



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

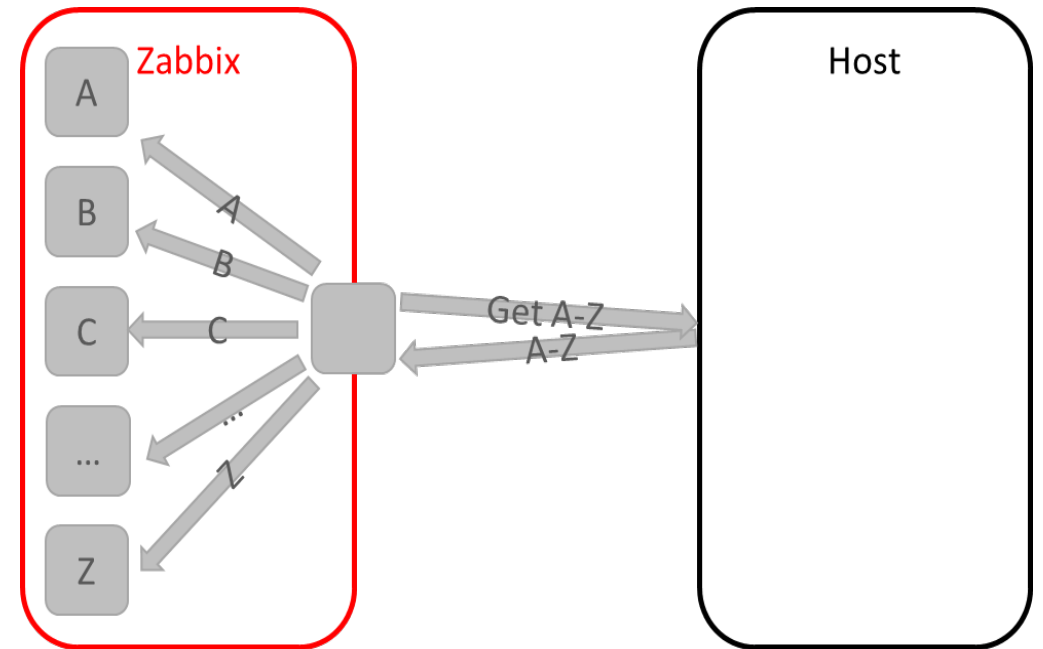
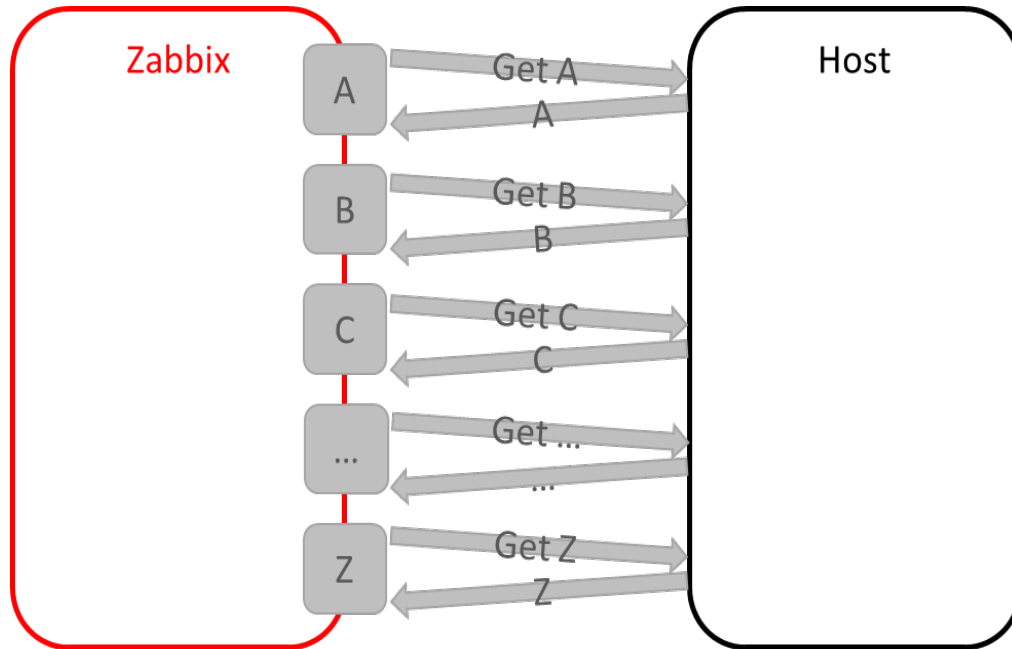
Preprocessing



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.



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****Regexp****Response code: 200
Size: 28083****Unstructured text****Regexp****Version: Apache 2.2.15 (Unix)
DNS lookup threads: 10**

Preprocessing

DATA FLOW

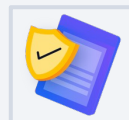


PostgreSQL



Agent
Text
HTML
JSON
XML

ZABBIX



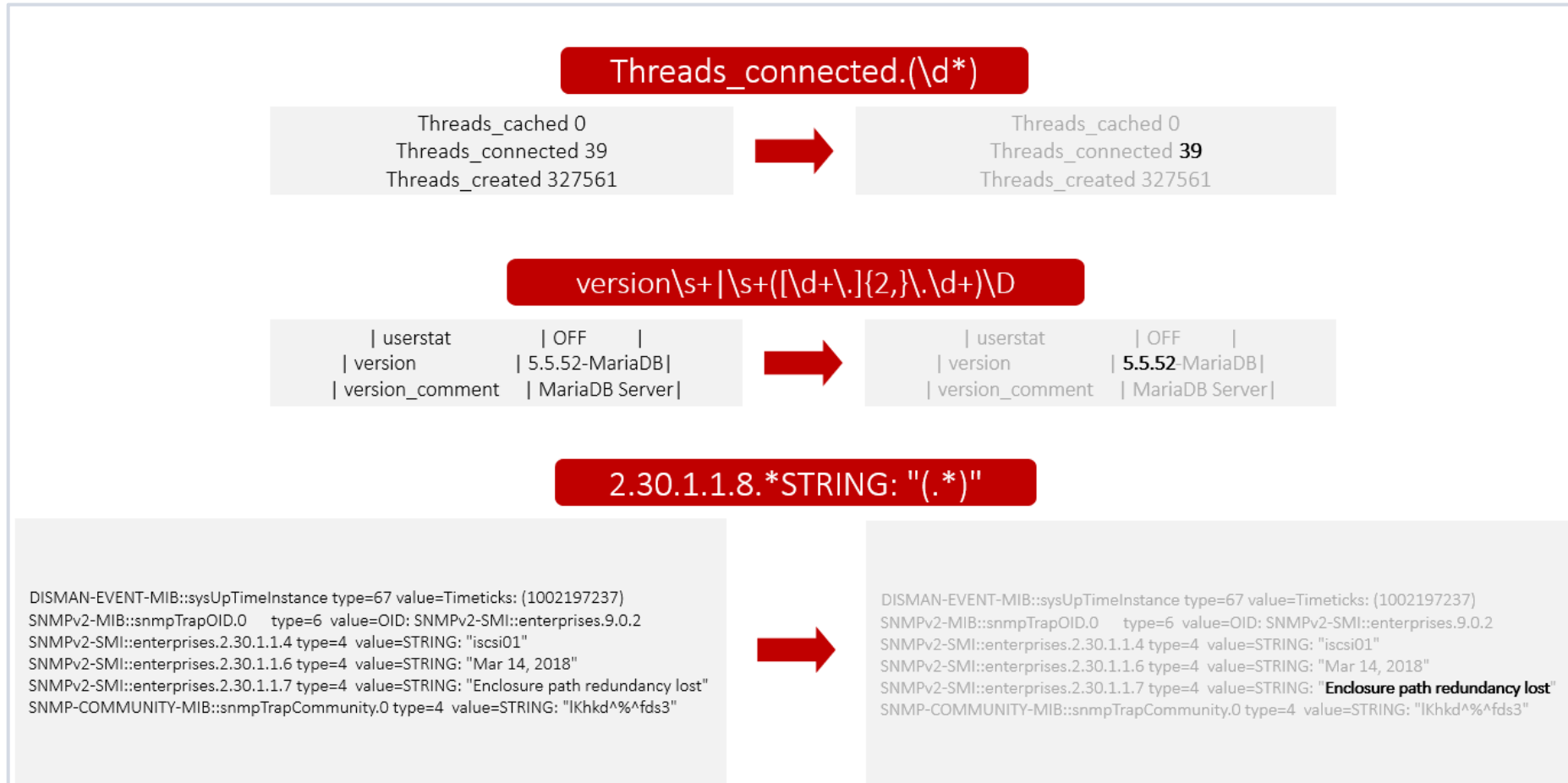
Preprocessing



History

Preprocessing

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



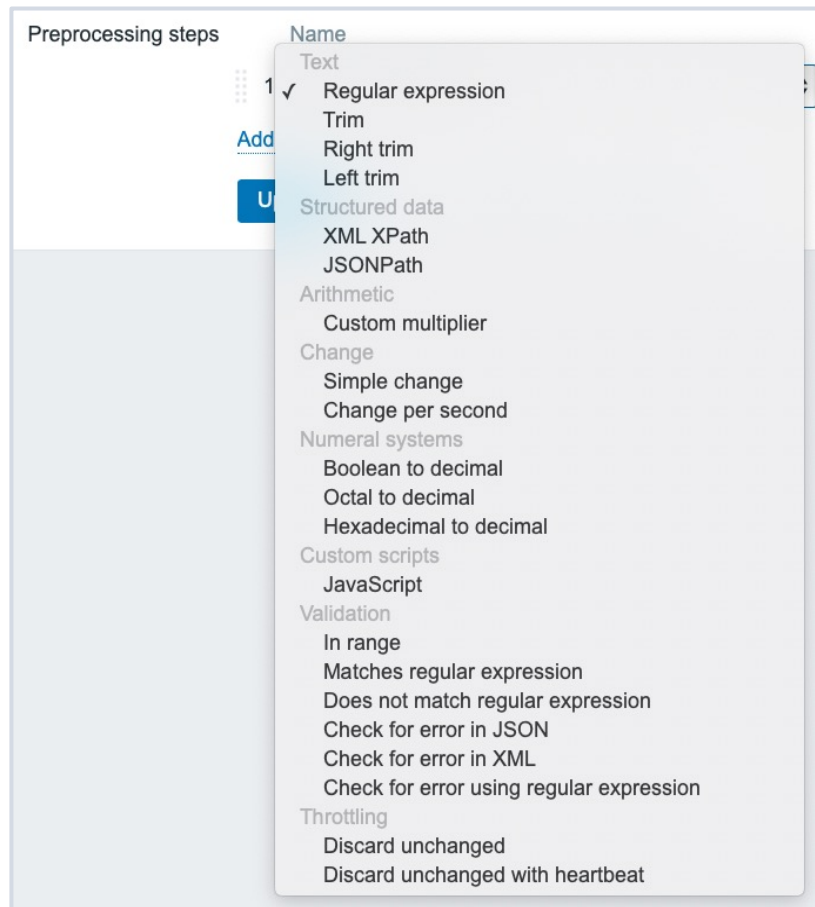
number(/bookstore/book[price<30]/price)

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.



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.

Use cases

- › Saves space on the disk
- › Usable graphs

Dependent metrics:

-
- An abstract illustration of a blue circuit board. A large yellow square chip is mounted in the center. To its left, a smaller blue board with two light blue chips is connected by a black ribbon cable. To the right, another blue board with a light blue chip is visible. The main board features various components like smaller chips, connectors, and a series of white circular pads along one edge. The style is clean and modern with a blue and yellow color palette.

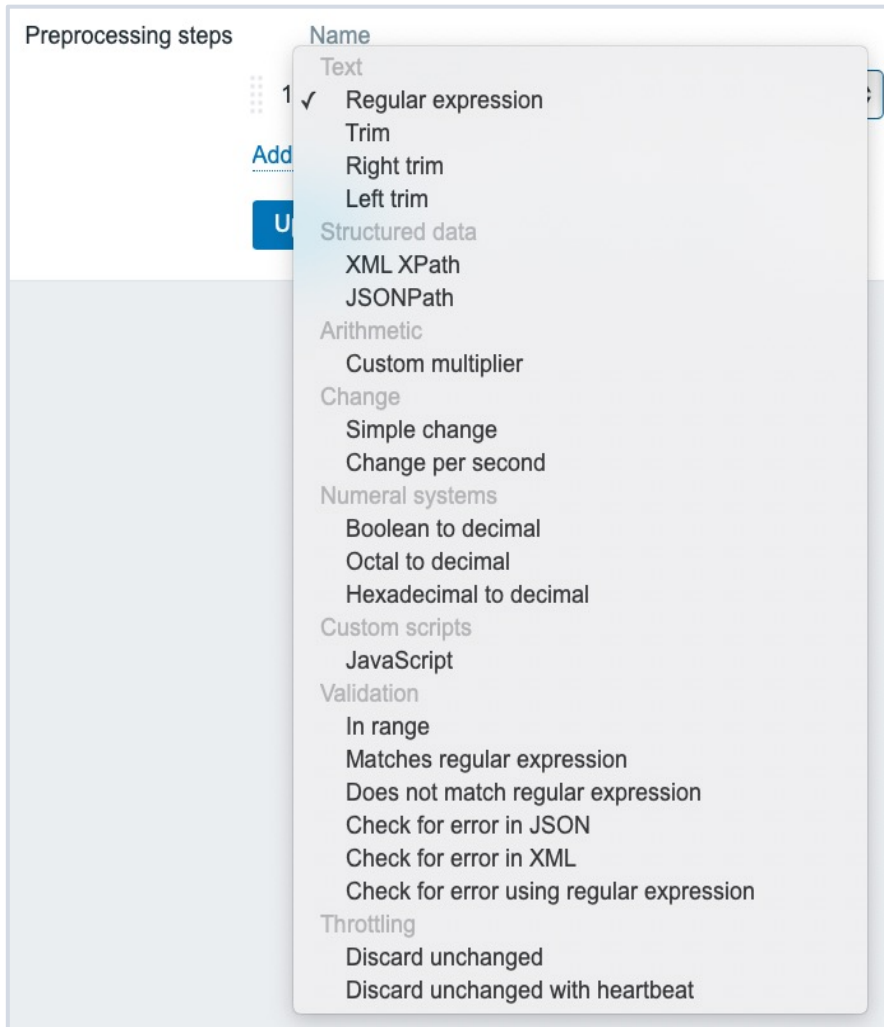
INTRODUCTION

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



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

Item Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Action
1:	In range	0 100	☐	Remove

- › Default error message

Item Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Action
1:	In range	0 100	☒	Remove
Custom on fail Discard value Set value to Set error to				

- › Discard values outside of the defined range

Item Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Action
1:	In range	0 100	☒	Remove
Custom on fail Discard value Set value to Set error to -1				

- › Set a custom value in case of an error

Item Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Action
1:	In range	0 100	☒	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:

Item

Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Actions
1:	JavaScript	<code>return (value - 32) * 5 / 9</code>	☐	Test Remove

Add

Add

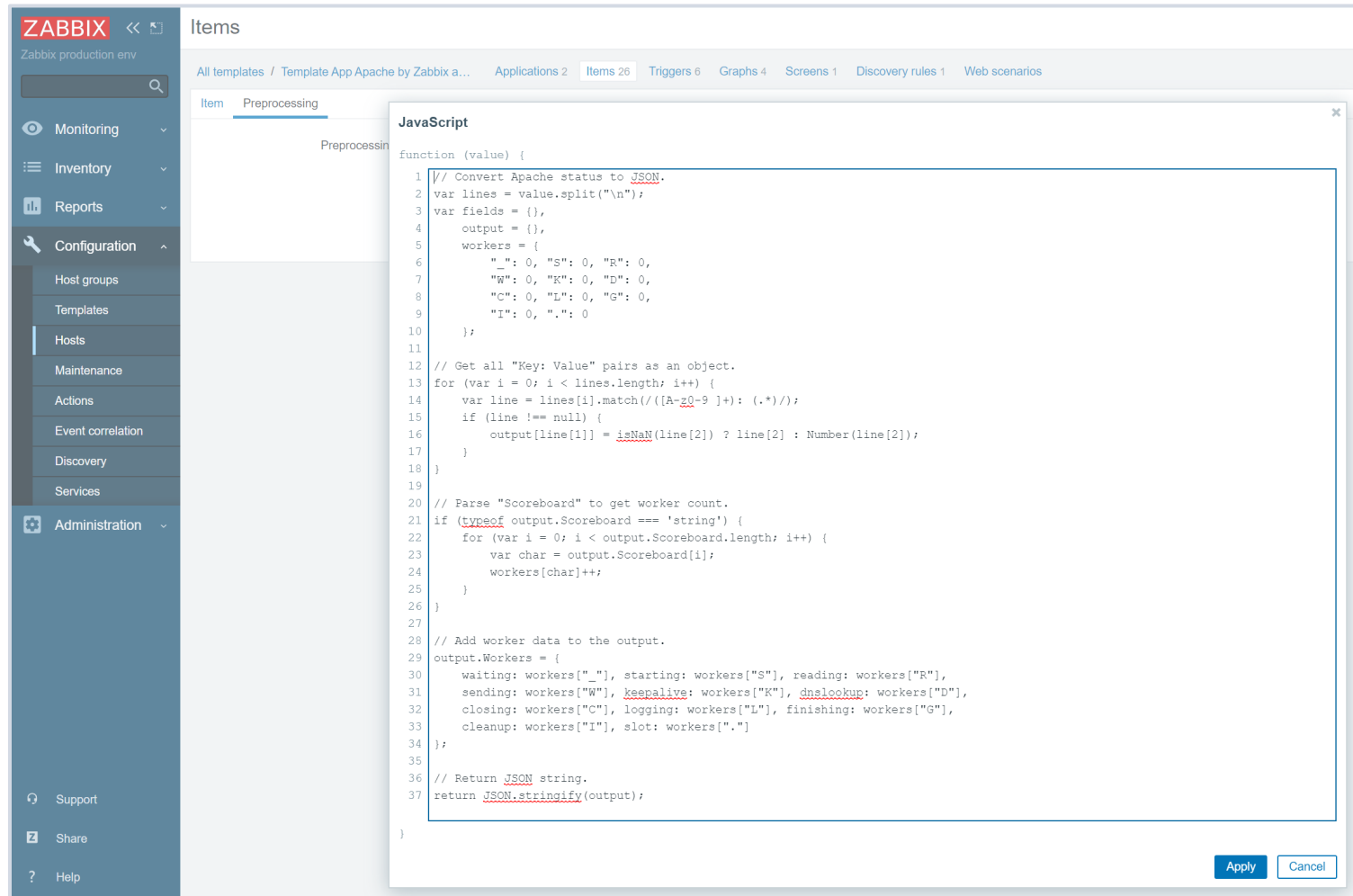
Cancel

- Name
- Text
- ☒ Regular expression
- Trim
- Right trim
- Left trim
- Structured data
- XML XPath
- JSONPath
- Arithmetic
- Custom multiplier
- Change
- Simple change
- Change per second
- Numeral systems
- Boolean to decimal
- Octal to decimal
- Hexadecimal to decimal
- 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
- Throttling
- Discard unchanged
- Discard unchanged with heartbeat

Preprocessing

JAVASCRIPT

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



The screenshot displays the Zabbix web interface. On the left is a sidebar with navigation links: Monitoring, Inventory, Reports, Configuration (Host groups, Templates, Hosts, Maintenance, Actions, Event correlation, Discovery, Services), and Administration (Support, Share, Help). The main panel is titled 'Items' and shows a list of items under the 'Preprocessing' tab. A modal window titled 'JavaScript' is open, showing a script for converting Apache status to JSON. The script uses a regular expression to parse the status line and counts the number of workers in each state.

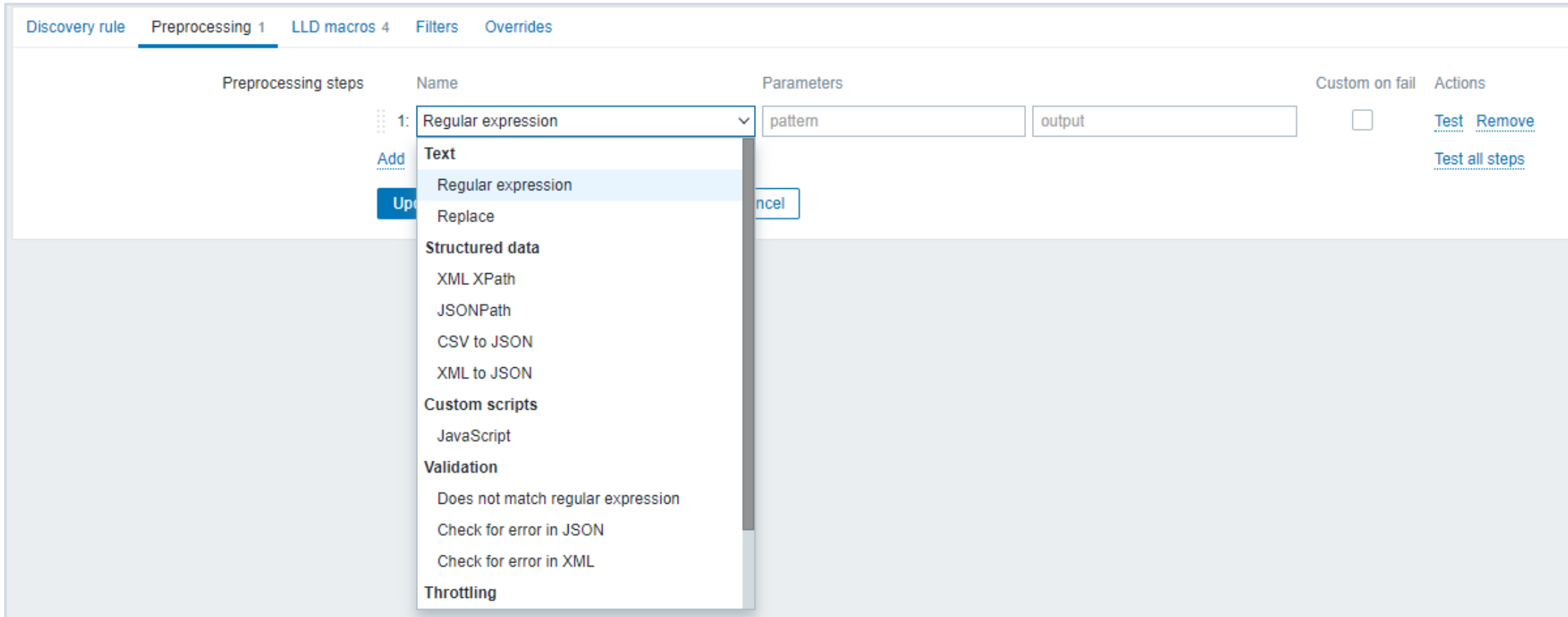
```
function (value) {  
  1 // Convert Apache status to JSON.  
  2 var lines = value.split("\n");  
  3 var fields = {},  
  4   output = {},  
  5   workers = {  
  6     "_": 0, "S": 0, "P": 0,  
  7     "W": 0, "K": 0, "D": 0,  
  8     "C": 0, "L": 0, "G": 0,  
  9     "I": 0, ".": 0  
 10  };  
 11  
 12 // Get all "Key: Value" pairs as an object.  
 13 for (var i = 0; i < lines.length; i++) {  
 14   var line = lines[i].match(/([A-Z0-9 ]+): (.*)/);  
 15   if (line !== null) {  
 16     output[line[1]] = isNaN(line[2]) ? line[2] : Number(line[2]);  
 17   }  
 18 }  
 19  
 20 // Parse "Scoreboard" to get worker count.  
 21 if (typeof output.Scoreboard === 'string') {  
 22   for (var i = 0; i < output.Scoreboard.length; i++) {  
 23     var char = output.Scoreboard[i];  
 24     workers[char]++;  
 25   }  
 26 }  
 27  
 28 // Add worker data to the output.  
 29 output.Workers = {  
 30   waiting: workers["_"], starting: workers["S"], reading: workers["R"],  
 31   sending: workers["W"], keepalive: workers["K"], dnslookup: workers["D"],  
 32   closing: workers["C"], logging: workers["L"], finishing: workers["G"],  
 33   cleanup: workers["I"], slot: workers["."] }  
 34 };  
 35  
 36 // Return JSON string.  
 37 return JSON.stringify(output);  
}
```

At the bottom right of the modal, there are 'Apply' and 'Cancel' buttons.

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 'Preprocessing 1' tab in the LLD configuration interface. The 'Preprocessing steps' table has one step named 'Regular expression'. A dropdown menu is open for this step, showing categories: Text, Structured data, Custom scripts, Validation, and Throttling. The 'Text' category is expanded, showing 'Regular expression' and 'Replace'. The 'Parameters' section has 'pattern' and 'output' fields. The 'Custom on fail' checkbox is unchecked. The 'Actions' column has 'Test', 'Remove', and 'Test all steps' links. The 'Add' button is visible on the left, and the 'Up' button is partially visible.

Preprocessing steps	Name	Parameters	Custom on fail	Actions	
1:	Regular expression	pattern	output	☐	Test Remove Test all steps

Text

- Regular expression
- Replace

Structured data

- XML XPath
- JSONPath
- CSV to JSON
- XML to JSON

Custom scripts

- JavaScript

Validation

- Does not match regular expression
- Check for error in JSON
- Check for error in XML

Throttling

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

Preprocessing

Preprocessing steps	Name	Parameters	Custom on fail	Actions
1:	Prometheus pattern	cpu_usage_system{cpu="cpu-total"}	<label name>	☒ Test Remove
Custom on fail		Discard value	Set value to	Set error to
Add		Test all steps		
Add		Cancel		

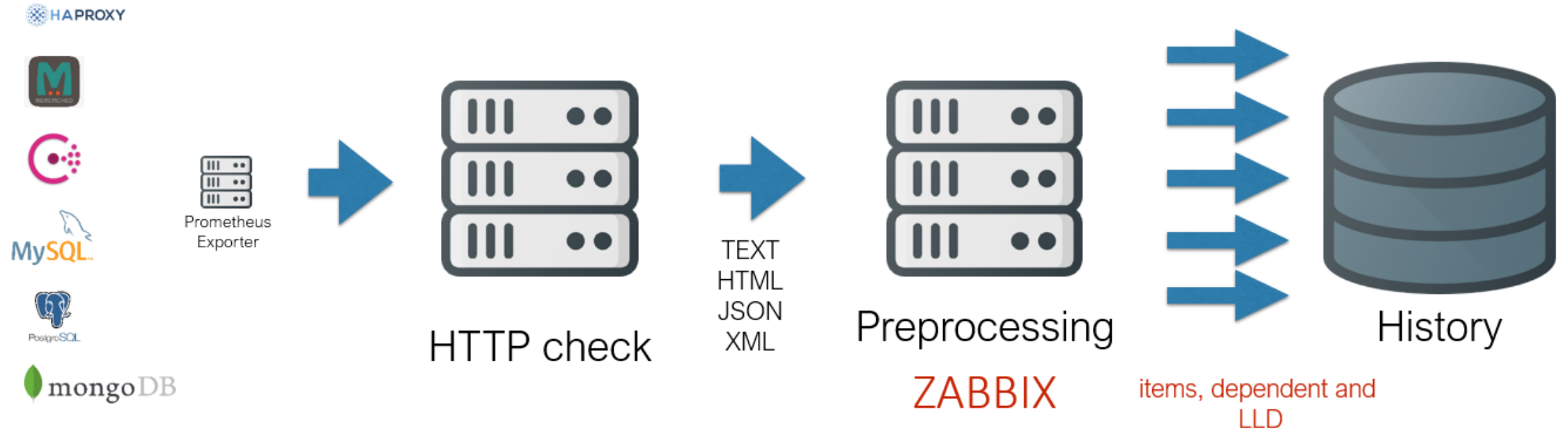
cpu_usage_system{cpu="cpu-total"}



1.1940298507220641

Preprocessing

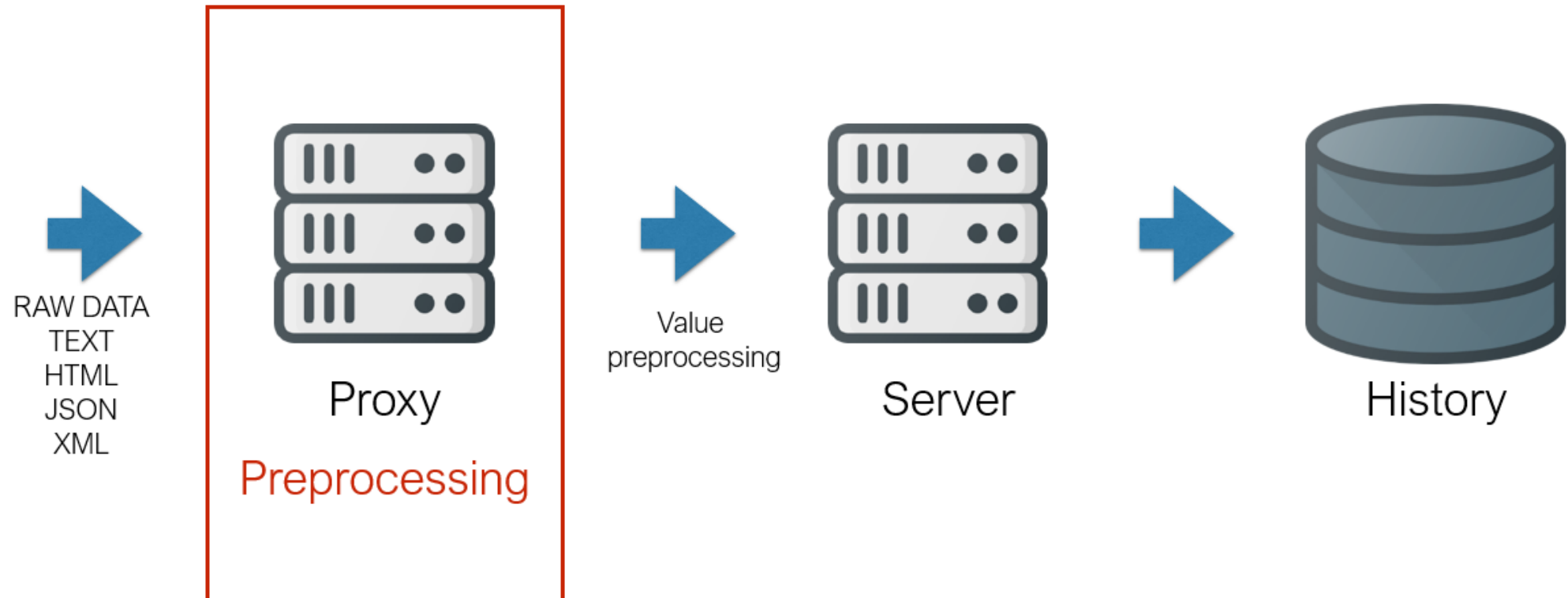
DATA FLOW



Prometheus data processing

Preprocessing

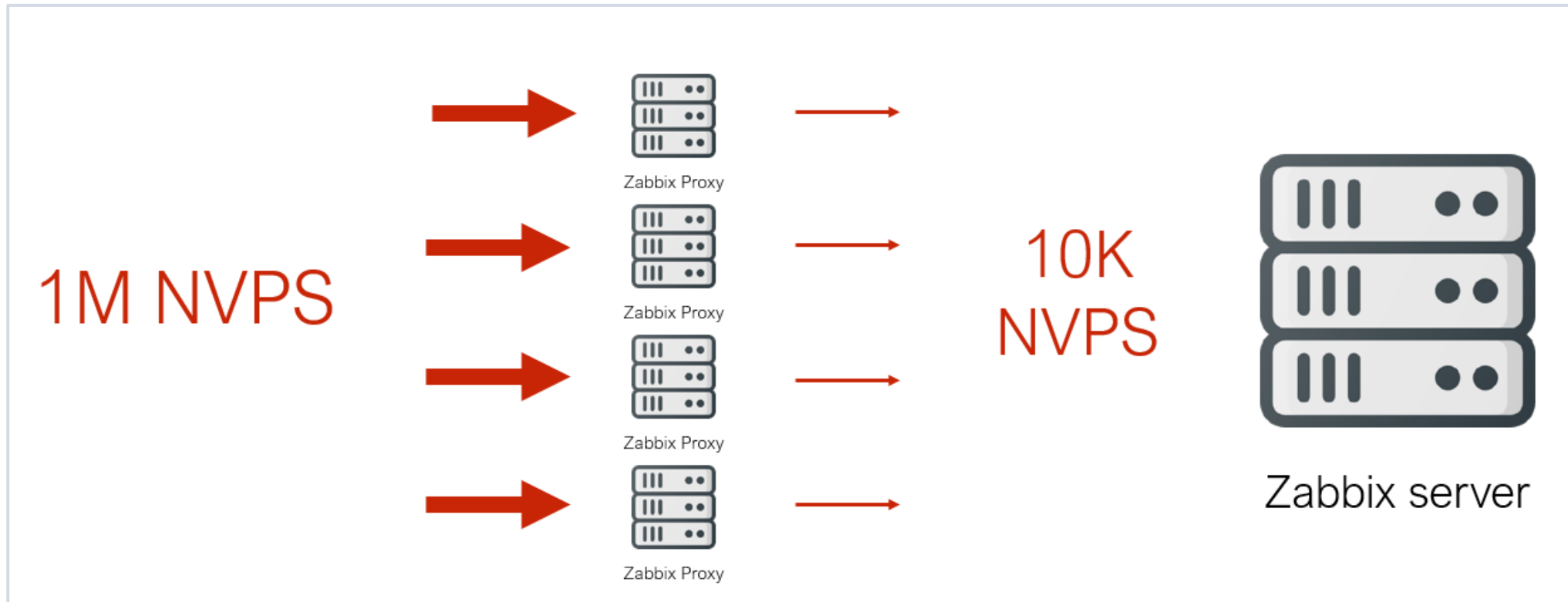
DATA FLOW



Preprocessing

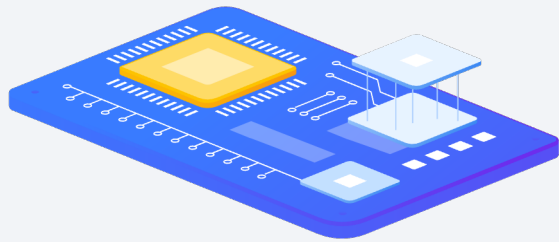
DATA FLOW

- ▶ 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	-	☐	Test Remove
2:	Custom multiplier	8	☐	Test Remove
3:	JavaScript	<code>return Math.round(value)</code>	☐	Test Remove
Add				Test all steps

Test item

Value

☐ Not supported

Time

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

Test

Cancel

USEFUL LINKS

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

- ▶ http://zabbix.org/wiki/Testing_Of_Preprocessing

2

Demonstration





Questions?



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