Systems Center Charleston

Deploying IPv6 in the Military

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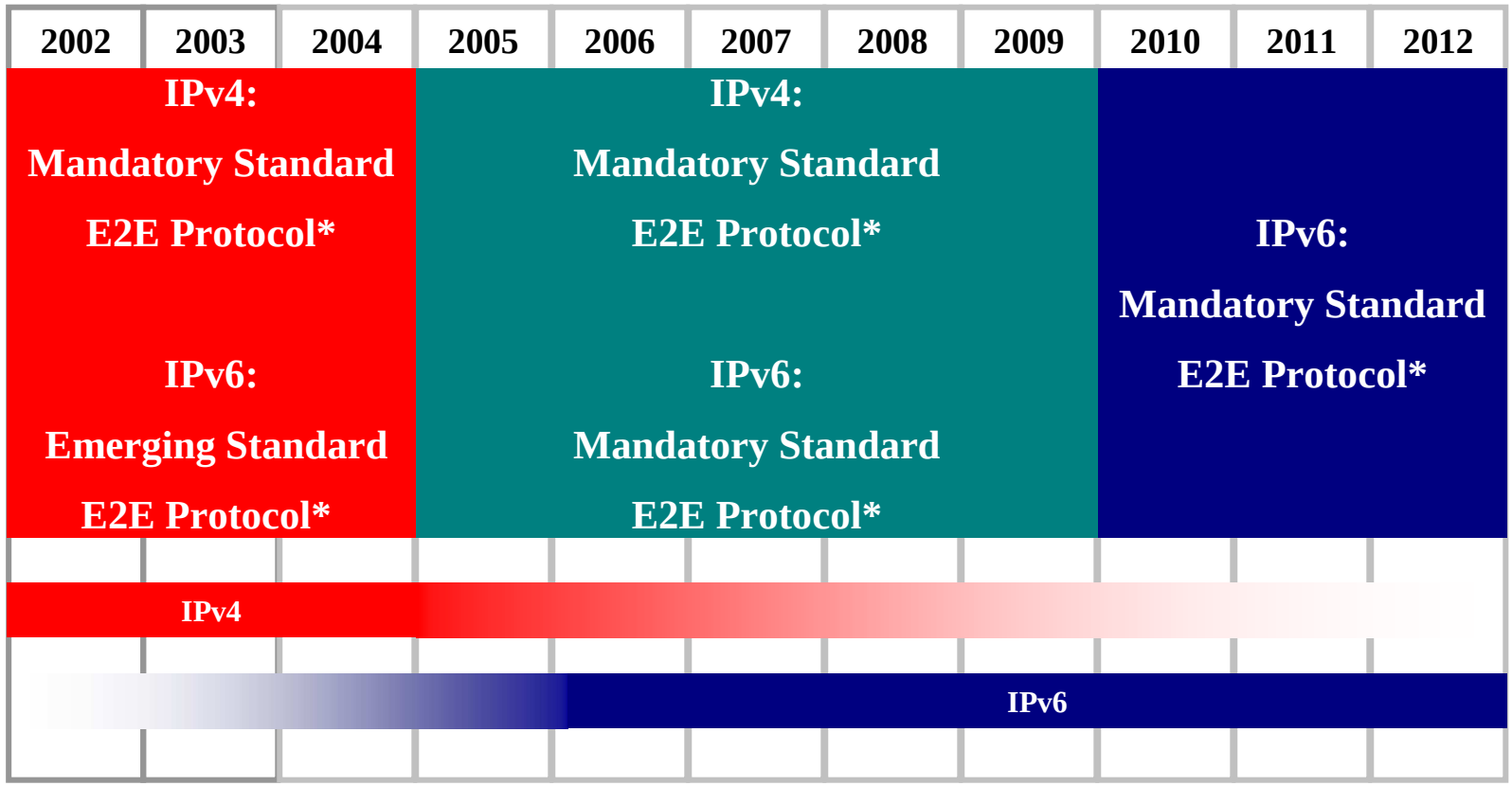
Background

- **IPv6 is a new end-to-end Internet Protocol**
  - **AKA network layer protocol**
  - **AKA layer 3 protocol**
- **IETF began developing in the mid 1990s**
- **Meant to eventually REPLACE IPv4.**
- **Coexistence mechanisms have been built in to reduce the pains of transitioning.**
- **Internet community deploying since 1999.**
- **Timing of the commercial move to IPv6 is still not clear.**

Military Overview

- **IPv4 has been a military standard since 1978.**
- **DoD has a tremendous capital investment in IPv4 technologies.**
- **IPv6 will likely have significant impacts to the DoD.**
- **IPv6 impacts will be both positive and negative.**
- **IPv6 impacts will cross nearly all programs and communities within the DoD.**
- **The transition will likely be more cost-effective if driven top down verses bottoms up.**

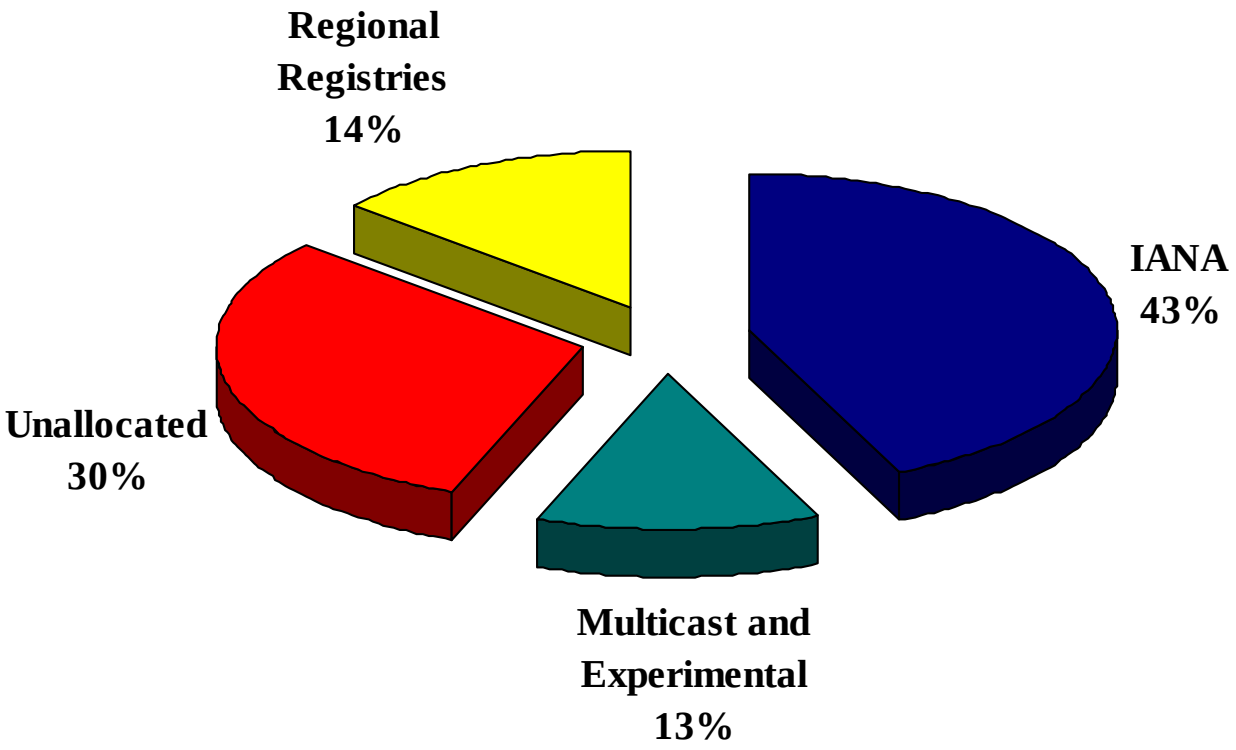
Projected DoD Timeline



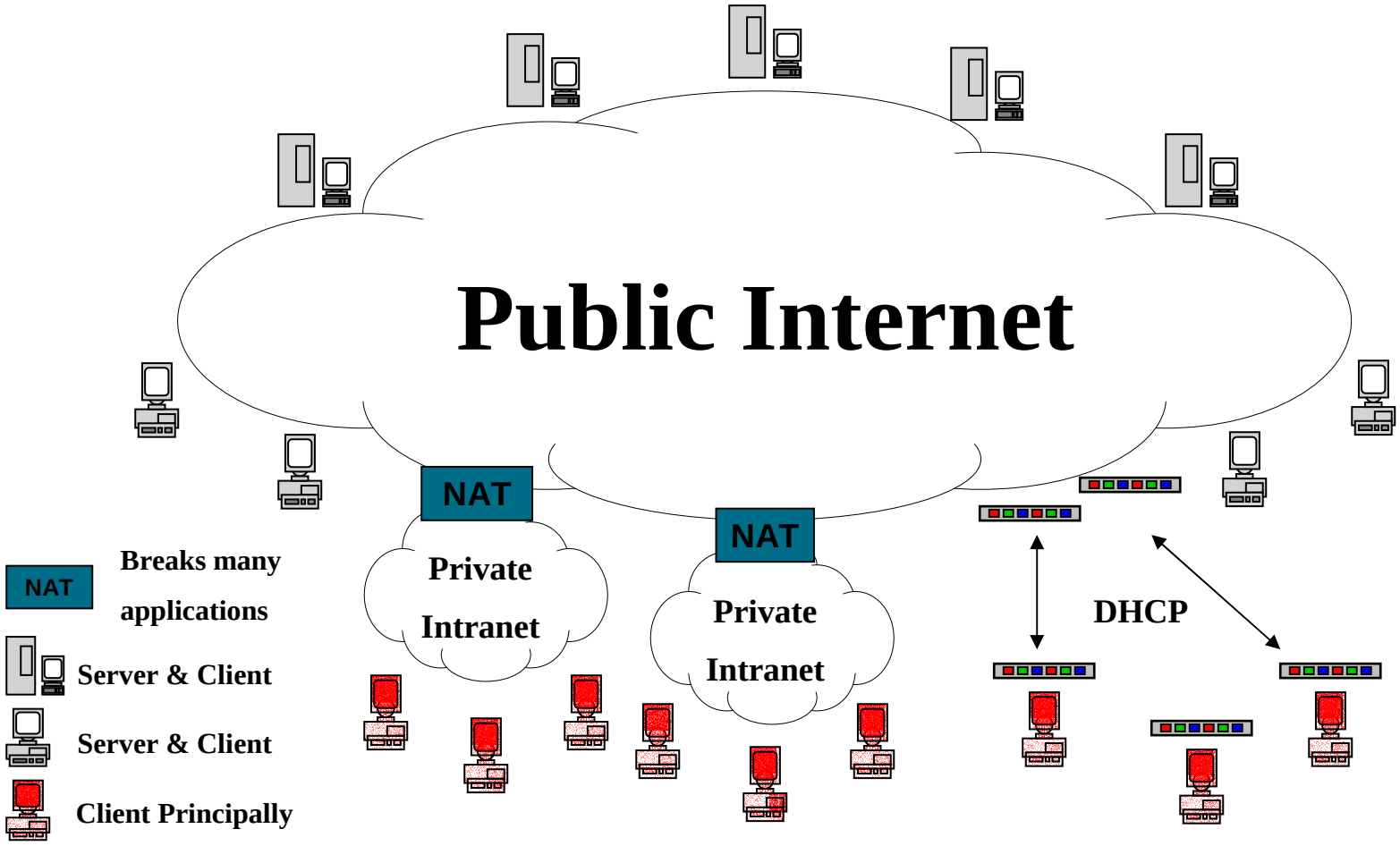
Principle Reasons for IPv6

- **Much larger address space**
  - >**IPv6 : 340,282,366,920,938,463,463,374,607,431,768,211,456 addresses**
  - >**IPv4 : 4,294,967,296 addresses**
- **Improved routing**
  - >**Route aggregation reduces the size of routing tables**
  - >**Simplified header reduces router processing loads**
- **Enhanced security and QoS**
  - >**Mandatory IPsec support for all fully IPv6 compliant devices**
- **Improved support for mobile IP and mobile (and add-hoc) computing devices**
- **Reduced Administration**

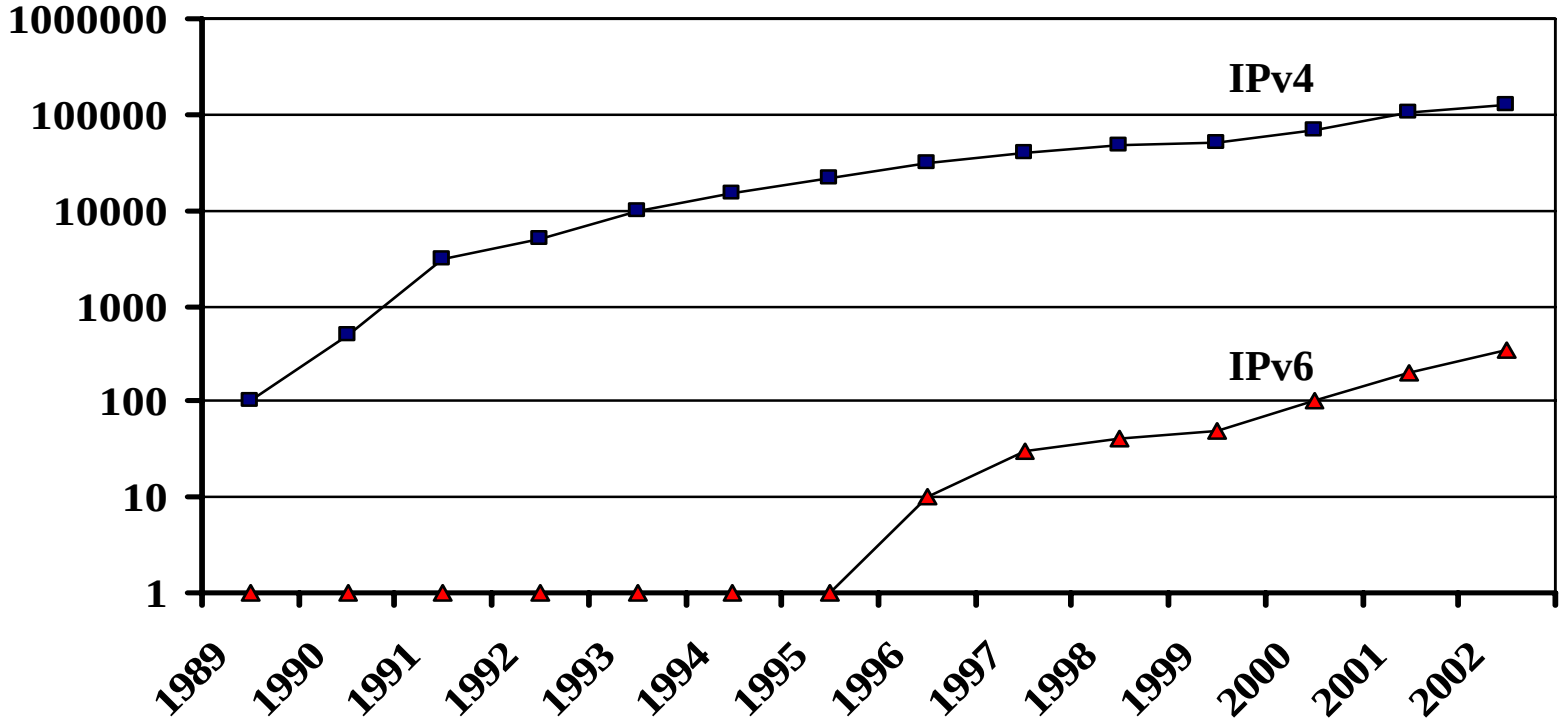
IPv4 Allocation Aug 02



IPv4 Address Shortage a Cause of the Digital Divide



IPv6 and IPv4 Routing Table Comparison



- IPv6 routing system demonstrates nearly three orders of magnitude improvement as compared to the IPv4 routing system.

Current IPv6 ISP Deployment

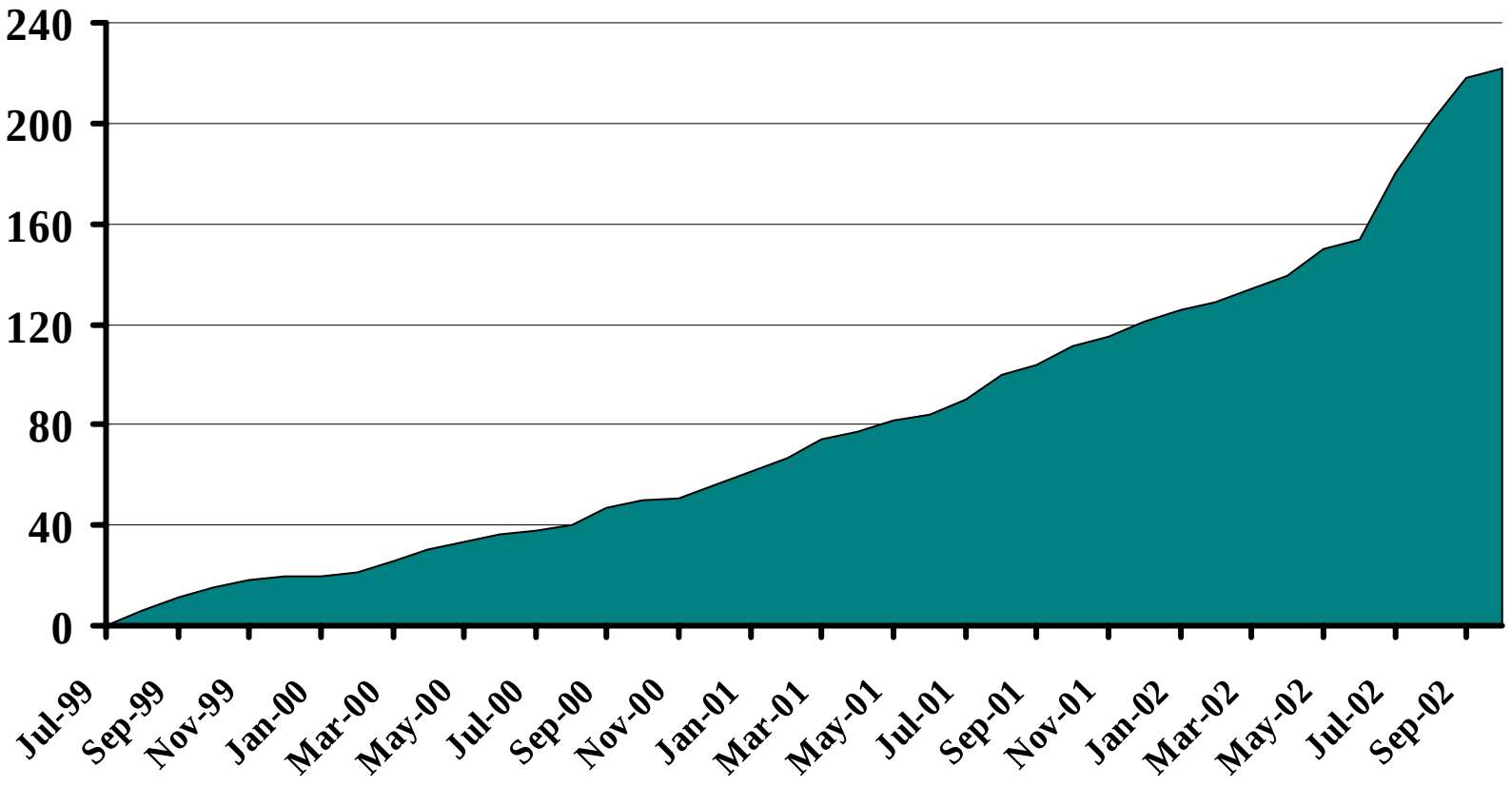
#	Country	ISPs
1	Japan	47
2	US	24
3	Germany	20
4	South Korea	14
5	UK	8
6	Netherlands	7
7	Europe	6
8	Austria	6
9	France	6
10	Taiwan	6
11	Mexico	5
12	Finland	5
13	Italy	5
14	Canada	4
15	Sweden	4

#	Country	ISPs
16	Norway	4
17	Poland	4
18	Switzerland	4
19	Australia	4
20	China	4
21	Portugal	3
22	Singapore	3
23	Thailand	3
24	Russia	2
25	Ireland	2
26	Spain	2
27	Lithuania	2
28	Denmark	2
29	Malaysia	2
30	Brazil	1

#	Country	ISPs
31	Luxembourg	1
32	Greece	1
33	Belgium	1
34	Czech	1
35	Hungary	1
36	Estonia	1
37	Cyprus	1
38	Yugoslavia	1
39	Turkey	1
40	UAE	1
41	Papua New Guinea	1
42	India	1

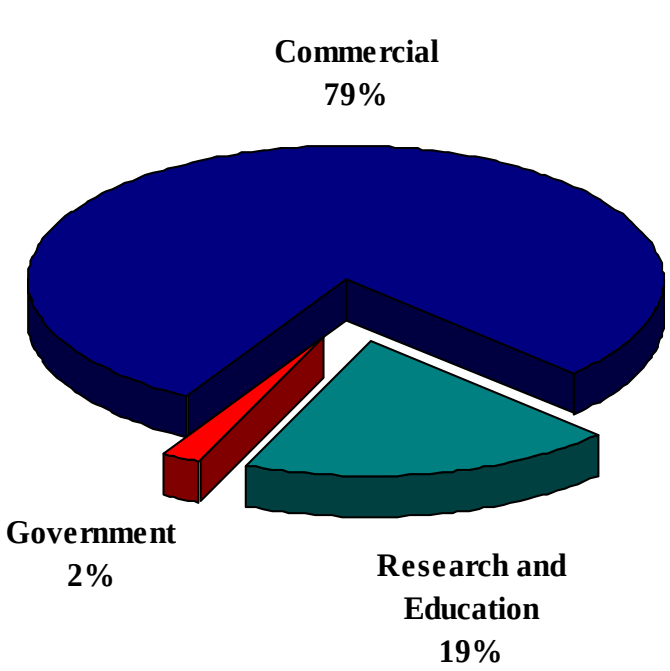
- **129 pTLAs in 56 nations (6BONE)**

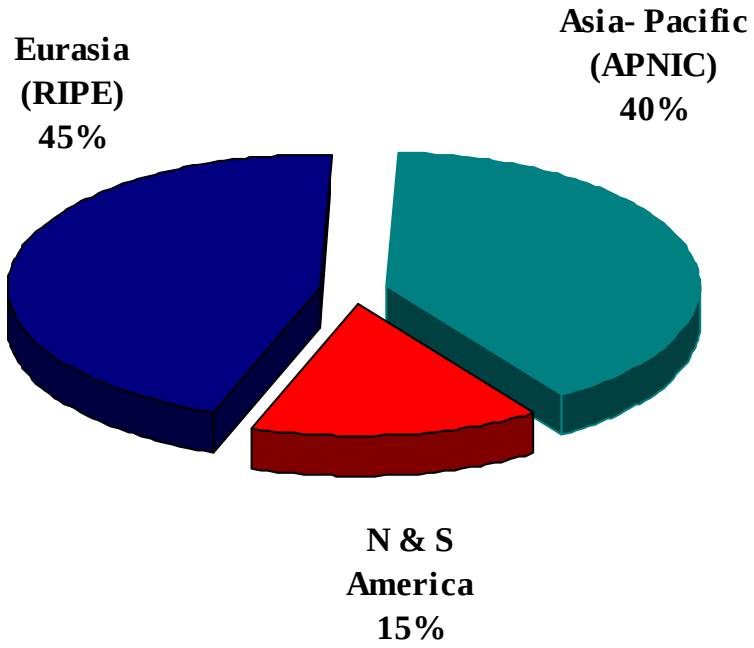
222 ISPs in 39 Months



IPv6 Internet demonstrates the trend of doubling in size every year.

Distribution of Production IPv6 ISPs





IPv6 Products

- **Many open source SW IPv6 products exist at this time.**
- **Microsoft : Windows XP, .NET Server, and CE.**
- **Cisco: IOS 12.2.(2).T +**
- **Juniper : 5.2 Internet Software**
- **Sun: Solaris 8.0 +**
- **SCO : Unixware 7.0 +**
- **HP : HPUX 11i + and Tru64 5.1+**
- **IBM : AIX 4.3 +**
- **Apple : “Jaguar” OS 10.2**
- **Symbian OS**
- **Checkpoint Firewall**
- **802.11b wireless devices**

IPv6 Coexistence Mechanisms

- **Dual Stack**
- **BITS**
- **BIA**
- **SOCKS**
- **SIIT (2.)**
- **NAT-PT**
- **TRT**
- **6over4**
- **ISATAP**
- **DSTM**
- **Teredo (2.)**
- **Configured Tunnels**
- **Automatic Tunnels**
- **Tunnel Broker**
- **6to4 (2.)**
- **BGP Tunnel**

1. **Some CMs are useful stand-alone, some in combination, some CMs must be used in combination, some are targeted for home use and not the enterprise, and some CMs are more mature than others.**
2. **CMs having dedicated IPv6 address prefixes.**

Potential Impacts of IPv6 on the USN and USMC

1. New NCW concepts and doctrine possible with IPv6.
2. IPv6 provides superior networking capabilities compared with IPv4.
3. New devices, applications, and services will be available with IPv6.
4. A new and growing Internet community is accessible via IPv6.
5. Enterprise synchronization could suffer during the transition.
6. Expect increased cost, complexity, and interoperability problems during the transition.
7. There is concern for resources shared between IPv4 and IPv6.
8. Policies, processes, procedures, and databases will need enhancement.
9. Network services will need enhancement.

Potential Impacts of IPv6 on the USN and USMC (cont)

10. **COTS and GOTS infrastructure will need enhancement.**
11. **COTS and GOTS software applications will need enhancement.**
12. **IPv6 will impact new and ongoing acquisition programs.**
13. **IPv6 T&E capabilies will be required.**
14. **Training will need enhancement.**
15. **Enterprise IA capabilities will need enhancement.**
16. **Enterprise IW capabilities will need enhancement.**
17. **The financial condition and resources of the enterprise could suffer because of the transition.**

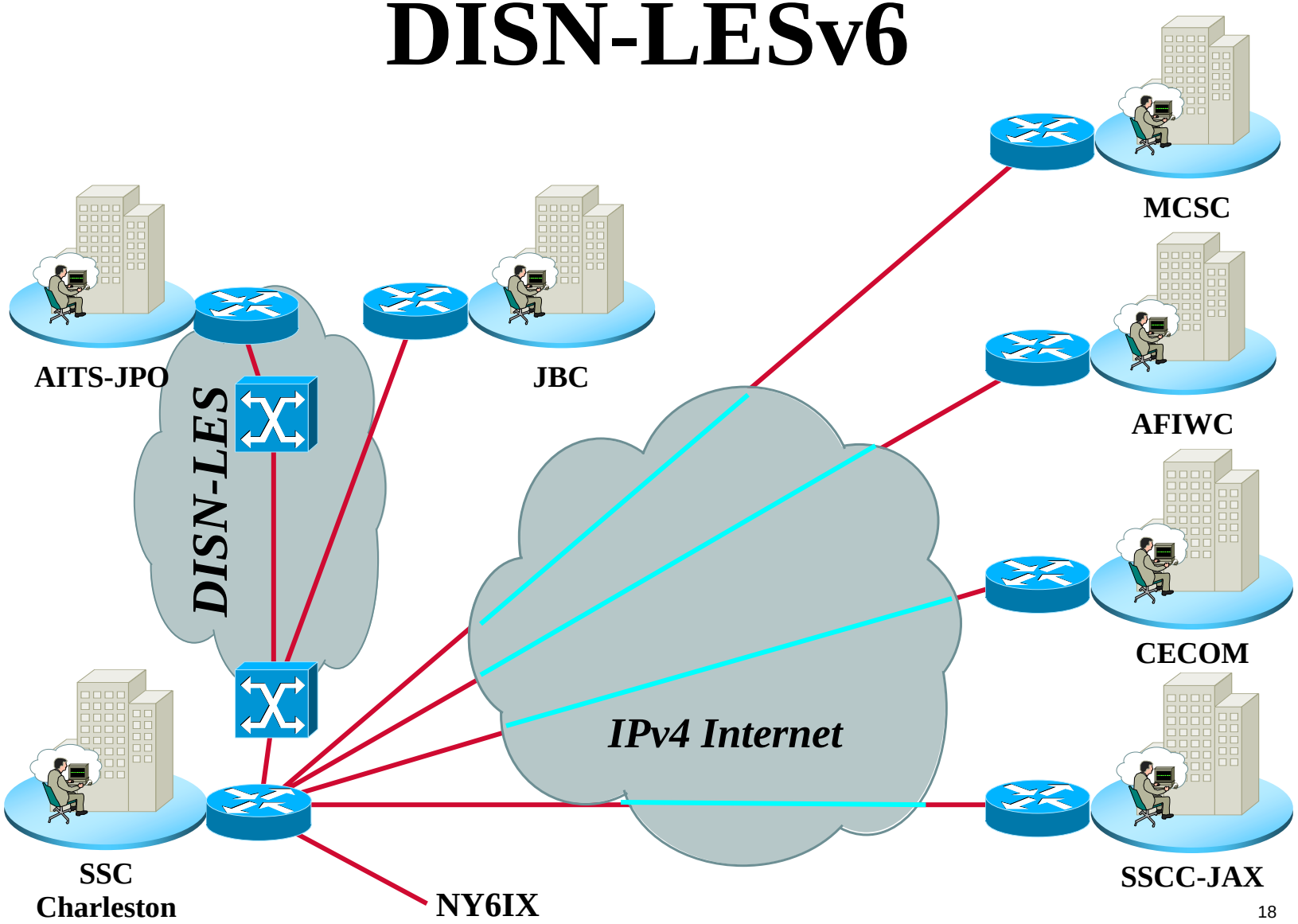
IPv6 Impacts on IA

- **Many IA vulnerabilities will be just as dangerous with IPv4 as IPv6.**
  - **Viruses, Worms, Trojan Horses, etc…**
- **Improved protection from snooping and spoofing attacks when IPsec is utilized.**
- **Improved security of DNS and other network services.**
- **New IA vulnerabilities with IPv6 associated with:**
  - **New features**
  - **Co-existence mechanisms**
  - **Resources shared between IPv4 and IPv6.**
- **It appears, new IPv6 vulnerabilities are not being tracked by the CERT at this time.**

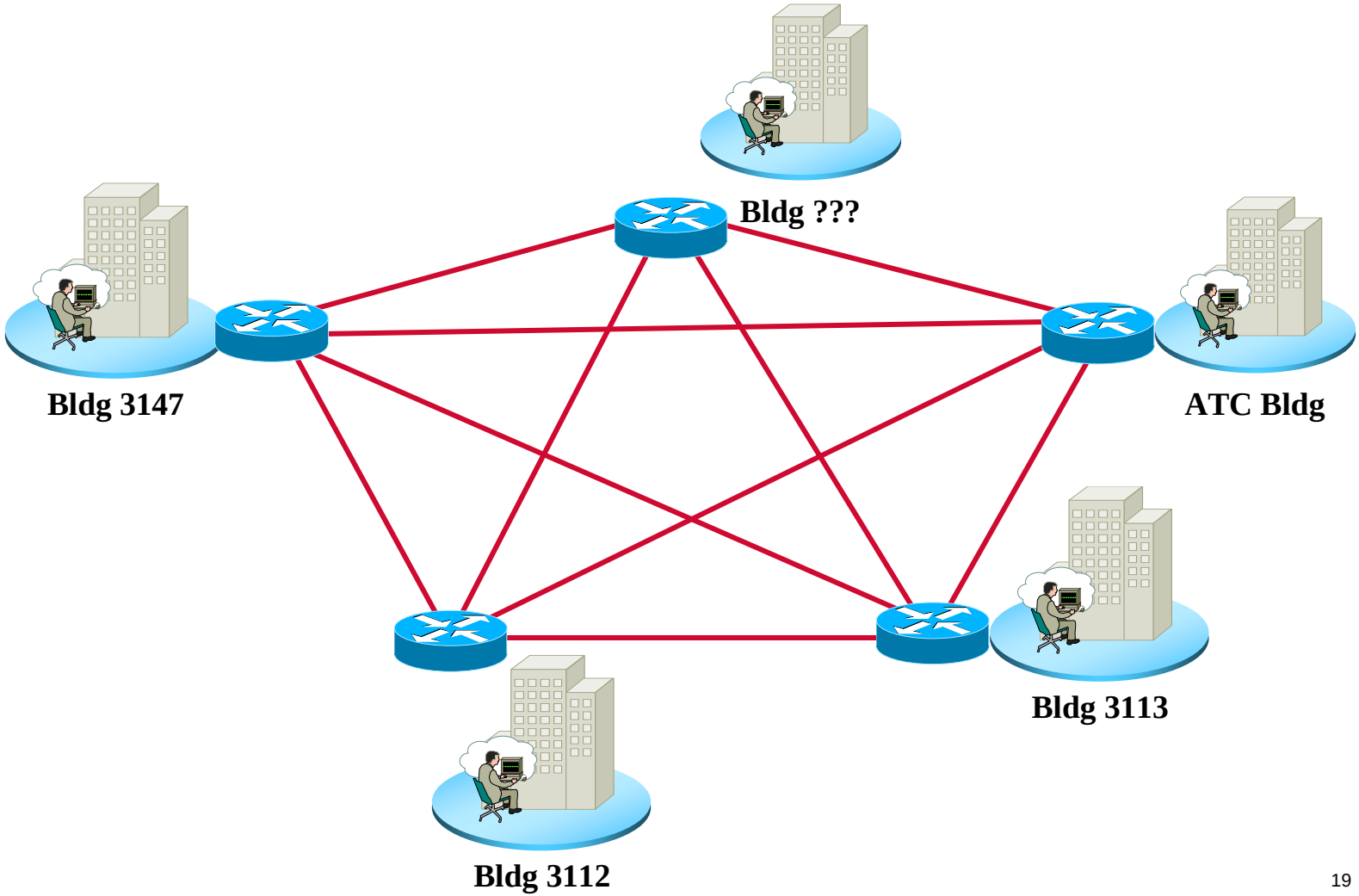
SSCC and IPv6

- **4 DoD IPv6 Conferences.**
- **White papers and presentations**
- **IPv6 computer model library**
- **IPv6 related analyses**
- **Lessons Learned**
- **Collaborations with other DoD organizations and industry.**

DISN-LESv6


MCSC
AFIWC
CECOM
SSCC-JAX
AITS-JPO
JBC
DISN-LES
IPv4 Internet
SSC
Charleston
NY6IX

SSCC IPv6 Campus



Draft DoD IPv6 Policy

- **No implementations of IPv6 are permitted on networks carrying operations traffic within DoD at this time.**
- **DoD Components are encouraged to coordinate, undertake, and participate in IPv6 demonstrations/testbeds and share the results.**
- **DoD activities acquiring new or upgrading existing IP-based technologies or services must recognize IPv6 readiness/compatibility as a likely future need.**
- **DISA is directed to acquire IPv6 address space sufficient to meet DoD's five year requirements by 30 Dec 02.**
- **DISA will continue to manage DOD IP address allocation, registration and control on an enterprise basis to promote interoperability and security.**
- **DoD users will only acquire IP address space originating from DISA.**
- **Finally, DISA is tasked to lead (with the support of the Joint Staff (JS), DoD Chief Information Officer (CIO) and Services) the effort to develop an initial implementation plan within six months from the date of this memo.**

Recommendations

- **Develop an IPv6 transition strategy for the USN and USMC Enterprise.**
- **Incorporate IPv6 in the new USN Shore Infrastructure Master Plan (SMP).**
- **Examine your policies, processes, and procedures for IPv4 dependencies.**
- **The acquisition and logistics communities should incorporate IPv6 support as a likely future requirement.**
- **Consider utilizing M&S for IPv6 communications and architectural studies.**
- **Consider SSCC as your IPv6 engineering center.**

Backup Slides

FEATURE	IPv4	IPv6
Address Length	32 bits, dotted-decimal	128 bits, colon-hex
IPSec Support	Optional	Required
QoS Support	Some	Better
Fragmentation	Hosts and Routers	Hosts only
Header Checksum	Yes	No
Link-Layer Address Resolution	ARP	Multicast Neighbor Discovery Messages
Uses Broadcast	Yes	No
Configuration	Manual, DHCP	Automatic, DHCP
DNS Name Queries	Uses A records	Uses AAAA and A6 records
Minimum MTU	576 Bytes	1280 Bytes
DNS Reverse Queries	Uses IN_ADDR.ARPA	IP6.ARPA and IP6.INT

IPv6 Deployment Factors

- **Policy**
- **Available Resources**
- **Real-Time Applications**
- **Security Posture**
- **Existing IPv4 Infrastructure**