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USAID Regional Energy Security, Efficiency & Trade Program (RESET)

Information Systems to Support Energy Markets

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Features of Information Interactions in Power Sector

- Long distance between information interaction sites

- Large volumes of data

- It is critically important to provide valid data on a timely basis

- High demands for system security

- Large diversity of the systems and metrological requirements

- Inheritance of aged data collection and data processing systems and system parts

- Large diversity of interfaces, protocols and communication channels

- Diversity of data exchange process, types of members and their information systems

- Relatively low budget

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Information Interaction Development Trends

- **Broadening of the spectrum of problems to resolve**

- **Growth in the number of data exchange participants, increase of small renewable generation with larger number of transactions; shift in the role of the customer**

- **Growth in the diversity of information systems from different vendors**

- **Growth in data volumes**

- **Difficulties in finding highly skilled specialists**

- **Increasing capacities of communication channels and cutting of data transmission costs**

- **Increasing hardware performance**

- **New technologies**

New Technologies Trends

- **Information-enabled "smart" hardware**

- **Automation-based decision support**

- **Expert systems for management of asset performance**

- **All level SCADA and state estimation applications**

- **Hardware with internal system monitoring and diagnostic capability**

- **Integration, middleware layers to enable co-mingling of data from discrete parts of the enterprise**

- **Convergence of planning and real time applications**

- **Increasing computational scale and speed to cope with more data coming from more sources than ever before even contemplated**

General Requirements for Information Systems of Market Operator and Market Participants
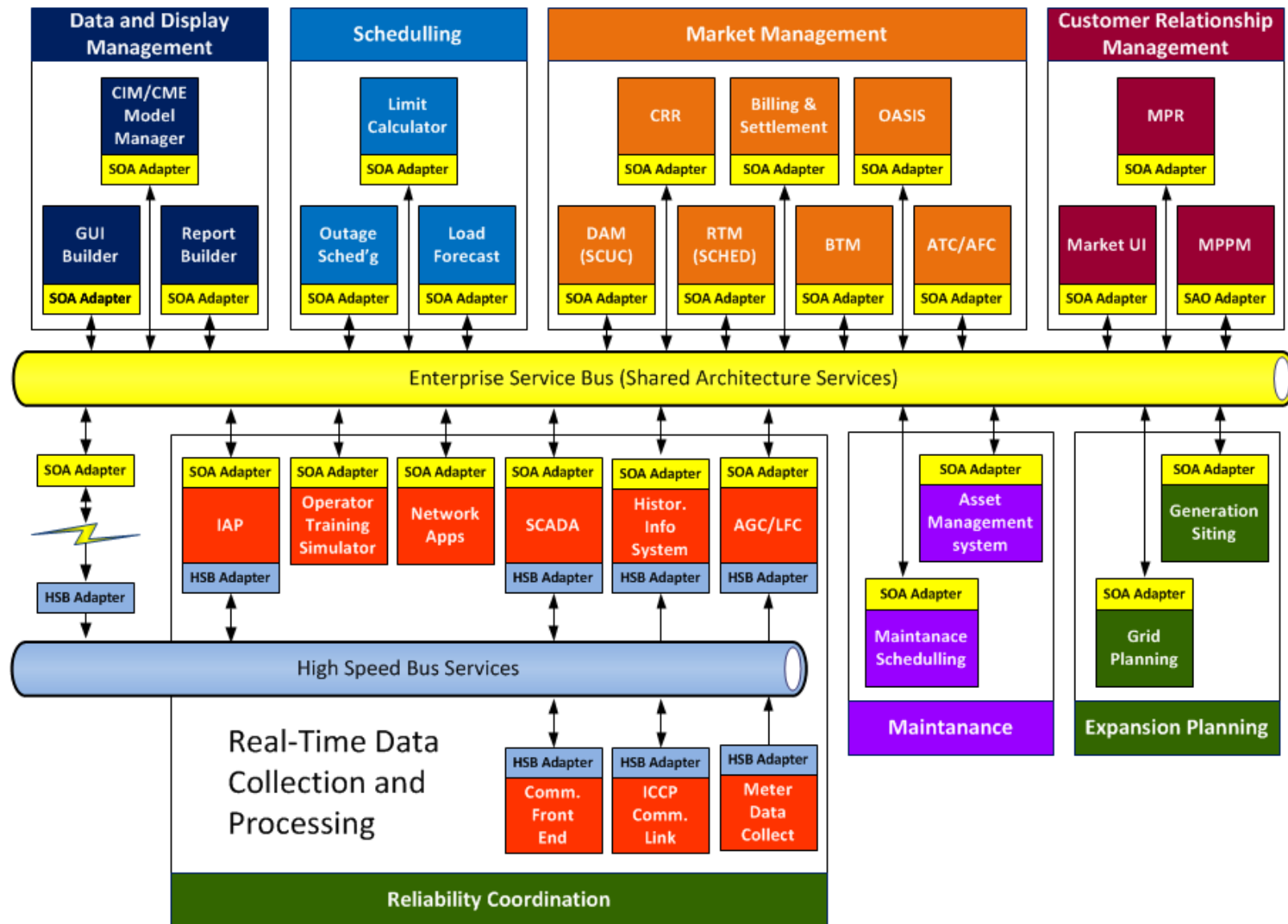
- **Provide high level of security**

- **Flexibility and scalability**

- **Collect and process data from unlimited number of sources**

- **Support standard interfaces and protocols**

- **Provide comfortable, secure interfaces for information exchange**

- **Provide flexible, effective tools for data exchange with different applications from different vendors**

- **Prompt response to market participants' new needs**

- **Provide high efficiency for future investments**

Service Oriented Architecture

Transfer from a variety of applications to provide different functionalities to a single application that incorporates all the needed functions.

- Application does what we need, but can now also do other things as well

- Separate applications are presented as a set of separate components (called services)

- Each service provides a separate function

- Applications communicate with each other through sending messages

- The user doesn't see the process of interaction between applications. The user works with one application which is able to provide functions from many different applications

- Special tools simplify development of service interaction process

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ISO/RTO Typical Architecture

Data and Display Management
- CIM/CME Model Manager — SOA Adapter
- GUI Builder — SOA Adapter
- Report Builder — SOA Adapter

Scheduling
- Limit Calculator — SOA Adapter
- Outage Sched'g — SOA Adapter
- Load Forecast — SOA Adapter

Market Management
- CRR — SOA Adapter
- Billing & Settlement — SOA Adapter
- OASIS — SOA Adapter
- DAM (SCUC) — SOA Adapter
- RTM (SCHED) — SOA Adapter
- BTM — SOA Adapter
- ATC/AFC — SOA Adapter

Customer Relationship Management
- MPR — SOA Adapter
- Market UI — SOA Adapter
- MPPM — SAO Adapter

Enterprise Service Bus (Shared Architecture Services)

- SOA Adapter / HSB Adapter
- IAP — SOA Adapter / HSB Adapter
- Operator Training Simulator — SOA Adapter
- Network Apps — SOA Adapter
- SCADA — SOA Adapter / HSB Adapter
- Histor. Info System — SOA Adapter / HSB Adapter
- AGC/LFC — SOA Adapter / HSB Adapter
- Asset Management system — SOA Adapter
- Generation Siting — SOA Adapter
- Maintenace Scheduling — SOA Adapter
- Grid Planning — SOA Adapter

High Speed Bus Services

Real-Time Data Collection and Processing
- Comm. Front End — HSB Adapter
- ICCP Comm. Link — HSB Adapter
- Meter Data Collect — HSB Adapter

Maintanance

Expansion Planning

Reliability Coordination

Market Operator as an Integrator of Its Participants

- **Market Operator brings the participants together for joint activities assuming information exchange**

- **The participants may have various hardware and software**

- **Various participants, depending on the functions they fulfill, may play multiple roles in the information exchange, i.e., they may act as suppliers, processors, or consumers of information**
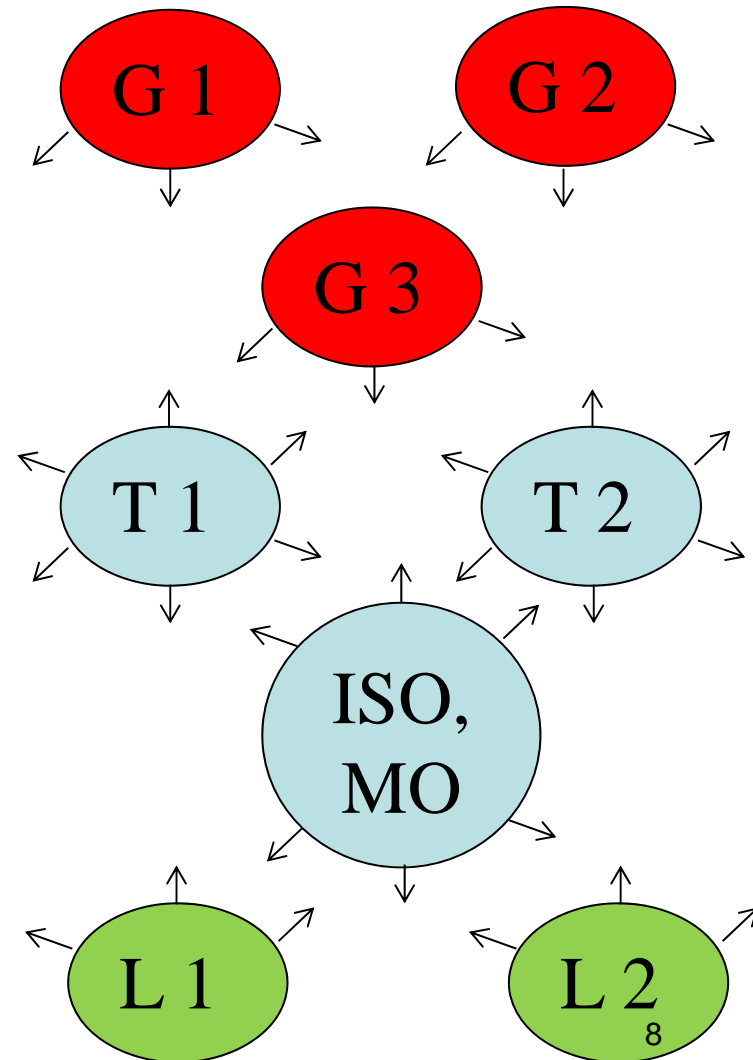
Market Operator as an Integrator of Its Participants (continued)

- **Fulfilling the functions of the integrator, the System Operator may play the role of the central body in the information exchange process**

- **Communications among the participants is notably simplified if they are limited to communicating with the integrator**
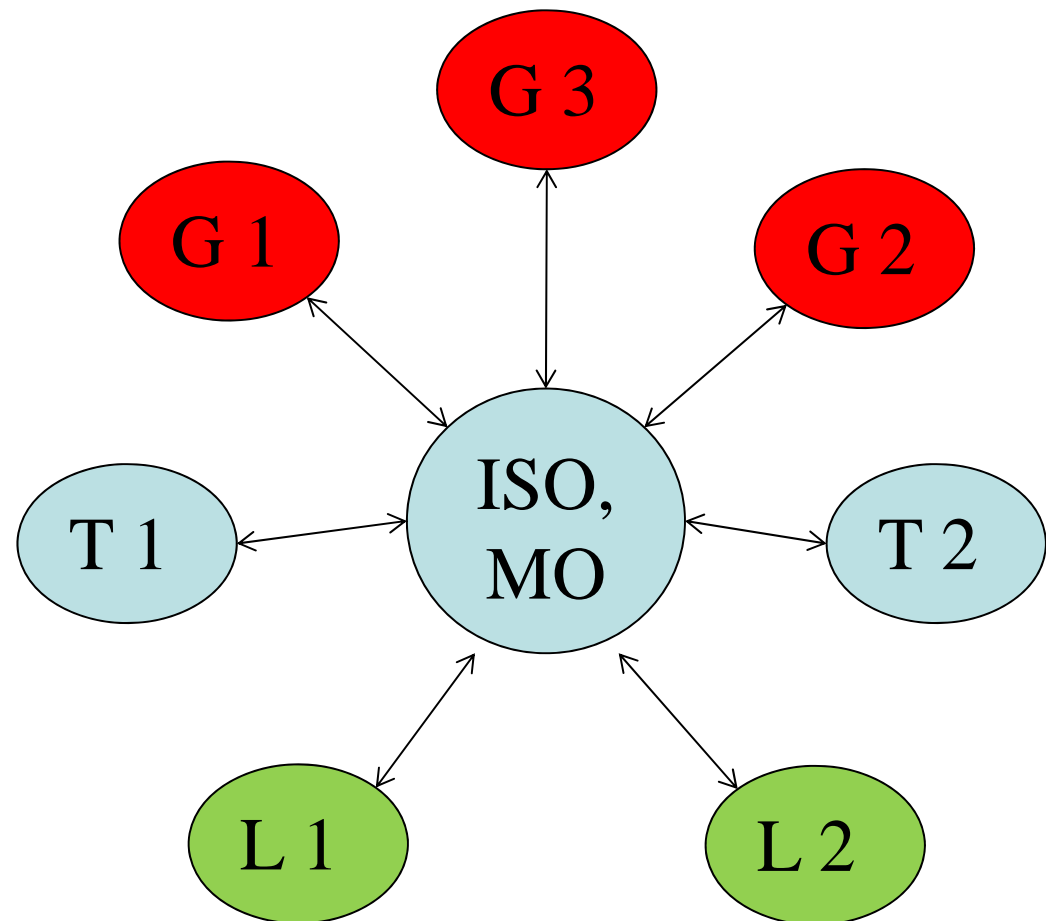
PJM as an Information Platform for Market Functioning

PJM ensures communications among the market players through:

- A well organized and controlled process of collecting information from all market participants;

- Centralized information storage with back-up and reliable control of access;

- Processing data and communication of results based on transparent balanced algorithms;

- Provision of an exhausting and constantly updated set of software tools for the activities of market participants;

- Provision of up-to-date technologies to connect the participants, including a simple mechanism for integration of the participants' applications within the PJM information systems.

PJM's Secret of Success

- **Built around the participants' interests;**

- **Flexibility and diversity of approaches to the implementation of communications;**

- **Establishment and maintenance of trust relationship with the participants;**

- **Progressive and consistent development of the system;**

- **Responsiveness to technical innovations and weighted, well structured approach to their implementation;**

- **Far-sighted in perceiving key innovative solutions;**

- **Global, long-term approach to the development of systems;**

- **Hard-boiled appraisal of the changing situation and formation of the response.**

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PJM Structure

- Two PJM System Operator control centers in Valley Forge and Milford are fully replaceable. The center in the Valley Forge is assigned a key role.

- Both centers have all necessary equipment and expertise to run the system in a full-fledged manner.

- In case it is impossible for the control center in Valley Forge to fulfill its functions, the control functions will be delegated to Milford.

- In the event of emergency – when both control centers are out of order - the procedures for speedy recovery of the centers are launched, and the transmission companies are temporarily vested with the system control functions ordinarily under the PJM dispatchers' supervision.

PJM Members

The following entities are allowed to be members of PJM Interconnection L.L.C. if they acknowledge their obligations arising from the PJM Operating Agreement:

- **Generating companies – owners of electric power plants (generating capacities)**

- **Transmission companies (owners of transmission networks)**

- **Load covering enterprises (power supply organizations, owners of distribution networks)**

- **Other market participants (virtual trade participants)**

- **Neighboring dispatch regulation zones**

One of the PJM members' obligations is to organize its own 24/7 local control center or, through a different PJM member, to coordinate its PJM operations.

PJM Members' Control Centers

The type of a control center is determined by the functions and obligations of individual participants:

- Local Control Center (LCC) – for transmission companies

- Market Operations Center (MOC) – for generating companies

- Local Service Center (LSC) – for owners of distribution networks

- Marketer – Marketing Center for other market players

Communications Among Control Centers

Generation Schedules

- MOCs provide PJM with the following information:

    - Information on available generating capacities;

    - Preliminary and final generation schedules, suggestions on (reservation) and regulation;

    - Outage schedules.

- PJM provides final generation schedules to LCCs, MOCs and LSCs.

Energy Management System (EMS)

- LCCs, MOCs, and LSCs provide PJM with the following data on a real-time basis:

    - Power generation and transmission

    - Availability of generation for regulation

- PJM provides information on the current state of the power generation and transmission systems, control (dispatch) instructions, warnings and notices

Communications Among Control Centers
(continued)

Scheduling Maintenance and Repair Works at Power Transmission Systems

- LCCs provide PJM with information on maintenance schedules of and repair works on the transmission systems agreed with PJM

- PJM disseminates the maintenance schedules and repair works to all the participants

Power Transmission Services

- LSCs and Market Operations Centers furnish information on reserving transmission resources

- PJM provides all control centers with information on the available transmission resources, transactions, restraints, and confirmed reservation, as well as other information on market activities

Communications Among Control Centers
(continued)

Transaction Related Services

- **All Control Centers furnish information on transactions based on bilateral contracts that are confirmed by PJM**

Long-term Planning

- **LCCs, MOCs, and LSCs provide PJM with information on resources, load, system parameters, operation of generators, production cost, and reports on outages and long-term planning**

- **PJM communicates findings of studies and assessments of long-term planning to all Control Centers**

Administrative Services

- **Through its website, PJM makes general administrative information and FERC documents available to all PJM participants**

Requirements for Control Centers

- **Control Centers act as sources of primary information for PJM Control Centers. PJM participants must meet the requirements for software and hardware pursuant to the Agreement.**

- **Transmission companies must ensure that the power transmission systems are monitored at their LCCs. The control systems must inform the maintenance staff of any substantial deviations detected in the work of the systems.**

- **If for some reason PJM refuses or is unable to monitor any part of the systems, it can direct the transmission company to monitor its own systems itself. In this case, the transmission company must:**

  - **Be available for continuous communication,**

  - **Inform PJM continuously of the state of the system's reliability based on SCADA data and analysis of the probability of an unexpected emergency; and**

  - **Promptly inform of any significant unforeseen situation or additional constraints.**

Requirements for Control Centers (continued)

- **Back-up and archiving;**

- **Safety of computer systems;**

- **Guaranteed service 24/7;**

- **Scaling;**

- **Data integrity – four levels of quality**

  - **Valid data**

  - **Manually inserted data**

  - **Telemetry failures**

  - **Doubtful data**

  PJM Control Centers must be provided with only reliable data. Even one group of data with errors or zeros can lead to major failures in the work of accessing the state of systems.

Requirements for New Participants' Control Centers

- Participants must ensure compatibility and reliability of communication of their information systems with PJM systems;

- PJM provides test servers to check compatibility and master interaction among new participants' system with those of PJM;

- Two-way interaction among the systems using DNP and ICCP protocols is mastered in accordance with approved regulations;

- Reliability of interaction is double checked through alternative channels;

- Post-failure restoration processes are tested to check server back-up, as well as at the network and channel levels;

- Specialist market participants are trained and certified as to issues related to market functioning, PJM software use, and communications among the participants.

Communication Interfaces

- **www.pjm.com**
  - **General information for all participants**
  - **Warnings and notices**
  - **Extensive information for various participants through web interfaces of the application package**
  - **Voice communications through various channels including:**
    - **Various fixed lines and diverse connection options – a call to everyone, conference connection**
    - **Mobile connection**
    - **Satellite connection**
- **Facsimile**
- **Web services**

Thank you!

Questions???

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