PostgreSQL监控实战 基于Pigsty解决实际监控问题



PostgreSQL DBA 2021/01/07



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- 快速上手:利用监控系统观察数据库状态
- 解决方案:如何部署属于自己的监控系统
- 解决问题:如何用监控系统解决实际问题





01 快速上手

利用监控系统观察数据库状态





实验1:利用监控系统观测查询负载

已有一主两从的数据库集群 pg-test ,为集群添加50的读写TPS ,1000的只读TPS ,从监控系统观察负载。

从库1K只读TPS 主库50写入TPS

while true; do pgbench -nv -P1 -c4 --select-only --rate=1000 -T10 postgres://test:test@pg-test:5434/test; done while true; do pgbench -nv -P1 -c2 --rate=50 -T10 postgres://test:test@pg-test:5433/test; done







用监控系统的图表数据 印证我们主动施加的负载

集群总TPS ≈ 1050 主库TPS ≈ 50 从库TPS ≈ 1000 每个从库实例TPS ≈ 500



使用十倍的连接数施加同样负载,观察系统状态

while true; do pgbench -nv -P1 -c40 --select-only --rate=1000 -T10 postgres://test:test@pg-test:5434/test; done while true; do pgbench -nv -P1 -c20 --rate=50 -T10 postgres://test:test@pg-test:5433/test; done 原来我们使用了2条读写连接,4条只读连接,现在翻十倍变为20条和40条。观察连接池在这一过程中起到的作用。



主库活跃客户端连接数 = 20 从库活跃客户端连接数 = 40 每个从库活跃客户端连接数 = 20 集群活跃服务端连接数 < 5



[-] 阿里云



使用尽可能大的负载,观察系统在过载下的表现

while true; do pgbench -nv -P1 -c40 --select-only -T10 postgres://test:test@pg-test:5434/test; done
while true; do pgbench -nv -P1 -c20 -T10 postgres://test:test@pg-test:5433/test; done







实验2 重启主库,观察集群领导权交接

ssh -t node-1 sudo reboot

Ellipigsty / PG Clu	uster ☆ ≪							
Cluster Cluster	Cluster V Pg-test Cluster ID Version		Instance ↑ pg-test-1 pg-test-2		IP <u>10.10.10.11</u> 10.10.10.12		Rol repl prin	
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FS Space 16.4%	Disk IO	Mem Usage 10.6%	CPU Usage 26.9%		~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~		11:12	11:13





主库宕机
土库彼移出集群 从库被提升为新主库
其他主库从新主库开始重建复制
旧土厍里后元戍 旧主库降级为从库
新从库重新加入集群









02 解決方案 Pigsty



PIGSTY /'pig_stai/ **Postgres In Graphic STYle**



https://pigsty.cc

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Pigsty: 图形化PostgreSQL



世界上最好的PostgreSQL监控系统

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https://pigsty.cc



~ Summary



Piqsty

III	\$	9	Last 12 hour	s v	Q
≡Overview	≡Shard	≡Cluster	≡Service	≡Ins	tance

	Max Active Server	Max Queue C	lients	Max Disk Usage	Ma	x Ag
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ert		<u>pg-</u>	2	<u>pg∹t-1</u>	<u>10.</u>	
		<u>pg</u>	3	<u>pgt-0</u>	<u>10.189</u>	
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Max Age









0





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了解Pigsty提供的图形化用户界面

Pigsty提供了专业且易用的PostgreSQL监控系统,浓缩了业界监控的最佳实践。您可以方 便地进行修改与定制;复用监控基础设施,或与其他监控系统相集成。下表是每个监控面 板介绍页面的快速导航连接。

	全局	集群	服务	实例	数据库
	Home	PG Cluster	PG Service	PG Instance	PG Database
	PG Overview	PG Cluster Replication	PG DNS	Node	PG Query
	PG Shard	PG Cluster Activity		PG Pgbouncer	PG Catalog
	PG Alert	PG Cluster Session		PG Proxy	PG Table
	PG KPI	PG Cluster Node		PG Exporter	PG Table Detail
	PG Capacity	PG Cluster Persist		PG Setting	
	PG Change	PG Cluster Database		PG Stat Activity	
	PG Monitor	PG Cluster Stats		PG Stat Statements	
		PG Cluster Table			
		PG Cluster Table Detail			
		PG Cluster Query			
		PG Cluster Health			
		PG Cluster Log			
1		PG Cluster All			

全局监控

Home

PG Overview

PG Shard

PG Alert

PG KPI

PG Capacity

PG Change

PG Monitor

集群监控

PG Cluster

PG Cluster Replication

PG Cluster Activity

PG Cluster Session

PG Cluster Node

PG Cluster Persist

PG Cluster Database

PG Cluster Stat

PG Cluster Table

PG Cluster Table Detail

PG Cluster Query

PG Cluster Health

PG Cluster Log

PG Cluster All

服务监控

PG Service

PG DNS

实例监控

PG Instance

Node

PG Pgbouncer

PG Proxy

PG Exporter

PG Setting

PG Stat Activity

PG Stat Statements

数据库监控

PG Database PG Pool PG Query PG Table Catalog

PG Table

PG Table Detail

PG Query Detail

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如何拥有?

Pigsty提供了沙箱环境 在您的笔记本上 迅速拉起PostgreSQL集群 与Pigsty监控系统

上手

基于vagrant, 快速在本机拉起演示系统

这篇文档将介绍如何在您手头的笔记本或PC机上,基于Vagrant与Virtualbox,一键拉起Pigsty演示沙箱。 本教程着眼于在本地单机创建Pigsty演示环境,如果您已经有可以用于部署的机器实例,可以参考部署教程

太长; 不看

如果您的本地计算机上已经安装有vagrant , virtualbox与ansible,那么只需要克隆并进入本项目后,依次执行以下命令即可:

make up	#	^た 拉起vagrant <u>虚</u> 拟机
make ssh	#	f 配置虚拟机ssh访问
make init	#	* 初始化Pigsty
sudo make dns	#	<i>「写入Pigsty静态DNS域名(需要sudo,可选)</i>
make mon-view	#	* 打开Pigsty首页(默认用户密码: admin:admin)

正常情况下执行结果详见参考-标准流程。

如果您希望了解详情,知晓每条命令背后完成的工作,请往下阅读。







pg_service : pg-test-replica







可及	见测性
实₿	示挑占

头际挑战 层次关系

命名规则 服务发现

监控指标

报警规则

系统架构

高可用

界面

- 快速导航 全局监控
- Home
- PG Overview
- PG Shard
- PG Alert
- PG KPI
- PG Change
- PG Monitor
- PG Capacity

集群监控

- PG Cluster PG Cluster Replication
- PG Cluster Activity
- PG Cluster Session
- PG Cluster Node
- PG Cluster Persist
- PG Cluster Database
- PG Cluster Stat
- PG Cluster Table
- PG Cluster Table Detail
- PG Cluster Query
- PG Cluster Health
- PG Cluster Log
- PG Cluster All

服务监控

PG Service PG DNS

实例监控

PG Instance Node PG Pgbouncer PG Proxy PG Exporter PG Setting PG Activity PG Statements 数据库监控

PG Database

Application

DNS

VIP

欢迎来到Pigsty中文文档

[DRAFT] Pigsty English Documentation

Pigsty是 PostgreSQL In Graphic STYle 的缩写,即"图形化Postgres"。

pigsty一词的的本意是猪圈,读作 Pig Style (/'pɪgˌstaɪ/)。



文档

Pigsty 针对大规模数据库集群监控与管理而设计,提供业界顶尖的监控系统与开箱即用的高可用数据库供给方案。 Pigsty基于开源生态构建,旨在降低PostgreSQL使用管理的门槛,为用户带来极致的可观测性与丝滑的数据库使用体 验。

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Pigsty经过长期迭代演进,久经实际生产环境考验,可免费用于测试生产。如需专业支持,Pigsty亦提供可选商业支持 与企业版订阅方案。

概览

快速了解Pigsty所解决的问题,采用的技术,适用的场景。

上手

基于vagrant,快速在本机拉起演示系统

概念

在使用Pigsty时需要了解的一些信息

界面

了解Pigsty提供的图形化用户界面

教程

如何配置与定制Pigsty

任务

高可用演练,数据库试用,一些可以在Pigsty中探索的任务

示例

在不同的环境中部署Pigsty

参考

Pigsty配置项细节参考

HA Agent Leader election

DCS







如何使用监控系统解决现实问题?



03 解决问题



常用指标

指标	缩写	层次	来源	种类
<mark>数据库负载</mark>	PG Load	DB	连接池	饱和度
<mark>数据库饱和度</mark>	PG Saturation	DB	连接池/节点	饱和度
主从复制延迟	Repl Lag	DB	数据库	延迟
平均查询响应时间	Query RT	DB	连接池	延迟
活跃后端进程数	Backends	DB	数据库	饱和度
数据库年龄	Age	DB	数据库	饱和度
CPU使用率	CPU Usage	SYS	机器节点	饱和度
每秒查询数	QPS	APP	连接池	流量
连接池排队数	Queue Clients	DB	连接池	错误
错误日志条数	Error Count	SYS/DB/APP	日志系统	错误

Pigsty 提供了约1200 个指标,但最重要的便是这10个

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QPS 4275	Commits 6458	Rollba 0
M	M	
Primary RT 2.11 ms	Replica RT 885 μs	Time Of 3.57
		MMMM
Active Servers 10	Queue Clients O	Age 0.01
Disk IO 2.3 MB/s	Mem Usage 9.9%	CPU Us 84.3
	QPS 4275 Primary RT 2.11 ms Active Servers 10	QPS 4275Commits 6458Primary RT 2.11 msReplica RT 885 µsActive Servers 10Queue Clients 0Queue Clients 0Disk IO 2.3 MB/sMem Usage 9.9%





核心指标 PG Load

衡量数据库的负载程度

归一化指标,PG活跃状态事务时长占CPU总可用时间之比

PG Load = TPS x AverageTransactionResponseTime / CPU Count

- record: pg:ins:xact_time_realtime
 expr: sum without (datname) (irate(pgbouncer_stat_total_xact_time{}[1m]))
- record: pg:ins:load0
 expr: pg:ins:xact_time_realtime / on (ip) group_left() node:ins:cpu_count

http://pigsty.cc/zh/blog/2020/05/29/postgresql%E7%9A%84kpi/







Overall Load : (200 + 400 + 800) / 2000 = 70%





核心指标 PG Saturation



饱和度用于反映数据库整体资源利用率 理论上应当取所有饱和度指标的最大值(PG,CPU,内存,网络,磁盘.....) PG Saturation = max(PG Load, CPU Usage, xxxUsage...)

实际应用中,饱和度指标取 PG Load与 CPU Usage的最大值作为饱和度

当数据库使用非独占式部署,其他应用占用CPU资源时, PG Saturation比单纯的PG Load更能反映数据库整体负载水位



衡量数据库的整体饱和度

- [-] 阿里云
- record: pg:ins:saturation0 expr: pg:ins:load0 > node:ins:cpu_usage or node:ins:cpu_usage
- record: pg:ins:saturation1 expr: pg:ins:load1 > node:ins:cpu_usage or node:ins:cpu_usage
- record: pg:ins:saturation5 expr: pg:ins:load5 > node:ins:cpu_usage or node:ins:cpu_usage
- record: pg:ins:saturation15 expr: pg:ins:load15 > node:ins:cpu_usage or node:ins:cpu_usage



水位评估:饱和度的历史分位点

过去一天中饱和度的99分位点

quantile_over_time(0.99, pg:cls:saturation15[1d])

		PgSQL Cluster Saturation
CI	uster	Saturation V
<u>pg-a</u>	<u>m-tt</u>	
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p	<u>tt</u>	
<u>pg-n</u>	ard13-tt	
<u>pg-</u>	ard6-tt	
<u>pg-i</u>	ard2-tt	
<u>pg-i</u>	ard9-tt	
<u>pg-n</u>	ard16-tt	
<u>pg-i</u>	ard5-tt	
<u>pg</u>	<u>t-tt</u>	
<u>pg-</u>	<u>12-tt</u>	
<u>pg</u> :	<u> 13-tt</u>	
<u>pg</u>	<u> 11-tt</u>	
<u>pg-</u>	<u>15-tt</u>	
Query 1	្មី Transform	1
Prometheus-	PgSQL ~ 🧿	> Query options MD = auto = 670 Interval = 15s
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Metrics ~	quantile_over_ti	<pre>ime(0.99, pg:cls:saturation15[1d])</pre>



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18.68%
17.98%
13.87%
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11.43%
11.02%



系统在99%的时间内 整体资源使用水平低于该值

根据您的具体场景与需求修改参数 例如:

过去一天 🖸 过去15天 99分位点 🖸 99.99分位点

用于水位评估 作为扩缩容,资源分配的依据





使用报警系统自动跟踪指标异常

```
# node avg CPU usage > 90% for 1m
- alert: NODE_CPU_HIGH
 expr: node:ins:cpu_usage > 0.90
 for: 1m
 labels:
   severity: P1
 annotations:
   summary: "P1 Node CPU High: {{ $labels.ins }} {{ $labels.ip }}"
   description:
     node:ins:cpu_usage[ins={{ $labels.ins }}, ip={{ $labels.ip }}] = {{ $value }} > 90%
     http://g.pigsty/d/node?&from=now-10m&to=now&viewPanel=28&fullscreen&var-ip={{ $label
# pg load1 high than 70% for 3m triggers a P1 alert
- alert: PGSQL_LOAD_HIGH
 expr: pg:ins:load1{} > 0.70
 for: 3m
 labels:
   severity: P1
 annotations:
   summary: "P1 PG Load High: {{ $labels.ins }} {{ $value }}"
   description:
     pg:ins:load1[ins={{ $labels.ins }}] = {{ $value }} > 70%
     http://g.pigsty/d/pg-instance?from=now-10m&to=now&viewPanel=210&fullscreen&var-ins={{ $labels.ins }}
```



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	A a.pigsty/#/alerts?silenced=false&inhibited=false&active=true&filter=%7Balertname @ C
	Alertmanager Alerts Silences Status Help
	Filter Group Receiver: All Silenced Inhibited
	alertname="NODE_CPU_HIGH" × Silence
	Custom matcher, e.g. env="production"
	- Collapse all groups
LS.IP }} -	alertname="NODE_CPU_HIGH" + 1 alert
	03:21:10, 2021-01-07 (UTC) – Info 🔀 Source 🔏 Silence
	description: node:ins:cpu_usage[ins=pg-test-2, ip=10.10.10.12] = 0.995000000000045 > 90% http://g.pigsty/d/node?&from=now- 10m&to=now&viewPanel=28&fullscreen&var-ip=10.10.10.12
	summary: P1 Node CPU High: pg-test-2 10.10.10.12
	cls="pg-test" + instance="10.10.10.12:9100" + ip="10.10.10.12" + job="pg" + role="primary" + severity="P1" +
	svc= pg-test-primary +





慢查询是数据库的大敌,这里我们使用 pgbench 用例模拟一个慢查询 ALTER TABLE pgbench_accounts DROP CONSTRAINT pgbench_accounts_pkey ; 该命令会移除 pgbench_accounts 表上的主键,导致相关查询变慢,系统瞬间雪崩过载。

单个从库实例的QPS从500下降至7, Query RT下降至300ms



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系统负载达到200%,触发机器负载过大,与查询响应时间过长的报警规则。





首先,使用PG Cluster面板定位慢查询所在的具体实例,这里以 pg-test-2为例 然后,使用PG Query面板定位具体的慢查询:编号为-6041100154778468427

器 pigsty / PG Query ☆ ペ								th i t	6	Ø	Ģ	<	2021
Instance pg-test-2 ~ Datname	test ~ Query	-104648775090	05170237 ~									≡ 0v	erview
~ Query Overview													
		Da	tabase Stateme	entes									ç
Query	Call	Call (rate1h)	Total	Total (rate1h)	RT	RT (rate1m)	Min	Max					
<u>-6041100154778468427</u>	2,245,867	476	6.3 min	102.8 ms	0.17 ms	0.31 ms	0.0065 ms	564 ms					
-1046487750905170237	2,508	0.5	29.5 s	5.8 ms	12 ms	0.013 ms	2.4 ms	30 ms					
<u>-7334410209165201802</u>	2,507	0.5	3.9 s	0.8 ms	1.6 ms	0.0064 ms	0.71 ms	23 ms					
5437899044496199443	450	0.089	3.2 s	0.7 ms	7.0 ms	0.042 ms	2.9 ms	90 ms					
<u>-9004258043330316261</u>	450	0.089	2.9 s	0.6 ms	6.3 ms	0.036 ms	2.8 ms	50 ms					
5497173621618854516	2,507	0.5	1.8 s	0.4 ms	0.70 ms	0.0048 ms	0.22 ms	32 ms	-	-60411	0015477	7846842	27
<u>-3092441162199975189</u>	450	0.089	1.1 s	0.2 ms	2.5 ms	0.011 ms	1.3 ms	19 ms		-73344	1020916	552018	37 02
5760961677013624247	2,507	0.5	559.8 ms	0.1 ms	0.22 ms	0.0011 ms	0.088 ms	13 ms		 54378 -90042 	9904449 5804333	619944 3031620	.3 61
6064237788636688634	2,507	0.5	368.9 ms	0.1 ms	0.15 ms	0.0011 ms	0.047 ms	10 ms		54971	7362161	885451	6
-4397529236085442437	2.507	0.5	396.7 ms	0.1 ms	0.16 ms	0.00042 ms	0.071 ms	6.1 ms		57609	5167701	362424	17
		Query Call										9	Stateme
600 ops						current ~	300 ms						
600 ops 500 ops				-604110	0154778468427	<mark>current</mark> ∽ 7 ops	300 ms						
600 ops 500 ops 400 ops				604110 - 9101975	0154778468427 98370095556	current ∽ 7 ops 1 ops	300 ms 250 ms						
600 ops 500 ops 400 ops				 -604110 9101975 7226155 	0154778468427 98370095556 5749781812196	current ∨ 7 ops 1 ops 1 ops	300 ms 250 ms 200 ms						
600 ops 500 ops 400 ops 300 ops				 -604110 9101975 7226155 6064237 	0154778468427 98370095556 6749781812196 788636688634	Current ∽ 7 ops 1 ops 1 ops 1 ops	300 ms 250 ms 200 ms 150 ms						
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600 ops 500 ops 400 ops 300 ops 200 ops 100 ops				 -604110 9101975 7226155 6064237 5760961 5497173 4771330 	0154778468427 98370095556 749781812196 788636688634 677013624247 6621618854516 9347278832148	Current ∽ 7 ops 1 ops 1 ops 1 ops 1 ops 1 ops 1 ops	300 ms 250 ms 200 ms 150 ms 100 ms 50 ms						
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600 ops 500 ops 400 ops 300 ops 200 ops 100 ops 0 ops 17:53 17:54 2.5 s 2.0 s 1.5 s 1.0 s	17:55 17:56 Statemer	17:57 ht Time Spend per	17:58 r Second	 -604110 9101975 7226155 6064237 5760961 57497173 4771330 4218728 2256769 	0154778468427 98370095556 749781812196 788636688634 677013624247 6621618854516 9347278832148 093343264628 00154778468427 7750905170237 0209165201802 8043330316261 044496199443	current ∨ 7 ops 1 ops	300 ms 250 ms 200 ms 150 ms 100 ms 50 ms 0 s 17:5 12.5 ms 10.0 ms 7.5 ms 5.0 ms	3 17:54		17:55	17	:56 State	17:5 ement R
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Statement RT Ranking

17:57

17:58

E 407470 (04 (400E 4E4 (
- 549/1/3621618854516	4 m
2525476255033030486	1 m
LUC 1007200606600601	1 m
	current ~
1046487750905170237	11.77 m

		ourront
	— -1046487750905170237	11.77 ms
	- 5437899044496199443	7.05 ms
	9004258043330316261	6.34 ms
	-3092441162199975189	2.46 ms
	7334410209165201802	1.55 ms
	— 5497173621618854516	0.70 ms
	- 7418061961315158265	0.40 ms
	— 3573345566830082659	0.25 ms
	- 5760961677013624247	0.22 ms

该查询表现出:

响应时间显著上升: 17us 升至 280ms 从500下降到 7 QPS 显著下降: 花费在该查询上的时间占比显著增加

可以确定:

就是这个查询变慢了!





接下来,利用PG Stat Statements面板,根据查询ID定位慢查询的具体语句。

<u>-6041100154778468427</u>	<u>test</u>	19353	SELECT abalance FROM pgbenc
-2525476255033030486	<u>test</u>	16385	SE: "SELECT abalance FROM po
2951481090153650440	<u>test</u>	16385	aid = \$1" SE

分析查询后提出猜想: 该查询变慢是pgbench_accounts表上aid列缺少索引

下一步, 查阅 PG Table Detail面板, 检查 pgbench_accounts 表上的访问



通过观察,我们发现表上的索引扫描归零,与此同时顺序扫描却有相应增长。这印证了我们的猜想!

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查询以 aid 作为过滤条件查询 pgbench_accounts 表 查询变慢,大概率是这张表上的索引出了问题。





我们尝试在 pgbench_accounts 表上为 aid 列添加索引, 看看能否解决这个问题。

12 ms

7 ms

7 ms

2 ms

2 ms

593 µs

581 µs

328 µs

016 ...

current ~

11.78 ms

7.13 ms

6.53 ms

2.55 ms

1.57 ms

0.73 ms

0.40 ms

0.25 ms

0 22 m

CREATE UNIQUE INDEX ON pgbench_accounts (aid);





可以看到,查询的响应时间与QPS已经恢复正常。 整个集群的负载水平也恢复正常,报警也平息下来。







精准衡量优化效果,直观展示工作成绩,真正做到数据驱动。



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