Network Data Use Case for Wavelength Division Service

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Background - wavelength division service

- Wavelength-division multiplexing (WDM)
- WDM system
- wavelength division network data

Motivation and Goal

Motivation:

• Traditional passive strategy is inefficient, and easily leads to long service interruption.

• Statistical characteristics of network data can help operator to judge the time point at which the service is abnormal or normal, or the service is risky or healthy .

Goal:

• illustrate the requirements of network data used to evaluate the performance of wavelength division service.

• demonstrate the different application scenarios of network data in wavelength division service.

• present the existing problem of learning network data

Terminologies

KPI: Key Performance Indicator.

Network KPI represents the operational state of a network device, link or network protocol in the network. KPI data is usually represented to users as a set of time series (e.g., KPI = x_i, i=1..t), each time series is corresponding to one network KPI indicator value at different time point during specific time period.

Characteristics of network data

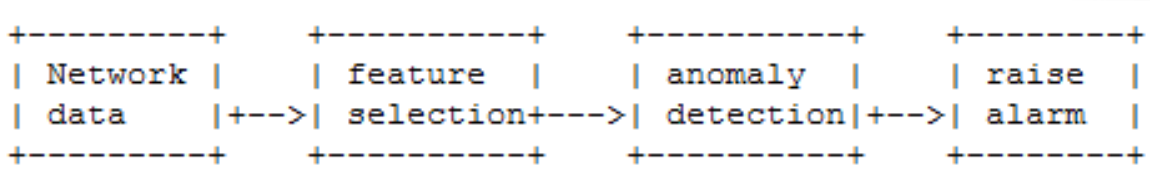
- Network data is a series of data points indexed in time order. It taken over time may have an internal structure (such as, trend, seasonal variation, or outliers).
- Network data mainly consists several major characteristics:
  - Subject
  - Measured values
  - Timestamp

timestamp	cluster	hostname	cpu	iops
2015-04-28T17:50:00Z	Cluster-A	host-a	10	10
2015-04-28T17:50:10Z	Cluster-A	host-b	20	30
2015-04-28T17:50:20Z	Cluster-A	host-a	5	8

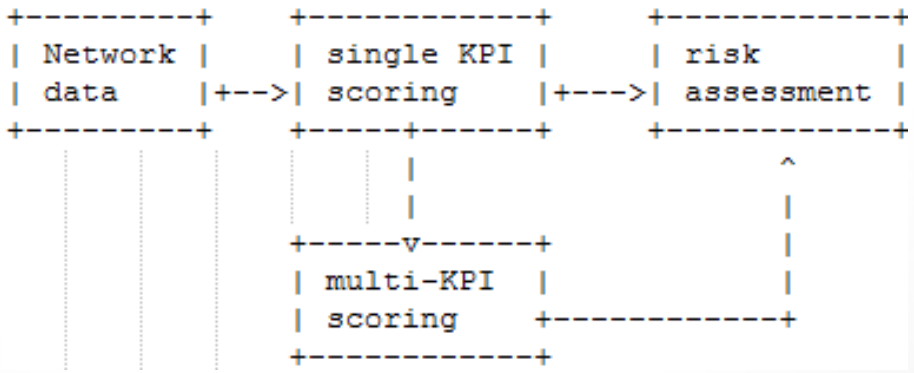
Timestamp Subject Measured values

Use cases

- Anomaly detection
  - Network data: FEC_bef, input optical power, laser bias current and other key factors can be selected to keep track of wavelength division service over time

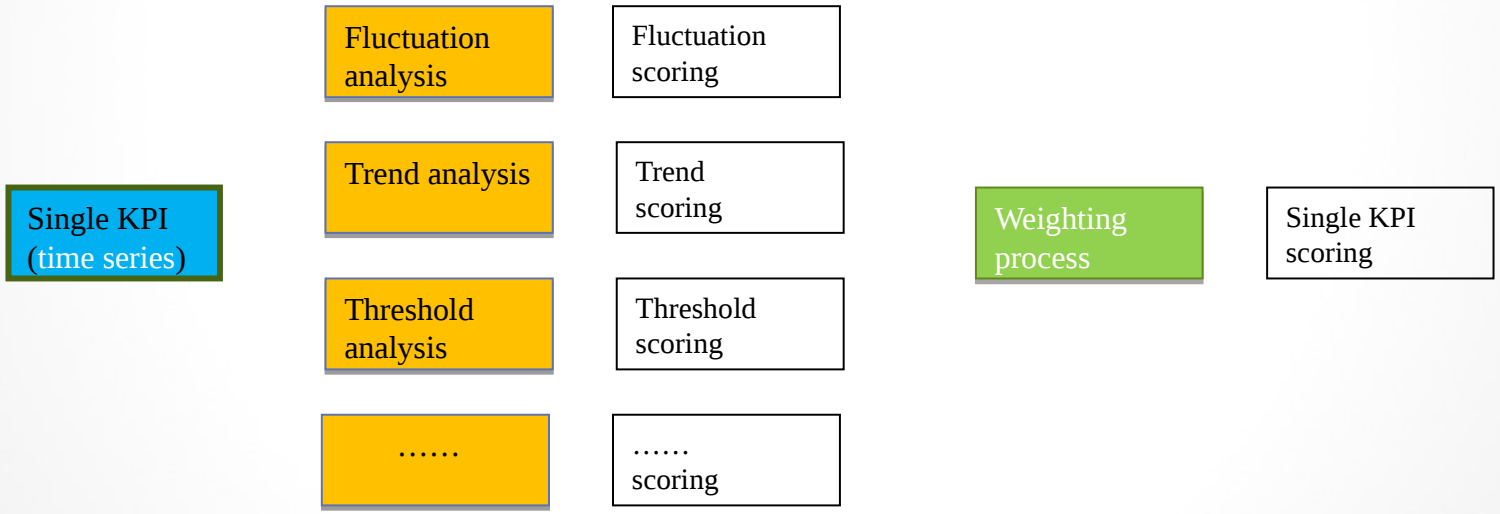


- Risk asses
  - Single KPI scoring: The scoring strategy for single KPI. In this case, different dimensions of a KPI should be examined to score a KPI;.
  - Multi-KPI scoring: The scoring strategy for assessing the network risk using values of many KPIs. If a device or a service is monitored by several key KPIs, the risk should be analyzed by the integration of these KPI scores.



Risk assessment - Single KPI (1)

- Single KPI scoring, different dimensions of a KPI were examined: fluctuation, trend, threshold, etc.
  - Fluctuation analysis
  - Trend analysis
  - Threshold analysis



Risk assessment - Single KPI (2)

- FEC_bef KPI scoring

FEC_score (5×169,236)

time	rid	befjitterscore	befdeviationscore	befthresholdscore
2017-07-01 00:00:00	r1	50.0073	87.7848	12.5
2017-07-01 00:00:00	r10	100	100	100
2017-07-01 00:00:00	r100	100	100	100
2017-07-01 00:00:00	r1000	100	100	100
2017-07-01 00:00:00	r1001	100	100	100
2017-07-01 00:00:00	r1002	83.0047	85.7769	37.5
2017-07-01 00:00:00	r1003	77.2716	100	25
2017-07-01 00:00:00	r1004	100	100	100
2017-07-01 00:00:00	r1005	100	100	100
2017-07-01 00:00:00	r1006	100	100	100
2017-07-01 00:00:00	r1007	100	90.3659	12.5
2017-07-01 00:00:00	r1008	79.8173	87.1236	0
2017-07-01 00:00:00	r1009	87.3081	95.2853	12.5
2017-07-01 00:00:00	r101	100	100	12.5
2017-07-01 00:00:00	r1010	100	100	100
2017-07-01 00:00:00	r1011	100	100	100
2017-07-01 00:00:00	r1012	100	100	100
2017-07-01 00:00:00	r1013	100	100	100
2017-07-01 00:00:00	r1014	100	100	100
2017-07-01 00:00:00	r1015	34.575	100	100
2017-07-01 00:00:00	r1016	100	100	100
2017-07-01 00:00:00	r1017	100	100	100
2017-07-01 00:00:00	r1018	100	100	100
2017-07-01 00:00:00	r1019	100	100	100
2017-07-01 00:00:00	r102	100	99.8157	12.5
2017-07-01 00:00:00	r1020	84.8477	100	100
2017-07-01 00:00:00	r1021	71.1991	100	100
2017-07-01 00:00:00	r1022	100	99.9679	0
2017-07-01 00:00:00	r1023	100	100	0
2017-07-01 00:00:00	r1024	100	100	100
2017-07-01 00:00:00	r1025	100	100	100
2017-07-01 00:00:00	r1026	100	100	100
2017-07-01 00:00:00	r1027	100	100	100
2017-07-01 00:00:00	r1028	81.1454	87.5456	37.5
2017-07-01 00:00:00	r1029	34.575	87.3236	62.5
2017-07-01 00:00:00	r103	100	100	100
2017-07-01 00:00:00	r1030	100	100	37.5

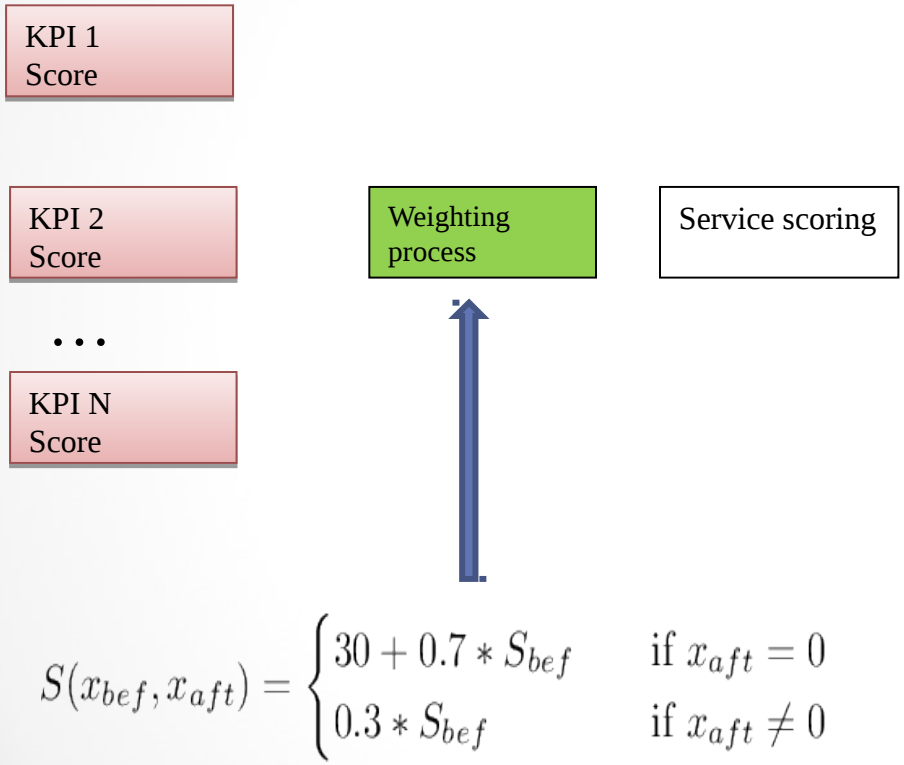
weighting

FEC_score (6×169,236)

time	rid	befjitterscore	befdeviationscore	befthresholdscore	befscore
2017-07-01 00:00:00	r1	50.0073	87.7848	12.5	55.7685
2017-07-01 00:00:00	r10	100	100	100	100
2017-07-01 00:00:00	r100	100	100	100	100
2017-07-01 00:00:00	r1000	100	100	100	100
2017-07-01 00:00:00	r1001	100	100	100	100
2017-07-01 00:00:00	r1002	83.0047	85.7769	37.5	68.4641
2017-07-01 00:00:00	r1003	77.2716	100	25	70.3407
2017-07-01 00:00:00	r1004	100	100	100	100
2017-07-01 00:00:00	r1005	100	100	100	100
2017-07-01 00:00:00	r1006	100	100	100	100
2017-07-01 00:00:00	r1007	100	90.3659	12.5	64.558
2017-07-01 00:00:00	r1008	79.8173	87.1236	0	55.5344
2017-07-01 00:00:00	r1009	87.3081	95.2853	12.5	65.1139
2017-07-01 00:00:00	r101	100	100	12.5	69.375
2017-07-01 00:00:00	r1010	100	100	100	100
2017-07-01 00:00:00	r1011	100	100	100	100
2017-07-01 00:00:00	r1012	100	100	100	100
2017-07-01 00:00:00	r1013	100	100	100	100
2017-07-01 00:00:00	r1014	100	100	100	100
2017-07-01 00:00:00	r1015	34.575	100	100	90.1862
2017-07-01 00:00:00	r1016	100	100	100	100
2017-07-01 00:00:00	r1017	100	100	100	100
2017-07-01 00:00:00	r1018	100	100	100	100
2017-07-01 00:00:00	r1019	100	100	100	100
2017-07-01 00:00:00	r102	100	99.8157	12.5	69.2828
2017-07-01 00:00:00	r1020	84.8477	100	100	97.7272
2017-07-01 00:00:00	r1021	71.1991	100	100	95.6799
2017-07-01 00:00:00	r1022	100	99.9679	0	64.984
2017-07-01 00:00:00	r1023	100	100	0	65
2017-07-01 00:00:00	r1024	100	100	100	100
2017-07-01 00:00:00	r1025	100	100	100	100
2017-07-01 00:00:00	r1026	100	100	100	100
2017-07-01 00:00:00	r1027	100	100	100	100
2017-07-01 00:00:00	r1028	81.1454	87.5456	37.5	69.0696
2017-07-01 00:00:00	r1029	34.575	87.3236	62.5	70.7231
2017-07-01 00:00:00	r103	100	100	100	100
2017-07-01 00:00:00	r1030	100	100	37.5	78.125

Risk assessment – Multi-KPI

- Multi-KPI scoring



$$S(x_{bef}, x_{aft}) = \begin{cases} 30 + 0.7 * S_{bef} & \text{if } x_{aft} = 0 \\ 0.3 * S_{bef} & \text{if } x_{aft} \neq 0 \end{cases}$$

FEC_score (5×169,236)

time	rid	aftcorrected	befscore	finalscore
2017-07-01 00:00:00	r1	0	55.7685	69.0379
2017-07-01 00:00:00	r10	0	100	100
2017-07-01 00:00:00	r100	0	100	100
2017-07-01 00:00:00	r1000	0	100	100
2017-07-01 00:00:00	r1001	0	100	100
2017-07-01 00:00:00	r1002	0	68.4641	77.9249
2017-07-01 00:00:00	r1003	0	70.3407	79.2385
2017-07-01 00:00:00	r1004	0	100	100
2017-07-01 00:00:00	r1005	0	100	100
2017-07-01 00:00:00	r1006	0	100	100
2017-07-01 00:00:00	r1007	0	64.558	75.1906
2017-07-01 00:00:00	r1008	0	55.5344	68.8741
2017-07-01 00:00:00	r1009	0	65.1139	75.5797
2017-07-01 00:00:00	r101	0	69.375	78.5625
2017-07-01 00:00:00	r1010	0	100	100
2017-07-01 00:00:00	r1011	0	100	100
2017-07-01 00:00:00	r1012	0	100	100
2017-07-01 00:00:00	r1013	0	100	100
2017-07-01 00:00:00	r1014	0	100	100
2017-07-01 00:00:00	r1015	0	90.1862	93.1304
2017-07-01 00:00:00	r1016	0	100	100
2017-07-01 00:00:00	r1017	0	100	100
2017-07-01 00:00:00	r1018	0	100	100
2017-07-01 00:00:00	r1019	0	100	100
2017-07-01 00:00:00	r102	0	69.2828	78.498
2017-07-01 00:00:00	r1020	0	97.7272	98.409
2017-07-01 00:00:00	r1021	0	95.6799	96.9759
2017-07-01 00:00:00	r1022	0	64.984	75.4888
2017-07-01 00:00:00	r1023	0	65	75.5
2017-07-01 00:00:00	r1024	0	100	100
2017-07-01 00:00:00	r1025	0	100	100
2017-07-01 00:00:00	r1026	0	100	100
2017-07-01 00:00:00	r1027	0	100	100
2017-07-01 00:00:00	r1028	0	69.0696	78.3487
2017-07-01 00:00:00	r1029	0	70.7231	79.5061
2017-07-01 00:00:00	r103	0	100	100
2017-07-01 00:00:00	r1030	0	78.125	84.6875

Open issues

- Merge data from different time periods?

  - For example, for a multi- domain deployment service, there are many different collection periods for network devices, such as 30s, 5min, 15min, and so on.
  - how these data sets are stored and assessed with high efficiency?

Q&A (and Tomato☺)

THANK YOU