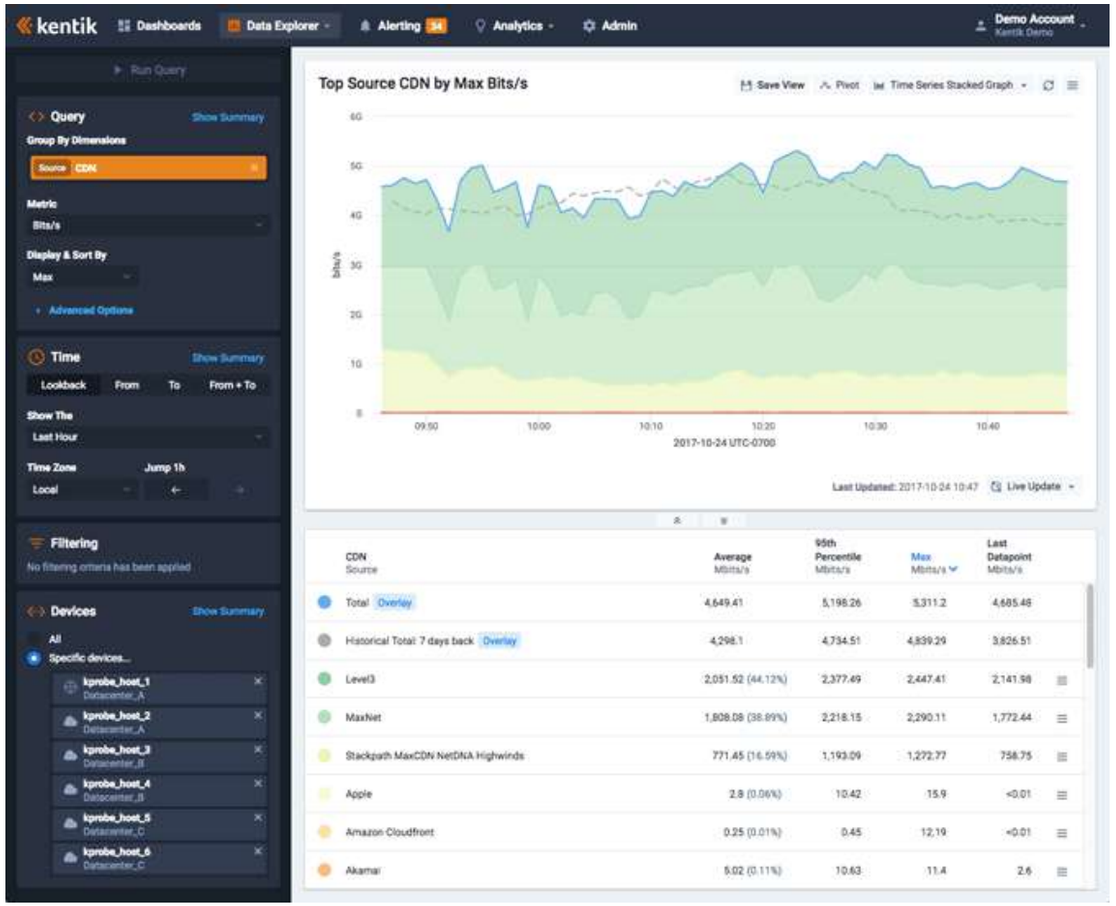
Akvorado: a Flow Collector and Visualizer

Vincent Bernat

2022-09-16 — FRnOG 36

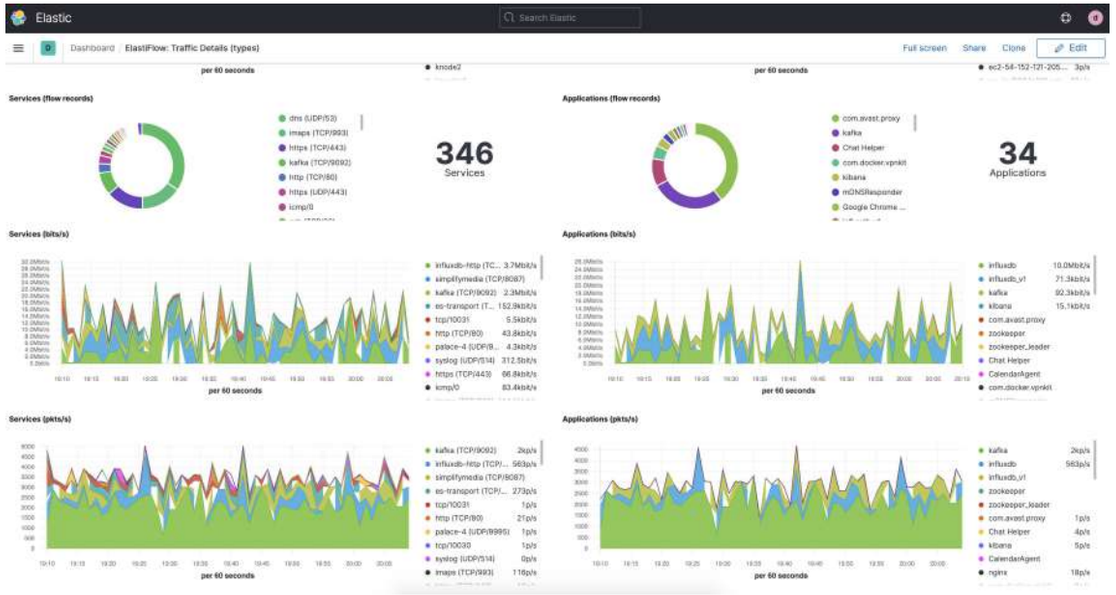
Existing solutions

Commercial solution: Kentik



- Easy to setup
- Featureful
- Hosted in the cloud
- Expensive
- Not open source

Commercial solution: Elastiflow



- Community edition available for free (as in beer) for low volume
- Self-hosted
- Expensive
- Not open source

DIY solution with open source

- pmacct + RabbitMQ + Elasticsearch + Kibana
- GoFlow2 + Kafka + ClickHouse + Grafana
- vflow + Kafka + Apache Pinot + Apache Superset
- Free (as in beer, as in speech)
- Flexible
- Self-hosted
- Some assembly required

New player: Akvorado

- NetFlow/IPFIX/sFlow collector
- Enrich data (GeoIP, interface names, classification)
- Serialize with Protobuf and send to **Kafka**
- Store data in **ClickHouse**
- Web UI to query data

Selling points

- Free (as in beer, as in speech)
- Performant
- No assembly required
- Web UI included
- Self-hosted

Free

- Published under the AGPLv3 license
- Developped by AS 12322
- No plan to sell anything

Performant

- Can be deployed on a single VM
- 1 TB, 64 GB, 24 vCPU
- 100k flows/s
- 5 year worth of data
- Older data is trimmed:
  - 1-minute, 5-minutes, 1-hour resolution
  - IP addresses and ports removed

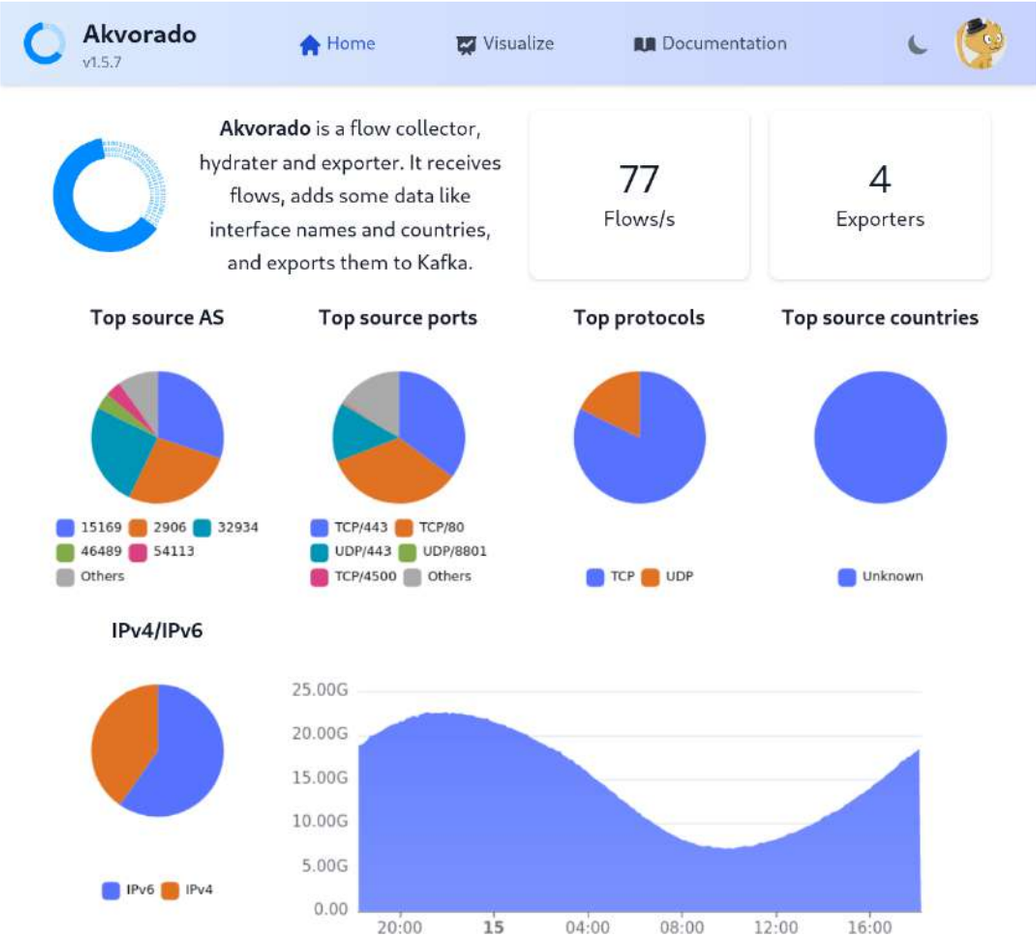
No assembly required

- Getting started with `docker-compose up`
- No knowledge of Kafka/ClickHouse required
- Special attention to simplify the operations (logs, metrics, backward compatibility of configuration files, automatic migrations)
- No magic: you still need to read the documentation

Shipped with a web frontend

- See your data immediately
- Test it on demo.akvorado.net

Homepage


Akvorado
v1.5.7
Home
Visualize
Documentation
Akvorado is a flow collector, hydrater and exporter. It receives flows, adds some data like interface names and countries, and exports them to Kafka.
77
Flows/s
4
Exporters
Top source AS
15169
2906
32934
46489
54113
Others
Top source ports
TCP/443
TCP/80
UDP/443
UDP/8801
TCP/4500
Others
Top protocols
TCP
UDP
Top source countries
Unknown
IPv4/IPv6
IPv6
IPv4
25.00G
20.00G
15.00G
10.00G
5.00G
0.00
20:00
15
04:00
08:00
12:00
16:00

Dark mode


Akvorado
v1.5.7
Home
Visualize
Documentation
Akvorado is a flow collector, hydrater and exporter. It receives flows, adds some data like interface names and countries, and exports them to Kafka.
77
Flows/s
4
Exporters
Top source AS
Top source ports
Top protocols
Top source countries
15169
2906
32934
46489
54113
Others
TCP/443
TCP/80
UDP/443
UDP/8801
TCP/4500
Others
TCP
UDP
Unknown
IPv4/IPv6
IPv6
IPv4
25.00G
20.00G
15.00G
10.00G
5.00G
0.00
20:00
15
04:00
08:00
12:00
16:00

Visualize


Akvorado
v1.5.7
Home
Visualize
Documentation
September 13, 2022 6:26 PM — September 15, 2022 6:26 PM
Stacked areas
10
25.00G
20.00G
15.00G
10.00G
5.00G
0.00
14
06:00
12:00
18:00
15
06:00
12:00
SRC AS
MIN
MAX
AVERAGE
~95TH
2906: Netflix
429.96Mbps
8.86Gbps
4.63Gbps
8.80Gbps
15169: Google
749.10Mbps
6.30Gbps
4.16Gbps
6.23Gbps

Documentation

Akvorado v1.5.7 | Home | Visualize | Documentation

GeoIP

The GeoIP component adds source and destination country, as well as the AS number of the source and destination IP if they are not present in the received flows. It needs two databases using the MaxMind DB file format, one for AS numbers, one for countries. If no database is provided, the component is inactive. It accepts the following keys:

- `asn-database` tells the path to the ASN database
- `geo-database` tells the path to the geo database (country or city)
- `optional` makes the presence of the databases optional on start (when not present on start, the component is just disabled)

If the files are updated while *Akvorado* is running, they are automatically refreshed.

SNMP

Flows only include interface indexes. To associate them with an interface name and description, SNMP

Getting started

Five first minutes

1. Grab the tarball from GitHub
2. Unpack and rename the directory to `akvorado`
3. `docker-compose up`
4. Point your browser to port 8081

Next hour

1. Grab the tarball, unpack and rename the directory.
2. Remove the `demo-exporter` section from `akvorado.yaml`
3. Remove `akvorado-exporter*` from `docker-compose.yml`
4. Configure everything else!

Flows

- No configuration needed on Akvorado side.
- Send IPFIX/Netflow to port 2055.
- Send sFlow to port 6343.

SNMP

- Interface names and descriptions with SNMP polling
- The source IP used for flows is used to query SNMP
- This is a mandatory step
- Configure the SNMP community in `akvorado.yaml`
- Check the documentation for details

Router classification

- A router can be attached to a group, role, site, region, and tenant
- Classification is done through rules
- This is not a mandatory step
- Brush up on your regex skills!

```
exporter-classifiers:
  - ClassifySiteRegex(Exporter.Name, "^([^-]+)-", "$1")
  - Exporter.Name endsWith ".it" && ClassifyRegion("italy")
  - Exporter.Name matches "^(washington|newyork).*" && ClassifyRegion("usa")
  - Exporter.Name endsWith ".fr" && ClassifyRegion("france")
```

Interface classification

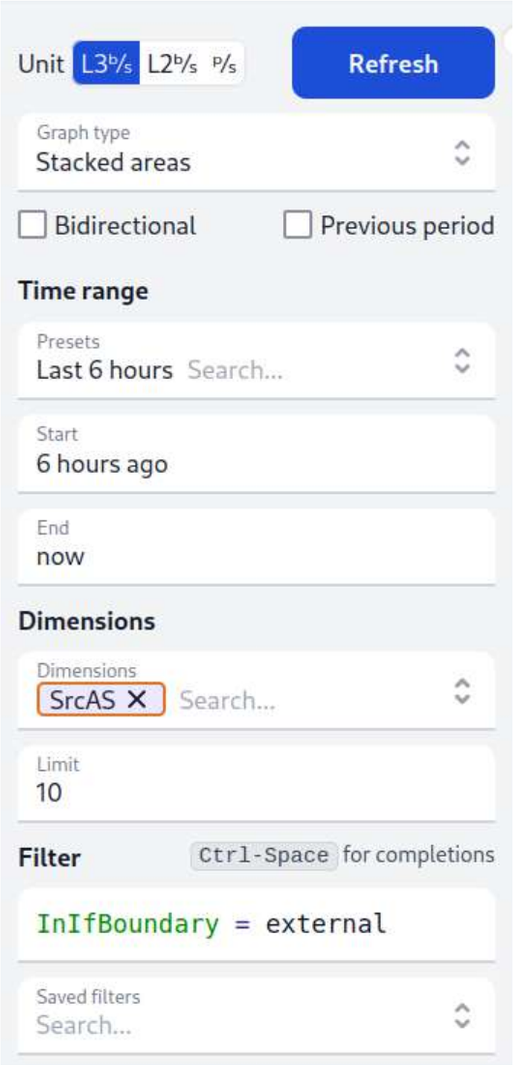
- Boundary: external, internal, or unclassified.
- Connectivity type: transit, PNI, PPNI, IX, ...
- Provider: Cogent, Telia, Scaleway, ...
- This step is not mandatory, but highly recommended.

```
interface-classifiers:
  - |
    ClassifyConnectivityRegex(Interface.Description, "^(?i)(transit|pni|ppni|ix):? ", "$1")
    ClassifyProviderRegex(Interface.Description, "^[^ ]+ ([^ ]+)", "$1") &&
    ClassifyExternal()
  - ClassifyInternal()
```

Remaining steps

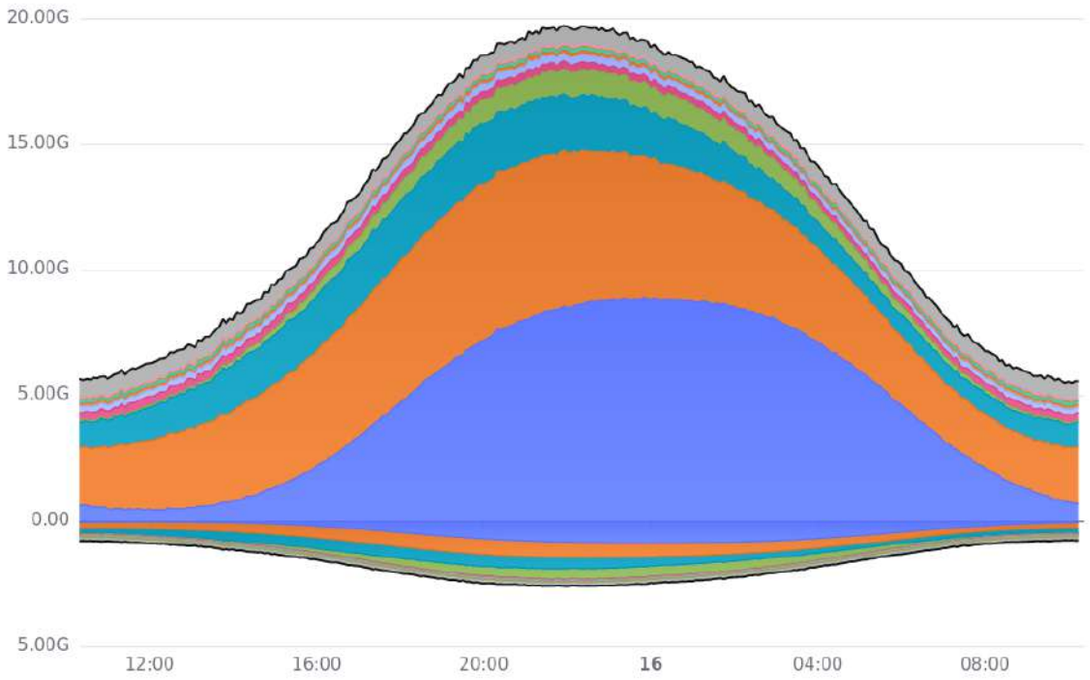
- Check the web interface
- Check the configuration section in the documentation
- Check the troubleshooting section too

Web UI



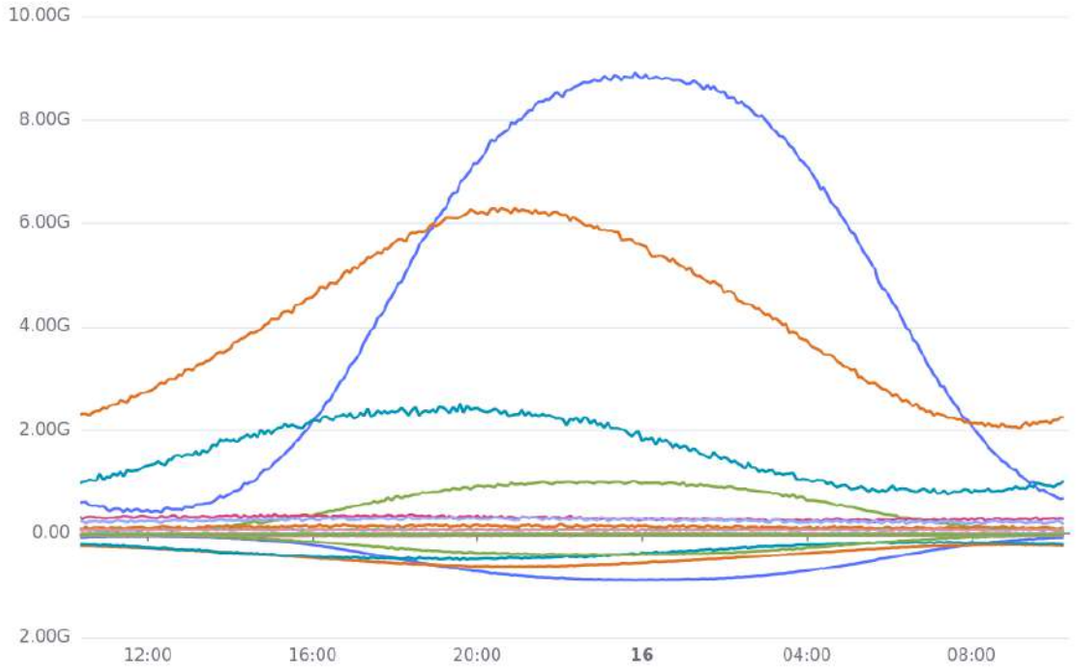
- Graph type: stacked areas, lines, grid, or sankey
- Time range: preset or manually specified
- Dimensions: group data by AS, countries, providers, ...
- Filters: using an SQL-like language

Examples



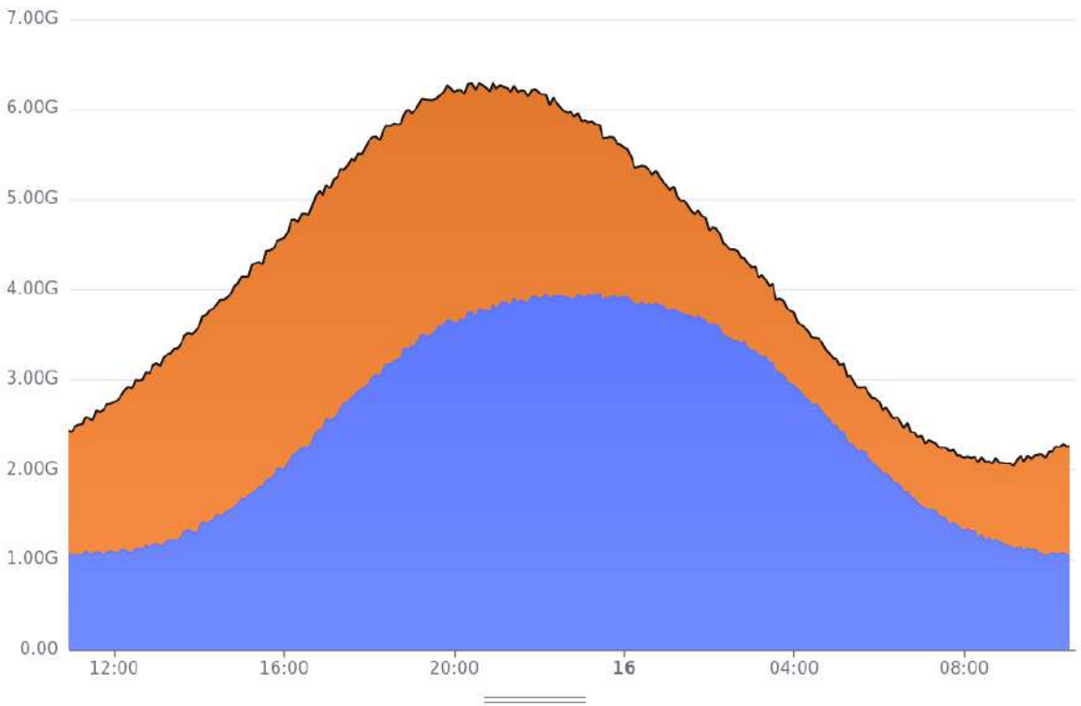
- Stacked areas
- Dimensions: `SrcAS`
- `InIfBoundary = external AND InIfProvider = "cogent"`

Examples



- Lines
- Dimensions: `SrcAS`
- `InIfBoundary = external AND InIfProvider = "cogent"`

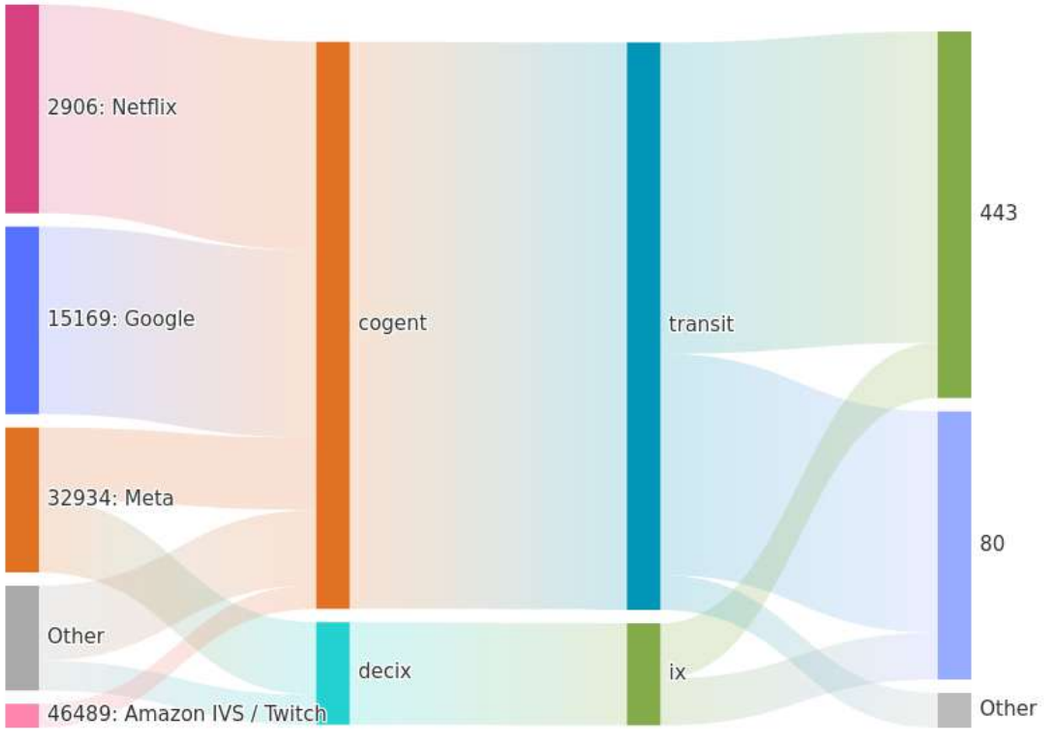
Examples



	ETYPE	MIN	MAX	AVERAGE	~95TH
	IPv6	1.04Gbps	3.95Gbps	2.51Gbps	3.92Gbps
	IPv4	702.26Mbps	2.68Gbps	1.69Gbps	2.63Gbps

- Stacked areas
- Dimensions: EType
- `InIfBoundary = external AND SrcAS IN (AS15169, AS36040)`

Examples

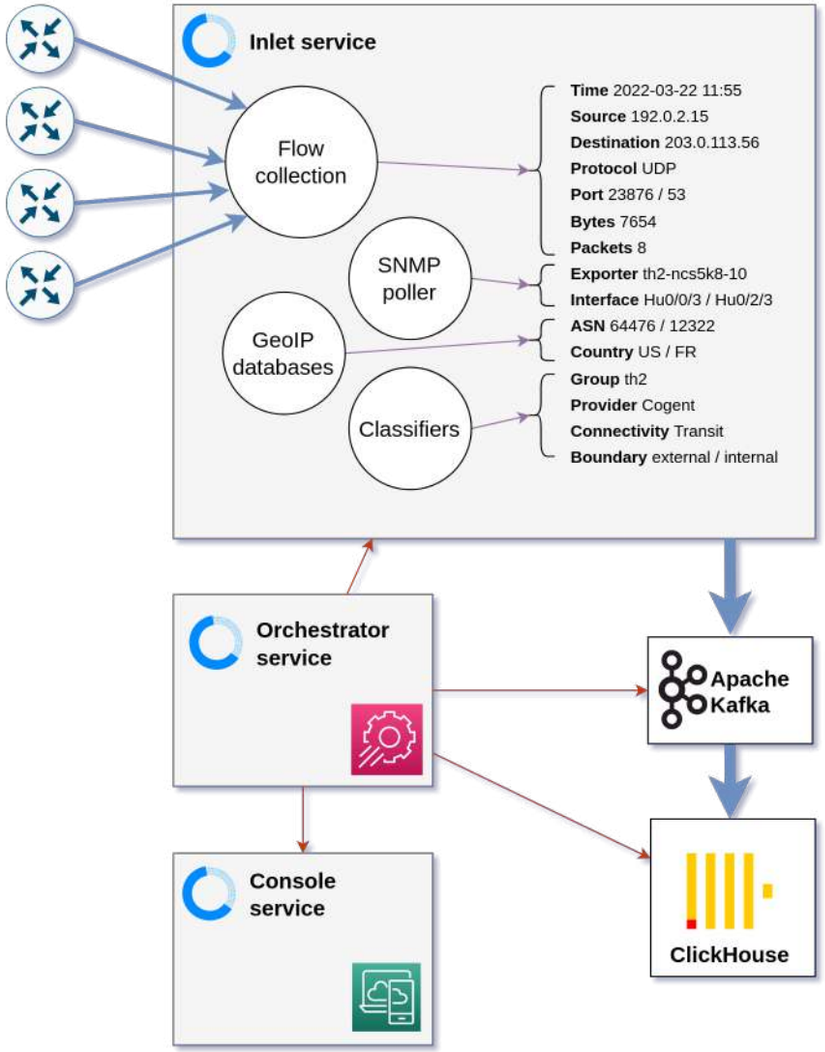


- Sankey
- Dimensions: `SrcAS`, `InIfProvider`, `InIfConnectivity`, `SrcPort`
- `InIfBoundary = external`

About AS names

- PeeringDB: most likely correct but incomplete
- RIR: complete but funny names (2906 is `AS-SSI`)
- Mix them, apply some cleaning rules, export as CSV, build weekly: https://vincentbernat.github.io/asn2org/
- Also use DB-IP as ARIN refuses to make the data available

Under the hood



- Written in Go
- **Inlet**: receive flows, add data, serialize to protobuf, send to Kafka
- **Console**: Web UI (including an API)
- **Orchestrator**: configure Kafka, ClickHouse, inlet, and console

Open source components (backend)

- GoFlow2 for collecting flows
- Shopify's `sarama` to talk with Kafka
- Prometheus Go client for metrics
- `zerolog` for logging
- Cobra for command-line handling
- Anton Medvedev's expr language
- Gin Web Framework
- mapstructure + validator for configuration files

Open source components (infrastructure)

- Apache Kafka as a bus message
  - Producers and consumers can be distributed
  - Well-known and low overhead
- ClickHouse as a database
  - Columnar database
  - SQL-like language
  - Super performant and low effort
  - Many functions

Open source components (frontend)

- Vue.js as the reactive framework
- Vite as the builder
- Tailwind as the CSS framework
- Headless UI and Flowbite for components
- CodeMirror as the text editor for filters
- Apache ECharts for graphs

Anti-DDOS

- Query ClickHouse every 10 seconds
- Build a FlowSpec rule to mitigate the attack

ClickHouse query

```
SELECT TimeReceived, DstAddr, protocol, SrcPort, Gbps, flows, sources, countries
FROM (SELECT
 toStartOfMinute(TimeReceived) AS TimeReceived,
 dictGetOrDefault('protocols', 'name', Proto, '???') AS protocol,
 DstAddr, SrcPort,
 SUM(Bytes*SamplingRate*8/1000/1000/1000)/300 AS Gbps,
 quantile(0.1)(Bytes/Packets) AS size,  COUNT(*) AS flows,
 uniq(SrcAddr) AS sources, uniq(SrcCountry) AS countries
FROM flows
WHERE TimeReceived > date_sub(minute, 5, now())
GROUP BY TimeReceived, DstAddr, protocol, SrcPort
)
WHERE (sources > 50 OR countries > 10)
 AND Gbps > 0.2 AND protocol = 'UDP'
ORDER BY TimeReceived DESC, Gbps DESC
```

FlowSpec rule

```
# Time: 2022-09-15 23:55:00 - 2022-09-15 23:55:00
# Source: 198.0.2.111, protocol: UDP, port: 123
# Gbps/Mpps: 1.61/0.432, packet size: 468<=X<=468
# Flows: 544, sources: 413, countries: 57

route flow4 {
  dst 78.193.168.168/32;
  sport = 123;
  length = 468;
  proto = 17;
}{
  bgp_ext_community.add((generic, 0x80060000, 0x00000000));
  bgp_community.add((65535, 65282));
};
```

Future plans

- BGP support for AS paths, communities, origin AS
- Forecasting and anomaly detection
- VRF support
- Dashboards

free

Questions?

- GitHub: https://github.com/akvorado/akvorado
- Demo: https://demo.akvorado.net