Efficient trouble shooting of service failures with multi-tag data analysis

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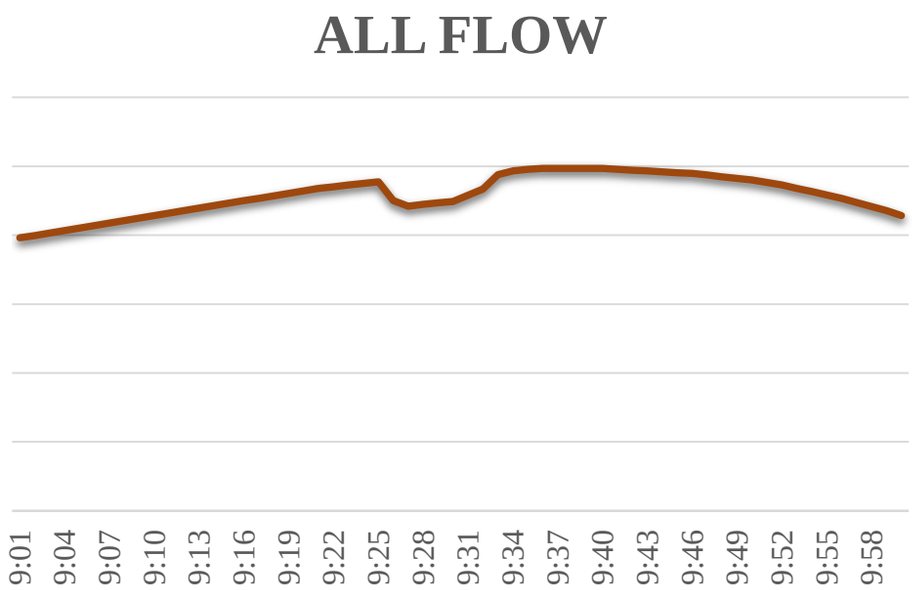
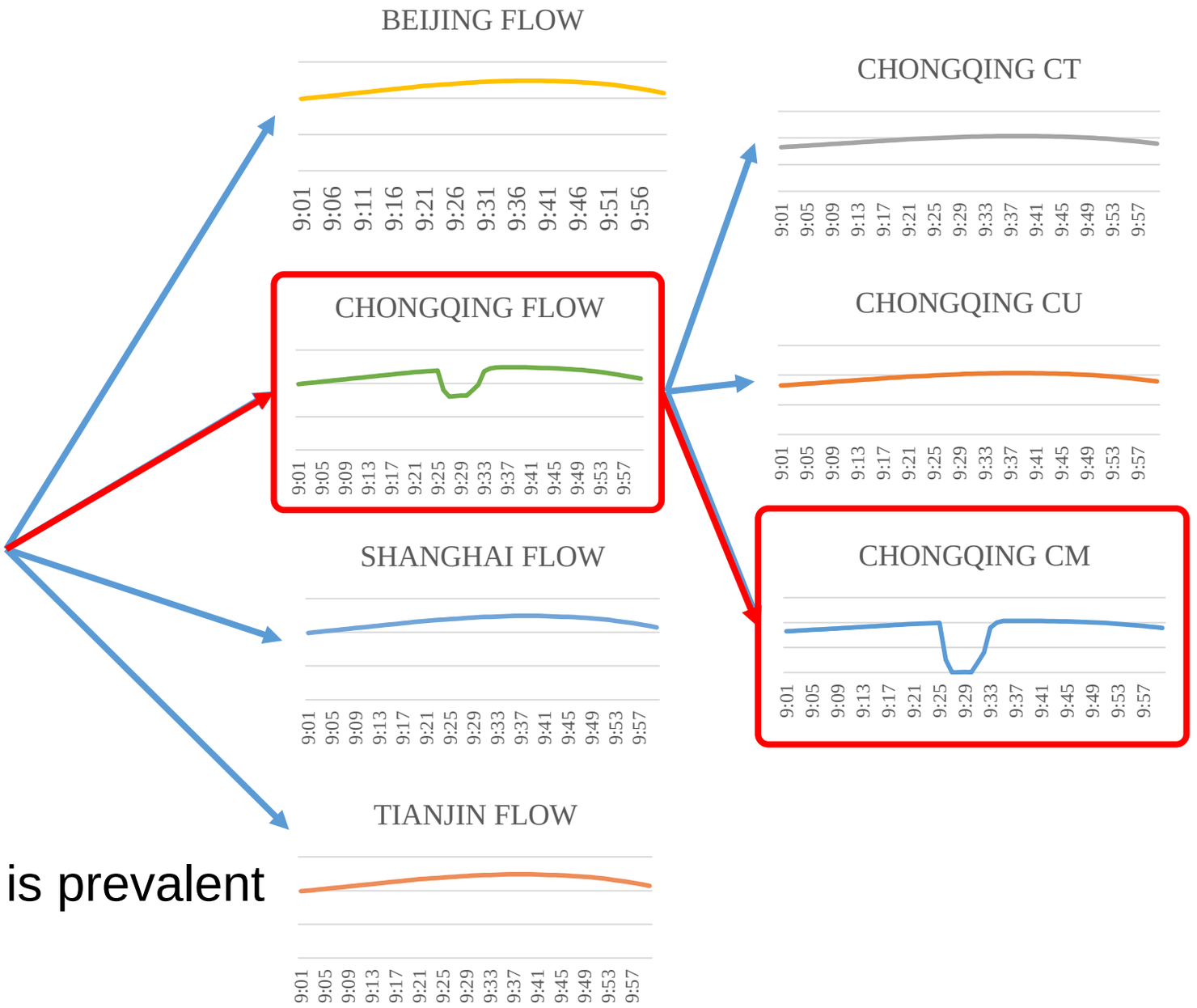
What's the trouble?

- Facing to the problem





- Troubles affecting partial traffic is prevalent

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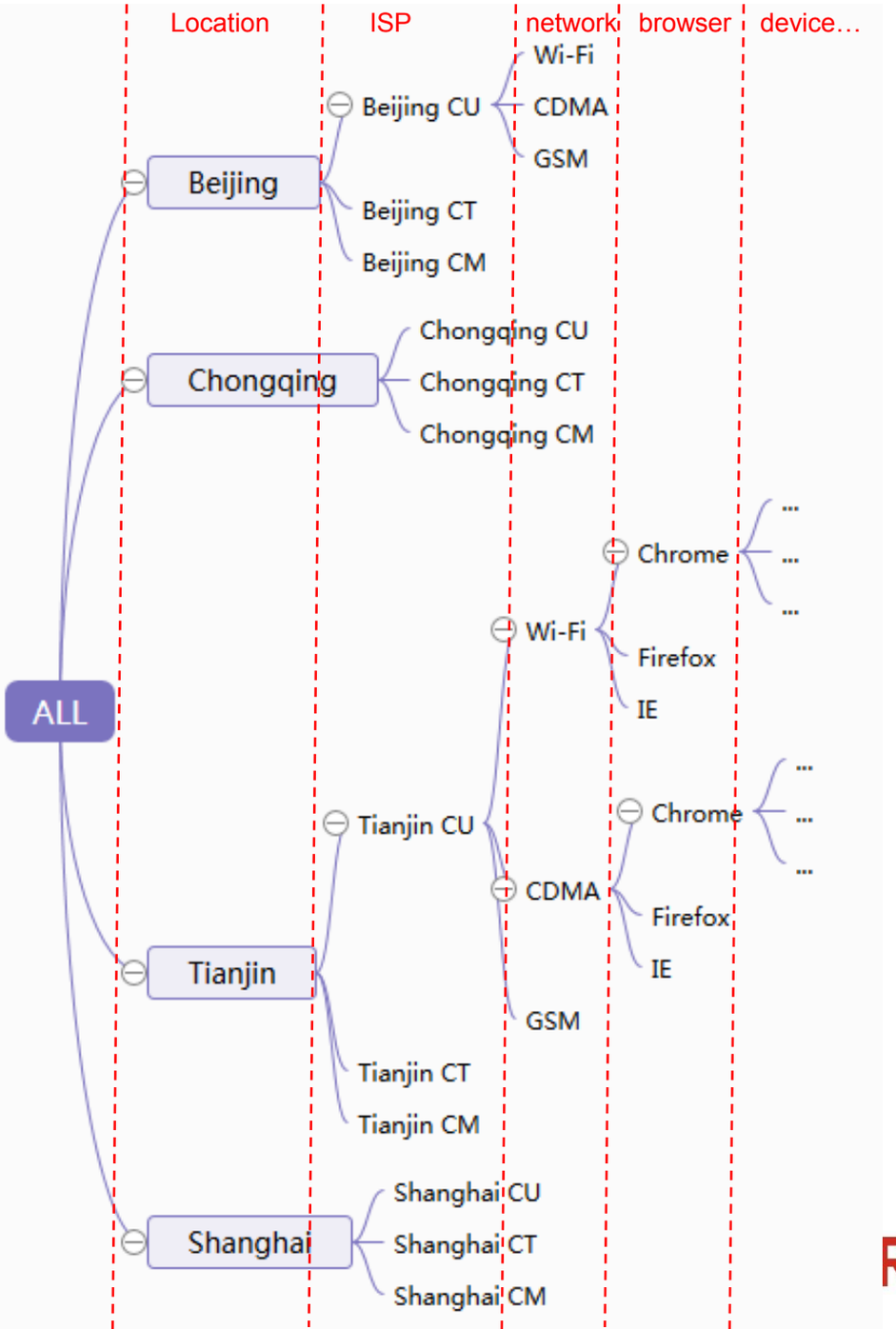
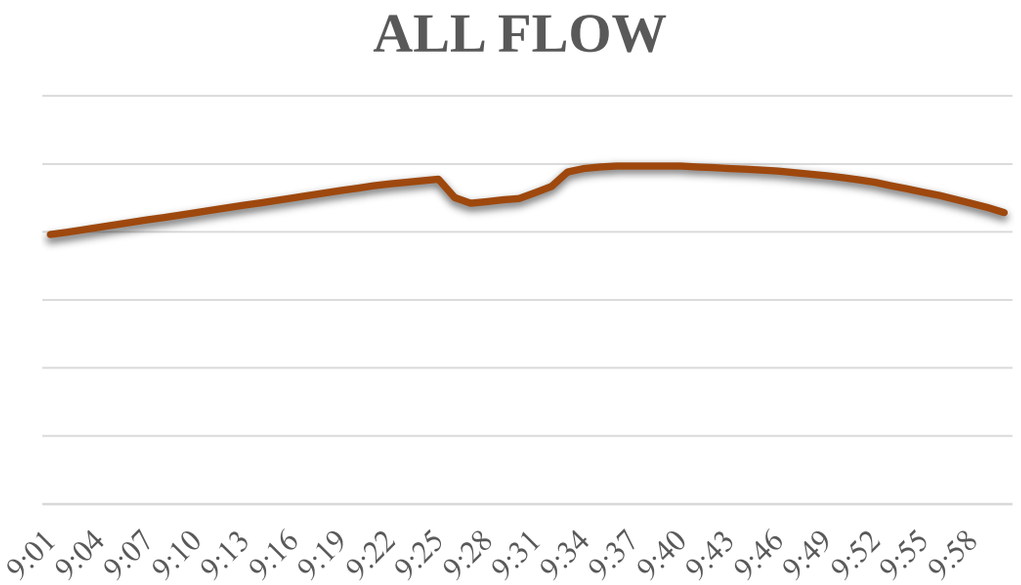
What's the trouble?

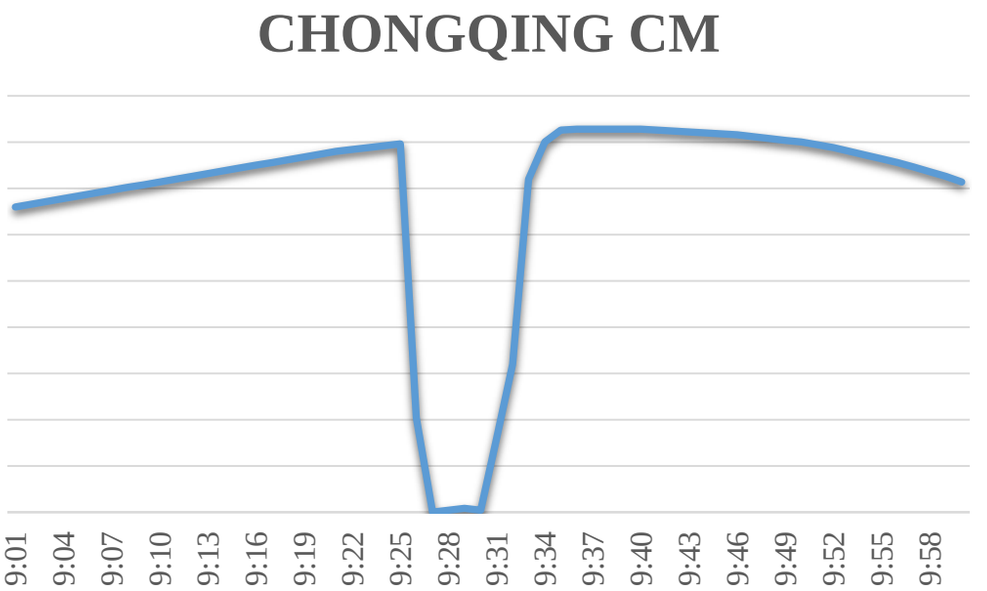
- Descartes accumulation set of all dimensions
- Lots of searching branches(waste of time)
- Need to narrow down the search scope
- Prune——Depending on SRE's experience



Ideal result

- We directly got the answer





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Our solution

- Pick a key indicator
- Procedure
  - Feature extraction —— assigning tags
  - Unsupervised anomaly detection
  - Entropy-based dimension reduction

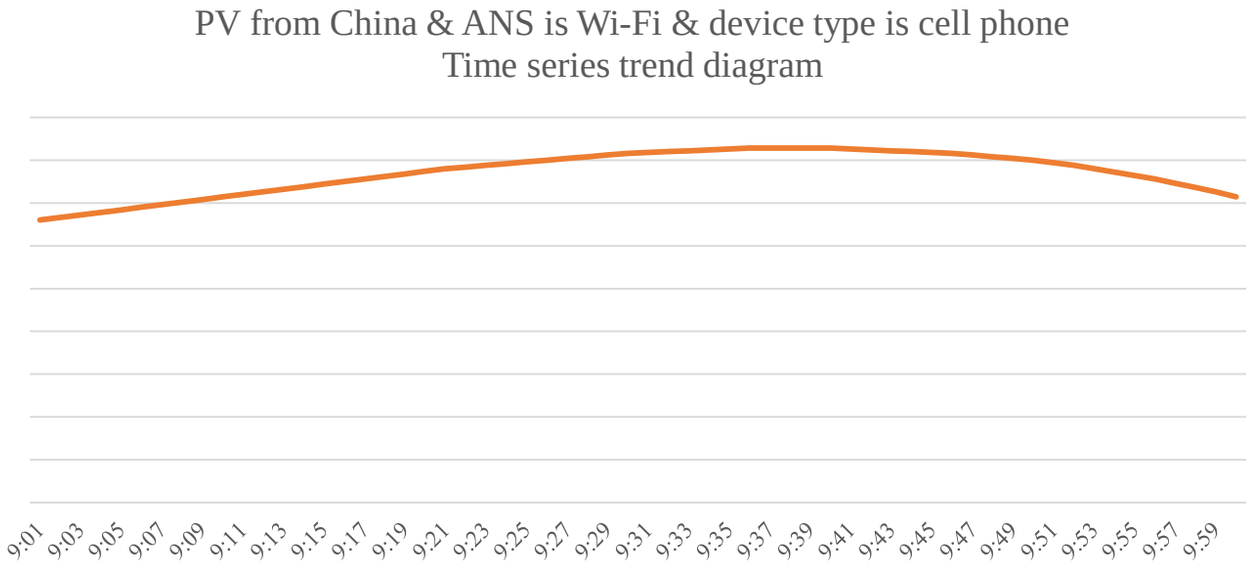
Assigning the tags

- Client-side tags
  - traffic location
  - browser type
  - access network standard
  - device type
  - ...
- Server-side tags
  - Service IDC
  - API Version
  - API type
  - ...

Query Word	Source area	ANS	browser	device	ISP	IDC	…
Driverless car	China	CDMA	Safari	Cell phone	CUCC	IDC-A	…
Sweater	Singapore	Wi-Fi	Chrome	Cell phone	Singtel	IDC-B	…
Machine learning	USA	Wi-Fi	Chrome	pad	T-Mobile	IDC-A	…
Forbidden city	China	Wi-Fi	Firefox	PC	CMCC	IDC-B	…
Pancake rolled with crisp fritter	Singapore	LTE	Safari	Cell phone	M1	IDC-A	…
…	…	…	…	…	…	…	…

Assigning the tags

- traffic location (country/province/city/etc…)
- browser type (chrome/safari/firefox/etc…)
- access network standard (Wi-Fi/CDMA/LTE/etc…)
- device type (PC/laptop/pad/cell phone/etc…)
- ...



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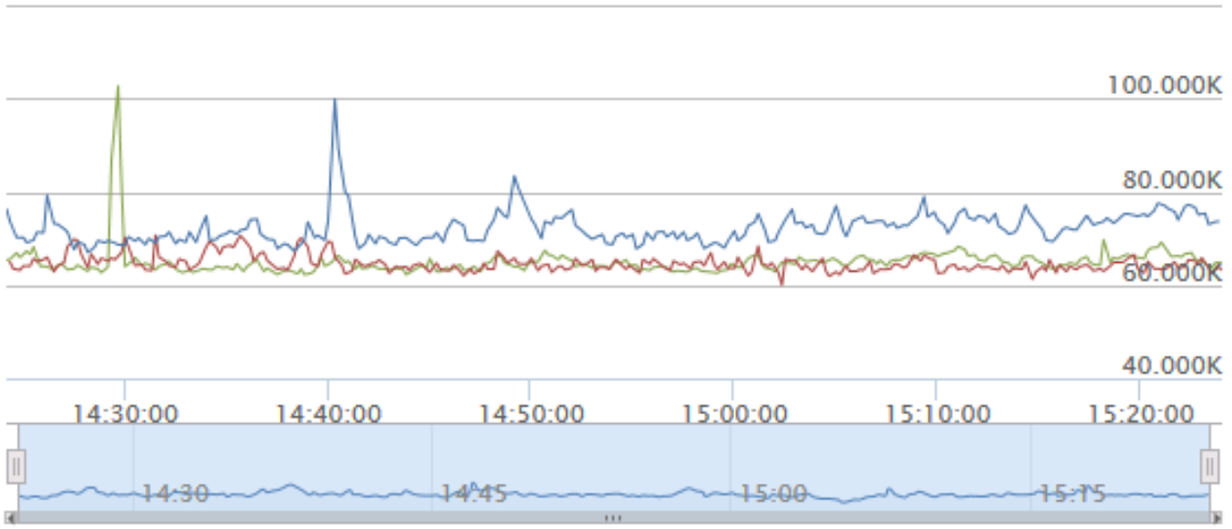
Unsupervised anomaly detection

- Each algorithm works very well for certain types of indicators
- Unsupervised training to get thresholds for all finest dimension combinations
  - why unsupervised? thousands of combinations
  - train thresholds based on history data
  - use latency as an example

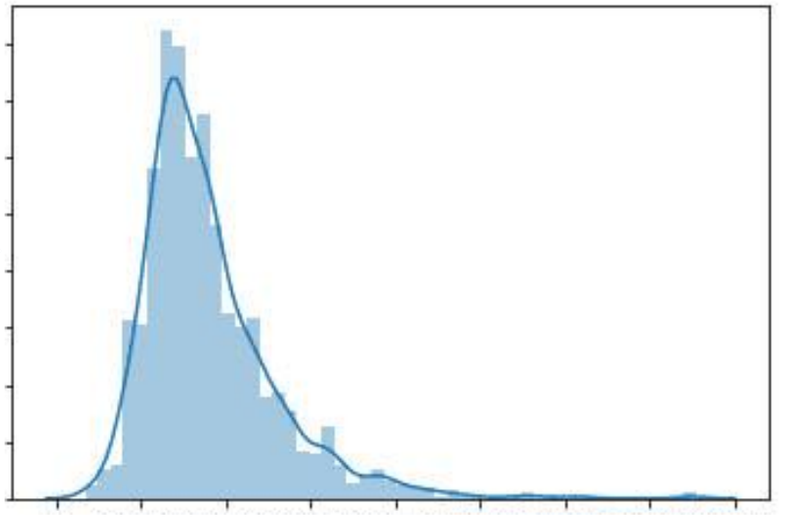
Unsupervised anomaly detection

- e.g. Anomaly detection on service latency
  - KEY- how to determine an appropriate delay threshold
  - build a probability distribution for latency values
  - usually single-peak distribution on the histogram

Time series service latency

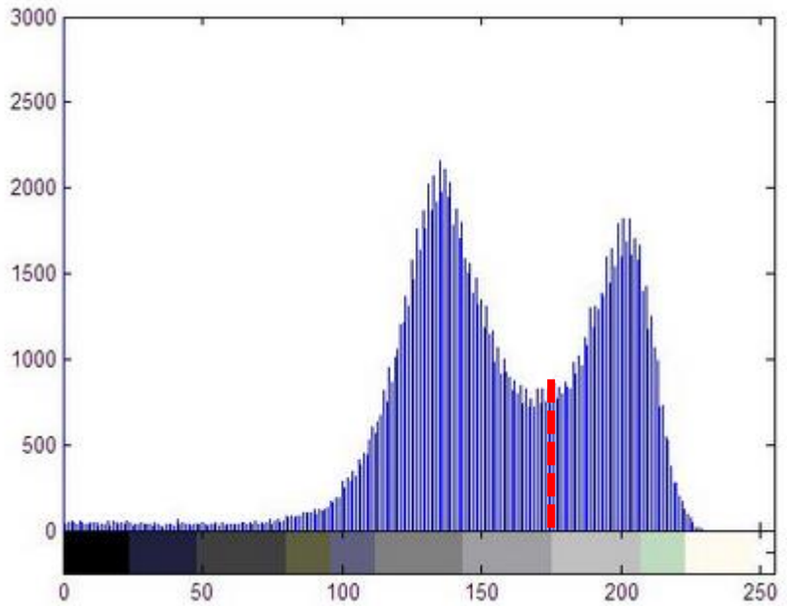


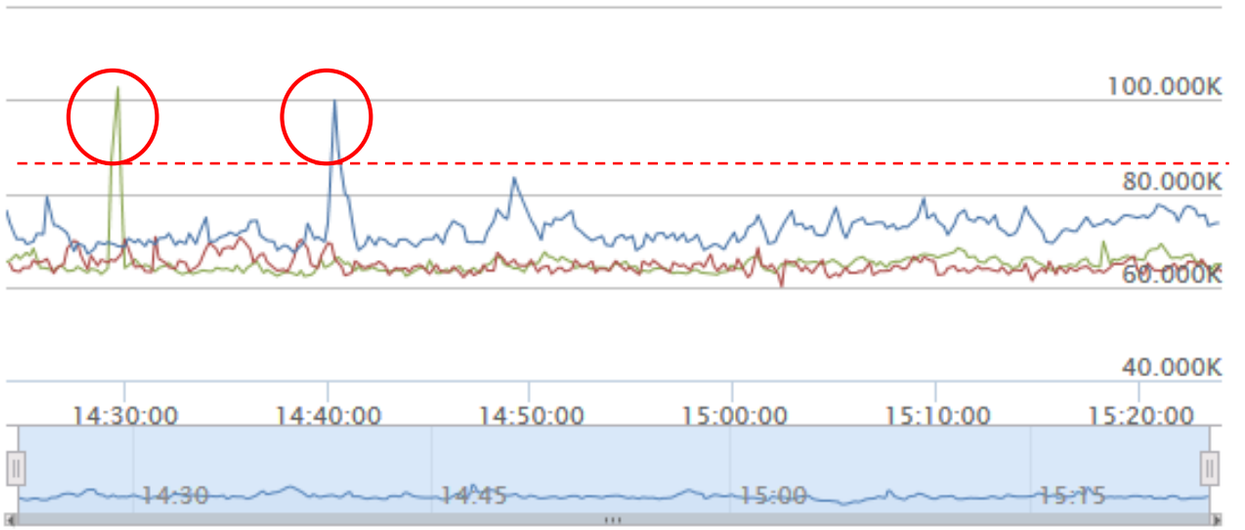
Histogram of service latency



Unsupervised anomaly detection

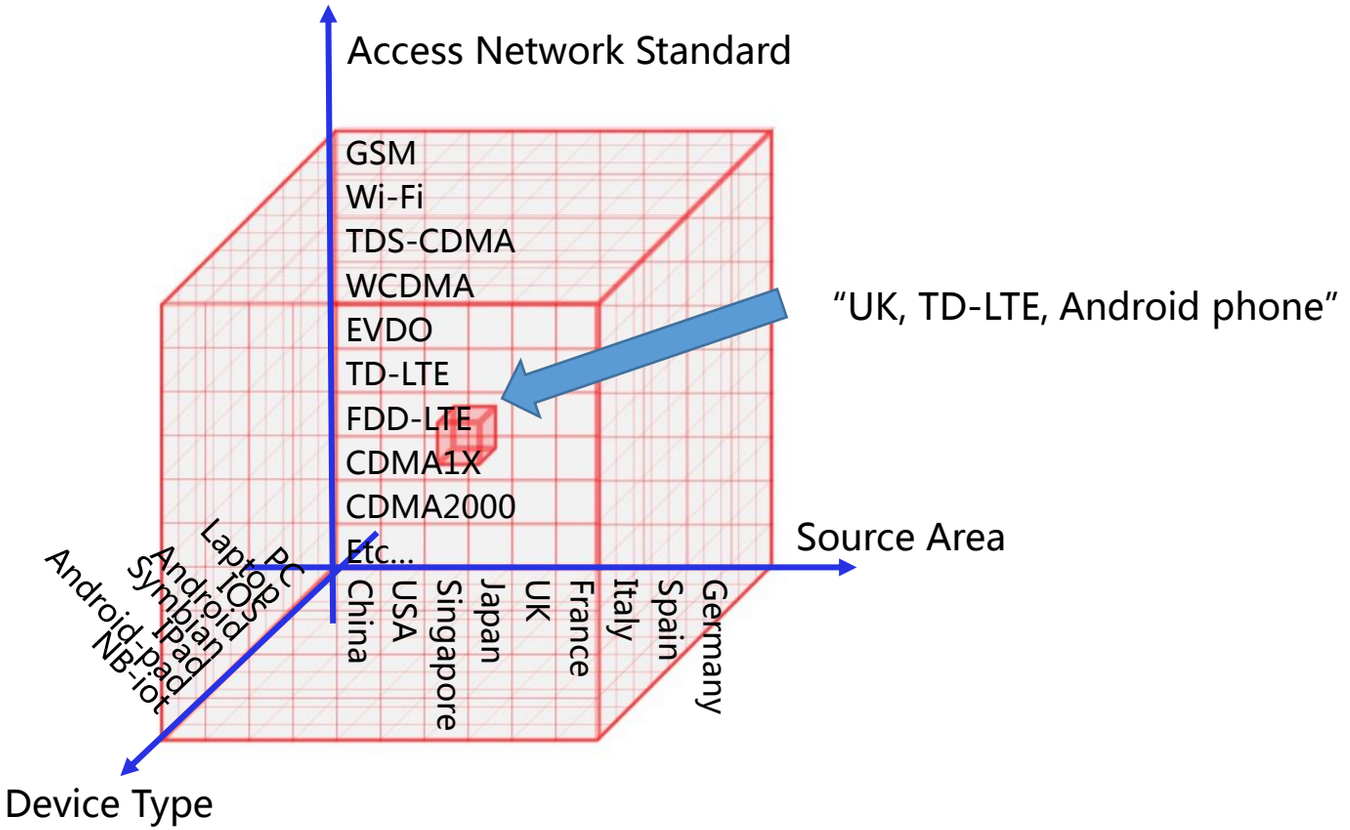
- Anomaly detection on service latency
  - Two/muti-peak distribution when failure happens
  - Maximize between-class scatter ->Threshold





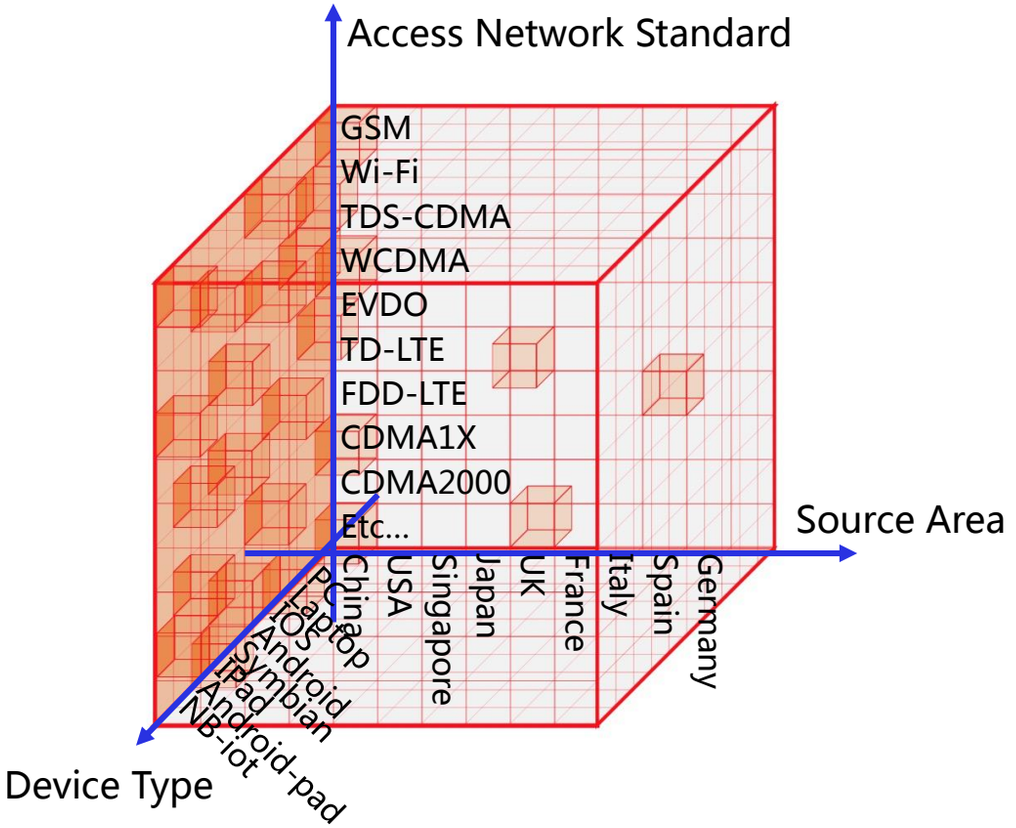
Entropy-based dimension reduction

- Error cube

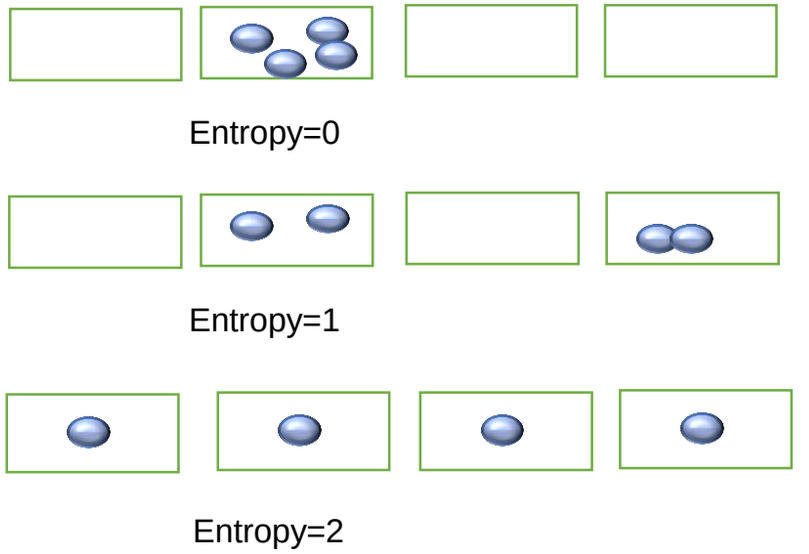


Entropy-based dimension reduction

- anomaly detection usually provides tens/hundreds of error cubes
- need to combine relevant error cubes together
- select the dimension of which the anomalies are least uniformly distributed
- entropy describes the uniformity of the distribution



$$Entropy\ (S) = -\sum_{i=1}^{n} P_i \log P_i$$



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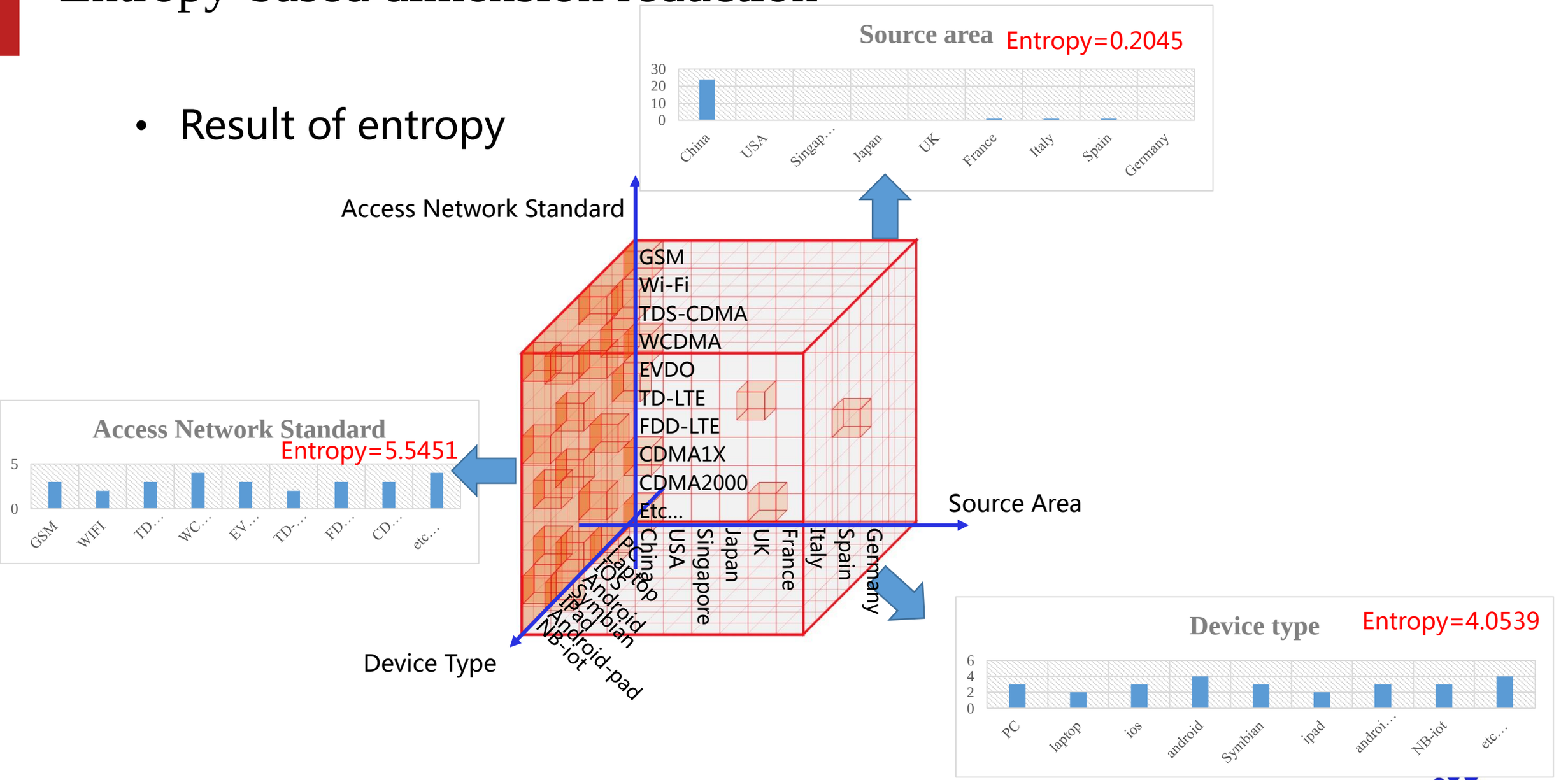
Entropy-based dimension reduction

- Result of entropy



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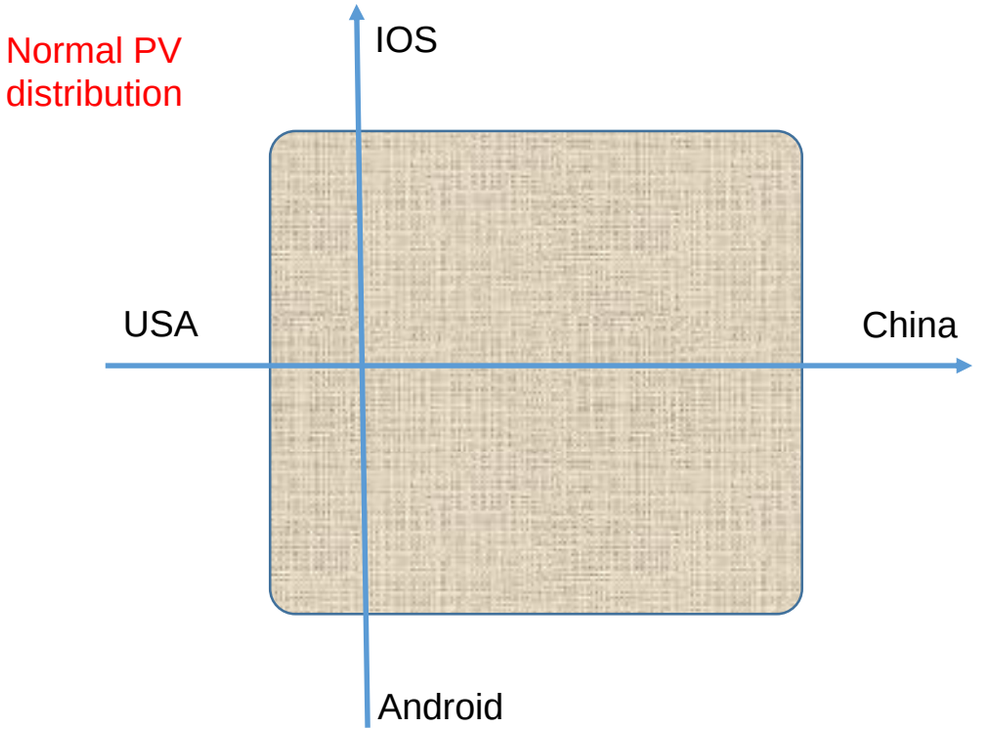
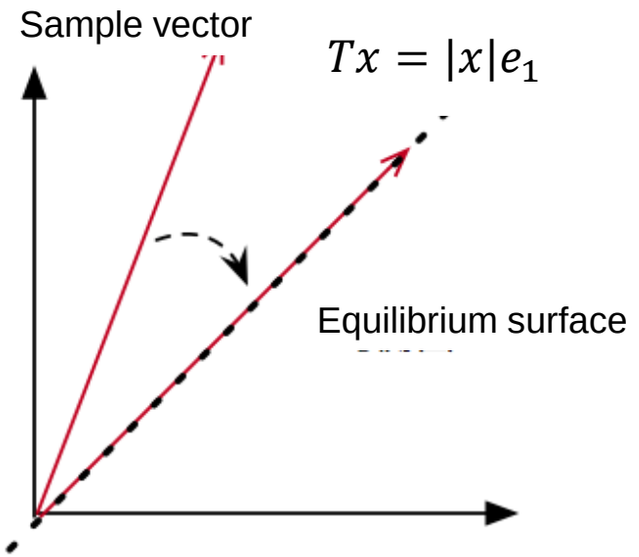
Unbalanced base distribution

- Mostly for metrics such as PV/PVLOST
- Givens transformation to convert base distribution to uniform





$$\begin{pmatrix} cos & sin \\ -sin & cos \end{pmatrix} \begin{pmatrix} a \\ b \end{pmatrix}$$

- transform error distribution in the same way

Summary

- What’s the trouble?
- feature extraction
- unsupervised anomaly detection
- entropy-based dimension reduction

- Q & A
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THANK YOU!