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INTELIGÊNCIA EM TI

Leveraging Zabbix trend functions for network monitoring anomaly detection and enhanced visibility

Introducing the issue

- **Issue overview**
  - Lots of operational monitoring, almost no tactical vision
  - Lack of essential information for the network environment management
  - In general, the network behavior in relation to its traffic is unknown and network administrators are reactive professionals

Purpose of the implementation and expected results

- **What is the purpose of the implementation?**
  - Improving or generating a network tactical layer monitoring
    - Using Zabbix Trend Functions
- **What is the expected result?**
  - Some piece of information about network behavior

1 Contextualizing

2 Scenario

3 Ordinary data

4 What's new?

5 Baseline

6 Standard Deviation

7 Anomaly Rate

8 Conclusion

1

Contextualizing

Contextualizing

- **What do I really need to monitor?**
  - CPU, memory, disk, etc...
- **Talking about network traffic**
  - The 5-tuple concept and some additional information
- **Why and how Netflow?**
  - What’s happening on the network?
- **How can Zabbix collect, store and analyse Netflow data?**
  - I can teach it and Zabbix can learn it (what if...?)
- **So, how can Zabbix help us understand the network behavior?**
  - Zabbix can bring to light some unknow behaviors

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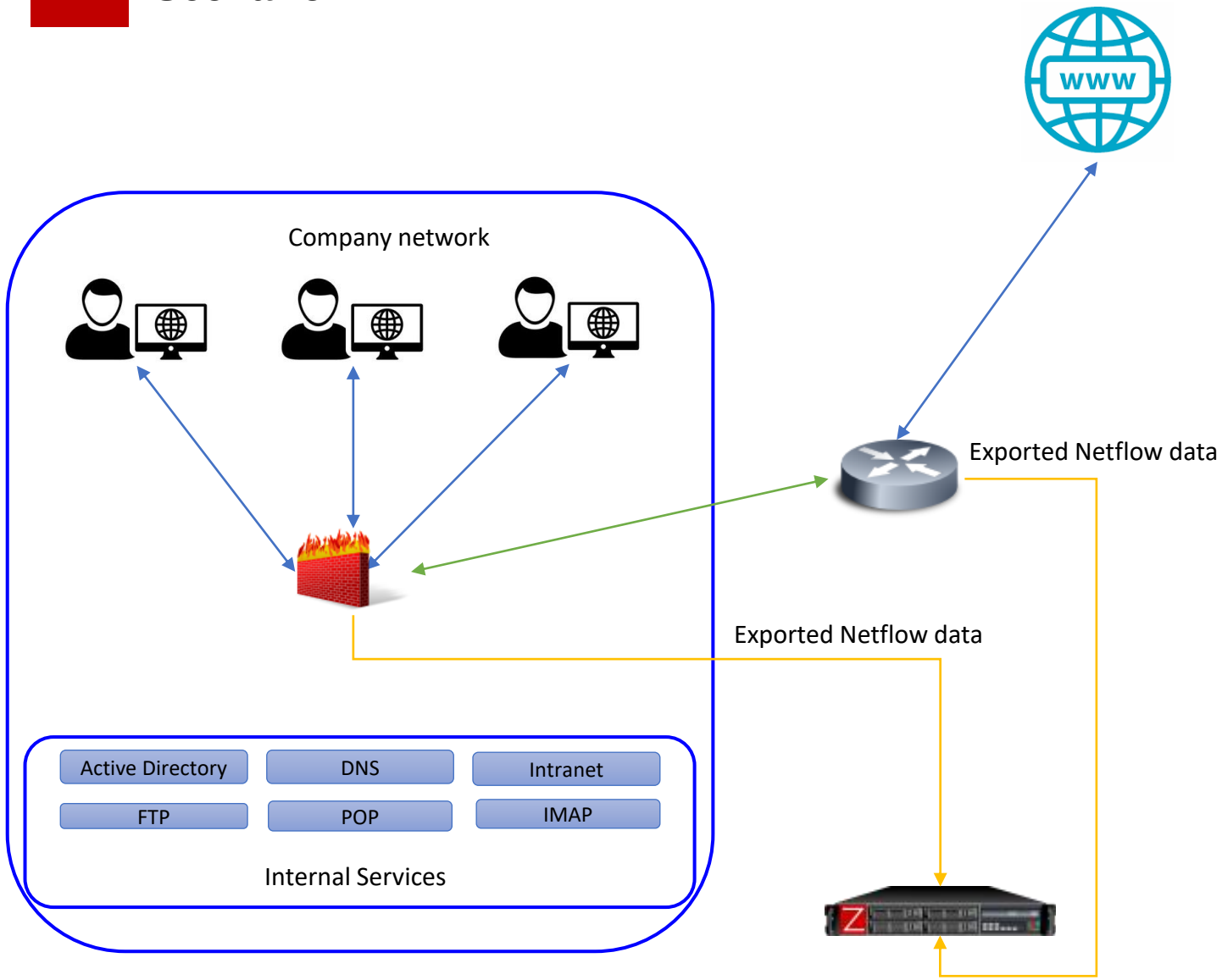
Scenario

Scenario



The 5-tuple:

- Source IP = x
- Source port = y
- Destination IP = z
- Destination port = w
- Protocol = p

Additional information

- Flows
- Packets
- Bytes

3

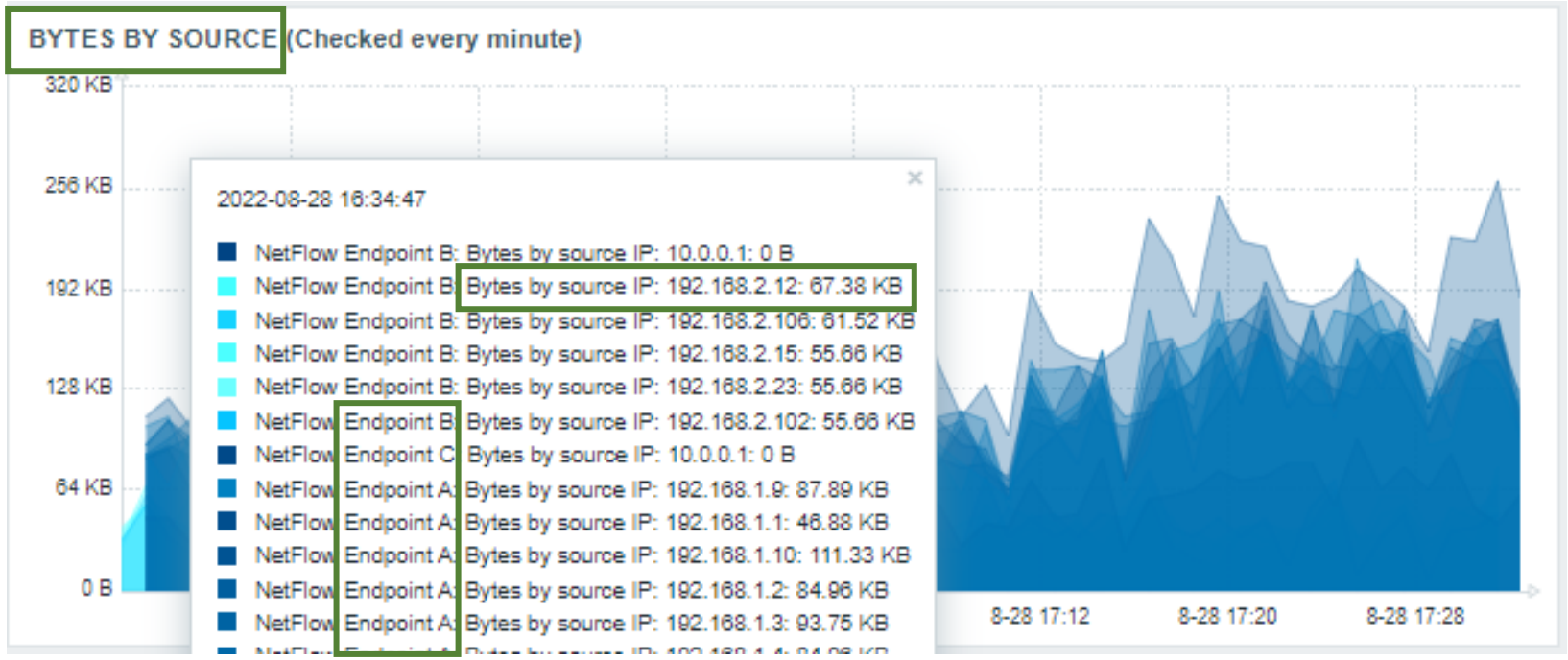
Ordinary data

Ordinary data

- What do I know so far?
- Can I say my network behavior is OK with these data?
- What was expected and what is still not clear?

Some prints – Part 1: Dashboard widget = Graph

Some prints – Part 1.1: Dashboard widget = Graph



The 5-tuple:

- Source IP = x
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Additional information

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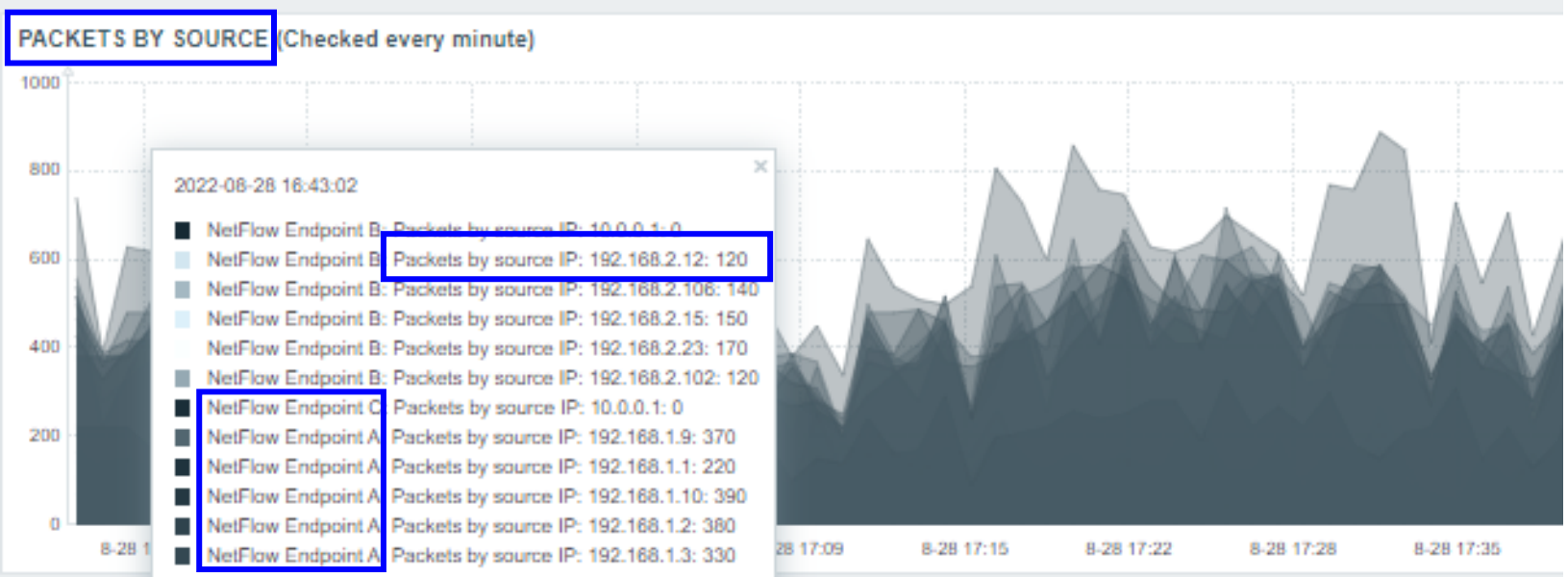
- Bytes

Some prints – Part 1.2: Dashboard widget = Graph



The 5-tuple:

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Additional information

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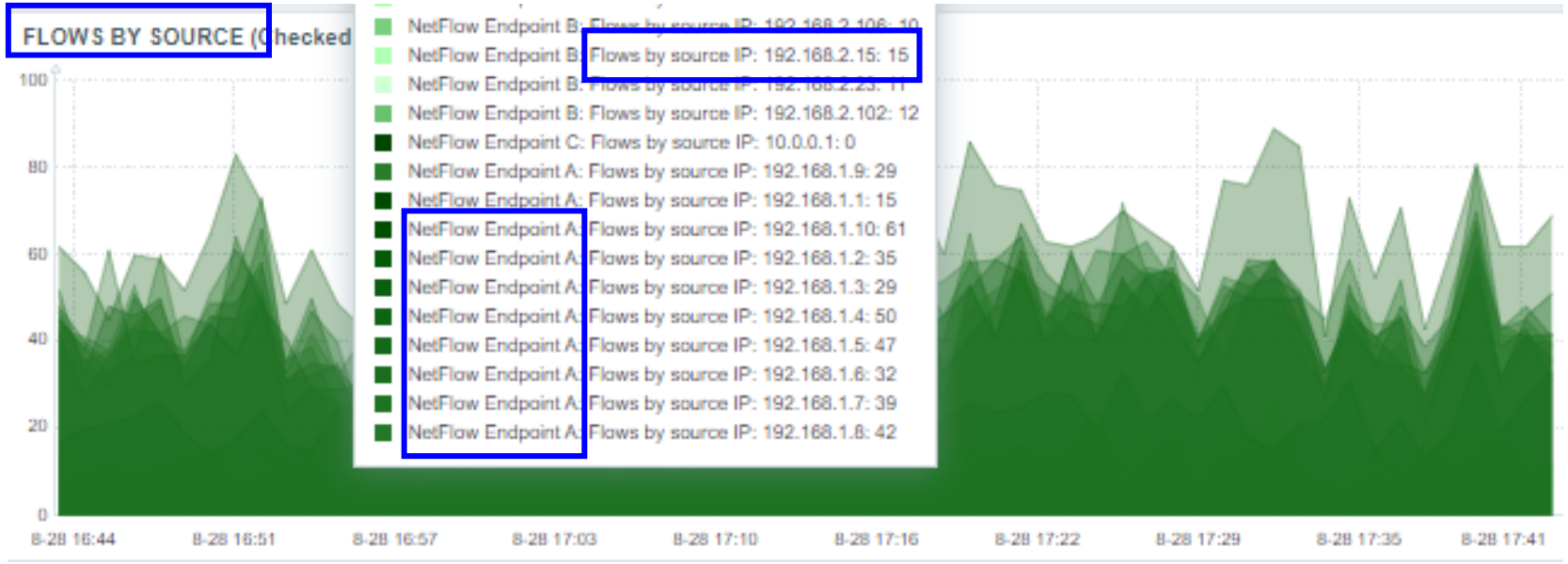
Some prints – Part 1.2: Dashboard widget = Graph



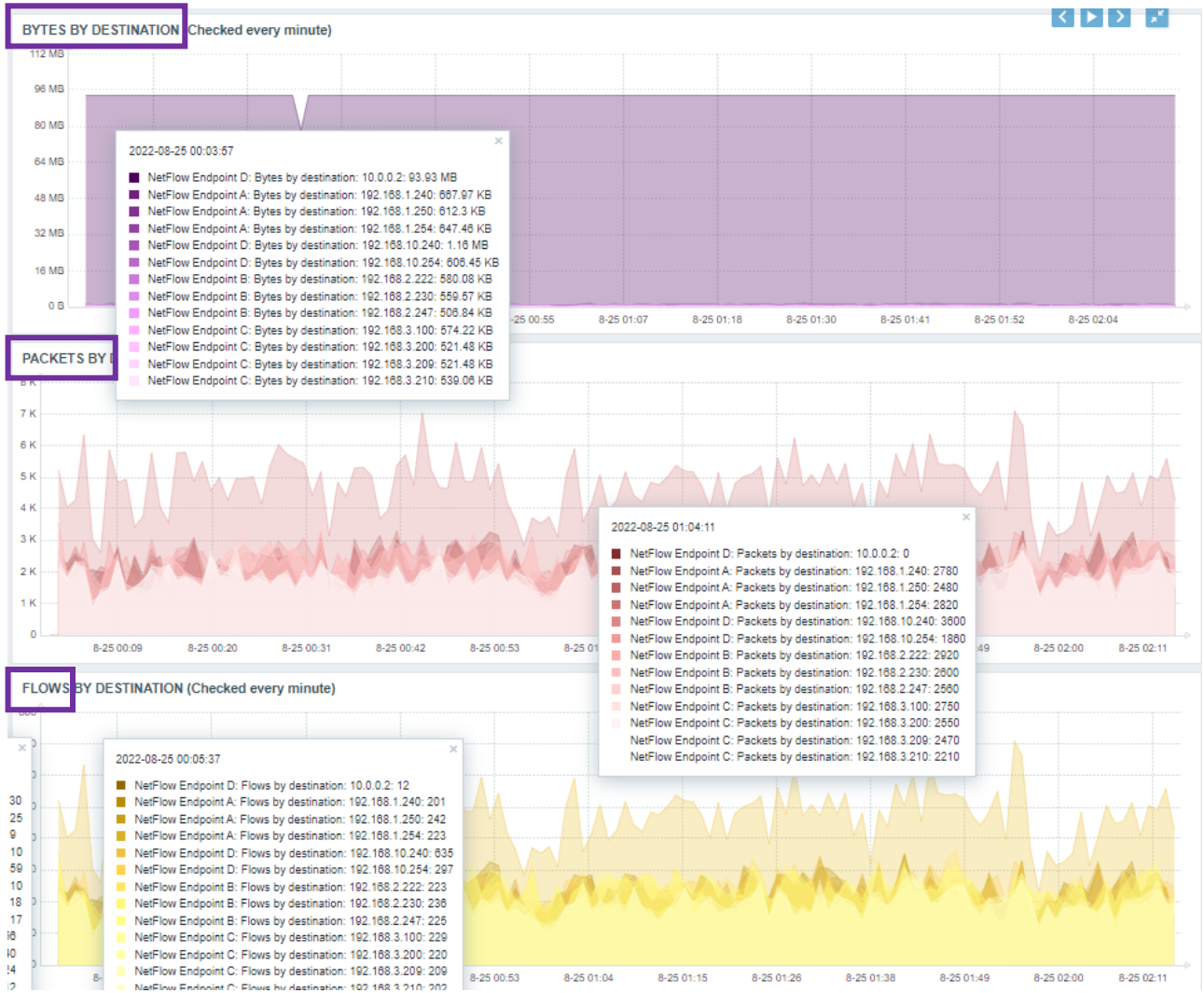
The 5-tuple:

- Source IP = x
- Source port = y
- Destination IP = z
- Destination port = w
- Protocol = p

Additional information

- Flows
- Packets
- Bytes

Some prints – Part 1.4: Dashboard widget = Graph



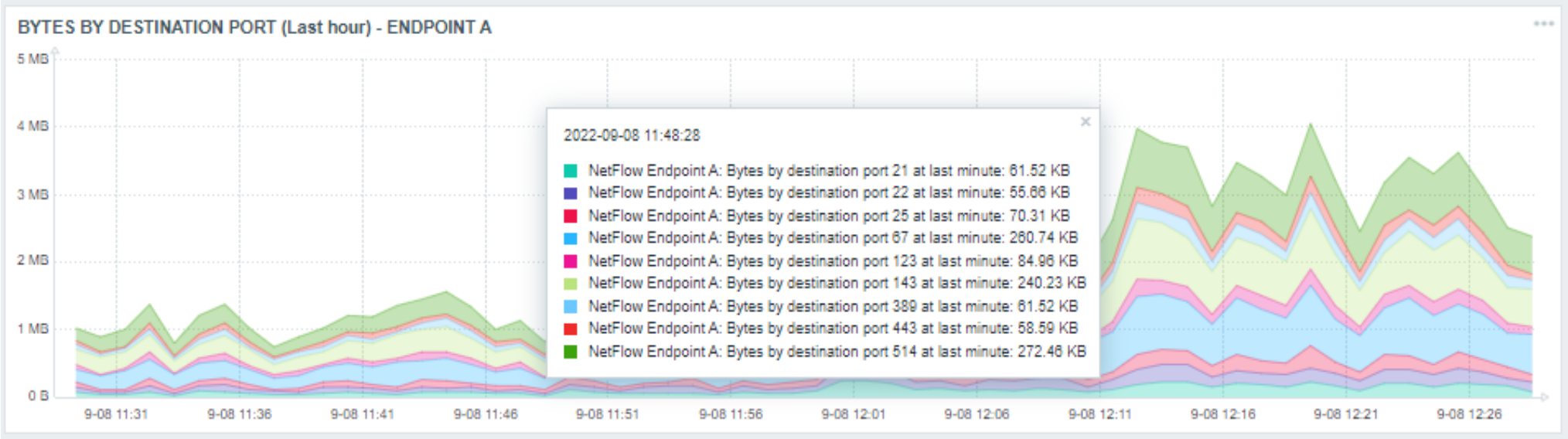
The 5-tuple:

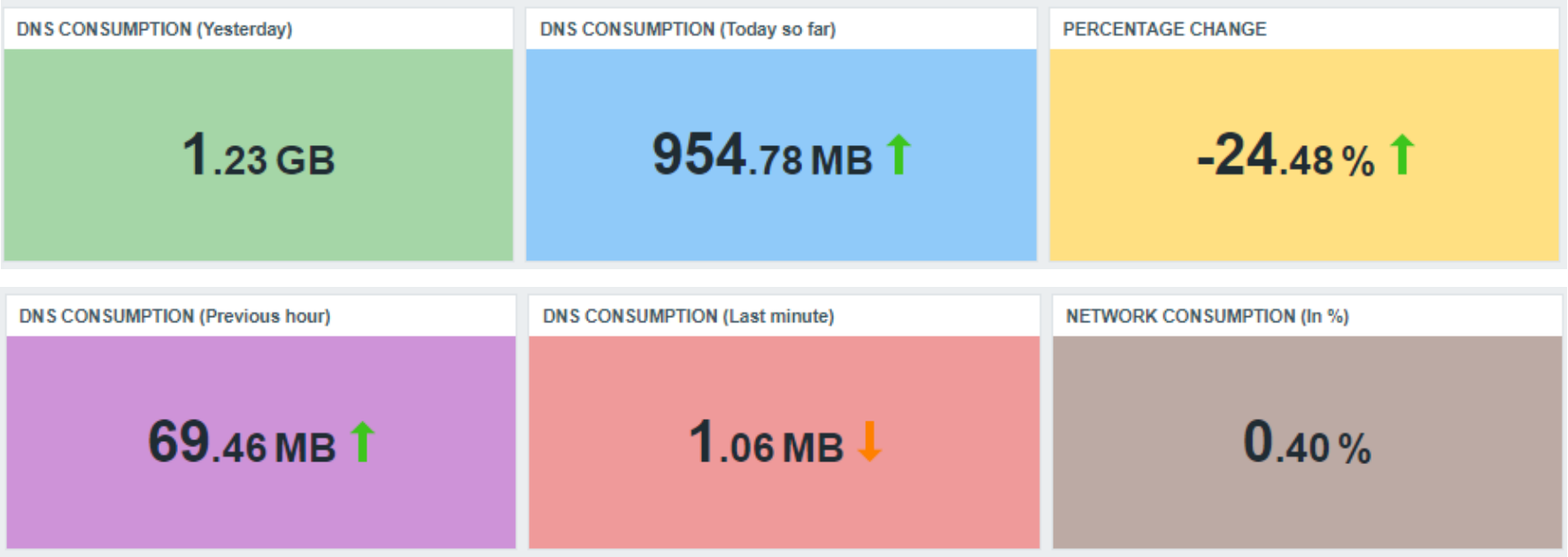
- Source IP = x
- Source port = y
- Destination IP = z
- Destination port = w
- Protocol = p

Additional information

- Flows
- Packets
- Bytes

Some prints – Part 2: Dashboard widget = Top host + Graph





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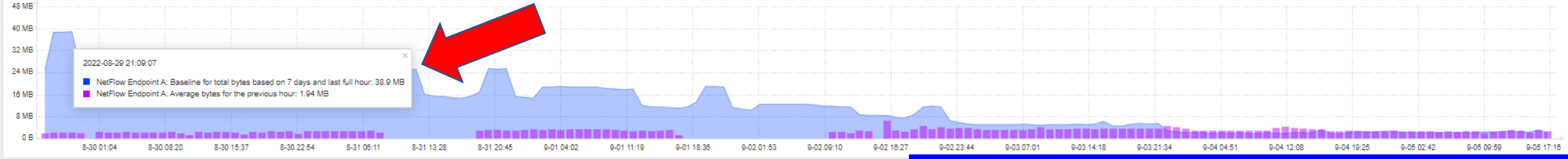
What’s new?

Extraordinary data

- What does extraordinary data means?
- What do you think about observability?
- Just monitor or search for something else?

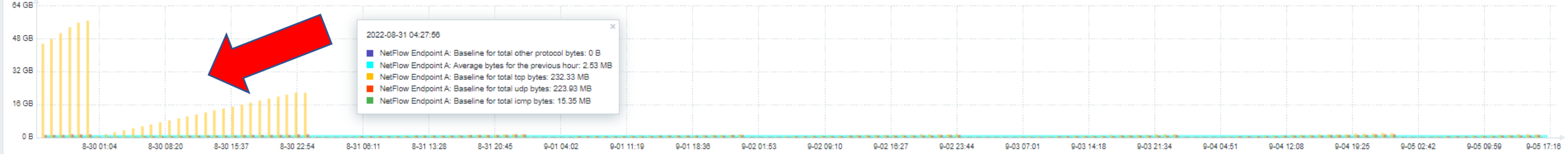
BYTES YESTERDAY	BYTES TODAY SO FAR	PERCENTAGE CHANGE	AVG / LAST HOUR > NOW	AVG BYTES / PREVIOUS HOUR	STANDARD DEVIATION	ANOMALY RATE
4.15 GB	2.66 GB ↑	-35.92 % ↑	Using history values 3.16 MB ↑	Using trend values 3.14 MB	Previous hour, 7 days, same timeframe 0.99 STD DEV ↑	Based on 24 hours, finding anomalies at last... 0.13 RATE
2022-09-05 00:05:01	2022-09-05 18:06:28	2022-09-05 18:05:46	2022-09-05 18:06:05	2022-09-05 18:05:00	2022-09-05 18:01:00	2022-09-05 18:05:00

BYTES RECEIVED / LAST FULL HOUR AND THE SAME HOUR OVER 7 DAYS IN THE SAME TIMEFRAME

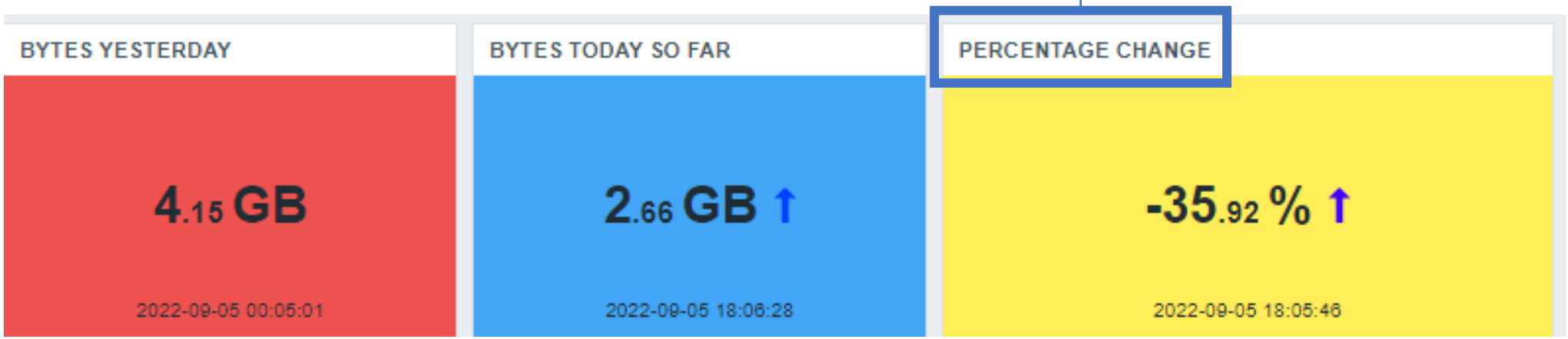


TCP BYTES YESTERDAY	TCP BYTES TODAY SO FAR	PERCENTAGE CHANGE	AVG / LAST HOUR > NOW	AVG BYTES / PREVIOUS HOUR	STANDARD DEVIATION	ANOMALY RATE
2.76 GB	2.06 GB ↑	-25.59 % ↑	2.43 MB ↑	687.69 KB	1.39 DEV ↑	0.13 RATE
UDP BYTES YESTERDAY	UDP BYTES TODAY SO FAR	PERCENTAGE CHANGE	AVG / LAST HOUR > NOW	AVG BYTES / PREVIOUS HOUR	STANDARD DEVIATION	ANOMALY RATE
1.32 GB	566.82 MB ↑	-58.12 % ↑	697.65 KB ↑	687.69 KB	0.05 DEV ↓	0.13 RATE
ICMP BYTES YESTERDAY	ICMP BYTES TODAY SO FAR	PERCENTAGE CHANGE	AVG / LAST HOUR > NOW	AVG BYTES / PREVIOUS HOUR	STANDARD DEVIATION	ANOMALY RATE
67.37 MB	50.83 MB ↑	-24.63 % ↑	48.00 KB	48.00 KB	0.16 DEV ↑	0.08 RATE
OTHER BYTES YESTERDAY	OTHER BYTES TODAY SO FAR	PERCENTAGE CHANGE	AVG / LAST HOUR > NOW	AVG BYTES / PREVIOUS HOUR	STANDARD DEVIATION	ANOMALY RATE
0 B	0 B	No data	0.00 B	0.00 B	0.00 DEV	0.00 RATE

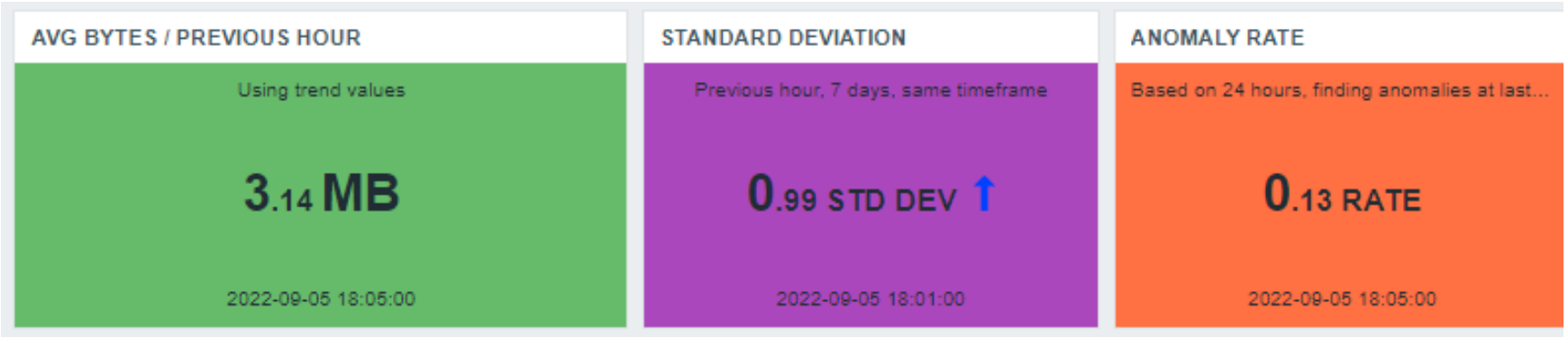
BYTES RECEIVED / LAST FULL HOUR AND THE SAME HOUR OVER 7 DAYS IN THE SAME TIMEFRAME



Comparing both



How far from the average?



Value for the last full hour

Deviations found

Key concept #1

- **What is Baseline?**
  - A way of analyzing past behavior so that I can predict what to receive

Key concept #2

- **What is Standard Deviation?**
  - A way of knowing how “far” values are from average

Key concept #3

- **What is Anomaly Rate?**
  - it is an indicator based on the number of deviations reached in a detection period

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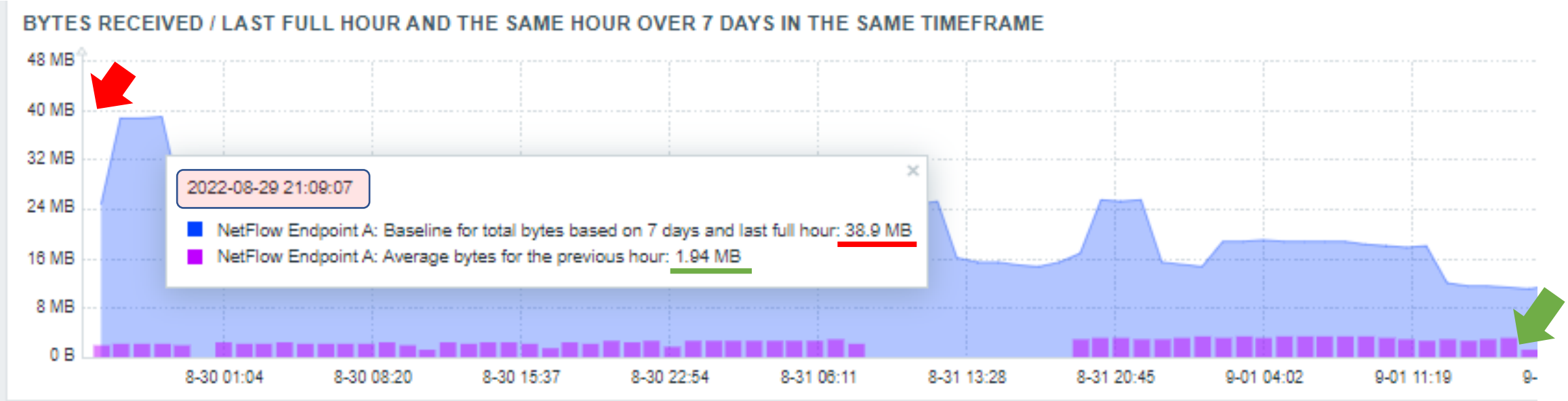
Baseline

Baseline for total bytes received from a Netflow exporter (firewall, router, etc.)

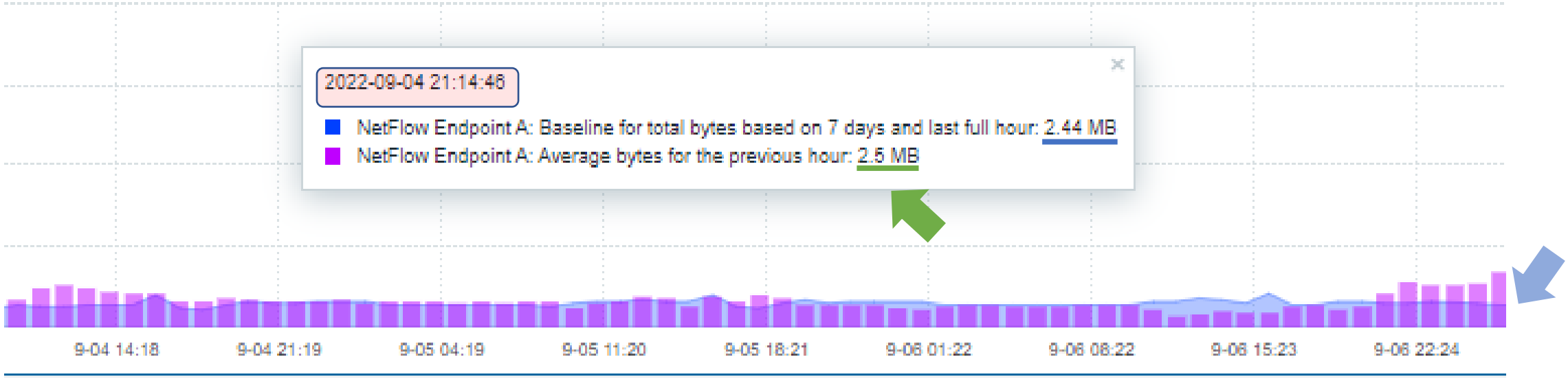


baselinewma(//total.bytes,**1h:now/h,"d",7**)

trendavg(//total.bytes,**1h:now/h**)

Baseline for total bytes received from a Netflow exporter (firewall or router)

Same time, few days later



baselinewma(//total.bytes,**1h:now/h,"d",7**)

trendavg(//total.bytes,**1h:now/h**)

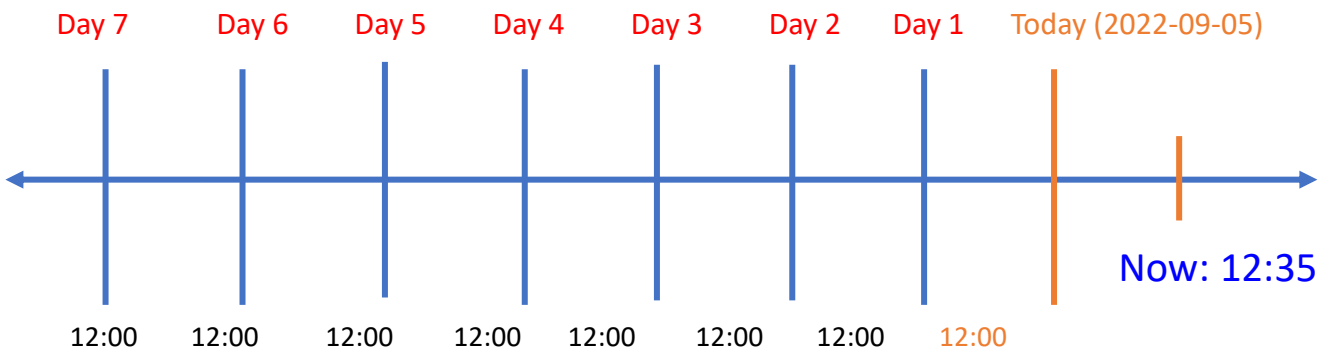
Graph explanation #Used baseline formula

Defining the data gathering period

Defining periodicity

Formula: **baselinewma**(//total.bytes,**1h:now/h**,"d",7)

Seasonality



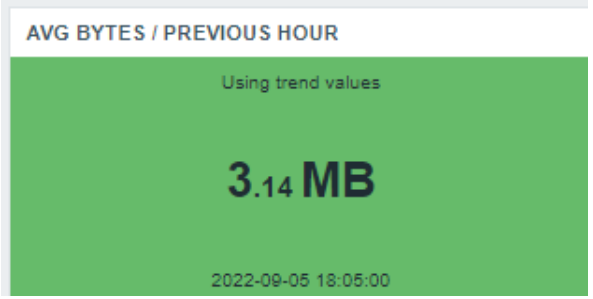
Based on received values in the last full hour: 11:00 – 11:59

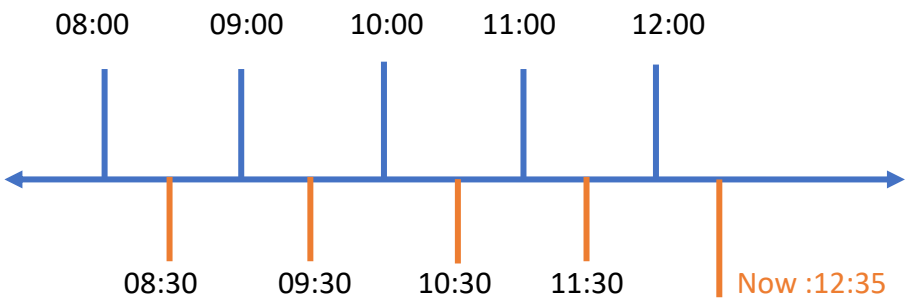
“trendavg x avg”

Using trends

Formula: trendavg(//total.bytes,1h:now/h)

The last full hour

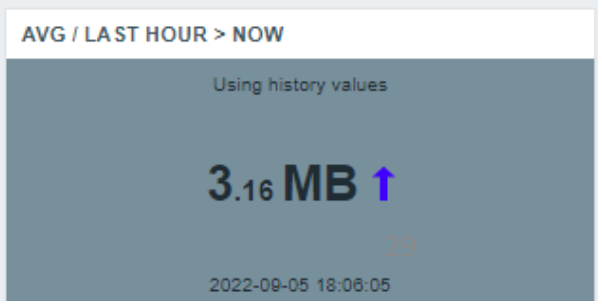




Formula: avg(//total.bytes,1h)

Last hour until now

Using history



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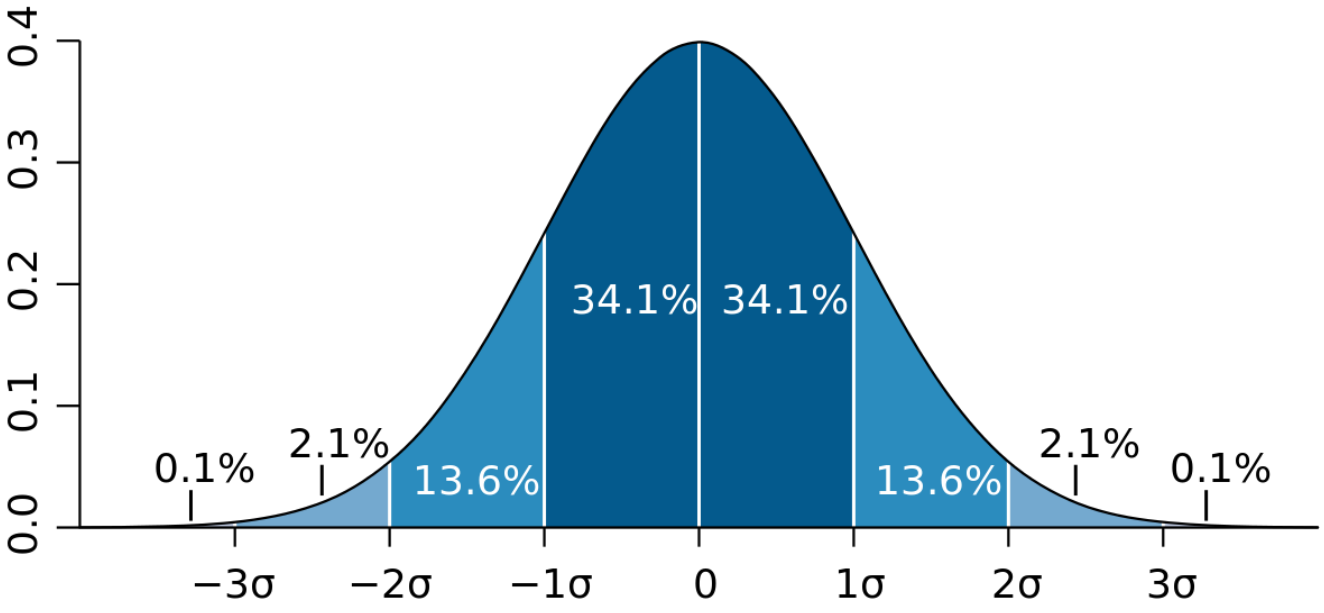
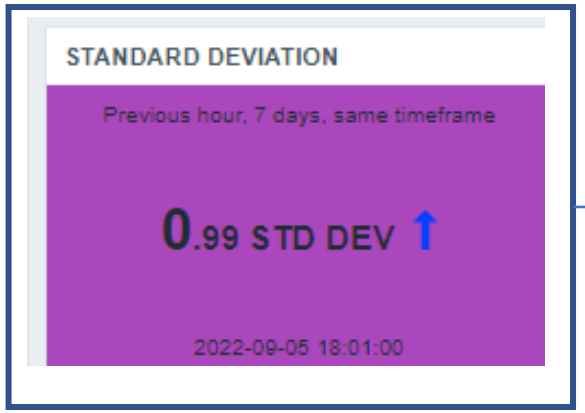
Standard Deviation

Standard Deviation



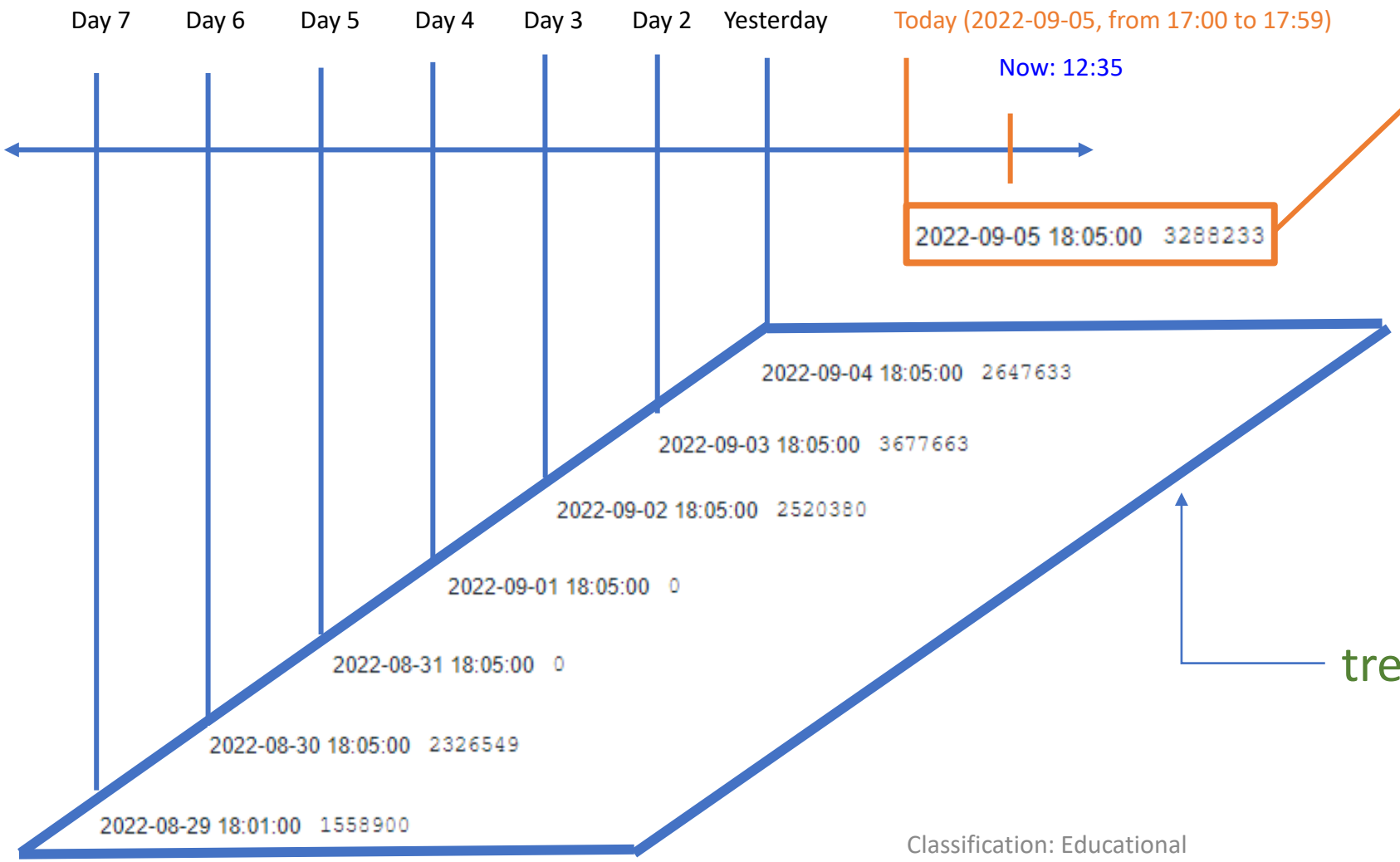
Standard Deviation

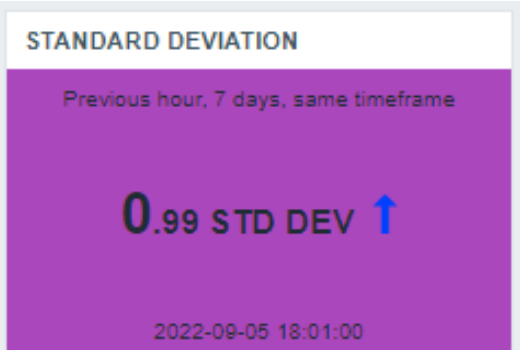


Formula: baselinedev(//total.bytes,1h:now/h,"d",7)

Standard Deviation

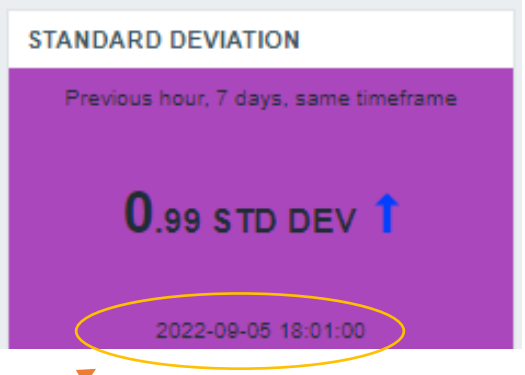
Formula: **baselinedev**(//total.bytes,1h:now/h,"d",7)

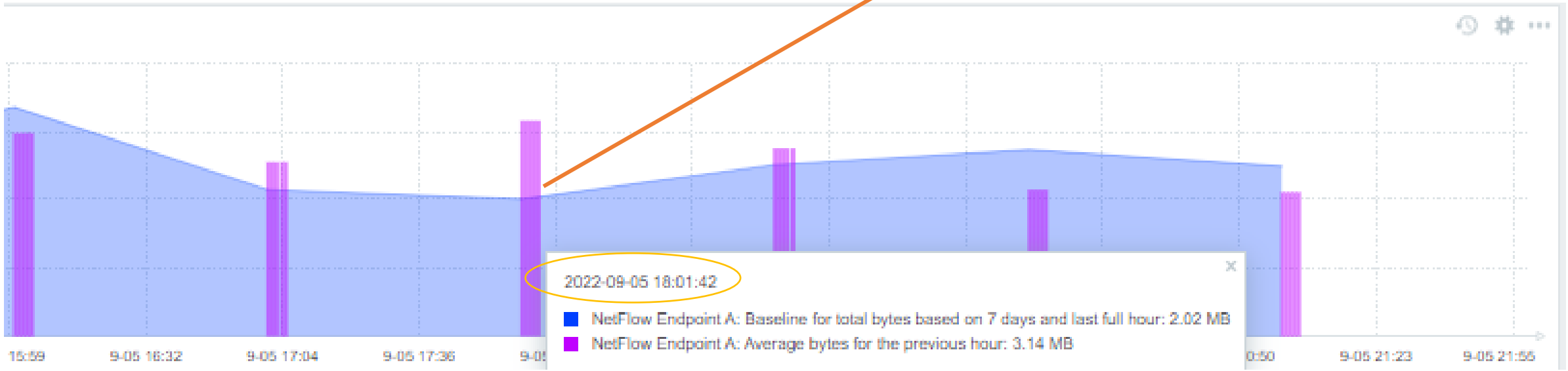




trendavg(//total.bytes,1h:now/h)

Standard Deviation





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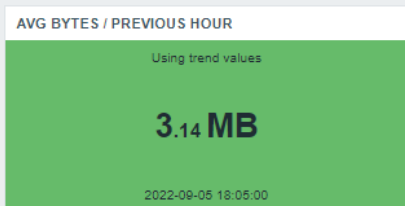
Anomaly Rate

Anomaly Rate

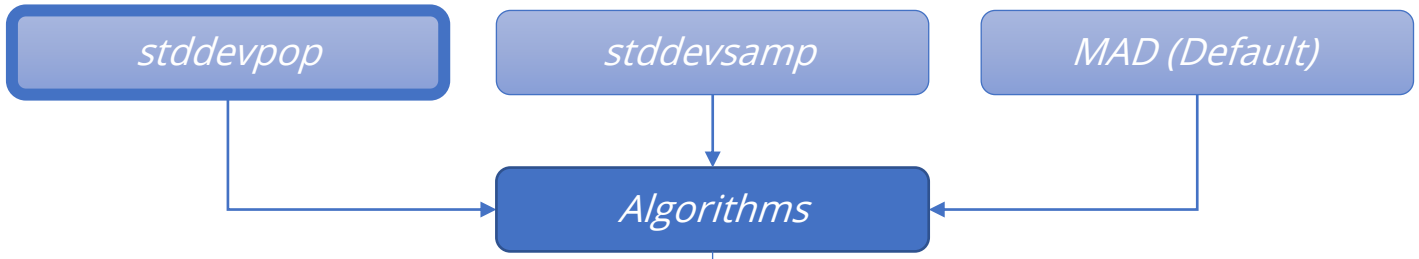
Formula: trendstl(//trendavg.1,24h:now/d,24h,2h,2,"stddevpop")

Item key: trendavg.1



Formula: trendavg(//total.bytes,1h:now/h)

Anomaly Rate



Number of deviations to considering

Formula: trendstl(//trendavg.1,24h:now/d,24h,2h,2,"stddevpop")

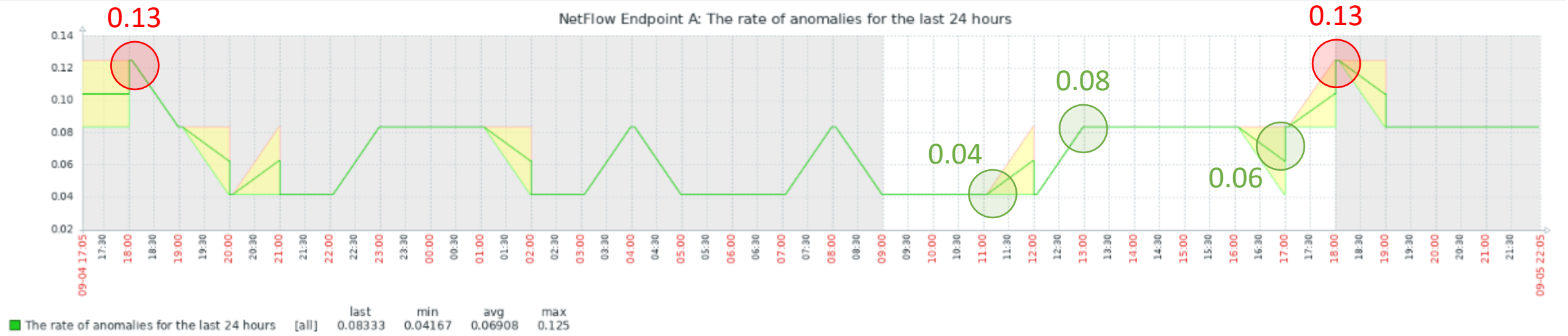
Observability period

Expected periodicity

Looking for anomalies here

In the last 24 hours “Anomaly Rate” is 0.13

Anomaly Rate



Something is happening at about 6 PM every day and needs some investigation!

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Conclusion

#Considerations

- A short time was used
- You can use graphs to show a Standard Deviation evolution
- In real life you must consider your business rules

Conclusion

- **In general, our goal was achieved**
  - Improving or generate network infrastructure visibility using some new Zabbix Trend Functions
    - Highlighting Baseline, Standard Deviation and Anomaly Rate ✓
  - Improving or generate a tactical layer monitoring in addition to operational layer monitoring ✓
  - Understanding our network behavior based on operational data received before by Zabbix (using Netflow integration) ✓

Conclusion

- **We have new challenges**
  - we need to create some triggers to be fired when a threshold is reached
  - we need to translate some business rules to Zabbix formulas and try to reflect the company reality
  - if you don’t use Zabbix 6.+ yet, make a plan and start as soon as possible!

Conclusion

- **Operational layer monitoring is easy and necessary**
  - if you can monitor the tactical layer, it will be desirable
- **There is no limit to monitor when using Zabbix**
  - if out-of-the-box features are not enough, just extend Zabbix
- **More questions instead answers**
  - Before: Poor visibility
  - Now: Operational and tactital layer monitoring
  - Next: Investigation

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