Clear and Present Danger Increase in Number of DNS AAAA Queries

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Outline

- Expect increase in number of DNS queries

Discussion
- Effect on cache server load and user response time
- How can we decrease number of unnecessary queries?
Today’s Topic

• We focus on increase in number of queries between users and cache servers caused by
  – 1. IPv6 support
    • Number of AAAA queries same as that of A queries
  – 2. Domain name completion
    • Domain name completion by operating system
    • Domain name completion by applications
(1) IPv6-enabled OS increases DNS queries
1. IPv6 and OS Resolver

- IPv6-enabled OSs send AAAA queries for every name resolution

- BSD / Windows
  - Sends both A and AAAA queries for every name resolution
    - Currently almost all applications do not specify “DNS Query Type”, therefore OS sends both.
    - Even if the response to AAAA query is “not exist such a domain name” (NXDomain), OS tries to send A query.
(2) Domain name completion increases DNS queries
2. Domain Name Completion

- When a name resolution fails, both OS and APP automatically resolve the domains with prefix/suffix completion.
  - e.g., when name resolution of “host” failed…
    - `host.com` → `host.org` → `host.net` ...

- OS using these domains to complete:
  - FreeBSD: specified by “search” in /etc/resolv.conf and distributed via DHCP
  - Windows: configured in control panel and distributed via DHCP

- Applications:
  - Mozilla: retries name resolution for a domain by adding “www. ” domain prefix
  - IE: searches domain using MSN search and then retries name resolutions for domains by adding `.com` → `.org` → `.net` → `.edu`
And these combinations increase queries more and more...
Combination in FreeBSD

- Combinations of AAAA queries and domain completions are **different depending on OS**
- FreeBSD
  - Tries domain completions for A and AAAA

(Ex) User Query: noexist-example.com
A    noexist-example.com
AAAA noexist-example.com
A    noexist-example.com.com
AAAA noexist-example.com.com
A    noexist-example.com.net
AAAA noexist-example.com.net

If IPv4 address is resolved, stop here.
Combination in Windows

• Combinations of AAAA queries and domain completions are different depending on OS

• Windows
  - Tries AAAA queries for all domain completions, and then A queries with domain completions

(Ex) User Query: noexist-example.com
AAAA noexist-example.com
AAAA noexist-example.com.com
AAAA noexist-example.com.com.net
A noexist-example.com
A noexist-example.com.com
A noexist-example.com.com.net ........
Current typical name resolution by IPv6-enabled Windows

• In the current Internet, almost domains
  – have IPv4 addresses
  – but does NOT have IPv6 addresses.

• IPv6-enabled Windows
  tries AAAA queries for all domain completions, and then sends A queries.

(Ex) User Query: no-v6addr.com

AAAA no-v6addr.com
AAAA no-v6addr.com.com.com
AAAA no-v6addr.com.net
A no-v6addr.com

Even if the domain has IPv4 addresses, firstly AAAA queries are sent!!!
We examined the forthcoming new Windows...
Longhorn (Windows Vista) β2 Build5270

• Default IPv6 enabled
  – Always try AAAA queries

• OS/Application domain name completion
  – Behavior of OS resolver is same as Windows XP
    • OS and applications make (unnecessary) suffix/prefix completions for domain names

Released This Year!
IPv6 enable + domain completion
A common case (IE7)

- Only 1 user click...
  - IPv6 address
    - x
    - domain completions
  - IPv4 Address
    - x
    - domain completions
  - MSN Search
    - using AAAA and A

- 1 user click ➔ 12 DNS queries
In the worst case...

User's 1 click → 40 queries...

- IE tried MSN search
- OS domain completion
- IE added “.com” and OS domain completion
- IE added “.net” and OS domain completion
- IE added “.org” and OS domain completion
- IE added “.edu” and OS domain completion
- IE tried MSN search
Consider these behaviors from the viewpoint of DNS cache servers...
Expected Increase
in Number of User Queries

Depending on Vista market share, number of AAAA queries will increase.
Conclusion

• Release of Windows Vista (IPv6 by default)
  – doubles the number of user queries
  – causes more queries in domain name completions and domain search sequence for AAAA and A queries

• Discussion
  – Operators
    • Cache servers should be prepared for those increases.
      – DNS response time has a serious impact on QoS to end users
    • e.g., stopping domain distribution to users by DHCP or PPPoE
  – Developers of OS
    • Is current search order of resolvers appropriate?
      – e.g., should “A” record be resolved before domain completion?
Questions or Comments?