PostgreSQL @ TOMTOM – lessons learned

pgconf.eu 2016

TOMTOM

About us

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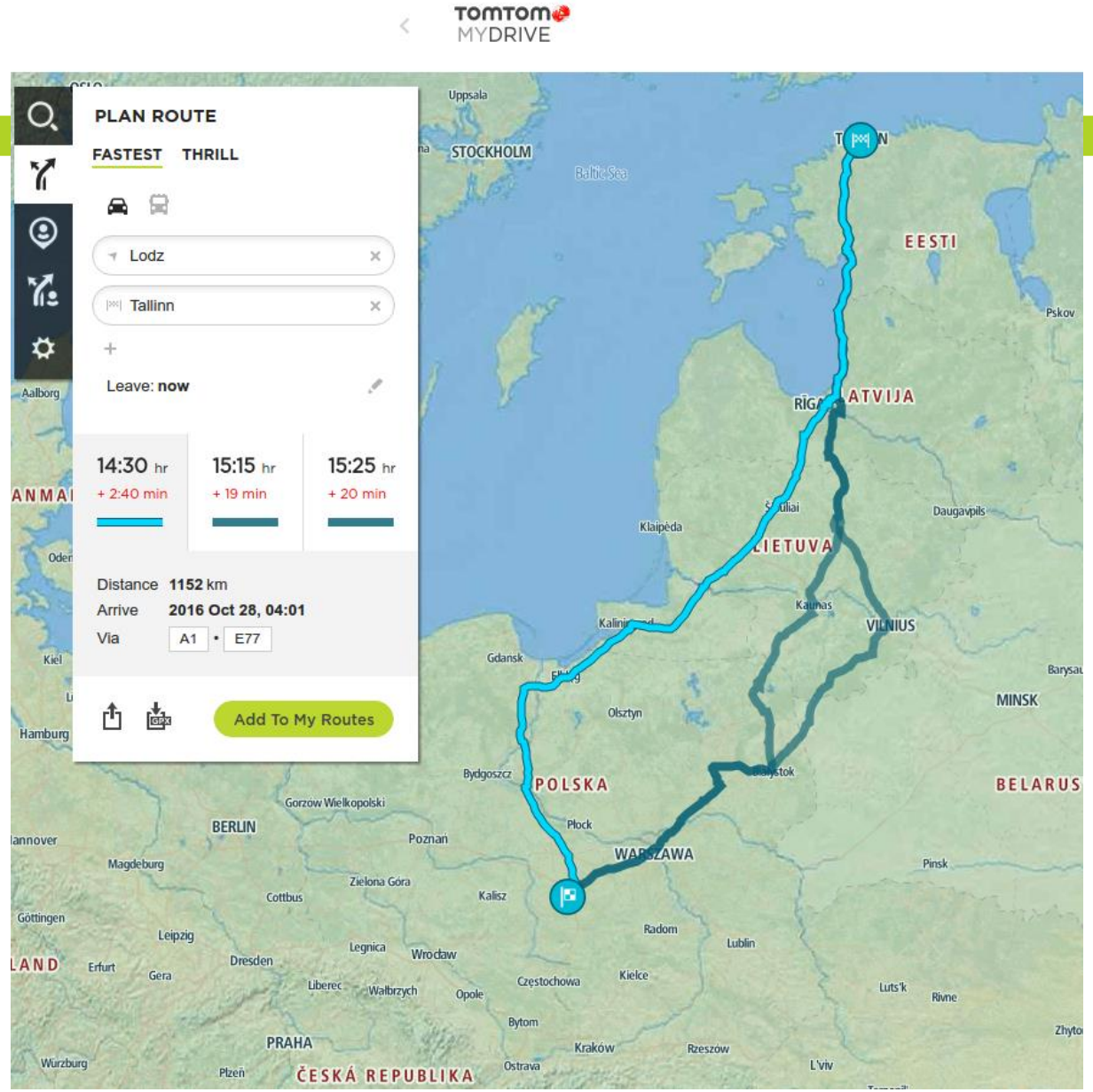
We are from Łódź, Poland!



TomTom – What do we do?

The New TomTom Go

The New TomTom VIO

Motorcycle

Camper & Caravan

Mobile

Business to Business

TOMTOM SPORTS

GET FIT GET BETTER GET OUT THERE

TomTom - What do we do?

- ✓ Database with spatial features
- ✓ Massive automated tools
- ✓ 2000+ of manual editors
- ✓ Billions of map objects

Map Making Platform

- ✓ Database Machines – 200+ machines (40 cores, 256GB RAM, RAID 10 ssd drives)
- ✓ Queries count – over 600k per second
- ✓ Inserted rows count 15k per second
- ✓ Storage – 30TB
- ✓ Daily db size increase – 200GB
- ✓ Reads : Writes ~ 100 : 1

PostgreSQL + PostGIS

- ✓ Out-off-the-box extension for geometry types
- ✓ Processing and analytic functions
- ✓ Spatial predicates: intersects, covers, covered by, inside
- ✓ Spatial GIST index on geometry (based on bounding boxes)
- ✓ Hint: spatial queries faster on simplified geometry

Query optimization: it is all about indexes

- ✓ Run analyze to update pg_statistics

  “ALTER TABLE SET STATISTICS to 1000” for large tables

- ✓ Benchmark queries on production data using “explain analyze”
- ✓ Changing parameters may completely change query plan
- ✓ Indexes are not for free - increases disk size and row insert time
- ✓ Multicolumn Indexes - order of columns in B-tree index definition does matter for quer

Customer table

name	order_date	type
John	2016-09-01	Paid
Alan	2016-09-02	Unpaid

idx_customer (name, order_date)

idx_type (type, order_date)

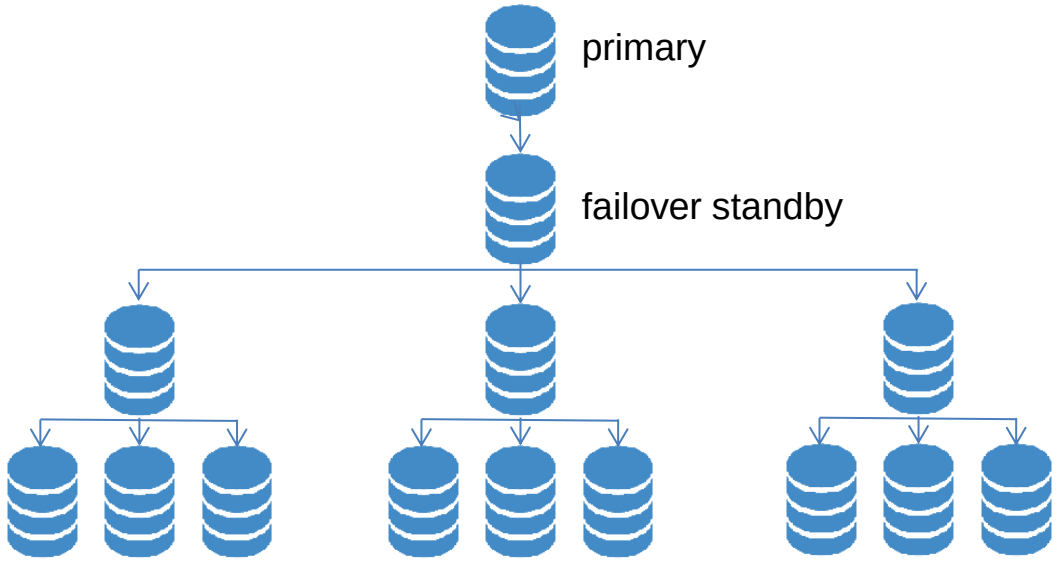
check out:
https://explain.depesz.com
http://use-the-index-luke.com/

Query optimization: index bloat

- ✓ Check bloat on indexes: updates, inserts, deletes causes increased latency of query execution time and increases size of indexes
- ✓ Remove not used indexes (pg_stat_all_indexes view shows usage)
- ✓ Requires “reindex” (locks entire table for writes) or re-creating an index

Replication: streaming replication

- ✓ Streaming vs logical
- ✓ Replication tree – failover
- ✓ Application is prechecking if data is available on standby
- ✓ Standby in physical replication is read-only
- ✓ Initial copy: rsync vs pg_basebackup.



Check out:
https://wiki.postgresql.org/wiki/Streaming_Replication

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Replication: replication lag

- ✓ High CPU/IO load
- ✓ Check with query: "SELECT now() - pg_last_xact_replay_timestamp()" or in pg_stat_replication view
- ✓ Graphite feed from nagios plugin
- ✓ Separate volumes for data, xlog, logs, pg_stats
- ✓ Use WALs compression for slow network – since 9.5 (increased CPU usage both on master and standby)
- ✓ Configuration tuning:

```
wal_keep_segments = 330000 # 5TB of WALs

max_wal_senders = 10
```

Replication: replication vs checkpoints

- ✓ Checkpoint configuration tuning:

  checkpoint_completion_target = 0.9

  checkpoint_timeout = 1h

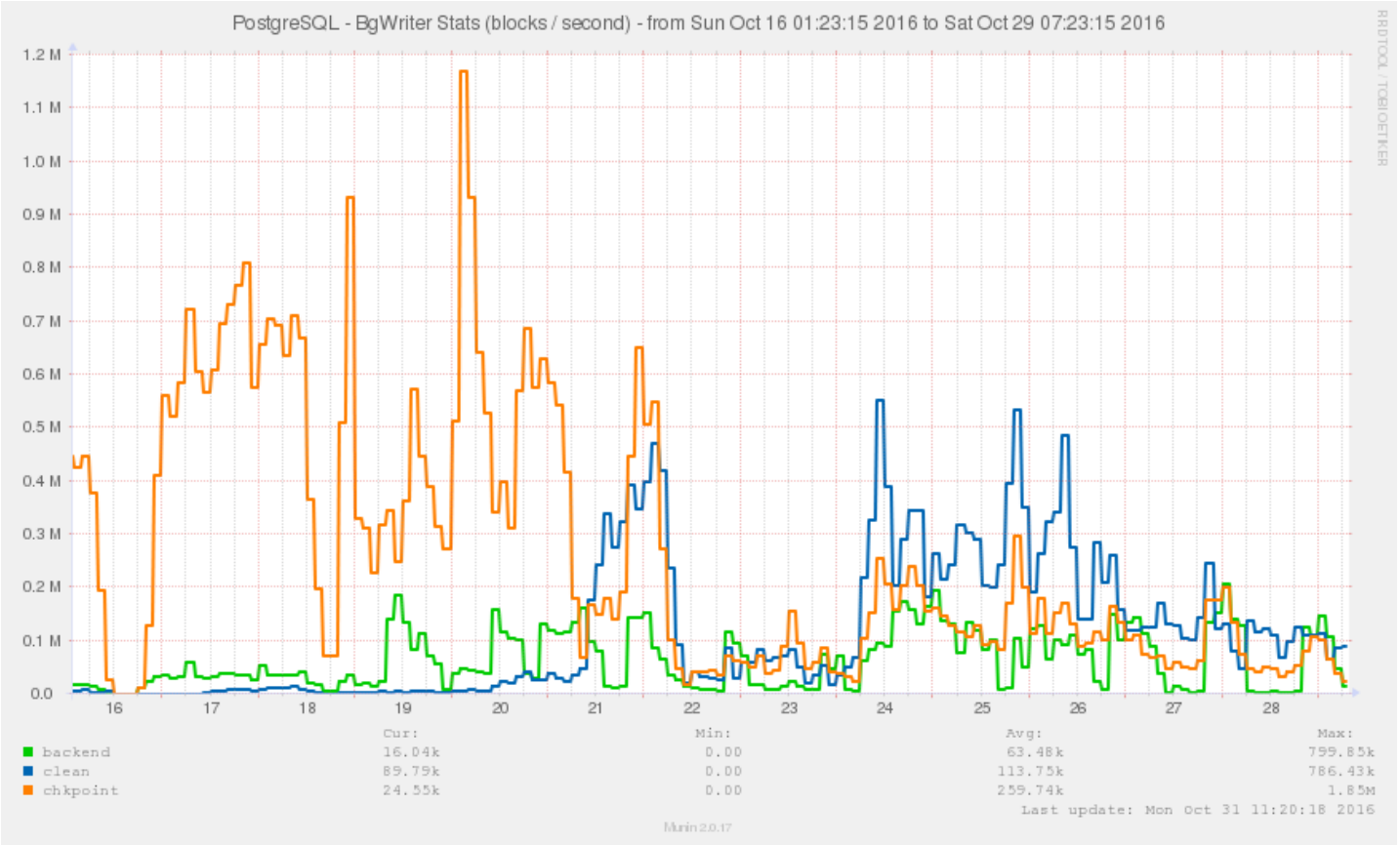
  checkpoint_warning = 30s

  max_wal_size = 100GB

  min_wal_size = 1GB

  bgwriter_delay = 50ms

  bgwriter_lru_maxpages = 2000



Database High Availability

What we learned you cannot do in live production system:

- ✓ Vacuum full -> well tuned autovacuum instead (more WALs)
- ✓ Create index -> Create index concurrently (takes longer)
- ✓ Reindex -> Create copy of index and switch with original (needs extra disk space)

DDL under control

- ✓ Versioning and tracking database layout with Liquibase
- ✓ Changes tested on pre-production environments – it lowers risk of human error and inconsistencies
- ✓ Rollback logic

```
<changeSet id="journaltransactions_index" author="TomTom">
    <createIndex tableName="journaltransactions"
    indexName="journal_version_index" schemaName="${schemaName}">
        <column name="txn_version" />
    </createIndex>
    <sql>
        CREATE INDEX CONCURRENTLY journal_geometry_extremes_index
        ON
        ${schemaName}.journaltransactions
        USING gist(txn_geometry_extremes)
    </sql>
    <rollback>
        <sql>
            DROP INDEX CONCURRENTLY ${schemaName}.journal_geometry_extremes_index;
        </sql>
    </rollback>
</changeSet>
```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Query optimization - monitoring

- ✓ Use statistics collector

  pg_stat_activity, pg_stats_statements

- ✓ Configuration in postgresql.conf

  log_min_duration_statement = 20000

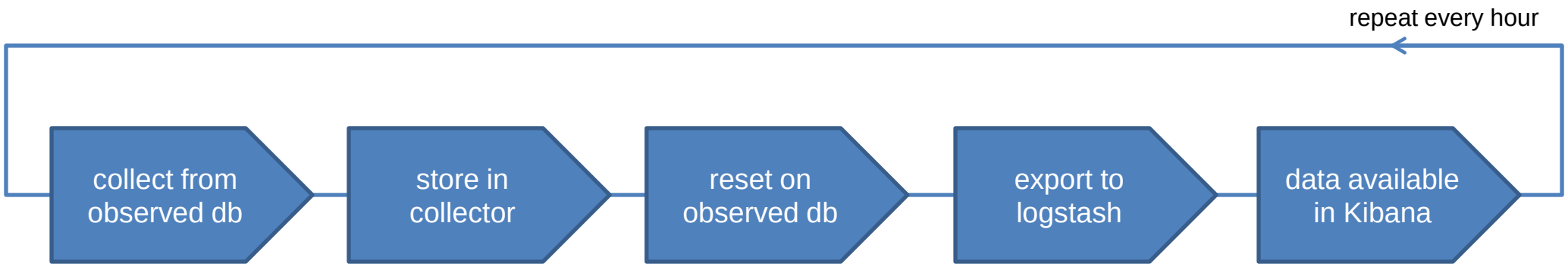
  shared_preload_libraries = 'pg_stat_statements,auto_explain'

  auto_explain.log_min_duration = 20000

  auto_explain.log_analyze = true; <--- can be expensive to run query twice

Monitoring: pg_stat_statements

- ✓ gathers a bunch of useful statistics of query execution
- ✓ the best way to track lots of short queries
- ✓ one cumulative sack
- ✓ not usable if you need track query behavior changes



ElastAlert https://github.com/Yelp/elastalert

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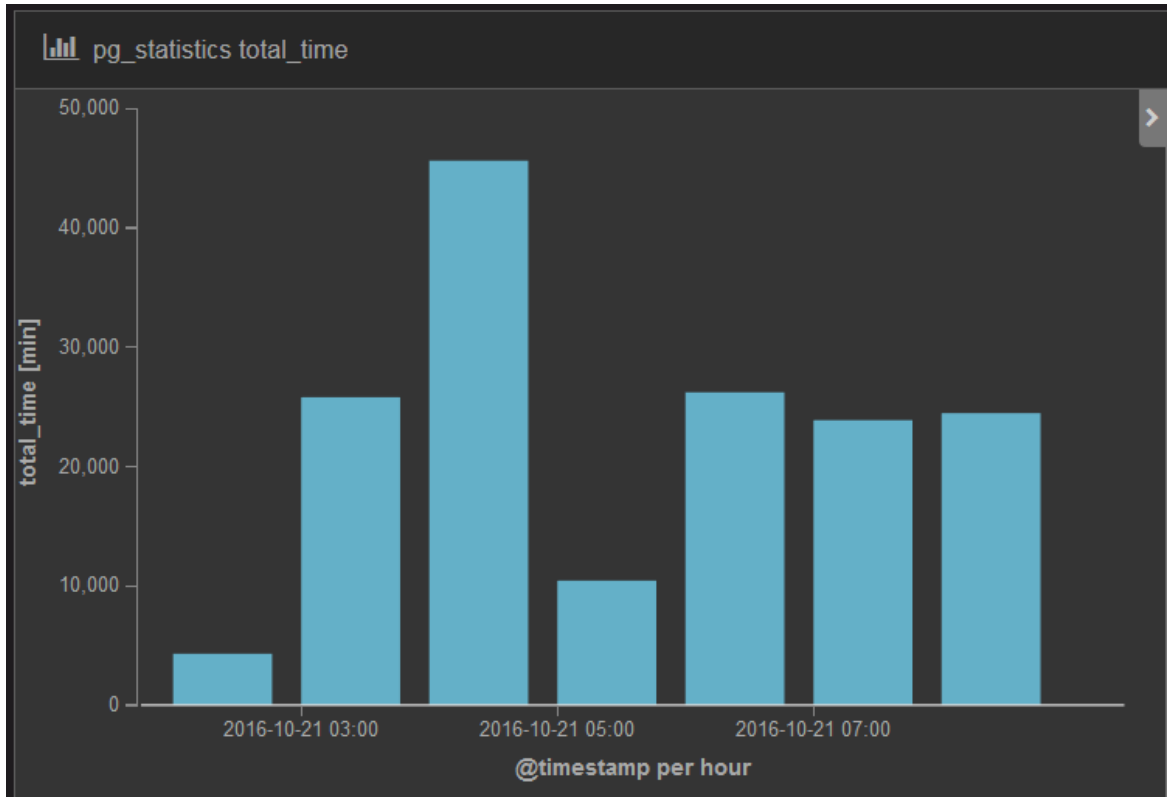
Monitoring: stat_statements in Kibana

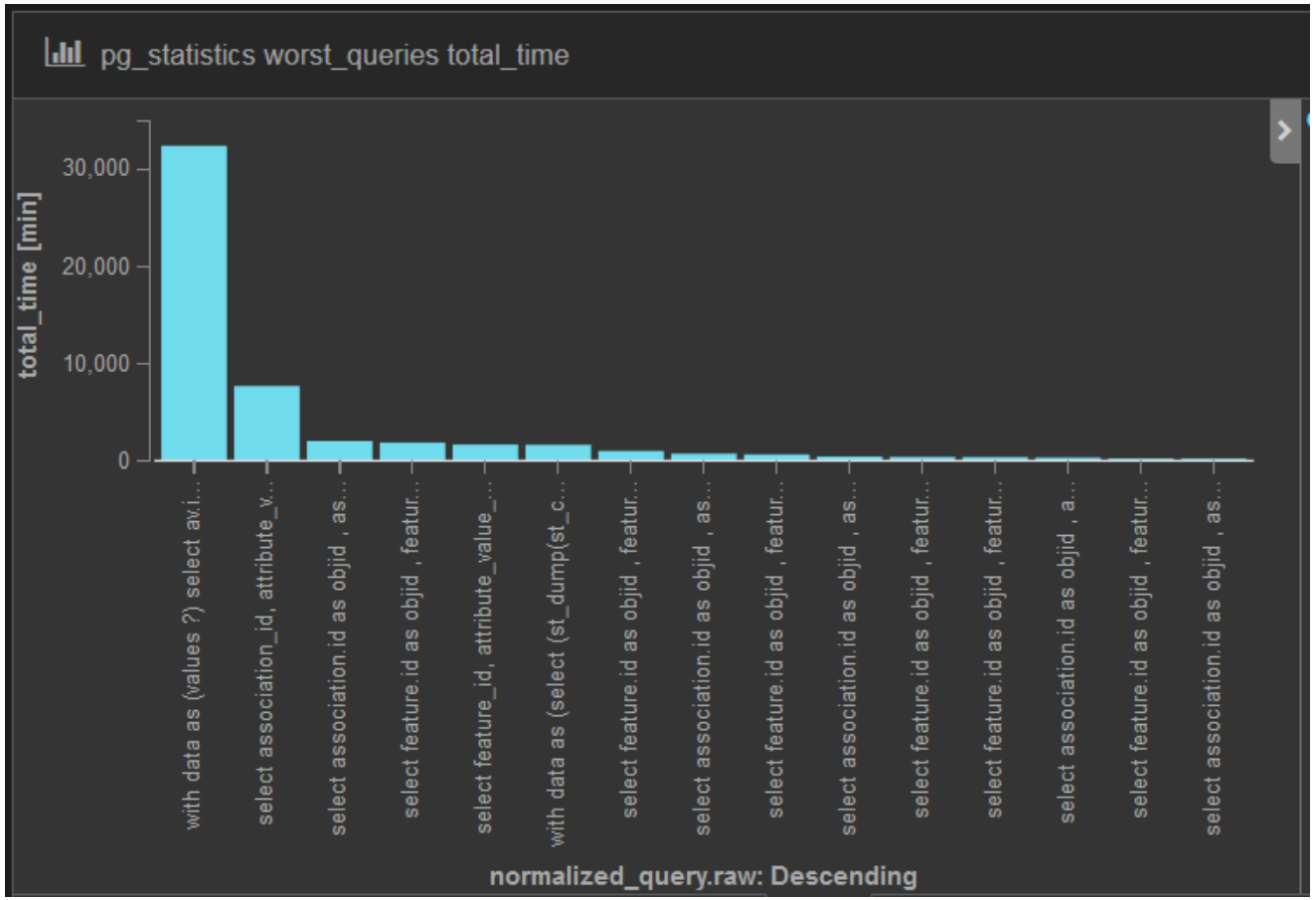
In Kibana, we can easily observe for each particular statement on each and every machine separately (if we want to):

- ✓ total execution time
- ✓ cpu execution time
- ✓ io execution time
- ✓ number of calls
- ✓ number of rows returned / affected
- ✓ average execution time
- ✓ average cpu execution time
- ✓ average io execution time
- ✓ average number of calls
- ✓ average number of rows returned / affected

In terms of:
- historical data
- trends
- behaviour changes
- the heaviest query
- distribution

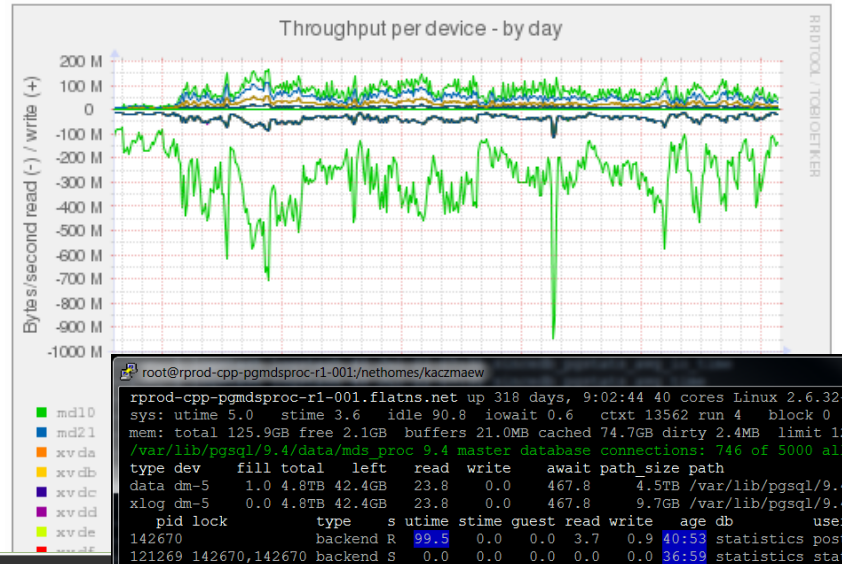
Monitoring: stat_statements in Kibana

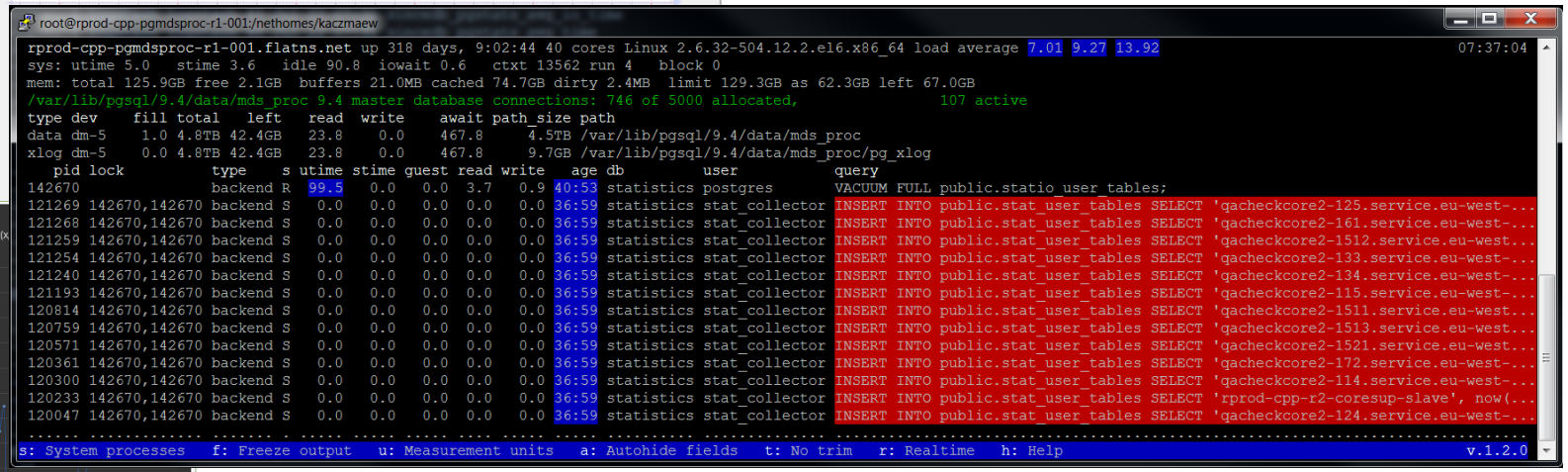


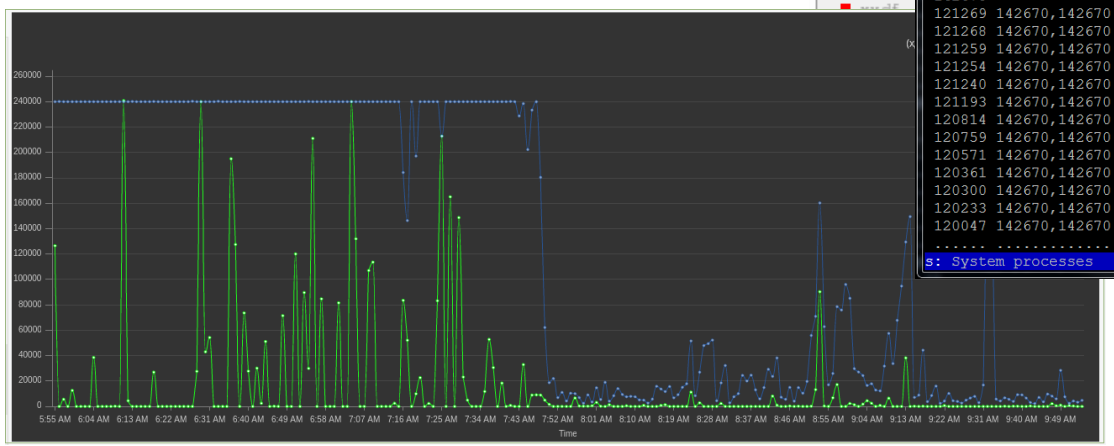


Monitoring: other tools we use

- ✓ Munin
- ✓ System/postgresql statistics
- ✓ AWS CloudWatch
- ✓ AppDynamics for performance
- ✓ Unix tools: htop / iotop
- ✓ pg_view







Questions?

We are hiring!