AMS-02 Monte Carlo Simulation in Science Operation Center at Southeast University

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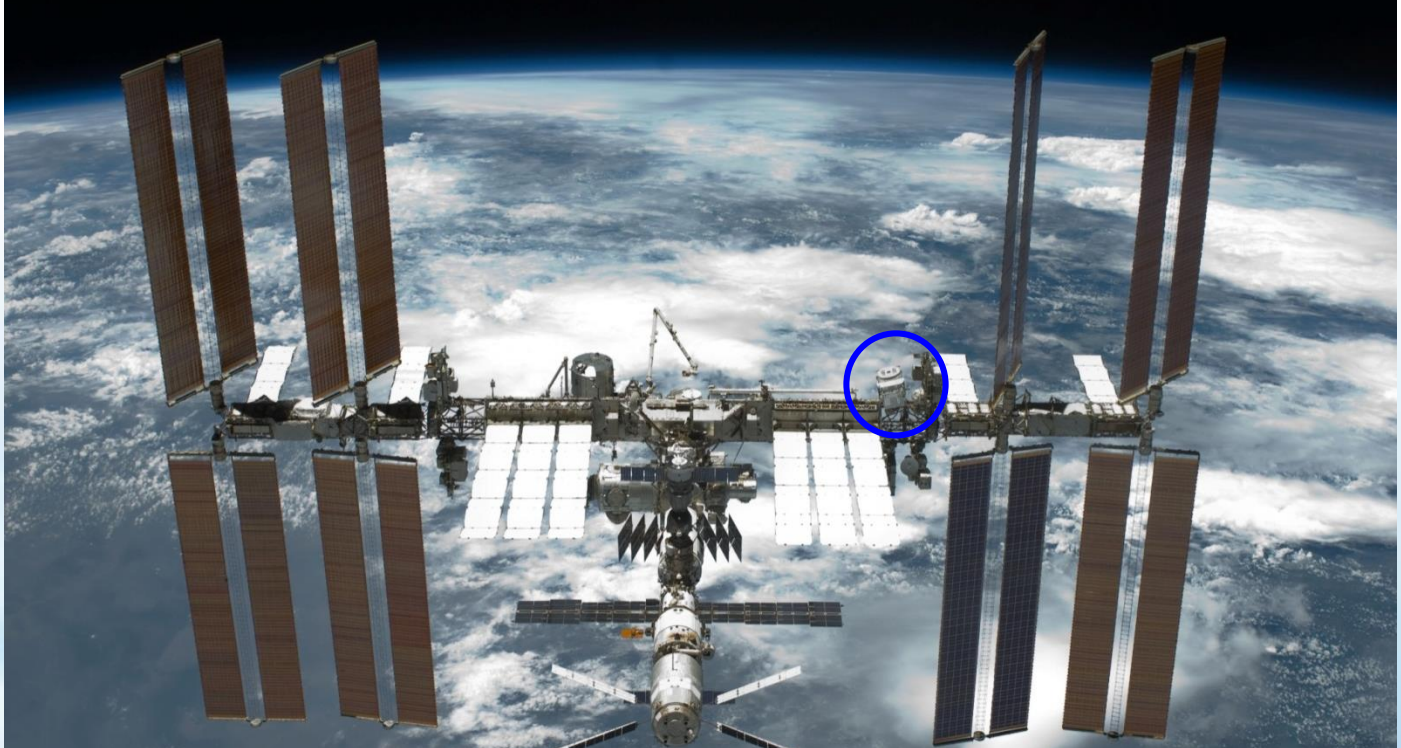
Outline

- AMS SEUSOC's Infrastructure
- AMS Monte Carlo production at SEUSOC
- Conclusions

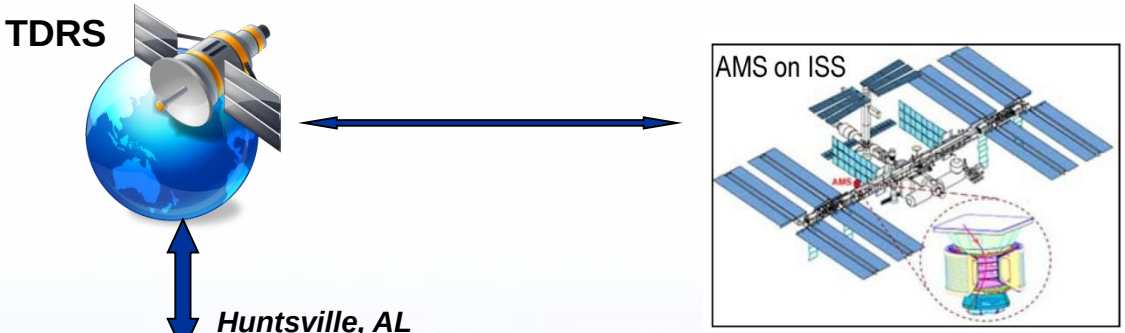
AMS-02 experiment

AMS-02 is a large scientific experiment on ISS



It is designed to measure antimatter in cosmic rays and search for evidence of dark matter. PI for AMS-02 is Nobel laureate particle physicist Samuel Ting. The launch of STS-134 carrying AMS-02 took place on 16 May 2011, and the spectrometer was installed on 19 May 2011.

AMS data flow to SEUSOC



Huntsville, AL

MSFC

AMS Scientific Operation Center

CERN

SEU

RWTH

Milano

…

POCC
- AMS commanding and monitoring

SOC
- Data production
- MC production
- Coordination
- Data Analysis

Regional SOC
- **MC production**
- Data production
- Data Analysis

AMS SEUSOC Infrastructure

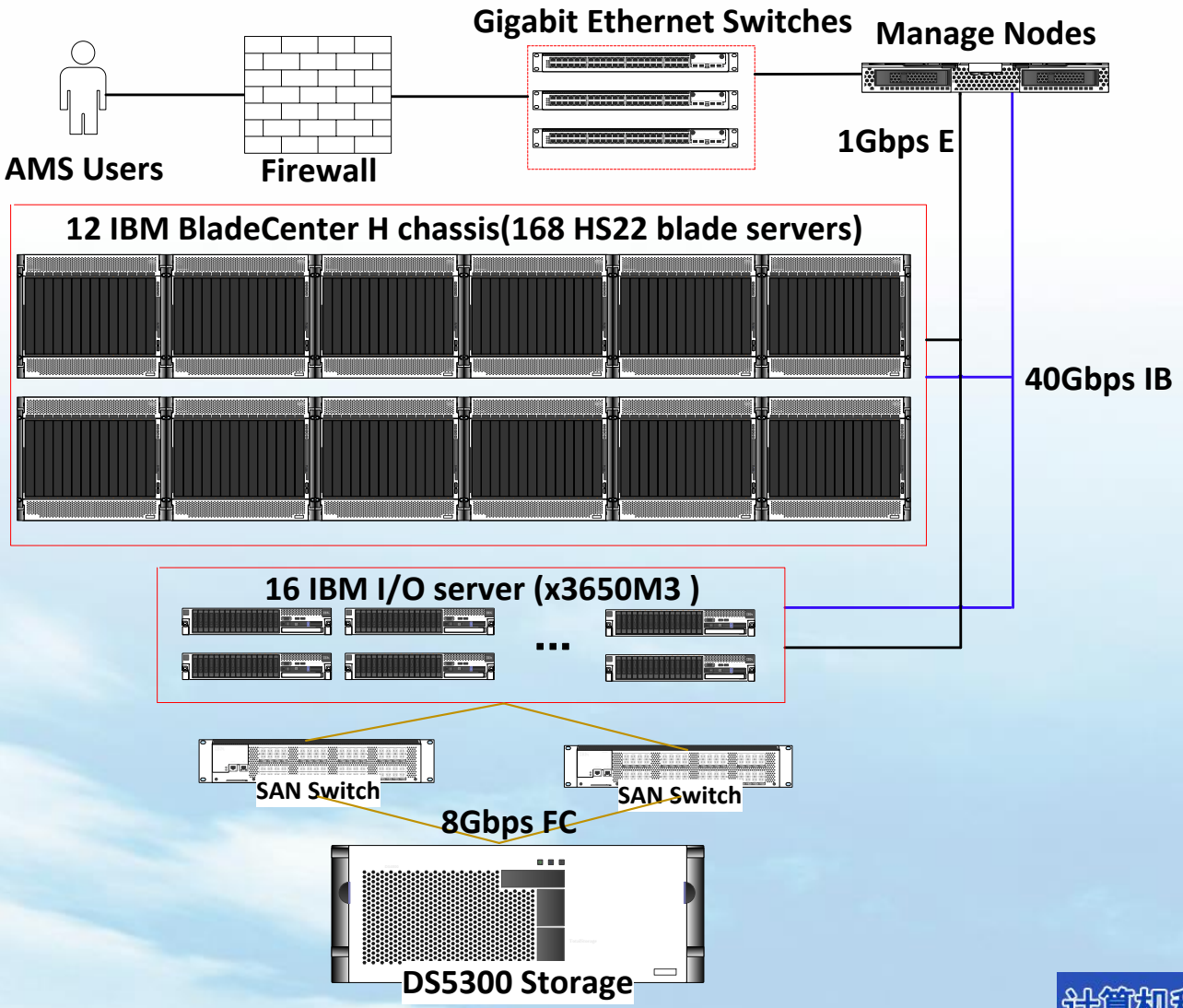
AMS SOC@SEU

AMS SEUSOC Infrastructure

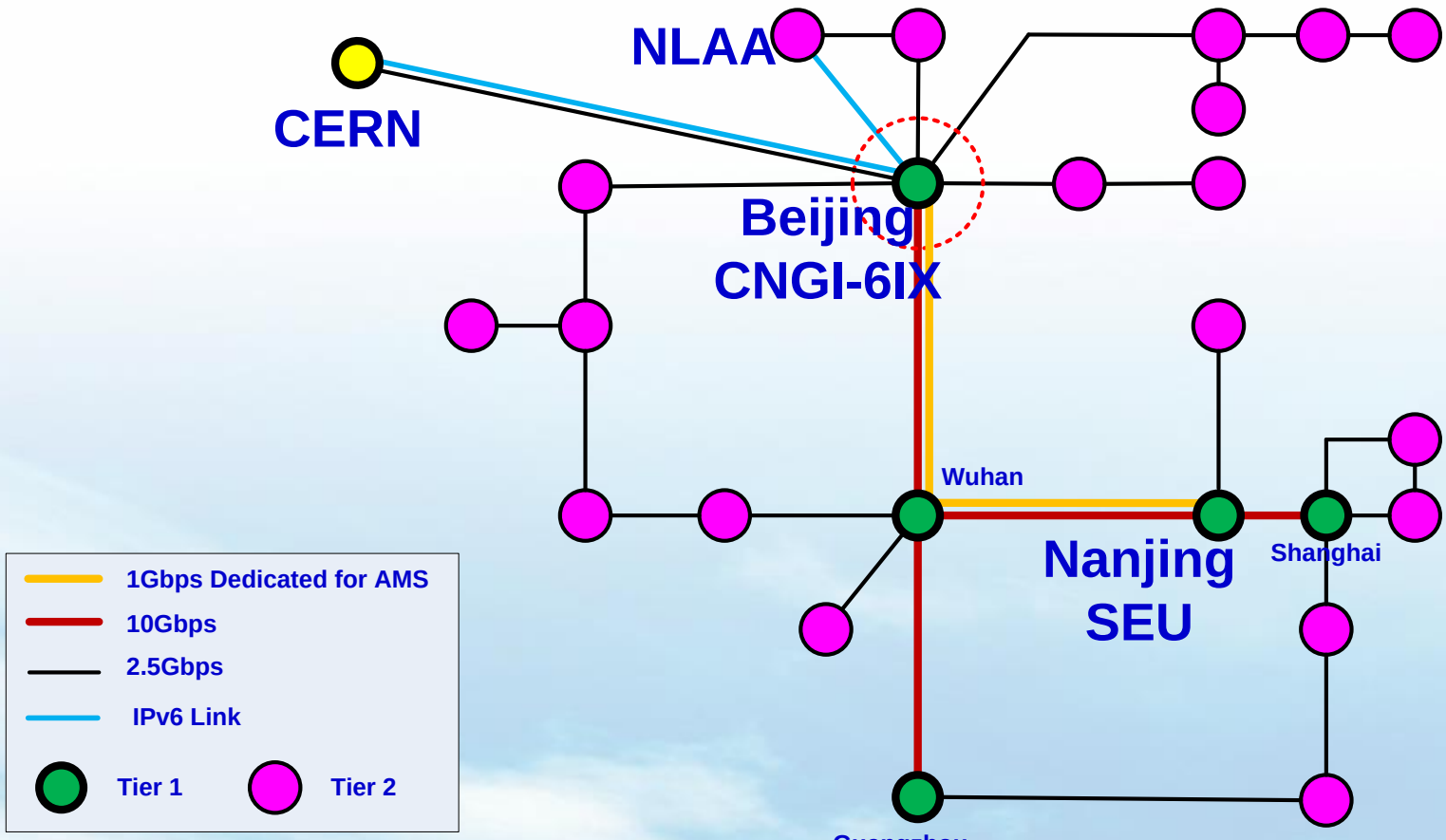
AMS SEUSOC Infrastructure

- **Computing devices**
  - 168 IBM HS22 blade servers
  - 2,016 Intel Xeon CPU X5650 cores
  - 4,032 cores with Hyper-Threading enabled
- **Storage and IO devices**
  - IBM DS5300 Storage System
  - 16 IBM X3650 rack servers
  - 500TB disk array
- **Network devices**
  - 40Gb Infiniband
  - 10Gb Ethernet

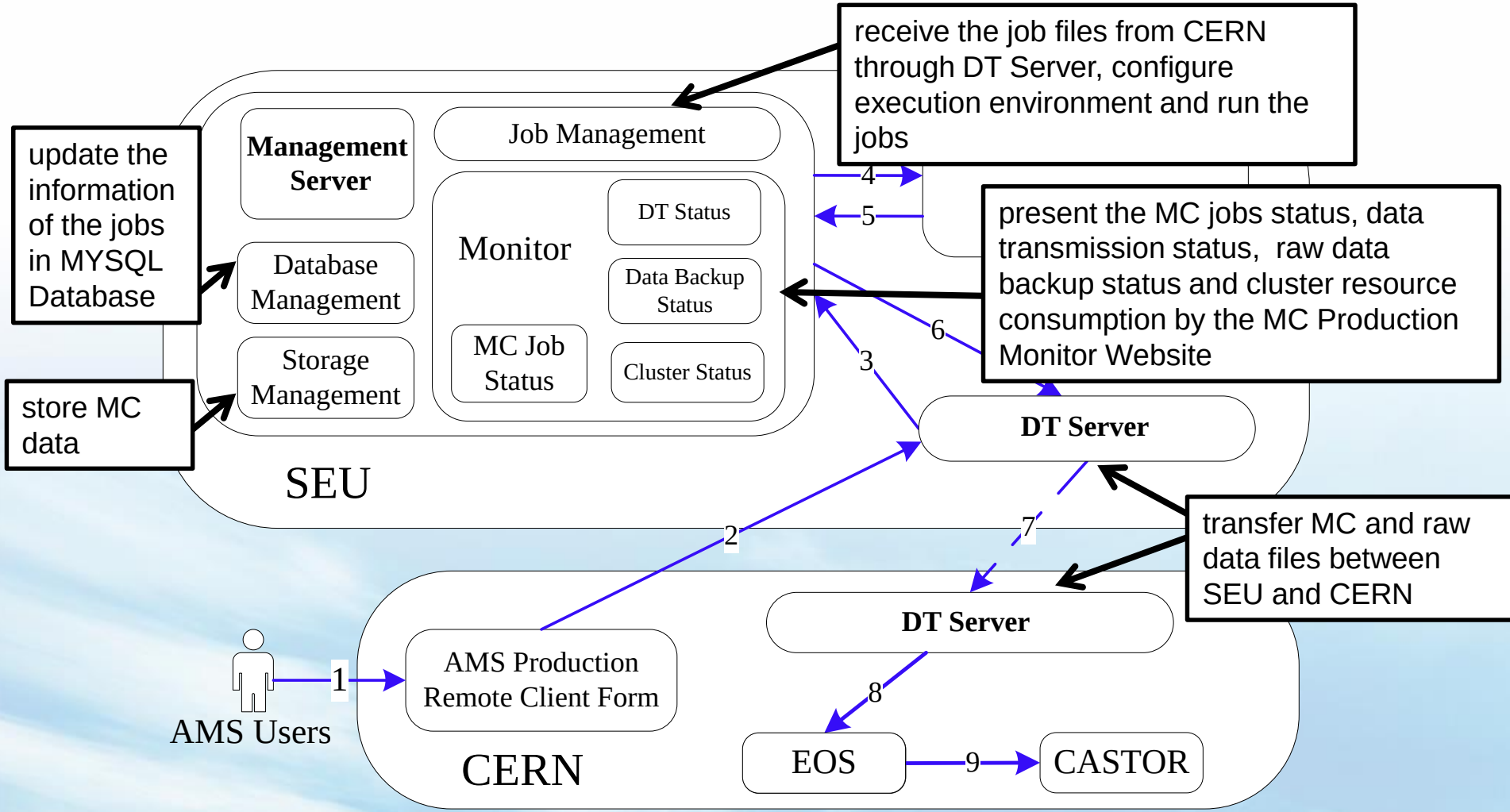
AMS SEUSOC Infrastructure



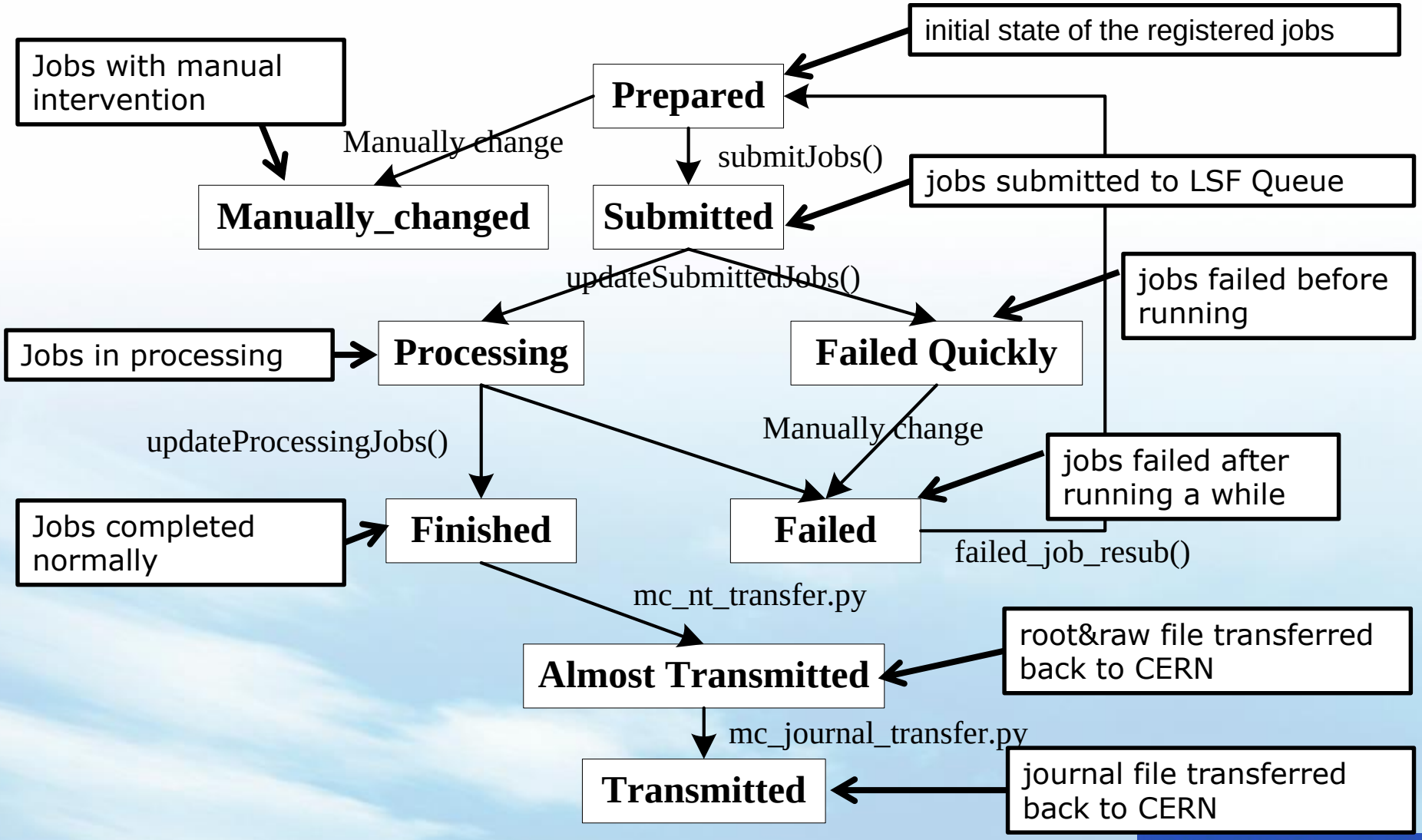
Networking facility between SEU and CERN



Process of MC job request and execution



Process of MC job request and execution



Data transmission optimization for LFN

- The Network between AMS and CERN is Long Fat Network which has large capacity(b)
  - capacity(b) = bandwidth(b/s)×round-triptime(s)
  - with RTT≈308ms, Bandwidth=1 Gbit/s
- To speed up the data transmission in LFN
  - enlarge the size of the TCP windows making it easier to fill up the LFN
  - use Hybla, which is designed for long RTTs network, as the TCP congestion control strategy . For the Cwnd increase of the Hybla:

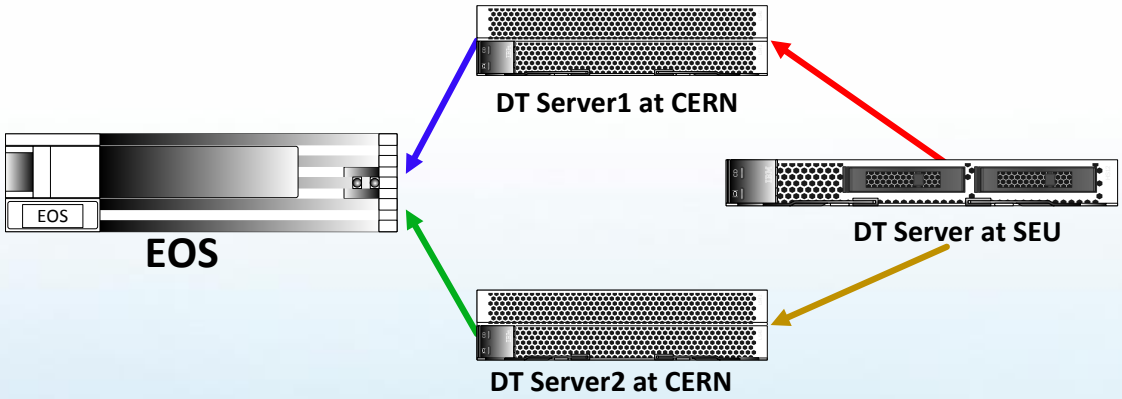
    cwnd+2^p-1 (slow start)

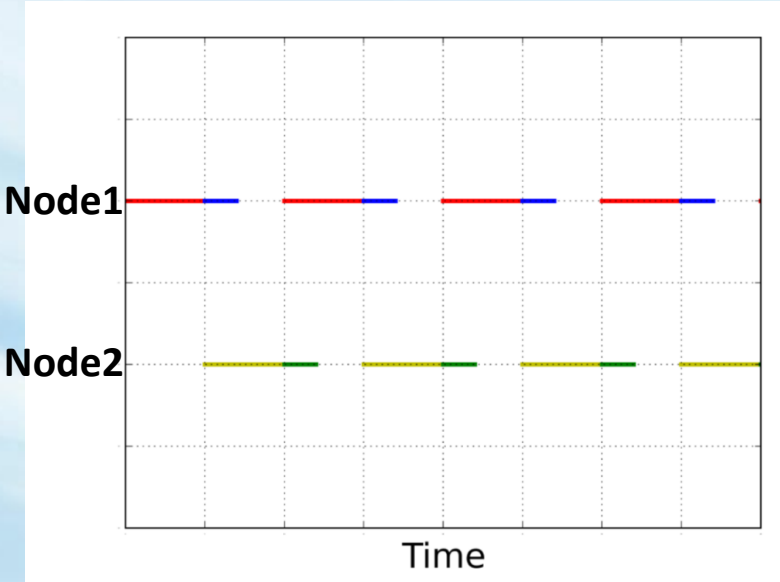
    cwnd+p^2 /cwnd (congestion avoidance)

  p= RTT/RTT_0. RTT_0 in linux is set to 25ms. With high RTT, Cwnd will increase quickly.

Data transmission optimization for LFN

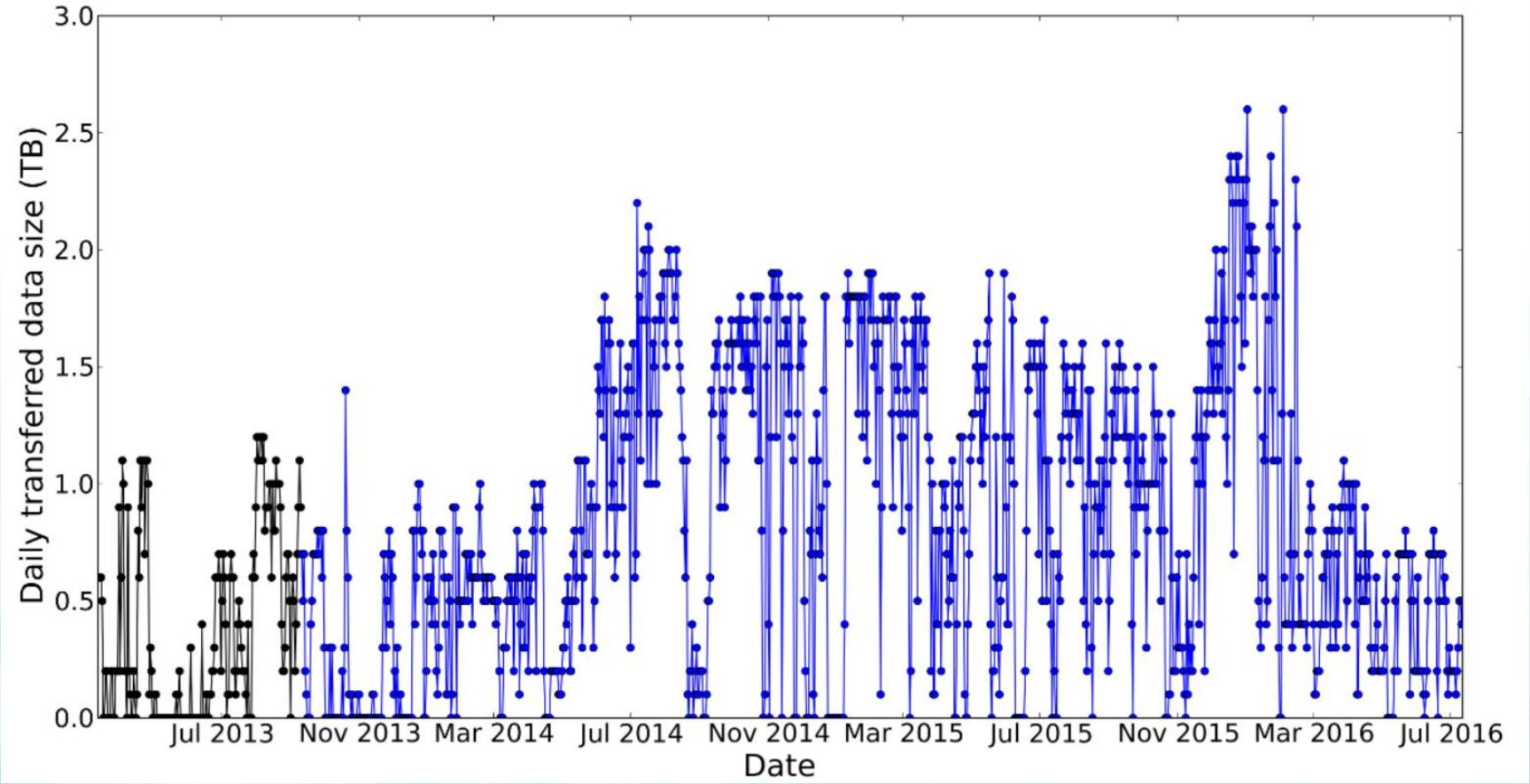
For all the DT servers:
TCP_window_size = 20MB
TCP_congestion_Control=hybla





Using two DT servers to receive the MC data can increase the network utilization, speed up the transmission rate.

Data transmission optimization for LFN



2 times faster, able to transfer 2.5TB/day

MC database and production monitoring tool

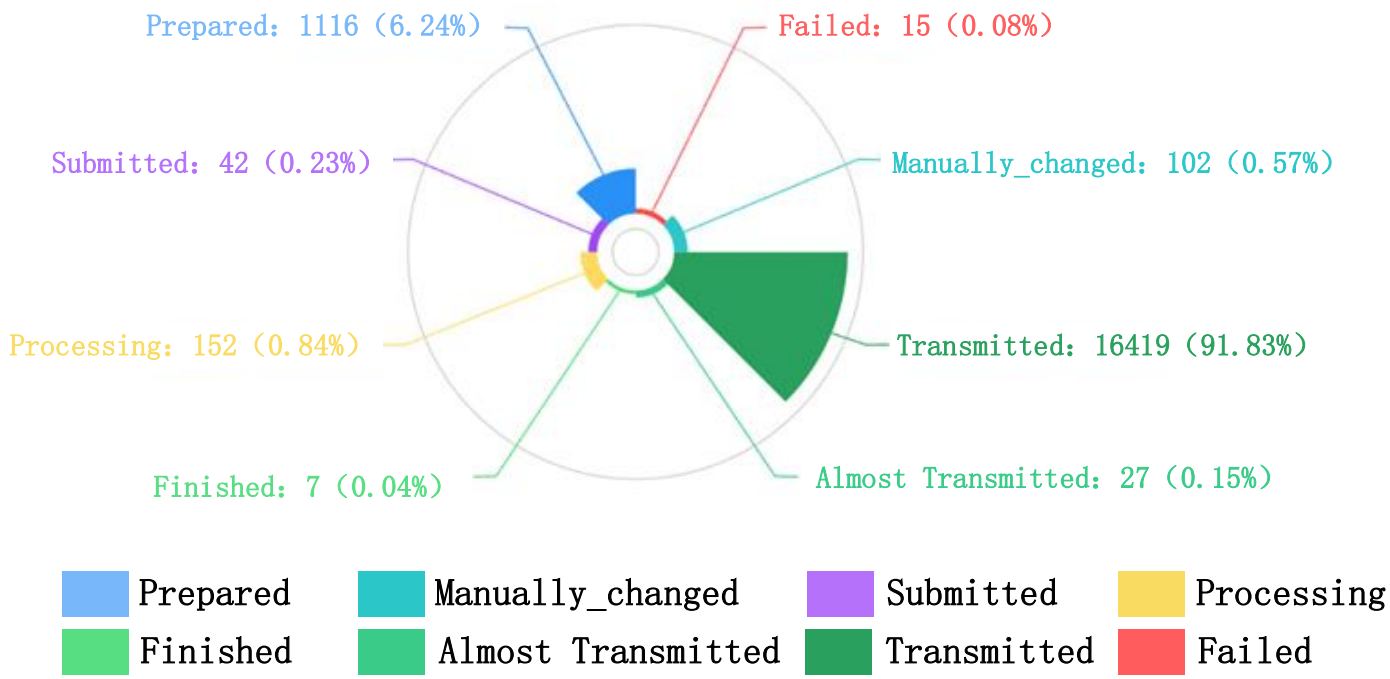
- **To facilitate monitoring and analyzing Monte Carlo production**
  - Record the detailed information of the Production status in the database, including the MC jobs, Raw data backup, MC data transmission etc.
  - Visualize the information of MC production with JavaScript and PHP
    - Overview of SEU MC Production status
    - Statistical MC Transmission status
    - Raw data backup status
    - SEU storage information

MC database and production monitoring tool

SEUSOC | MC Production | MC Transmission | RAW Backup | Disk Space | Welcome, ChinaGrid

SEU MC Production Status

2016-08-07 - 2016-09-06

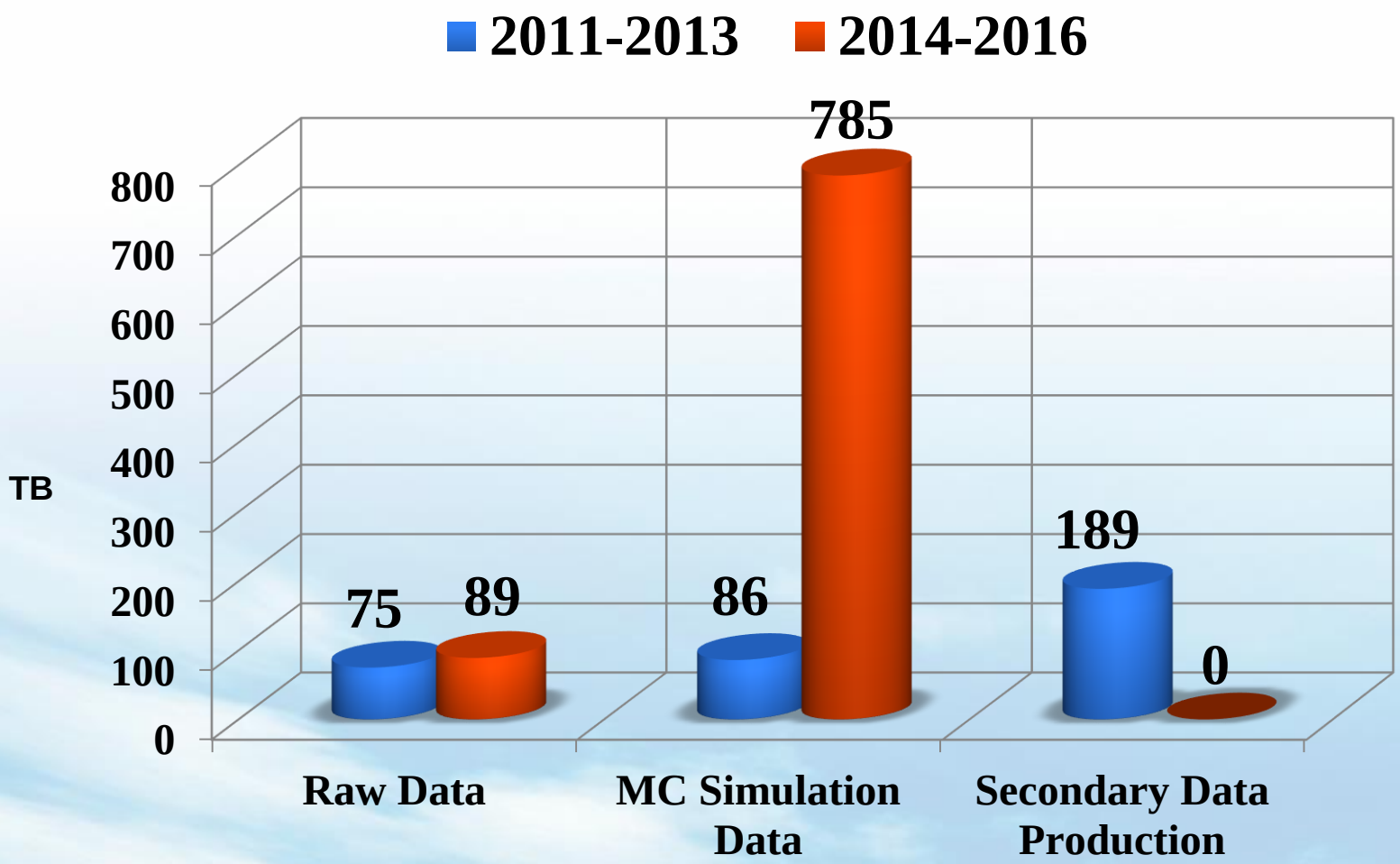


2016-08-07 - 2016-09-06

Why Fail?

SEUSOC of AMS-02 Experiment, 2014

AMS MC data processed at SEUSOC



Conclusions

- An automated MC production system with optimized data transmission strategy is developed at SEUSOC
- SEUSOC contributed a total of 30% of the CPU time in AMS Monte Carlo simulations and ranked 1st among all regional AMS Monte Carlo centers around the world