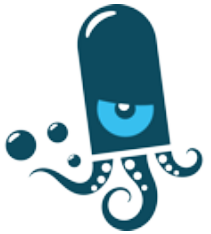
# Collecting telemetry data with pmacct

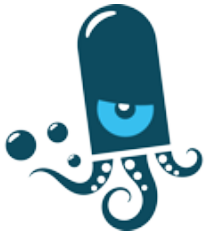


Paolo Lucente

pmacct

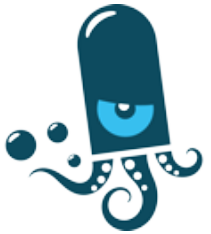
AfPIF 2017, Abidjan – Aug 2017

# Presentation history



- 1.1:
  - MENOG 13 meeting, Kuwait City, Sep 2013
- 1.2:
  - SEE 3 meeting, Sofia, Apr 2014
- 1.3:
  - AfPIF 2017 meeting, Abidjan, Aug 2017

# Collecting telemetry data with pmacct



## Agenda

- **Introduction**
- pmacct architecture & benefits
- example, data aggregation: traffic matrices
- example, logging micro-flows or events
- tee: briefly on horizontal scalability

# whoami

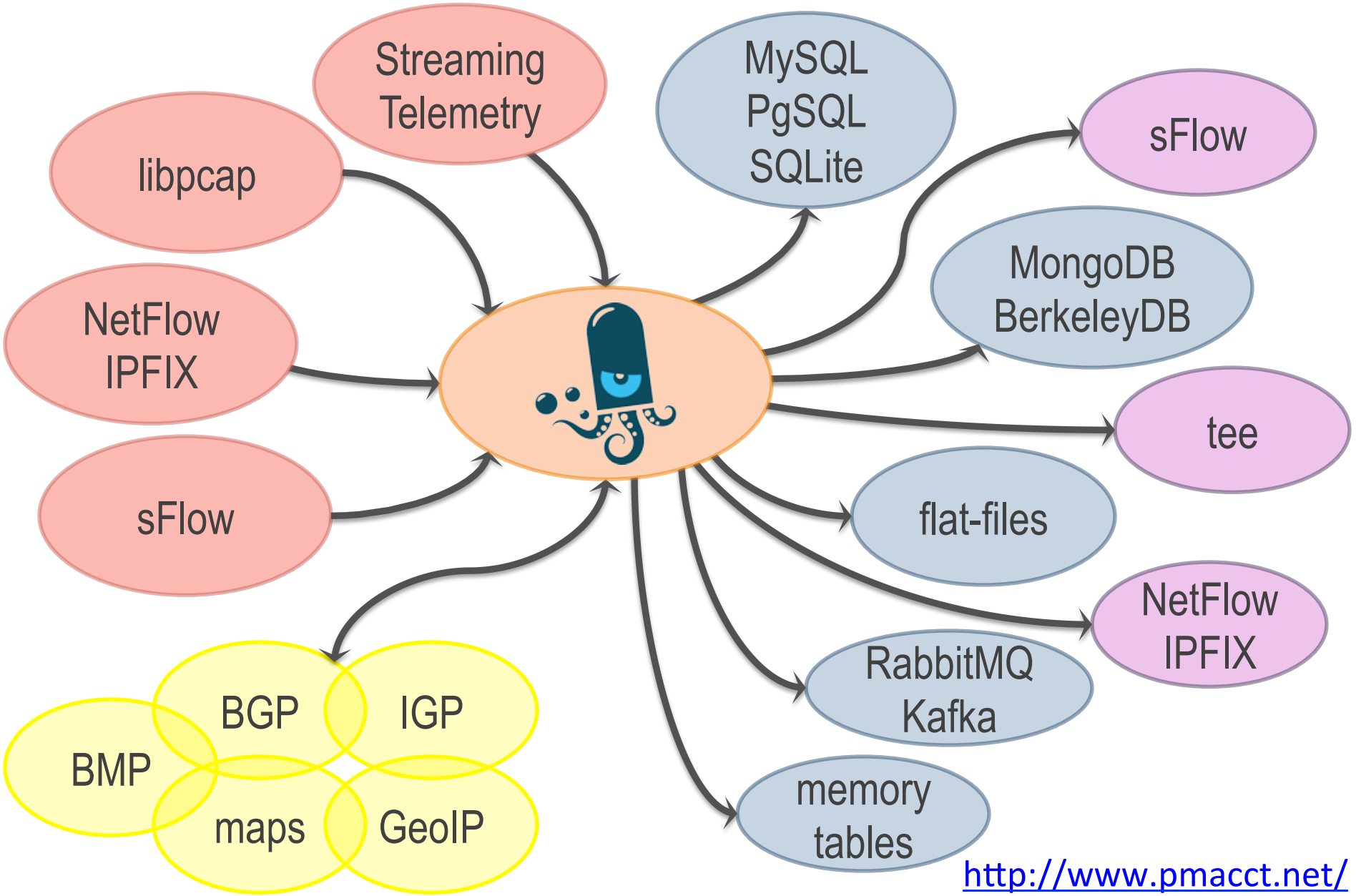
Paolo Lucente

GitHub: paololucente

LinkedIn: plucente

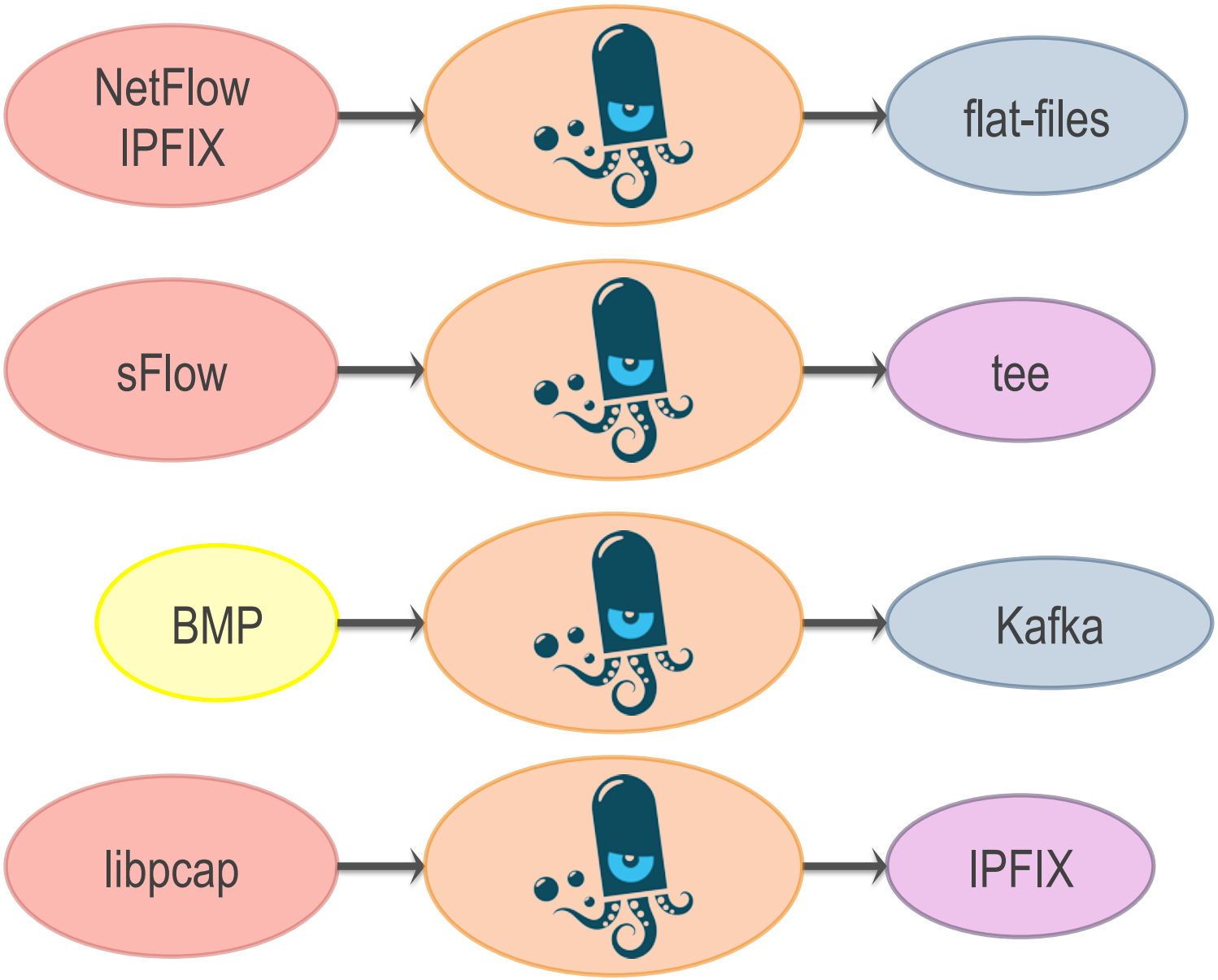
Digging data out of networks worldwide for fun and profit for more than 10 years

# pmacct is open-source, free, GPL'ed software

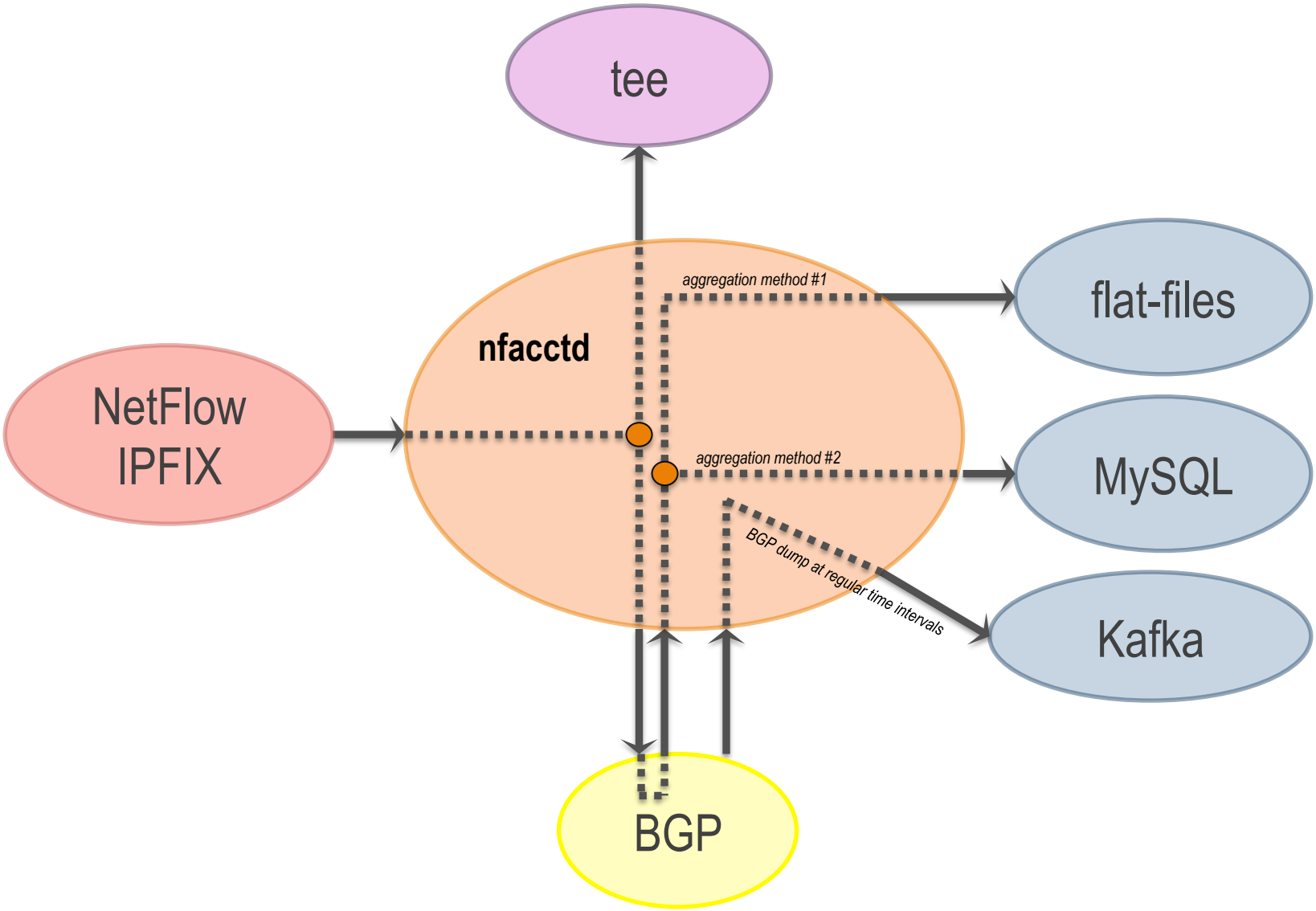



http://www.pmacct.net/

# pmacct: a few simple use-cases

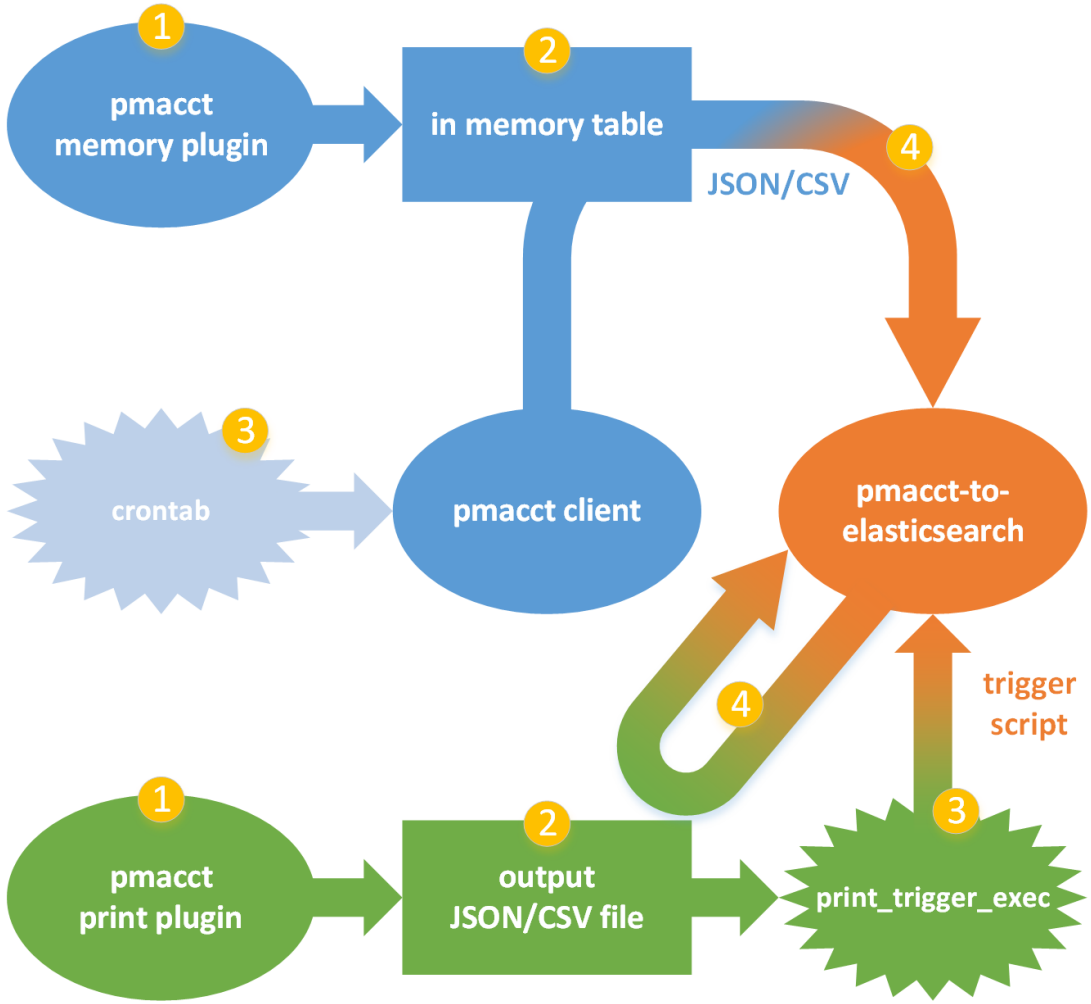


# pmacct: a slightly more complex use-case



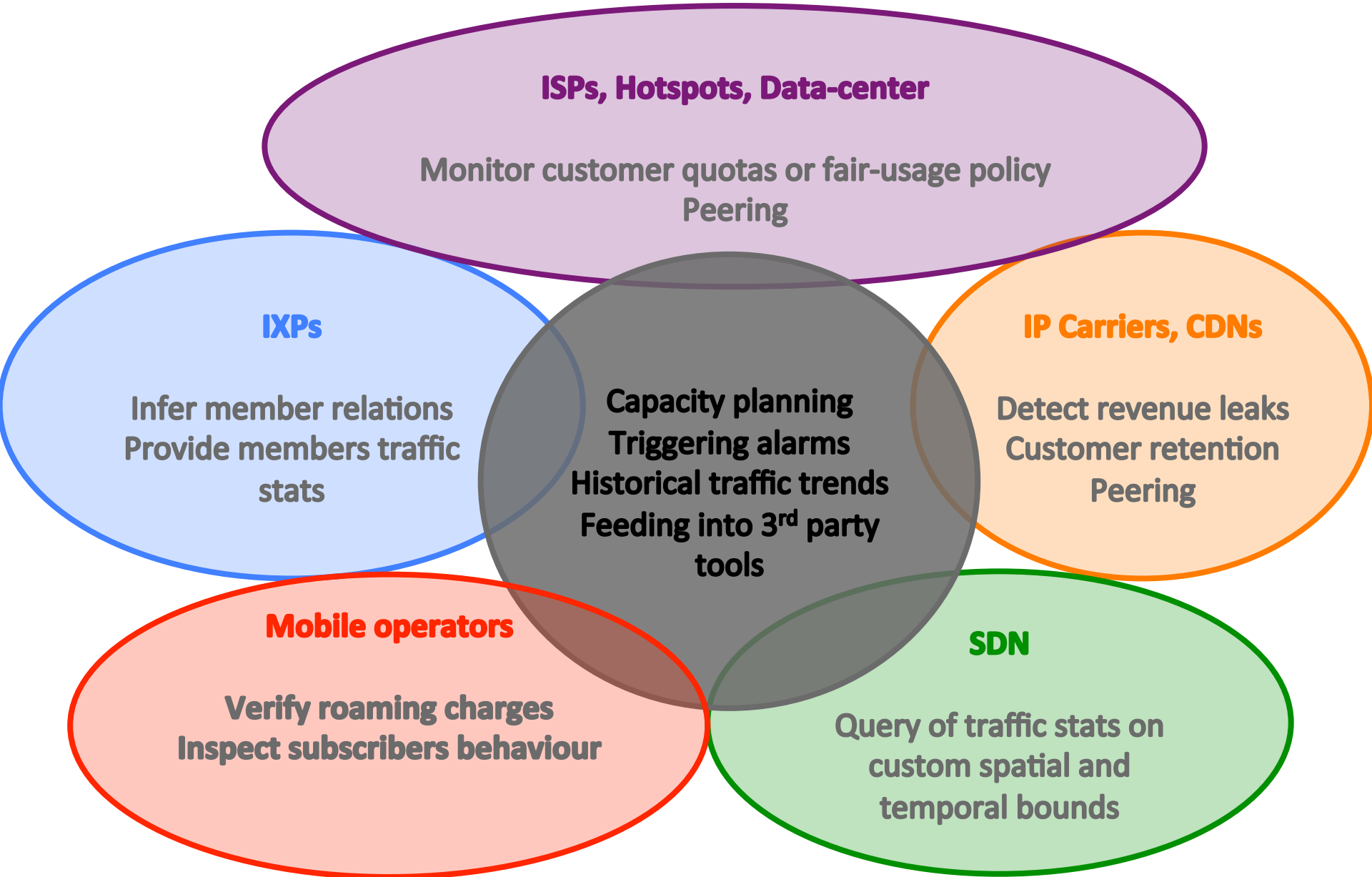
# The use-case for message brokers

# pmacct-to-elasticsearch 0.3.0




Credits to: Pier Carlo Chiodi, https://github.com/pierky/pmacct-to-elasticsearch

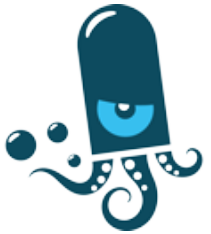
# Use cases by industry



# Key pmacct non-technical facts

- 10+ years old project
- Can’t spell the name after the second drink
- Free, open-source, independent
- Under active development
- Innovation being introduced
- Well deployed around, also in large SPs/IXPs
- Close to the SP/IXP community needs

# Collecting telemetry data with pmacct



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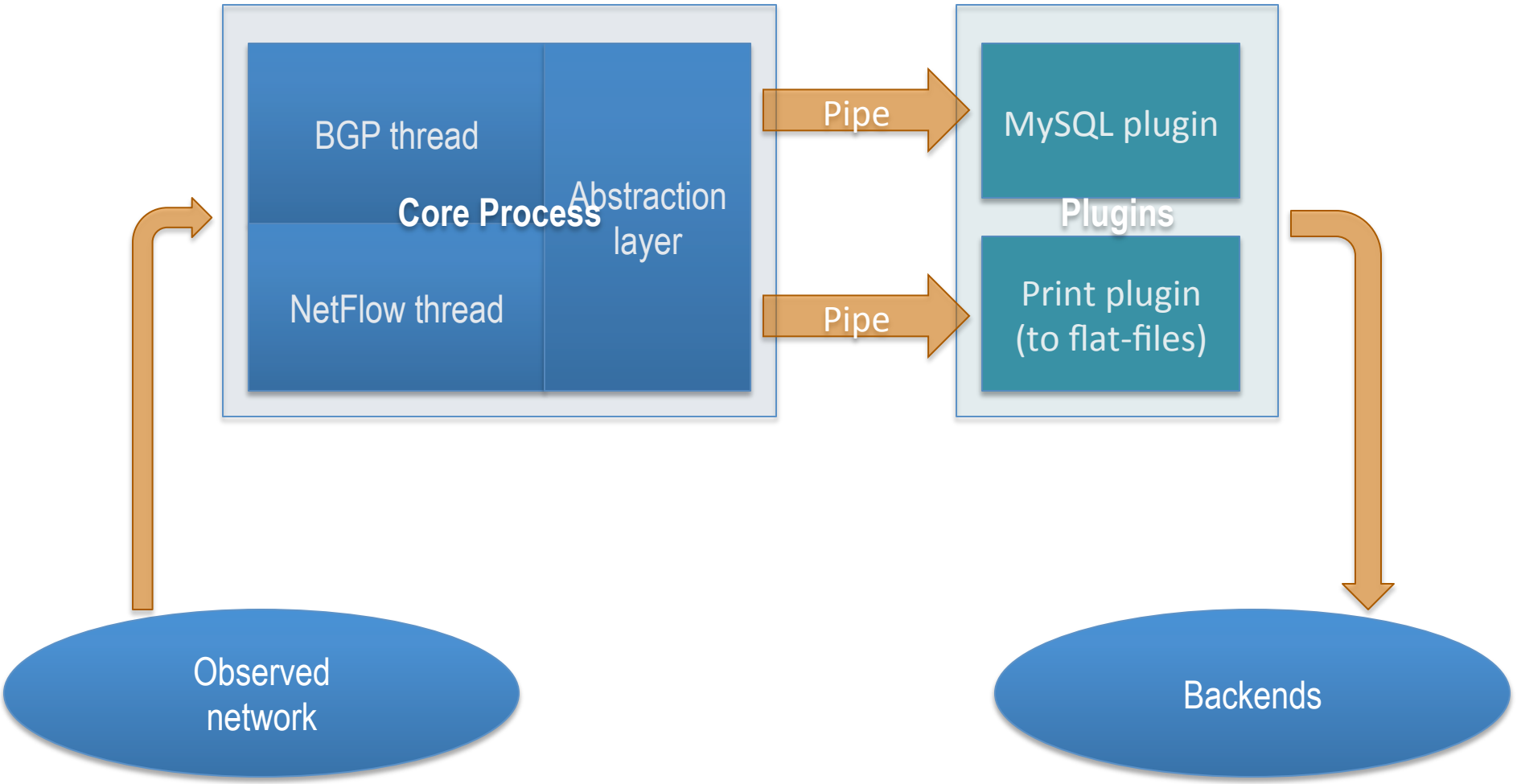
# Some technical facts

- Pluggable architecture:
  - Can easily add support for new data sources and backends
- Correlation of data sources:
  - Natively supported data sources (ie. flow telemetry, BGP, BMP, IGP, Streaming Telemetry)
  - Enrich with external data sources via tags and labels
- Enable analytics against each data source:
  - Stream real-time
  - Dump at regular time intervals (possible state compression)

# Some technical facts (cont.d)



# Some technical facts (cont.d)

- Build multiple views out of the very same collected network traffic, ie.:
  - Unaggregated to flat-files for security and forensics; or to message brokers (RabbitMQ, Kafka) for Big Data
  - Aggregated as [ <ingress router>, <ingress interface>, <BGP next-hop>, <peer destination ASN> ] and sent to a SQL DB to build an internal traffic matrix for capacity planning purposes
- Pervasive data-reduction techniques, ie.:
  - Data aggregation
  - Filtering
  - Sampling

# Touching ground: a config snippet for both aggregated and unaggregated views

```
nfacctd_ip: 10.0.0.1
nfacctd_port: 2100
!
plugins: print[forensics], mysql[int_traffic_matrix]
!
aggregate[forensics]: etype, src_host, dst_host, \
 peer_src_ip, peer_dst_ip, in_iface, out_iface, \
 timestamp_start, timestamp_end, src_port, \
 dst_port, proto, tos, src_mask, dst_mask, src_as, \
 dst_as, tcpflags, export_proto_seqno
!
aggregate[int_traffic_matrix]: in_iface, peer_src_ip, \
 peer_dst_ip, peer_dst_as
!
! <rest of config skipped>
```

Basic daemon config

Instantiating plugins

Defining plugin aggregation methods

# Touching ground: data aggregation & custom-defined primitives

- Config file snippet:

```
! …
aggregate[int_traffic_matrix]: peer_src_ip, \
 mplsTopLabelIPv4Address
!
aggregate_primitives: /path/to/primitives.lst
! …
```

Node-to-node internal TM (egress NetFlow)

mplsTopLabelIPv4Address not supported natively, let's define it!

- Custom primitive definition:

```
! …
name=mplsTopLabelIPv4Address field_type=47  len=4   semantics=ip
! …
```

Primitive name, will be used for everything

NetFlow field type, IPFIX Information Element

NetFlow/IPFIX field length

Data presentation: [ u_int, hex, ip, mac, str ]

# BGP integration

- pmacct introduced a Quagga-based BGP daemon:
  - Implemented as a parallel thread within the collector
  - Doesn't send UPDATEs whatsoever
  - Behaves as a passive BGP neighbor
  - Maintains per-peer BGP RIBs
  - Supports 32-bit ASNs; IPv4, IPv6 and VPN families
  - Supports ADD-PATH: draft-ietf-idr-add-paths
- Why BGP at the collector?
  - Telemetry reports on forwarding-plane, and a bit more
  - Extended visibility into control-plane information

# BMP integration

- pmacct introduced a BMP daemon written from scratch:
  - BMP is: BGP Monitoring Protocol
  - Implemented as a parallel thread within the collector
  - All goodies already described for the BGP daemon:
    - Contributing to IETF draft-ietf-grow-bmp-local-rib
  - Visibility in Adj-RIB-In
  - Visibility in Adj-RIB-Out:
    - Contributing to IETF draft-ietf-grow-bmp-adj-rib-out

# IGP (IS-IS) integration

- A Quagga-based IS-IS daemon was introduced:
  - Implemented as a parallel thread within the collector
  - IS-IS neighborship over a GRE tunnel
  - Currently limited to single neighborhip, single level, single topology
  - Useful to look up non BGP-routed networks
- It will get eventually replaced (BGP-LS)

# Storing data persistently

- Data need to be aggregated both in spatial and temporal dimensions before being written down:
  - Optimal usage of system resources
  - Avoids expensive consolidation of micro-flows
- Build project-driven data set(s):
  - No shame in multiple partly overlapping data-sets
  - Optimize computing

# Storing data persistently (cont.d)

- "noSQL" databases (Big Data ☺):
  - Able to handle large time-series data-sets
  - Meaningful subset of SQL query language
  - Innovative storage and indexing engines
  - Scalable: clustering, spatial and temporal partitioning
  - UI-ready: ie. ELK and TICK stacks
- Open-source RDBMS:
  - Able to handle large data-sets
  - Flexible and standardized SQL query language
  - Solid storage and indexing engines
  - Scalable: clustering, spatial and temporal partitioning

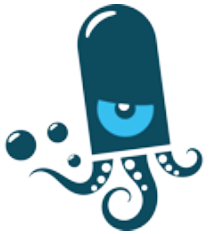
# Storing data persisently: MongoDB

- Once it was pmacct opening to noSQL databases:
  - Mess up with the C API over time
  - 2017 reality check: lack of interest, discontinuing
- noSQL landscape difficult to move through, ie. fragmented and lacks of standardization
- MongoDB seemed interesting for:
  - Native grouping operation (more performing and less complex than map/reduce)
  - Horizontal scaling concept (sharding)

# Brokering data around: RabbitMQ, Kafka message exchanges

- noSQL landscape difficult to move through, ie. fragmented and lacks of standardization, am i repeating myself? ☺
- Data can be picked up at the message exchange in the preferred programming/scripting language
- Data can be then easily inserted in the preferred backend, ie. not natively supported by pmacct

# Collecting telemetry data with pmacct



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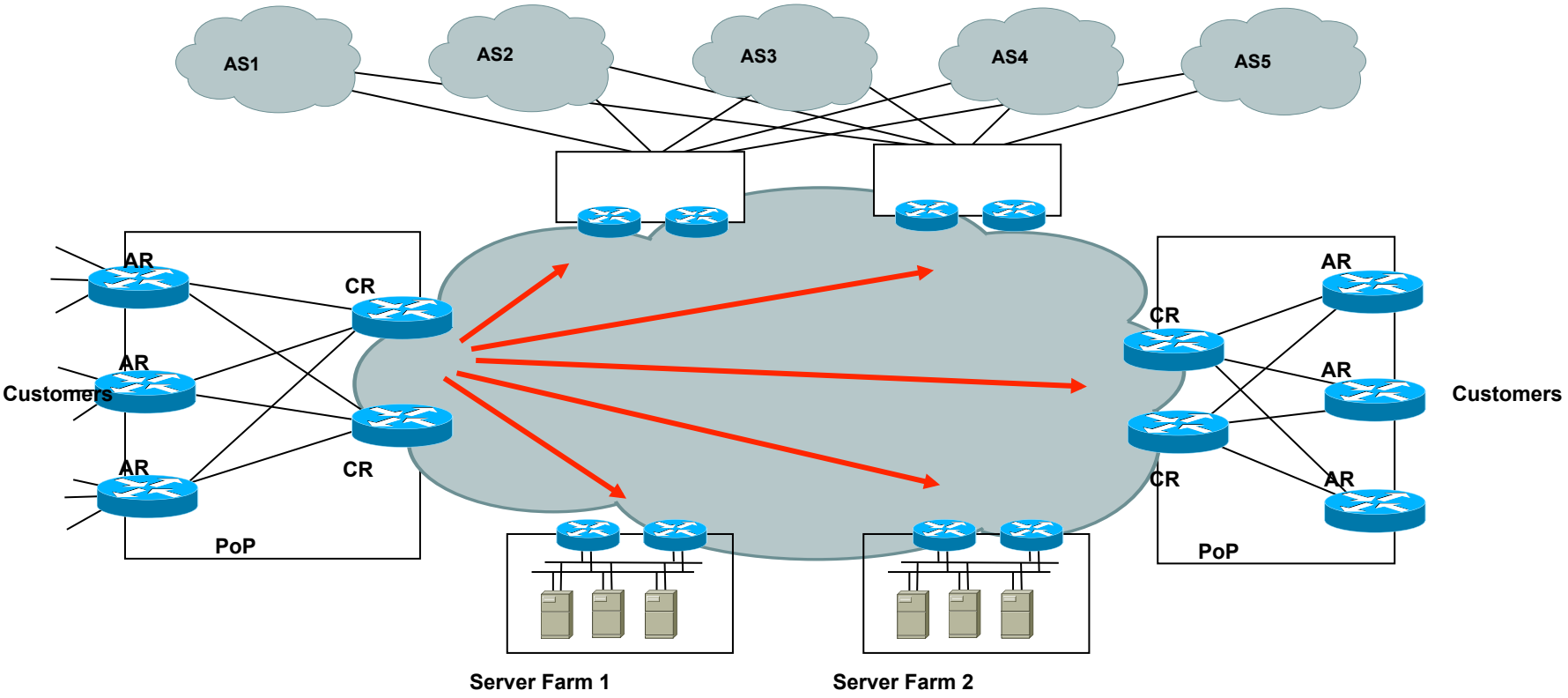
# Why speaking of traffic matrices?

- Are traffic matrices useful to a network operator in the first place? Yes …
  - Capacity planning (build capacity where needed)
  - Traffic Engineering (steer traffic where capacity is available)
  - Better understand traffic patterns (what to expect, without a crystal ball)
  - Support peering decisions (traffic insight, traffic engineering at the border, support what if scenarios)

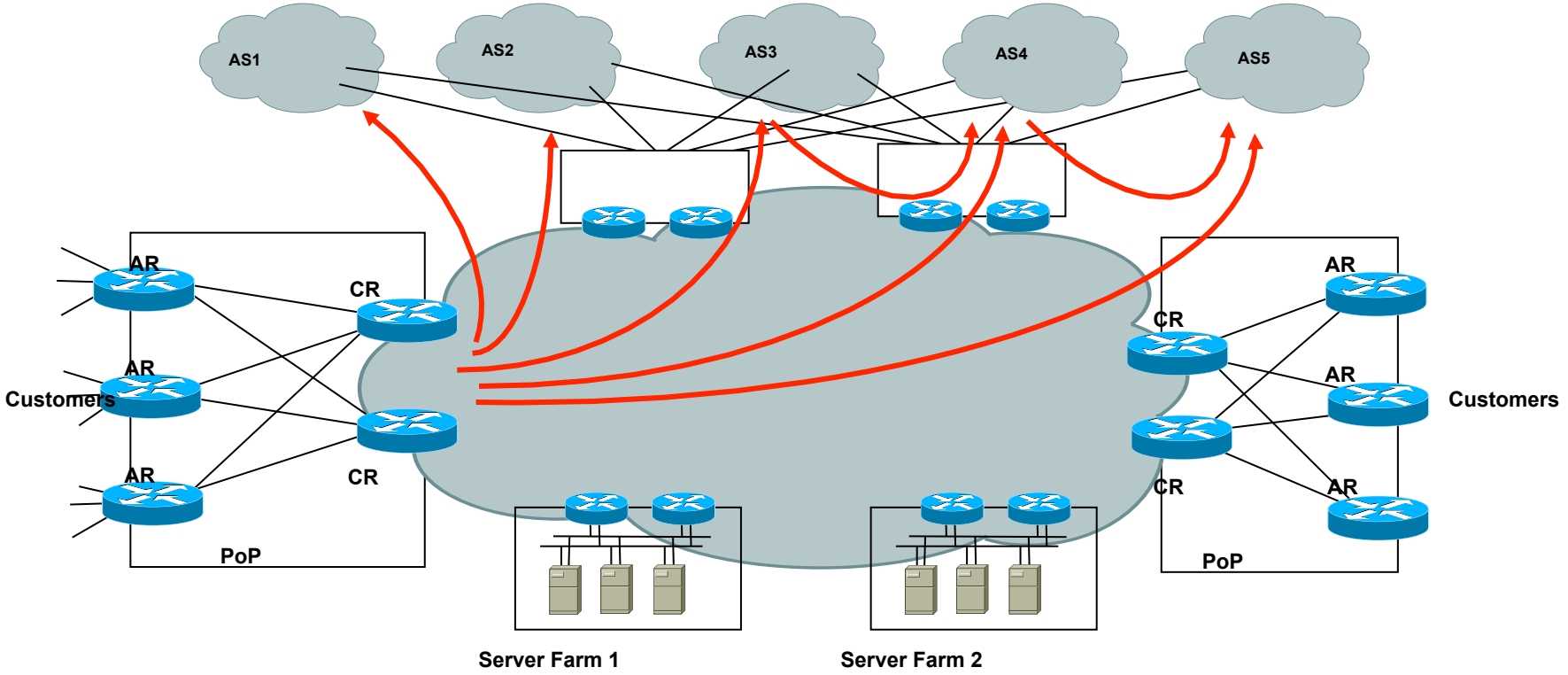
# Review of traffic matrices: internal

- POP to POP, AR to AR, CR to CR



# Review of traffic matrices: external

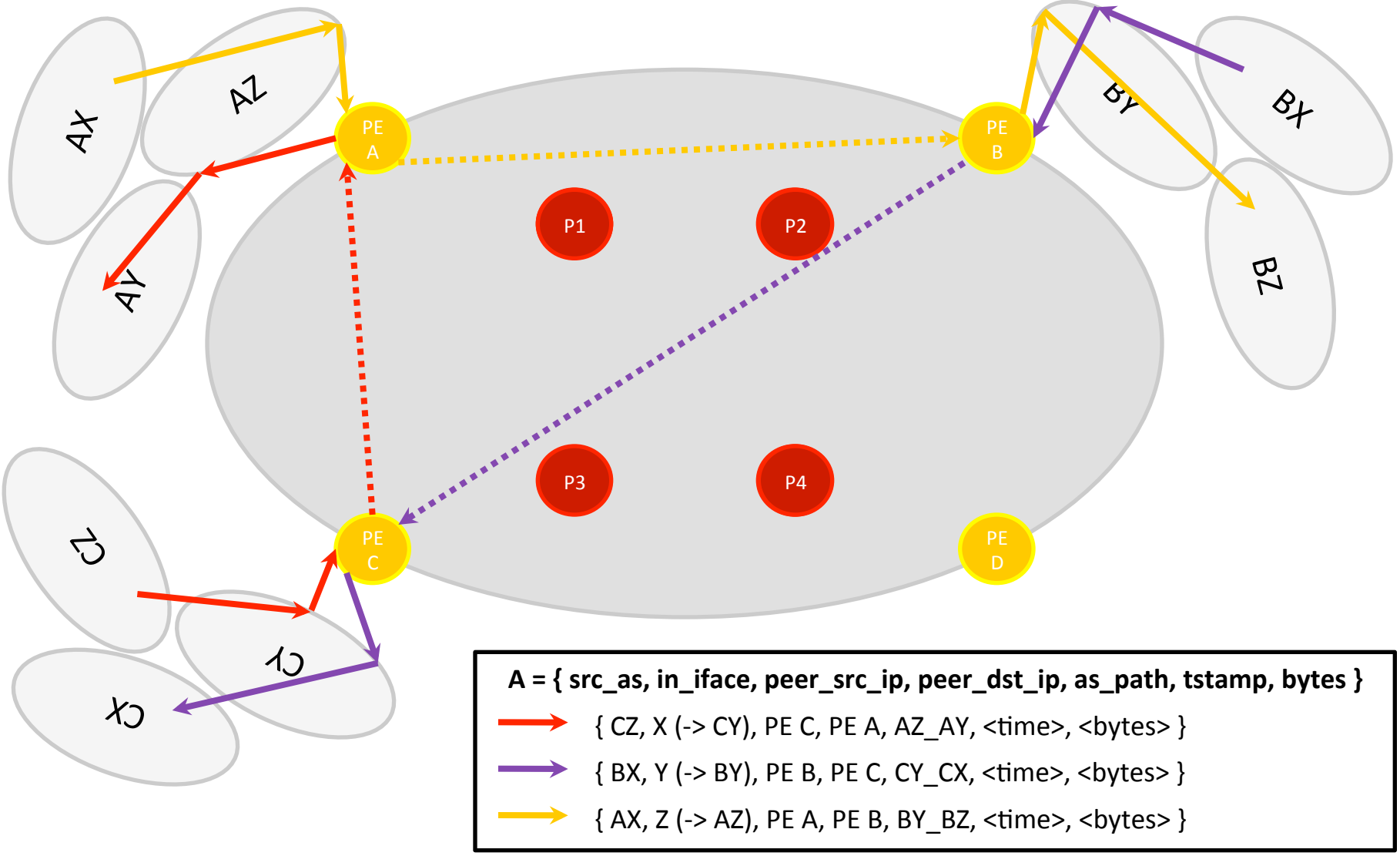
- Router (AR or CR) to external AS or external AS to external AS (for IP transit providers)



# Let's focus on an external traffic matrix to support peering decisions

- Analysis of existing peers and interconnects:
  - Support policy and routing changes
  - Fine-grained accounting of traffic volumes and ratios
  - Determine backbone costs associated to peering
  - Determine revenue leaks
- Planning of new peers and interconnects:
  - Who to peer next
  - Where to place next interconnect
  - Modeling and forecasting

# Our traffic matrix visualized

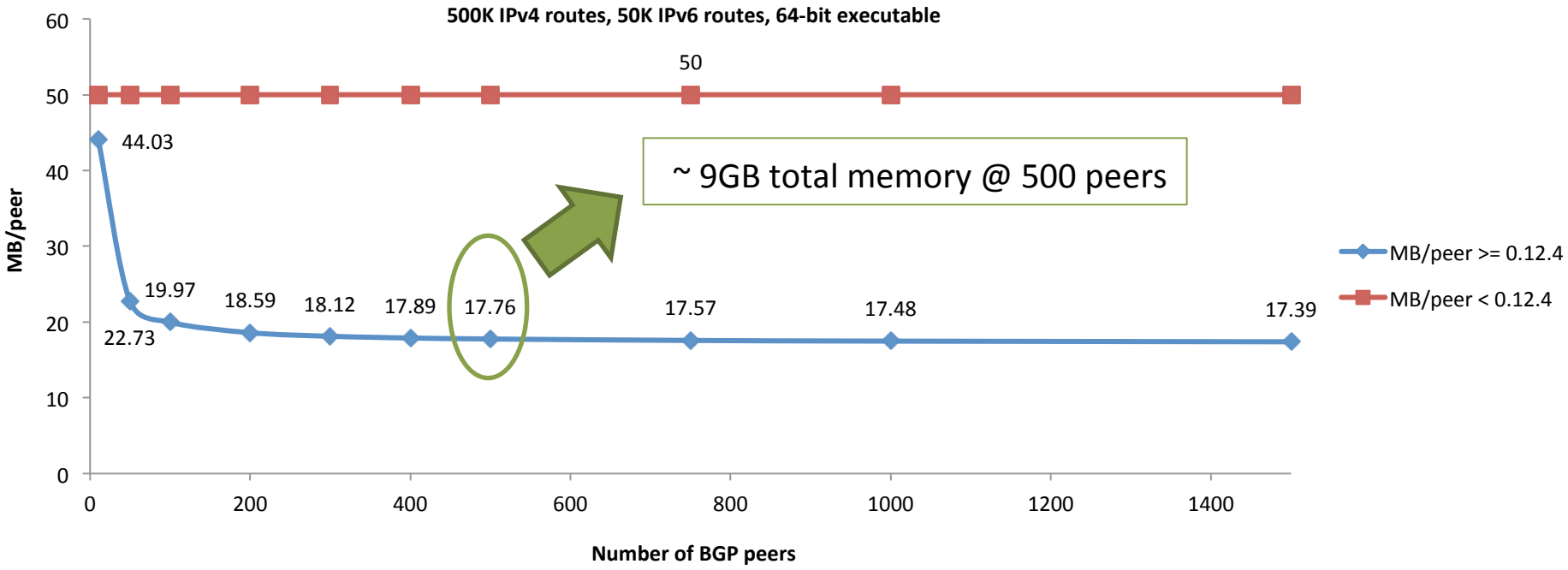


# Getting BGP to the collector

- Needed for technical reasons:
  - Flow exporters use NetFlow v5, ie. no BGP next-hop
  - Flow exporters are unaware of BGP
  - Libpcap is used to collect traffic data
- Needed for topology or traffic related reasons:
  - Transiting traffic to 3rd parties
  - Dominated by outbound traffic

# Getting BGP to the collector (cont.d)

- Let the collector BGP peer with all PE devices: facing peers, transit and customers.
- Determine memory footprint (below in MB/peer, using BGP best-path sessions)



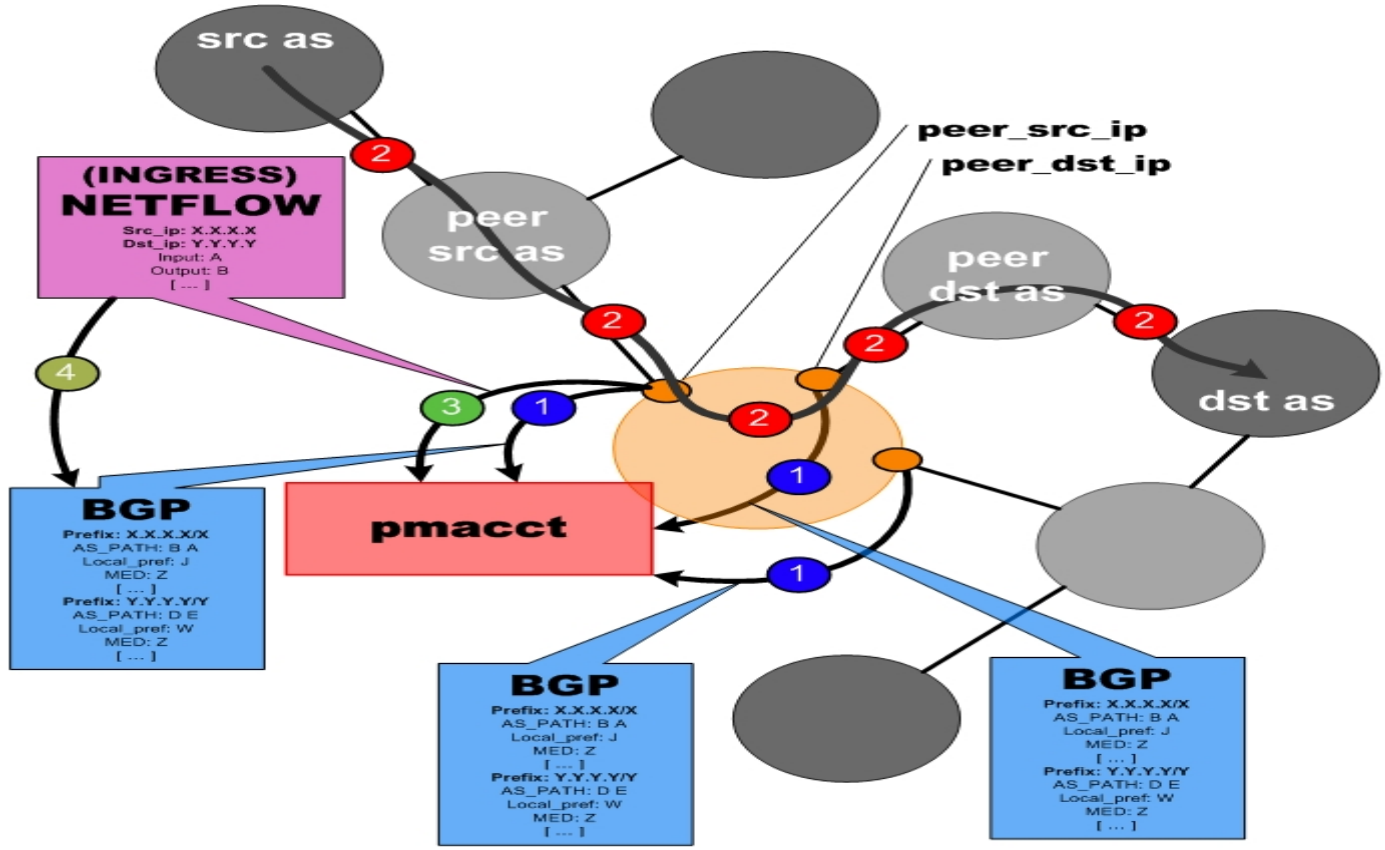
# Getting BGP to the collector (cont.d)

- Set the collector as iBGP peer at the PE devices:
  - Configure it as a RR client to get full table
  - Collector acts as iBGP peer across (sub-)ASes
- BGP next-hop has to represent the remote edge of the network model:
  - Typical scenario for MPLS networks
  - Can be followed up to cover specific scenarios like:
    - BGP confederations
    - default gateway defined due to partial or default-only routing tables

# Getting telemetry to the collector

- Export ingress-only measurements at all PE devices: facing peers, transit and customers.
  - Traffic is routed to destination, so plenty of information on where it's going to
    - True, some eBGP multi-path scenarios may get challenging
  - It's crucial instead to get as much as possible about where traffic is coming from, ie.:
    - input interface at ingress router
    - source MAC address
- Perform data reduction at the PE (ie. sampling)

# Telemetry data/BGP correlation




1. Edge routers send full BGP tables to pmacct
2. Traffic flows
3. NetFlow records are sent to pmacct
4. pmacct looks up BGP information: NF src addr == BGP src addr

# Touching ground: a config snippet for traffic matrices

```
plugins: mysql[int_tm], mysql[ext_tm]
!
aggregate[int_tm]: in_iface, peer_src_ip, \
 peer_dst_ip, peer_dst_as
!
aggregate[ext_tm]: src_as, in_iface, peer_src_ip, \
 peer_dst_ip, peer_dst_as, as_path, dst_as
!
sql_table[int_tm]: int_tm-%Y%m%d_%H%M
!
sql_table[ext_tm]: ext_tm-%Y%m%d_%H%M
sql_cache_entries[ext_tm]: 99991
!
sql_refresh_time: 300
sql_history: 5m
!
! <rest of config skipped>
```

Port-to-port internal TM

AS-to-AS external TM

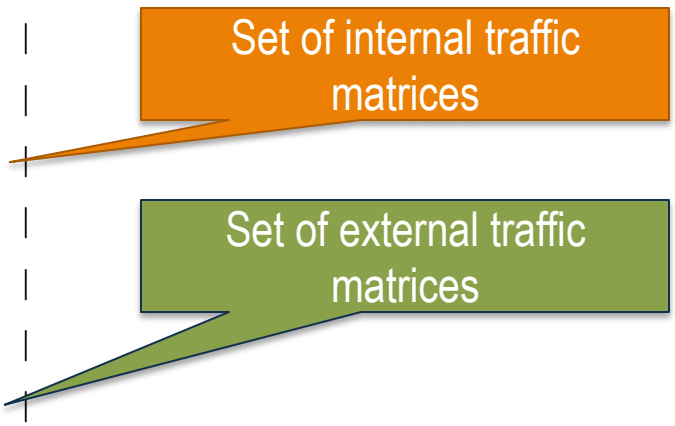
Dynamic SQL table names, ie.: XXX_tm-20130803_1400

Insert data every 5 mins

Build time bins of 5 mins

# Touching ground: how data would look like: internal traffic matrix example (1/2)

```
mysql> SHOW TABLES FROM pmacct;
+----------------------+
| Tables_in_pmacct     |
+----------------------+
| …                    |
| int_tm-20130803_1400 |
| int_tm-20130803_1405 |
| int_tm-20130803_1410 |
| …                    |
| ext_tm-20130803_1400 |
| ext_tm-20130803_1405 |
| ext_tm-20130803_1410 |
| …                    |
+----------------------+
```




NOTE: sub-aggregation is expensive: we could also have had our traffic matrices over multiple temporal aggregations in parallel, ie. 5 mins (as above) but also hourly and daily.

# Touching ground: how data would look like: internal traffic matrix example (2/2)

```
mysql> SELECT * FROM int_tm-20130803_1400 LIMIT 10;
+----------+------------+------------+------------+------------------+-------+
| iface_in | peer_ip_src | peer_ip_dst | peer_dst_as | stamp_inserted   | bytes |
+----------+------------+------------+------------+------------------+-------+
|      212 | 10.0.0.107  | 10.0.0.3    |       65000 | 03-08-2013 14:00 |   859 |
|      212 | 10.0.0.107  | 10.0.0.253  |       65001 | 03-08-2013 14:00 |  5358 |
|      212 | 10.0.0.107  | 10.0.0.234  |       65002 | 03-08-2013 14:00 |  6181 |
|      212 | 10.0.0.107  | 10.0.0.251  |       65003 | 03-08-2013 14:00 | 27002 |
|      205 | 10.0.0.107  | 10.0.0.233  |       65004 | 03-08-2013 14:00 |  1200 |
|      258 | 10.0.0.107  | 10.0.0.240  |       65005 | 03-08-2013 14:00 |   560 |
|      212 | 10.0.0.107  | 10.0.0.252  |       65006 | 03-08-2013 14:00 | 62682 |
|      212 | 10.0.0.107  | 10.0.0.234  |       65007 | 03-08-2013 14:00 |  3843 |
|      212 | 10.0.0.107  | 10.0.0.17   |       65008 | 03-08-2013 14:00 | 21074 |
|      205 | 10.0.0.107  | 10.0.0.254  |       65009 | 03-08-2013 14:00 |  2023 |
+----------+------------+------------+------------+------------------+-------+
10 rows in set (0.0
```

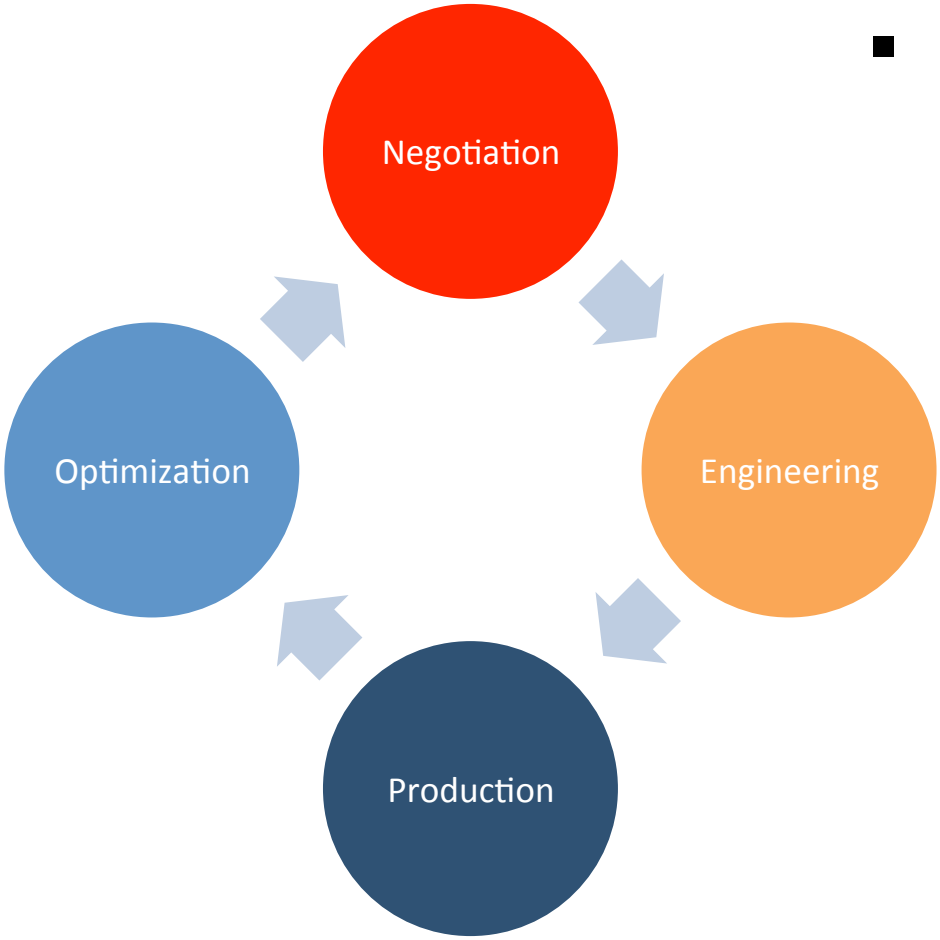
Here is our matrix

Getting ingress NetFlow from 10.0.0.7

Time reference

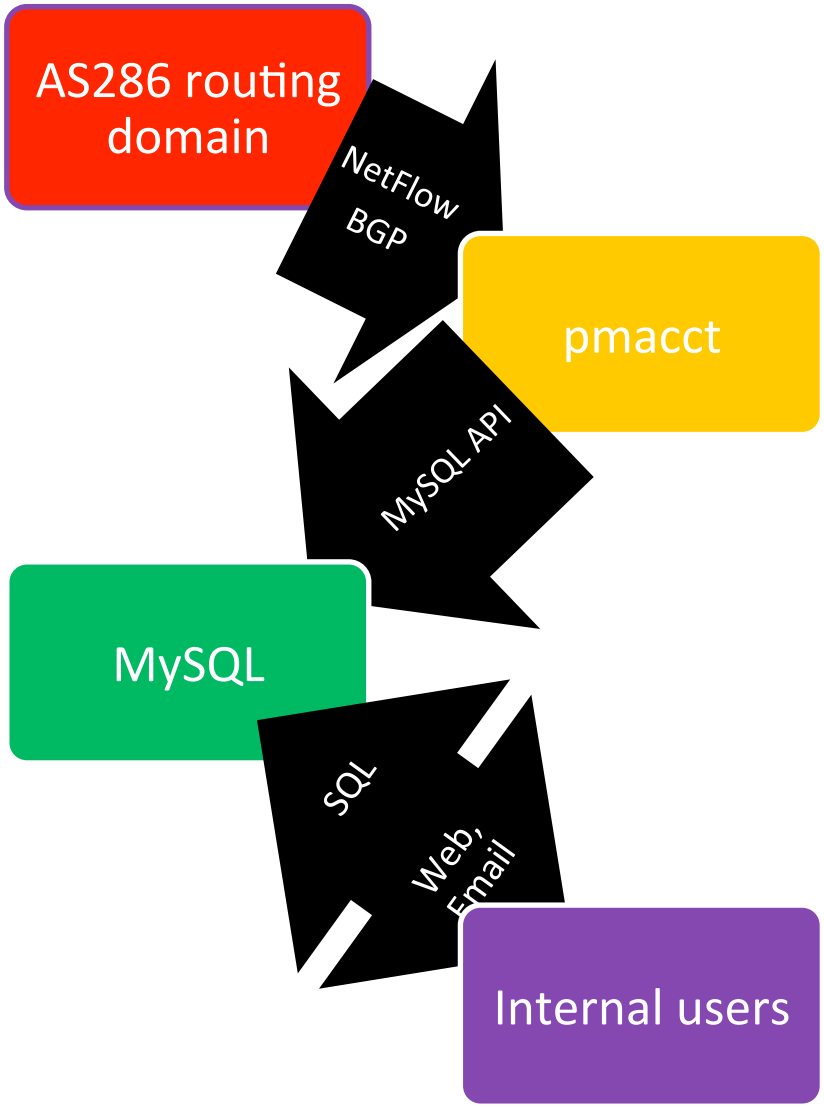
Amount of traffic sent in the time window 14:00 – 14:05

# Case-study: peering at AS286 [year 2009]




- Peering as a cycle
- NetFlow + BGP traffic matrix steers peering optimization:
  - Identify new and "old" peers
  - Traffic analysis: backbone costs, 95$^{th}$ percentiles, ratios
  - Analysis of interconnection density and traffic dispersion
  - Forecasting and trending
  - Ad-hoc queries from Design & Engineering and indeed … the IPT Product Manager

# Case-study: peering at AS286 [year 2009]

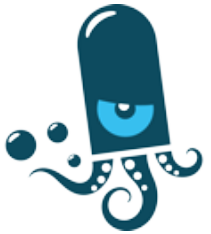



- 250+ Gbps routing-domain
- 100+ high-end routers around the globe:
  - Export sampled NetFlow
  - Advertise full routing table
  - Mix of Juniper and Cisco
- Collector environment:
  - Runs on 2 Solaris/SPARC zones
  - pmacct: dual-core, 4GB RAM
  - MySQL: quad-core, 24GB RAM, 500 GB disk
- Data retention: 6 months

# Case-study: peering at AS286 [year 2009]

- AS286 backbone routers are first configured from templates:
  - NetFlow + BGP collector IP address defined over there
  - Enabler for auto-discovery of new devices
- Edge interfaces are provisioned following service delivery manuals:
  - Relevant manuals and TSDs include NetFlow activation
  - Periodic checks NetFlow is active where it should
- Maps, ie. source peer-AS to ingress interfaces, are re-built periodically

# Collecting telemetry data with pmacct



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- Introduction
- pmacct architecture & benefits
- example, data aggregation: traffic matrices
- **example, logging micro-flows or events**
- tee: briefly on horizontal scalability

# pmacct, logging & flat-files: brief history (1/2)

- Originally pmacct was about memory tables and RDBMS (no flat-files)
- It was also about data aggregation (no logging micro-flows)
- Other tools were doing this greatly already – better invest in new ideas
- In 2011 pmacct opened to flat-files (see next slide)

# pmacct, logging & flat-files: brief history (2/2)

- In recent years the landscape changed and NetFlow and IPFIX protocols were being generalized besides flows
- Noticeably, they entered in the Event Logging space, ie.:
  - Cisco NEL, ie. (CG)NAT events
  - Cisco NSEL, ie. security events
- This was great time to review the strategy around flat-files and logging (of events and, as a consequence, of micro-flows)

# Logging use-cases

- Micro-flows:
  - R&D, lab activities
  - Security, DDoS detection, forensics
  - Related to data aggregation:
    - Analysis, temporary: elaborate aggregation methods
    - Back-up, permanent: keep raw data in case useful
- Events:
  - NAT events: compliancy with local authorities
  - FW events: security reports

# Logging features

- Split data in files and directories basing on time of the day and (some) primitive values, ie.:
  - 5 mins, hourly, daily files (fully customizable)
  - IP address of telemetry exporter
- Can append to an existing file: ie. hourly files but refreshed every 5 mins
- Files can be then archived right away via triggers, print_trigger_exec)
- Pointer to latest file in time-series

# Logging data formats

- Text formats supported: tab-spaced, CSV and JSON
  - CSV: quickest serialization, not self-descriptive
  - JSON: verbose, (hence) slower to serialize, self-descriptive
- Binary format supported: Apache Avro
  - Space efficient, schema-based, indirect access
  - GPB being avoided
  - Maybe revisit Cap'n Proto in future

# Touching ground: a config snippet for logging micro-flows

```
plugins: print[forensics]
!
aggregate[forensics]: src_host, dst_host, \
 peer_src_ip, peer_dst_ip, in_iface, out_iface, \
 timestamp_start, timestamp_end, src_port, \
 dst_port, proto, tos, src_mask, dst_mask, src_as, \
 dst_as, tcpflags
!
print_output_file[forensics]: /path/to/forensics-%Y%m%d_%H%M.txt
print_output[forensics]: csv
print_refresh_time[forensics]: 300
print_history[forensics]: 5m
print_output_file_append[forensics]: true
!
print_latest_file[forensics]: /path/to/forensics-latest
! <rest of config skipped>
```

Micro-flow (de)aggregation

Dynamic file names, ie.: forensics-20130803_1400

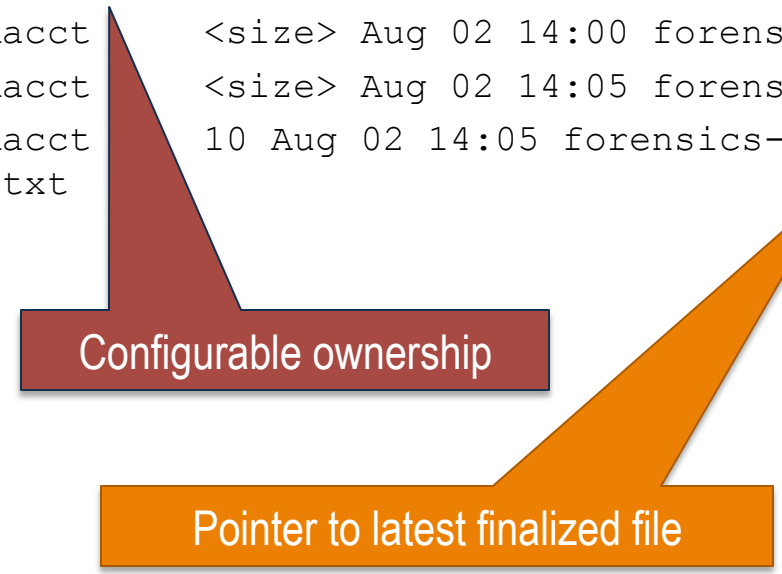
[ formatted, csv, json ]

Insert data every 5 mins, append to file if exists

Pointer to latest file to become optional and explicitly configured

# Touching ground: how data would look like: logging micro-flows (1/2)

```
shell> ls -la
…
-rw-------  1 pmacct  pmacct     <size> Aug 02 13:50 forensics-20130802-1345.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 13:55 forensics-20130802-1350.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 14:00 forensics-20130802-1355.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 14:05 forensics-20130802-1400.txt
lrwxrwxrwx  1 pmacct  pmacct     10 Aug 02 14:05 forensics-latest -> /path/to/
forensics-20130802-1400.txt
…
```



# Touching ground: how data would look like: logging micro-flows (2/2)

```
shell> cat forensics-latest


SRC_AS,DST_AS,PEER_SRC_IP,PEER_DST_IP,IN_IFACE,OUT_IFACE,SRC_IP,DST_IP,
SRC_MASK,DST_MASK,SRC_PORT,DST_PORT,TCP_FLAGS,PROTOCOL,TOS,TIMESTAMP_ST
ART,TIMESTAMP_END,PACKETS,BYTES
65001,65002,10.0.0.1,10.0.0.100,101,8,192.168.158.133,192.168.126.141,2
4,24,61912,22,24,tcp,16,2013-08-04 17:40:12.167216,2013-08-04
17:41:36.140279,21,1407
[ .. ]
```

# Touching ground: a config snippet for logging NAT events

```
plugins: print[cgn]
!
aggregate[cgn]: src_host, post_nat_src_host, src_port, \
 post_nat_src_port, proto, nat_event, timestamp_start
!
print_output_file[cgn]: /path/to/cgn-%Y%m%d_%H%M.txt
print_output[cgn]: json
print_refresh_time[cgn]: 300
print_history[cgn]: 5m
print_cache_entries[cgn]: 9999991
print_output_file_append[cgn]: true
! <rest of config skipped>
```

Well-defined NAT event

Let's increase readability ☺

Bigger cache size to cope with increased number of records

NOTE 1: see config snippet for micro-flows (a few slides back) for additional comments on configuration directives listed above.

NOTE 2: a bigger cache is beneficial to limit scattering of writes to the backend. If the configured cache is unable to contain all records, a purge of data to the backend is triggered and cache content is flushed so to make room to new data.

# Touching ground: how data would look like: logging NAT events (1/2)

```
shell> ls -la
…
-rw-------  1 pmacct  pmacct     <size> Aug 02 13:50 cgn-20130802-1345.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 13:55 cgn-20130802-1350.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 14:00 cgn-20130802-1355.txt
-rw-------  1 pmacct  pmacct     <size> Aug 02 14:05 cgn-20130802-1400.txt
lrwxrwxrwx  1 pmacct  pmacct     10 Aug 02 14:05 cgn-latest -> /path/to/
cgn-20130802-1400.txt
…
```

# Touching ground: how data would look like: logging NAT events (2/2)

```
shell> cat cgn-latest

{"timestamp_start": "2013-02-21 16:56:33.518000000", "ip_proto": "tcp",
"post_nat_ip_src": ”1.2.179.16", "ip_src": ”192.168.37.51", "port_src":
61020, "nat_event": 1, "post_nat_port_src": 31392}
[ .. ]
```

# A single (set of) collector(s) for both micro-flows and events logging?

- Yes, possible:
  - All NetFlow, regardless, pointed to the same place
  - Makes sense on small-medium deployments
  - On larger ones potentially pressuring the (same set of) collector(s) with, say, an ongoing DDoS and a CGN blade rebooting is not a good idea. Go for splitting.
- pmacct able to tag and channelize data (ie. send data selectively to plugins) basing on a number of clauses

# Touching ground: a config snippet for both micro-flows and event logging (1/2)

```
plugins: print[forensics], print[cgn]
!
pre_tag_filter[forensics]: 10
aggregate[forensics]: <micro-flows aggregation method>
print_output_file[forensics]: /path/to/forensics-%Y%m%d_%H%M.txt
!
pre_tag_filter[cgn]: 20
aggregate[cgn]: <NAT events aggregation method>
print_output_file[cgn]: /path/to/cgn-%Y%m%d_%H%M.txt
print_cache_entries[cgn]: 9999991
!
print_output: csv
print_refresh_time: 300
print_output_file_append: true
!
pre_tag_map: /path/to/pretag.map
! <rest of config skipped>
```

Allowing only flows through (see next slide)

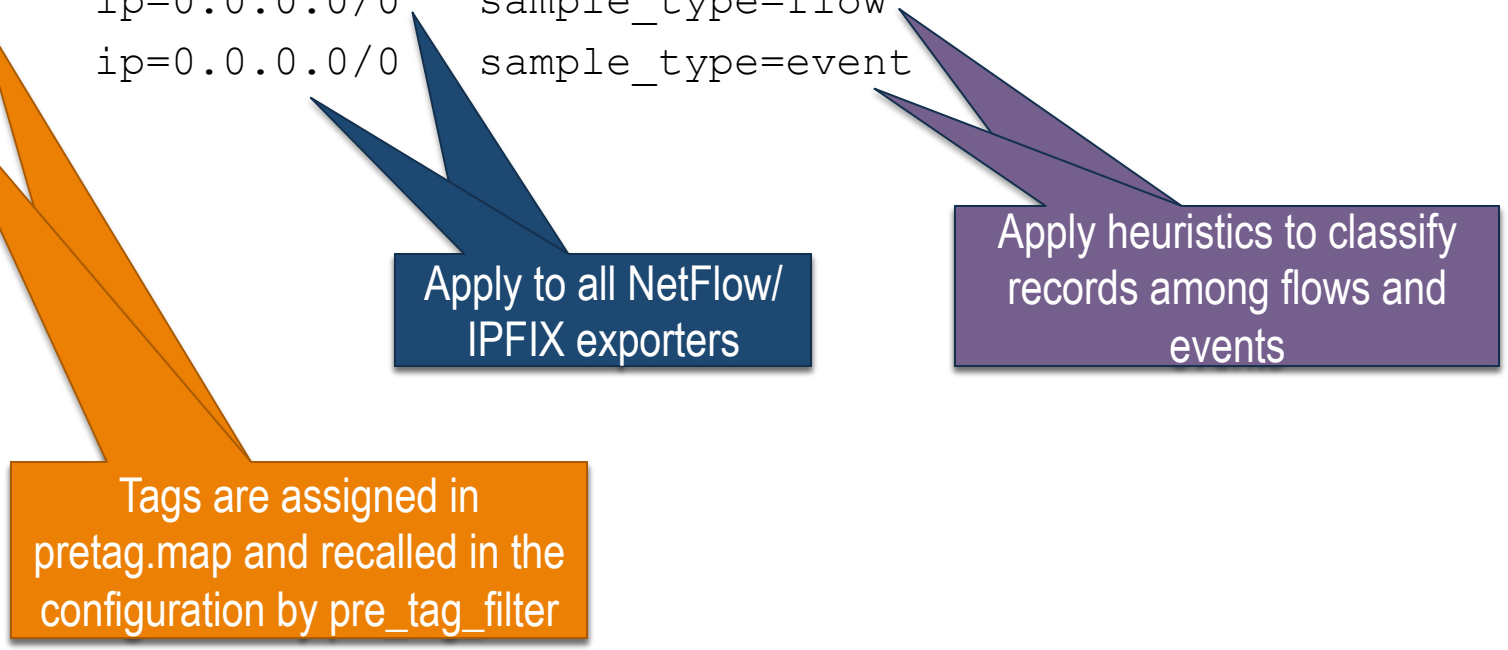
Allowing only events through (see next slide)

Enabler for channelizing data to the correct plugin instance: map to assign tags to records

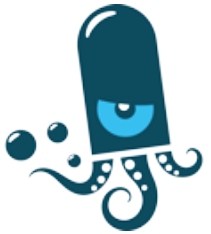
NOTE: This configuration merely merges the micro-flows and event logging configurations seen before. Check them out (a few slides back) for additional comments on configuration directives listed above.

# Touching ground: a config snippet for both micro-flows and event logging (2/2)

```
shell> cat pretag.map

set_tag=10      ip=0.0.0.0/0    sample_type=flow
set_tag=20      ip=0.0.0.0/0    sample_type=event
```



# Collecting telemetry data with pmacct



## Agenda

- Introduction
- pmacct architecture & benefits
- example, data aggregation: traffic matrices
- example, logging micro-flows or events
- **tee: briefly on horizontal scalability**

# Briefly on scalability

- A single collector might not fit it all:
  - Memory: can't store all BGP full routing tables
  - CPU: can't cope with the pace of telemetry export
- Divide-et-impera approach is valid:
  - Assign PEs (both telemetry and BGP) to collectors
  - If natively supported DB:
    - Assign collectors to DB nodes
    - Cluster the DB
  - If not-natively supported DB:
    - Assign collectors to message brokers
    - Cluster the messaging infrastructure

# Briefly on scalability (cont.d)

- Intuitively, the matrix can become big:
  - Can be reduced by excluding entities negligible to the specific scenario:
    - Keep smaller routers out of the equation
    - Filter out specific (class of) customers
    - Focus on downstream if CDN, upstream if ISP
    - Sample or put thresholds on traffic relevance

# Need for horizontal scalability in a telemetry collector

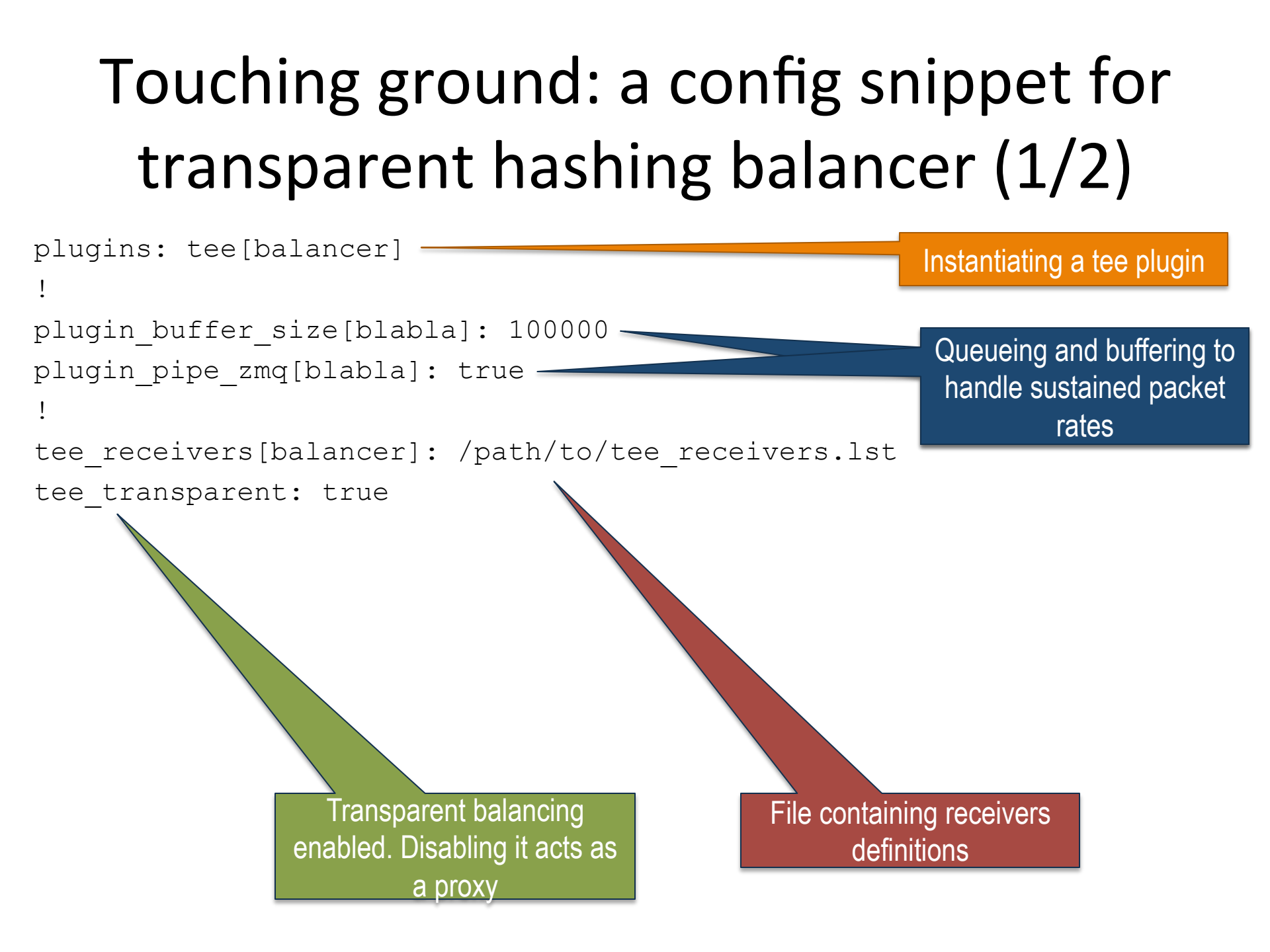
- High-frequency sampling (ie. security)
- Cope with increasing data rates:
  - 10G to 100G but, depending on the application, sampling rates might stay the same
  - Events logging: ie. NetFlow challenges Syslog in the space of logging Carrier Grade NAT (CGN) and firewall events
- Scale without super-computing powers

# pmacct & horizontal scaling

- Supports a ‘tee’ plugin
  - Receivers can be added/changed/removed on the fly
  - Load-balenced tee’ing (hashed or round-robin)
  - Selective tee’ing
- Multiple pmacct collectors can run in parallel
  - Coupling telemetry and routing data from same PE

# Touching ground: a config snippet for transparent hashing balancer (1/2)

```
plugins: tee[balancer]
!
plugin_buffer_size[blabla]: 100000
plugin_pipe_zmq[blabla]: true
!
tee_receivers[balancer]: /path/to/tee_receivers.lst
tee_transparent: true
```



# Touching ground: a config snippet for transparent hashing balancer (2/2)

```
shell> cat tee_receivers.lst

id=1 \
ip=192.168.5.1:2100,192.168.5.2:2100,192.168.5.3:2100 \
balance-alg=hash-agent
```

# Touching ground: a config snippet for transparent selective balancer (1/2)

```
plugins: tee[balancer]
!
plugin_buffer_size[blabla]: 100000
plugin_pipe_zmq[blabla]: true
!
tee_receivers[balancer]: /path/to/tee_receivers.lst
tee_transparent: true
!
pre_tag_map: /path/to/pretag.map
```

Enabler for selective balancing: map to assign tags to NetFlow/IPFIX exporters

NOTE: see config snippet for transparent hashing balancer (a few slides back) for additional comments on configuration directives listed above.

# Touching ground: a config snippet for transparent selective balancer (2/2)

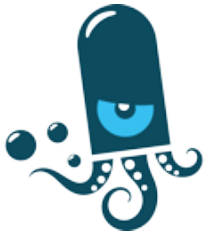
```
shell> cat tee_receivers.lst

id=2    ip=192.168.4.1:2100 tag=100
id=3    ip=192.168.4.2:2100 tag=200


shell> cat pretag.map

set_tag=100     ip=10.0.0.0/25
set_tag=200     ip=10.0.0.128/25
```

Tags are assigned in pretag.map and recalled in tee_receivers.lst

# Further information about pmacct

- https://github.com/pmacct/pmacct
  - Official GitHub repository, where star and watch us ☺
- http://www.pmacct.net/lucente_pmacct_uknof14.pdf
  - More about coupling telemetry and BGP
- http://ripe61.ripe.net/presentations/156-ripe61-bcp-planning-and-te.pdf
  - More about traffic matrices, capacity planning & TE
- https://github.com/pmacct/pmacct/wiki/
  - Wiki: docs, implementation notes, ecosystem, etc.

# Collecting telemetry data with pmacct



## Thanks! Questions?

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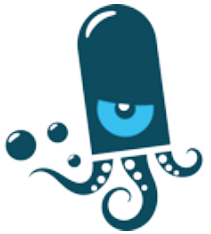
http://www.pmacct.net/ | https://github.com/pmacct/pmacct

AfPIF 2017, Abidjan – Aug 2017

# Collecting telemetry data with pmacct



## Backup slides

# Post-processing RDBMS and reporting (1/2)

- Traffic delivered to a BGP peer, per location:

```
mysql> SELECT  peer_as_dst, peer_ip_dst, SUM(bytes), stamp_inserted
       FROM acct_bgp
       WHERE peer_as_dst = <peer | customer | IP transit> AND
             stamp_inserted = < today | last hour | last 5 mins >
       GROUP BY peer_as_dst, peer_ip_dst;
```

- Aggregate AS PATHs to the second hop:

```
mysql> SELECT SUBSTRING_INDEX(as_path, '.', 2) AS as_path, bytes
       FROM acct_bgp
       WHERE local_pref = < IP transit pref> AND
             stamp_inserted = < today | yesterday | last week >
       GROUP BY SUBSTRING_INDEX(as_path, '.', 2)
       ORDER BY SUM(bytes);
```

- Focus peak hour (say, 8pm) data:

```
mysql> SELECT … FROM … WHERE stamp_inserted LIKE '2010-02-% 20:00:00'
       …
```

# Post-processing RDBMS and reporting (2/2)

- Traffic breakdown, ie. top N grouping BGP peers of the same kind (ie. peers, customers, transit):

```
mysql> SELECT … FROM … WHERE …
       local_pref = <<peer | customer | IP transit> pref>
       …
```

- Download traffic matrix (or a subset of it) to 3rd party backbone planning/traffic engineering application (ie. Cariden, Wandl, etc.):

```
mysql> SELECT peer_ip_src, peer_ip_dst, bytes, stamp_inserted
       FROM acct_bgp
       WHERE [ peer_ip_src = <location A> AND
             peer_ip_dst = <location Z> AND … ]
             stamp_inserted = < today | last hour | last 5 mins >
       GROUP BY peer_ip_src, peer_ip_dst;
```