



Webinar

Preprocessing

all our microphones are muted

ask your questions in Q&A, not in the Chat

use Chat for discussion, networking or applause

1

Preprocessing

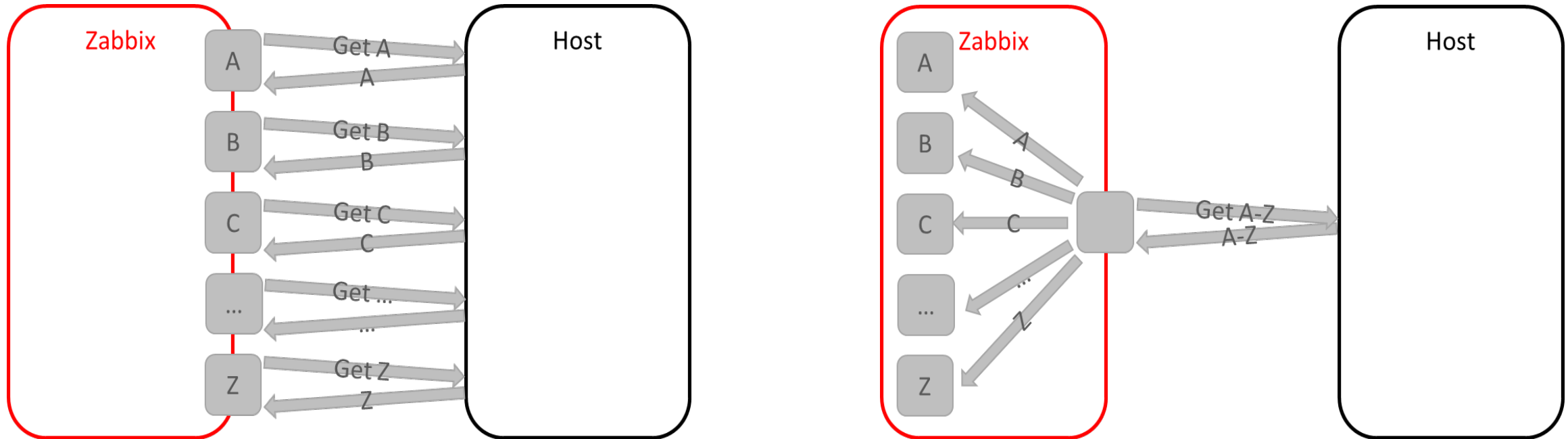


Preprocessing

VALUE PREPROCESSING

- ▶ Preprocessing of item values allows to define and execute data transformation rules for received item values.
- ▶ This can be used for simple as well as dependent items.

```
/usr/sbin/zabbix_server: preprocessing manager #1 [queued 41, processed 100 values, idle 5.001769 sec during 5.005980 sec]
```



VALUE PREPROCESSING

12 C



Trim



Temperature: 12

OFF (down)



Replace



Service: 0 (down)

{"users":10004}



JSON



Number of users: 10004

"GET /index.html HTTP/1.0"
200 28083

Regex

Response code: 200
Size: 28083

Unstructured text

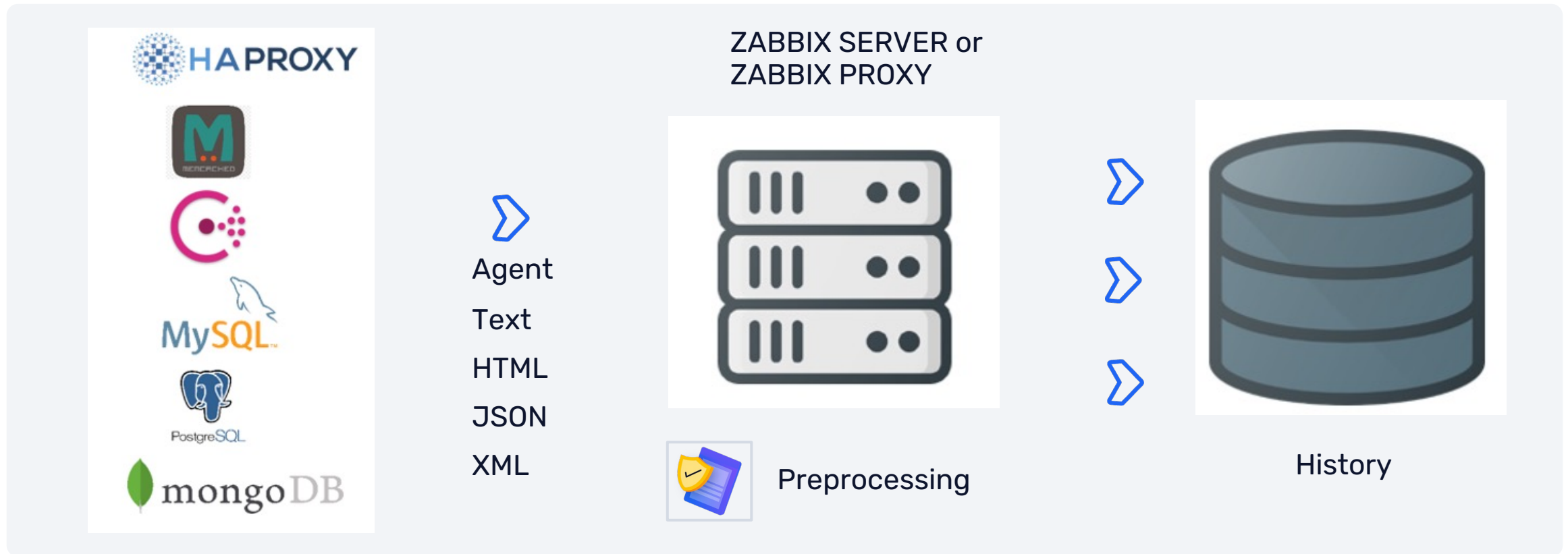


Regex

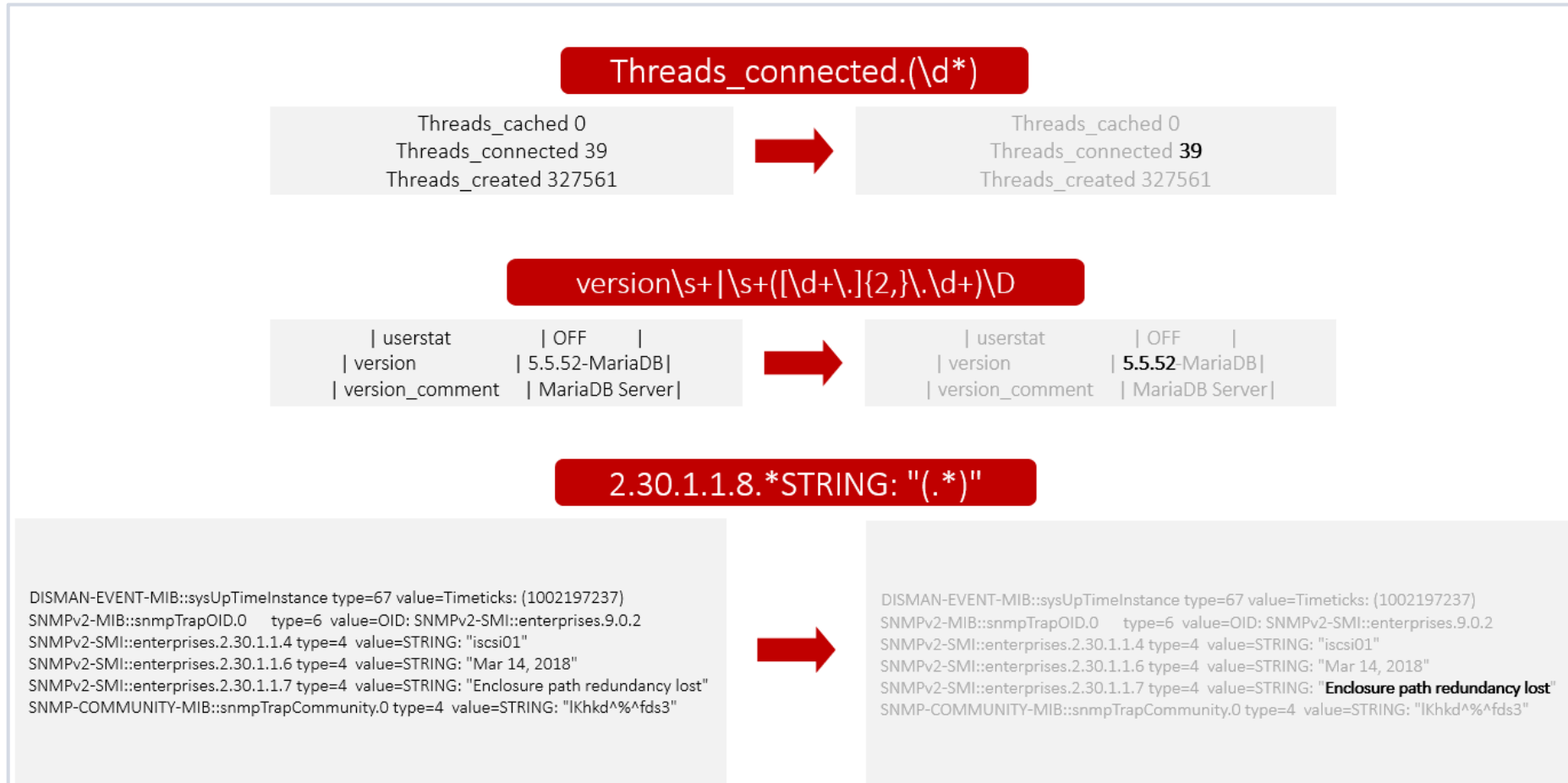
Version: Apache 2.2.15 (Unix)
DNS lookup threads: 10

Preprocessing

DATA FLOW



PCRE Examples



Preprocessing

JSON PATH

`$.store.book[0].price`

```
{ "store": {  
  "book": [  
    { "category": "reference",  
      "author": "Nigel Rees",  
      "title": "Sayings of the Century",  
      "price": 8.95  
    },  
    { "category": "fiction",  
      "author": "Evelyn Waugh",  
      "title": "Sword of Honour",  
      "price": 12.99  
    },  
    { "category": "fiction",  
      "author": "J. R. R. Tolkien",  
      "title": "The Lord of the Rings",  
      "isbn": "0-395-19395-8",  
      "price": 22.99  
    }  
  ],  
  "bicycle": {  
    "color": "red",  
    "price": 19.95  
  }  
}
```



```
{ "store": {  
  "book": [  
    { "category": "reference",  
      "author": "Nigel Rees",  
      "title": "Sayings of the Century",  
      "price": 8.95  
    },  
    { "category": "fiction",  
      "author": "Evelyn Waugh",  
      "title": "Sword of Honour",  
      "price": 12.99  
    },  
    { "category": "fiction",  
      "author": "J. R. R. Tolkien",  
      "title": "The Lord of the Rings",  
      "isbn": "0-395-19395-8",  
      "price": 22.99  
    }  
  ],  
  "bicycle": {  
    "color": "red",  
    "price": 19.95  
  }  
}
```

Preprocessing

JSON PATH

\$.store.bicycle

```
{ "store": {  
  "book": [  
    { "category": "reference",  
      "author": "Nigel Rees",  
      "title": "Sayings of the Century",  
      "price": 8.95  
    },  
    { "category": "fiction",  
      "author": "Evelyn Waugh",  
      "title": "Sword of Honour",  
      "price": 12.99  
    },  
    { "category": "fiction",  
      "author": "J. R. R. Tolkien",  
      "title": "The Lord of the Rings",  
      "isbn": "0-395-19395-8",  
      "price": 22.99  
    }  
  ],  
  "bicycle": {  
    "color": "red",  
    "price": 19.95  
  }  
}
```



```
{ "store": {  
  "book": [  
    { "category": "reference",  
      "author": "Nigel Rees",  
      "title": "Sayings of the Century",  
      "price": 8.95  
    },  
    { "category": "fiction",  
      "author": "Evelyn Waugh",  
      "title": "Sword of Honour",  
      "price": 12.99  
    },  
    { "category": "fiction",  
      "author": "J. R. R. Tolkien",  
      "title": "The Lord of the Rings",  
      "isbn": "0-395-19395-8",  
      "price": 22.99  
    }  
  ],  
  "bicycle": {  
    "color": "red",  
    "price": 19.95  
  }  
}
```


Preprocessing

XML PATH

```
<?xml version="1.0" encoding="UTF-8"?>
<bookstore>
  <book category="cooking">
    <title lang="en">Everyday Italian</title>
    <author>Giada De Laurentiis</author>
    <year>2005</year> <price>30.00</price>
  </book>
  <book category="children">
    <title lang="en">Harry Potter</title>
    <author>J K. Rowling</author>
    <year>2005</year>
    <price>29.99</price>
  </book>
  <book category="web">
    <title lang="en">Learning XML</title>
    <author>Erik T. Ray</author>
    <year>2003</year>
    <price>39.95</price>
  </book>
</bookstore>
```



`sum(/bookstore/book/price)`

99.94



`count(/bookstore/book)`

3



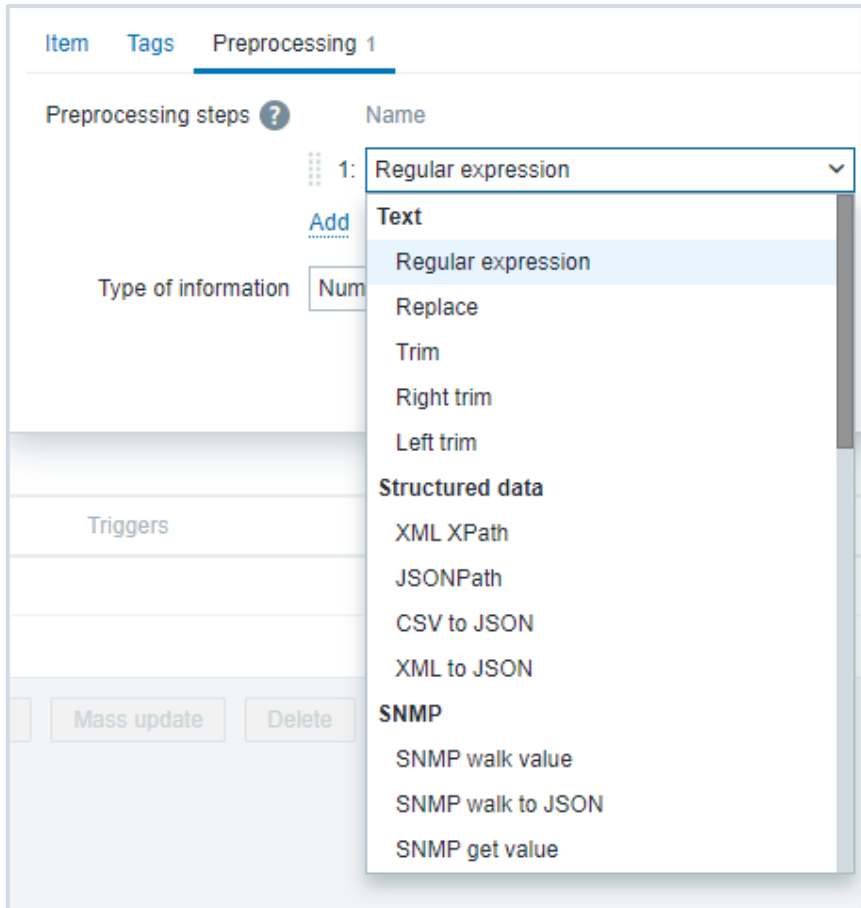
`number(/bookstore/book[price<30]/price)`

29.99

Preprocessing

THROTTLING

The throttling functionality allows to gather values from devices and applications at a very frequent interval, but the data is written to the database only when the incoming values are changed.



The screenshot shows the Zabbix web interface for configuring preprocessing steps. The main heading is "Preprocessing 1". Below it, there is a section for "Preprocessing steps" with a question mark icon. A dropdown menu is open, showing a list of preprocessing types. The "Text" category is selected, and its options are: Regular expression, Replace, Trim, Right trim, and Left trim. Other categories visible include "Structured data" (XML XPath, JSONPath, CSV to JSON, XML to JSON) and "SNMP" (SNMP walk value, SNMP walk to JSON, SNMP get value). On the left, there are buttons for "Add" and "Type of information" (with "Num" selected). At the bottom, there are "Mass update" and "Delete" buttons.

Zabbix simply ignores repeating values.

- ▶ The repeating values are not saved as historical data and don't have an impact on triggers.

Options:

- ▶ Discard a value if it has not changed.
- ▶ (empty graphs and nodata() can cause false alarms)
- ▶ Discard a value with a heartbeat.

Preprocessing

THROTTLING

Use cases

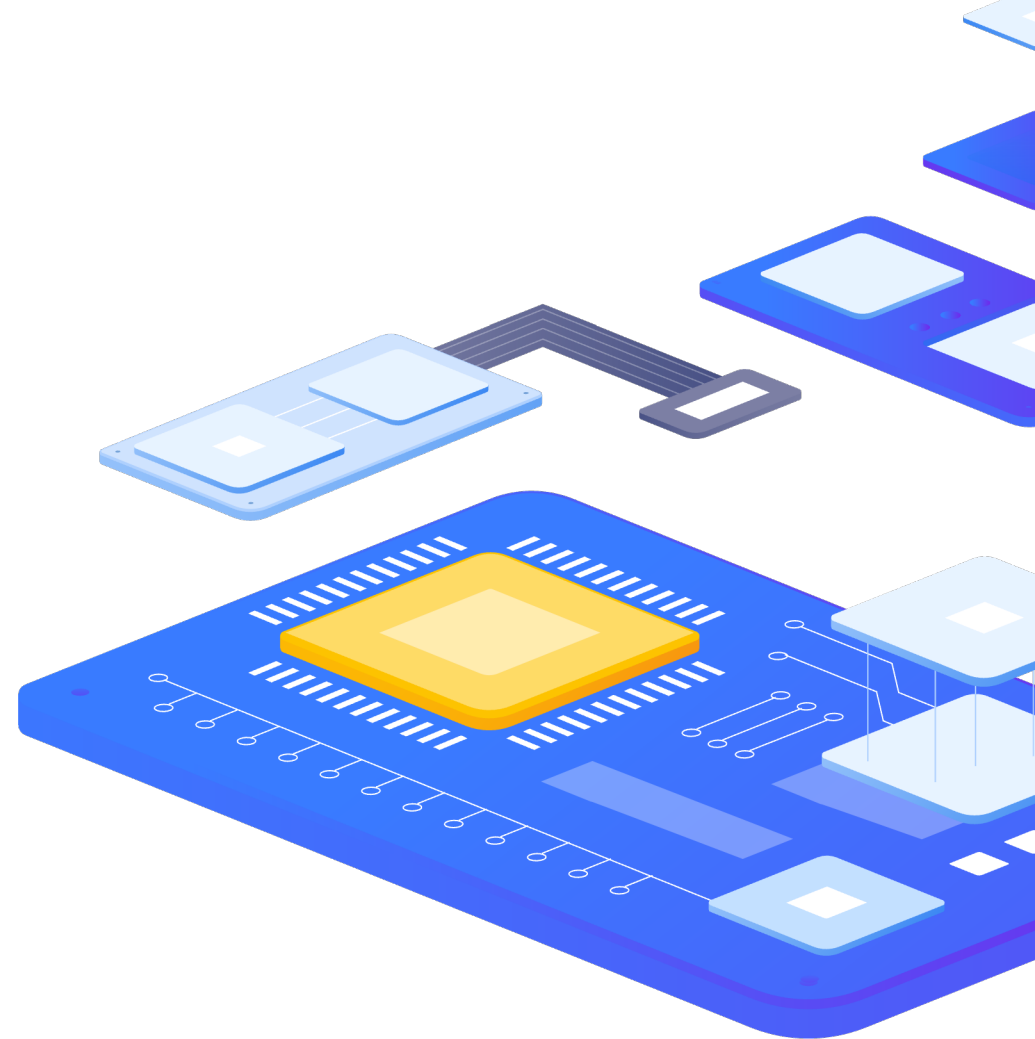
High frequency monitoring:

- › Saves space on the disk
- › Usable graphs

Monitoring of discrete data: statuses, states

Dependent metrics:

- › Master: 10s
- › Dependent metrics: 60s Throttling with a heartbeat

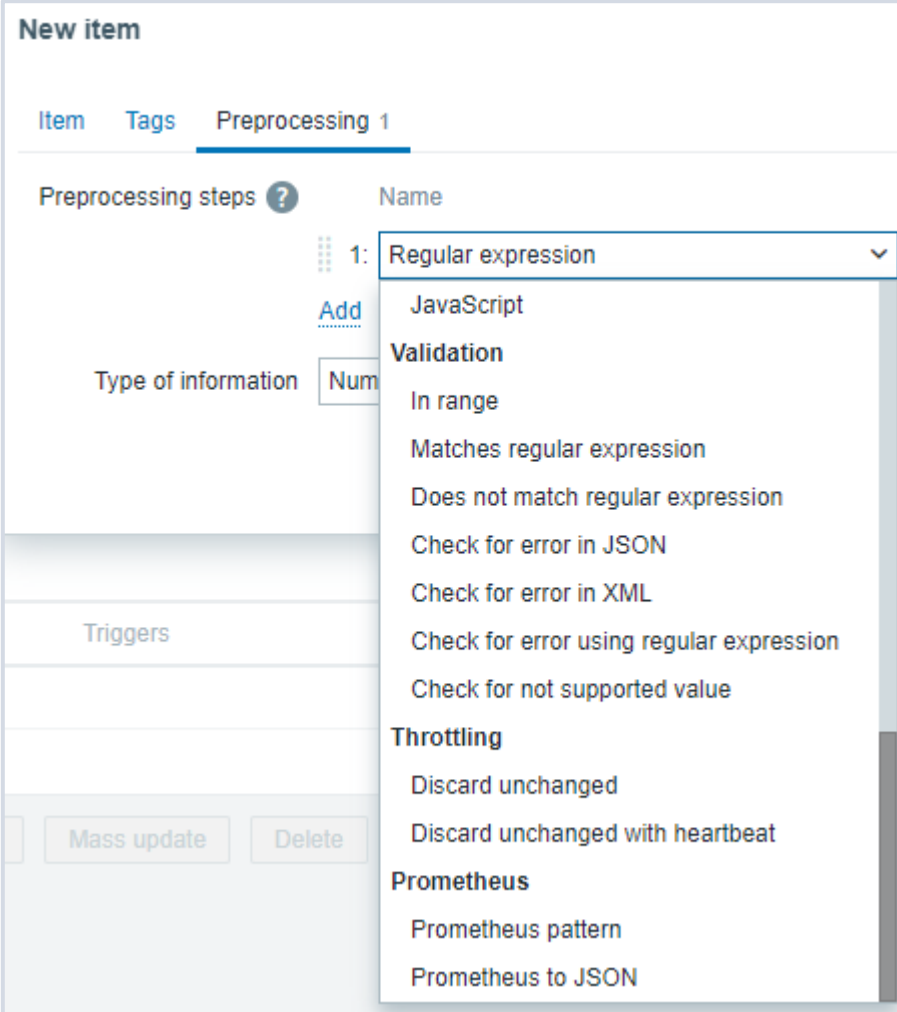


THROTTLING Example

mm:ss	Values	Discard unchanged	Discard unchanged with heartbeat 30s	
00:00	0	0	0	
00:05	0			No value because same as previous
00:10	0			
00:15	1	1	1	Received different value
00:20	1			
00:25	1			
00:30	1			
00:35	1			
00:40	0	0	0	Received different value
00:45	0			
00:50	0			
00:55	0			
01:00	0			
01:05	0			
01:10	0		0	Value written because of heartbeat 30s
01:15	0			
01:20	1	1	1	Received different value
01:25	1			
01:30	0	0	0	Received different value
01:35	0			
01:40	0			
01:45	0			
01:50	0			
01:55	0			
02:00	0		0	Value written because of heartbeat 30s
02:05	0			

Preprocessing

DATA VALIDATION



The screenshot shows the 'New item' configuration page in Grafana. The 'Preprocessing steps' section is active, showing a list of steps. The first step is 'Regular expression'. A dropdown menu is open, showing the following options:

- JavaScript
- Validation**
- In range
- Matches regular expression
- Does not match regular expression
- Check for error in JSON
- Check for error in XML
- Check for error using regular expression
- Check for not supported value
- Throttling**
- Discard unchanged
- Discard unchanged with heartbeat
- Prometheus**
- Prometheus pattern
- Prometheus to JSON

Options:

- › In Range: A - B
- › Matches regular expression
- › Does not match regular expression
- › Check for error in JSON/XML
- › Check for error using regex

Preprocessing

ERROR PROCESSING

Name	Parameters	Custom on fail	Actions
1: In range	0 100	<input type="checkbox"/>	Test Remove Test all steps

[Add](#)

► Default error message

Name	Parameters	Custom on fail	Actions
1: In range	0 100	<input checked="" type="checkbox"/>	Test Remove

Custom on fail **Discard value** Set value to Set error to

► Discard values outside of the defined range

Name	Parameters	Custom on fail	Actions
1: In range	0 100	<input checked="" type="checkbox"/>	Test Remove

Custom on fail Discard value **Set value to** Set error to -1

► Set a custom value in case of an error

Name	Parameters	Custom on fail	Actions
1: In range	0 100	<input checked="" type="checkbox"/>	Test Remove

Custom on fail Discard value Set value to **Set error to** Temperature must be in range of 0 - 100

► Custom error message on fail

Preprocessing

JAVASCRIPT

► Creation of custom Javascript processing scripts

► A simple example:

Name	Parameters	Custom on fail	Actions
1: JavaScript	<code>return (value -32) * 5 / 9</code>	<input type="checkbox"/>	Test Remove

[Add](#) [Test all steps](#)

Name

1: JavaScript

[Add](#)

Num

Custom scripts

JavaScript

Validation

In range

Matches regular expression

Does not match regular expression

Check for error in JSON

Check for error in XML

Check for error using regular expression

Check for not supported value

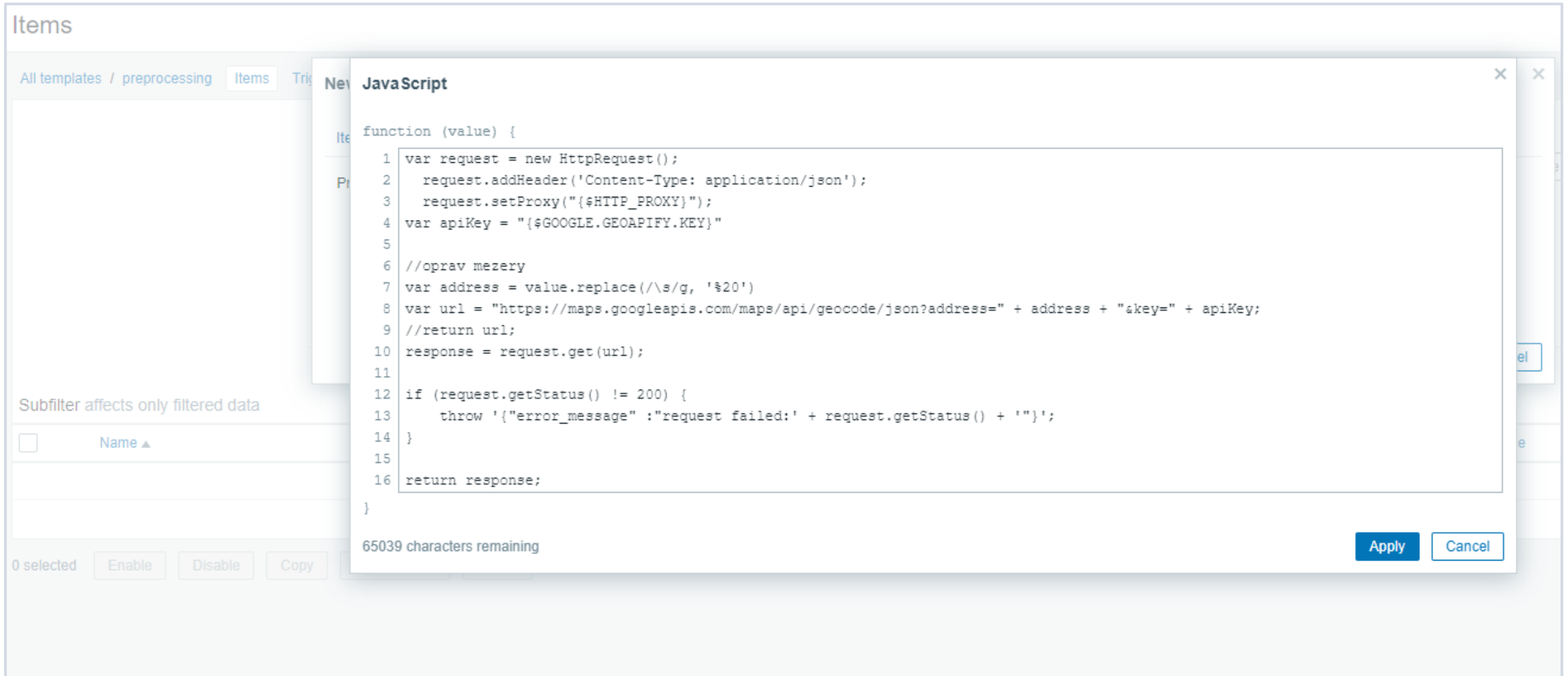
Throttling

Discard unchanged

Preprocessing

JAVASCRIPT

- ▶ Transformation, aggregation, filters, arithmetic and logic operations and many more.



The screenshot shows a software interface with a 'Items' window. A 'New JavaScript' dialog box is open, displaying a JavaScript function. The function is designed to make an HTTP request to a Google Maps API endpoint, parse the response, and throw an error if the request fails. The code is as follows:

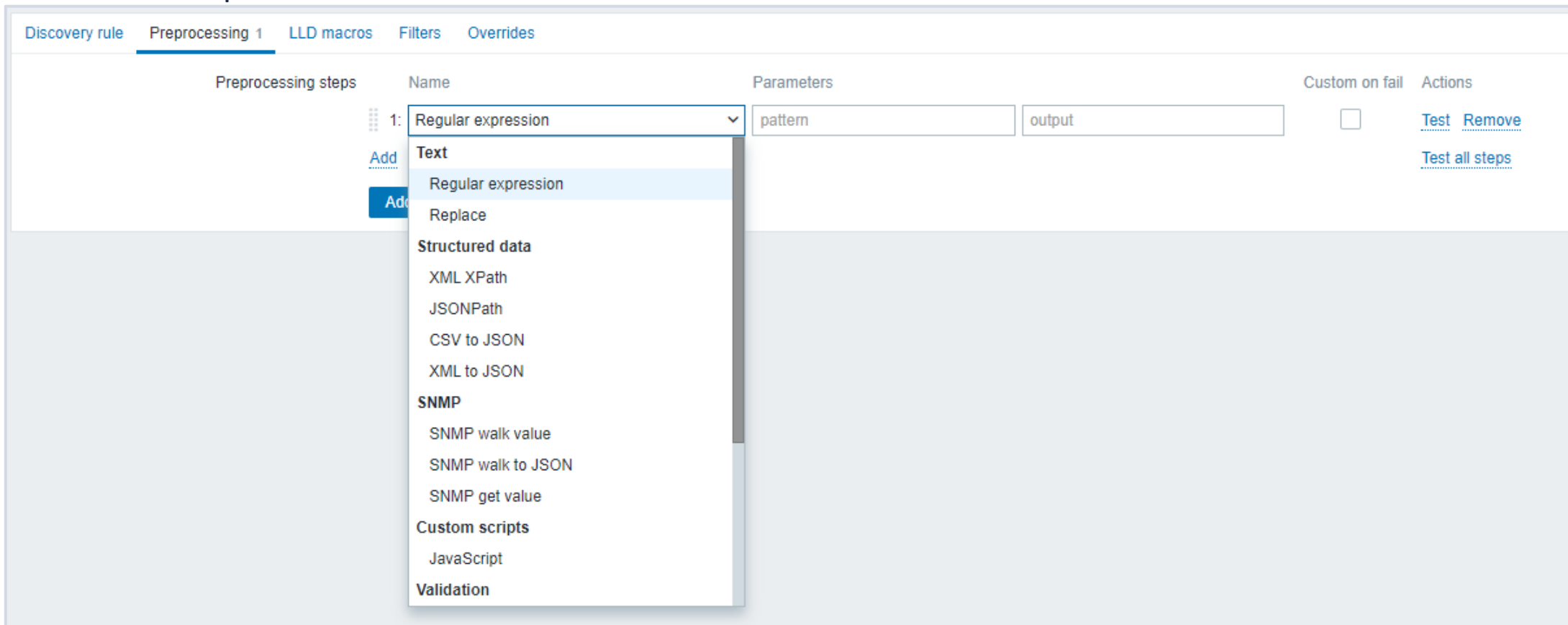
```
function (value) {  
  1 var request = new HttpRequest();  
  2   request.addHeader('Content-Type: application/json');  
  3   request.setProxy("${HTTP_PROXY}");  
  4   var apiKey = "${GOOGLE.GEOAPIFY.KEY}"  
  5  
  6   //oprav mezery  
  7   var address = value.replace(/\s/g, '%20')  
  8   var url = "https://maps.googleapis.com/maps/api/geocode/json?address=" + address + "&key=" + apiKey;  
  9   //return url;  
 10  response = request.get(url);  
 11  
 12  if (request.getStatus() != 200) {  
 13    throw '{"error_message": "request failed:" + request.getStatus() + "'};'  
 14  }  
 15  
 16  return response;  
}
```

At the bottom of the dialog, it indicates '65039 characters remaining'. The background interface shows a table with a 'Name' column and buttons for 'Enable', 'Disable', and 'Copy'.

Preprocessing

LLD PREPROCESSING

- ▶ LLD supports preprocessing
- ▶ HTTP agent and JavaScript support enables the ability to perform the discovery without the need to use external scripts



The screenshot shows the configuration interface for LLD preprocessing steps. The interface is divided into several tabs: "Discovery rule", "Preprocessing 1", "LLD macros", "Filters", and "Overrides". The "Preprocessing 1" tab is active, showing a table of preprocessing steps.

Preprocessing steps	Name	Parameters	Custom on fail	Actions
1:	Regular expression	pattern: <input type="text" value="pattern"/> output: <input type="text" value="output"/>	<input type="checkbox"/>	Test Remove

A dropdown menu is open under the "Name" column, listing various preprocessing options:

- Text**
 - Regular expression
 - Replace
- Structured data**
 - XML XPath
 - JSONPath
 - CSV to JSON
 - XML to JSON
- SNMP**
 - SNMP walk value
 - SNMP walk to JSON
 - SNMP get value
- Custom scripts**
 - JavaScript
- Validation**

Preprocessing

PROMETHEUS

Storage

- Ceph exporter
- Ceph RADOSGW exporter
- Gluster exporter
- Hadoop HDFS FSImage exporter
- Lustre exporter
- ScaleIO exporter

HTTP

- Apache exporter
- HAProxy exporter (**official**)
- Nginx metric library
- Nginx VTS exporter
- Passenger exporter
- Squid exporter
- Tinyproxy exporter
- Varnish exporter
- WebDriver exporter

APIs

- AWS ECS exporter
- AWS Health exporter
- AWS SQS exporter
- Cloudflare exporter
- DigitalOcean exporter
- Docker Cloud exporter
- Docker Hub exporter
- GitHub exporter
- InstaClustr exporter
- Mozilla Observatory exporter
- OpenWeatherMap exporter
- Pagespeed exporter
- Rancher exporter
- Speedtest exporter

Hardware related

- apcupsd exporter
- Collins exporter
- IBM Z HMC exporter
- IoT Edison exporter
- IPMI exporter
- knxd exporter
- Netgear Cable Modem Exporter
- Netgear Router exporter
- Node/system metrics exporter (**official**)
- NVIDIA GPU exporter
- ProSAFE exporter
- Ubiquiti UniFi exporter

Messaging systems

- Beanstalkd exporter
- EMQ exporter
- Gearman exporter
- Kafka exporter
- NATS exporter
- NSQ exporter
- Mirth Connect exporter
- MQTT blackbox exporter
- RabbitMQ exporter
- RabbitMQ Management Plugin exporter

Other monitoring systems

- Akamai Cloudmonitor exporter
- Alibaba Cloudmonitor exporter
- AWS CloudWatch exporter (**official**)
- Cloud Foundry Firehose exporter
- Collectd exporter (**official**)
- Google Stackdriver exporter
- Graphite exporter (**official**)
- Heka dashboard exporter
- Heka exporter
- InfluxDB exporter (**official**)
- JavaMelody exporter
- JMX exporter (**official**)
- Munin exporter
- Nagios / Naemon exporter
- New Relic exporter
- NRPE exporter
- Osquery exporter
- OTC CloudEye exporter
- Pingdom exporter
- scollector exporter
- Sensu exporter
- SNMP exporter (**official**)
- StatsD exporter (**official**)

Databases

- Aerospike exporter
- ClickHouse exporter
- Consul exporter (**official**)
- Couchbase exporter
- CouchDB exporter
- Elasticsearch exporter
- EventStore exporter
- Memcached exporter (**official**)
- MongoDB exporter
- MSSQL server exporter
- MySQL server exporter (**official**)
- OpenTSDB Exporter
- Oracle DB Exporter
- PgBouncer exporter
- PostgreSQL exporter
- ProxySQL exporter
- RavenDB exporter
- Redis exporter
- RethinkDB exporter
- SQL exporter
- Tarantool metric library
- Twemproxy

Preprocessing

PROMETHEUS

```
# HELP wmi_logical_disk_free_bytes Free space in bytes (LogicalDisk.PercentFreeSpace)
```

```
# TYPE wmi_logical_disk_free_bytes gauge
```

```
wmi_logical_disk_free_bytes{volume="C:"} 3.5180249088e+11
```

```
wmi_logical_disk_free_bytes{volume="D:"} 2.627731456e+09
```

```
wmi_logical_disk_free_bytes{volume="HarddiskVolume4"} 4.59276288e+08
```

```
wmi_service_state{name="devicesflowusersvc_7b100",state="running"} 1
```

```
wmi_service_state{name="devicesflowusersvc_7b100",state="start pending"} 0
```

```
wmi_service_state{name="devicesflowusersvc_7b100",state="stop pending"} 0
```

```
wmi_service_state{name="devicesflowusersvc_7b100",state="stopped"} 0
```

```
wmi_service_state{name="devicesflowusersvc_7b100",state="unknown"} 0
```

```
wmi_service_state{name="dhcp",state="continue pending"} 0
```

```
wmi_service_state{name="dhcp",state="pause pending"} 0
```

```
wmi_service_state{name="dhcp",state="paused"} 0
```

```
wmi_service_state{name="dhcp",state="running"} 1
```

```
wmi_service_state{name="dhcp",state="start pending"} 0
```

```
wmi_service_state{name="dhcp",state="stop pending"} 0
```

```
wmi_service_state{name="dhcp",state="stopped"} 0
```

```
wmi_service_state{name="dhcp",state="unknown"} 0
```

Preprocessing

PROMETHEUS

```
# HELP cpu_usage_system Telegraf collected metric
# TYPE cpu_usage_system gauge
cpu_usage_system{cpu="cpu-total",host="host1"} 1.1940298507220641
cpu_usage_system{cpu="cpu0",host="host1"} 1.1940298507220641
cpu_usage_system{cpu="cpu1",host="host1"} 1.1340298507220641
```

Item	Tags	Preprocessing 1			
Preprocessing steps ?					
	Name	Parameters	Custom on fail	Actions	
	1: Prometheus pattern	cpu_usage_system{cp	value	<label name>	<input checked="" type="checkbox"/> Test Remove
	Custom on fail	Discard value	Set value to	Set error to	
	Add				Test all steps
Type of information	Numeric (unsigned)				

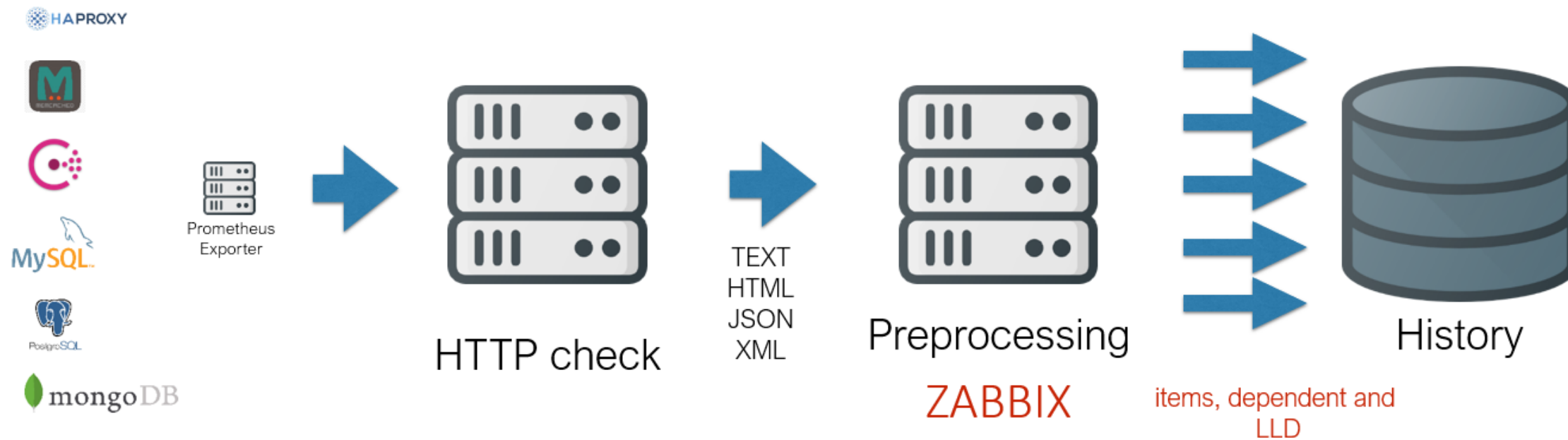
cpu_usage_system{cpu="cpu-total"}



1.1940298507220641

Preprocessing

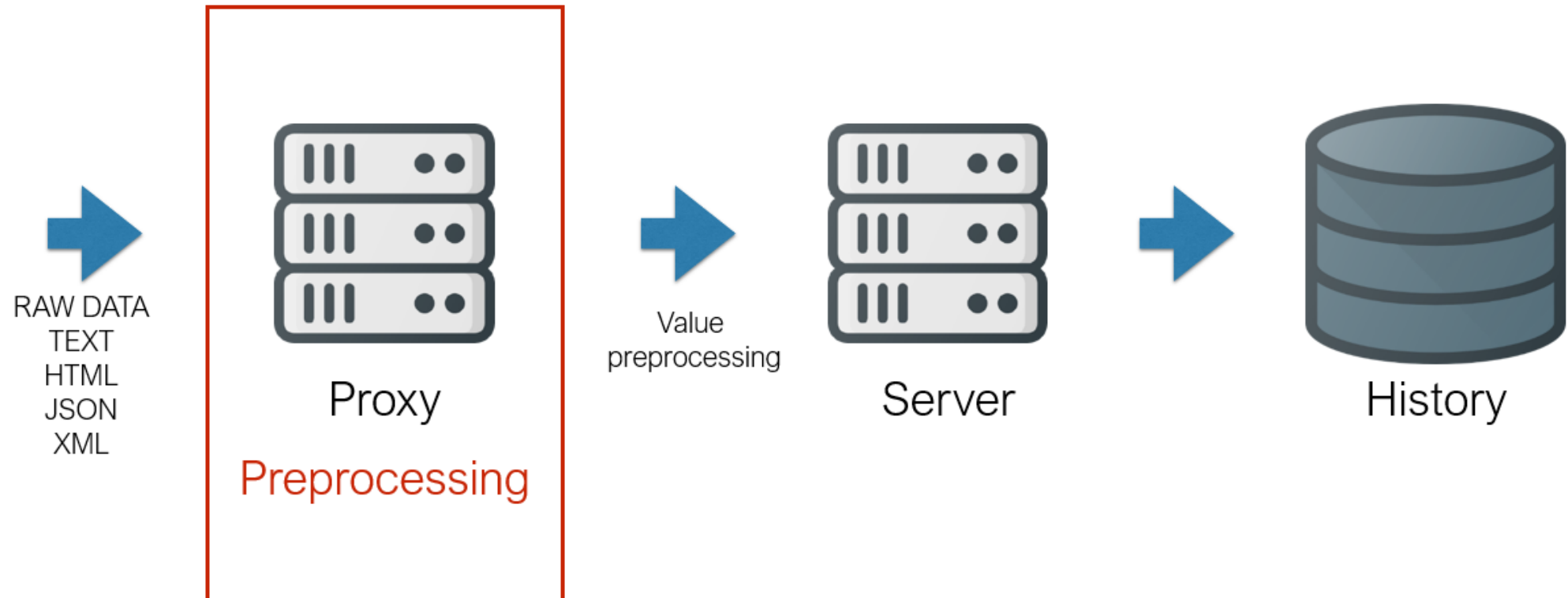
DATA FLOW



Prometheus data processing

Preprocessing

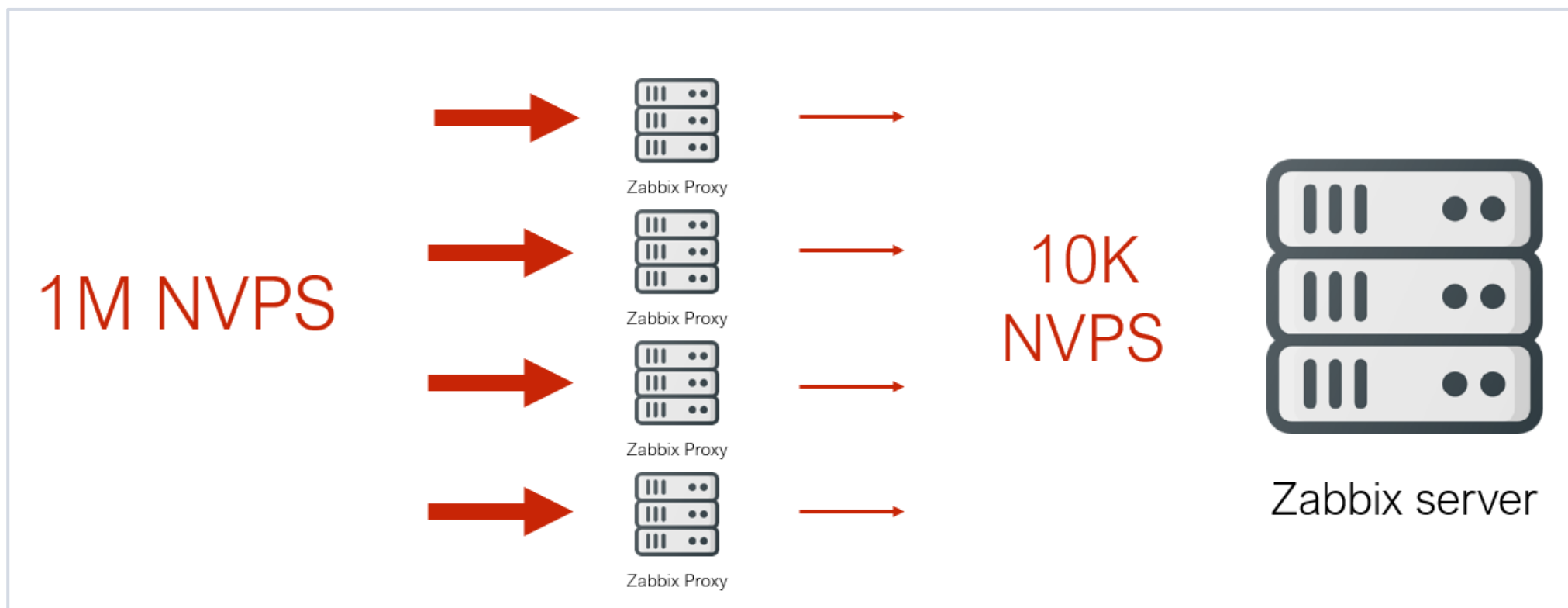
DATA FLOW



Preprocessing

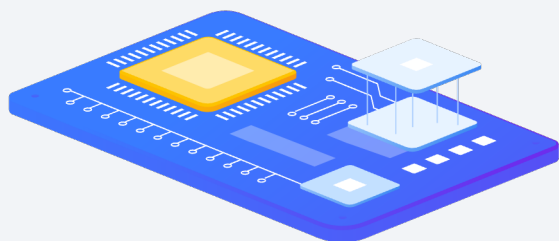
DATA FLOW

- ▶ Effective load scaling on the account of preprocessing being performed on the proxy side



Preprocessing

DATA FLOW



Preprocessing on the
proxy side



Advantages



Improved Zabbix server performance by offloading preprocessing



Proxy + throttling enables high frequency monitoring

Preprocessing

TESTING THE PREPROCESSING STEPS

- ▶ Testing of the defined preprocessing steps can be done on the web frontend for rapid debugging

Preprocessing steps	Name	Parameters	Custom on fail	Actions
1:	Left trim	-	<input type="checkbox"/>	Test Remove
2:	Custom multiplier	8	<input type="checkbox"/>	Test Remove
3:	JavaScript	<code>return Math.round(value)</code>	<input type="checkbox"/>	Test Remove
Add				Test all steps

Test item

Value Time

Not supported

Previous value Prev. time

End of line sequence LF CRLF

Preprocessing steps	Name	Result
1:	Left trim	1.234
2:	Custom multiplier	9.872
3:	JavaScript	10

Result 10

Preprocessing

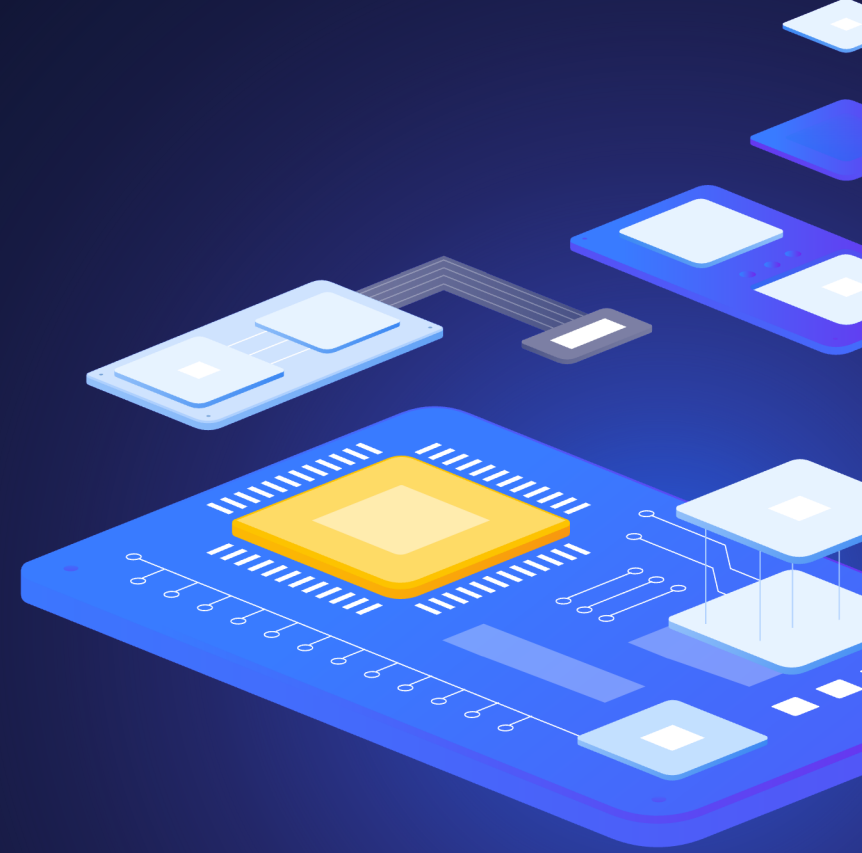
USEFUL LINKS

- ▶ XPath: "xmllint" or <https://codebeautify.org/Xpath-Tester>
- ▶ PCRE: "grep -P" or <https://regex101.com/>
- ▶ JsonPath: <https://jsonpath.com>

- ▶ Official Zabbix documentation

2

News!



ZABBIX 6.0 News - preprocessing

- › Bulk processing for Prometheus metrics
- › Result processing for Prometheus pattern
- › Field size limit - Item preprocessing parameters
- › Handling of NaN values in Prometheus preprocessing

ZABBIX 6.2 News - preprocessing

- ▶ Limits for JavaScript objects in preprocessing (backported in **6.0.14**)

The total size of all messages that can be logged with the `log()` method has been limited to **8 MB** per script execution.

The initialization of multiple `HttpRequest` objects has been limited to **10 per script execution**.

The total length of header fields that can be added to a single `HttpRequest` object with the `addHeader()` method has been limited to **128 Kbytes** (special characters and header names included).

Preprocessing

ZABBIX 6.4 News - preprocessing

- ▶ Two new preprocessing steps have been added

SNMP walk to JSON - convert SNMP walk values to JSON

SNMP walk value - extract and format SNMP walk value

- ▶ **Thread-based preprocessing workers**

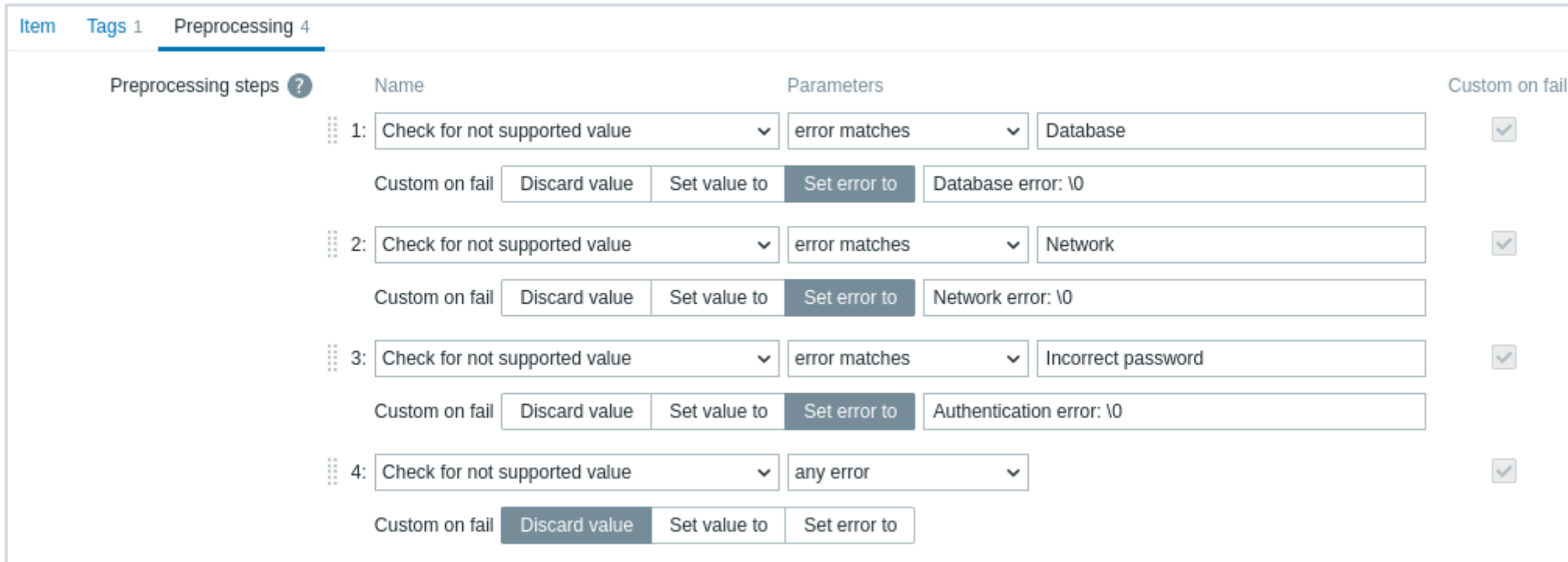
The item value preprocessing has been rewritten to use thread-based preprocessing workers for enhanced parallelism and reduced overhead. This development should help avoid situations when the prolonged preprocessing of one item holds up others.

This change adds a new required library for Zabbix server/proxy - libevent_pthreads.

Preprocessing

ZABBIX 7.0 News - preprocessing

- ▶ Advanced root-cause handling for unsupported item state
- ▶ It is now possible to match the error message to a regular expression.
- ▶ If the error matches (or does not match) it is possible to specify how the error case should be processed.



The screenshot shows the Zabbix web interface for configuring preprocessing steps. The interface is titled "Preprocessing 4" and includes a "Preprocessing steps" section with a help icon. The configuration is organized into four rows, each representing a preprocessing step. Each step has a "Name" column, a "Parameters" column, and a "Custom on fail" column. The "Custom on fail" column contains a dropdown menu with options: "Discard value", "Set value to", "Set error to", and "Database error: \0".

	Name	Parameters	Custom on fail
1:	Check for not supported value	error matches	Database
	Custom on fail	Discard value Set value to Set error to	Database error: \0
2:	Check for not supported value	error matches	Network
	Custom on fail	Discard value Set value to Set error to	Network error: \0
3:	Check for not supported value	error matches	Incorrect password
	Custom on fail	Discard value Set value to Set error to	Authentication error: \0
4:	Check for not supported value	any error	
	Custom on fail	Discard value Set value to Set error to	

Preprocessing

ZABBIX 7.0 News - preprocessing

- › Better usability for preprocessing step mass update
- › New design Replace and Remove all radio buttons have been added.

Mass update

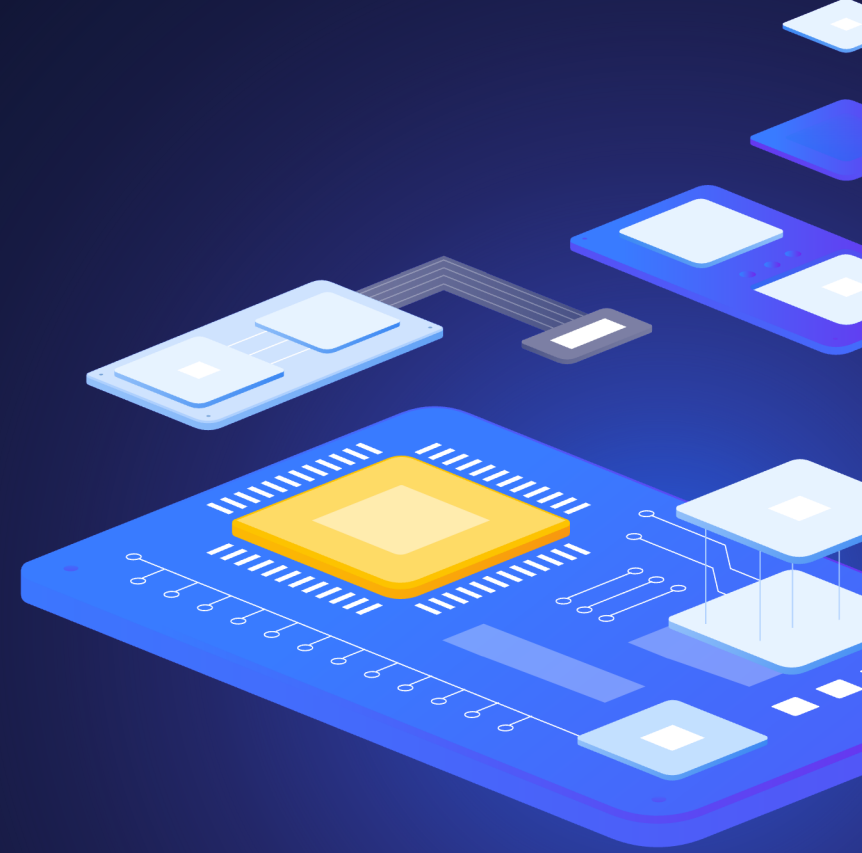
[Item](#) [Tags](#) [Preprocessing](#)

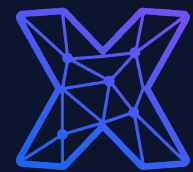
Preprocessing steps Replace Remove all

	Name	Parameters
1:	Regular expression	pattern

3

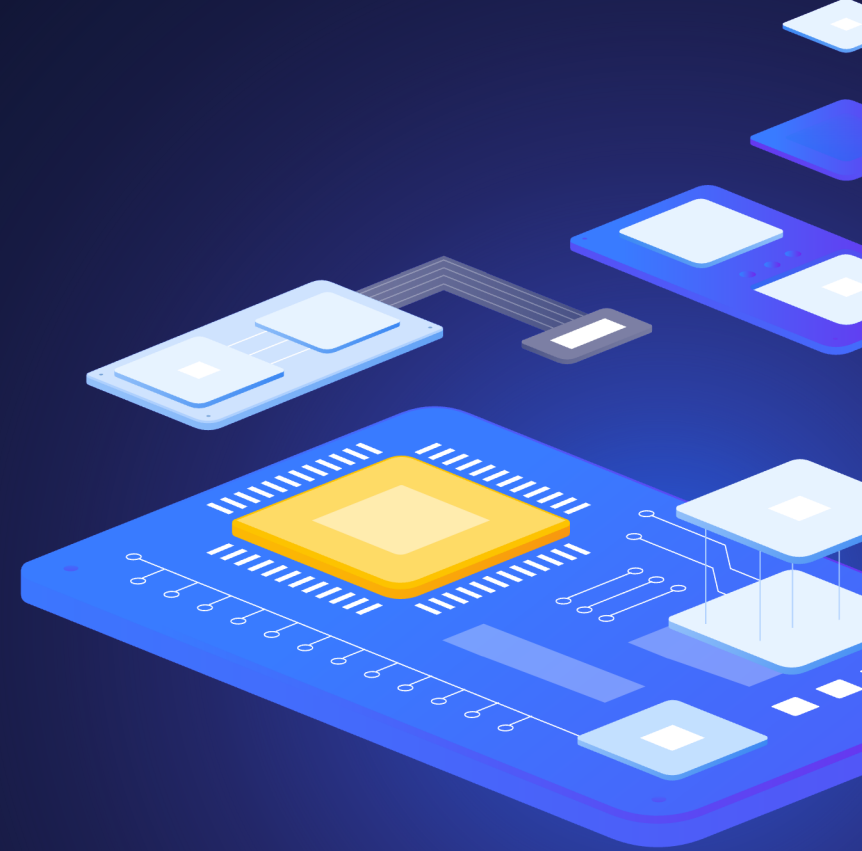
Demonstration





initMAX

Questions?



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