Universität Münster

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IIJ Seminar

A brief look at cloud IBR

Ongoing work

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living.knowledge

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Who am I

- Hello, I’m Nils 👋
- First year PhD Student @ University of Münster, Germany
- Interested in network telescopes and new approaches to them
- Advised by Ralph Holz

🔭 Network telescope (mis)-adventures

Internet Background Radiation (IBR) & network telescopes

- IBR describes all unsolicited traffic a host receives
- Mainly made up of three types:
  - Scans
  - DDoS backscatter
  - Misconfigurations
- Captured mainly by the use of darknets / Internet telescopes
  - Typically deployed in unused IP ranges of university networks → UCSD-NT, MERIT-NT
  - May introduce bias, other notable approaches:
  - Deployment in company networks (Bailey et al. 2005)
  - Deployment at IXPs (Wagner et al. 2023)
  - Deployment in CDNs (Richter & Berger 2019)
  - Deployment in public clouds (Pauley et al. 2023)

Idea(s)

- Different telescopes/ vantage-points provide different views
- Understanding which is best for specific observations
- Cloud-based approaches seem promising
  - Still unclear what the best way to operate them is
  - e.g. Holding time of an IP Address,
  - VM configuration,
  - economic perspective

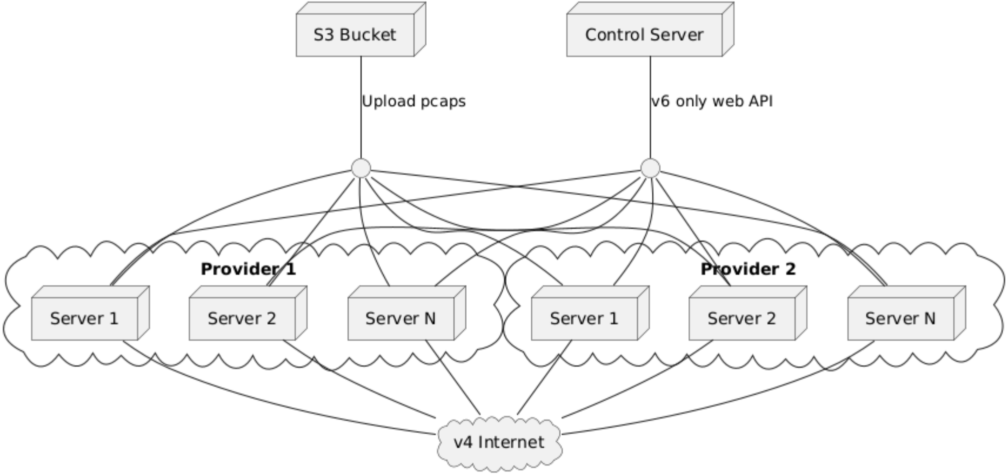
When do we need which lense?

- *current literature™* dosn't provide clear answers yet

Approach - data collection

- **Idea:** Build a distributed, multi-cloud network telescope
  - configurable lifetime
  - provider agnostic
  - variable size
- **Current state:**
  - Build with Terraform as Infrastructure as Code (IaC)
  - 5 cloud providers supported: AWS, GCP, Azure, Vultr, DigitalOcean
  - Create 1 VM/ IP per “availability zone”
  - approx. 300 VMs total

Approach - data collection



Cost consideration

Provider	Cost (IP/M)	Approach
DigitalOcean	4.0$	One VM per IP
OVH	1.8$	Leasing subnet
AWS	7.5$	One VM per IP
Azure	9.0$	One VM per IP
Azure	4.8$	Load balancer
GCP	8.5$	One VM per IP
GCP	5.4$	Load balancer
Alibaba	3.8$	VM with multiple IPs
Vultr	3.5$	One VM per IP

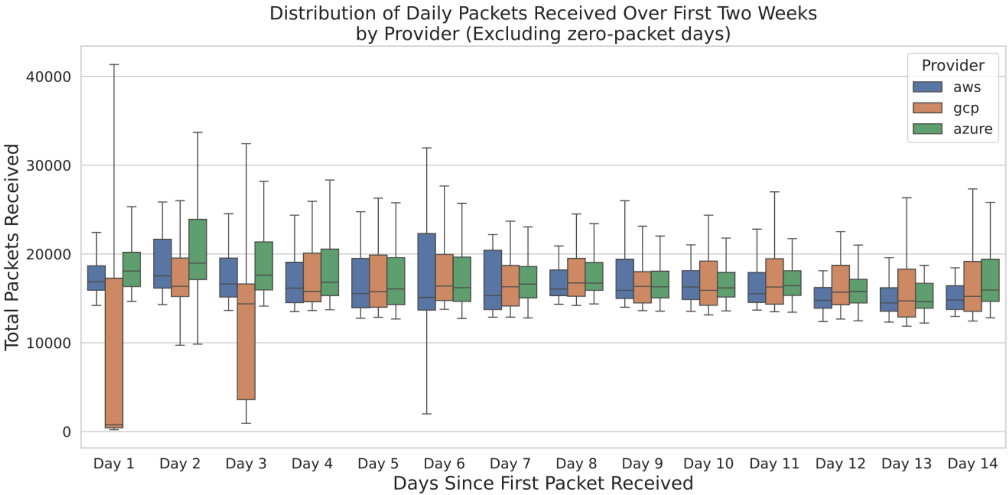
Deployment - learnings

- Deploying a cloud-telescope is hard
    - All cloud-providers work a bit different
    - Destination IPs are often not directly linked to the interface (NAT)
    - Old software
    - Cloud-internal traffic

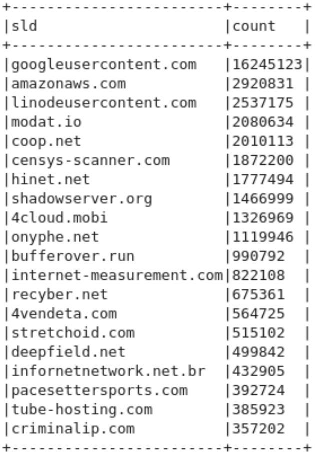
Deployment results

- Data collected over two weeks (April 3–17, 2025)
- Approx. 115k PCAP files
- Approx. 130M connections from 985k sources
- Stable Baseline of packets with notable variance

Deployment results

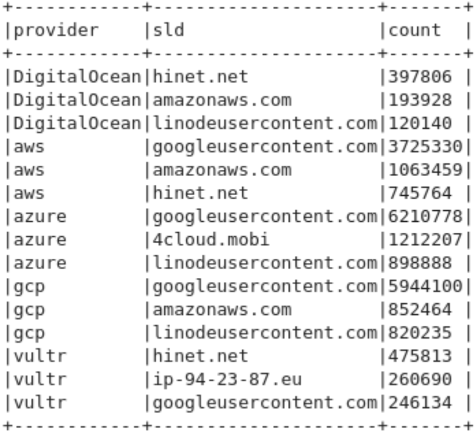


Deployment results



```
+------------------------+--------+
|sld                     |count   |
+------------------------+--------+
|googleusercontent.com   |16245123|
|amazonaws.com           |2920831 |
|linodeusercontent.com   |2537175 |
|modat.io                |2080634 |
|coop.net                |2010113 |
|censys-scanner.com      |1872200 |
|hinet.net               |1777494 |
|shadowserver.org        |1466999 |
|4cloud.mobi             |1326969 |
|onyphe.net              |1119946 |
|bufferover.run          |990792  |
|internet-measurement.com|822108  |
|recyber.net             |675361  |
|4vendeta.com            |564725  |
|stretchoid.com          |515102  |
|deepfield.net           |499842  |
|infornetnetwork.net.br  |432905  |
|pacesettersports.com    |392724  |
|tube-hosting.com        |385923  |
|criminalip.com          |357202  |
+------------------------+--------+
```

Figure: Top source SLDs over all



```
+------------+---------------------+-------+
|provider    |sld                  |count  |
+------------+---------------------+-------+
|DigitalOcean|hinet.net            |397806 |
|DigitalOcean|amazonaws.com        |193928 |
|DigitalOcean|linodeusercontent.com|120140 |
|aws         |googleusercontent.com|3725330|
|aws         |amazonaws.com        |1063459|
|aws         |hinet.net            |745764 |
|azure       |googleusercontent.com|6210778|
|azure       |4cloud.mobi          |1212207|
|azure       |linodeusercontent.com|898888 |
|gcp         |googleusercontent.com|5944100|
|gcp         |amazonaws.com        |852464 |
|gcp         |linodeusercontent.com|820235 |
|vultr       |hinet.net            |475813 |
|vultr       |ip-94-23-87.eu       |260690 |
|vultr       |googleusercontent.com|246134 |
+------------+---------------------+-------+
```

Figure: Top 3 source SLDs per provider

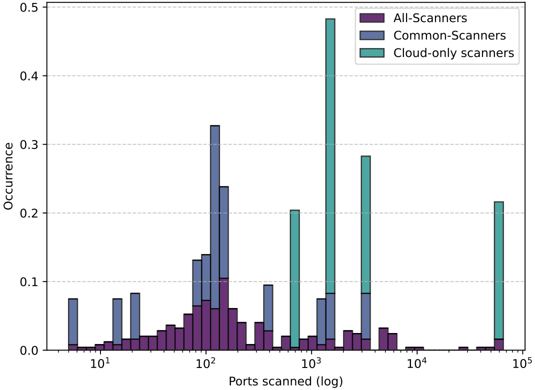
Future work - open questions

- Evaluate importance of cloud-telescope IP's history for IBR
- Evaluate traffic patterns across different regions and/or cloud-providers
- Evaluate best approach for cloud setup (e.g. responsiveness)
- Evaluate scanner behavior in cloud vs. "normal" telescopes

Current/ Future work

- Data enrichment:
  - OpenIntel reverse DNS data for source IPs
  - CAIDAs Hoiho for rDNS based geolocation
  - IPInfo geolocation
  - Routeviews prefix to ASN
- IDS scanner detection
- Filter cloud internal traffic
- Compare to other network telescopes

Future work - inspiration



- If you scan cloud address space you are likely to hit something
- Resource intensive scans could be more focussed and may not be seen in “normal” telescopes.
- Further investigation of cloud-scanner behavior is needed.

Questions?