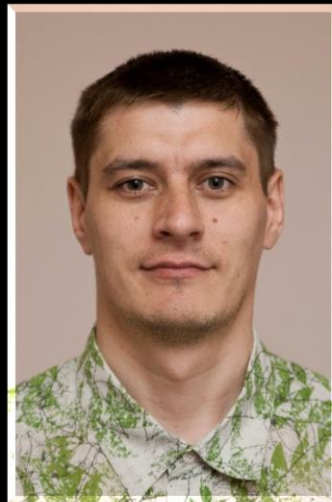


DOT  
NEXT

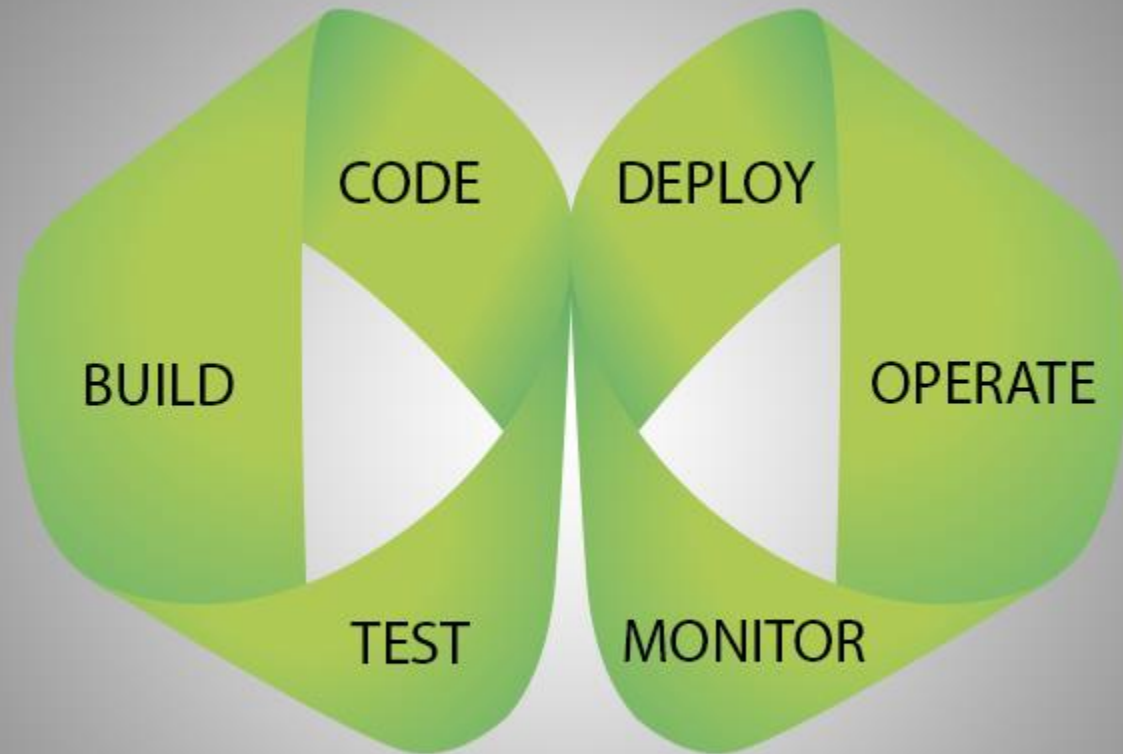


Anatoly Kulakov

The Metrix has you...







# Why metrics?

- **Troubleshooting & Remediation**  
*- Where did the problem occur?*
- **Performance & Cost**  
*- How my changes impact overall performance?*
- **Learning & Improvement**  
*- Can I detect or prevent this problem in the future?*
- **Trends**  
*- Do I need to scale?*
- **Customer Experience**  
*- Are my customers getting a good experience?*



NET-КОНФЕРЕНЦИЯ  
В РОССИИ;



Event Viewer (Local)

Custom Views

Windows Logs

- Application
- Security
- Setup
- System
- Forwarded Events

Applications and Services Logs

Subscriptions

Security

Number of events: 51,565 (!) New events available

Keywords	Date and Time	Source	Event ID	Task Category
Audit Failure	30.09.2017 13:04:24	Microsoft Windows security auditing.	4656	File System
Audit Success	30.09.2017 13:04:24	Microsoft Windows security auditing.	4611	Security System Extension
Audit Failure	30.09.2017 13:04:24	Microsoft Windows security auditing.	4656	File System
Audit Success	30.09.2017 13:04:24	Microsoft Windows security auditing.	4611	Security System Extension
Audit Failure	30.09.2017 12:37:34	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:36:14	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:34:57	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:34:56	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:34:55	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Success	30.09.2017 12:34:42	Microsoft Windows security auditing.	4672	Special Logon
Audit Success	30.09.2017 12:34:42	Microsoft Windows security auditing.	4624	Logon
Audit Failure	30.09.2017 12:34:41	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:34:37	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:34:31	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Success	30.09.2017 12:33:03	Microsoft Windows security auditing.	4985	File System
Audit Success	30.09.2017 12:33:03	Microsoft Windows security auditing.	4985	File System
Audit Failure	30.09.2017 12:31:15	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:15	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:10	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:10	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:10	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:06	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:06	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:31:03	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:30:11	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:30:03	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Failure	30.09.2017 12:29:46	Microsoft Windows security auditing.	4673	Sensitive Privilege Use
Audit Success	30.09.2017 12:30:20	Microsoft Windows security auditing.	4985	File System

Event 4656, Microsoft Windows security auditing.

General

Details

A handle to an object was requested.

Subject:

Security ID:AKulakov

Account Name:AKulakov

Account Domain:PAL

Logon ID:0x6b3e6

Log Name:

Security

Source:

Microsoft Windows security

Event ID:

4656

Level:

Information

User:

N/A

OpCode:

Info

More Information:

Event Log Online Help

Logged:

30.09.2017 12:27:34

Task Category:

Other Object Access Events

Keywords:

Audit Failure

Computer:

AKulak.com

Actions

Security

Open Saved Log...

Create Custom View...

Import Custom View...

Clear Log...

Filter Current Log...

Properties

Find...

Save All Events As...

Attach a Task To This Log...

View

Refresh

Help

Event 4656, Microsoft Windows security auditing.

Event Properties

Attach Task To This Event...

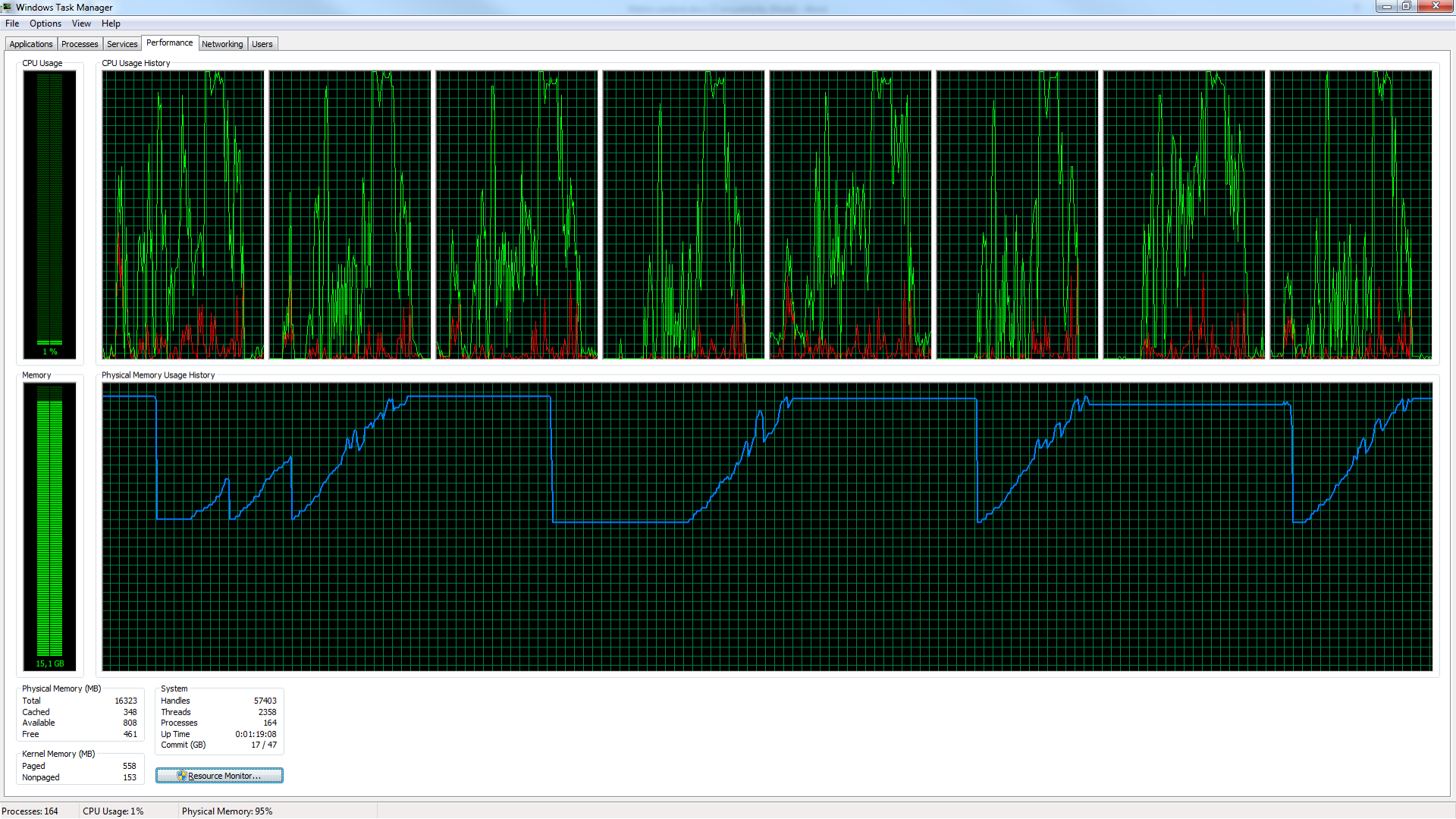
Copy

Save Selected Events...

Refresh

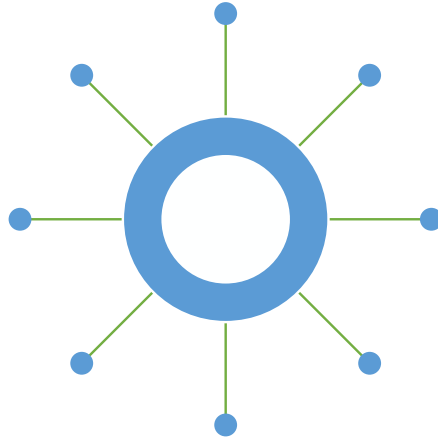
Help







**200** hosts



**100** measurements



every **10** sec

× **86 400**  
seconds in a day



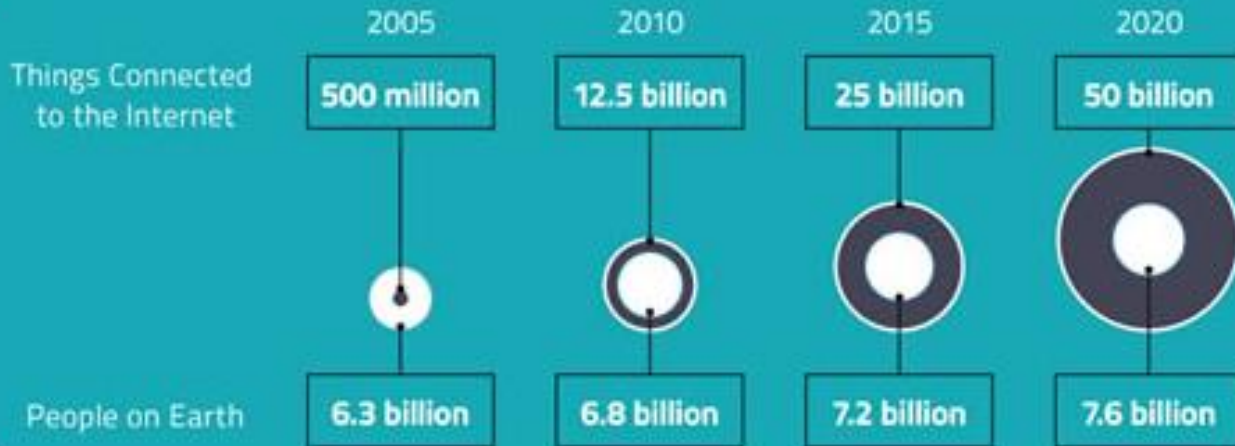
**172 800 000**  
points per day





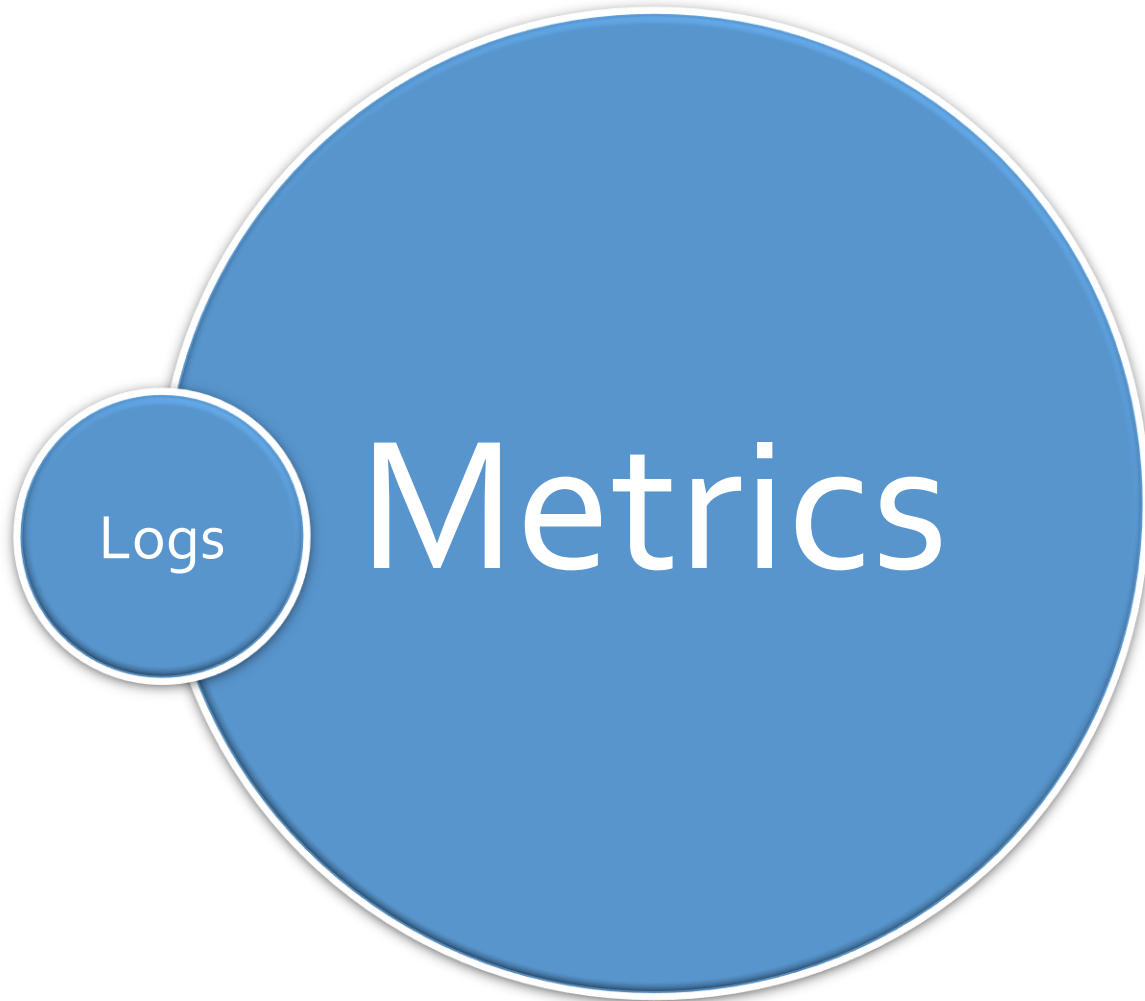
By 2020, there will be  
**50 billion devices**  
connected to the internet.

<https://www.i-scoop.eu/internet-of-things-guide/>

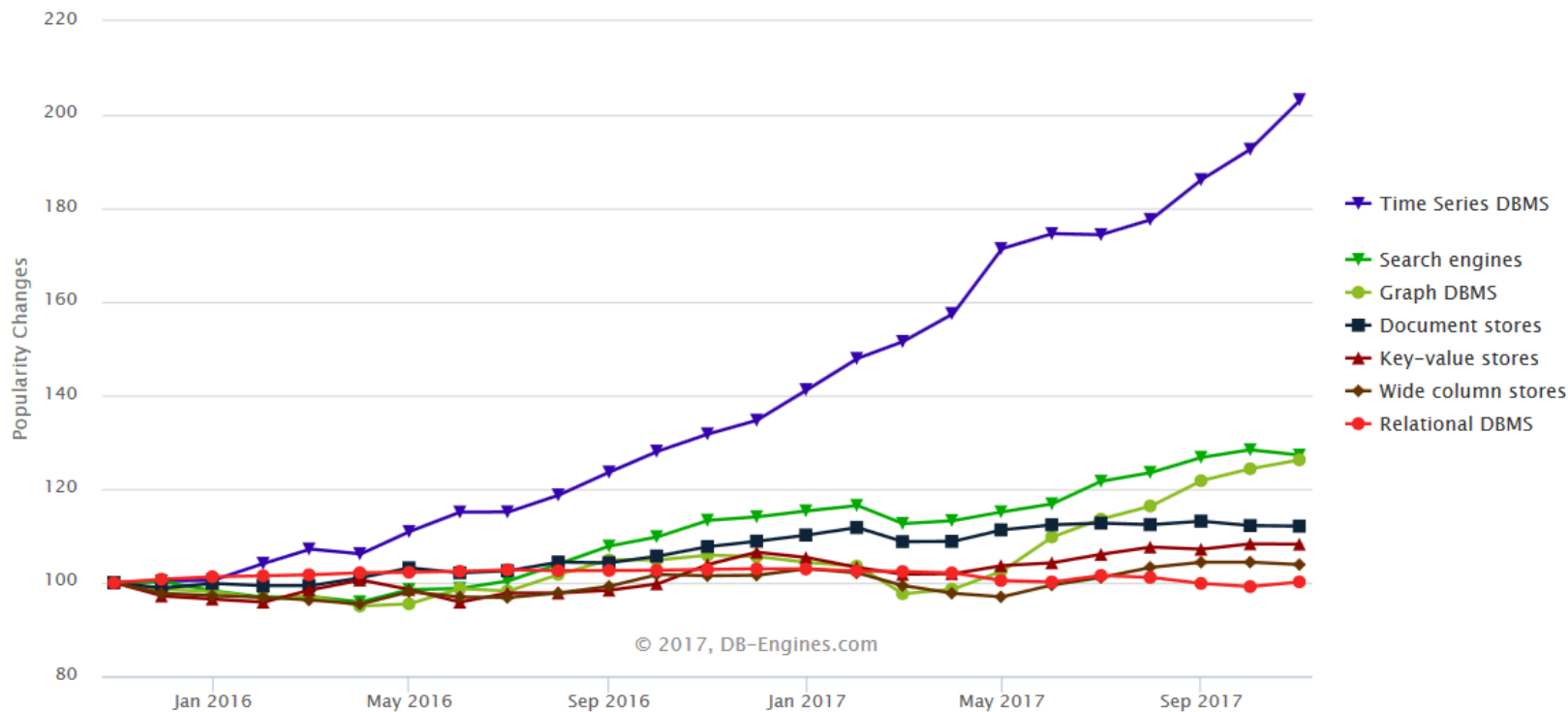


Source: Cisco IBSG





# DBMS by model popularity



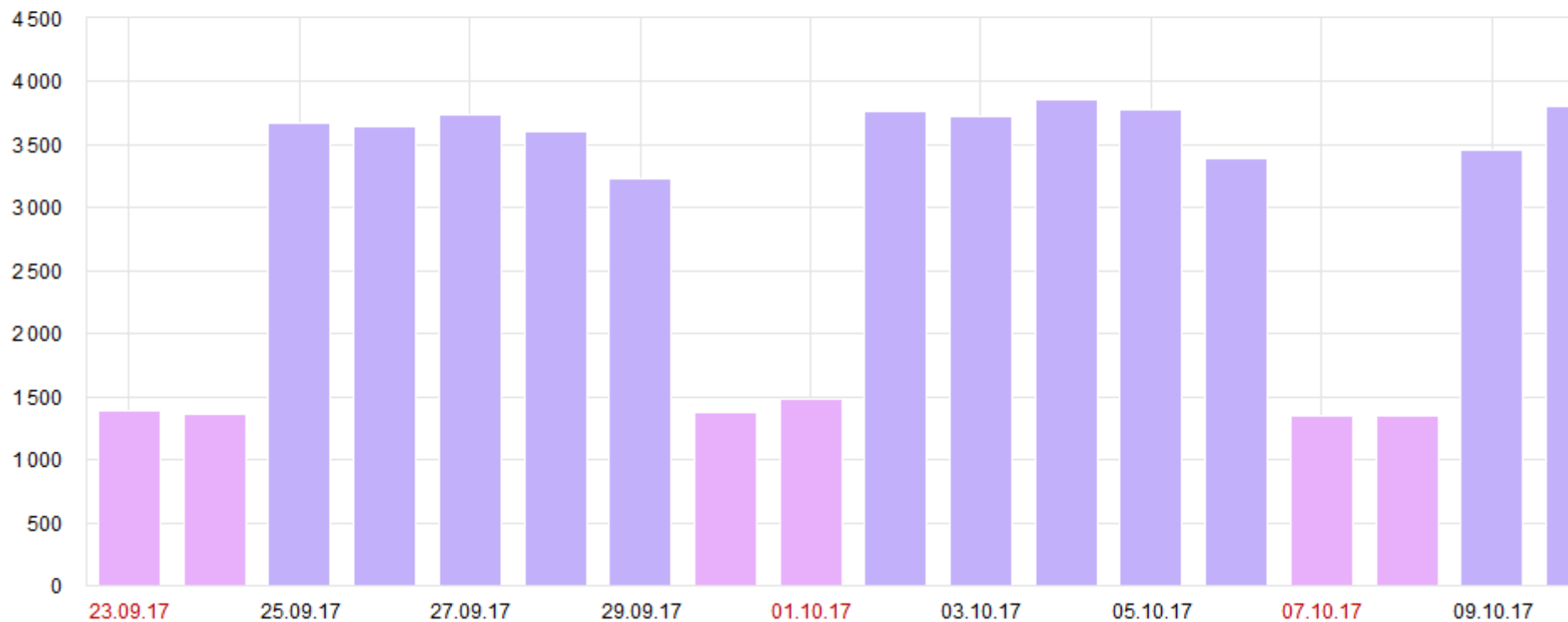
[https://db-engines.com/en/ranking\\_categories](https://db-engines.com/en/ranking_categories)

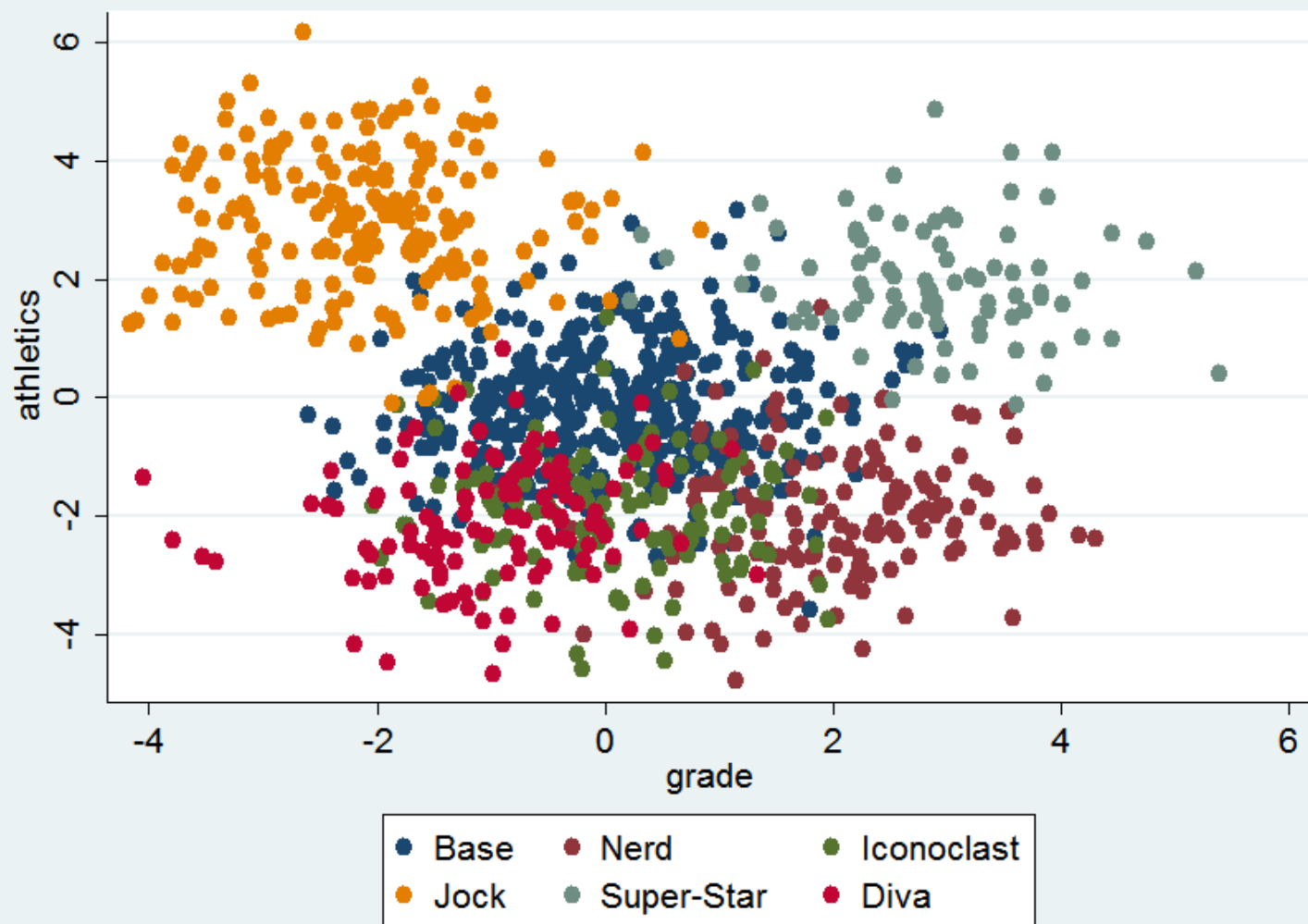
Сегодня Вчера Неделя **Месяц** Квартал Год

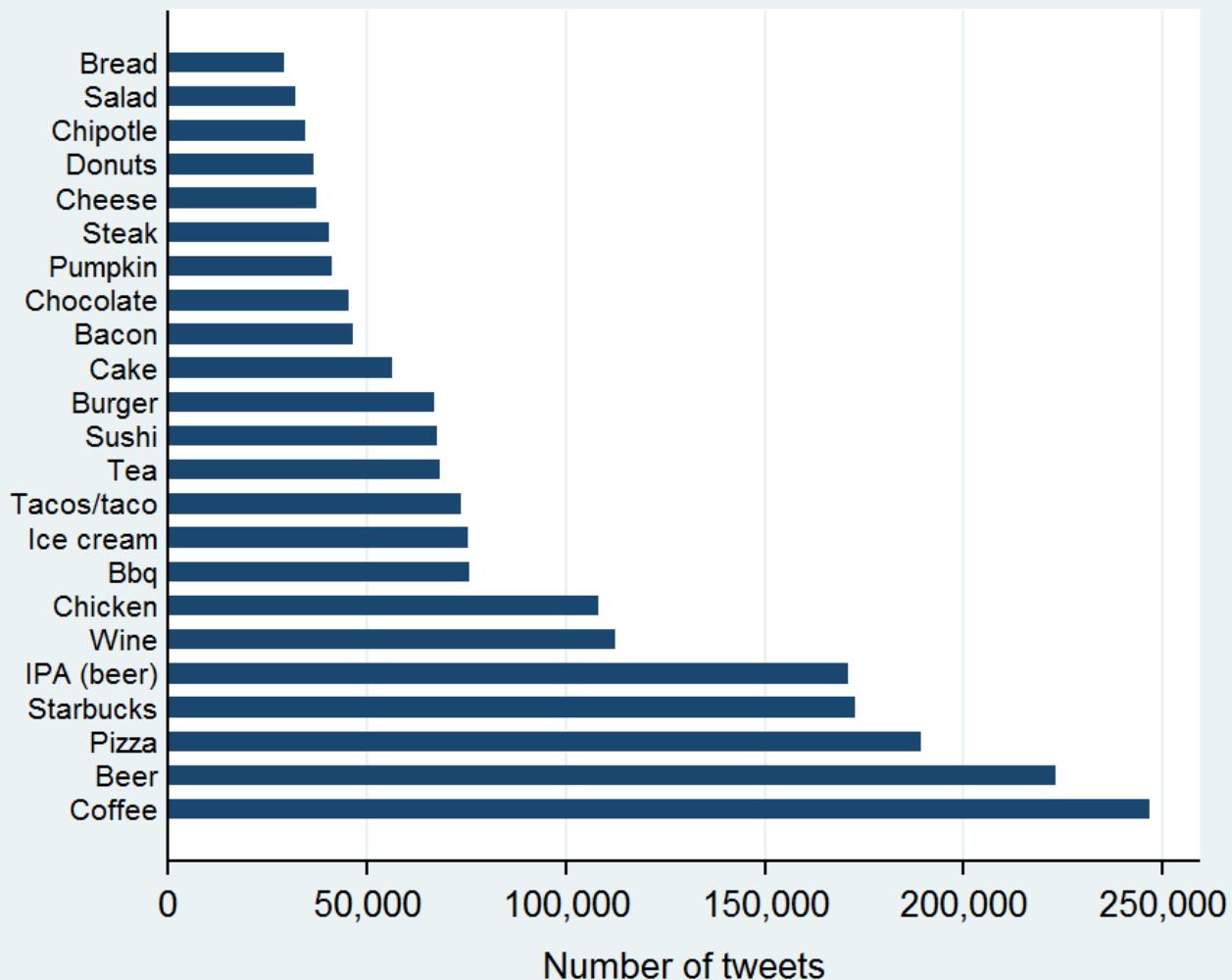
23 сен — 22 окт 2017

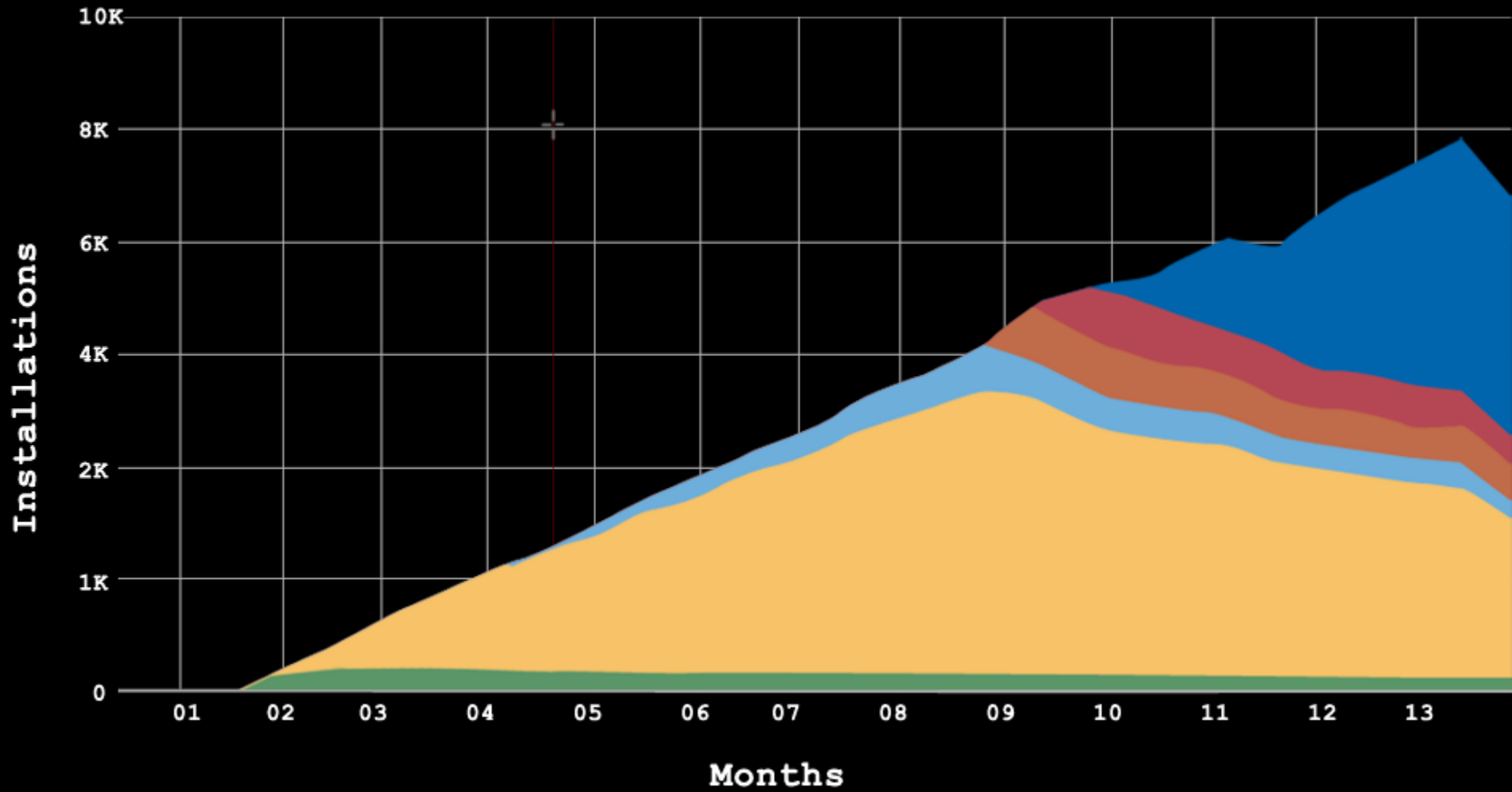
Детализация: по дням

## Визиты

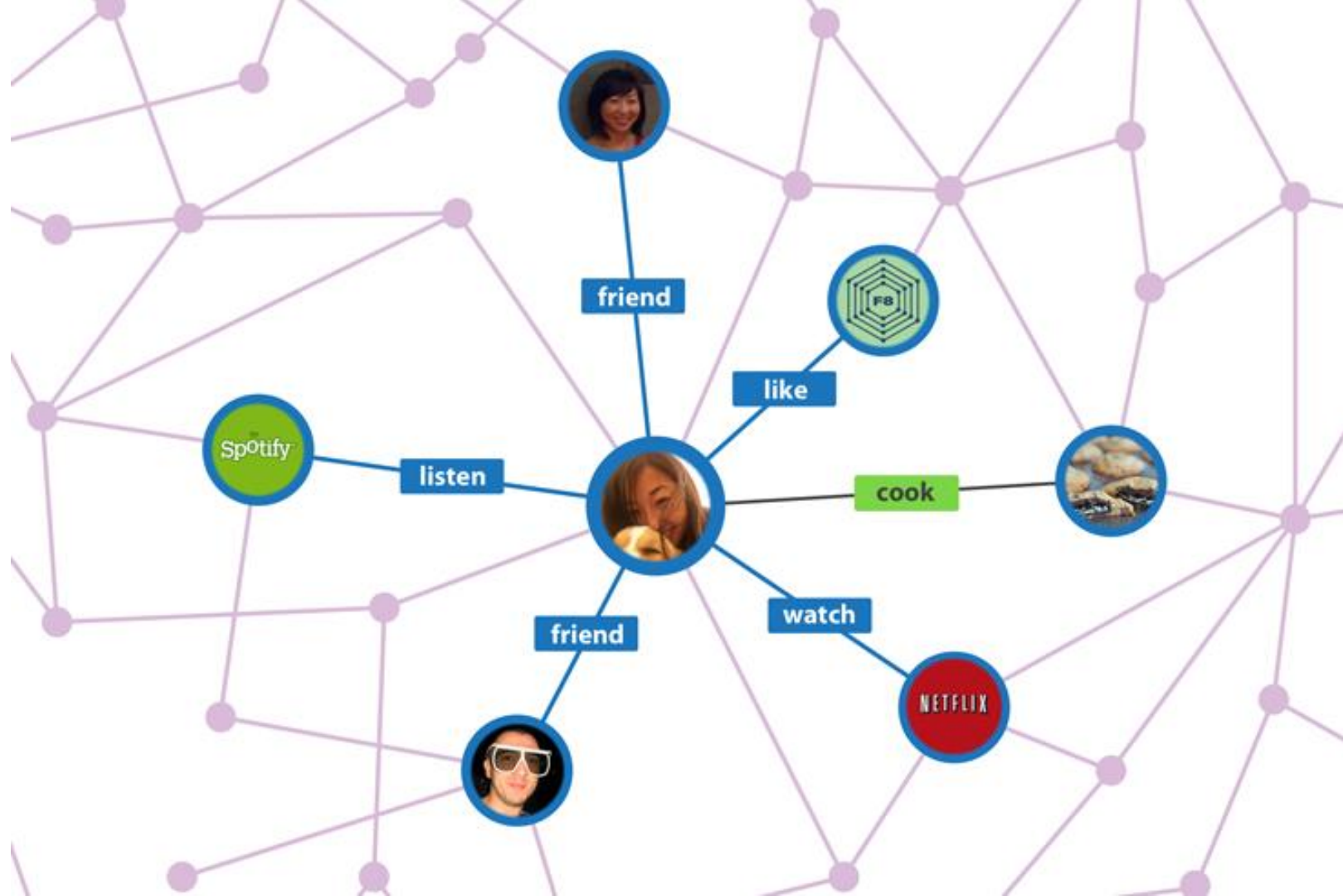












# Microsoft Corporation

NASDAQ: MSFT - Oct 20, 7:59 PM EDT

**78.81** USD ↑0.90 (1.16%)

After-hours: 78.81 0.00%

1 day

5 day

1 month

3 month

1 year

**5 year**

max



Open 78.32

High 78.97

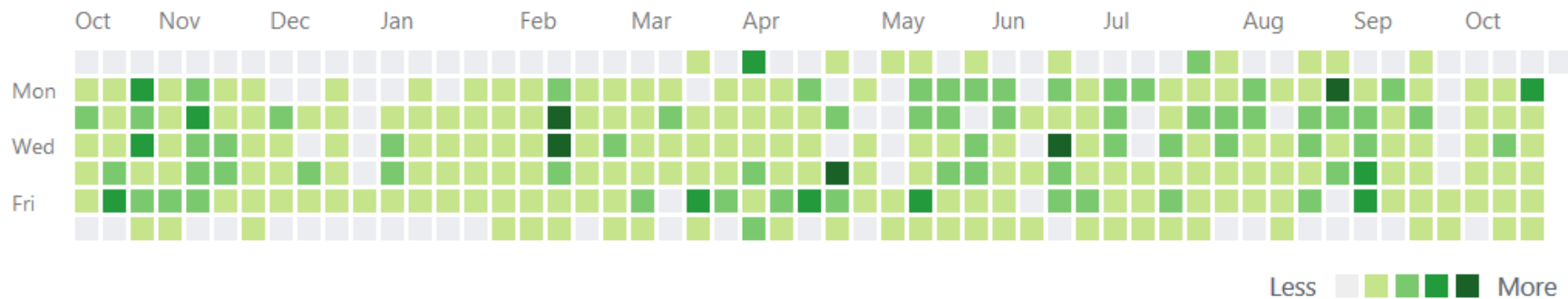
Low 78.22

Mkt cap 608.05B

P/E ratio 29.1

Div yield 2.13%

2,271 contributions in the last year





14 человек  
купили этот товар  
на этой неделе



14 человек  
купили этот товар  
на этой неделе



*la***moda**

# Time Series structure

## Network

### Timestamp



2017-11-12T06:42:17

2017-11-12T06:43:18

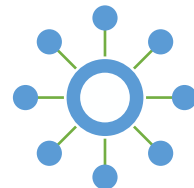
### Tags



host = **dev**  
if = **eth1**

host = **dev**  
if = **wlan1**

### Fields



rx = **42**  
tx = **10**

rx = **50**  
tx = **88**

# Time Series analogy

## Network

Timestamp



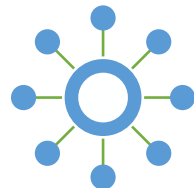
Primary Key

Tags



Indexed Column

Fields



Not Indexed Column

# Time Series size

## Network

Timestamp



DateTime

**8 bytes**

*2017-11-12T06:42:17*

Tags



string[]

**≈ 24 bytes**

*dev, eth1, ...*

Fields



double

**8 bytes**

*42.0173, 1.0, ...*



**BIG DATA, HDFS, S3?**

I ♥  
BigData

**2 BYTES, CARL!**



*bzip2*

# Series

## Network

Tags



host = **dev**  
if = **eth1**

host = **dev**  
if = **wlan1**



network,host=dev,if=eth1

network,host=dev,if=wlan1

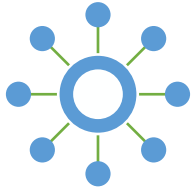
# Timestamp



	<u>Delta</u>	<u>Delta 2</u>
2017-11-12T06:00:00	-	-
2017-11-12T06:00:05	05	-
2017-11-12T06:00:10	05	0
2017-11-12T06:00:15	05	0

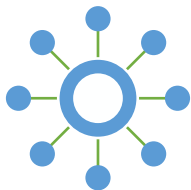
«We have found that about **96%** of all time stamps can be compressed to a **single bit**.»

# Fields



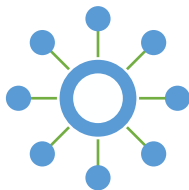
Decimal
15.5
14.0625
3.25
8.625

# Fields



Decimal	Double Representation
15.5	0x402f000000000000
14.0625	0x402c200000000000
3.25	0x400a000000000000
8.625	0x4021400000000000

# Fields



Decimal	Double Representation	XOR with previous
15.5	0x402f000000000000	
14.0625	0x402c200000000000	0x0003200000000000
3.25	0x400a000000000000	0x0026200000000000
8.625	0x4021400000000000	0x002b400000000000

«Roughly **51%** of all values are compressed to a **single bit**»

«... compress time series to an average of **1.37 bytes** per point»



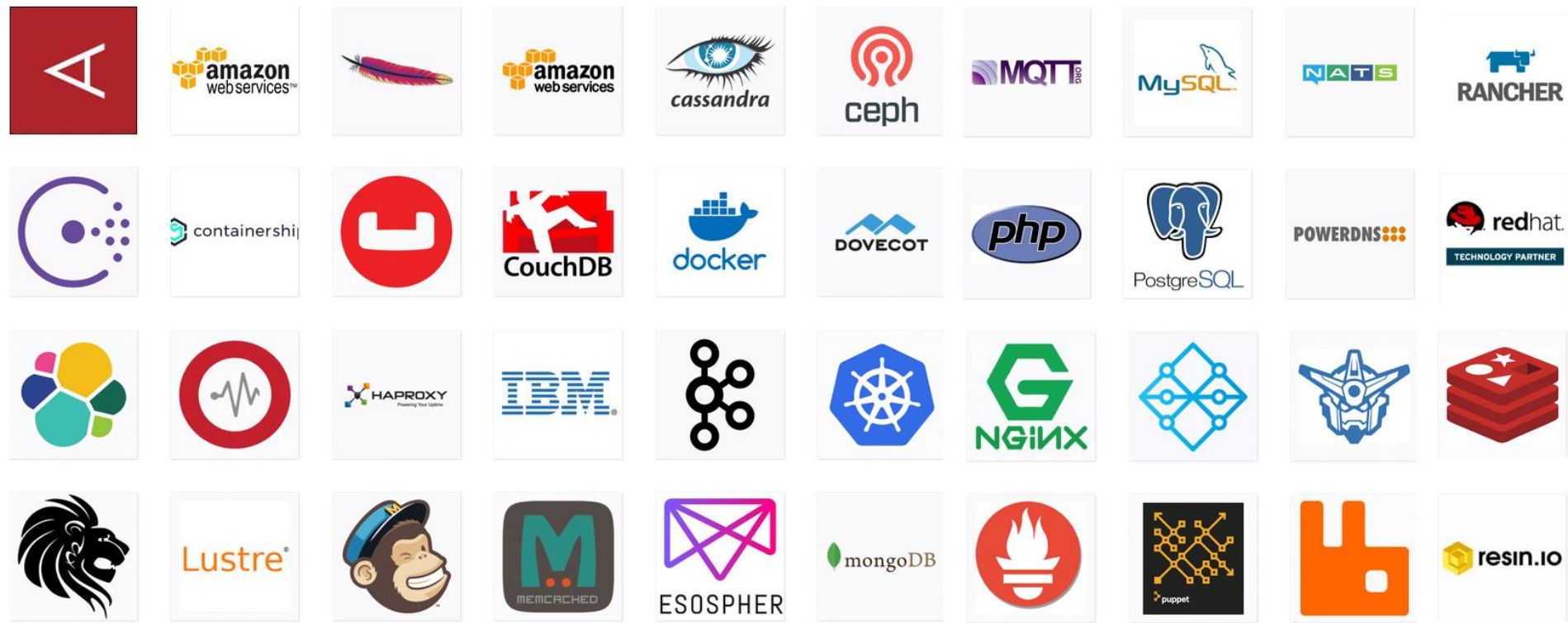
# Time Series sources

- Performance Counters
- Third party statistics API
- Event Tracing for Windows
- Application measurements

# Telegraf



# Telegraf Integrations





Demo powered by

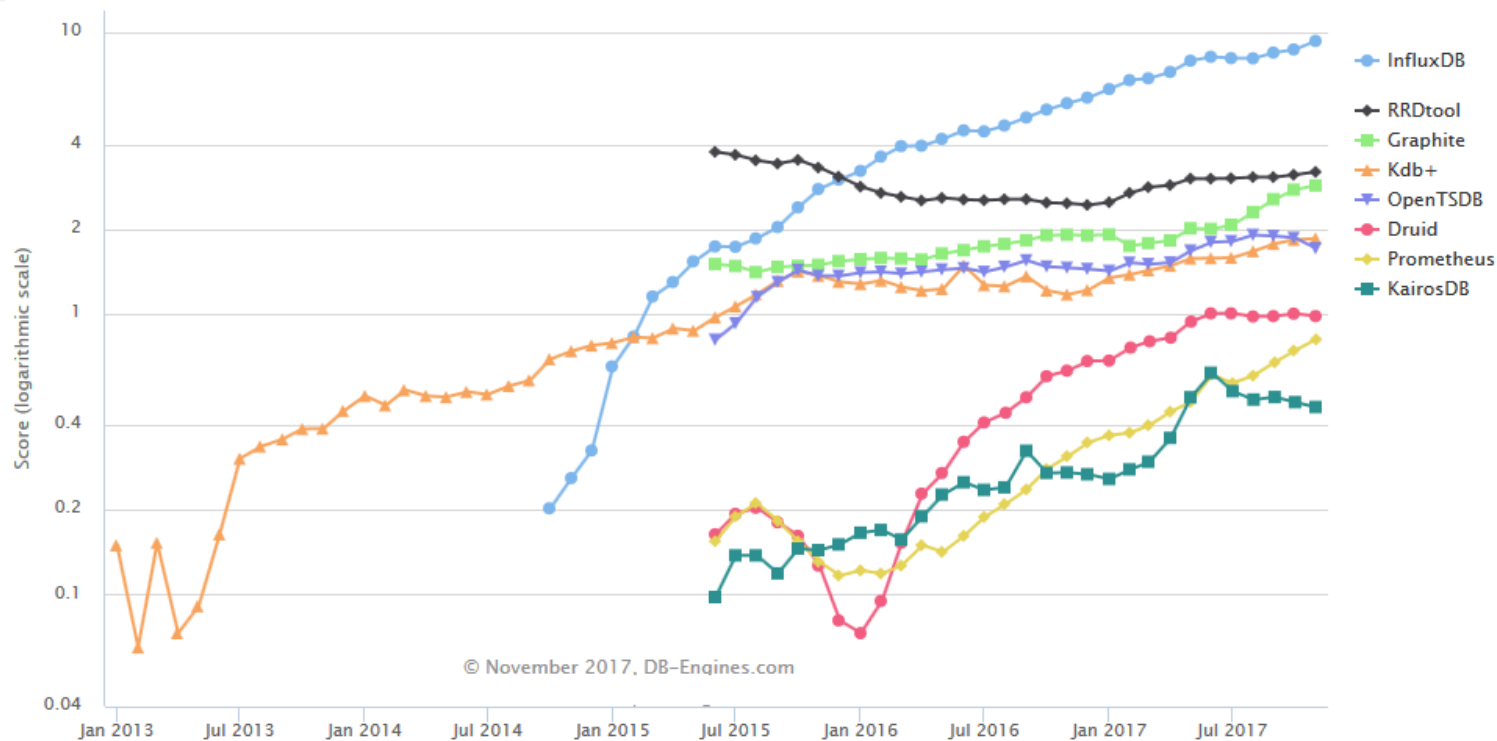


Telegraf



**InfluxDB**

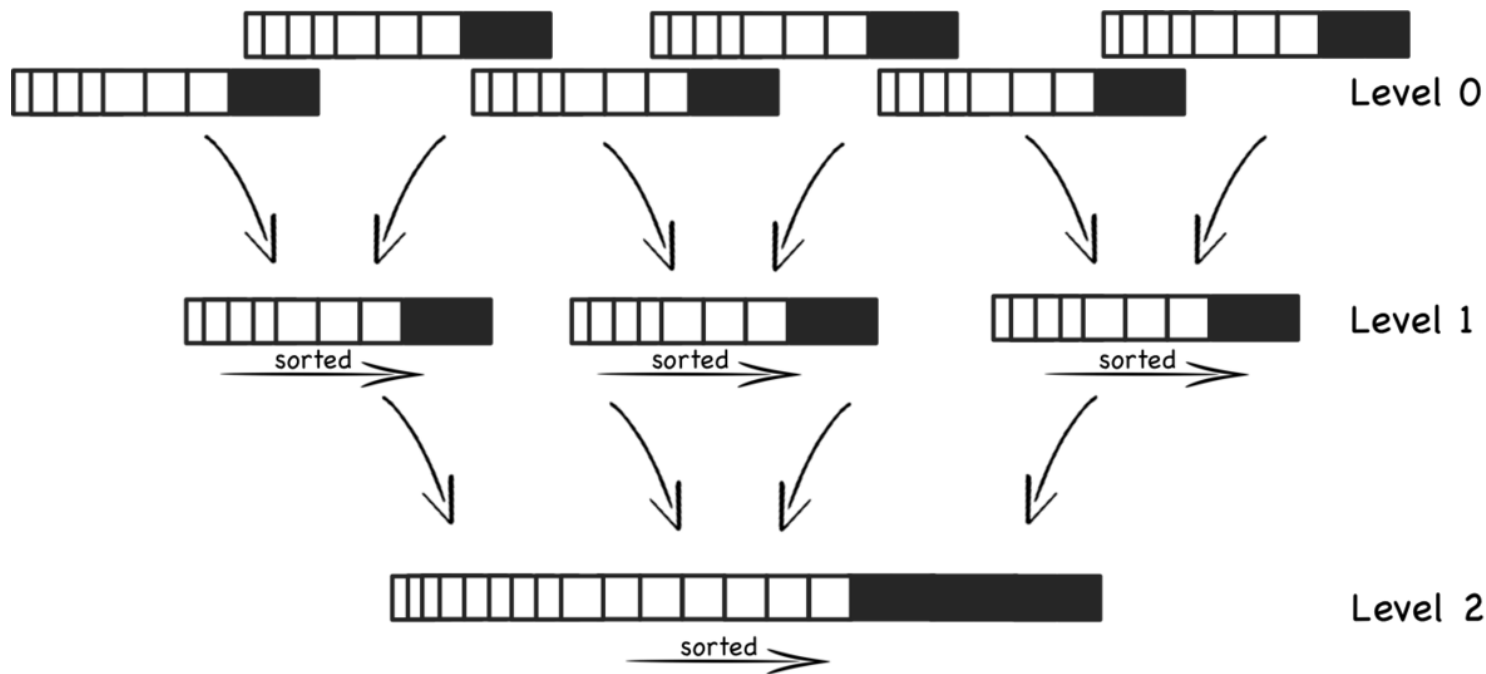
# Time Series DBMS Popularity



# Specifics of the workloads

- Billions of individual data points
- High write throughput
- High read throughput
- Large deletes (data expiration)
- Mostly an insert/append workload, very few updates

# Time-structured merge-tree

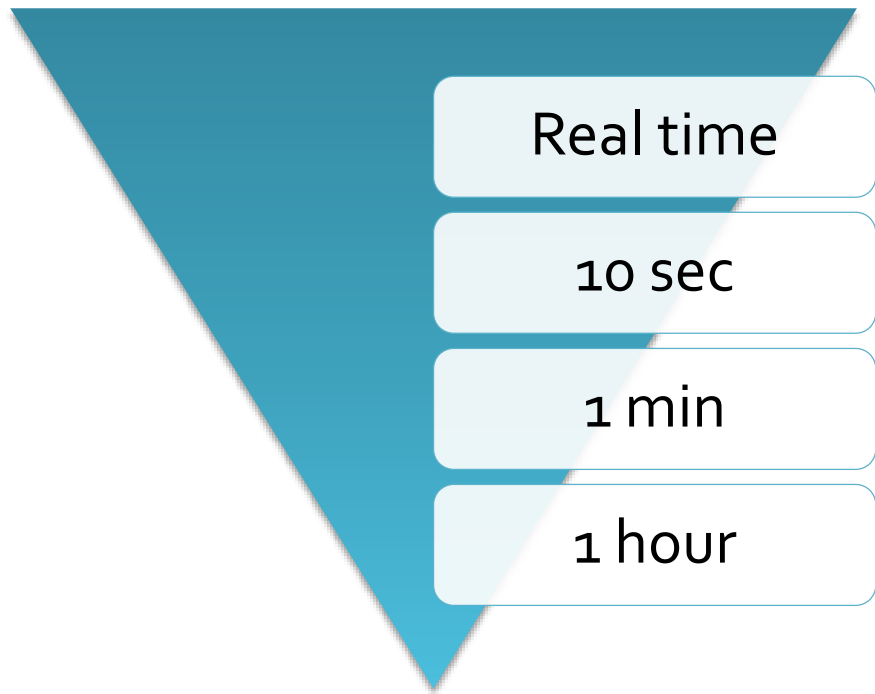




# InfluxQL

```
SELECT median(rx), mean(tx)
FROM network
WHERE time > now() - 15m
      AND host = 'dev'
GROUP BY time(10s)
```

# Retention policies



# Single node performance

CPU: 4-6 cores  
RAM: 8-32 GB  
IOPS: 500-1000



# Single node performance

CPU: 4-6 cores  
RAM: 8-32 GB  
IOPS: 500-1000

Load	Field writes per second	Queries per second	Unique series
Low	< 5 thousand	< 5	< 100 thousand
Moderate	< 250 thousand	< 25	< 1 million
High	> 250 thousand	> 25	> 1 million
Infeasible	> 750 thousand	> 100	> 10 million

# Mortal Kombat

InfluxDB



OPENTSDDB



*cassandra*



mongoDB

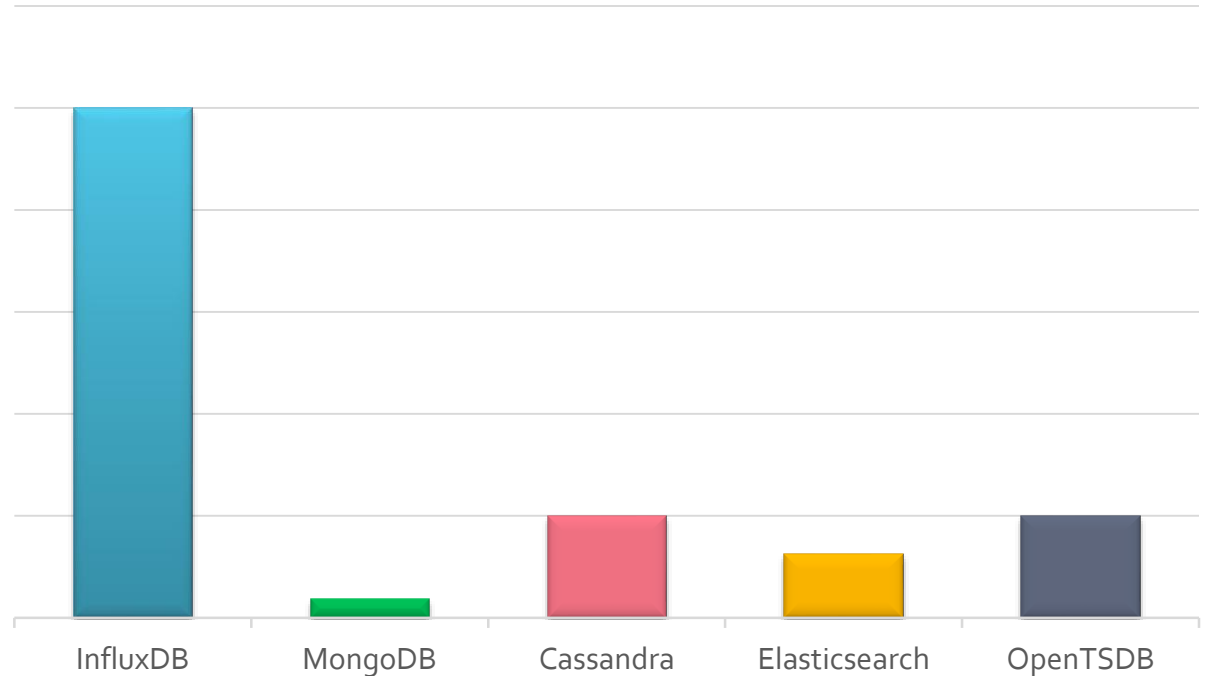


elasticsearch

## Write Performance

InfluxDB outperformed:

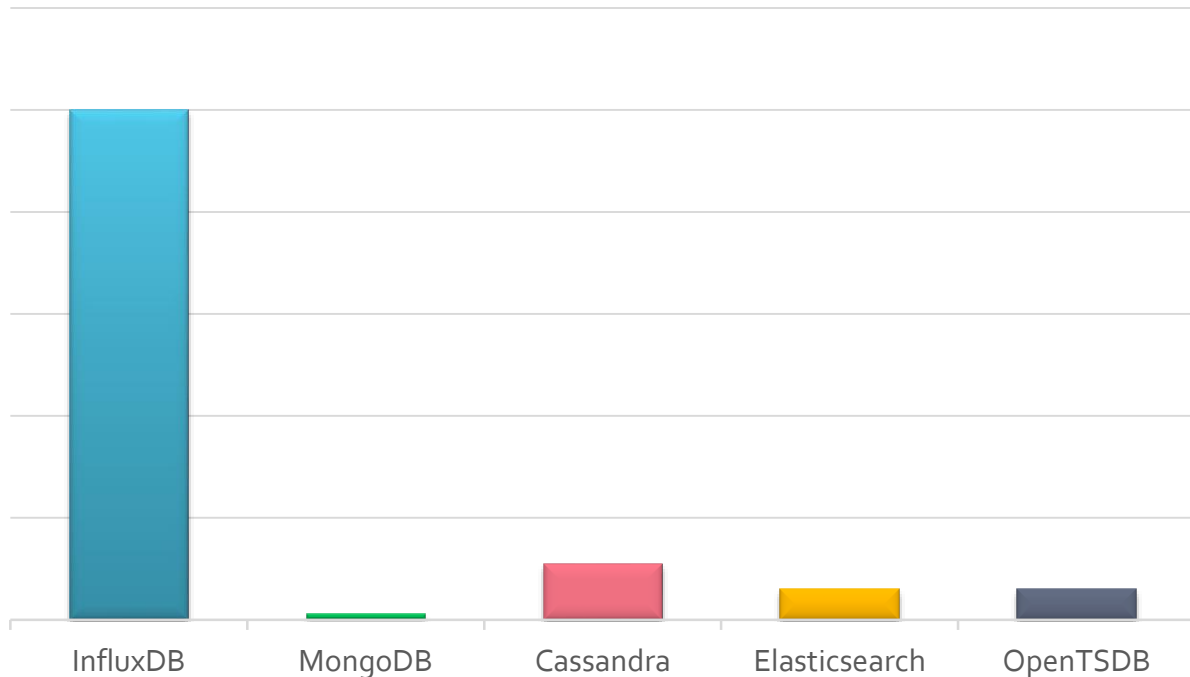
- MongoDB by **27x**
- Cassandra by **5x**
- Elasticsearch by **8x**
- OpenTSDB by **5x**



# Compression

InfluxDB outperformed:

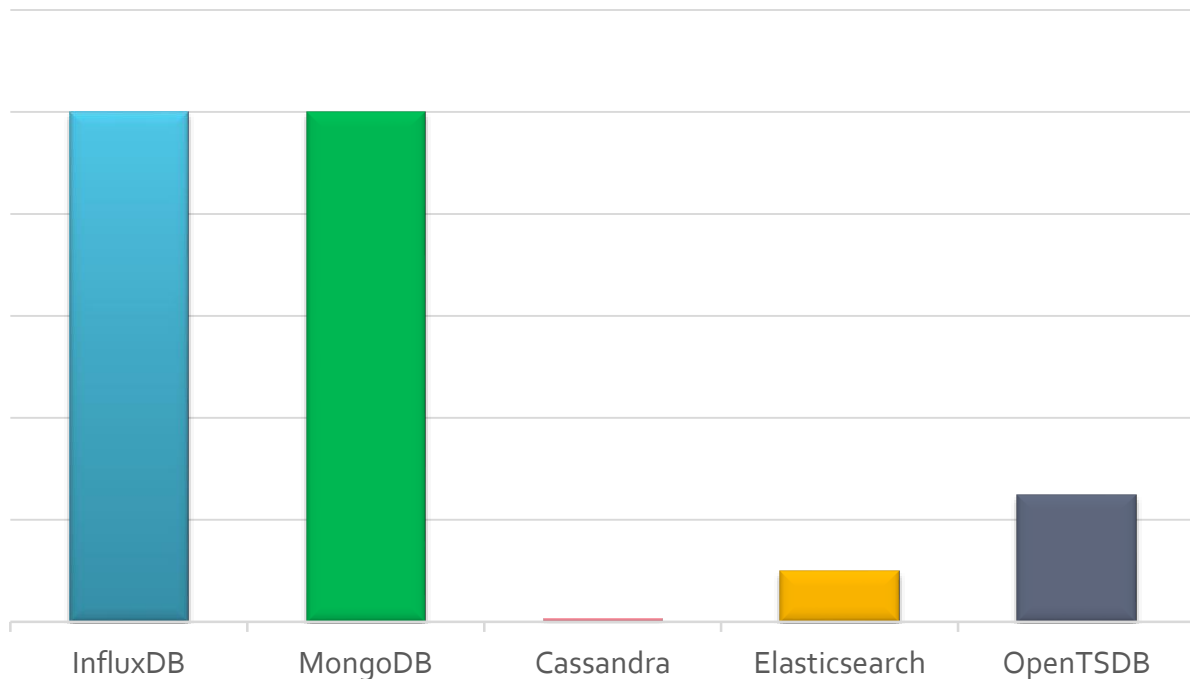
- MongoDB by **84x**
- Cassandra by **9x**
- Elasticsearch by **16x**
- OpenTSDB by **16x**



## Query Performance

InfluxDB outperformed:

- MongoDB similarly
- Cassandra by **168x**
- Elasticsearch by **10x**
- OpenTSDB by **4x**





DEMO POWERED BY



APPMETRICS



InfluxDB  
Grafana



# First Step

- Install [Telegraf](#) and [Dashboard](#)
- Install [AppMetrics](#) and [Dashboard](#)
- Use it
- Remove unnecessary metrics
- Add new application-specific metrics

Demo powered by



# BenchmarkDotNet

Powerful .NET library for benchmarking



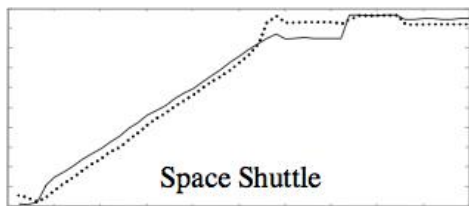
Demo powered by



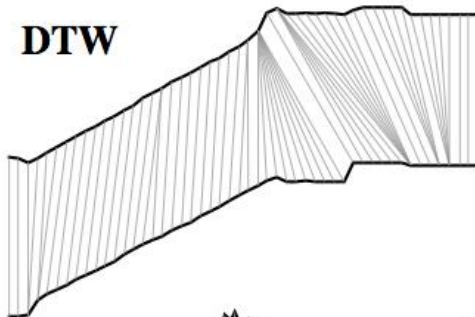
# BenchmarkDOTNEXT

Powerful .NET library for benchmarking

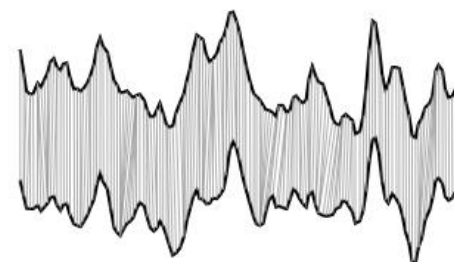
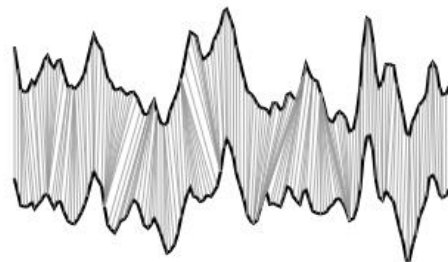
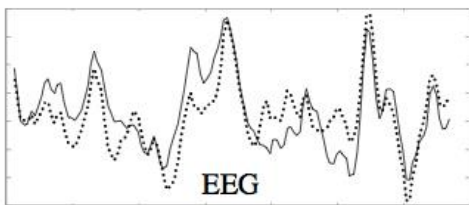
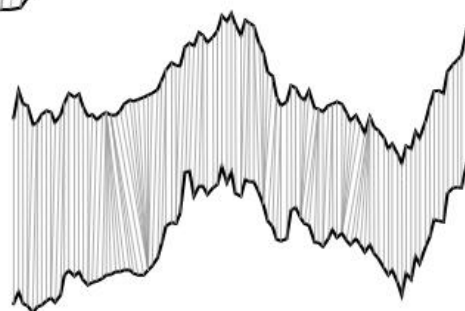
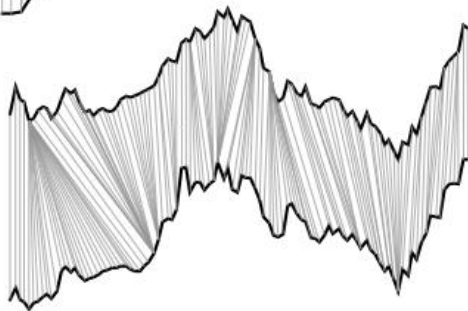
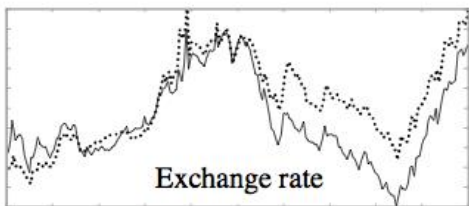
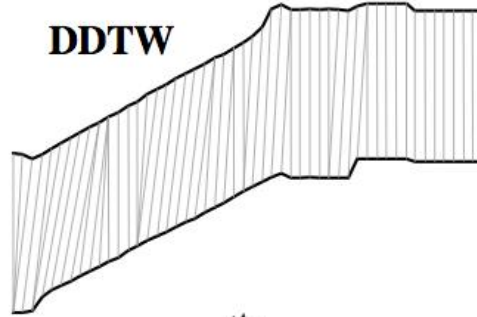




**DTW**



**DDTW**













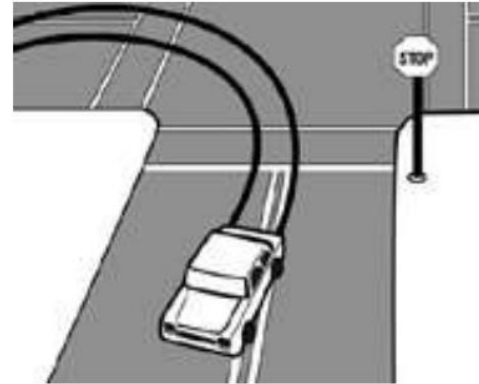
(a)weaving



(b)drifting



(c)swerving



(d)turning with wide radius

*Telegraf*

*InfluxDB*

*Chronograf*

*Kapacitor*

Agent for collecting  
and reporting metrics

*Telegraf*

*InfluxDB*

*Chronograf*

*Kapacitor*

Time series database

*Telegraf*

*InfluxDB*

*Chronograf*

*Kapacitor*

User interface for:

- monitoring
- alert management
- data visualization
- db management

*Telegraf*

*InfluxDB*





*Chronograf*

*Kapacitor*

Data processing  
framework for:

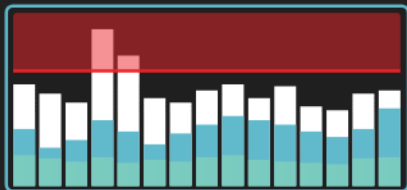
- create alerts
- run ETL jobs
- detect anomalies

# Grafana

 35 data sources,  28 panels,  16 apps and  530 dashboards available.



Graphite



2017-3-9-13:13:00	329 °F	249 °F
2017-3-9-13:12:50	315 °F	315 °F
2017-3-9-13:12:40	270 °F	255 °F
2017-3-9-13:12:30	309 °F	232 °F
2017-3-9-13:12:20	228 °F	228 °F



Elasticsearch



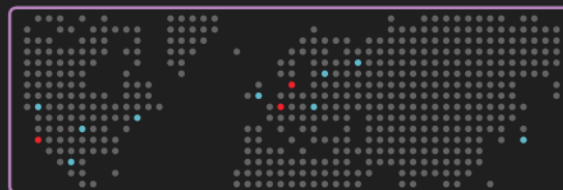
Cloudwatch



InfluxDB

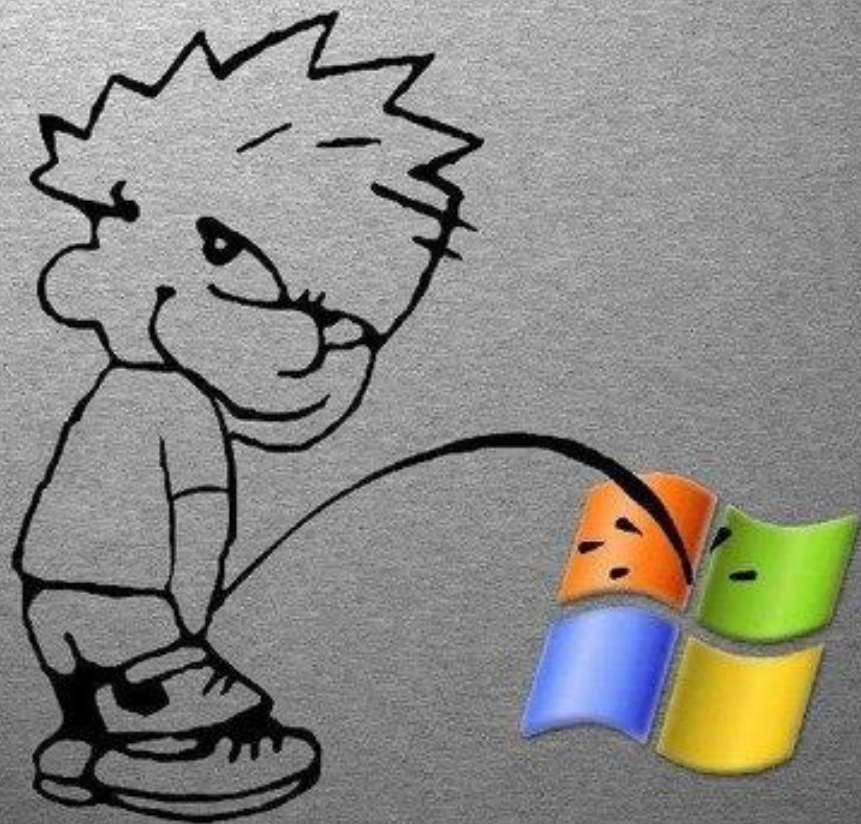


Prometheus



Hosted Metrics







**Realtime Analysis**

**High Loads**

**Query and Write  
performance**

**Compression**

**High Throughput**

**Retention Policy**



**Statistics and  
Aggregation**

**Downsampling**

**Continuous Queries**

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**Continuous Queries**



# Realtime Analysis

High Loads

Compression

Retention Policy

Statistics and  
Aggregation



# Realtime Analysis

High Loads

Compression

Retention Policy



# Realtime Analysis

High Loads

Compression





# Realtime Analysis

**High Loads**



## Realtime Analysis







# Resources

- [Gorilla Paper](#)
- [Akumuli](#)
- [Run-length encoding](#)
- [Varints](#), [ZigZag](#)
- [Dynamic time warping](#)
- [Sketch-based change detection](#)

# Resources

- InfluxData Docs ([docs.influxdata.com](https://docs.influxdata.com))
- Grafana Docs ([docs.grafana.org](https://docs.grafana.org))
- App Metrics ([app-metrics.io](https://app-metrics.io))
- Non-Sucking Service Manager ([nssm.cc](https://nssm.cc))

# Resources

- [Anatoly.Kulakov@outlook.com](mailto:Anatoly.Kulakov@outlook.com)
- [twitter.com/KulakovT](https://twitter.com/KulakovT)
- [github.com/AnatolyKulakov](https://github.com/AnatolyKulakov)
- [SpbDotNet.org](http://SpbDotNet.org)

