Anomaly Detection in Large Scale BGP/MPLS VPN networks

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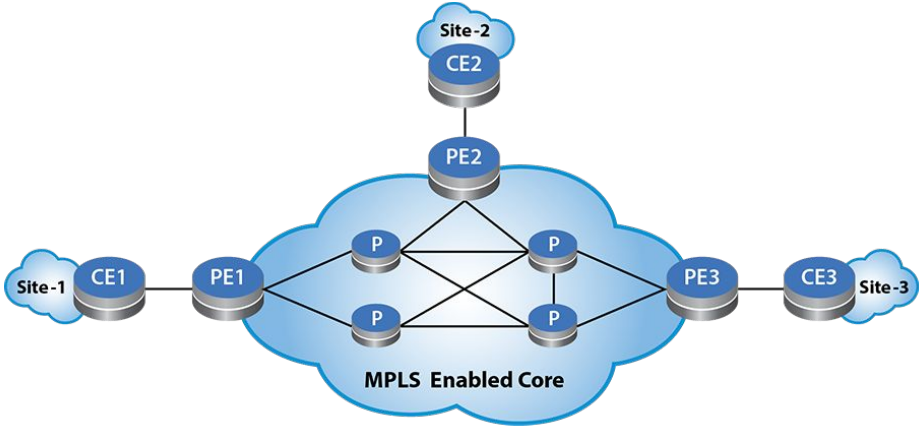
Project

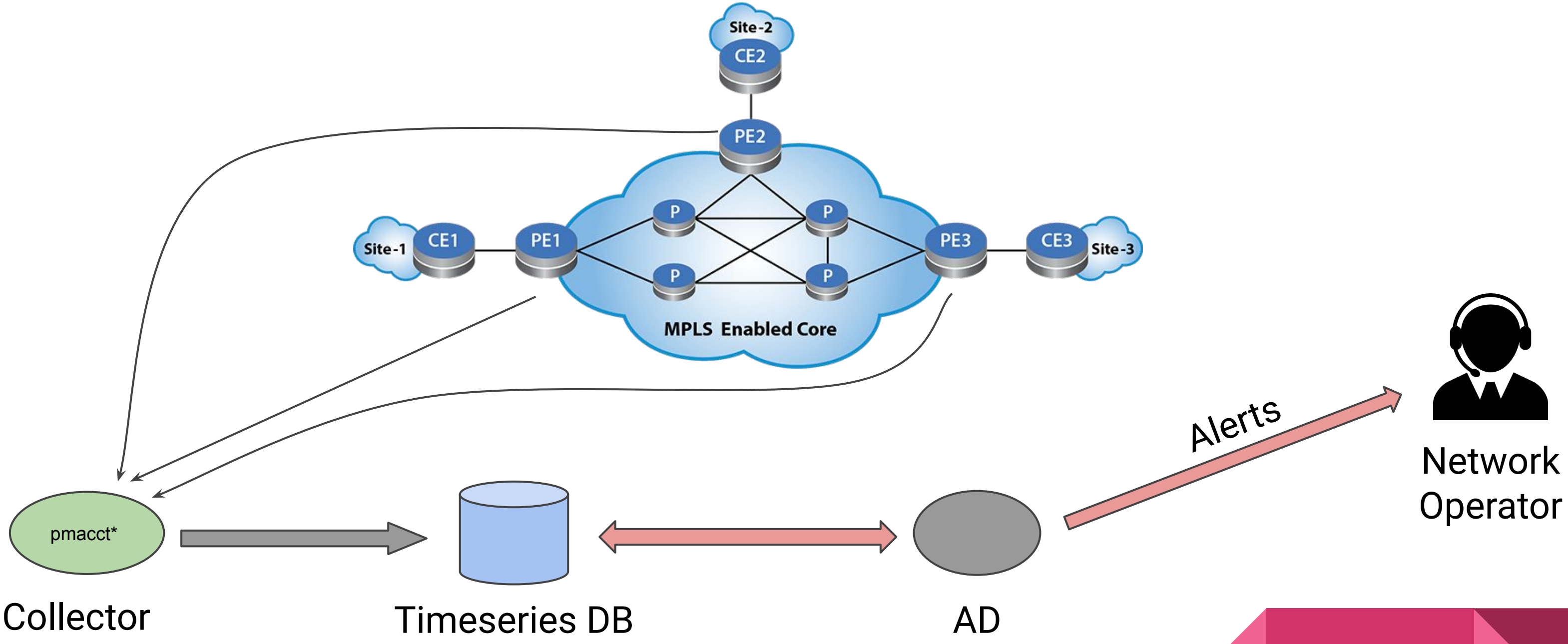
- Project funded by Swisscom A.G.
- Research and Open Source Development
  - Network information collection
    - Research
    - Standardisation
    - Implementation
  - Network measurements
    - Research
    - Standardisation
    - Implementation
  - → Scalable Anomaly Detection Solution

Context - BGP/MPLS VPNs



- ~10K VPN customers
- Multiple dimensions
  - Traffic
  - Routing protocols
  - Network elements
- ~1M msg/s when nothing's happening

Anomaly detection - Architecture



** Collector: http://pmacct.net/*

Functional Requirements

- Scalability
  - ~10K VPN customers
  - Many dimensions
  - ~ Real Time responsiveness
- Configurability
  - Minimal configuration effort, yet,
  - Not all customers are alike
- Extensibility
  - Ability to define a new anomaly detection technique on their own
- Standard Interfaces
  - Protocols should be IETF standards
  - Messaging system should be standard

Architecture Challenges

- Inventory
  - Know which client we want to monitor
- Onboarding
  - Know which nodes are monitored
  - Know which monitoring features are available on the monitored nodes
- Profiling
  - Know the behavior of the customer
- Collecting
  - Collect metrics from the monitored nodes
  - Correlate collected metrics
- Detecting
  - Find appropriate approaches to detect anomalies for customer profiles
  - Generate alerts when anomalies are detected

Research challenges

- SoA of Machine Learning to detect anomalies in core networks still not convincing
  - False positives
  - False negatives
  - Unrealistic assumptions on the network (all fully onboarded customers)
  - Customers cannot be looked at the same way

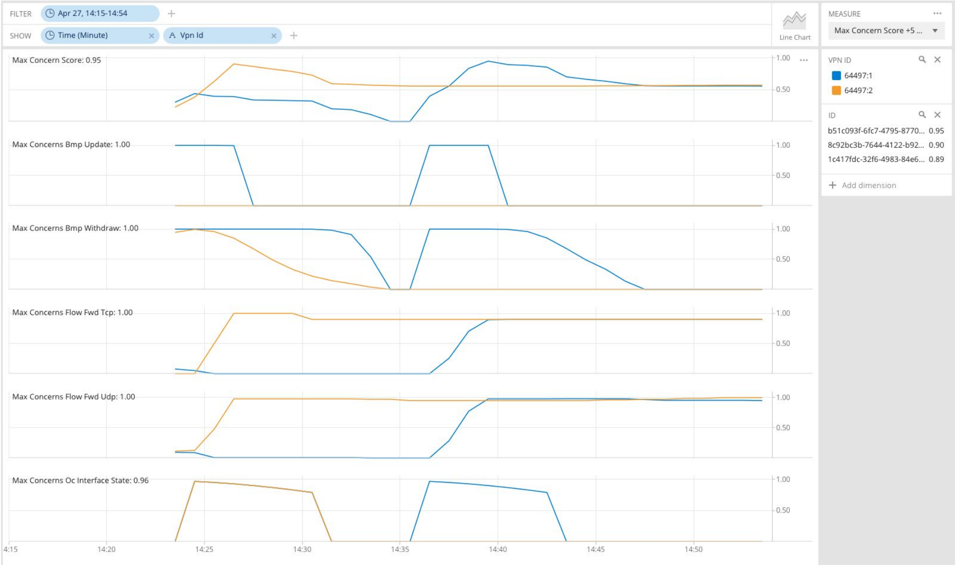
- An anomaly is *“whatever a human operator would frown at when looking at the monitored data, knowing how the customer usually behaves”*
- First step:
  - Rule based AD
  - ML Based customer profiling

IETF challenges

- Getting very large amounts of data from the router without stressing the router
  - draft-ietf-netconf-udp-notif-09
- New core network technology : SRv6
  - draft-tgraf-opsawg-ipfix-srv6-srh-05
- New metrics
  - draft-tgraf-opsawg-ipfix-on-path-telemetry-01

Current development status

- PoC AD developed in Python
- Interop testing of upcoming standards with main vendors (Cisco, Huawei, …)



FILTER Apr 27, 14:15-14:54

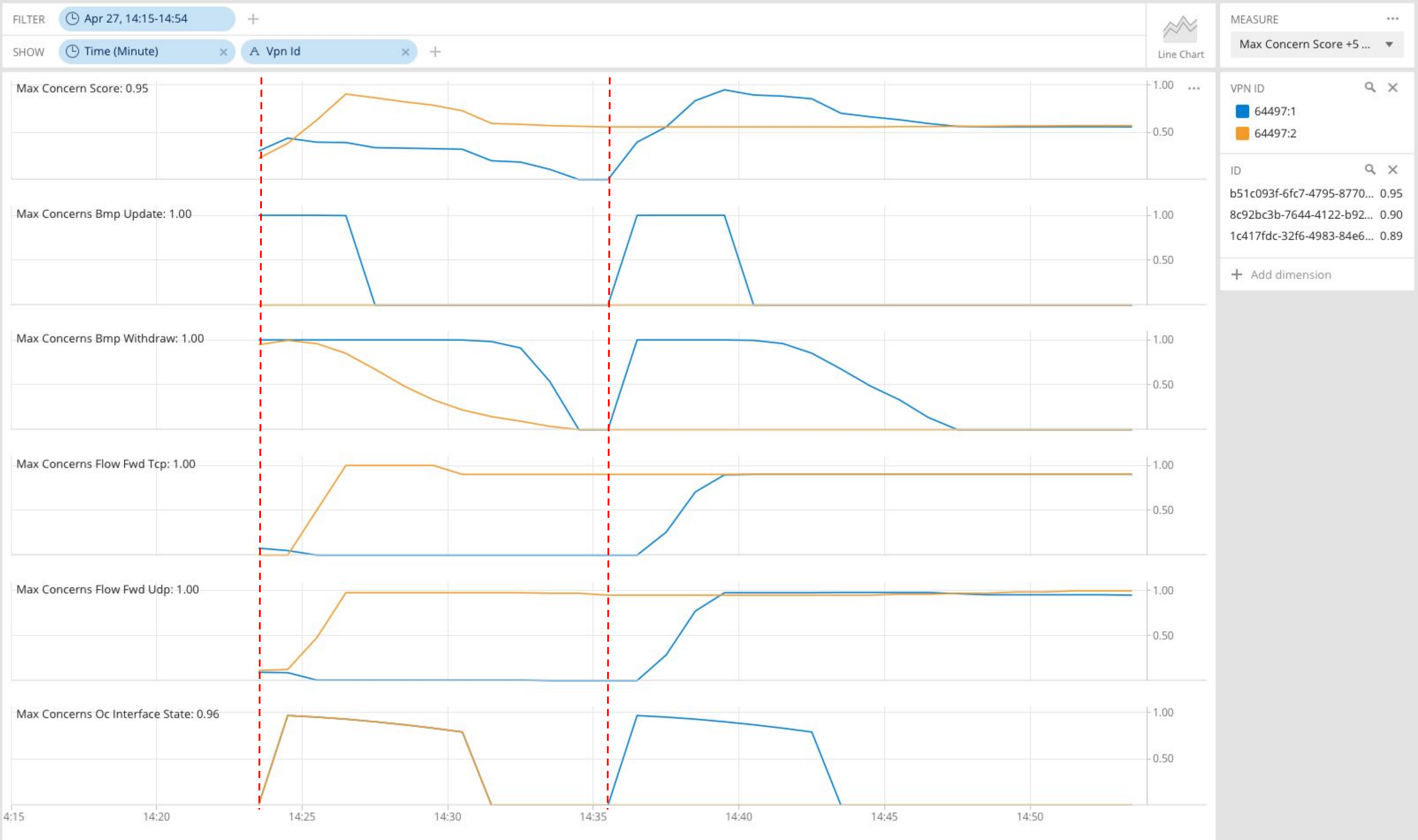
SHOW Time (Minute) Vpn Id

MEASURE Max Concern Score +5 ...

VPN ID
🟦 64497:1
🟧 64497:2

ID
b51c093f-6fc7-4795-8770... 0.95
8c92bc3b-7644-4122-b92... 0.90
1c417fdc-32f6-4983-84e6... 0.89

Line Chart
Add dimension
Max Concern Score: 0.95
Max Concerns Bmp Update: 1.00
Max Concerns Bmp Withdraw: 1.00
Max Concerns Flow Fwd Tcp: 1.00
Max Concerns Flow Fwd Udp: 1.00
Max Concerns Oc Interface State: 0.96
1.00
0.50
4:15
14:20
14:25
14:30
14:35
14:40
14:45
14:50



FILTER Apr 27, 14:15-14:54 +

SHOW Time (Minute) × Vpn Id × +

Line Chart

MEASURE ···

Max Concern Score +5 ... ▼

VPN ID

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14:50

Conclusion

- Anomaly detection in BGP/MPLS VPN networks
    - is not easy when you’re actually trying to do it
    - still requires standards and running open source code
    - requires real operational data
    - we hope ML will actually help, one day