White Paper of

AISWare Digital Gemini V4.0

AISWare Digital Gemini is an innovative design and construction tool tailored for the creation of digital twin applications, enabling users to independently design, build, and maintain various digital twin applications.

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Leading Artificial Intelligence Enterprise in China

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Outstanding Catalyst Contribution to TM Forum Assets

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The Most Innovative Application of AI & Automation of FutureNet Asia

The Most Influential Enterprise in China Software Industry

Top 100 China Software Business Revenue List for consecutive years

Contents

1 Executive Summary

Concentrating on volume, twin, intelligence, and scenarios, AISWare Digital Gemini can simulate and interact with the real world in real-time with deep integration of technologies such as big data, IoT, GIS, BIM, AI, and immersive visualization. It maps and connects the physical and virtual worlds to develop a digital infrastructure, supporting real-time updates, historical reviews, future predictions, and scenario simulation. This universal digital twin platform empowers various industries for panoramic visibility, ubiquitous intelligence, flexible usage, quick orchestration, intelligent simulation, and efficient delivery.

This White Paper will elaborate on AISWare Digital Gemini from different aspects to bring the audience a round-up picture of the product. It showcases the immense potential of digital twin technology in innovating business, boosting operational efficiency, and intellectualizing decision-making.

2 Abbreviations and Terms

Abbreviations and terms are shown in Table 2-1.

Table 2-1 Abbreviations and Terms

Abbreviation and Term	Full Name	Explanation
AI	Artificial Intelligence	A new field of technology science that studies and develops theories, methods, technologies, and application systems for simulating, extending, and enhancing human intelligence.
AIOps	Artificial Intelligence for IT Operations	Intelligent Operations and Maintenance
BIM	Building Information Modeling	A data-driven tool used in engineering design, construction, and management. By integrating data and information models of a building, it facilitates sharing and transmission throughout the entire lifecycle of project planning, operation, and maintenance.
CIM	City Information Modeling	Establish a 3D urban spatial model and an organic integrated urban information system based on urban information data, consisting of large-scale GIS data and BIM data; it also serves as fundamental data for Smart City.
DT	digital twin	A digital twin is a concept that transcends reality and can be viewed as a digital mapping system of one or more critical,

Abbreviation and Term	Full Name	Explanation
		interdependent equipment systems.
DTN	Digital Twin Network	A virtual replica of a physical network entity created digitally, enabling real-time interaction and mapping with its physical counterpart. The core elements include: data, models, interaction, and mapping.
GIS	Geographic Information System	A crucial spatial information system. It is a technical system supported by computer hardware and software that involves the collection, storage, management, computation, analysis, display, and description of geographic distribution data related to the Earth's surface, atmosphere, and subsurface, either partially or entirely.
IoT	Internet of Things	An extension and expansion of the internet infrastructure. It forms a vast network by integrating various information-sensing devices with the network, enabling connectivity and communication between people, machines, and objects at any time and from any place.
Kafka	-	An open-source stream processing platform developed by the Apache Software Foundation, written in Scala and Java. Kafka is a high-throughput distributed publish-subscribe messaging system that can handle all stream data related to

Abbreviation and Term	Full Name	Explanation
		consumer actions on a website.
LLM	Large Language Model	A deep learning model trained on a large amount of text data, capable of generating natural language text or understanding the meanings of language texts.
PBR	Physically-Based Rendering	Physically-based lighting and shading techniques can accurately represent the true material properties of objects.
WYSIWYG	What You See Is What You Get	What You See Is What You Get

3 Product Overview

AISWare Digital Gemini (hereinafter as “Digital Gemini” or the “Platform”) is a versatile digital twin-framing platform for business innovation and application development across industries. It deeply integrates technologies, such as big data, IoT, GIS, BIM, AI, knowledge graphs, edge computing, and immersive visualization, to enable precise simulation and modeling, cloud-edge collaboration, data-driven decision-making, real-time sensing, and dynamic interaction, as well as continuous cognition and predictive simulation.

Digital Gemini not only enables real-time updates and historical traceability, but also simulates scenarios and future predictions, providing in-depth digital twin solutions for Smart City, industrial internet, and Digital Twin Network. It allows users to deep analysis and optimized management among complex systems in the real world.

3.1 Trends and Challenges

Digital twin technology is driven by global policies and growing market demands and is crucial for urban planning/operation and infrastructure management. Technological innovations are accelerating the digital twin towards deeper system integration and application innovation. Industrial standardization and the evolution of open-source technologies have enhanced platform interoperability and scalability, facilitating data and model sharing. Furthermore, the use cases of digital twins, such as Smart City, Smart Manufacturing, and energy control, have been multiplying, with the application of LLMs further intellectualizing and automating its development/optimization processes.

Despite the immense potential of digital twins, it also faces challenges. The high cost and the professional staff for development and maintenance limit its adoption. Data security and privacy protection pose another significant challenge, especially when dealing with massive sensitive data. Technical integration obstacles, including compatibility among technical engines and tools from different sources, also need specialized resolutions. Furthermore, the higher accuracy and reliability of simulation with lower system complexity require more attention in technology development. From the societal perspective,

legislation and ethical standards, along with user acceptance and participation are essential for technology implementation. Digital twin will grow in a healthy environment only if the cooperation union is established among interdisciplinary cooperation, policy support, technology breakthroughs, and education.

3.2 Product Definition

AISWare Digital Gemini is a set of creative design and framing tools for digital twin applications as a universal foundation, it enables all-round monitoring, analysis, and management by a precise virtual digital replica of physical entities, and empowers various industries.

3.3 Product Positioning

AISWare Digital Gemini serves as a creative platform tailored for Smart City in a WYSIWYG approach, integrating technologies such as GIS, IoT, and cloud rendering. It supports low-code construction of application scenarios and provides a twin designing toolkit for the visual definition of basic models, data, charts, geo-models, functional models, rule configurations, command controls, and so on.

Digital Gemini is also acting as a platform for Digital Twin Network with multi-dimensional existing network modeling capability and simulation on both the individual and scenario levels, as well as process simulation based on physical network resources, virtual network resources, and business processes.

AISWare Digital Gemini is also an essential part of industrial solutions. As a digital platform tailored for vertical industries, it forms several Digital twin solutions with professional simulation capabilities such as Smart Water and Smart Transport. It shows three main advantages:

- Evolve from real business and user needs with large-scale software delivery.
- Integrate significant software development capabilities, while externally connecting the full industry chain vertically.

- Emphasize general capabilities, lower the delivery cost for vertical business applications, respond among departments, and lead the construction models among industries.

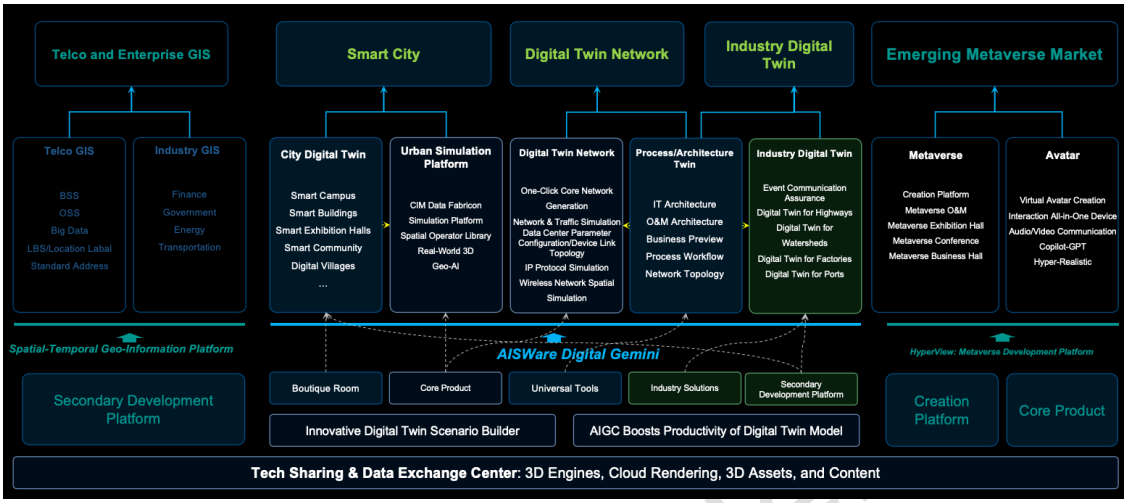

Figure 3-1 Solutions and target markets of AISWare Digital Gemini

Note: The markets highlighted on the left and right sides refer to the target markets associated with the AISWare Digital Gemini (the AISWare AIMAP and AISWare HyperView).

4 Product Portfolio

The functional architecture of AISWare Digital Gemini is shown below:

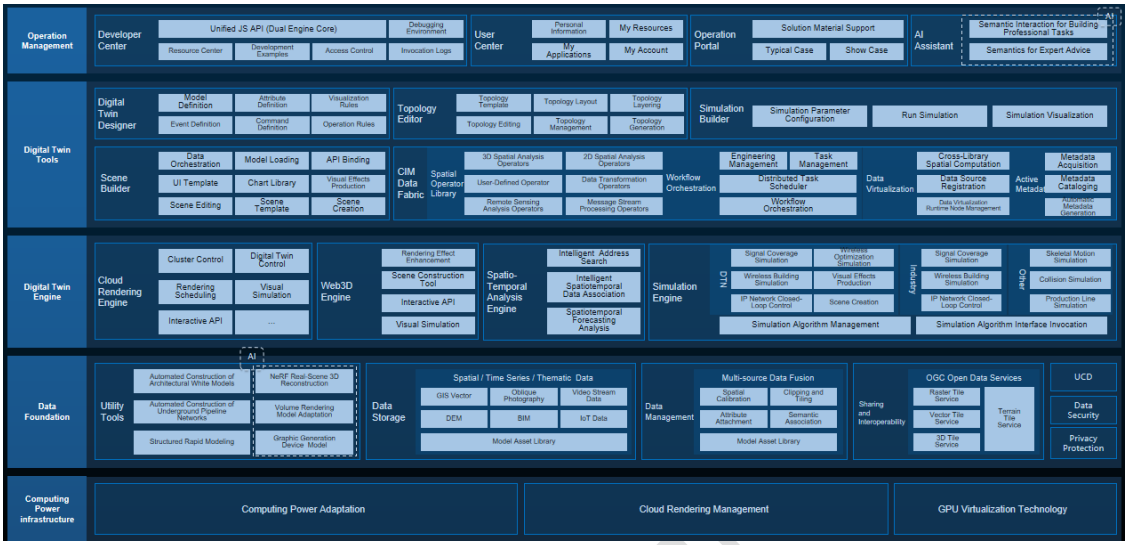

Figure 4-1 Functional architecture of AISWare Digital Gemini

- **Operation management**: Digital Gemini offers the Developer Center, User Center, Operation Portal, and AI Assistant. This approach serves developers, tenants, and a wide range of users with better experience and value innovations.
- **Twinning toolkit**: Designed for Smart City, Digital Twin Network, and other vertical industry sectors, Digital Gemini offers development tools for constructing scenarios, consisting of Twin Designer, Topology Editor, Data Integrator, Scenario Builder, and Simulator.
- **Twinning engines**: Responsible for graphic rendering and interaction, cross-platform 3D visualization, spatiotemporal data processing, and analysis, as well as simulation of physical and system behaviors.
- **Database**: Ensure accurate reflection on the physical entities by digital twins and components, such as the state, behavior, and environmental information, including modules of model processing, data storage, data management, and data sharing/interoperability. It provides a strong data foundation for decision-making support, monitoring and alerting, and optimization analysis.

- **Computing power infrastructure**: The fundamental computation resource layer for platform operations with flexible, efficient and scalable computation capabilities, including key components such as computing resource adaptation, cloud rendering, and GPU virtualization. It meets the demands of high-performance computation, large-scale data processing, and real-time rendering.

5 Basic Functions

This chapter mainly describes the basic functions of AISWare Digital Gemini.

5.1 Twin Designer

The twinning process is to digitalize and visualize the physical world to be perceived, recognized, and analyzed by computer and network in real-time, enabling dynamic interactions between twinned objects and their physical entities.

Twin Designer can define physical entities in multiple dimensions by defining attributes, setting command rules, visualizing objects, and accessing data interfaces. Driven by real-time operation data of physical entities, it provides an accurate depiction of actual behaviors and operation status. It supports connections across various types of devices by seamlessly integrating with IoT platforms.

Key features of the twin body:

1. **Cloud-edge collaboration driven by data**: Digital twins can make decisions by data and execute them as distributed microservices on the cloud and at the edge based on a cloud-native architecture.
2. **WYSIWYG by real-time perception**: Digital twins emphasize the collecting, transmitting, processing, analyzing, and presenting of real-time data to perceive, demonstrate, and drive corresponding physical entities in real-time.
3. **Constant recognition for predictive simulation:** Digital twins discover patterns through continuous cognition of the evolution of physical entities through historical data on the cloud, and can predict trends through AI simulation.

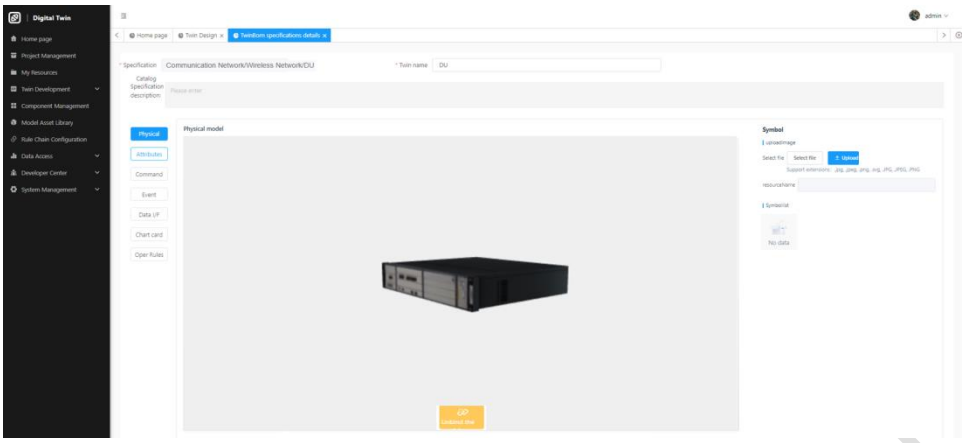

Figure 5-1 Twin Designer

5.2 Scenario Builder

Scenario Builder allows for the definition and operation of combinations, orchestration, and operational rules of digital twins within specific business scenarios. It supports component-based online orchestration of business scenarios, enabling flexible definition of application scenarios with zero-code configuration.

It offers a rich component library and scenario-building capabilities, including intelligent components for AIOps, facial recognition, fire detection, behavior recognition, and trend analysis. It supports the integration and registration of third-party AI services through standard interfaces.

Utilizing GIS data, satellite maps, drone oblique photography, digital assets, LiDAR, DSLR oblique photography data, and BIM data, the Scenario Builder facilitates city modeling. It enables the accurate replication of large-scale urban scenarios, sizable city and regional scenarios, medium-sized city and park scenarios, centimeter-level high-fidelity urban road details, and millimeter-level fully realistic city details. The builder supports hierarchical visualization capabilities from Earth, city, park, building, and room perspectives, with varying structural precision and texture requirements. It efficiently simulates physical properties such as water, ice, fog, lighting, illumination, and shadows, adjusting based on time, season, weather, and solar position to make scenarios more realistic.

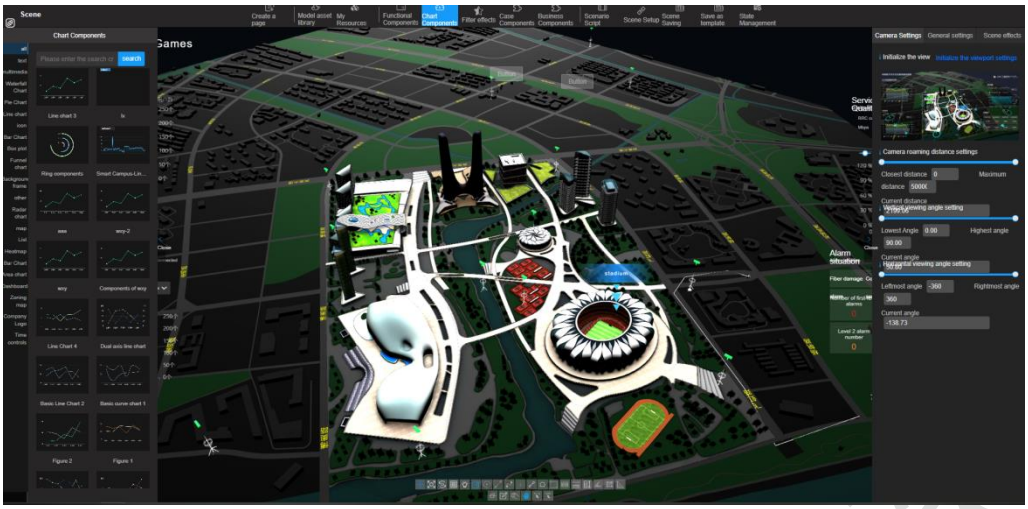

Figure 5-2 Scenario Builder

5.3 Topology Editor

Topology Editor is designed for various network twin scenarios. Driven by data, it can generate topologies based on definitions from Twin Designer, and support dynamic demonstration of network service processes to further promote real-time network service-oriented presentations.

It supports customized configurations and flexible expansion with a range of intelligent algorithms for automatic topology structure generation.

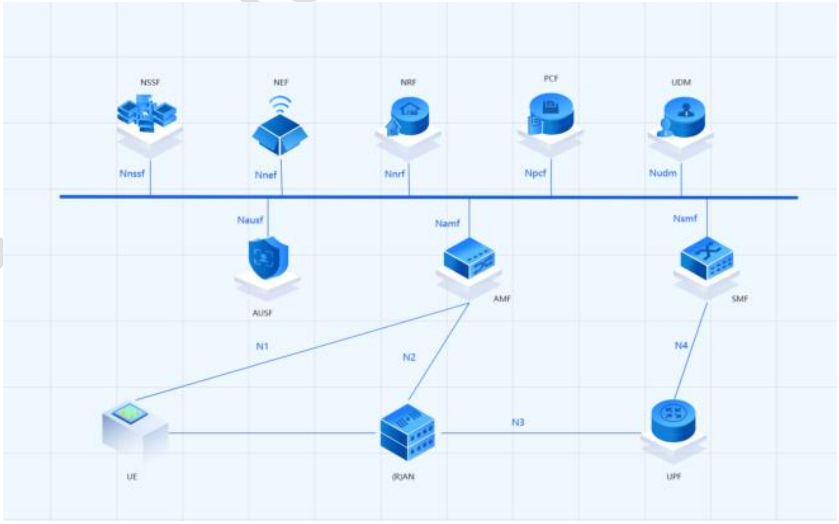

Figure 5-3 Topology Editor

5.4 Simulator

Simulator can simulate and predict the city and network in the real world by visual modeling.

For city simulation, the Simulator can simulate dynamic behaviors, such as humans and traffic flow; it also supports the simulation of physical phenomena, such as collision and gravity occasions. With respect to some industry-specific scenarios, domain capabilities are simulated through this engine, such as flooding analysis for Smart Water.

Figure 5-4 Smart Transport

Simulator for network scenarios currently offers two simulation capabilities:

- **Signal coverage simulation** creates 3D wireless coverage models to better support decision-making on planning and optimization of outdoor base stations based on station parameters, especially in urban environments with commercial concentration.
- **Wireless optimization simulation** allows for real-time 3D modeling and visualization for wiser decision-making for wireless network optimization based on network parameters or device configurations.

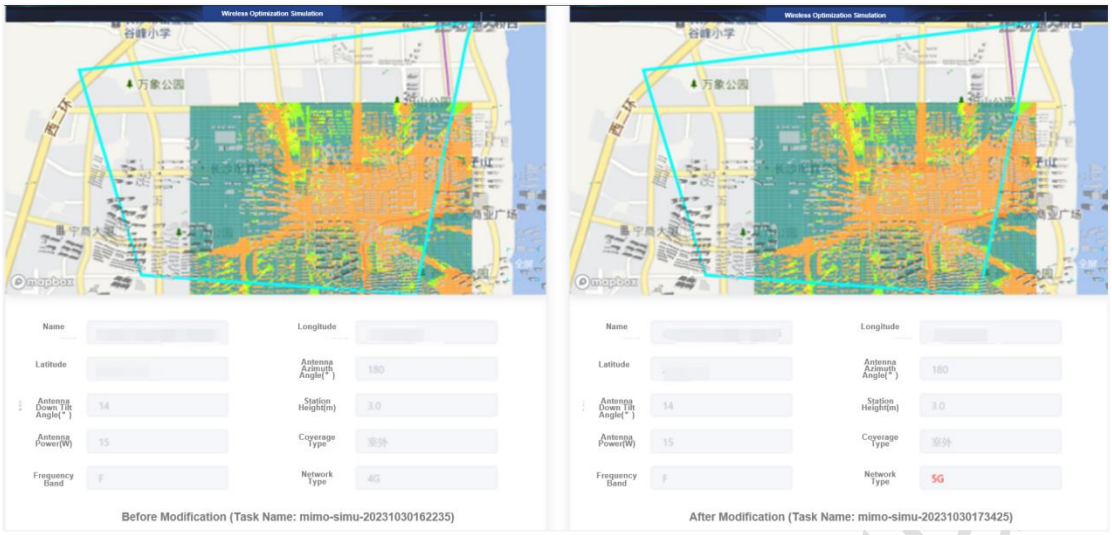

Figure 5-5 Wireless optimization simulation

5.5 Data Management

AISWare Digital Gemini is equipped with docking capabilities for service types such as databases, HTTP/HTTPS interfaces, Kafka messages, and video streaming. It can support online registration, testing, and data management for quick access to data from multiple sources.

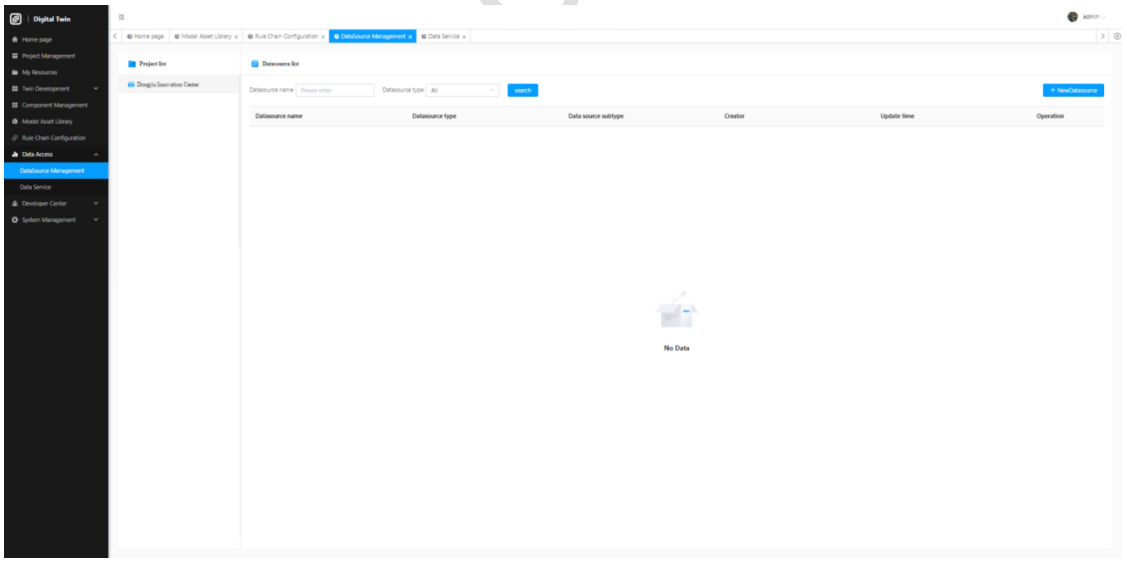

Figure 5-6 Data management

5.6 Model Asset Library

The model asset library can accumulate digital assets including spatial model assets and monolithic model assets developed during the construction of digital

twin applications. The scenario builder can drag-and-drop load spatial models to layout the twin application and the twin designer can select corresponding monolithic models from the library for binding to improve model utilization.

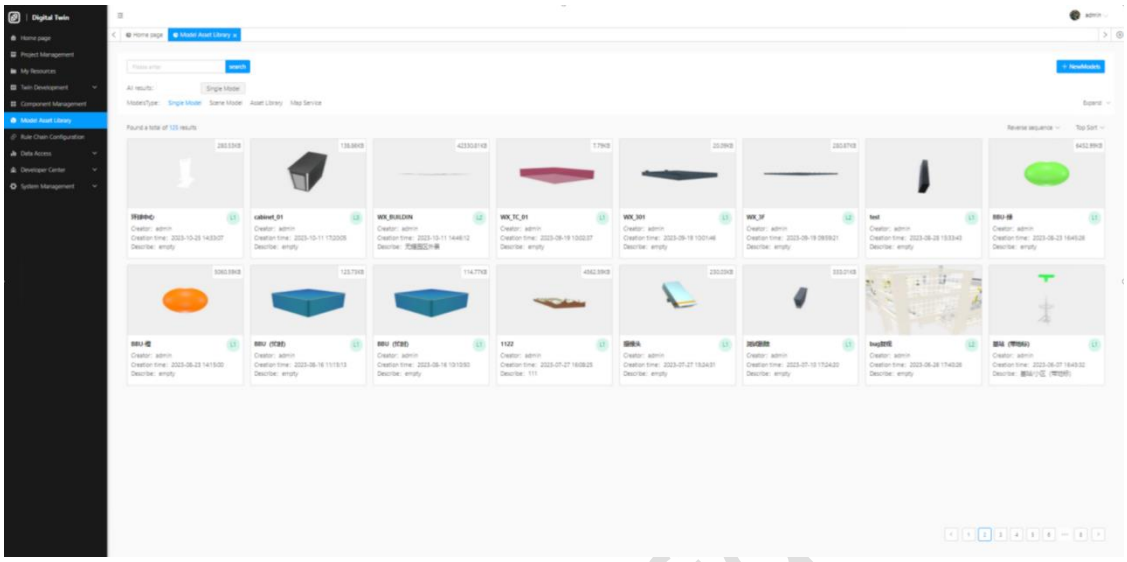

Figure 5-7 Model asset library

5.7 Component Manager

Component manager provides rich components for users to DIY service components based on real demands.

The general components consist of charts, functions, and filters. Chart components enable graphical visualization of data in the digital twin application; functional components allow function jumping between multiple scenarios, layers, and elements; filter components are applied to light, light source, and weather settings, and with third-party data (e.g. weather), the real world can be accurately reproduced.

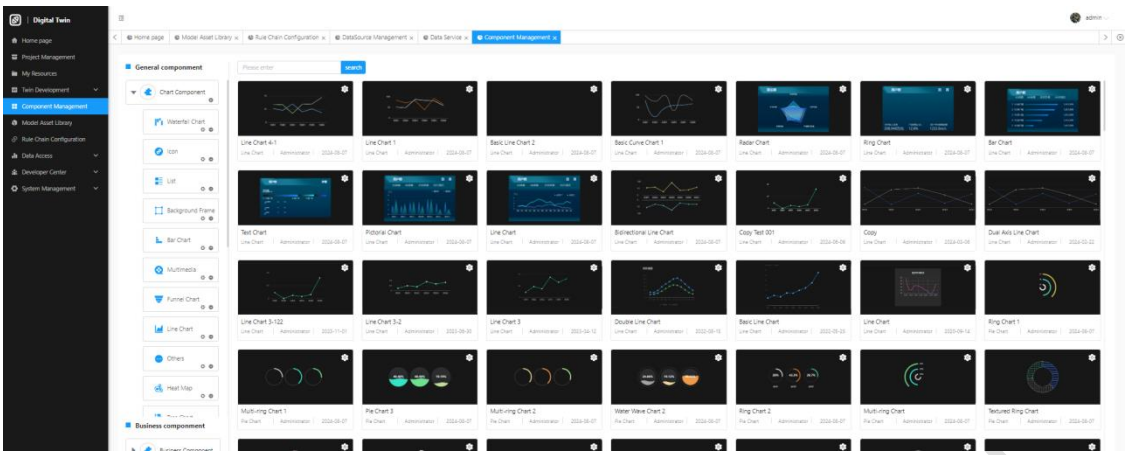

Figure 5-8 Component manager

Service components are customized during twin development, such as DTN service load DIY. Through style and script, this kind of component development can demonstrate service data.

5.8 Secondary Development SDK

Secondary development SDK works with all main front-end frameworks. It includes a cloud rendering engine with WebGL. It leverages interactive APIs for users to create, show or hide, and move models and labels, as well as to set up materials, and events. This provides a set of API for basic 3D applications.

The SDK instance center supports real-time preview of 3D visual scenarios and effects after running the code. And detailed API documents are provided to help users understand and use available APIs.

6 Featured Functions

This chapter mainly describes the featured functions of AISWare Digital Gemini.

6.1 Rule Chain Governance

Rule chain governance correlates twin instances utilized in data service and twin scenarios and associates fields of the data services with twin attributes based on the third-party data obtained from the service to update the data of the twin instances. Corresponding running rules can be configured per twin node, and during scenario preview, the twin instance data is computed with the running rules to trigger the corresponding twin events.

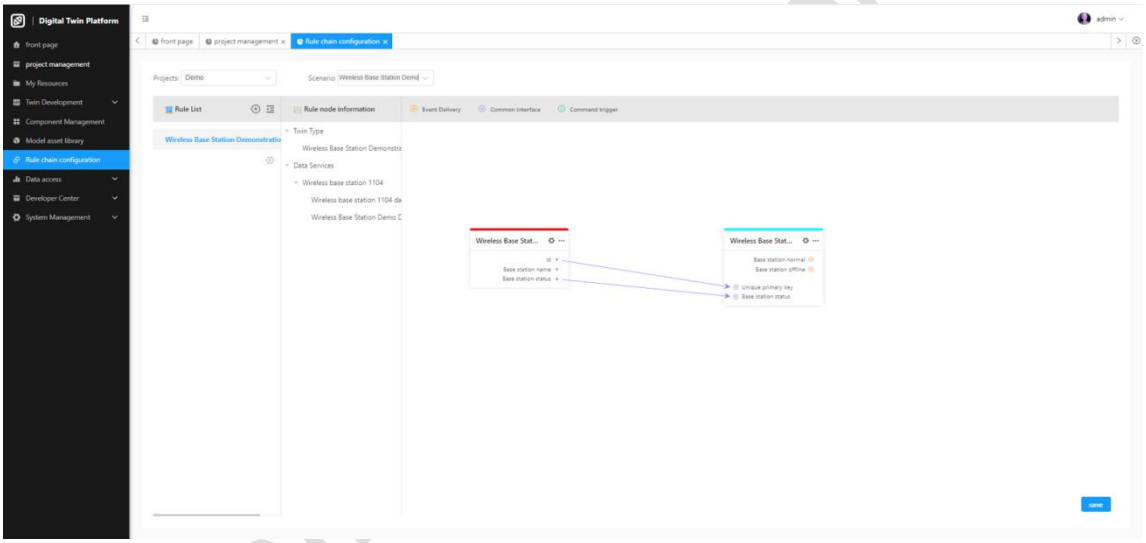

Figure 6-1 Rule chain governance

6.2 High-Definition Cloud Rendering Engine

Visualization capabilities are graded from different angles as well as different structural accuracy and texture requirements based on physical renderings such as game engine PBR and lighting effects such as IBL. The physical attributes in reality, such as water, ice, fog, light, lamplight, shadow, etc., are simulated efficiently. The scenarios can be much closer to reality by following the changes in time, season, weather, and solar position.

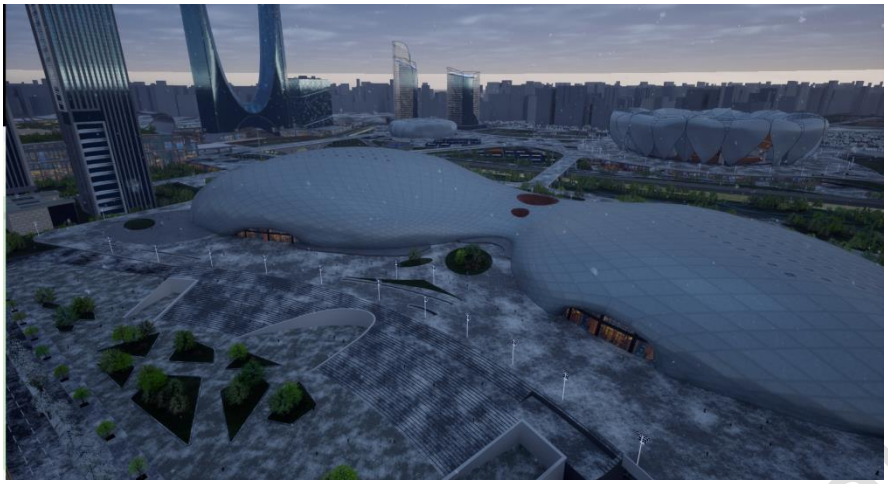

Figure 6-2 Smart Park

Figure 6-3 High-fidelity cloud rendering engine

6.3 CIM Data Fabric

Based on the concept of data virtualization + data fabric, the data virtualization technology can orchestrate data through low-code without extractions, and access data by simulation algorithm processing, so as to build a shared database for city infrastructure to link data silos. It can support spatial expression and meet computation demands through multi-party collaboration.

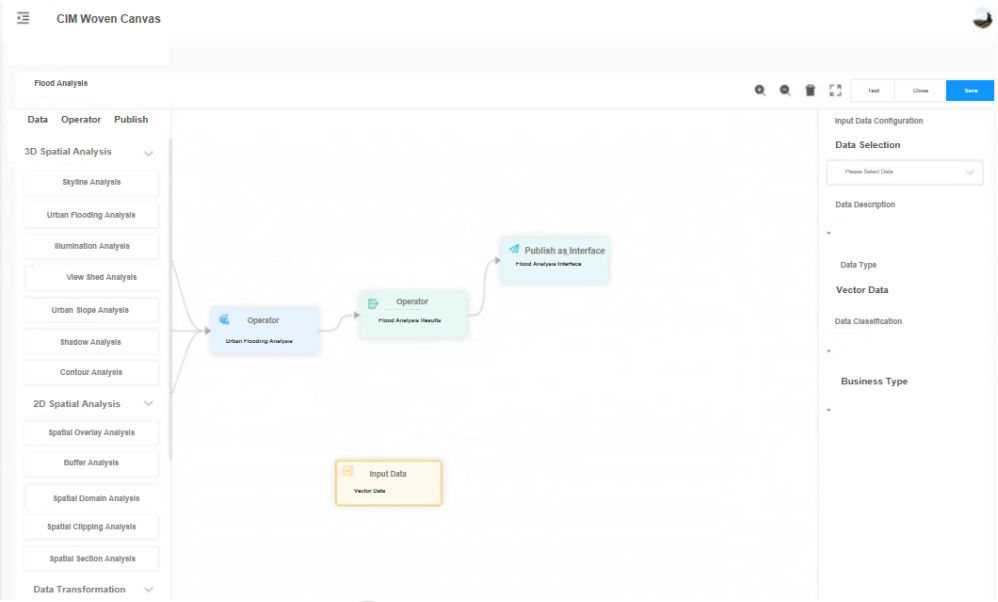

Figure 6-4 CIM fabric canvas

6.4 NeRF 3D Reconstruction

Traditional manual modeling of digital twins is expensive and slow with low visualization. As technology advances, modeling methods have changed to photogrammetry, then to parametric, and now to Neural Radiance Fields (NeRF). Comparing by five main factors, efficiency, labor, cost, fidelity, and easy-to-use, NeRF excels over manual modeling in all aspects and is also easier to use and cheaper than photogrammetry.

7 Unique Advantages

7.1 Design of Digital Twins

The physical object is modeled in multi-dimensions from a digital twin perspective and through toolkit UI. It unifies the physical model, relationship rules, and operation data to display the real world through intuitive and holistic virtual demonstration. The twin enables end-to-end operation monitoring, real-time simulated interaction driven by data, and AI-based diagnosis and decision-making.

7.2 Modular Design

With the idea of modular design, Digital Gemini can integrate related tools and modularize the standard code for drag-and-drop application development through the graphical UI. It enables developers to concentrate on key business logic with lower costs and higher efficiency.

7.3 Sustainable Digital Assets

Following the path of digital asset management of twins, Digital Gemini provides a fresh Smart City experience with accumulated assets with transactable models. It transforms the traditional development of digital twins of cities from scratch and improves the modeling efficiency at lower cost.

7.4 Domain Simulation

Digital Gemini provides visual simulation of radio network coverage and electromagnetic signal irradiation to empower decision-making on network planning and optimization.

It can simulate and visualize physical conditions, such as vehicle movement, mechanical skeleton functioning, and pipeline operation, and support the twin simulation in industrial scenarios.

7.5 Dual-Engine Hybrid Rendering

Digital Gemini concurrently works with the WebGL engine at the front-end and a game engine at the back-end for hybrid rendering at the front-end by cloud rendering to satisfy customer needs on rendering of an operating environment and complex visualization. It allows establishing a cloud rendering twin scenario in the form of low/zero code and configures the camera viewpoint, weather, and time, as well as control of the twin rendering on the cloud, such as creation, visualization, movement, scaling, and rotation of twins.

The digital twin scenarios allow interactive APIs for flexible developments among partners through the WebGL engine and APIs of cloud rendering engines in Digital Gemini, allowing SDK engineers to customize according to the APIs.

8 Scenario Solutions

AsiaInfo is enriching our solutions based on AISWare Digital Gemini across industries, with several successful scenario-based use cases with online user experience: Smart Park, Smart Exhibition Hall, Smart Buildings, Digital Village, Smart Community, Smart Mine, and Smart IDC, as well as the Digital Twin Network tailored for telcos.

Figure 8-1 Scenario Solutions of AISWare Digital Gemini

8.1 Smart Building

8.1.1 Application Scenarios for Smart Building

By deploying Digital Gemini, an integrated platform of Smart Building connects management systems, staff, and facilities, as well as IoT sensors, and enables real-time monitoring and analysis of key information for centralized surveillance, energy consumption control, and O&M. It links all systems for cooperation at lower cost and upgrades the security, efficiency, and user experience of buildings through intelligent technologies.

8.1.2 Service Requirements for Smart Building

- **Office management**: To manage employee information, including work seats, meeting room reservations, and office equipment, such as printers.

- **Energy consumption control**: To monitor water and electricity consumption, including energy usage for air conditioners, lighting, elevators, and other utilities.
- **Security surveillance**: To manage security information, including surveillance cameras, entrance guards, and fire emergency equipment with fire alarms.
- **Parking perception**: To manage parking garages with real-time monitoring of parking space availability and 3D vehicle search.

8.1.3 Solution for Smart Building

The solution for Smart Building consists of several parts:

- **Panoramic visualization**: Model the building in a detailed and comprehensive view, including its structure, floors, parking space, rooms, and pipelines
- **IoT perception**: Integrate with the building's IoT platform, various devices, and systems for real-time monitoring.
- **Data analysis**: Analyze and process collected data for management decision-making, including data mining and trend analysis.
- **Remote control**: Dock to IoT platform for remote control on various devices and systems within the building, including remote alerts for device anomalies and one-click operations for power switches.

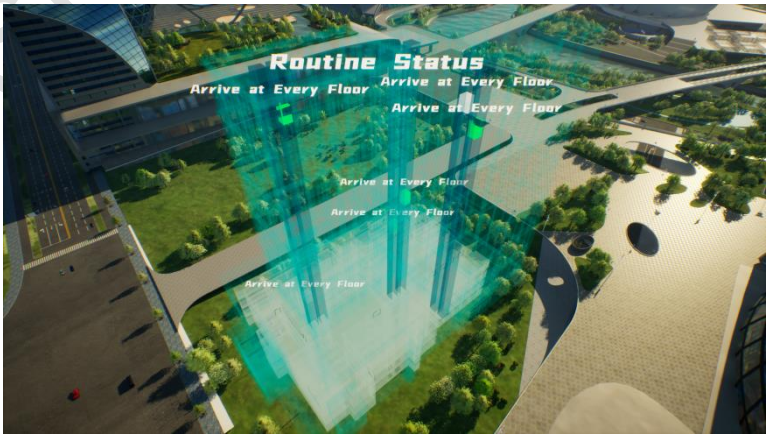

Figure 8-2 Smart Building

8.2 Smart Park

8.2.1 Application Scenarios for Smart Park

Digital Gemini is featured in ultra-visualization, ubiquitous intelligence, agile with efficiency, and holographic vividness. Based on such features, Smart Park is developed with an operation methodology of full lifecycle management and IT support in several scenarios, such as security surveillance and energy consumption control. It satisfies the demands of new Parks in intelligent management and investments and meets the requirements of existing Parks in establishing a digital platform for centralized service system management to serve enterprises and customers with better experience, thus reinventing the income structure.

8.2.2 Service Requirements for Smart Park

- **Security surveillance**: Protect the security of both personnel and property in the Park, including video surveillance, intrusion detection, entrance guard, fire alarms, and so on.
- **Energy control**: Monitor and control energy consumption for better utilization with lower cost, including electricity, water, gas, and other energy sources.
- **Facility management**: Supervise the environment in higher quality, including air quality, noise, water quality, and so on.
- **Data analysis**: Analyze and process various data for higher management efficiency and better decision-making capability.

Figure 8-3 Smart Park

8.2.3 Solution for Smart Park

The solution for Smart Park consists of several parts:

- Based on data storage and edge-cloud collaboration, the platform has established a unified data standards and specification system to break data silos.
- By integrating IoT and the Internet, the platform expands channels for data collection, gains real-time insights into park conditions, and enhances information-based operations.
- With GIS + BIM + digital twin, the platform has unified the Park planning and efficiently managed facilities with 3D visual modeling and GPS technology.
- The platform provides comprehensive terminal services and assists decision-making for resident enterprises, employees, and other visitors.

8.3 Digital Village

8.3.1 Application Scenarios for Digital Village

AISWare Digital Gemini for Digital Village deeply integrates technologies such as IoT, big data, blockchain, AI, and 5G, integrating data from various service systems. It serves as a comprehensive operations platform to address

application challenges in rural governance, ecological/agricultural monitoring, resource management, and party governance. By embedding digital technologies into every service process, it empowers rural revitalization.

8.3.2 Service Requirements for Digital Village

- **Agriculture production**: Monitor and control the agricultural environments remotely with high technologies for effective productivity, including pest monitoring, soil moisture levels, and environmental conditions.
- **Rural governance**: Digital management of population, land and social security.
- **Rural E-commerce**: Dock to sales channels, analyze the e-commerce data in real-time, and support decision-making.

8.3.3 Solution for Digital Village

With AISWare Digital Gemini as the technical base, a *Digital Village Graph* is formed with technologies such as GIS, BIM, innovative surveying and mapping, as well as edge AI. It incorporates the systems of administration, personnel, and equipment management, and collects existing data from the Village via a variety of sensors, data collection equipment, and business systems. Within this *Graph*, it is straighter to govern the village in the visual demo from multi-dimensions such as situation overview, ecological environment, Smart Agriculture, industry and resource, and comprehensive social management. By utilizing AsiaInfo's 3D digital village with immersive reality and virtual-real interaction, the village can be governed dynamically in layout/adjustment, operational management, and new industry development through such a visual toolkit.

8.4 Digital Twin Network

8.4.1 Application Scenarios for Digital Twin Network

Digital Twin Network in 5G network services exhibit the following three characteristics:

- Low-cost experimentation
- Intelligent prediction
- Highly efficient innovation and delivery

In the future, the combination of AI and digital twins with the massive data from telcos can provide services such as traffic forecasting, new business trial predictions, configuration pre-checks, and network pre-planning.

8.4.2 Service Requirements for Digital Twin Network

- New application scenarios with new challenges: With the diversified scenarios and performance needs, the network needs to provide different services for different terminals, so the on-demand networking solution emerges as an inevitable trend.
- Inefficient traditional network O&M with a high cost: There are diversified network architectures, complex network topologies, isolated and dispersed data, and weak automation in O&M processes. The future intelligent network will be characterized by omni-perception, comprehensive analysis, integrated control, and intelligent O&M.

8.4.3 Solution for Digital Twin Network

The solution for Digital Twin Network (hereinafter as the “DTN”) consists of several parts:

- **Twin Design Center**: Define the attributes, geometric model, event-command interaction, and visualization of the DTN, define and design the specification of the physical entities of the communication network, and provide the northbound service interface to support the DTN scenario construction.
- **Scenario Construction Platform**: Construct typical communication network application scenarios and define related service rules. With multiple running environments for DTN, it supports data sharing and multi-threading between DTN.

- **Application Scenarios Instances**: Visualize the communication network topology geographically to monitor physical network operation status, restore the optical access to the optical network ring to identify potential risks, and diagnose problems with simulated scenarios.

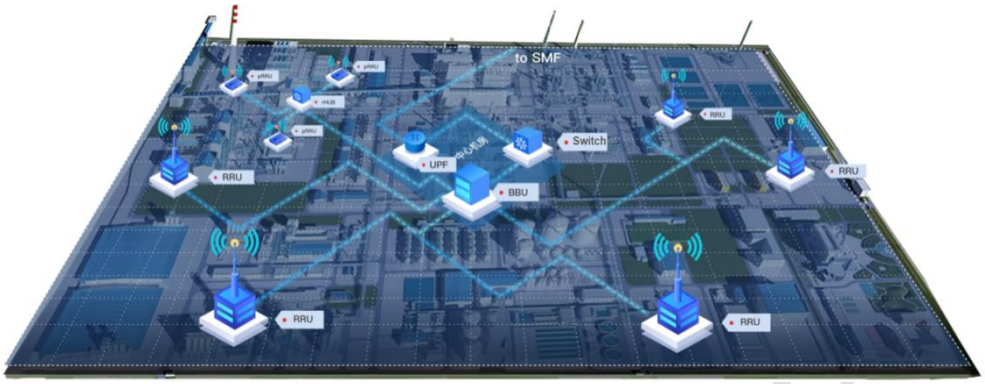

Figure 8-4 End-to-end business simulation of network slicing

8.5 Smart Community

8.5.1 Application Scenarios for Smart Community

Smart Community aims to provide citizens with a one-stop innovative solution for full lifecycle services, social security, and public management. By connecting human beings, objects, and information within the community, it enhances the perception, analysis, decision-making, and early warning of different units with reduced costs but higher quality.

8.5.2 Service Requirements for Smart Community

- **Security surveillance**: To develop a security monitoring system to protect residents and property, including video surveillance, entrance guards, and smart security devices.
- **Environment governance**: To establish an intelligent environment monitoring and governance system to enhance livelihood, including air quality monitoring, waste classification, and plant maintenance.
- **Energy control**: To establish an intelligent energy consumption monitoring and control system for higher energy utilization efficiency

with lower costs, including electricity consumption monitoring, energy consumption optimization, and renewable energy utilization.

- **Citizen services**: To provide intelligent citizen services in high efficiency, such as Smart Parking, Smart Parcel Lockers, and Smart Property Management.
- **Communication and interaction**: To establish an intelligent communication and interaction platform, including community Apps, smart noticeboards, and smart forums.
- **Management and operation**: To establish an intelligent community management system with better management performance, including property management, equipment maintenance, and data analysis.

8.5.3 Solution for Smart Community

The solution for Smart Community consists of several parts:

- **Situation overview**: Build a geospatial visualization system for 3D communities/parks to dynamically display the internal operations in real-time.
- **Grid presentation**: Provide 3D visualization of infrastructure, network access, resource distribution, and user behavior and interactions.
- **Smart Security**: Connect IoT for real-time data perception and form a closed-loop response model for comprehensive community protection.
- **Emergency response**: Develop a decision-making engine for major governance issues, and assess errors, alarm risks, and emergency response with AI.

8.6 Smart Stadium

8.6.1 Application Scenarios for Smart Stadium

Smart Stadium utilizes indoor and outdoor 3D spatial modeling and integrates sensing data from the IoT, video collection, and real-time positioning to provide the operation team of stadiums and events with efficient digital tools for

thematic events. It supports services for crowd monitoring, fire emergency drills, emergency evacuation practice, energy consumption monitoring, customer preference detection, and precise marketing.

8.6.2 Service Requirements for Smart Stadium

With 5G and IoT as the touchpoints, it focuses on the event/exhibition economy, and creates a digital twin of the city for crowd flow, fire protection, emergency response, and energy consumption monitoring; it also provides customers with intelligent and value-added services by identifying, connecting, pushing, and matching specific people in specific space.

8.6.3 Solution for Smart Stadium

The solution for Smart Exhibition Hall consists of several parts:

- Autonomous and efficient scenario/application design: Twin the exhibition halls and stadiums for continuous operation with one-time investment; customize the autonomous indoor design with various theme templates to serve exhibitors and consumers; integrate IoT, AI all-in-one machine and other capabilities for simulating, interacting, deducting and predicting based on real-time data.
- Sustainable digital twin assets: develop digital twins for stadium-type buildings and internal sensors, and evolve them into enterprise assets for effective and autonomous delivery capabilities with reusable twins and configurable twinning scenarios, so as to promote market extension capability in the professional field, refined and scalable industries with precise perceptions and lower costs.

The core functions of the Smart Exhibition Hall:

- **Operation Center**: Twin the exhibition hall to monitor and analyze comprehensive operation indicators such as traffic, visitor flow, energy consumption, and security within and around the stadium.
- **Emergency response**: Establish emergency response plans and drills for firefighting and network errors, and enable pre-event simulations,

real-time resolution during the emergency, and human-machine reviews post-event.

- **Network assurance**: Monitor the network status of the exhibition hall, with aggregated analysis of traffic volume, service quality, and alarms. Wireless signal coverage is visually presented using heatmaps.
- **Online Booth**: Create a 1:1 booth representation, integrating with monitoring videos for real-time on-site participation detection. Visitors can immerse themselves in an interactive online experience cockpit.

Figure 8-5 Smart Exhibition Hall

8.7 Smart Mine

8.7.1 Application Scenarios for Smart Mine

In order to optimize the labor environment with high security, the mining industry in China has undergone mechanization towards automation in the past decades. With the development of 5G, AI, cloud computing, big data, digital twins, and other emerging technologies, the transformation to digitalization and intelligence has become an inevitable step for high-quality development.

8.7.2 Service Requirements for Smart Mining

- **Secured operations**: Some tasks can be operated through remote monitoring for reduced production risks.

- **Visualized management**: With more control data collected from geological exploration to good construction, excavation, and mining, the spatial structure and attributes of coal beds need to be transformed from invisible to partially visible, and approaching unlimited transparency to total transparency.
- **Lower cost and higher efficiency**: To reduce manpower and improve efficiency in the mining stage, to reduce unmanned operation in the comprehensive mining stage, and to realize unattended duty and remote monitoring of fixed positions in underground and open pit coal mines.
- **Multi-source data integration**: Scattered data from various business systems and lack of a linkage for alarms to stop the analysis of mine safety status and operation indicators comprehensively, bringing inconvenience to supervision.

8.7.3 Solution for Smart Mine

Through a space-time information model, Smart Mine solution has formed a digital twin for mine with simulations on mining, excavating, transporting, and communicating. It unifies monitoring, controlling, and management based on 5G + IoT to interconnect data and create virtual-real interactions.

Digital Twin for mines can map the physical environment accurately, interact intelligently, and integrate the real and virtual reality, so as to manage O&M in a refined approach.

- **Situation supervision**: Integrate and converge real-time data such as mine resources, production, sales and inventory, production status, coal mining, and excavation; with real-time production monitoring video, a 3D panorama can demonstrate the mining situation for real-time control of the production and operation.
- **Risk alarming**: Digital twins for real-time monitoring and alarming of mine roadways, including ventilation routes, transportation routes, escape routes, and so on, and support dynamic display of the current status.

- **Production monitoring**: Real-time situation monitoring of the environment, staff, facility O&M, production progress, and other information, real-time alarms on various types of abnormal situations.
- **Equipment control**: Unified control of mining equipment, and support on real-time equipment status check of online/offline, operation/failure, and so on, then to maintain the equipment in failure.

Figure 8-6 Smart Mine

8.8 Smart Water

8.8.1 Application Scenarios for Smart Water

The water industry, encompassing water resource recycling, pipeline construction, maintenance, and equipment production, is a foundational sector for both economic and social development while ensuring public well-being through its dual role in public utility and environmental protection. As urbanization accelerates and favorable policies are implemented, the demand for refined management within the industry continues to grow. Consequently, the shift toward smart water management based on industrial internet technology has become essential. Among the key measures for advancing high-quality development, the construction of Digital Twin water projects is pivotal in realizing the strategic directives of governments.

8.8.2 Service Requirements for Smart Water

The water industry faces challenges such as fragmented information systems and a lack of data interoperability between subsystems, leading to difficulties in business integration, low operational efficiency, high management costs, and limited innovation. A unified digital twin platform can provide integrated information and intelligent services with low costs and higher efficiency, and effectively break information silos.

Data from the water industry lacks completeness, accuracy, and standards, while the level of intelligent applications remains low. Advanced technologies such as image recognition, AI, mixed reality, and full-process control should be used to integrate safety management into digital twin systems, enabling real-time safety inspections, traceability, and emergency response for improved management.

8.8.3 Solution for Smart Water

AsiaInfo's Smart Water solution with Digital Gemini utilizes a shared model library and a digital twin engine based on data governance to map, simulate, and predict. Centered on water security, the solution supports applications like safety monitoring, operation management, sewage overflow detection, and energy analysis, enabling comprehensive intelligent data monitoring and control across the whole water system.

By modeling the real water sources, water treatment plants, water usage zones, and sewage treatment facilities in 3D panoramas, it integrates key indicators and visualizes water monitoring data by leveraging 5G and IoT technology to enable real-time monitoring and control of the whole management chain. The solution also employs low-code construction and orchestration techniques to model the digital twin of water affairs, boosting management efficiency at low cost.

9 Use Cases

AISWare Digital Gemini has been applied in Smart City and Digital Twin Network with several use cases. Based on the universal digital twin base and scenario-based application theme, it empowers customers with simplified projects and O&M.

9.1 Smart Park

This section describes a typical use case of Smart Park.

9.1.1 Customer Requirements

The customer is looking forward to establishing a comprehensive operation system for intelligence transformation to integrate and analyze data from various sources, including people, vehicles, objects, and events. The innovative Smart Park Platform needs to interface with existing subsystems to connect data and systems, fully leveraging the capabilities of IoT and big data to break information silos and transform the Park's information system into a sustainable ecosystem.

9.1.2 Solutions and Effects

This project constructs a Smart Park Platform (hereinafter as the “Platform”) based on Digital Gemini for real-time monitoring, analysis, and optimization of the operations in the real world. The Platform applies a game engine to render the Park in high precision and incorporates weather components to simulate real-world time, seasons, and weather, making the twin of the Park more realistic and immersive. Real-time cloud rendering supports smooth loading across multi-terminals with lower hardware requirements for end devices. The Platform includes the following application scenarios:

- **Comprehensive situation**: Demonstrate the overall operational status of the Park in a 3D visualization by integrating user resource systems and other business information. The management staff can control the overall status in a Dashboard, including economic indicators, industry distribution, enterprise introduction, and talent requirements.

- **Smart Operation**: An all-round platform with investment promotion and Smart Property to show the investment situation and recent economic situation in the Park, with sub-functions such as investment promotion services, complaints and advice, resident enterprises, key enterprises, and Park services.
- **Smart Assets**: Overall statistics show the situation of equipment alarms and processing, including an alarm overview, fault alarms count and historical statistics, the number of equipment assets, trends, Top equipment with faults, situation of toilets/well covers/trash containers.
- **Smart Security**: Comprehensive monitoring of personnel, vehicles, construction sites, and security events in the park, including real-time video, entry/exit statistics, parking usage, security analysis, and fire monitoring.

After implementation, the project has achieved:

- **Equipment alarms** have improved fault resolution efficiency by 50% and reduced fault occurrence rate by 20%.
- **Resource utilization statistics** are able to check the real-time utilization status of resources directly, with a 10% increase in resource utilization rate.
- **Enterprise/industry analysis** can provide data support for industrial investment and ecosystem development through data analysis.
- **Property service** integrates property data and enhances management efficiency by visualizing work orders, reducing manpower for operations and maintenance.
- **Emergency response** enhances response efficiency and reduces emergency rates by pre-analysis and alarms.

9.2 Network Assurance for the Asian Games

This section describes a typical use case of network assurance for the Asian Games by Digital Twin Network solution.

9.2.1 Customer Requirements

The 19th Asian Games Hangzhou was held with Chinese style specializing in features of Hangzhou, and co-built with a shared principle of “Green, Intelligent, Economical, and Civilized”, advancing with high-quality preparations and operational support.

With difficulties in numerous stadiums, large crowd flows, and long event cycles, this use case is designed with Digital Gemini to ensure secured communication through wired and wireless networks in key Games areas, guarantee high-quality network operation, and provide seamless network access and high-speed 5G for attendees, relevant staff, and IoT devices in stadiums.

9.2.2 Solutions and Effects

AsiaInfo has deployed AISWare Digital Gemini as the technical base for the Digital Twin Network Platform to guarantee the Asia Game.

- **Real-time monitoring**: Develop and design the spatial models and object models of the stadiums and networking through the digital twin. The spatial twin based on the CIM model integrates and governs multi-source data for a unified service through GIS, BIM, surveying/scanning, and geometric modeling. The object twin based on the IoT platform can perceive and reflect in real time and interact dynamically between the virtual and the real.
- **Interactive visualization**: Holographic visualization by Digital Twin Network of real-time status, various network elements, topology information, and the dynamic process of the network lifecycle, such as real-time status, service volume, service load, and fault information. With a friendly and immersive interactive UI, it provides users with a clear sense of the network status and more efficiently mines valuable information mining.

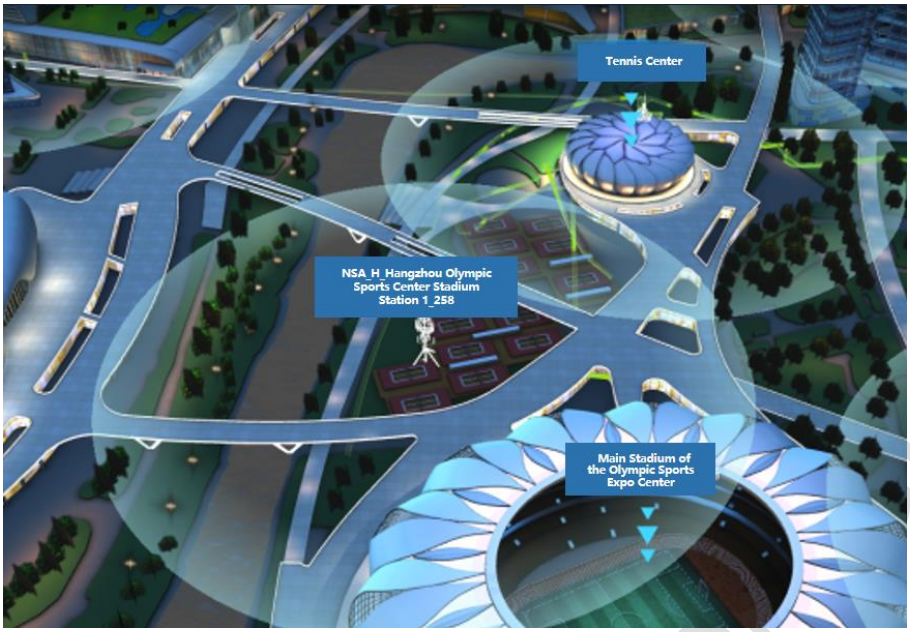

Figure 9-1 Network assurance for the Asian Games

- **Service forecasting**: establish a data warehouse by collecting and storing various configuration and operation data of network entities through the southbound interface, and based on the network and business-related data in warehouse, use AI algorithms such as deep learning and machine learning to model scenarios such as service prediction, network performance prediction, coverage optimization, capacity planning, and station planning; by continuous data warehousing and training data updated to the model, the model will iterate to form an adaptive AI model mechanism for more accurate prediction. With the evolution of the digital twin system, more knowledge models and external AI capabilities can be accessed for the more correct prediction of networks.

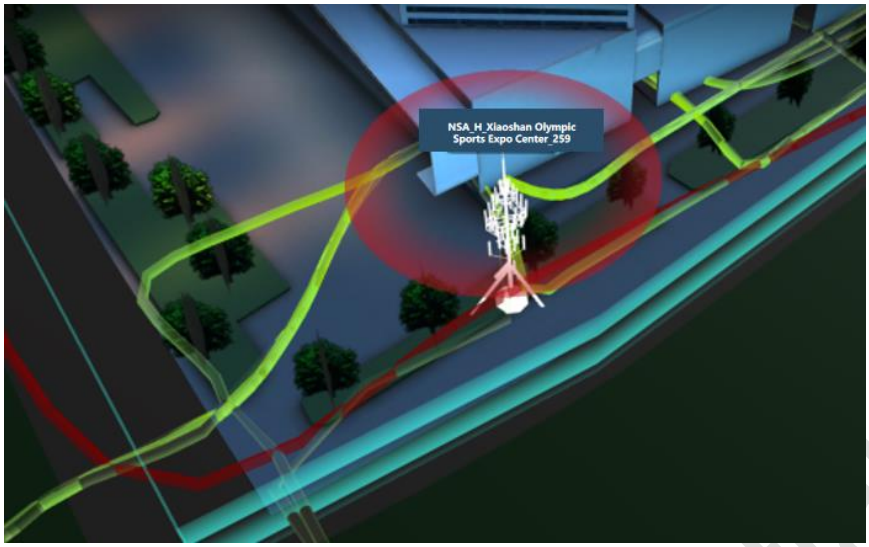

Figure 9-2 Network assurance for the Asian Games - Traffic Forecasting

- **Emergency response**: Visualize the information of various network emergency elements by VR and GIS, such as the cable fault location, the troubleshooting personnel, the repair engineering team, and the arrangement of emergency vehicles. It provides the emergency response departments with 3D response plan for quick decision-making in high efficiency.

The Platform optimizes and simulates network solutions, reducing deployment risks and costs while improving efficiency. Real-time monitoring and prediction enhance network security and predictive maintenance accuracy. Built-in emergency protocols improve fault resolution and resource allocation. After implementation, network failure rates dropped by 90%, and emergency response efficiency increased by 60%.

9.3 Smart Water

This section describes a typical use case of Smart Water.

9.3.1 Customer Requirements

The customer faced the following business pain points:

- **Large scale and difficult management**: Large management area with numerous monitoring sites and lack of holistic management.

- **Scattered systems at high costs:** Videos, sensors, and other data are scattered in different systems with a high manual cost for checking.
- **Massive data with application challenges**: High data dimensionality with massive basic data is difficult to combine with business scenarios.

The project aims to combine the new-generation ICT, IoT sensors, and digital twin to build a Smart Water Platform (hereinafter as the “Platform”) that integrates the functions of monitoring, O&M, governance, and decision-making. The Platform can improve the level of information integration and sharing, as well as business intelligence to drive the modernization of the water governance system and capabilities.

9.3.2 Solutions and Effects

The construction plan for the Platform is as follows:

- **Integrated IoT management**: Visualize the whole chain by collecting monitoring data through front-end equipment, intelligent alarming/analysis by big data, excessive alarming, remote valve control, and realize the integrated control from the water source to the water plant, to the residents' water consumption, and the wastewater treatment plant.
- **All-Pipe-in-One-Map**: Visualize 3D pipeline network SCADA data on a GIS map to present the overall distribution and direction of the network and manage water supply, drainage, and sewage pipeline information; the thematic layer can be used for specialized management of the water supply pipeline network, personnel maintenance/scheduling, pipeline network diseases, sewage treatment, monitoring equipment, and other business scenarios.
- **Real-time process simulation**: Comprehensively manage the information of various facilities and equipment and the records of maintenance. Simultaneously, it can map the whole process by drag-and-drop and access the real-time data of the equipment. It's convenient for managers to master the important equipment assets and process flow and visualize data in the water plant-wide.

- All-round water management visualization: Visualize and analyze the energy consumption of equipment, workshop, and plant with digital twin with dual-carbon policy.

After implementation, the project has achieved:

The Platform monitors the whole water service process, providing real-time data integration and analysis regarding water supply and drainage. It enables intelligent decision-making in areas such as water balance scheduling and quality monitoring. After implementation, operational efficiency for personnel scheduling improved by 16%, and workflows across systems were optimized.

Figure 9-3 Smart Water

10 Certificates and Awards

AISWare Digital Gemini has received certificates from CAICT on the digital twin and low-code platform. It has also been awarded the TMF Catalyst Project for three consecutive years and has participated in the compilation of multiple international and domestic standards related to digital twins.

Figure 10-1 Certificates for AISWare Digital Gemini

Figure 10-2 Awards for AISWare Digital Gemini

11 Contact Us

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