

Case Study: IPv6 Enabling Malaysia's .my Domain

Google IPv6 Implementer's Conference 2009

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- Over ten years providing IPv6 services
- Comprehensive IPv6 training portfolio
- Advanced IPv6 consultancy services
- World leader in IPv6 enabled Windows-Unix/Linux integration

<http://www.erion.co.uk>

<http://www.ipv6training.com>

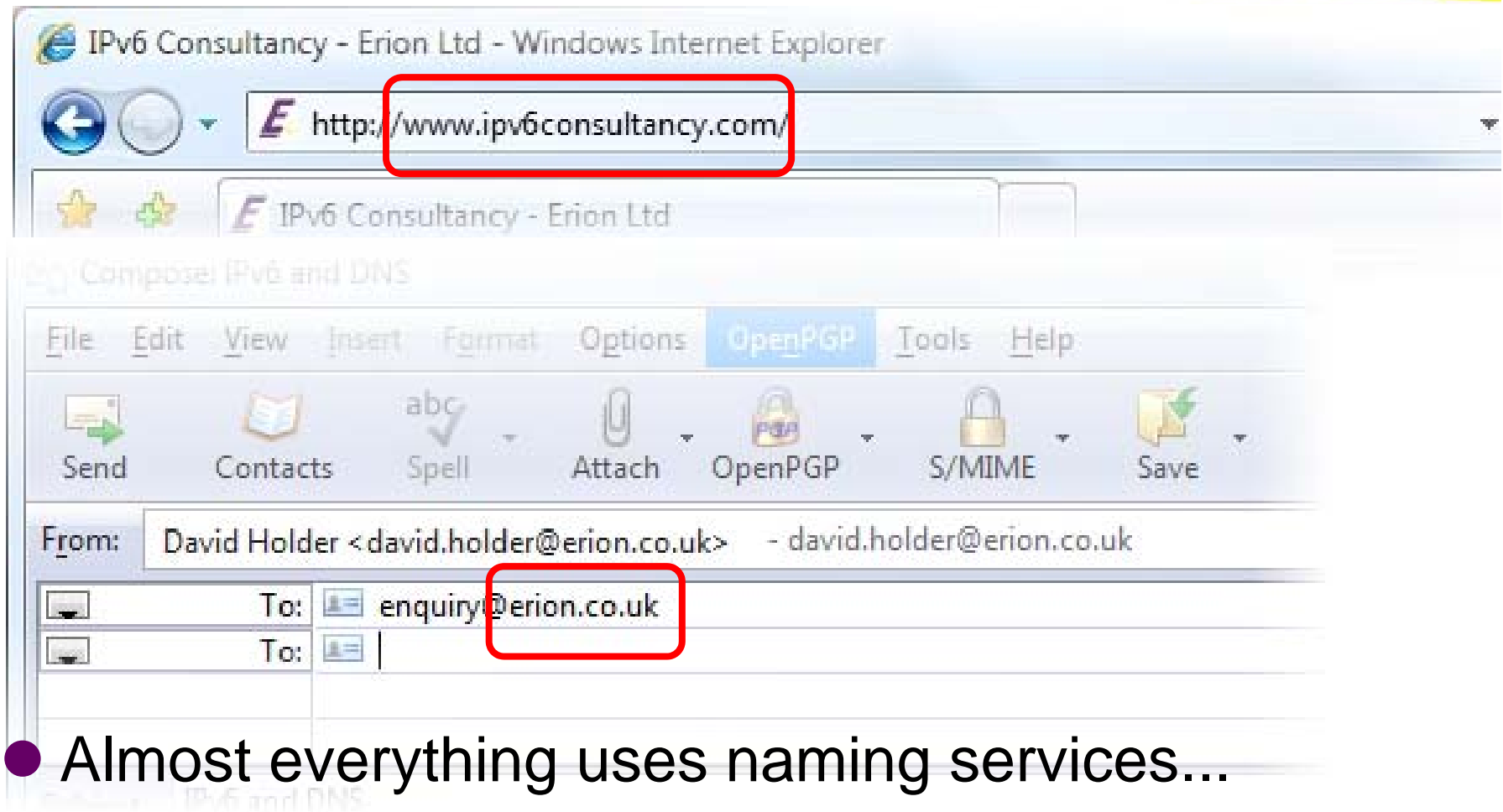
<http://www.ipv6consultancy.com>

IPv6 Enabling .my Domain

- Background to DNS and IPv6
- Case Study: MYNIC
- Domain Statistics
- Summary



DNS is Crucial to Internet



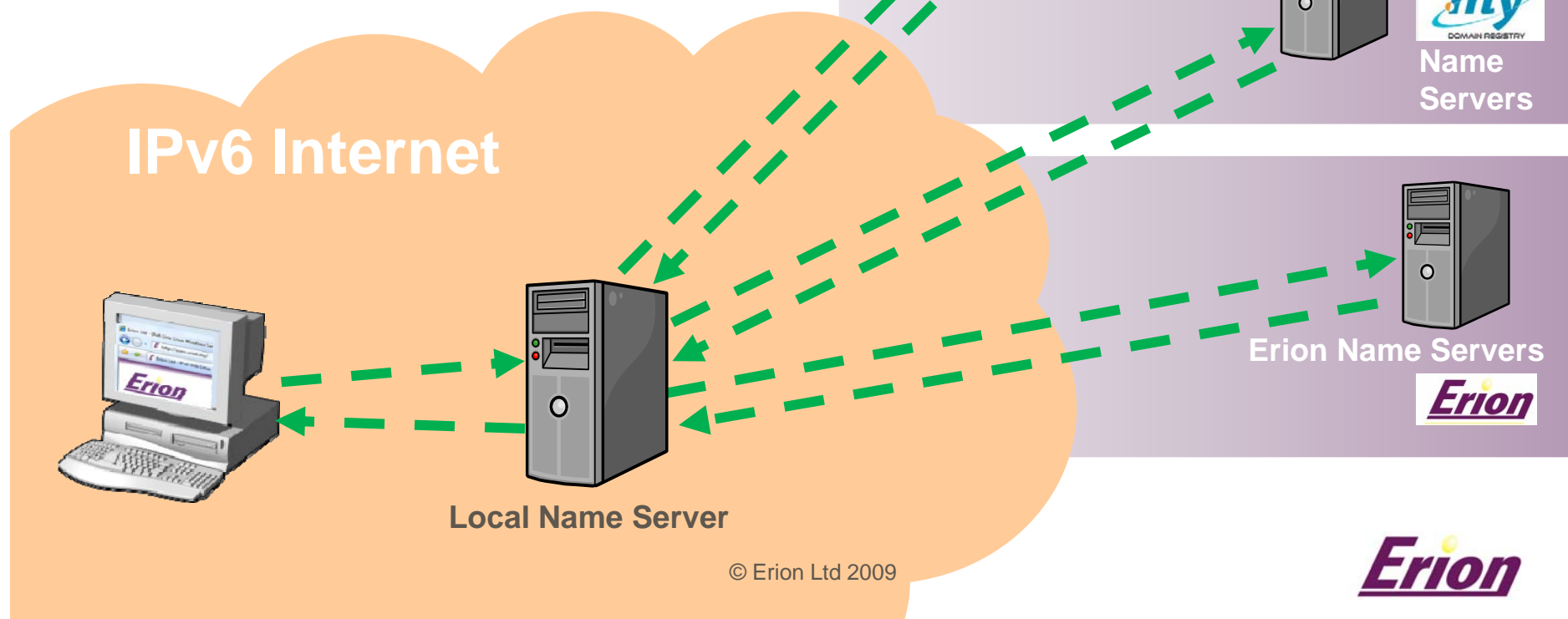
- Almost everything uses naming services...

DNS is Critical for Successful IPv6 Deployments

- Name resolution is critical to IPv6 deployments
- Management and users will perceive:
 - Failures in name resolution to be failures of IPv6
 - Performance problems due to name resolution to be performance problems with IPv6

The Domain Name System

- Query IPv6 addresses
- IPv6 reverse lookup
- Zone transfers etc...
- All over IPv6 transport



IPv6 Forward Lookups

```
erion.co.uk      IN      AAAA      2001:960:2:585::2
```

- AAAA data four times larger than A records
- A6 records are now experimental

IPv6

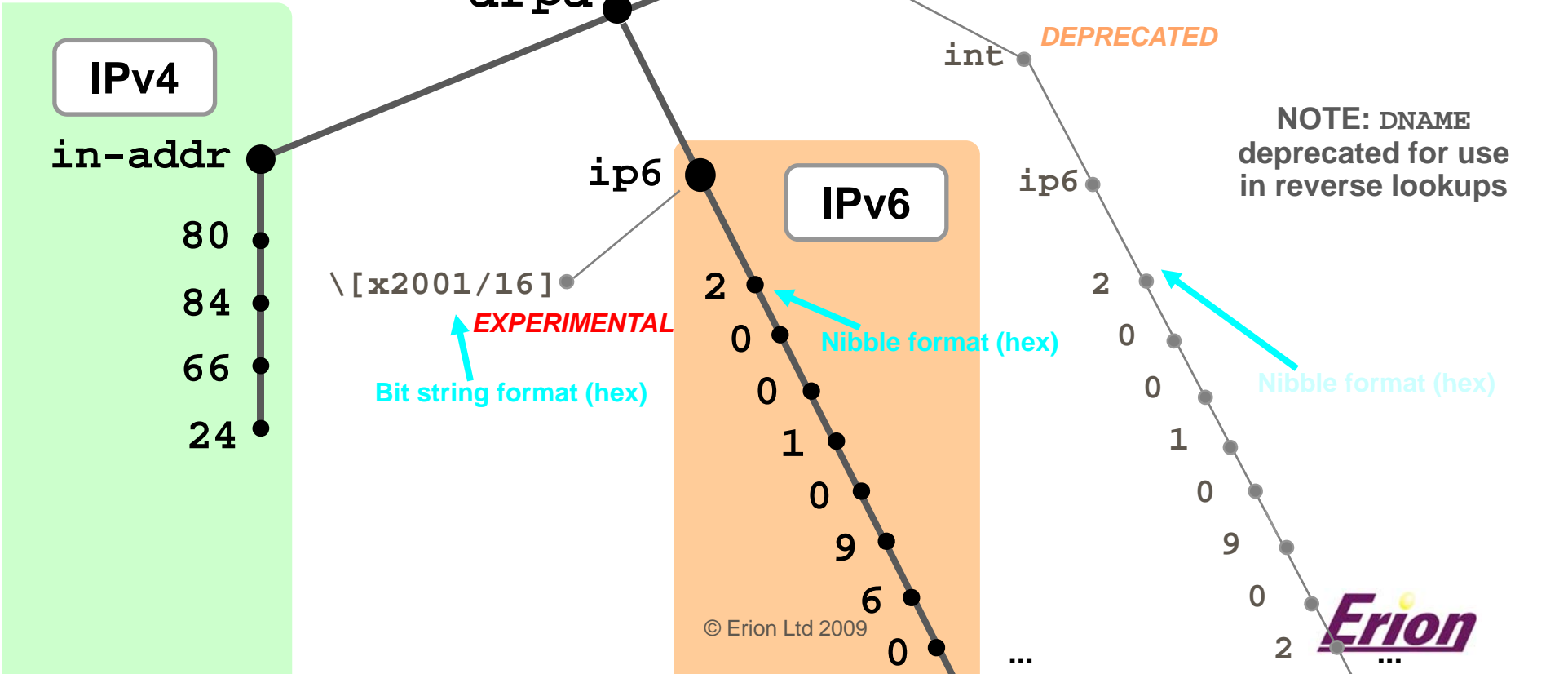
[illegible]

01010000010110000100001000011000

IPv4

IPv6 Reverse Lookups

2.0.0.0.0.0.0.0.0.0.0.0.0.0.5.8.5.0.2.0.0.0.0.6.9.0.1.0.0.2.ip6.arpa.
IN PTR www.erion.co.uk



EDNS0 (RFC 2671)

- DNS UDP datagrams explicitly limited to 512 bytes
- AAAA RRs can require more than 512 bytes
 - DNSSEC and other mechanisms can also exceed 512 byte limit
- Fall-back to TCP is inefficient
- EDNS0
 - Provides signalling extensions to DNS protocol
 - Includes provision for UDP datagrams up to 65535 bytes
 - EDNS0 is standard on modern DNS servers
- Consequences for firewalls, hosts and DNS servers

EDNS0 - Example

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: dns Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
10	2.794933	3101::101	3101::100	DNS	Standard query NS large.example.com
11	2.795665	3101::100	3101::101	DNS	Standard query response NS longname16.example.com

Frame 10 (108 bytes on wire, 108 bytes captured)

- Ethernet II, Src: Vmware_dd:c6:bd (00:0c:29:dd:c6:bd), Dst: Vmware_b5:a8:1e (00:0c:29:b5:a8:1e)
- Internet Protocol Version 6
- User Datagram Protocol, Src Port: filenet-tms (32768), Dst Port: domain (53)
- Domain Name System (query)
 - [Response In: 11]
 - Transaction ID: 0x78cf
 - Flags: 0x0100 (standard query)
 - Questions: 1
 - Answer RRs: 0
 - Authority RRs: 0
 - Additional RRs: 1
 - Queries
 - Additional records
 - <Root>: type OPT
 - Name: <Root>
 - Type: OPT (EDNS0 option)
 - UDP payload size: 4096
 - Higher bits in extended RCODE: 0x0
 - EDNS0 version: 0
 - Z: 0x0
 - Data length: 0

Frame (frame), 108 bytes Packets: 42 Displayed: 2 Marked: 0 Dropped: 0

(Untitled) - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter: dns Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
10	2.794933	3101::101	3101::100	DNS	Standard query NS large.example.com
11	2.795665	3101::100	3101::101	DNS	Standard query response NS longname16.example.com

Internet Protocol Version 6

User Datagram Protocol, Src Port: domain (53), Dst Port: filenet-tms (32768)

Domain Name System (response)

- [Request In: 10]
- [Time: 0.000732000 seconds]
- Transaction ID: 0x78cf
- Flags: 0x8580 (Standard query response, No error)
- Questions: 1
- Answer RRs: 28
- Authority RRs: 0
- Additional RRs: 3
- Queries
- Answers
 - large.example.com: type NS, class IN, ns longname16.example.com
 - large.example.com: type NS, class IN, ns longname3.example.com
 - large.example.com: type NS, class IN, ns longname.example.com
 - large.example.com: type NS, class IN, ns longname10.example.com
 - large.example.com: type NS, class IN, ns longname24.example.com
 - large.example.com: type NS, class IN, ns longname23.example.com
 - large.example.com: type NS, class IN, ns longname25.example.com
 - large.example.com: type NS, class IN, ns longname12.example.com
 - large.example.com: type NS, class IN, ns longname4.example.com

Frame (frame), 835 bytes Packets: 42 Displayed: 2 Marked: 0 Dropped: 0

Case Study: MYNIC

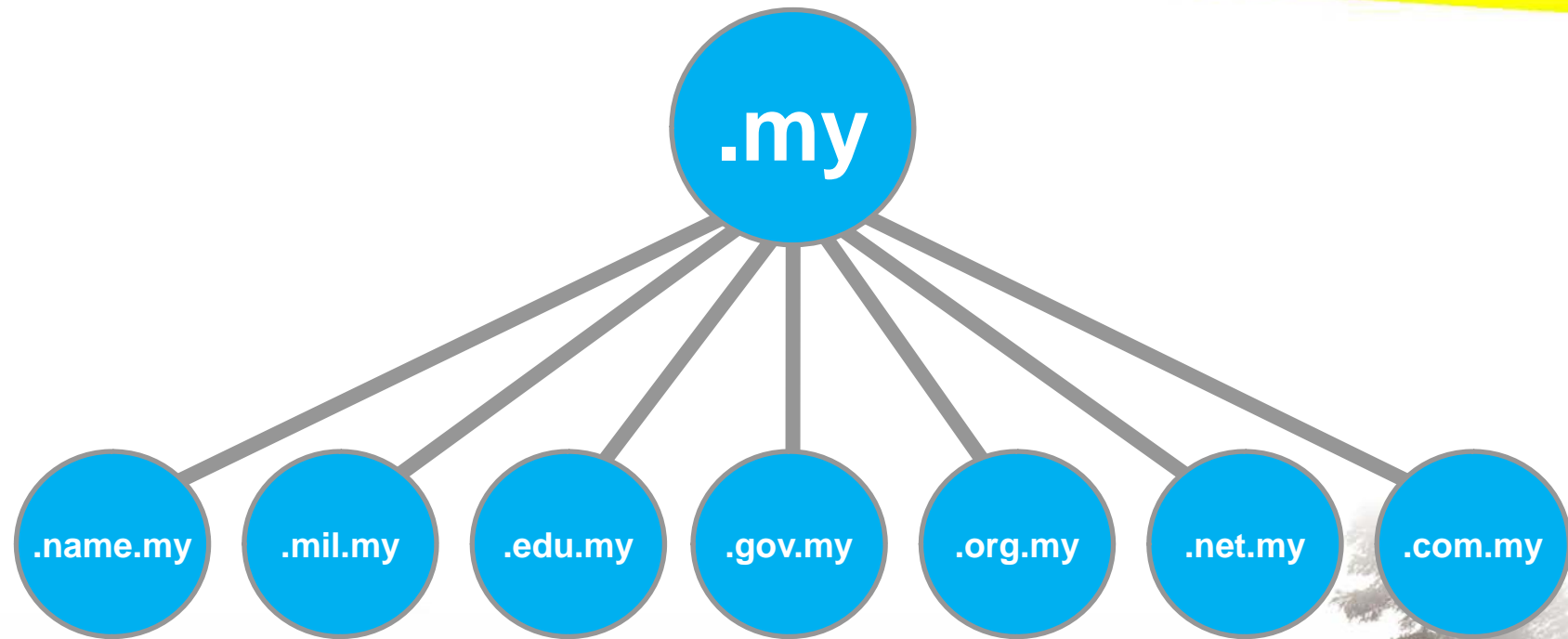
- MYNIC is the domain registrar for Malaysia's .my domain



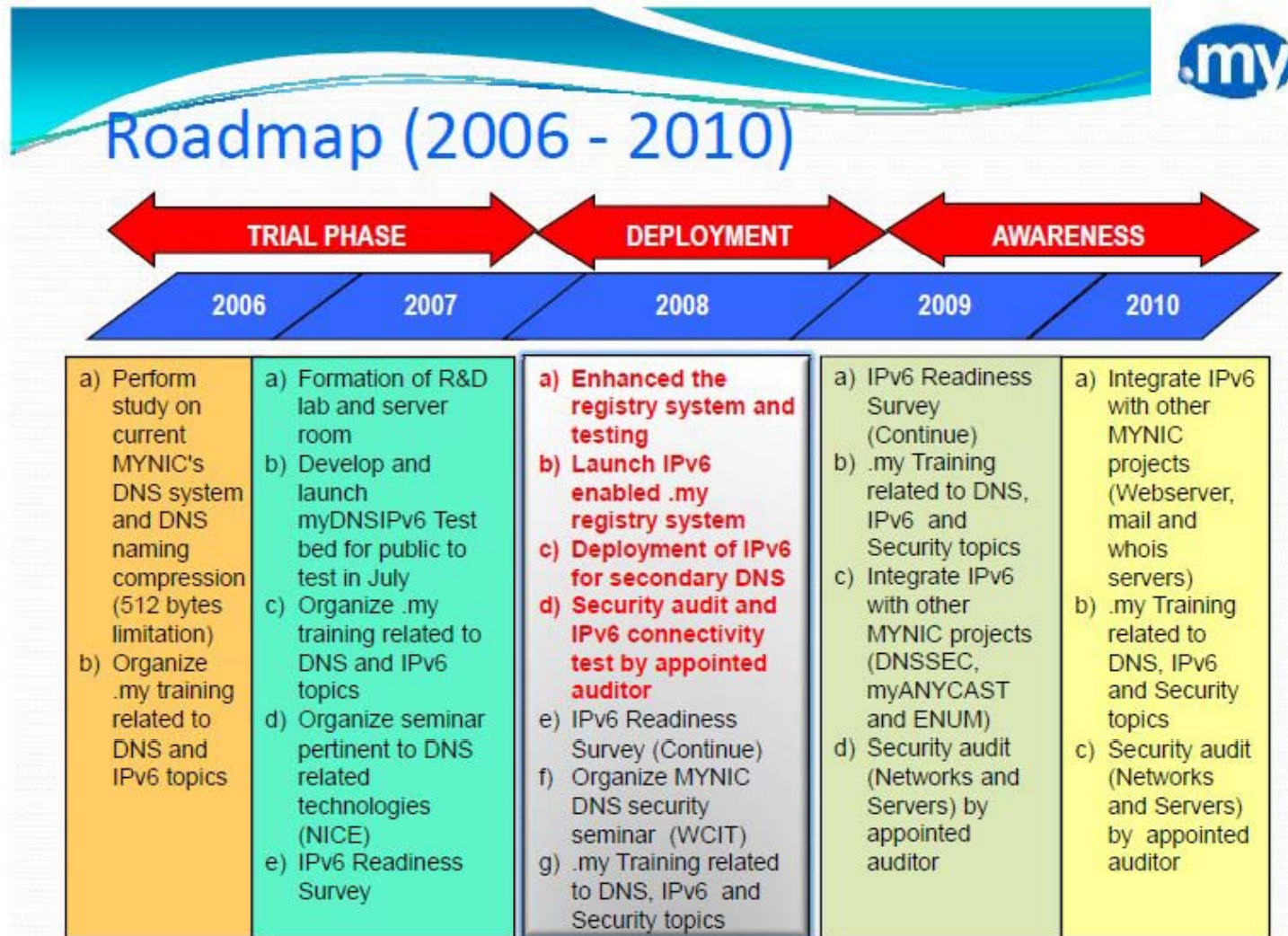
- Note: As of 23rd February 2009 MYNIC is now .my Domain Registry www.domainregistry.my



.my Domains

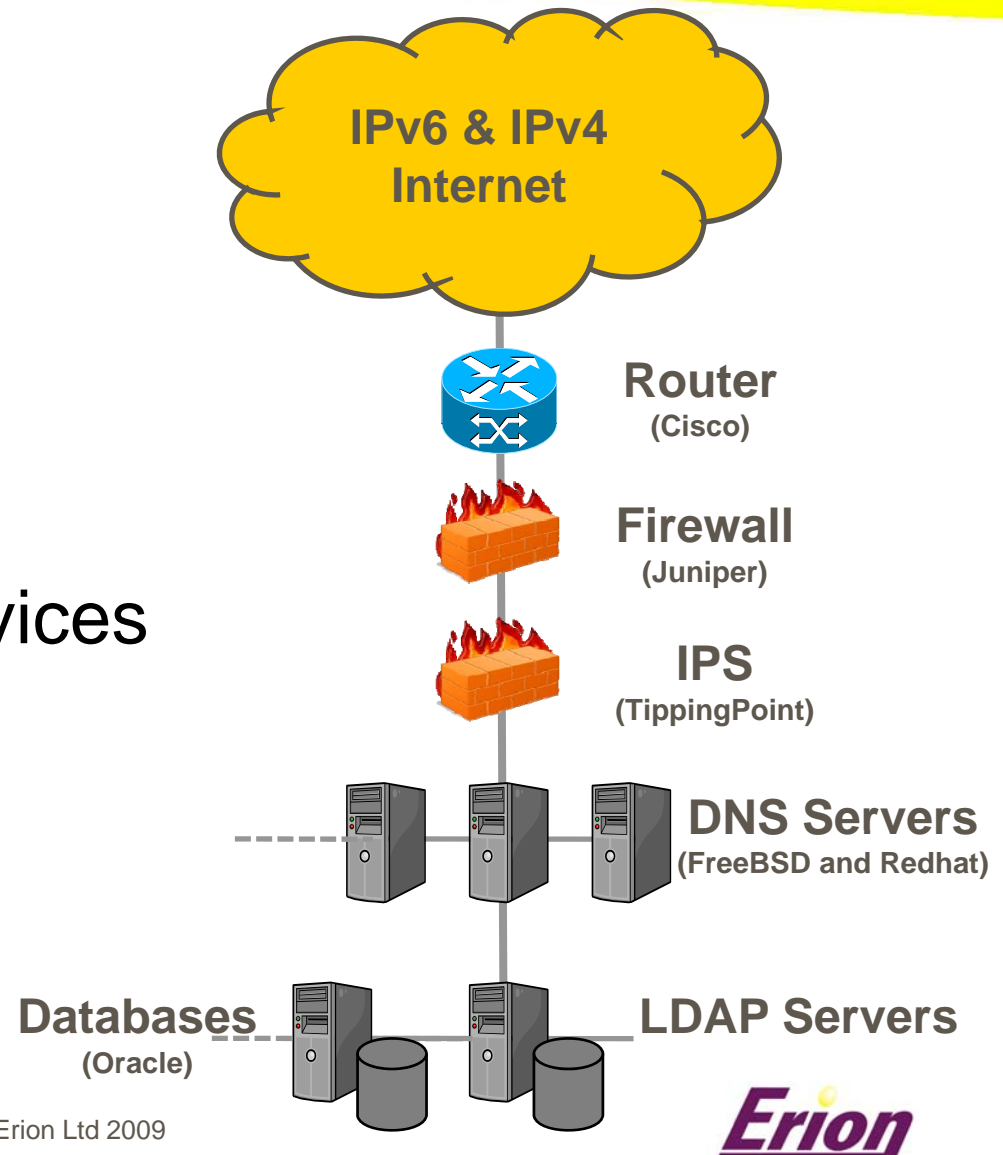


MYNIC IPv6 Roadmap



MYNIC Network

- Multiple Sites
- Multiple Servers
 - DNS
 - Database
 - LDAP
 - Web
- Multiple Network Devices
- Two main sites
- Test site ✓



Changes Necessary for IPv6

- DNS Servers and Network Infrastructure
 - Servers (Redhat and FreeBSD)
 - Firewalls (Juniper SSG 550M)
 - IPS (TippingPoint 600E)
- Security
 - DNS, host operating systems, network devices
- Domain Name Database
 - Add field for IPv6 addresses
- Management Web Interface
 - Allow IPv6 as well as IPv4 addresses

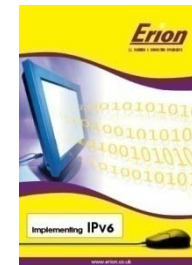
Erion and MYNIC IPv6 Deployment

- Erion IPv6 Training
 - Tailored migration training
 - Training is **essential** to every IPv6 migration project
- Erion IPv6 Consultancy
 - IPv6 Configuration Consultancy
 - Security Audit Consultancy

IPv6 Training

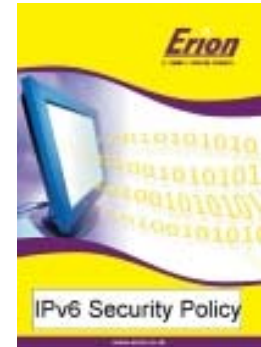
- Created tailored training program
 - Using Erion's large portfolio of IPv6 courses
- Matching training aims:
 - Specific topics
 - Operating systems and platforms
 - Delegate experience and knowledge
- Based mainly on two courses:
 - *Implementing IPv6* (4 days)
 - *Securing IPv6* (3 days)

(<http://www.ipv6training.com>)



IPv6 Security Audit

- Erion IPv6 security audit of MYNIC
- Consultancy to harden servers & network
- MYNIC successfully awarded IPv6 connectivity and security accreditation from national IPv6 body



Name Server IPv6 Addresses

```
# dig @dns2.mynic.net.my. -t ns my.
```

```
; <<>> DiG 9.3.4-P1 <<>> @dns2.mynic.net.my. -t ns my.
; (1 server found)
;; global options: printcmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49350
;; flags: qr aa rd; QUERY: 1, ANSWER: 8, AUTHORITY: 0, ADDITIONAL: 9
```

```
;; QUESTION SECTION:
my.                IN      NS
```

```
;; ANSWER SECTION:
my.                86400   IN      NS      dns.mynic.net.my.
my.                86400   IN      NS      ns2.cuhk.edu.hk.
my.                86400   IN      NS      ns5.jaring.my.
my.                86400   IN      NS      ns6.jaring.my.
my.                86400   IN      NS      dns2.mynic.net.my.
my.                86400   IN      NS      ns20.iij.ad.jp.
my.                86400   IN      NS      ns-my.nic.fr.
my.                86400   IN      NS      ns.uu.net.
```

```
;; ADDITIONAL SECTION:
ns.uu.net.         2105    IN      A        137.39.1.3
dns.mynic.net.my. 86400   IN      A        192.228.180.5
```

```
dns.mynic.net.my.      86400   IN      AAAA     2001:328:1000:3::5
```

```
ns5.jaring.my.       2107    IN      A        61.6.38.139
ns6.jaring.my.       54838   IN      A        192.228.128.16
dns2.mynic.net.my.   86400   IN      A        202.75.39.36
ns20.iij.ad.jp.      54837   IN      A        202.232.2.161
ns-my.nic.fr.        141241  IN      A        192.134.0.49
```

```
ns-my.nic.fr.         141249  IN      AAAA     2001:660:3006:1::1:1
```



Reverse Lookups

```
# dig -x 2001:328:1000:3::5
```

```
; <<>> DiG 9.3.4-P1 <<>> -x 2001:328:1000:3::5
;; global options: printcmd
;; Got answer:
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 9448
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 1
```

;; QUESTION SECTION:

```
;5.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.3.0.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. IN PTR
```

;; ANSWER SECTION:

[illegible]

;; AUTHORITY SECTION:

```
3.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. 86400 IN NS dns1.mynic.net.my.
```

```
3.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. 86400 IN NS dns2.mynic.net.my.
```

;; ADDITIONAL SECTION:

```
dns2.mynic.net.my.      61058      IN         A          202.75.39.36
```



IPv6 Glue

- Don't forget to add IPv6 glue

```
;; AUTHORITY SECTION:
my.      172800 IN      NS       ns.uu.net.
my.      172800 IN      NS       dns.mynic.net.my.
my.      172800 IN      NS       ns2.cuhk.edu.hk.
my.      172800 IN      NS       ns5.jaring.my.
my.      172800 IN      NS       ns6.jaring.my.
my.      172800 IN      NS       dns2.mynic.net.my.
my.      172800 IN      NS       ns20.iij.ad.jp.
my.      172800 IN      NS       ns-my.nic.fr.
```

;; ADDITIONAL SECTION:

```
ns.uu.net.      172800 IN      A        137.39.1.3
dns.mynic.net.my. 172800 IN      A        192.228.180.5
ns2.cuhk.edu.hk. 172800 IN      A        137.189.6.21
ns5.jaring.my.  172800 IN      A        61.6.38.139
ns6.jaring.my.  172800 IN      A        192.228.128.16
dns2.mynic.net.my. 172800 IN      A        202.75.39.36
ns20.iij.ad.jp.  172800 IN      A        202.232.2.161
ns-my.nic.fr.    172800 IN      A        192.134.0.49
```

IPv6 Glue

```
dns.mynic.net.my.      172800 IN      AAAA     2001:328:1000:3::5
ns-my.nic.fr.          172800 IN      AAAA     2001:660:3006:1::1:1
```

```
;; Query time: 267 msec
```

```
;; SERVER: 2001:500:1::803f:235#53(H.ROOT-SERVERS.NET)
```

```
;; WHEN: Mon Mar 16 14:44:09 2009
```

```
;; MSG SIZE rcvd: 410
```

Example .my Domain

```
; <>> DiG 9.3.4-P1 <>> -t aaaa www.erion.my.  
;; global options: printcmd  
;; Got answer:  
;; ->>HEADER<- opcode: QUERY, status: NOERROR, id: 23083  
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 2, ADDITIONAL: 4
```

```
;; QUESTION SECTION:
```

```
www.erion.my.                IN      AAAA
```

```
;; ANSWER SECTION:
```

```
www.erion.my.                10800   IN      AAAA      2001:470:1f08:61d::2
```

```
;; AUTHORITY SECTION:
```

```
erion.my.                    10800   IN      NS        n2.erion.my.
```

```
erion.my.                    10800   IN      NS        n1.erion.my.
```

```
;; ADDITIONAL SECTION:
```

```
n1.erion.my.                10800   IN      A         78.40.241.30
```

```
n1.erion.my.                10800   IN      AAAA      2001:470:1f08:61d::2
```

```
n2.erion.my.                10800   IN      A         80.84.66.24
```

```
n2.erion.my.                10800   IN      AAAA      2001:960:2:585::2
```



Domain Registrar Tools

- Address validation

Modify Domain Name : Welcome To .my DOMAIN REGISTRY - Internet Identity For All - Windows Internet Explorer

http://www.domainregistry.my/modify.php

Live Search

Modify Domain Name : Welcome To .my DOMAL...

Technical Contact Module of Domain Name erion.my
Please modify your option:

1. Modify Primary (Pri.) and/or Secondary (Sec.) IP Address

NS	Code	Hostname	Netaddress	IPv6 Netaddress
Pri.	SVA019794	n1.erion.my	78.40.241.30	2001:470:1f08:61d::2
Sec. a.	SVA019795	n2.erion.my	80.84.66.24	2001:960:2:585::2

Modify

[[.my DOMAIN REGISTRY Homepage](#)]

Developed and maintained by MYNIC Berhad
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Erion

IPv6 Address Validation

- Important to validate addresses entered in DNS
- Certain IPv6 address are undesirable in DNS

```
root@oak:~  
[root@oak ~]# netstat --inet6 -n  
Active Internet connections (w/o servers)  
Proto Recv-Q Send-Q Local Address           Foreign Address         State  
tcp        0      132 ::ffff:192.168.50.100:22 ::ffff:192.168.50.1:49471 ESTABLISHED  
[root@oak ~]#
```

```
IPv4 Subnet Mask      255.255.255.0  
IPv4 Default Gateway  192.168.108.132  
IPv4 DNS Server       192.168.108.132  
IPv4 WINS Server  
NetBIOS over Tcpip Enabled Yes  
IPv6 IP Address       3000:0:20:0:85cc:a568:4656:fb20  
Temporary IPv6 Address 3000:0:20:0:f84e:405b:1039:3f02  
Link-local IPv6 Address fe80::85cc:a568:4656:fb20%8  
IPv6 Default Gateway  fe80::20c:29ff:fea3:8bb1%8  
IPv6 DNS Server       3000:0:20:0:20c:29ff:fef1:925b
```

Examples:

- IPv4 mapped IPv6 addresses
- Temporary (private) addresses
- Link-Local addresses
- Special addresses reserved for certain transition mechanisms

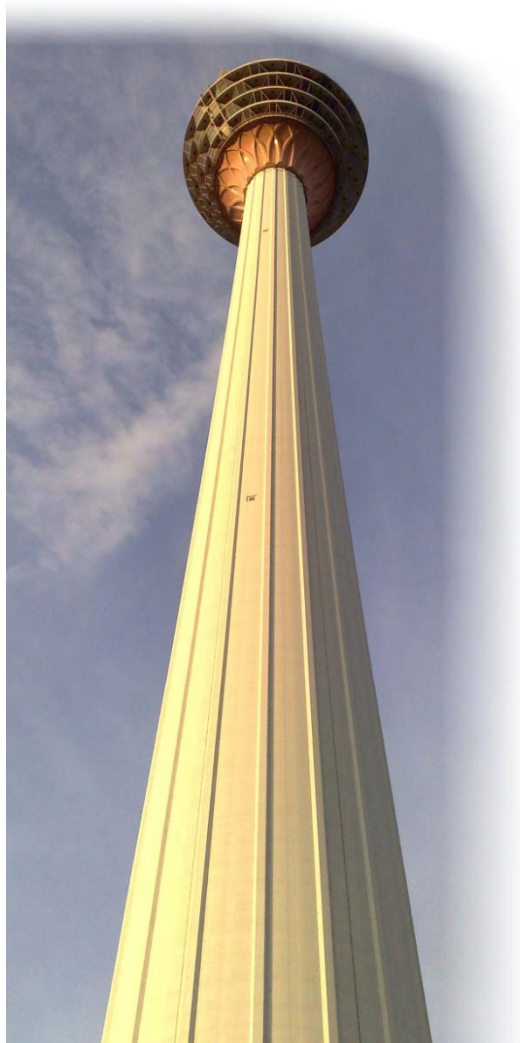
Domain Statistics

- 73% of ccTLDs have IPv6 name server
 - But few resellers have IPv6 name servers
 - For example 0% of .my resellers have IPv6 name servers
- Fortune 100 companies:
 - 4 have IPv6 addresses for name servers
 - 2 have IPv6 enabled web servers
 - 0 have IPv6 addresses for mail servers
- FTSE 100 companies:
 - 4 have IPv6 addresses for name servers
 - 2 have IPv6 enabled web servers
 - 0 have IPv6 addresses for mail servers



Summary

- DNS and IPv6
- .my successfully IPv6 enabled
- DNS statistics



Erion and IPv6 References

- IPv6 Services
 - <http://www.erion.co.uk/ipv6.html>
- IPv6 Blog
 - <http://www.ipv6consultancy.com/ipv6blog>
- IPv6 Training
 - <http://www.ipv6training.com>
- IPv6 Consultancy
 - <http://www.ipv6consultancy.com>
- Contact enquiry@erion.co.uk

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Questions

Thank you for listening