A brief story of how the internet works

Peter Van Roste - peter@centr.org
Nina Elzer - nina@centr.org
Brussels, Belgium
17 December 2017
Practicalities

• Red pointers indicate policy aspects
• You can ask questions after the presentation
• More questions later? nina@centr.org
• This is a basic training (some corners were cut)
What is CENTR?

The association for exchange, dialogue and innovation of country code domain registries in Europe
Council of European National Top-Level Domain Registries

54 FULL MEMBERS

9 ASSOCIATE MEMBERS

13 OBSERVERS

MANAGING 76 ccTLDs

MANAGING 10 ccTLDs

AU CC CN 中国 中国 CO JP NZ TV US + 29 gTLDs

AFTLD APTLD	EuroISPA
eco EU Commission
ICANN ISC ISOC LACTLD
NLnet Labs OARC RIPE NCC

Netnod
GLOBAL MEMBER STATISTICS

>73M
REGISTERED DOMAINS

>1,300
EMPLOYEES
(1-140 PER REGISTRY)

50%
OF REGISTERED ccTLDs WORLDWIDE

80%
OF REGISTRIES ARE NOT-FOR-PROFIT ORGANISATIONS
What CENTR does (services to members)
What will you learn today?

• What the internet really looks like (it’s not a cloud)
• What IP addresses are
• How they connect to each other
• How networks work
• How the domain name system (DNS) works
• Why the root is important and why IANA matters
• Who does what in the technical layers of the internet
• Why this all matters for the Internet Governance discussions
One year ago in the news
So what happened?

Orange subscribers

French Ministry of the Interior

Anti-Terrorism (?)
What the internet is made of
What the internet is made of

- No sanctions
- No one (really) owns the internet
- No one sets the rules for all
- No overall controlling network

Voluntary agreements “Common rules” (standards & protocols)
Who “governs” the internet?

INTERNET ECOSYSTEM

INTERNET GOVERNANCE ARENAS

INTERNET SOCIETY

POLICY-DEVELOPING ORGANISATIONS

UNIVERSITIES AND ACADEMIC INSTITUTIONS

TECHNICAL LAYER

INFRASTRUCTURE

STANDARDS AND PROTOCOLS

NUMBERING COMMUNITY

NAMING COMMUNITY

You are here

...and here

...and here

Who “governs” the internet?

You are here

...and here
Not only cable...

Spectrum
(allocation of frequencies)
ePrivacy
(protection of personal and metadata)

Free flow of data
(no localisation requirements)
NIS Directive
(network & information security of critical infrastructure)
North America (ARIN)
Europe (RIPE)
Latin America (LACNIC)
Asia Pacific (APNIC)
Africa (AFRINIC)

“Backbone” (highly connected networks)
Let’s add the domain name system (DNS)

• Why do we need the DNS?
• How does it work?
• The Root
• The top-level domain
Why do we need the DNS?

There are three main reasons:

• Remembering addresses
• Flexibility (the underlying IP address/servers can change without any impact on the users)
• Security (Requests can be diverted to avoid server overload)

(And a fourth one)

• (Internet of Things [e.g. flood early warning system])
The Need for Domain Names
The Need for Domain Names
The DNS explained

https://www.youtube.com/watch?v=vZ007Vi5H1M
CENTR on YouTube: CENTRDNS
<table>
<thead>
<tr>
<th>Category</th>
<th>Responsible Party</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROOTZONE</td>
<td>Rootzone Maintainer (IANA)</td>
</tr>
<tr>
<td>TLD ZONEFILE</td>
<td>TLD Registry (EURid)</td>
</tr>
<tr>
<td>DOMAIN</td>
<td>Domain Admin (Commission)</td>
</tr>
</tbody>
</table>
Council of European National Top-Level Domain Registries

THE ROOT

THE TOP-LEVEL DOMAIN (TLD)

.europa.eu  eurid.eu  euractiv.eu

THE SECOND-LEVEL DOMAIN

curia.europa.eu  ec.europa.eu  smtp.europa.eu

THE DOMAIN SERVER
1. The Root
1. The Root

- IANA manages the root zone database
  - The root zone file is extracted from the root zone database
- The root zone file is hosted on 13 identical root servers, managed by different organisations (2 by EU orgs: RIPE & NetNod)
- Each of those 13 has many copies around the globe
- 4 of those copies are hosted in Brussels
- The US government (NTIA) no longer oversees the IANA function (transition occurred on 1 October 2016)
1. The Root - root zone file (root servers)

eu. 172800 IN NS x.dns.eu.
eu. 172800 IN NS y.dns.eu.
eu. 172800 IN NS cz.dns.eu.
eu. 172800 IN NS nl.dns.eu.
eu. 172800 IN NS si.dns.eu.
eu. 172800 IN NS uk.dns.eu.
EU. 86400 IN DS 61179 7 1 87E2B3544884B45F36A0DA72DADCCB0239C4D73D4
EU. 86400 IN DS 61179 7 2 3B526BCC354AE085AD9984C9BE73D271411023EFF421EF184BCE41ACE3DE9F8B
cz.dns.eu. 172800 IN A 93.190.128.138
nl.dns.eu. 172800 IN A 91.200.16.100
si.dns.eu. 172800 IN A 193.2.221.60
si.dns.eu. 172800 IN AAAA 2001:1470:8000:100:0:0:0:1
uk.dns.eu. 172800 IN A 195.66.241.178
x.dns.eu. 172800 IN A 194.0.1.19
x.dns.eu. 172800 IN AAAA 2001:678:4:0:0:0:0:13
y.dns.eu. 172800 IN A 194.146.106.90
y.dns.eu. 172800 IN AAAA 2001:67C:1010:23:0:0:0:53
ns6.nominum.eu. 172800 IN A 81.200.69.35
eu. 86400 IN NSEC eurovision. NS DS RRSIG NSEC

eu. 86400 IN RRSIG NSEC 8 1 86400 20150411170000 20150401160000 48613.
Y2+jPipksunT5NSn9BGs6XUpONfCFX8wLYywZug1+Hh4xrh3f+YzoHAmtm3maHqN/A2QwB+tWKxbQhLx9blR4vFajJ2H8fEGOFSP+P6e3X2lRRxYOcEkubx+v9QweLpSq
5yp5uA6OVpOUQ/phShZLDVVfCTbLOxbBacFeXTQFSLZJQ=
2. The top-level domains

- There are (currently) 1,532 top-level domains

<table>
<thead>
<tr>
<th>ccTLDs</th>
<th>gTLDs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country code top level domains</td>
<td>Generic top level domain</td>
</tr>
<tr>
<td>ISO 3166 – 1 alpha 2 list Delegated based on IETF standard RFC 1591</td>
<td>1200-ish</td>
</tr>
<tr>
<td>Restricted but costly long ICANN process</td>
<td>.wine / .vin</td>
</tr>
<tr>
<td>Managed locally – serving the local internet community – funded by registration fees</td>
<td>Managed by independent operator under contract with ICANN – operator pays ICANN</td>
</tr>
</tbody>
</table>
Council of European National Top-Level Domain Registries

THE ROOT

THE TOP-LEVEL DOMAIN (TLD)

.eu
.EU
.COM
.EE
...

THE SECOND-LEVEL DOMAIN

.europa.eu
eurid.eu
euractiv.eu

THE DOMAIN SERVER

curia.europa.eu
ec.europa.eu
smtp.europa.eu
## 2. .eu WHOIS record for europa.eu

![WHOIS record for europa.eu](https://whois.eurid.eu/en/)

<table>
<thead>
<tr>
<th>NAME SERVERS</th>
<th>IP Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>ns1bru.europa.eu</td>
<td>158.169.131.22</td>
</tr>
<tr>
<td>ns2eu.bt.net</td>
<td>2a01:7080:14:101::2</td>
</tr>
<tr>
<td>ns3bru.europa.eu</td>
<td>158.169.9.30</td>
</tr>
<tr>
<td>ns2lux.europa.eu</td>
<td>158.169.9.11</td>
</tr>
<tr>
<td>ns1lux.europa.eu</td>
<td>158.169.131.32</td>
</tr>
<tr>
<td>ns2bru.europa.eu</td>
<td></td>
</tr>
<tr>
<td>ns1.be.colt.net</td>
<td>2a01:7080:24:101::2</td>
</tr>
<tr>
<td>ns1.bt.net</td>
<td></td>
</tr>
<tr>
<td>ns3lux.europa.eu</td>
<td></td>
</tr>
</tbody>
</table>

Fax: Email: friedrich.kloibhofer@ec.europa.eu
1. User types domain name into browser
1. User types domain name into browser

www.example.eu
2. Browser asks Access Provider for IP address of www.example.eu

What’s the IP address for www.example.eu?
3. DNS Resolver asks Root Name Server for IP of a DNS server for .eu

Where’s the .eu registry DNS server?
3. DNS Resolver asks Root Name Server for IP of a DNS server for .eu

It’s at IP address: 198.51.100.56
4. DNS Resolver asks .eu DNS server for IP of the DNS server for example.eu
4. DNS Resolver asks .eu DNS server for IP of the DNS server for example.eu

It’s at IP address: 203.0.113.185
5. DNS Resolver asks for the IP address for www.example.eu ...

What’s the IP address for www.example.eu?
5. DNS Resolver asks for the IP address for www.example.eu ...

It’s at IP address: 192.0.2.12
6. ... and passes the IP address back to the browser

The IP address for www.example.eu is:
192.0.2.12
7. ... which contacts the website host using the IP address

www.example.eu

Contacting 192.0.2.12
8. HTTP traffic begins
How DNS Blocking Works
How DNS blocking works

What’s the IP address for www.example.eu?
How DNS blocking works

No such domain.
How DNS blocking works

Or...
How DNS blocking works

What’s the IP address for www.example.eu?
How DNS blocking works

It’s at (cough) IP: 203.0.113.234 (cough)
How DNS blocking works

Police controlled server

Access Provider

DNS Resolver

203.0.113.234
Technical flaws in DNS blocking
Technical flaws: multiple / changing domain names

What’s the IP address for www.example.eu?

Access Provider

DNS Resolver

www.example.eu
www.ejemplo.eu
Technical flaws: user can bypass DNS by typing IP address directly into browser

192.0.2.12
Technical flaws: many companies run their own DNS resolver

What’s the IP address for www.example.eu?
Technical flaws: client can use a third-party DNS resolver
Technical flaws: client can use a third-party DNS resolver
Technical flaws: client can use a third-party DNS resolver
Technical flaws: client can use a third-party DNS resolver
Technical flaws: client can use a third-party DNS resolver
Conclusions

• “DNS blocking” is a technical term
  – It describes a technical procedure, not an outcome
  – It is not synonymous with “preventing access using DNS”
  – It is unlikely to prevent users from reaching content they are actively seeking

• There is a big difference between seeking to protect users from content they wish to avoid, and seeking to obstruct users from reaching content they seek
  – In the first case, you can enlist the support of users and the software and services they use
  – In the latter, there is always a way around any impediment, and these ways can and will be made easy for anyone to use
Time to wrap up
Who “governs” the internet?

INTERNET SOCIETY

INTERNET GOVERNANCE ARENAS

INTERNET ECOSYSTEM

TECHNICAL LAYER

INFRASTRUCTURE

STANDARDS AND PROTOCOLS

NUMBERING COMMUNITY

NAMING COMMUNITY

Who "governs" the internet? Multistakeholder

...and here

...and here
What did we learn today?
What did we learn today?

www.europa.eu

www.allegro.pl

blog.orange.fr

info@standaard.be

рнидс.срб
What did we learn today?
One year ago in the news

Google down: Orange bloque et redirige par erreur ses internautes vers le ministère de l'Intérieur [MAJ]

Réseaux : Depuis ce matin, les abonnés de chez Orange qui souhaitent se rendre sur le site de Google, de Wikipedia ou encore d'OVH rencontrent des difficultés. Certains utilisateurs se sont même vu servir une page du ministère de l'Intérieur, signalant le blocage administratif d'un site. Une erreur de DNS est en cause.

Par La rédaction de ZDNet.fr | Lundi 17 Octobre 2016
Some corners were cut in the making of this presentation.
Thanks to Malcolm Hutty (Linx) for the fancy slides on blocking!
One more thing...

RIPE NCC and CENTR are signing a MoU!
You are very welcome to join us @ the NRO booth
Monday 18 December - 18.00 - 19.00
Thank you

peter@centr.org
nina@centr.org