



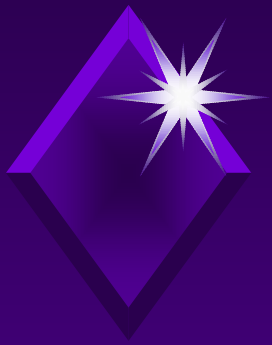
Global IPv6 Summit

Beijing, China

Vint Cerf

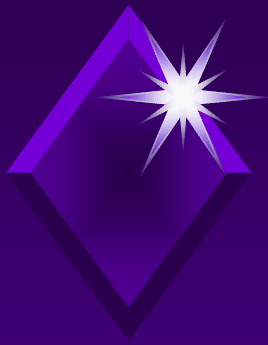
MCI

April 13, 2004



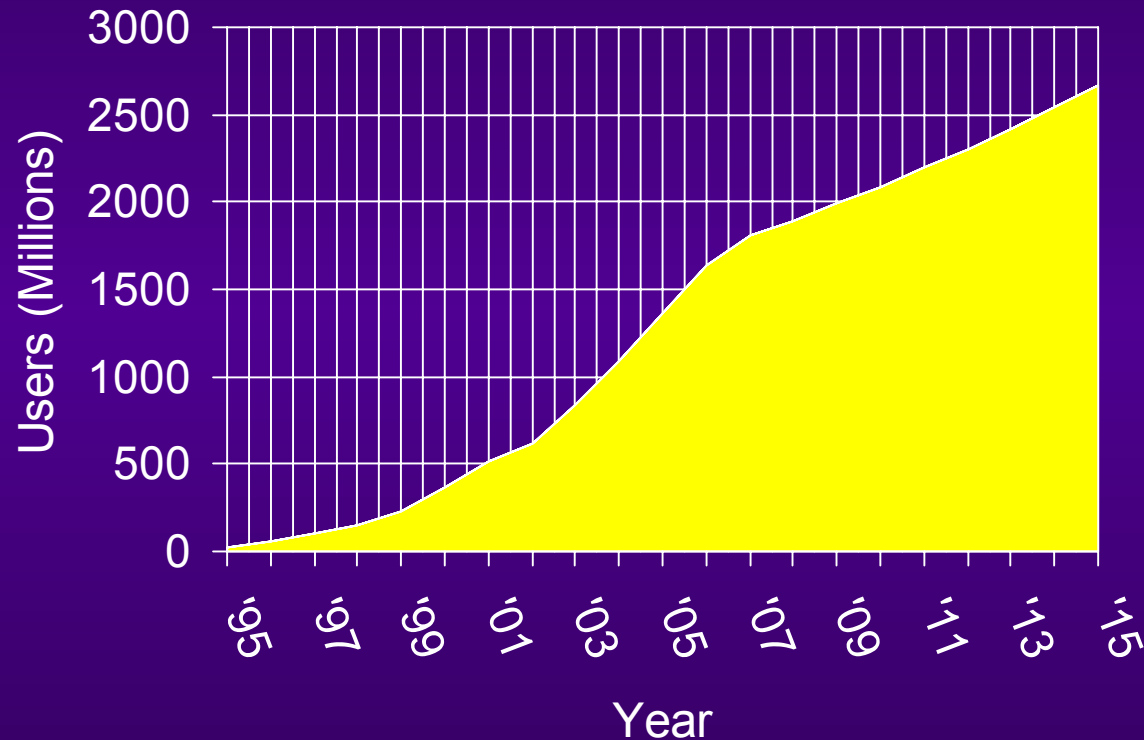
Assumptions

- ◆ Participants are familiar with IPv6 design
- ◆ Motivations for use of IPv6 are well known
- ◆ Relatively slow uptake of IPv6 also known (but speeding up in Asia and Europe)

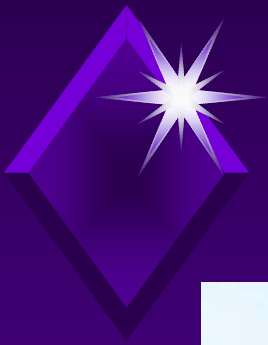


Internet User Growth Trend

Estimate revised 4/2003

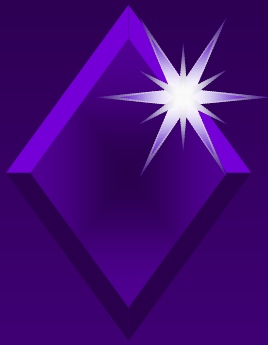


Source: Nua Internet Surveys + vgc projections



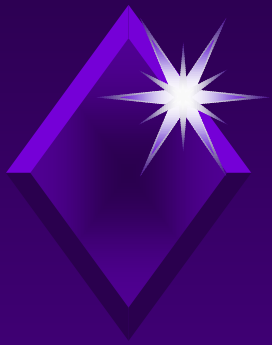
Internet expansion (Belize)





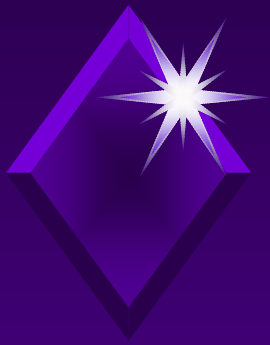
Internet-enabled Appliances





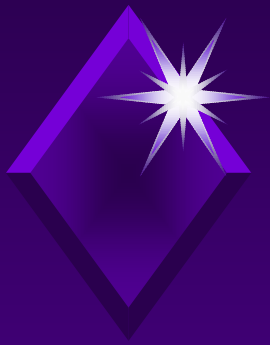
IP Address Consumption

- ◆ Extreme concern in early 1990s that IPv4 address space would be consumed within a decade or less
- ◆ Led to lengthy IETF work on IPng (next generation).
- ◆ Many competing proposals – eventually boiling down to 128 bit IPv6
- ◆ Simplification of IP packet format, headers and options
- ◆ Current IPv4 runout projections as late as 2020's
- ◆ 89 /8s (35%) remain – but CIDR begets NATs



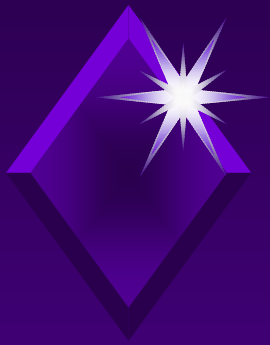
The Real Issues for IPv6

- ◆ Mass of software that must be created or updated
- ◆ Operational side effects (routing, order entry, provisioning, parallel operation, interoperation w/IPv4?, domain name resolution, customer service...)
- ◆ Minimum requirements for successful operation



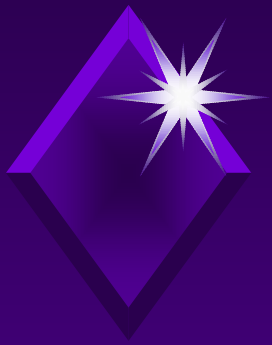
Single Stack/Dual Stack

- ◆ Users could be either
 - ◆ Interoperation is harder if one participant is single stack only
 - ◆ If users have dual stack, picking one for any given interaction might be driven by DNS response or configuration preference
- ◆ Servers work better with dual stacks



Single Stack Side-effects

- ◆ Limited to matching correspondents only (who may be dual stack)
- ◆ Proxies needed for conversion to servers capable of only one stack
- ◆ NAT boxes, if they persist, get more complicated (more combinations)
- ◆ Tunneling through other-stack clouds



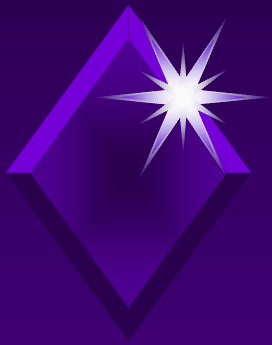
Core Software Requirement

- ◆ Dual Stack routers (routing, forwarding, filtering, tunneling?)
- ◆ MPLS and dual stack operation
- ◆ Dual Stack network management
- ◆ Dual Stack DNS resolvers and servers
- ◆ Registrar, Registry, WHOIS databases for IPv4 and IPv6
- ◆ Dual Stack application software (endless)



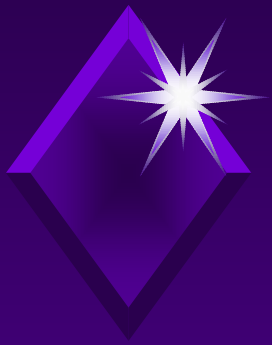
Order entry, provisioning

- ◆ All order entry software has to cope with IPv4 and IPv6 information
- ◆ All backoffice software should work with BOTH
- ◆ How does DHCP work with BOTH?



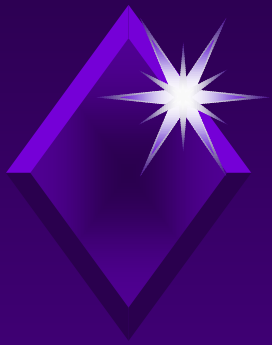
Whither NAT boxes?

- ◆ Do NAT boxes wither away?
- ◆ Use for mapping between IPv4/v6?
- ◆ Tunneling mode only?
- ◆ Impact of mixed mode on NAT bypass mechanisms?



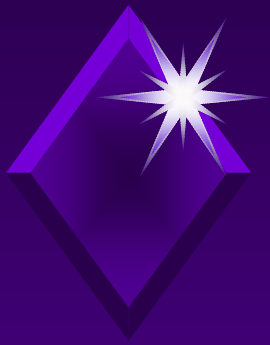
Peer-to-Peer and Servers

- ◆ IPv6 and non-NAT IPv4 have similar qualities: DNS binds to IP addresses
- ◆ Peers and Servers can use DNS to find each other
- ◆ Note use of Presence and Rendezvous with non-DNS identifiers to locate peers (allows for mobile/portable dynamic IP addressing)



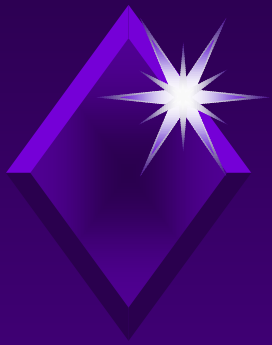
Security

- ◆ IPSEC is defined but need to work on key distribution
- ◆ PKI has worked for intra-organization applications but less well for
 - ◆ Inter-organization
 - ◆ Public
- ◆ Note other layers (TLS, SSL) also available for security



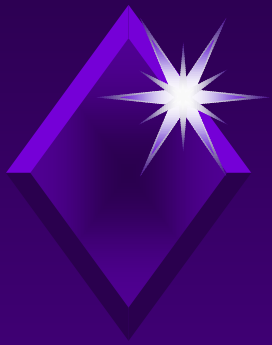
Address Assignment

- ◆ End points can have multiple addresses
- ◆ Equipment service company and operator can maintain distinct addresses and routing paths and access policies to the same device
- ◆ Anecdote: IPv6-enabled windshield wiper speed detectors in Japan!



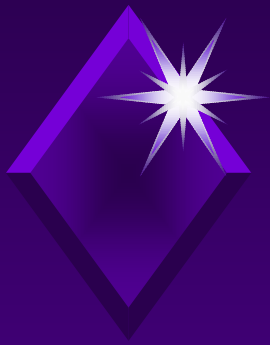
Header Compression

- ◆ IPv6 can be compressed to smaller size than IPv4 – reducing latency on low speed links.
- ◆ Compression costs vs latency of NATs



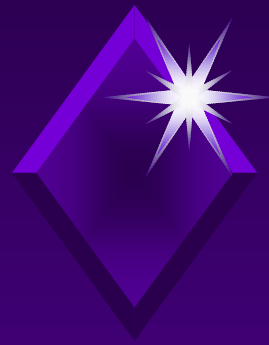
Tunneling

- ◆ 6to4 – needs public IPv4 addresses at each end
- ◆ Isatap – restricted to private networks
- ◆ Teredo – works with NATs but only from endpoints, not within a router
- ◆ Manual tunneling does not scale well



Bottom Line

- ◆ Substantial analysis and documentation would be helpful to guide IPv6 development requirements at all layers
- ◆ Application drivers will be the key to providing ISP incentive to deploy IPv6
- ◆ Seems unlikely that IPv4 will ever fully disappear but IPv6 is only clean option to get more address space



Cerf's slides and other IPv6
and Internet information can
be found at:

[*www.mci.com/cerfsup*](http://www.mci.com/cerfsup)

[*www.ipv6forum.com*](http://www.ipv6forum.com)

[*livinginternet.com*](http://livinginternet.com)

