BEKK

BEATING THE TRAFFIC JAM

using embedded devices, OPC UA, Akka, NoSQL

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Scientist, BEKK

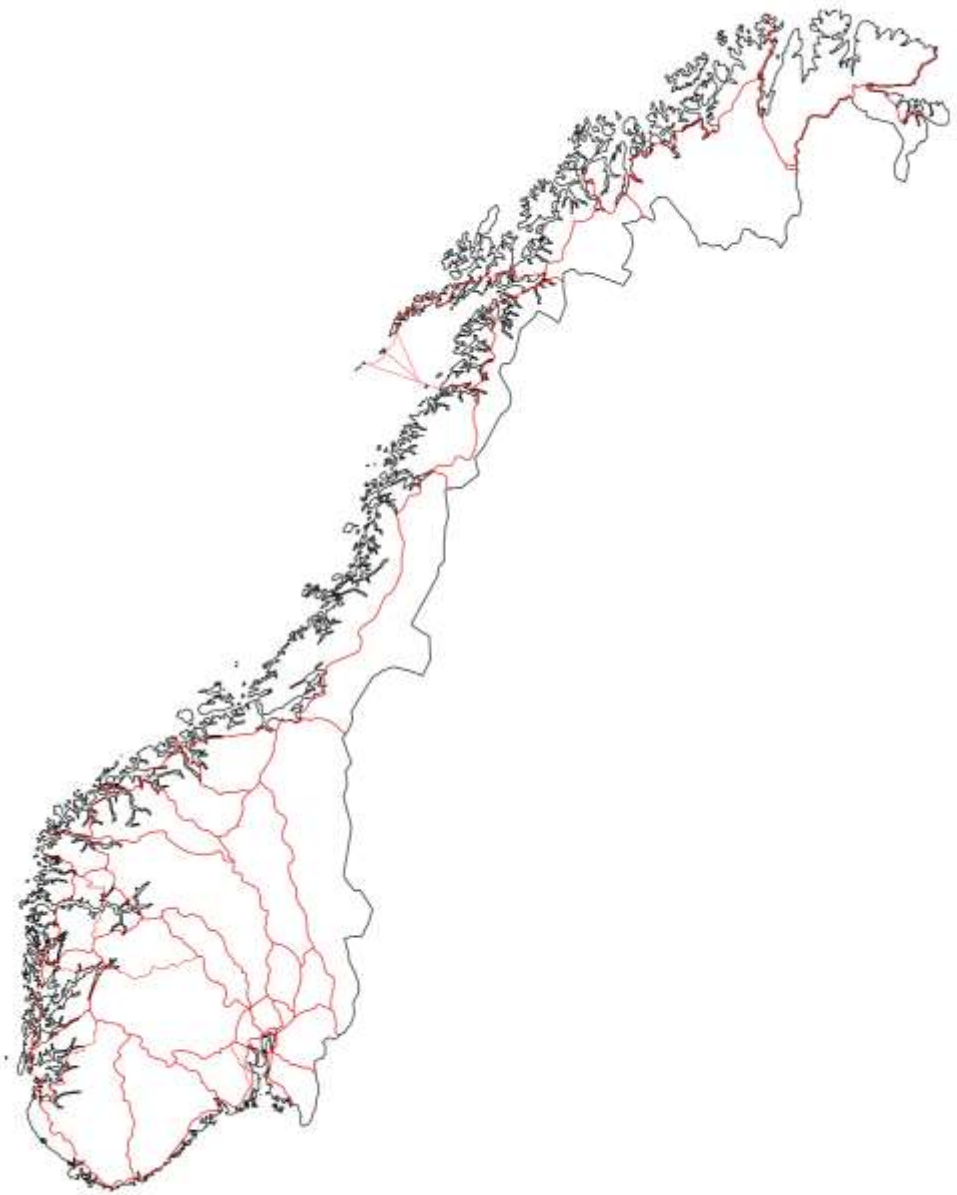
Public Roads Administration

Responsible for state and county roads
Planning, construction, operation
7500 employees
Spending: GBP 4.1 Billion (2013)

BEKK

Norwegian consulting firm
Private and public sector enterprises
Strategy, technology, digital services
370 employees

	Population (mill)	Area (1000 km²)	Roads (1000 km)
Germany	81	360	640
UK	64	240	400
Norway	5	390	100



E18 Vestfold – Undrumsdal. Photo: Hans A. Rosbach

Atlanterhavsveien, www.nasjonaleturistveger.no. Photo: Harald Mowinckel


Trollstigen, www.nasjonaleturistveger.no. Photo: Steinar Skaar

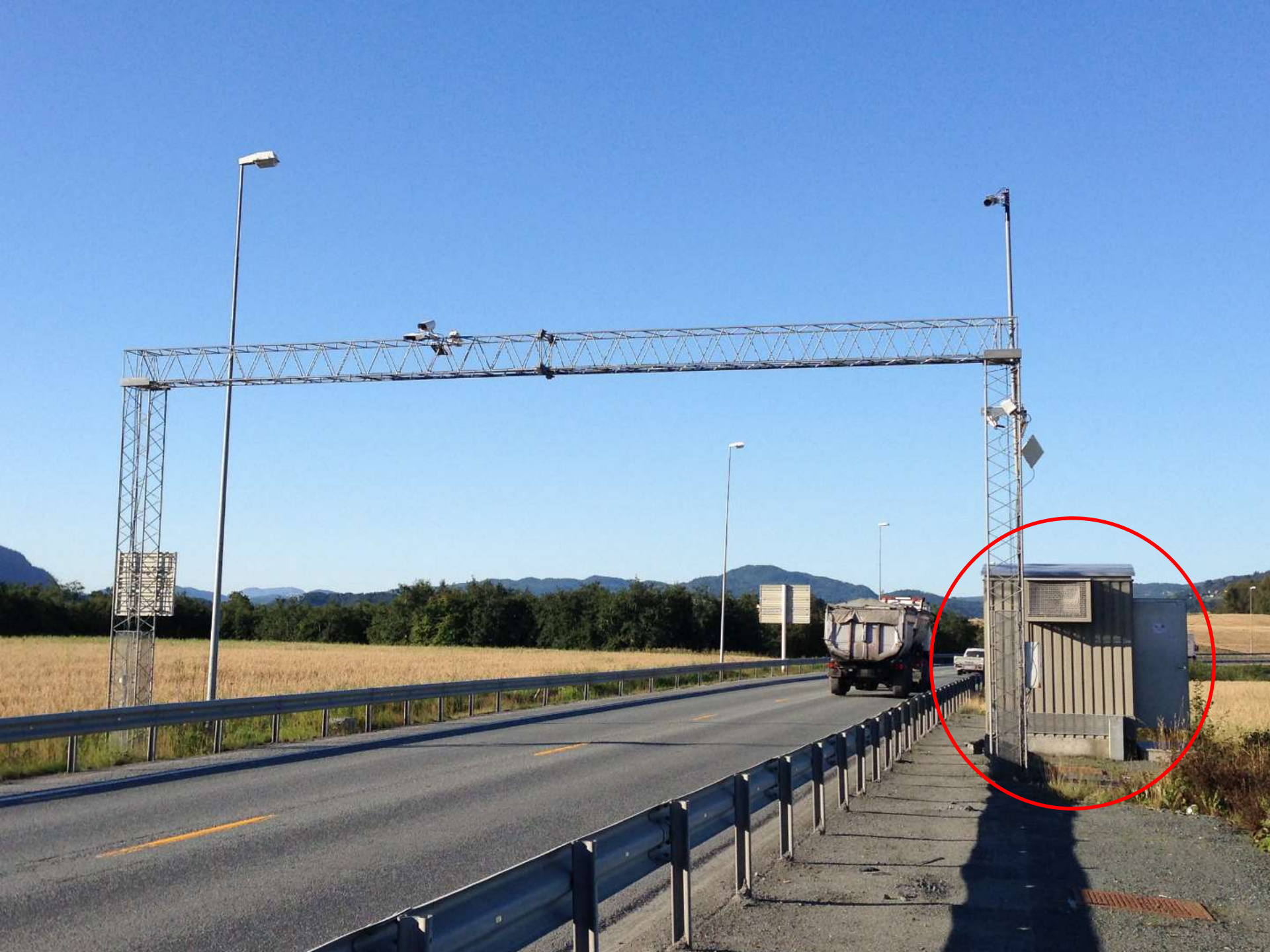
Aurlandsfjellet, www.nasjonaleturistveger.no. Photo: Bjørn Andresen

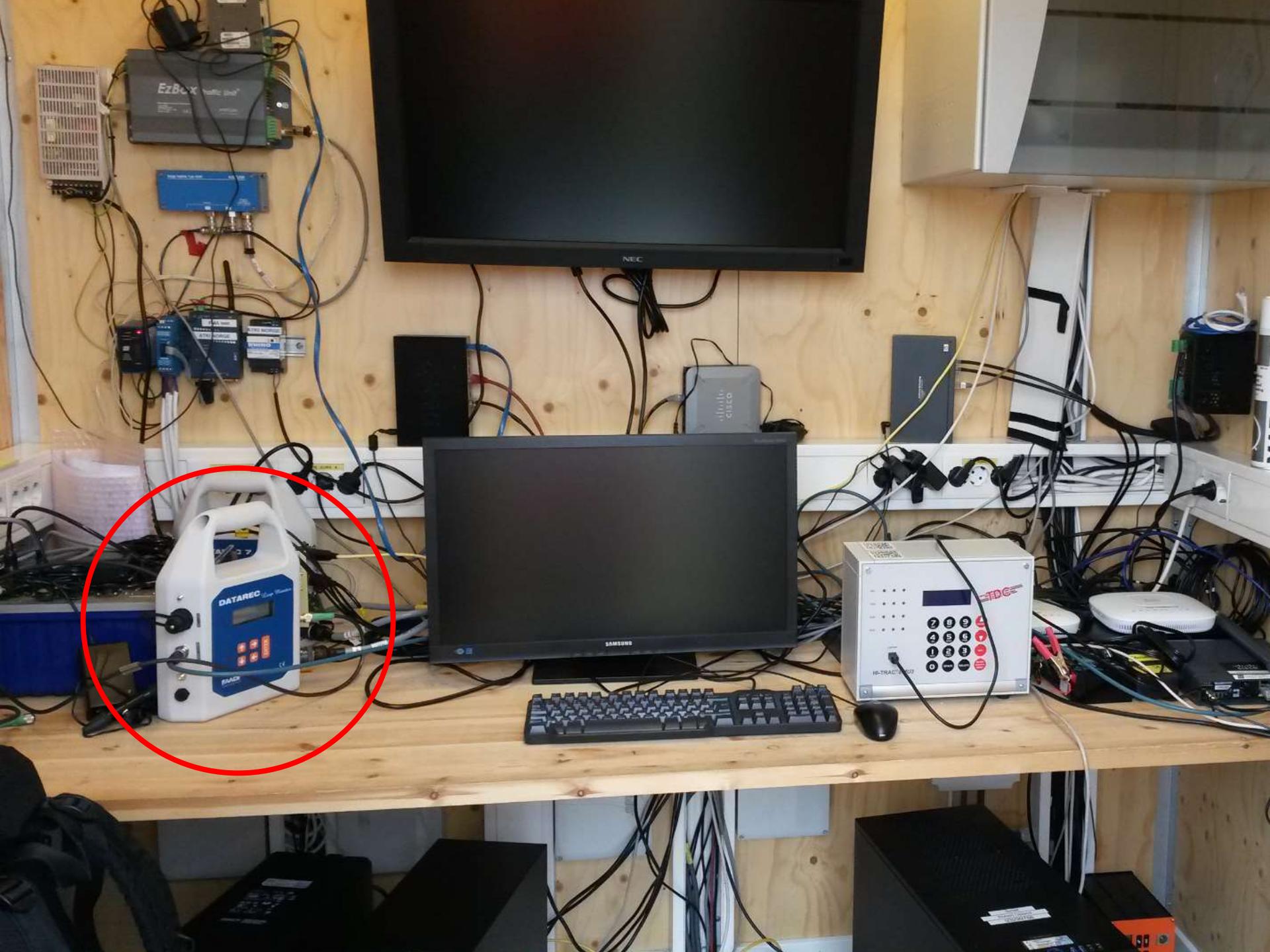
ROAD MAINTENANCE IS EXPENSIVE

Climate	Chemicals	Traffic
Snow plowing	Road salting	Vehicle count
Studded tires	Sea spray	Vehicle weight
Frost heave	Bird droppings	

A TRAFFIC EVENT

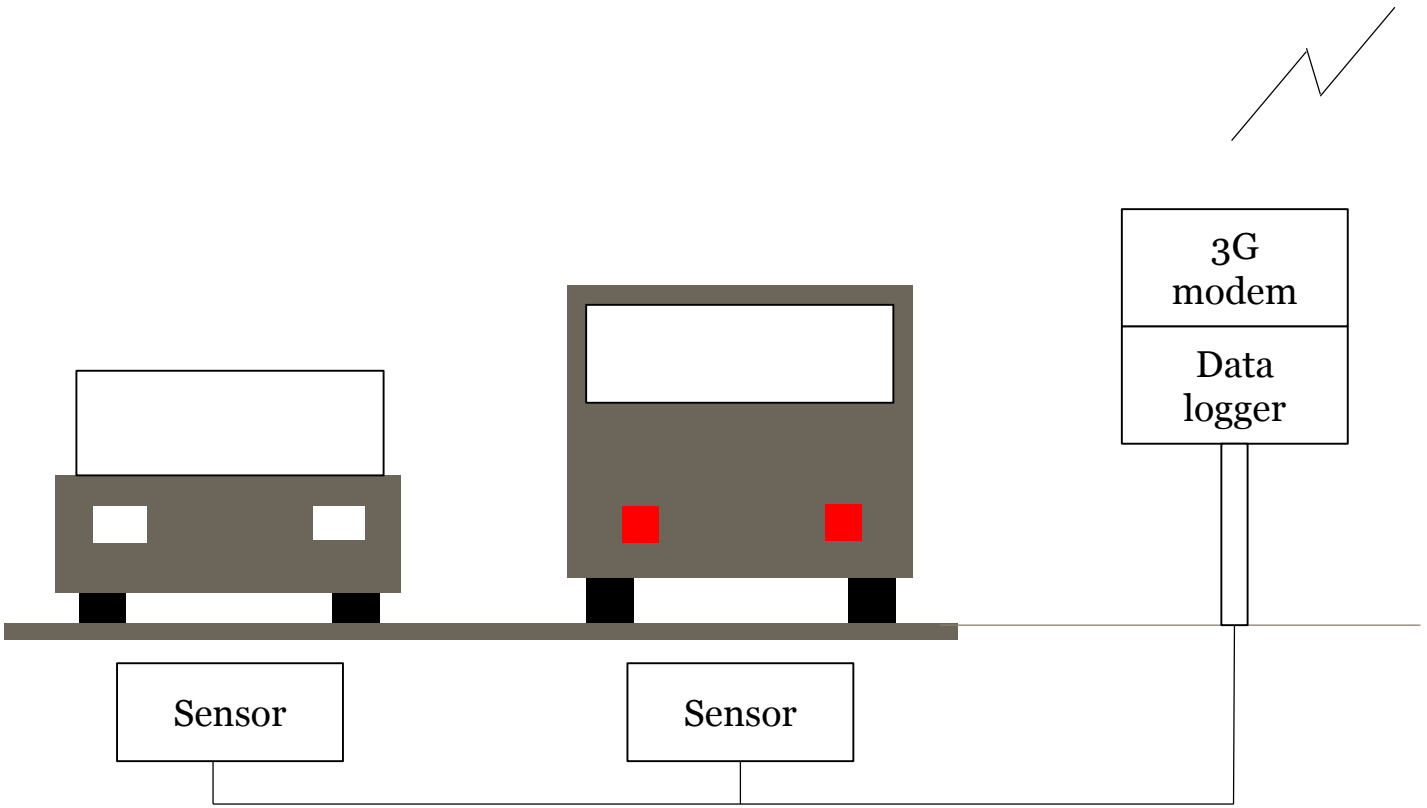

```
"measure_point_number": 1601436,
"county_id": 16,
"region_id": 2,
"server_local_timestamp": "2015-01-31T01:58:44.330+02:00",
"server_utc_timestamp": "2015-01-30T23:58:44.330Z",
"client_utc_timestamp": "2015-01-30T23:58:45.229Z",
"event_number": 2319762,
"vehicle_type": 3,
"vehicle_type_raw": "9",
"vehicle_type_quality": 22228,
"vehicle_number": 2319762,
"speed": 80.9,
"length": 16.46,
"lane": 1,
"gap": 10.3
```



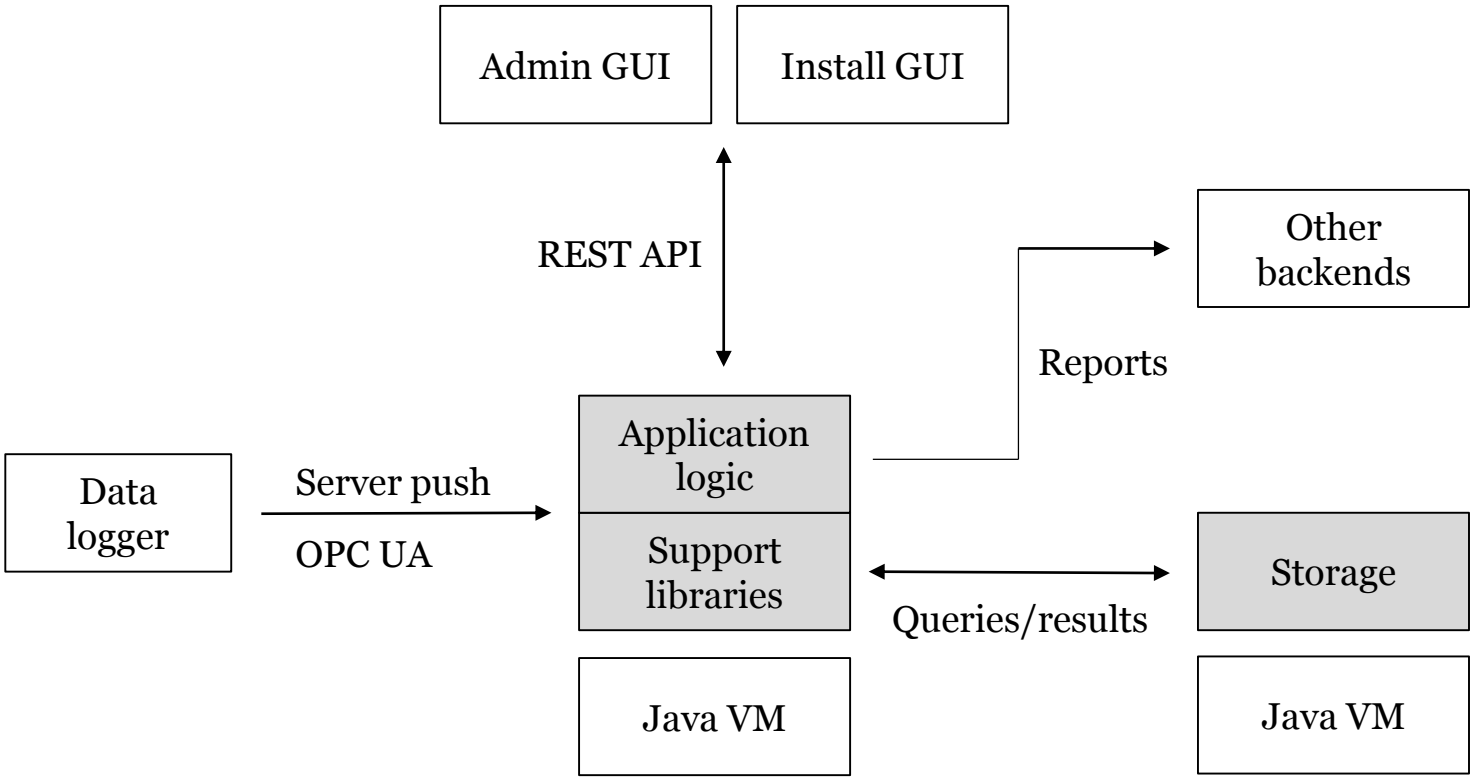

NEC
DATAREC
SAMSUNG

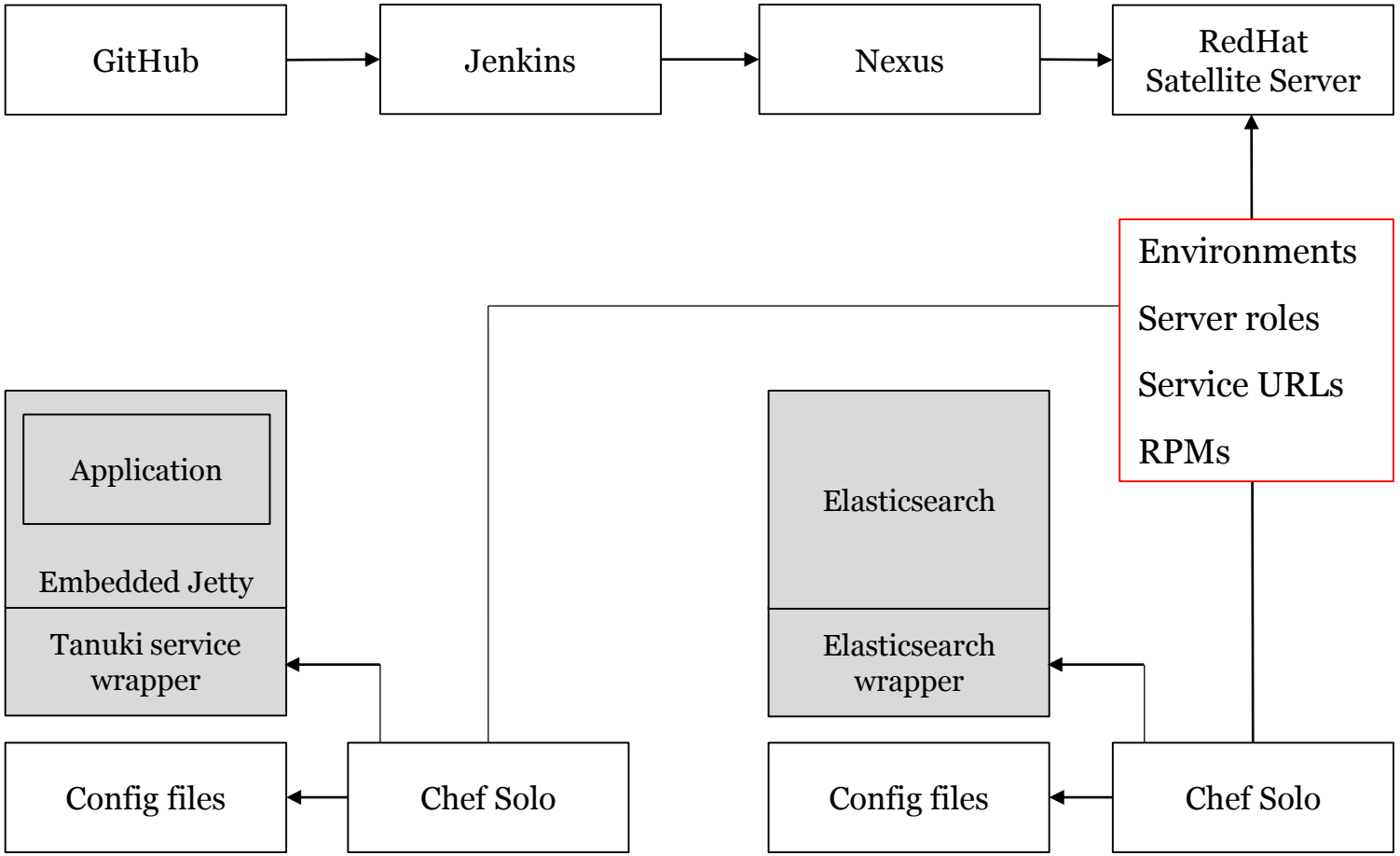

TUDOR

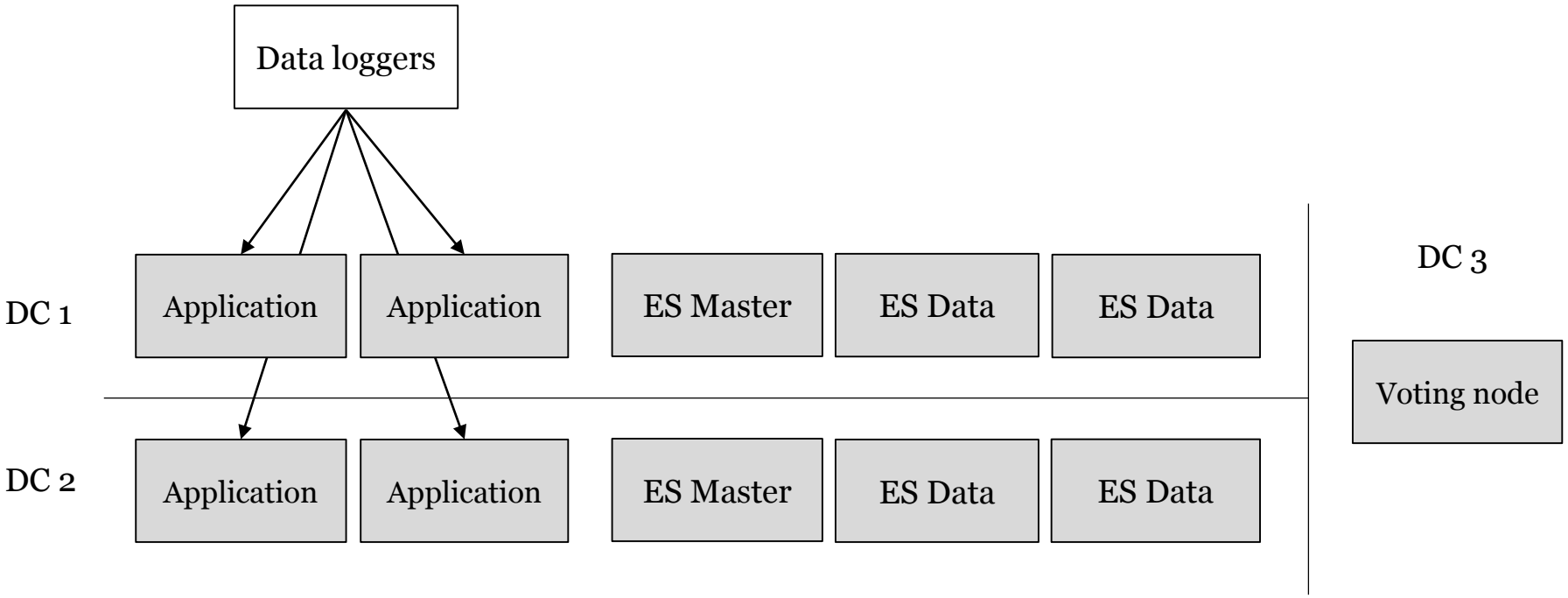
DATA FLOW: ROADSIDE EQUIPMENT



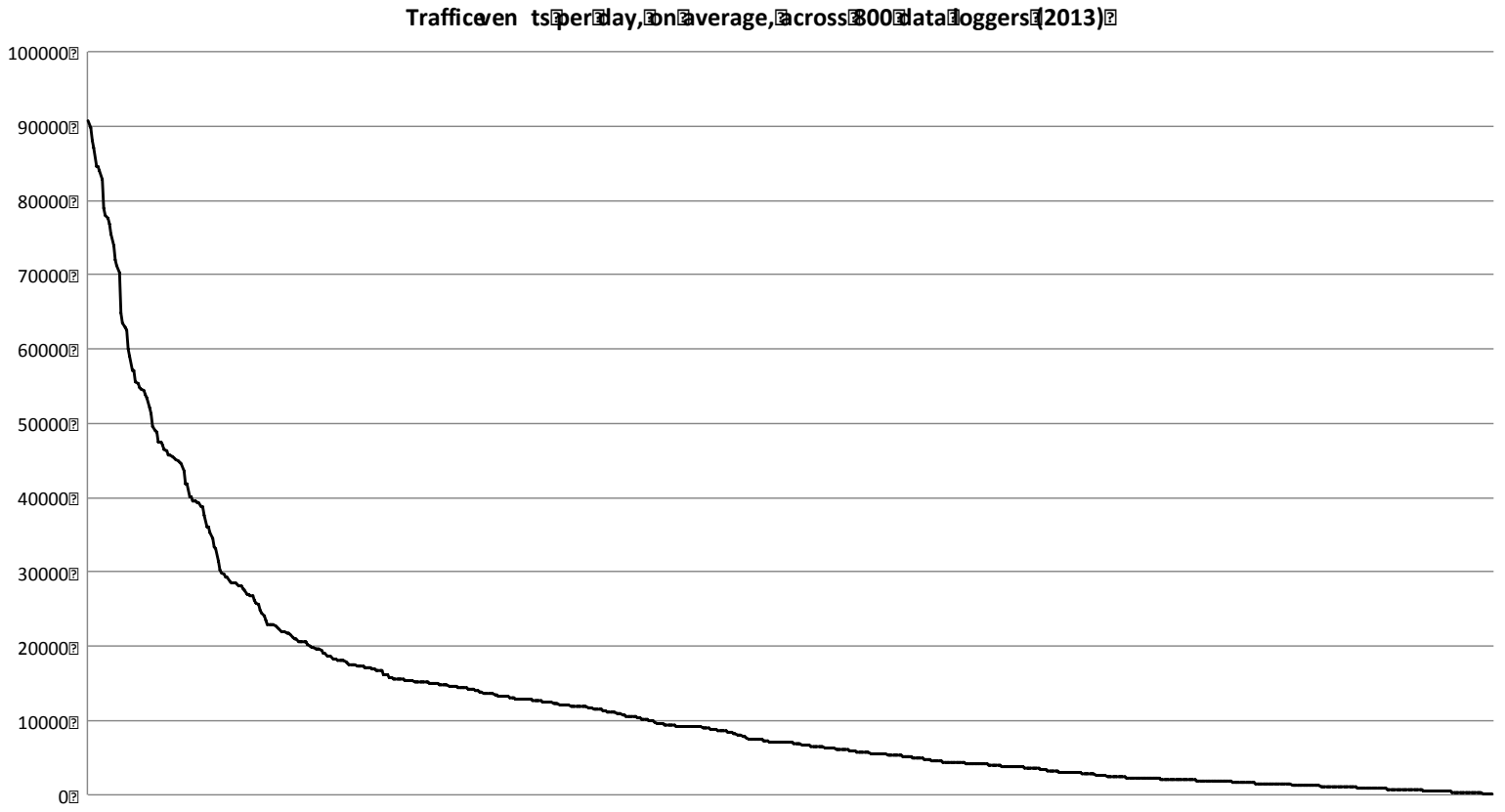
DATA FLOW: APPLICATION

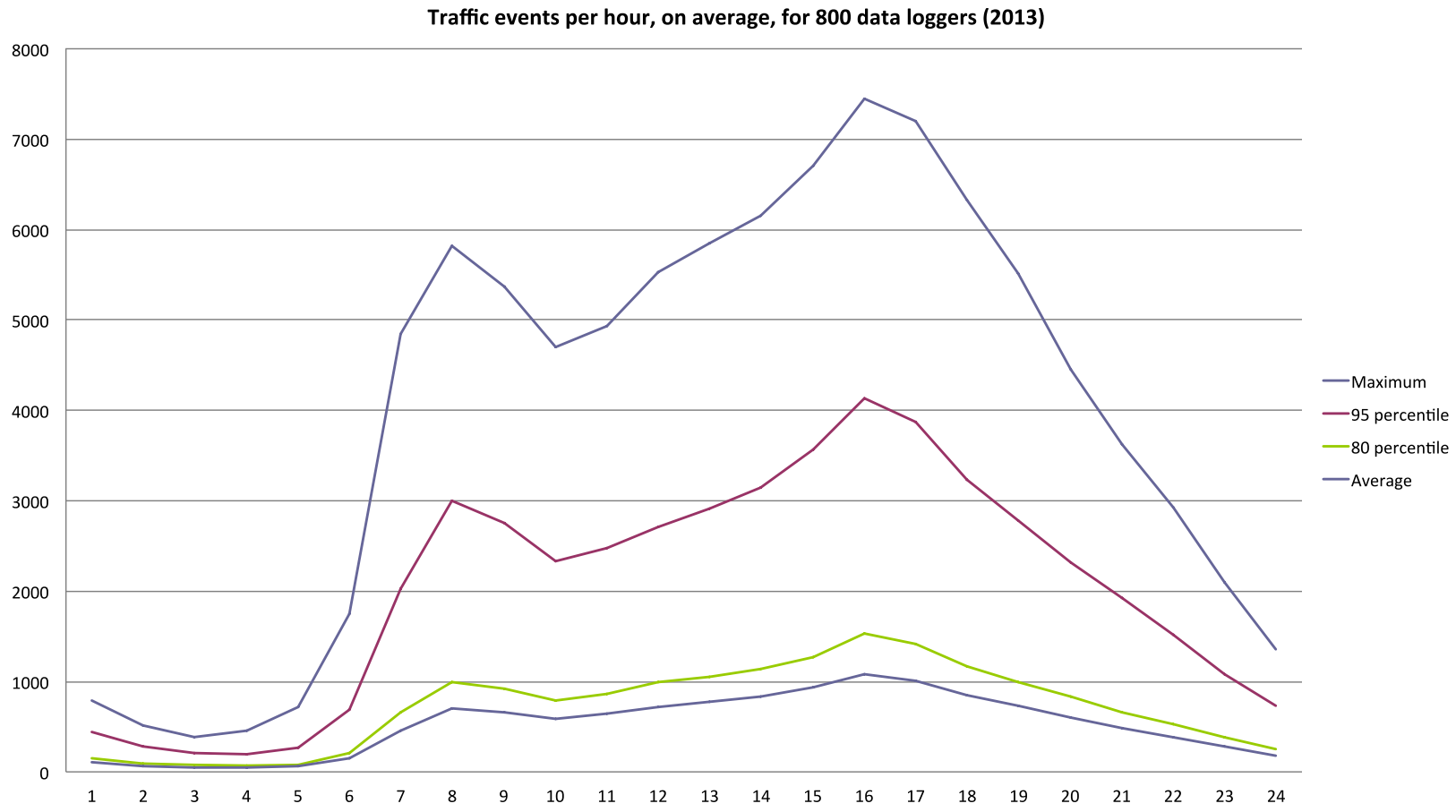



GitHub
Jenkins
Nexus
RedHat Satellite Server
Environments
Server roles
Service URLs
RPMs
Application
Embedded Jetty
Tanuki service wrapper
Elasticsearch
Elasticsearch wrapper
Config files
Chef Solo
Config files
Chef Solo


Data loggers
DC 1
Application
Application
ES Master
ES Data
ES Data
DC 2
Application
Application
ES Master
ES Data
ES Data
DC 3
Voting node

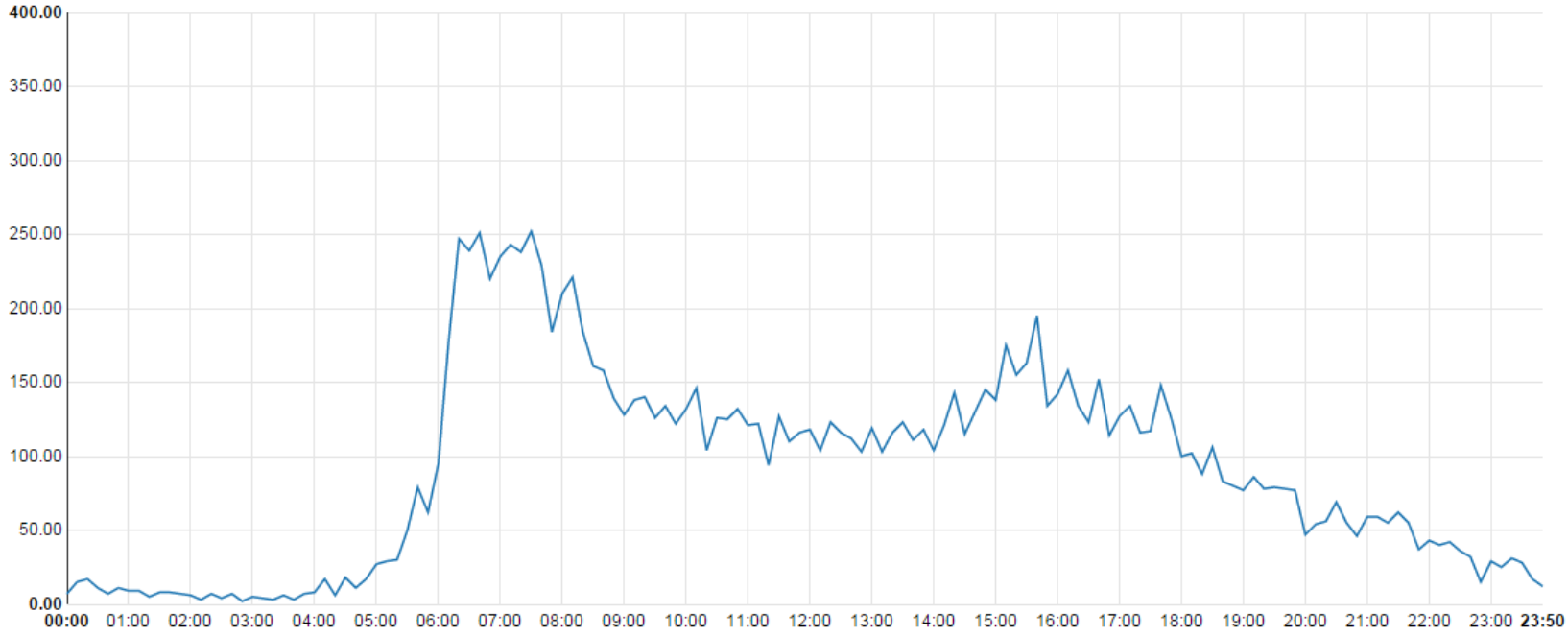
(INTERLUDE)


Traffic events per day, on average, across 300 data loggers (2013)
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0

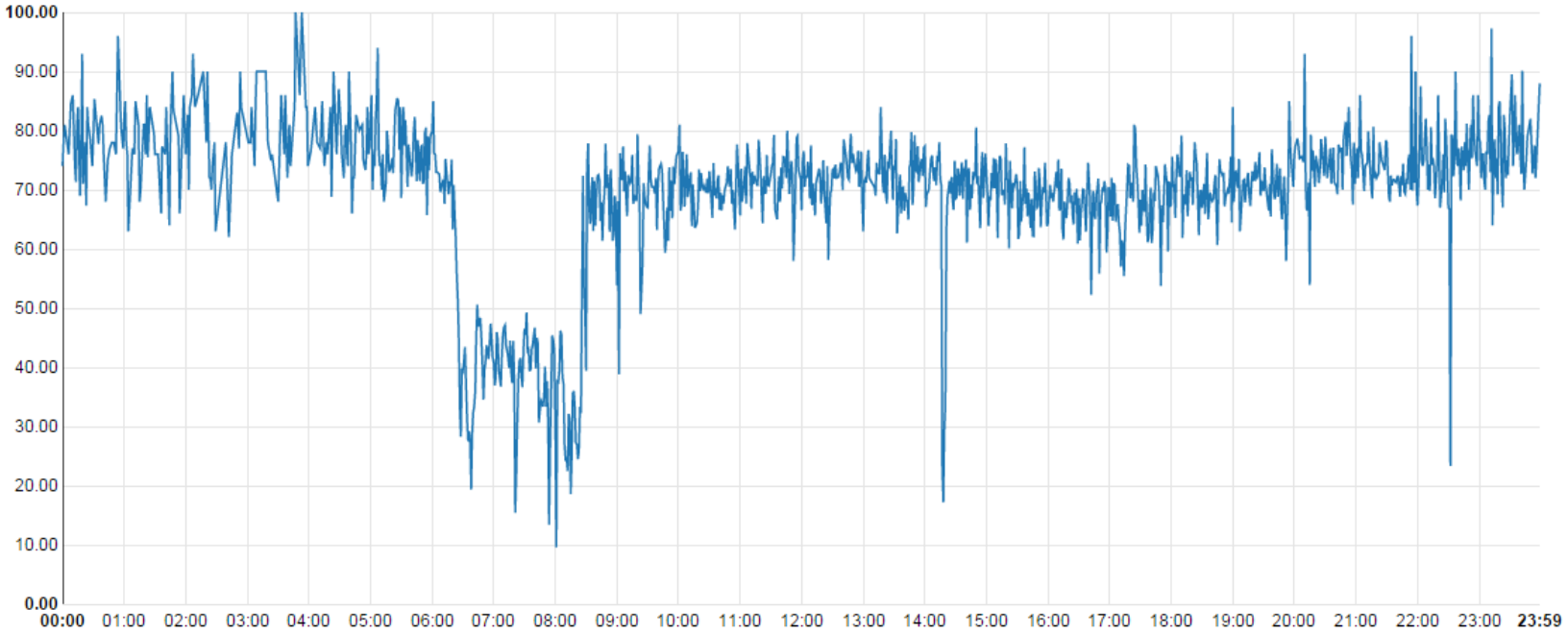

Traffic events per hour, on average, for 800 data loggers (2013)
8000
7000
6000
5000
4000
3000
2000
1000
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Maximum
95 percentile
80 percentile
Average

	Current system	New system
Data loggers	800	5000
Events/day	1 mill	6 mill
Events/year	365 mill	2.2 bill
Storage/year		2 TB

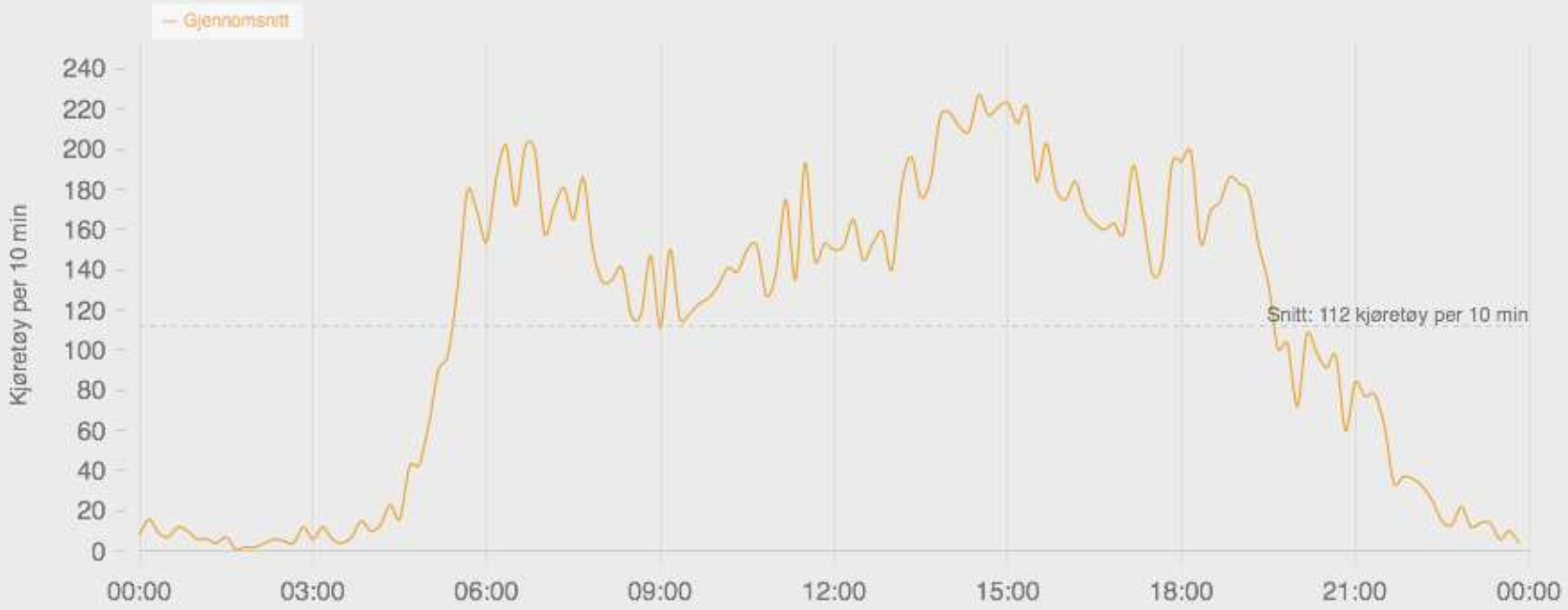
TRAFFIC PATTERNS: VEHICLE FLOW (10 MIN AVERAGE)



TRAFFIC PATTERNS: VEHICLE SPEED (1 MIN AVERAGE)

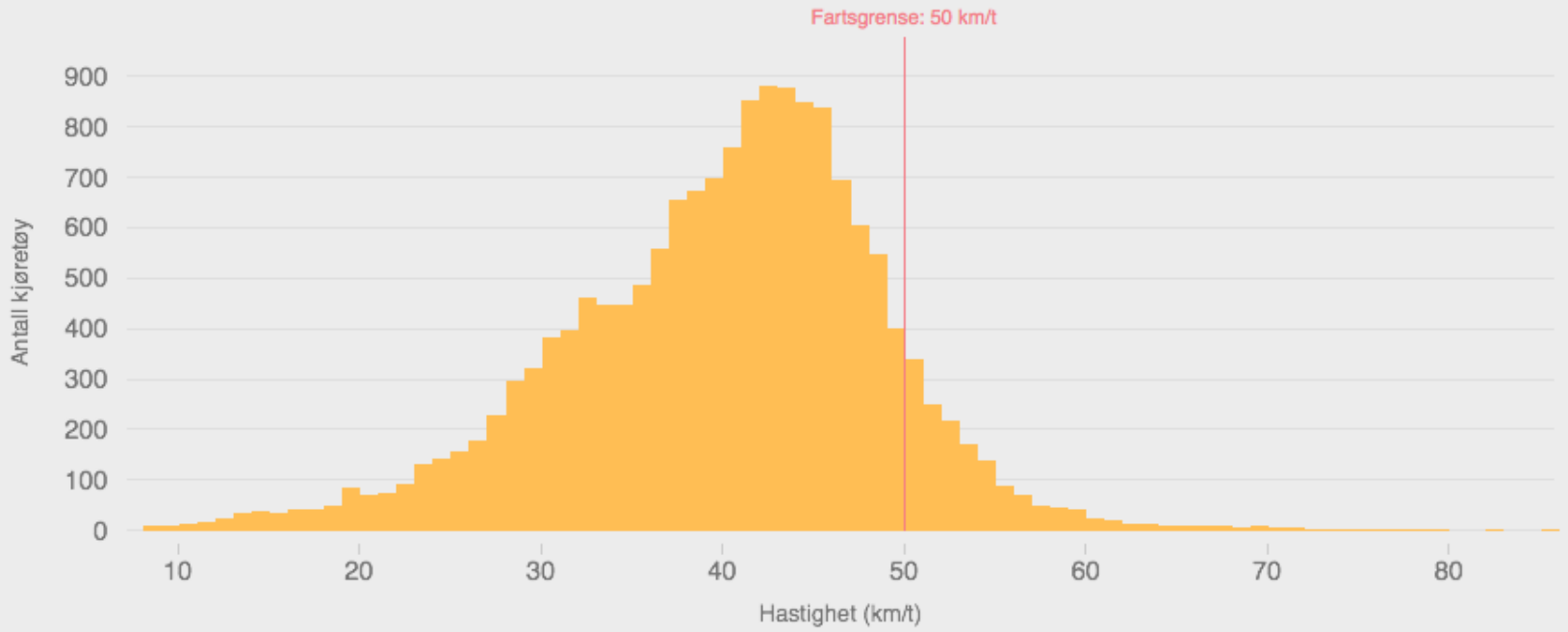


Flyt, mandag. 12. jan



Hastighet, mandag. 12. jan

Fordeling, hastighet, torsdag. 22. jan



(INTERLUDE END)

ELK = Elasticsearch, Logstash, Kibana

For a given time interval, provide:

- The total vehicle count and average speed,
- The 85 and 95 percentile speeds,
- and, in each of 5 vehicle length categories: the vehicle count and average speed,
- and, in each of 12 vehicle speed categories: the vehicle count,
- among the **eligible** traffic events

...and all of this for:

- each traffic lane connected to a data logger,
- each data logger within a geographical region

From Play to Embedded Jetty + Akka + various libraries

From MongoDB to Elasticsearch

From SVN to Github

From deployment by file copying to RedHat Satellite Server and Chef Solo

From 3 identical server nodes to 11 server nodes having 4 roles

From 1 to 3 data centers

From Java 7 to Java 8

From ElasticSearch 0.90.3 to Elasticsearch 1.4.2

From Elasticsearch faceting and scripts to Elasticsearch aggregation framework

From 0 to 100 data loggers

In production for 1 year

Stable, no data loss

Handles 1200 data loggers

Started small - few moving parts

Replacing an existing system

Mindset: Exploration

Transaction rates are predictable

Built-in event replay support

Simplified changes
(We now need to split up the application)

Scaling targets are known
Slow ramp up

Evaluate and change

No sudden, uncontrolled peaks

Robustness

Can process incoming traffic OR send buffered data

Has clock drift, despite containing a GPS

Has GPS, but reports the wrong position!

Sends GPS coordinates out as mysterious byte arrays

Has a non-correct implementation of OPC UA
(and so did we)

Has response times longer than response timeouts

Pushes events round robin among all connected clients

Reports	Real-time	Forecasts
Maintenance	Expected travel time	Traffic forecast
Measuring changes	Routing	Advise on routing
Weather impact	Alternatives to cars	Shape commuting habits

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THANK YOU!

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