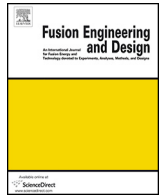




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The first-step of EAST remote participation system

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HIGHLIGHTS

- A new design for remote participation system for EAST tokamak is proposed.
- Rich Internet Application (RIA) and NoSQL Database was select to implement the system.
- Two kind of technique for accessing EPICS PV data remotely through Internet was proposed.

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ABSTRACT

The EAST Tokamak at Institute of Plasma Physics Chinese Academy of Sciences (CASIPP) is the first fully-superconducting Tokamak facility. International collaboration can improve the quality and impact of fusion research. It is a key feature for EAST research. During 2014 EAST campaign, more than 60 physicists and experts visited CASIPP and participated in EAST discharging experiment. With an increasing number of collaborations, remote participation becomes important as an economical and effective alternative to traditional way. This paper presents an overview of the first-step development work of the EAST Remote Participation System (EAST RPS). At current stage, the EAST RPS is focused on remote access to engineering data, NoSQL-based data archiving engine, message service and video service.

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1. Introduction

The Experimental Advanced Superconducting Tokamak (EAST, formerly HT-7U) [1] is the first Tokamak facility with fully super-conductive poloidal and toroidal magnet coils. It was constructed by CASIPP in Hefei China. Since archived the first plasma in 2006, EAST tokamak gains widespread attention and established close international collaboration with the scientists from laborites and institutes all over the world. During 2014 EAST campaign, there were over 60 physicists and technical experts visited CASIPP to participate in EAST experiment. They worked closely together with EAST team in plasma control, operation and diagnostic. EAST has benefited from these collaborations.

The traditional international collaboration model is on-site model. The collaborators must visit CASIPP through international travel, which is very costly and time-consuming. The collaborations are limited by region and financial factor. It is essential to provide an efficient and economical alternative solution to satisfy the requirement of frequent international collaboration. The main target of EAST Remote Participation System (EAST RPS) is to provide a web-

based integration platform to monitor, configure and access EAST data remotely.

The development of EAST RPS will be divided into several stages. The first-step of RPS is to focus on system structure design, remote engineering data access and stream video service.

This paper presents the progress and major job of development at current stage. The major objectives are described in Section 2 and the detail of system design will be present in Sections 3–5. In Sections 5 and 6, the hardware deployment and a test tool will be introduced

2. Major objectives

The EAST RPS will provide an integration platform through which the collaborators can monitor system status, configure pre-set parameters, access engineering or physical data and even control the EAST facility remotely via internet in the future.

The development of EAST RPS will be divided into several stages. The system Structure design and implement is the most important task in first-step stage. How to balance of user convenience with high security is an important consideration of RPS system structure design. One of the main function of RPS is to provide remote data access. At current stage, we will focus on the engineering data remote access. Engineering data comes from engineering subsystems (e.g. vacuum system, cryogenic system, magnet coil diagnostic

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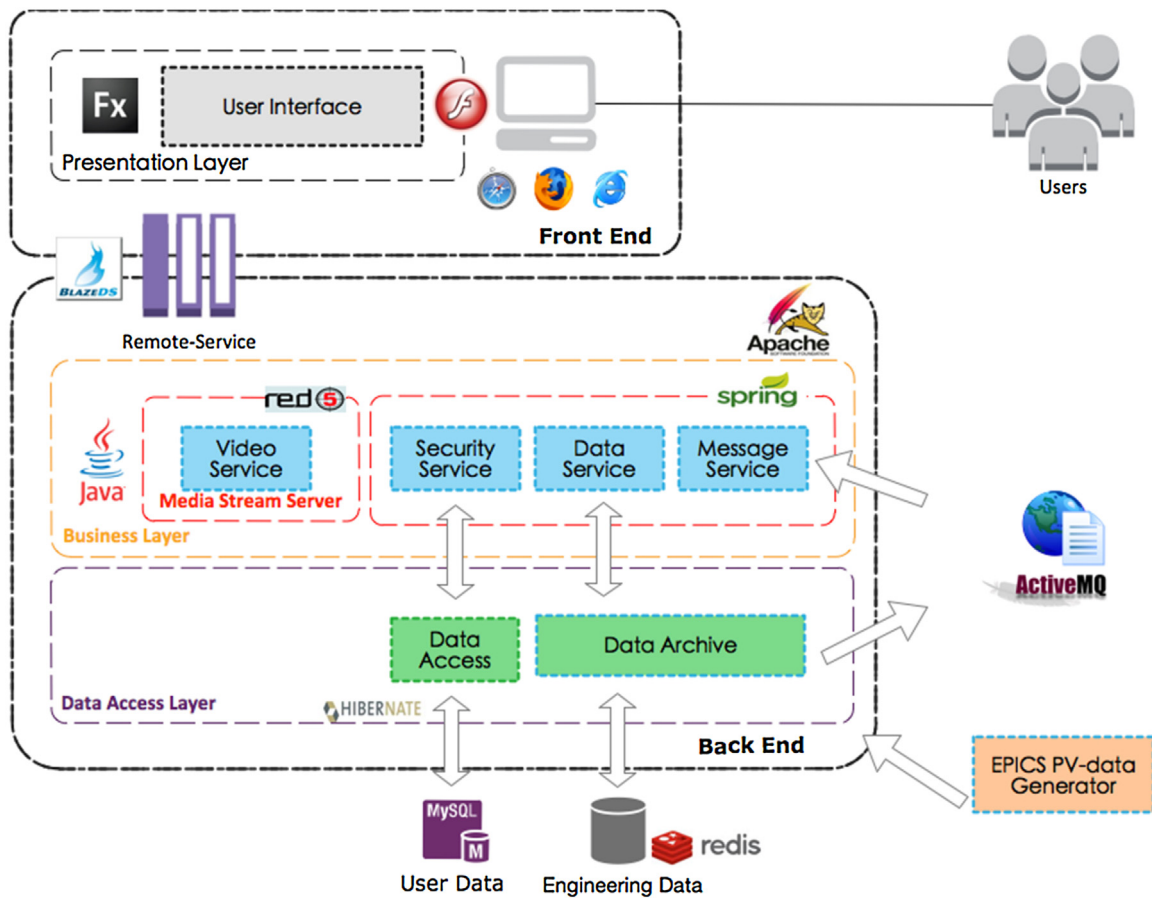


Fig. 1. System Architecture & Technology Stack of RPS.

system) and has features of low sample rate(≤ 10 Hz) and long sample range (24×7). The total number of EAST engineering data is about 500. EAST RPS will provide a remote access interface of EAST engineering system, central control [2] and central interlock system [3]. Experimental Physics and Industrial Control System (EPICS) [4] has been widely used to develop control system. In the next few years, some of EAST engineering system will be updated using EPICS framework. It is essential to provide a technical proposal to access EPICS Process Variable (EPICS PV) data through internet.

The main development objectives of current stage are shown as below:

- System Structure design and implement
- Remote access of Engineering data
- To provide a technical proposal to access the value of EPICS PV via Internet.

3. System design

In a previous paper [5], we analyzed the popular structure of remote participation system for tokamak facilities [6–11] and demonstrated that the Rich Internet Application (RIA) [12] architecture is suitable for building an integration remote participation platform. RIA is a web application that has many characteristics of desktop application software. RIA runs in a browser plug-in and allows the client-side to handle local activities, calculation to reduce bandwidth requirement and server load. EAST RPS is divided into front-end, back-end and databases three parts. The system architecture and technology stack is described in detail in Fig. 1.

Front-End contains all the views and graphical components to the user. Apache flex [13] was selected for front-end development. Flex is an open source RIA framework. It has browser portability. Many browsers support Flex Player virtual machine, Flex and its scripting language ActionScript(AS). Client-side caching ability can reduce network round trips if the same data is required. Flex also supports skin, vector graphics and other Flasher player features which is benefit to develop rich user interface components.

The Back-End includes the business layer and the data access layer. The business layer represents the business service of application. The business services for EAST remote participation include security service, data service, message service and video service. The data access layer provides the methods to save, send and retrieve data. Spring Framework [14] is an open source configurable framework for implementing enterprise application. Spring provides services and resources for database connection & transaction, security, messaging and caching. We use Java Spring Framework to simplified application development.

In a local area network (LAN) environment, EPICS client can get PV data from Input/Output Controller (IOC) via Channel Access(CA) protocol [15]. In the process of CA communication, the client discovers the address of the host for an EPICS PV by name resolution and waits for responses from the servers that host the channels identified. Because of the name resolution is based on directed broadcast which are often limited by the default router configuration [16]. In a wide area network (WAN), the remote clients can not automatic connect to the IOC by name resolution. And frequent remote connections use resources on the IOC, which might cause negative impact. EPICS CA Proxy Gateway Module is developed to solve remote EPICS remote connection problem [17]. Exter-

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