

## 7 - 26 The Design of the Configuration Administration System for HIAF Timing System

Ma Tao<sup>1</sup>, An Jingrui<sup>1</sup>, Bao Ruiming<sup>2</sup>, Yue Min<sup>1</sup>, Yuan Chao<sup>1</sup> and Gou Shizhe<sup>1</sup>

<sup>1</sup>Institute of Modern Physics, Chinese Academy of Sciences, Lanzhou 730000, China;

<sup>2</sup>University of Chinese Academy of Sciences, Beijing 100049, China)

The High Intensity Heavy-ion Accelerator Facility (HIAF) is one of the world’s leading heavy-ion accelerator complexes under construction. HIAF provides unprecedented high pulse beam intensity and versatile operation mode<sup>[1]</sup>. The HIAF accelerator requires a synchronization accuracy better than 2 ns, and supplies the timing service for about 600 devices located within 1 km<sup>[2]</sup>. Thus a high-precision timing system has implemented based on White Rabbit technology to provide reliable synchronization for accelerator devices and deterministic data transformation of the whole control system. White Rabbit is an extension of standard Gigabit Ethernet and uses physical layer clock distribution technology to achieve clock frequency distribution. It can provide sub-nanosecond synchronization over 1 Gps Ethernet networks.

An ordinary network architecture of the White Rabbit timing system is as Fig. 1. The WR Master distributes the reference time provided by atomic clock or GPS over the timing system<sup>[4]</sup>. The WR Switch is the backbone of the White Rabbit network, which transfers both the timing and data packets of the timing system. The WR Node receives ethernet frames to synchronizes its internal oscillator from Master device and provides the timing information for other IP cores or device. A management system is needed to ensure the HIAF Timing System operates reliably and effectively. Therefore, we designed a configuration administration system to manage the configuration and running status of the HIAF Timing System.

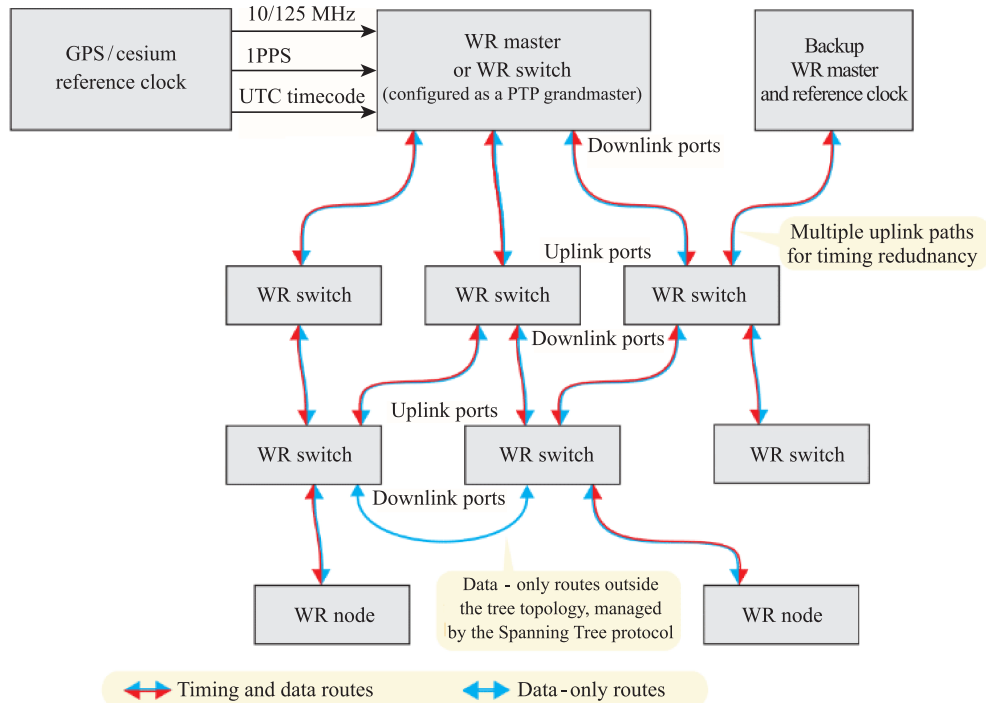


Fig. 1 (color online) White Rabbit timing system network architecture<sup>[3]</sup>.

The architecture of the Configuration Administration System is shown as Fig. 2. At the bottom level, different databases are designed to fit for a data driven configuration administration system. The Device and Configuration Database manages the information of White Rabbit switches, nodes and other device connected to the White Rabbit timing network. The Time-series database stores the monitoring metrics and events of all device and the White Rabbit Network. The Logging Database manages the syslog of the White Rabbit switches and nodes. Then Device

Management Service, Configuration Management Service and Monitoring Service were built. The Configuration Management Service ensures registered device can get its configuration on boot or reload a new one once modification was made by administrator from the Configuration Administration System web interface. The Monitoring Service uses SNMP and syslog to monitor the status of the White Rabbit timing network. A web interface was designed to manage the configuration and monitoring status of the White Rabbit timing system.

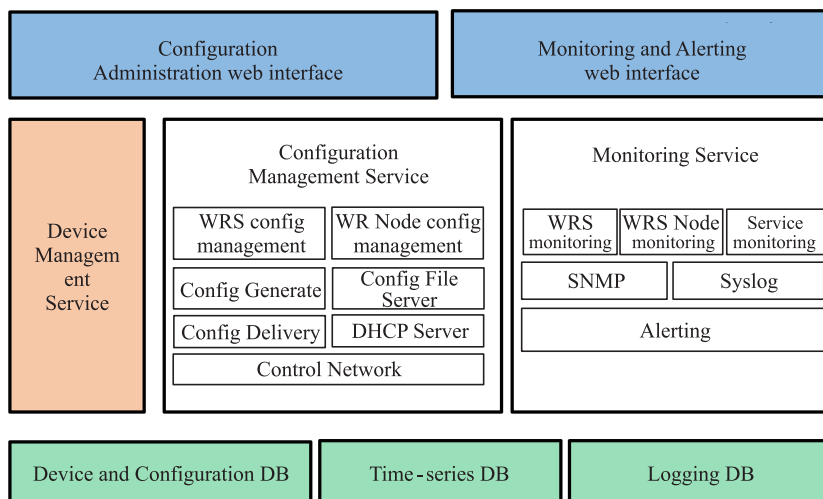


Fig. 2 (color online) General architecture of the Configuration Administration System.

Fig. 3 is a simplified workflow of the Configuration Management Service. Based on the Configuration Database and the DHCP server. Any registered White Rabbit switch can automatically get its management IP address and download its own configuration from config file server on boot. The config file can be managed by authorized administrators from the web client of the Configuration Administration System.

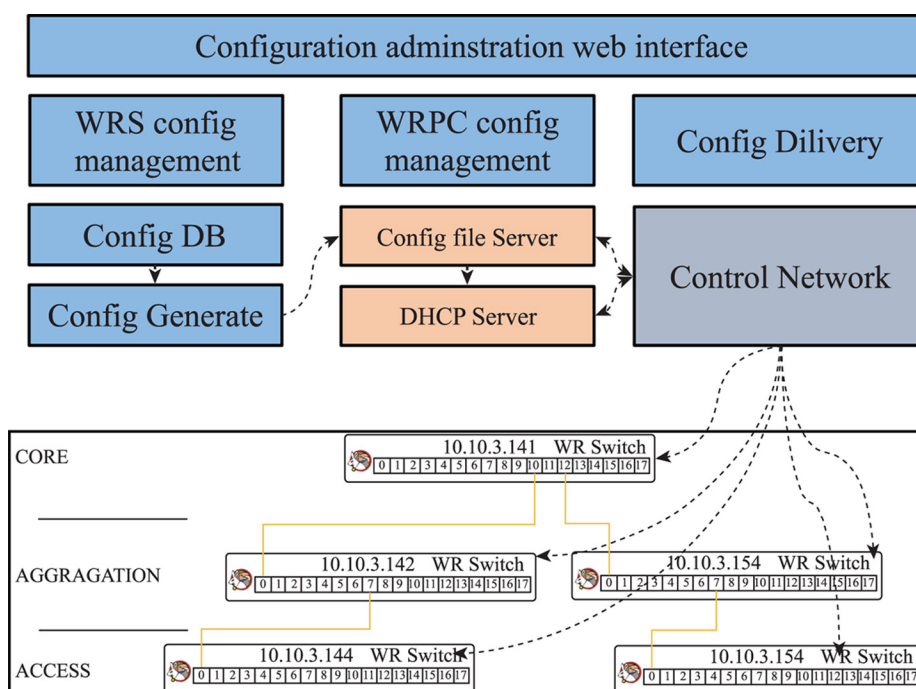


Fig. 3 (color online) Workflow of the Configuration Management Service.

The Configuration Administration System provides a centralized management system for HIAF Timing System, and it also suitable for other large scientific facilities.

## References

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# 7 - 27 Progress in Civil Construction of HIAF

Zhao Xiaoyun, Zhou Luncai, Qi Xueqin, Yu Haiyan, Kong Haoran and Yang Wenhong

## 1. National Investment Component of HIAF

HIAF civil construction covers about 33 025.51 m<sup>2</sup> in total that are jointly supported by the National investment and local government. The actual construction scale of national investment in High Intensity Heavy-ion Accelerator Facility (HIAF) civil engineering is about 33 025.51 m<sup>2</sup>. The planned commencement date was December 18, 2020, the planned completion date was December 31, 2023, and the actual commencement date was in December 2020. The construction content includes six dedicated buildings, including the Operation Building, Accelerator Tunnel, iLinac Building, No.1 Comprehensive Station, No.2 Comprehensive Station, and No.3 Comprehensive Station.

By the end of 2022, procedures such as the construction preparation, construction drawing design, budget estimate and budget preparation, civil construction bidding, construction supervision bidding, cost consultation bidding, construction contract signing, construction permit handling, and so on have been completed. In terms of civil construction, 75% of the overall construction work has been completed. Started in December 2020, 98% of the Operation Building has been completed. Started in March 2021, 93% of the Accelerator Tunnel covered by National Investment has been finished. Started in the middle of October 2021, 98% of the No.3 Comprehensive Station building has been completed. The overlook of each dedicated building is shown in Fig. 1.



Fig. 1 (color online) The Aerial view of HIAF campus by the end of 2022 (The buildings with yellow labels are supported by local government, and those with white labels are supported by National Investment).

## 2. Civil Construction and Campus Engineering of 48 000 Square Meters in the Installation Area

The actual total construction scale of the supporting project of HIAF and CiADS supported by local government is about 48 880 m<sup>2</sup>. The planned commencement date was October 15, 2021, and the planned completion date was April 30, 2023, but the actual commencement date was April 2021. Its construction content includes 13 dedicated buildings, which include the No.1 Test Hall, No.2 Test Hall, The Comprehensive Test Hall, the No.1 Cooling Center,