Extended Abstract: Data Processing in EAST Remote Participation

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Abstract–**International collaboration has become increasingly frequent in fusion research and improves the quality and efficiency of the research in EAST facility. The traditional face-to-face collaboration has proved inadequate in current situation. The remote participation system for EAST Tokamak (EAST RPS) will play an important role in EAST operation experiment. Data processing for remote access through internet is a critical issue for EAST RPS. In this paper, we present the design and development of the data processing for EAST Remote Participation System.**

I. INTRODUCTION

THE Experimental Advanced Superconducting Tokamak (EAST) [1], formerly HT-7U, began fusion experiments at the Institute of Plasma Physics Chinese Academy of Sciences (CASIPP) and achieved the first plasma in 2006. International Collaboration can improve the quality and impact of EAST fusion research. There are more 50 foreign physics and other experts traveling to CASIPP to participate EAST experiments each EAST campaign. The remote participate will be an important part of EAST Central Control System [2] as an economical and effective alternative to traditional face-to-face collaborative way.

As previously reported [3], the EAST remote participation system was implemented by the Rich Internet Application (RIA) architecture. RIA is a web application that has many characteristics of desktop application software, runs in a browser plug-in and allows the client-side to handle local activities. Users can use RIA application without installation of support files on clients' computers. The EAST RPS was divided in to front-end, back-end and databases three parts. The remote data access is the core function to remote participation. Remote data access speed is the most important important performance metric for remote participation system. The remote access speed is limited by the network bandwidth, data size and disk read-time. It is very difficult to add network bandwidth in a short time. The research of data processing in EAST RPS will focus on data-caching and data compression.

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According to different sources and types, the EAST remote participation data could be divided in to 3 different types:1) engineer data 2) scientific data 3) camera data.

The engineer data comes from engineering subsystem (e.g., vacuum system [4], cryogenic system [5], technical diagnostic system [6]). Low sample rate ($<=10HZ$) and Long sample range (24*7) are the main features of EAST engineer data. The total number of engineer data in remote participation system is about 500. Experimental Physics and Industrial Control System (EPICS) [7] has been widely used to develop control systems. Some of EAST engineering subsystems will be updated using EPICS framework in the next few years. In local area network (LAN) environment, EPICS client interacts with EPICS Input/Output Controller (IOC) through the Channel Access (CA) protocol [8]. Limited by name resolution, EPICS CA does not support to get PV data in a wide area network (WAN) environment. And frequent remote connections might cause negative impact for IOC. In EAST RPS, a new No-SQL based EPICS data archiving engine wad developed to provide remote access function for EPICS Process Variable (EPICS PV) through internet. The archiving engine for EAST RPS consists of CA client and data cache. The EPICS PVManager is an EPICS client utility library to collect and process PV value data and was selected to be EPICS client. The key-value store is a type of NoSQL databases and widely used in real-time web application. Using key-value database as data storage has some advantages:1) key-value database uses less memory than rational database to store the same database; 2) key-value database supports in-memory data storage which can lead to large performance gains in workloads.

The scientific raw data is acquired from dozens of EAST subsystems. This raw data is transferred to and stored on centralized MDSplus [9] data servers. To share data with collaborators, the raw data is transferred from EAST to the mirror servers in remote site (eg. DIII_D). Data reduction technology, including data compression and De-duplication, are being investigated. We proposal to use hardware acceleration card to instead of software tools to performance scientific data processing. EXAR Express DX 1740 [10] is a multifunctional PCIe acceleration card which support eLZS. LZS and GZIP data compression algorithms and AES, DES, 3DES and ARC4 encryption algorithms. The maximum throughput is 800MB/s.

The camera capability of EAST Charge coupled Device (CCD) diagnostic system is maximum 100 frames per second (fps), typical resolution is 656*490 pixels and number of bits

is 8. The CCD system can produce 300MB of data per shot. The camera data is archived and stored as uncompressed Audio Video Interleave (AVI) format file. For remote access, the .avi files will converted to Flash Video format using open soure tool FFmpeg. Red5 is a free media streaming server and support .flv files access through Real Time Messaging Protocol (RTMP). It was used to build EAST video service. EAST .flv format camera data are published to Red5 server. Client-side can access the videos via RTMP.

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