TESTING IOT / 5G TEST NETWORK
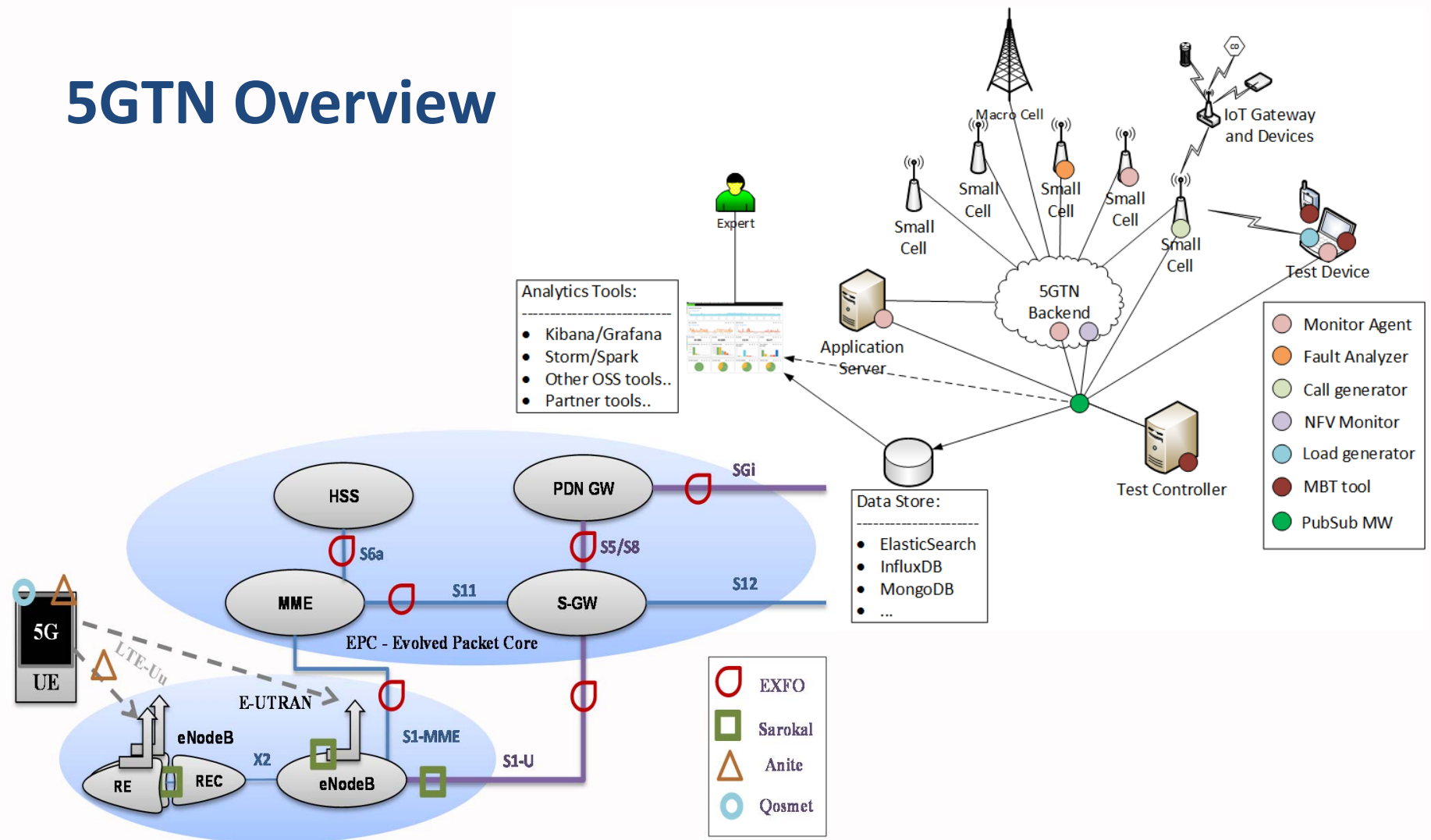
Teemu Kanstrén, Jussi Liikka, Jukka Mäkelä, Pekka Ruuska

VTT Technical Research Center of Finland

5GTN

5GTN Overview
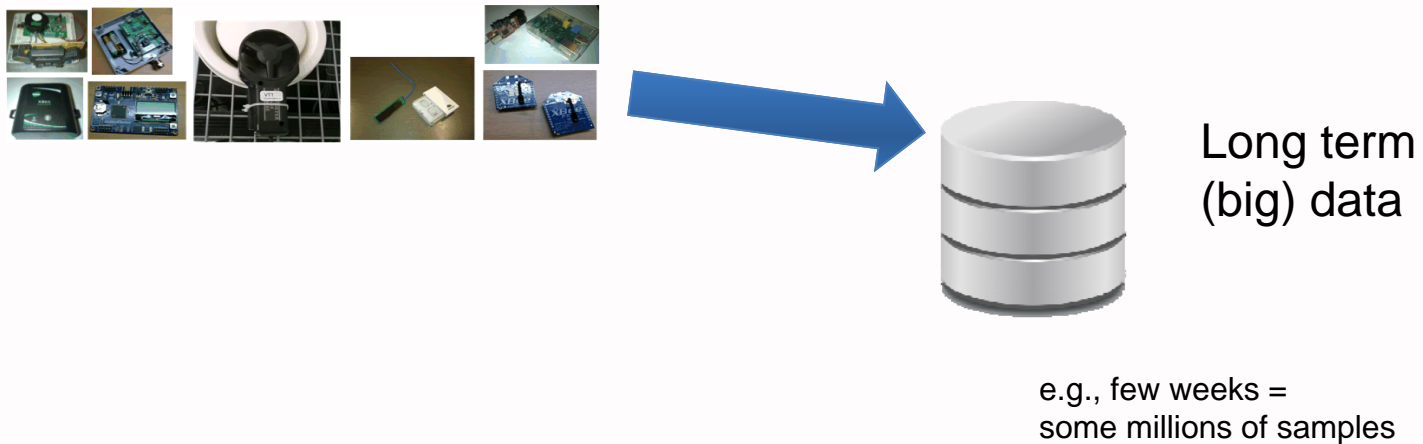
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Internet of Things, Big Data, Machine Learning, …

- Testing IoT?
  - Simple devices, complex combinations

- Using data analytics & machine learning for test analysis?
  - IoT, distributed systems, etc. produce "big data". How do we evaluate it?

- Using test generation to generate data for analysis?
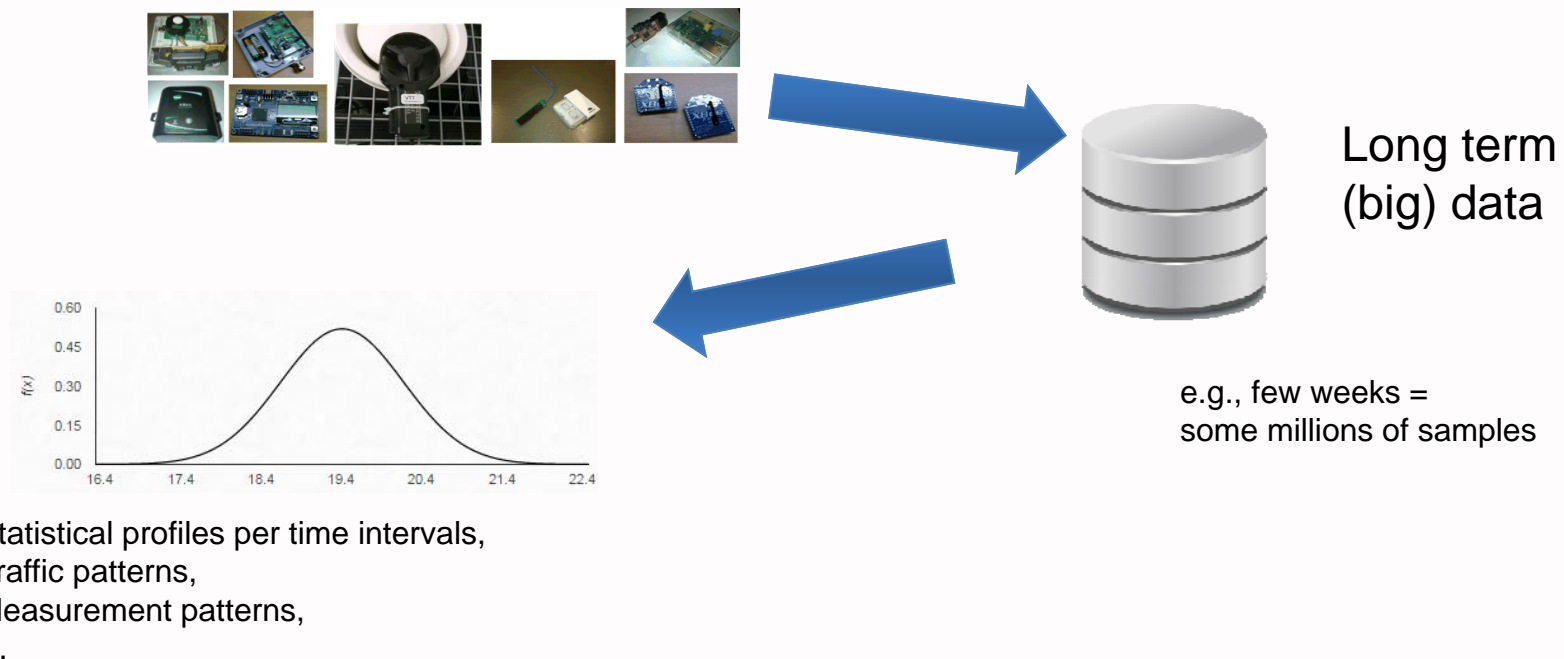 - Getting the required data to develop algorithms, tools, features can be a challenge

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Basic sensor profiling

Basic sensor profiling

Long term
(big) data

e.g., few weeks =
some millions of samples

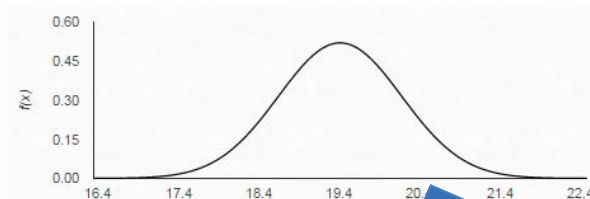User Conference on
Advanced Automated Testing

Basic sensor profiling

Long term (big) data

e.g., few weeks = some millions of samples

Statistical profiles per time intervals,
Traffic patterns,
Measurement patterns,
…

Basic sensor profiling

Long term (big) data

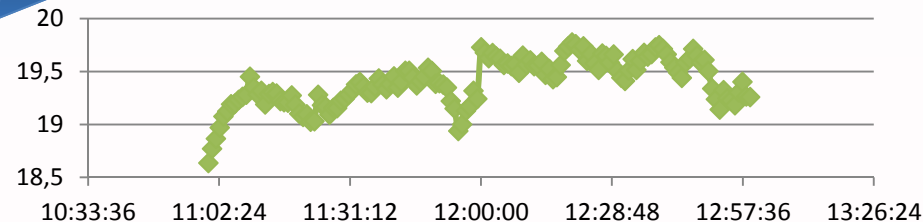e.g., few weeks =
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Statistical profiles per time intervals,
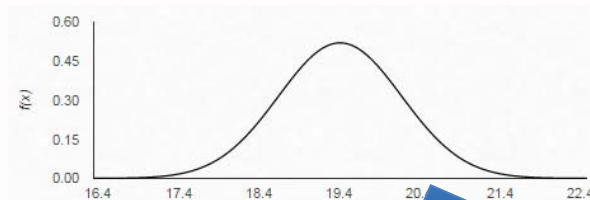Traffic patterns,
Measurement patterns,
…

temperature

Basic sensor profiling

Similarly, e.g., network data profiles
(packet sizes, frequencies, …)

Long term
(big) data

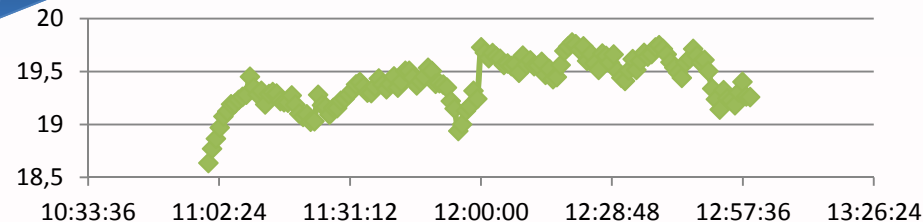e.g., few weeks =
some millions of samples

Statistical profiles per time intervals,
Traffic patterns,
Measurement patterns,
…

temperature

temperature

More Complex Sensor Networks

- For example, indoor location via beacons
  - Several beacons evaluated at any time
  - Location = value function of sensors

- Need to consider sensor relations
  - Signal strength vs others
  - Environmental factors

- Or relation to sensor itself
  - Smoothing curve vs hop
  - Moving: allowed, expected, service functions, …
  - …

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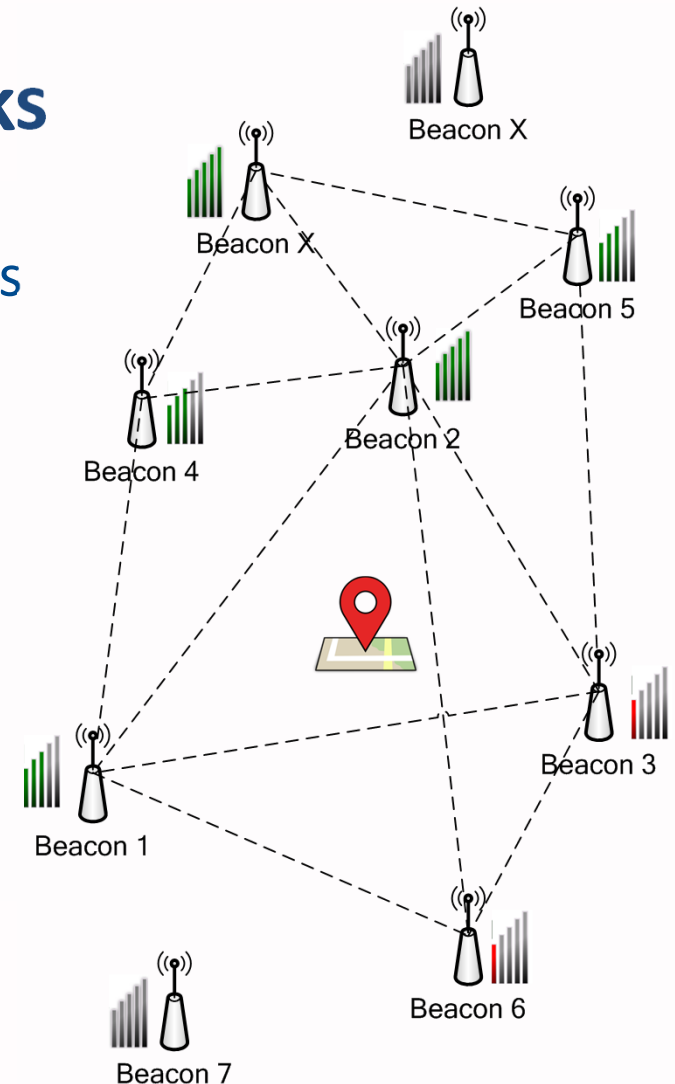
Analysing the Data (Test Oracle?)

- With thousands of parameters and up to millions or billions of data values from the tests…

- What happened?

- What matters?

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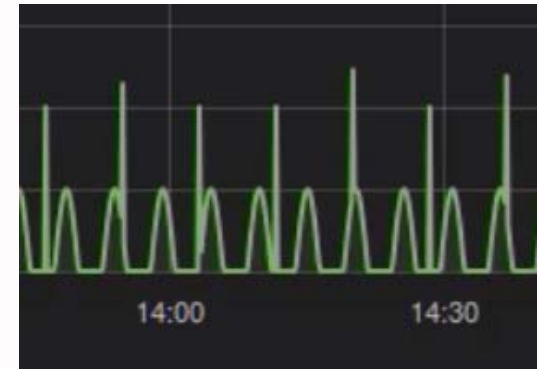User Conference on
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Problem area identification

- Automated analysis of large test data sets
- E.g.,
  - performance spikes, drops,
  - Important data elements,
  - causes..

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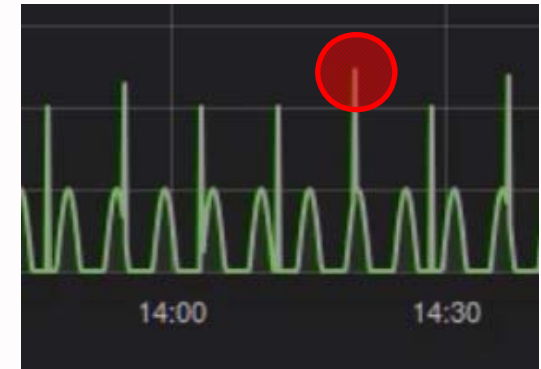
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- A simple case: statistical profiling and automated outlier detection

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From: 2016-03-30 14:10:55 to: 2016-03-30 14:11:55 LINK: http://127.0.0.1:3000/dashboard/db/debugtest_dash?from=1459336255000&to=1459336315000
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```

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From: 2016-03-30 14:27:40 to: 2016-03-30 14:28:40 LINK: http://127.0.0.1:3000/dashboard/db/debugtest_dash?from=1459337260000&to=1459337320000
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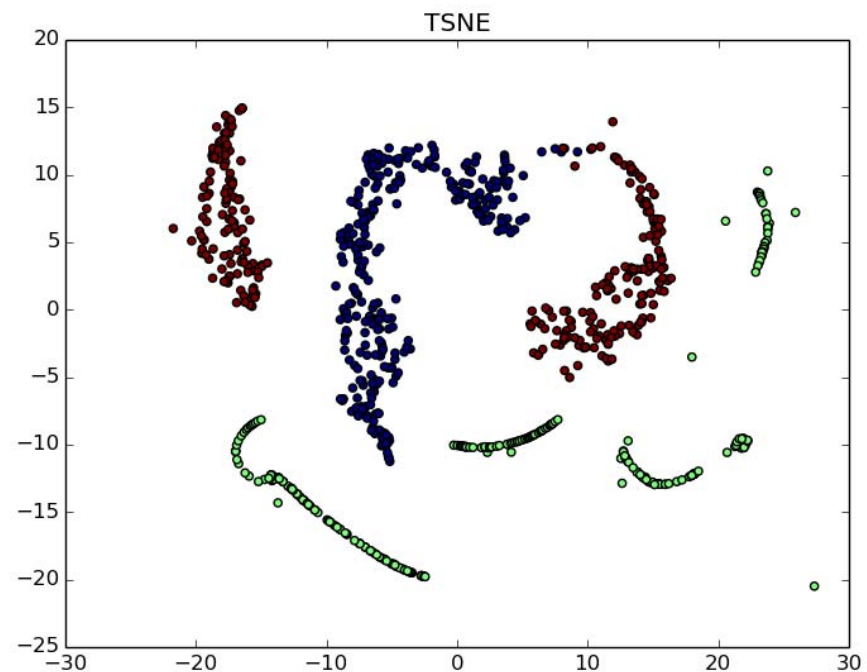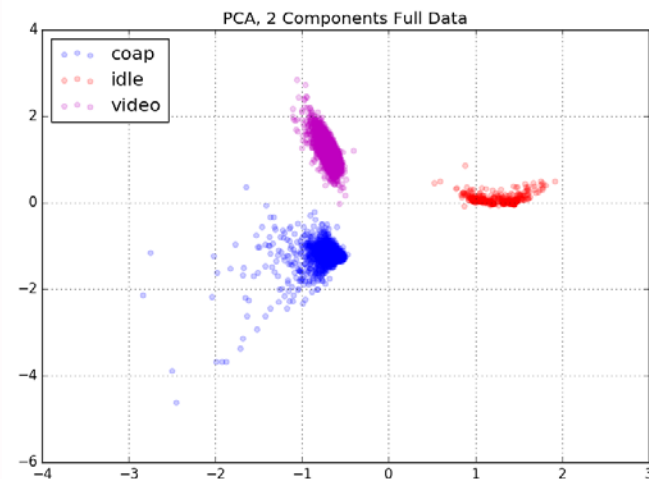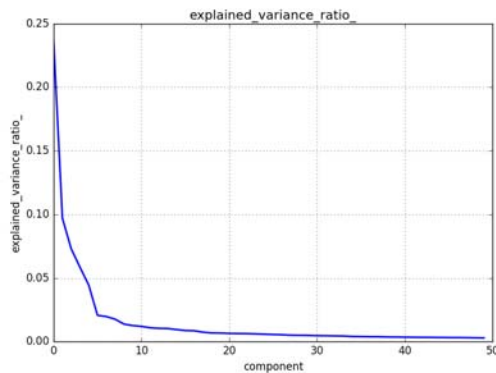
Profiling via test scenarios

- Labeled datasets
  - IoT = L1
  - Video = L2
  - Idle = L3

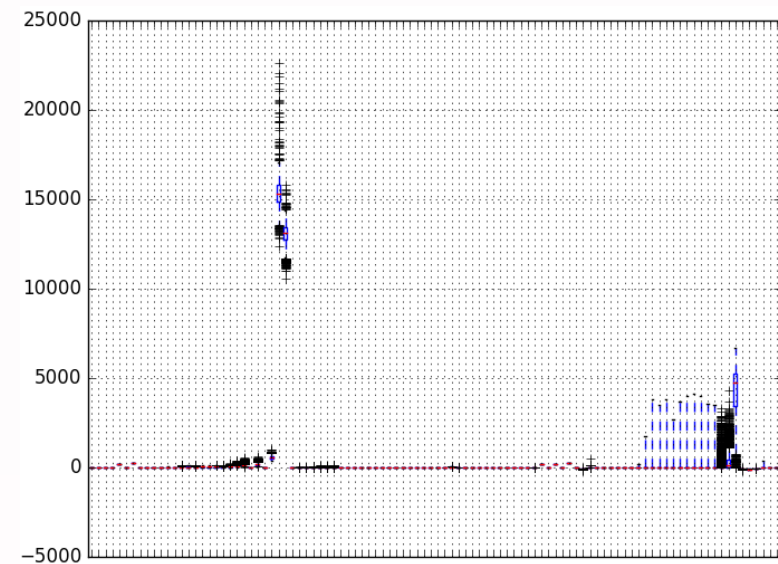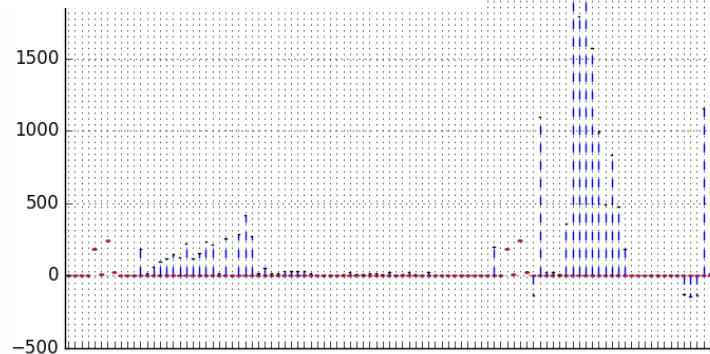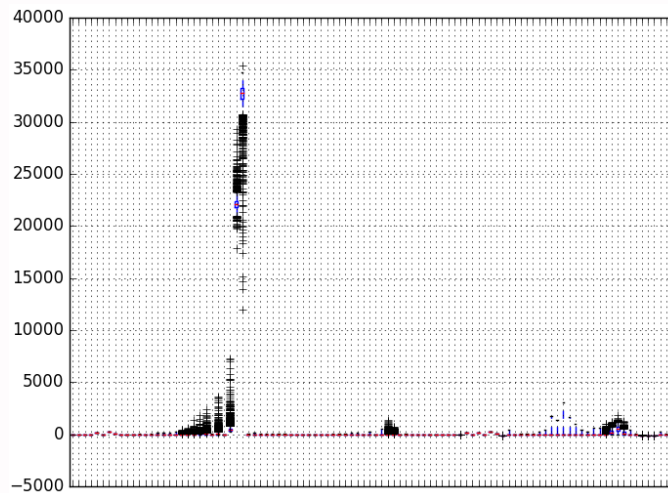| IoT (L1)	Video (L2)	Idle (L3)
55659	30025	64
55985	28009	1
55604	28021	5
55303	35789	0
55744	28950	0
…	…	…

Single variable data from thousands

- What are the impacts?

- Inputs to learning algorithms,

- To find labeled targets (categories)

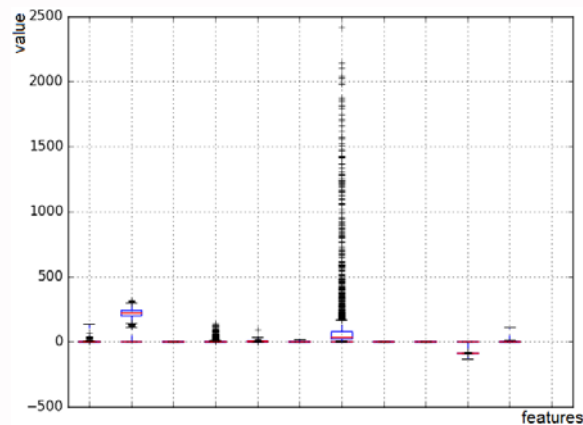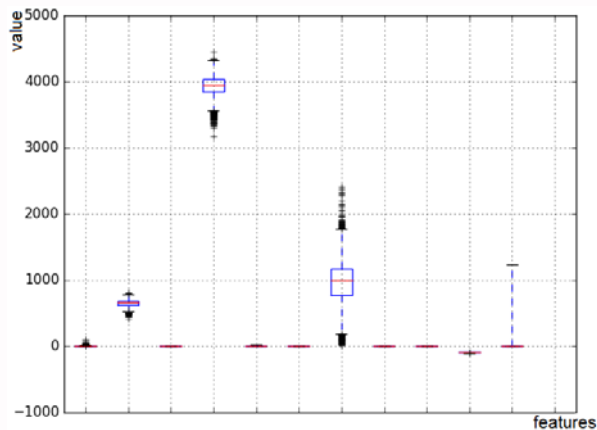# Example: Visualizations with PCA, TSNE, …

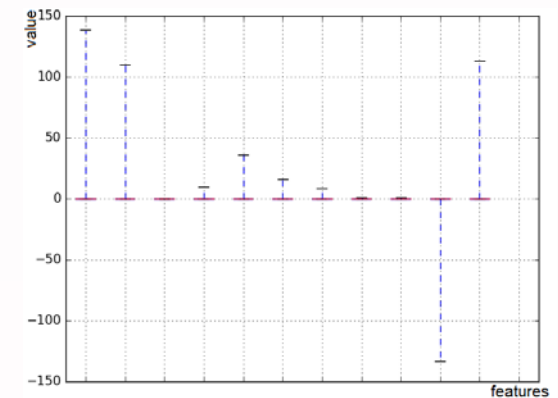# Finding the relevant features

Just a small subset ->
Manually exploring all the data is hard

Finding important features: Automation

e.g., Recursive feature elimination
(RFE) algorithm

What for?

- Test devices, networks, services against new types of input profiles

- Provide new inputs and datasets for development

- Analyze and evaluate results, identify interesting properties and characteristics
  - Profiles for users, devices, sensors, environmental factors, …
  - Performance statistics

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Conclusions

- IoT properties & challenges
  - Simple sensors form complex combinations
  - Combining with big data, data analytics & machine learning
- Testing here
  - Exploring the impact of parameters, profiles, configurations, performance results, functionality
  - Providing inputs to features, algorithms, optimizations, …

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Questions?

TECHNOLOGY FOR BUSINESS