



Webinar

Advanced problem detection

all our microphones are muted

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

use Chat for discussion, networking or applause

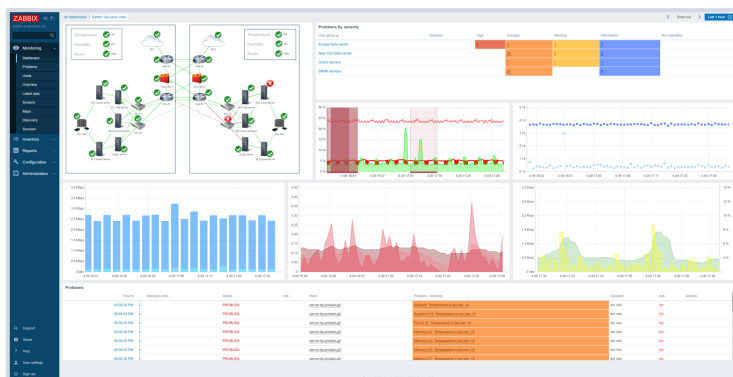


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Zabbix data flow

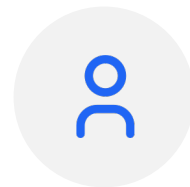
ADVANCED PROBLEM DETECTION

Zabbix data flow



Visualization

Notifications



DATABASE

ZABBIX SERVER

History

Analysis

Data collection



ADVANCED PROBLEM DETECTION

How often to execute checks?

Every N seconds

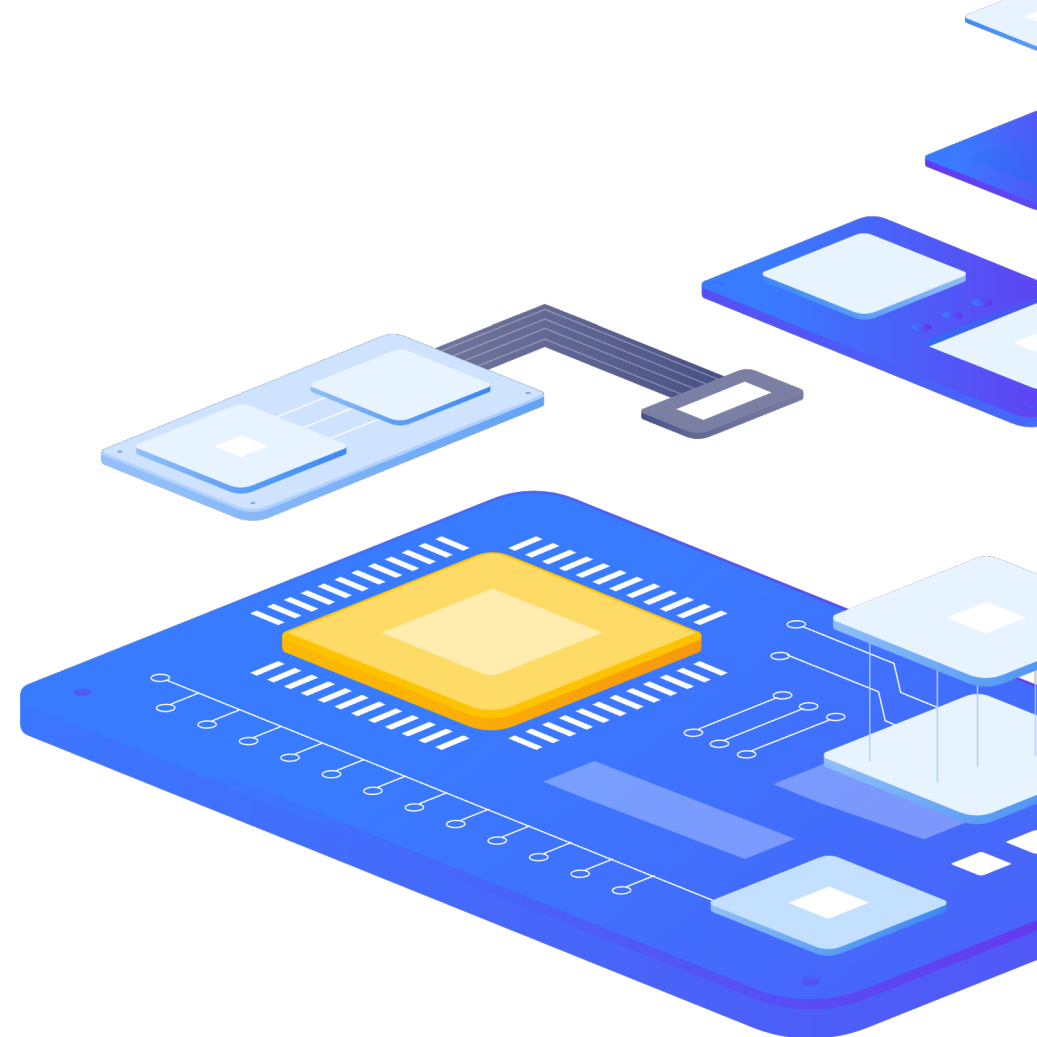
- › Zabbix will evenly distribute checks

Different frequency in different time periods

- › Every X seconds in working time
- › Every Y second in weekend

At a specific time (Zabbix 3.0)

- › Ready for business checks
- › Every hour starting from 9:00 at working hours (9:00, 10:00, ..., 18:00)



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Triggers



ADVANCED PROBLEM DETECTION

Trigger – problem definition

Operators

› - + / * < > = <> >= <= not or and

Functions

› min max avg last count date time diff regexp and much more!

Analyze everything: any metric and any host

- › `last(/server/system.cpu.load) > 5`
- › `last(/node1/system.cpu.load) > 5 and last(/node2/system.cpu.load) > 5 and last(/nodes/tps) < 5000`

Scope of Usage

› Triggers, calculated items, expression macros

Trigger Functions

Function group	Functions
Aggregate functions	avg, bucket_percentile, count, histogram_quantile, item_count, kurtosis, mad, max, min, skewness, stddevpop, stddevsamp, sum, sumofsquares, varpop, varsamp
Bitwise functions	bitand, bitlshift, bitnot, bitor, bitrshift, bitxor
Date and time functions	date, dayofmonth, dayofweek, now, time
History functions	change, changecount, count, countunique, find, first, fuzzytime, last, logeventid, logseverity, logsource, monodec, monoinc, nodata, percentile, rate
Trend functions	baselinedev, baselinewma, trendavg, trendcount, trendmax, trendmin, trendstl, trendsum
Mathematical functions	abs, acos, asin, atan, atan2, avg, cbrt, ceil, cos, cosh, cot, degrees, e, exp, expm1, floor, log, log10, max, min, mod, pi, power, radians, rand, round, signum, sin, sinh, sqrt, sum, tan, truncate
Operator functions	between, in
Prediction functions	forecast, timeleft
String functions	ascii, bitlength, bytelength, char, concat, insert, left, length, ltrim, mid, repeat, replace, right, rtrim, trim

Foreach Functions - tip

- › avg_foreach
- › bucket_rate_foreach
- › count_foreach
- › exists_foreach
- › last_foreach
- › max_foreach
- › min_foreach
- › sum_foreach

Calculated Items on:

Host level

- › `sum(last_foreach(/host/net.if.in[*]))`

Hostgroup level

- › `avg_foreach(/*/mysql.qps?[group="MySQL Servers"],5m)`

TAG level

- › `avg_foreach(/*/key[a,*,c]?[(tag=„ENV:production“)],10m)`

Complex level

- › `avg_foreach(/*/key[a,*,c]?[(group=„Servers" and tag=„EU") or (group=„Linux,") and (tag=„CZ" or tag=„ENV:production“)]),5m)`

ADVANCED PROBLEM DETECTION

Zabbix 7.0

jsonpath(value,path,<default>)

Return the JSONPath result.

Supported value types: String, Text, Log.

› `jsonpath(last(/host/proc.get[zabbix_agentd,,,summary]),"$..size")`

xmlxpath(value,path,<default>)

Return the XML XPath result.

Supported value types: String, Text, Log.

› `xmlxpath(last(/host/xml_result),"/response/error/status")`

Zabbix 7.0

Updated functions

- ▶ Aggregate functions now also support non-numeric types for calculation. This may be useful, for example, with the `count` and `count_foreach` functions.
- ▶ The `count` and `count_foreach` aggregate functions support optional parameters `operator` and `pattern`, which can be used to fine-tune item filtering and only count values that match given criteria.
- ▶ All `foreach` functions no longer include unsupported items in the count.
- ▶ The function `last_foreach`, previously configured to ignore the time period argument, accepts it as an optional parameter.
- ▶ Supported range for values returned by prediction functions has been expanded to match the range of double data type. Now `timeleft()` function can accept values up to $1.7976931348623158E+308$ and `forecast()` function can accept values ranging from $-1.7976931348623158E+308$ to $1.7976931348623158E+308$.

ADVANCED PROBLEM DETECTION

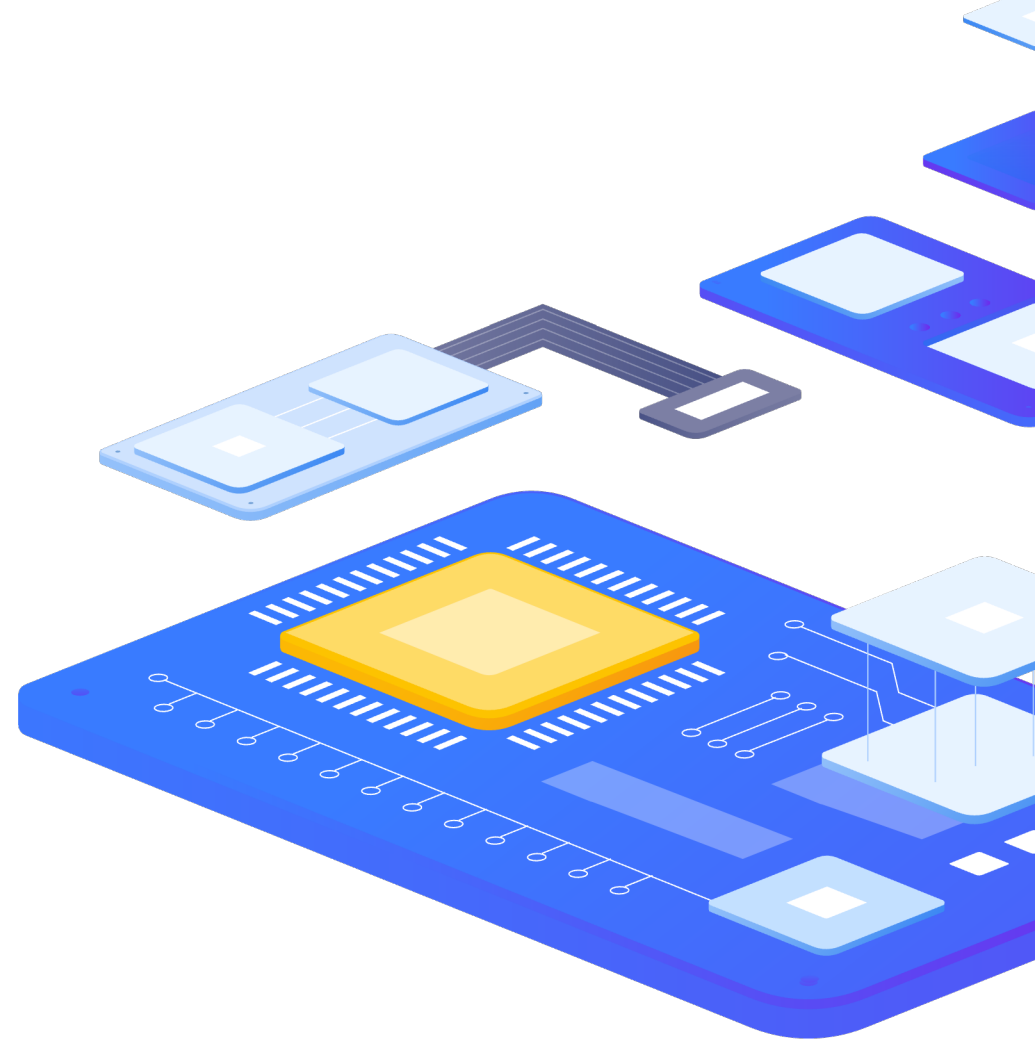
Junior level

Performance

- ▶ `last(/server/system.cpu.load) > 5`

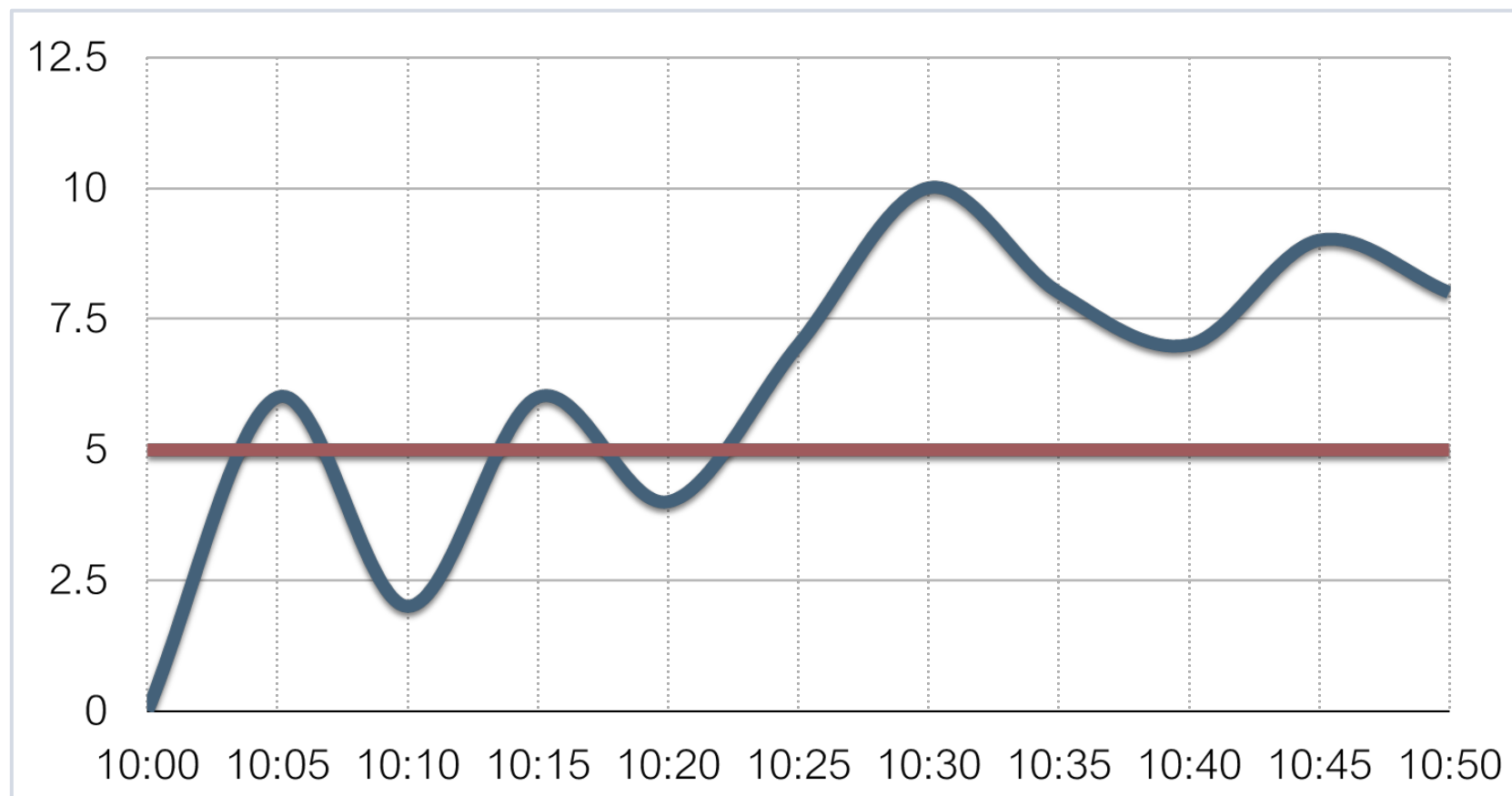
Availability

- ▶ `last(/server/net.tcp.service[http]) = 0`



ADVANCED PROBLEM DETECTION

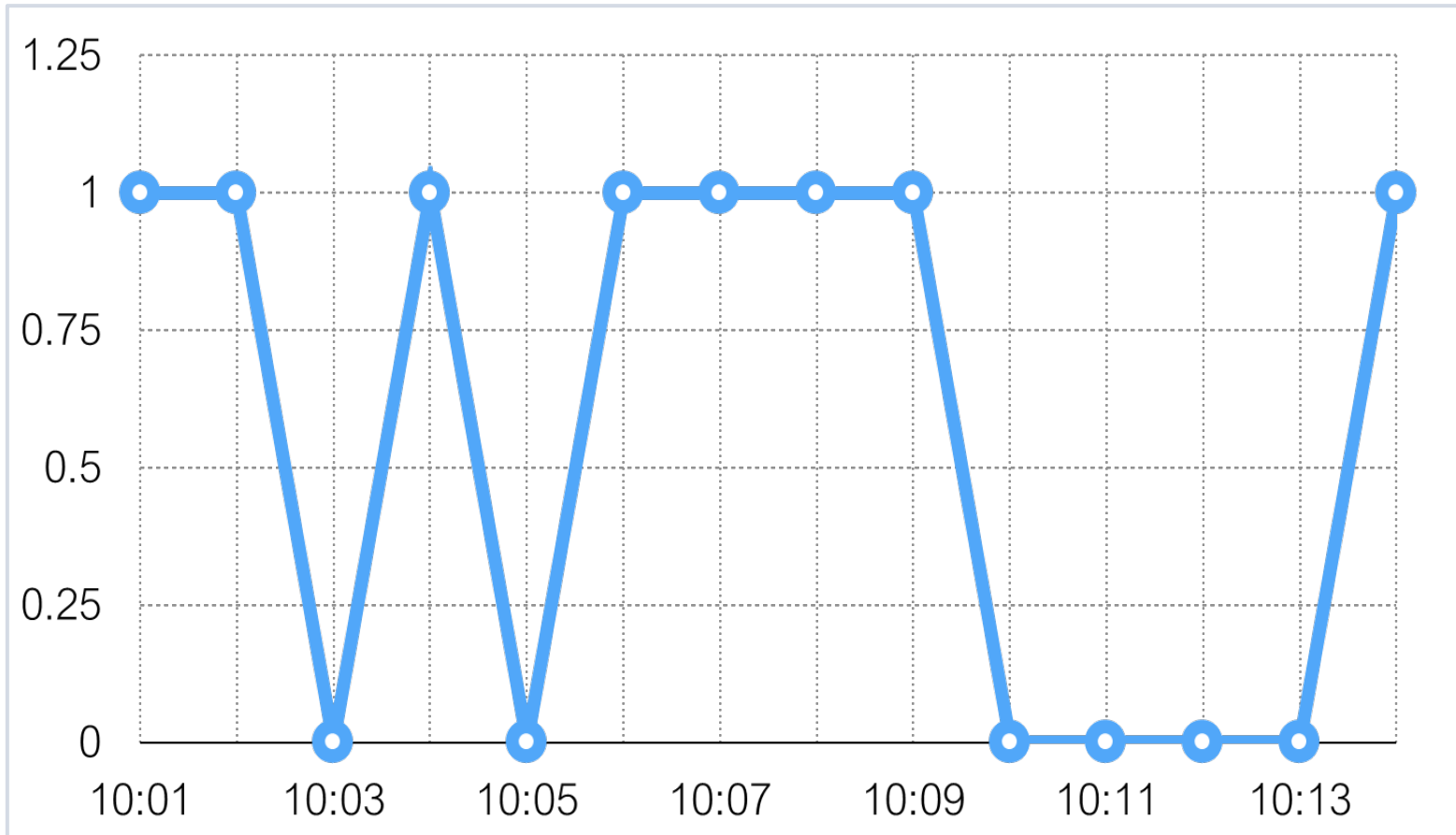
False positives



```
last(/server/system.cpu.load) > 5
```

ADVANCED PROBLEM DETECTION

Too sensitive



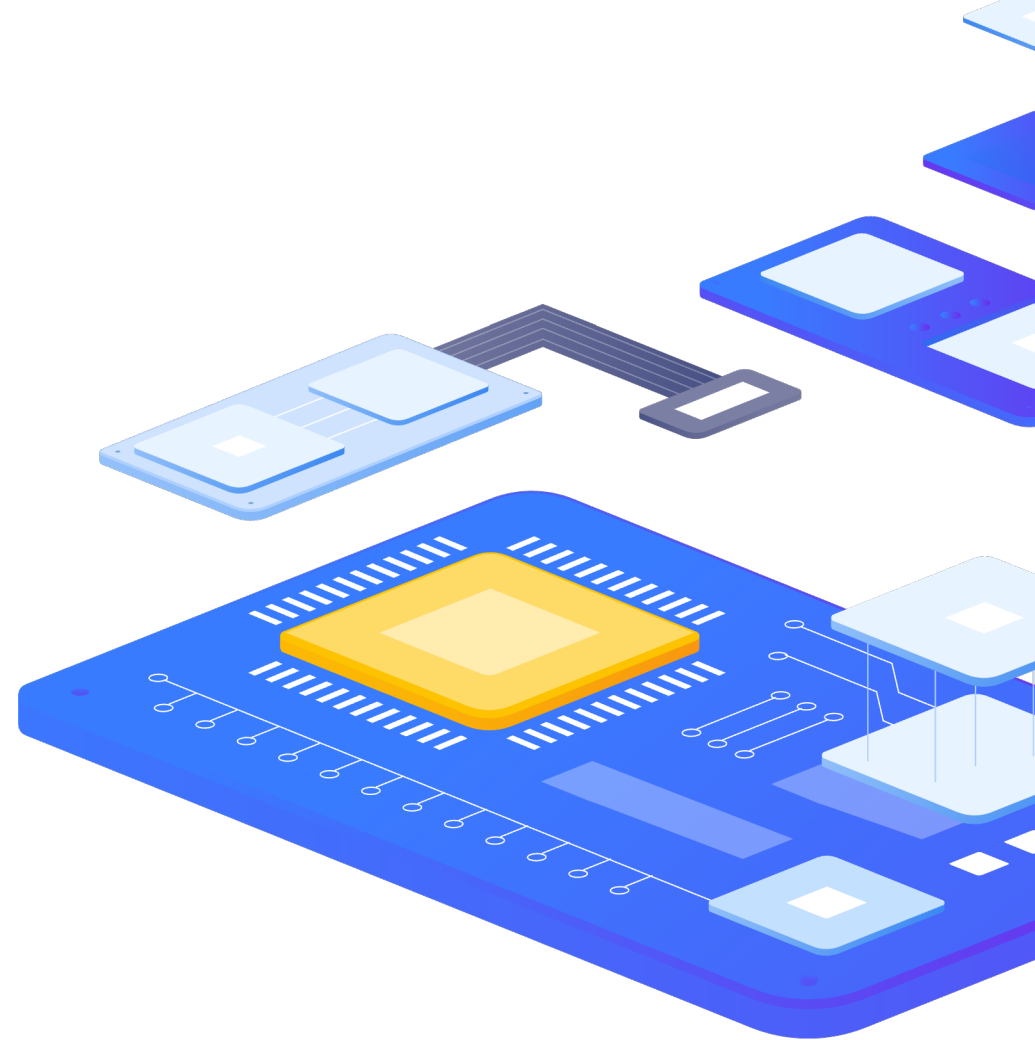
`last(/server/net.tcp.service[http]) = 0`

Advanced problem detection

Junior level

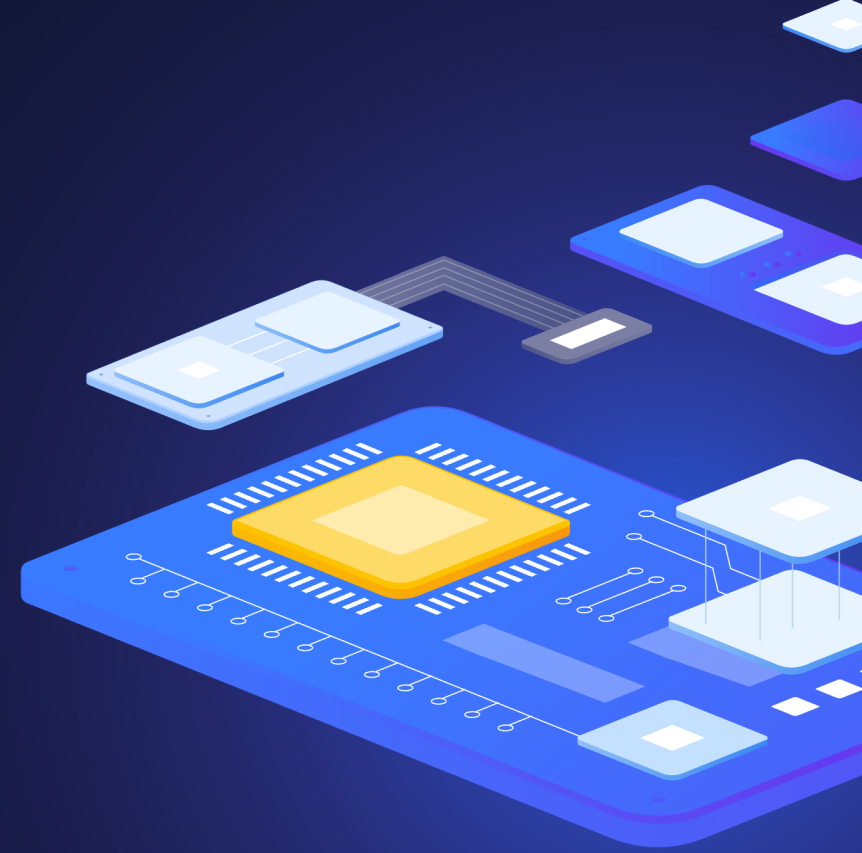
Too sensitive leads to

- ▶ False positives



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False positives



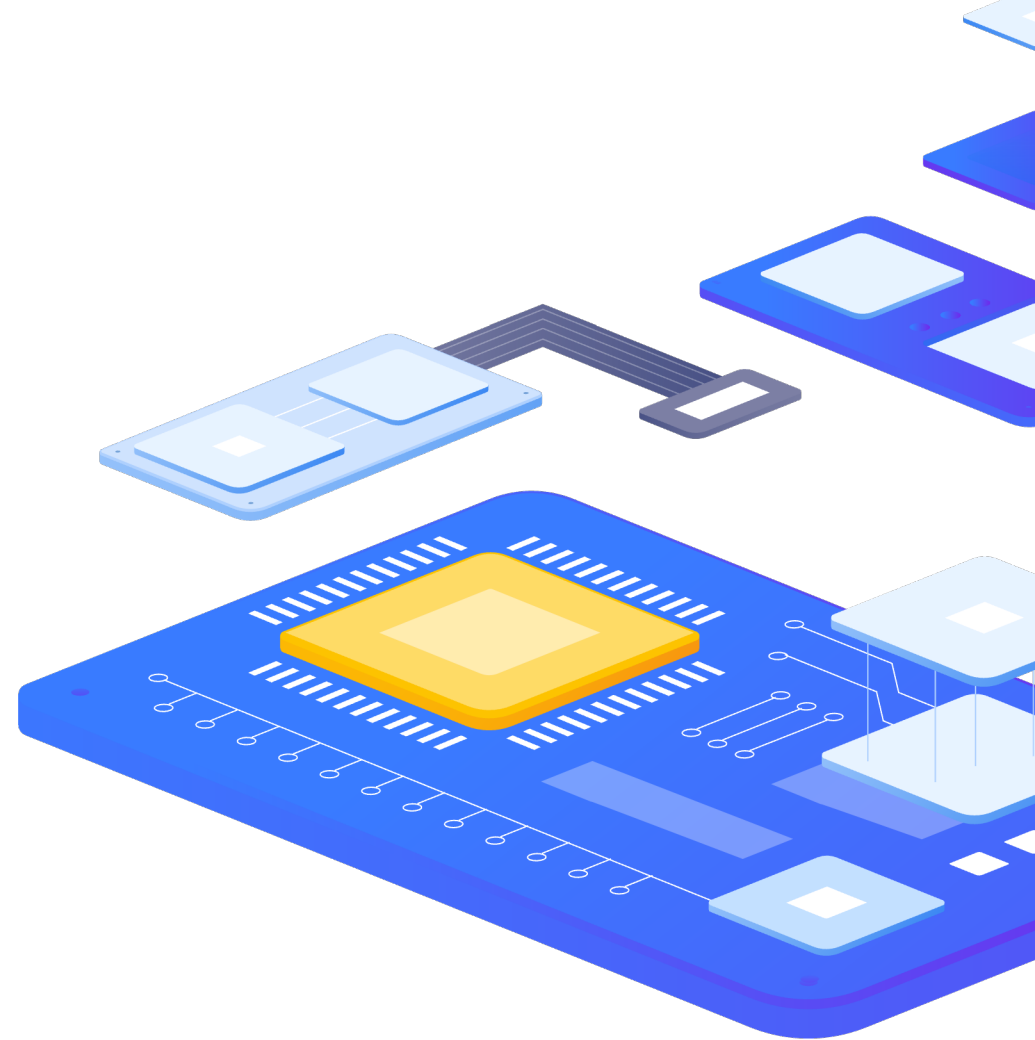
ADVANCED PROBLEM DETECTION

How to avoid false positives?

Be careful and define problems wisely!

What does it really mean?

- › system is overloaded
- › application does not work
- › service is not available



ADVANCED PROBLEM DETECTION

Examples

Problem:

- › CPU load > 5

No problem:

- › CPU load = 4.99 → Resolved?

Problem:

- › free disk space < 10%

No problem:

- › free disk space = 10.001% → Resolved?

Problem:

- › SSH check failed

No problem:

- SSH is up → Resolved?

Analyze history

Performance

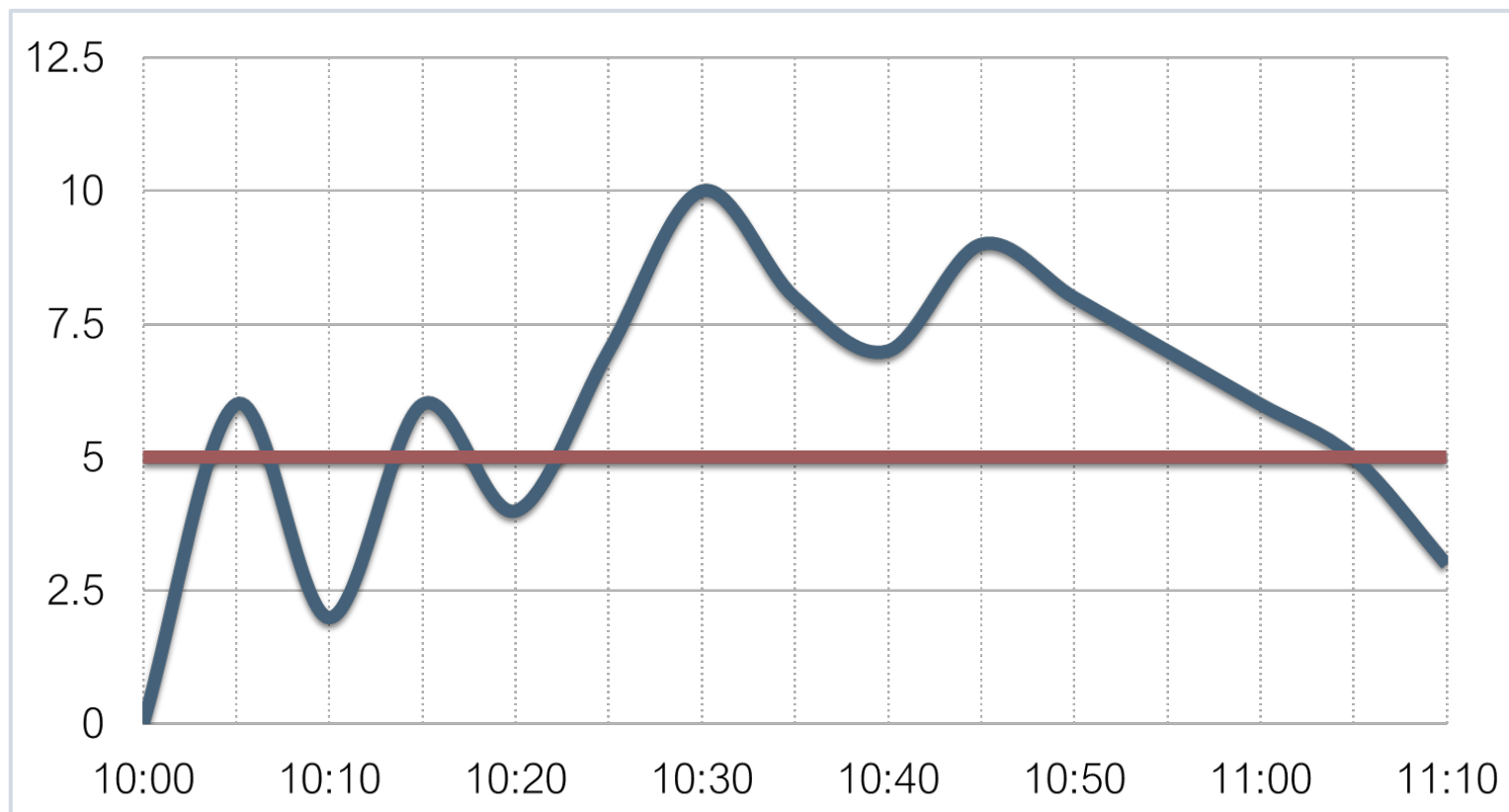
- ▶ $\min(/server/system.cpu.load,10m) > 5$

Availability

- ▶ $\max(/server/net.tcp.service[http],5m) = 0$
- ▶ $\max(/server/net.tcp.service[http],\#3) = 0$

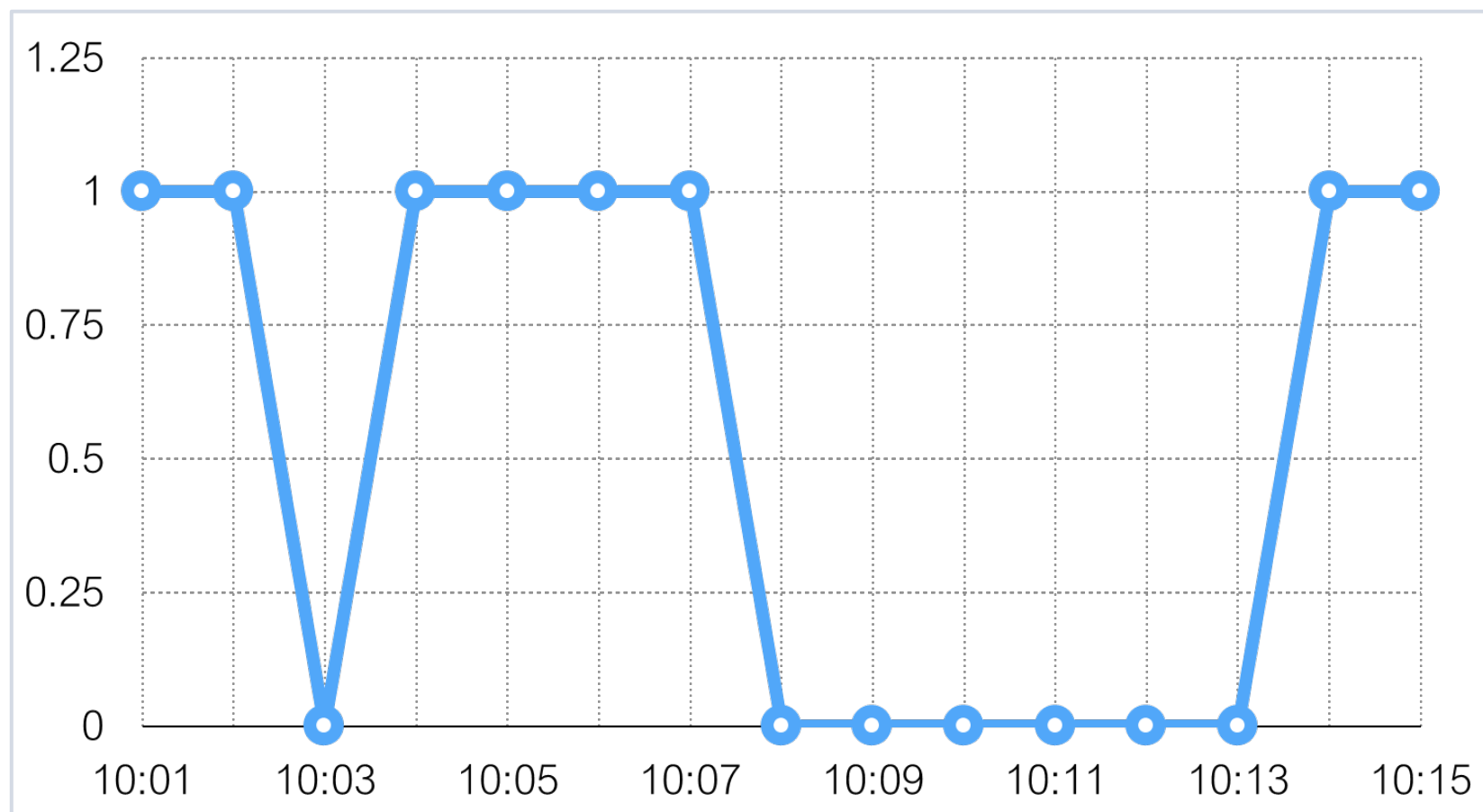
ADVANCED PROBLEM DETECTION

Analyze history



```
min(/server/system.cpu.load,10m) > 5
```

Analyze history



`max(/server/net.tcp.service[http],#3) = 0`

Different conditions for problem and recovery

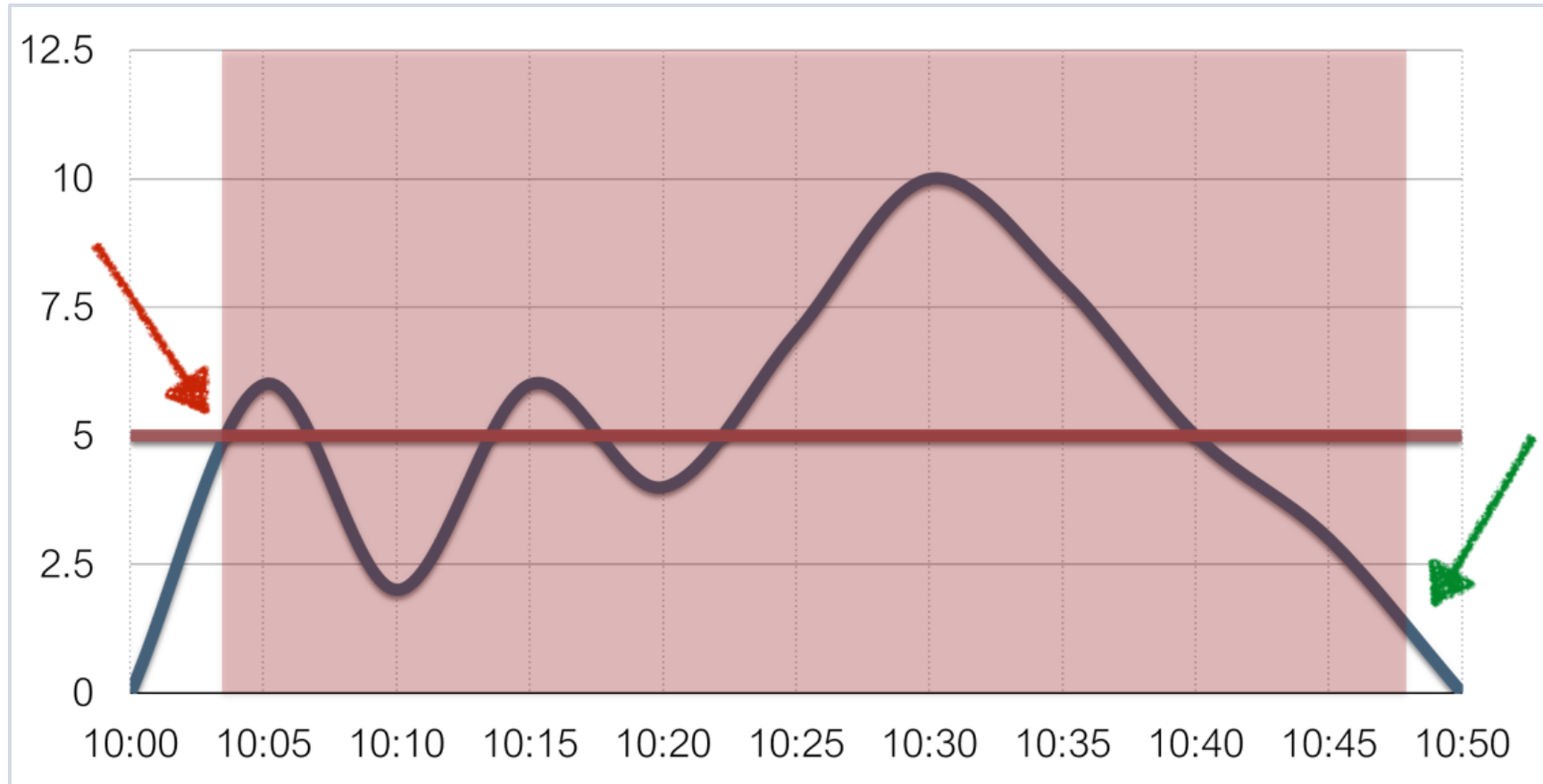
Before

- › `last(/server/system.cpu.load) > 5`

Now

- › Problem definition: `last(/server/system.cpu.load)>5`
- › Recovery expression: `last(/server/system.cpu.load)}<=1`

Different conditions for problem and recovery



Problem definition: `last(/server/system.cpu.load)>5` ...Recovery expression: `last(/server/system.cpu.load)}<=1`

ADVANCED PROBLEM DETECTION

Examples

System is overloaded

Problem definition:

- ▶ $\min(/server/system.cpu.load,5m)>3$

Recovery expression:

- ▶ $\max(/server/system.cpu.load,2m)\leq 1$

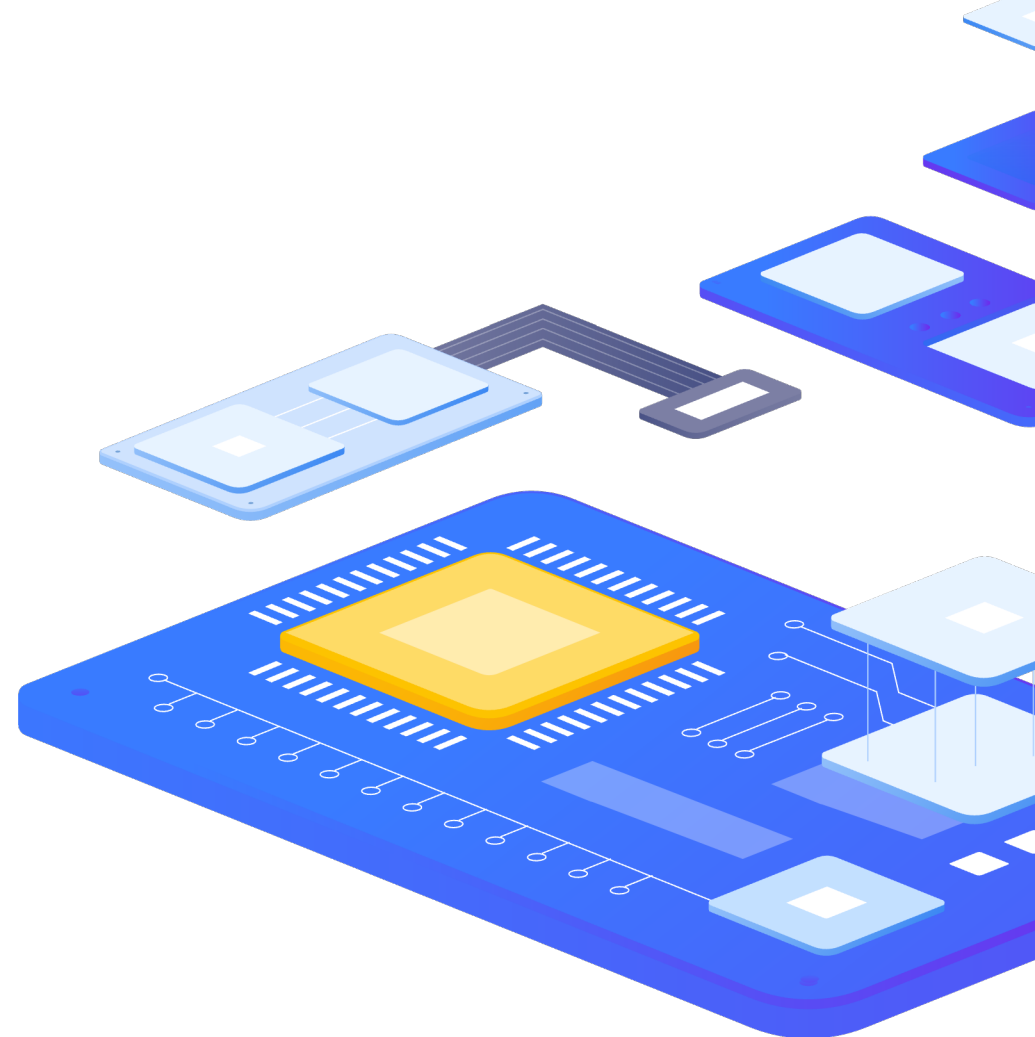
No free disk space /

Problem definition:

- ▶ $\text{last}(/server/vfs.fs.size[/,pfree])<10$

Recovery expression:

- ▶ $\min(/server/vfs.fs.size[/,pfree],15m)>30$



ADVANCED PROBLEM DETECTION

Examples

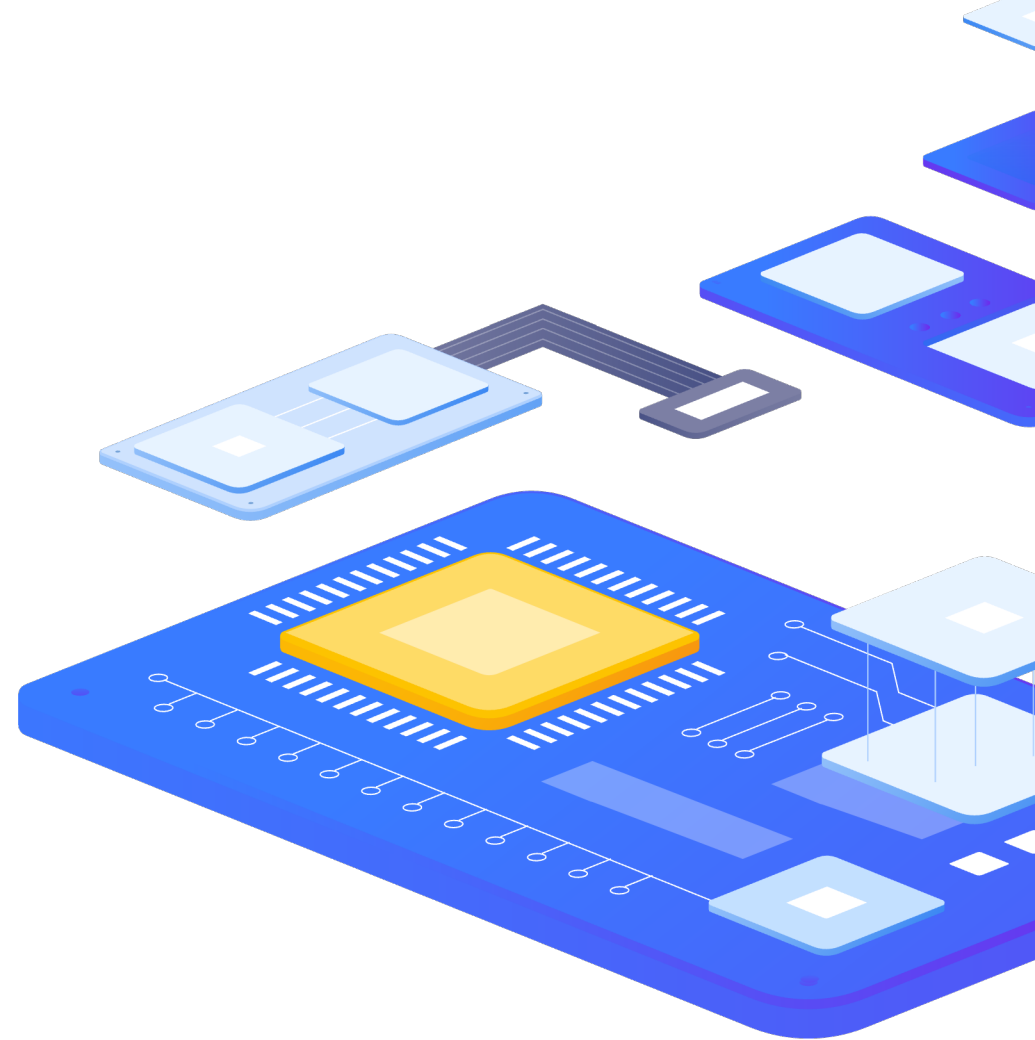
SSH is not available

Problem definition:

› $\max(/server/net.tcp.service[ssh],\#3)=0$

Recovery expression:

› $\min(/server/net.tcp.service[ssh],\#10)=1$



Anomalies

How to detect?

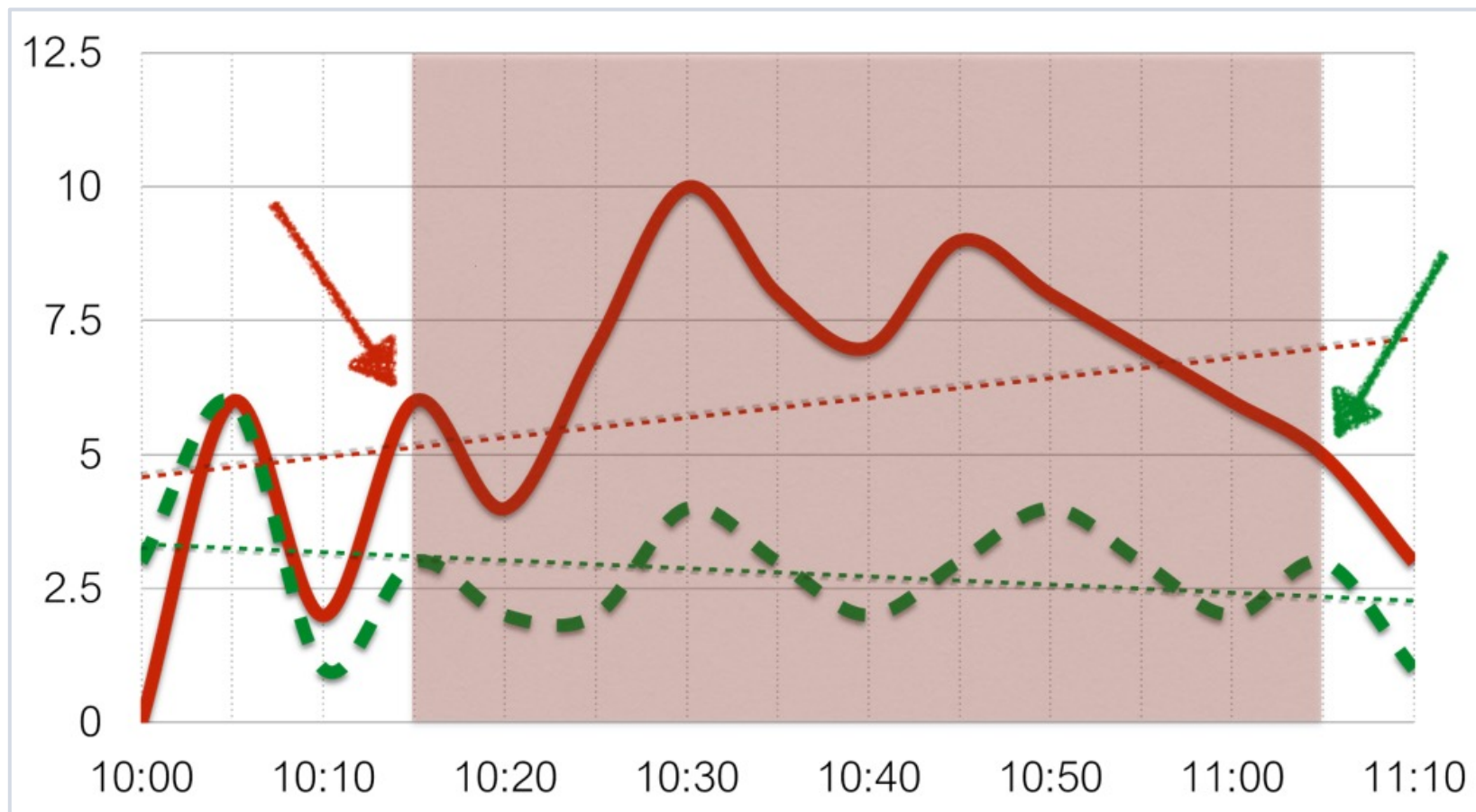
By comparing with the data from the same period, the period is taken from the past.

Average CPU load for the last hour is 2x higher than

CPU load for the same period week ago

▶ `avg(/server/system.cpu.load,1h) > 2* avg(/server/system.cpu.load,1h:now-7d)`

Anomalies



Comparison with the data 7 days ago

Flapping

How to detect?

By comparing changecount of the data from the time period.

Operational status changes of interface

▶ `changecount(/SNMP v2/net.if.status[ifOperStatus.{#SNMPINDEX}],{$FLAP.PERIOD})>{$FLAP.NUMBER}`

Trigger dependency

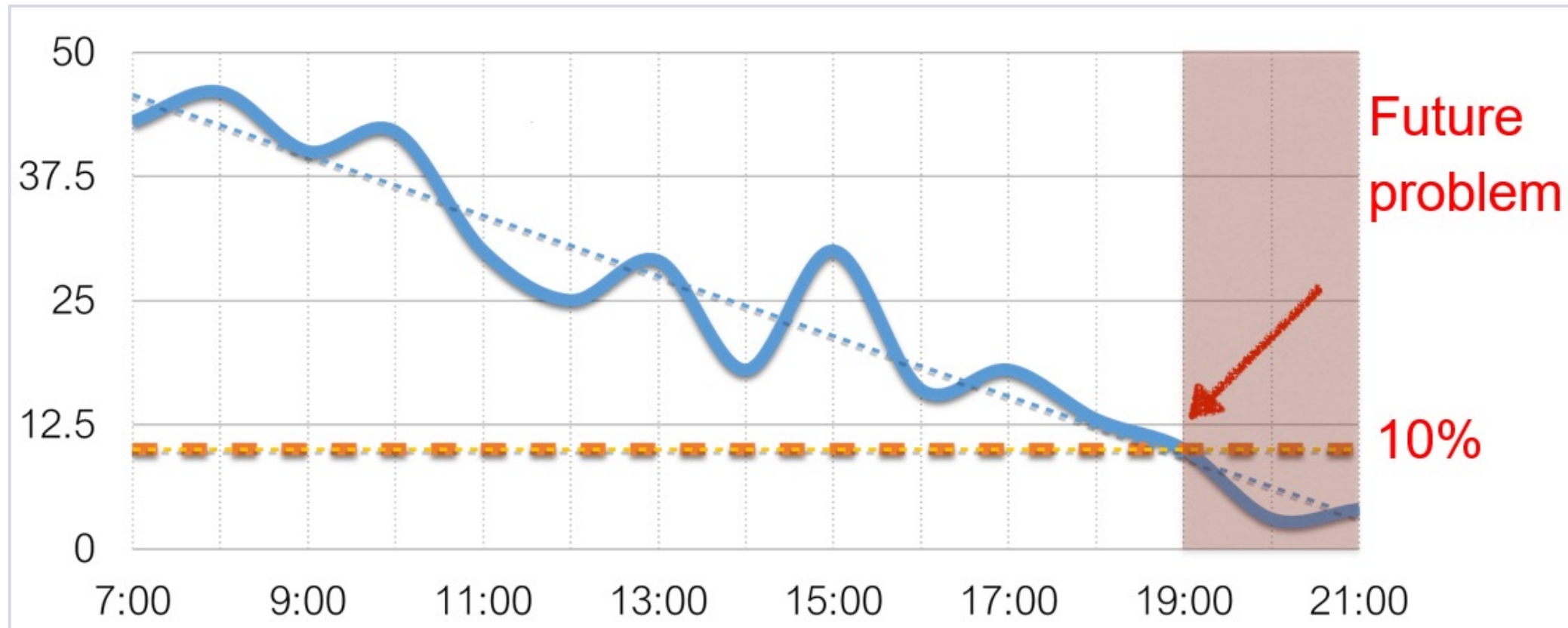
Link down -> Flapping Detected

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Forecast

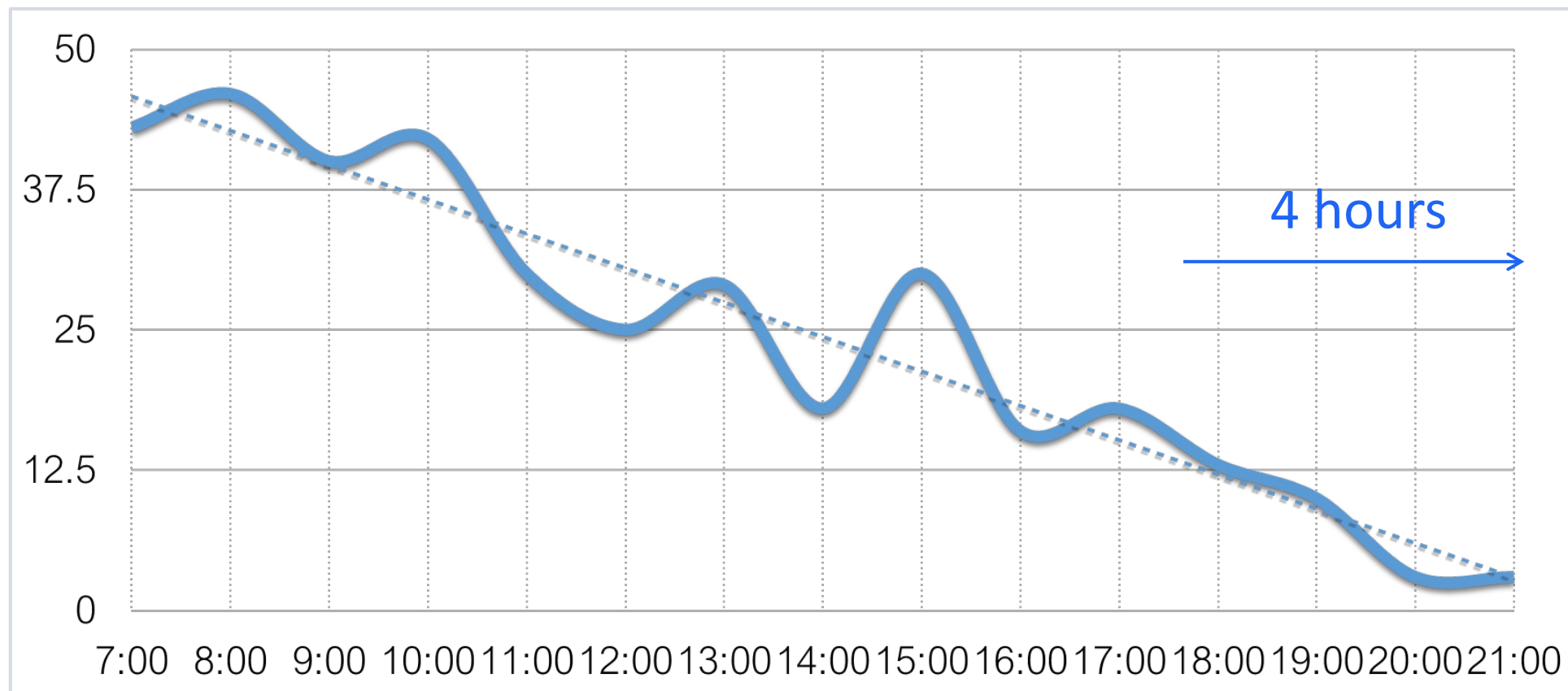


Forecast



Trigger function timeleft

Forecast



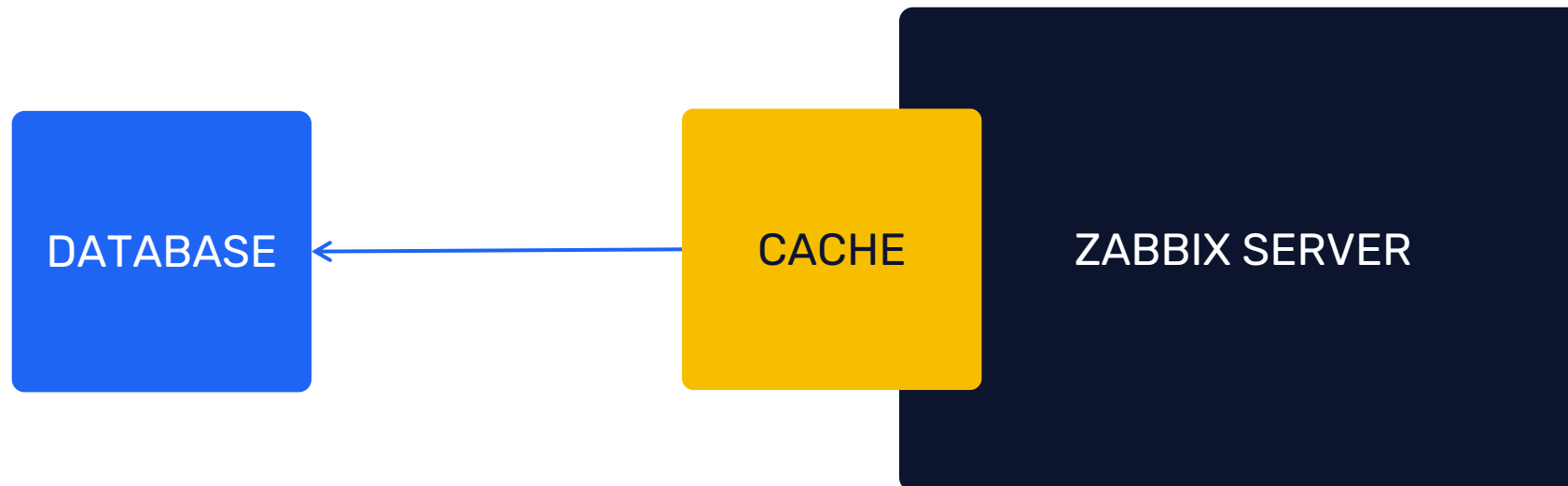
Trigger function forecast

ADVANCED PROBLEM DETECTION

Does history analysis affect performance of Zabbix?

Yes, but not significantly.

Especially as of Zabbix 2.2.0.



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Dependencies



Dependencies

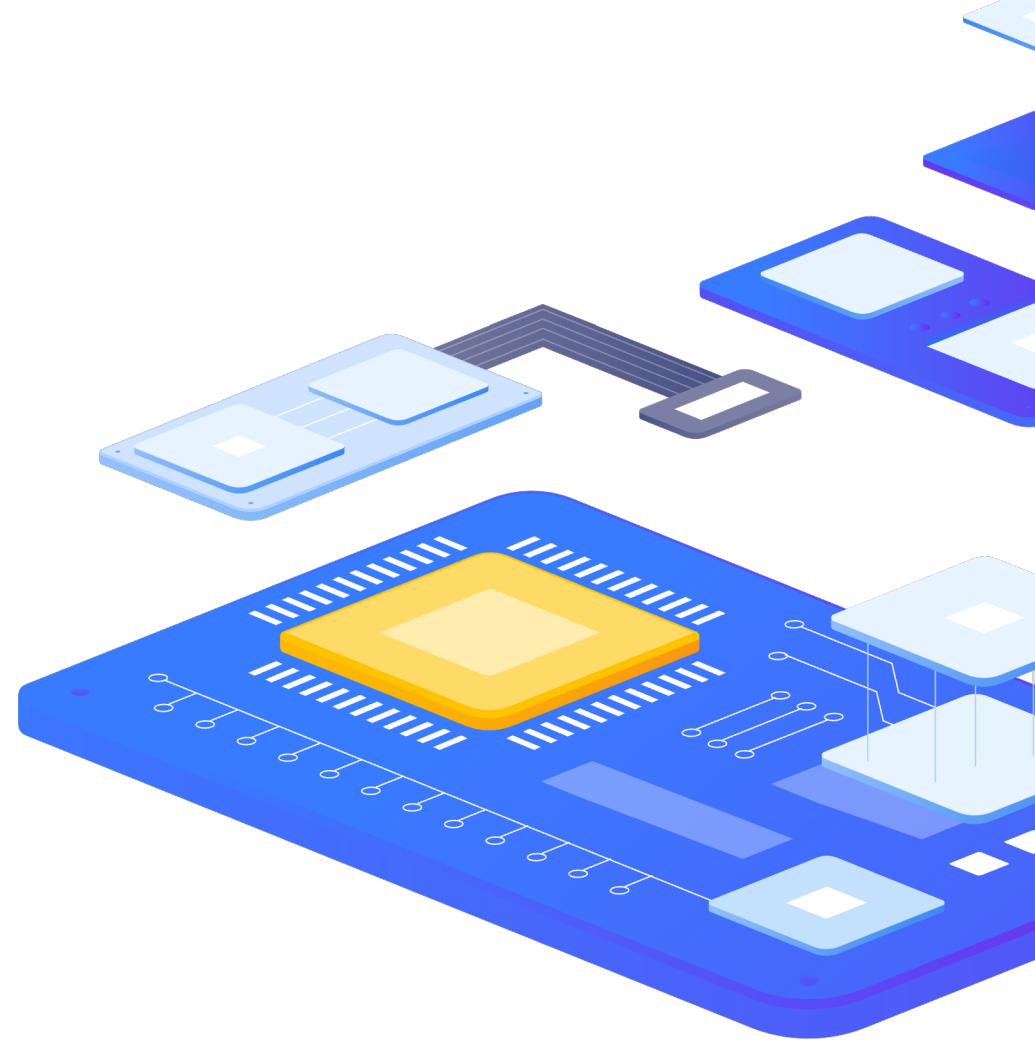
CRM is not working



DB is unavailable




No free disk space



ADVANCED PROBLEM DETECTION

Section „Problems“



Problems Export to CSV

Test | Tags

Show: Recent problems **Problems** History

Host groups: Select

Hosts: Select

Triggers: Select

Problem:

Severity: Not classified Warning High
 Information Average Disaster

Age less than: 14 days

Show symptoms:

Show suppressed problems:

Show unacknowledged only:

Host inventory: Type Remove

[Add](#)

Tags: And/Or Or

tag Contains value Remove

[Add](#)

Show tags: None 1 2 **3** Tag name Full Shortened None

Tag display priority: comma-separated list

Show operational data: None Separately With problem name

Compact view: Show timeline

Show details: Highlight whole row

Save as Apply Reset

<input type="checkbox"/>	Time	Severity	Info	Host	Problem	Duration	Update	Actions	Tags
<input type="checkbox"/>	5 2023-11-29 17:20:48	Average		Azure virtual machine LOZA001	Azure: There are errors in requests to API ?	16h 18m 48s	Update		class: software component: raw location: eastus2 ...
Yesterday									
<input type="checkbox"/>	2023-11-24 20:10:59	Warning		Docker01	Number of Not Supported Items is rising on Host	5d 13h 28m	Update		
<input type="checkbox"/>	2023-11-24 11:57:30	Warning		Docker01	↑ /: Disk space is low (used > 80%) ?	5d 21h 42m	Update		Application: Filesystem /
November									
<input type="checkbox"/>	2 2023-10-26 09:26:30	Warning		Zabbix server	Number of Not Supported Items is rising on Host	1M 5d 1h	Update		ENV: PROD
October									
<input type="checkbox"/>	2023-08-10 12:56:07	High		web01	↑ Cert: SSL certificate data.zschynov.cz is invalid ?	3M 21d 21h	Update		hostname: data.zschy... resource: general target: cert ...
<input type="checkbox"/>	2023-08-06 15:23:10	Average		AP_SOUSEDI	↑ Disk-131072: Disk space is critically low (used > 90%) ?	3M 25d 19h	Update		Application: Storage device: ap
August									
<input type="checkbox"/>	2023-06-21 13:45:44	Average		Webinar	Zabbix agent is not available (or nodata for 30m) ?	5M 11d 20h	Update		Application: Status
<input type="checkbox"/>	2023-06-14 11:11:09	Average		LAB_Proxy_2	Proxy LAB_Proxy_2 nekomunikuje se serverem	5M 18d 23h	Update		
<input type="checkbox"/>	2023-06-14 11:11:08	Average		LAB_Proxy_1	Proxy LAB_Proxy_1 nekomunikuje se serverem	5M 18d 23h	Update		

Debug

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Tags



Tags

Tag word: meaning

Customer: Alza

Customer: Globus

Datacenter: NY2

Datacenter: San Francisco

Area: Performance

Area: Availability

Area: Security

Environment: Staging

Environment: Test

User impact: None

User impact: Critical

ADVANCED PROBLEM DETECTION

Use of obtained values

Use of useful information in tags or names

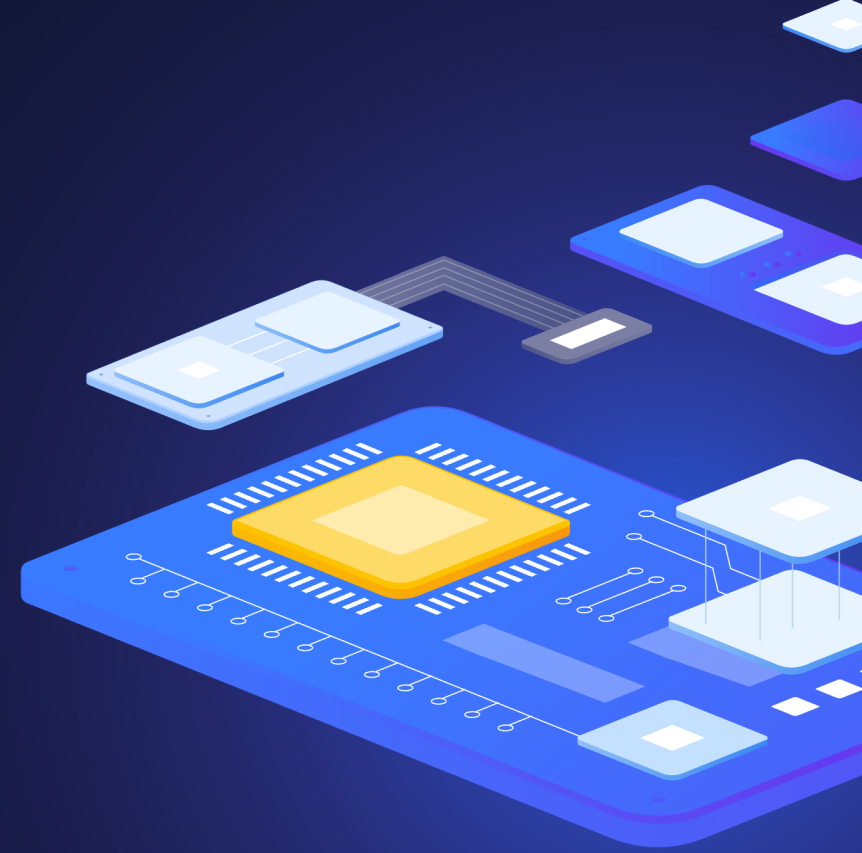
* Name	Free disk space is less than $\{\$LOW_SPACE_PCT_HIGH:\#\text{FSNAME}\}\%$ on volur
Event name	Free disk space is less than $\{\$LOW_SPACE_PCT_HIGH:\#\text{FSNAME}\}\%$ on volume $\{\#\text{FSNAME}\}$
Operational data	$\{\text{ITEM.LASTVALUE1}\}$ (Total: $\{\text{ITEM.LASTVALUE2}\}$, Free: $\{\text{ITEM.LASTVALUE3}\}$)
Severity	<input type="checkbox"/> Not classified <input type="checkbox"/> Information <input type="checkbox"/> Warning <input type="checkbox"/> Average <input checked="" type="checkbox"/> High <input type="checkbox"/> Disaster
* Expression	<pre>last(/Template OS - Windows - za/vfs.fs.size[$\{\#\text{FSNAME}\}$,pfree]) <$\{\\$LOW_SPACE_PCT_HIGH:\#\text{FSNAME}\}$ and last(/Template OS - Windows - za/vfs.fs.size[$\{\#\text{FSNAME}\}$,total])>=0 and last(/Template OS - Windows - za/vfs.fs.size[$\{\#\text{FSNAME}\}$,free])>=0</pre> <div style="text-align: right;"><input type="button" value="Add"/></div>
Expression constructor	
OK event generation	<input checked="" type="checkbox"/> Expression <input type="checkbox"/> Recovery expression <input type="checkbox"/> None

Possible reactions

- › Event correlation
- › Automatized problem solving
- › Manual problem closing
- › Sending notifications to a user or a group of users
- › Registration of tasks in the Helpdesk system

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Event correlations



ADVANCED PROBLEM DETECTION

Event correlation on trigger level

Trigger Tags Dependencies

Name Service `{{ITEM.VALUE}}.regsub("^.* service ([a-zA-Z]*) .*$", "\1")` stopped

Event name Service `{{ITEM.VALUE}}.regsub("^.* service ([a-zA-Z]*) .*$", "\1")` stopped

Operational data

Severity Not classified Information Warning Average **High** Disas

Problem expression `find(/My host/log[/var /log/syslog],, "regexp", "Stopping")=1` [Add](#)

[Expression constructor](#)

OK event generation Expression **Recovery expression** None

Recovery expression `find(/My host/log[/var /log/syslog],, "regexp", "Starting")=1` [Add](#)

[Expression constructor](#)

PROBLEM event generation mode Single **Multiple**

OK event closes All problems **All problems if tag values match**

Tag for matching Service

Correlation of events at the trigger level allows you to compare individual problems reported by a single trigger.

Trigger Tags 2 Dependencies

Trigger tags Inherited and trigger tags

Name	Value
Datcenter	value
Service	<code>{{ITEM.VALUE}}.regsub("^.* service ([a-zA-Z]*) .*\$", "\1")</code>

[Add](#)

Event correlation on trigger level

How does it work?

10/Feb/2022:06:25:30 service Jira stopped

“Service Jira stopped”

PROBLEM

ADVANCED PROBLEM DETECTION

Event correlation on trigger level

How does it work?

10/Feb/2022:06:25:30 service Jira stopped "Service Jira stopped" **PROBLEM**

10/Feb/2022:06:27:32 service MySQL stopped "Service MySQL stopped" **PROBLEM**

ADVANCED PROBLEM DETECTION

Event correlation on trigger level

How does it work?

10/Feb/2022:06:25:30 service Jira stopped	"Service Jira stopped"	PROBLEM
10/Feb/2022:06:27:32 service MySQL stopped	"Service MySQL stopped"	RESOLVED
10/Feb/2022:06:28:11 service MySQL started		

ADVANCED PROBLEM DETECTION

Event correlation on trigger level

How does it work?

10/Feb/2022:06:25:30 service Jira stopped	"Service Jira stopped"	PROBLEM
10/Feb/2022:06:27:32 service MySQL stopped	"Service MySQL stopped"	RESOLVED
10/Feb/2022:06:28:11 service MySQL started		
10/Feb/2022:06:34:22 service Redis stopped	"Service Redis stopped"	PROBLEM

ADVANCED PROBLEM DETECTION

Event correlation on trigger level

How does it work?

10/Feb/2022:06:25:30 service Jira stopped	"Service Jira stopped"	PROBLEM
10/Feb/2022:06:27:32 service MySQL stopped	"Service MySQL stopped"	RESOLVED
10/Feb/2022:06:28:11 service MySQL started		
10/Feb/2022:06:34:22 service Redis stopped	"Service Redis stopped"	RESOLVED
10/Feb/2022:06:37:58 service Redis started		

ADVANCED PROBLEM DETECTION

Event correlation on trigger level

How does it work?

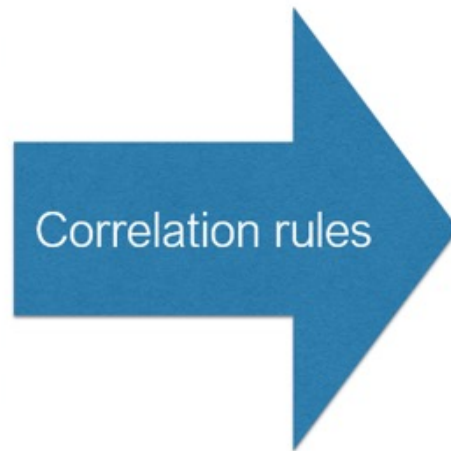
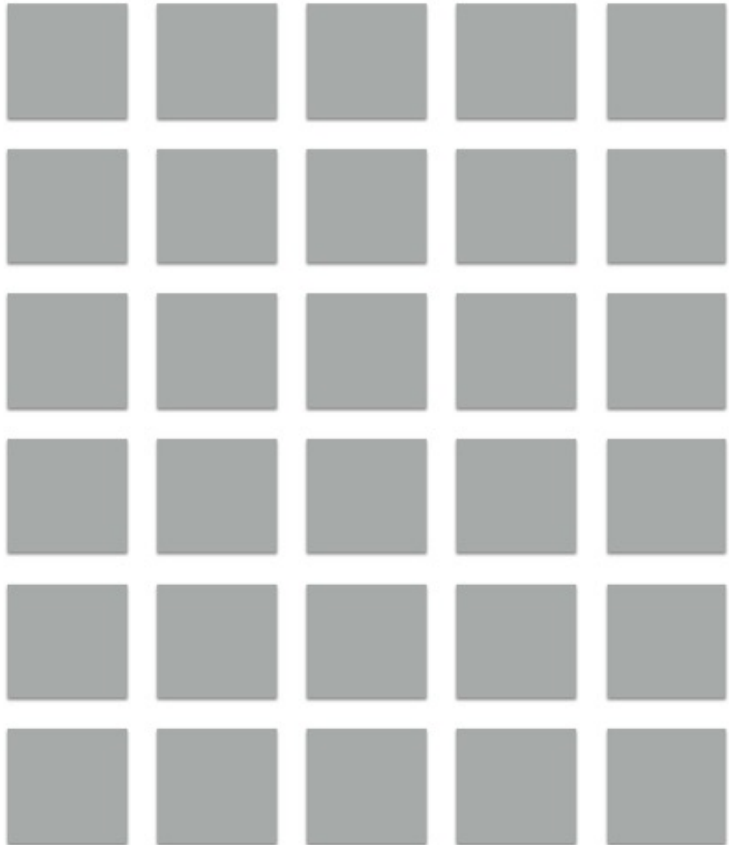
10/Feb/2022:06:25:30 service Jira stopped	"Service Jira stopped"	RESOLVED
10/Feb/2022:06:27:32 service MySQL stopped	"Service MySQL stopped"	RESOLVED
10/Feb/2022:06:28:11 service MySQL started		
10/Feb/2022:06:34:22 service Redis stopped	"Service Redis stopped"	RESOLVED
10/Feb/2022:06:37:58 service Redis started		
10/Feb/2022:06:55:31 service Jira started		

Event correlation

A new problem appears

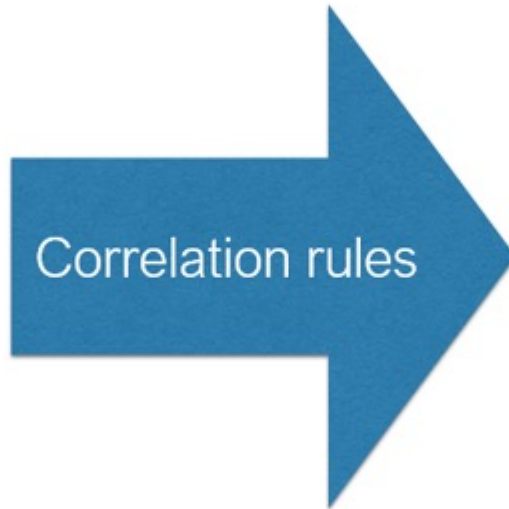
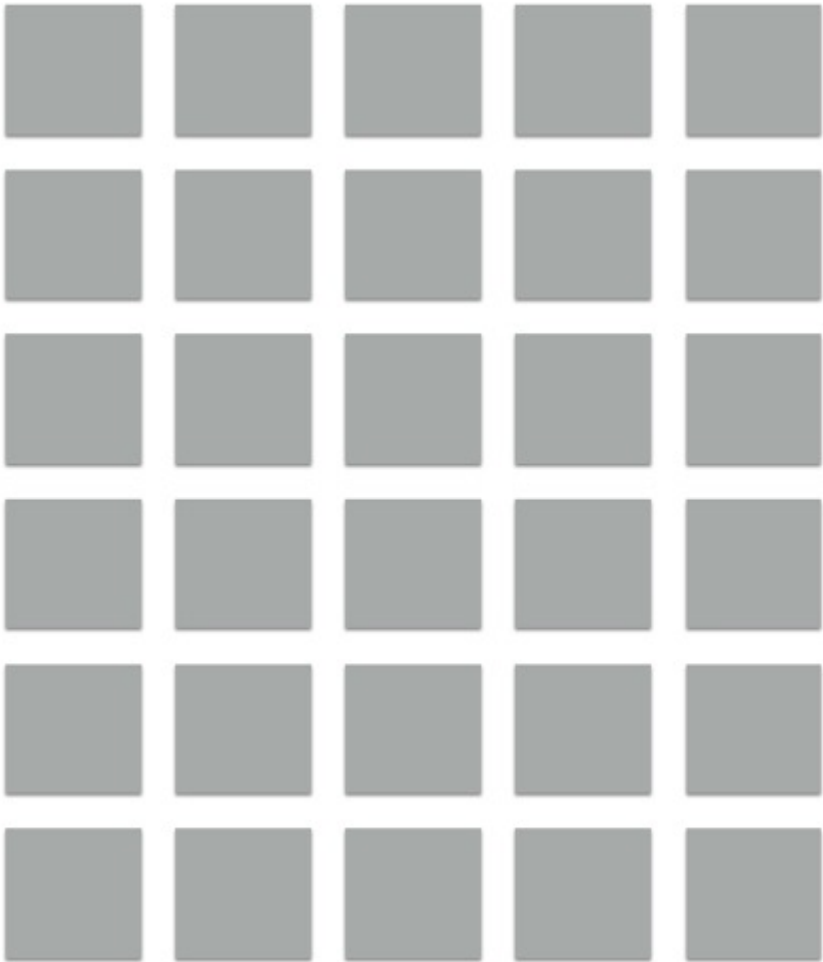


Existing problems

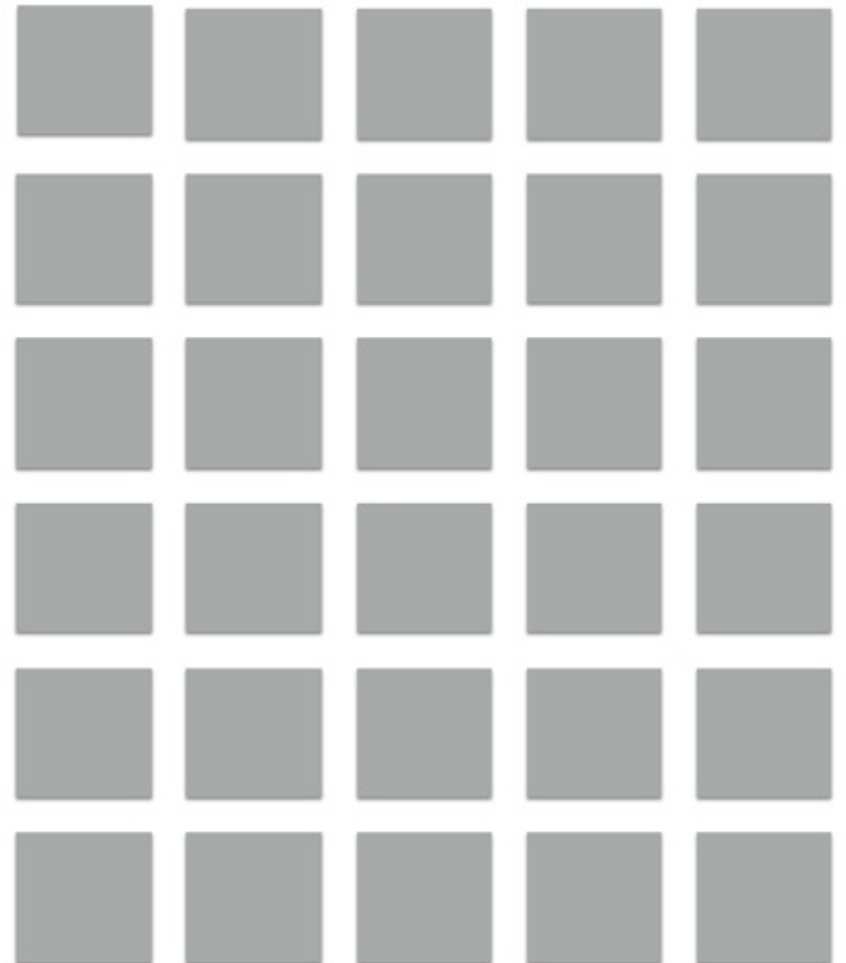


Event correlation

Existing problems

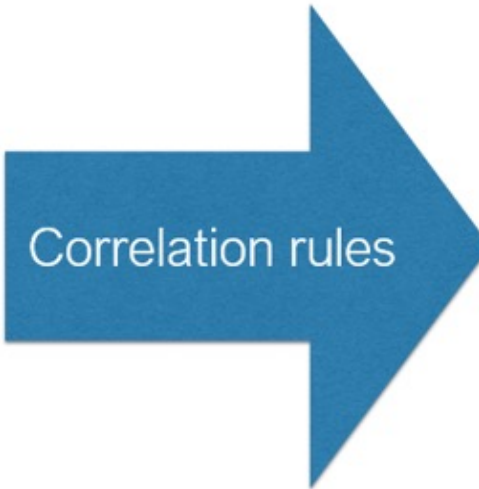
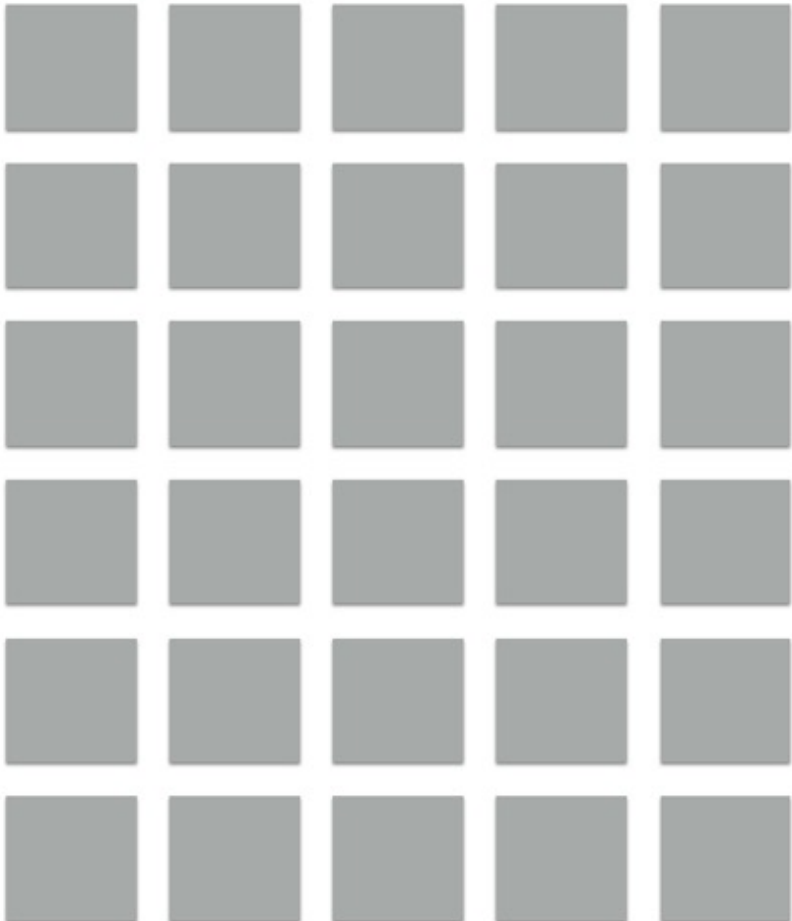


No correlation rules

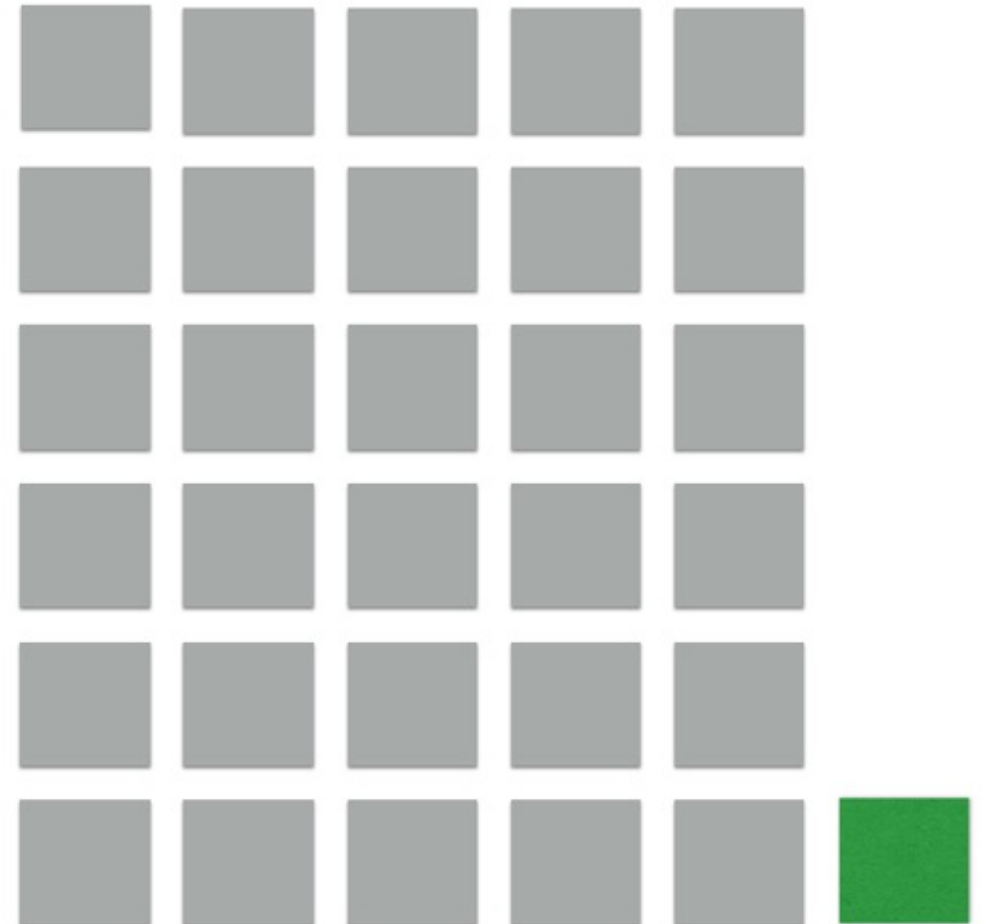


Event correlation

Existing problems

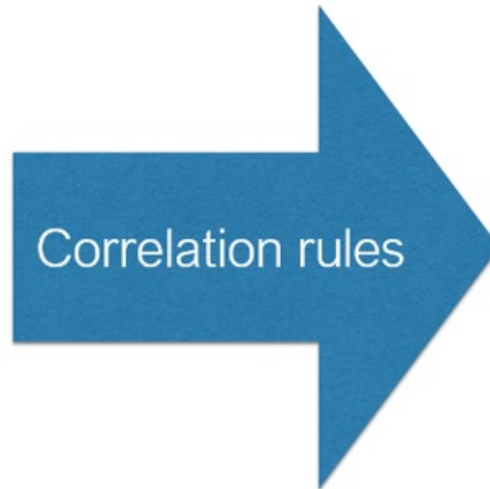
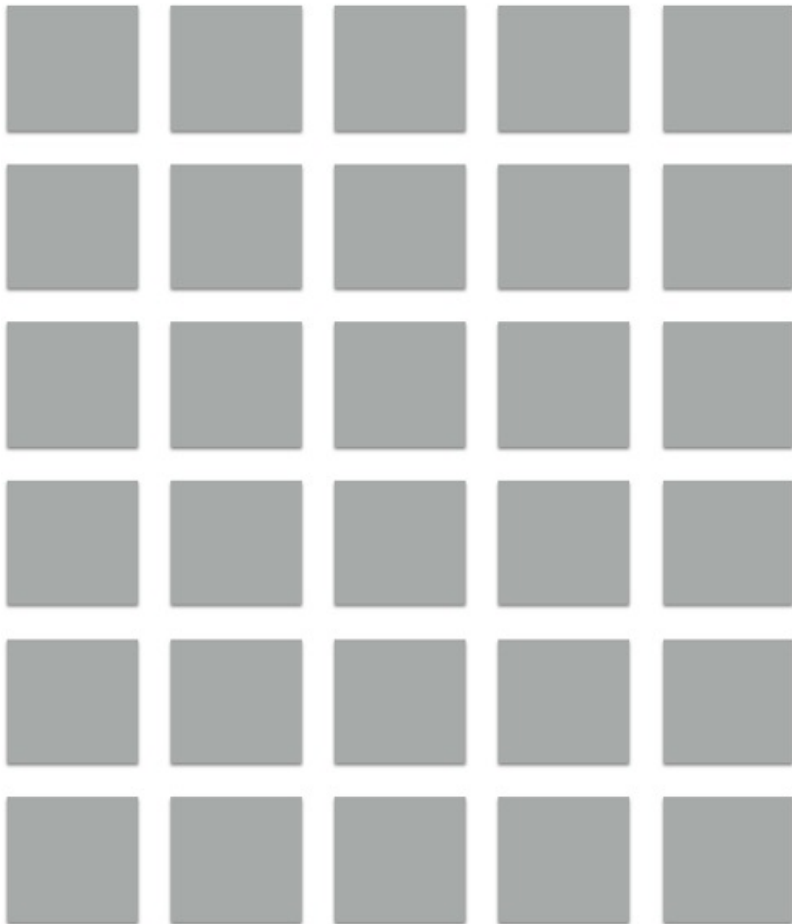


No correlation rules

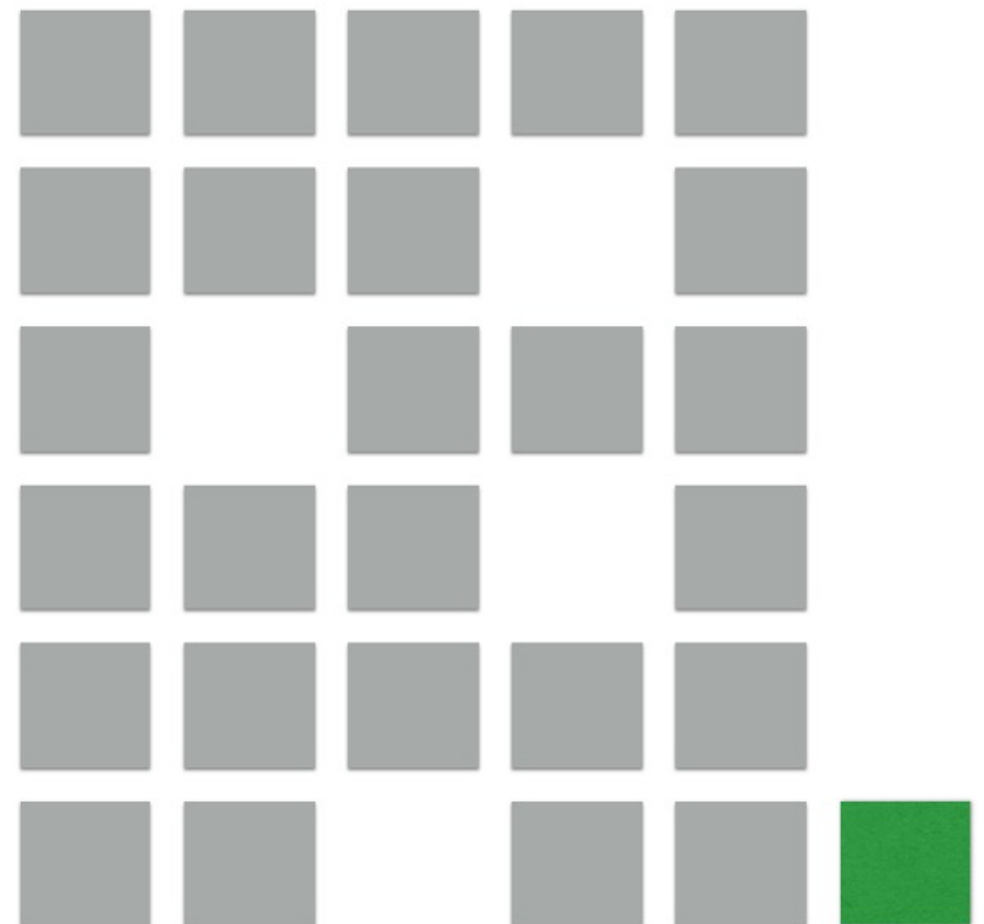


Event correlation

Existing problems



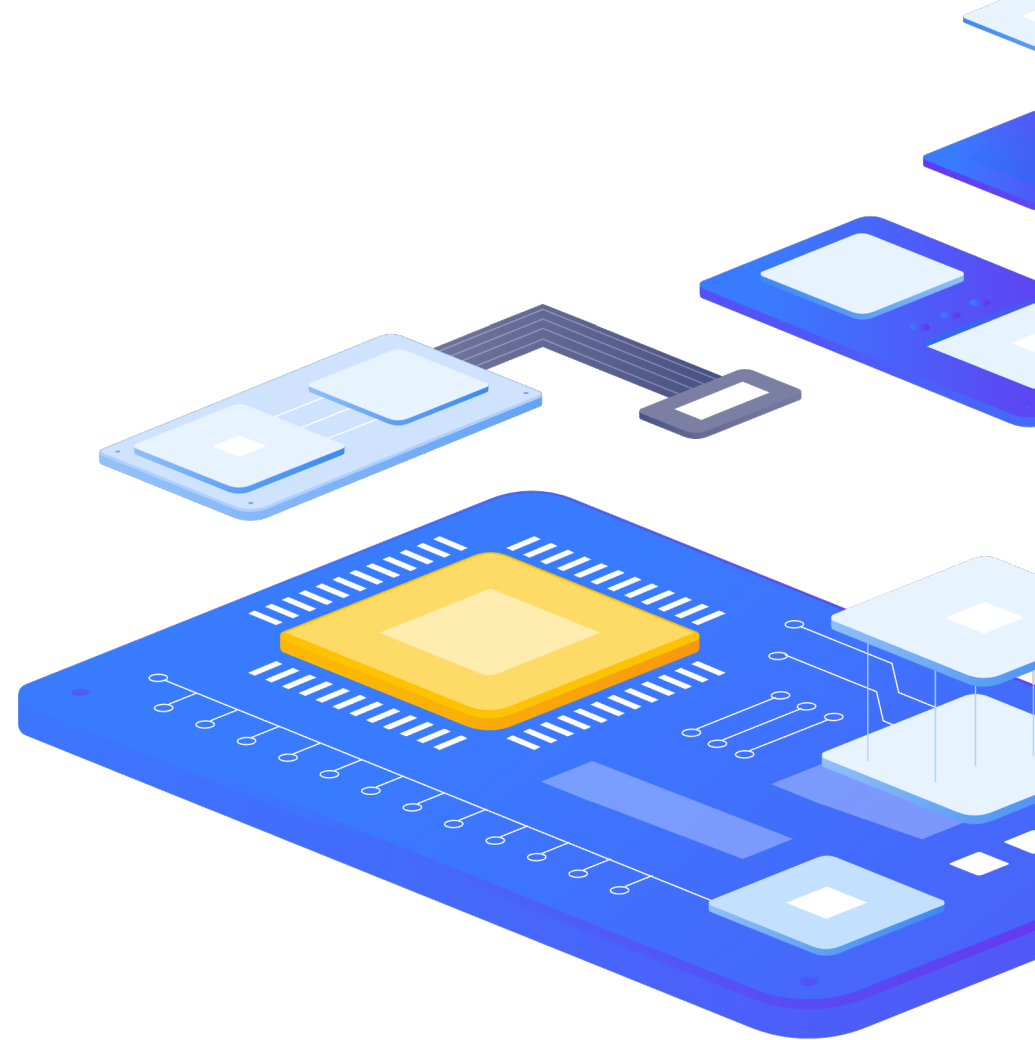
Correlation rules (close old)



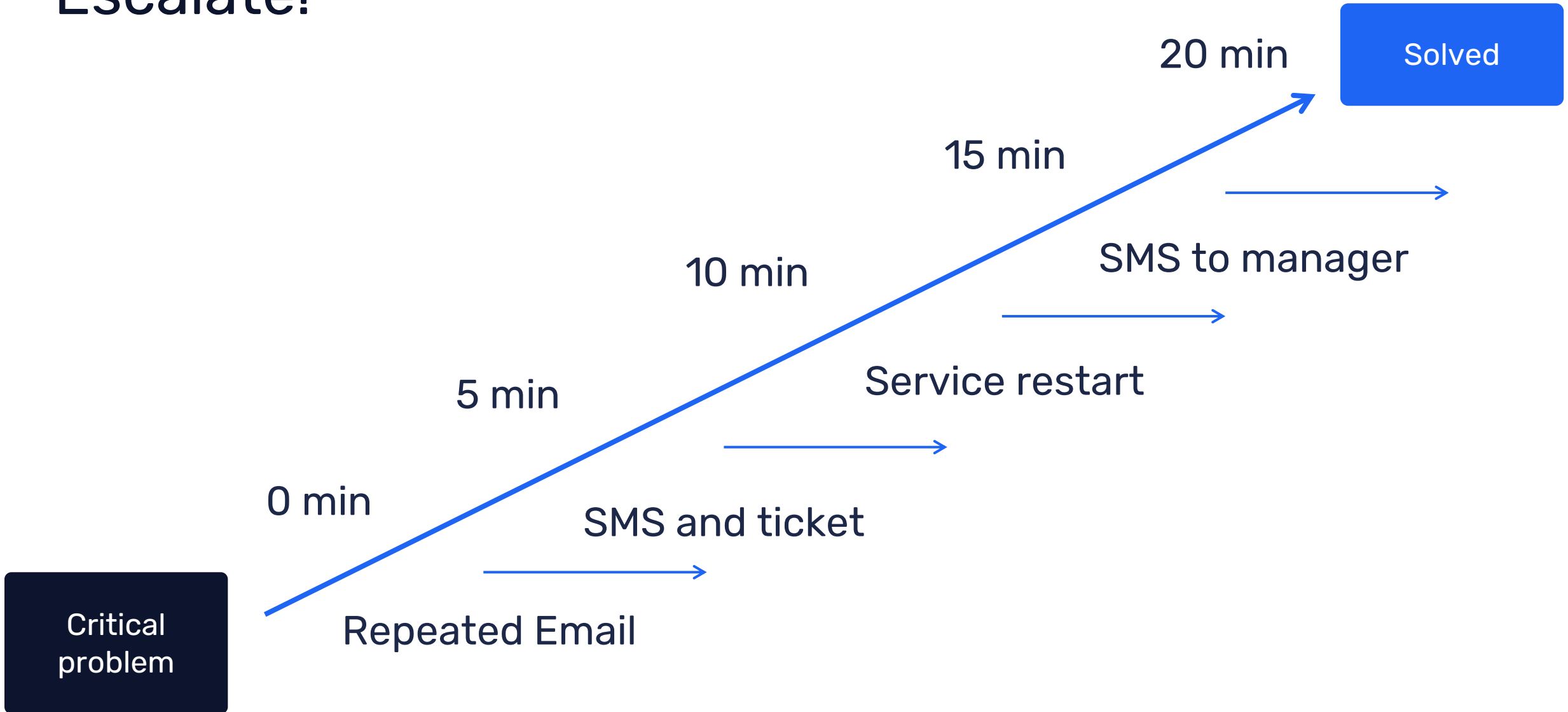
ADVANCED PROBLEM DETECTION

Escalate!

- › Immediate reaction
- › Delayed reaction
- › Notification if automatic action failed
- › Repeated notifications
- › Escalation to a new level



Escalate!



ADVANCED PROBLEM DETECTION

In summary

- › Analyze history
- › No problem!= Solution
- › Use different conditions for problem definition and recovery
- › Pay attention to anomaly detection
- › Use correlation
- › Resolve common problems automatically
- › Do not hesitate to escalate!

7

Expression macros



ADVANCED PROBLEM DETECTION

{?EXPRESSION_MACROS}

- ▶ If defined, this name will be used to create the problem event name, instead of the trigger name.
- ▶ The event name may be used to build meaningful alerts containing problem data
- ▶ The same set of macros is supported as in the trigger name, plus {TIME} and {?EXPRESSION} expression macros.
- ▶ Supported since Zabbix 5.2.0
- ▶ Can be used in different locations – **Event Name**, Maps, name of Graphs

ADVANCED PROBLEM DETECTION

{?EXPRESSION_MACROS}

Junior

- ▶ Problem: Load of **Exchange** server increased by more than 10% last month

Expert

- ▶ Problem: Load of **Exchange** server increased by **24%** in **July (0.69)** comparing to **June (0.56)**
- ▶ Load of {HOST.HOST} server increased by
 - ▶ `{{?100*trendavg(//system.cpu.load,1M:now/M)/trendavg(//system.cpu.load,1M:now/M-1M)}.fmtnum(0)}%` in
 - ▶ `{{TIME}.fmttime(%B,-1M)}`
 - ▶ `{{?trendavg(//system.cpu.load,1M:now/M)}.fmtnum(2)}` comparing to
 - ▶ `{{TIME}.fmttime(%B,-2M)}`
 - ▶ `{{?trendavg(//system.cpu.load,1M:now/M-1M)}.fmtnum(2)}`

<https://www.zabbix.com/documentation/6.0/en/manual/config/triggers/expression?hl=expression#examples-of-triggers>

8

Cause and symptoms



ADVANCED PROBLEM DETECTION

Cause and symptom events

Zabbix 6.4 adds the ability to mark events as Cause or Symptom events. This allows Zabbix users to filter events in a way, where they can see only root cause problems, instead of being overwhelmed by symptom events

<input type="checkbox"/>	Time ▲	Severity	Info	Host	Problem	Duration	Update	Actions
<input type="checkbox"/>	5 ^ 21:19:47	Disaster		snmp-initMAX-DEMO	Some event with severity: disaster	7m 46s	Update	
<input type="checkbox"/>	↳ 21:19:54	High		snmp-initMAX-DEMO	Some event with severity: high	7m 39s	Update	1 →
<input type="checkbox"/>	↳ 21:19:58	Average		snmp-initMAX-DEMO	Some event with severity: average	7m 35s	Update	1 →
<input type="checkbox"/>	↳ 21:19:58	Warning		snmp-initMAX-DEMO	Some event with severity: warning	7m 35s	Update	1 →
<input type="checkbox"/>	↳ 21:20:01	Average		snmp-initMAX-DEMO	Some event with severity: average	7m 32s	Update	1 →
<input type="checkbox"/>	↳ 21:20:01	Warning		snmp-initMAX-DEMO	Some event with severity: warning	7m 32s	Update	1 →

ADVANCED PROBLEM DETECTION

Cause and symptom events

- ▶ Events can now be marked as cause or symptom events
- ▶ By default, all new problems are considered as cause events

<input checked="" type="checkbox"/>	Time ▲	Severity	Info	Host	Problem	Duration	Update	Actions	Tags
<input checked="" type="checkbox"/>	21:19:47	Disaster		snmp-initMAX-DEMO	Some event with severity: disaster	11m 44s	Update		
<input checked="" type="checkbox"/>	21:19:54	High		snmp-initMAX-DEMO	S...	11m 37s	Update	2 →	
<input checked="" type="checkbox"/>	21:19:58	Average		snmp-initMAX-DEMO	S...	11m 33s	Update	2 →	
<input checked="" type="checkbox"/>	21:19:58	Warning		snmp-initMAX-DEMO	S...	11m 33s	Update	2 →	
<input checked="" type="checkbox"/>	21:20:01	Average		snmp-initMAX-DEMO	S...	11m 30s	Update	2 →	
<input checked="" type="checkbox"/>	21:20:01	Warning		snmp-initMAX-DEMO	S...	11m 30s	Update	2 →	

6 selected [Mass update](#)

- VIEW
- Problems
- History ▶
- CONFIGURATION
- Trigger
- Items ▶
- PROBLEM**
- Mark as cause
- Mark selected as symptoms
- LINKS
- initMAX - WEB

Displaying 6 of 6 found

Cause and symptom events

- ▶ Symptom events can be converted to cause events by pressing the update button in the problem list (previously – Ack button)

Update problem

Problem Some event with severity: high

Message

History	Time	User	User action	Message
	2023-03-15 21:41:24	tomas.hermanek@initmax.cz (Tomáš Heřmánek)	↳	

Scope

Only selected problem

Selected and all other problems of related triggers 1 event

Change severity Not classified Information Warning Average High Disaster

Suppress Indefinitely Until now+1d

Unsuppress

Acknowledge

Convert to cause

Close problem

* At least one update operation or message must exist.

Update Cancel

ADVANCED PROBLEM DETECTION

Symptom problems – actions

- ▶ It is possible to pause operations for symptom problems

Action Operations 6

* Default operation step duration

Operations	Steps	Details	Start in	Duration	Action
	2	Send message to user groups: NOC Team via Office365	00:15:00	Default	Edit Remove
	3	Send message to user groups: Engineers via MS Teams	00:30:00	Default	Edit Remove
	3	Send message to user groups: Engineers via Office365	00:30:00	Default	Edit Remove
	6	Send message to user groups: Management via SMS	01:15:00	Default	Edit Remove
	Add				

Recovery operations

Details	Action
Notify all involved	Edit Remove
Add	

Update operations

Details	Action
Notify all involved	Edit Remove
Add	

Pause operations for symptom problems

Pause operations for suppressed problems

Notify about canceled escalations

* At least one operation must exist.

ADVANCED PROBLEM DETECTION

Symptom problems – actions

Multiple new macros have been introduced to present cause events

- › Cause event name - {EVENT.CAUSE.NAME}
- › Cause event tags - {EVENT.CAUSE.TAGS}
- › Cause event severity - {EVENT.CAUSE.SEVERITY}
- › Cause event status - {EVENT.CAUSE.STATUS}
- › Cause event value - {EVENT.CAUSE.VALUE}
- › More about new cause macros can be found in documentation
https://www.zabbix.com/documentation/6.4/en/manual/appendix/macros/supported_by_location#cause-and-symptom-events

These macros can be used in

- › Trigger-based notifications and commands
- › Problem update notifications and commands
- › Manual event action scripts

ADVANCED PROBLEM DETECTION

Cause and symptom events – API changes

Multiple event related API calls now support filtering by cause and symptom events

- ▶ `event.get` and `problem.get` – new symptom parameter (true – symptom, false – cause)
- ▶ Cause event ID can also be returned in the request response:

```
{
  "jsonrpc": "2.0",
  "result": [
    {
      "eventid": "9695",
      "source": "0",
      "object": "0",
      "objectid": "13926",
      "clock": "1347970410",
      "value": "1",
      "acknowledged": "1",
      "ns": "413316245",
      "name": "MySQL is down",
      "severity": "5",
      "r_eventid": "0",
      "c_eventid": "0",
      "correlationid": "0",
      "userid": "0",
      "cause_eventid": "0",
      ...
    }
  ]
}
```

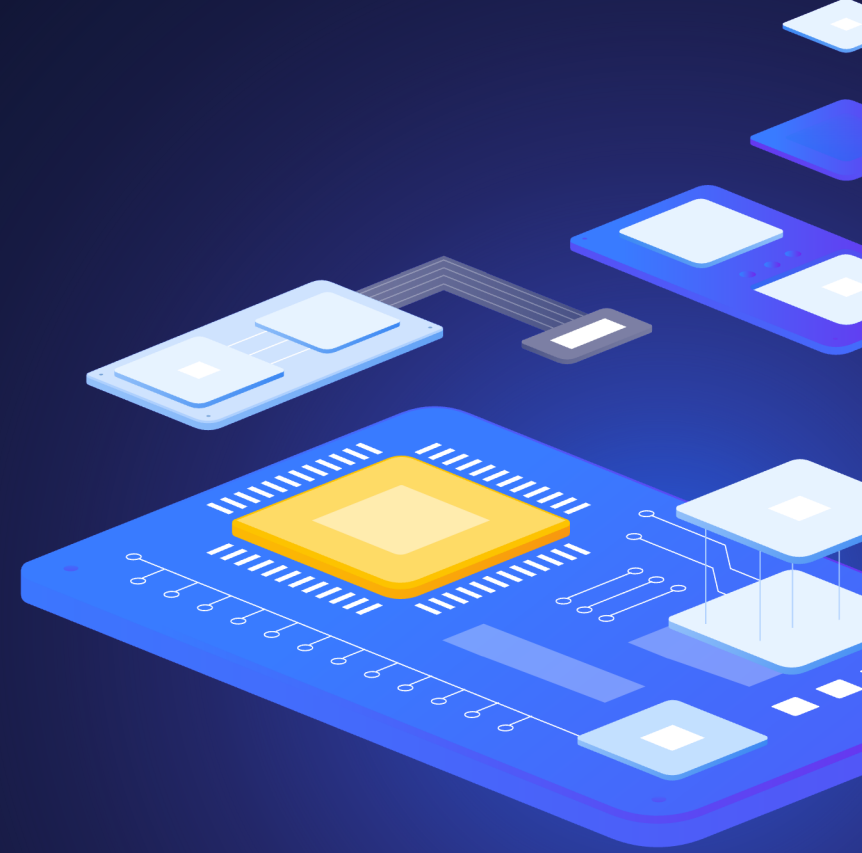
9

Demo



10

Questions



Contact us:

Phone:



+420 800 244 442

Web:



<https://www.initmax.cz>

Email:



tomas.hermanek@initmax.cz

LinkedIn:



<https://www.linkedin.com/company/initmax>

Twitter:



<https://twitter.com/initmax>

Tomáš Heřmánek:



+420 732 447 184