Analysis of Difficulties in the Construction of Digital Twin Watersheds

Junjie Wang Yongbing Xu SHANDONG SURVEY AND DESIGN INSTITUTE OF WATER CONSERVANCY CO., LTD

Objectives

The national "14th Five-Year Plan" puts forth a clear directive to build an intelligent water conservancy system, with a focus on watershed-based enhancement of water situation monitoring and intelligent scheduling capabilities. Guided by this plan, Shandong Province has invested 250 million yuan in the development of the Xiaoqinghe digital twin watershed, with the objective of exploring the construction of a watershed intelligent water conservancy system that encompasses forecasting, early warning, simulation, and contingency planning functionalities.

Figure 1 Simplified Diagram of the Xiaoqinghe Watershed

Figure 2 Framework Diagram of the Established Xiaoqinghe Automated Scheduling System

Methods

The Xiaoqinghe digital twin watershed project revolves around the Xiaoqinghe watershed as its core. It utilizes physical watershed data, spatio-temporal data, mathematical models, and water conservancy knowledge to establish a digital representation of the Xiaoqinghe watershed. This includes the creation of a digital scene, intelligent simulation, and a command system for flood control and disaster reduction. Key technologies employed in this project encompass intelligent monitoring, big data governance, water cycle simulation, knowledge mining, and virtual reality, among others.

Results

The initial results of the Xiaoqinghe digital twin watershed construction have shown promising outcomes. Through the digitization of the watershed scene and the implementation of intelligent simulation, it has become possible to predict and analyze water situation changes within the Xiaoqinghe watershed. The flood control and disaster reduction intelligent command system enables real-time monitoring, early warning, and flood command, providing decision-making support and facilitating emergency response measures.

Conclusions

The construction of the Xiaoqinghe digital twin watershed encounters several challenges, including difficulties in engineering digitization, integration of data across multiple industries, accuracy of watershed flood forecasting, and the complexity of organizing and implementing integration. In order to advance the development of digital twin watershed projects, the article proposes recommendations to support the project owners and contractors involved in the pioneering construction of digital twin watersheds. By analyzing the key technologies and challenges of the Xiaoqinghe digital twin watershed, the aim is to explore better solutions for digital twin watershed development.
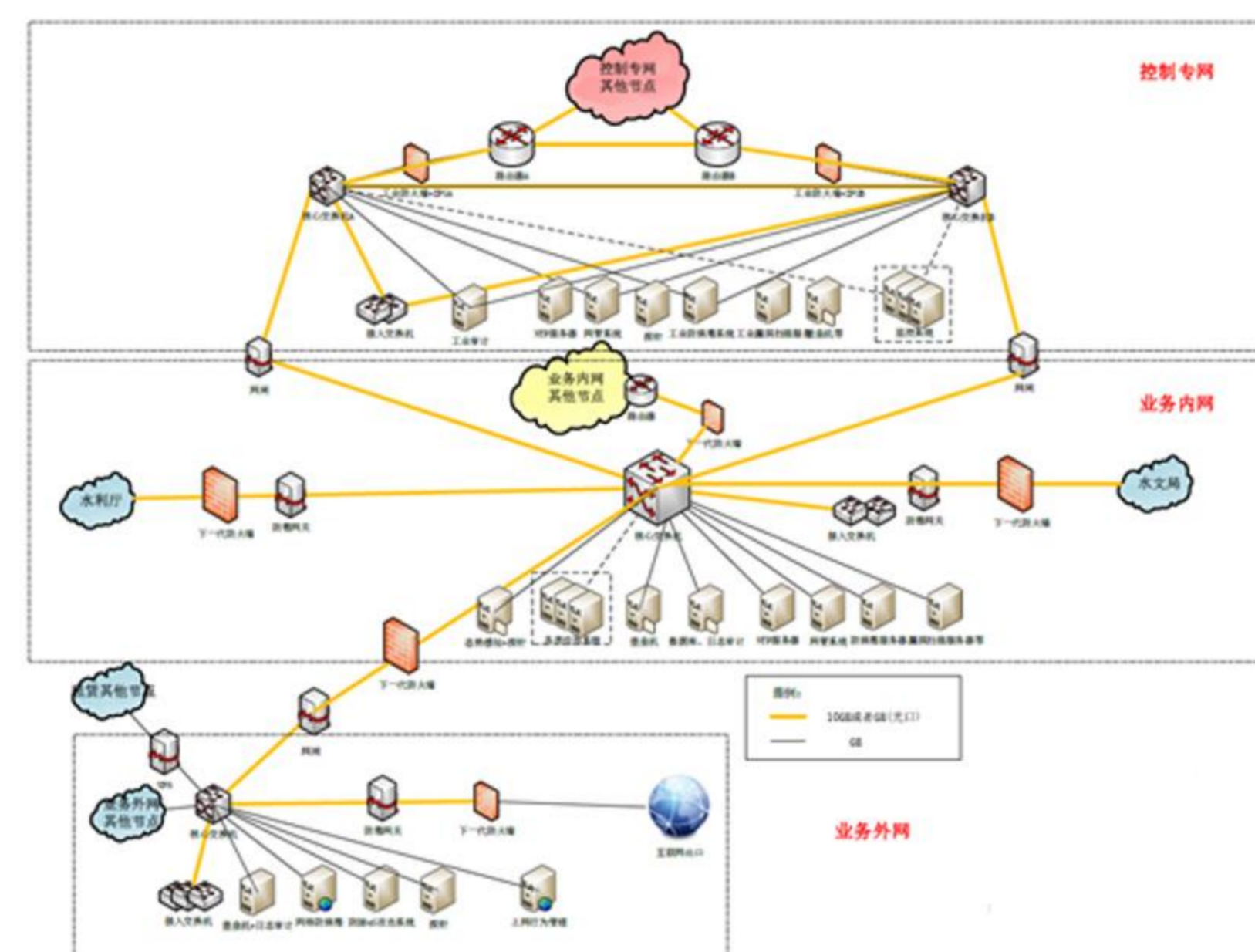

Figure 3 Network Structure Topology Diagram of the Xiaoqinghe

Figure 4 Xiaoqinghe Digital Twin Watershed Application System

XVIII
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