

The Distribution Network Operation Online Monitoring and Analysis System of State Grid Corporation (Phase 5)

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Abstract. Under the organization of Information & Communication Department and the Operation & Monitor Center in State Grid Corporation's headquarter, and after two years of construction from 2015 to 2016, the operational efficiency research and monitoring work was carried out at the three-level operation and monitor centers including headquarters, provincial and prefecture level. This provided quantitative evaluation and decision-making basis for the state grid planning and production operations. The leaders of Corporation highly affirmed the results of the special analysis of the operational efficiency of the distribution network assets which is actively explored by the operation & Monitor center. The leaders also put forward the higher requirement on this. To this end, improving the online monitoring and analysis system of the State Grid Corporation's network distribution operation has stronger practicality.

1. Introduction

Under the organization of Information & Communication Department and the Operation & Monitor Center in State Grid Corporation's headquarter, and after two years of construction from 2015 to 2016, monitoring and other functions of the operational efficiency of the 110kV and below power grids has been realized from three dimensions[1]: single equipment, substation and administrative district. It covers five major functional modules: load monitoring, efficiency monitoring, coordination degree [2] monitoring, decision analysis, and simulation prediction; the implementation scope is company headquarters and 27 provincial (city) companies.

The online monitoring and analysis system of the State Grid distribution network operation integrates key information such as equipment, load and assets from the PMS, EMS, ERP systems, which is realized the cross-platform data fusion of distribution network data. It lays a solid foundation for the on-line monitoring analysis and follow-up business development. The system also realized the online monitoring and analysis function of distribution network operation efficiency, completed the distribution network efficiency from offline qualitative description to online quantitative monitoring. Also, from the perspective of efficiency, this system provides the auxiliary decision support for the distribution network's planning, construction and operation[3].

Through the operational efficiency research and monitoring work carried out at the headquarters as well as provincial & prefecture-level operation and monitor centers, quantitative evaluation and decision-making basis were provided for the company's power grid planning and production operations. The leaders of Corporation highly affirmed the results of the special analysis of the operational efficiency of the distribution network assets which was actively explored by the operation & Monitor center, also put forward the higher requirement as: 1) further expanding the scope of power grid operation's monitoring, carrying out monitoring of equipment operation which the efficiency are 220kV or above, 2) deepen the monitoring capacity of power grid operation, for example, carrying out



the power supply capacity monitoring, courts voltage monitoring, load Monitoring and courts power outage monitoring, thus realizing the value for the application of power grid operation monitoring in 3 aspects that are precision investment, lean operation and maintenance, and quality service.

2. Overall Structure

The design of the online monitoring and analysis system of the State Grid Corporation's distribution network operation follows the idea of "business-driven, application-oriented, inheritance development, and continuous improvement". The overall business structure [4] was formed through the analysis of business structure and experience of the operational monitoring (control) center, also the overall system application structure design and data structure design were deducted. Then, the technical structure was designed as the requirement of the application Structure and data structure, and based on all above, the special technical solutions' design was done, accordingly, it formed the complete structure of distribution network operation online monitoring and analysis system to ensure effective support of the system.

2.1. Business Structure

The construction of distribution network online monitoring and analysis system was carried out to enhance information level and implement the intensification and specialization management of power grid operation and monitoring work. The construction work was in accordance with the plan for the company's grid operation information construction, combined with the grid operation monitoring business needs, as well as based on fully investigating the status quo of grid operation and extensively collecting opinions and suggestions from various units of the company[5]. It mainly includes five major businesses: operational efficiency, power supply capability, decision support, platform monitoring and data quality as Figure 1.

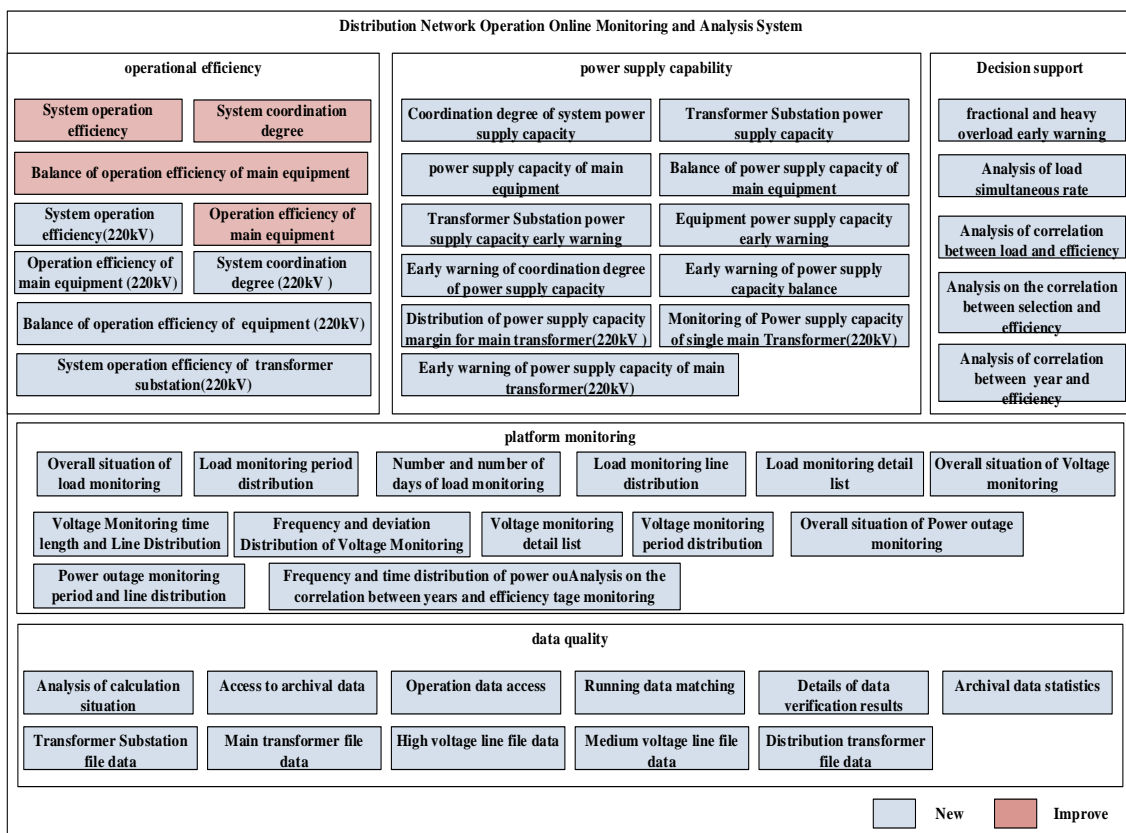


Figure 1. The Business Structure of State Grid Corporation Distribution Network Operation Online Monitoring and Analysis System

2.2. Application Structure

Based on the business structure, it conducted detailed analysis and comprehensively discussed the overall application architecture of the grid operation monitoring business application. The application structure laid the foundation for data architecture design, technology implementation and subsequent development. It is shown in Figure 2.

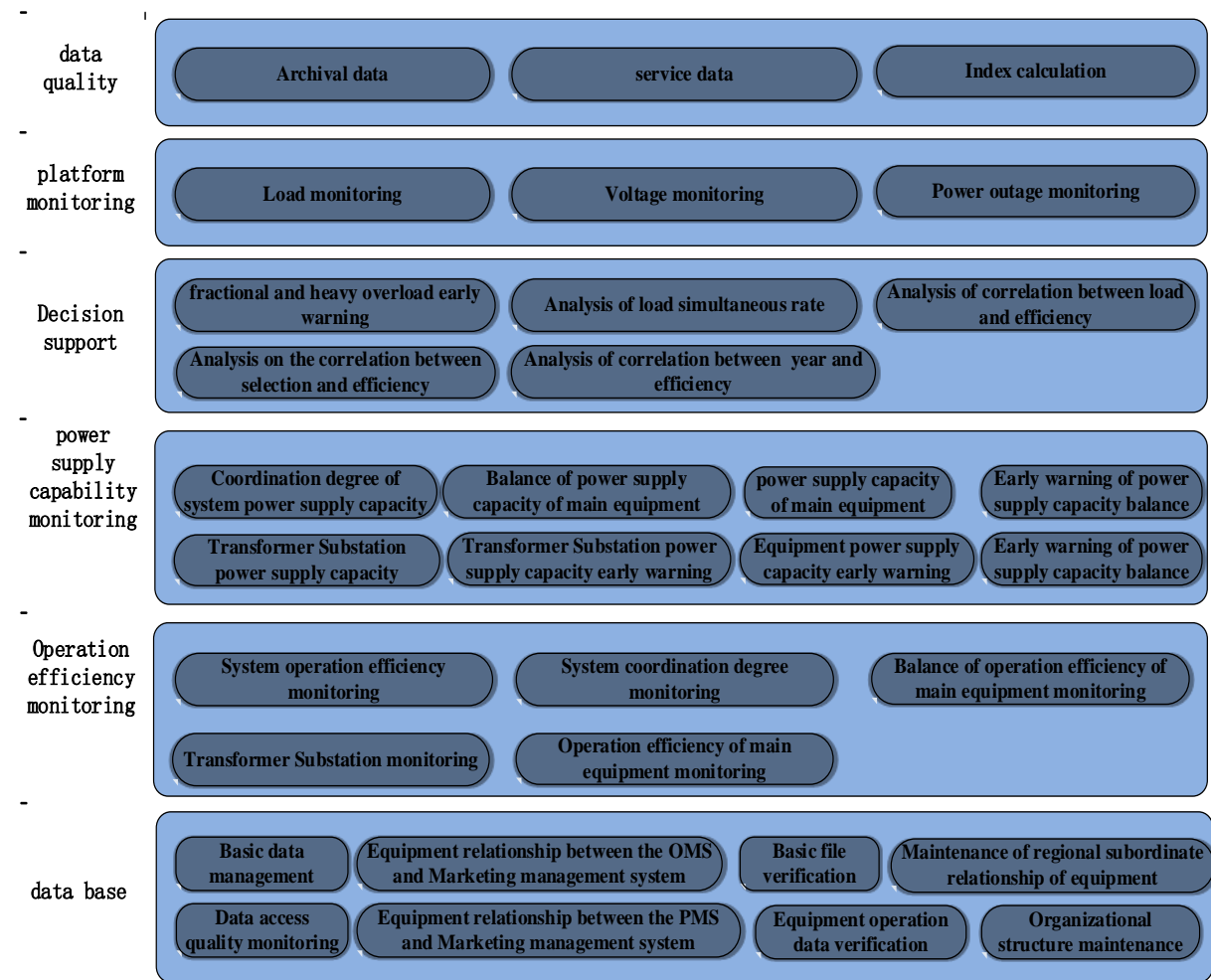


Figure 2. The Application Structure of State Grid Corporation Distribution Network Operation Online Monitoring and Analysis System

2.3. Data Structure

The data source come from Structured Data Platform(SDP) and Massive Data Platform(MDP) , the data about the main transformer, the line, the distribution transformer and other archival data in Structured Data Platform come from the PMS and the Customer Marketing System(CMS), the data about the equipment of running data in MDP come from the OMS and the Power Information Collecting System(PICS). The data structure is shown in Figure 3.

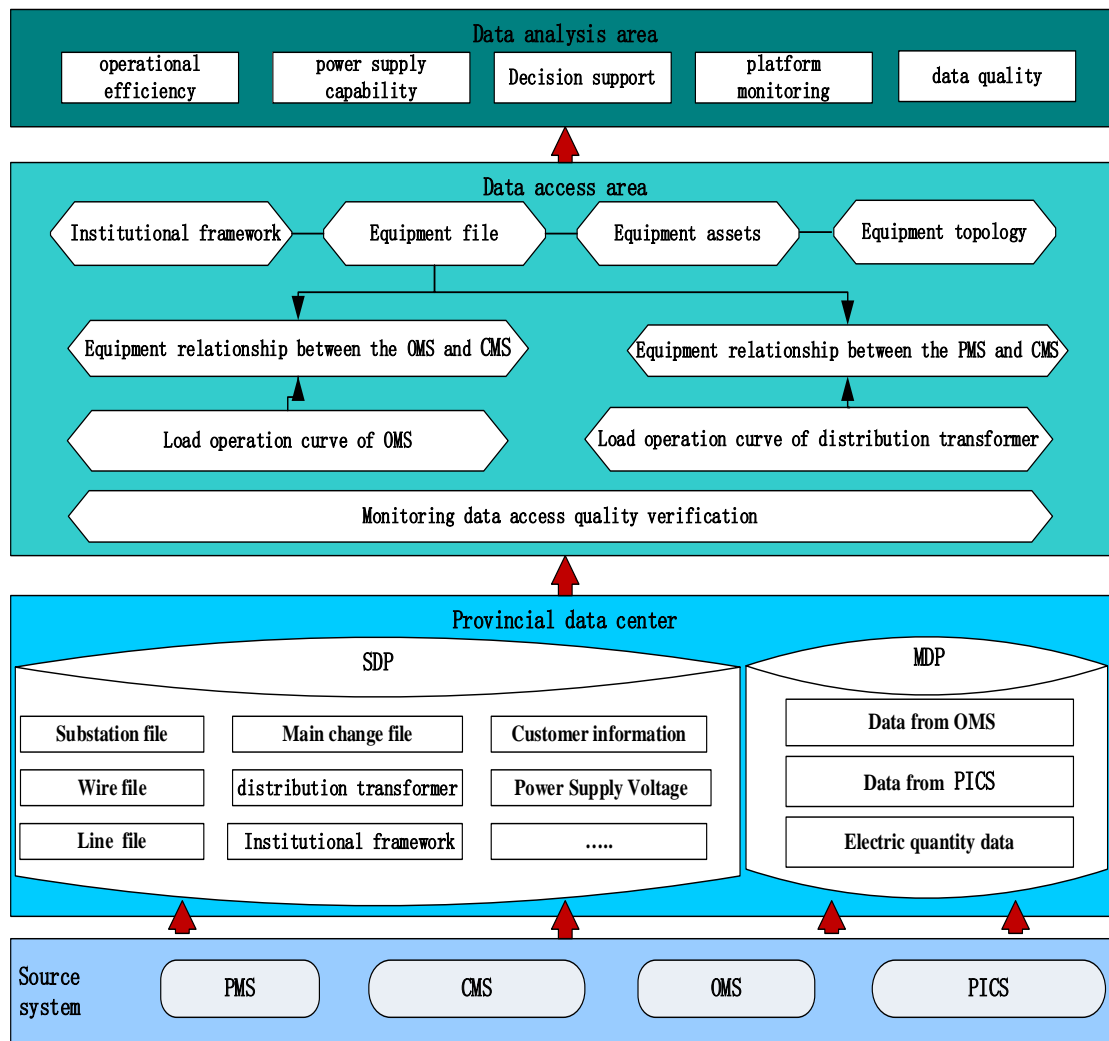


Figure 3. The Data Structure of State Grid Corporation Distribution Network Operation Online Monitoring and Analysis System

2.4. Technical Structure

The online monitoring and analysis system for distribution network operation followed the technical structure of the early stage of the system, based on the SG-UAP platform development, with the Oracle database. The technical structure includes: infrastructure service layer, technical service layer, basic business service layer, application logic layer, and presentation layer as shown in Figure 4.

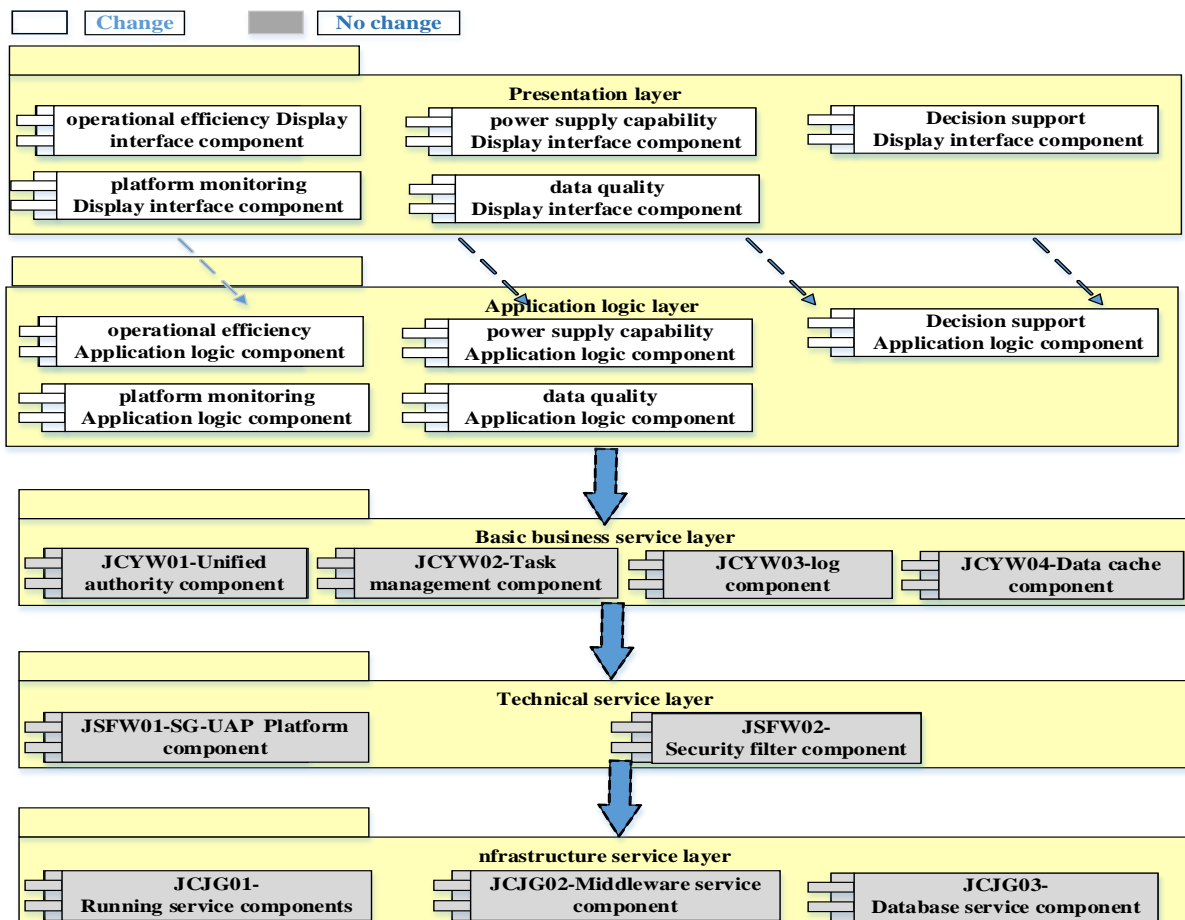


Figure 4. The Technical Structure of State Grid Corporation Distribution Network Operation Online Monitoring and Analysis System

3. Deployment Scheme

The online monitoring and analysis system of distribution network operation adopted the cluster high-availability deployment mode: the intranet application was deployed along the deployment, the server was placed in the production area, the service application included two nodes, and the load balancing is implemented by F5 technology as shown in Figure 5.

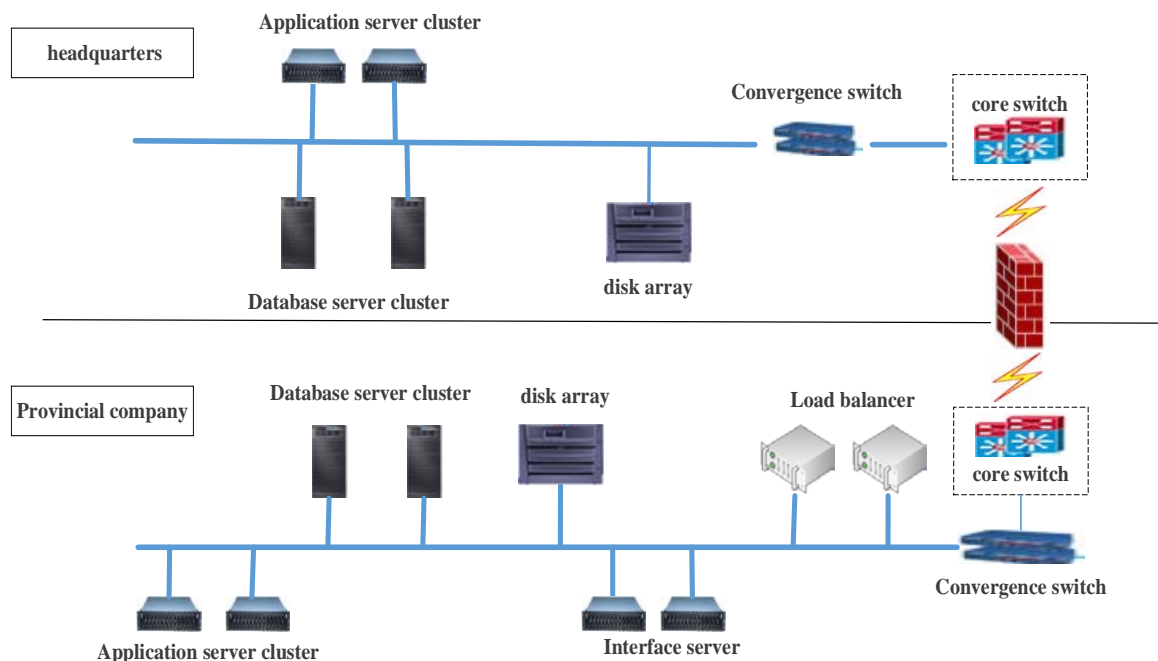


Figure 5. The Deployment Structure of State Grid Corporation Distribution Network Operation Online Monitoring and Analysis System

4. Conclusion

The system has realized the real-time monitoring and comprehensive evaluation of the operating efficiency and power supply capacity of 27 provincial power grid assets [6]. As analysis, the grid efficiency was 0.2538 in 2018, the transmission grid efficiency was 0.3, up 5.64%, and the distribution grid efficiency was 0.2596, down 3.97% year-on-year; 0.2853 in the east, 0.256 in the middle, 0.2413 in the west, and the efficiency in the east-middle-west was gradually decreasing. The load levels of the voltage levels are reasonable, but the regional differences were large. The distribution network high voltage lines, main transformers, medium voltage lines, and distribution transformer power supply margins are 0.4015, 0.2163, 0.3597, and 0.5204, respectively. Among them, the distribution capacity margin can be equivalent to the five-year expansion demand. The comprehensive evaluation results have provided the decision support for the company's power grid planning, construction and production operations, also and promoted the level of grid input and output efficiency as well as the asset lean management level [7].

5. References

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