

# Considerations and Actions of Content Providers in Adopting IPv6

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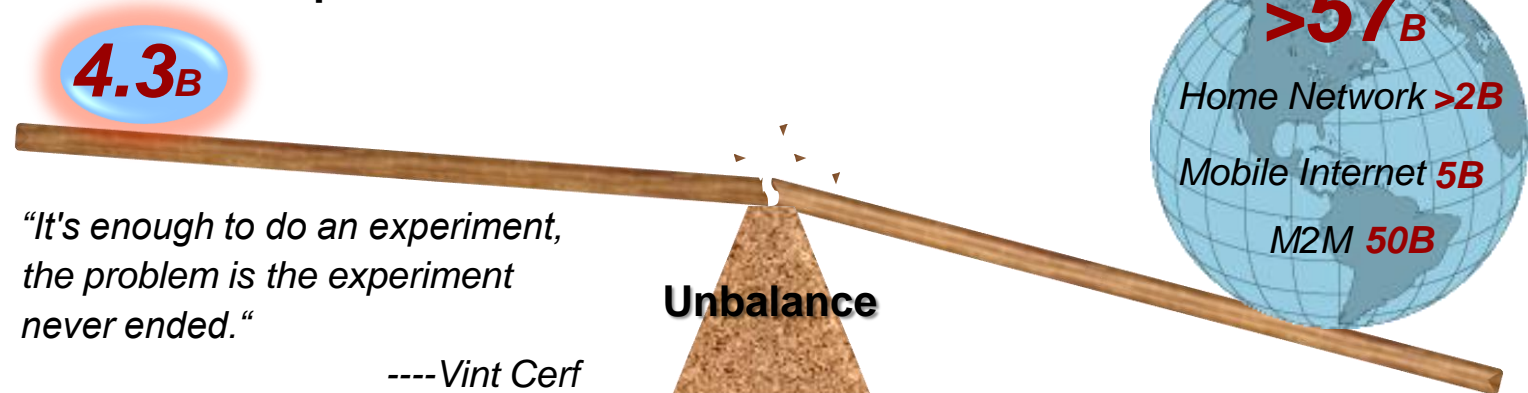
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# IPv6 Trends

- **Global IPv4 registry (IANA) ran out of spare blocks of IPv4 addresses in February 2011**
  - Users without direct IPv4 access are likely to appear
  - direct IPv6 access might provide better performance than indirect access via NAT
  - NAT444 Still Has Major Impacts to Applications

## IPv4 Address Space



# IPv6 Industry Chain: Rump up but Imbalance

- **Blockers for IPv6 adoption**

- ✓ OS support






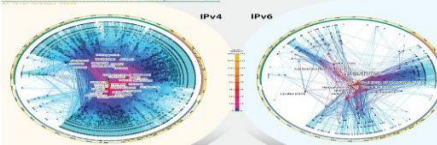


- ✓ Infrastructure/backbone support

- ✓ Client software support

- ✓ Content availability

- ✓ End-user connectivity

- ✓ End-user CPE device

<p><b>Standard</b></p> 	<ul style="list-style-type: none"> <li>■ <b>The core standards are stable</b></li> <li>■ Ongoing work will be continued to address the new issues in more specific scenarios</li> </ul>	
<p><b>Terminal</b></p> 	<ul style="list-style-type: none"> <li>■ <b>The main Operating Systems are ready</b></li> <li>■ Windows 8/7/XP/Vista, Mac OS, Linux, Solaris, Android, iOS, Symbian</li> </ul>	
<p><b>Network</b></p> 	<ul style="list-style-type: none"> <li>■ <b>Global IPv6 transit network are ready</b></li> <li>■ Backbone networks of big carriers support dual stack; Many IPv6 commercial trials are ongoing</li> </ul>	
<p><b>Content</b></p> 	<ul style="list-style-type: none"> <li>■ <b>20% of ISPs now offer IPv6 services</b></li> <li>■ More than 30% of content are available through IPv6. The number will go up</li> </ul>	

# Message for ICPs and ASPs

- **RFC 6883 “IPv6 Guidance for Internet Content Providers and Application Service Providers”**
  - Published March 2013, IETF V6OPS Working Group
  - Intend to provide guidance and suggestions for Internet Content Providers (ICPs) and Application Service Providers (ASPs) who wish to offer their services to both IPv6 and IPv4 customers but who are currently supporting only IPv4. Also apply to hosting provider and enterprise networks
  - The introduction of IPv6 service should not make service for IPv4 customers worse
- **The main message - **prepare a strategy****



# Start Point



- **The most common strategy for an ICP is to provide dual-stack services -- both IPv4 and IPv6 on an equal basis**
  - IPv4-only and IPv6-only users will be existing for a long time
  - Dual stack is simplest and best
- **Choose between outside-in and inside-out**
  - Outside-in: convert customer-facing service to dual stack first (e.g. dual stack HTTP proxy), then convert core services when convenient
  - Inside-out: convert core services first, then expose IPv6 access later
- **The network should not need major changes when it becomes possible to transition to IPv6-only at some point in the future**
- **Checking hardware and software suppliers' plan for providing sufficient IPv6 support, with performance equivalent to IPv4**

# Considerations

- **Education and Skills**
- **IPv6 Connectivity**
- **Address and subnet assignment**
- **Routing & DNS**
- **Firewalls & Load Balancers**
- **Proxies**

- **Servers**
- **Transition Technologies**
- **Content Delivery Networks**
- **Operations and Management**
- **Security**

# Arrange IPv6 Connectivity



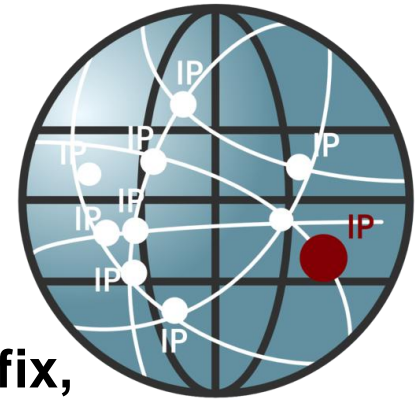
- **Native**

- ICP's border router(s) are upgraded to dual stack
- ISP that has no definite plan to offer native IPv6 service should be avoided
- ISPs' internal transit mechanisms does not matter much

- **Managed Tunnel**

- An IPv6-in-IPv4 tunnel to a remote IPv6 ISP; A dual-stack router in the ICP's network will act as a tunnel endpoint
- Reasonable for initial testing and skills acquisition
- Otherwise, not recommended; performance bottleneck, PMTUD problems likely
- Unmanaged tunnels should be avoided





# Address & subnet assignment - IPv6 Infrastructure

- **Decide whether to apply for PI (Provider Independent) prefix, or run one PA (Provider Aggregated) prefix per ISP**
  - Changing ISP would cause changing PA
  - [RFC4192] and [RFC6879] provide enterprise network renumbering guidance
- **Decide whether to run Unique Local Address prefix (ULA, RFC4193] for internal traffic only**
- **/48 or /56? multiple sites need a prefix per location**
- **Ensure address management tool is adequate**
- **Decide whether to run DHCPv6 (may need interoperation with DNS) or SLAAC with dynamic DNS**





# Routing & DNS

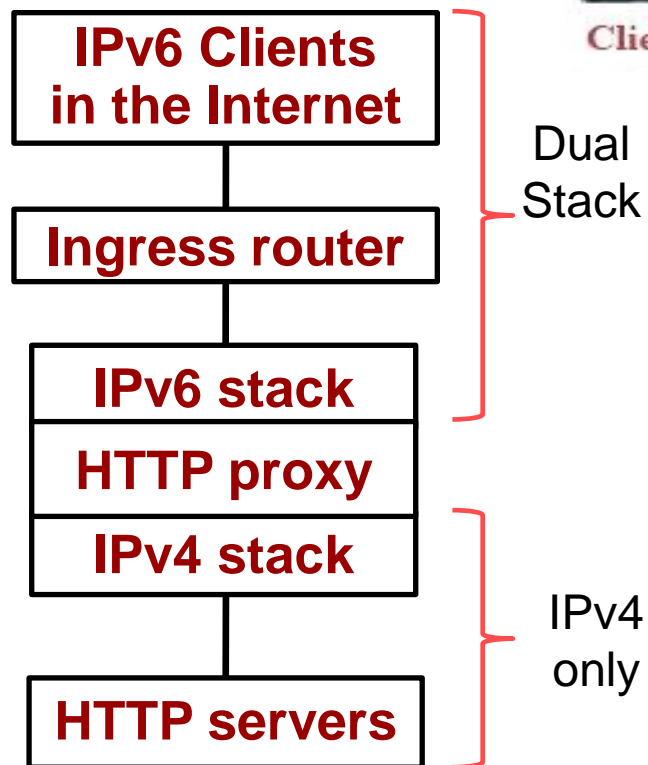
## - IPv6 Infrastructure

- **Operate IPv4 and IPv6 routing protocols in a dual-stack network in parallel**
  - most IPv4 and IPv6 interior routing protocols operate quite independently
  - source-based routing rules might be needed in multiple PA env
- **Support AAAA and queries via both IPv4 and IPv6**
  - ensure that IPv6 works on its servers, load balancers, before adding their AAAA records to DNS
- **Firewalls and load balancers**
  - Checking for their fully support IPv6 (including IPv6 fragmentation and correct ICMPv6 handling)

# Proxies



- An HTTP proxy can readily be configured to handle incoming connections over IPv6 and to proxy them to a server over IPv4
- Proxy can be used as the first step in an outside-in strategy



# Servers and Applications

- **Network stack – dual stack readily available**
- **Applications**
  - HTTP, email servers readily available
  - Check every proprietary application carefully
  - Testing of both client and server applications should be performed in IPv4-only, IPv6-only, and dual-stack
  - Use DNS names, not IP addresses, wherever possible
  - Any cookie mechanism based on 32-bit IPv4 addresses will need significant re-modeling
    - More than just replaced by 128-bit IPv6 addresses. IPv6 addresses may change frequently
  - Logging system should be upgrade – native IPv6 provides better traceback than NATed IPv4
  - Check your geolocation mechanism for IPv6



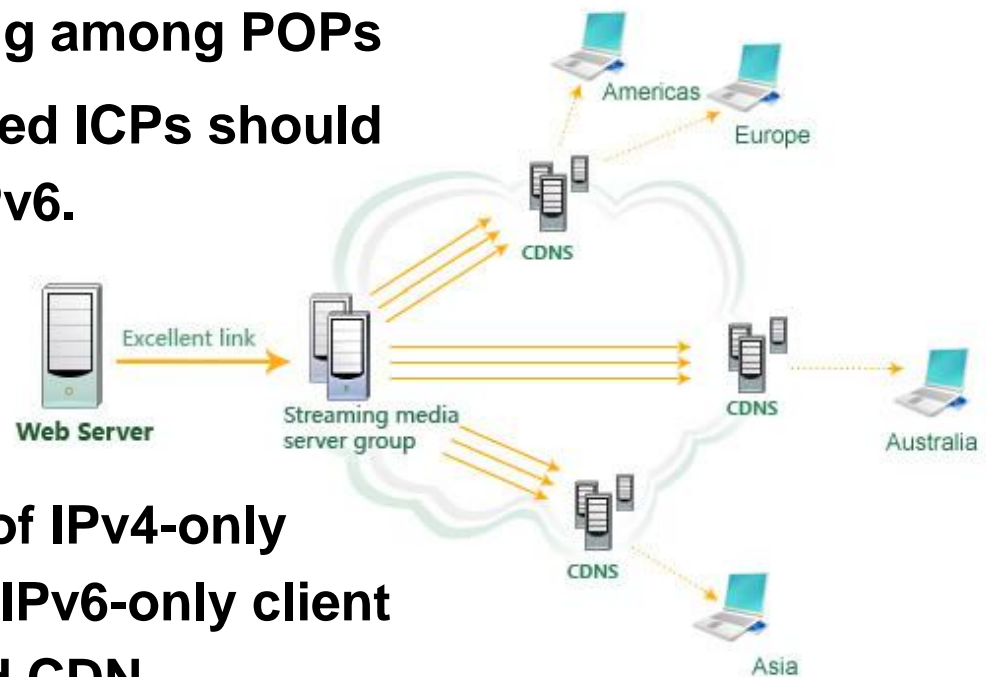


# Cope with Transition Technologies

- **ICPs and ASPs should avoid them within their network**
- **Must be aware that some clients will reach via a v6/v4 translator, v6-in-v4 tunnel or v4-over-v6 tunnel**
  - Translation will inaccurate geolocation of IPv6 addresses
  - Ensure that PMTUD works properly for behind-tunnel clients
  - Server-side TCP implementation supports the Maximum Segment Size (MSS) negotiation mechanism
- **Testing service may consider to offer IPv6-only support via a specific DNS name, e.g., ipv6.example.com**
- **"Happy Eyeballs" [RFC6555] approach on client-side APP may improve the performance for dual stack clients**

# Content Delivery Network

- DNS-based techniques for diverting users to CDN points of presence (POPs) will work for IPv6, if AAAA and A records are provided
- CDN operator should operate a full dual-stack service at each POP and dual-stack routing among POPs
- If using a CDN, IPv6-enabled ICPs should make sure they support IPv6. Otherwise, IPv6 clients will get no benefit from the CDN
- Conversely, the contents of IPv4-only ICPs may be accessed by IPv6-only client through their IPv6-enabled CDN



# More considerations

- **Cooperation with business partner for IPv6 connectivities**
- **ICP should track the IPv6 availability of embedded resources**
- **Be aware that a client may switch between IPv4 and IPv6 or change its IPv6 address changes frequently for privacy reasons. Such changes may affect cookies, geolocation, load balancing, and transactional integrity**
- **Checking network management tools support IPv6 and IPv6 features (such as multiple addresses per host)**
- **Mutual dependency between IPv4 and IPv6 should be avoided, for both the management data and the transport**
- **IPv4 security rules should be matched into IPv6 and more for IPv6-specific and cross-contamination**



## Further Read List

- RFC 4057, J. Bound, Ed., “IPv6 Enterprise Network Scenarios”, June 2005.
- RFC 6180, J. Arkko, F. Baker, “Guidelines for Using IPv6 Transition Mechanisms during IPv6 Deployment”, May 2011.
- RFC 6879, S. Jiang, B. Liu, B. Carpenter, “IPv6 Enterprise Network Renumbering Scenarios, Considerations, and Methods”, February 2013.
- RFC 6883, B. Carpenter, S. Jiang, “IPv6 Guidance for Internet Content Providers and Application Service Providers”, March 2013 .
- draft-ietf-v6ops-enterprise-incremental-ipv6, K. Chittimaneni, T. Chown, Lee Howard, “Enterprise IPv6 Deployment Guidelines”, working in progress.

# Thank you

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