Influence of Root & TLD Servers on DNS System Performance

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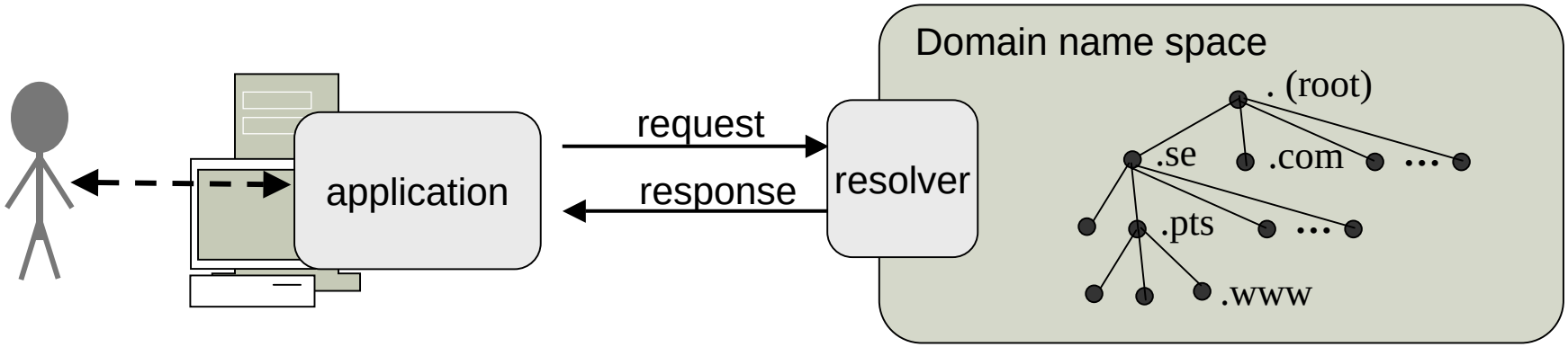
Goal of these tests

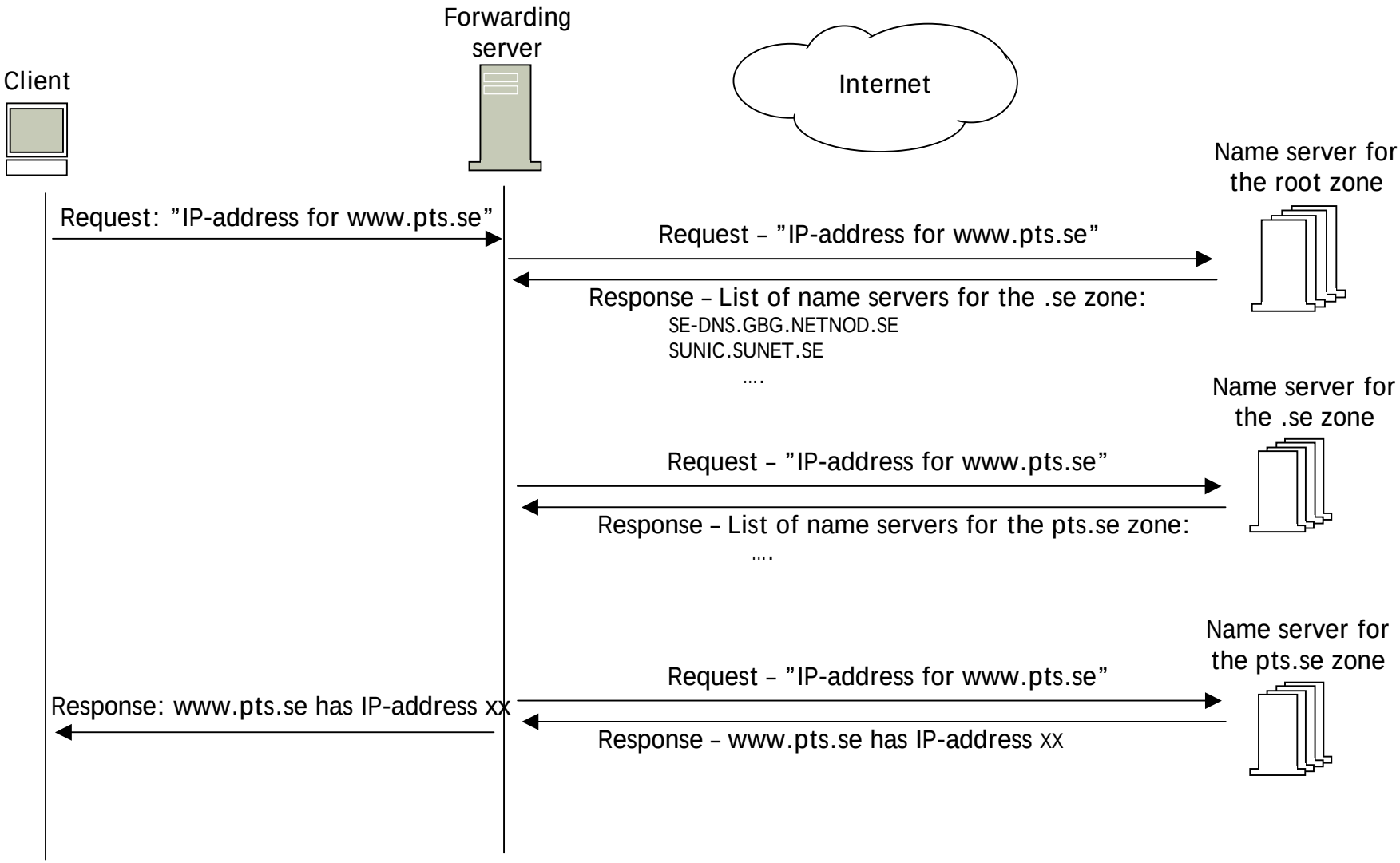
To investigate how the DNS service behaves and what the consequences are for the end-users when servers at .se or root level is subjected to stress and inconsistencies.

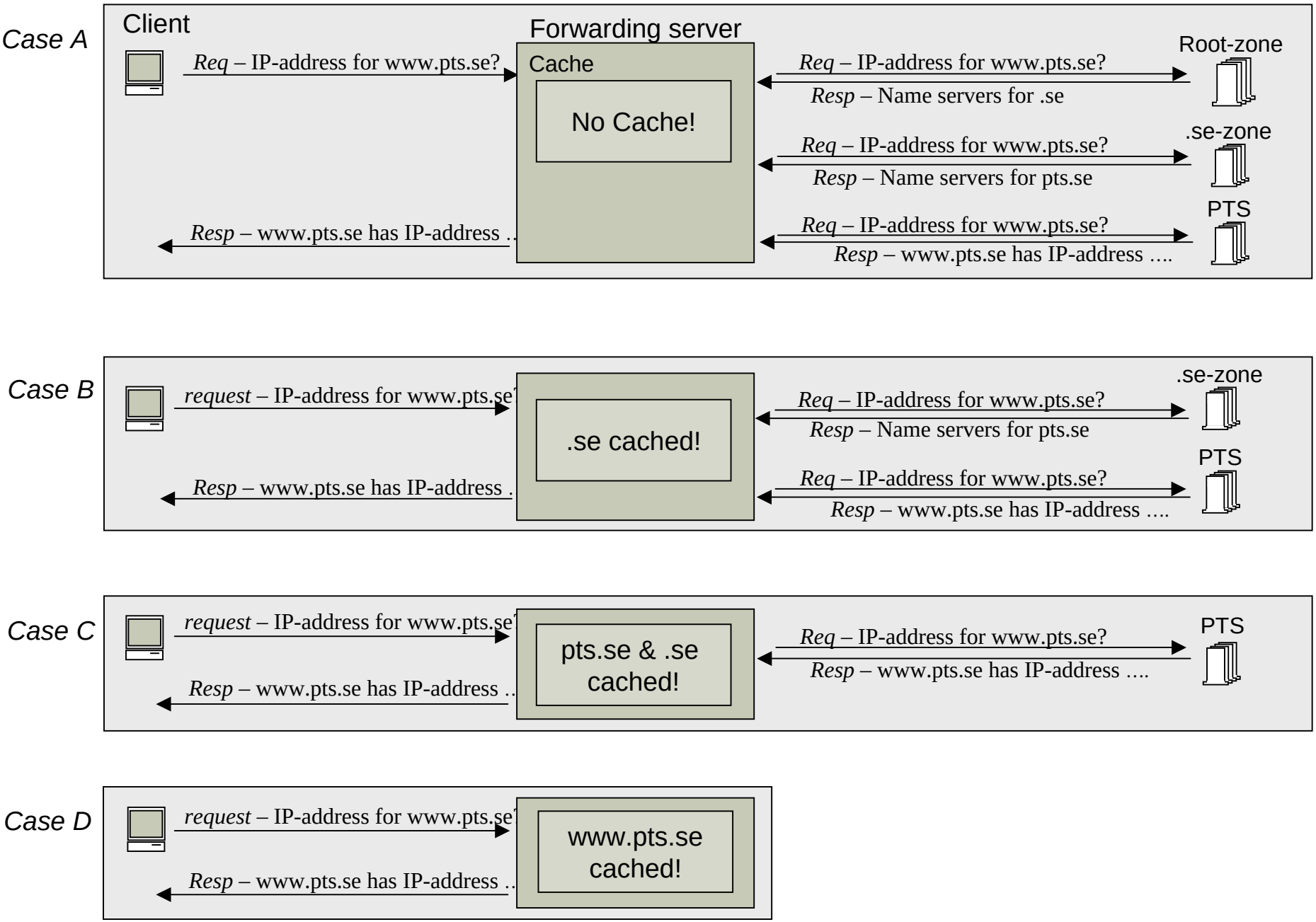
DNS from a users point of view (RFC 1034)



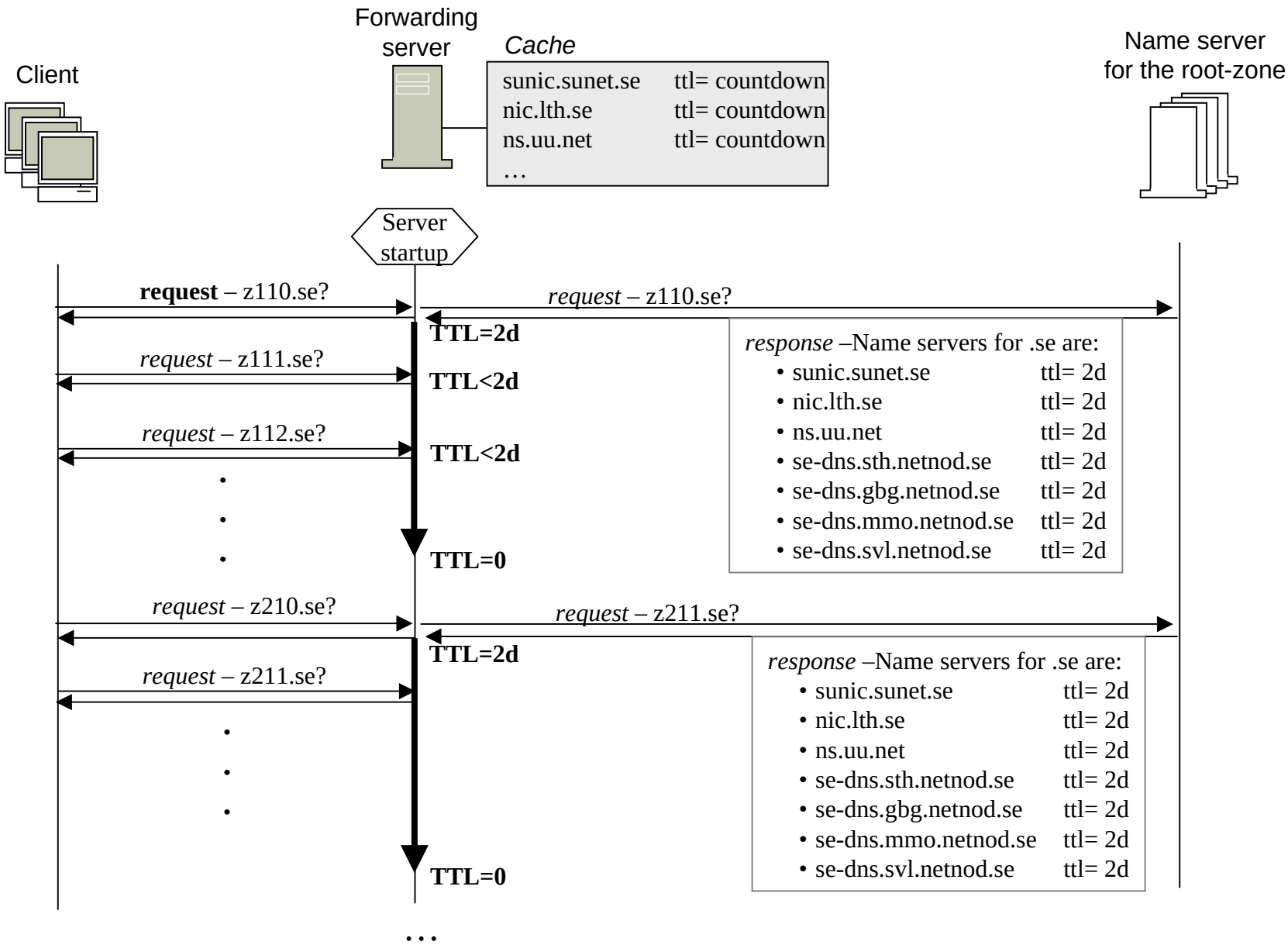
- ”From the user's point of view, the domain system is accessed through a simple procedure or OS call to a local resolver. The domain space consists of a single tree and the user can request information from any section of the tree.” - (RFC 1034)

DNS query


Forwarding server
Client
Internet
Name server for the root zone
Request: ”IP-address for www.pts.se”
Request – ”IP-address for www.pts.se”
Response – List of name servers for the .se zone:
SE-DNS.GBG.NETNOD.SE
SUNIC.SUNET.SE
….
Name server for the .se zone
Request – ”IP-address for www.pts.se”
Response – List of name servers for the pts.se zone:
….
Name server for the pts.se zone
Request – ”IP-address for www.pts.se”
Response: www.pts.se has IP-address xx
Response – www.pts.se has IP-address XX


Case A
Client
Forwarding server
Cache
No Cache!
Root-zone
.se-zone
PTS
Req – IP-address for www.pts.se?
Resp – Name servers for .se
Req – IP-address for www.pts.se?
Resp – Name servers for pts.se
Req – IP-address for www.pts.se?
Resp – www.pts.se has IP-address ….
Resp – www.pts.se has IP-address ..
Case B
request – IP-address for www.pts.se
.se cached!
.se-zone
PTS
Req – IP-address for www.pts.se?
Resp – Name servers for pts.se
Req – IP-address for www.pts.se?
Resp – www.pts.se has IP-address ….
Resp – www.pts.se has IP-address .
Case C
request – IP-address for www.pts.se
pts.se & .se cached!
PTS
Req – IP-address for www.pts.se?
Resp – www.pts.se has IP-address ….
Resp – www.pts.se has IP-address ..
Case D
request – IP-address for www.pts.se
www.pts.se cached!
Resp – www.pts.se has IP-address ..

Cache Timeouts



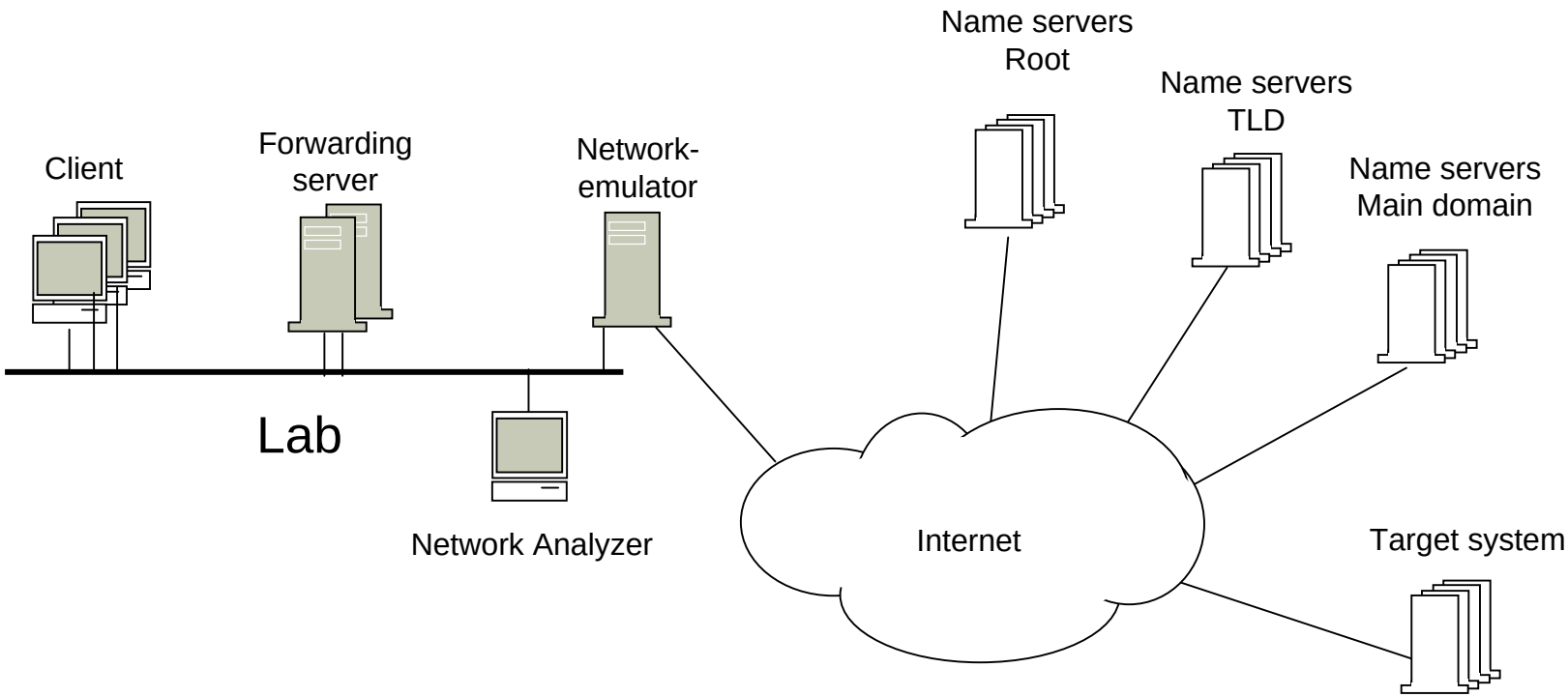
Some TTL values (November 2002)

Zon	TTL for NS	TTL for A
Root	6 days	41 days, 16 hours
Root about TLD	2 days	2 days
.se about domains below .se	1 day	
Verisign about domains below .com, .net och .org	2 days	
.NU Domain about domains below .nu	1 day	
www.sverigedirekt.riksdagen.se		1 day
www.regeringen.se		1 day
www.pts.se		1 day
www.tt.se		1 day

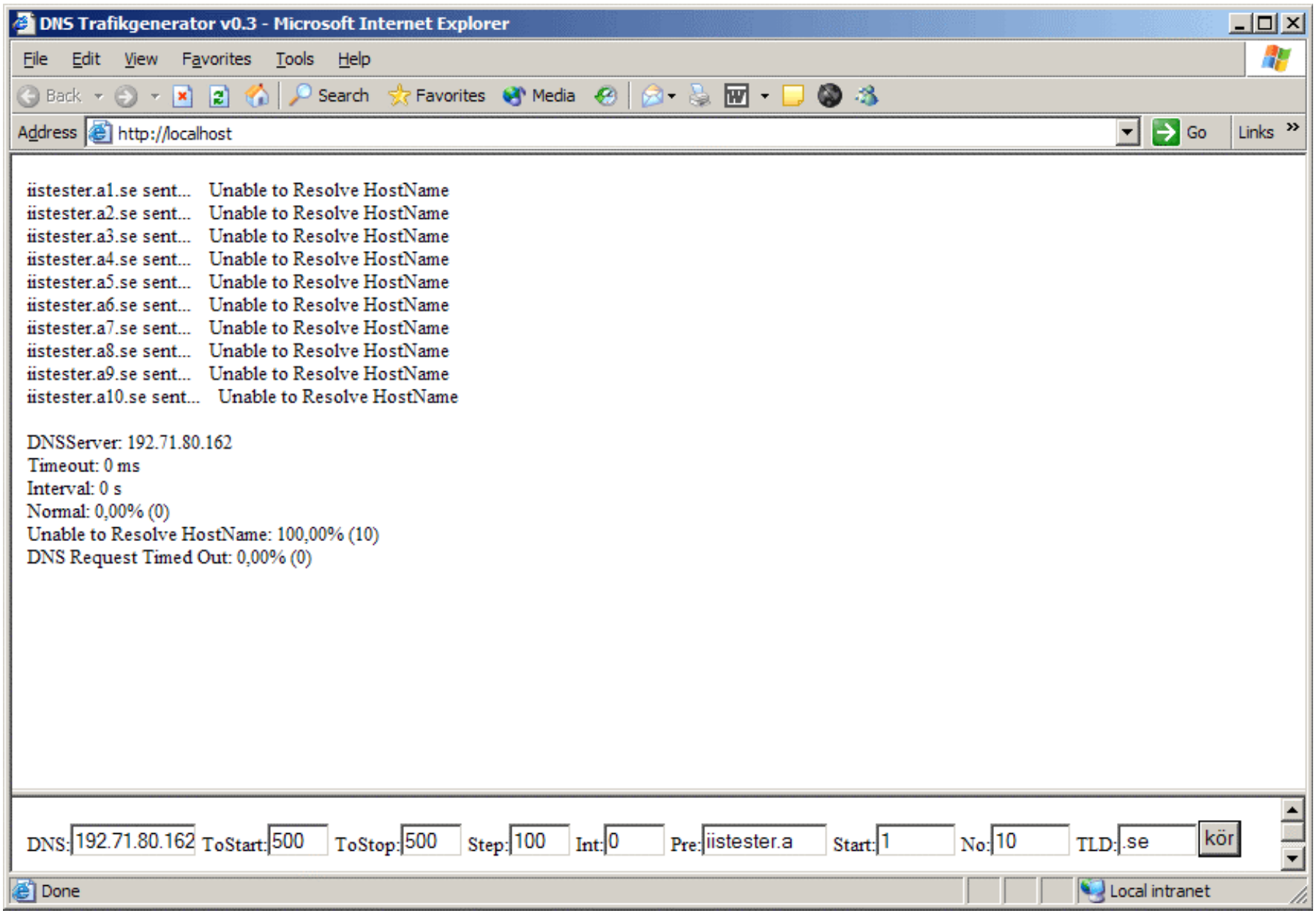
Resolver Software

- Bind 9
  - Bind 9.2.0
- Bind 8
  - Bind 8.3.3
- Microsoft
  - DNS service running on Windows 2000 5.00.2195
- Cisco
  - Cisco Registrar DNS 5.5.1

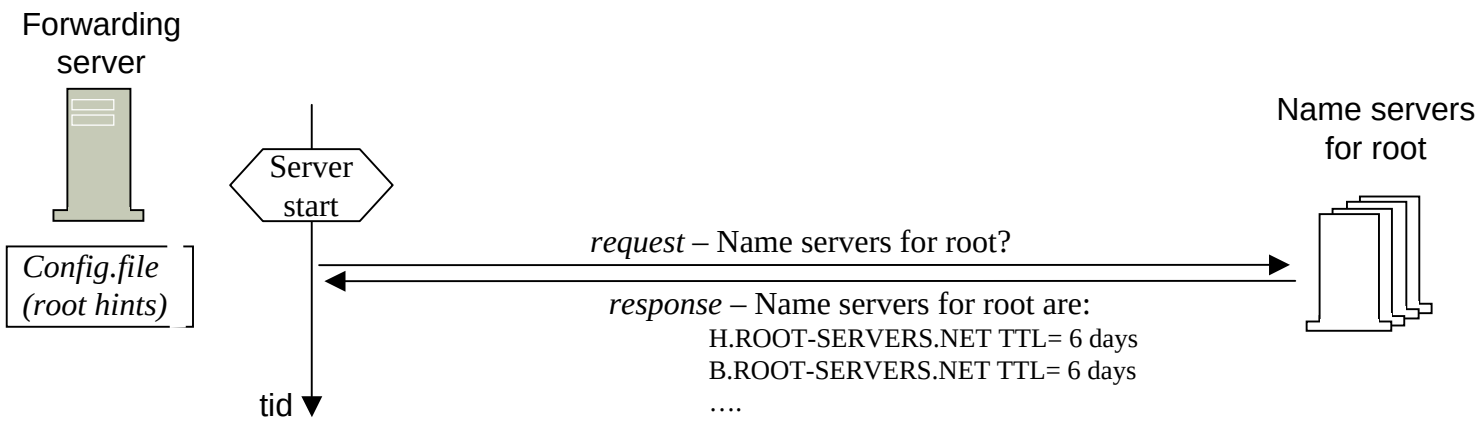
The test environment



The traffic generator

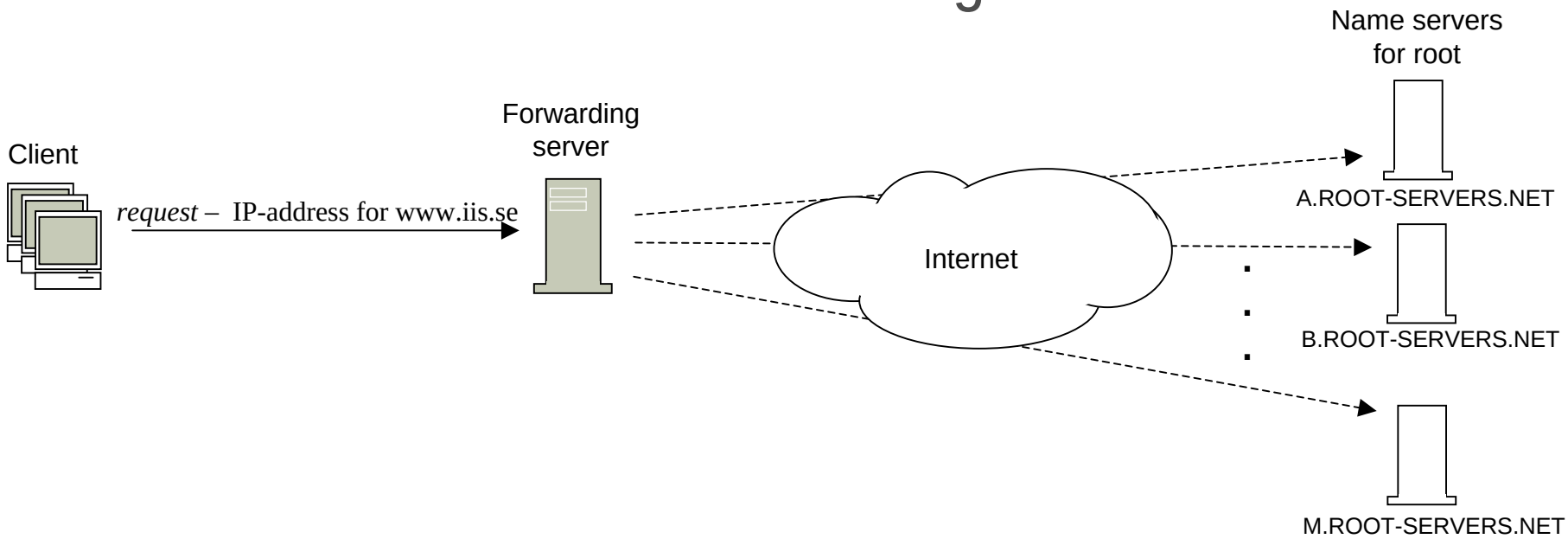


Test 1 – Behavior of resolver at start-up



	Bind 8	Bind 9	MS DNS	CNR
Local file with ”root hints” where used?	YES	YES	YES	YES
When did the update of root servers occur?	At start-up	After the first request from the client	After the first request from the client	At start-up
How did the resolver choose which server to use from the “root hints”	Random	Random	Random	Always the first server (A-root)

Test 2 - Method for choosing root server

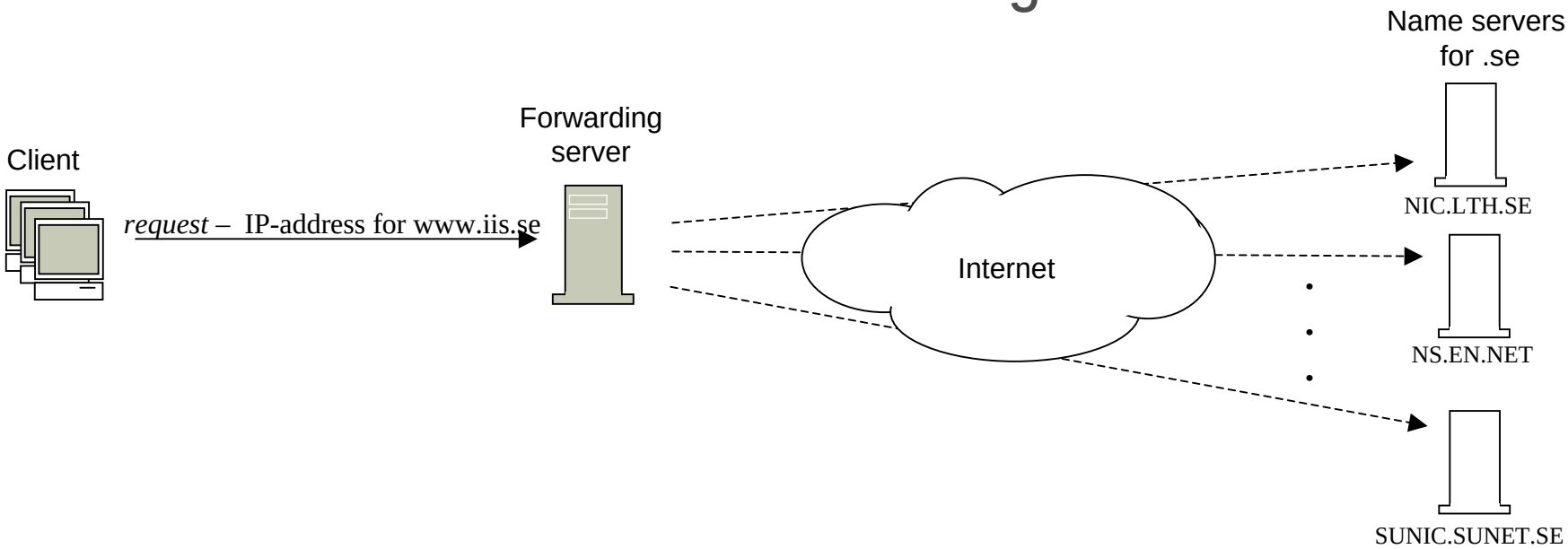


	A-ROOT	B-ROOT	C-ROOT	D-ROOT	E-ROOT	F-ROOT	G-ROOT	H-ROOT	I-ROOT	J-ROOT	K-ROOT	L-ROOT	M-ROOT
BIND 8	2,7%	2,2%	1,6%	2,7%	1,1%	1,1%	1,6%	2,2%	70,7%	2,7%	8,7%	1,6%	1,1%
BIND 9									100%				
MS DNS				100%									
Cisco CNR	13%	4%	4%	10%	3%	3%	9%	7%	16%	8%	16%	4%	3%

Method: Approx 200 requests to different servers. The first 20 request where discarded.

Note: I-root had the best response time from the test network.

Test 3 - Method for choosing tld server

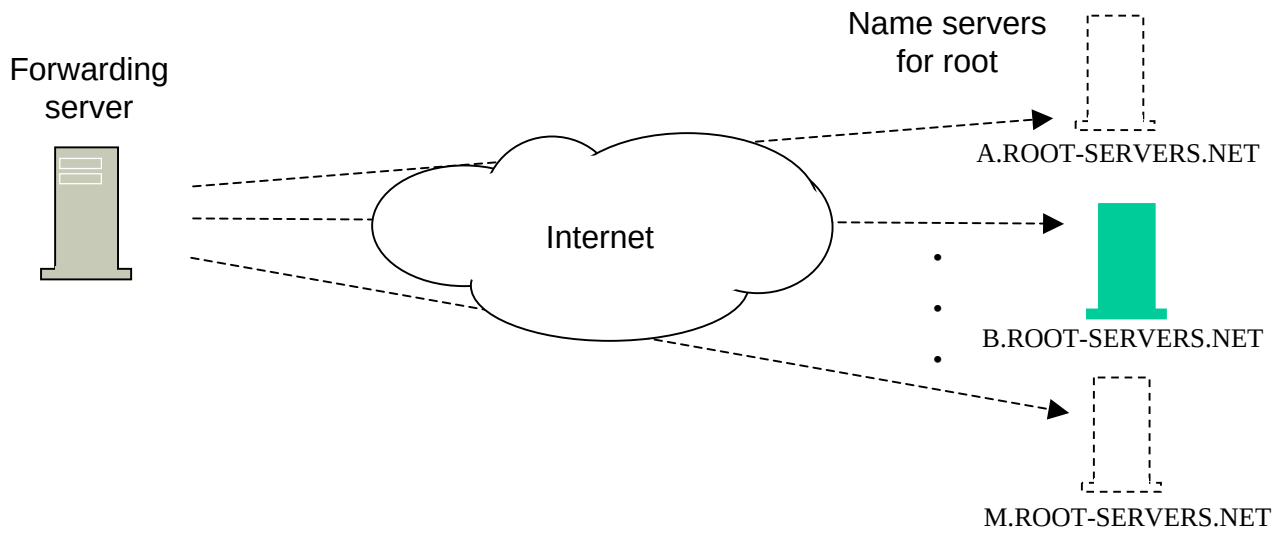


	nic.lth.se	ns.eu.net	ns.uu.net	se-dns.gbg.netnod.se	se-dns.sth.netnod.se	sunic.sunet.se
BIND 8	2%	7%	2%	0%	1%	88%
BIND 9				1%	10%	89%
MS DNS			100%			
Cisco CNR	20%	12%	10%	12%	12%	34%

Method: Approx 100 requests to different servers. The first 20 request where discarded.

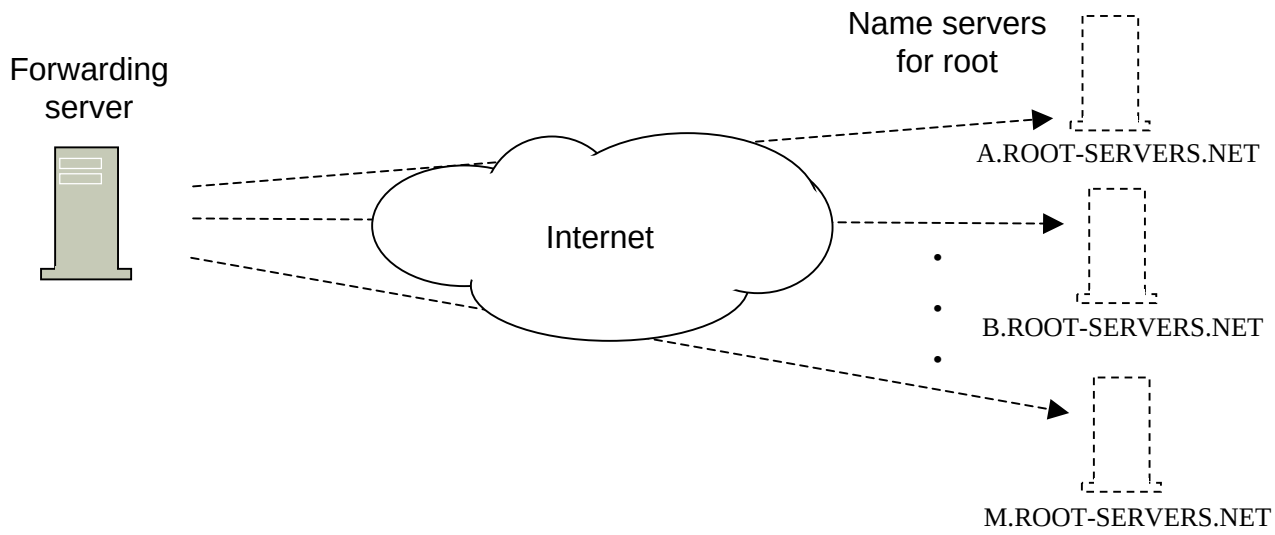
Note: sunic.sunet.se had the best response time from the test network.

Test 4 – Absence of all root-servers but one



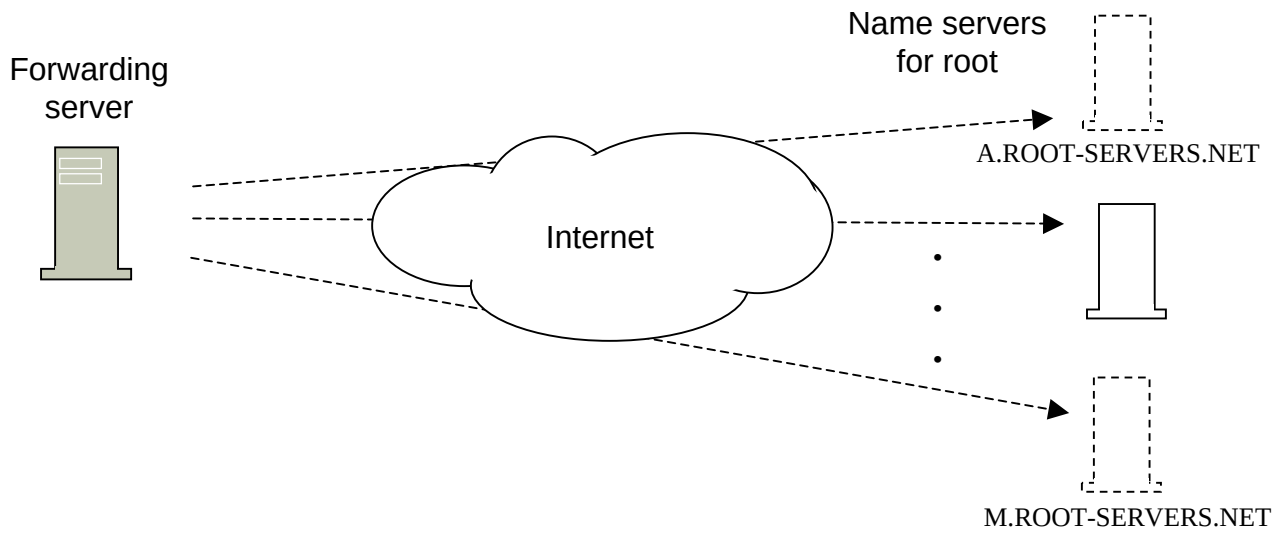
	Bind 8	Bind 9	MS DNS	CNR
Got response?	YES	YES	YES	YES
Did if search thru the root list until a server was found?	YES	YES	YES	YES
Time out between requests?	4 sec	2 sec	3 sec	4 sec

Test 5– Absence of all root-servers at start-up



	Bind 8	Bind 9	MS DNS	CNR
Method of selecting which root-server to try next	Random	Random	Random	In order (a-m)
Time-out between request	4-8 sec …	2 sec, 8 sec after 52 sec…	3 sec, ..	4 sec, …

Test 6 – Absence of all root-servers but one while running

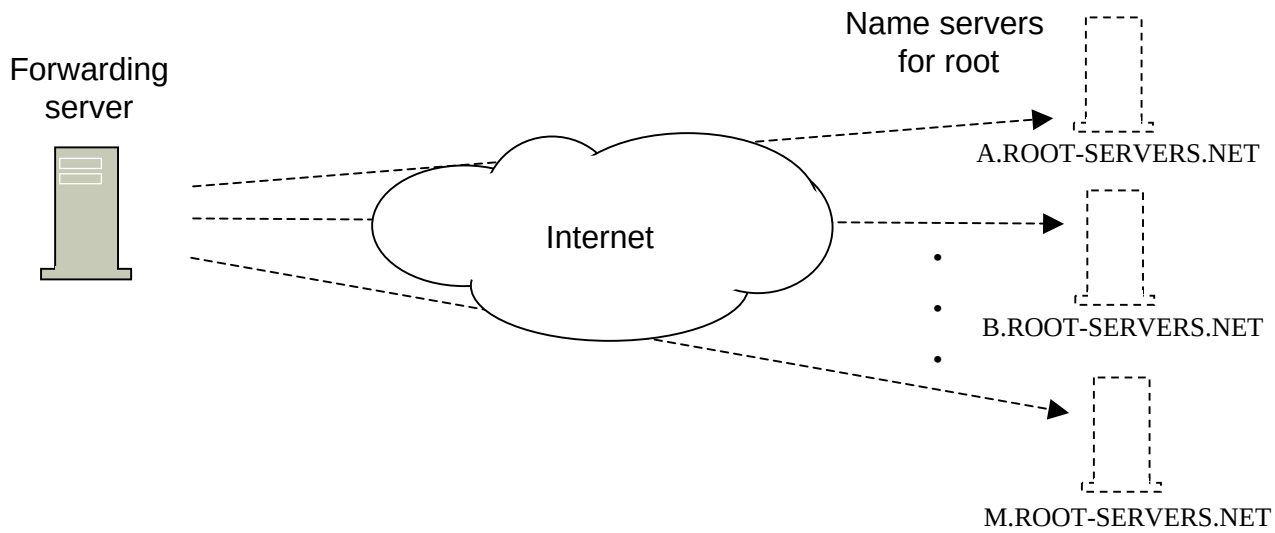


If the following are true does the resolver answer queries:

- One root server is reachable
- All TTL have expired for cached information about the TLD name server

Bind 8	Bind 9	MS DNS	CNR
YES	YES	YES	YES

Test 7 - Absence of all root-servers while running

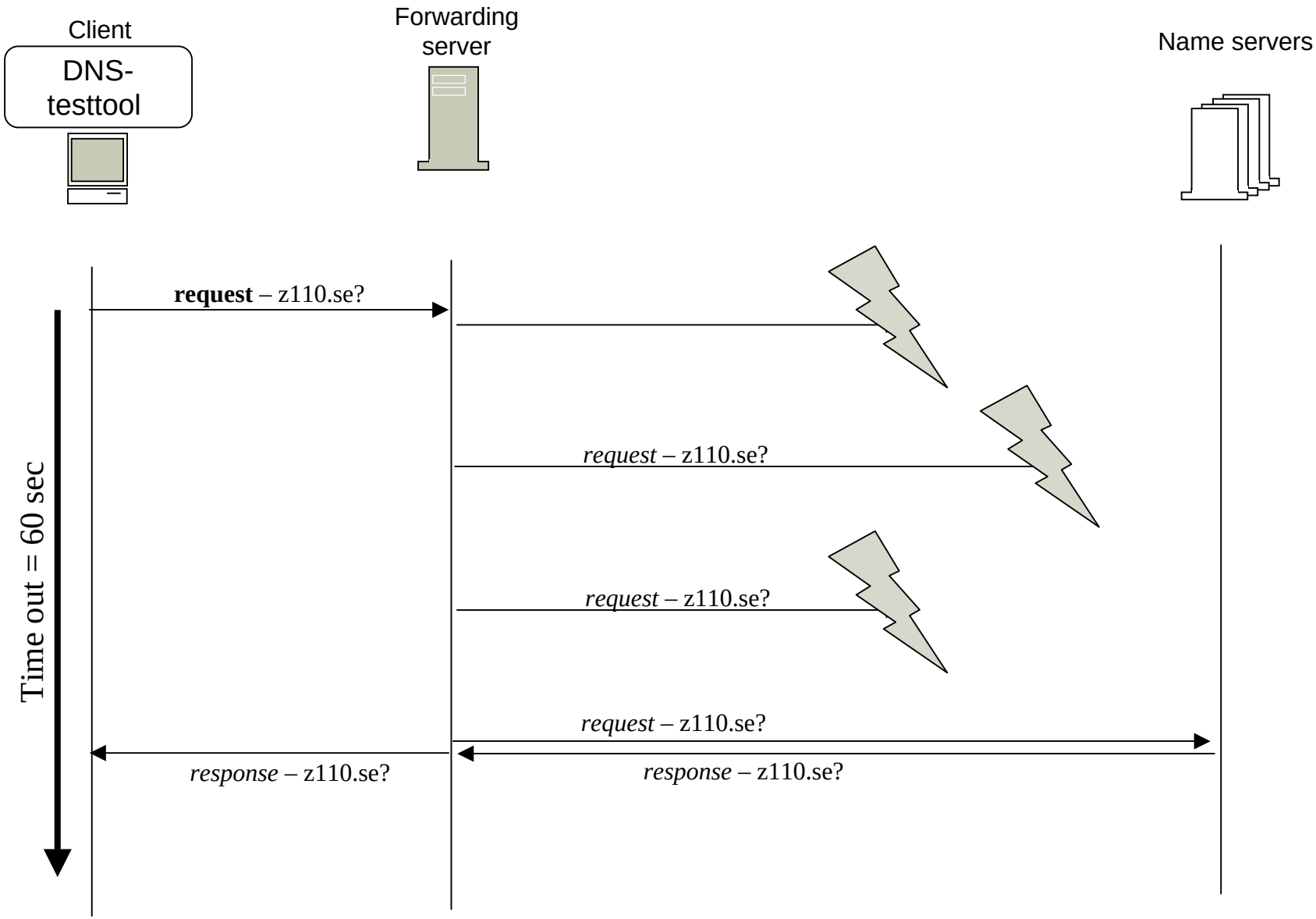


If the following are thru does the resolver answer queries:

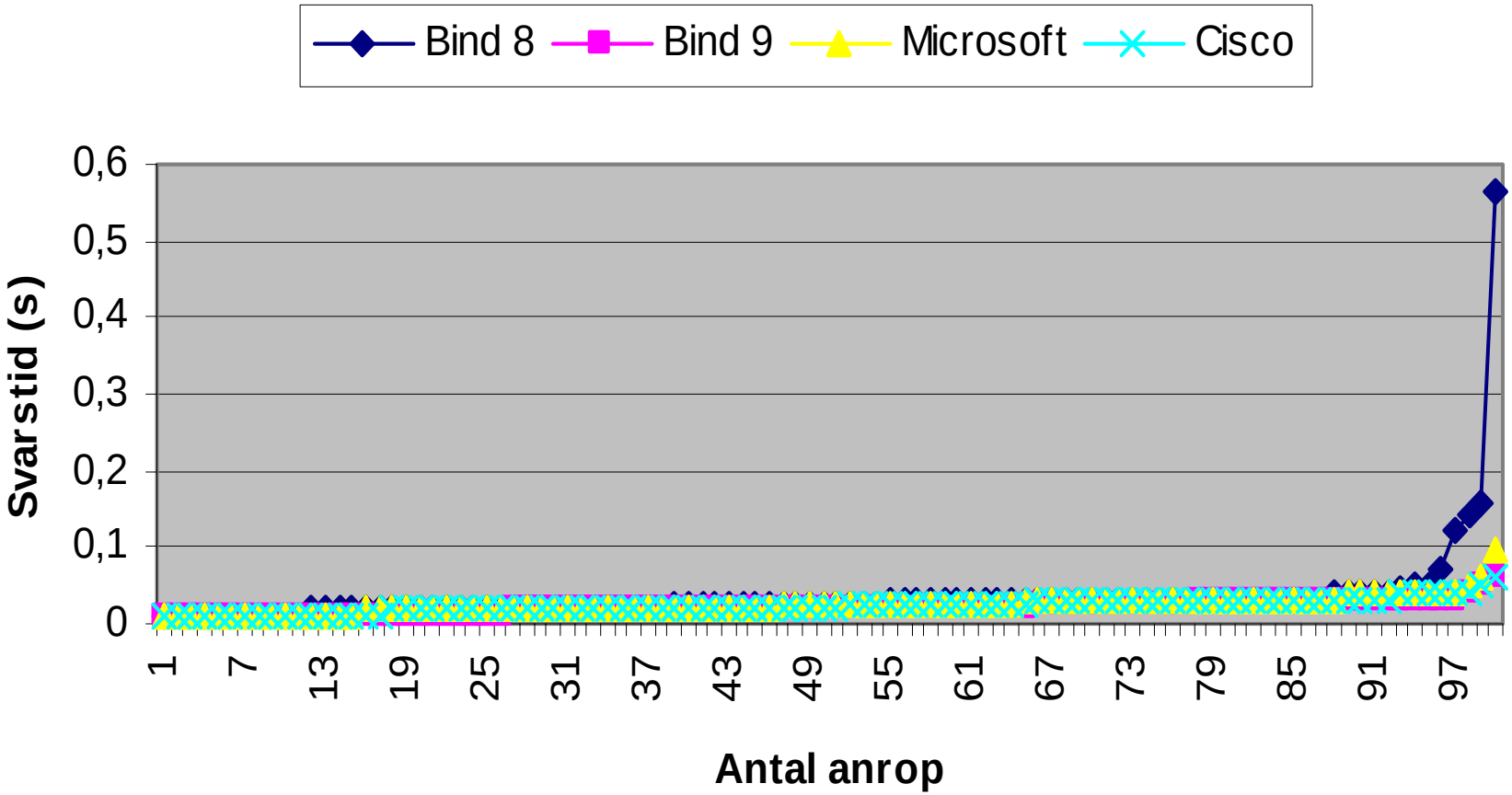
- Root servers are not reachable
- All TTL have expired for cached information about the TLD name server

Bind 8	Bind 9	MS DNS	CNR
NO	NO	NO	NO

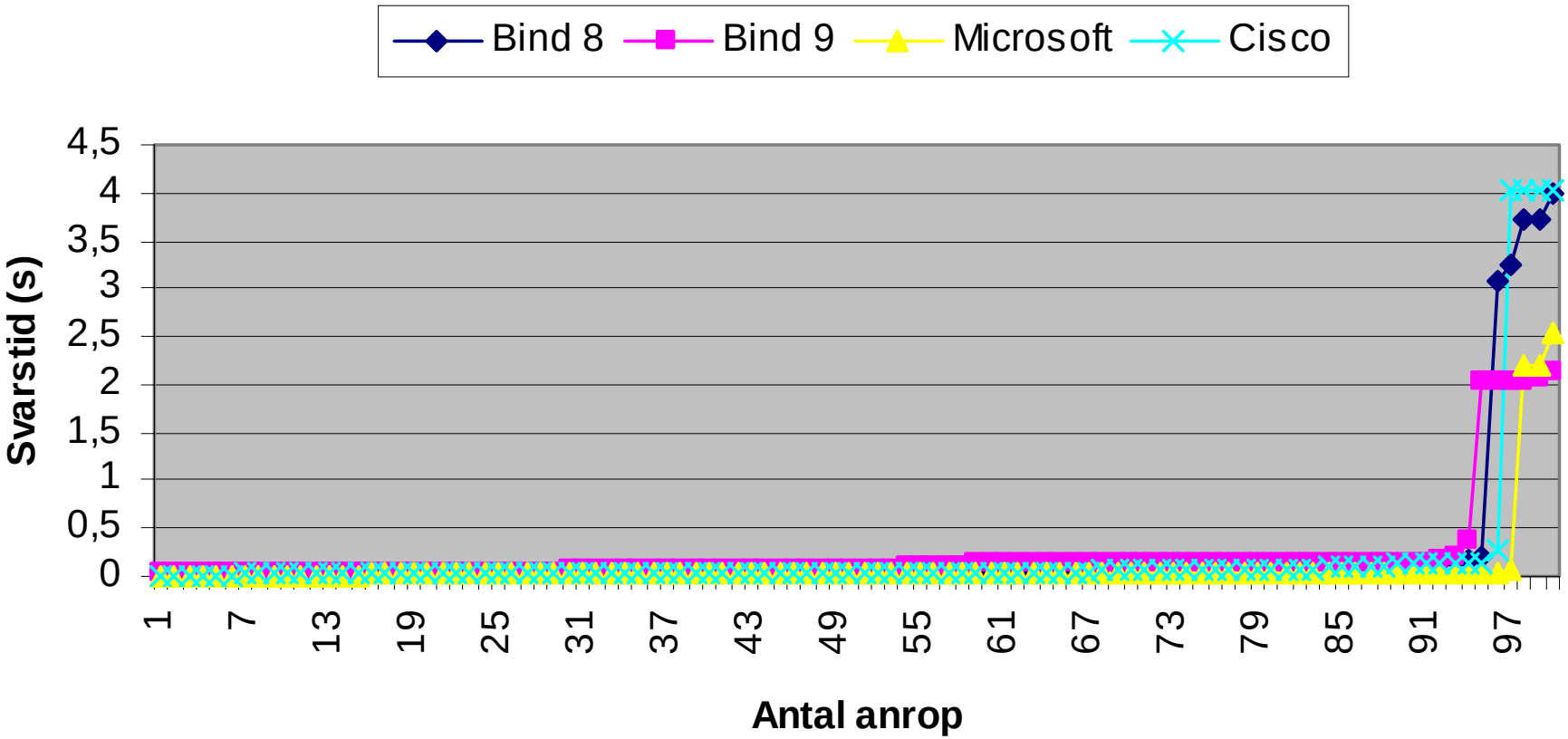
Test 8 - Packet-loss



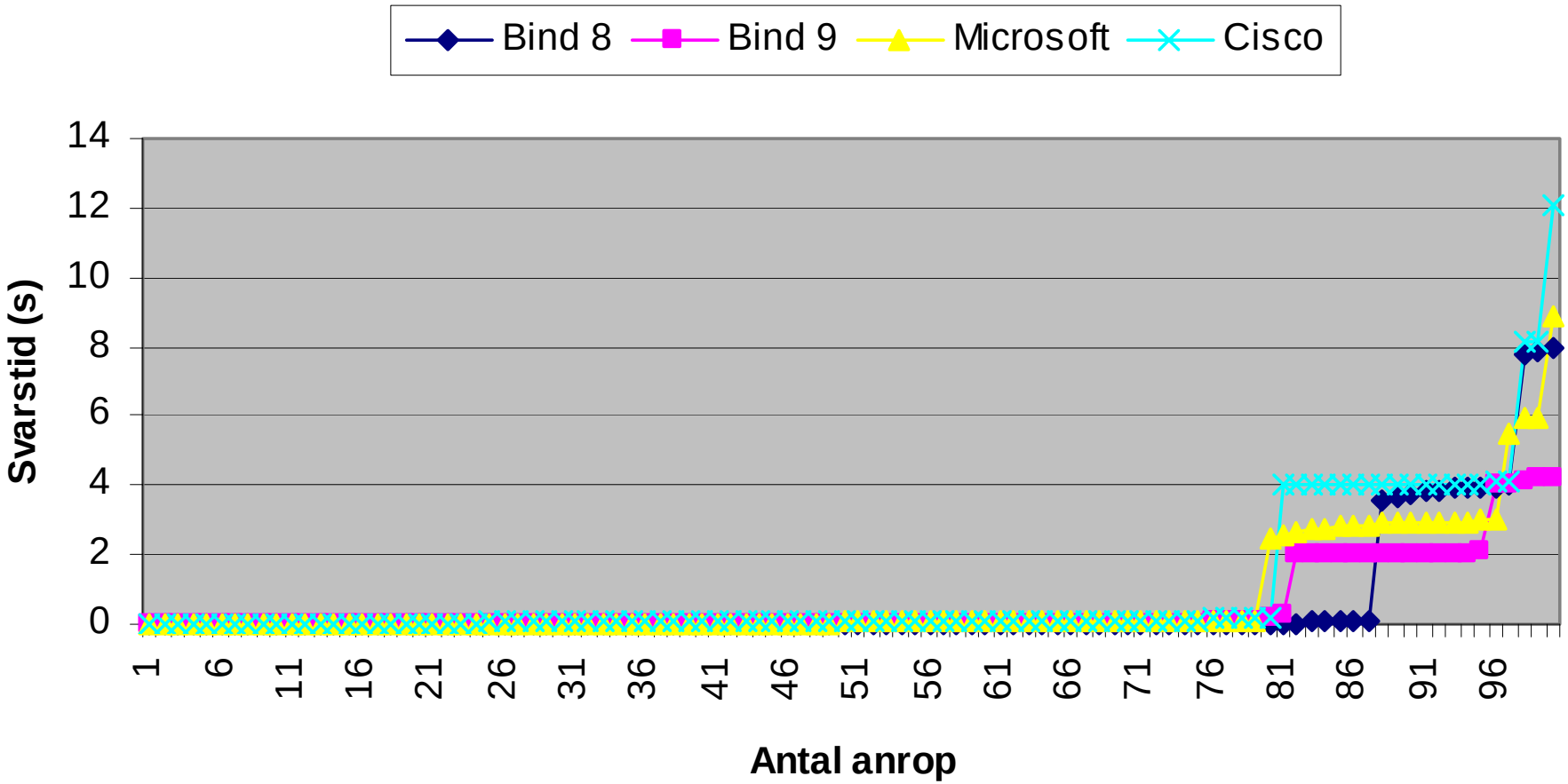
Distribution of response times at 0% packet-loss



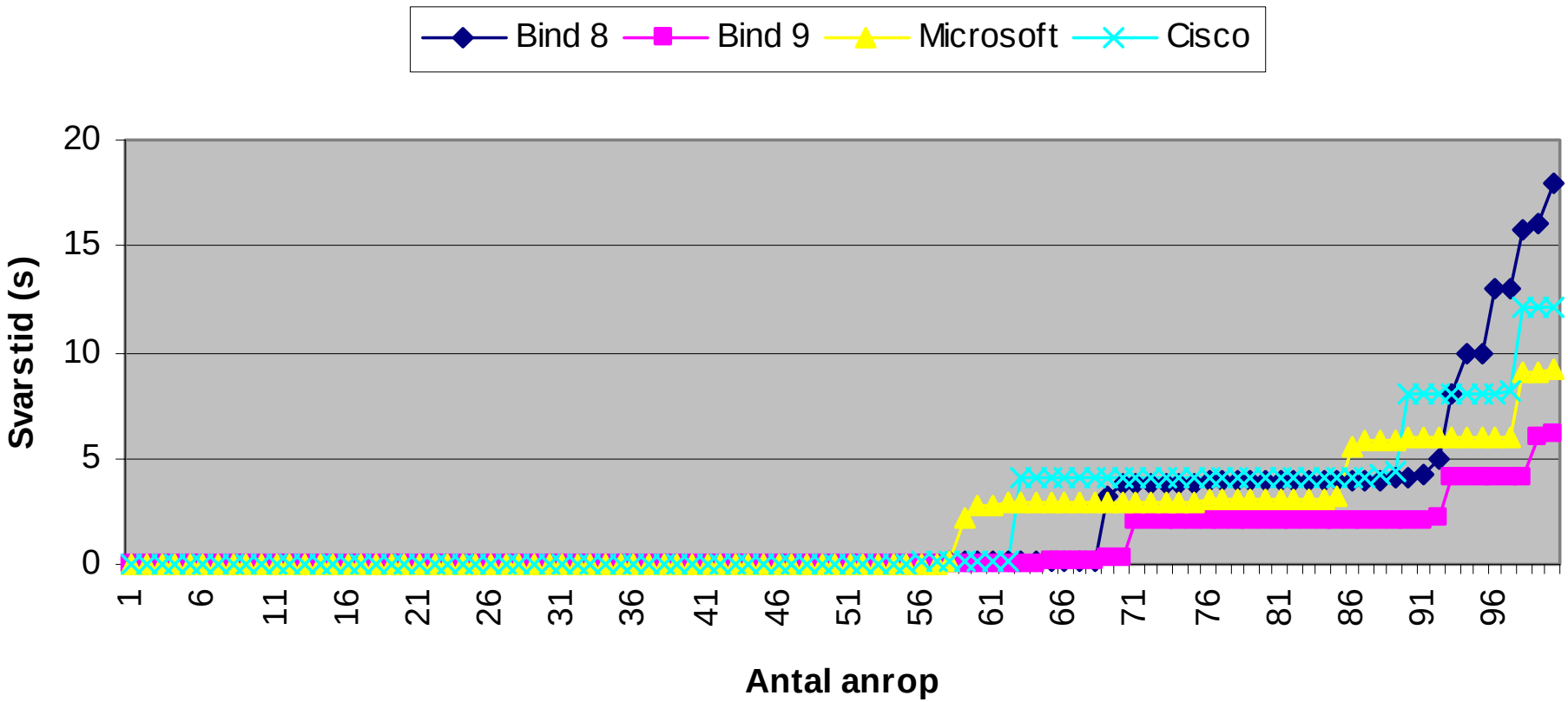
Distribution of response times at 2% packet-loss



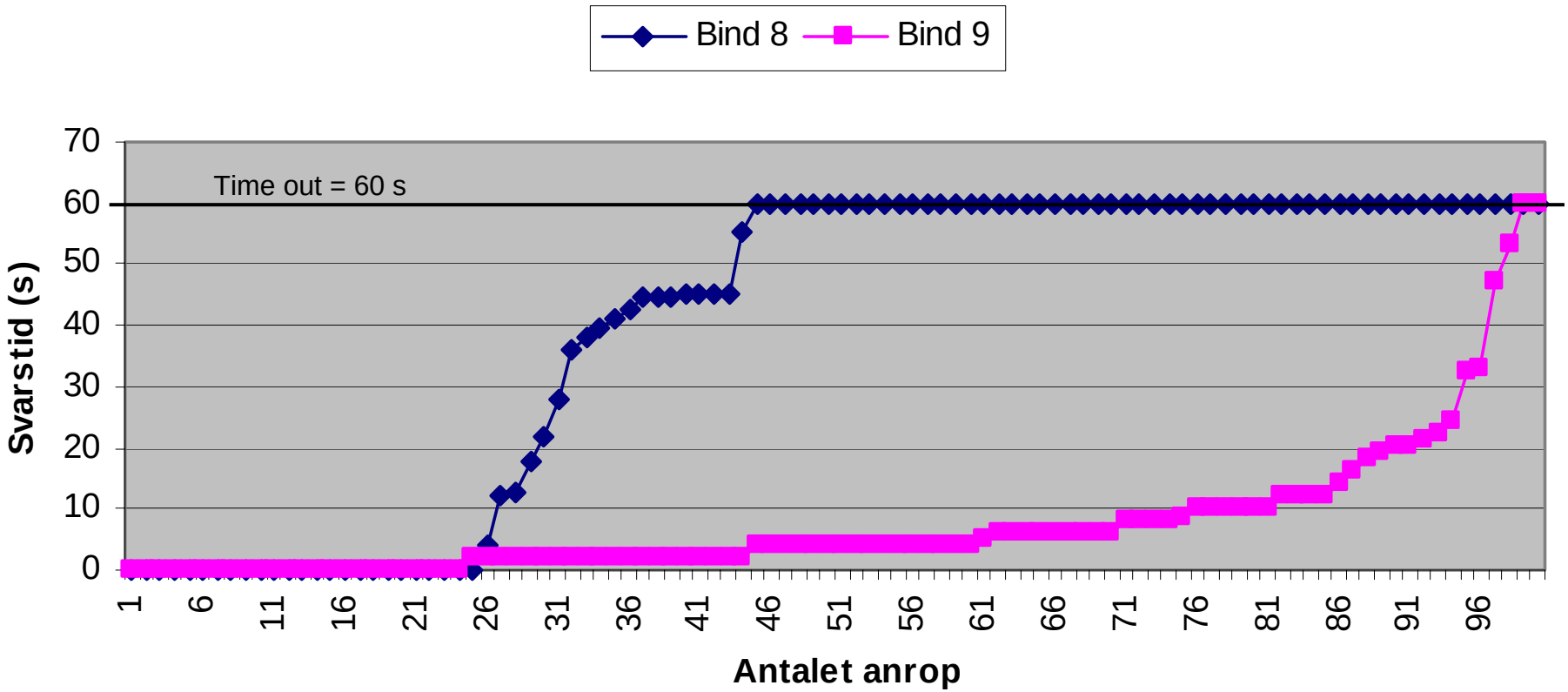
Distribution of response times at 10% packet-loss



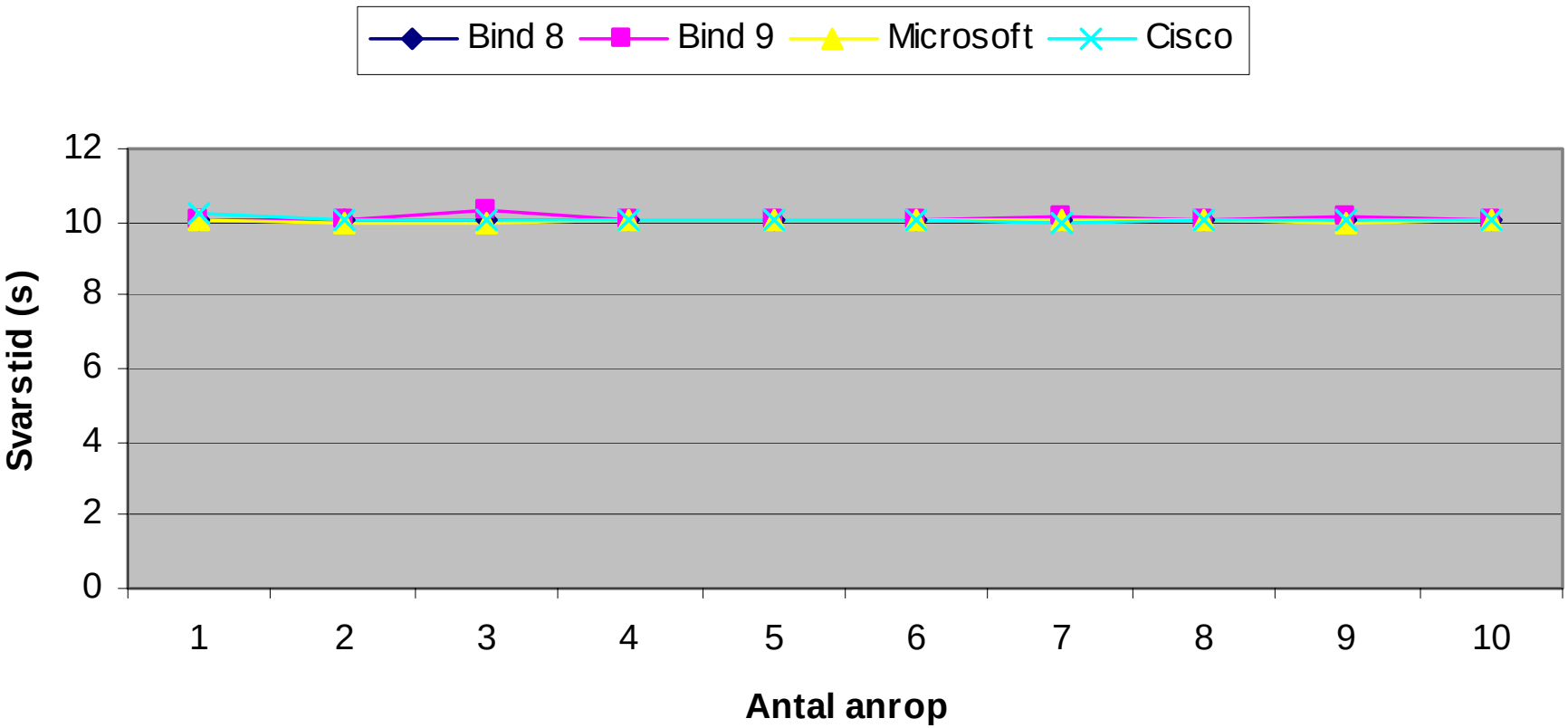
Distribution of response times at 20% packet-loss



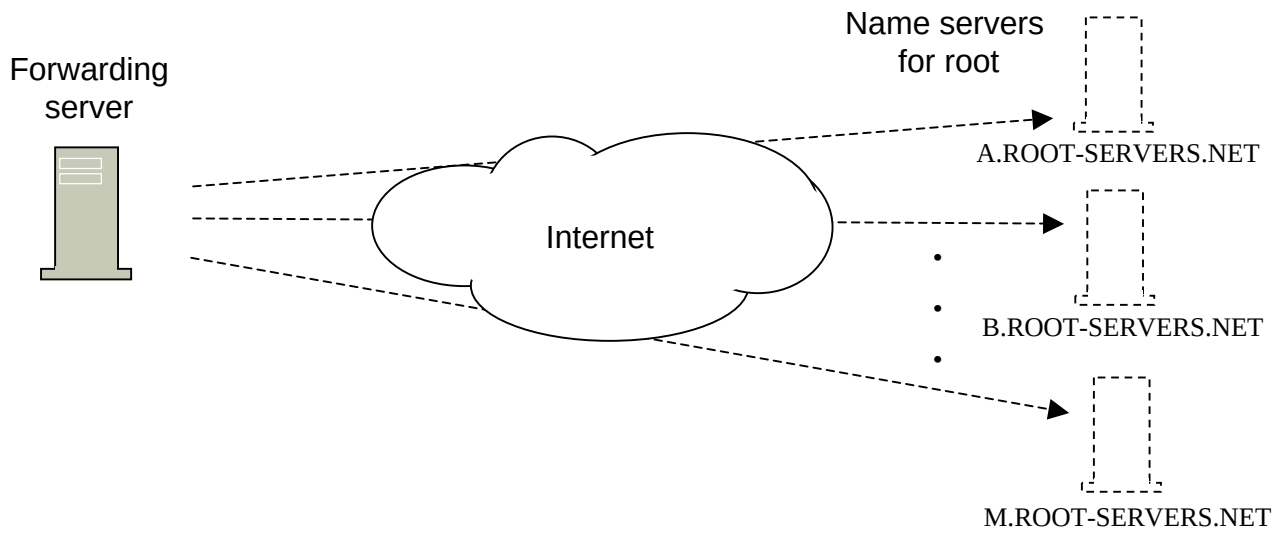
Distribution of response times at 50% packet-loss



Test 9 – 5 seconds packet delays



Test 10 - Absence of all root-servers while running when a the TLD name server is cached.

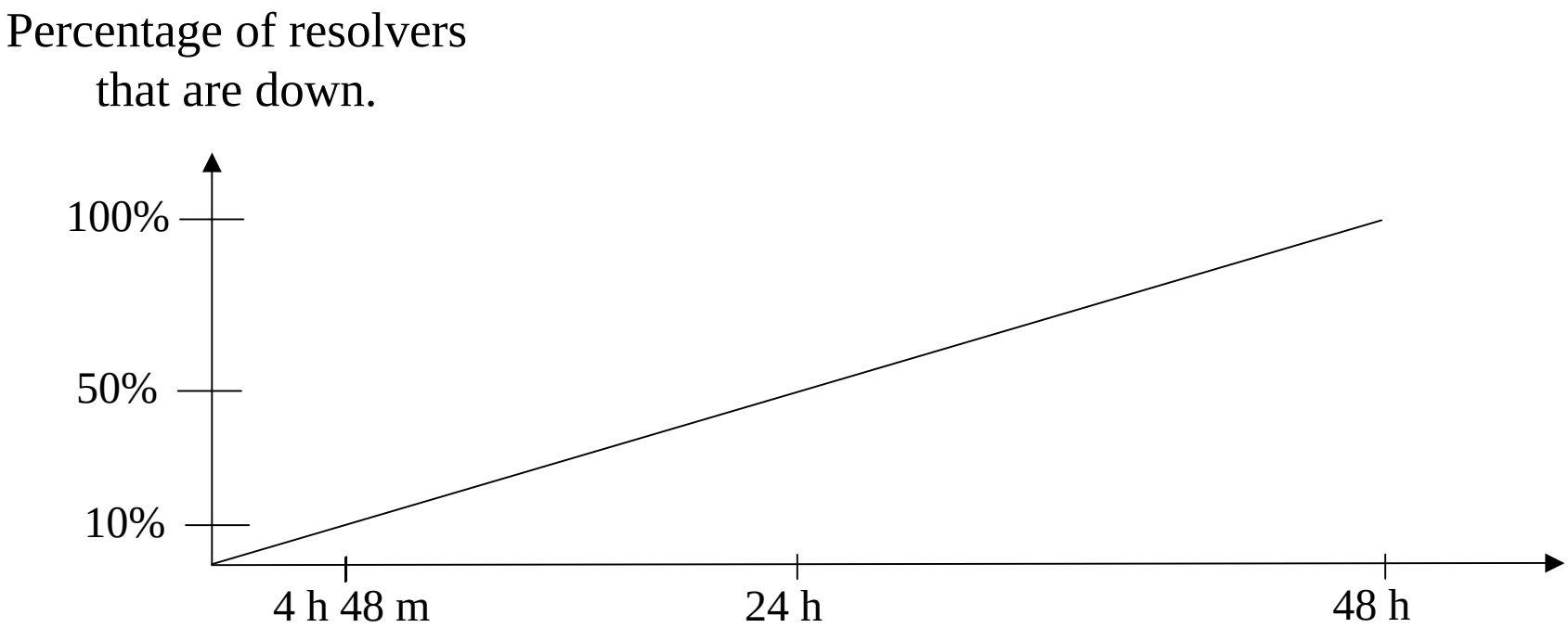


If the following are thru does the resolver answer queries:

- Root servers are not reachable
- All TTL have expired for cached information about the root name server
- All TTL have expired for cached information about the target
- TTL has not expired for cached information about the TLD name server

Bind 8	Bind 9	MS DNS	CNR
NO	NO	NO	NO

What if all tld servers are unavailable?



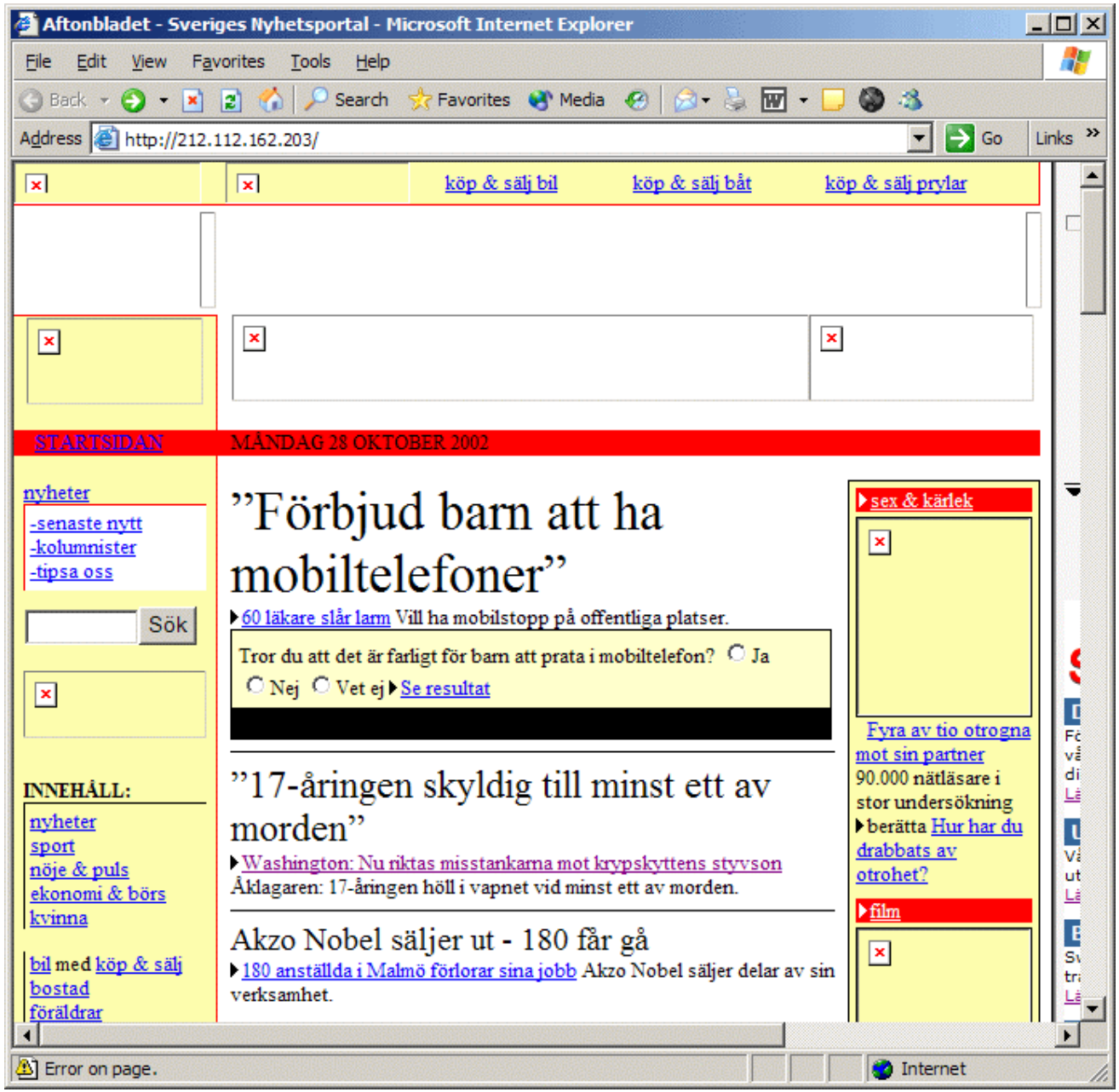
- prerequisites
  - No re-starts of the resolvers.
  - This implies that the TLD is up to date and cached. TLD that are not in the cache are not available at all.
  - The TTL for the TLD name server are 48 hours
  - etc…

The ”expire”-value

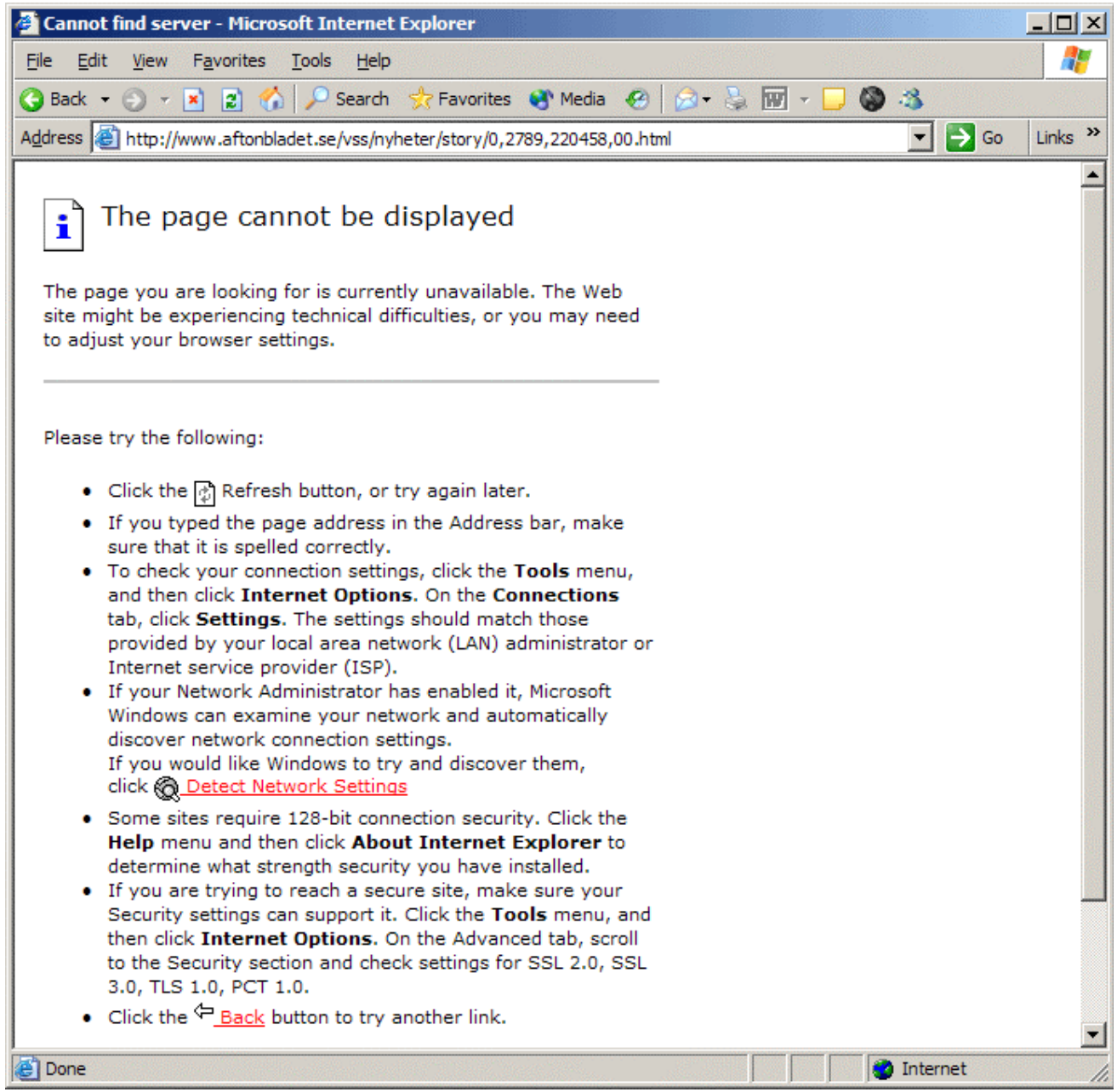
Zon	Expire
rot	7 days
.se	28 days
.com	7 days
.nu	30 days

Client applications - Email

Client applications - Web



Client applications - Web



Client applications - Web

Conclusions

The DNS system is well designed and works very well in practice.

DNS handles network disturbances very well.

All tested resolvers did what they where expected to do and did if well.

Most applications are dependent on DNS and does not work very well without it.

There is no easy way to replace DNS if it fails.

More information about the tests

This presentation and the full test specification (in Swedish) are provided at:

http://www.iis.se/meta/english.shtml

http://www.learnswedish.nu

For questions contact me:

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