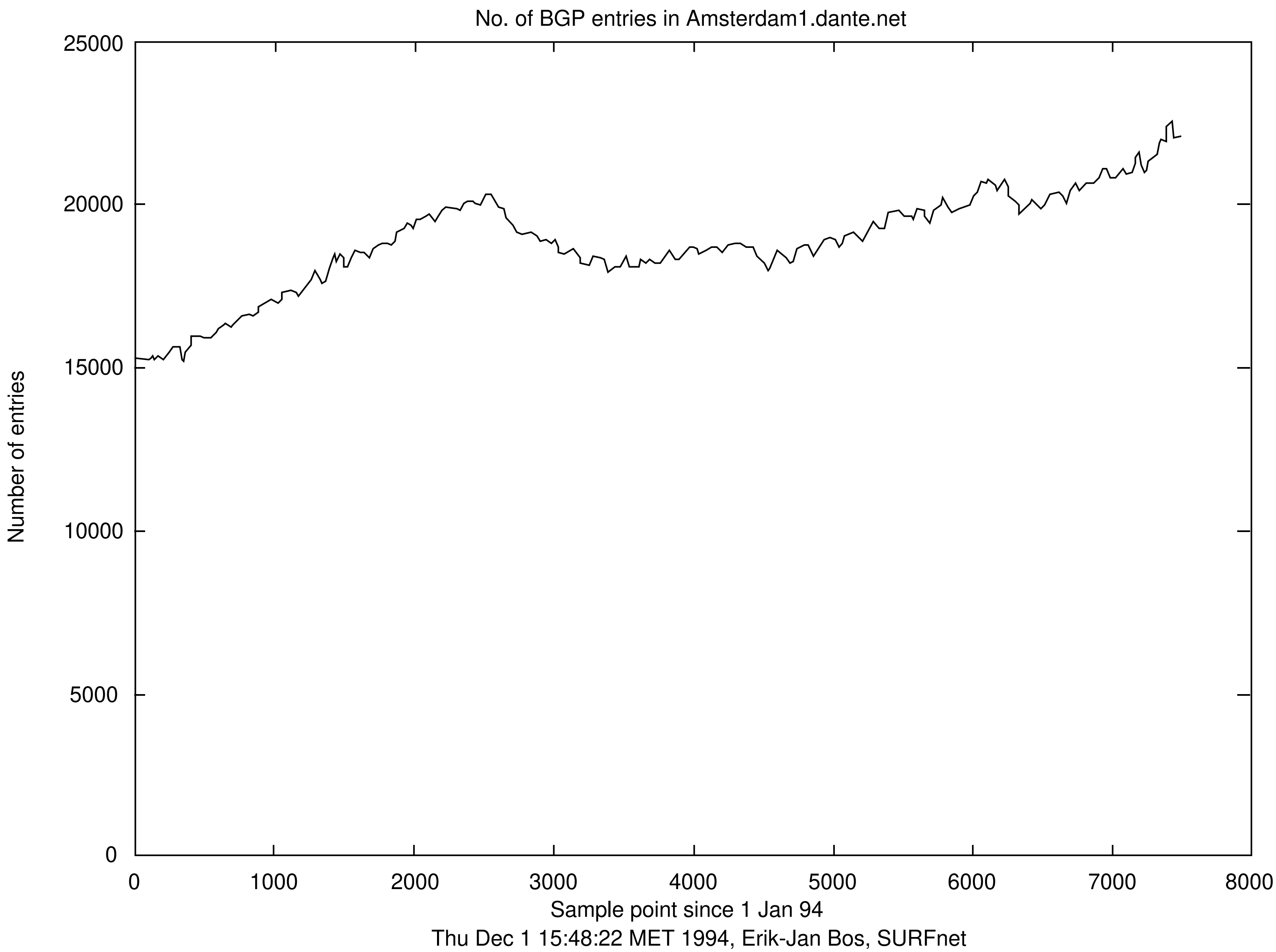
Available Timeframe

- Address Lifetime Expectations (ALE) working group
  - Frank Solensky, FTP Software <solensky@ftp.com>
  - Tony Li, Cisco Systems <tli@cisco.com>
- made prediction at Seattle & Toronto IETF meetings
  - 2005 - 2011
  - mixed view of confidence level
  - questions on base data & assumes no paradigm shifts
  - routing tables are still going to be a problem (CIDR helps)
- ADs endorse current address assignment policies
- ADs do not currently recommend address reclamation efforts

Classless InterDomain Routing (CIDR)

- aggregate routing information
- assign addresses in power-of-two chunks
- advertise power-of-two sized chunk of address space per entry
  - all of a providers' customers can be aggregated into one advertisement
  - reduce size & rate of growth of routing table
- some issues
  - assumes customers renumber to provider address range
  - tends to bind customer to a provider
  - problem with multi-homed customers
- it works

Routing Table Size



Scope of IPng

- development, testing & deployment will take time
- still we seem to have adequate time in IPv4 address space usage
  - but not excessive (excluding paradigm shifts)
- can do more than 'just' fix addresses
- use requirements process to determine actual scope

IPng Technical Requirements

- IPng requirements process (ngreq)
  - Frank Kastenholz, FTP Software <kasten@ftp.com>
  - Jon Crowcroft, UCL <J.Crowcroft@cs.ucl.ac.uk>
- used big-internet mailing list
- RFC1550 white papers
- BOF in Seattle
- requirements document
  - based on Frank Kastenholz/Craig Partridge draft
  - criteria, discussion & time frame
- RFC 1726

White Papers

Adamson, B.	Tactical Radio Frequency Communication Requirements for IPng, RFC 1677
Bellovin, S.	On Many Addresses per Host, RFC 1681
Bellovin, S.	Security Concerns for IPng, RFC 1675
Bound, J.	IPng BSD Host Implementation Analysis, RFC 1682,
Brazdziunas, C.,	IPng Support for ATM Services, RFC 1680
Britton, E. et al	IPng Requirements of Large Corporate Networks, RFC 1678
Brownlee, J.,	Accounting Requirements for IPng, RFC 1672
Carpenter, B.,	IPng White Paper on Transition and Other Considerations, RFC 1671
Chiappa, J. N.	IPng Tech. Req. Of the Nimrod Routing and Addressing Architecture, RFC 1753
Clark, R. et al	Multiprotocol Interoperability In IPng, RFC 1683,
Curran, J.	Market Viability as a IPng Criteria, RFC 1669
Estrin, D. et al	Unified Routing Requirements for IPng, RFC 1668
Fleischman, E.,	A Large Corporate User's View of IPng, RFC 1687
Green, D et al	HPN Working Group Input to the IPng Requirements Solicitation, RFC 1679
Ghiselli, A. et al	INFN Requirements for an IPng, RFC 1676
Heagerty, D.	Input to IPng Engineering Considerations, RFC 1670
Simpson, W.	IPng Mobility Considerations, RFC 1688
Skelton, R.,	Electric Power Research Institute Comments on IPng, RFC 1673
Symington, S. et al	Modeling and Simulation Requirements for IPng, RFC 1667
Taylor, M.	A Cellular Industry View of IPng, RFC 1674
Vecchi, M.	IPng Requirements: A Cable Television Industry Viewpoint, RFC 1686

IPng Criteria

- at least 10^9 networks, 10^{12} end-systems
  safer goal 10^{12} nets, 10^{15} end-systems
- conservative routing schemes
- topologically flexible
- high performance
- straightforward transition plan from IPv4
- robust service
- media independent
- datagram service
- autoconfiguration
- secure operation

IPng Criteria, contd.

- globally unique names
- access to standards
- support multicasting
- extensible
- support service classes
- support mobility
- include control protocol (ping etc.)
- support for private networks (tunneling)

Reviews of IPng Proposals

- directorate did continuous reviews of proposals during its teleconferences and on its mailing list
- aspects of proposals discussed on big-internet mailing list
- directorate asked to do formal reviews of the IPng proposals before the retreat on May 19 & 20 1994

Result of Reviews

- significant flaws seen in all proposals
- revised proposal offered by SIPP WG after retreat
- answer most of the perceived problems:
  - routing and addressing
  - transition
  - autoconfiguration
  - source routing support
- some still unresolved issues
  - mobility
- synthesis of multiple efforts

Address Length

- hotly discussed issue
- four basic views
    - 8 bytes is enough, more is inefficient
    - 16 bytes is about right, 8 is not enough
    - use 20 byte NSAPs, provide global harmonization
    - variable length gives best safety and efficiency
- many detailed arguments
- consensus is that 16 bytes is enough

IPng Addresses

- propose mapping algorithms from and to other environments
  - where addresses are globally unique and assigned with regard to network topology
- IETF should work with other organizations for development of such mappings
- permits unified management of address space among multiple protocol families
- common addresses facilitate transition to IPng
- goal to provide a 1:1 mapping between address types
  - e.g. IPX, NSAP, E164

Transition

- two IPng transition efforts
  - short term (technology focus)
    - refine IPng-specific documents for proposed standard
  - long term (operations focus)
    - transition, coexistence & testing
- work together

Security

- there is a recognition that the Internet needs strong security
- the goal is to provide strong protection as a matter of course throughout the Internet
- support of authentication header is required in IPng
- support of privacy header is required in IPng
- a key management infrastructure is required but outside of IPng effort
- need framework for firewalls under IPng

Other Needed Work

- changing the size of the internetwork layer address and other IPng changes affects many IETF standards
  - 27 of 51 full standards, 6 of 20 draft, 25 of 130 proposed
- new working groups must be formed in many IETF areas to examine and resolve changes required, some work can be done by IPng WG
  - TCP, UDP, ICMP ...
  - FTP, SNMP, DNS, BOOTP, DHCP ...
  - IDRP, ISIS, OSPF, RIPv2 ...
  - host & router requirements
- APIs - may or may not be IETF issue but needs to be addressed (Informational RFC)

Expected Time Line

- July 1994 - IPng recommendation
- October 1994 - IESG approved recommendation
- March 1995 - documents submitted as proposed standards
- July 1995 - 1st beta versions of release software
- December 1995 - initial scaling tests complete
- December 1995 - 1st production software releases