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CMS REMOTE CENTER AT JINR

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The dedicated remote center of CMS Experiment at the LHC has been founded in JINR (Dubna). The main mission of the center is operational and efficient monitoring of the CMS detector systems, including the measurements of performance parameters during the prompt data analysis, monitoring of data acquisition and quality of data. Since 2009 the center is involved in remote shifts and operation works of the CMS.

Для оперативного контроля состояния детекторных систем эксперимента CMS, их работоспособности, включая измерение физико-технических характеристик в ходе быстрого анализа получаемых данных, мониторинга набора экспериментальных данных в ОИЯИ создан региональный центр удаленного контроля и анализа экспериментальных данных. Начиная с 2009 г. центр обеспечивает удаленное участие в сменах по набору и анализу данных физиков из ОИЯИ.

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INTRODUCTION

The remote operation plays an important role in the detector operations, monitoring and prompt data analysis for the Compact Muon Solenoid experiment (CMS) [1] at the LHC. To provide participation in CMS operations of a large number of collaborating scientists and engineers, the dedicated CMS remote worldwide-distributed operation centers (ROC) were built in different scientific organizations (Fig. 1).

The purpose of the worldwide centers is to help specialists working on CMS contribute remotely their expertise to commissioning and operations at CERN [2].

One of these centers was founded at the Joint Institute for Nuclear Research (JINR) [3]. This center is located at the Laboratory of High Energy Physics of JINR (LHEP). JINR CMS ROC is focused on operations and monitoring of inner endcap detectors, where the collaboration of Russia and Dubna Member States institutions (RDMS) bears a full responsibility on Endcap Hadron Calorimeters (HE) [4] and First Forward Muon Stations (ME1/1) [5].

1. THE PURPOSE AND FUNCTIONS

The JINR CMS ROC should provide effective facilities to support activities which are associated both with the main CMS Center in the CERN main site in Meyrin and in part with the CMS Control Room at the LHC interaction point 5 in Cessy. The JINR ROC has the following main functions:

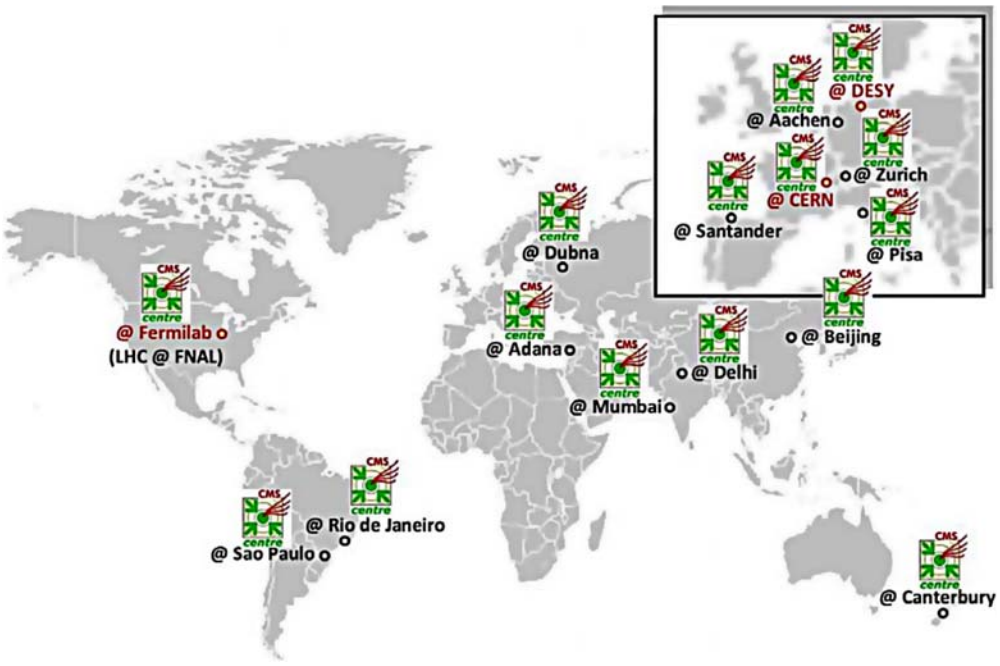

Fig. 1. Locations of operating or planned CMS centers worldwide [2]

1. Monitoring of the detector systems including data acquisition (DAQ) system, detector control system (DCS), i.e., slow control system for both high-voltage and low-voltage systems, temperature monitoring, etc., and data quality monitoring (DQM).

2. On-the-fly Data Analysis Operations, in particular detector performance measurements, display events, calibrations of sub-detector systems, etc.

3. Effective participation in remote shifts as well as prompt access of experts to experimental information. Communication of shifter with system experts during data taking and CMS systems operations.

4. Offline Computing Operations for coordinating the processing, storage and distribution of real CMS data, MC data, their transfers at RDMS Tier-1 and JINR Tier-2.

5. Training and outreach.

The important point is to have secure access to information that is available in control rooms and operation centers at CERN.

2. THE STRUCTURE

The JINR ROC consists of the a file and graphic server, a monitoring and analysis system, user workstations, and a video-conferencing system. The scheme of JINR ROC is given in Fig. 2. The main ROC room is shown on the left with the server and three monitoring workstations, while the right plot depicts user workstations (a total of nine stations) which

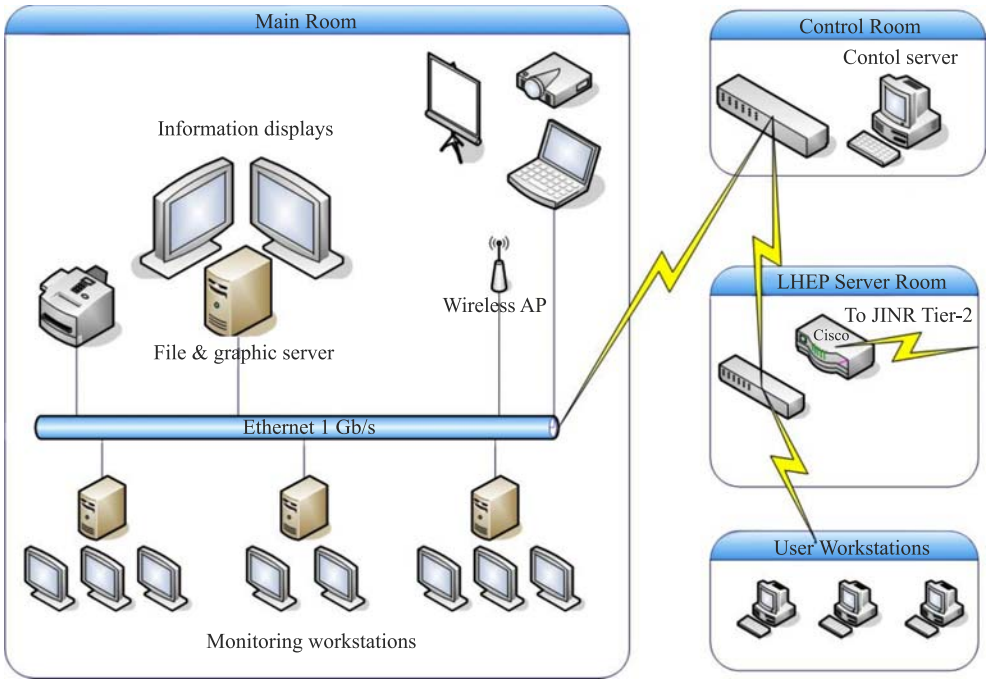

Fig. 2. The scheme of the JINR Remote Operations Center

are located outside of the main room. The conference system includes a screen, a projector and a high-quality Tandberg 550MXP video-conferencing system.

The monitoring system of JINR ROC includes the SLC Linux graphic and file server, two 40′ LCD screens (information displays) mounted on the wall and connected to the server, and three monitoring workstations (working places).

The server is used for prompt analysis, storage of files with monitoring information and results of data analysis. The server is based on Dual Xeon 2.53GHz processor, 16GB RAM, and 6TB HDD with 2 gigabit Ethernet cards and 9600GT dual-head video card.

One of the information displays shows the «LHC page 1» [6] with information about the LHC beam status. The second screen maps the CMS data taking including the DAQ system, DCS, and event displays [7].

Two of the three working places are equipped with an interactive console SLC Linux PC (Intel CoreDuo 3GHz, 4GB RAM, 750GB HDD, 2 dual-head video card) and three 20′ LCD screens each. They are assigned for operations of two CMS detector sub-systems (HE and ME1/1). Their main functions include monitoring of detector operations and data quality. One screen provides information on status of parameters of the sub-detector control system — low and high voltage, cooling system etc., as well as information on a run number, run type, number of stored events, and monitoring of data taking. The second one allows one to monitor data quality and to display results of prompt analysis. The third screen provides access to the e-log book of shifts and shifter manuals, as well as serves for other interactive works.

Fig. 3. The JINR Remote Operations Center

The third working place has two LCD screens. It is for shift leader and/or offline computing operations (Fig. 3).

Each of the working places is equipped with local communication tools (web-cameras and headphones) to enable connections between shifter and experts when needed.

3. LINKS AND COMMUNICATIONS

The center is managed by a special control server placed in a single room (ROC Control Room). The gigabit router, network switch and a wireless network are used to link the ROC parts (server, monitoring workstations, network printer, and video-conferencing system) to each other. The ROC Control Room is connected to the 16-port gigabit switch in the main server room of LHEP, JINR. This switch provides links between the JINR ROC and JINR Tier-2 located at the Laboratory of Information Technologies of JINR. The user workstations are also linked directly with the LHEP Server Room.

Experimental data are transferred from CERN (Tier-0/RDMS Tier-1) as well as from other CMS Tier-1 sites to the JINR Tier-2 site. The CMS GRID transfer system (PHEDEX) [8] is used for the bulk transfer. Then data are processed at Tier-2 and analyzed in JINR ROC. The small part of data can be transferred directly to the JINR ROC for prompt processing and detailed analysis. The CMS individual file transfer system (FileMover) [9] is applied for this case.

There are various Web applications to help follow CMS operations, notably the DQM system used by all CMS sub-systems [2].

The high definition H.323 point-to-point features of Tandberg video-conference system allow one to involve the center in the CMS TV outreach events for public overview of LHC and CMS Status, Live Event Displays, etc. The video-conference system also uses a software-based video system (EVO) [10] to help to coordinate shifters and experts, and makes easy weekly meetings.

4. OPERATIONS

The JINR ROC has been tested in cosmic tests and the first LHC collisions on 0.9 and 2.36 TeV in 2009. The sub-system data quality monitoring, online and offline global data quality monitoring, slow control systems, and DAQ monitoring system were in use remotely. In 2010 the JINR ROC center provided three shifter working places for participation in data taking and analysis within 24 hours during 7 TeV CMS Run.

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