Internet 101
The Technical Roots of Internet Governance

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External Relations
RIPE NCC

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About this session

- An overview of the Internet's fundamental structure
- The key elements:
  - Numbers
  - Names
  - Routing
- An open architecture -> open governance model

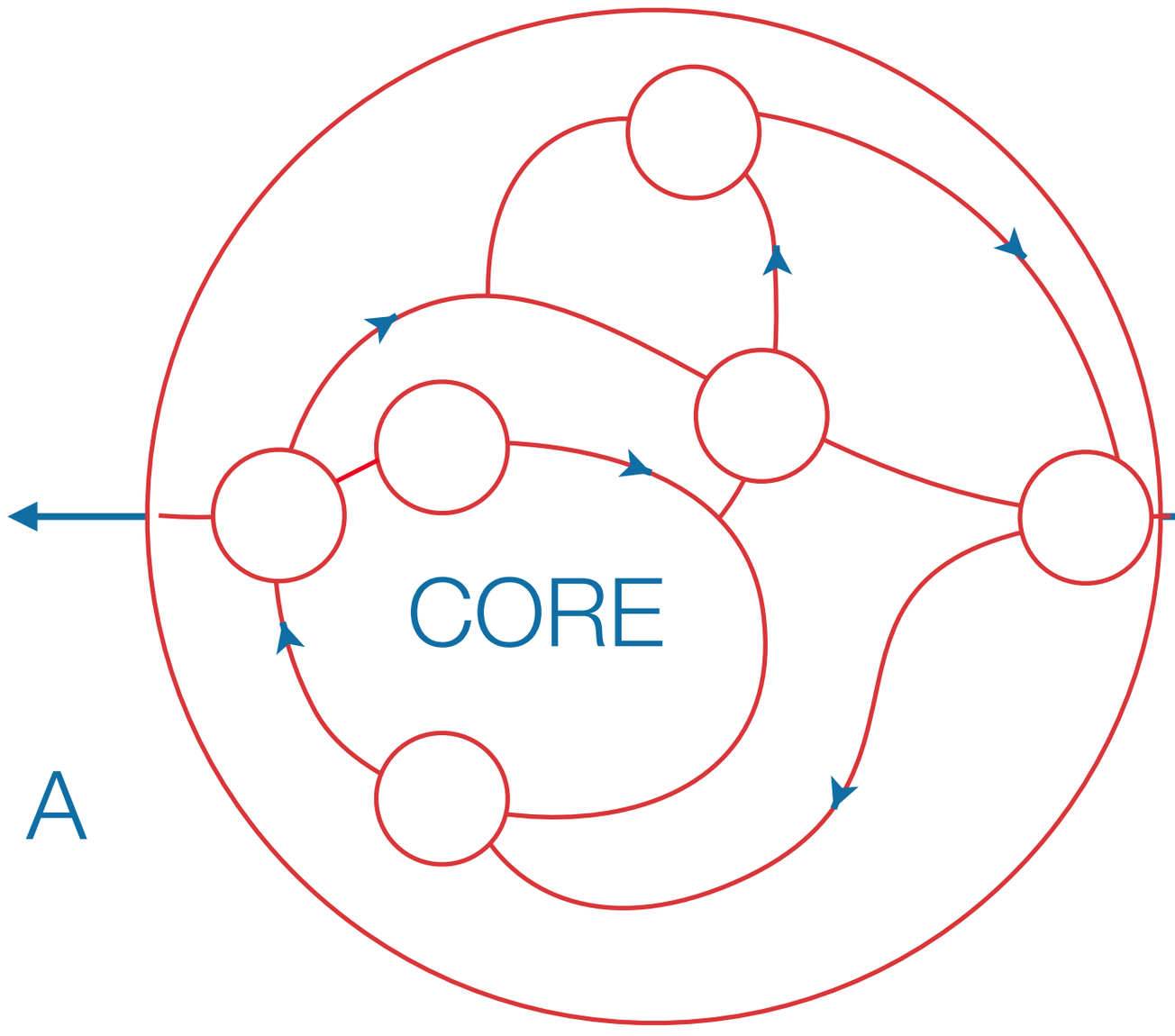
The Internet is a Dumb Network

- Fundamental to the design
- All the interesting things happen at the “edge”
  - Computers, tablets and phones
- Allows for great diversity in services and applications
  - Which can be developed without making changes in the network
- Contributes to network resilience

The Internet: “Edge” and “Core”

EDGE

IP address A



EDGE

IP address B

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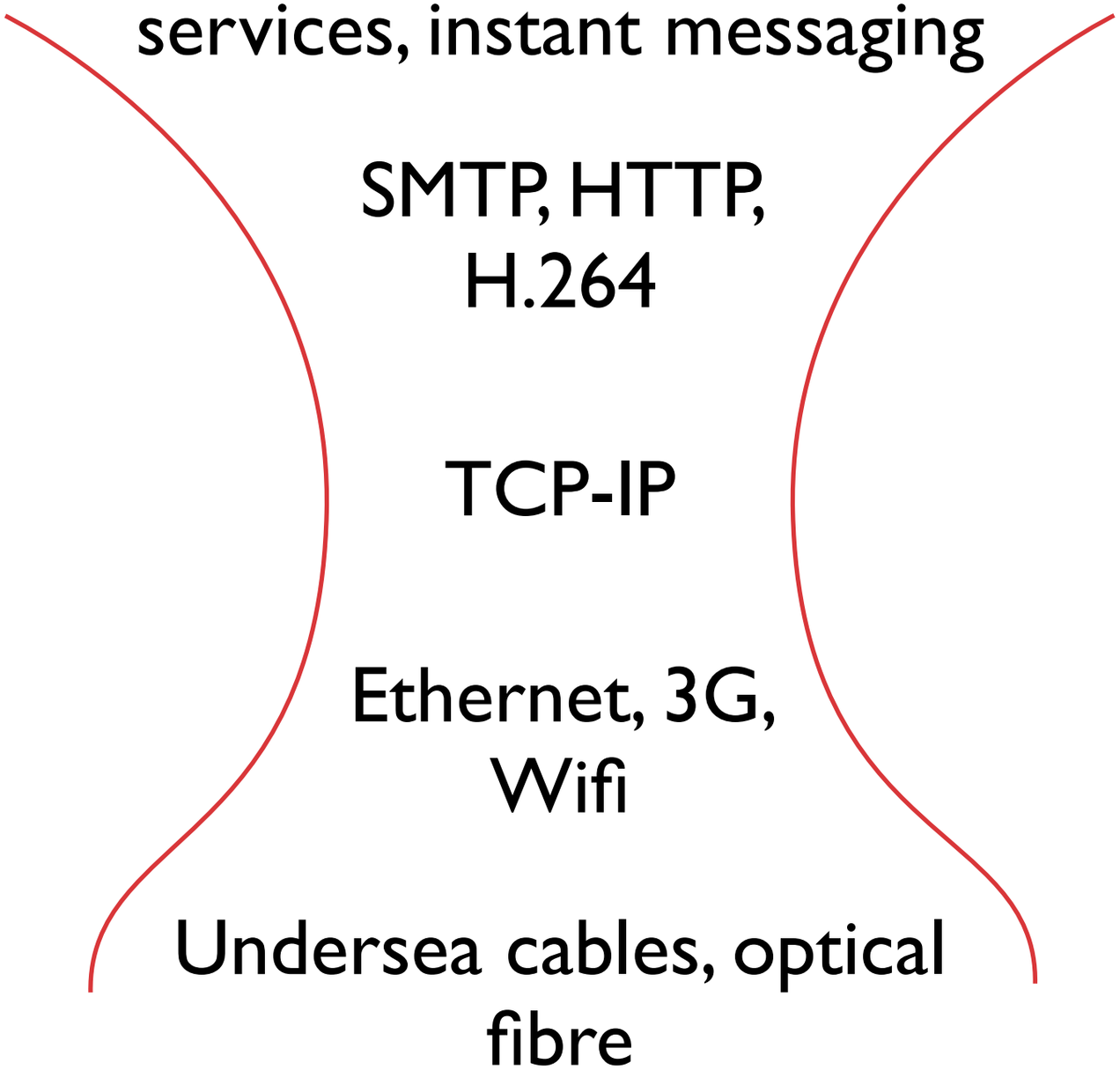
The Hourglass Model



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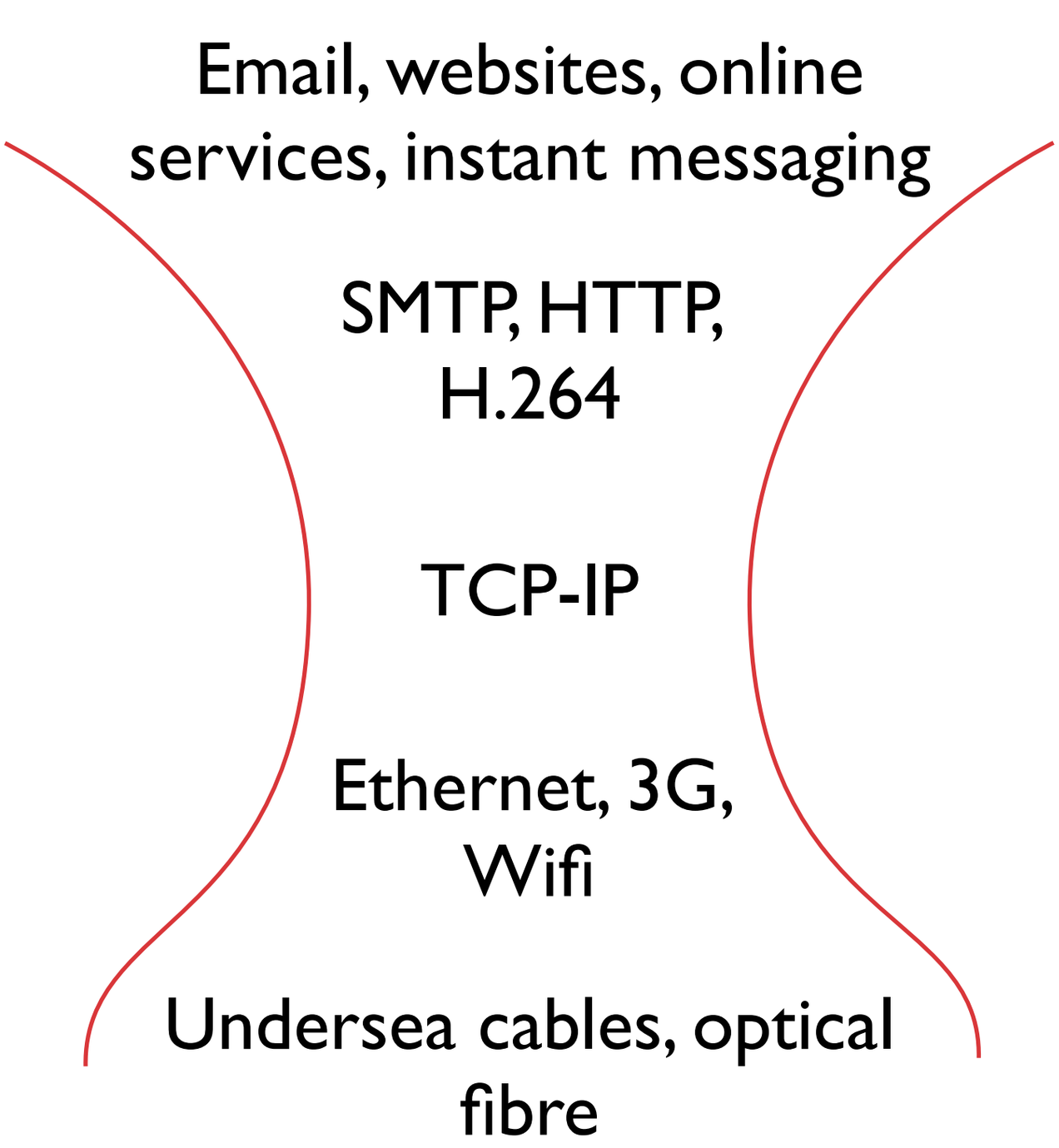

Many protocols

Fewer protocols

More protocols

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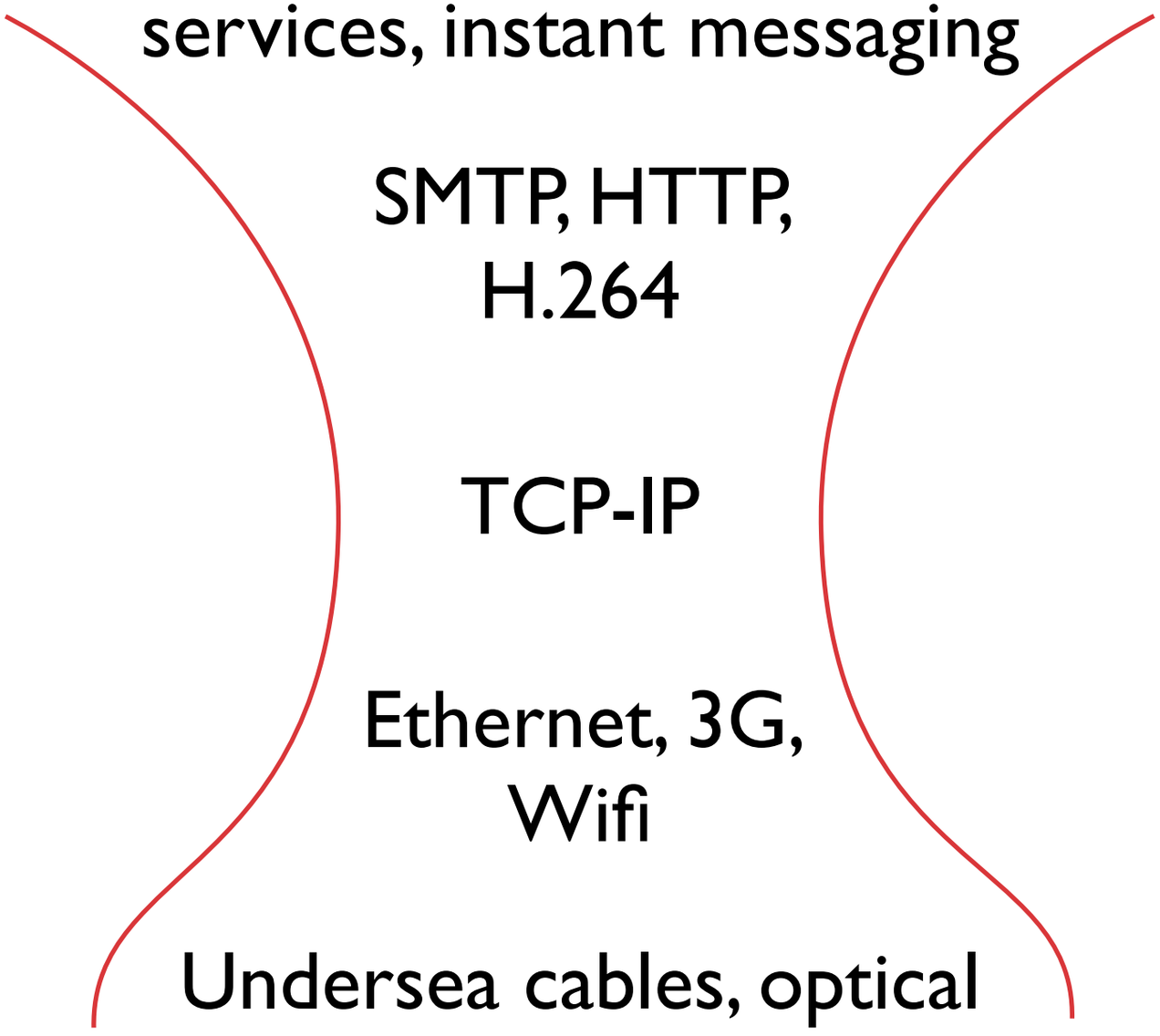
The Hourglass Model



Many protocols

Fewer protocols

More protocols

Application
Presentation
Session
Transport
Network
Data link
Physical

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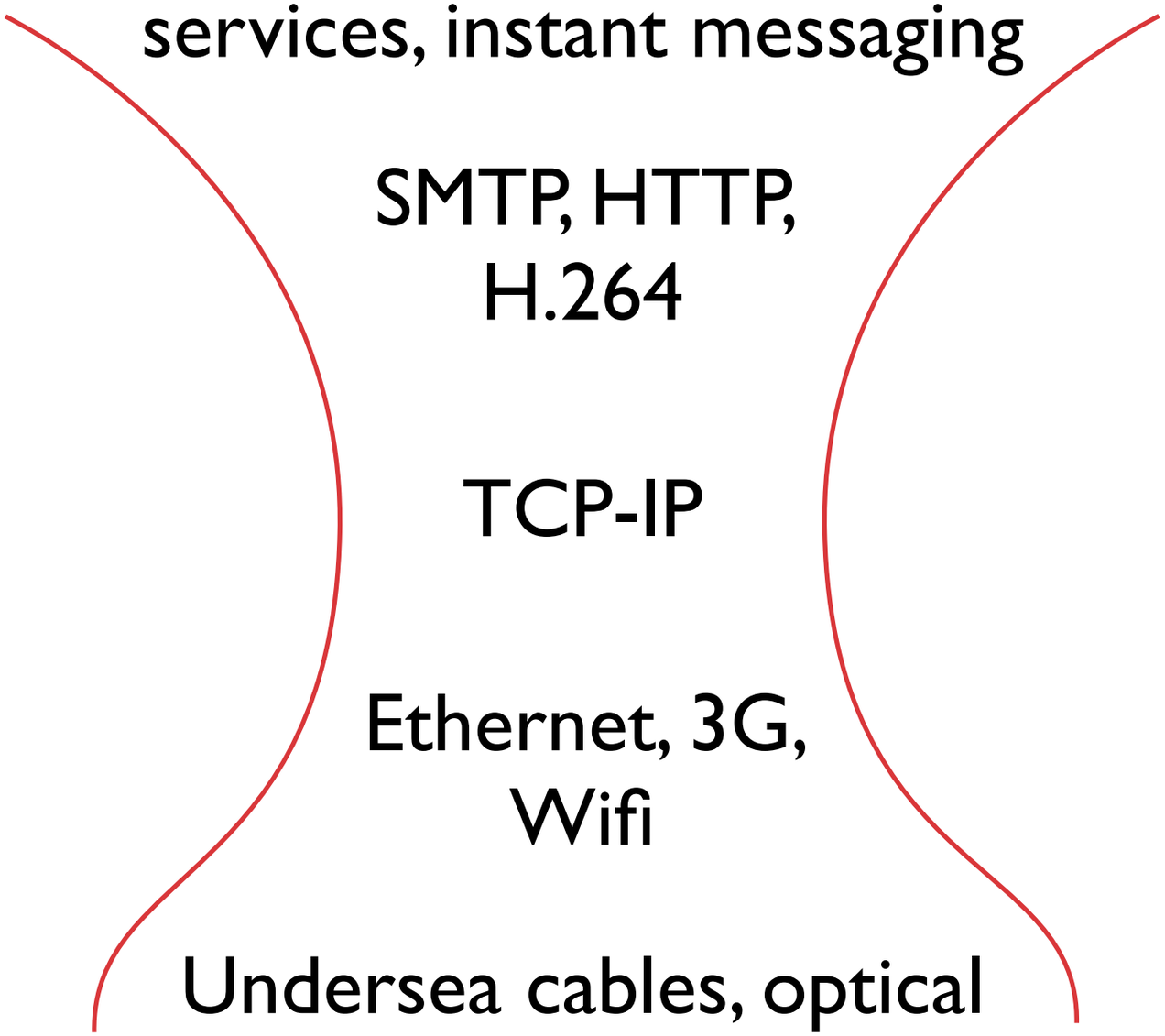
The Hourglass Model



Google, Skype, Facebook, Netflix

Carriers (Tata, Cogent)

Access layer (my ISP)

What is IP Addressing?

- IP address = a number assigned to devices in a network that uses the Internet Protocol for communication
  - IPv4 e.g. 192.0.2.17 (32 bits)
  - IPv6 e.g. 2001:db8:0:1234:0:567:8:1 (128 bits)

- IP addresses on the public Internet must be unique

An IP address is just a starting point…

- Where should I go?
  - Domain Name System (DNS)
- How do I get there?
  - Inter-domain Routing

- “A name indicates what we seek.
  An address indicates where it is.
  A route indicates how to get there.”

The Domain Name System (DNS)

Hostnames

- The Internet uses numeric identifiers
  - IP Address
  - Port number
- People can’t remember numbers
  - So we use names
  - Uniform Resource Locator (URL)
- Added bonus: you can change the number

The Domain Name System (DNS)

- Original “translation” provided by static files
- Needed a more scalable solution
- DNS is a “distributed database”

The DNS at Work

The DNS at Work

http://www.ripe.net

The DNS at Work

http://www.ripe.net

Protocol to use
(port number)

The DNS at Work

http://www.ripe.net

Fully Qualified Domain Name (FQDN)

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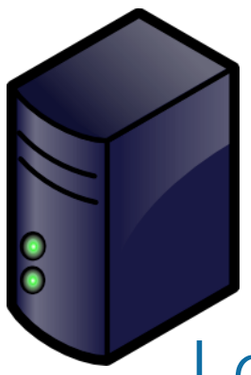
http://www.ripe.net



Local DNS Server
(“resolver”)

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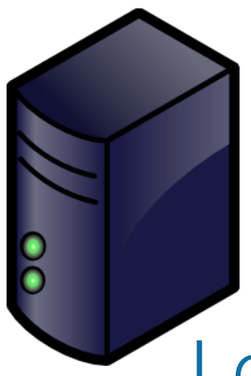
The DNS at Work

http://www.ripe.net

IP address for www.ripe.net?



Local DNS Server
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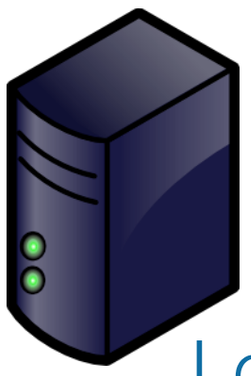
The DNS at Work

http://www.ripe.net

IP address for www.ripe.net?



IP address for www.ripe.net?

Local DNS Server
("resolver")

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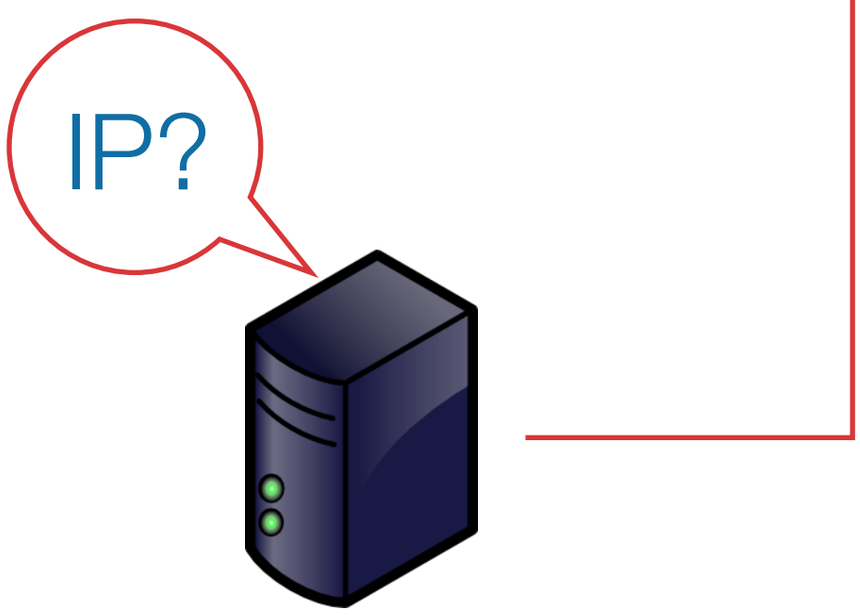
www.ripe.net.

The DNS at Work

Root Server

.

www.ripe.net.



RIPE NCC

The DNS at Work

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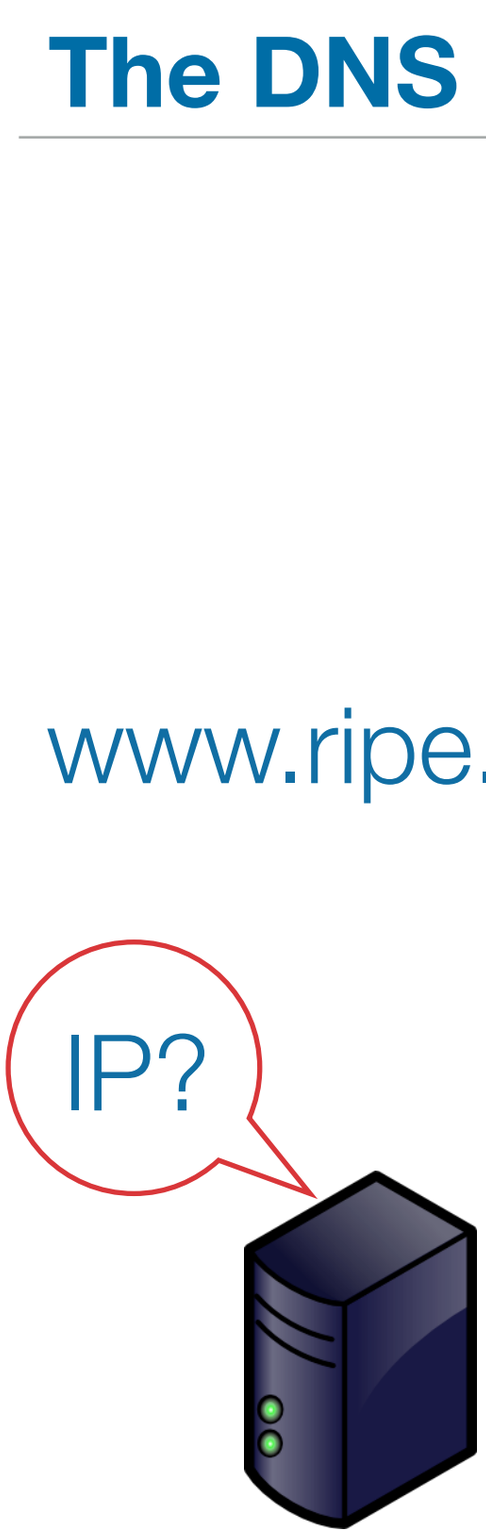
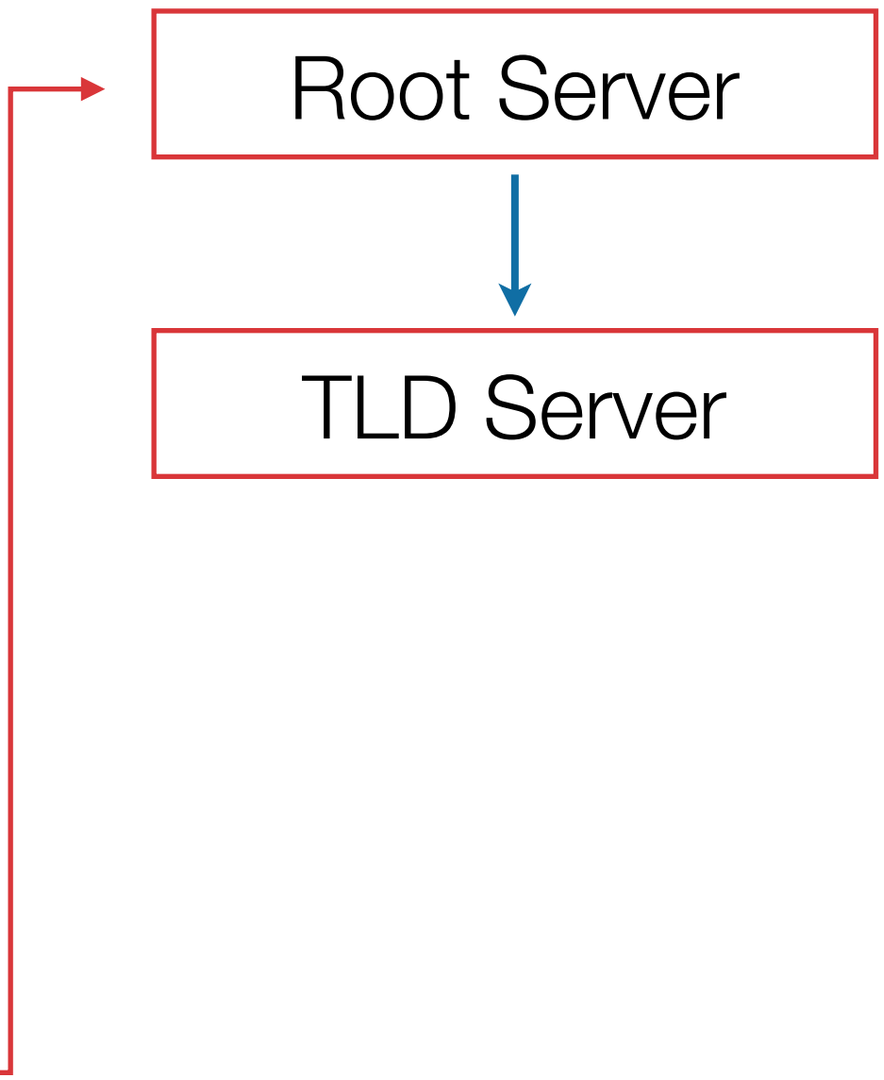


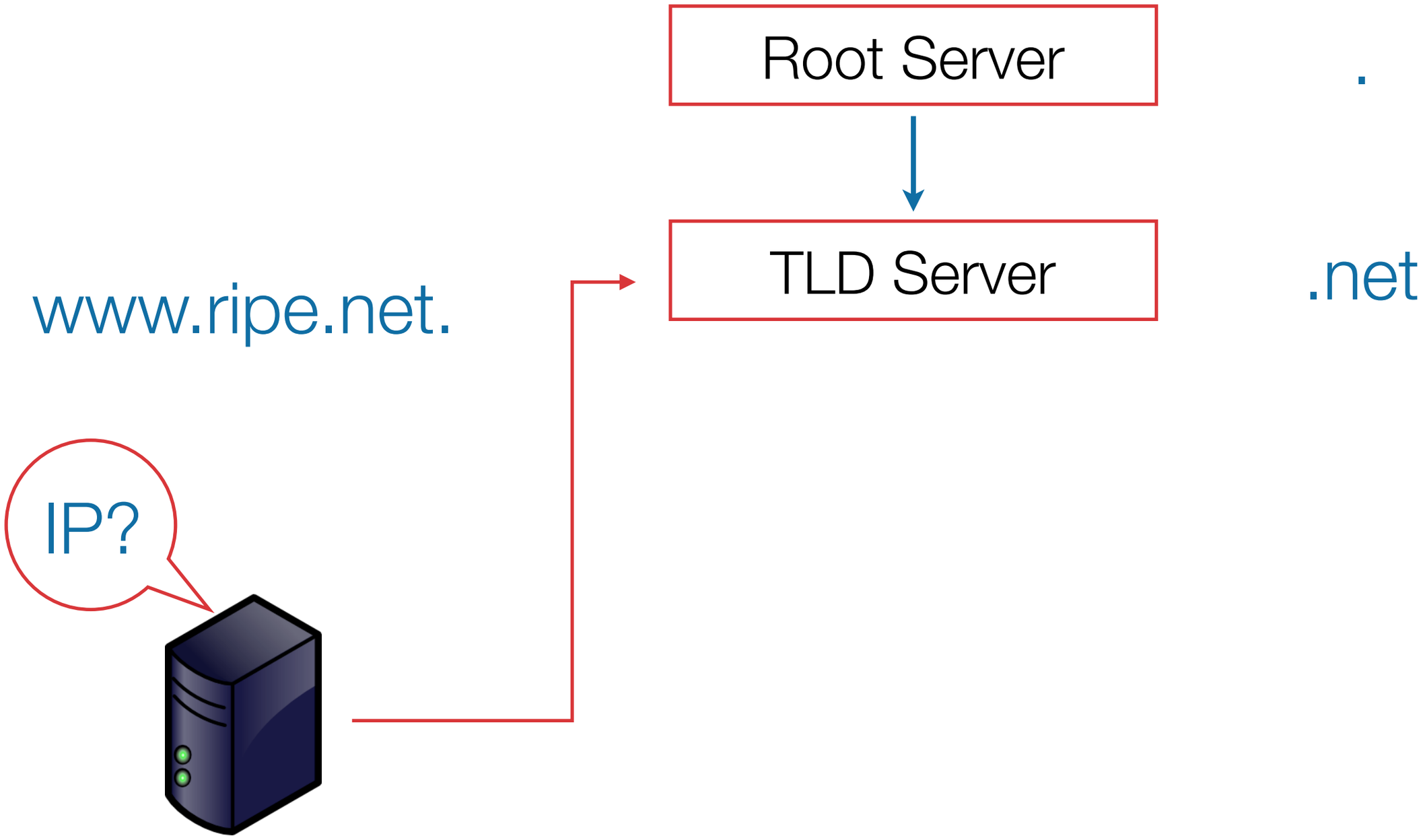


.

.net

RIPE NCC

The DNS at Work



The DNS at Work

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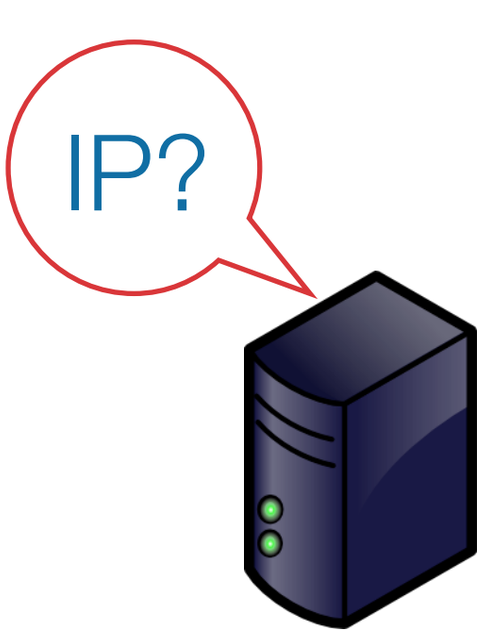


Root Server

.

TLD Server

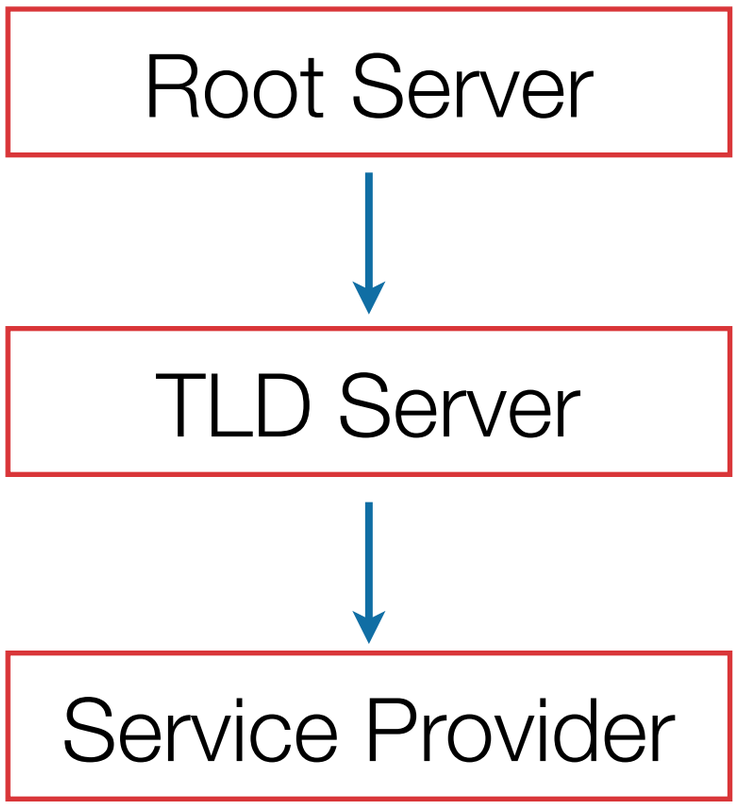
.net

Service Provider

ripe.net

The DNS at Work

193.0.6.139



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.net

ripe.net

RIPE NCC

The DNS at Work

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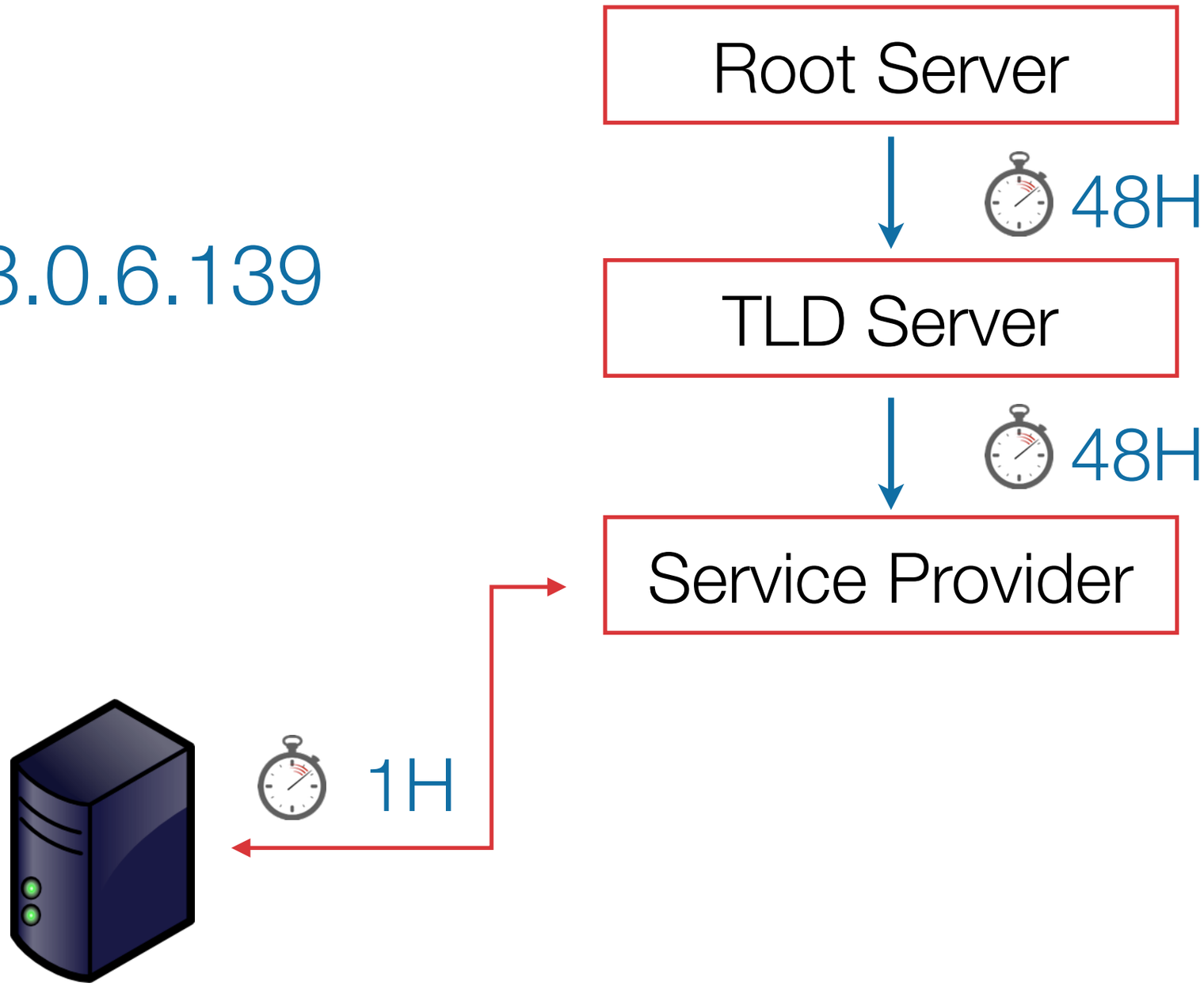
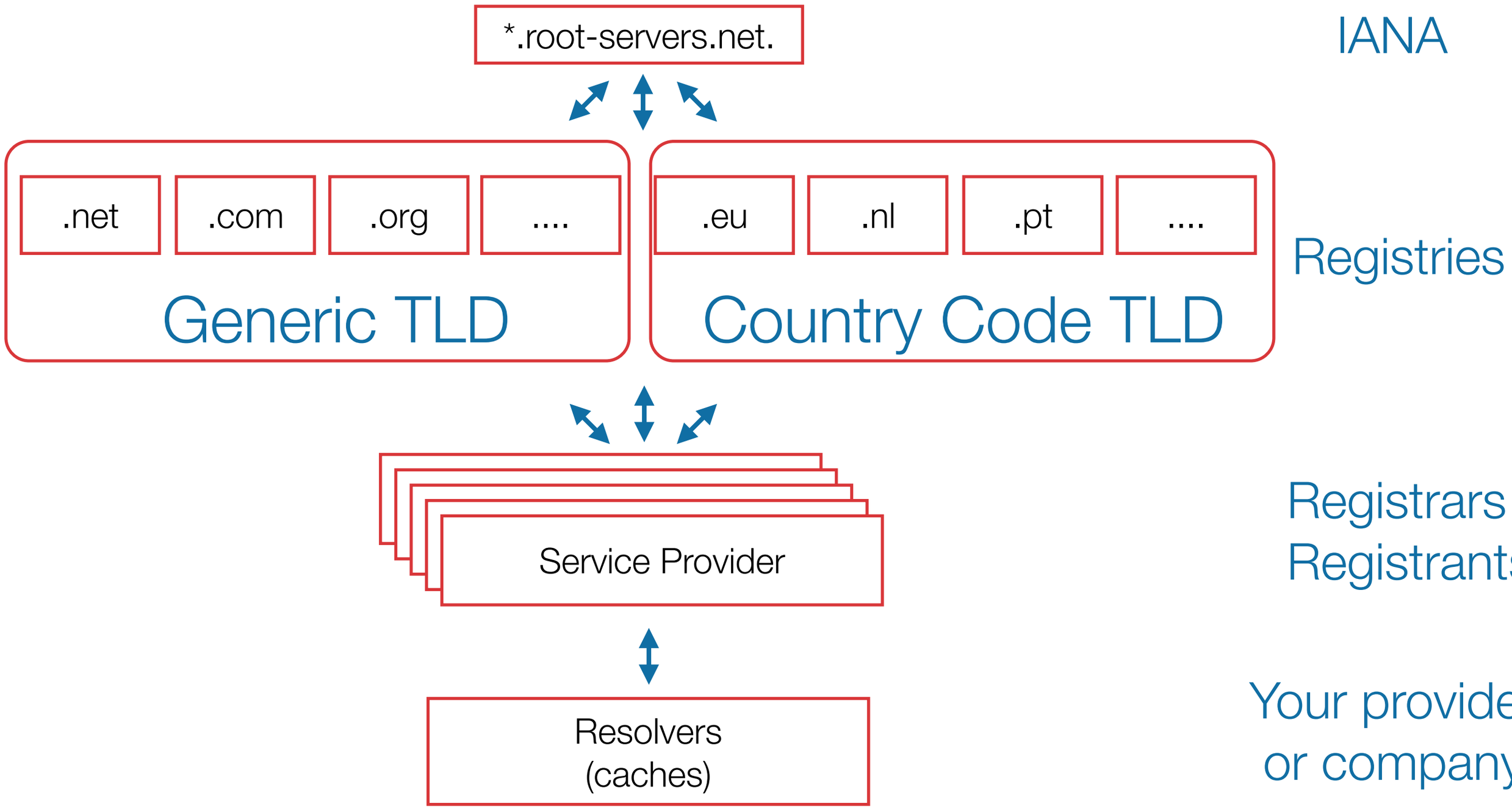


The Domain Name System



DNS Root Servers

- 13 different Root Servers and 12 operators
- Provides high level of resilience:
  - Different software and architecture
  - Geographical diversity
  - Protects against a single operator failing
- They all provide the same answer
  - Resolvers try and use the fastest

Myths About Root Servers

- DNS Root Servers don't forward any packets
- Not a likely cause for a slow connection
  - Only needed to resolve TLDs
  - Answers are valid for 48 hours
- Having a Root Server in your network doesn't protect against other failures:
  - Still need the TLDs to be reachable
  - Still need outside connectivity

Questions?

Routing

A Short History of Routing

- In the early days routing was based on manual input, so called “static routing”
- Replaced by a more scalable and dynamic solution: Border Gateway Protocol (BGP)
  - Static and other alternatives still around
  - BGP the de-facto standard for inter-domain routing

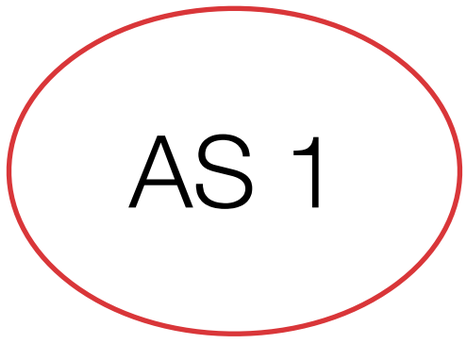
Internet Routing

- Non-hierarchical
  - There is no central controlling entity
- Open
  - Every network can participate
  - Provided you comply with technical standards
- Free
  - You pay for your operations and capacity
  - You can connect to everybody

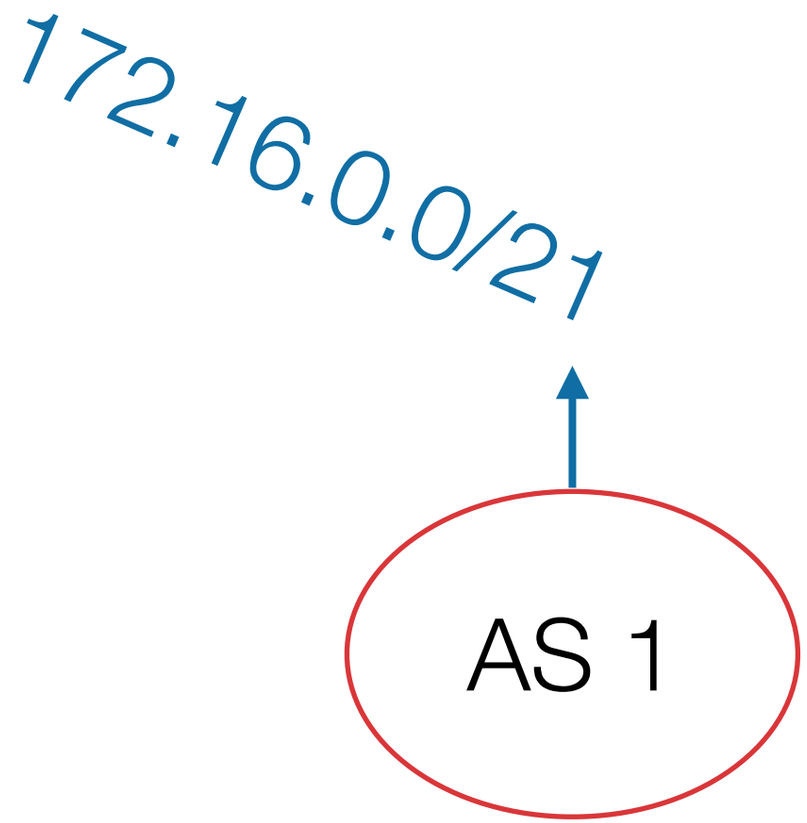
Definitions

- Autonomous System (AS)
  - Network that falls under a single administration
  - Identified by a Autonomous System Number (ASN)
- Peering
  - Connection between two ASNs
  - Exchanging routing or reachability information

Route Announcement



Route Announcement



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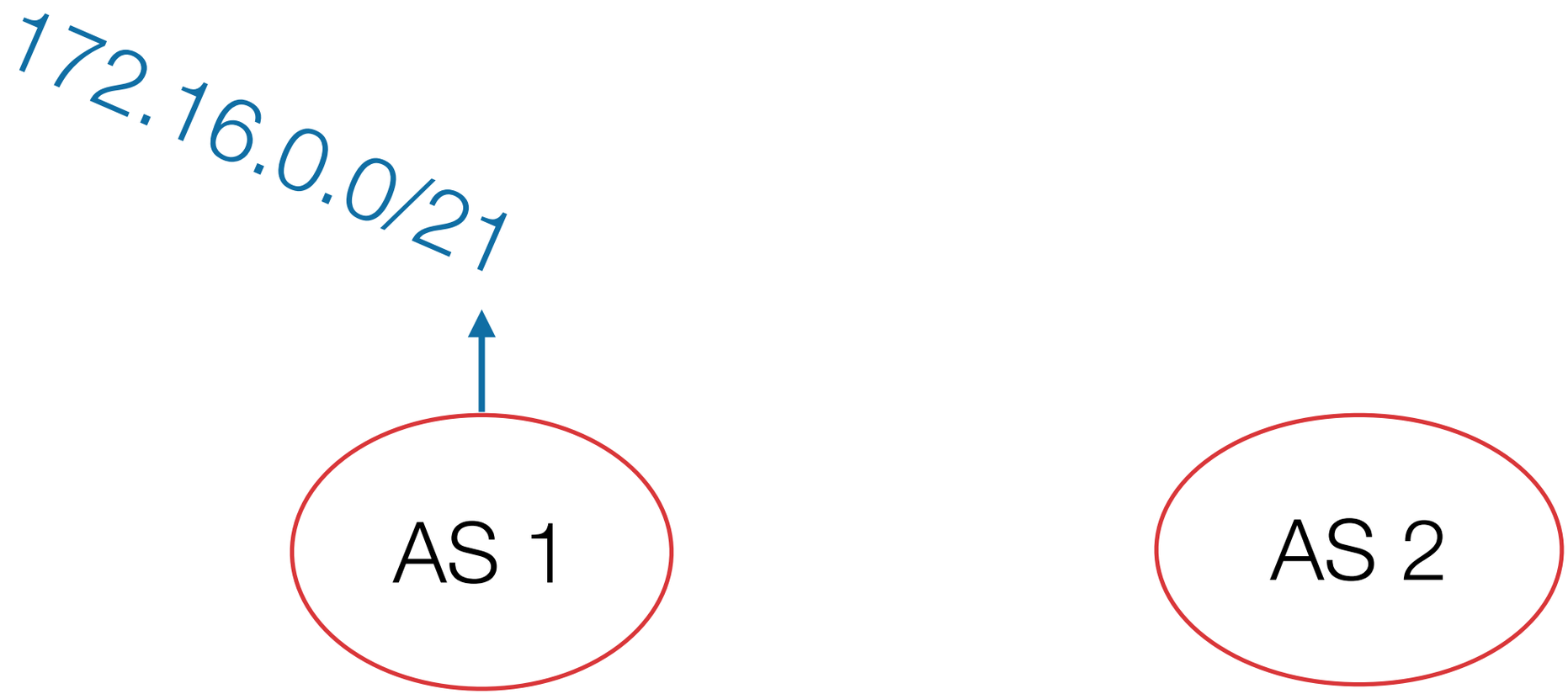

Route Announcement

"Hi, I am AS 1 and
you can send any
traffic for
172.16.0.0/21
to me"

Route Announcement

"Hi, I am AS 1 and
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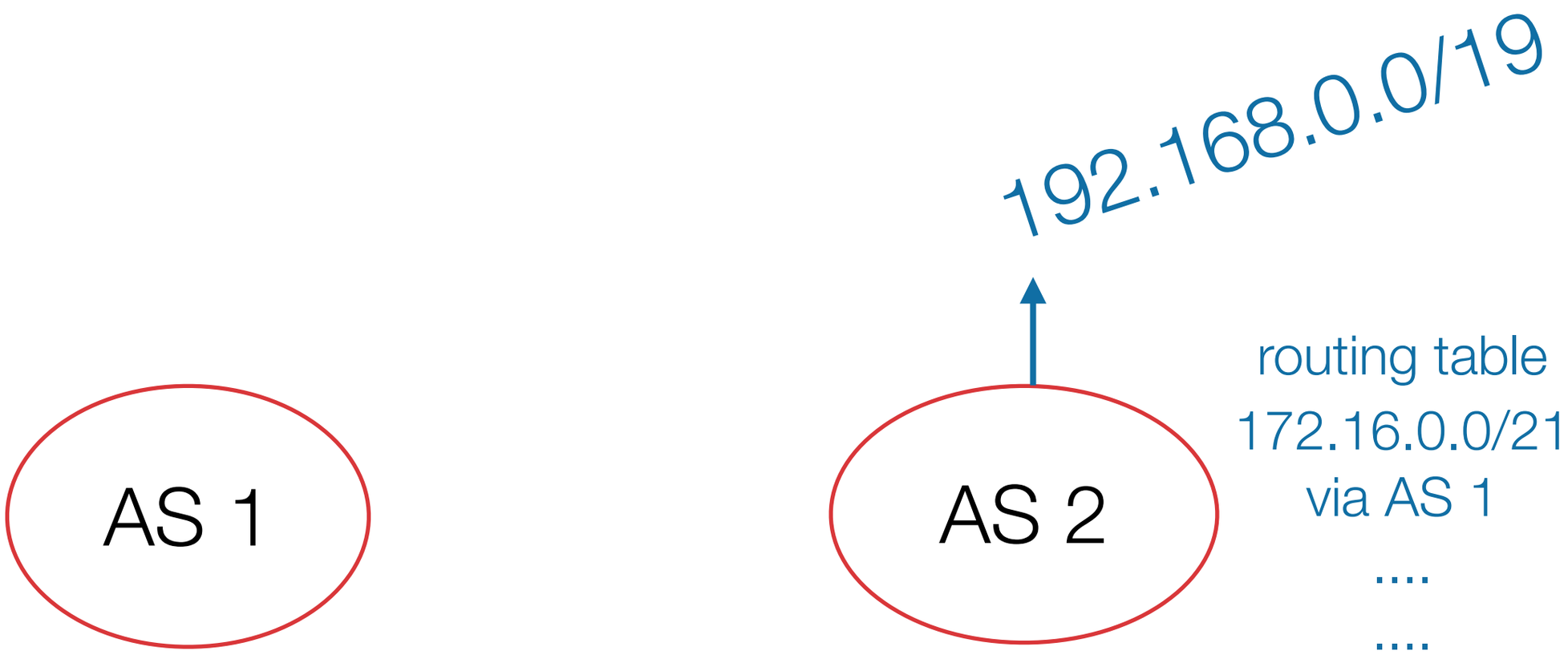
to me"

routing table
172.16.0.0/21
via AS 1

....

....

Route Announcement



Route Announcement

routing table
172.16.0.0/21
via AS 1
....
....

"Hi, I am AS 2 and you can send any traffic for 192.168.0.0/19 to me"

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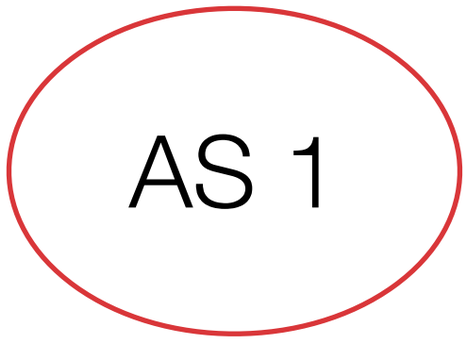
Route Announcement

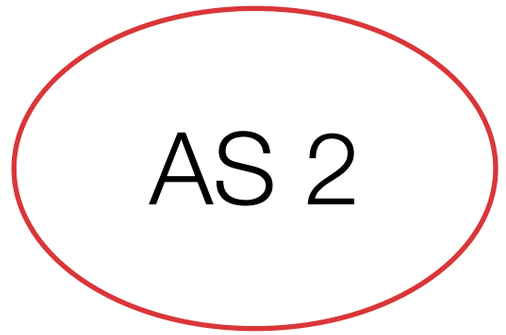
routing table

192.168.0.0/19
via AS 2

....

....





routing table

172.16.0.0/21
via AS 1

....

....

Growing the Network

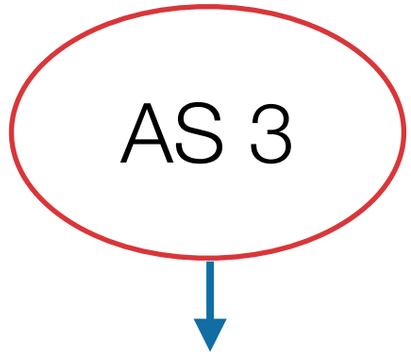
routing table
192.168.0.0/19 via AS 2

routing table
172.16.0.0/21 via AS 1

Growing the Network

routing table
192.168.0.0/19 via AS 2

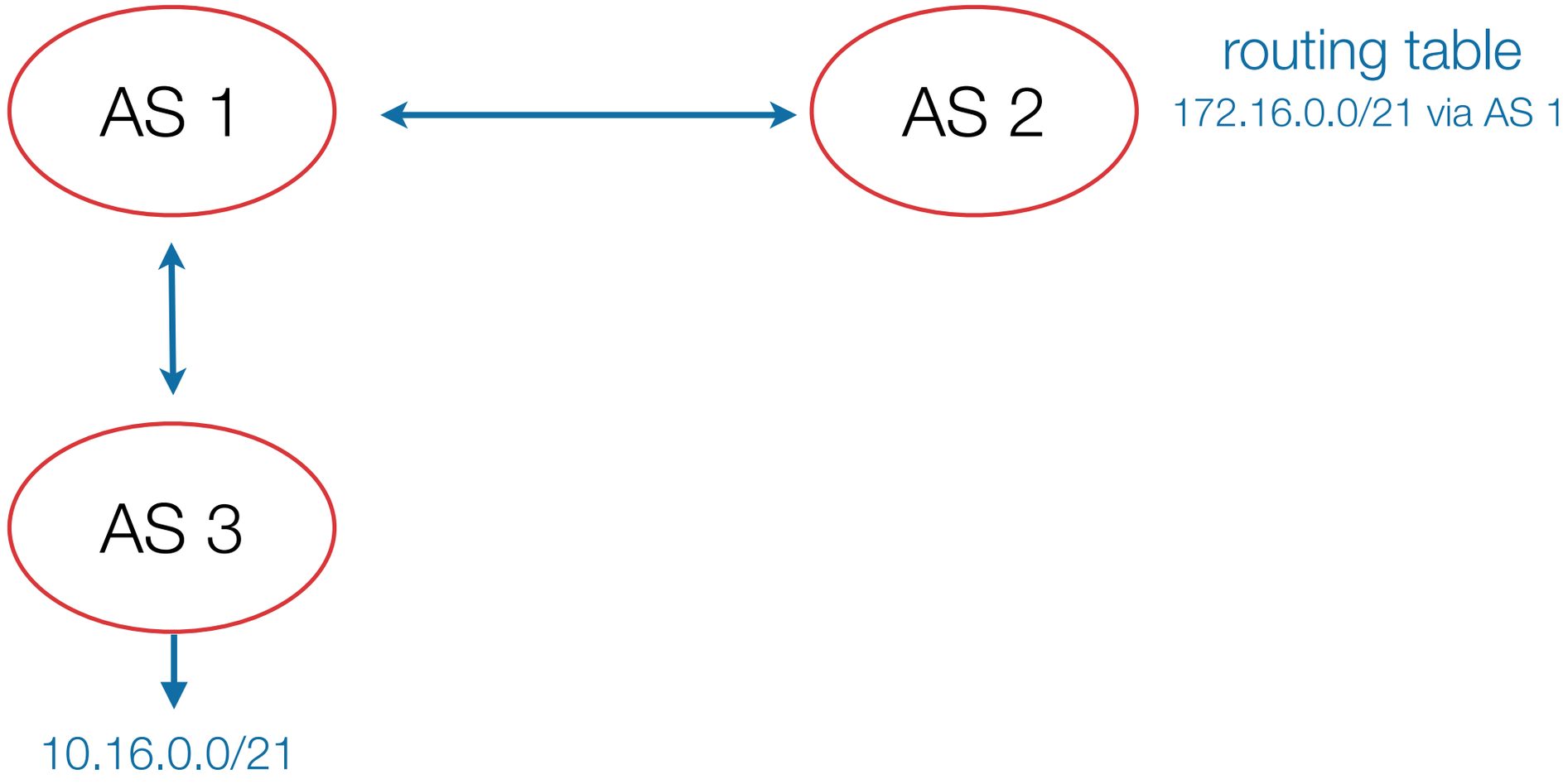
routing table
172.16.0.0/21 via AS 1



10.16.0.0/21

Growing the Network

routing table
192.168.0.0/19 via AS 2



routing table
172.16.0.0/21 via AS 1

Growing the Network

routing table
192.168.0.0/19 via AS 2

AS 1

AS 2

routing table
172.16.0.0/21 via AS 1

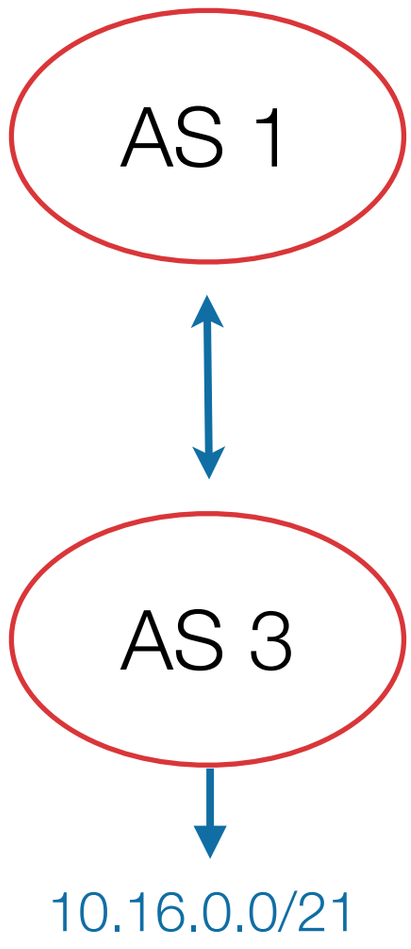
"Hi, I am AS 3
and
any traffic for
10.16.0.0/21
you can send to
me"

AS 3

10.16.0.0/21

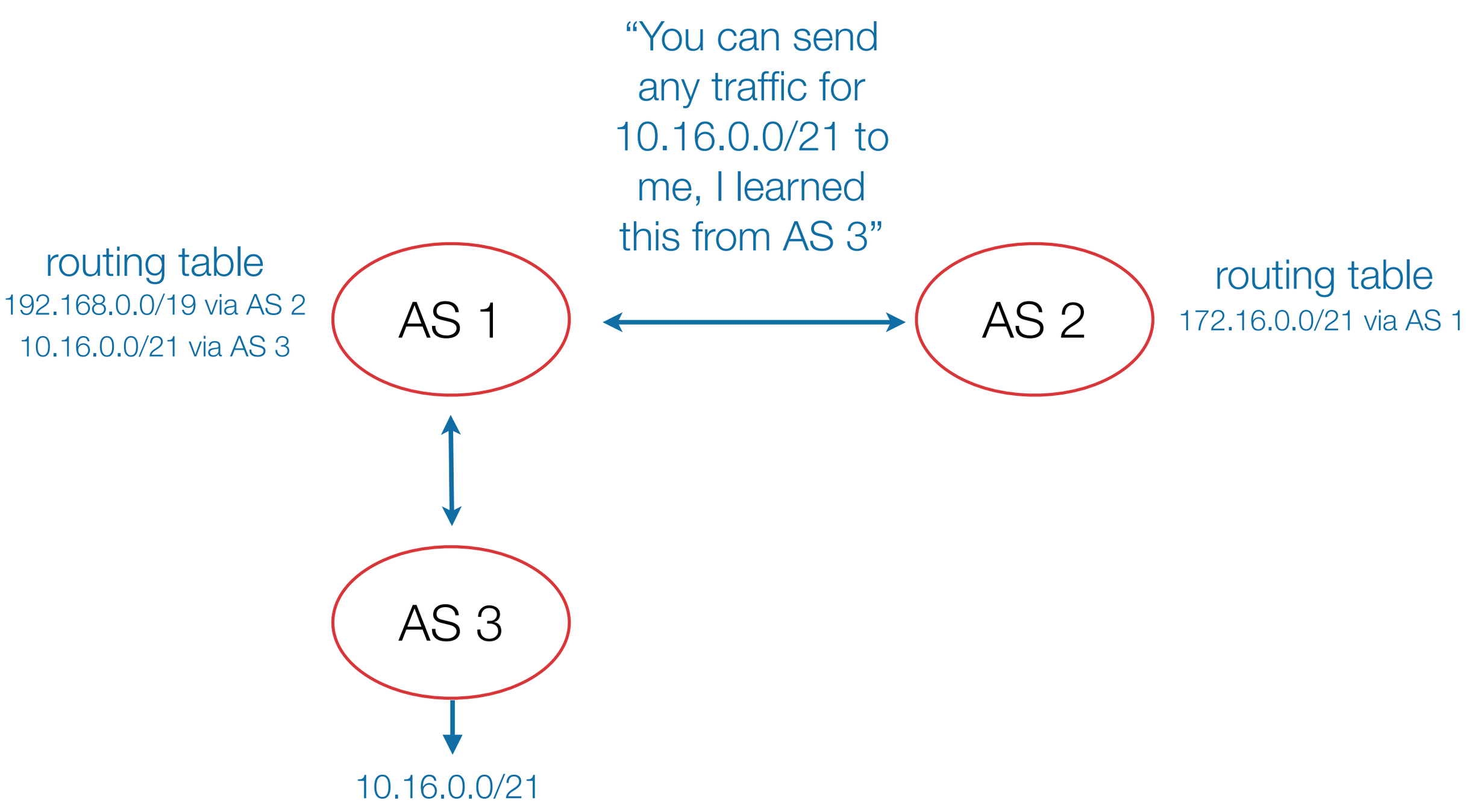
Growing the Network

routing table
192.168.0.0/19 via AS 2
10.16.0.0/21 via AS 3



routing table
172.16.0.0/21 via AS 1

Growing the Network



Growing the Network

"AS 1 is a transit for AS 3"

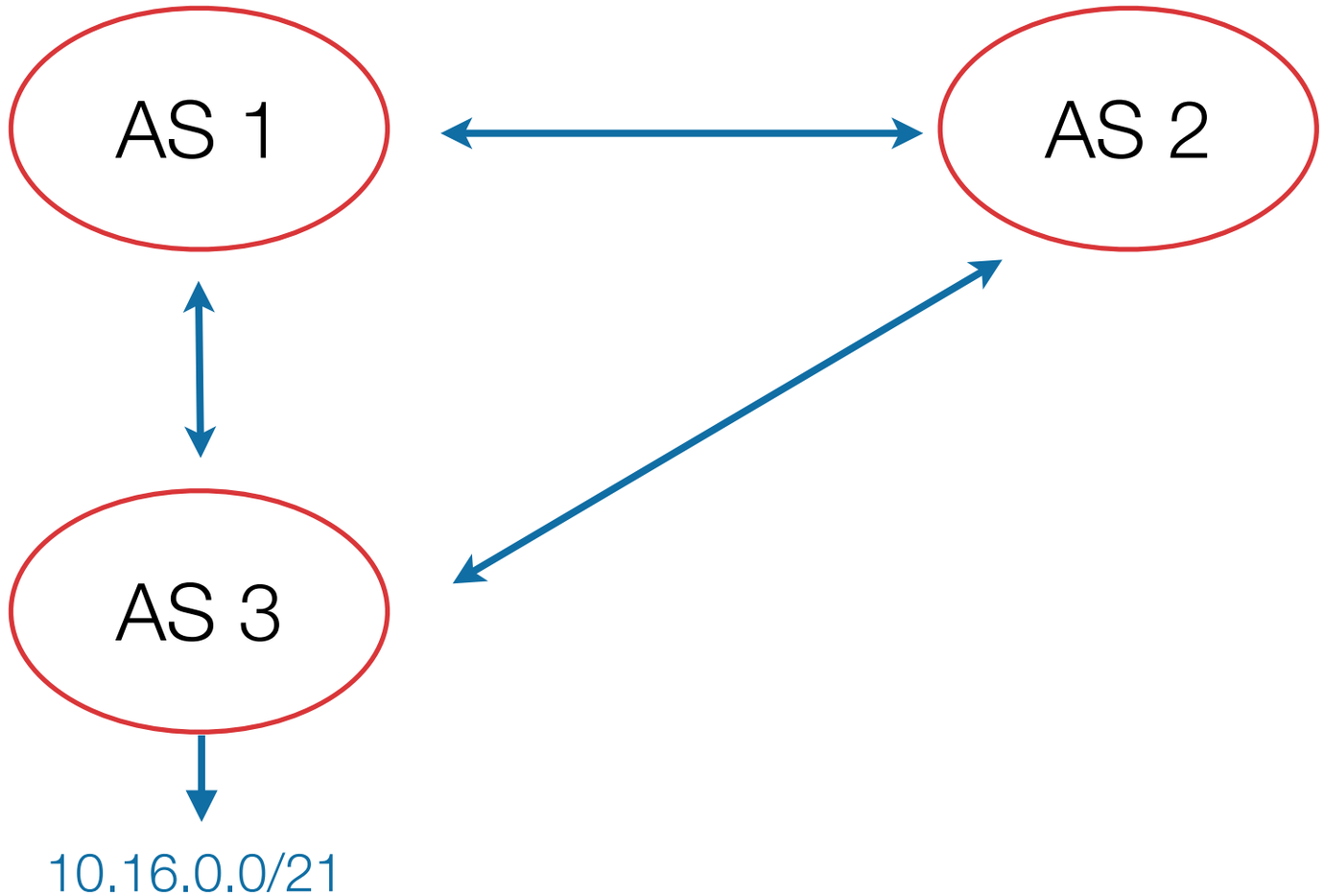
routing table
192.168.0.0/19 via AS 2
10.16.0.0/21 via AS 3

routing table
172.16.0.0/21 via AS 1
10.16.0.0/21 via AS 1, AS 3

Growing the Network

"AS 1 is a transit for AS 3"

routing table
192.168.0.0/19 via AS 2
10.16.0.0/21 via AS 3



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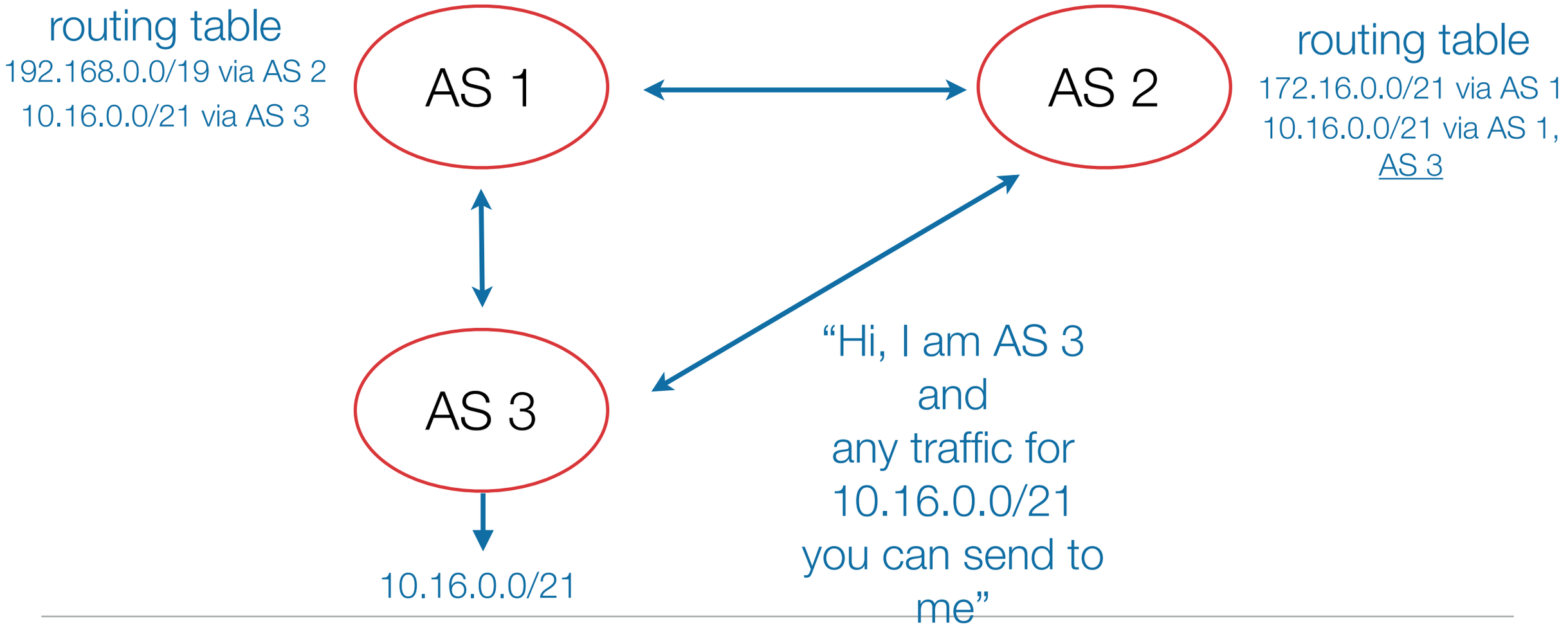
10.16.0.0/21 via AS 1, AS 3

Growing the Network

"AS 1 is a transit for AS 3"



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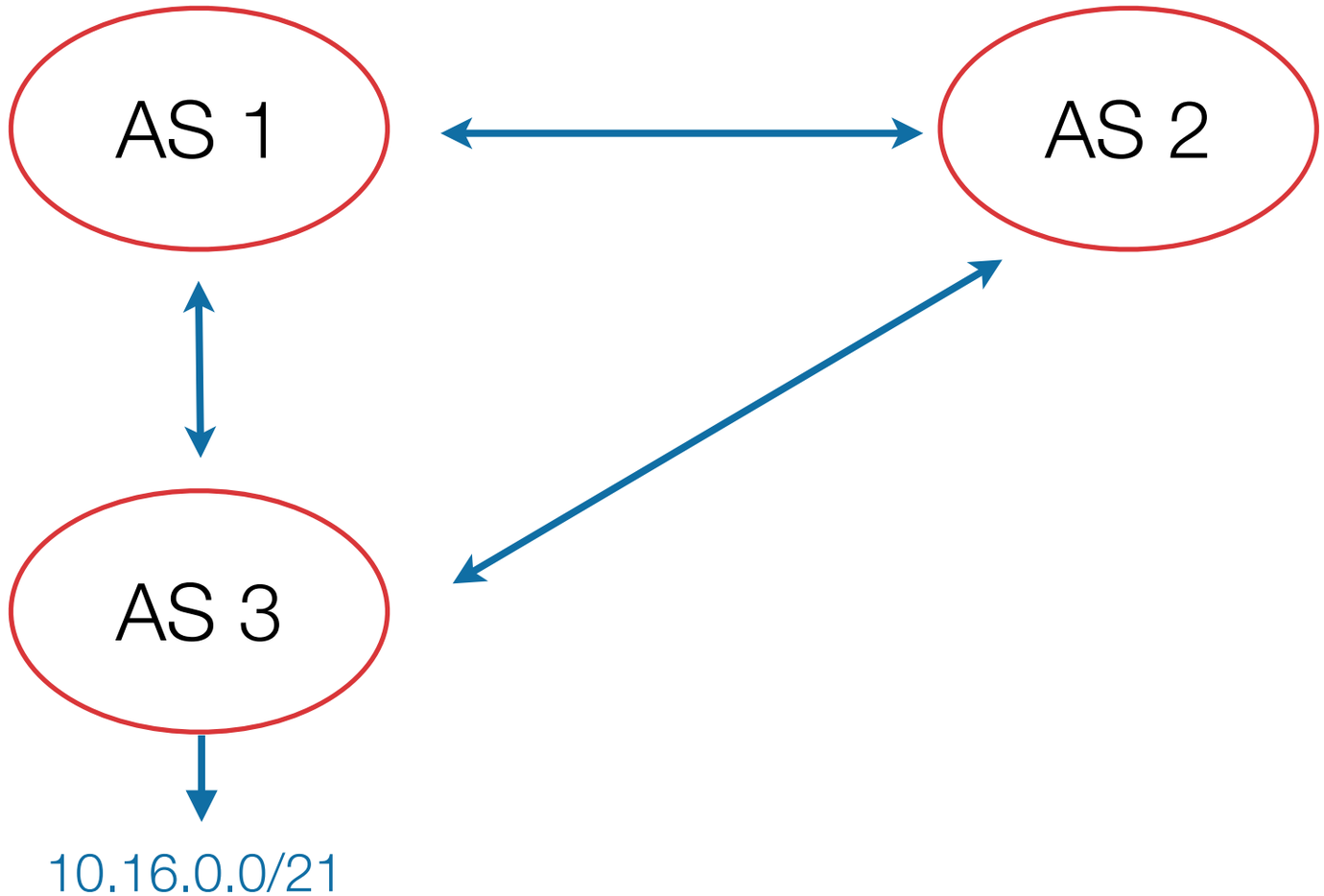
Growing the Network

"AS 1 is a transit for AS 3"

routing table
192.168.0.0/19 via AS 2
10.16.0.0/21 via AS 3

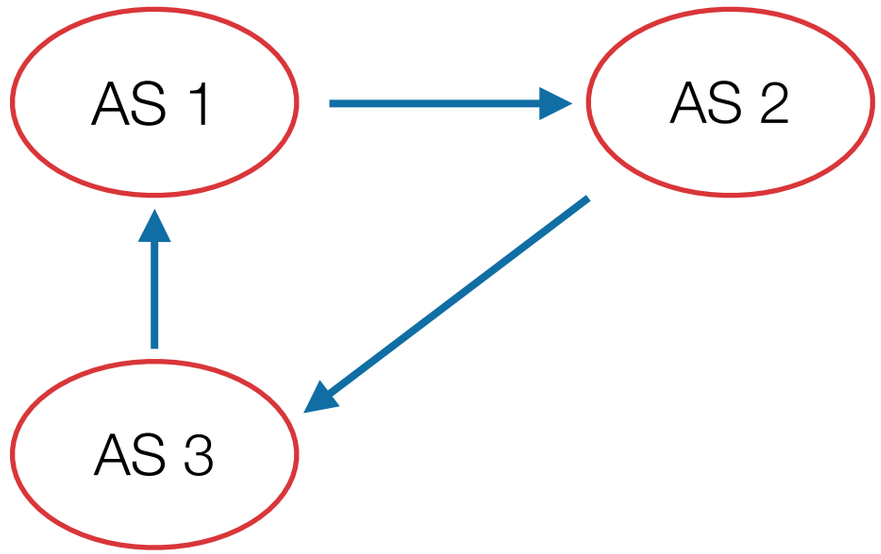


routing table
172.16.0.0/21 via AS 1
10.16.0.0/21 via AS 1, AS 3
10.16.0.0/21 via AS 3

"AS 2 and AS 3 are peering"

Border Gateway Protocol

- Shortest path usually wins
  - But could be a longer path, as it is “cheaper”
- Can only control outgoing traffic
  - You decide where to send it next
- Packets my take a different route on the way back
  - Asymmetric routing



Commercial Translation

- “Peering”
  - Settlement free connection between two networks
  - Based on mutual benefit
  - Usually the involved parties are “equal”
- “Transit”
  - Arrangements where one party pays the other
  - Most commonly on peak capacity used per month

Questions?

The Transition of IANA Oversight

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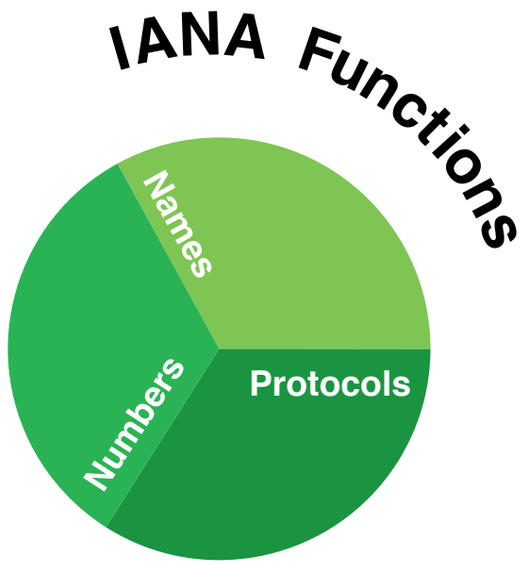
The IANA Functions

The IANA Functions



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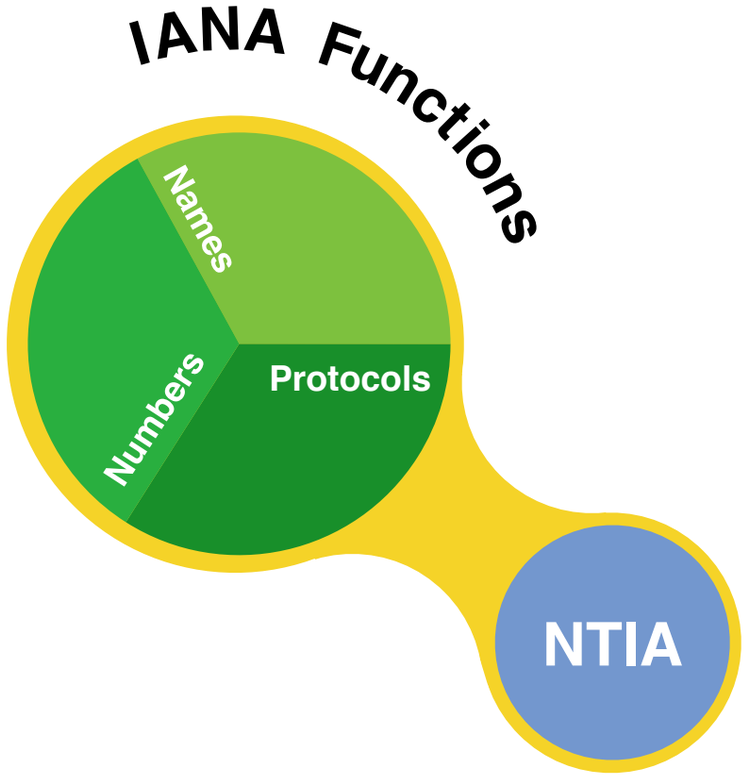

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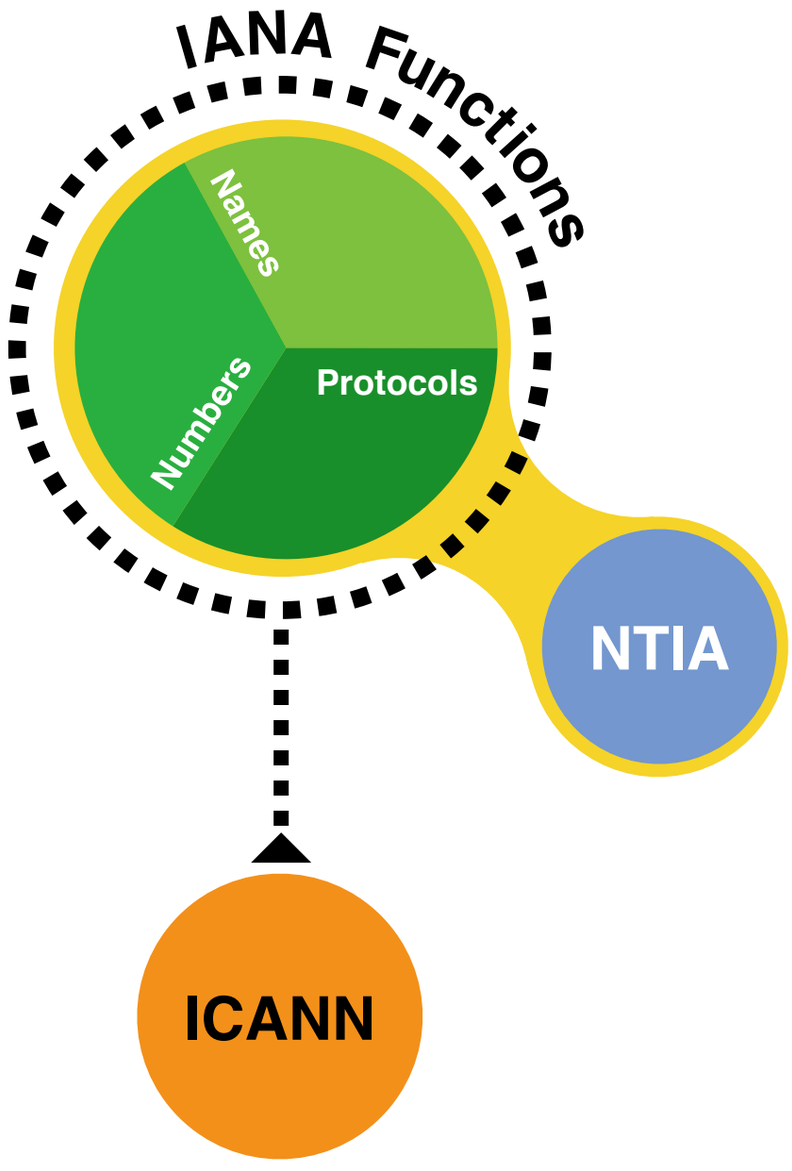

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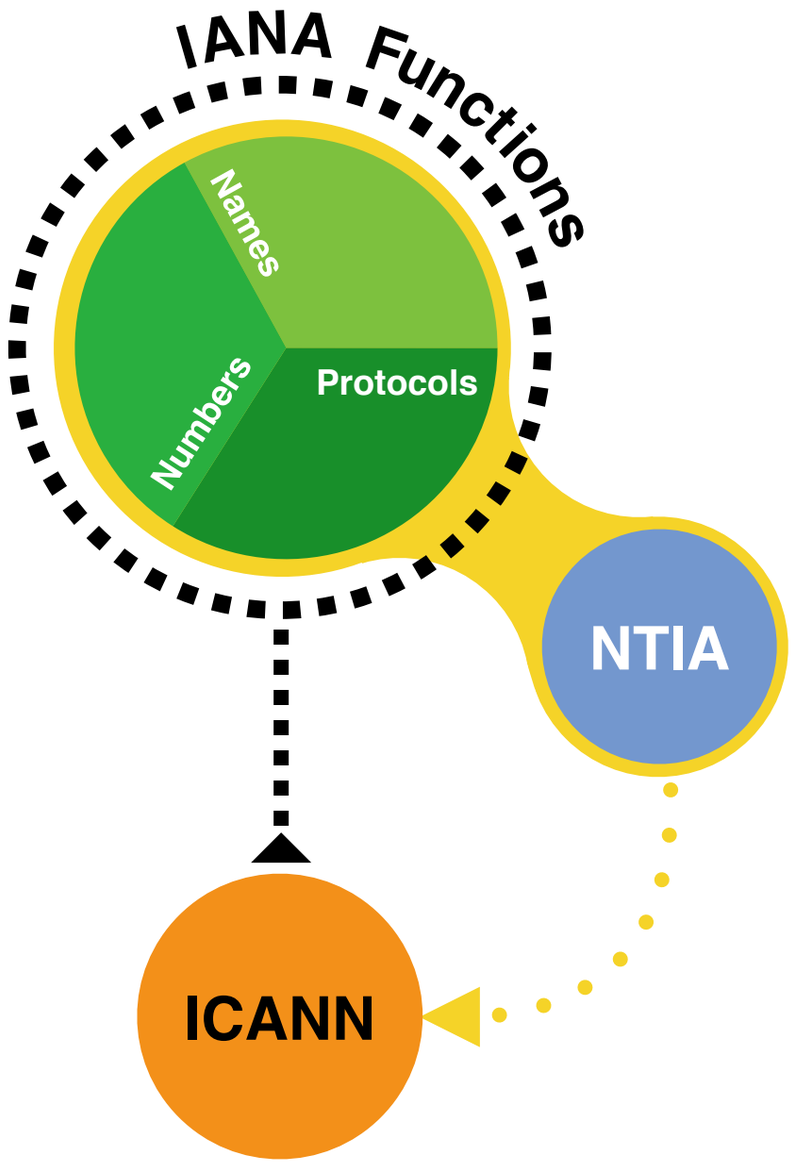

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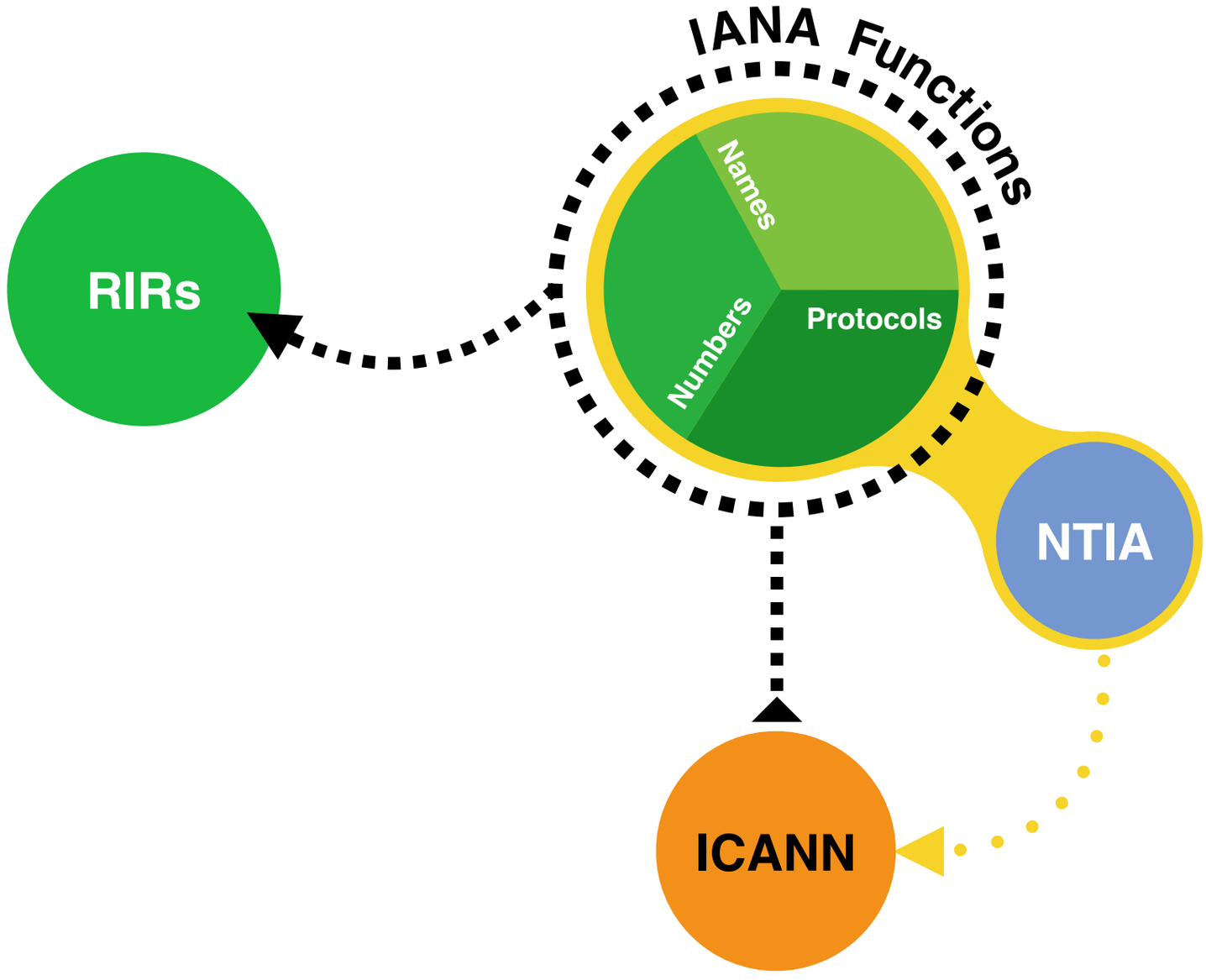

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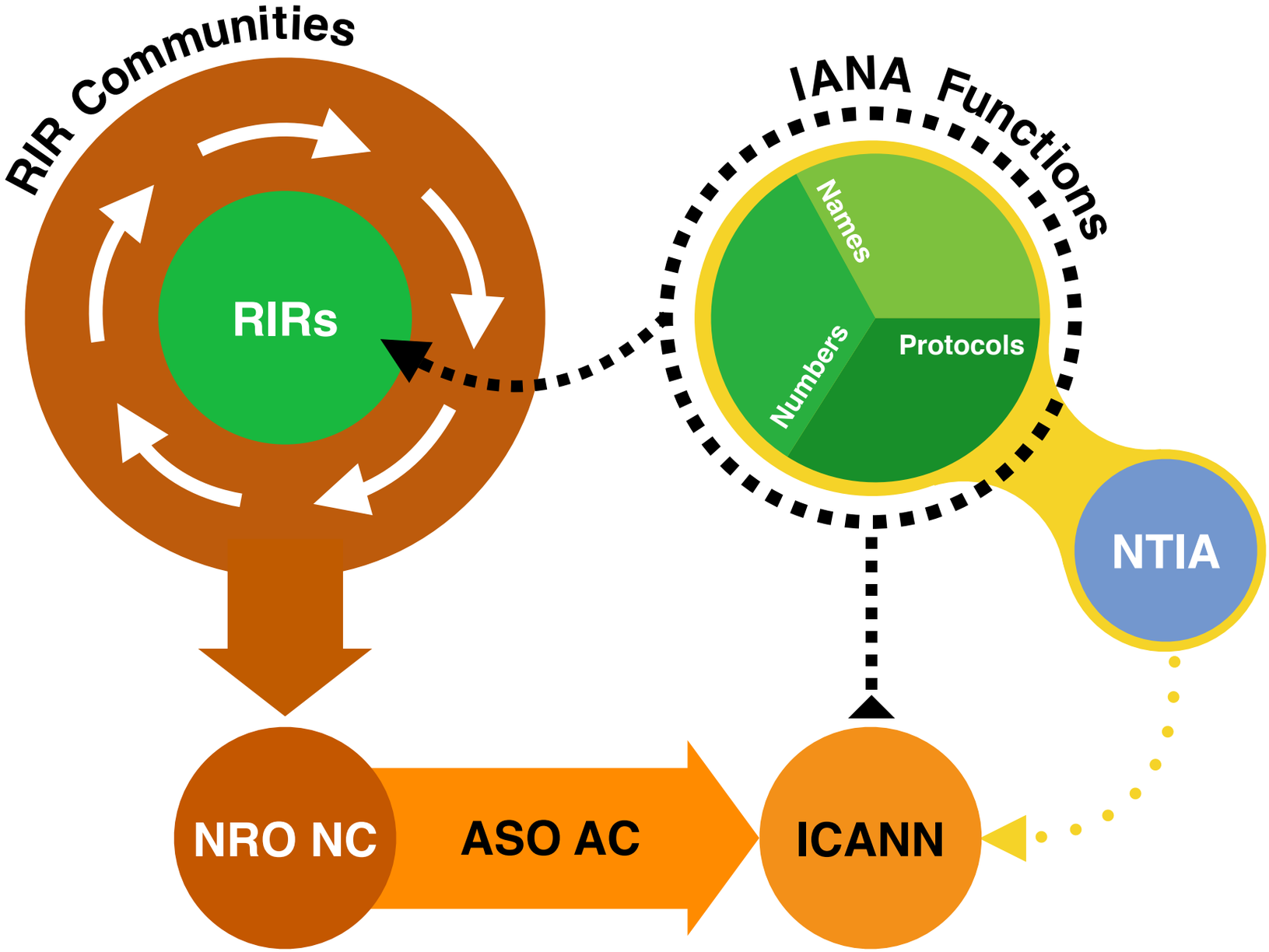

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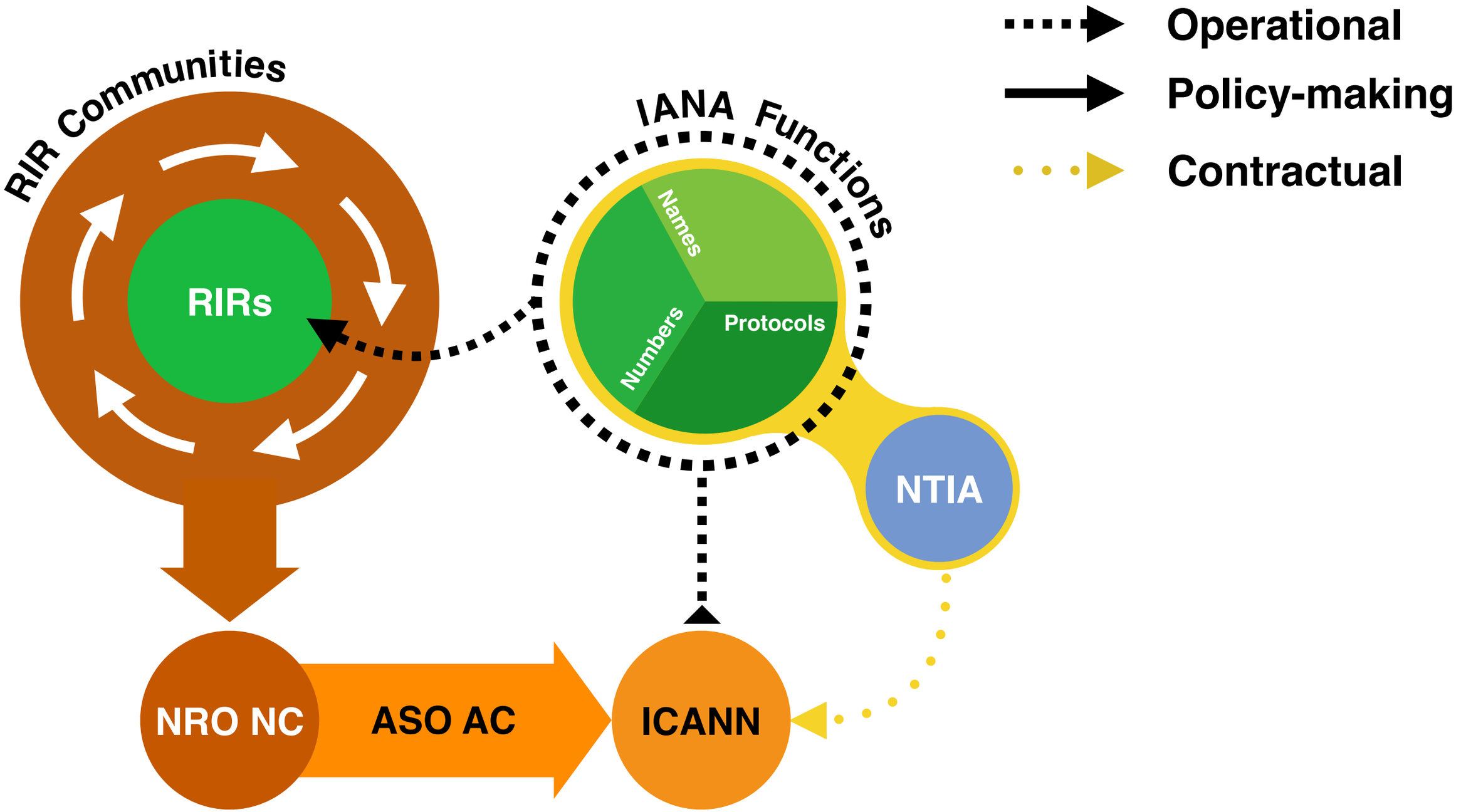
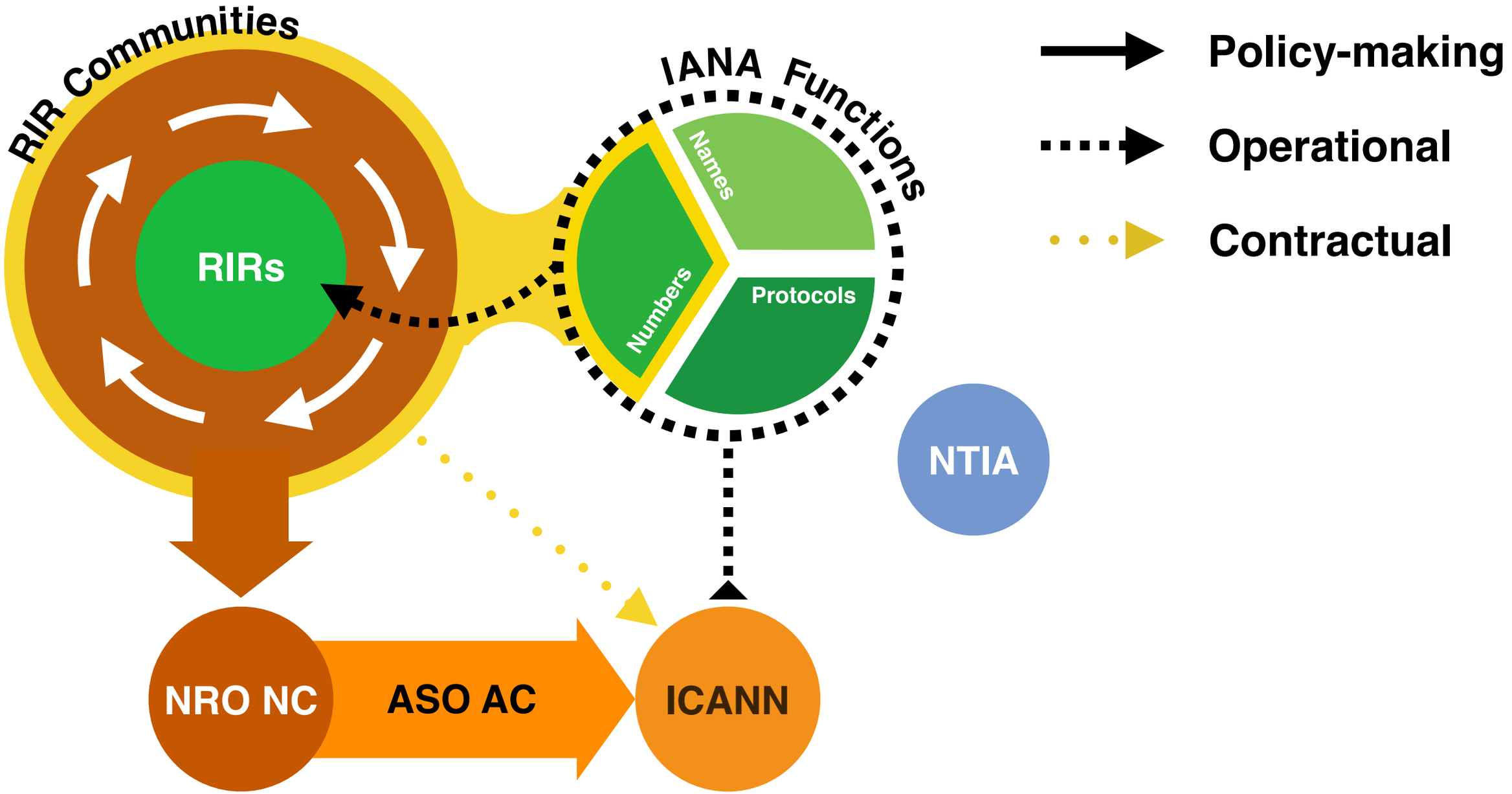
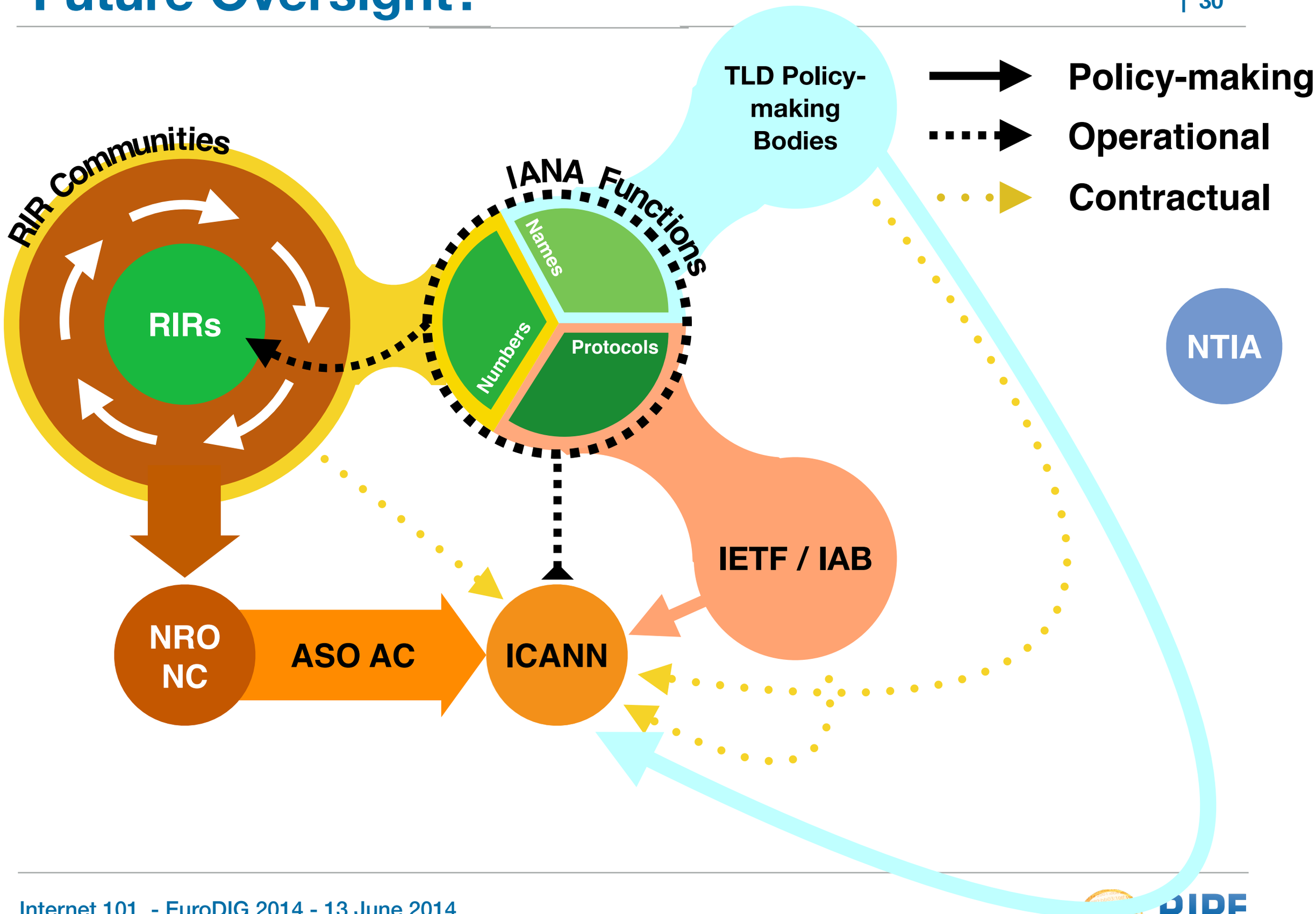
The IANA Functions



Future Oversight?



Future Oversight?



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Transition Process

- NTIA statement established certain ground rules:
  - Global, multi-stakeholder process convened by ICANN
  - Any proposal must meet certain requirements:

> ...the transition proposal must have broad community support and address the following four principles:
>
> - Support and enhance the multistakeholder model;
> - Maintain the security, stability, and resiliency of the Internet DNS;
> - Meet the needs and expectation of the global customers and partners of the IANA services; and,
> - Maintain the openness of the Internet.

Be Part of the Process!

- ICANN has established the ianatransition@icann.org mailing list
  - Also looking at a steering committee/coordination group to channel global input
- RIPE discussion will take place primarily within the Cooperation Working Group
  - There will also be discussion in other forums (MENOG, ENOG), RIPE NCC regional meetings
  - Output from these discussions will be fed into the global process
  - The RIPE NCC will facilitate coordination with other RIR communities

Questions?