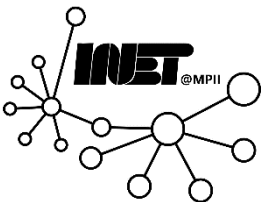# IP Anycast

Prof. Anja Feldmann, Ph.D.

Dr. Oliver Gasser
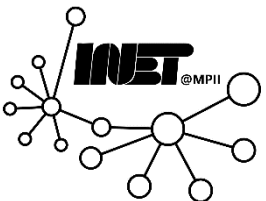
Introduction

Terminology

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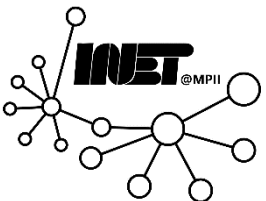
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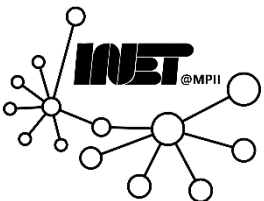 - Heavily used in IPv6 for signaling

- Anycast: Communication between a single source and any destination
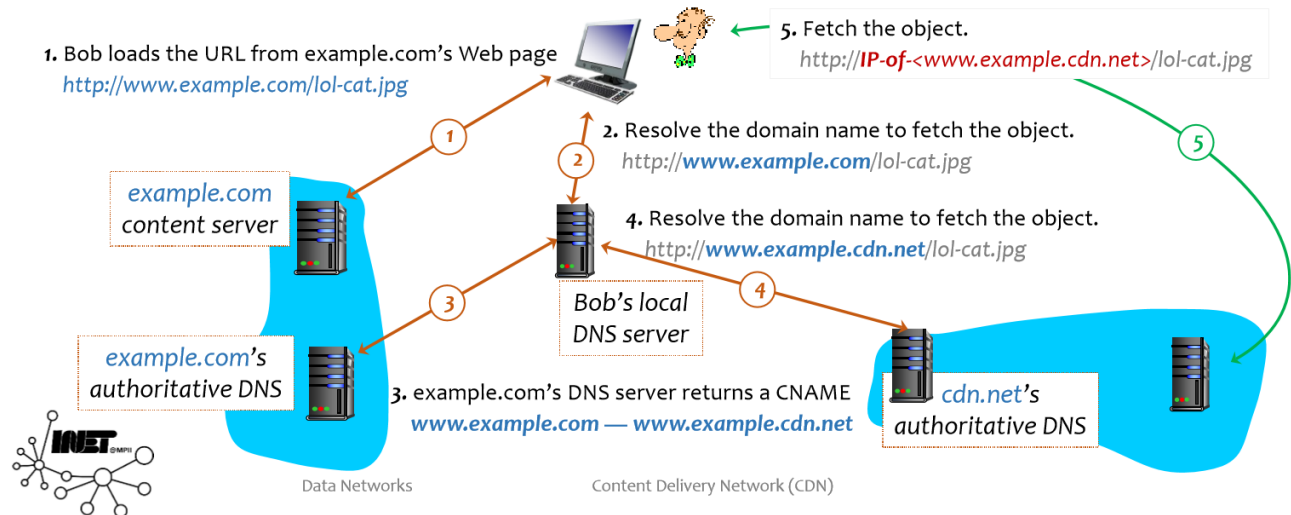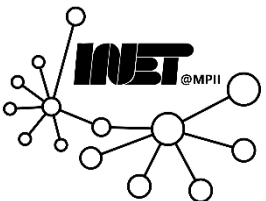 - Useful for communication to the closest server of a group of servers

Recall: CDN Lecture

Serving content via CDN

- User requests image at URL *http://**www.example.com**/lol-cat.jpg*
  - Image stored in CDN at *http://**www.example.cdn.net**/12lol34cat56*

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5. Fetch the object.
  *http://**IP-of**-<www.example.cdn.net>/lol-cat.jpg*

2. Resolve the domain name to fetch the object.
  *http://**www.example.com**/lol-cat.jpg*

example.com
content server

4. Resolve the domain name to fetch the object.
  *http://**www.example.cdn.net**/lol-cat.jpg*

Bob's local DNS server

example.com's authoritative DNS

3. example.com's DNS server returns a CNAME
  www.example.com — www.example.cdn.net

cdn.net's authoritative DNS

Data Networks   Content Delivery Network (CDN)   17

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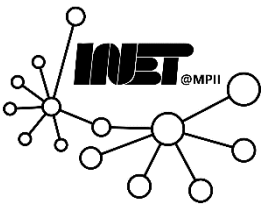Data Networks   Content Delivery Network (CDN)   17

- DNS-based load-balancing
  - DNS CNAME records

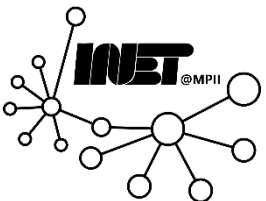- IP Anycast
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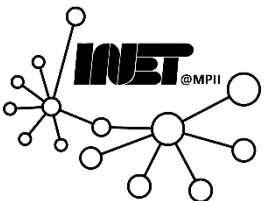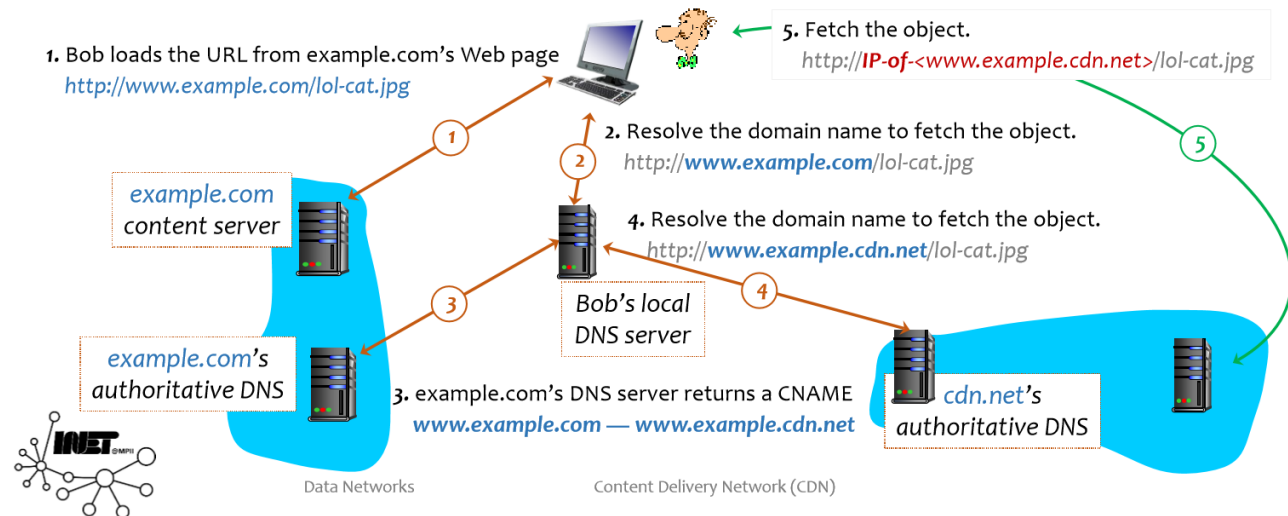
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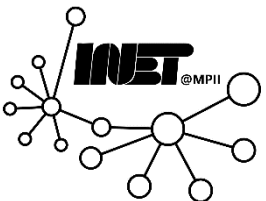 - No difference to regular unicast IP address

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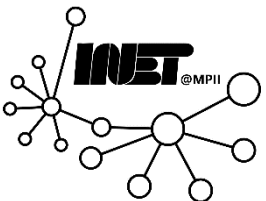 - Announce the same prefix from multiple locations in BGP
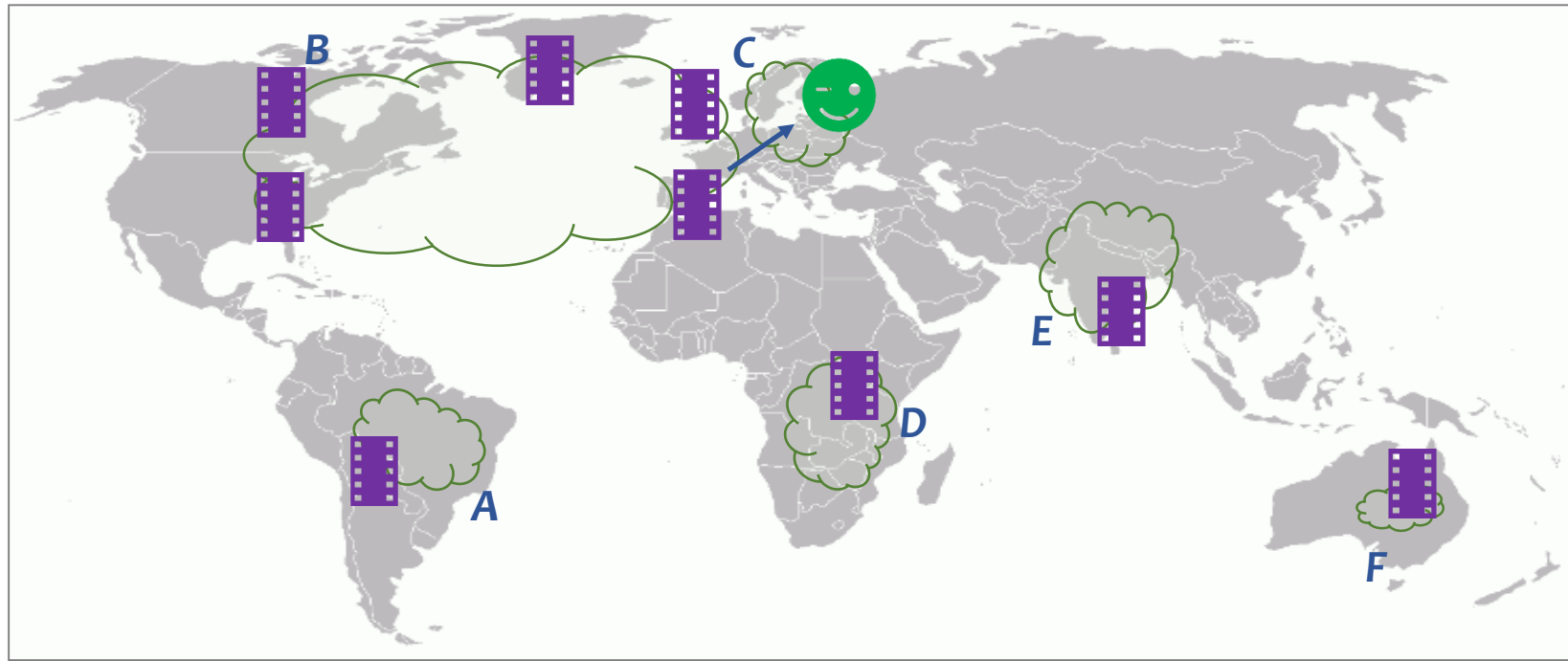
IP Anycast: BGP

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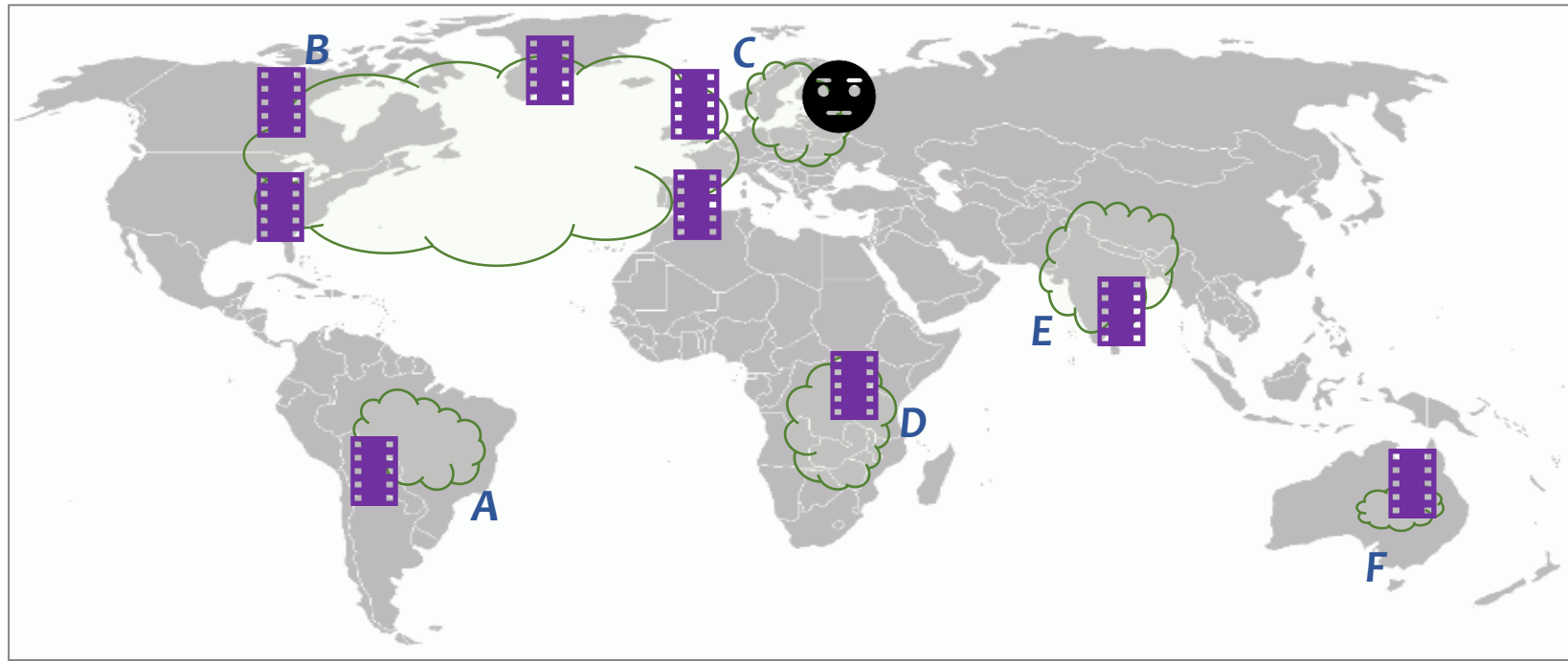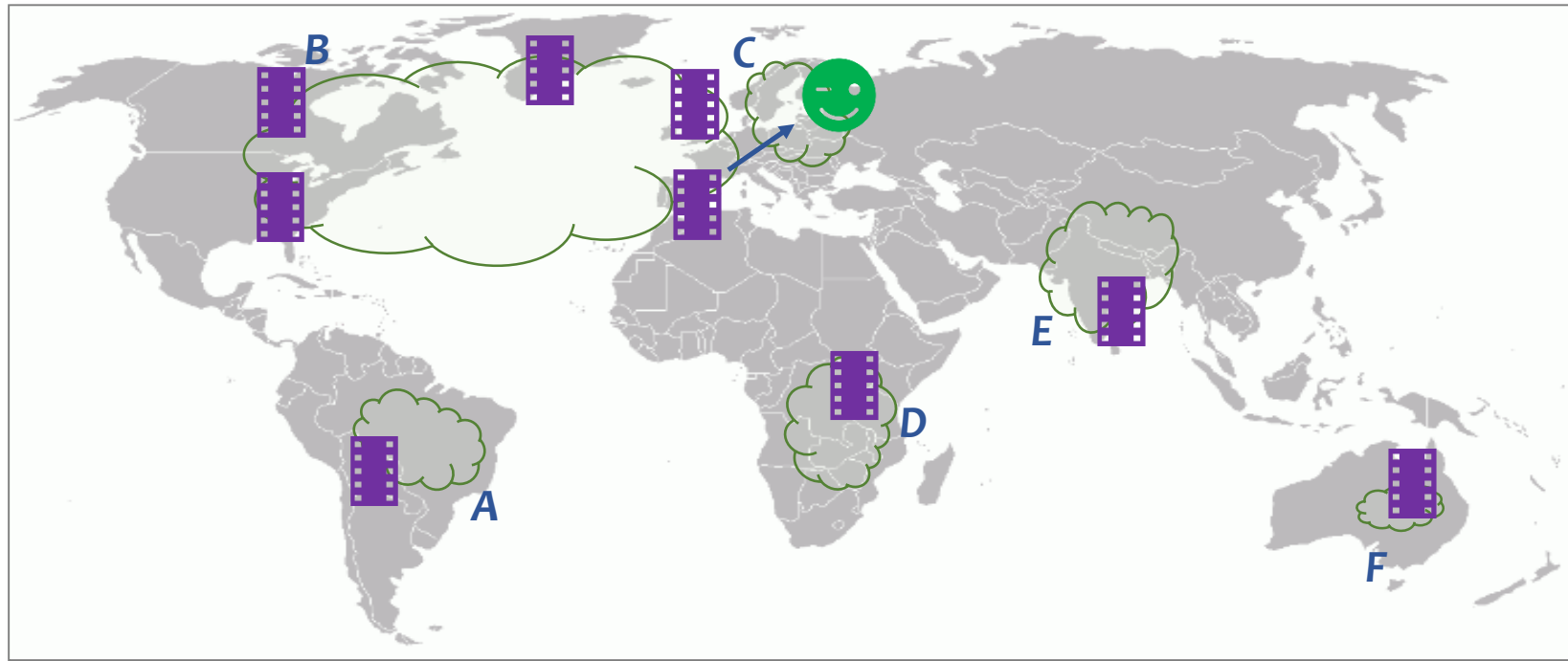
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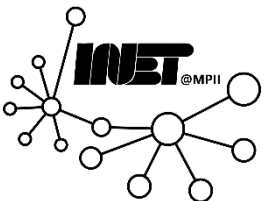- Announce the same IP prefix from multiple locations

IP Anycast: BGP

- Announce the same IP prefix from multiple locations

- BGP automatically "chooses" the nearest location

Challenges with IP Anycast

- Many factors influence BGP routing decision: AS path, local preference, BGP communities, MED,...

- Chosen anycast replica can change repeatedly
  - cf. "Broad and Load-Aware Anycast Mapping with Verfploeter" by de Vries et al.

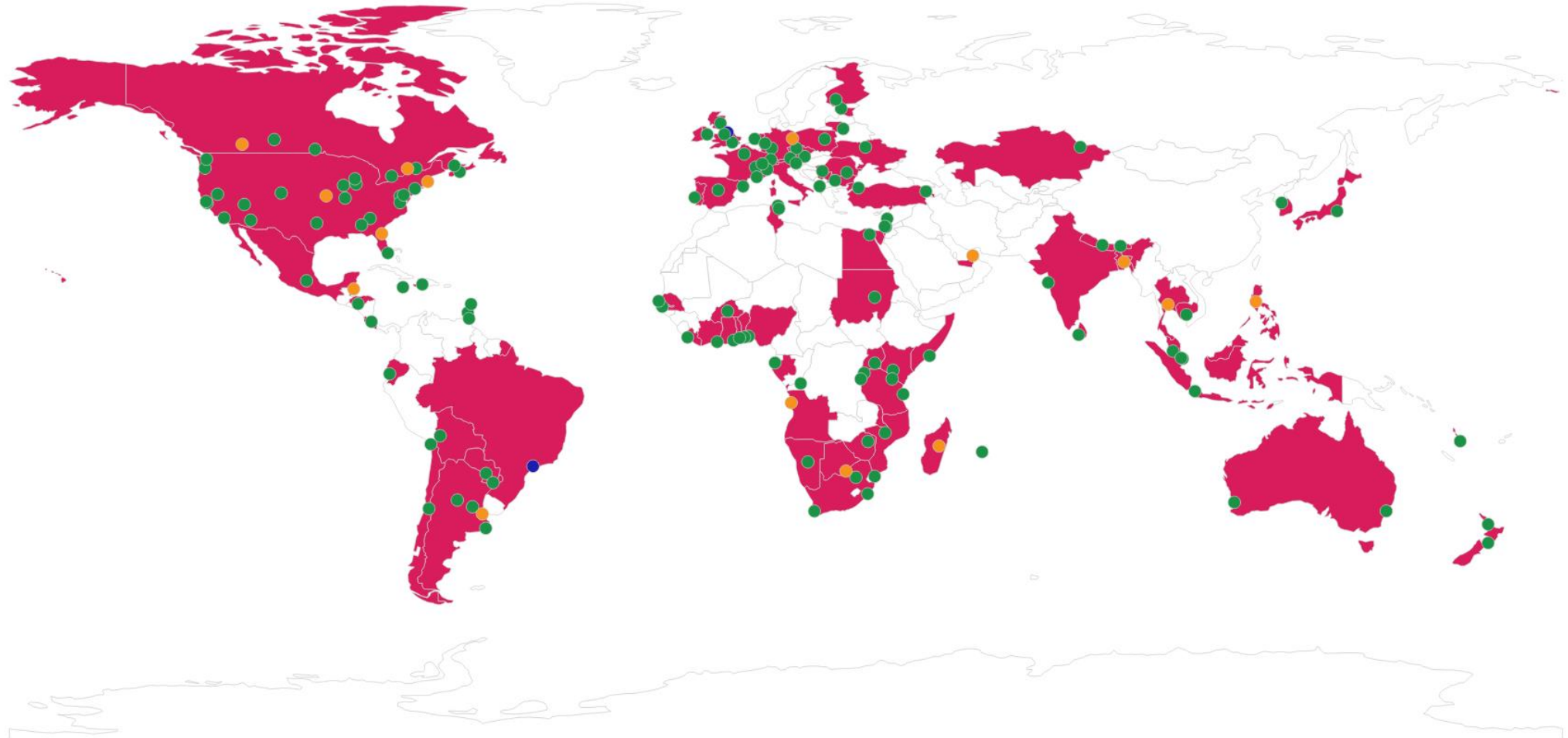- Connectionless services are best suited for IP anycast

Use Case: DNS Open Resolvers

- Google Public DNS
  - 8.8.8.8, 8.8.4.4, 2001:4860:4860::8888, 2001:4860:4860::8844

- 1.1.1.1: operated by Cloudflare
  - 1.1.1.1, 1.0.0.1, 2606:4700:4700::1111, 2606:4700:4700::1001

- Quad9: operated by PCH
  - 9.9.9.9, 149.112.112.112, 2620:fe::fe, 2620:fe::9
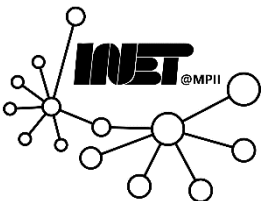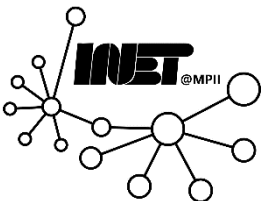
Quad9: 131 Anycast Replicas

POP Status: 131 online, 17 in bypass, 0 in maintenance, 0 degraded, 2 coming soon

Source: quad9.net

Data Networks   Anycast

EDNS Client Subnet

- Problem: the authoritative nameserver does not know the original client's IP address
    - DNS-based load-balancing using CNAMEs not really possible

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  - DNS-based load-balancing using CNAMEs not really possible

- Solution: EDNS Client Subnet DNS extension
  - Recursive resolver signals the original client's prefix
  - Authoritative nameserver can answer based on the client prefix

Recap

- IP anycast

- BGP enables anycast

- Use case: DNS open resolvers