

# IPv6 Training – Case Study: IPv6 Enabling Malaysia's .my Domain

**Slovenia IPv6 Summit 2010**

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- Over a decade providing IPv6 services
- Worlds most comprehensive IPv6 training portfolio
- Advanced IPv6 consultancy services
- World leader in IPv6 enabled Windows-Unix/Linux integration

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

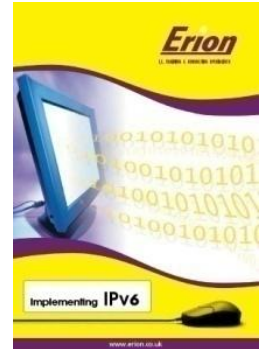
<http://www.ipv6training.com>

<http://www.ipv6consultancy.com>

# Erion IPv6 Training

- World's largest portfolio of IPv6 courses
  - Covers all aspects of IPv6
  - Different audiences (management, systems administrators, software developers etc)
  - Multiple operating systems and platforms
  - Extensive course and exercise materials
  - Over a decade of development
- Examples:
  - *Implementing IPv6* (4 days)
  - *Securing IPv6* (3 days)
  - *IPv6 for Software Developers* (4 days)

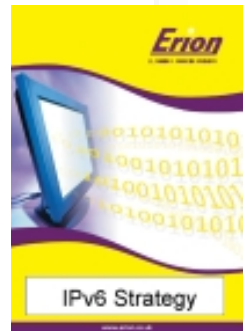
Further information at <http://www.ipv6training.com>



# Erion IPv6 Consultancy

- Over a decade of IPv6 Consultancy provision
- Covering all aspects of IPv6:
  - IPv6 audits, strategic planning, transition projects and technical consultancy
- IPv6 Technical consultancy covering:
  - Transition and implementation
  - Host and server transition
  - Network implementation and management
  - IPv6 security
  - IPv6 software development
  - IPv6 application migration
- Erion uses best practice IPv6 and project management methodologies

Further information at <http://www.ipv6consultancy.com>



# Example Erion Customers



# IPv6 Enabling .my Domain

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

# DNS is Crucial to Internet

The image shows two overlapping windows from a Windows operating system. The top window is a Microsoft Internet Explorer browser window titled "IPv6 Consultancy - Erion Ltd - Windows Internet Explorer". The address bar contains the URL "http://www.ipv6consultancy.com/", which is highlighted with a red rectangular box. Below the browser window is an Outlook email compose window titled "Compose: IPv6 and DNS". The "From:" field shows "David Holder <david.holder@erion.co.uk>". The "To:" field shows "enquiry@erion.co.uk", which is also highlighted with a red rectangular box. The Outlook window includes a menu bar with "File", "Edit", "View", "Insert", "Format", "Options", "OpenPGP", "Tools", and "Help". Below the menu bar is a toolbar with icons for "Send", "Contacts", "Spell", "Attach", "OpenPGP", "S/MIME", and "Save".

- Almost everything uses naming services...

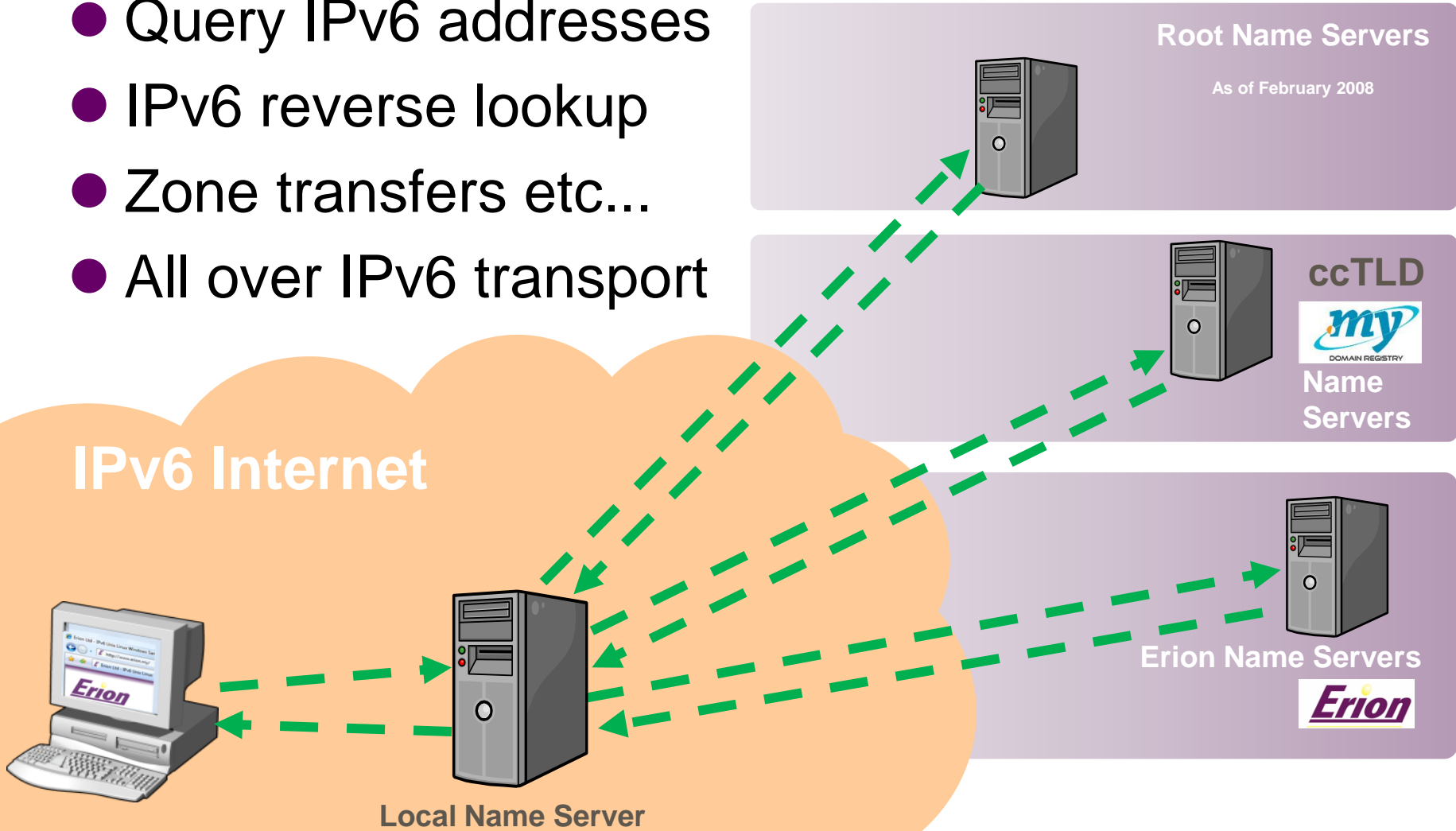
# DNS is Critical for Successful IPv6 Deployments

- 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 IPv6's fault
- Crucial that you get IPv6 name resolution right!



# The Domain Name System

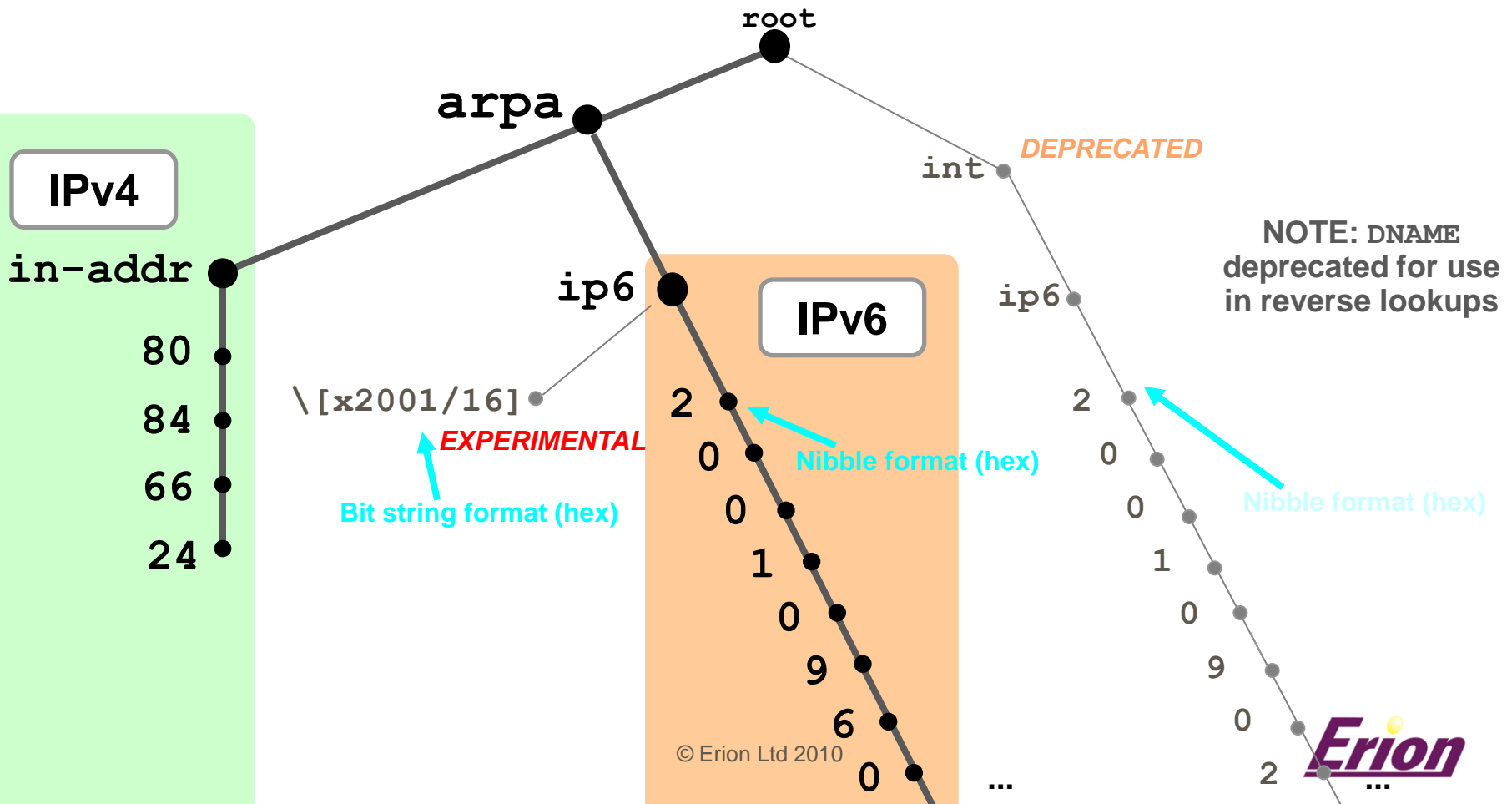
- Query IPv6 addresses
- IPv6 reverse lookup
- Zone transfers etc...
- All over IPv6 transport





# IPv6 Reverse Lookups

2.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.5.8.5.0.2.0.0.0.0.6.9.0.1.0.0.2.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

Filter: dns

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

Filter: dns

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



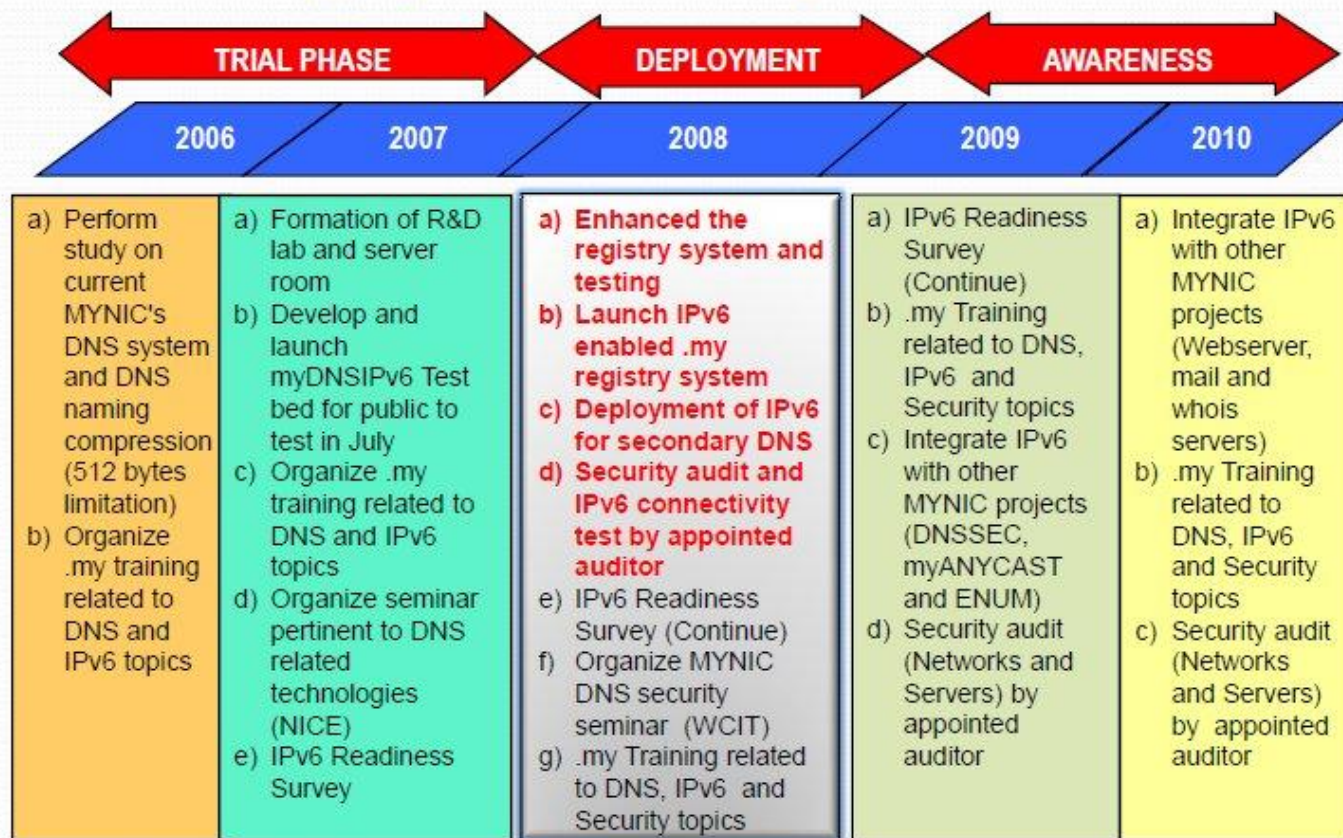
- Note: As of 23<sup>rd</sup> February 2009 MYNIC is now .my Domain Registry [www.domainregistry.my](http://www.domainregistry.my)



# MYNIC IPv6 Roadmap



## Roadmap (2006 - 2010)



# MYNIC Network

- Multiple Sites
- Multiple Servers
  - DNS
  - Database
  - LDAP
  - Web
- Multiple Network Devices
- Two main sites
- Plus test site

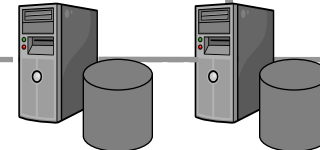


Staff

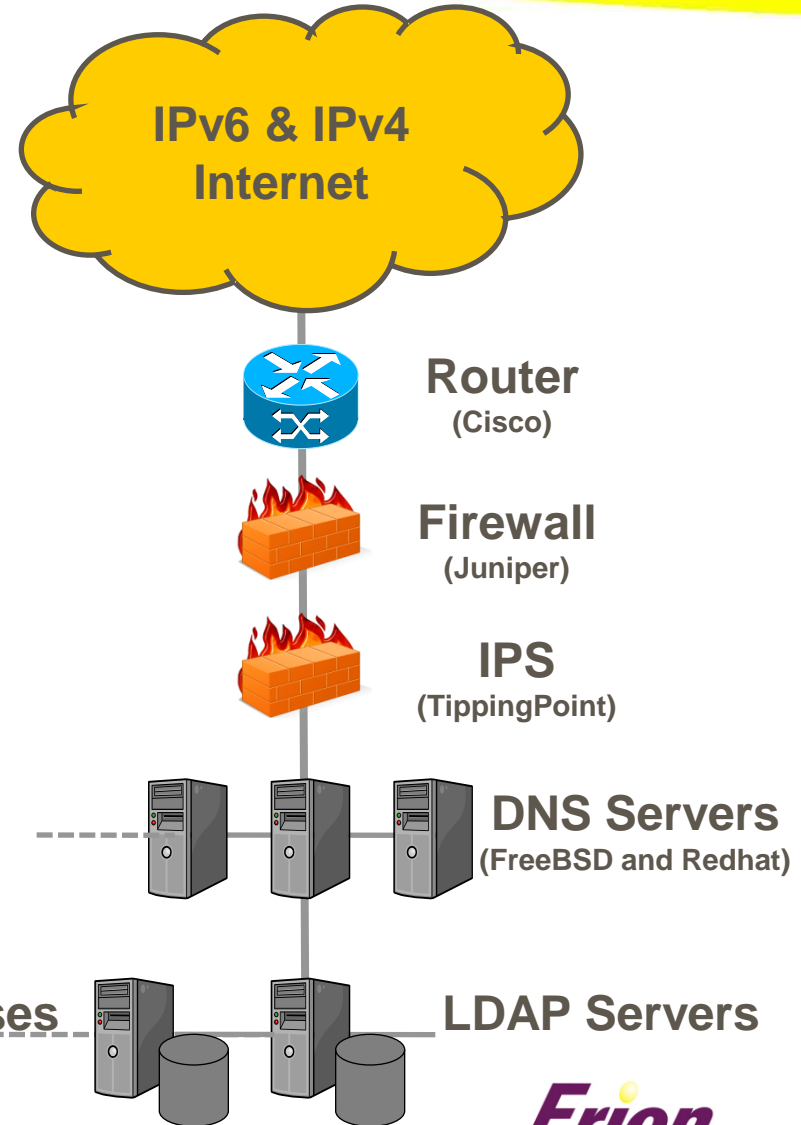


Web Interface

Databases  
(Oracle)



LDAP Servers





# 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
- Staff skills!

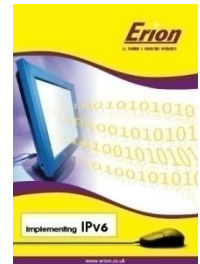
# Erion and MYNIC IPv6 Deployment

- 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

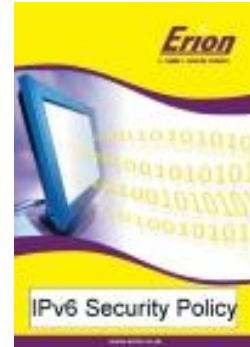
- Created tailored training program
  - Using Erion's large portfolio of IPv6 courses
- Matching training aims:
  - Specific topics
  - Operating systems and platforms
  - Delegate experience and knowledge
- Based mainly on two courses:
  - *Implementing IPv6* (4 days)
  - *Securing IPv6* (3 days)

(<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:  
;5.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.3.0.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. IN PTR
```

```
;; ANSWER SECTION:  
5.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.0.3.0.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. 86400IN PTR dns.mynic.net.my.
```

```
;; AUTHORITY SECTION:  
3.0.0.0.0.0.0.1.8.2.3.0.1.0.0.2.ip6.arpa. 86400 IN NS dns1.mynic.net.my.  
3.0.0.0.0.0.0.1.8.2.3.0.1.0.0.2.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
```

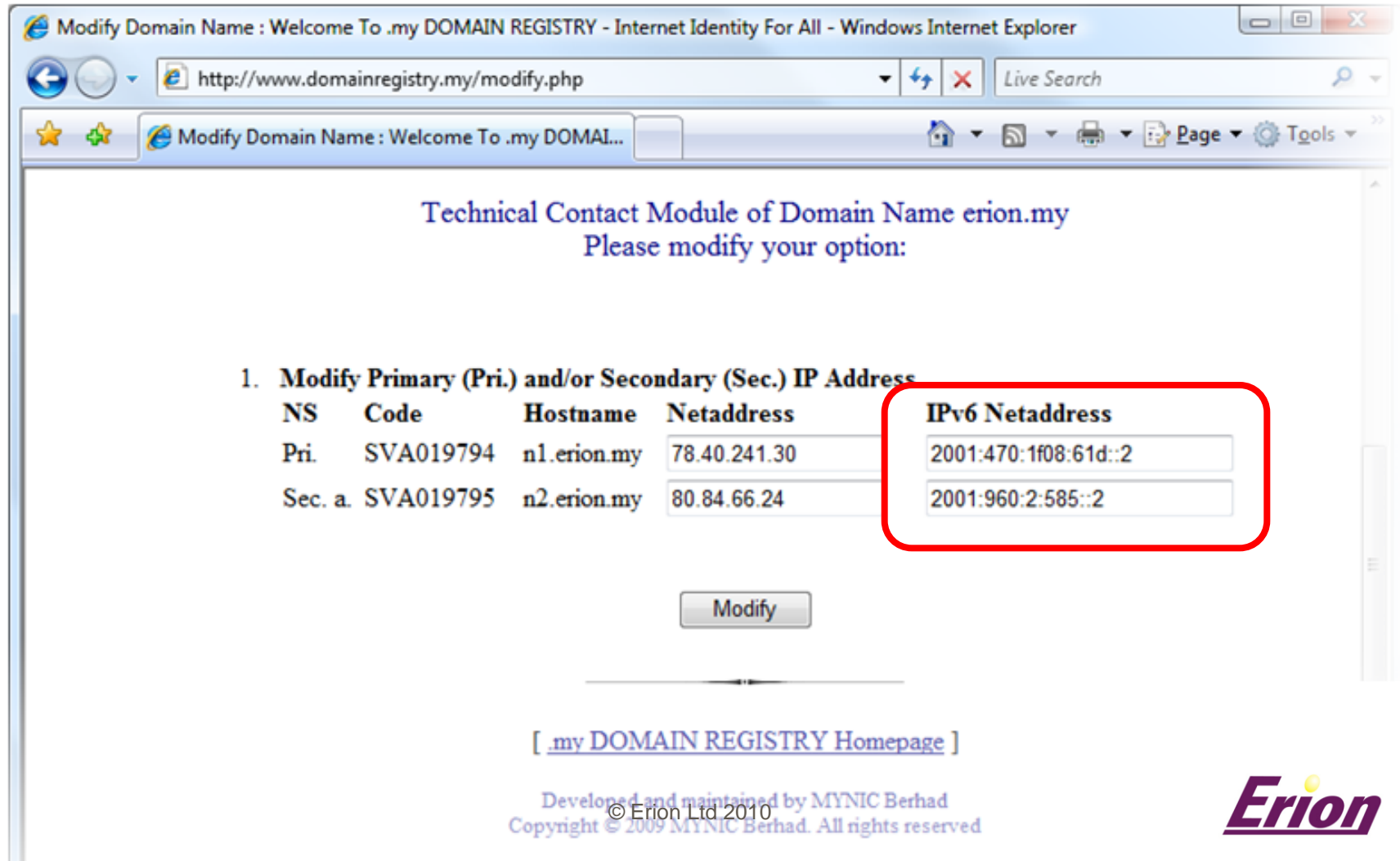
```
n2.erion.my.           10800      IN          AAAA          2001:960:2:585::2
```





# 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](#) ]

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**Erion**

# IPv6 Address Validation

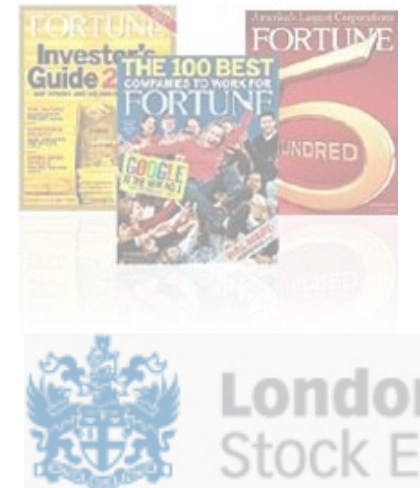
- Important to validate addresses entered in DNS
- Certain IPv6 address are undesirable in DNS

```
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  
IPv4 DNS Server       192.168.108.132  
IPv4 WINS Server  
NetBIOS over Tcpi... 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
```

# Domain Statistics

- 79% (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
    - 1 (2) have IPv6 enabled web servers
  - FTSE 100 companies:
    - 4 have IPv6 addresses for name servers
    - 2 have IPv6 enabled web servers
- Values in parenthesis are from March 2009



# IPv6 Addresses – Quick Test

2045:5249:4f4e::2

::ffff:50.10.1.10

fe80::1

ff02::2

2001:0000:0102:0304::efff:f6ff:ffffe

2002:0800:0001::1

3ffe:0302:0011:0020:0000:5EFE:0102:0304

fe80::5EFE:0102:0304

# Conclusions

- Training is essential to successful IPv6 deployment
- Staff are a part of the migration
- Name services are critical to IPv6 migration
- IPv6 security needs addressing even for “IPv4 only” organisations
- Training is essential to IPv6 deployment

# Questions

**World-class IPv6 Training in Ljubljana**

***Implementing IPv6 (4 days)***

**19<sup>th</sup>-23<sup>rd</sup> July 2010**

**Instructor: David Holder**

**See sheet for further details...**

**Thank you for listening**

# Erion and IPv6 References

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