How the Internet works?

IPGO v3.2

1. Network Operators
2. Building a Network
3. Devices
4. IP Addresses
5. Routing Packets
6. Sending Packets
7. IPv6
8. DNS

1. Network Operators

video

IPGO – 5 Islands

Banana

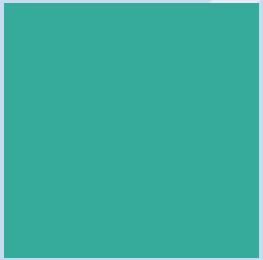
Coconut

Apple

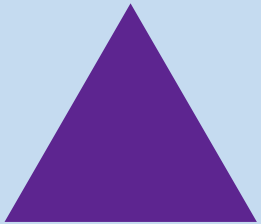
Pineapple

Watermelon

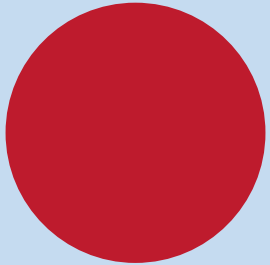
IPGO – 8 Network Operators



Square

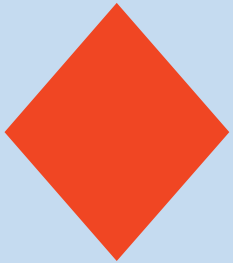


Triangle



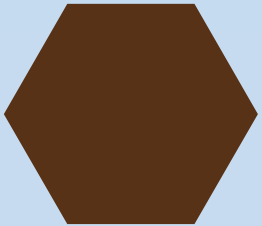
Circle

Heart



Diamond

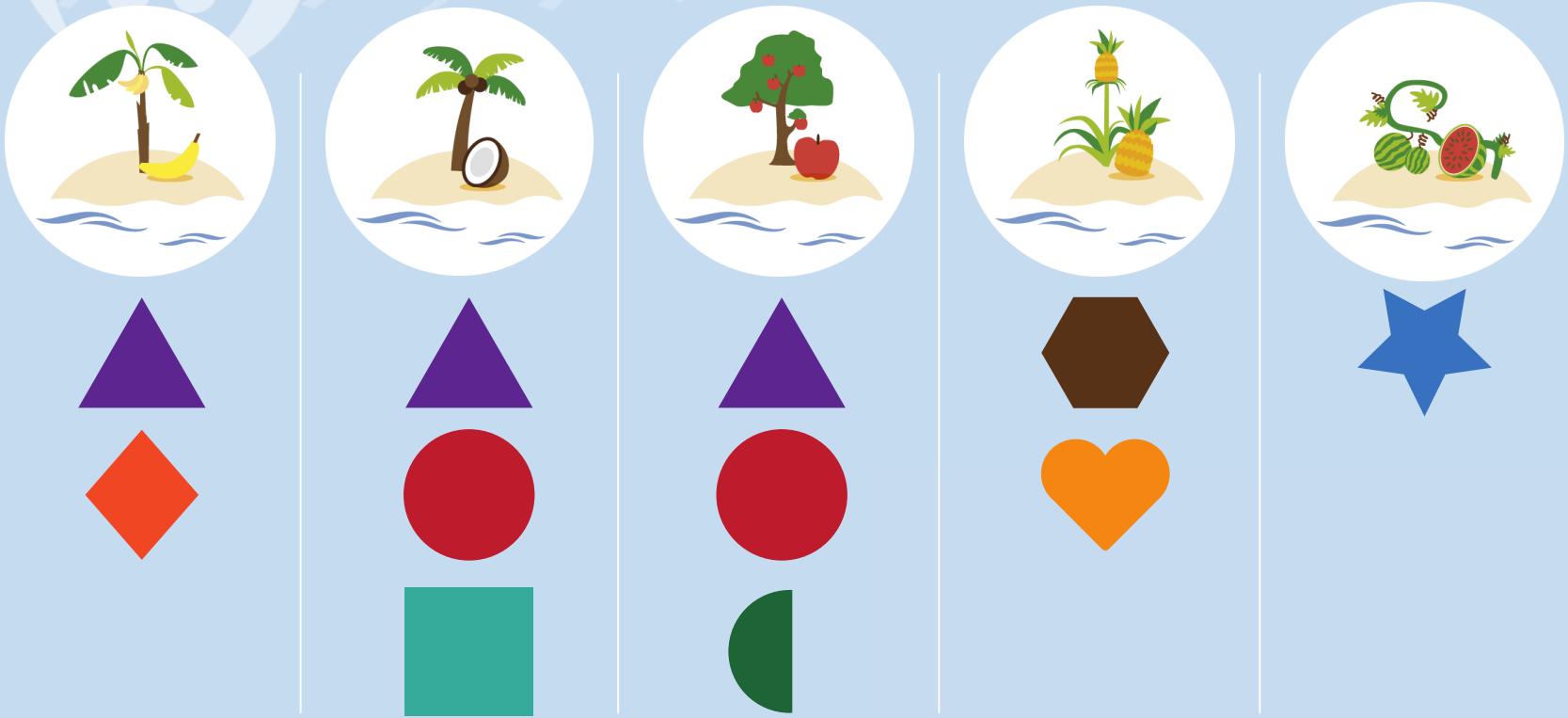
Star



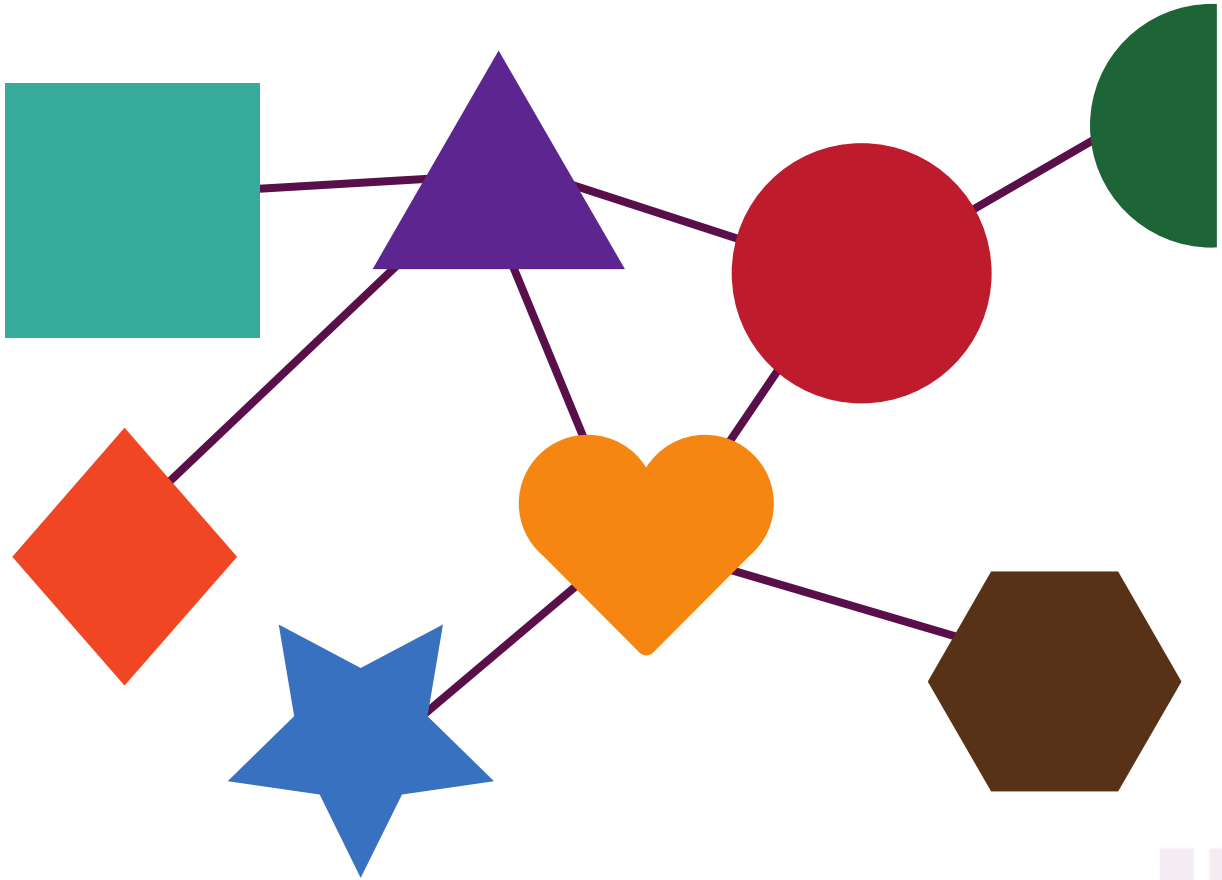
Hexagon

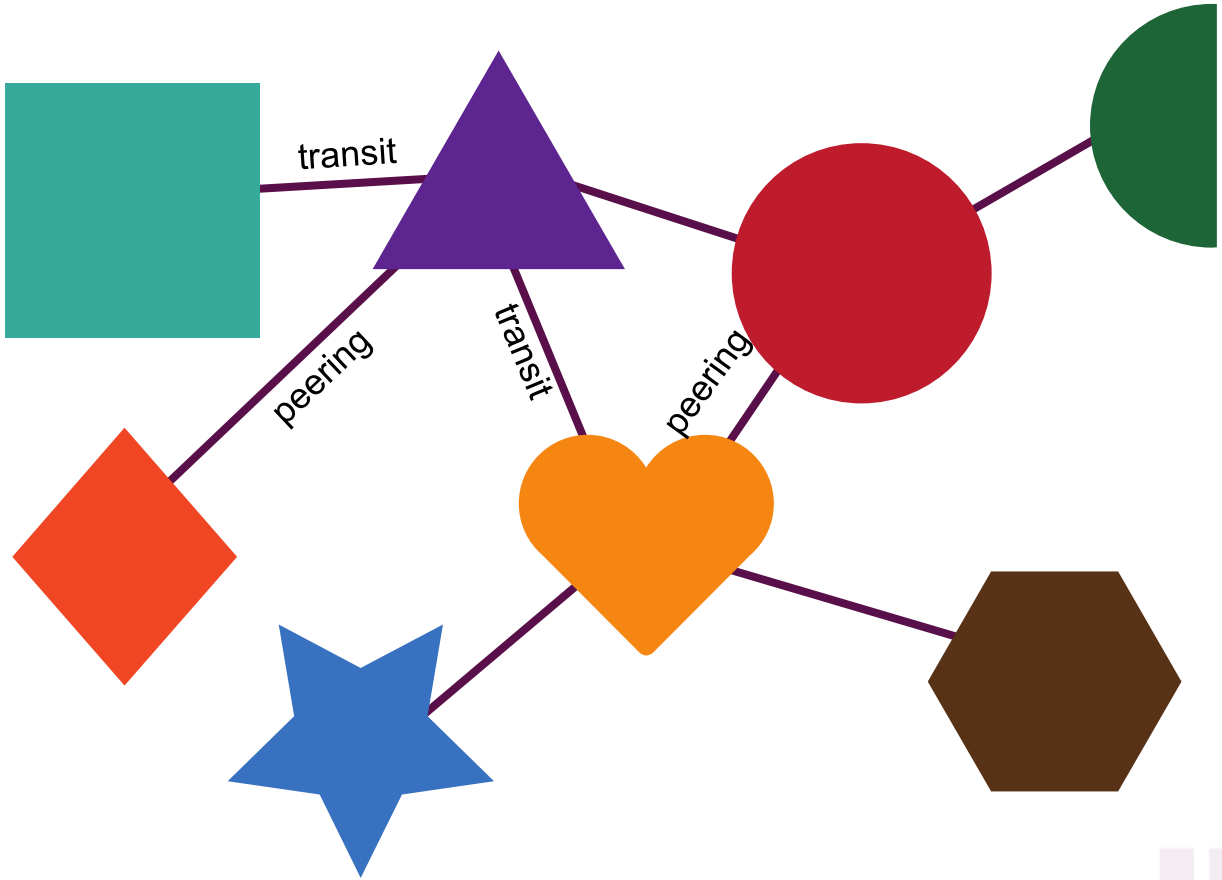
Semicircle

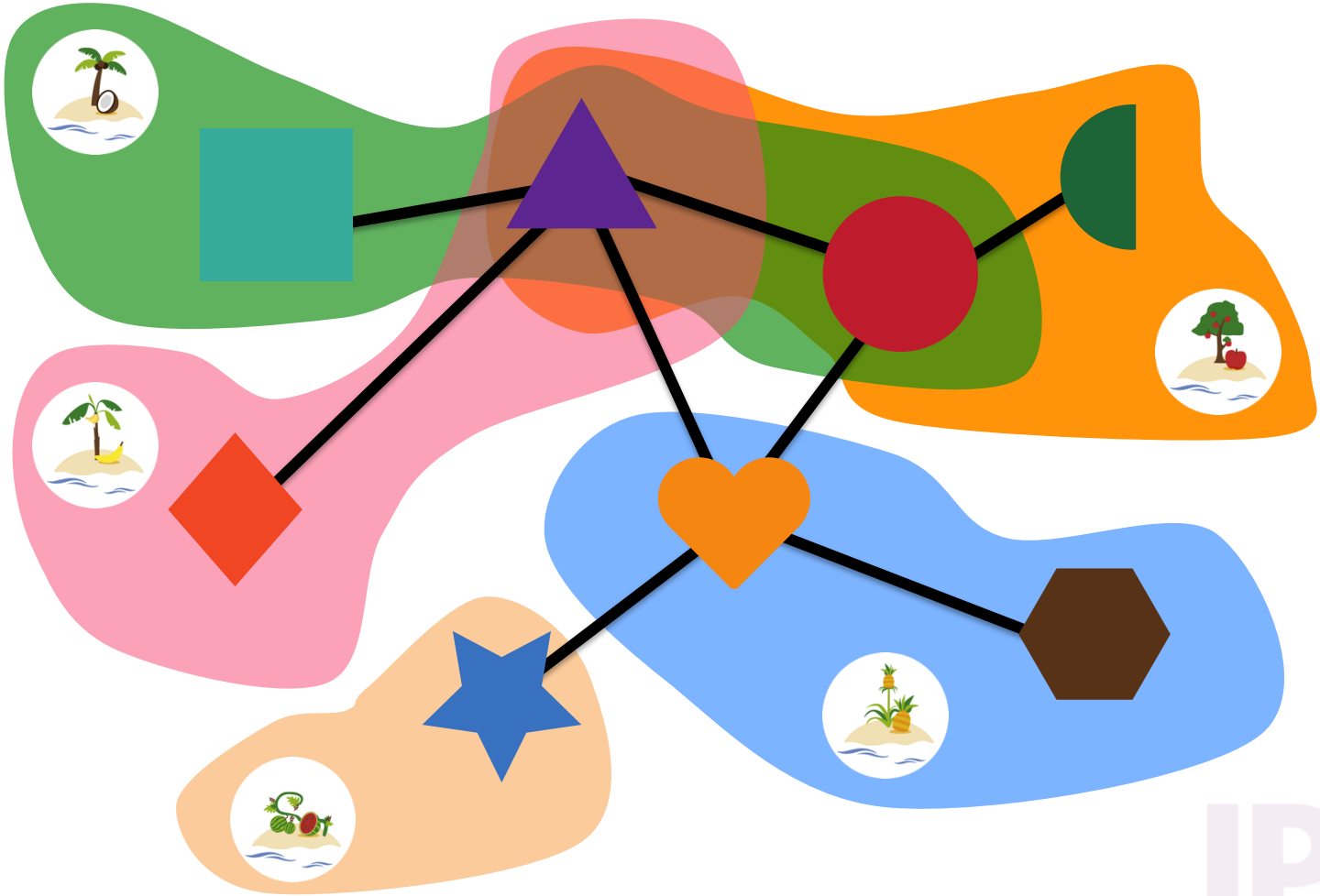
IPGO – Market Presence



2. Building a Network




transit
peering
transit
peering



3. Devices

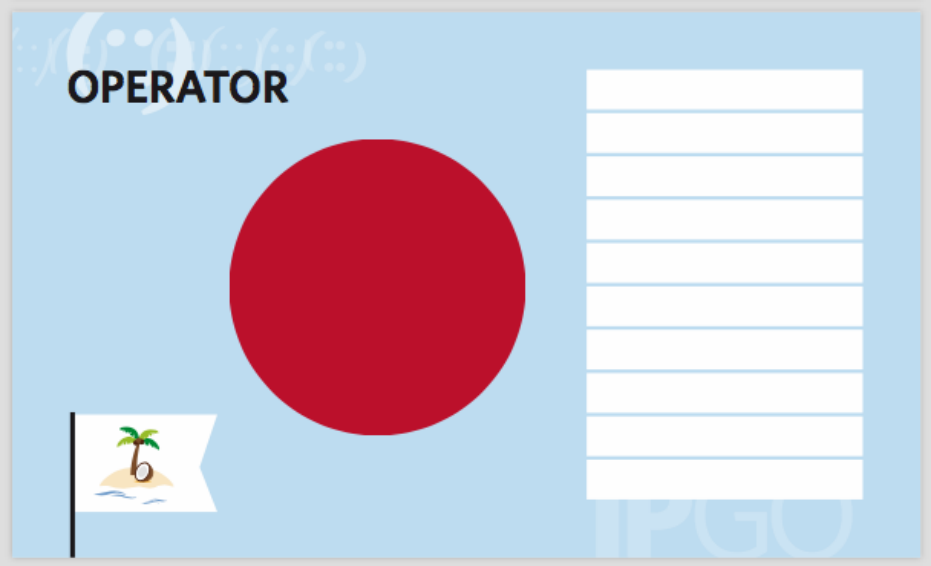
IPGO – Devices

Operators

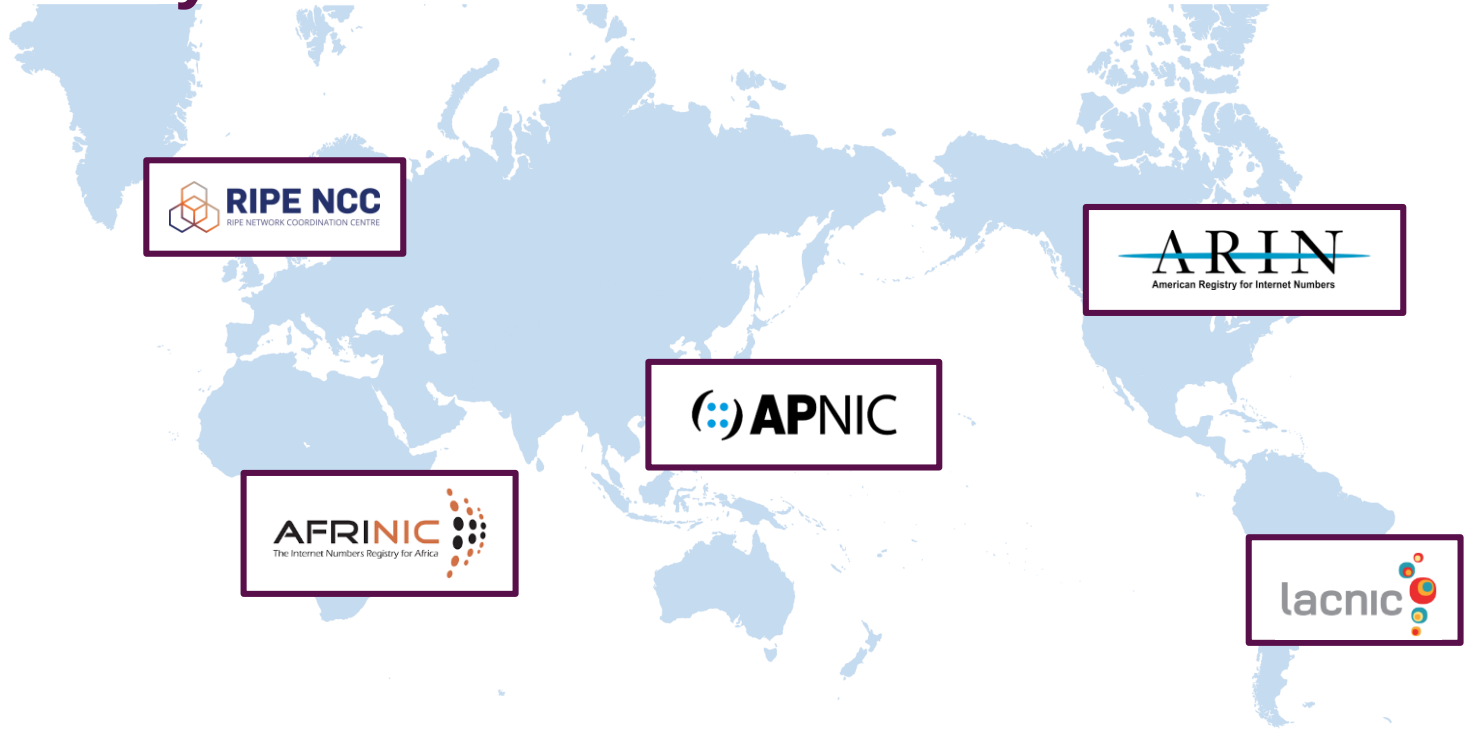
Devices

4. IP Addresses

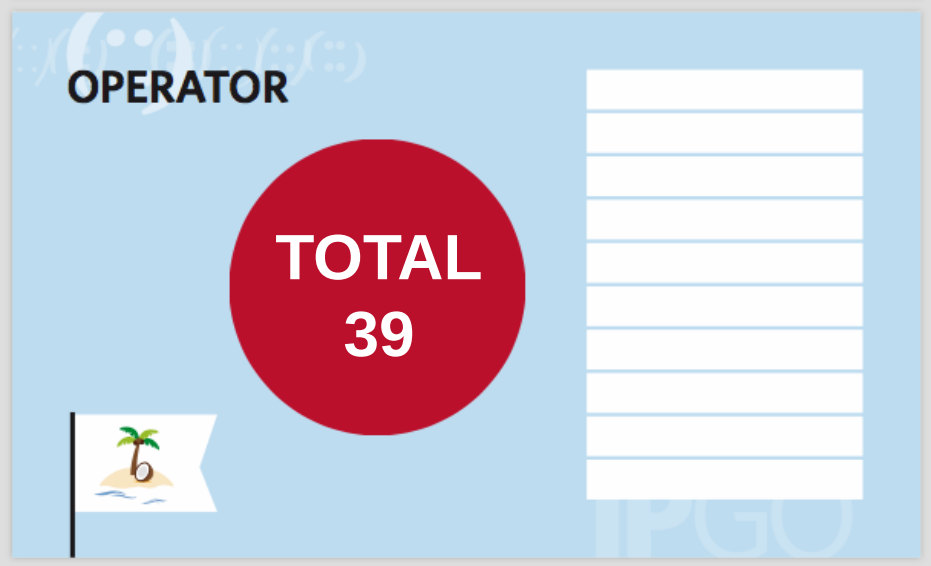
1. **Operators** request **IP addresses** according to their needs.



RIR system


RIPE NCC
RIPE NETWORK COORDINATION CENTRE
ARIN
American Registry for Internet Numbers
APNIC
AFRINIC
The Internet Numbers Registry for Africa
lacnic

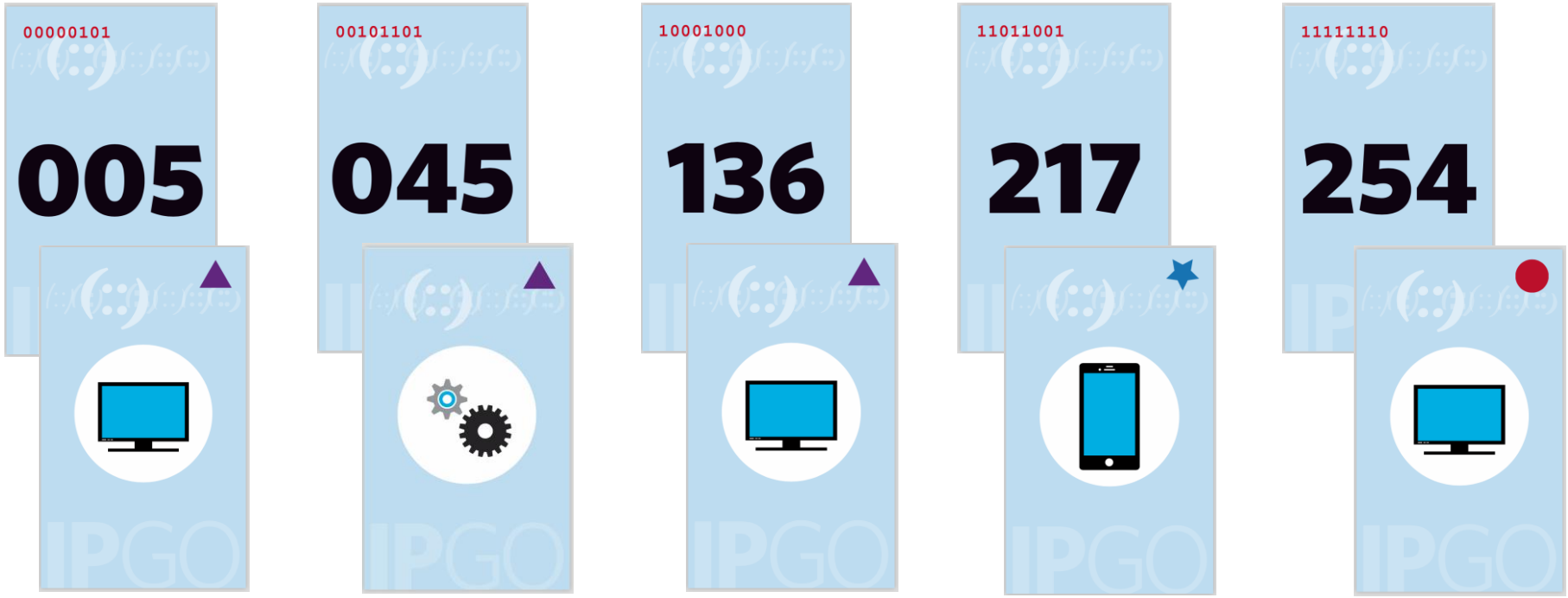
1. **Operators** request **IP addresses** according to their needs.



1. **Operators** request **IP addresses** according to their needs.

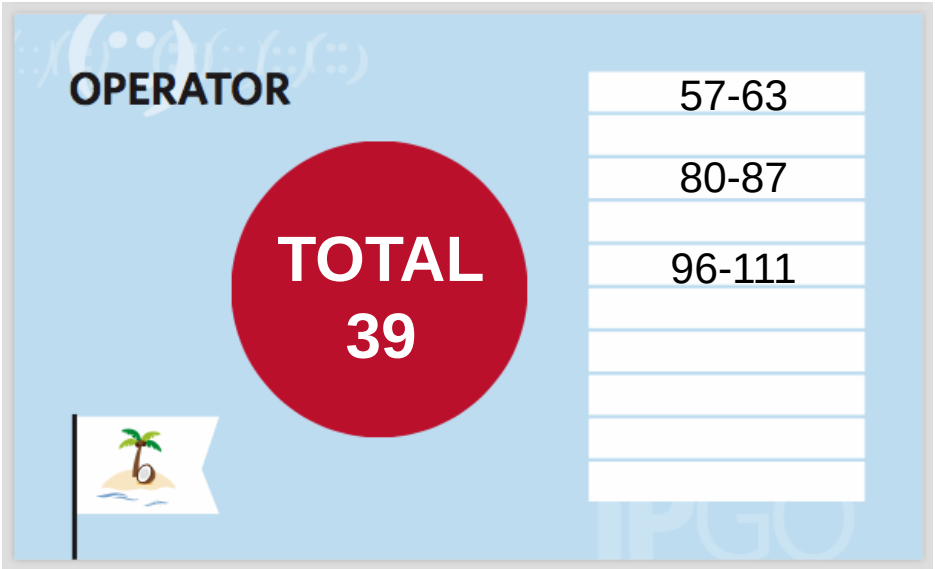
2. **Operators** receive an allocation of IP addresses according to the size of their networks.

Each **operator** assigns IP addresses to their subscribed **devices**…



- Keep IP addresses with their respective operator
    - Do not mix the IP addresses between operators

3. **Operators** build routing tables aggregating ranges of IP addresses.



OPERATOR
128-135
OPERATOR
216-223
OPERATOR
144-159
224-231
OPERATOR
200-207
OPERATOR
184-191
OPERATOR
232-239

IPv4

$$(\mathbf{0} \times 2^7) + (\mathbf{0} \times 2^6) + (\mathbf{1} \times 2^5) + (\mathbf{1} \times 2^4) + (\mathbf{1} \times 2^3) + (\mathbf{1} \times 2^2) + (\mathbf{0} \times 2^1) + (\mathbf{1} \times$$

$$(\mathbf{0} \times 128) + (\mathbf{0} \times 64) + (\mathbf{1} \times 32) + (\mathbf{1} \times 16) + (\mathbf{1} \times 8) + (\mathbf{1} \times 4) + (\mathbf{0} \times 2) + (\mathbf{1} \times$$

$$(0) + (0) + (32) + (16) + (8) + (4) + (0) + (1) \quad = \mathbf{61}$$

IPv4

decimal	203	.	119	.	101	.	61					
binary	11001011	.	01110111	.	01100101	.	00111101					

eight bits one byte

32 bits (4 × 8) = 4 bytes

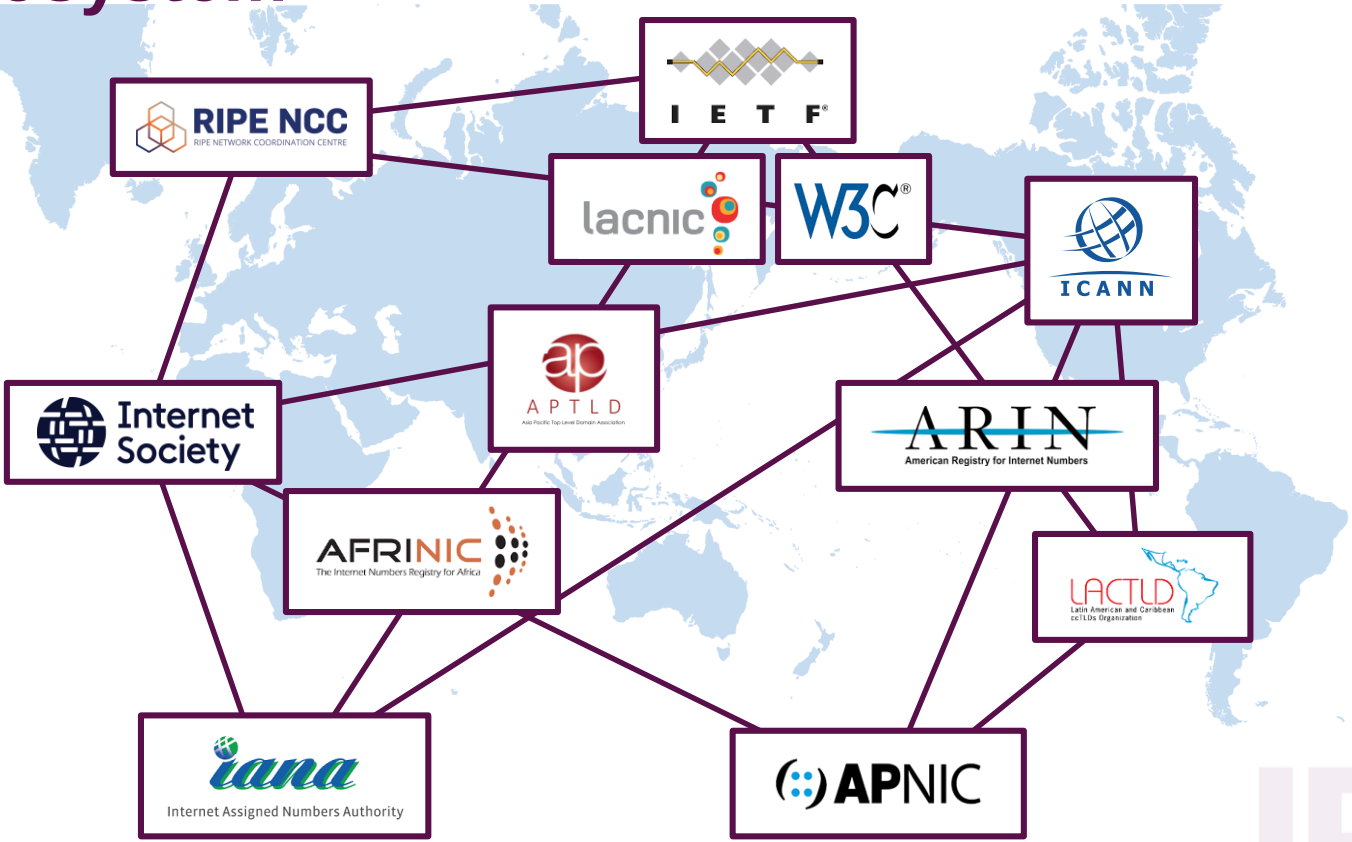
IPv4

decimal	**203**	.	**119**	.	**101**	.	**61**
binary	11001011	.	01110111	.	01100101	.	00111101

$2^{32} =$ 4,294,967,296 $\approx$ **4.3 billion** addresses

32 bits

I* Ecosystem


RIPE NCC
RIPE NETWORK COORDINATION CENTRE
I E T F
lacnic
W3C
ICANN
APTLD
Internet Society
ARIN
American Registry for Internet Numbers
AFRINIC
The Internet Numbers Registry for Africa
LACTLD
Latin American and Caribbean ccTLDs Organization
iana
Internet Assigned Numbers Authority
APNIC

5. Routing Packets

Test: connect with

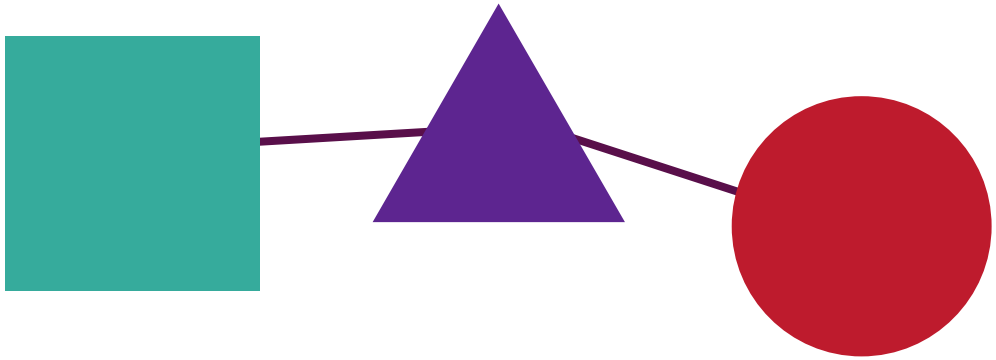
Test: connect

with

Test: connect with

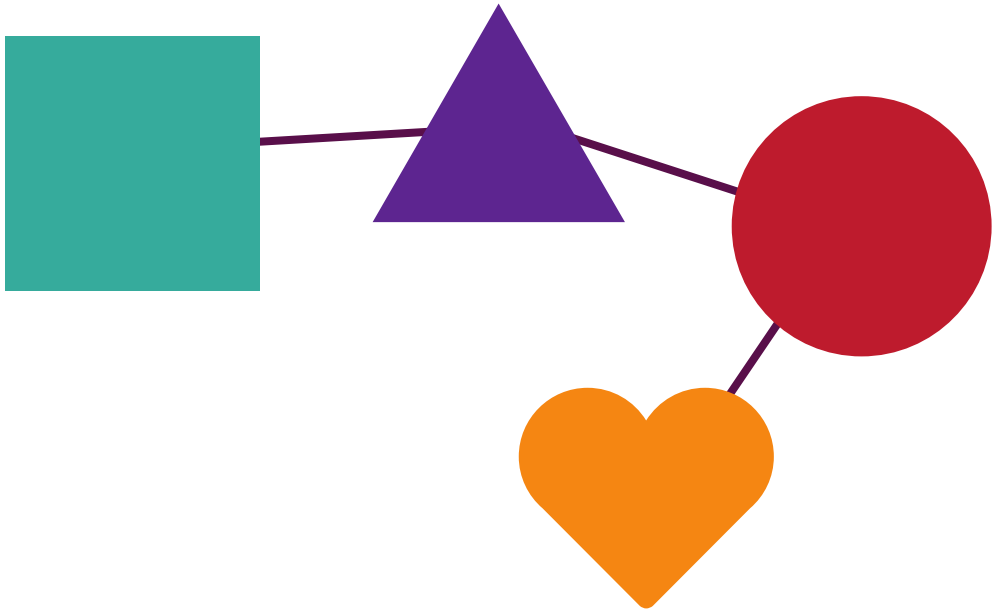
Test: connect

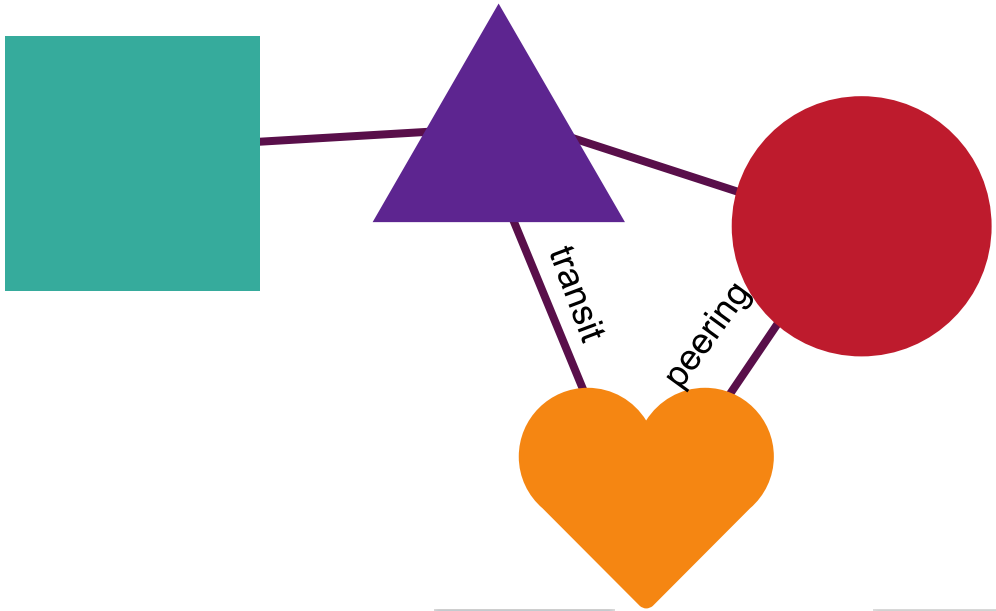
with



Test: connect

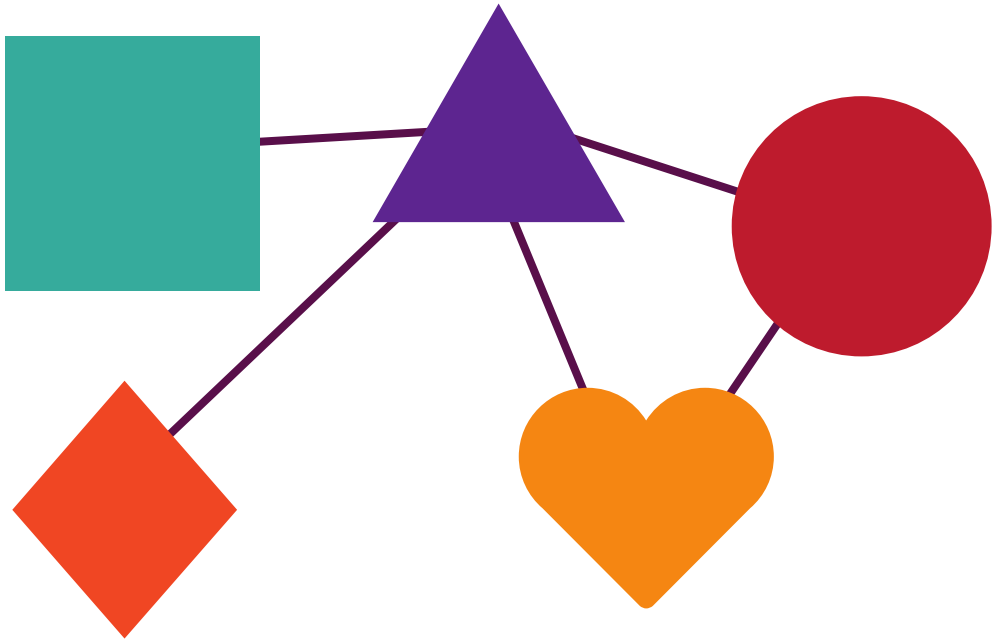
with

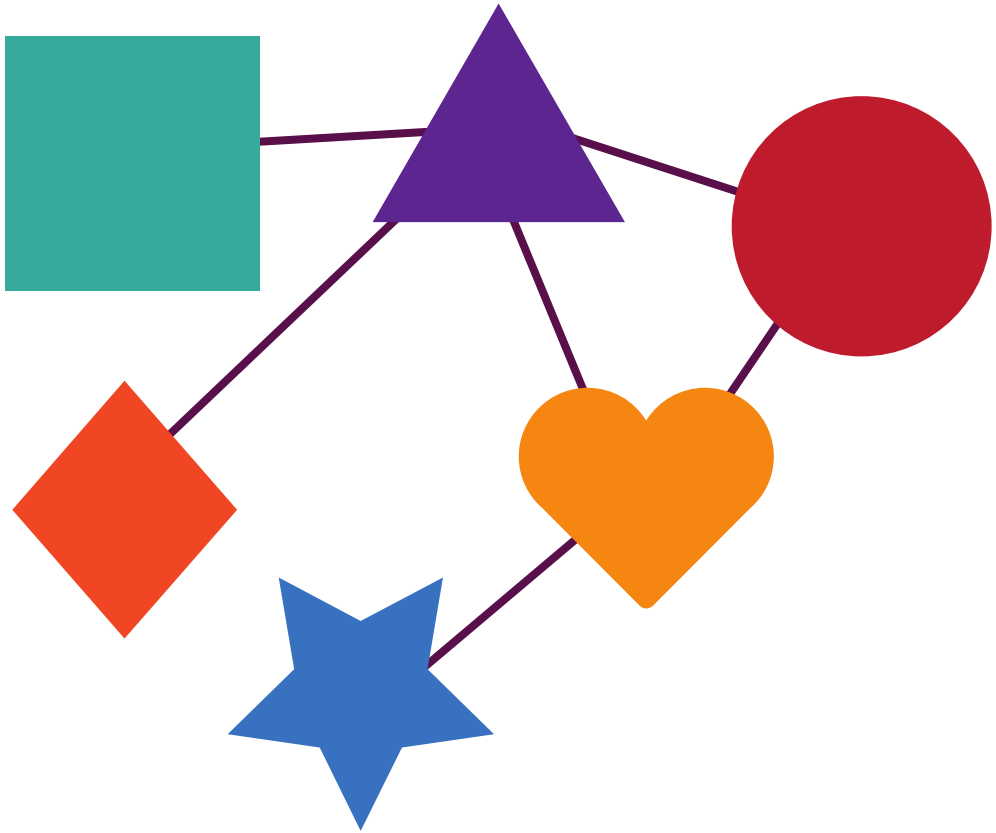


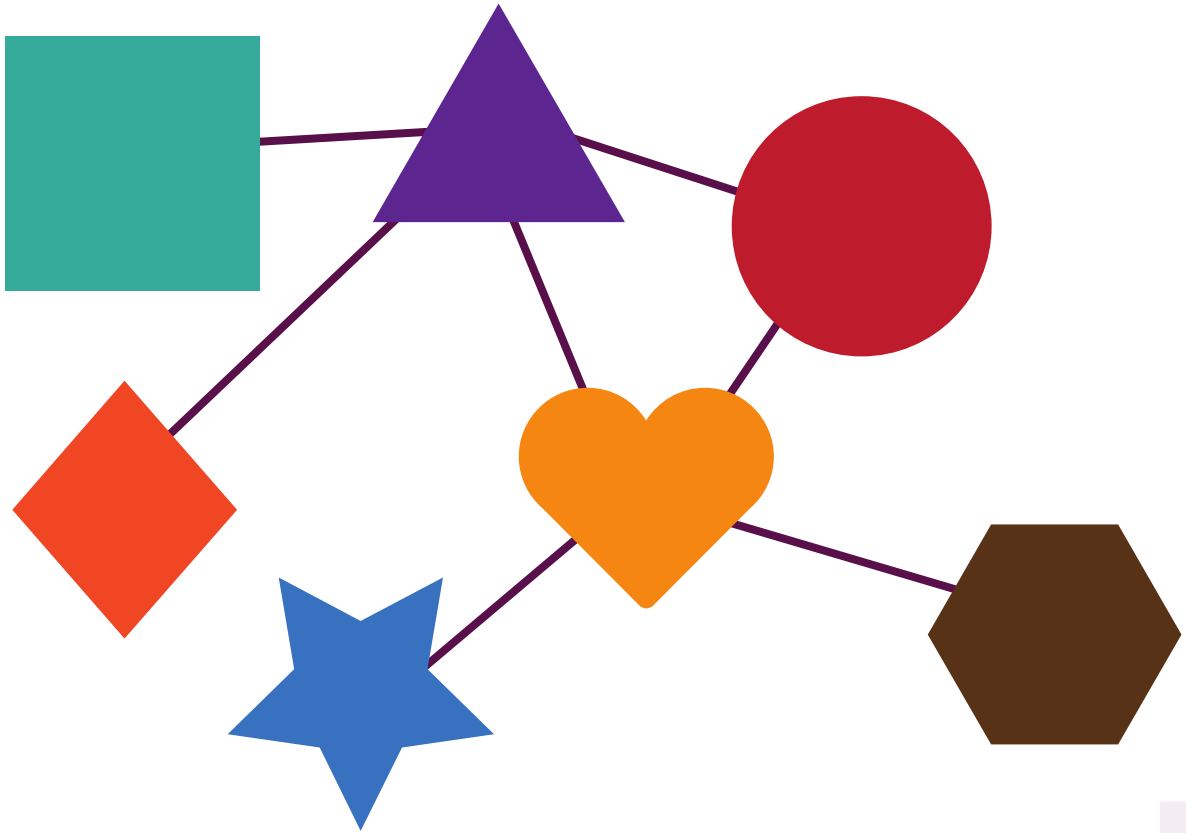


Test: connect

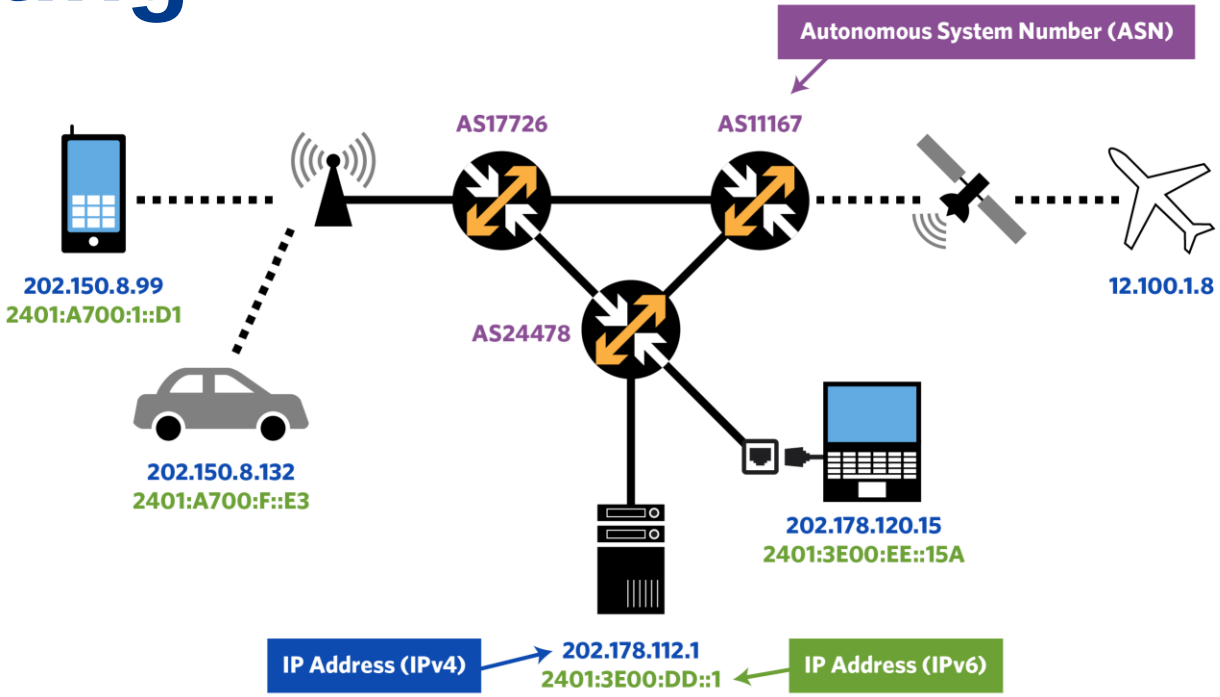
with



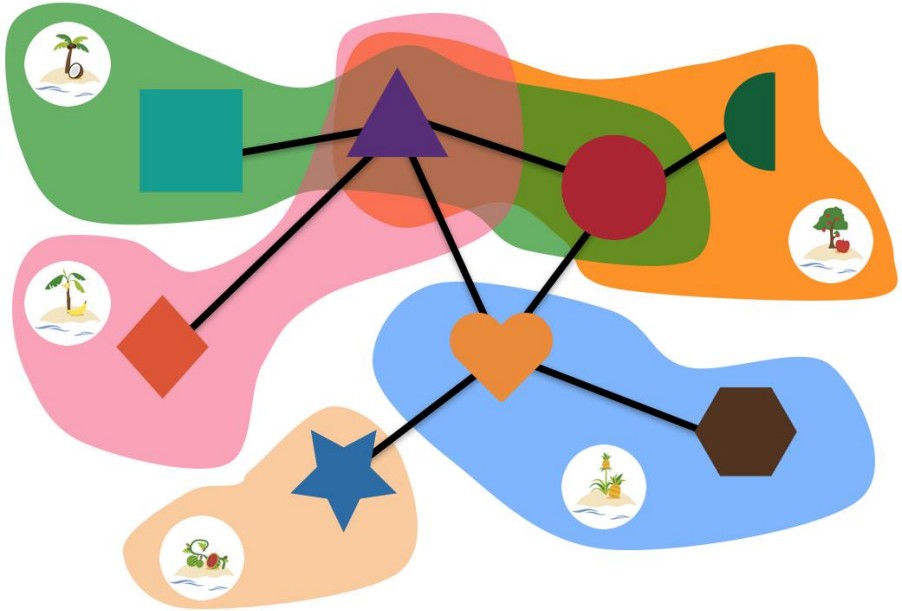




Routing


Autonomous System Number (ASN)
AS17726
AS11167
AS24478
202.150.8.99
2401:A700:1::D1
12.100.1.8
202.150.8.132
2401:A700:F::E3
202.178.120.15
2401:3E00:EE::15A
IP Address (IPv4)
202.178.112.1
2401:3E00:DD::1
IP Address (IPv6)

6. Sending Packets



Send: From 11101111 **239** to: 10000001 **129**

7. IPv6

In the beginning there were

3.7 billion

IPv4 addresses available

012
076
140
237

012
076
140
237

The answer is

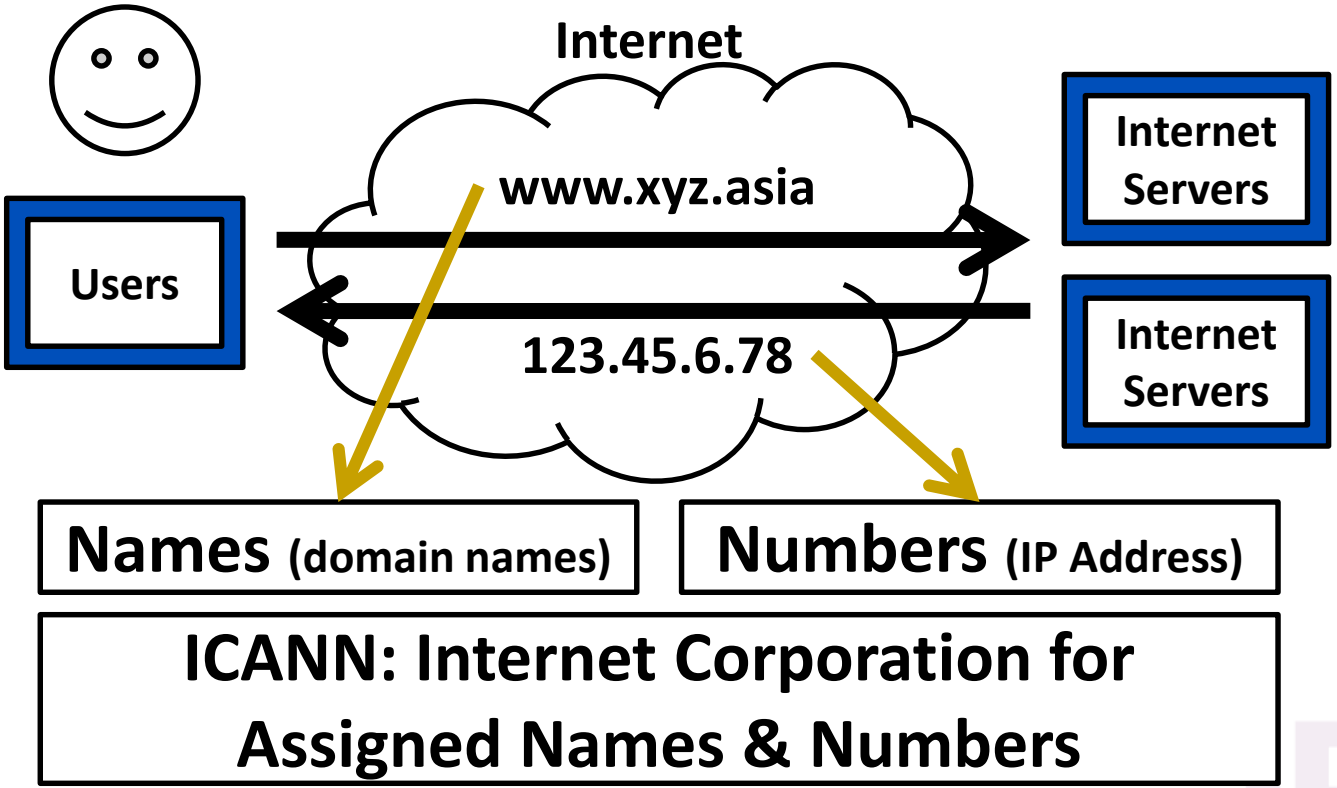
340,282,366,920,
938,463,463,374,607,
431,768,211,456

IPv6 addresses

8. DNS

7. Domain Name System

How the DNS Works



Internet Governance (Names/No.)

ICANN: Internet Corporation for Names & Numbers

Names

ccTLD

253 country-code Top Level Domains:

- .CN – China
- .JP – Japan
- .KR – Korea
- .UK – United Kingdom
- .US – United States
- …

gTLD

1200 generic TLDs:

- .COM .NET .ORG
- .ARPA .MIL .INT .EDU .GOV
- 2001 (+7): .INFO .BIZ .AERO .MUSEUM .COOP .NAME .PRO
- 2004 (+7): .TRAVEL .ASIA .CAT .TRAVEL .TEL .MOBI .POST
- 2012 (+1000)

Numbers

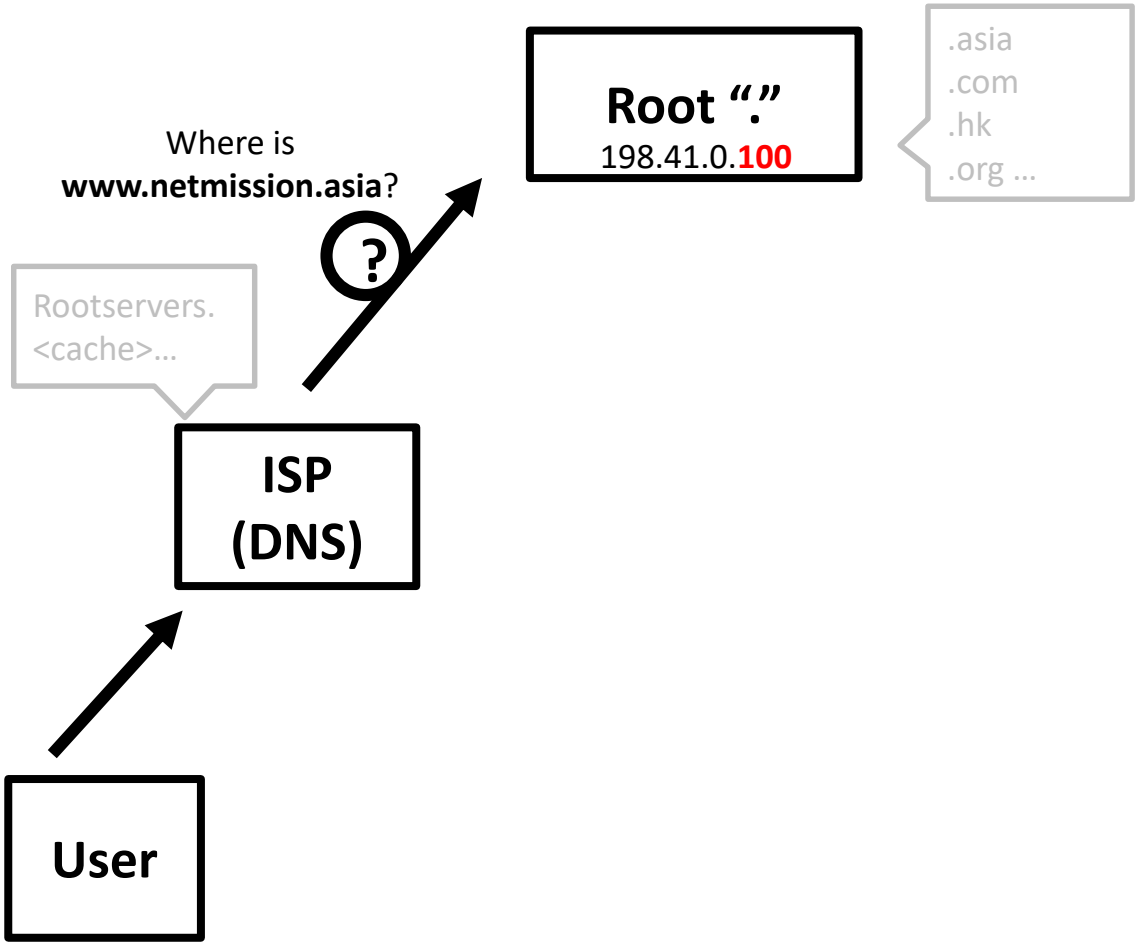
Regional Internet Registries

- APNIC (Asia Pacific)
- ARIN (North America)
- LACNIC (Latin America)
- RIPE (Europe)
- AFRINIC (Africa)

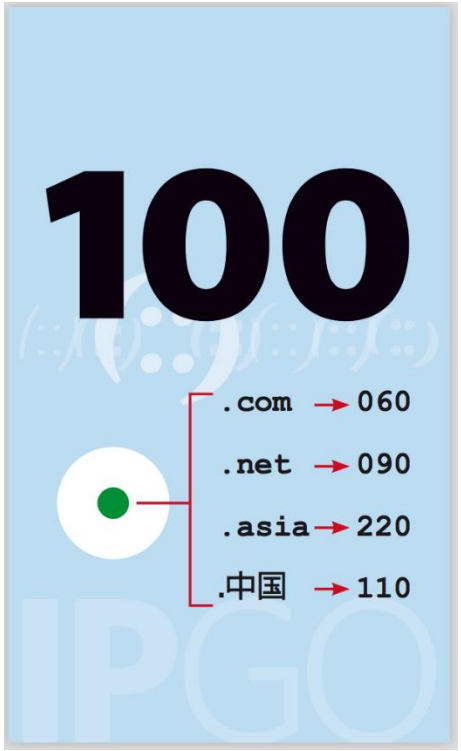
.ASIA

DNS

Query
www.netmission.asia
Response
Rootserver
TLD .asia
netmission.asia
www.netmission.asia


Root "."
198.41.0.100
.asia
.com
.hk
.org …
Where is
www.netmission.asia?
?
Rootservers.
<cache>…
ISP
(DNS)
User

Root Server

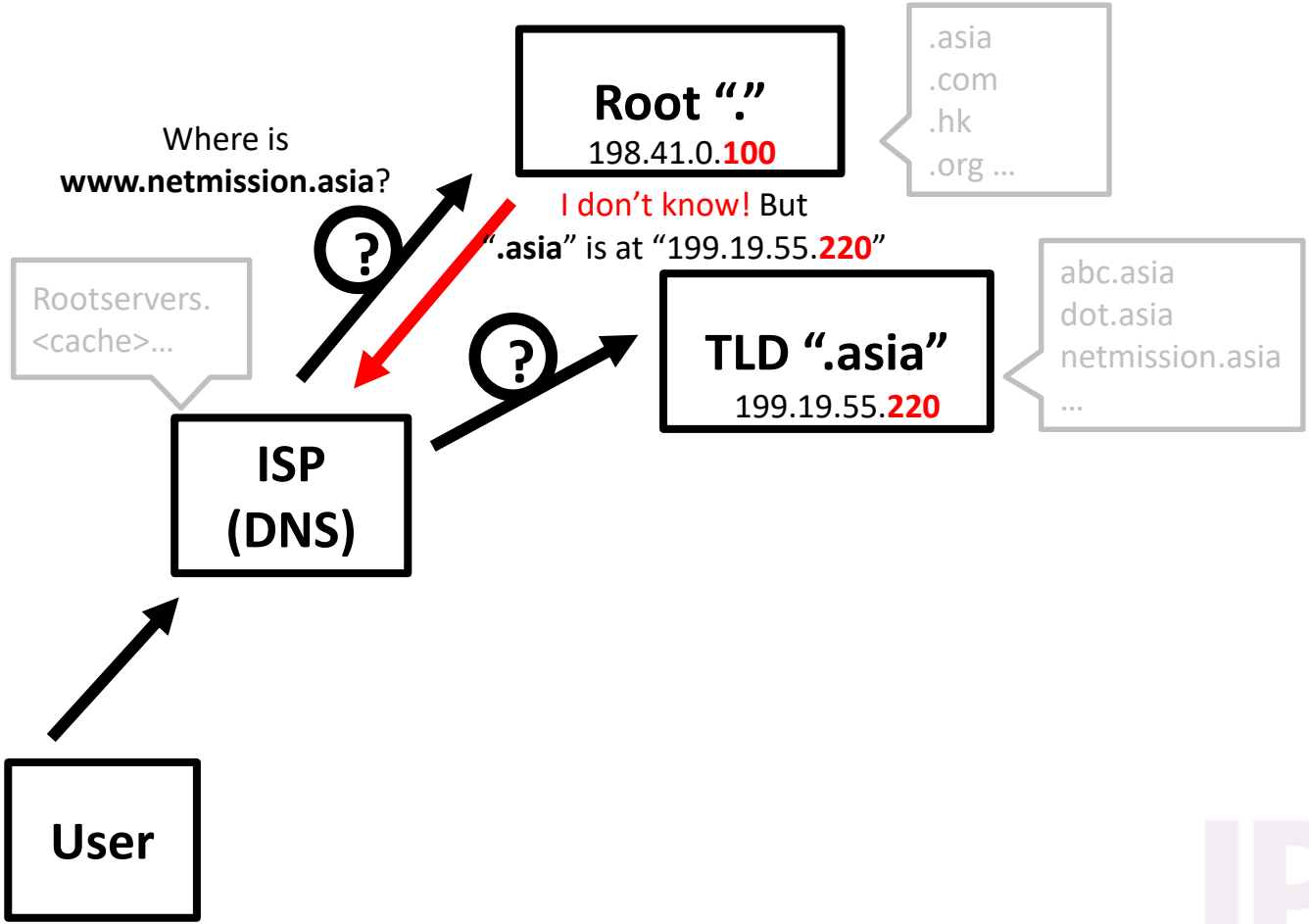


DNS Query

- Query:
- Where is: **www.netmission.asia**

- Response (From Root):
- **I don’t know**
- But **.asia** is at: **220**

.asia Registry

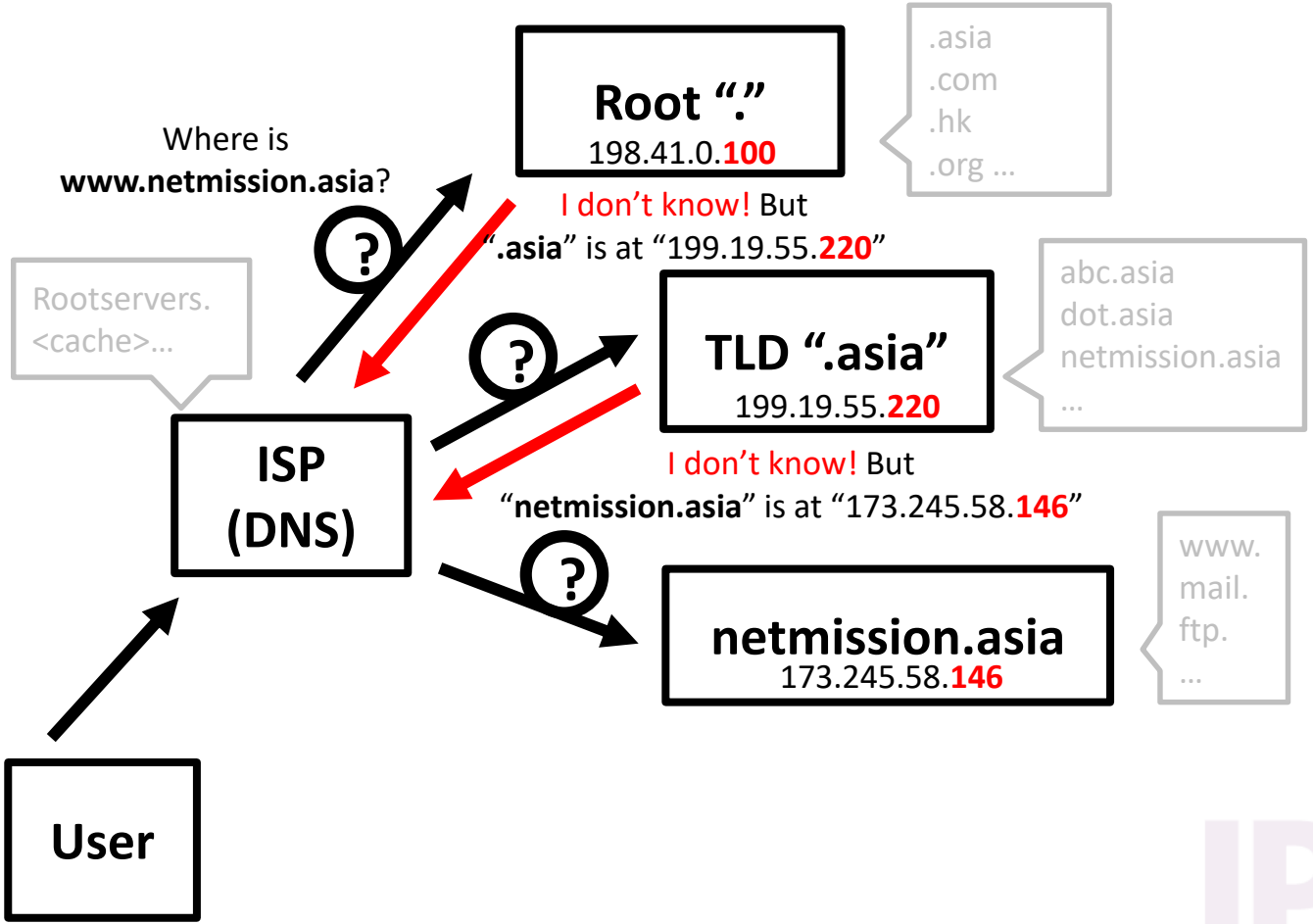

Root "."
198.41.0.100
.asia
.com
.hk
.org …
Where is
www.netmission.asia?
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>…
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
…
ISP
(DNS)
User

DNS Query

- Query:
- Where is: **www.netmission.asia**

- Response (From .asia Top Level Domain “TLD”):
- **I don’t know**
- But **netmission.asia** is at: **146**

netmission.asia Website

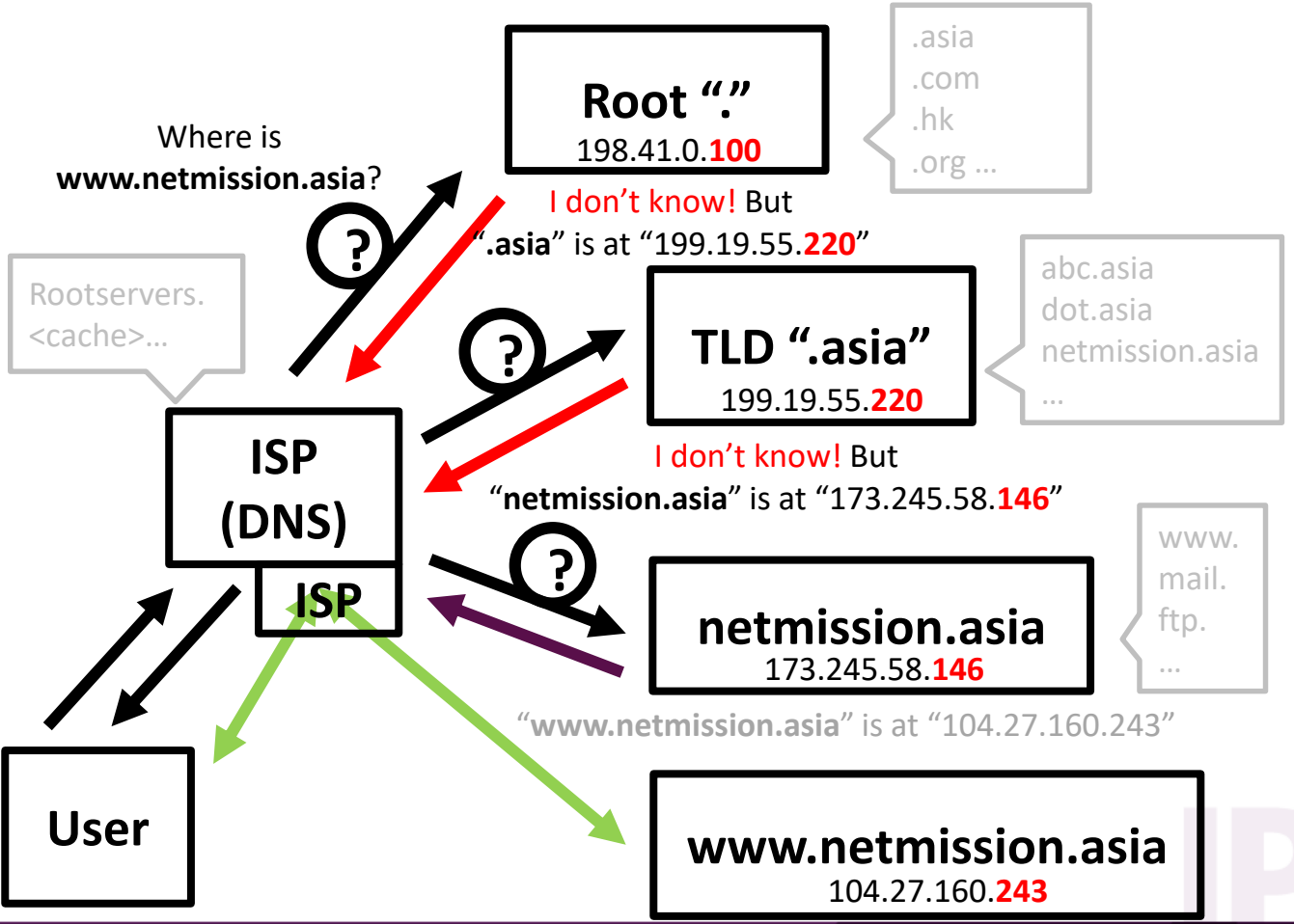

Root "."
198.41.0.100
.asia
.com
.hk
.org …
Where is
www.netmission.asia?
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>…
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
…
ISP
(DNS)
I don't know! But
"netmission.asia" is at "173.245.58.146"
www.
mail.
ftp.
…
netmission.asia
173.245.58.146
User

DNS Query

- Query:
- Where is: **www.netmission.asia**

- Response (From netmission.asia Name Server):
- **www.netmission.asia** is at: **243**

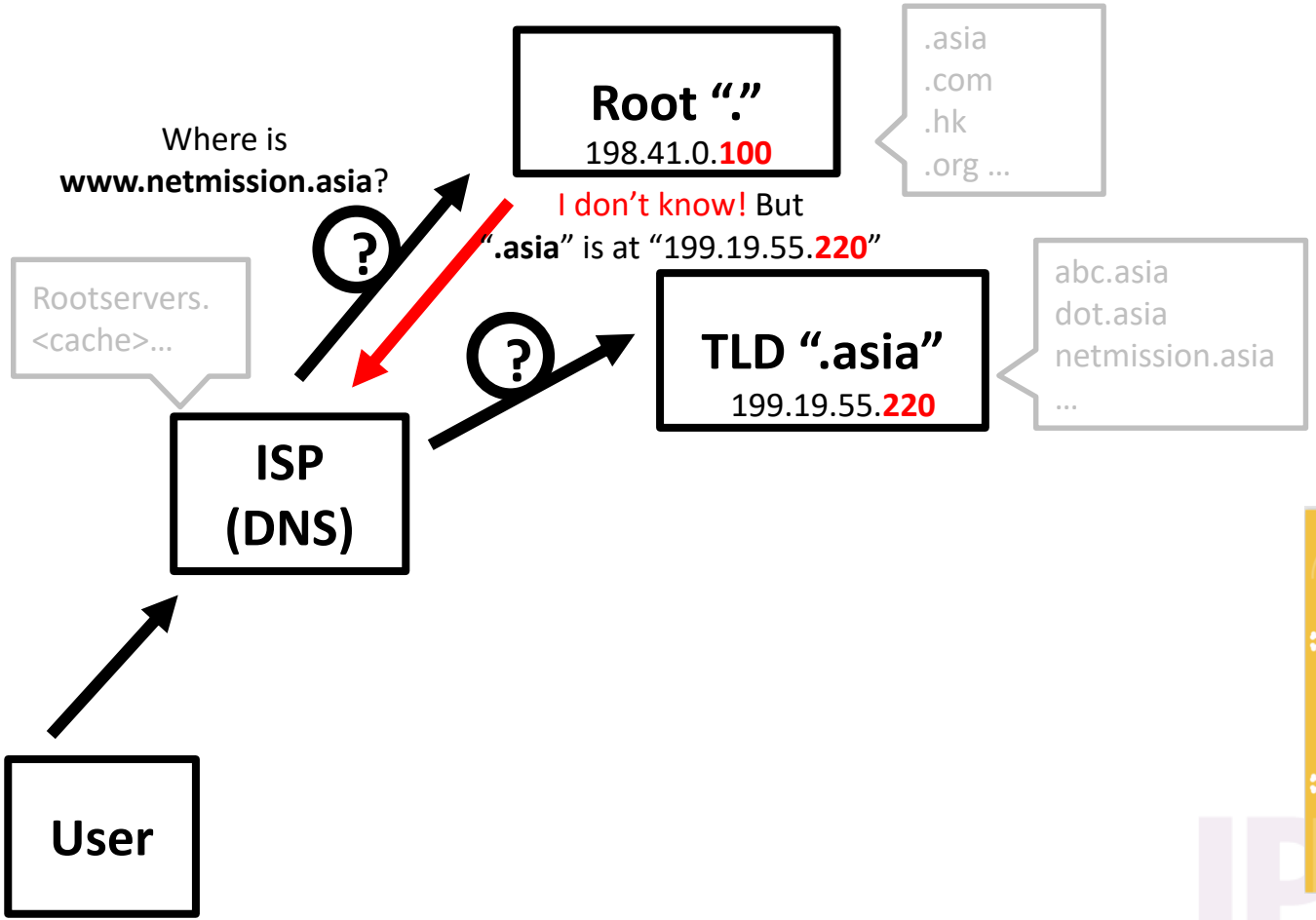
www.netmission.asia Website


Root "."
198.41.0.100
.asia
.com
.hk
.org ...
Where is
www.netmission.asia?
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>...
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
...
ISP
(DNS)
I don't know! But
"netmission.asia" is at "173.245.58.146"
ISP
www.
mail.
ftp.
...
netmission.asia
173.245.58.146
"www.netmission.asia" is at "104.27.160.243"
User
www.netmission.asia
104.27.160.243

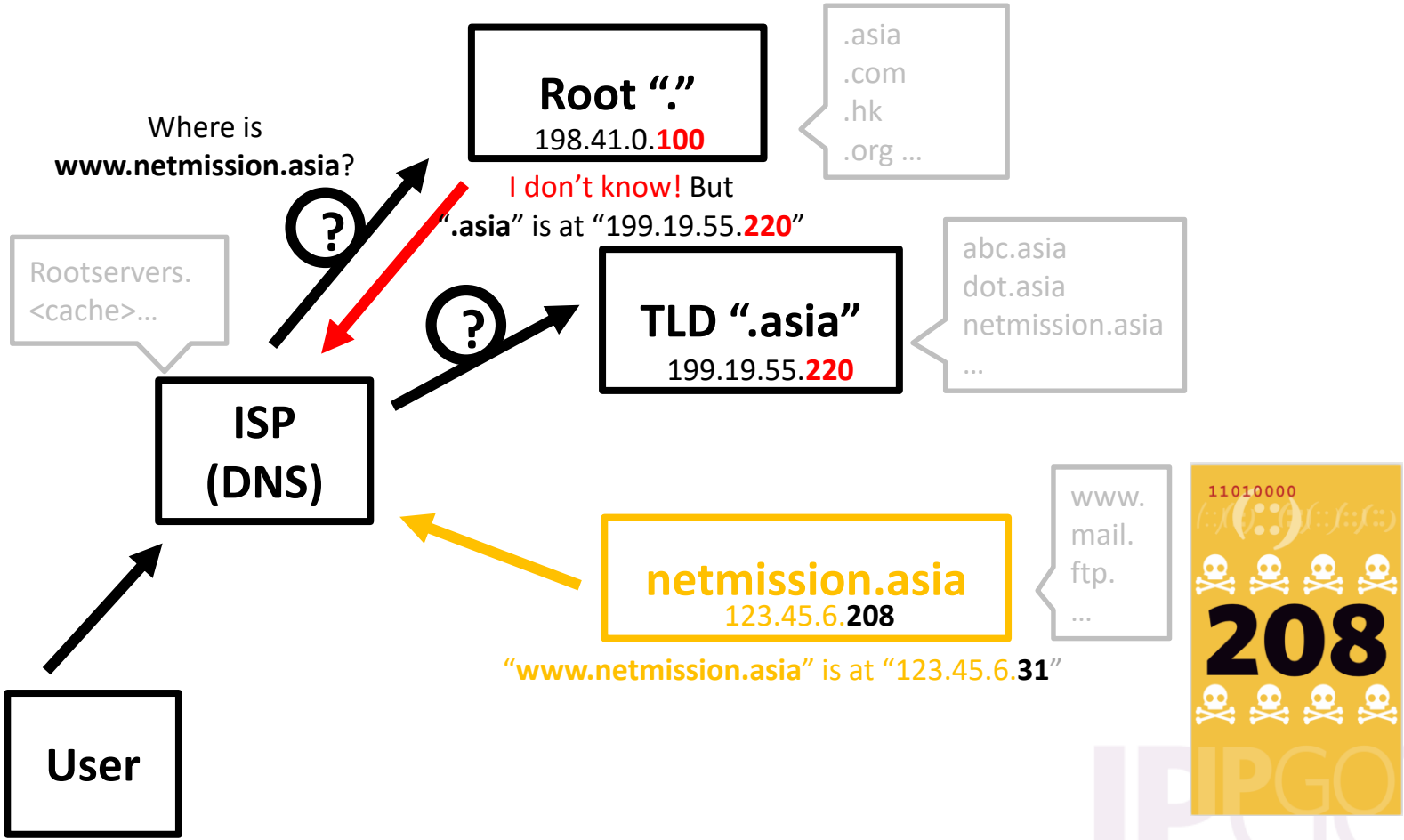
Lets Try Again!
DNS Query

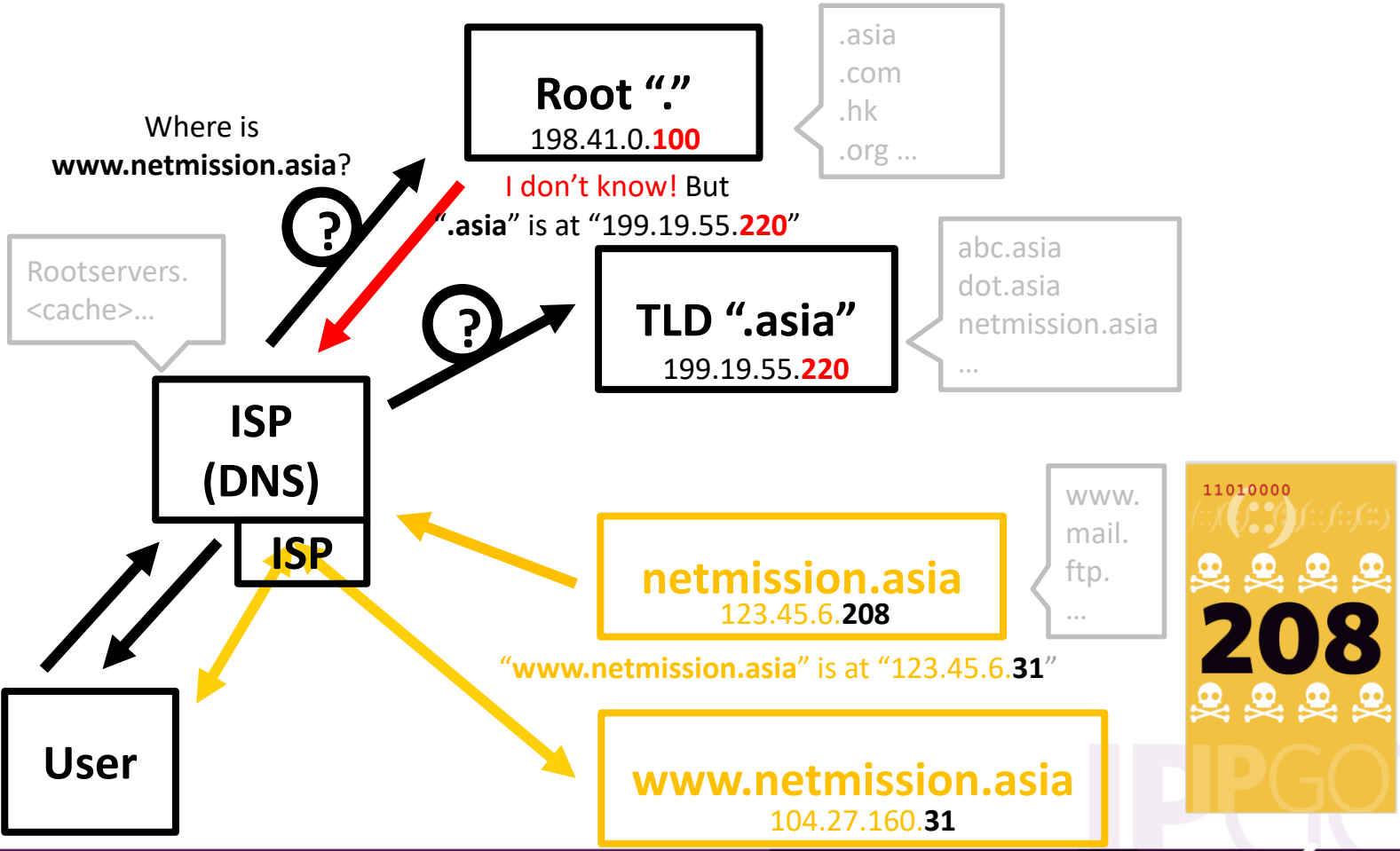
- Query:
- Where is: **www.netmission.asia**

- Response (From Root):
- **I don’t know**
- But **.asia** is at: **220**


Root "."
198.41.0.100
.asia
.com
.hk
.org ...
Where is
www.netmission.asia?
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>...
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
...
ISP
(DNS)
User

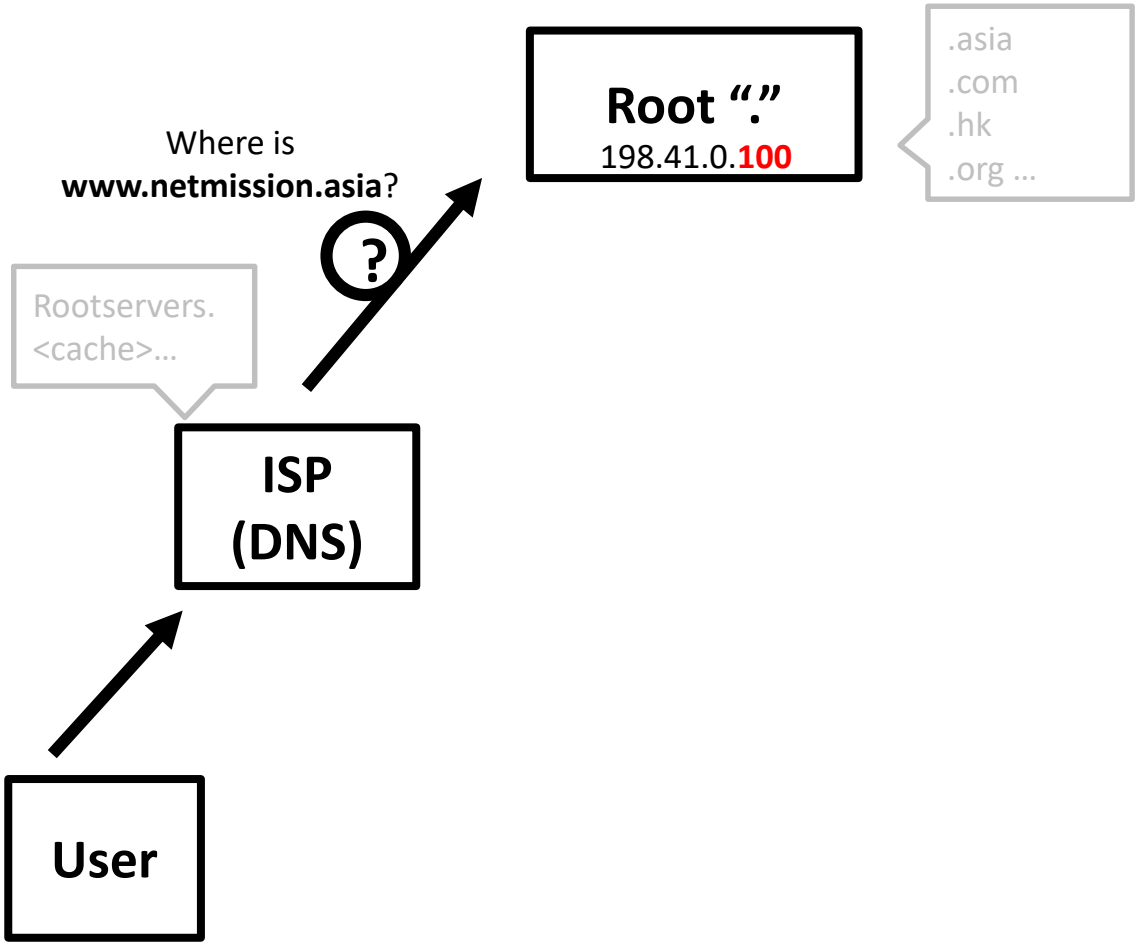
11010000
208


Root "."
198.41.0.100
.asia
.com
.hk
.org ...
Where is
www.netmission.asia?
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>...
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
...
ISP
(DNS)
netmission.asia
123.45.6.208
www.
mail.
ftp.
...
"www.netmission.asia" is at "123.45.6.31"
User
11010000
208


Where is
www.netmission.asia?
Root "."
198.41.0.100
.asia
.com
.hk
.org ...
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>...
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
...
ISP
(DNS)
ISP
netmission.asia
123.45.6.208
www.
mail.
ftp.
...
"www.netmission.asia" is at "123.45.6.31"
User
www.netmission.asia
104.27.160.31
11010000
208

DNS Security Extensions (DNSSEC)

- Signing & Distribution/Depositing of Certificates:
  1. Root → Internet At Large (ISPs)
  2. TLD (.asia) → Root
  3. netmission.asia → .asia TLD
- Resolution Path:

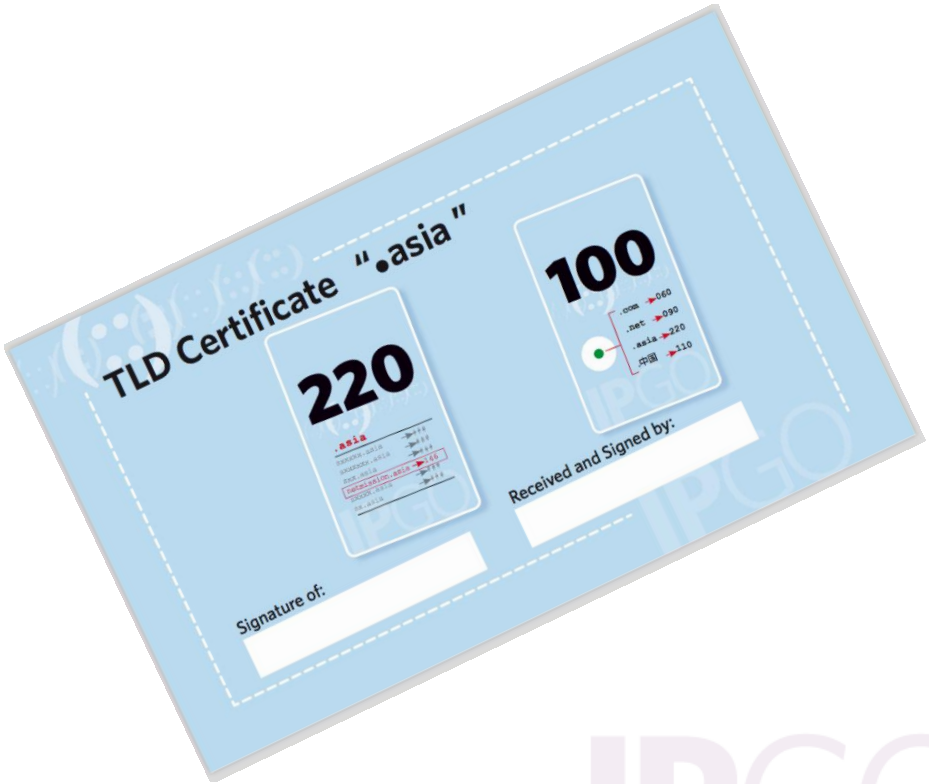

Root "."
198.41.0.100
.asia
.com
.hk
.org …
Where is
www.netmission.asia?
?
Rootservers.
<cache>…
ISP
(DNS)
User

DNS Query

- Query:
- Where is: **www.netmission.asia**

- Response (From Root):
- **I don't know**
- But **.asia** is at: **220**

- **AND** here is the **.asia Certificate**
- as received by the Root



DNS Query

- Query:
- Where is: **www.netmission.asia**

- Response (From .asia “TLD”):
- **I don’t know**
- But **netmission.asia** is at: **146**

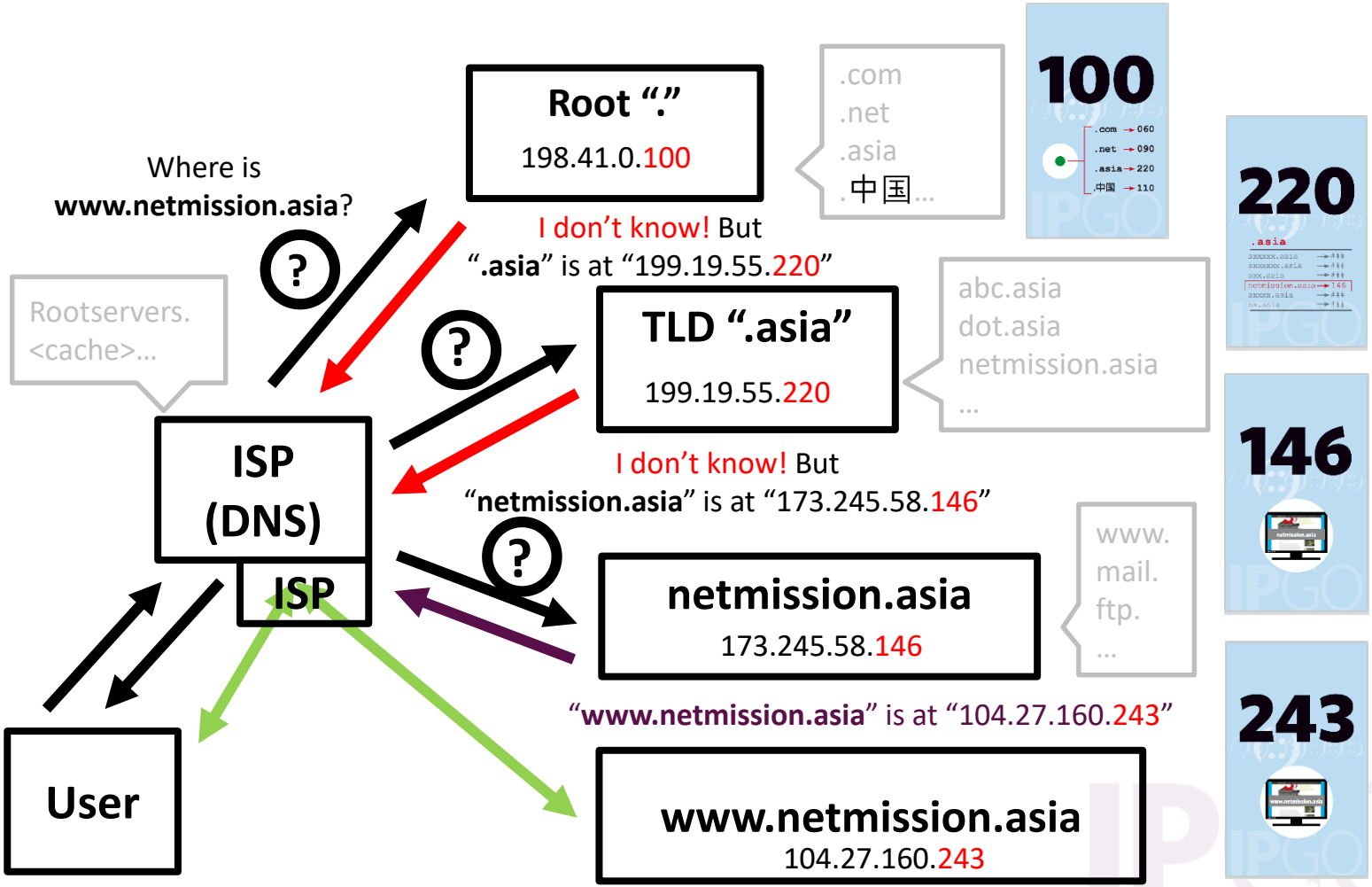
- **AND** here is the **netmission.asia Certificate**
- as received by .asia TLD

DNS Security Extensions (DNSSEC)

- Signing & Distribution/Depositing of Certificates:
  1. Root → Internet At Large (ISPs)
  2. TLD (.asia) → Root
  3. netmission.asia → .asia TLD

- Resolution Path:
  1. Root → response + TLD (**.asia**) Certificate
  2. TLD (.asia) → response + **netmission.asia** Certificate

- Verification Logic:
  - ISP already has Root Cert → Verify response from **Root** for **.asia**
  - Uses .asia Cert obtained from Root → Verify response from **.asia TLD** for **netmission.asia**
  - Uses netmission.asia Cert obtained from .asia TLD → verify response from **netmission.asia** for **www.netmission.asia**

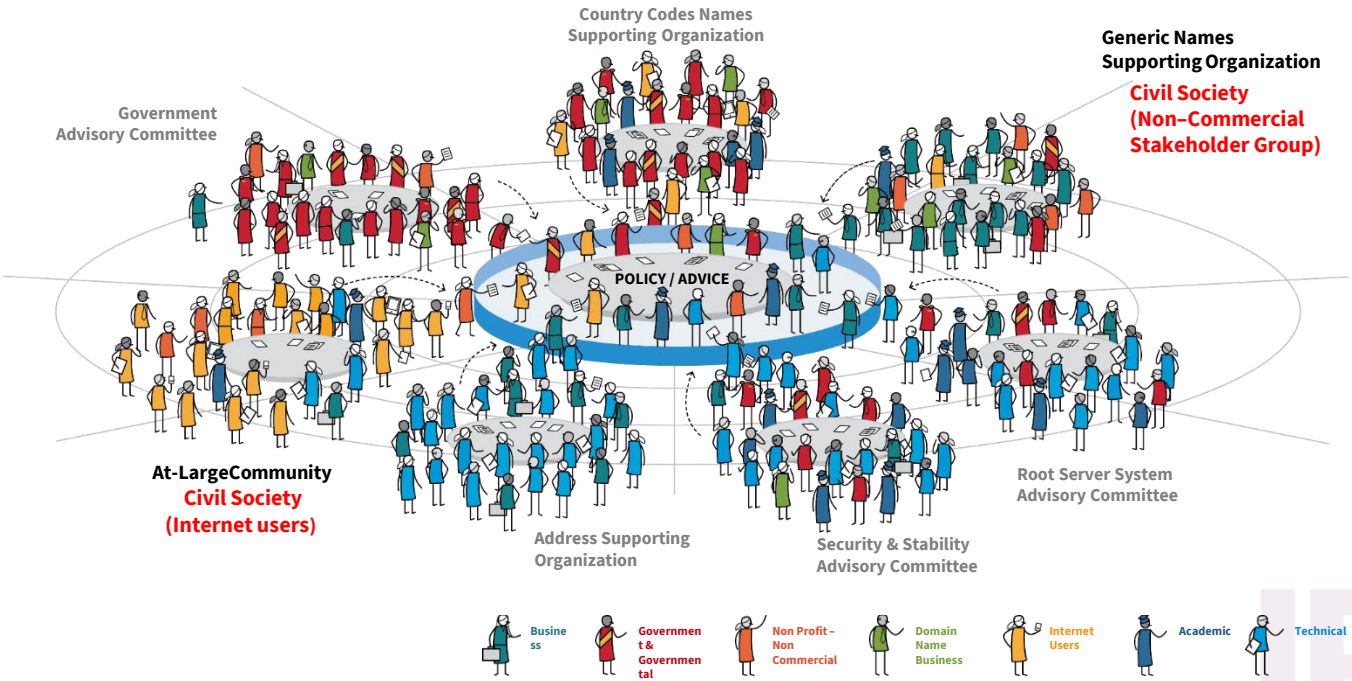

Where is
www.netmission.asia?
Root "."
198.41.0.100
.com
.net
.asia
.中国...
I don't know! But
".asia" is at "199.19.55.220"
Rootservers.
<cache>...
TLD ".asia"
199.19.55.220
abc.asia
dot.asia
netmission.asia
...
ISP
(DNS)
ISP
I don't know! But
"netmission.asia" is at "173.245.58.146"
www.
mail.
ftp.
...
netmission.asia
173.245.58.146
"www.netmission.asia" is at "104.27.160.243"
User
www.netmission.asia
104.27.160.243
100
.com → 060
.net → 090
.asia → 220
.中国 → 110
220
.asia
146
243

The ICANN Community At Work

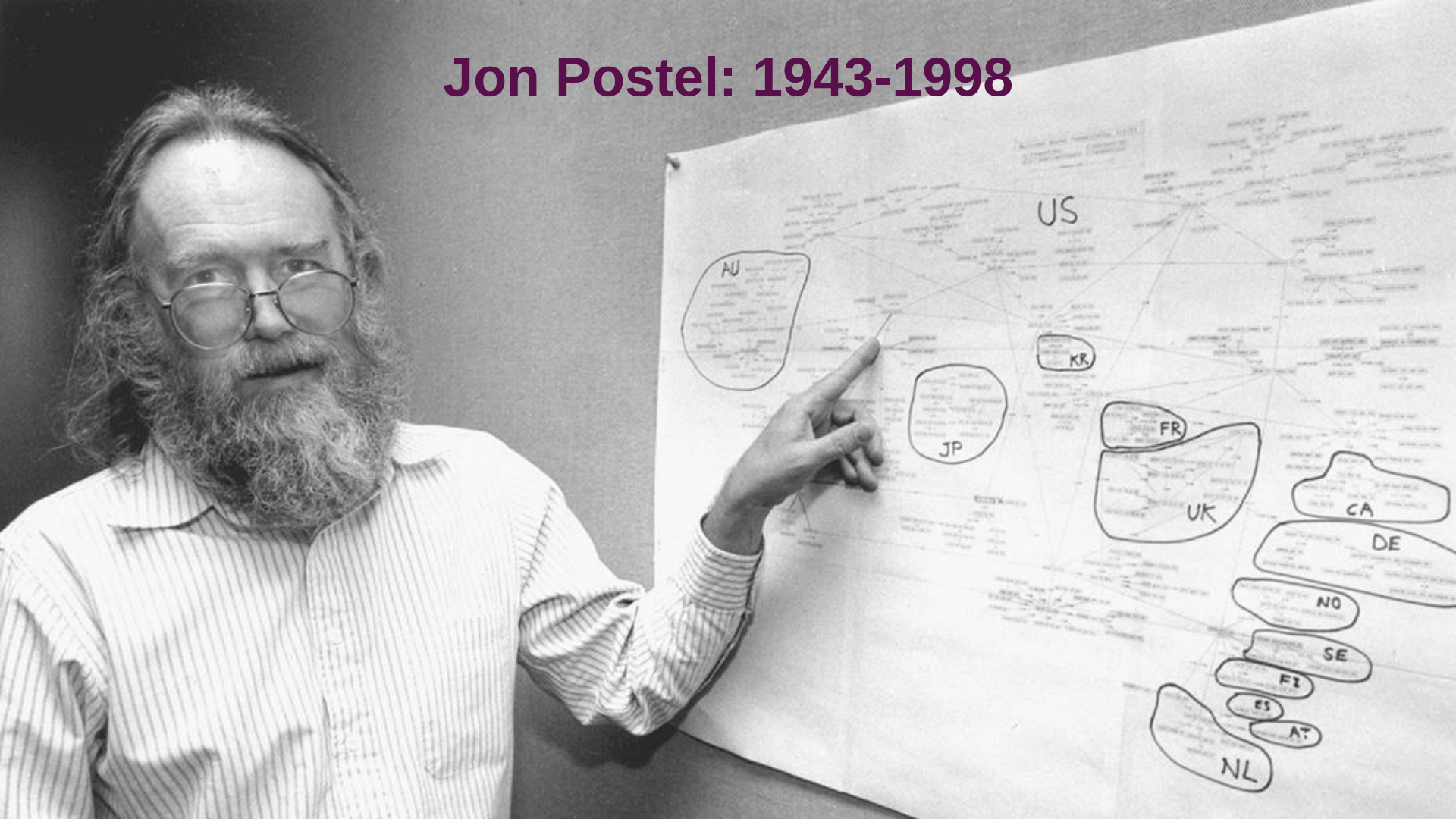
The Bottom-Up Multistakeholder Model

The collective efforts of the ICANN community culminate in a common shared goal:

A single, interoperable Internet supported by stable, secure and resilient unique identifier systems.



Jon Postel: 1943-1998



www.domainnameæasia

www.नाम.asia

www.नाम.असिअ

U-Label
Native Form /
Unicode Label

Unicode
ISO10646 Standard

U+0928 U+093E U+092E U+0905 U+0938 U+093F U+0905

Punycode
IETF IDN Standard

xn--l2bm1c xn--l1ba6m2a

www.xn--l2bm1c.xn--l1ba6m2a

A-Label
ACE (ASCII
Compatible
Encoding)

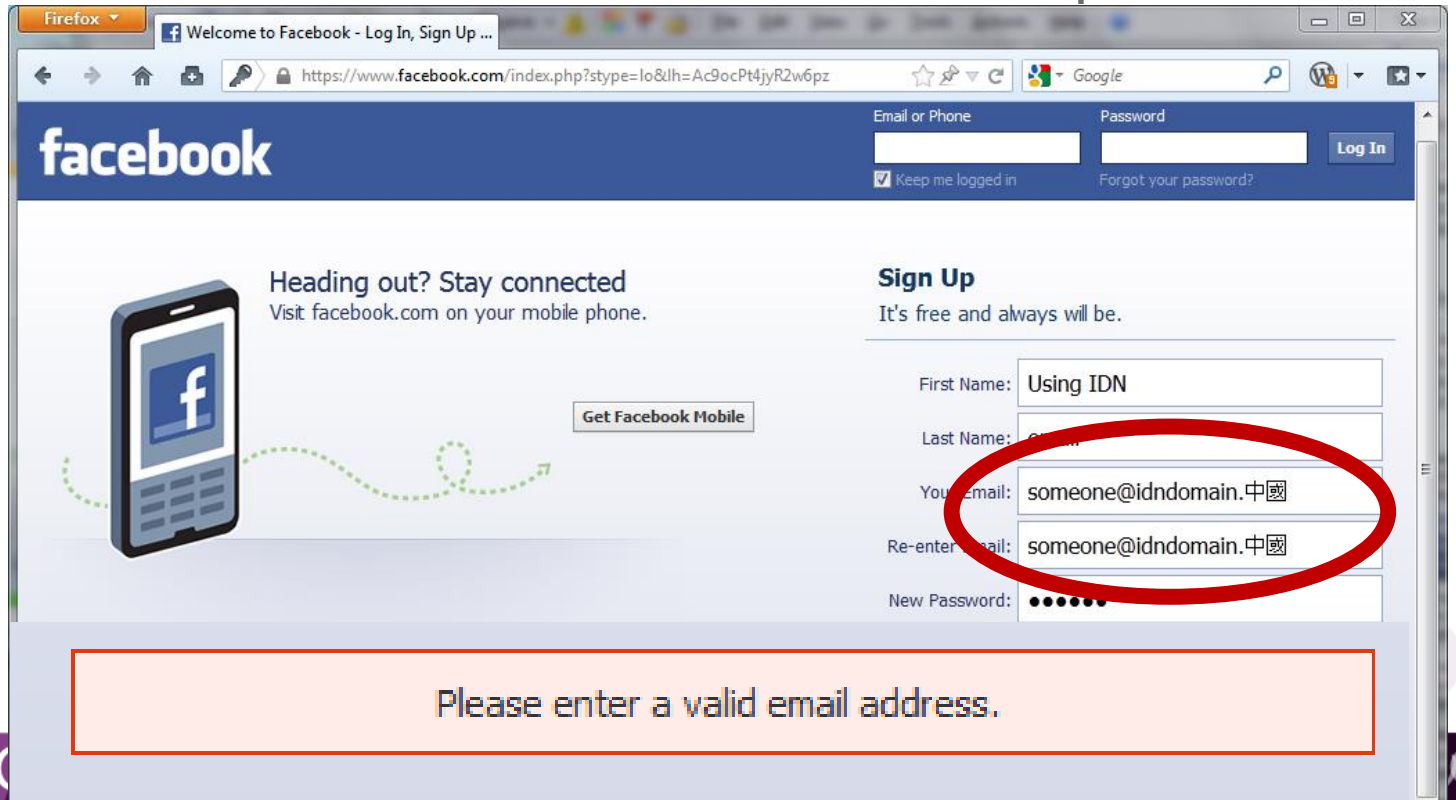
Punycode / IDNA prefix

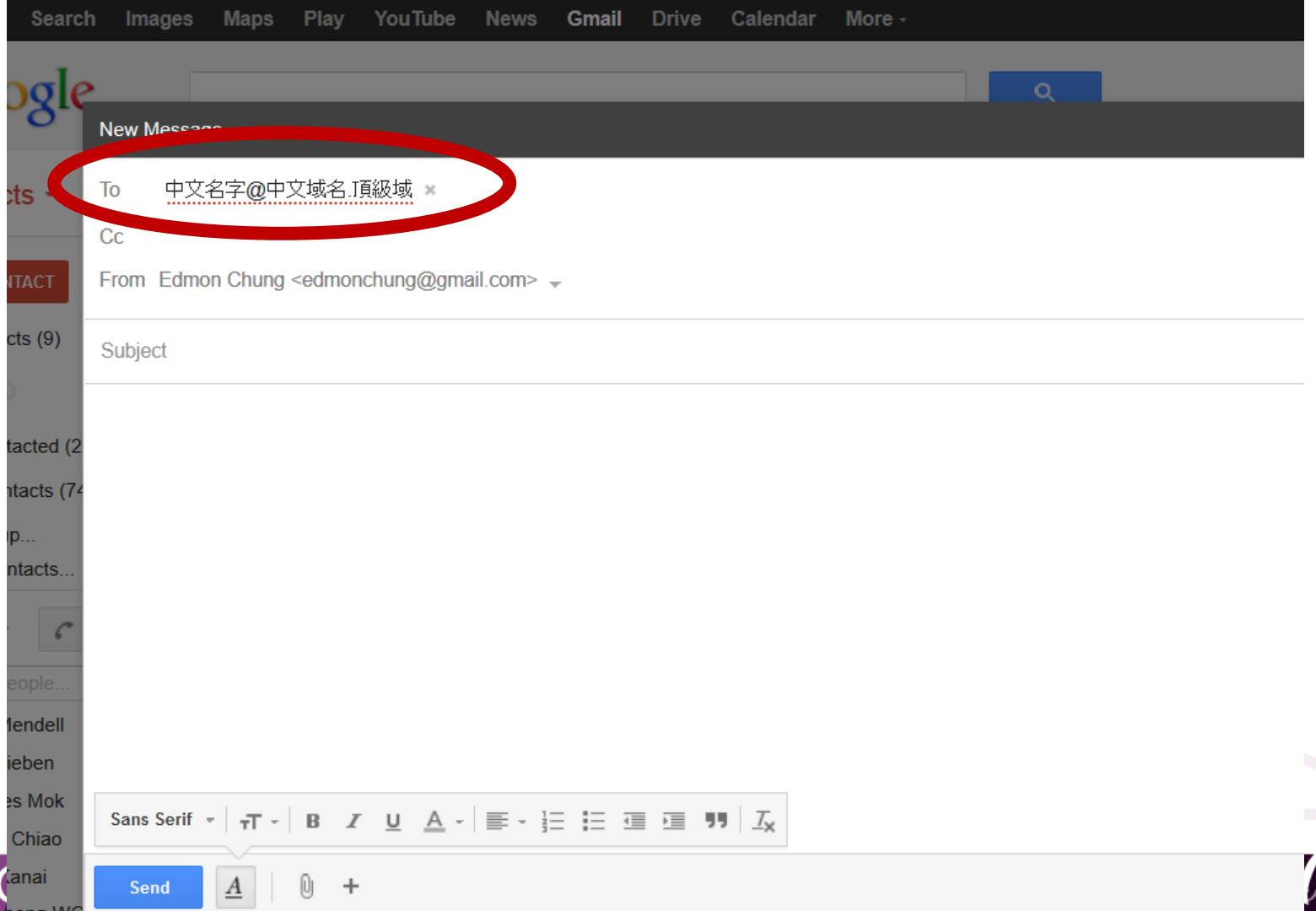
“xn--”

Local Businesses are Known in their Local Language

It is hard to imagine that Chinese users would be speaking to their phone in English.

Universal Acceptance




Search
Images
Maps
Play
YouTube
News
Gmail
Drive
Calendar
More
New Message
To
中文名字@中文域名.頂級域
Cc
From
Edmon Chung <edmonchung@gmail.com>
Subject
Sans Serif
Send

What Does “Universal Acceptance” Mean?

ACCEPT

VALIDATE

STORE

PROCESS

DISPLAY

Software and online services support Universal Acceptance when they offer the capabilities listed above for all domains and email names.

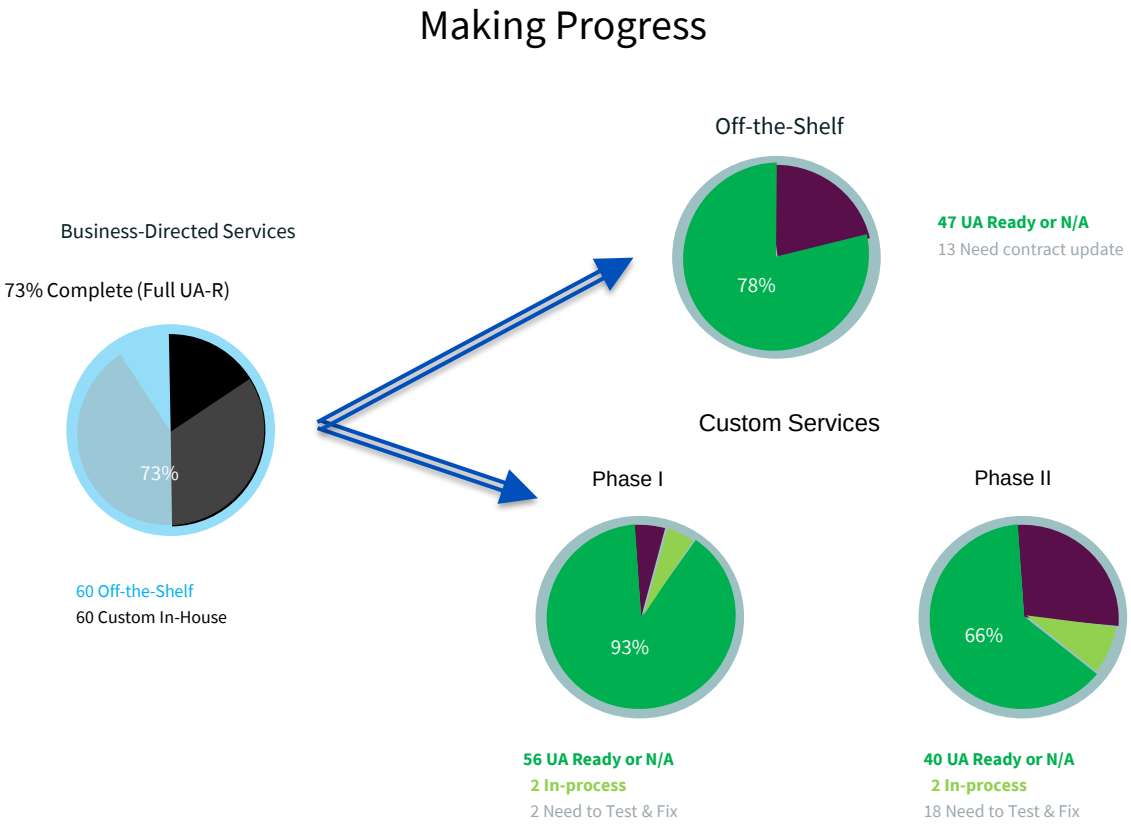
Universal Acceptance (UA) is the state where all valid domain names and email addresses are accepted, validated, stored, processed and displayed correctly and consistently by all Internet-enabled applications, devices and systems. Due to the rapidly changing domain name landscape, many systems do not recognize or appropriately process new domain names, primarily because they may be more than three characters in length or in a non-ASCII format. The same is true for email addresses that incorporate these new extensions.

The Universal Acceptance Steering Group (UASG), established by Internet Corporation for Assigned Names and Numbers (ICANN), is a community-led, industry-wide initiative working on creating awareness and identifying and resolving problems associated with the universal acceptance of domain names. The purpose of these efforts is to help ensure a consistent and positive experience for Internet users globally.

For more information on the UASG and recent developments, visit: https://goo.gl/k8Byax.

Note that accept, validate and process are treated as distinct in this document. In actual practice these capabilities may overlap.

Universal Acceptance at ICANN



IDN Variant Policies

- Simplified and Traditional Chinese
  - Uses

- Homoglyphs / Homographs
  - **expo.space** → Cyrillic (Russian characters)
  - **expo.space** → Latin (English characters)
  - 1 / I / l and 0 / O

Base	IDN Variants	
★	✸	✸
▲	◣	▼

Base	IDN Variants	
★	✸	✸
✸	★	✸
✸	★	✸
▲	◣	▼
◣	▲	▼
▼	▲	◣

Primary IDN (Applied for):

★▲.TLD

IDN Variants:

★◣.TLD

★▼.TLD

✸▲.TLD

✸◣.TLD

✸▼.TLD

✸▲.TLD

✸◣.TLD

✸▼.TLD

IDN Tables (IDN Variants)

IDN Related Projects/Policies @ ICANN

- **Root Zone Label Generation Rules (RZ-LGR)**
  - A community driven project aiming to define conservative mechanisms for introducing IDN TLDs into the Internet's Root Zone in a stable and secure manner.

- **IDN Variant TLD Implementation**
  - A project to support the development of policy and procedures for implementing IDN variant TLDs.

- **LGR Tool**
  - An application that enables users to create, use and manage IDN tables in the formal, machine-readable format, called Label Generation Rules.

- **IDN ccTLD Fast Track Process**
  - Fast track process created by Internet community for evaluation of top-level IDN labels representing countries and territories.

- **IDN Implementation Guidelines**
  - Recommended practices developed through a community-led process to reduce user confusion and promote consistent use of IDNs for registries implementing IDNs at the second level.

- **Second-level LGR References**
  - Reference second level LGRs, reviewed by experts and community, being provided to assist registries offering IDNs during Pre-Delegation Testing and the Registry Service Evaluation Process.

www.asia × //*.*/ Universal Acceptance

SUSTAINABLE DEVELOPMENT GOALS

17 GOALS TO TRANSFORM OUR WORLD

1 NO POVERTY

2 ZERO HUNGER

3 GOOD HEALTH AND WELL-BEING

4 QUALITY EDUCATION

5 GENDER EQUALITY

6 CLEAN WATER AND SANITATION

7 AFFORDABLE AND CLEAN ENERGY

8 DECENT WORK AND ECONOMIC GROWTH

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE

10 REDUCED INEQUALITIES

11 SUSTAINABLE CITIES AND COMMUNITIES

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

13 CLIMATE ACTION

14 LIFE BELOW WATER

15 LIFE ON LAND

16 PEACE AND JUSTICE STRONG INSTITUTIONS

17 PARTNERSHIPS FOR THE GOALS

THE GLOBAL GOALS
For Sustainable Development

APNIC

IPGO

addressing the Internet in the Asia Pacific