

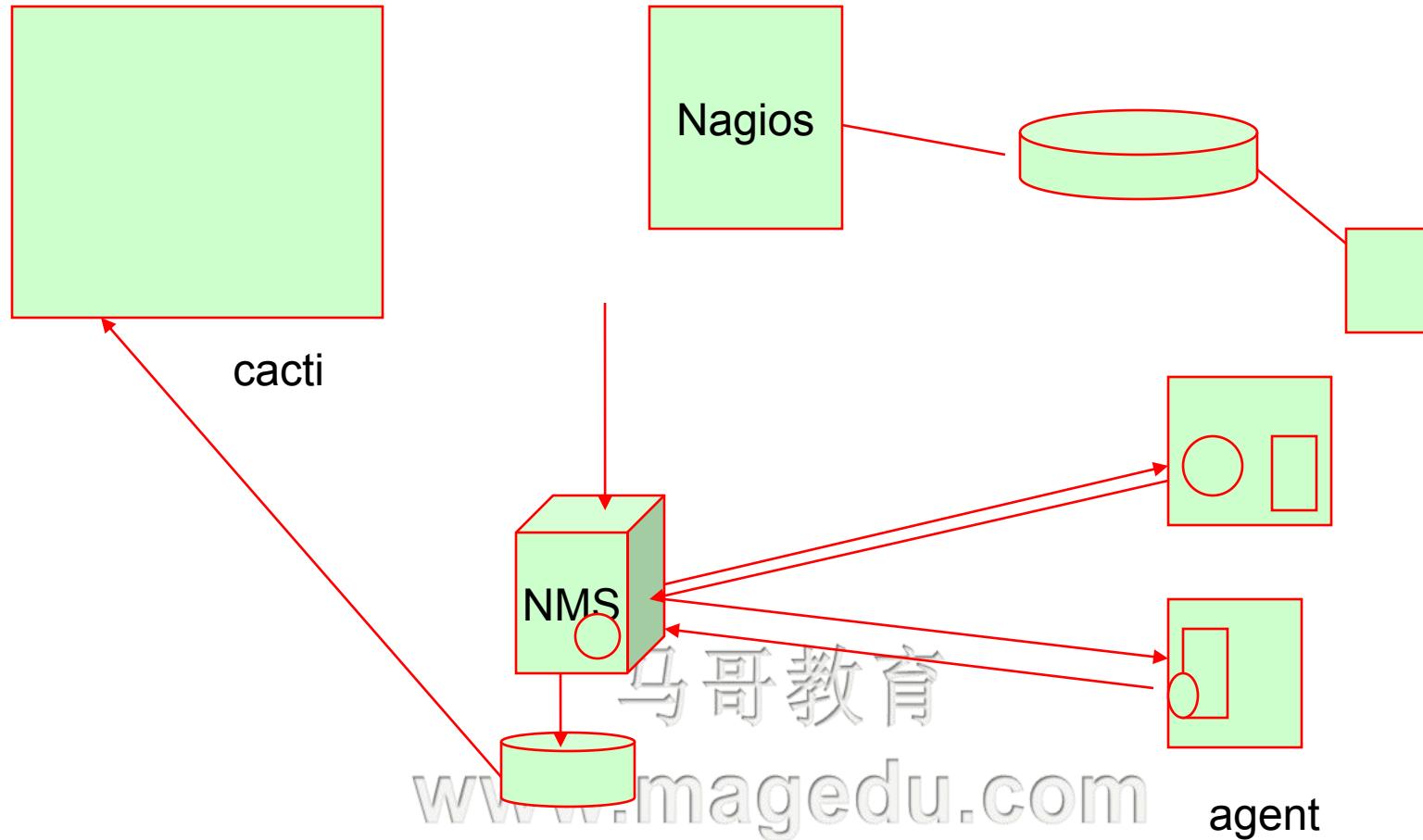
马
哥
教
育

ZABBIX

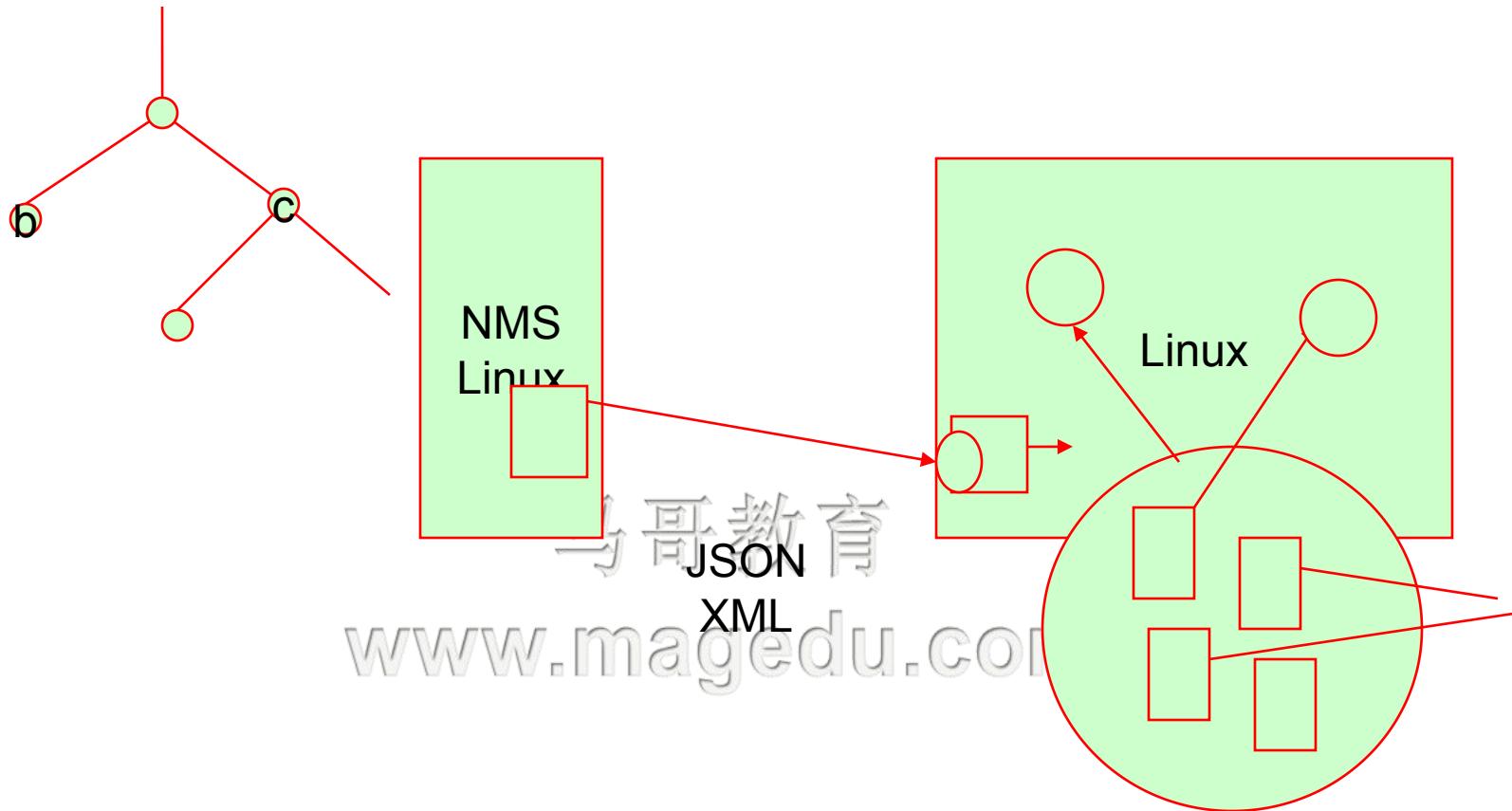
主讲：马永亮(马哥)
QQ:113228115

客服QQ：2813150558, 1661815153
<http://www.magedu.com>
<http://magedu.blog.51cto.com>

SNMP, 即时绘制



❖ OID



自动化运维技术—运维框架



自动化监控

监控评估

API

数据采集（主动）

Client

公共插件

自定义脚本

服务状态探测（被动）

服务状态

程序状态

用户访问
质量

第三方信息

公司内相
关系统

数据处理

复杂计算

阈值判别

智能分析

报警与联动

报警策略

联动处理

报警跟踪

问题管理

Agenda

- ❖ Zabbix概述
- ❖ Zabbix快速入门
- ❖ Zabbix使用进阶
- ❖ Zabbix分布式监控



马哥教育

www.magedu.com

Zabbix概述

主讲：马永亮(马哥)

QQ:113228115

客服QQ：2813150558, 1661815153

<http://www.magedu.com>

<http://magedu.blog.51cto.com>

What to monitor?

❖ Devices / Software

- ➔ Server, Router, Switches, I/O systems etc.
- ➔ Operating System, Networks, Applications, etc.

❖ Incidents

- ➔ DB down, Replication stopped, Server not reachable, etc.

❖ Critical Events

- ➔ Disk more than n% full or less than m Gbyte free,
Replication more than n seconds lagging, Data node down,

❖ 100% CPU utilization, etc.

- ➔ → Alert, immediate intervention, fire fighting

What to monitor?

- ❖ Trends (includes time!)
- ❖ → Graphs
- ❖ How long does it take until ...
 - ➔ ... my disk is full?
 - ➔ ... my Index Memory is filled up?
- ❖ When does it happen?
 - ➔ Peak? Backup?
- ❖ How often does it happen? Does it happen periodically?
 - ➔ Once a day? Always at Sunday night?
- ❖ How does it correlate to other informations?
 - ➔ I/O problems during our backup window?
- ❖ Reading the patterns!
 - ➔ → this can help us to find the root cause of problems...

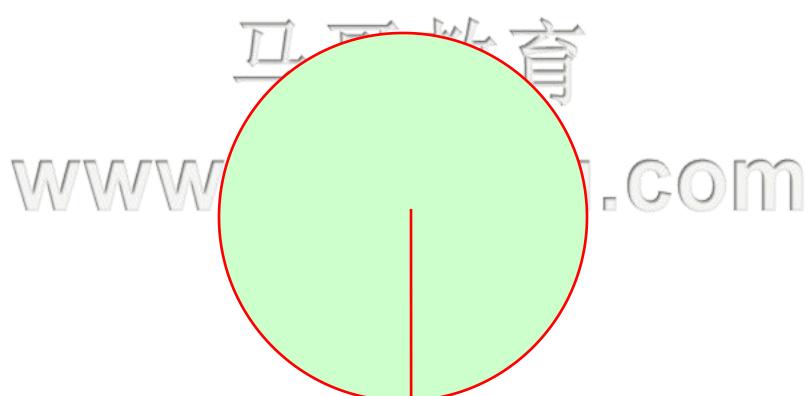
How to monitor?

❖ Basic solutions:

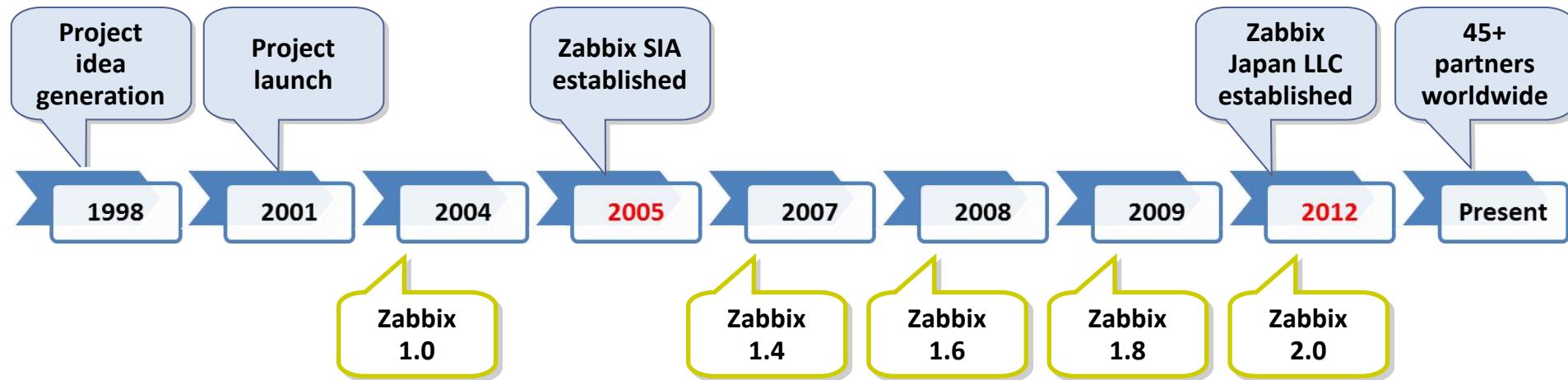
- ☛ top, vmstat, iostat, mytop, innotop, SHOW GLOBAL STATUS, SHOW INNODB STATUS
- ☛ CLI!, no graphs, no log term information, but good for adhoc analysis!

❖ Graphical solutions

- ☛ Nagios(Opsview, Icinga), Cacti, Zabbix, ...
- ☛ Typically NOT specialised in DB monitoring...



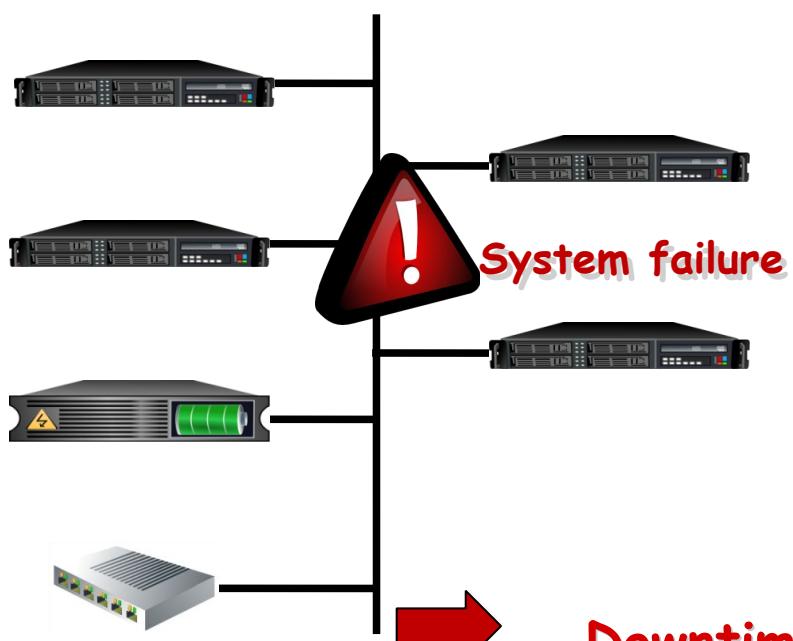
How Zabbix is progressing?



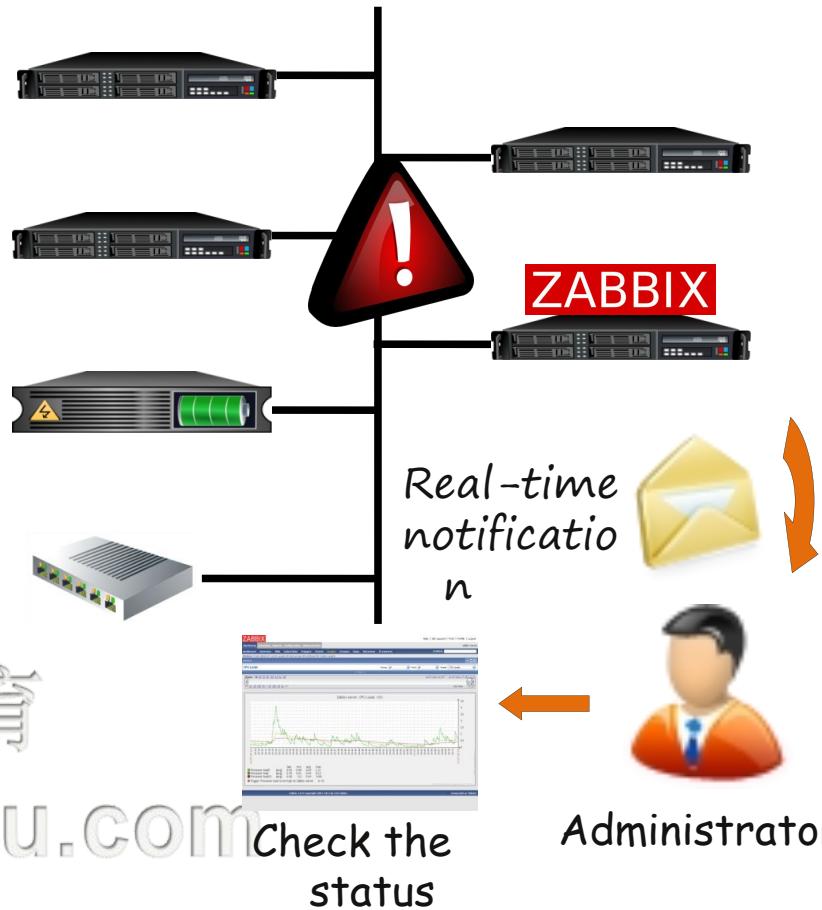
马哥教育

www.magedu.com

Why use monitoring solution?



Downtime
is very expensive



Check the
status



Administrator

Real-time
notification

www.magedu.com

**Monitoring Solution
SAVES your money**

What are the functionalities of MS?



❖ Data gathering

- ➔ Gathered using various methods, including SNMP, native agents, IPMI and others



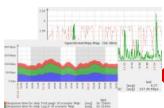
❖ Alerting

- ➔ Gathered data can be compared to thresholds and alerts sent out using different channels like e-mail or SMS



❖ Data storage

- ➔ Once we have gathered the data it doesn't make sense to throw it away, so we will often want to store it for later analysis

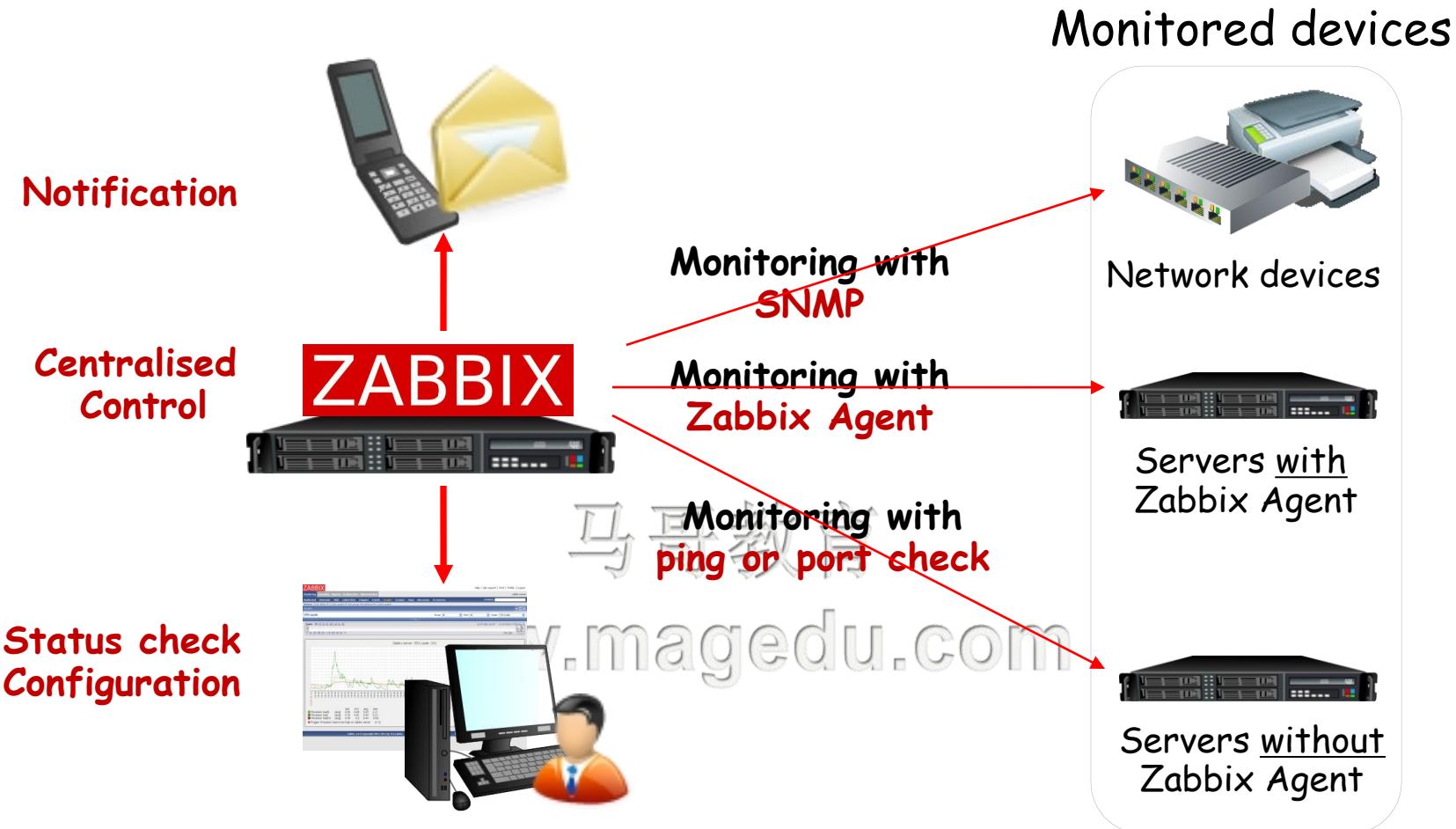


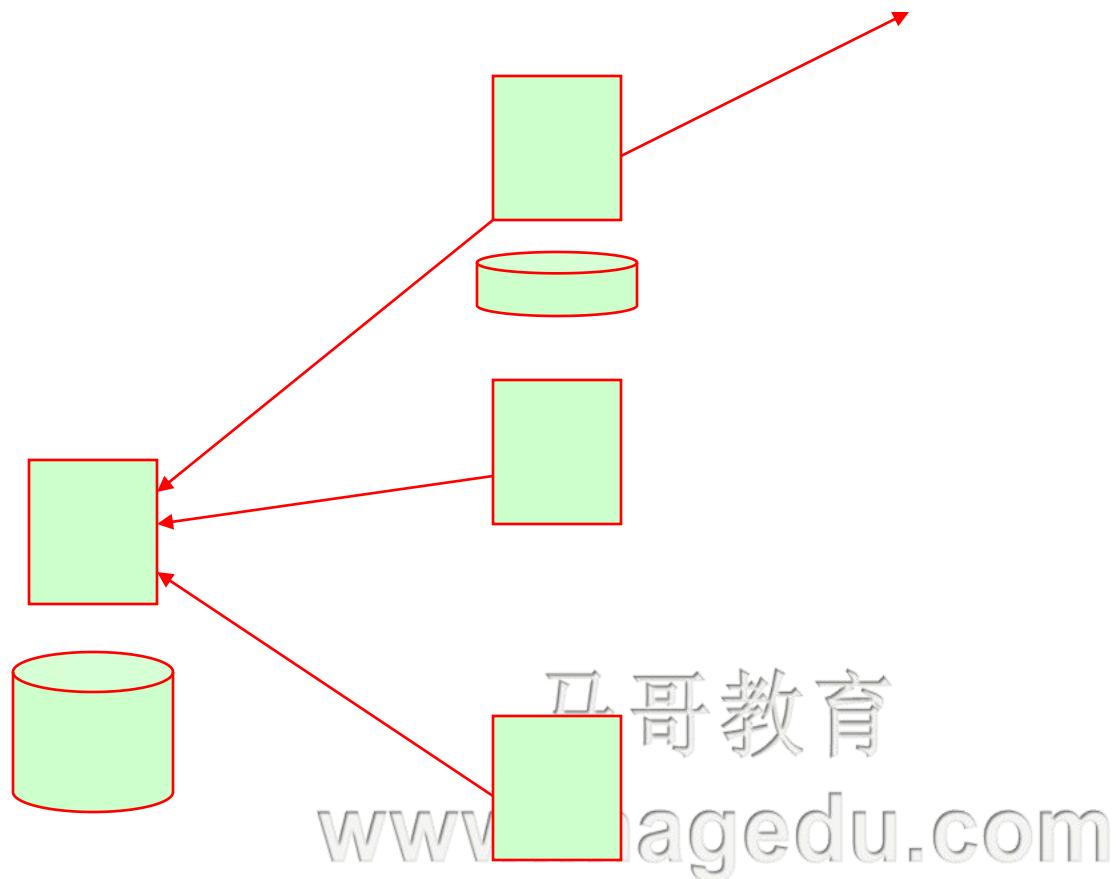
❖ Visualisation

- ➔ Humans are better at distinguishing visualised data, especially when there is huge amounts of data

What is Zabbix?

❖ The Enterprise-class Monitoring Solution





Why choose Zabbix?



- ❖ Zabbix is an enterprise level monitoring software
 - Scales up-to 100 000 of monitored devices
 - Distributed monitoring
 - Supports virtually all platforms and methods of monitoring
- ❖ True Open Source, no proprietary add-ons, and no “professional” or “enterprise” versions
- ❖ Estimated number of users is more than 40 000, but could be several times greater

www.magedu.com

Which platforms does Zabbix support?



Various Monitoring Functions

- ❖ Zabbix Agent
- ❖ SNMP Agent
- ❖ IPMI Agent
- ❖ Agentless Monitoring
- ❖ Web Monitoring
- ❖ Database Monitoring
- ❖ Internal Check
- ❖ Calculated Monitoring
- ❖ Custom Command Monitoring

Zabbix Agent
Monitoring Functions

马哥教育

www.magedu.com

CPU	Load Average CPU Utilization
Memory	Memory Utilization Swap / Pagefile Utilization
Network	Network Transfer Network Error / Drop Packet Collisions
Disk	Filesystem Utilization Disk I/O
Service	Process Monitoring Windows Service TCP Port connectivity TCP Port response time DNS Monitoring NTP Monitoring
Log	Text Log Eventlog
File	File Monitoring
Other	Performance Counter (Windows only)

What can be monitored on the Web?

- ❖ Response time
- ❖ Download speed
- ❖ Response code
- ❖ Availability of certain content
- ❖ Complex web scenarios with login and logout capability
- ❖ Support for HTTP and HTTPS

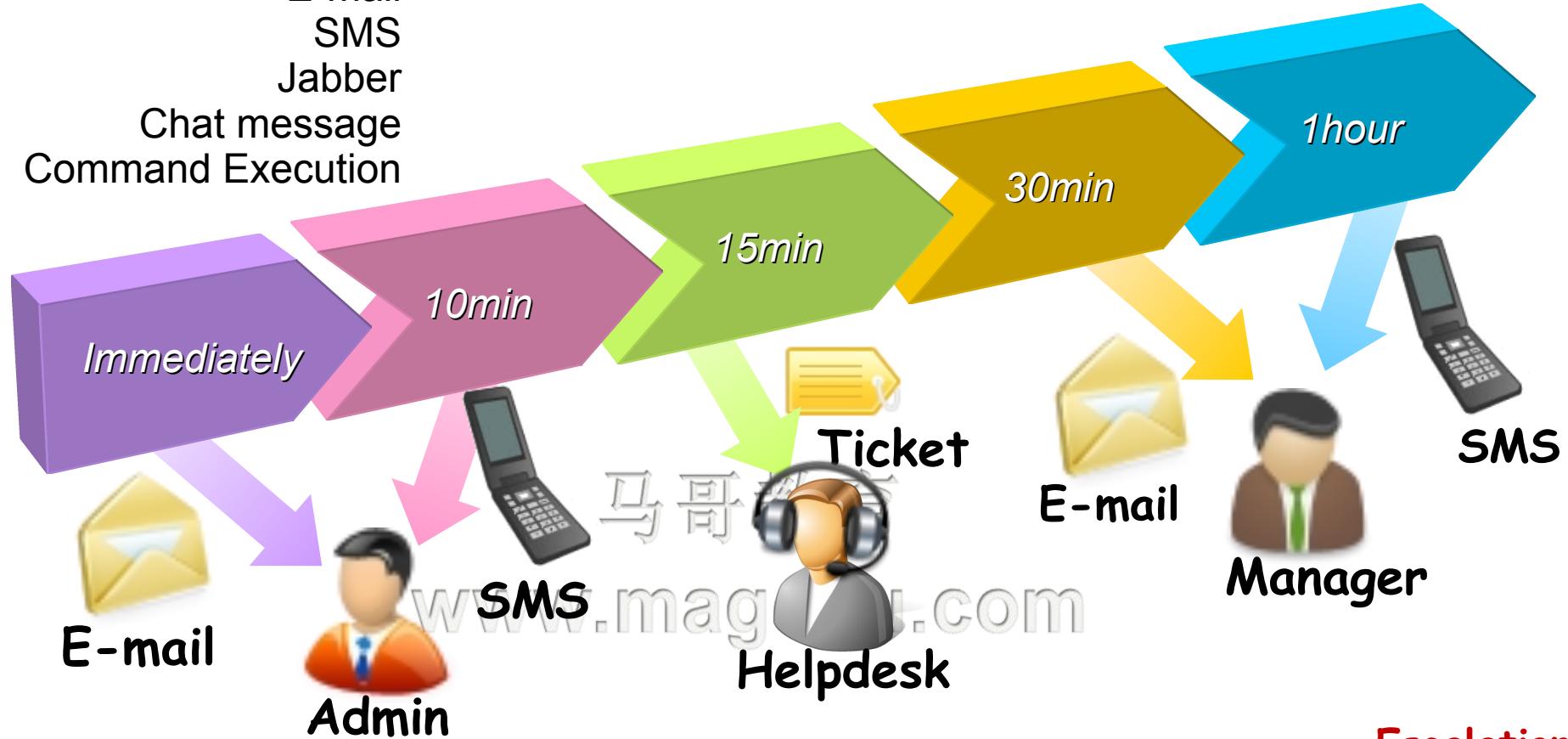
马哥教
www.magedu.com



How you get notified?

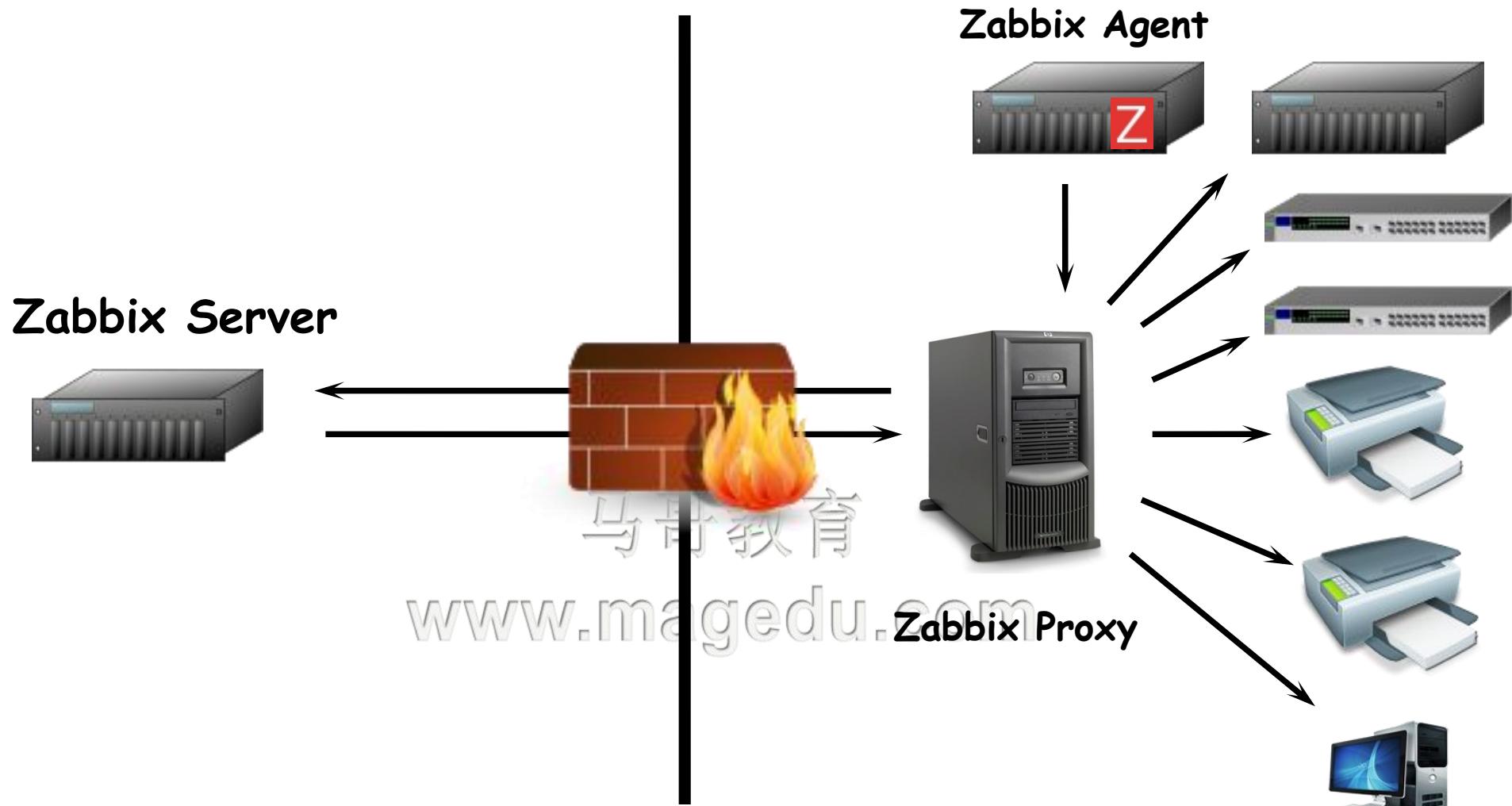
Notification method:

E-mail
SMS
Jabber
Chat message
Command Execution



Escalation:
Escalation alert to other person / other notification method
Repeat notification

Zabbix Proxy

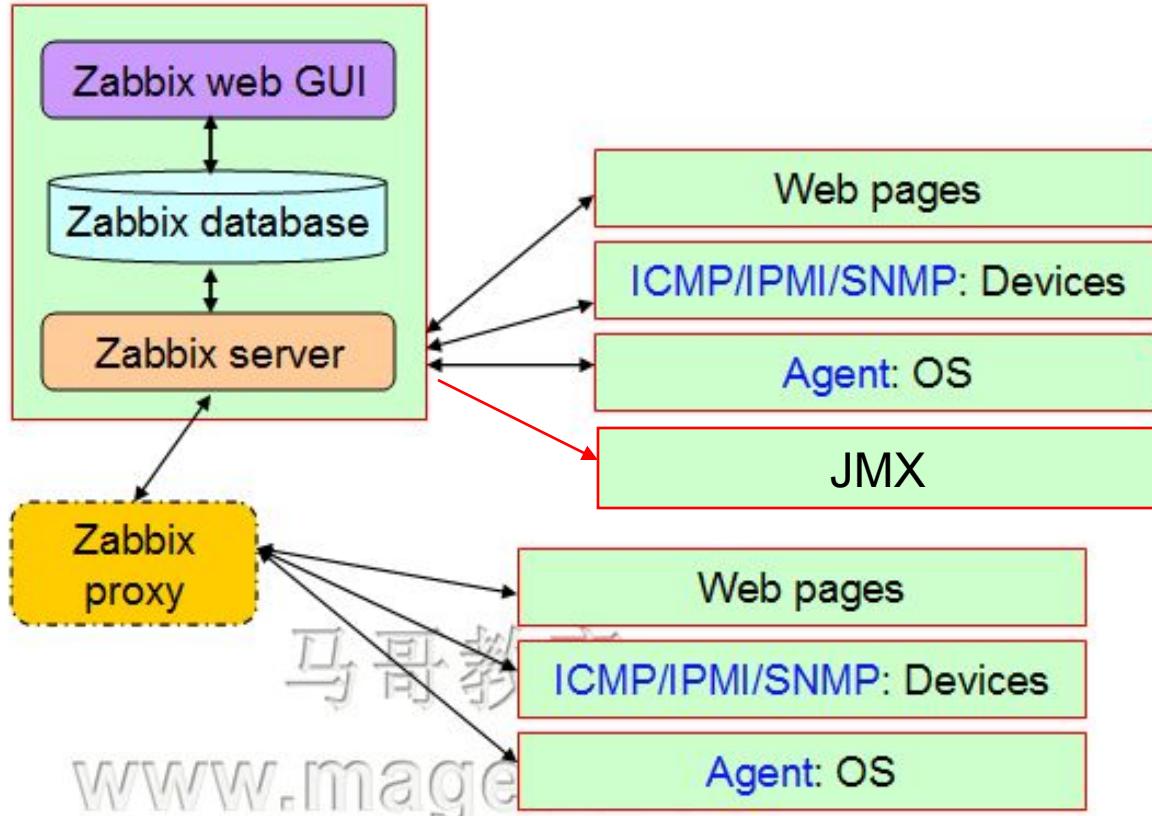


zabbix程序架构

主讲：马永亮(马哥)
QQ:113228115

客服QQ： 2813150558, 1661815153
<http://www.magedu.com>
<http://magedu.blog.51cto.com>

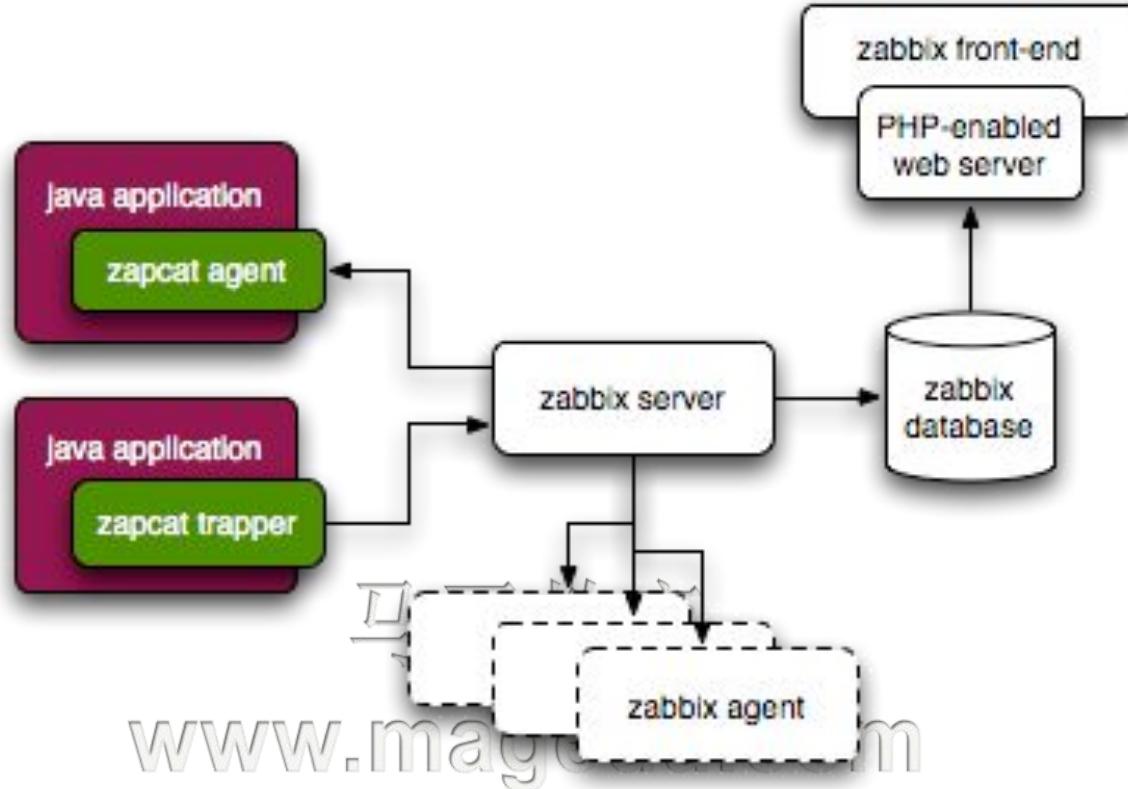
Zabbix architecture



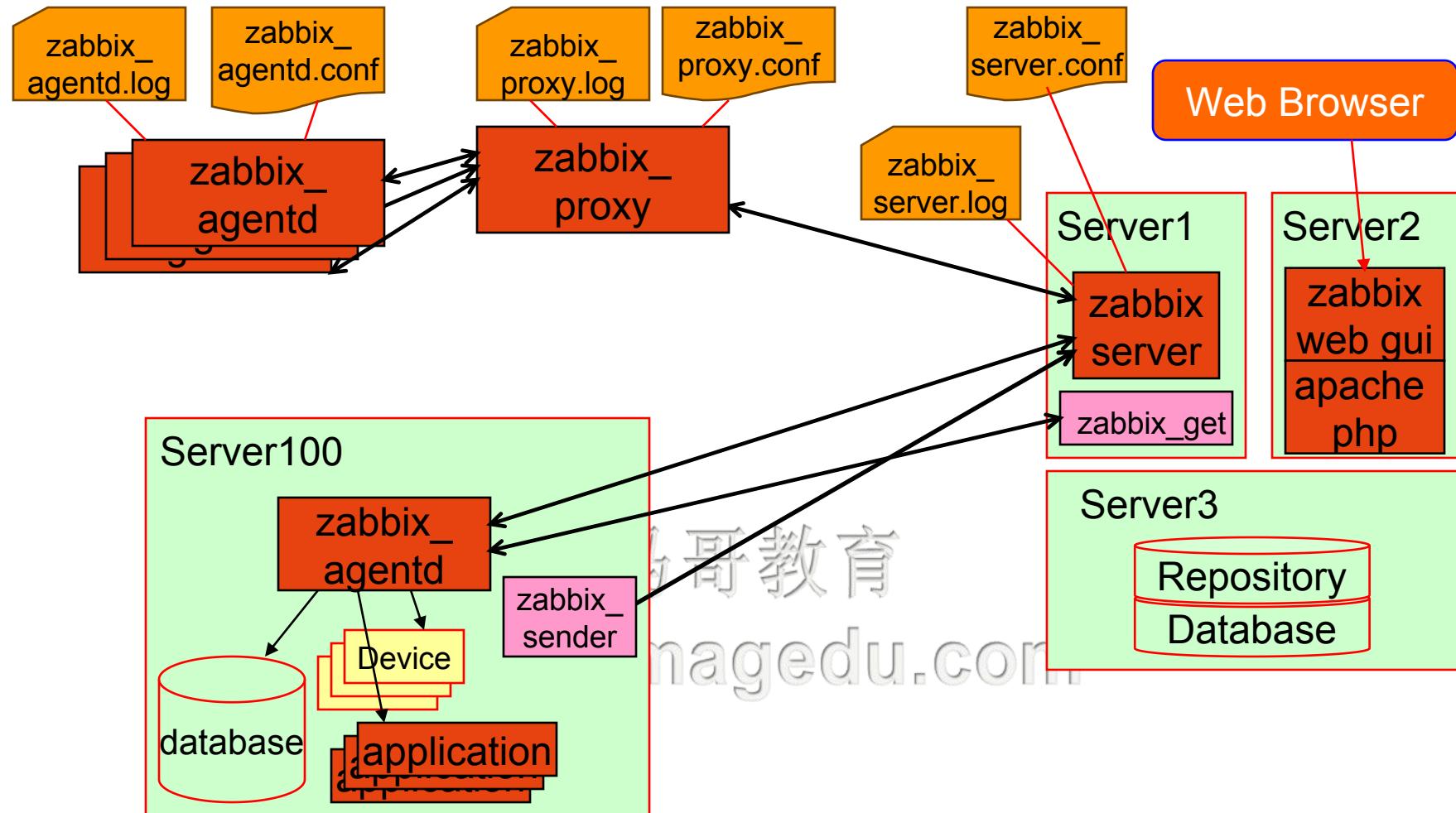
Zabbix组件概述

- ❖ **Zabbix Server:** 负责接收agent发送的报告信息的核心组件，所有配置、统计数据及操作数据均由其组织进行；
- ❖ **Database Storage:** 专用于存储所有配置信息，以及由zabbix收集的数据；
- ❖ **Web interface:** zabbix的GUI接口，通常与Server运行在同一台主机上；
- ❖ **Proxy:** 可选组件，常用于分布监控环境中，代理Server收集部分被监控端的监控数据并统一发往Server端；
- ❖ **Agent:** 部署在被监控主机上，负责收集本地数据并发往Server端或Proxy端；

Zabbix监控Java应用



Zabbix Architecture



Zabbix常用的术语

- ❖ **主机(host):** 要监控的网络设备，可由**IP**或**DNS**名称指定；
- ❖ **主机组(host group):** 主机的逻辑容器，可以包含主机和模板，但同一个组内的主机和模板不能互相链接；主机组通常在给用户或用户组指派监控权限时使用；
- ❖ **监控项(item):** 一个特定监控指标的相关数据，这些数据来自于被监控对象；**item**是**zabbix**进行数据收集的核心，没有**item**，将没有数据；相对某监控对象来说，每个**item**都由“**key**”进行标识；
- ❖ **触发器(trigger):** 一个表达式，用于评估某监控对象的某特定**item**内所接收到的数据是否在合理范围内，即阈值；接收到的数据量大于阈值时，触发器状态将从“**OK**”转变为“**Problem**”，当数据量再次回归到合理范围时，其状态将从“**Problem**”转换回“**OK**”；

Zabbix常用的术语

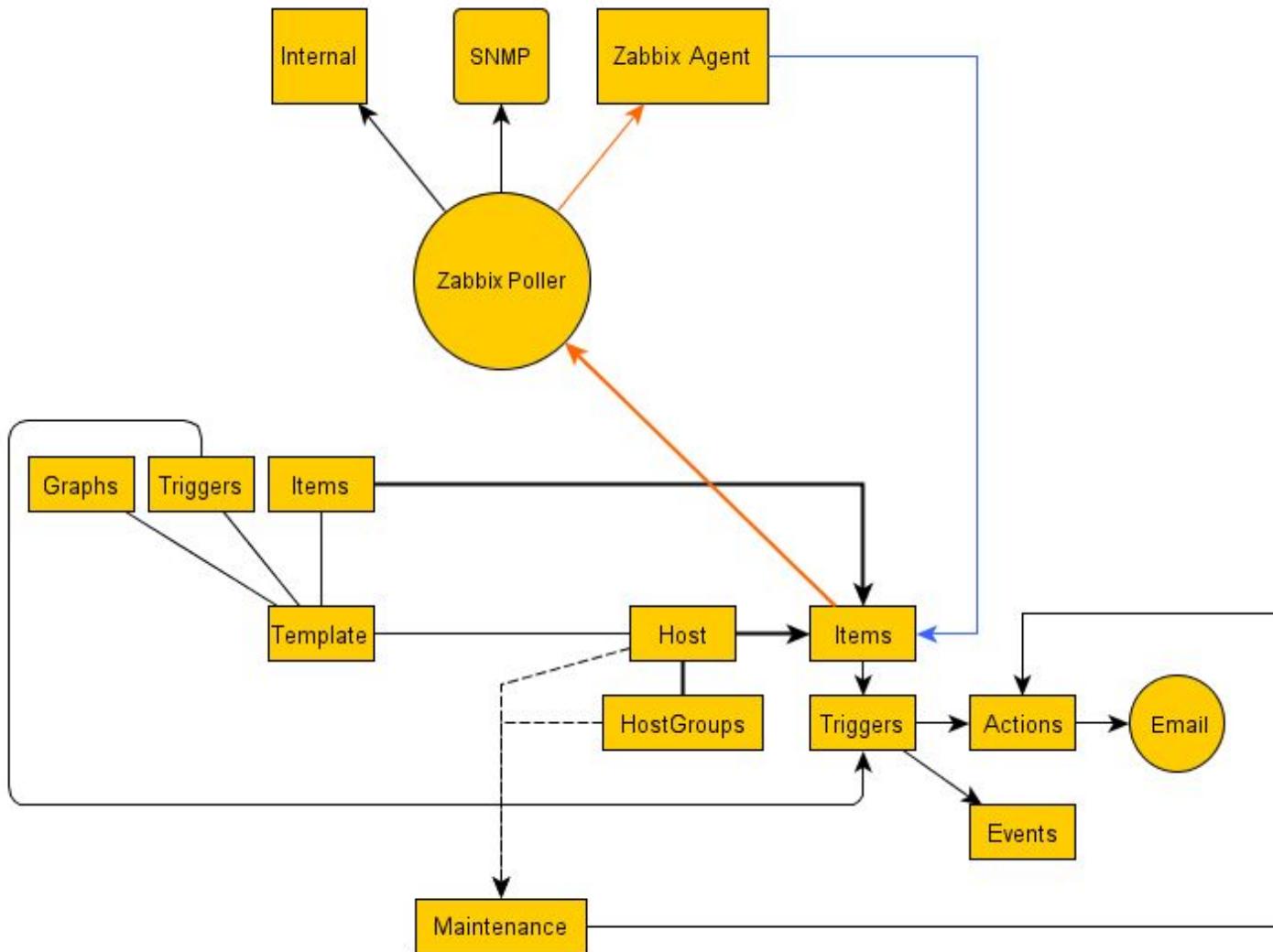
- ❖ 事件(**event**): 即发生的一个值得关注的事情，例如触发器的状态转变，新的**agent**或重新上线的**agent**的自动注册等；
- ❖ 动作(**action**): 指对于特定事件事先定义的处理方法，通过包含操作(如发送通知)和条件(何时执行操作)；
- ❖ 报警升级(**escalation**): 发送警报或执行远程命令的自定义方案，如每隔5分钟发送一次警报，共发送5次等；
- ❖ 媒介(**media**): 发送通知的手段或通道，如Email、Jabber或SMS、Script等；
- ❖ 通知(**notification**): 通过选定的媒介向用户发送的有关某事件的信息；

www.magedu.com

Zabbix常用的术语

- ❖ 远程命令(**remote command**): 预定义的命令，可在被监控主机处于某特定条件下时自动执行；
- ❖ 模板(**template**): 用于快速定义被监控主机的预设条目集合，通常包含了**item**、**trigger**、**graph**、**screen**、**application**以及**low-level discovery rule**；模板可以直接链接至单个主机；
- ❖ 应用 (**application**): 一组**item**的集合；
- ❖ web场景(**web scenario**): 用于检测**web**站点可用性的一个或多个HTTP请求；
- ❖ 前端(**frontend**): Zabbix的**web**接口；

Zabbix的逻辑架构



Zabbix Server Processes



Zabbix Installation

主讲：马永亮(马哥)

QQ:113228115

客服QQ：2813150558, 1661815153

<http://www.magedu.com>

<http://magedu.blog.51cto.com>

Requirements

❖ Hardware Examples

Name	Platform	CPU/Memory	Database	Monitored hosts
<i>Small</i>	Ubuntu Linux	PII 350MHz 256MB	SQLite	20
<i>Medium</i>	Ubuntu Linux 64 bit	AMD Athlon 3200+ 2GB	MySQL InnoDB	500
<i>Large</i>	Ubuntu Linux 64 bit	Intel Dual Core 6400 4GB	RAID10 MySQL InnoDB or PostgreSQL	>1000
<i>Very large</i>	RedHat Enterprise	Intel Xeon 2xCPU 8GB	Fast RAID10 MySQL InnoDB or PostgreSQL	>10000

与可教育

www.magedu.com

Requirements

❖ Software - DBMS

Software	Version	Comments
MySQL	5.0 or later	Required if MySQL is used as Zabbix back end database. InnoDB engine is required.
Oracle	10g or later	Required if Oracle is used as Zabbix back-end database.
PostgreSQL	8.1 or later	Required if PostgreSQL is used as Zabbix back-end database. It is suggested to use at least PostgreSQL 8.3, which introduced much better VACUUM performance.
SQLite	3.3.5 or later	Required if SQLite is used as Zabbix back-end database.
IBM DB2	9.7 or later	Required if IBM DB2 is used as Zabbix back end database.

www.magedu.com

Requirements

❖ Software - Frontend

Software	Version	Comments
Apache	1.3.12 or later	
PHP	5.1.6 or later	
PHP extensions:		
gd	2.0 or later	PHP GD extension must support PNG images (--with-png-dir), JPEG (--with-jpeg-dir) images and FreeType 2 (--with-freetype-dir).
bcmath		php-bcmath (--enable-bcmath)
ctype		php-ctype (--enable-ctype)
libXML	2.6.15 or later	php-xml or php5-dom, if provided as a separate package by the distributor.
xmlreader		php-xmlreader, if provided as a separate package by the distributor.
xmlwriter		php-xmlwriter, if provided as a separate package by the distributor.
session		php-session, if provided as a separate package by the distributor.
sockets		php-net-socket (--enable-sockets). Required for user script support.
mbstring		php-mbstring (--enable-mbstring)
gettext		php-gettext (--with-gettext)
ibm_db2		Required if IBM DB2 is used as Zabbix back end database.
mysql		Required if MySQL is used as Zabbix back end database.
oci8		Required if Oracle is used as Zabbix back-end database.
pgsql		Required if PostgreSQL is used as Zabbix back-end database.
sqlite3		Required if SQLite is used as Zabbix back-end database.

Requirements

❖ Software - Server

Requirement	Description
<i>OpenIPMI</i>	Required for IPMI support.
<i>libssh2</i>	Required for SSH support. Version 1.0 or higher.
<i>fping</i>	Required for ICMP ping items.
<i>libcurl</i>	Required for web monitoring.
<i>libiksemel</i>	Required for Jabber support.
<i>net-snmp</i>	Required for SNMP support.

马哥教育

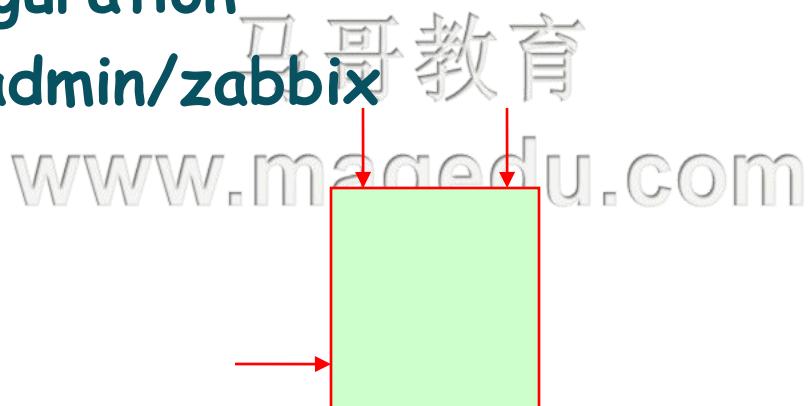
www.magedu.com

Install Zabbix

- ❖ Create zabbix user
- ❖ Untar source tarball
- ❖ Create zabbix database and populate it
 - ➔ A MySQL (PostgreSQL, ...) installation is needed...
- ❖ ./configure ; make ; make install
 - ➔ Some packages may be missing...
 - ➔ Does not take too long (< 10 min)
- ❖ Create configuration file for zabbix server
 - ➔ (misc/conf/zabbix_server.conf)
- ❖ Start the zabbix server

Install the Zabbix web interface

- ❖ Apache/PHP is required
 - ➲ Copy PHP files to \$DocumentRoot/zabbix
 - ➲ <http://localhost/zabbix>
- ❖ Change php.ini
 - ➲ Default settings are by far not enough!
 - ➲ date.timezone = Asia/Shanghai
- ❖ Restart webserver
- ❖ Finish configuration
- ❖ Login with admin/zabbix



Install the Zabbix web interface



The Zabbix web interface

❖ It works

The screenshot shows the Zabbix web interface with the following sections:

- PERSONAL DASHBOARD**:
 - Favourite graphs**: List is empty. [Graphs »](#)
 - Favourite screens**: List is empty. [Screens »](#)
 - Favourite maps**: List is empty. [Maps »](#)
- Status of Zabbix**:

Parameter	Value	Details
Zabbix server is running	Yes	172.16.100.15:10051
Number of hosts (monitored/not monitored/templates)	24	0 / 1 / 23
Number of items (monitored/disabled/not supported)	0	0 / 0 / 0
Number of triggers (enabled/disabled)[problem/unknown/ok]	0	0 / 0 [0 / 0 / 0]
Number of users (online)	2	1
Required server performance, new values per second	0	-

Updated: 16:41:51
- System status**:

Host group	Disaster	High	Average	Warning	Information	Not classified
...						

Updated: 16:41:51

Zabbix web 接口概览

❖ Zabbix主菜单功能介绍

- ① **Monitoring:** 与“监控”功能相关的页面大多都在此处，如 **graphs**、**triggers**、**screens** 及 **maps** 等；
- ② **Inventory:** 主机资产清单；
- ③ **Reports:** 提供强大且直观报告功能；
- ④ **Configuration:** 监控系统的所有配置功能均位于此处，例如定义主机组、模板、主机等；
- ⑤ **Administration:** 与 Zabbix 自身相关功能，如认证方法、用户、权限、脚本、媒介类型(**media type**)、审计、通知及全局配置等；

鸟哥教育

www.magedu.com

zabbix使用入门

主讲：马永亮(马哥)
QQ:113228115

客服QQ：2813150558, 1661815153
<http://www.magedu.com>
<http://magedu.blog.51cto.com>

Quick start

- ❖ Login and configuring user
- ❖ New host
- ❖ New item
 - ➔ Adding item
 - ➔ Seeing data
- ❖ New trigger
- ❖ Receiving problem notification
 - ➔ E-mail settings
 - ➔ New action
 - ➔ Receiving notification
- ❖ New template
 - ➔ Adding template
 - ➔ Adding item to template
 - ➔ Linking template to host



马哥教育

www.magedu.com

配置zabbix全局特性

❖ Administration → General

- 可以设置zabbix的多种全局工作属性，例如Web接口的显示特性(GUI)、Housekeeper、Images、Macros、working time及Regular expressions等

The screenshot shows the Zabbix Administration interface with the 'General' tab selected under 'Administration'. The main content area is titled 'CONFIGURATION OF GUI'. It contains several configuration options:

- Default theme: Original blue (dropdown menu)
- Dropdown first entry: All (dropdown menu), remember selected (checkbox checked)
- Search/Filter elements limit: 1000
- Max count of elements to show inside table cell: 50
- Enable event acknowledges: checked (checkbox checked)
- Show events not older than 7 (in days): 7 (text input field)
- Max count of events per trigger to show: 100
- Show warning if Zabbix server is down: checked (checkbox checked)

At the bottom of the configuration form is a 'Save' button.

管理Zabbix用户及其权限

❖ Administration → User

⌚ 可管理组、用户及用户的权限等

The screenshot shows the Zabbix Administration interface for managing users. The top navigation bar includes Monitoring, Inventory, Reports, Configuration, and Administration. Under Administration, the 'Users' tab is selected. A breadcrumb trail at the top indicates the path: History: Dashboard > Configuration of user groups > Configuration of users > Configuration of GUI > Configuration of user groups. Below the navigation, there's a search bar and a 'Create user' button. The main content area is titled 'CONFIGURATION OF USERS AND USER GROUPS' and displays a table of users. The table columns are: Alias, Name, Surname, User type, Groups, Is online?, Login, and Frontend access. Two users are listed: 'Admin' (Zabbix Super Admin) and 'guest' (Default User). The 'Admin' user is online, while 'guest' is not. Both have 'System default' as their frontend access. At the bottom of the table, there are buttons for 'Unblock selected' and 'Go (0)'.

Alias	Name	Surname	User type	Groups	Is online?	Login	Frontend access
<input type="checkbox"/> Admin	Zabbix	Administrator	Zabbix Super Admin	Zabbix administrators	Yes (Mon, 14 Oct 2013 16:54:21 +0800)	Ok	System default
<input type="checkbox"/> guest	Default	User	Zabbix User	Guests	No	Ok	System default

www.magedu.com

定义要监控的主机

- ❖ 在zabbix中，“主机(host)”是指网络上可以被监控的对象，包括物理机、虚拟机、路由器、打印机、Java虚拟机进程等。不过，需要注意的是，不同的主机其支持的监控方式可能会不尽相同
- ❖ Configuration → Hosts

Host name:

Visible name:

Groups:

In groups:

Other groups:

New host group:

Agent interfaces:

IP address	DNS name	Connect to	Port	Default
127.0.0.1	<input type="text"/>	<input type="radio"/> IP <input type="radio"/> DNS	10050	<input checked="" type="radio"/> Default <input type="button" value="Remove"/>

Add

SNMP interfaces:

Add

JMX interfaces:

Add

IPMI interfaces:

Add

Host Group

❖ Zabbix 支持 Host Group

- ⌚ 用于对监控对象的分组操作

❖ 创建分组的维度

- ⌚ **Location:** 地域 (按地理位置分组)

- ⌚ **Module:** 业务

- ⌚ **Function:** 基于实现的功能分组 (运行的服务)

马哥教育

www.magedu.com

监控数据类型

❖ 基础监控

- ④ 如cpu、memory、noprocs、nofiles、disk usage等

❖ 应用监控

- ④ 如tomcat、mogilefs、mysql、haproxy等

❖ 日志监控

- ④ 日志收集服务为数据源，如Flume

❖ 运营数据监控

- ④ 如流量、注册人数等

马哥教育

www.magedu.com

监控项(item)

- ❖ “监控项(item)”是Zabbix 服务器用于监控一个特定对象上的一个特定指标，并负载针对其收集相关的监控数据
 - ➡ 比如CPU每分钟的平均负载可以是一个item，每5分钟的平均负载是一个item，某特定网络接口接收报文的速率又是一个item等
- ❖ 每一个Item都拥有相应的“类型(Type)”,
 - ➡ 例如“Zabbix agent”、“SNMP”、“External check”、“IPMI agent”、“SSH agent”、“JMX agent”等
 - ➡ Zabbix服务器会使用相应类型的协议或机制同被监控端通信

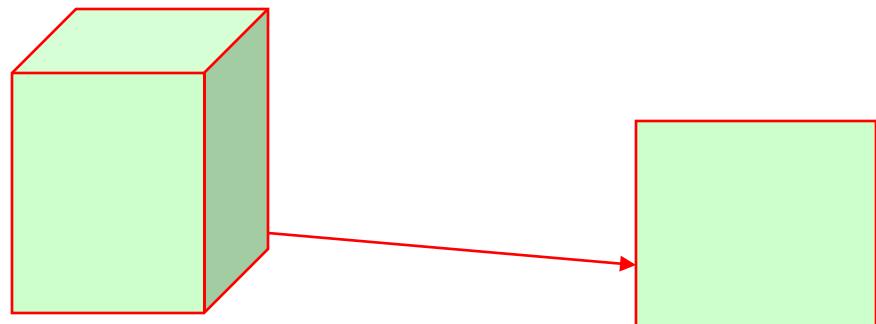
与奇教育

www.magedu.com

监控项(item)

❖ item key

- ① 每一个item都有其专用的“Key”
- ② Zabbix服务器在与被监控端通信时就使用相应的协议或机制去询问被监控端这个Key的值，被监控端则调用与此Key对应的监控脚本获取数据并返回给服务器端
- ③ Key的命名只能使用“0-9a-zA-Z_-.”(引号中的内容)等字符，且可以接受参数，其命令习惯如system.cpu.load[<cpu>,<mode>]，其中，中括号中的内容为参数，且分别可以按次序使用\$1、\$2、...进行引用，此示例中仅有两个参数
 - 若要使用不定数目的参数，则可以使用“*”表示
- ④ zabbix有许多预定义的key，详细信息的获取地址：
https://www.zabbix.com/documentation/2.0/manual/config/items/itemtypes/zabbix_agent
- ⑤ 对于每一个item，Zabbix服务器还定义了怎么存储这个item的数据以、数据采集的频率及历史数据的保存时长等
- ⑥ 多个item还可归类为一个由“application”定义的逻辑组



马哥教育

www.magedu.com

创建监控项(item)

❖ Configuration → Hosts

Monitoring Inventory Reports Configuration Administration

Host groups | Templates | **Hosts** | Maintenance | Web | Actions | Screens | Slide shows | Maps | Discovery | IT services

History: Configuration of user groups » Configuration of users » Configuration of host groups » Configuration of hosts » Configuration of items

CONFIGURATION OF ITEMS

« Host list Host: node3 Monitored Applications (0) Items (0) Triggers (0) Graphs (0) Discovery rules (0)

Item

Host	node3	Select						
Name								
Type	Zabbix agent	▼						
Key	Select							
Host interface	172.16.100.16 : 10050	▼						
Type of information	Numeric (unsigned) ▼							
Data type	Decimal	▼						
Units								
Use custom multiplier	<input type="checkbox"/>	1						
Update interval (in sec)	30							
Flexible intervals	<table border="1"><thead><tr><th>Interval</th><th>Period</th><th>Action</th></tr></thead><tbody><tr><td colspan="3">No flexible intervals defined.</td></tr></tbody></table>		Interval	Period	Action	No flexible intervals defined.		
Interval	Period	Action						
No flexible intervals defined.								
New flexible interval	Interval (in sec)	50	Period	1-7,00:00-24:00	Add			

创建监控项(item)

❖ 主要属性介绍

- ① **Host:** 选择新建的item所属的主机或模板；默认为点击“item”时所属的主机或模板；
- ② **Name:** item的名称，可以使用宏\$1、\$2、.....、\$9，用于引用相应Key中的对应的参数；例如，名称“CPU \$2 time”对于system.cpu.util[,iowait]来说，其名称为“CPU iowait time”；
- ③ **Type:** item类型；
- ④ **Key:** 当前item的key，每个item所支持使用的key取决于所选择的“Type”；对一个主机来讲，每个key必须是惟一的；如果Type为“Zabbix agent”，“Zabbix agent (active)”，“Simple check”或者“Zabbix aggregate”，其Key值必须要被Zabbix agent及Zabbix Server支持才行；

创建监控项(item)

❖ 主要属性介绍(续)

- ① **Type of information:** 从被监控端取得的数据的存储格式;
 - **Numeric (unsigned):** 64位无符号整数;
 - **Numeric (float):** 浮点数;
 - **Character:** 字符或字符串, 最长为**255**字节;
 - **Log:** 日志文件, 只能在**key**为**log[]**时使用;
 - **Text:** 文本, 无长度限制;
- ② **Data type:** 专用于数据类型为“**Numeric (unsigned)**”时为其指定希望使用的数据格式;
 - **Boolean:** 布尔型值, 1表示“真”, 0表示“假”; 填入**true**、**t**、**yes**、**y**、**up**、**running**、**enabled**或**available**均会被转换为1; 真入**false**、**f**、**no**、**n**、**down**、**unused**或**unavailable**均会被转换为0;
 - **Octal:** 八进制数据;
 - **Decimal:** 十进制数据;
 - **Hexadecimal:** 十六进制数据;

创建监控项(item)

❖ 主要属性介绍(续)

- ① **Update interval (in sec):** 获取数据的时间间隔，0表示不去拉取数据；
- ② **Flexible intervals:** 自定义数据更新时间间隔，例如**Interval (in sec)**为10，**Period**值为6-7,00:24:00表示周六和周日全天每10秒钟获取一次数据；
- ③ **Keep history (in days) :** 历史数据保留时长，单位为天；超过此时长的数据都会由**Housekeeper**清除；一般来说，仅需要保留所需要的时间跨度的最小天数内的数据；
- ④ **Keep trends (in days):** 聚合数据（如min、max、avg、count等数据）的保留时长，单位为天；超过此时长的数据都会由**Housekeeper**清除；

创建监控项(item)

❖ 主要属性介绍(续)

① Store value:

- As is: 不做任何处理;
- Delta (speed per second): 保存为 $(\text{value} - \text{prev_value}) / (\text{time} - \text{prev_time})$ 的计算结果, 即当前值减去前一次获取的数据值, 除以当前时间戳减去前一次值获取时的时间戳得到的结果; 如果当前值小于前一次的值, 其将会被丢弃;
- Delta (simple change): 保存为 $(\text{value} - \text{prev_value})$ 的计算结果;

② Status:

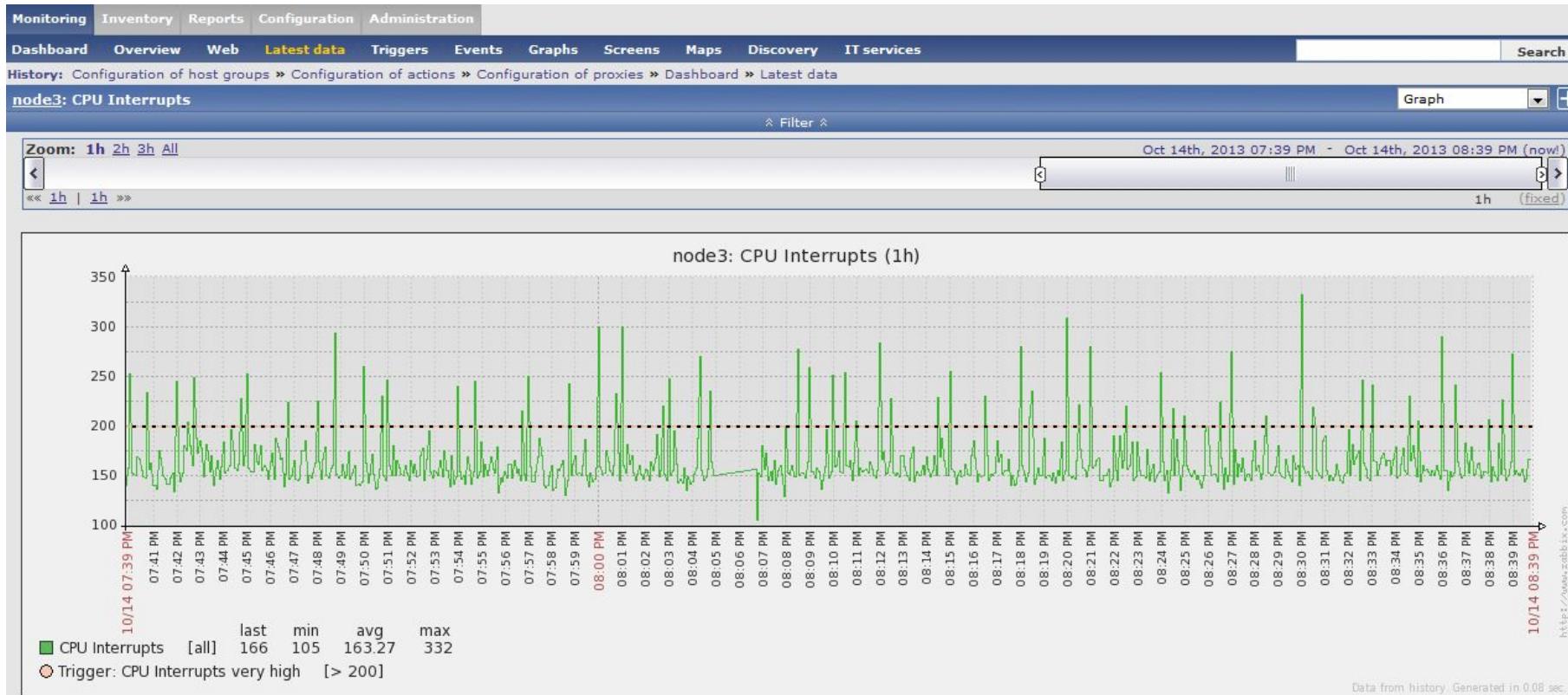
- Enabled: 启用;
- Disabled: 禁用;
- Not supported: 不支持;

马哥教育

www.magedu.com

zabbix内置的简单图形(simper graphs)

- ❖ zabbix默认会为每个收集了数据并处于启用状态的item创建一个简单图像
- ❖ Monitoring → Latest Data



创建触发器(trigger)

- ❖ “监控项”仅负责收集数据，而通常收集数据的目的还包括在某指标对应的数据超出合理范围时给相关人员发送告警信息，“触发器”正是用于为监控项所收集的数据定义阈值
- ❖ 每一个触发器仅能关联至一个监控项，但可以为一个监控项同时使用多个触发器
 - ➡ 事实上，为一个监控项定义多个具有不同阈值的触发器，可以实现不同级别的报警功能
- ❖ 一个触发器由一个表达式构成，它定义了监控项所采取的数据的一个阈值
- ❖ 一旦某次采集的数据超出了此触发器定义的阈值，触发器状态将会转换为“**Problem**”；而当采取的数据再次回归至合理范围内时，其状态将重新返回到“**OK**”

马哥教育

触发器表达式

- ❖ 触发器表达式高度灵活，可以以之创建出非常复杂的测试条件
- ❖ 基本的触发器表达式格式如下所示

{<server>:<key>.function(<parameter>)}<operator><constant>

- ⌚ **server:** 主机名称；
- ⌚ **key:** 主机上关系的相应监控项的**key**；
- ⌚ **function:** 评估采集到的数据是否在合理范围内时所使用的函数，其评估过程可以根据采取的数据、当前时间及其它因素进行；
- ⌚ 目前，触发器所支持的函数有**avg**、**count**、**change**、**date**、**dayofweek**、**delta**、**diff**、**iregexp**、**last**、**max**、**min**、**nodata**、**now**、**sum**等
- ⌚ **parameter:** 函数参数；大多数数值函数可以接受秒数为其参数，而如果在数值参数之前使用“#”做为前缀，则表示为最近几次的取值，如**sum(300)**表示300秒内所有取值之和，而**sum(#10)**则表示最近10次取值之和；
- ⌚ 此外，**avg**、**count**、**last**、**min**和**max**还支持使用第二个参数，用于完成时间限定；例如，**max(1h,7d)**将返回一周之前的最大值；

触发器表达式

⇒ **operator:** 表达式所支持的运算符及其功能如下表所示

PRIORITY	OPERATOR	DEFINITION
1	/	Division
2	*	Multiplication
3	-	Arithmetical minus
4	+	Arithmetical plus
5	<	Less than. The operator is defined as: $A < B \Leftrightarrow (A \leq B - 0.000001)$
6	>	More than. The operator is defined as: $A > B \Leftrightarrow (A \geq B + 0.000001)$
7	#	Not equal. The operator is defined as: $A \neq B \Leftrightarrow (A \leq B - 0.000001) \mid (A \geq B + 0.000001)$
8	=	Is equal. The operator is defined as: $A = B \Leftrightarrow (A > B - 0.000001) \& (A < B + 0.000001)$
9	&	Logical AND
10		Logical OR

触发器表达式的例子

❖ 一个例子

{www.magedu.com:system.cpu.load[all,avg1].last(0)}>3

- ⌚ 表示主机www.magedu.com上所有CPU的过去1分钟内的平均负载的最后一次取值大于3时将触发状态变换
- ⌚ 对last函数来说，last(0)相当于last(#1)

马哥教育
www.magedu.com

触发器间的依赖关系

- ❖ 在一个网络中，主机的可用性之间可能存在依赖关系
 - ☛ 例如，当某网关主机不可用时，其背后的所有主机都将无法正常访问
 - ☛ 如果所有主机都配置了触发器并定义了相关的通知功能，相关人员将会接收到许多告警信息，这既不利于快速定位问题，也会浪费资源
 - ☛ 正确定义的触发器依赖关系可以避免类似情况的发生，它将使用通知机制仅发送最根本问题相关的告警
- ❖ 注意：目前**zabbix**不能够直接定义主机间的依赖关系，其依赖关系仅能通过触发器来定义

www.magedu.com

触发器等级

- ❖ 触发器等级用于标示事件的严重性
- ❖ zabbix支持以如下表所示的等级

SEVERITY	DEFINITION	COLOUR
Not classified	Unknown severity.	Grey
Information	For information purposes.	Light green
Warning	Be warned.	Yellow
Average	Average problem.	Orange
High	Something important has happened.	Red
Disaster	Disaster. Financial losses, etc.	Bright red

www.magedu.com

创建触发器

- ❖ Configuration → Hosts
- ❖ Trigger → Create Trigger

CONFIGURATION OF TRIGGERS

« Host list Host: node3 Monitored Applications (1) Items (2) Triggers (0) Graphs (0) Discovery rules (0)

Trigger Dependencies

Name:

Expression: Add

Expression constructor

Multiple PROBLEM events generation:

Description:

URL:

Severity: Not classified Information Warning Average High Disaster

Enabled:

创建触发器

❖ 创建触发器可用的各属性说明

- ① **Name:** 触发器名称，可以使用宏，如\$1、\$2、.....、\$9等；
- ② **Expression:** 逻辑表达式，用于评估触发器状态；
- ③ **Multiple PROBLEM events generation:** 依赖于当前触发器的“Problem”状态生成其它事件；
- ④ **Description:** 当前触发器的描述信息；
- ⑤ **URL:** 在screen的“Status of Trigger”中显示的内容的链接；
- ⑥ **Severity:** 当前触发器的严重级别；
- ⑦ **Enabled:** 是否启用当前触发器；

www.magedu.com

基于Expression constructor创建触发器

Monitoring Inventory Reports Configuration Administration

Host groups | Templates | **Hosts** | Maintenance | Web | Actions | Screens | Slide shows | Maps | Discovery | IT se

History: Configuration of host groups » Latest data » History » Configuration of hosts » Configuration of triggers

CONFIGURATION OF TRIGGERS

« Host list Host: node3 Monitored Applications (1) Items (2) Triggers (1) Graphs (0) Discovery rules (0)

Trigger Dependencies

Name	CPU Interrupts very high					
Expression	{172.16.100.17:system.cpu.intr.last(0)}>200					
Expression constructor						
Multiple PROBLEM events generation	<input type="checkbox"/>					
Description						
URL						
Severity	Average	Not classified	Information	Warning	High	Disaster
Enabled	<input checked="" type="checkbox"/>					

执行动作 (action)

- ❖ 在配置好监控项和触发器之后，一旦正常工作中的某触发器状态发生改变，一般意味着有异常情况发生，此时通常需要采取一定的动作(**action**)，如告警或者执行远程命令等
- ❖ 并非所有的触发器状态发生改变的场景都需要对其进行干预，如转变为“OK”状态时，相应地，如果触发器的状态转变为“Problem”，就需要告知所有关心其相关监控指标的人员了。
- ⇒ “通知(notification)”是zabbix中最常用的“动作”之一

马哥教育

www.magedu.com

执行动作 (action)

- ❖ 实现**zabbix**的通知功能，一般需要两个步骤：
 - ① 定义所需的“媒介(media)”: 通常指发送信息的途径，如邮件、**Jabber**和**SMS**等；
 - ② 配置一个“动作(action)": 发送信息至某“媒介”；
- ❖ 动作由“条件”和“操作”组成，它的逻辑为当“条件”满足时，就执行相应的“操作”
 - ③ “发送通知”和“执行远程命令”是两个最基本的操作

马哥教育

www.magedu.com

Zabbix事件(event)

- ❖ Zabbix的事件是基于时间戳进行标记的，它们是采取动作(**action**)如发送邮件通知的基础，其主要来源于三种途径
 - ➡ 触发器(**trigger**)事件：触发器状态每次发生改变，都会生成相应“事件”，且通常包含详细信息，如发生的时间及新的状态等；
 - ➡ 发现(**discovery**)事件：Zabbix会周期性地扫描“网络发现规则”中指定的IP范围，一旦发现主机或服务，就会生成一个或几个发现事件；
 - ➡ 发现事件有8类：**Service Up**、**Service Down**、**Host Up**、**Host Down**、**Service Discovered**、**Service Lost**、**Host Discovered**和**Host Lost**；
 - ➡ 主动**agent**自动发现事件（也称作“自动注册事件”）：当一个此前状态未知的主动**agent**发起检测请求时会生成此类事件；
- ❖ 因此，Zabbix的通知机制也称作基于事件的通知机制，也只有理解了事件本身，才能定制出符合需求的通知系统

媒介类型 (Media type)

❖ 在**zabbix**中，媒介指发送通知信息的通道，其通常有以下几种类型

- ☛ **E-mail**: 电子邮件，即通知邮件的方式传送通知信息；
- ☛ **SMS**: 手机短信，即通过连接至**zabbix**服务器**GSM Modem**发送通知；
- ☛ **Jabber**: **jabber**消息；**Jabber**是一个开放的、基于**XML**的协议，能够实现基于**Internet**或**LAN**的即时通讯服务；
- ☛ 自定义的通知脚本：以上方式不能满足需求时，**zabbix**可以调用位于其配置文件“**AlertScriptsPath**”变量所定义的脚本查找目录中的脚本来完成通知功能；

www.magedu.com

创建电子邮件

- ❖ Administration → Media types → Create media type
- ❖ 同一种类型的媒介可以有多个，但要确保全部都做了正确配置

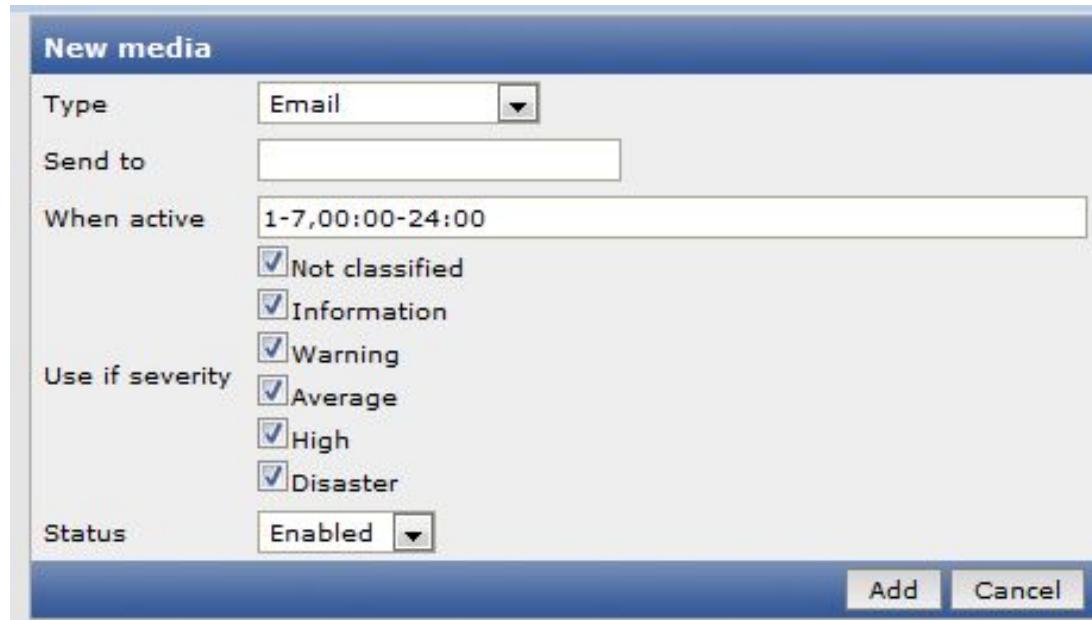
The screenshot shows the Zabbix Administration interface with the 'Media types' tab selected. The page title is 'CONFIGURATION OF MEDIA TYPES' under the 'Media' section. The form fields are as follows:

Description	<input type="text"/>
Type	Email
SMTP server	localhost
SMTP helo	localhost
SMTP email	zabbix@localhost
Enabled	<input checked="" type="checkbox"/>

At the bottom, there are 'Save' and 'Cancel' buttons.

定义通知信息接收者

- ❖ 接下来需要定义收件人地址，即通知信息的接收者，其通常被称为“用户媒介(User media)”
- ❖ 在zabbix中，邮件接收者是zabbix用户，其一般会有邮箱地址
- ❖ Administration→Users→“someuser”→“Media”



创建动作 (action)

- ❖ zabbix环境中，要基于特定的事件执行指定的操作，需要用**action**来实现；
 - ➡ 在某“**Condition(条件)**”下执行的“**Operation(操作)**”称为“**action**”，故此，在定义一个**action**时，还需要为其定义条件和操作，它们分别通过对对应的选项卡进行定义

The screenshot shows the Zabbix Configuration interface with the 'Actions' tab selected. The 'Conditions' and 'Operations' tabs are highlighted with red boxes. The 'Operations' tab displays the following configuration:

- Name: [Input field]
- Default operation step duration: 3600 (minimum 60 seconds)
- Default subject: {TRIGGER.STATUS}: {TRIGGER.NAME}
- Default message:
Trigger: {TRIGGER.NAME}
Trigger status: {TRIGGER.STATUS}
Trigger severity: {TRIGGER.SEVERITY}
Trigger URL: {TRIGGER.URL}
- Item values:
1. {ITEM.NAME1} ({HOST.NAME1}:{ITEM.KEY1}): [Input field]
- Recovery message: [Input field]
- Enabled: [Checkmark]

❖ action主要属性的说明

- ① **Name:** 当前action的独有名称;
- ② **Default operation step duration:** 默认每一级“告警升级”的周期;
- ③ **Default subject:** 默认的消息主题，可以使用宏;
- ④ **Default message:** 默认的消息，可以包含宏;
- ⑤ **Recovery:** 监控项从“问题”状态恢复之后是否发送的消息；如果启用，恢复消息仅发送给监控项转换为“问题”状态时的通知对象;
- ⑥ **Recovery subject:** 恢复消息主题，可以包含宏;
- ⑦ **Recovery message:** 恢复消息，可以包含宏;
- ⑧ **Enabled:** 是否启用当前action;

Action的操作(operation)

- ❖ zabbix支持的操作有两类：“发送通知”和“执行远程命令”
- ❖ 而对于“发现”类事件来说，其支持的操作还有添加主机、移除主机、启用主机、禁用主机、添加到组、从组中删除、链接到模板及从模板上拆除关联等
- ❖ 对于“自动注册”类事件来说，支持的操作为添加主机、禁用主机、添加到组及链接至模板等

马哥教育

www.magedu.com

创建operation

Action Conditions Operations

Action operations	Steps	Details	Start in	Duration (sec)	Action
	No operations defined.				

Operation details

Step	From	1	
To	1	(0 - infinitely)	
Step duration	0	(minimum 60 seconds, 0 - use action default)	
Operation type	Send message	▼	
Send to User groups	User group	Action	
	Add		
Send to Users	User	Action	
	Add		
Send only to	- All -	▼	
Default message	<input checked="" type="checkbox"/>		
Conditions	Label	Name	Action
	New		

[Add](#) [Cancel](#)

❖ Operation相关的属性说明

- ① **Step:** 告警升级(escalation)调度方式;
 - **From:** 操作开始的位置; 即第几次升级间隔时间到达后检测仍然有“问题”时开始执行操作;
 - **To:** 直到哪一步为止, 其减去From中的数字再加1即表示要操作的次序; 0表示无限;
 - **Step duration:** 前述自定义告警升级的时间间隔, 0表示使用默认;
- ② **Operation type:** 操作类别; 选定不同的操作类别, 其后续的其它属性也有所不同;
 - **Send message:** 发送消息;
 - **Remote command:** 执行远程命令;
- ③ **Conditions:** 执行操作的条件;
 - **Not ack:** 仅在事件为“未知(unacknowledged)”时执行操作;
 - **Ack:** 仅在事件可被识别(acknowledged)时执行操作;

❖ 类别为“Send message”时的相关属性：

- ① **Send to User groups:** 给选定组中的所有用户发送通知；
- ② **Send to users:** 给选定的用户发送通知；
- ③ **Send only to:** 发送通知时所使用的媒介，**all**为所有媒介；
- ④ **Default message:** 如果启用，则发送默认消息；
- ⑤ **Subject:** 消息的自定义主题，可以包含宏；
- ⑥ **Message:** 要发送的消息内容，可以使用宏；

马哥教育

www.magedu.com

❖ 类别为“remote command”时的相关属性：

- ① **Target list:** 远程命令执行的目标主机，可以是当前主机、其它主机或主机组；
- ② **Type:** 命令类型；
 - **IPMI:** IPMI命令；
 - **Custom script:** 自定义脚本，可以选择其是在zabbix server上还是 zabbix agent上执行；
 - **SSH:** 通过ssh执行命令，需要提供目标主机上的用户帐号、相关的认证方式及认证所需要额外信息；
 - **Telnet:** 通过telnet执行命令，需要指定用户名、口令及远程主机 telnet服务监听的端口；
 - **Global script:** 全局脚本，执行“Administration→Scripts”定义的脚本的其中之一；
- ③ **Commands:** 要执行的命令；

创建条件(condition)

❖ action中定义的“操作”仅在指定的条件满足时才会执行

The screenshot shows the 'Configuration' tab selected in the top navigation bar of the Zabbix interface. Under 'Actions', the 'Configuration of actions' section is active. The 'Action' tab is selected in the sub-navigation. The main area displays the 'CONFIGURATION OF ACTIONS' form.

Type of calculation: AND / OR (A) and (B)

Conditions:

Label	Name	Action
(A)	Maintenance status not in "maintenance"	Remove
(B)	Trigger value = "PROBLEM"	Remove

New condition: Trigger name like

Save

A dropdown menu is open over the 'Trigger name' field, listing various trigger-related options: Application, Host group, Host template, Host, Trigger, Trigger name (which is currently selected), Trigger severity, Trigger value, Time period, and Maintenance status.

告警升级(escalation)

- ❖ **escalation**用于实现用于定制发送通知或执行远程命令的方式，常用于实现如下场景：
 - ⌚ 出现问题时立即发送通知；
 - ⌚ 问题得不到解决时多次发送通知给用户；
 - ⌚ 按需延迟发送通知；
 - ⌚ 问题长久得不到解决时发送给级别更高的用户；
 - ⌚ 立即执行远程命令或经过一个预定的时长后仍未解决问题时执行远程命令；
 - ⌚ 故障恢复时发送相关信息；

与哥教育
www.magedu.com

告警升级(escalation)

- ❖ 实际操作中，**action**的**escalation**机制的实现依赖于“**escalation step**(升级步长)”，**step**是一个时间长度；
- ❖ 为了简化操作过程，可以为**step**定义默认的时长，只有在必要时才为**action**自定义其**step**
- ❖ 可以在任何有效的**step**到达时启动**action**，第1个**step**表示立即启动；
- ❖ 如果要延迟启动**action**，可以选择在后面的其它**step**上启动
- ❖ 下面示例表示延迟一个**step**之后才启用**action**

马哥教育

Step	From	2
	To	5 (0 - infinitely)
	Step duration	300 (minimum 60 seconds, 0 - use action default)

一个配置示例

Steps	Details	Start in	Duration (sec)	Action
1 - 5	Send message to users: MageEdu	Immediately	300	Edit Remove
3	Run remote commands on hosts: HAProxy Server 1	00:10:00	300	Edit Remove
4 - 5	Send message to users: Manager	00:15:00	300	Edit Remove
6 - 0	Send message to users: CTO, MageEdu, Manager	00:25:00	300	Edit Remove

- ❖ 第一条表示一旦相应的**action**启用、**condition**得到满足，其会立即发送告警信息给**MageEdu**用户，并且每隔5分钟发送一次，一共5次
- ❖ 在第3个**step**到来时，第二条的配置会在**HAProxy Server 1**主机上执行一条远程命令
- ❖ 第三条表示，第4个**step**到来时，会将告警信息发送一份给**Manager**，发送两次
- ❖ 最后一条表示，从第6个**step**开始，会每隔5分钟发送一次告警信息给**CTO**、**Manager**和**MageEdu**用户，直到问题解决

zabbix使用进阶

主讲：马永亮(马哥)

QQ:113228115

客服QQ：2813150558, 1661815153

<http://www.magedu.com>

<http://magedu.blog.51cto.com>

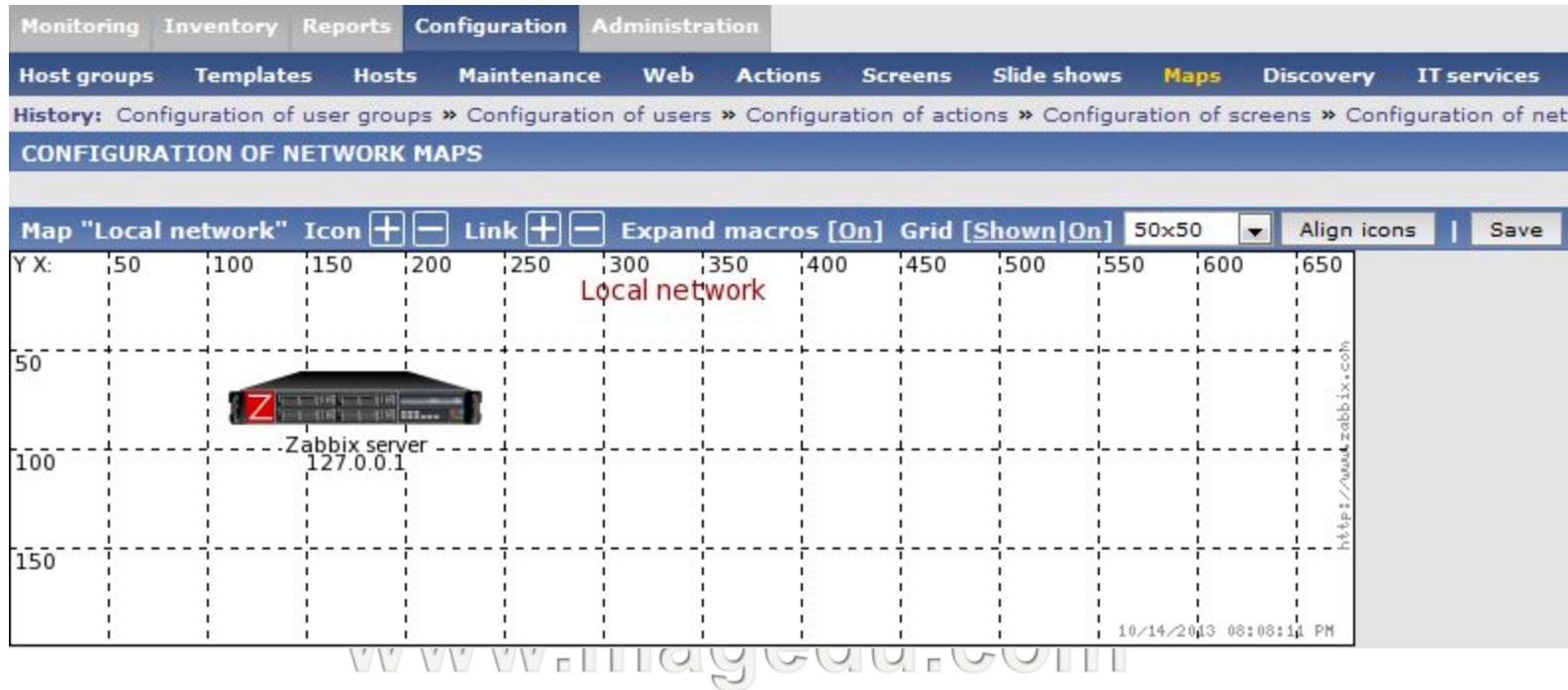
Agenda

- ❖ zabbix可视化
 - ⌚ 自定义图形(graphs)
 - ⌚ 屏幕(screen)
- ❖ 宏(macros)
- ❖ 用户参数(User parameters)
- ❖ zabbix模板
- ❖ zabbix自动发现
- ❖ web监控

马哥教育

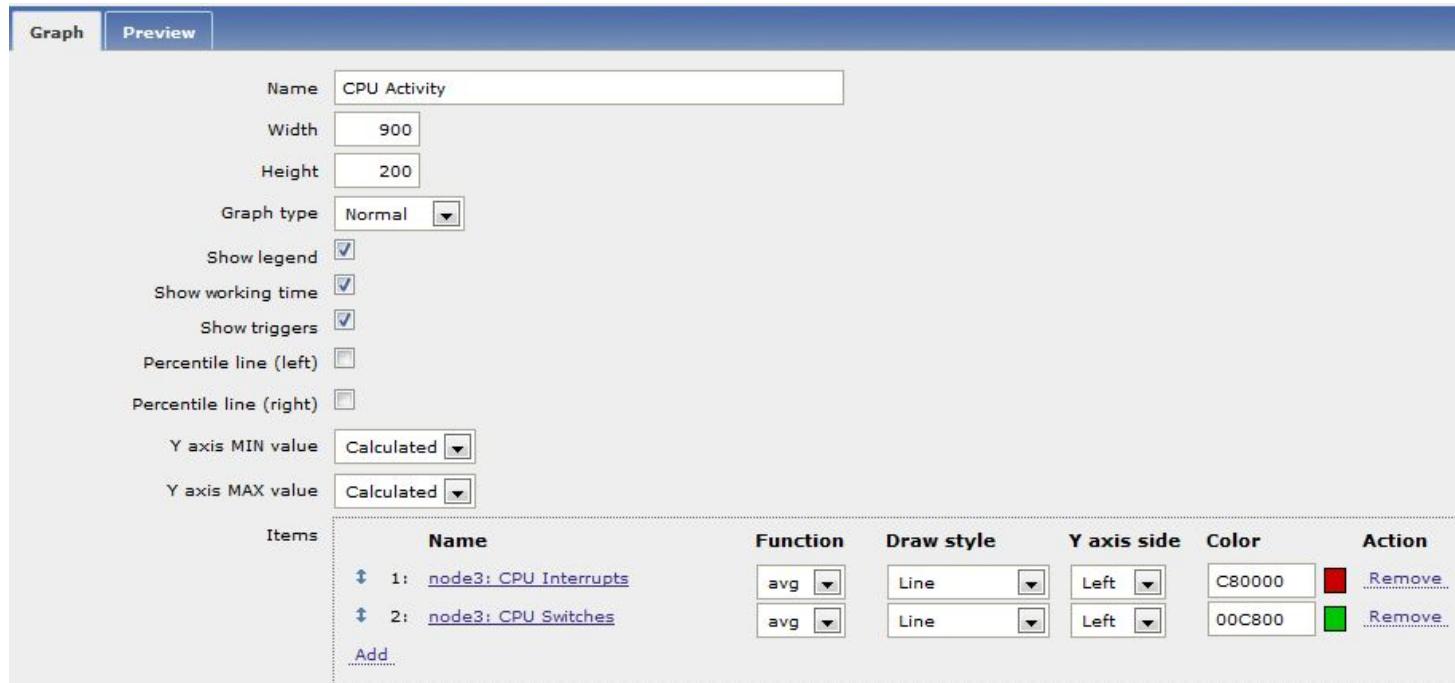
www.magedu.com

- ❖ zabbix提示了众多的可视化工具提供直观展示，如graph、screen及map等



自定义图形 (graphs)

- ❖ 自定义图形中可以集中展示多个时间序列的数据流
- ❖ 支持“线状图(normal)”、“堆叠面积图(stacked)”、“饼图(pie)”和“分离型饼图(exploded)”四种不同形式的图形
- ❖ “Configuration → Hosts (或者Templates) → Graphs → Create graph”



❖ 自定义图形的相关属性说明

- ① **Name:** 图形的独有名称;
- ② **Width:** 图形的宽度, 单位为像素; 仅适用于“预览(preview)”模式、饼图或分离型饼图;
- ③ **Height:** 图形的高度, 单位为像素;
- ④ **Graph type:** 图形类型, 共有四种, 即“线状图(normal)”、“堆叠面积图(stacked)”、“饼图(pie)”和“分离型饼图(exploded)”;
- ⑤ **Show legend:** 是否显示图例, 即图形数据序列说明;
- ⑥ **Show working time:** 是否高亮显示工作时间区域; 选定时, 非工作时间区间的背景为灰色; 此功能不适用于pie和exploded;
- ⑦ **Show triggers:** 是否显示触发器; 此功能不适用于pie和exploded;

❖ 自定义图形的相关属性说明(续)

- ① **Y axis MIN value:** Y轴最小刻度，其类型有三种；
 - **Calculated:** 自动计算；
 - **Fixed:** 固定值，此功能不适用于**pie**和**exploded**；
 - **Item:** 相关item的最近一次取值为其最小刻度；
- ② **Y axis MAX value:** Y轴最大刻度，其类型同上述最小刻度的说明；
- ③ **3D view:** 3D风格，此功能仅适用于**pie**和**exploded**；
- ④ **Items:** 图形展示的数据序列所来自的item，一个图形中可以同时展示多个item；

www.magedu.com

❖ 在一个图形中，不同item的图形还有一些可单独配置的属性，如图形颜色、绘图风格等

① **Function:** 展示何种聚合数据；

- **min:** 仅展示最小值；
- **avg:** 仅展示平均值；
- **max:** 仅展示最大值；
- **all:** 展示所有，即上面三类数据；

② **Draw style:** 绘图风格，仅适用于线状图；

- **Line:** 绘制为简单线条；
- **Filled region:** 区域填充图，即面积图；
- **Bold line:** 加粗线条；
- **Dot:** 虚线图，以稀疏的点组成；
- **Dashed line:** 虚线图，以破折号组成；

③ **Y axis side:** Y轴显示的位置，可以为图形左侧或右侧；

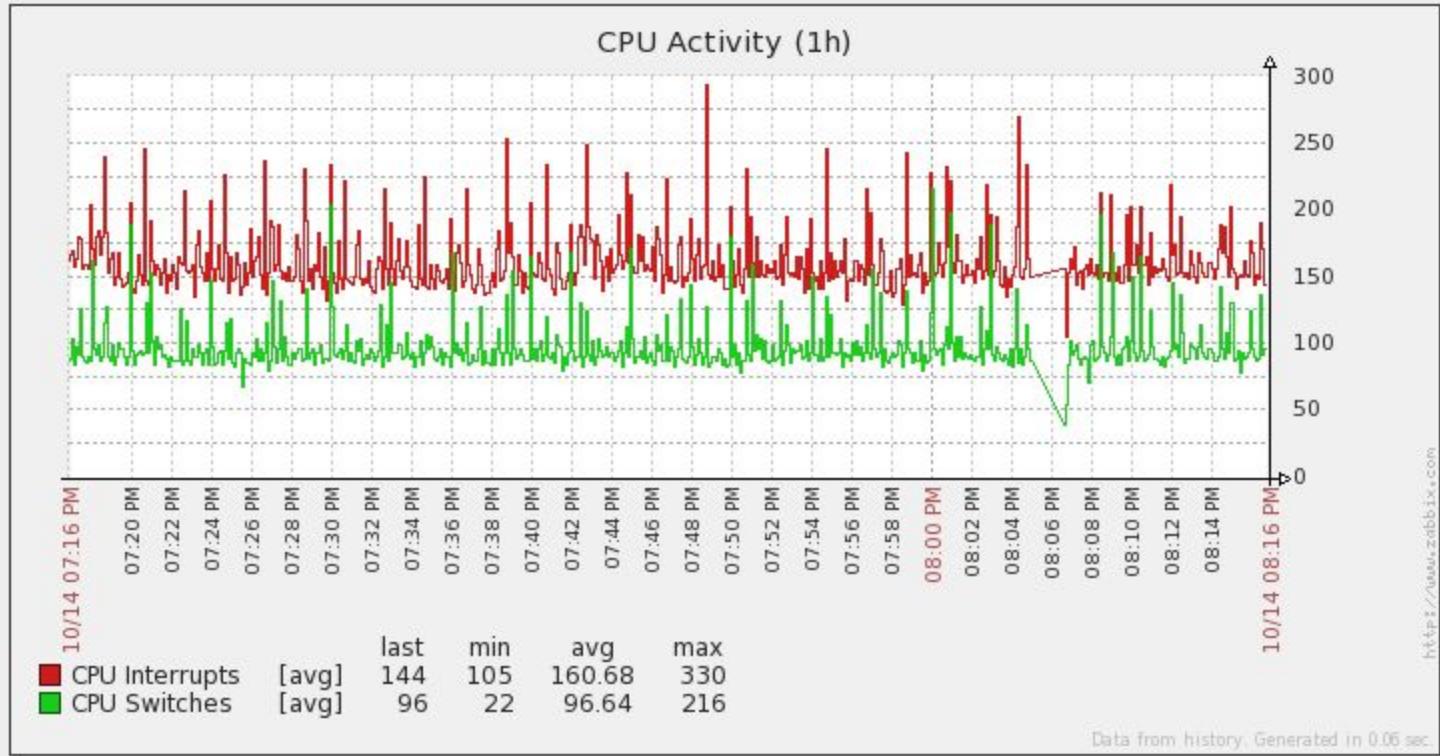
④ **Colour:** 图形颜色；

一个例子

CONFIGURATION OF GRAPHS

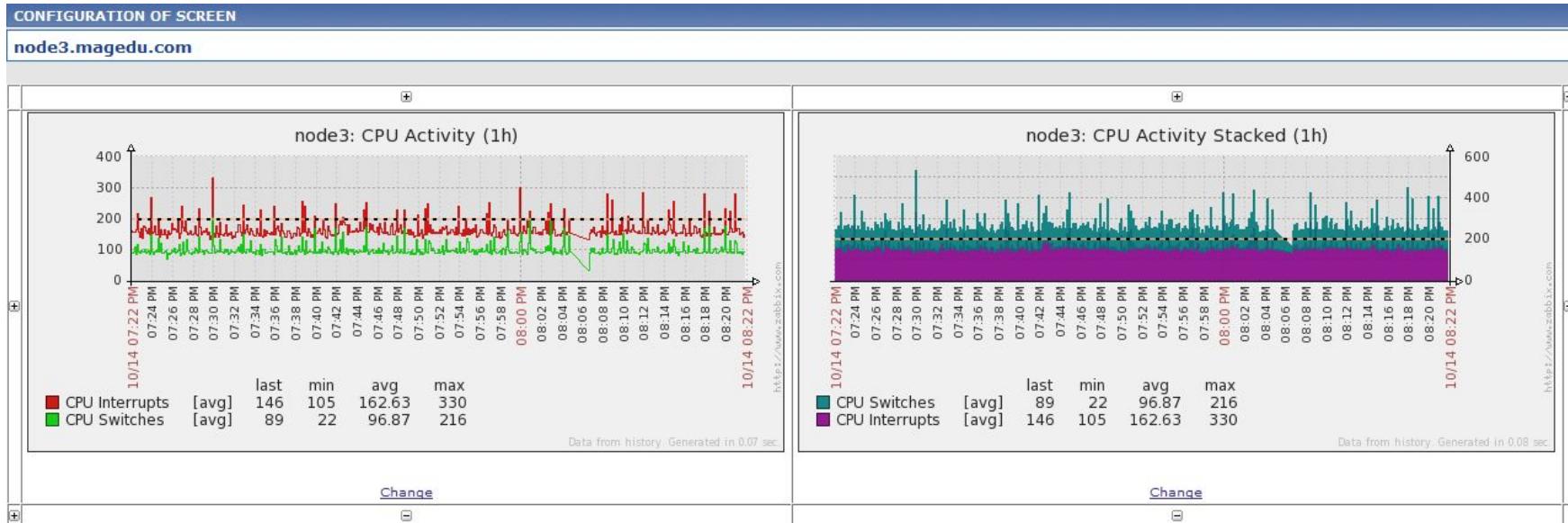
< Host list Host: node3 Monitored Z Applications (1) Items (2) Triggers (1) Graphs (1) Discovery rules (0)

Graph Preview



屏幕(screen)

- ❖ 屏幕用于集中展示多个数据源的相关信息，可实现快速浏览关注的信息
- ❖ 从根本上来讲，**screen**就是一个图表，可以在创建时可以指定其行数和列数，而后在每个格子中指定要展示的内容



屏幕(screen)

- ❖ screen可以展示的信息有许多种，如：简单图形、用户自定义图形、maps、其它screen、文本信息、概述的服务器信息、概述的主机信息、概述的触发器信息、触发器状态、系统状态等等
- ❖ 查看
 - ➡ Configuration → Screens → Create Screen
- ❖ 创建
 - ➡ Monitoring → Screens

马哥教育

www.magedu.com

宏(macros)

- ❖ 宏是一种抽象(**Abstraction**)，它根据一系列预定义的规则替换一定的文本模式，而解释器或编译器在遇到宏时会自动进行这一模式替换
- ❖ 类似地，**zabbix**基于宏保存预设文本模式，并且在调用时将其替换为其中的文本
- ❖ **zabbix**有许多内置的宏，如{HOST.NAME}、{HOST.IP}、{TRIGGER.DESCRIPTION}、{TRIGGER.NAME}、{TRIGGER.EVENTS.ACK}等
- ❖ 详细信息请参考官方文档
 - ➲ https://www.zabbix.com/documentation/2.0/manual/appendix/macros/supported_by_location

宏(macros)

- ❖ 为了更强的灵活性，**zabbix**还支持在全局、模板或主机级别使用用户自定义宏(**user macro**)
- ❖ 用户自定义宏要使用“{\$MACRO}”这种特殊的语法格式
- ❖ 宏可以应用在**item keys**和**descriptions**、**trigger**名称和表达式、主机接口**IP/DNS**及端口、**discovery**机制的**SNMP**协议的相关信息中等
- ❖ 宏的名称只能使用大写字母、数字及下划线
- ❖ 进一步信息请参考

https://www.zabbix.com/documentation/2.0/manual/appendix/macros/supported_by_location#additional_support_for_user_macros

www.magedu.com

宏替换次序

- ❖ 首先是主机级别的宏；
- ❖ 其次是当前主机上一级模板中(直接链接至主机的模板)的宏，多个一级模板按其**ID**号排序；
- ❖ 再接着是二级模板中的宏；而后依次类推；
- ❖ 最后检查的是全局宏；
- ❖ **zabbix**如果无法查找到某主机定义使用的宏，则不会对其进行替换操作。要使用用户自定义宏，有以下两种算途径：
 - ➔ 全局宏：“Administration → General → Macros”
 - ➔ 主机或模板级别的宏：编辑相应主机或模板的属性即可

www.magedu.com

Macros使用示例

- ❖ 在主机级别定义一个名为{\$CPUMAXSWITCHES}的宏，以定义当前主机所接受的CPU上下文切换的合理次数

CONFIGURATION OF HOSTS

Host: node3 Monitored Applications (1) Items (2) Triggers (1) Graphs (2) Discovery rules (0)

Host Templates IPMI Macros Host inventory

Macro	Value
{\$CPUMAXSWITCHES}	= 200

Remove



- ❖ 而后在主机的triggers中使用此宏

CONFIGURATION OF TRIGGERS

Host: node3 Monitored Applications (1) Items (2) Triggers (1) Graphs (2) Discovery rules (0)

Trigger Dependencies

Name
CPU Interrupts very high

Name: CPU Interrupts very high

Expression: {172.16.100.17:system.cpu.intr.last(0)}>{\$CPUMAXSWITCHES}

Add

Expression constructor



User parameters

- ❖ Sometimes you may want to run an agent check that does not come predefined with Zabbix
- ❖ You may write a command that retrieves the data you need and include it in the user parameter in the agent configuration file ('UserParameter' configuration parameter)
- ❖ syntax
 - ➡ **UserParameter=<key>,<command>**
 - A user parameter also contains a key
 - The key will be necessary when configuring an item
 - Note: Need to restart the agent

- ❖ User parameters are commands executed by Zabbix agent
- ❖ Up to 512KB of data can be returned
- ❖ /bin/sh is used as a command line interpreter under UNIX operating systems
- ❖ An example
 - ➲ UserParameter=mysql.ping,mysqladmin -uroot ping|grep -c alive
 - ➔ The agent will return '1', if MySQL server is alive, '0' - otherwise

马哥教育

www.magedu.com

Flexible user parameters

- ❖ Flexible user parameters accept parameters with the key
- ❖ This way a flexible user parameter can be the basis for creating several items
- ❖ **Syntax**
 - ➡ UserParameter=key[*],command

Parameter	Description
Key	Unique item key. The [*] defines that this key accepts parameters within the brackets.
Command	Command to be executed to evaluate value of the key. Zabbix parses the content of [] and substitutes \$1,...,\$9 in the command accordingly. \$0 will be substituted by the original command (prior to expansion of \$0,...,\$9) to be run.

Flexible user parameters

- ❖ To use positional references unaltered, specify double dollar sign - for example, awk '{print \$\$2}'
- ❖ Unless `UnsafeUserParameters` agent daemon configuration option is enabled, it is not allowed to pass flexible parameters containing these symbols: \ ' " ` * ? [] { } ~ \$! & : () < > | # @

马哥教育

www.magedu.com

Flexible user parameters

❖ 使用示例

- ① UserParameter=Memfree,cat /proc/meminfo | awk '/^MemFree/{print \$2}'
 - Key为Memfree, 后面是要执行的命令, 命令的执行结果为返回值
 - 重启agent后方能生效
 - 在server端使用zabbix_get命令测试获取数据即可
- ② UserParameter=Memusage[*],cat /proc/meminfo | awk '/^\$1/{print \$\$2}'
 - Key为Memusage, 且能够接受一个参数
 - 由于\$1、\$2等要用于UserParameter的参数调用, awk中的\$2之前要多用一个\$符;
 - 在Server测试时, 其调用的Key可以为Memusage[MemFree], Memusage[MemTotal]等;

www.magedu.com

模板(Templates)

- ❖ 模板是一系列配置的集合，它可以方便地快速部署在某监控对象上，并支持重复应用
 - ⇒ **items**
 - ⇒ **triggers**
 - ⇒ **graphs**
 - ⇒ **applications**
 - ⇒ **screens (since Zabbix 2.0)**
 - ⇒ **low-level discovery rules (since Zabbix 2.0)**
- ❖ 将模板应用至某主机上时，其定义的所有条目都会自动添加
- ❖ 模板的另一个好处在于，必要时，修改了模板，被应用的主机都会相应的作出修改

创建模板(Templates)

❖ Configuration → Templates

The screenshot shows the Zabbix configuration interface for creating templates. The top navigation bar includes Monitoring, Inventory, Reports, Configuration (selected), Administration, Host groups, Templates (selected), Hosts, Maintenance, Web, Actions, Screens, Slide shows, Maps, Discovery, and IT services. A breadcrumb trail at the top indicates: History: Configuration of proxies > Dashboard > Latest data > History > Configuration of templates.

The main section is titled "CONFIGURATION OF TEMPLATES". It features three tabs: Template, Linked templates (selected), and Macros. The "Template name" field is empty. The "Visible name" field is also empty. The "Groups" section contains two panels: "In groups" (empty) and "Other groups" (containing "Discovered hosts", "Linux servers", "Templates", "test servers", and "Zabbix servers"). Below these are "New group" and "Hosts / templates In" sections, both of which are currently empty. A dropdown menu for "Other | group" is set to "Discovered hosts".

编辑模板

- ❖ 在模板上可以按需添加item、trigger、screen、graph、application及发现规则

The screenshot shows the Zabbix Configuration interface. The top navigation bar includes links for Monitoring, Inventory, Reports, Configuration (which is selected), Administration, Host groups, Templates (highlighted in red), Hosts, Maintenance, Web, Actions, Screens, Slide shows, Maps, Discovery, and IT services. A search bar and buttons for 'Create template' and 'Import' are also present. The main content area displays the 'CONFIGURATION OF TEMPLATES' section, which lists various templates with their details: Applications, Items, Triggers, Graphs, Screens, Discovery, Linked templates, and Linked to. The 'Discovery' column for the 'Linux Server Memory Usage' template is highlighted with a red border.

Templates	Applications	Items	Triggers	Graphs	Screens	Discovery	Linked templates	Linked to
Linux Server Memory Usage	Applications (1)	Items (2)	Triggers (0)	Graphs (1)	Screens (1)	Discovery (0)	-	node4
Nginx Service	Applications (0)	Items (0)	Triggers (0)	Graphs (0)	Screens (0)	Discovery (0)	-	-
Template App Agentless	Applications (1)	Items (12)	Triggers (12)	Graphs (0)	Screens (0)	Discovery (0)	-	-
Template App MySQL	Applications (1)	Items (14)	Triggers (1)	Graphs (2)	Screens (1)	Discovery (0)	-	-

www.magedu.com

Network discovery

❖ 网络发现是**zabbix**最具特色的功能之一，它能够根据用户事先定义的规则自动添加监控的主机或服务等

- ➔ speed up Zabbix deployment
- ➔ simplify administration
- ➔ use Zabbix in rapidly changing environments without excessive administration

❖ **Zabbix**的网络发现功能可基于如下信息进行

- ➔ IP ranges
- ➔ Availability of external services (FTP, SSH, WEB, POP3, IMAP, TCP, etc)
- ➔ Information received from Zabbix agent
- ➔ Information received from SNMP agent

网络发现：过程阶段

- ❖ 网络发现通常包含两个阶段：discovery和actions
- ❖ Discovery
 - ⇒ Zabbix periodically scans the IP ranges defined in network discovery rules
 - ↳ The frequency of the check is configurable for each rule individually
 - ⇒ Each rule has a set of service checks defined to be performed for the IP range
 - ⇒ Every check of a service and a host (IP) performed by the network discovery module generates a discovery event

www.magedu.com

网络发现: Discovery

❖ Discovery中的事件

Event	Generated
Service Up	Every time Zabbix detects active service.
Service Down	Every time Zabbix cannot detect service.
Host Up	If at least one of the services is 'up' for the IP.
Host Down	If all services are not responding.
Service Discovered	If the service is back after downtime or discovered for the first time.
Service Lost	If the service is lost after being up.
Host Discovered	If host is back after downtime or discovered for the first time.
Host Lost	If host is lost after being up.

马哥教育

www.magedu.com

网络发现: Action

❖ Actions

- ⌚ 网络发现中的事件可以触发action，从而自动执行指定的操作，如
 - ⌚ Sending notifications
 - ⌚ Adding/removing hosts
 - ⌚ Enabling/disabling hosts
 - ⌚ Adding hosts to a group
 - ⌚ Removing hosts from a group
 - ⌚ Linking hosts to/unlinking from a template
 - ⌚ Executing remote scripts
- ⌚ 这些事件的配置还可以基于设备的类型、IP、状态、上线/离线等进行配置

网络发现：接口添加

- ❖ 网络发现中添加主机时会自动创建**interface**

- ⌚ **the services detected**

- ⌚ 例如，如果基于**SNMP**检测成功，则会创建**SNMP**接口
 - ⌚ 如果某服务同时响应给了**agent**和**SNMP**，则两种接口都会创建
 - ⌚ 如果同一种发现机制(如**agent**)返回了非惟一数据，则第一个接口被识别为默认，其它的为额外接口
 - ⌚ 即便是某主机开始时只有**agent**接口，后来又通过**snmp**发现了它，同样会为其添加额外的**snmp**接口
 - ⌚ 不同的主机如果返回了相同的数据，则第一个主机将被添加，余下的主机会被当作第一个主机的额外接口

www.magedu.com

网络发现：配置发现规则

❖ Configuration → Discovery

Monitoring Inventory Reports Configuration Administration

Host groups Templates Hosts Maintenance Web Actions Screens Slide shows Maps Discovery IT services

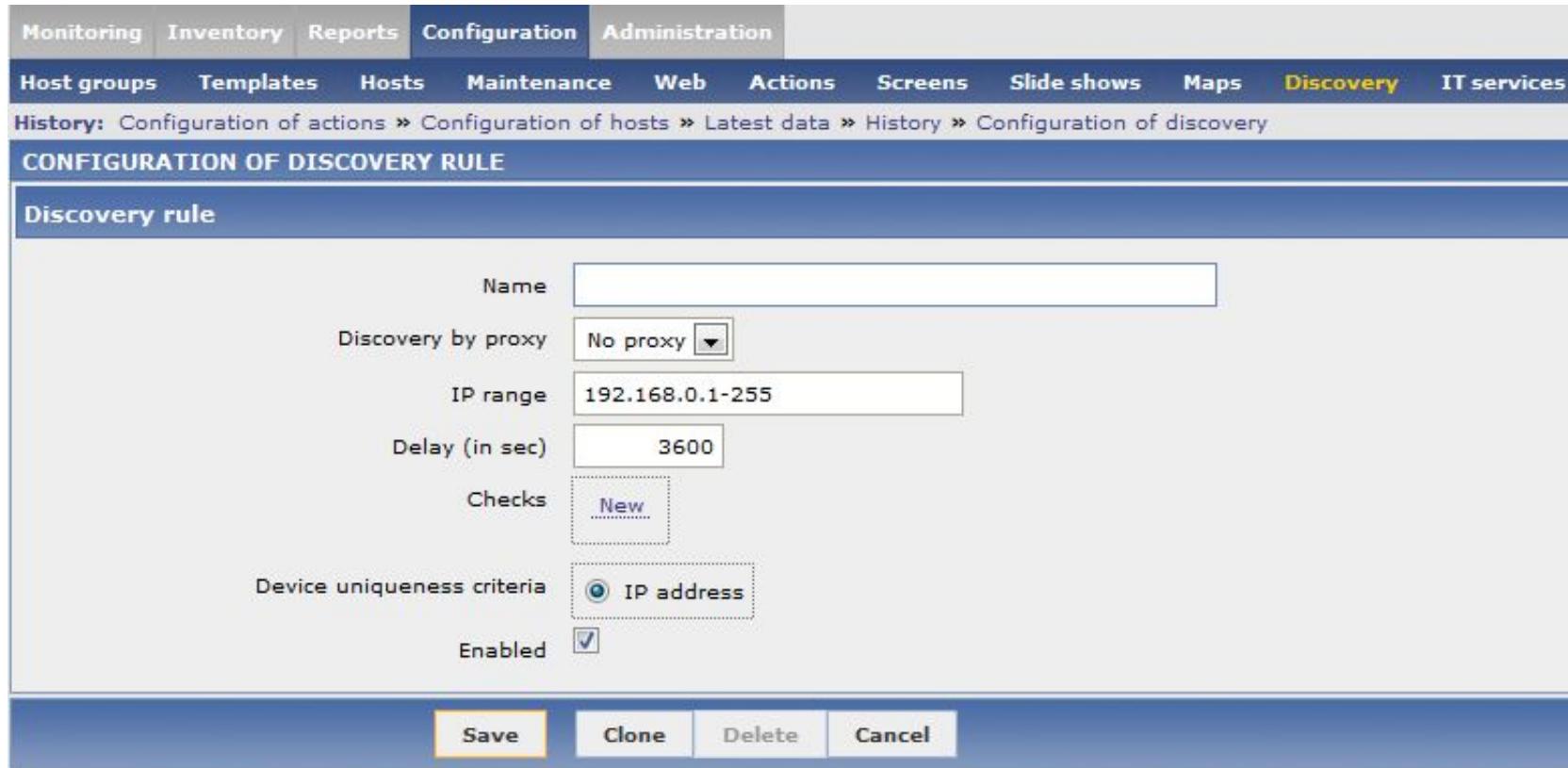
History: Configuration of actions » Configuration of hosts » Latest data » History » Configuration of discovery

CONFIGURATION OF DISCOVERY RULE

Discovery rule

Name	<input type="text"/>
Discovery by proxy	No proxy <input type="button" value="▼"/>
IP range	192.168.0.1-255
Delay (in sec)	3600
Checks	<input type="button" value="New"/> <input type="button" value="..."/>
Device uniqueness criteria	<input checked="" type="radio"/> IP address
Enabled	<input checked="" type="checkbox"/>

Save Clone Delete Cancel



网络发现：配置发现规则

Parameter	Description
Name	Unique name of the rule. For example, "Local network".
Discovery by proxy	What performs discovery: no proxy - Zabbix server is doing discovery <proxy name> - this proxy performs discovery
IP range	The range of IP addresses for discovery. It may have the following formats: Single IP: 192.168.1.33 Range of IP addresses: 192.168.1.1-255 IP mask: 192.168.4.0/24 Supported IP masks: /16 - /32 for IPv4 addresses /112 - /128 for IPv6 addresses List: 192.168.1.1-255,192.168.2.1-100,192.168.2.200,192.168.4.0/24 Note: Each IP address should be included only once; having multiple rules for a single IP address can have unexpected behavior such as having deadlocks and/or duplicate hosts in the database. The same could happen if two hosts having the same DNS name are included in separate discovery rules.
Delay (seconds)	This parameter defines how often Zabbix will execute the rule.
Checks	Zabbix will use this list of checks for discovery. Supported checks: SSH, LDAP, SMTP, FTP, HTTP, POP, NNTP, IMAP, TCP, Zabbix agent, SNMPv1 agent, SNMPv2 agent, SNMPv3 agent, ICMP ping. A protocol-based discovery uses the net.tcp.service[] functionality to test each host, except for SNMP which queries an SNMP OID . Zabbix agent is tested by querying an item. Please see agent items for more details. The 'Ports' parameter may be one of following: Single port: 22 Range of ports: 22-45 List: 22-45,55,60-70
Device uniqueness criteria	Uniqueness criteria may be: IP address - no processing of multiple single-IP devices. If a device with the same IP already exists it will be considered already discovered and a new host will not be added. Type of discovery check - either SNMP or Zabbix agent check.
Status	Active - the rule is active and will be executed by Zabbix server Disabled - the rule is not active. It won't be executed.

网络发现：配置发现action

❖ Configuration → Actions → Event source (Discovery) → Create action

CONFIGURATION OF ACTIONS

Action Conditions Operations

Type of calculation: AND / OR (A) and (B) and (C)

Conditions:

Label	Name	Action
(A)	Discovery rule = "Local network"	Remove
(B)	Service type = "Zabbix agent"	Remove
(C)	Host IP = "172.16.100.1-100"	Remove

New condition: Host IP = 192.168.0.1-127,192.168.2.1
[Add](#)

定义发现条件

与可致用



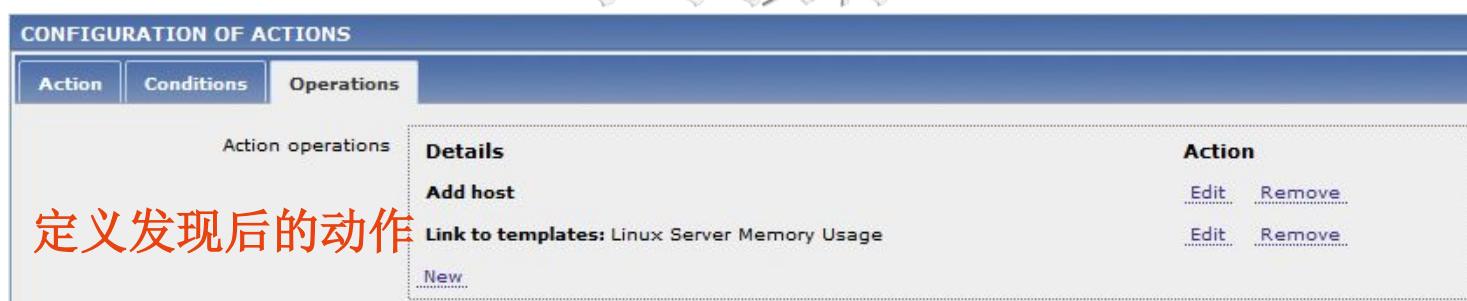
CONFIGURATION OF ACTIONS

Action Conditions Operations

Action operations:

Details	Action
Add host	Edit Remove
Link to templates: Linux Server Memory Usage	Edit Remove
New	

定义发现后的动作



网络发现：配置发现action

❖ Configuration → Actions → Event source (Discovery) → Create action

CONFIGURATION OF ACTIONS

Action Conditions Operations

Type of calculation: AND / OR (A) and (B) and (C)

Conditions:

Label	Name	Action
(A)	Uptime/Downtime >= "300"	Remove
(B)	Discovery status = "Down"	Remove
(C)	Host IP = "172.16.100.1-100"	Remove

New condition:

Discovery status = Up

Add...

定义发现条件
(离线)

CONFIGURATION OF ACTIONS

Action Conditions Operations

Action operations:

Details	Action
Remove host	Edit Remove
New	

定义发现(离线)后的
动作

网络发现: agent自动注册

- ❖ Zabbix支持**active agent**的自动注册(**auto-registration**)功能，通常用于此前故障的**agent**重新上线时的场景
- ❖ 也可基于**active agent**的自动注册机制添加被动检测，这会通过**active agent**注册时提供的“**ListenIP**”和“**ListenPort**”进行
- ❖ **Server**端在收到自动注册请求后以接收到的**IP**和**Port**为接口属性

马哥教育

www.magedu.com

网络发现：配置active agent自动注册

- ❖ Configuration → Actions → Event source (Auto registration) → Create action

只用定义
operations, 无需
定义conditions

Action	Conditions	Operations
Details	Add host	Link to templates: Linux Server Memory Usage
	New	
Action		
Edit Remove		
Edit Remove		

- ❖ 此外，还需要配置agent的工作属性，并重启agent

- ④ zabbix-agentd.conf
 - ServerActive=172.16.100.15
 - # 指向zabbix server

Web监控

- ❖ Zabbix还可以进行web站点的可用性检测
- ❖ 创建web监控需要先定义一个web方案(**scenarios**)
 - ⌚ web方案包括一个或多个HTTP请求或“步骤(step)”
 - ⌚ 步骤(step)的执行过程按照预先定义的顺序进行执行
- ❖ 通过web监控可实获取如下信息
 - ⌚ 整个web方案中所有的步骤的平均下载速度
 - ⌚ 失败的步骤号
 - ⌚ 失败的报错信息
- ❖ 在web方案的具体步骤中，可以按需使用如下信息
 - ⌚ 该步骤的下载速度
 - ⌚ 回应时间
 - ⌚ 回应状态码
- ❖ Zabbix可以检测获取到的HTML页面中是否包含预设的字符串，也可以实现登录和页面点击

Web监控：创建web方案

- ❖ 创建web方案的前提需要创建一个适用的应用(application)
- ❖ 可以在“Hosts”或“Templates”上创建应用
- ❖ 如果在“Templates”上创建应用，则需要将此“Templates”链接至要监控其web的主机上方能使用此“application”

CONFIGURATION OF APPLICATIONS

« [Template list](#) **Template:** [Web Servers](#) Applications (0) [Items \(0\)](#) [Triggers \(0\)](#) [Graphs \(0\)](#) [Screens \(0\)](#) [Discovery rules \(0\)](#)

Application

Host	<input type="text" value="Web Servers"/>	<input type="button" value="Select"/>
Name	<input type="text" value="Web scenarios"/>	

马哥教育

www.magedu.com

Web监控：创建web方案

❖ Configuration → Web

The screenshot shows the Nagios configuration interface with the 'Configuration' tab selected. Under the 'Web' section, a new scenario is being configured. The configuration details are as follows:

- Application:** Web scenarios
- Name:** www.magedu.com
- Authentication:** None
- Update interval (in sec):** 60
- Agent:** Google Chrome 17
- Variables:** (Empty text area)
- Active:**

Web监控：创建web方案

Parameter	Description
Application	Select an application the scenario will belong to. The application must exist.
Name	Unique scenario name.
Authentication	<p>Authentication options.</p> <p>None - no authentication used.</p> <p>Basic authentication - basic authentication is used.</p> <p>NTLM authentication - NTLM (Windows NT LAN Manager) authentication is used.</p> <p>Selecting an authentication method will provide two additional fields for entering a user name and password.</p>
Update interval (in sec)	How often the scenario will be executed, in seconds.
Agent	<p>Select a client agent.</p> <p>Zabbix will pretend to be the selected browser. This is useful when a website returns different content for different browsers.</p>
Variables	<p>List of variables (macros) for use in scenario steps (URL, Post variables).</p> <p>They have the following format:</p> <p>{macro1}=value1 {macro2}=value2</p> <p>For example:</p> <p>{username}=Alexei {password}=kj3h5kJ34bd</p> <p>The macros can then be referenced in the steps as {username} and {password}. Zabbix will automatically replace them with actual values.</p>
Active	The scenario is active if this box is checked, otherwise - disabled.

Web监控：创建web方案

❖ 定义steps

可以定义多个
step以实现监控
多个页面

Step of scenario

Name	Home
URL	http://www.magedu.com/
Post	
定义step	
Timeout	15
Required string	
Required status codes	200

Update Cancel

创建后的结果

Steps	Name	Timeout	URL	Required	Status	Action
				codes		
1:	Home	15 sec	http://172.16.100.18/	200		Remove
	Add					

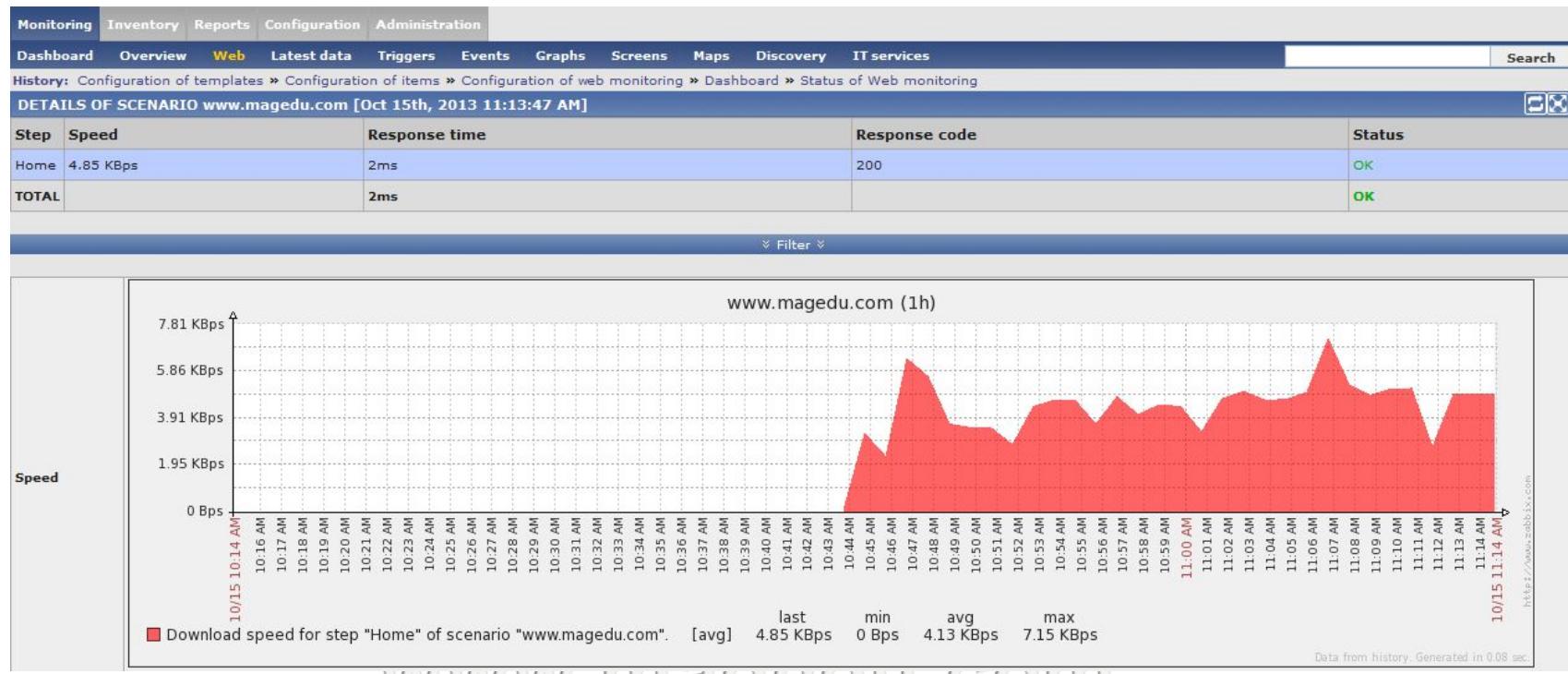
Web监控：创建web方案

❖ step的各属性说明

Parameter	Description
Name	Unique step name.
URL	URL to connect to and retrieve data. For example: <code>http://www.zabbix.com</code> <code>https://www.google.com</code> GET variables can be passed in the <code>URL</code> parameter.
Post	HTTP POST variables, if any. For example: <code>id=2345&userid={user}</code> If <code>{user}</code> is defined as a macro of the web scenario, it will be replaced by its value when the step is executed. The information will be sent as is.
Timeout	Zabbix will not spend more than the set amount of seconds on processing the <code>URL</code> . Actually this parameter defines maximum time for making connection to the <code>URL</code> and maximum time for performing an <code>HTTP</code> request. Therefore, Zabbix will not spend more than 2 x Timeout seconds on the step. For example: 15
Required	Required regular expressions pattern. Unless retrieved content (<code>HTML</code>) matches required pattern the step will fail. If empty, no check is performed. For example: Homepage of Zabbix <code>Welcome.*admin</code> Note: Referencing <code>regular expressions</code> created in the Zabbix frontend is not supported in this field.
Status codes	List of expected <code>HTTP</code> status codes. If Zabbix gets a code which is not in the list, the step will fail. If empty, no check is performed. For example: 200,201,210-299

Web监控：查看web监控图像

❖ Monitoring → Web 或者 Monitoring → Latest data



Web监控: Scenario items

- ❖ 方案创建完成后，Zabbix将会自动在链接的application中添加如下监控项

Item	Description
<i>Download speed for scenario <Scenario></i>	This item will collect information about the download speed (bytes per second) of the whole scenario, i.e. average for all steps. Item key: <u>web.test.in[Scenario,,bps]</u> Type: Numeric(float)
<i>Failed step of scenario <Scenario></i>	This item will display the number of the step that failed on the scenario. If all steps are executed successfully, 0 is returned. Item key: <u>web.test.fail[Scenario]</u> Type: Numeric(unsigned)
<i>Last error message of scenario <Scenario></i>	This item returns the last error message text of the scenario. Item key: <u>web.test.error[Scenario]</u>

注意：使用时需要将“Scenario”替换为真实的方案名称

- ❖ 在创建触发器和告警时可以利用这些监控项，例如

- ☞ {host:web.test.fail[www.magedu.com].last(0)}#0
- ☞ {host:web.test.in[www.magedu.com,,bps].last(0)}<10000

Web监控: Step items

- ❖ 在创建完一个步骤后，Zabbix自动会在选择的应用中添加如下三个监控项

Item	Description
<i>Download speed for step <Step> of scenario <Scenario></i>	This item will collect information about the download speed (bytes per second) of the step. Item key: web.test.in[Scenario,Step,bps] Type: Numeric(float)
<i>Response time for step <Step> of scenario <Scenario></i>	This item will collect information about the response time of the step in seconds. Response time is counted from the beginning of the request until all information has been transferred. Item key: web.test.time[Scenario,Step] Type: Numeric(float)
<i>Response code for step <Step> of scenario <Scenario></i>	This item will collect response codes of the step. Item key: web.test.rspcode[Scenario,Step] Type: Numeric(unsigned)

注意：使用时需要将“Scenario”和“Step”替换为具体的名称

- ❖ 这些监控值可以用于创建触发器及定义告警条件，例如
 - ⌚ {zabbix:web.test.time[www.magedu.com,Home].last(0)}>3

Zabbix分布式监控

主讲：马永亮(马哥)
QQ:113228115
客服QQ: 2813150558, 1661815153
<http://www.magedu.com>
<http://magedu.blog.51cto.com>

Agenda

- ❖ 分布式监控概述
- ❖ proxy and node
- ❖ Zabbix的三种架构
 - ➔ Server-agent
 - ➔ Server-Node-agent
 - ➔ Server-Proxy-agent
- ❖ 监控Zabbix

马哥教育

www.magedu.com

Zabbix分布式监控概述

- ❖ Zabbix能高效地监控分布式IT架构
- ❖ 在大型环境中Zabbix提供两种解决方案
 - ⇒ 使用代理(proxy)
 - ⇒ 使用节点(node)
- ❖ Proxy or Node?

⇒ 代理(proxy)用于本区域数据收集，并将数据发送给server

⇒ 节点(node)提供完整的Zabbix server用以建立分布式监控中的层级

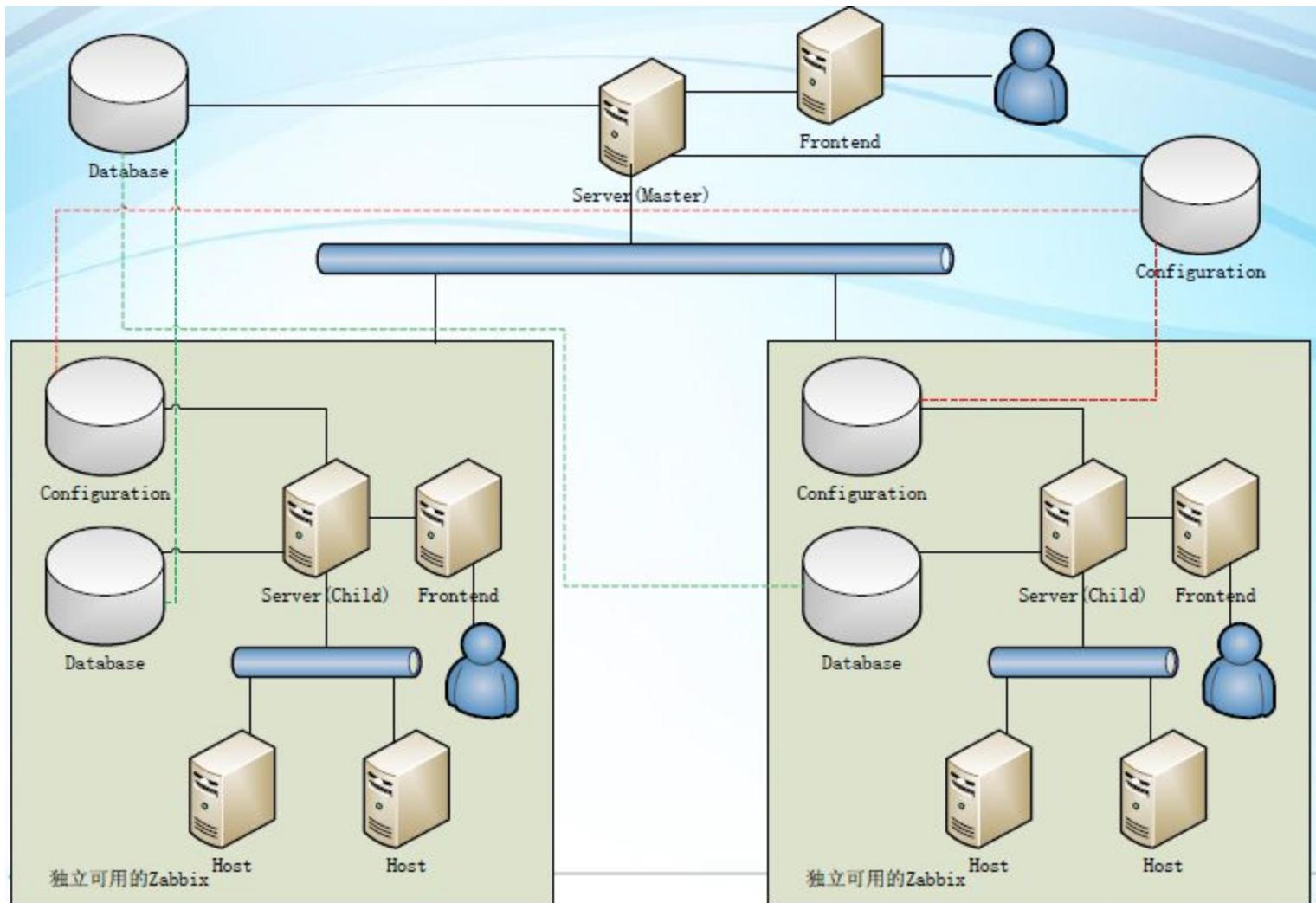
	Proxy	Node
<i>Lightweight</i>	Yes	No
<i>GUI</i>	No	Yes
<i>Works independently</i>	Yes	Yes
<i>Easy maintenance</i>	Yes	No
<i>Automatic DB creation¹</i>	Yes	No
<i>Local administration</i>	No	Yes
<i>Ready for embedded hardware</i>	Yes	No
<i>One way TCP connections</i>	Yes	Yes
<i>Centralised configuration</i>	Yes	No
<i>Generates notifications</i>	No	Yes

Proxy vs Node

- ❖ **Node**本身是一台**server**, 它有完整的**web**页面, 完整的数据**库**, 它将数据源源不断传送给**Master**
- ❖ **Proxy**只有一个**proxy**的**daemon**进程, **Proxy**也有自己的**数据****库**, 但它的**数据库**只会保存一定时间的数据, 它与**Master**通信是将一批信息打包后发送到**Master**, **Master**将这些数据**merge**入**Mater****数据库**
- ❖ **Master-Proxy**相比**Master-Node**的优点有以下
 - ➲ **Proxy**压力小, 数据库只存储一定时间数据
 - ➲ **Master**压力变小, 数据不是源源不断获取, 减小**IO**压力
 - ➲ 架构更清晰, 易维护

www.magedu.com

Server-Node-Client



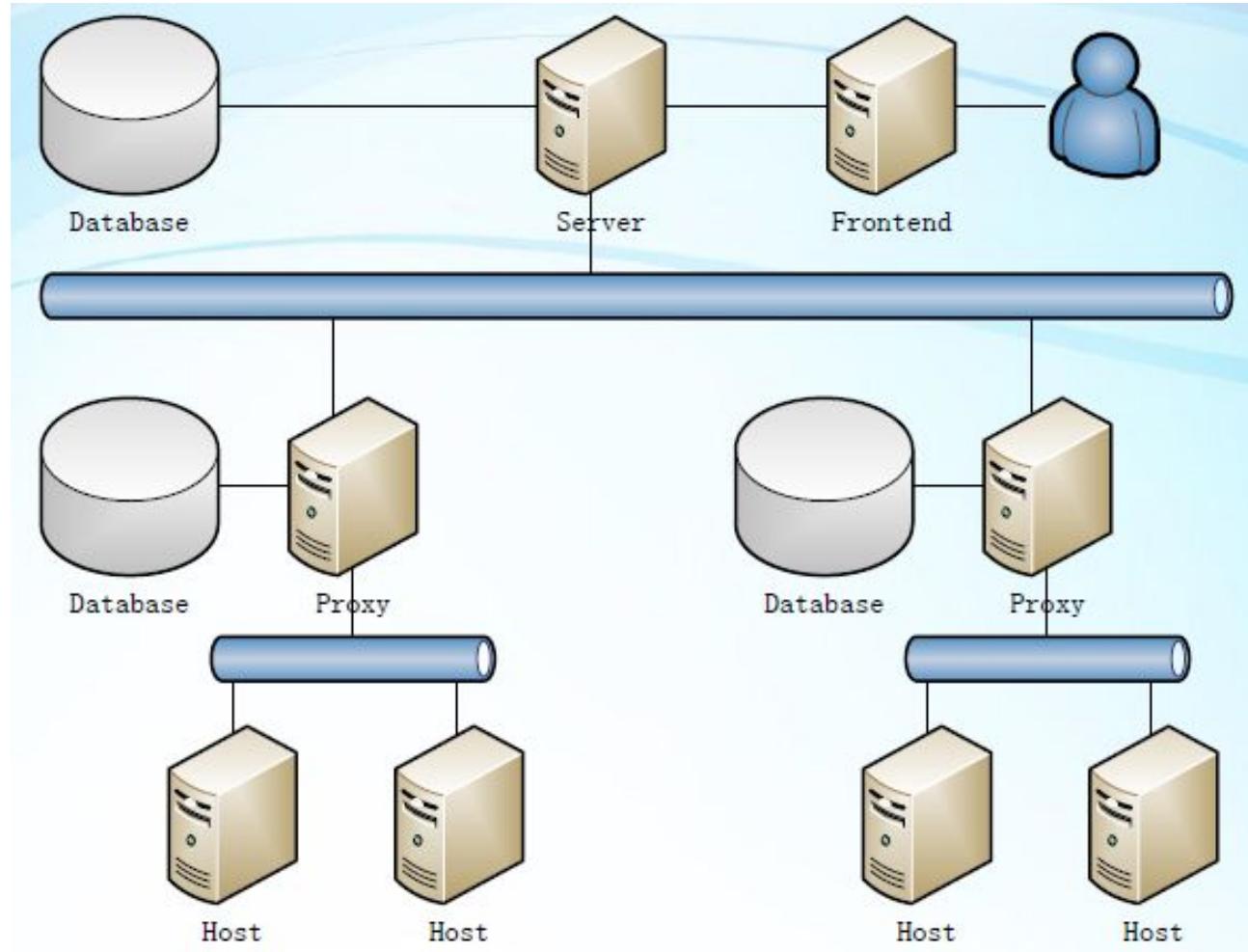
Reference: (姚仁捷) <http://www.slideshare.net/baniuyao/pptv-zabbix-14620298>

Server-Node-Client特性

- ❖ 解决host过多时单台**Server**面临性能瓶颈的问题
 - ⌚ 使用多个instance
 - ⌚ 每个instance是独立的一套zabbix，有database和Frontend (optional)
- ❖ 支持热插拔，**Node**和**Server**的连接可以随时断开，但不影响**Node**的正常运行
- ❖ **Node**定时给**Server**发送**configuration, history, event**
- ❖ **Server**定时给**Node**发送**configuration**
- ❖ 所有配置变更只能在**Node**节点操作，不能再**Server**操作。
<http://www.zabbix.com/forum/showthread.php?t=20863>
- ❖ 支持树状结构，**Node**又可以是个**Server**

Reference: (姚仁捷) <http://www.slideshare.net/baniuyao/pptv-zabbix-14620298>

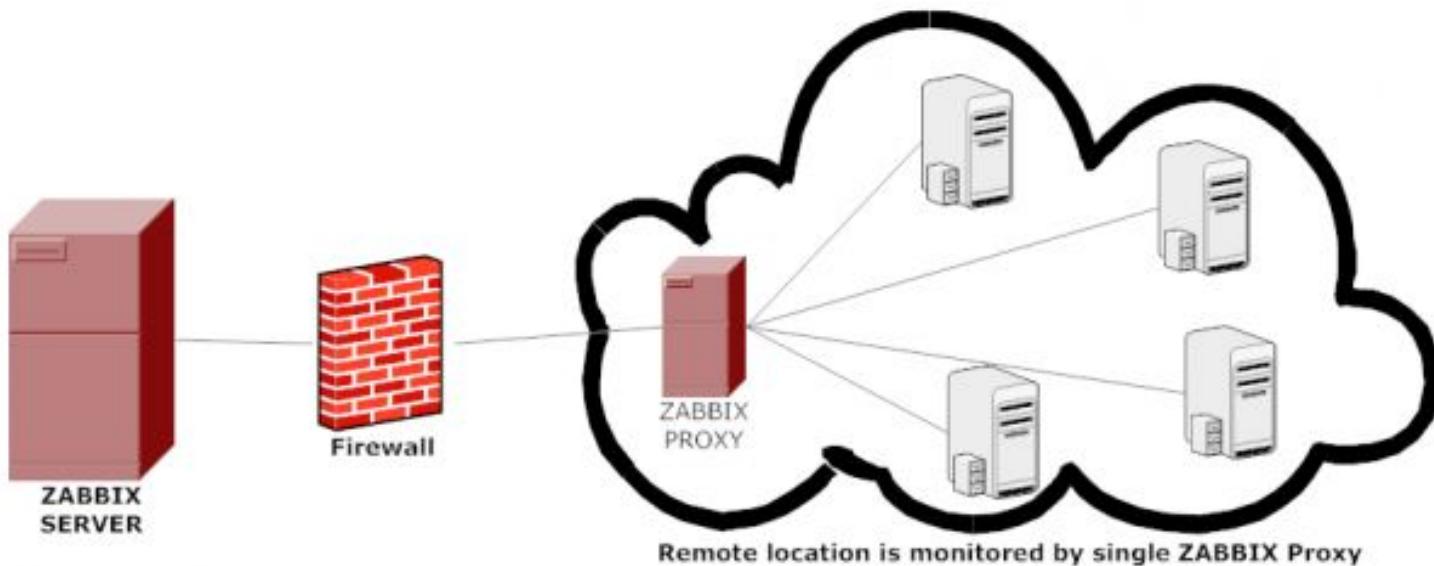
Server-Proxy-Client



Reference: (姚仁捷) <http://www.slideshare.net/baniuyao/pptv-zabbix-14620298>

Server-Proxy-Client工作特性

- ❖ Proxy不会向Server同步Configuration，只会接收
- ❖ Proxy的数据库定时会将数据传送给Server，Proxy本地数据库只保存最近没有发送的数据



Zabbix proxy 的功能

❖ 功能

- ➔ Monitor remote locations
- ➔ Monitor locations having unreliable communications
- ➔ Offload the Zabbix server when monitoring thousands of devices
- ➔ Simplify the maintenance of distributed monitoring

❖ The proxy requires only one TCP connection to the Zabbix server

- ➔ This way it is easier to get around a firewall as you only need to configure one firewall rule

❖ 注意

- ➔ Zabbix proxy must use a separate database
- ➔ Pointing it to the Zabbix server database will break the configuration

Zabbix Proxy 特性

- ❖ All data collected by the proxy is stored locally before transmitting it over to the server
 - ➡ The `ProxyLocalBuffer` and `ProxyOfflineBuffer` parameters in the proxy configuration file control for how long the data are kept locally
- ❖ Zabbix proxy is a data collector
 - ➡ It does not calculate triggers, process events or send alerts

马哥教育

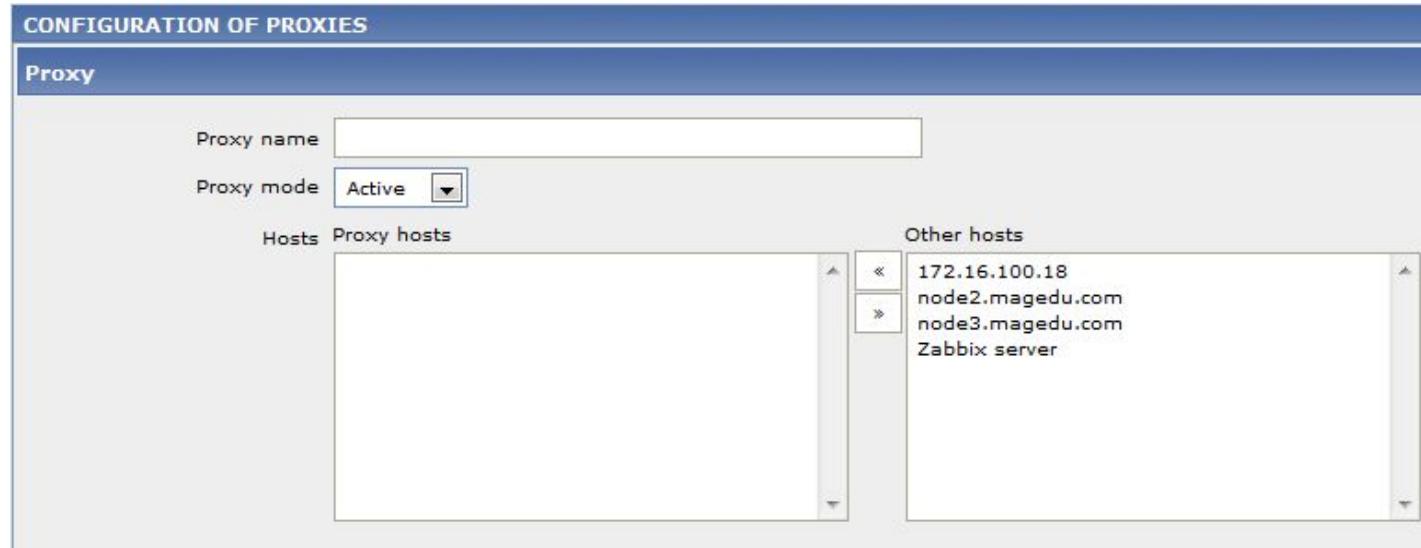
www.magedu.com

Zabbix Proxy 特性

Function	Supported by proxy
Items	
<i>Zabbix agent checks</i>	Yes
<i>Zabbix agent checks (active)</i>	Yes ¹
<i>Simple checks</i>	Yes
<i>Trapper items</i>	Yes
<i>SNMP checks</i>	Yes
<i>SNMP traps</i>	Yes
<i>IPMI checks</i>	Yes
<i>JMX checks</i>	Yes
<i>Log file monitoring</i>	Yes
<i>Internal checks</i>	No
<i>SSH checks</i>	Yes
<i>Telnet checks</i>	Yes
<i>External checks</i>	Yes
Built-in web monitoring	Yes
Network discovery	Yes
Low-level discovery	Yes
Calculating triggers	No
Processing events	No
Sending alerts	No
Remote commands	No

通过Web GUI添加proxy

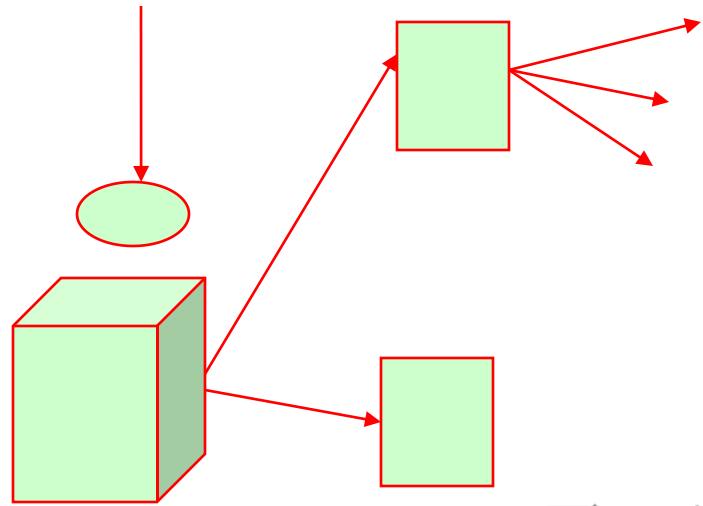
❖ Administration → DM



❖ 各属性说明

马哥教育

Parameter	Description
Proxy name	Enter the proxy name. It must be the same name as in the <i>Hostname</i> parameter in the proxy configuration file.
Proxy mode	Select the proxy mode. Active - the proxy will connect to the Zabbix server and request configuration data Passive - Zabbix server connects to the proxy
Hosts	Add hosts to be monitored by the proxy.



马哥教育

www.magedu.com

- ❖ 需要机制确保**zabbix**自身的健康状态
- ❖ 利用**nagios**来监控**zabbix**

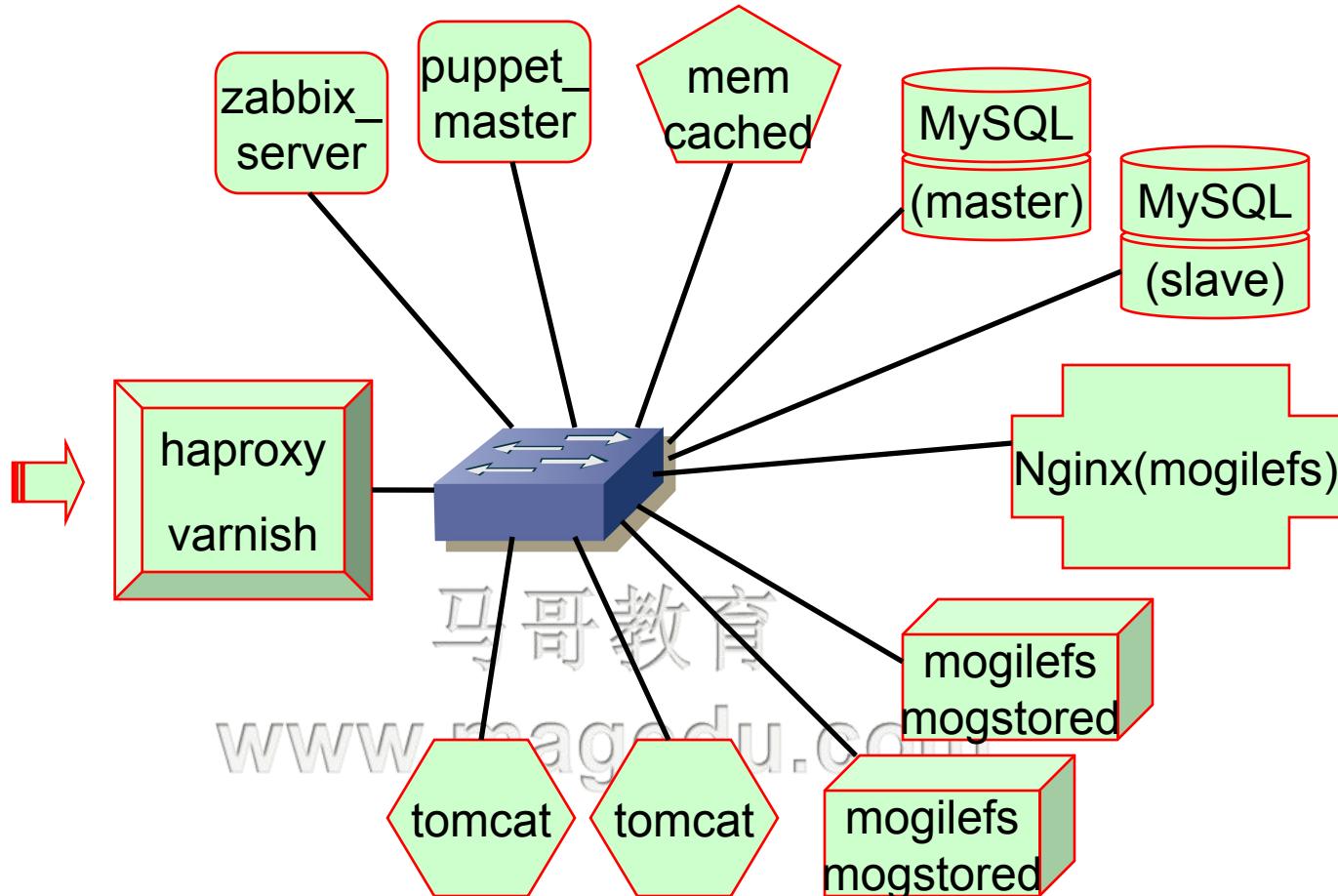
Nagios



马哥教育

www.magedu.com

项目案例



关于马哥教育

- ❖ 博客: <http://magedu.blog.51cto.com>
- ❖ 主页: <http://www.magedu.com>
- ❖ QQ: 2813150558, 1661815153, 113228115
- ❖ QQ群: 203585050, 279599283



马
哥
教
育

Thank You!