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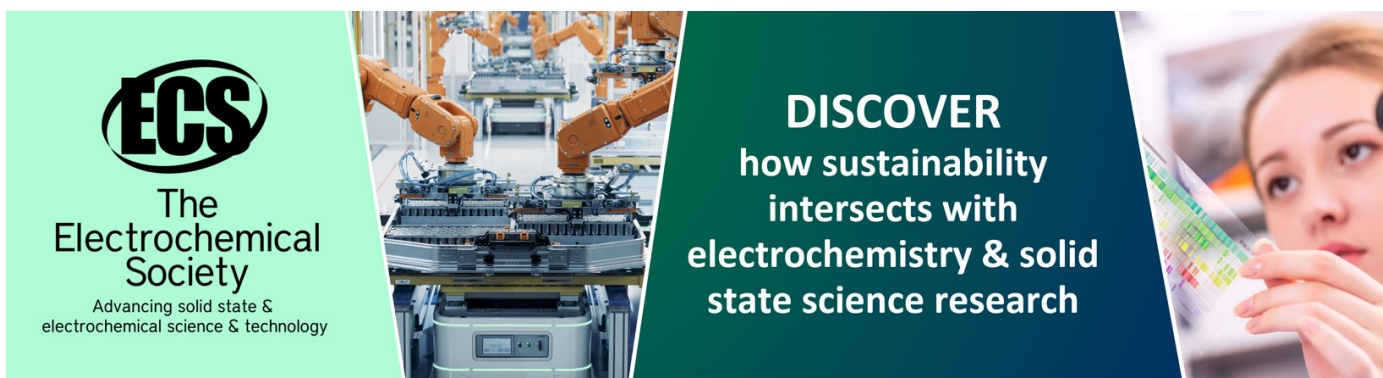
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Analysis on Demand and Development Direction of Smart Grid under the Background of Two-network Convergence

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Abstract. With regard to development strategy of "two networks integration", based on improvement of power supply capacity, power supply security and reliability, fault response, information collection capability as well as improvement, intelligence, integration and automation upgrade on real-time monitoring capability, "two networks integration" planning strategy and implementation plan, such as planning for distribution network, distribution itself, ubiquitous power Internet of Things, are made to greatly improve overall capacity of distribution network, which further provides reference for similar projects, such as high-quality, stable, efficient and green power supply.

1. Introduction

With the gradual construction development of "three episodes and five majors" system, management mode of power information network and communication data network is also improving, especially application of information technology in management, which greatly enhances the intelligence capability of information services so that grid management can be gradually moved from traditional model to modern era. Nowadays, integration of power information network and communication data network has become the key to the construction of smart grid, and it is one of the important means to improve the management level of power information communication as well. However, since it is a short time that integration of the two networks exists in China, intensive research is needed for fusion strategy and effect. Therefore, it is necessary to conduct fusion of power information network and communication data network[1-2].

2. Brief Introduction on Power Information Network and Communication Data Network

In the development of power system, professional technologies of power information network and communication data network develop together, penetrate and cooperate mutually, which provides basic support for normal operation of power grid. In addition, information network is based on communication data network, while communication data network is supported by information network technology, where the integration of two networks has been an irreversible trend.

2.1. Power Information Network

Power information network is the bearer network of power system business, and as the carrier of grid service operation, it is the first step of grid management information construction. Moreover, after entering information age, wiring of information network has been extended to any aspect in power system, which covers a wide range[3-4]. The main structure of power information network is as follows.



2.1.1. Local backbone layer. In general, two routers are set up as local information network outlets, which are connected to other power company information networks through dynamic routing protocols.

2.1.2. Local aggregation layer. The layer mainly consists of two sub-layers. On the first layer, 2 routers are set up in central station and connected to local backbone router through dynamic routing protocol, where one router-Ethernet is connected to other power supply company devices, and each service segment gateway is set on the router. Moreover, the other router is set as connection device between power supply company and service center of downlink. On the second layer, one router is set up in other power supply companies to be responsible for the access ports of switching equipment in other power supply company.

2.1.3. Local access layer. Local access layer is mainly composed by access switches, which covers the entire office, and it is connected to the second layer in local aggregation layer through two-layer cascading manner.

2.2. Power Communication Data Network

Power communication data network whose service carrying capacity far exceeds traditional power transmission network mainly carries business payment, IP telephony, video surveillance and other services. Nowadays, border gateway protocol is adopted in power communication data network, where each service is separately divided into VPN so that an independent reason table can be given to the whole network to ensure smooth development of various services[5-6]. Main structure of power communication data network is as follows.

2.2.1. Local backbone network. Two routers which are connected to routers from other power supply companies are used as route reflectors to form local communication data network outlet.

2.2.2. Local aggregation layer. 5 router devices are chosen in local aggregation layer, each of which is connected to a router in the local backbone.

2.2.3. Local access layer. Main component of local access later is still access switch, and each device must be configured with virtual router, which uses redundant protocol to access devices in local aggregation layer.

3. Fusion Strategy of Power Information Network and Communication Data Network

Power information network and communication data network are deeply integrated to integrate the two networks into one network. From the past work experience and the same type of engineering operation practice, integration of the two networks can be carried out from four aspects, and the specific strategies and related situations are as follows.

3.1. Improve equipment redundancy

Operation method is as follows. Two routers of central station in power information network are hung under two routers of central station in power communication data network. Meanwhile, two routers in power information network are transplanted to redundant backup site of superior power supply company, which can be used as the second exit of local power information network. Therefore, when power outage or other failure occurs in the central station equipment of power information network, the second outlet can be used to ensure the smooth completion of service in power information network and communication data network.

3.2. Improve network transmission speed

Since conditions such as transmission channel quality and optical cable resources have great influence on service transmission of power information network and communication data network, in order to ensure maximum business continuity, dynamic routing protocol dual bare fiber or adjacent two-way connection of one light and one electric mode can be adopted in connection mode between local

convergence layer device in power information network and local aggregation layer device in power communication data network, where even if the device in local aggregation layer fails in a single route, service transmission can be completed through other routes, and the physical link redundancy can be used to achieve the effect of service transmission protection.

3.3. Achieve efficiency and economic integration

When power information network and communication data network are integrated, devices in two network access layers should retain only one, which aims to realize unified bearer of power information and communication data services at the access layer so that unification of business interfaces and exports can be facilitated to realize the integration of information and communication. Meanwhile, setting as mentioned above can avoid repeated setting on access layer equipment, which reduces the waste of equipment resources, and maximize the economic benefits of equipment investment and operation.

3.4. Convergent management and highlight innovation

Power information network and communication data network are two different professional network systems, where certain professional barriers exists.

In order to promote and ensure smooth development of the two networks integration work, work flow should be sorted out, integration objectives and management scope should be clarified, and integration plan around the goal of network unification should be designed to unify implementation of energy release method, uniformly check the equipment, and uniformly maintain the network so that effectiveness of network management can be improved and difficulty of operation and maintenance can be reduced. Moreover, power structure development idea based on design of the two networks is shown in Figure 1.

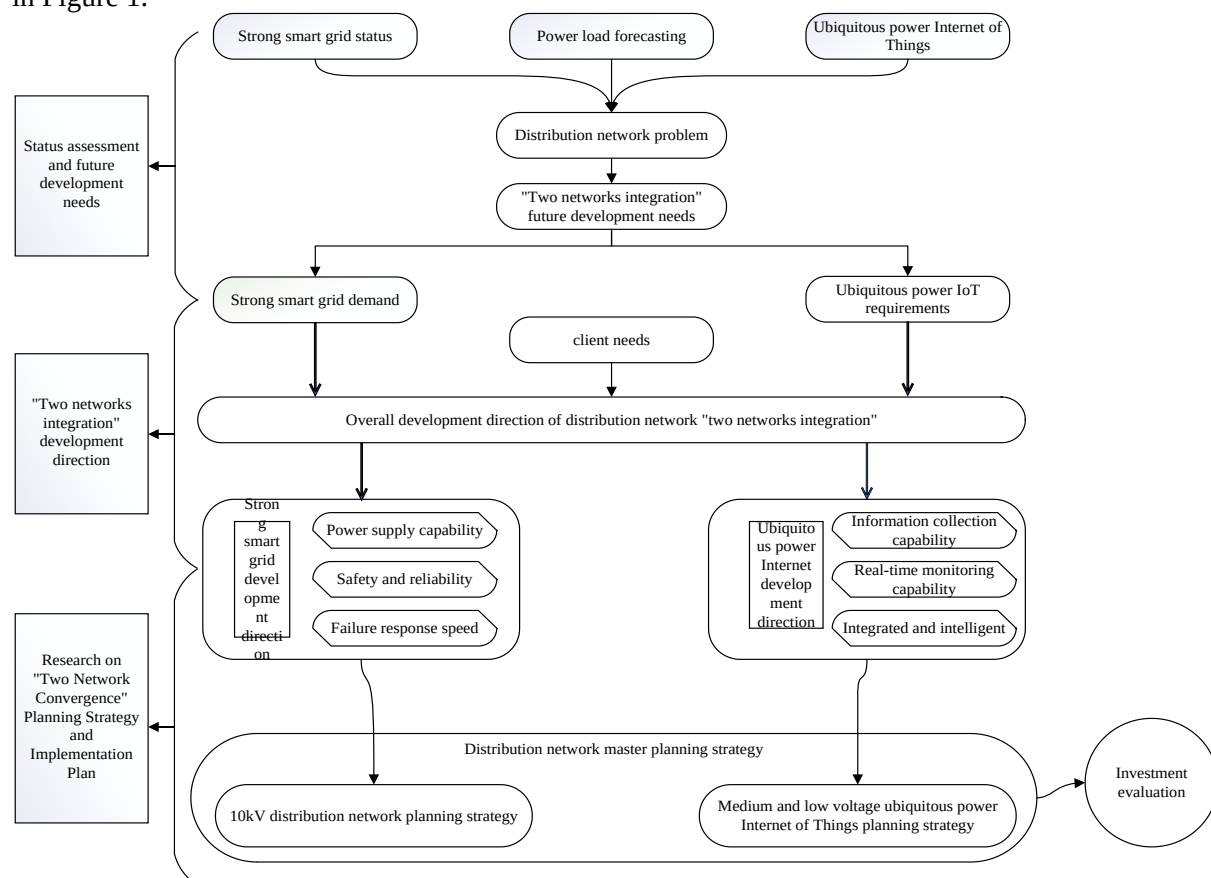


Figure 1. Development of Power Structure for Two-network Integration Design

4. Power Grid Development Plan under Integration of Two Networks

4.1. Establishment on Distributed Energy Storage Structure

Network structure of upgrade and transformation of converged power grid in power communication network and communication data network as well as ubiquitous internet technology for regional distributed energy storage application are shown in FIG. 2.

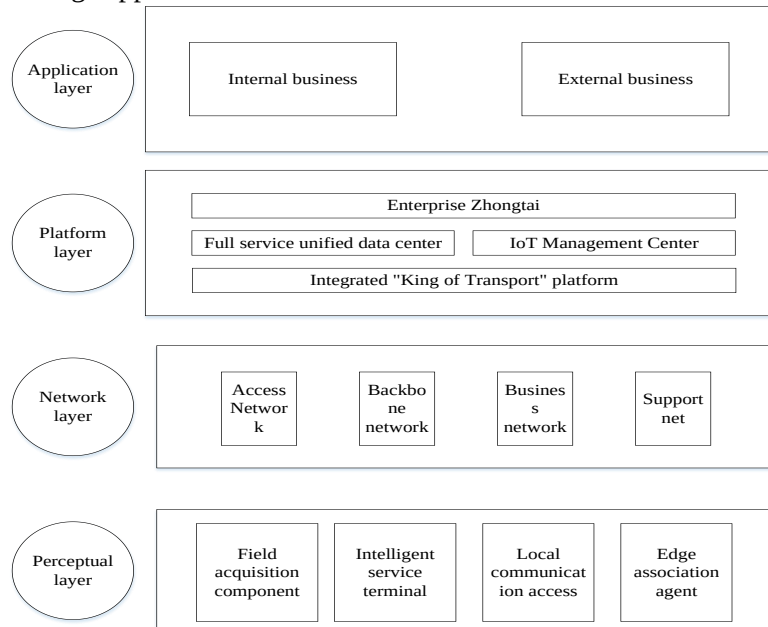


Figure 2. Ubiquitous Internet Network Structure

Container design mode with plug-and-play function is adopted, which is convenient, fast, flexible and practical. What's more, the AC side is connected to 400 V area transformer low-voltage bus, and two-level control unit with intelligent distribution terminal is formed to coordinately solve seasonal and intermittent peak load, which further reduces the impact of diversity load on power quality of distribution network so that power supply reliability will be strengthened, investment in distribution network equipment will be reduced, and equipment utilization will be improved as well.

Implementation function: Intelligent power tracking adjustment can be realized to ensure power supply reliability. Moreover, power quality online management can be achieved to improve power supply level in the station, and off-grid operation can be supported to meet critical load power demand. In addition, peaks and fill valleys can be cut to improve grid load characteristics and reduce line loss. Besides it, intelligent communication can be performed to meet plug-and-play requirements of IoT devices.

4.2. Active Operation and Maintenance on Fault with Comprehensively Aware

Relying on full coverage project of intelligent distribution terminal, low-voltage sensors are deployed at branch box and line end to collect low-voltage operation information and abnormal state information. Besides it, combined with main station upgrade of distribution automation, functions such as low-voltage data display and abnormal alarm, active push of power failure information, accurate prediction of power distribution equipment status, automatic identification of low-voltage topology, automatic judgment of low-voltage faults, and fine control of low-voltage line loss can be achieved to assist battalion coordination and through-end fusion, which will improve comprehensive research and judgment ability of medium and low-voltage distribution network faults as well as fault repair efficiency and customer service level.

4.3. Comprehensive Management on Power Quality

In terms of agricultural greenhouses, electric irrigation, electric flue-cured tobacco and electric tea, the development of rural electrification, on the one hand, affects the power quality of rural power grid. On the other hand, some projects have higher requirements on power quality of rural power grids due to its processing technology. Moreover, according to intelligent equipment and real-time load, low-voltage

commutation switch, reactive compensation capacitor, active filter, static var generator (SVG) and other equipment can be differentially configured in station area to realize evaluation of treatment effect on automatic commutation load regulation, reactive power automatic regulation, power quality monitoring, operation status of control device and power quality management device.

5. Conclusion

Integration of power information network and communication data network is an inevitable trend of power grid construction and development, where discussion and research should be strengthened, and integration of power information network and communication data network should be explored to effectively promote integration of the two networks so that network management mode of power system can be further promoted and the security of network information will be improved as well.

6. References

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