Recently network R&D work in IHEP

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on behalf of IHEP network group

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About our team

- **Network is one of the disciplinary directions in IHEP CC**

- **I am the network team leader of IHEP CC**

  – 5 staffs and 2 graduate students

- **Mission of our team**

  – In charge of the network design, construction and maintenance of all the network environment of IHEP both in Beijing as well as the remote sites

    • Campus network

    • Data center network

    • Wide area network

    • Beamline control network

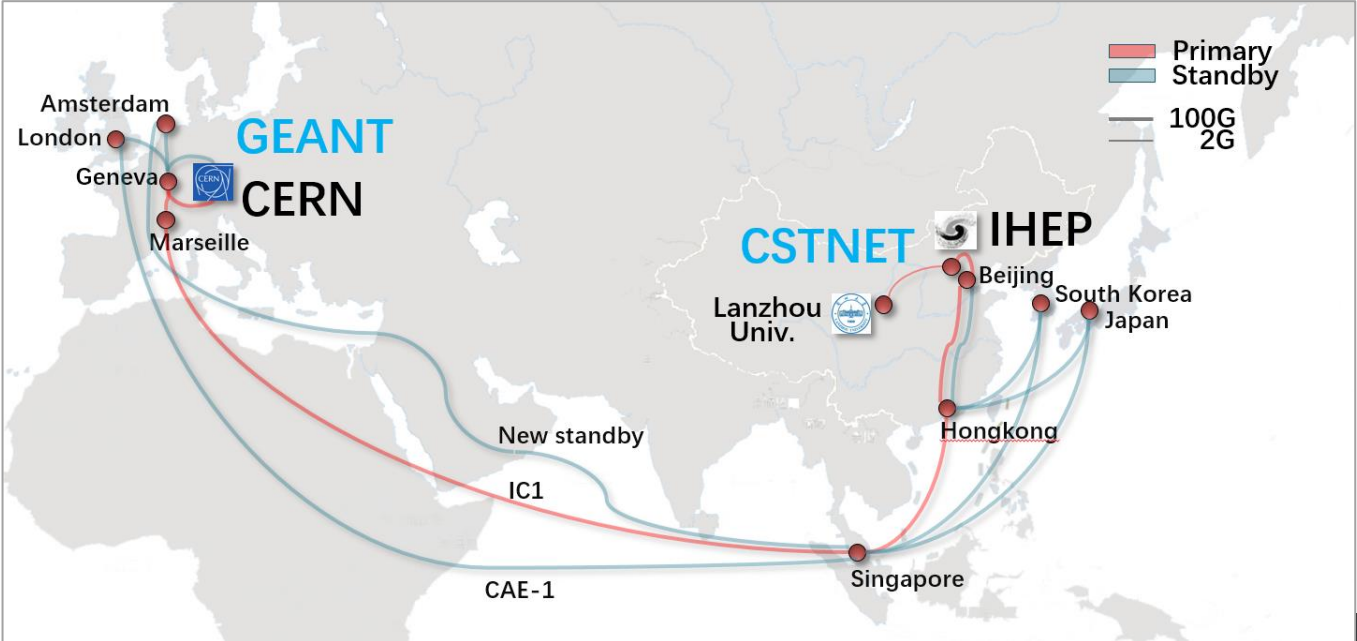 – Network R&D work related to network maintenance

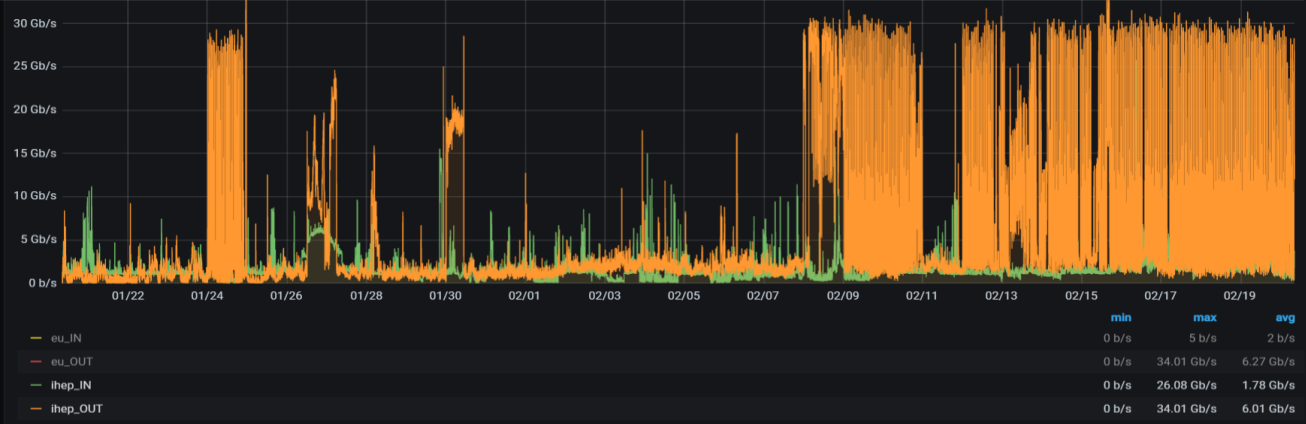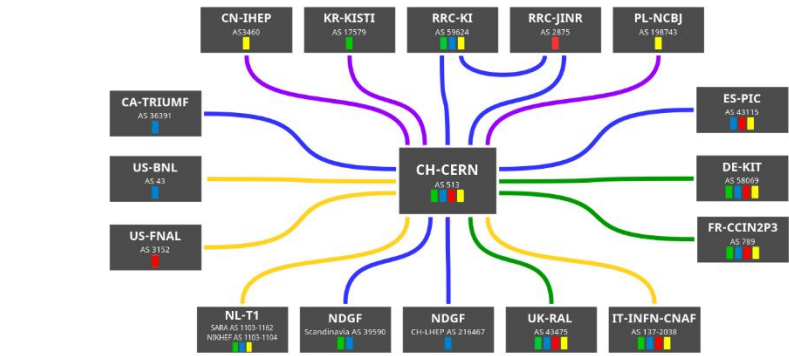   • Help to improve the network service quality
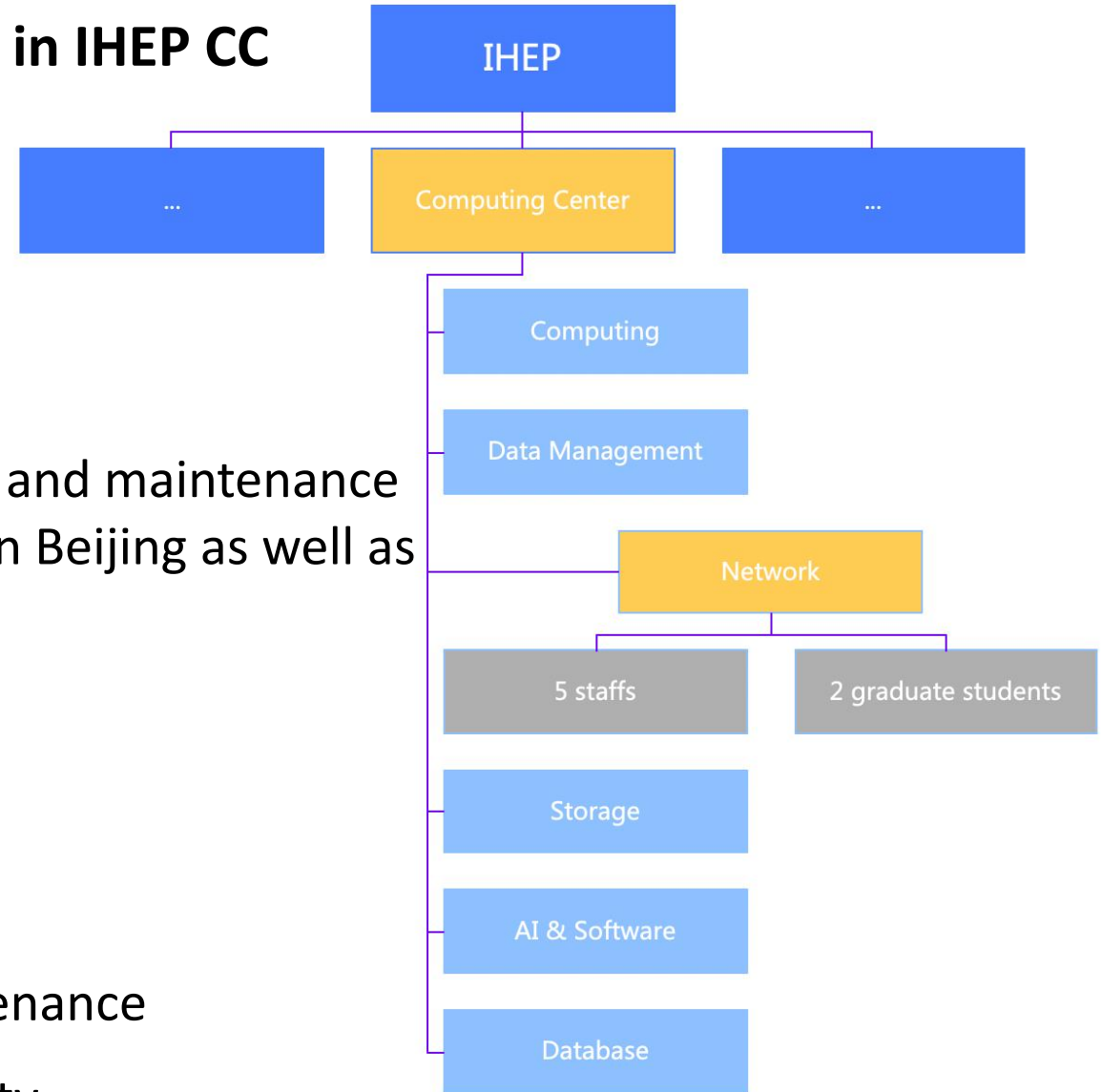
Background

- **IHEP endorsed as a new WLCG Tier-1 site (June,2024), WAN bandwidth was upgraded from 40Gbps to 100Gbps**

  - LHCOPN@IHEP
    - 20Gbps bandwidth guaranteed
    - 3 links redundancy
    - ~ 200ms latency
  - LHCONE@IHEP
    - 100Gbps bandwidth shared

Background：network challenges

- **Network is a critical part of WLCG's infrastructure, becomes more and more important to assure the site availability and reliability**

- **Many network challenges from daily network operation**

    – Issue debugging is difficult and time-consuming

    – How to thoroughly and vividly demonstrate various network measurement results to the application

    – How to promptly detect and resolve the network issues

    – How to make full use of the limited and expensive dedicated links

What we are currently doing?
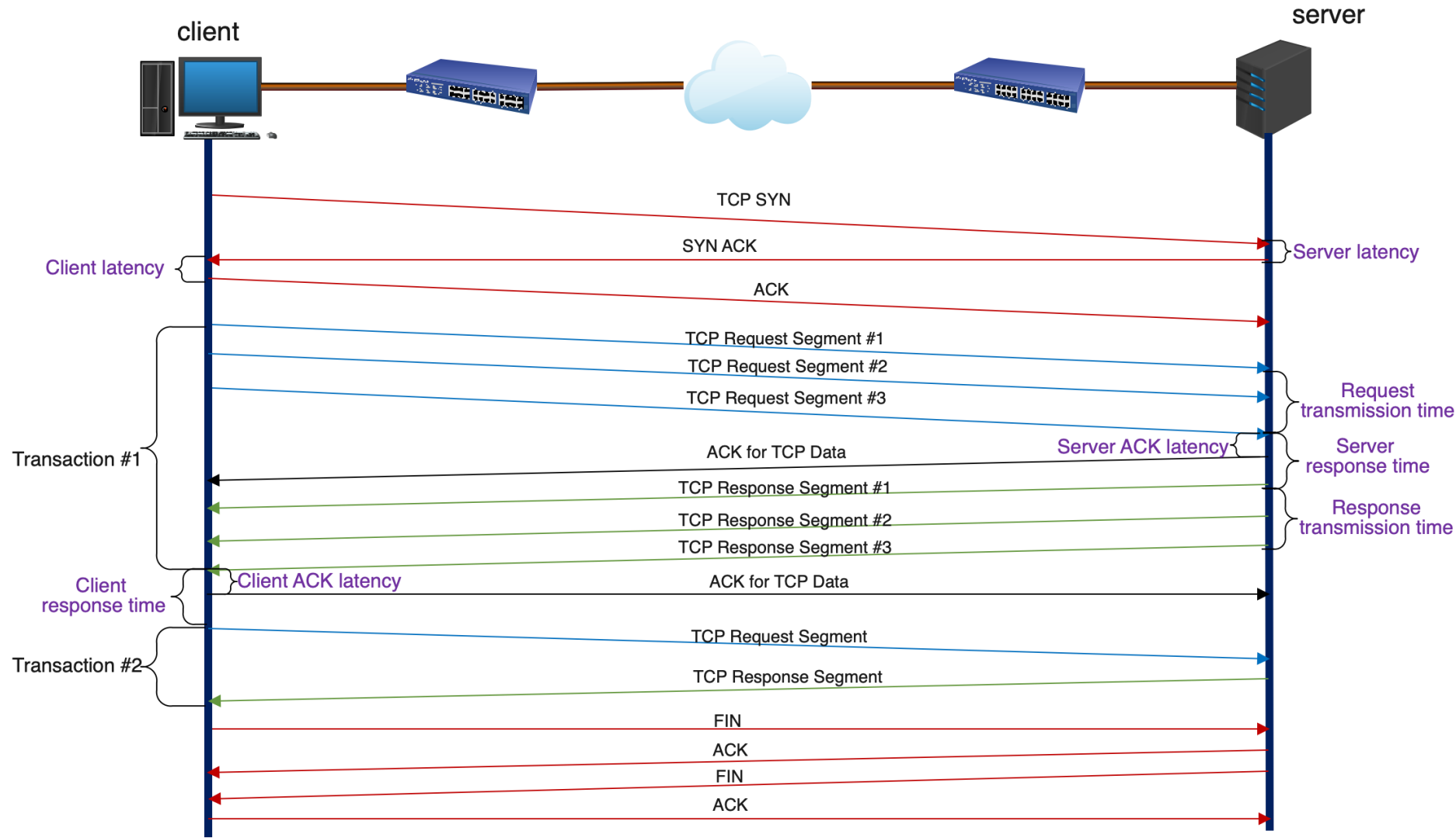
- **NPM: Network Performance Manager**

  – Mirroring key application related network traffic, stored it and analyze it

  – Coordinated monitoring of the network and application tiers

  – Network session analysis: based on tshark

  – Return the network and application performance KPIs to debugging issues

  – Detect the network anomalies and return the anomaly type and time occurred

- **Network QoS assurance done by a self-defined SDN controller**

  – **Background**: many applications shared a limited dedicated link, while certain key application (JUNO Raw data movement: HiDTS) needs bandwidth assurance

  – To make full use of the limited dedicated link, we dynamically predict the needed bandwidth based on the data volume which needs to be transferred

Some performance KPIs defined in NPM

Key KPIs
Server latency
Client latency
Server ACK latency
Client ACK latency
Server response time
Client response time
Request transmission time
Response transmission time
……

client

server

TCP SYN

SYN ACK — Server latency

Client latency

ACK

TCP Request Segment #1
TCP Request Segment #2
TCP Request Segment #3 — Request transmission time

Transaction #1

ACK for TCP Data — Server ACK latency — Server response time

TCP Response Segment #1
TCP Response Segment #2 — Response transmission time
TCP Response Segment #3

Client response time — Client ACK latency — ACK for TCP Data

TCP Request Segment

Transaction #2

TCP Response Segment

FIN
ACK
FIN
ACK

Ideas of the NPM

- **Analyze each TCP session packet by packet through tshark**

- **Define the significant application through five-tuple information**

- **Calculate the performance KPIs and stored them in the data warehouse**

- **Create the KPI baseline of the connection between client and servers**

- **Based on ML method to detect anomalies**

NPM work progress

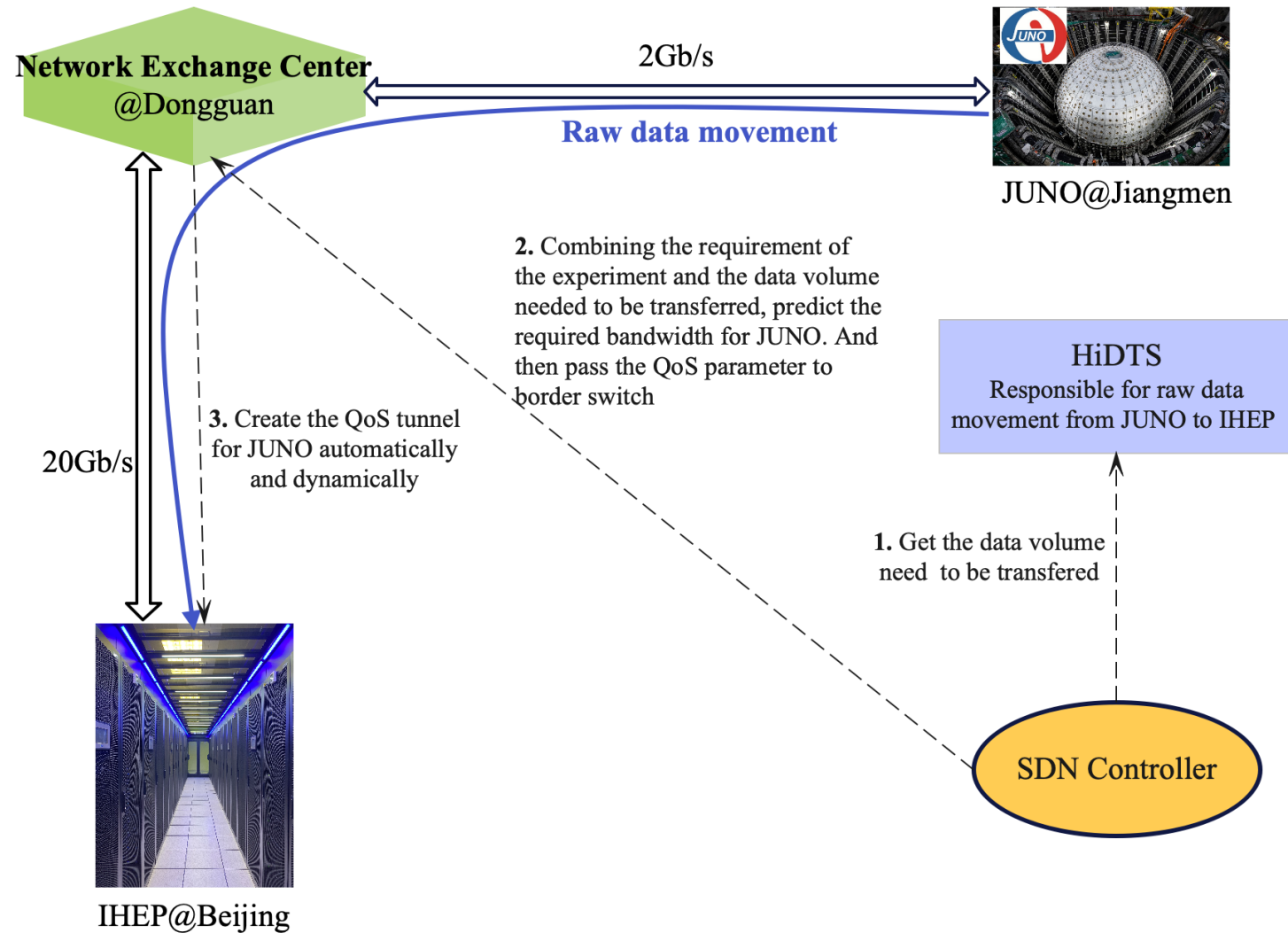- **NPM work is really huge and time-consuming**

  - Architecture has been designed

  - Network traffic packet has been captured and stored

  - Data warehouse has been created and established

  - Calculate algorithm of the network performance KPIs have been designed

- **The unsupervised model based on LSTM-AE for anomaly detection has been deployed**
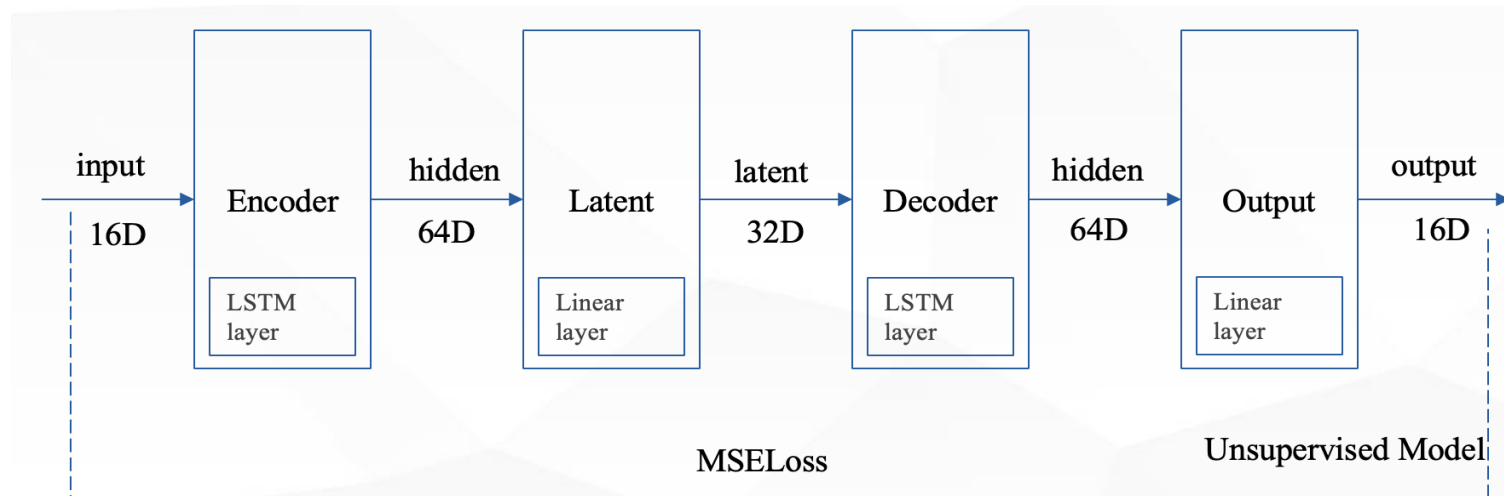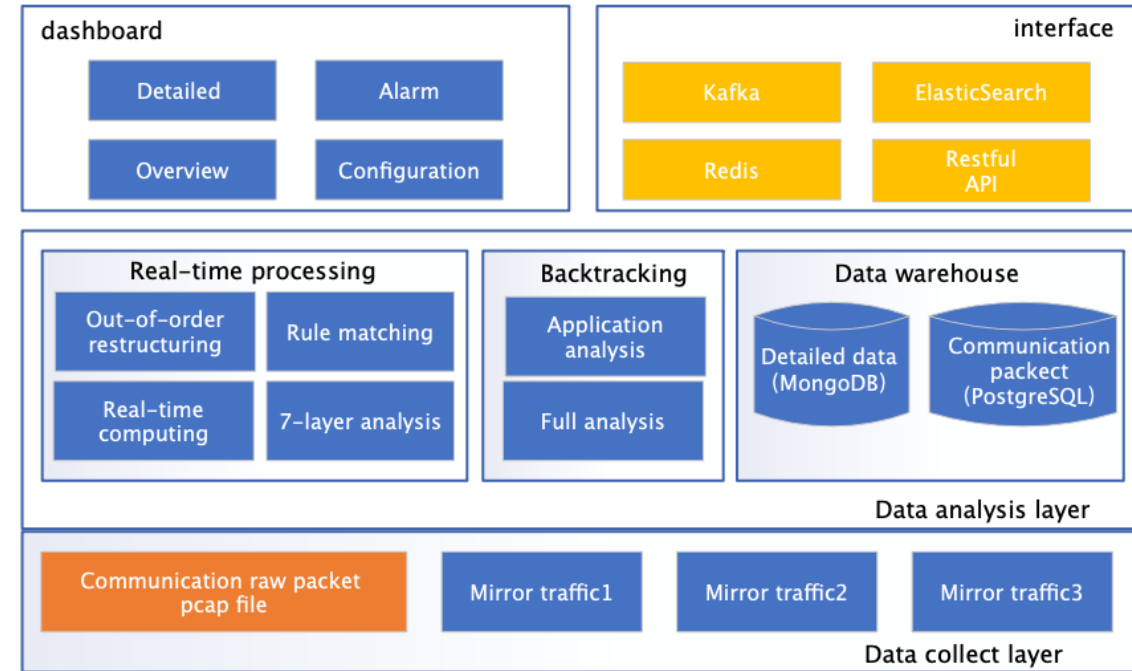
Network QoS assurance work progress

- **SDN Controller has been developed**

- **Joint-test with the border switch has been finished and successfully**

- **The program to create the QoS tunnel for JUNO automatically and dynamically has been developed and tested**

- **The whole system will be online in the next few weeks**

Network Exchange Center @Dongguan

2Gb/s

Raw data movement

JUNO@Jiangmen

2. Combining the requirement of the experiment and the data volume needed to be transferred, predict the required bandwidth for JUNO. And then pass the QoS parameter to border switch

HiDTS Responsible for raw data movement from JUNO to IHEP

3. Create the QoS tunnel for JUNO automatically and dynamically

20Gb/s

1. Get the data volume need to be transfered

IHEP@Beijing

SDN Controller

Future plan

- **Develop the real-time processing and backtracking module to get the performance KPIs**

- **Based on data set of the performance KPIs, train the anomaly detection model**

- **NPM work is just started and all collaborations are welcomed**

Thanks for your attentions

Questions, Comments, Suggestions?