

MONITORING SYSTEM FOR IT INFRASTRUCTURE AND EPICS CONTROL SYSTEM AT SuperKEKB

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The monitoring system has been deployed to efficiently monitor IT infrastructure and EPICS control system at SuperKEKB. **The system monitors two types of data: metrics and logs.** Metrics such as a network traffic and a CPU utilization are monitored with Zabbix. The data stored in Zabbix are visualized on Grafana, which allows us to easily create dashboards and analyze the data. Logs such as text data are monitored with Elastic Stack, which provides log collection, searching, analysis and visualization. We have applied it to monitor broadcast packets in the control network and EPICS control system. In addition, **we have developed the EPICS Channel Access client software that sends PV values to Zabbix server and the status of each IOC is monitored with it.** We have also developed the Grafana plugin and API gateway to visualize the data from pvAccess RPC servers. Various data such as CSS alarm status data is displayed on it.

Abstract

Metric Monitoring

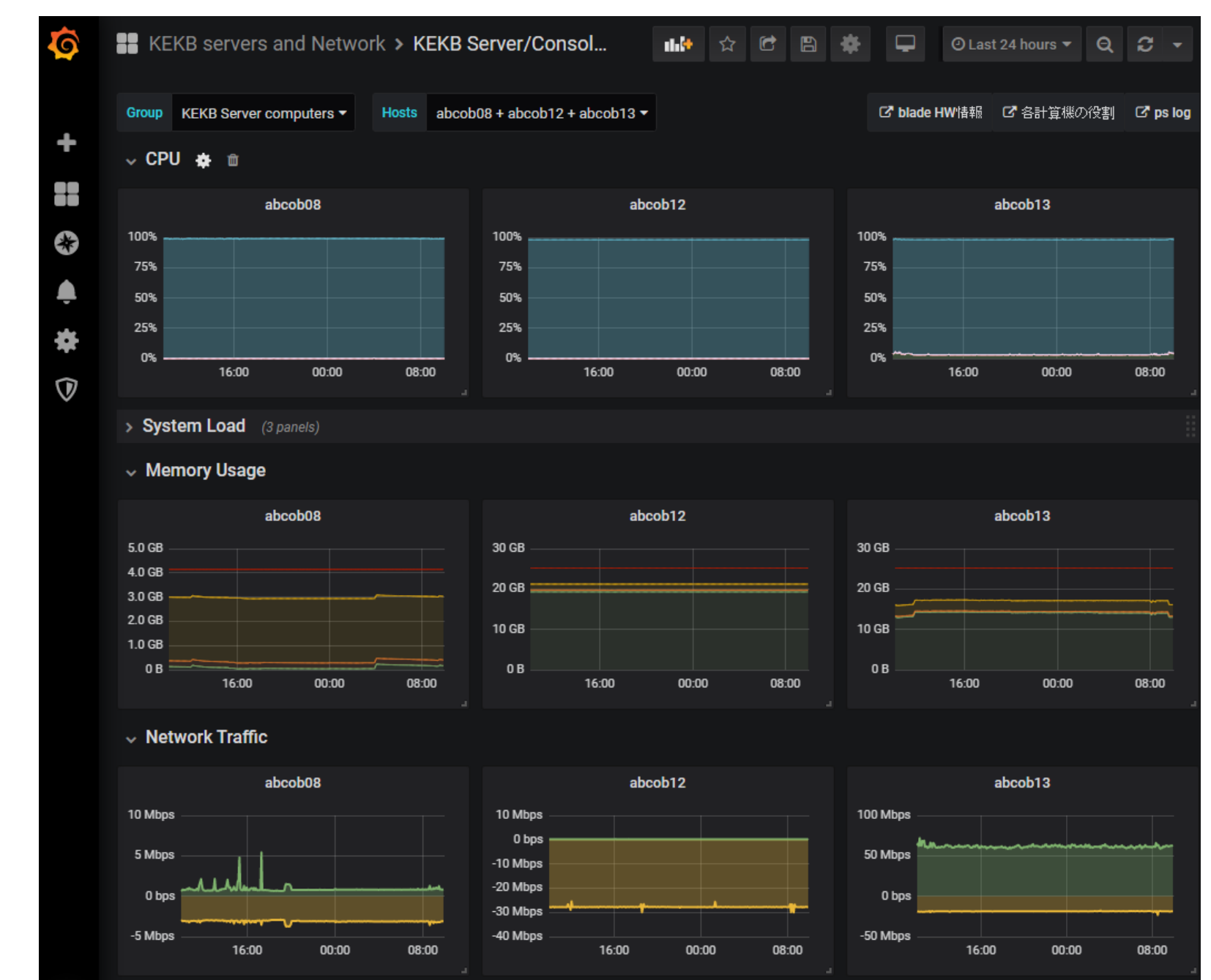
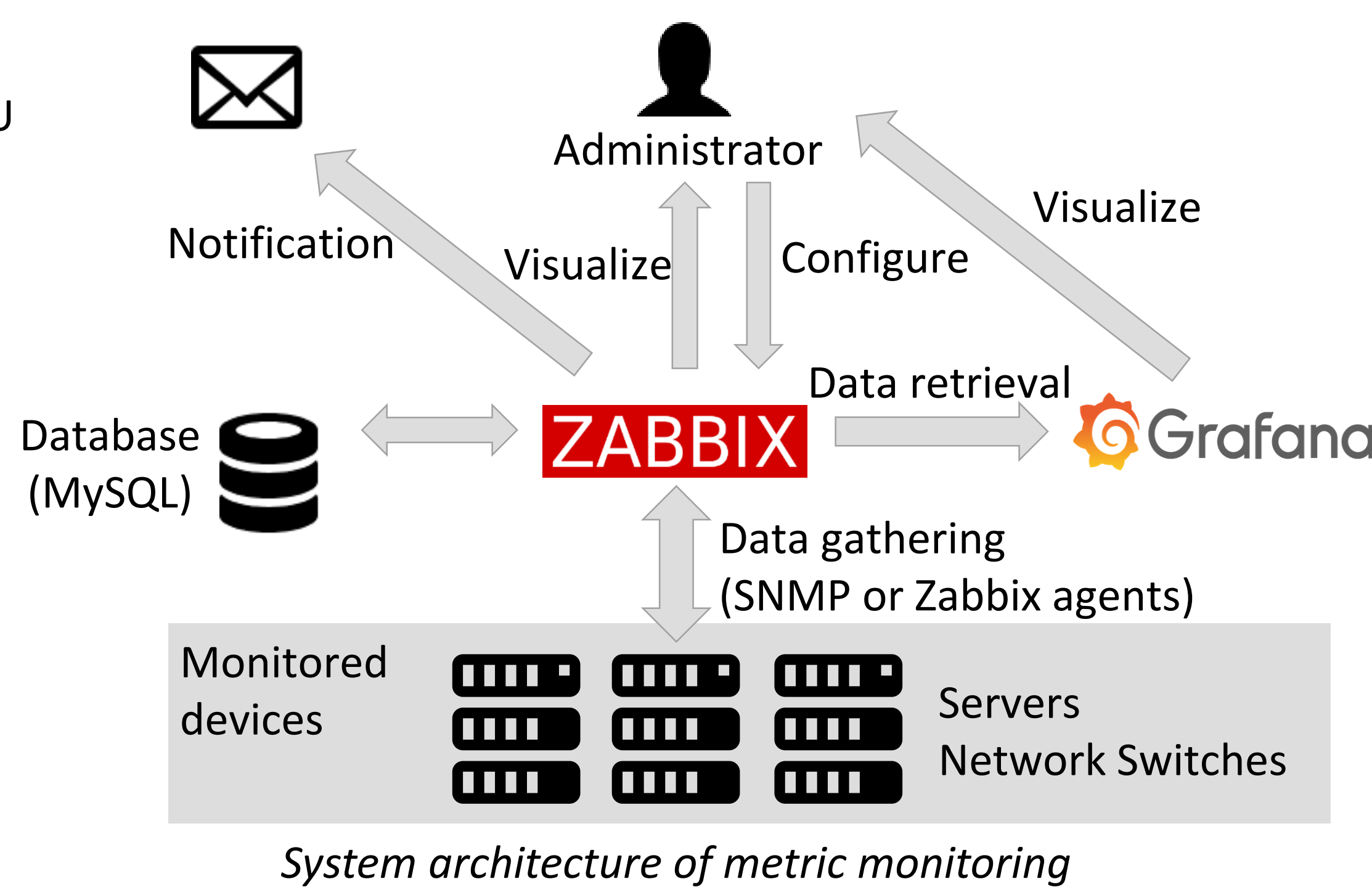
- Metrics are collection of a measurement at a certain point in time
- We have monitored the metrics such as a network traffic and a CPU utilization with Zabbix

ZABBIX

- Open-source monitoring software tool
- Integrated multiple features for monitoring

Grafana

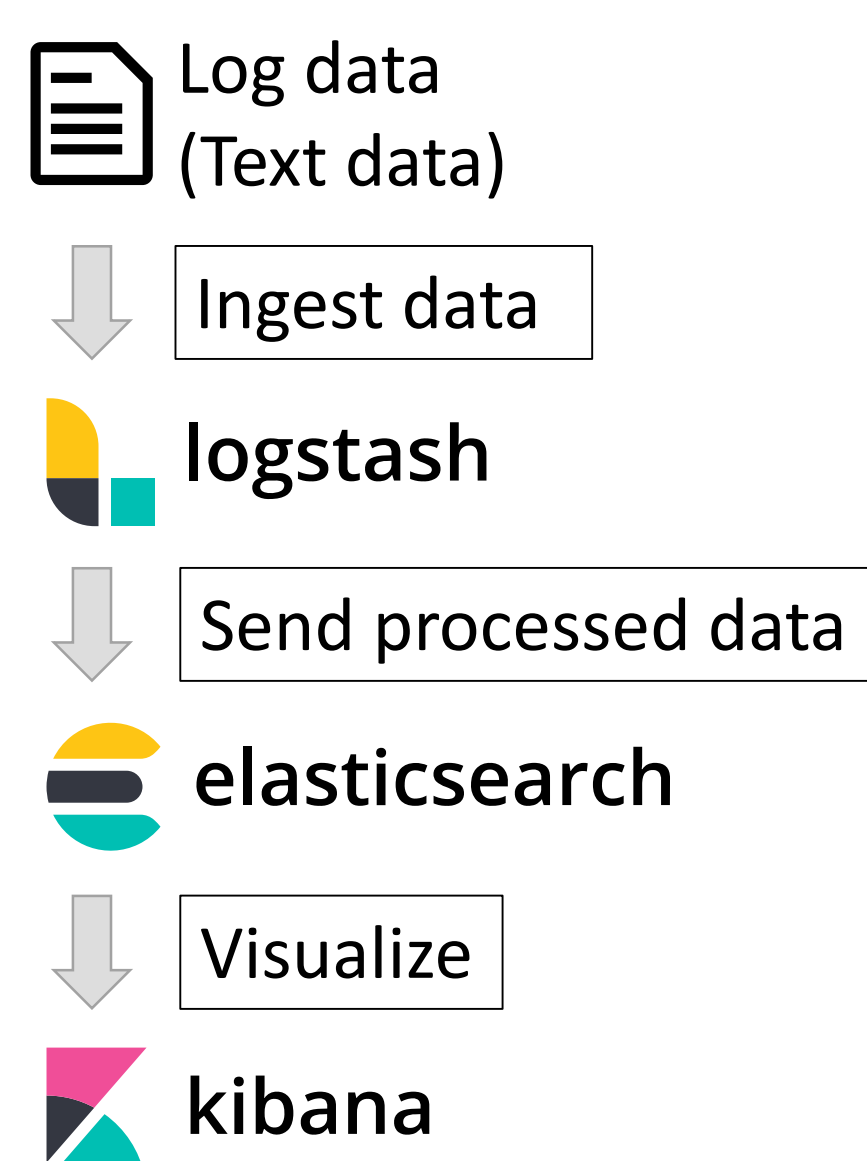
- Open-source software tool for data visualization and analysis
- Allows to visualize data from various data storage backend
- We have applied Zabbix plugin to Grafana to visualize the data stored in Zabbix data storage



Grafana dashboard for computer performance metrics

Log Monitoring

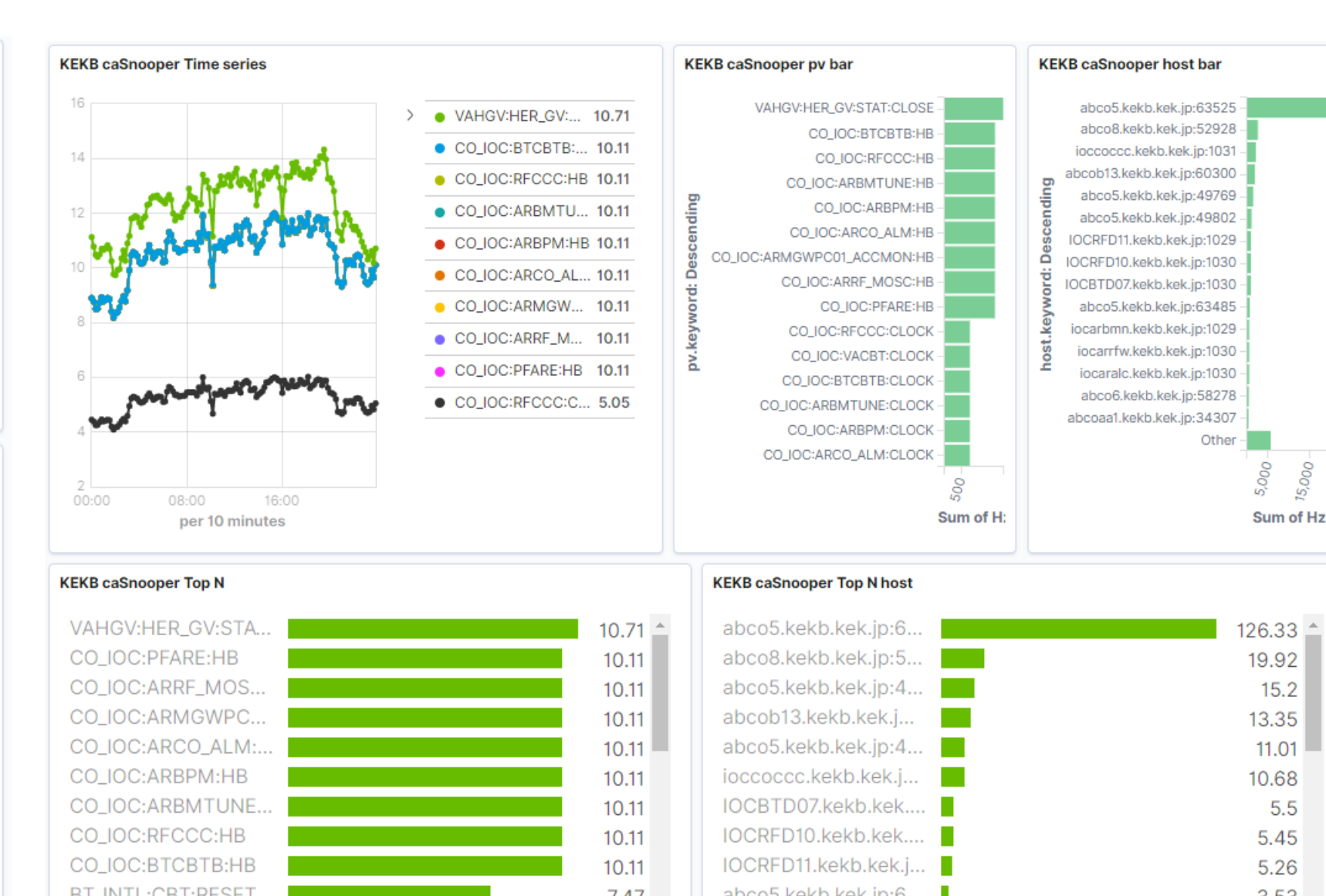
- Log is text messages generated from an operating system or other software
- We adopt Elastic Stack for log data collection, searching, analysis and visualization
- We apply Elastic Stack to monitor broadcast packets and the EPICS control system



System architecture of log monitoring



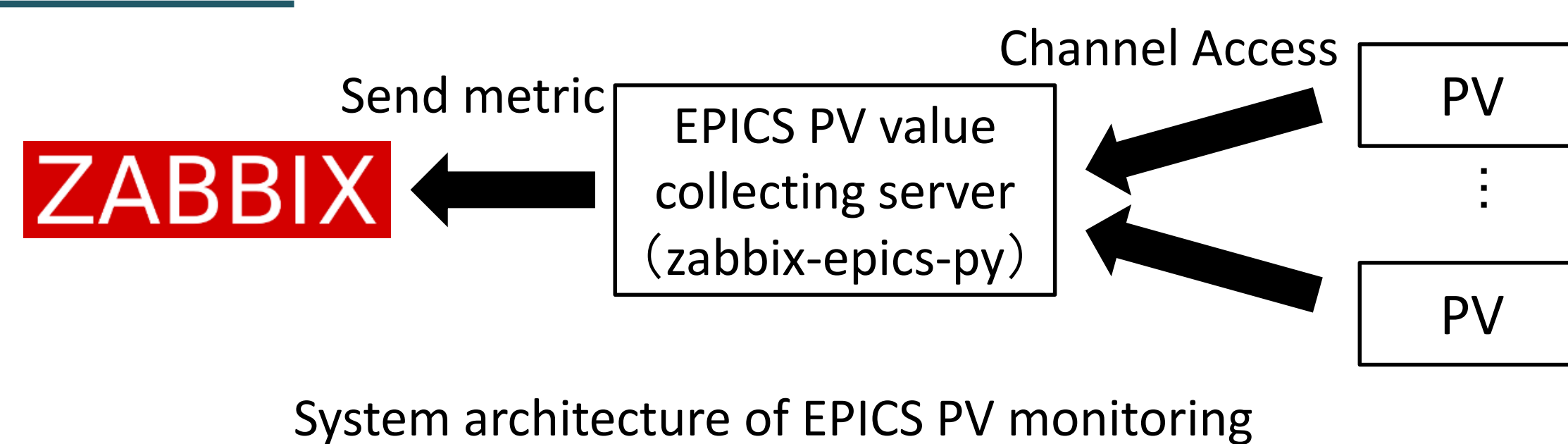
Channel Access broadcast packets monitoring on Kibana using Wireshark and CA protocol dissector (cashark)



PV search frequencies monitoring with caSnooper

EPICS PV Monitoring with Zabbix

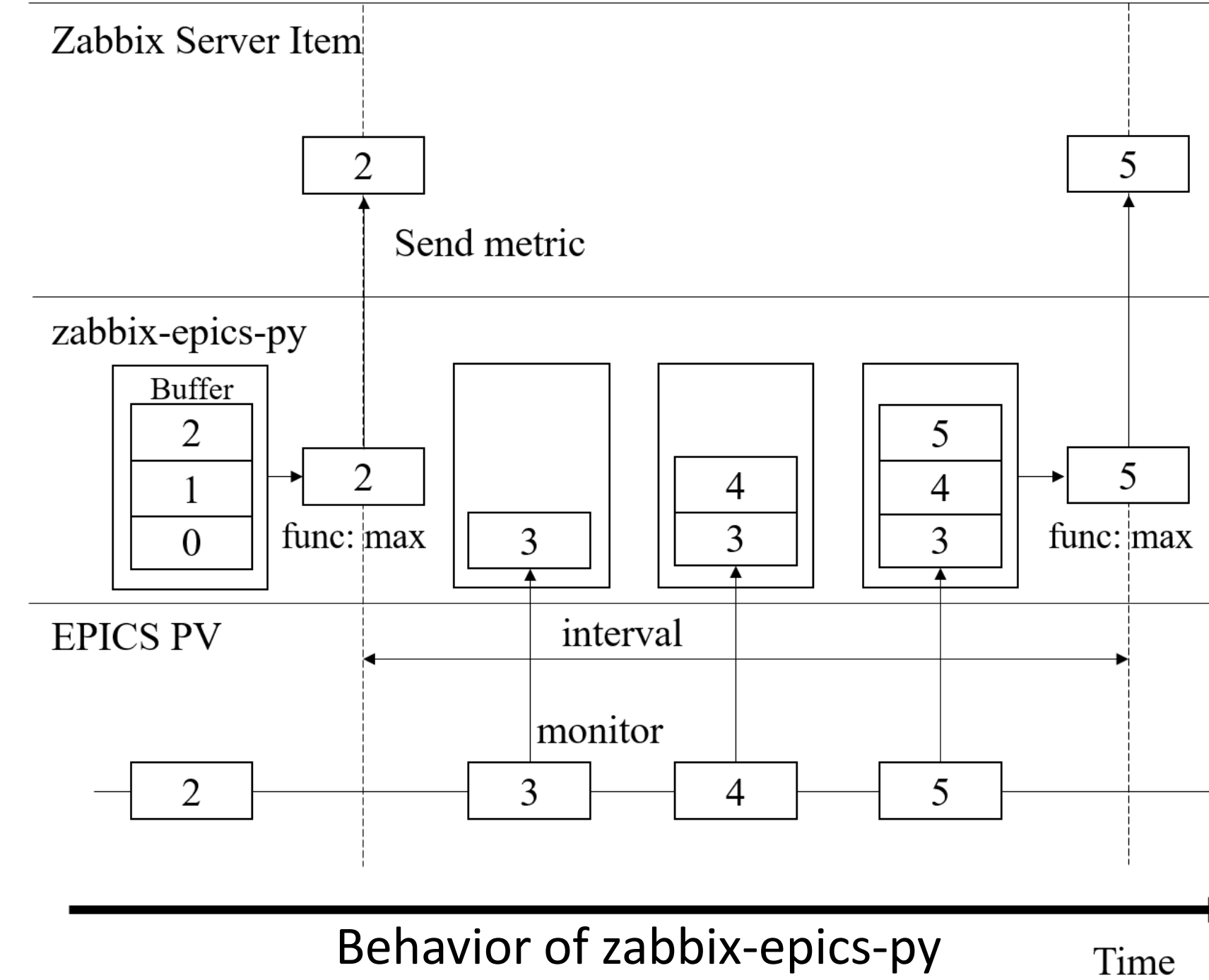
- We had several problems on EPICS IOC
- For example, new CA client was rejected due to high CPU utilization or high memory consumption
- To keep IOC healthy, monitoring IOC performance is required
- We have implemented EPICS PV monitoring system with Zabbix for IOC monitoring
- PV values are monitored as metrics and they are managed as well as the metrics for IT infrastructure
- PV values are stored in a buffer in the interval
- Func determines what function is applied to the buffer before sending metric
- We have monitored PVs of CPU utilization, memory usage, number of CA clients and so on provided by DevlocStats device support.



System architecture of EPICS PV monitoring

```
>>> from zbxepics import ZabbixSenderCA
>>> server_ip = '127.0.0.1'
>>> port = 10051
>>> config = False
>>> items = [dict(host='dummyHost', pv='TEST:PV', interval=30,
>>>               item_key='zabbix-epics-py-test.item', func='last')]
>>> sender = ZabbixSenderCA(server_ip, port, config, items)
>>> sender.run()
```

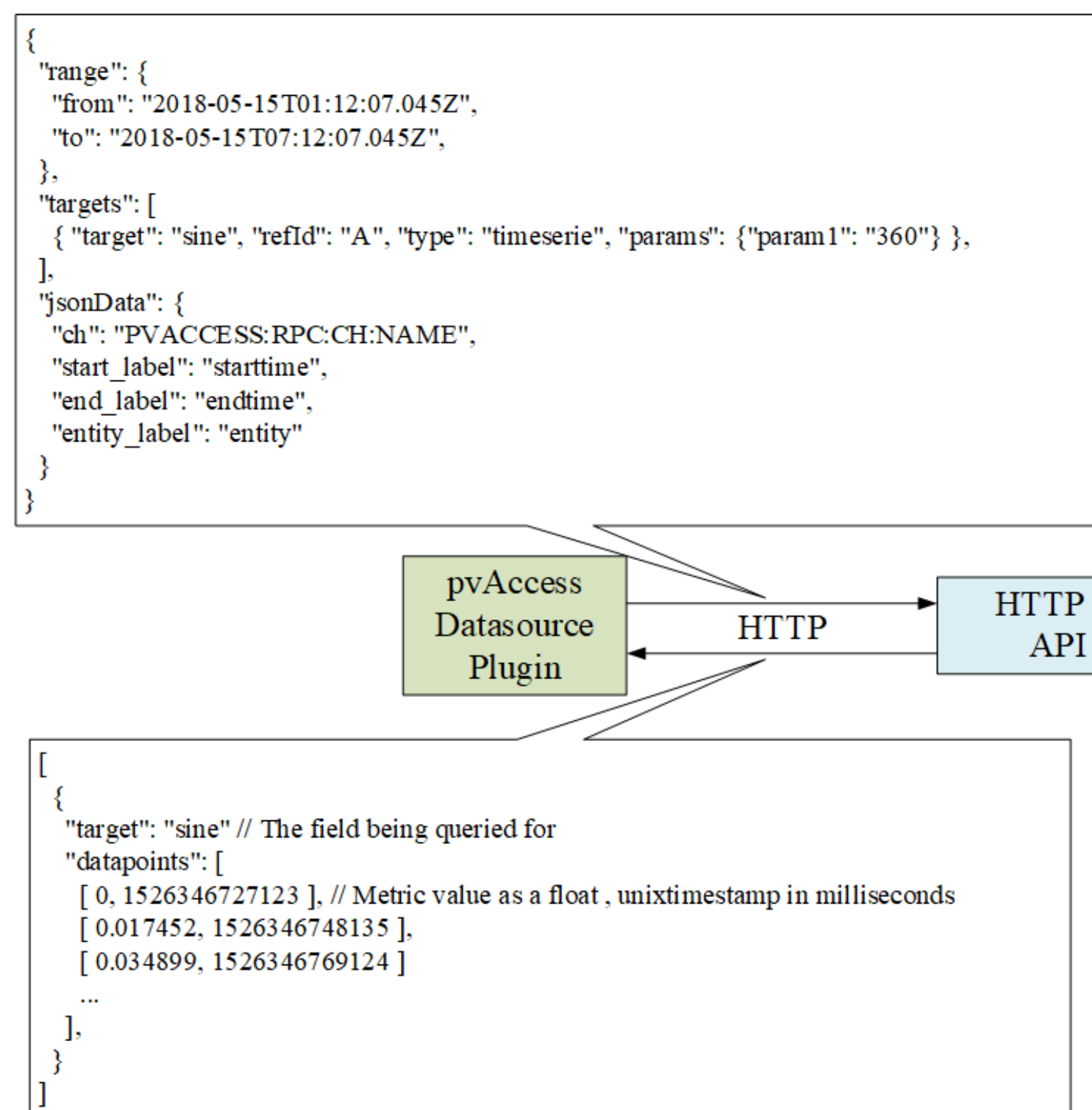
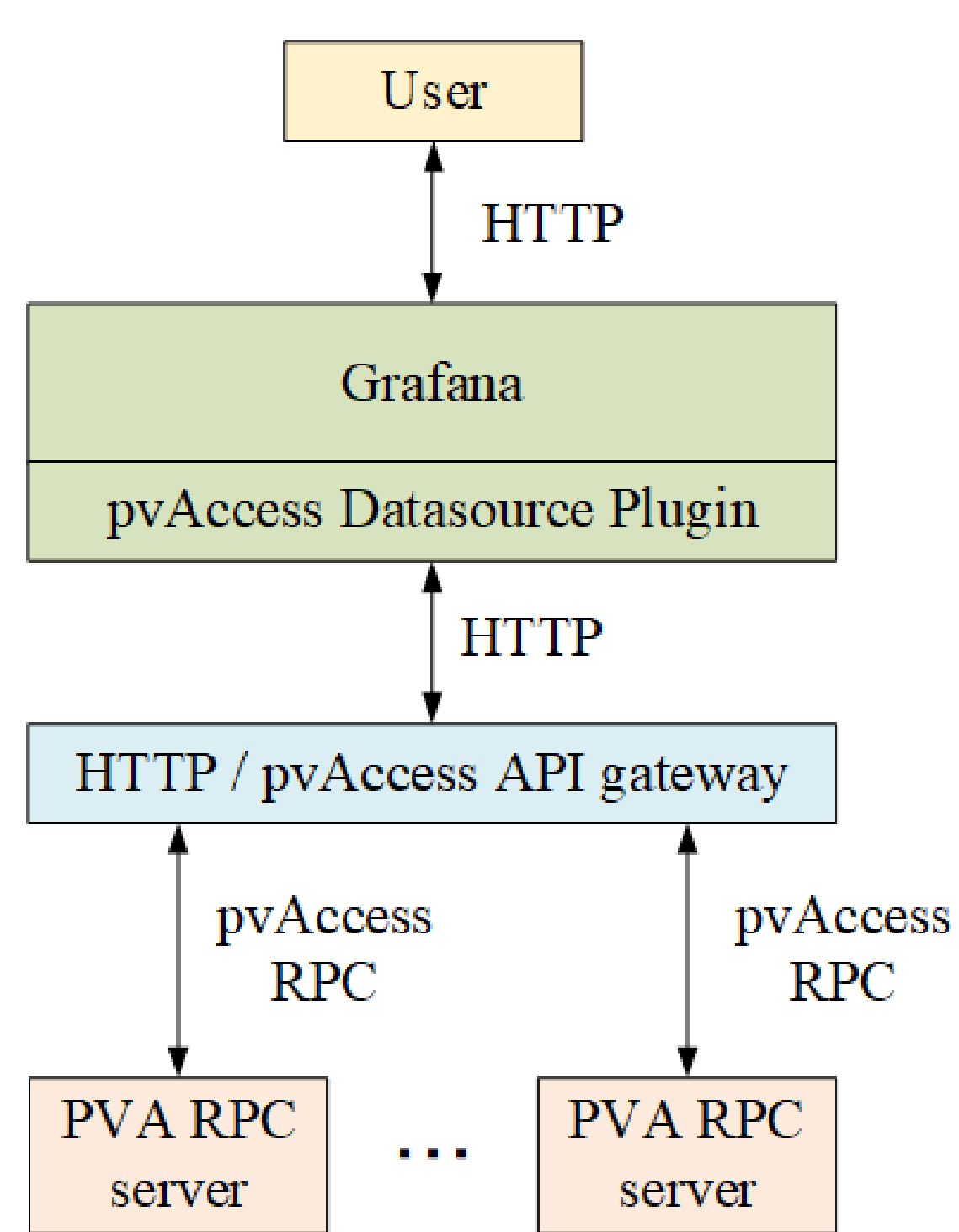
Example usage of zabbix-epics-py



Behavior of zabbix-epics-py

Visualize pvAccess RPC Data on Grafana

- We have developed Grafana datasource plugin and HTTP / pvAccess API gateway to visualize arbitrary data on Grafana
- These applications allow to visualize the data from pvAccess RPC servers



Message flow in the data visualization system

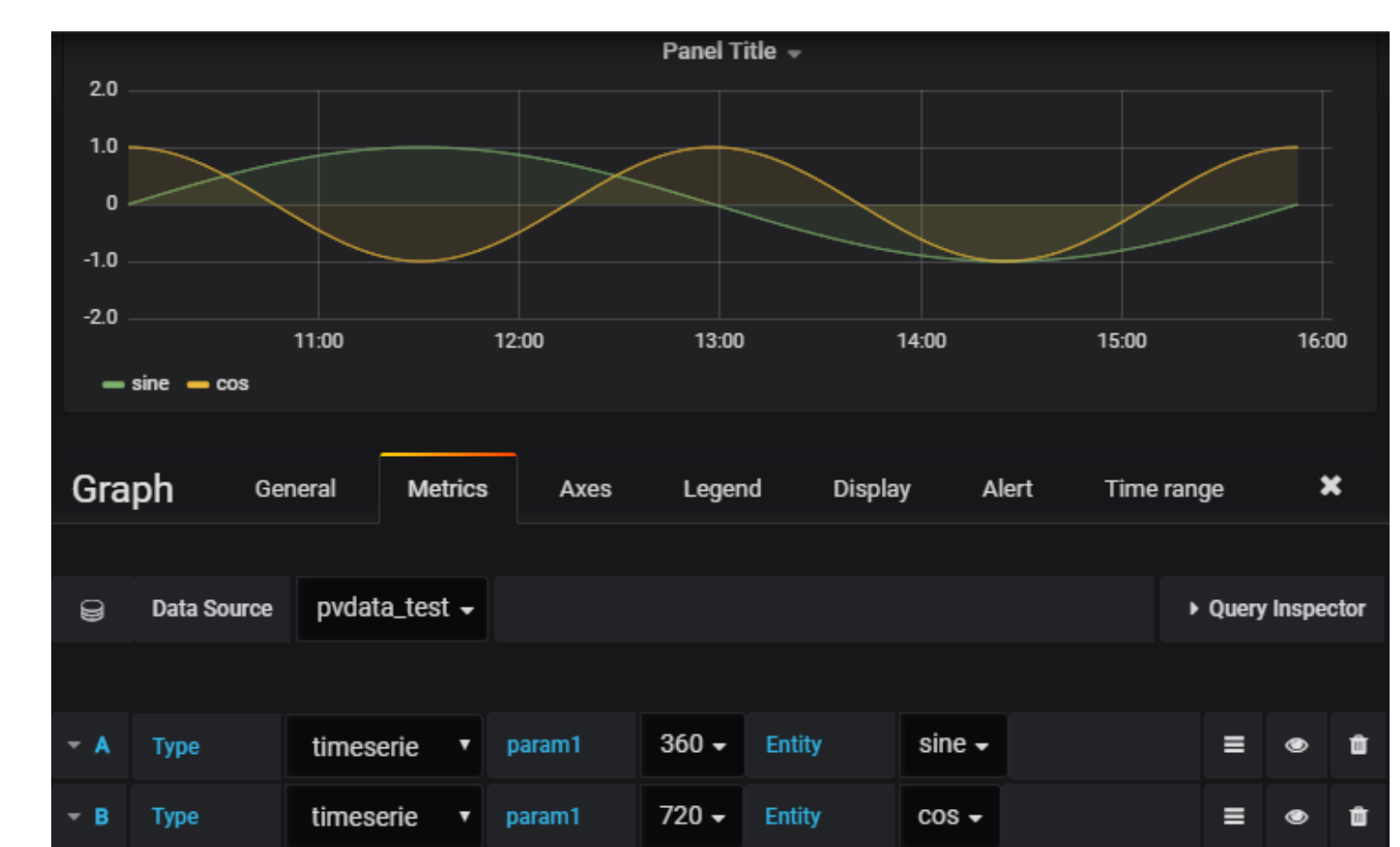
Arguments as shown below are essential:

- starttime
- endtime
- entity

Optional arguments are also allowed to use

```
structure
string starttime 2018-05-15T10:12:07
string endtime 2018-05-15T16:12:07
string entity sine
string param1 360
```

Returned value must be NTable type



Visualized pvAccess RPC sample data

time	group	severity_id	status	message	record
2018-07-03 13:24:21.028229	MG (LER)	MINOR	LINK_ALARM	Magnet PS ES23 NA or IL	MG_PS_ES23_ALARM
2018-07-03 13:24:20.611962	MG (LER)	MINOR	LINK_ALARM	Magnet PS ES12 NA or IL	MG_PS_ES12_ALARM
2018-07-03 13:24:20.528229	MG (HER)	MINOR	LINK_ALARM	Magnet PS OC2LE NA or IL	MG_PS_OC2LE_ALARM
2018-07-03 13:24:20.511962	MG (LER)	MINOR	LINK_ALARM	Magnet PS OC2RP NA or IL	MG_PS_OC2RP_ALARM
2018-07-03 13:24:20.494896	MG (LER)	MINOR	LINK_ALARM	Magnet PS OC2LP NA or IL	MG_PS_OC2LP_ALARM
2018-07-03 13:24:20.478229	MG (HER)	MINOR	LINK_ALARM	Magnet PS OC2LE NA or IL	MG_PS_OC2LE_ALARM
2018-07-03 13:24:20.461962	MG (LER)	MINOR	LINK_ALARM	Magnet PS OC2RE NA or IL	MG_PS_OC2RE_ALARM
2018-07-03 13:24:20.445295	MG (LER)	MINOR	LINK_ALARM	Magnet PS ES11 NA or IL	MG_PS_ES11_ALARM
2018-07-03 13:24:20.428229	MG (LER)	MINOR	LINK_ALARM	Magnet PS OC2LP NA or IL	MG_PS_OC2LP_ALARM

Table of current CSS alarm data

System architecture of the data visualization system for pvAccess RPC data