White Paper for

AISWare Digital Gemini V4.5

AISWare Digital Gemini is a set of creative design and modeling tools for users to design, build, and maintain digital twin applications. By bridging the real and virtual worlds, it paves towards the metaverse era.

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Leading Artificial Intelligence Enterprise in China

Leading Enterprise of Advanced Smart City

Outstanding Catalyst Contribution to TM Forum Assets

The Best Innovation and Future Techco of TM Forum

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The Most Influential Enterprise in China Software Industry

Top 100 China Software Business Revenue List for consecutive years

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1 Executive Summary

AISWare Digital Gemini, serving as an innovative digital twin platform, focuses on Spatial Intelligence with an AI-Native architecture, and is designed to empower vertical industries through modular agent toolkits. By standardizing workflows, it enhances model generation, scenario visualization, and spatial computing, forming an all-in-one framework for data, visualization, and computation.

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, interdependent equipment systems.

Abbreviation and Term	Full Name	Explanation
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 consumer actions on a website.

Abbreviation and Term	Full Name	Explanation
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
DSLR	Digital Single-Lens Reflex Camera	A digital single-lens reflex camera is a digital camera that combines the optics and mechanisms of a single-lens reflex camera with a solid-state image sensor and digitally records the images from the sensor.
LiDAR	Light Detection And Ranging	A light detection and ranging is a method for determining ranges by targeting an object or a surface with a laser and measuring the time for the reflected light to return to the receiver.
TA	Twin Agent	A twin agent is a task-specific module that powers core functions like modeling, simulation, or visualization in a digital twin system.
3DGS	3D Gaussian Splatting	A 3D gaussian splatting is a real-time rendering and 3D reconstruction method that represents scenes using a set of 3D Gaussians, enabling fast and photorealistic visualization

Abbreviation and Term	Full Name	Explanation
		from image-based inputs.
AR	Augmented Reality	Augmented reality is a technology that overlays real-time 3D-rendered computer graphics onto a portion of the real world through a display, such as a handheld device or head-mounted display.
VR	Virtual Reality	Virtual reality is a simulated experience that employs 3D near-eye displays and pose tracking to give the user an immersive feel of a virtual world.
AAP	Augmented Analysis Platform	Augmented analysis platform is an AI-powered platform that supports data processing, spatial analysis, simulation, and decision-making. It provides the foundation for intelligent agents in digital twin systems.
MCP	Model Control Protocol	Model control protocol is a protocol for managing and interacting with 3D models in digital twin environments, including actions like loading, movement, visibility, and behavior control.
GUI	Graphical User Interface	A graphical user interface, is a form of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation.
CUI	Character User Interface	Character user interface is a text-based interface that allows users to interact with a system by entering

Abbreviation and Term	Full Name	Explanation
		commands through a keyboard, typically within a command-line environment.
WebGL	Web Graphics Library	Web graphics library is a JavaScript API for rendering interactive 2D and 3D graphics within any compatible web browser without the use of plug-ins.
UAV	Unmanned Aerial Vehicle	An unmanned aerial vehicle commonly known as a drone, is an aircraft with no human pilot, crew, or passengers on board, but rather is controlled remotely or is autonomous.
NPC	Non-Player Character	A non-player character is a game character not controlled by the player. The term comes from tabletop role-playing games, where such characters are controlled by the game master instead of players.
EV	Electric Vehicle	An electric vehicle is a motor vehicle whose propulsion is powered fully or mostly by electricity.
HVAC	Heating, Ventilation, and Air Conditioning	Heating, ventilation, and air conditioning is the use of various technologies to control the temperature, humidity, and purity of the air in an enclosed space.

3 Product Overview

AISWare Digital Gemini (hereinafter as “Digital Gemini” or the “Platform”) is a versatile modeling 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 provides a digital twin platform for smart cities by integrating GIS, IoT, and cloud rendering, supporting low-code scenario modeling and visualized design of models, data, charts, geometry, functions, and control channels for WYSIWYG twin design.

Driven by AI agents, the Platform combines spatial intelligence and simulation for standard workflows. It supports scenario innovation with professional simulation models and 3DGS reconstruction through dual rendering engines to deliver end-to-end products and engineering services.

It delivers digital twin solutions and simulation capabilities for verticals such as Smart Transport, Smart Mining, and Smart Water Service.

- Evolve from real business and user needs with large-scale software delivery
- Integrate significant software development capabilities, while externally connecting the full industry chain
- Emphasize general capabilities, lower the delivery cost for vertical business applications, respond among departments, and lead the construction models among industries

4 Product Portfolio

The functional architecture of AISWare Digital Gemini is shown below:

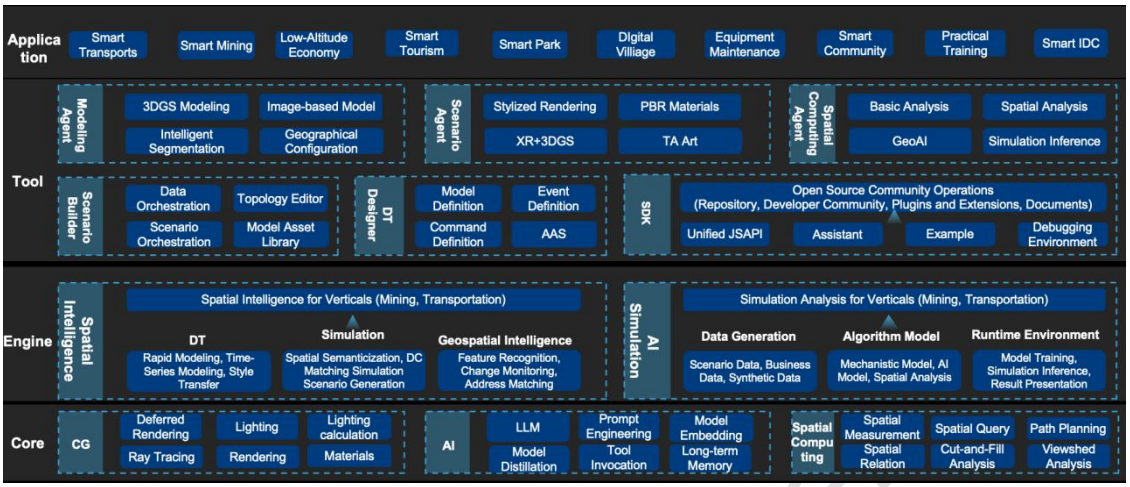

Figure 4-1 Functional architecture of AISWare Digital Gemini

- **Twining applications:** It provides industry model libraries, domain-specific Q&A, AI tools, and solution templates to enhance developer experience
- **Twining toolkit:** It offers scenario modeling tools for twin instantiation, scenario setup, and Secondary Development SDK, as well as model generation, stylized rendering, spatial analysis, and simulation.
- **Twining engines:** It is consisting of Spatiotemporal Analytics Engine and AI Simulator for spatiotemporal data processing, spatial reasoning, and domain simulation.
- **Twining core:** It delivers CG, AI, and spatial computing capabilities for high-fidelity 3D visualization, intelligent operations, and spatial interaction.

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.

By entering the unified user portal, the Platform enables multi-dimensional modeling of physical entities. It unifies models, operational data, and rule logic, for all-round digital visualization end-to-end operational monitoring, and real-time simulation

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.

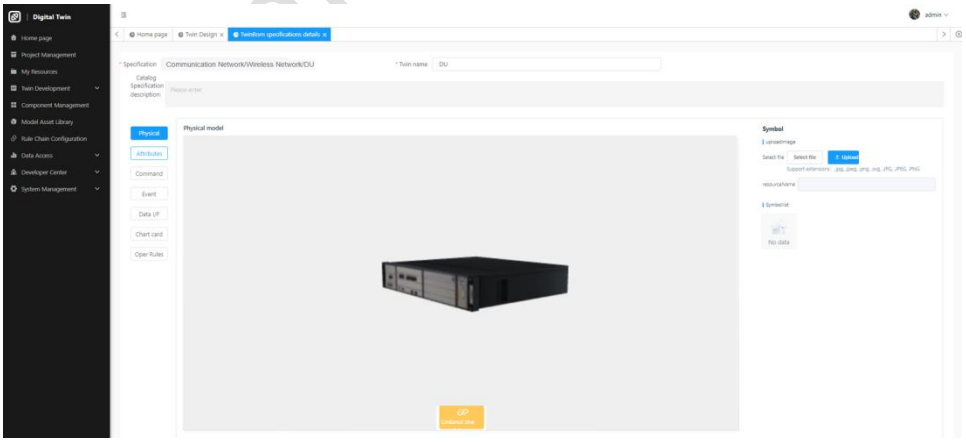

Figure 5-1 Twin Designer

5.2 Scenario Builder

Scenario Builder adopts a modular design approach by integrating development tools and code blocks. Developers can build applications via a drag-and-drop interface based core business logics. It can define and combine digital twins and run rules in specific scenarios, as well as supports component-based online orchestration and zero-code configuration for flexible scenario modeling.

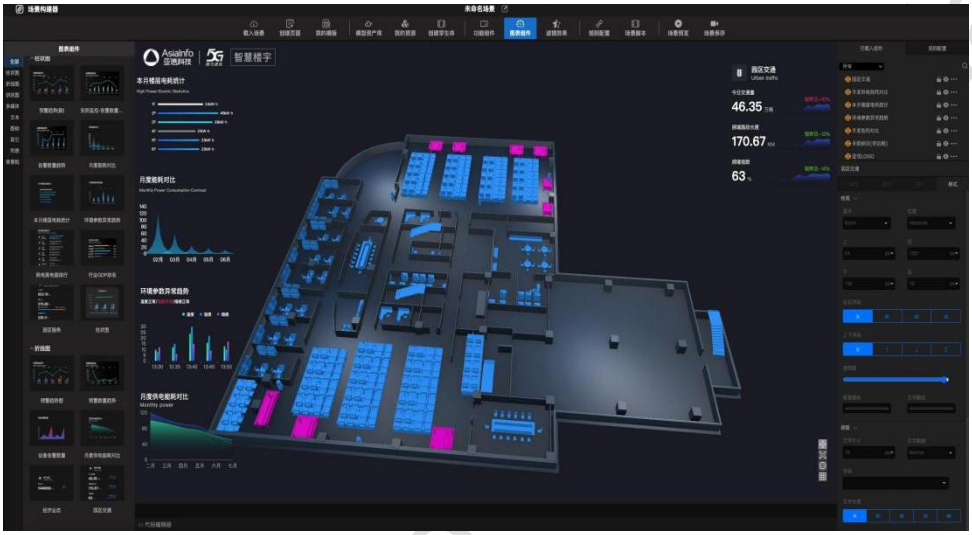

Figure 5-2 Scenario Builder

Utilizing GIS data, satellite maps, drone oblique photography, digital assets, LiDAR, DSLR, and BIM data, the Scenario Builder facilitates city modeling. It enables the accurate replication of large-scale urban scenarios. The builder supports hierarchical visualization from Earth, city, park, buildings, 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. AI functions, such as AIOps, facial recognition, fire detection, behavior recognition, and trend analysis, are available, supporting third-party AI services via standard interfaces.

5.3 Topology Editor

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

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

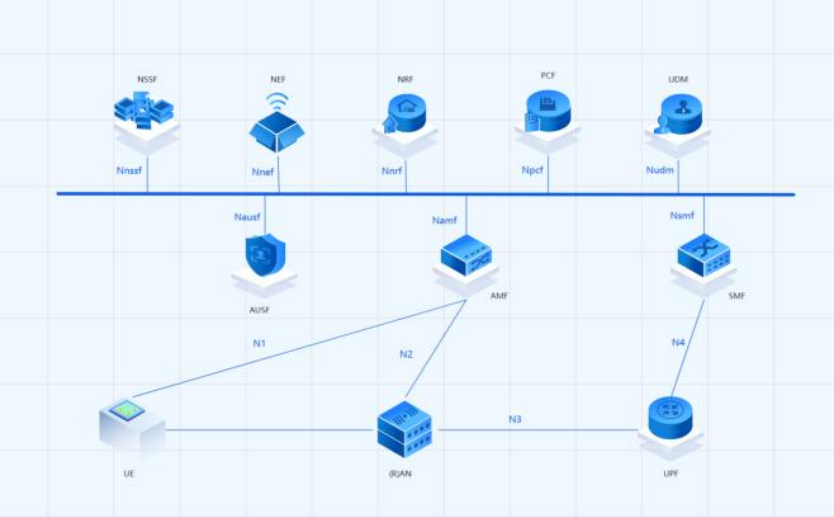

Figure 5-3 Topology Editor

5.4 AI Simulator

AI 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 can also simulate physical phenomena, such as collision and gravity occasions. For industry-specific scenarios, domain capabilities are simulated, such as flooding analysis for Smart Water Service, as well as the simulation of vehicle movement, skeletal motion, and production line operations.

Figure 5-4 Smart Transport

AI Simulator for network scenarios currently offers two simulation capabilities:

- **Signal coverage simulation** creates 3D radio network coverage models to better support decision-making on planning and optimization of outdoor base stations, especially in urban environments with commercial concentration.
- **Radio network 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.

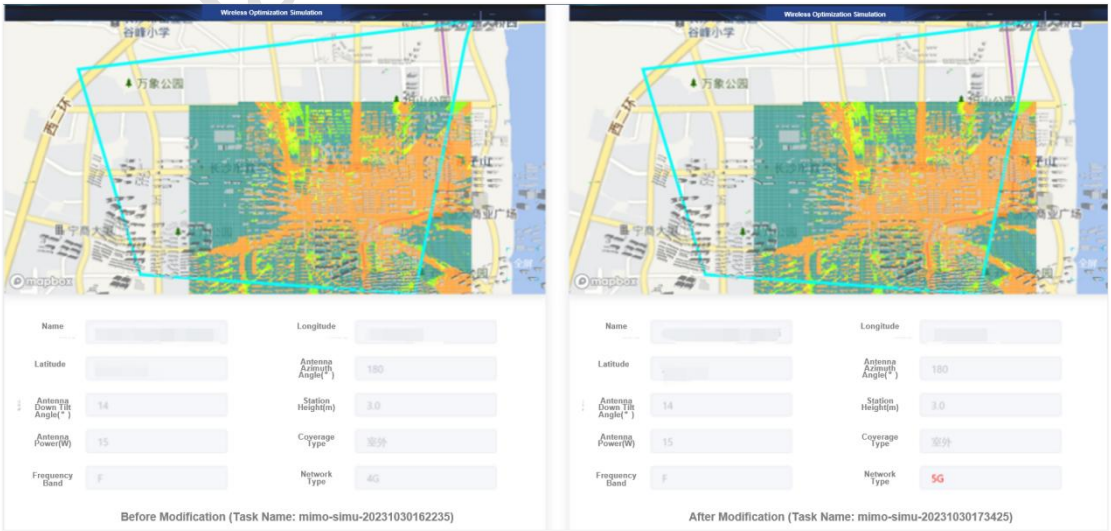

Figure 5-5 Wireless optimization simulation

5.5 Data Service

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.

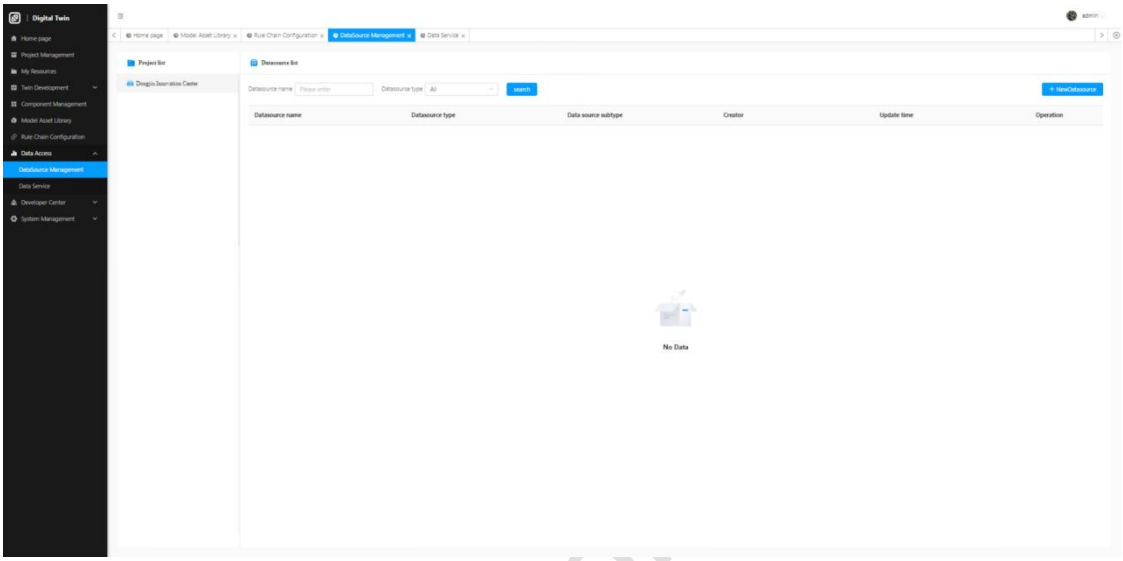

Figure 5-6 Data service

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.

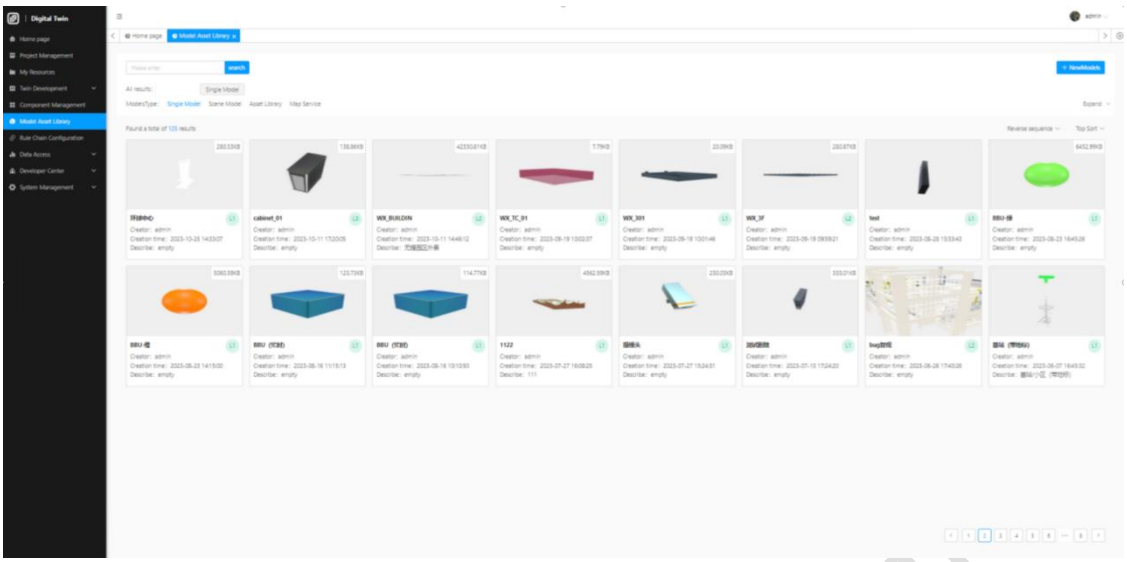

Figure 5-7 Model asset library

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.

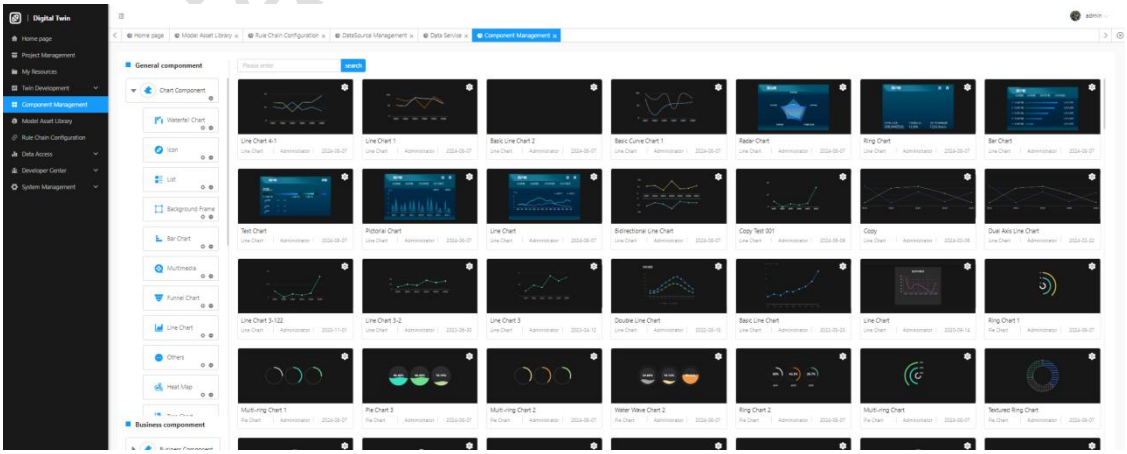

Figure 5-8 Component manager

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.

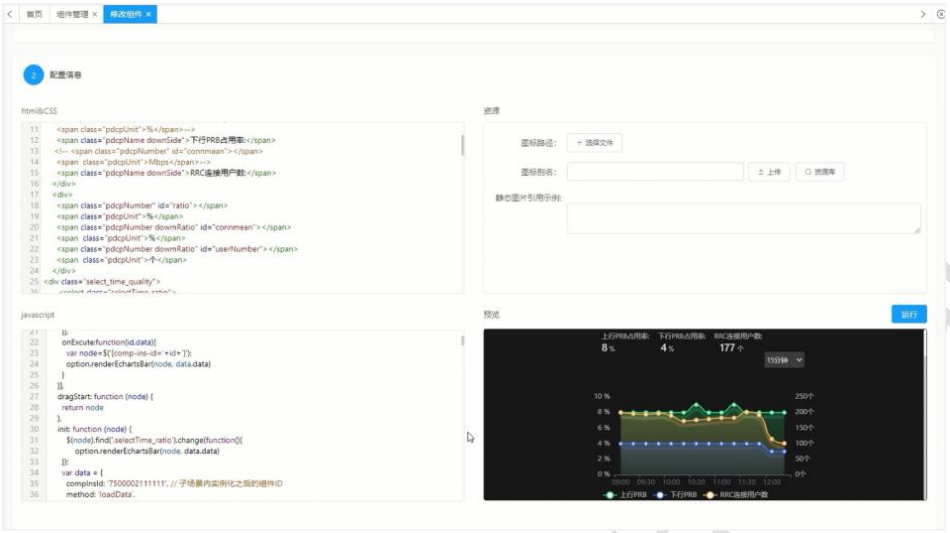

Figure 5-9 DTN service load

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.

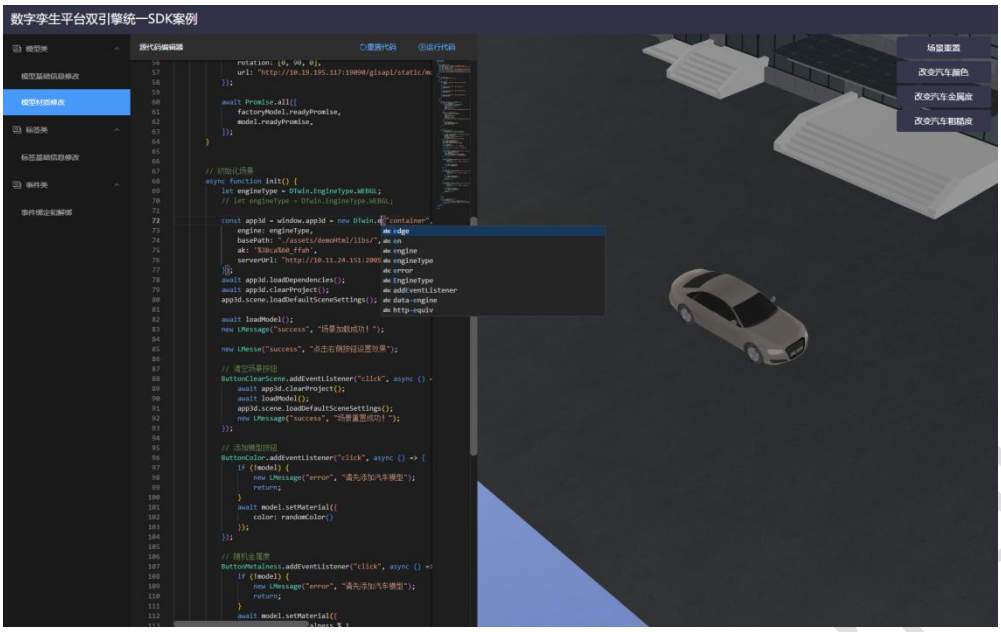

Figure 5-10 SDK Example

And detailed API documents are provided to help users understand and use available APIs.

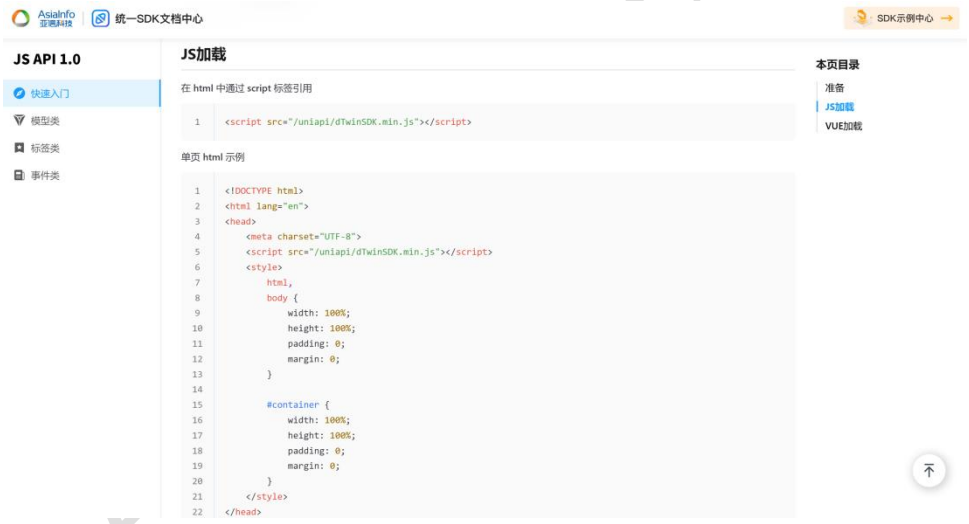

Figure 5-11 API Documents

6 Featured Functions

6.1 Modeling Agent

The Modeling Agent, powered by 3DGS, offers monolithic and semantic model capabilities. It greatly improves fidelity and usability, and outperforms oblique photogrammetry in cost and easy-to-use. It supports lightweight and standard models for real-time and large-scale indoor/outdoor scenarios.

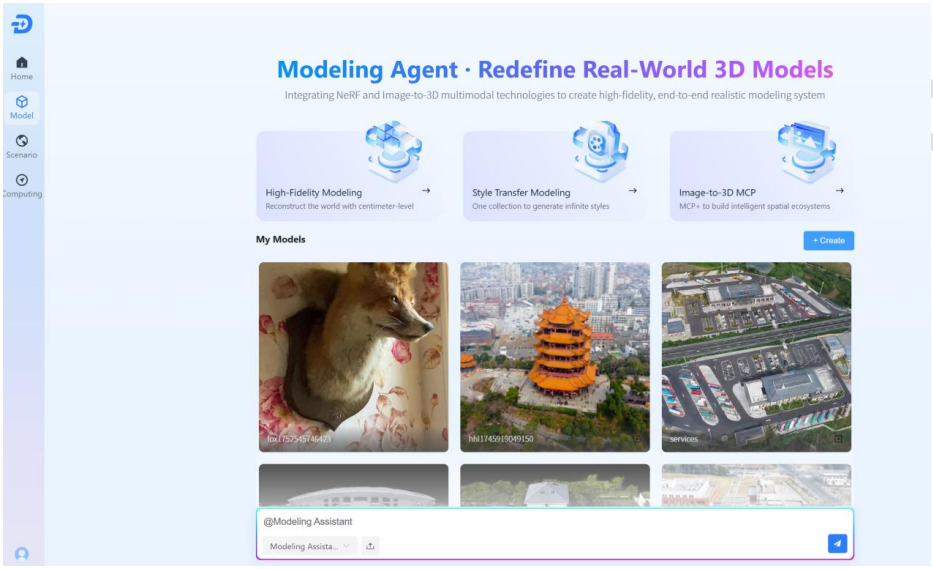

Figure 6-1 Modeling Agent Portal

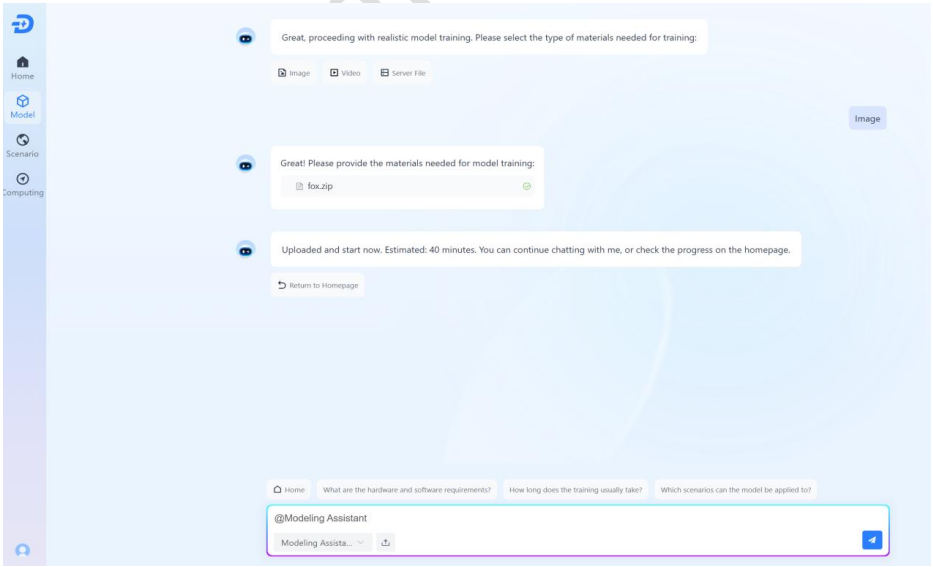

Figure 6-2 Agent training

The modeling agent, built on AAP, supports Q&A and conversational real-world model training and integrates Blender MCP to enable Image-to-3D Model.

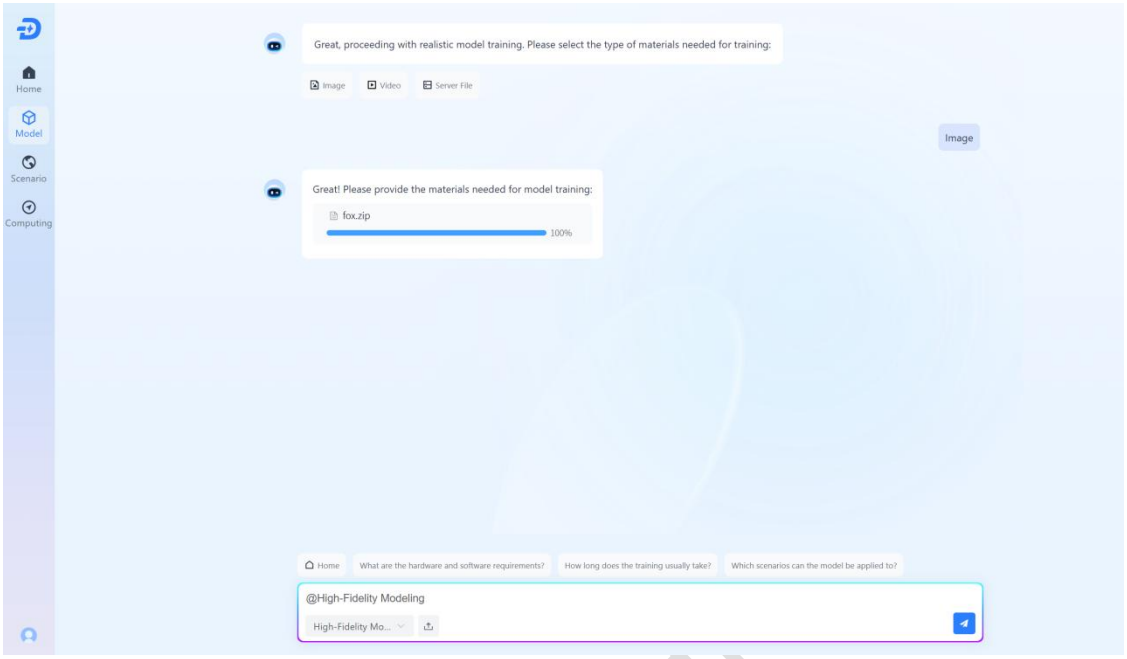

Figure 6-3 Modeling Agent Image-to-3D Model

6.2 Scenario Agent

The Scenario Agent leverages a hyper-converged rendering engine for dynamic adjustment of season, weather, and material styles. It provides PBR rendering, dynamic lighting, and an effects library based on TA technology to generate high-fidelity 3D environments.

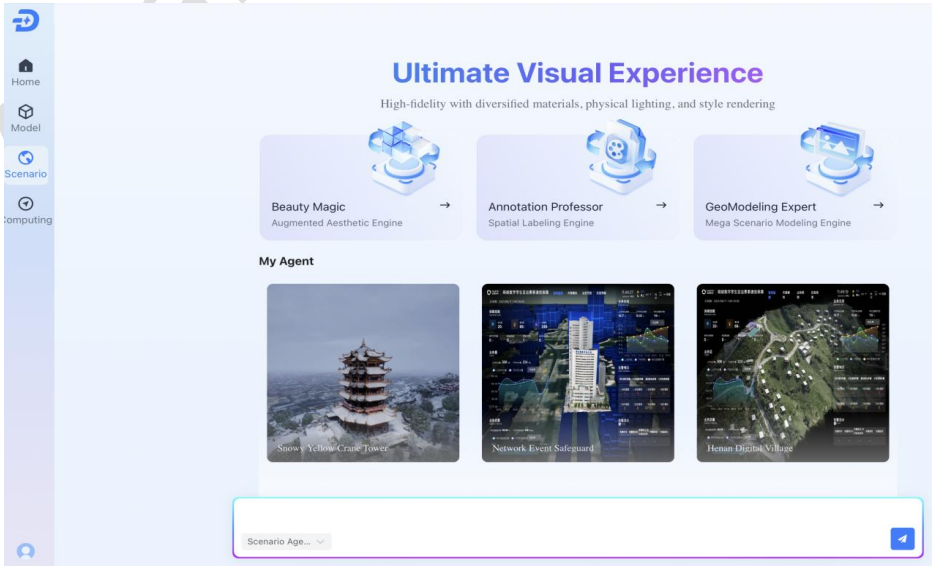

Figure 6-4 Scenario Agent Portal

The Scenario Agent generates real-time 3D scenarios with seasonal and weather styles, enhancing immersive lighting, materials, and physics effects.

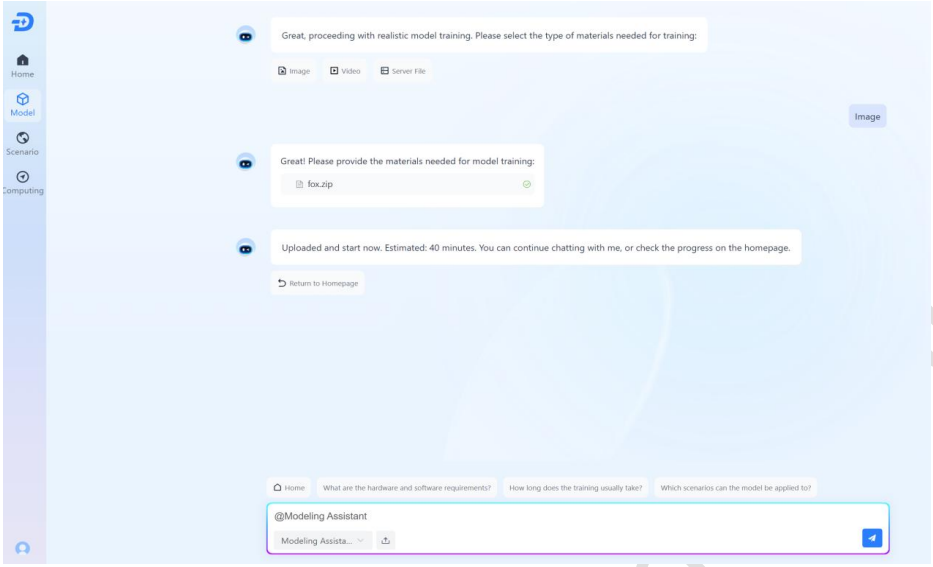

Figure 6-5 Style Training

It combines interactive 3D with AR/VR to create personalized virtual scenes and enhance interactivity.

Figure 6-6 Stylized Visualization

6.3 Spacial Computing Agent

The Spatial Computing Agent provides 3D spatial analysis, including advanced analytics, centimeter-level measurement and query based on 3DGS models, path planning, and visual analysis. It also supports physical and domain-specific simulations for vertical industries.

Figure 6-7 Spacial Computing Agent Portal

The Spatial Computing Agent is developed through AAP, supporting knowledge Q&A and combining GUI and CUI. It enables conversational access to measurement tools within 3D scenarios, allowing users to easily perform linear and zone measurements.

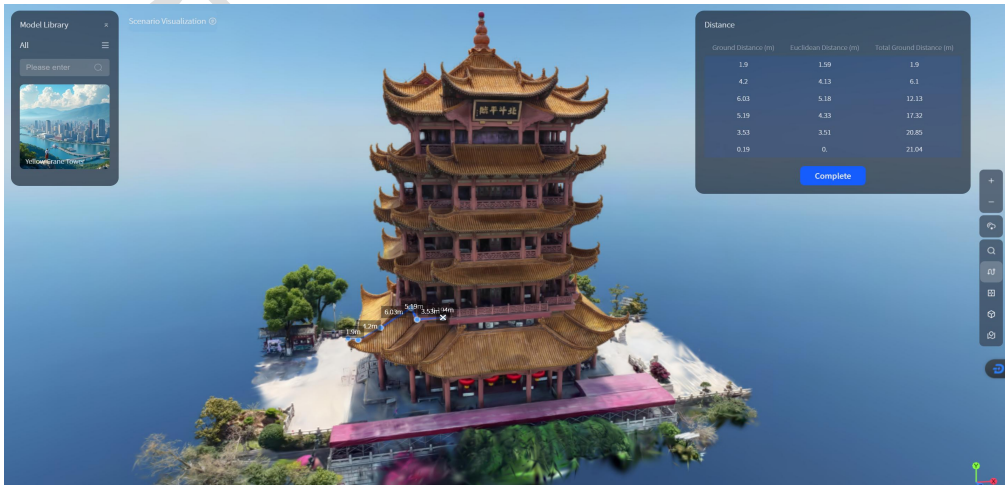

Figure 6-8 Conversational measurement tools

7 Unique Advantages

7.1 Real-World 3D Reconstruction

With 3DGS, the Platform quickly generates high-fidelity 3D models from photos or videos, and supports AI-driven lightweight and standard models.

7.2 Semantic Modeling

The Platform can develop scenarios based on AI Agent through Q&A, process orchestration, and semantic modeling.

7.3 Dual-Engine Rendering

The platform integrates both front-end WebGL and back-end game engines with next-gen PBR rendering technology, enabling hybrid rendering on private cloud deployments to meet complex visualization and operational environment requirements. It supports low-code/no-code development, allowing users to configure camera angles, weather, time, and other settings. Twinning entities can be controlled through the Platform, including their creation, visibility, movement, scaling, and rotation.

Digital Gemini also bundles interactive APIs with twinning scenarios, enabling partners to build solutions.

7.4 Multi-Domain Simulation

The Platform enables simulations for Digital Twin City and Digital Twin Network, supporting risk assessment, emergency planning, and prediction.

7.5 Twin Design

The Platform provides multi-dimensional digital modeling of physical objects, integrating models, rules, and data. It provides an intuitive global digital visualization, enabling end-to-end operation monitoring, supporting real-time simulations based on data and AI capabilities for diagnostic decision-making

7.6 Reusable Digital Assets

By accumulating models and workflows, the Platform manages digital twins as reusable assets to reduce project costs in digital twin city development.

8 Scenario Solutions

AsiaInfo is enriching scenario solutions based on AISWare Digital Gemini across industries, with several successful use cases with better user experience.

Figure 8-1 Scenario Solutions

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.

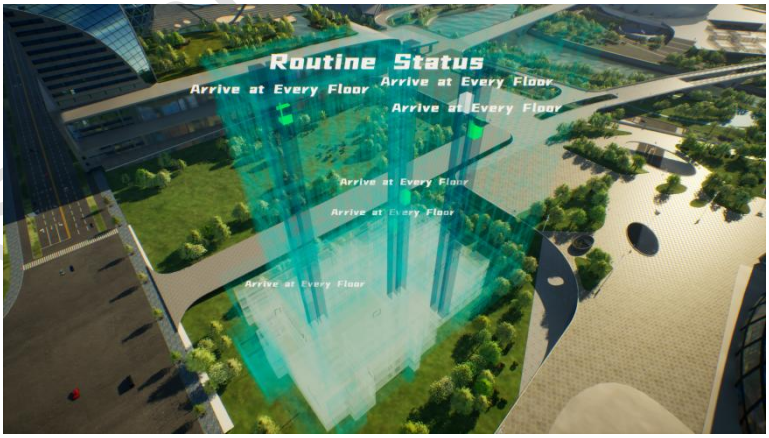

Figure 8-2 Smart Building

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 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.

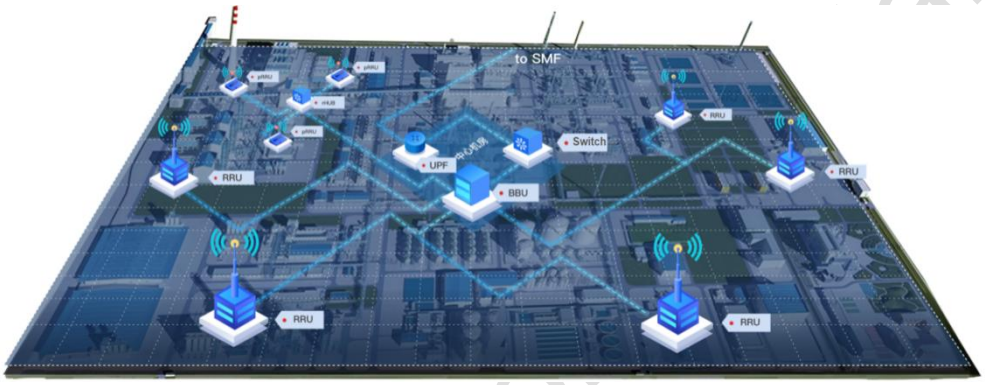

Figure 8-4 End-to-end business simulation of network slicing

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.

8.9 Low-Altitude Economy

8.9.1 Application Scenarios for Low-Altitude Economy

Powered by digital twin and 3DGS, the low-altitude economy has evolved into a multi-scenario system:

In logistics, the Platform models low-altitude networks and simulates swarm coordination and environment adaptation, while 3DGS generates centimeter-level 3D models.

In urban air mobility, it simulates aircraft interaction and manages airspace; with 3DGS reconstruction, the simulated skyline can support landing site selection and route planning.

In emergency response, disaster twin models and 3DGS maps simulate rescue paths and improve resource dispatch by 40%.

Low-altitude mapping integrates drone and 3DGS data with meteorological and traffic information for subsidence monitoring and disaster early warning.

8.9.2 Service Requirements for Low-Altitude Economy

Precise Urban Modeling: For canyons, mountains, and dynamic obstacles.

Airspace Rules: Avoiding no-fly zones such as airports and military areas.

Virtual Simulation: Reducing physical testing costs and preventing route failures caused by outdated mapping.

Data Integration Across Departments: Cutting redundant collection and reducing planning time from hours to minutes.

8.9.3 Solution for Low-Altitude Economy

Low-Altitude Flight Guardian: 3DGS builds static models and integrates millimeter-wave radar for dynamic detection, ensuring UAV safety in dense

areas with accuracy at 0.1m. Real-time simulation provides millisecond conflict alarms (⩽50 ms) and endurance optimization.

Legal Compliance: The Platform integrates national airspace rules and 3DGS no-fly zone models (e.g., high-voltage towers) for automatic compliance checks during route planning.

Low-Altitude Mission Simulation: Supports cloud-based conflict validation and endurance optimization for million-scale UAV fleets. 3DGS generates dynamic environment models from real-time data for fast route updates and auto obstacle avoidance.

Swarm Collaboration: Data service integrates traffic heatmaps, rainfall forecasts, and 5G base station data via APIs to optimize UAV operations and relay placement.

8.10 Smart Tourism

8.10.1 Application Scenarios for Smart Tourism

Immersive Virtual Tourism: 3DGS provides millimeter-level 3D reconstruction of scenic areas, historical buildings, and relics, creating interactive virtual scenes. Combined with VR/AR, it offers cloud-based tours. The Digital Twin Platform integrates real-time weather and crowd data to generate personalized route recommendations.

Digital Preservation and Revitalization: 3DGS builds high-fidelity digital archives of endangered relics and ancient sites. The Digital Twin simulates environmental impacts to support preservation strategies and delivers interactive experiences such as virtual restoration and historical reconstruction.

Smart Operations and Emergency Management: The Digital Twin integrates IoT data on traffic, security, and environment to enable crowd alerts, resource coordination, and rapid response to incidents. 3DGS helps plan new facilities by simulating their impact on the landscape.

8.10.2 Service Requirements for Smart Tourism

Better Visitor Experiences: No-contact services and immersive experiences requires virtual-real integration. Younger visitors prefer social and gamified interactions, which need generative content modeling like virtual NPC guides and treasure hunts.

Sustainable Heritage: Balancing preservation and tourism needs digital solutions to reduce physical contact and unlock cultural IP value. Digital tools help promote heritage across regions and support education.

Refined Operations: Traditional scenic areas face visitor fluctuations and complex management. Digital twins enable energy optimization, dynamic resource allocation, predictive maintenance, and emergency response.

8.10.3 Solution for Smart Tourism

Data Collection and Modeling: Capture spatial data via drones and mobile devices, with 3DGS featuring light reflection properties. IoT sensors stream real-time environment, equipment, and crowd data, layered onto static models to create dynamic digital twins.

Platform Capabilities: The Smart Tourism Platform integrates GIS maps, AI engine, and blockchain with cross-platform APIs to connect ticketing, online guidance, and third-party platforms for data sharing.

Application Scenarios: A Tourism Metaverse APP offers AR role-play and digital souvenirs. A digital twin copilot enables carbon monitoring, heritage assessment, and 3D emergency command.

9 Use Cases

9.1 Smart Transport Hub for a High-Speed Rail Station

9.1.1 Customer Requirements

The customer needed a Smart Transport Hub Platform (the “Platform”) to integrate geospatial, road, and management data. The solution combines spatial analysis and visualization for unified data and spatial management, enabling real-time monitoring of equipment, passenger flow, and heat maps to support resource allocation and improve response efficiency.

9.1.2 Solutions and Effects

The Platform covers application scenarios shown in **Figure 9-1:**

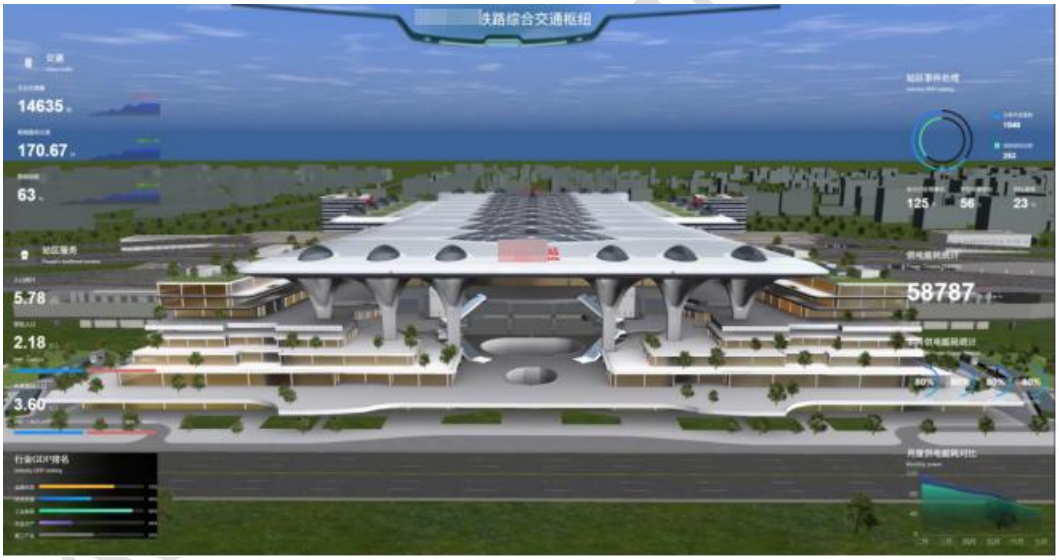

Figure 9-1 Application

- **Better Monitoring:** The Platform enables comprehensive monitoring of station operations, including announcements, security, equipment, lighting, AI personnel distribution/movement, and robot patrol.
- **Optimized Traffic Control:** With detailed monitoring of passenger flow, vehicle flow, and train data, the Platform optimizes traffic organization and ensures efficient station operations.

- **Strengthened Scheduling:** The Platform can alarm link event mechanisms to optimize operations and scheduling.
- **Improved Emergency Response:** The Platform supports emergency assessment with 3D measurements, impact analysis, and evacuation route recommendations to maximize safety.
- **Efficient Maintenance:** The Platform integrates visual tools to monitor equipment status and patrol routes, improving team response and O&M efficiency.
- **Reliable Facility Operation:** The Platform ensures stable and timely maintenance of facilities, providing a reliable passenger environment.
- **Smart Management:** Intelligent functions provide better decision support, advancing station management towards automation and intelligence.
- **Better Passenger Service:** Intelligent services and information visualization improve overall passenger experience.

9.2 The Digital Twin Platform for a PV Data Center

9.2.1 Customer Requirements

The project installed 3,165 pieces of 550Wp monocrystalline modules on rooftops of warehouses and data center buildings, with total capacity of 1.55 MWp. It built a user-friendly energy system to provide sustainable energy for the data center. Real-time energy and equipment monitoring ensure both supply stability and environmental benefits.

9.2.2 Solutions and Effects

The Digital Twin Platform for the PV Data Center (the “Platform”) covers the following scenarios.

Figure 9-2 The Digital Twin for a PV Data Center

- **PV Generation Statistics:** The Platform accurately reflects output and efficiency of PV stations at the warehouse and data center, and provides critical data for energy planning, market dispatching, and economic evaluation, supporting sustainable development.
- **Environment-Friendly:** The Platform measures CO_2 and SO_2 reductions, coal savings, and equivalent tree planting to improve air quality.
- **Real-Time Energy Monitoring:** It can track daily utilization and system capacity to assess energy allocation and performance. Real-time monitoring and adjustments help optimize resource use and improve overall system efficiency.
- **Equipment Monitoring:** It continuously monitors equipment to detect and resolve issues promptly, ensuring stable output.

9.3 The Zero-Carbon Highway Service Area

9.3.1 Customer Requirements

The customer is aiming to develop a digital twin platform for zero-carbon highway service area (the “Platform”) for green transition and sustainable

development, enabling real-time monitoring of electricity, water, and EV charging stations, while supporting smart devices like lighting and HVAC to enhance intelligent management.

9.3.2 Solutions and Effects

The Platform covers the following application scenarios.

Figure 9-3 The zero-carbon highway service area

- **Energy Analysis:** The Platform monitors energy consumption across buildings in the service area, and analyzes historical data and model algorithms to forecast trends and plan energy utilization.
- **Resource Utilization:** It covers the management and sustainable use of water, energy, land, and waste recycling to protect the environment.
- **Scheduling Control:** It manages vehicle access, parking, facility operations, logistics, emergency response, and customer services to ensure smooth operations and quality service delivery.
- **Emergency Response:** It provides alarms, resource dispatch, incident handling, medical aid, and evacuation measures to ensure safety during emergencies.

9.4 Smart Park

9.4.1 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.

9.4.2 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.

9.5 Network Assurance for the Asian Games

9.5.1 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.

9.5.2 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.

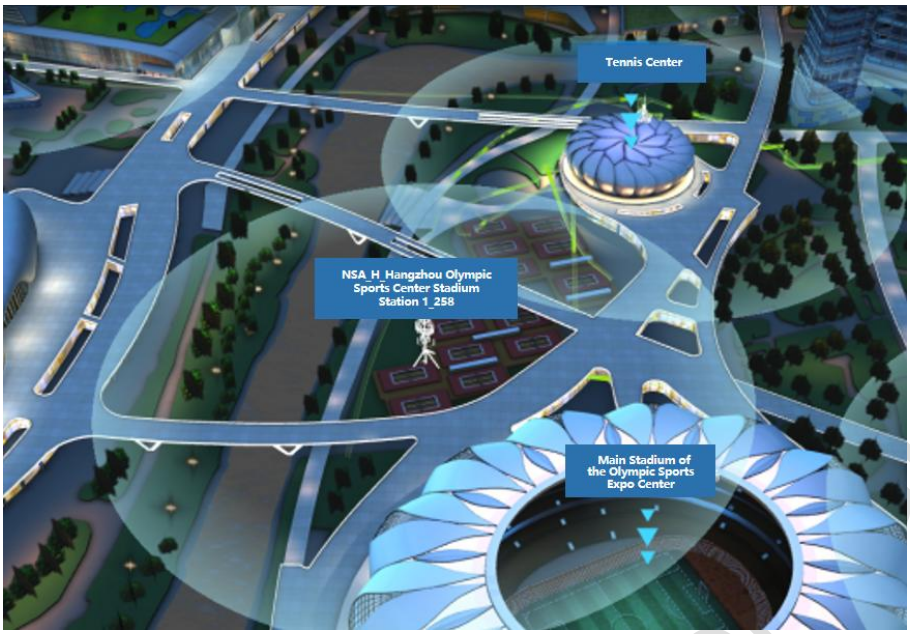

Figure 9-1 Network assurance for the Asian Games

- **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.

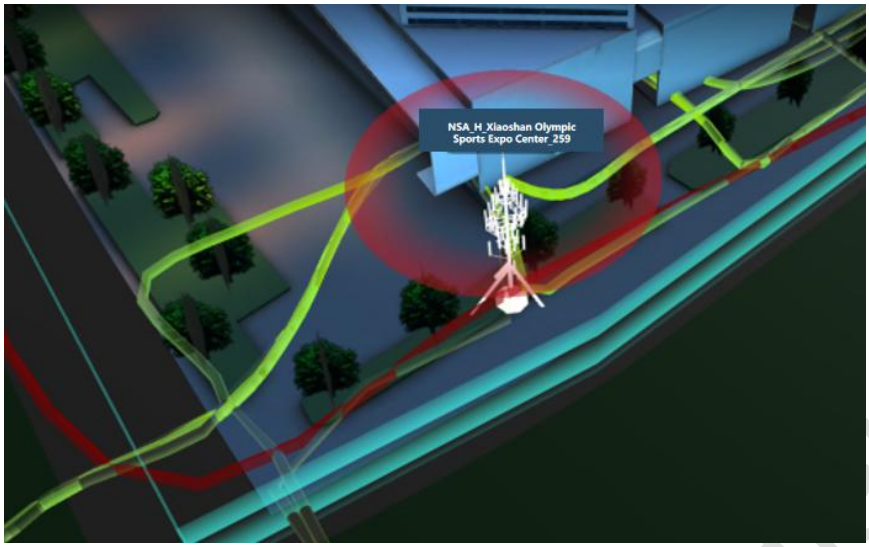

Figure 9-2 Network assurance for the Asian Games - Traffic Forecasting

- **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%.

9.6 Smart Water

9.6.1 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.

9.6.2 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 been featured in Gartner Reports. It has also been awarded the TMF Catalyst Project for three consecutive years (2021–2023) and has participated in the compilation of multiple international and domestic standards related to digital twins.

Gartner

Emerging Tech: Adoption Trends in Simulation Twins Show New Long-Term Revenue Opportunities

28 November 2024 - 15 min read By: Alfonso Velosa, Ethan Cai, Evan Brown

Initiatives:Emerging Technologies and Trends Impact on Products and Services

Enterprises are using simulation twins to improve business decisions, offering providers opportunities to build trust and embed products in client businesses. Product leaders will fail to capture this revenue unless they build business outcome-focused simulation twins using IoT, AI and analytics.

Overview

Key Findings

- Enterprise buyers employ simulation twins for process transformation and new business outcomes, such as improving asset health or supply chain planning. However, most product leaders make the mistake of positioning simulation twins primarily as a technology sale.
- There is a growing market opportunity for long-term, "sticky" revenue and high switching costs by embedding simulation twin technologies directly into customer business processes. While the leading adopters of simulation twins center in manufacturing and oil and gas, government, communications and other asset-light sectors and business processes are also adopting the technology.
- Providers of successful simulation twin business solutions must use combinations of technologies such as the Internet of Things (IoT), AI, analytics, and integration platform-as-a-service (PaaS) to deliver high-value, embedded solutions.

Recommendations

Product leaders planning to innovate using simulation twins should:

- Drive long-term revenue by using the technology as a tool to embed your product in key enterprises' business processes and operational transformation efforts.

Figure 10-1 Gartner Emerging Tech: Adoption Trends in Simulation Twins Show New Long-Term Revenue Opportunities

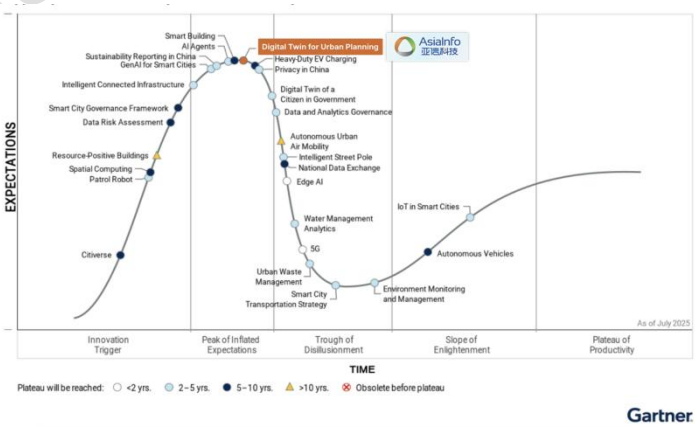

Figure 10-2 Hype Cycle for Smart City and Sustainability in China, 2025

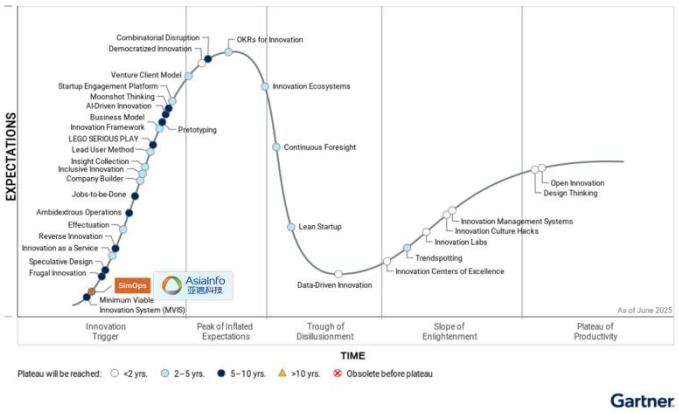

Figure 10-3 Hype Cycle for Innovation Practices, 2025

Figure 10-4 TMF2023 “Catalyst Best Innovation and Future Techo”

Figure10-5 TMF2021 “Best Industry Influence” Award

Figure10-6 "Outstanding Innovative Software Product"

Figure 10-7 WGDC2023 "The Most Innovative Product"

Figure 10-8 Gold Award of iF Design 2022

11 Contact Us

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