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Digital Twins Help Improve Maritime Operations

Digital Twin Applications Enhance Port Decision-Making, Cost Savings, and Operations

Digital Twin Benefits:

- Better operational responsiveness and adaptability to changing port needs.

- Improved cargo handling and error-free vessel loading.

- Helps reduce environmental impact to address financial, regulatory, and societal pressures for ships and ports.

- Enhanced physical security and monitoring to help protect employees, data, buildings, assets, and cargo.

- Enhanced cybersecurity to help protect business continuity, data, and equipment.

Summary

The United Nations forecasts sixty-eight percent of the global population will live in urban areas by 2050[1]. As the demand for consumer goods increases, so will the demand for global shipping. Maritime organizations will need to manage increasing container volume to meet worldwide demand.

Additionally, new global trends toward port automation, automated ship navigation, environmental sustainability, and increasing physical and cyber security attacks on ships and ports will push organizations to invest in new digital systems to operate more efficiently, meet regulatory demands, and guard against business continuity disruptions. Intel-powered port solutions combine digitally integrated hardware and software to help port authorities connect assets, simulate predictive changes, and optimize operations.

Global Cargo Demand Increases Port Operation Risks

Today's maritime organizations seek new ways to adapt to changing market conditions to control costs and ensure predictable operations, enhance compliance with regulations, and improve safety. Port operators want to use modern technologies like sensors, edge computing, artificial intelligence (AI), and connectivity to help mitigate risks to their operations.

Port organizations need innovative ways to gain better spatial awareness over their facilities to create safer and more efficient operations. Unfortunately, disparate data, processes, and systems constrain an organization's ability to function efficiently. Disconnected systems prevent improved coordination of assets, increases risk of accidents, and hinder reliable operations.

Digital Twins Help Ports Save Money and Improve Operational Reliability

A digital twin is a dynamic replica of a real-world situation continuously updated in near real-time using multimodal digital data streams and analytics. Digital twin technologies help maritime organizations can gain better spatial awareness and better insights to help make more informed decision-making. These benefits help reduce costs, improve security, and decrease the time to market for new port systems, assets, or processes.

Digital twins also enable organizations to construct accurate planning simulations and models across a variety of scenarios like adverse weather conditions, new container management technologies, increased container volume forecasts, or security incidents. Ports can make better, more strategic decisions by simulating the impact of changes and interventions before implementing changes in their physical environment.

1. 2018 Revision of World Urbanization Prospects

Using powerful graphing technologies and analytics engines, digital twins can generate live visual insights, and recommendations for coordinated operations to help improve predictive maintenance and reliable operations. This consolidated visual platform helps increase spatial awareness and enables improved strategic decision making for all stake holders.
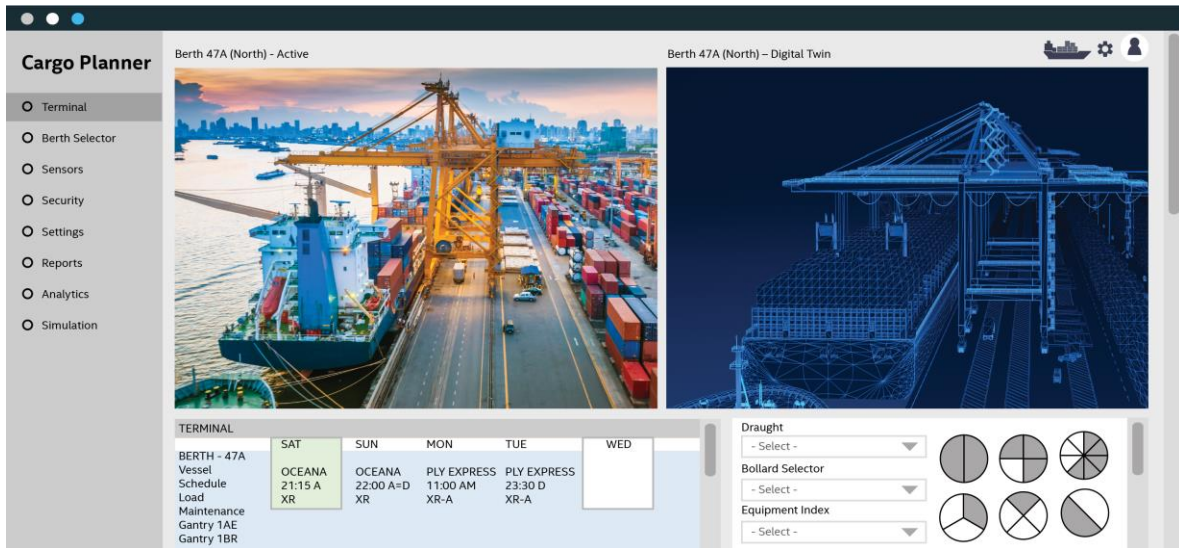

Figure 1. Simulated Digital Twin Application

How Digital Twins Work: Introducing Intel® SceneScape

Digital twins are comprised of three primary parts: hardware, software, and third-party partner applications. Cameras and other sensors positioned at various locations at a port facility collect raw data and process it at the network edge. Software technologies, like Intel® SceneScape, use this data to create and update the digital twin of the space. This technology can be used for building spatial awareness visualizations, ingesting processed data, and combining it with enterprise data. Enterprise data such as facility infrastructure specification, systems, engineering drawings and historical logs are used to create visual graphs before sending the information to Intel-powered cloud-based servers and controllers for further processing.

Cloud-based servers combine the information with live, continuously updated external edge-compute data feeds. An analytics and inferencing engine develop insights and operations recommendations based on running model or simulations.

Intel partner applications manage the constant data stream updates, graph data, and system insights to create a near real time visualization of a port's connected assets and operations. Maritime workers access and interact with the visualizations and system recommendations via mobile or desktop devices to simulate changes and optimize real-world changes.

Intel® SceneScape Capabilities

Intel® SceneScape is a software platform that reaches beyond vision-based AI to realize spatial awareness from sensor data. It transforms data from many sensors to create and provide live updates to a four-dimensional (4D) digital twin of a physical space. Digital twins can be applied to customers' use cases to look at past analytics, track what is happening in the present, and make predictive decisions for the future.

Intel® SceneScape provides customers with the breadth and scale to track anything, anywhere—whether that be a shipping container arriving at a port, assets within a large navy base, or worker safety during a ship's journey from one port to another. Some of the key benefits and capabilities delivered with Intel® SceneScape include:

- Intel® SceneScape utilizes knowledge about the sensors to apply scene context. For example, the position of a smart camera in a port allows for mapping the context of detected people from the camera view into geographic coordinates.

- Intel® SceneScape's base analytics tools enable developers to create and modify regions of interest, tripwires over a scene and dwell time in a region.

- Multiple sensor fusion means Intel® SceneScape will detect an asset at multiple angles in different sensors but know to only display the asset once in the digital twin. High value information can be extracted with minimal cameras, many cameras, or a combination of sensors—the choice is yours.

- Avoid vendor lock in, upgrade at your own pace, and see a greater return on investment by connecting to your existing sensors to Intel® SceneScape for quick start-up.

- Multimodal tracking allows users to decide what sensors fit their unique needs such as audio, vision, LIDAR, RF, and time series data like ambient temperature, barometric pressure, and air quality.

- A simple, clean, intuitive UI makes Intel® SceneScape user friendly for both technical and non-technical users.
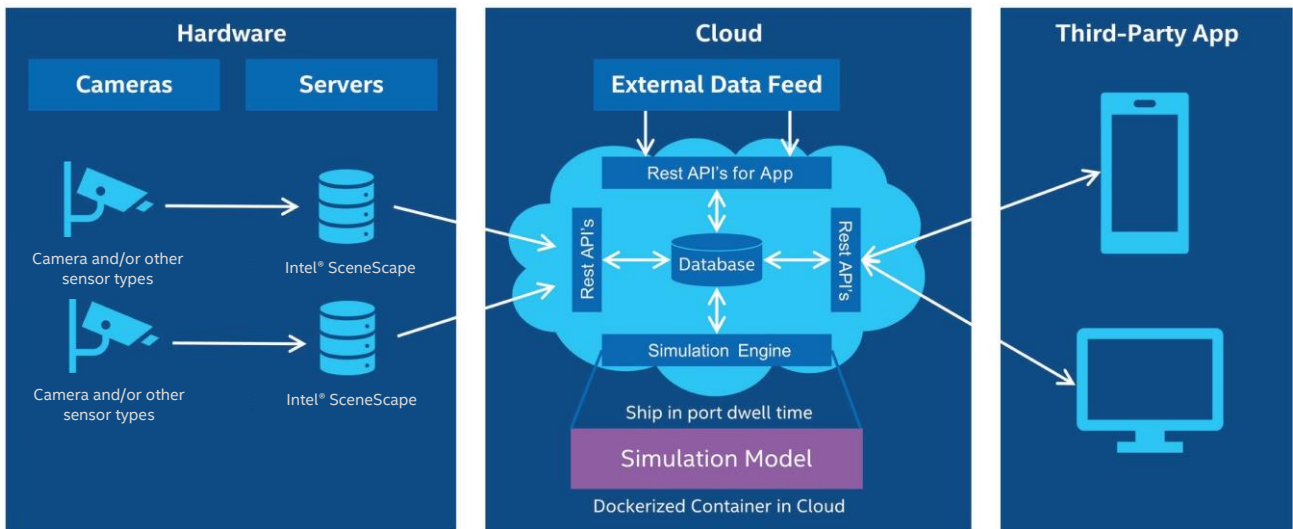
Figure 2. Digital Twin for Maritime Port with Intel® SceneScape

Intel End-to-End Solution Portfolio

Intel's ecosystem partner solutions help enhance workload convergence technologies, such as containerization and hyperconverged infrastructure. Intel-based solutions can perform multiple functions, maximizing the value of each network asset. By using solutions based on Intel processors, maritime organizations can integrate a wide array of devices that work together to provide a holistic view of their equipment and network.
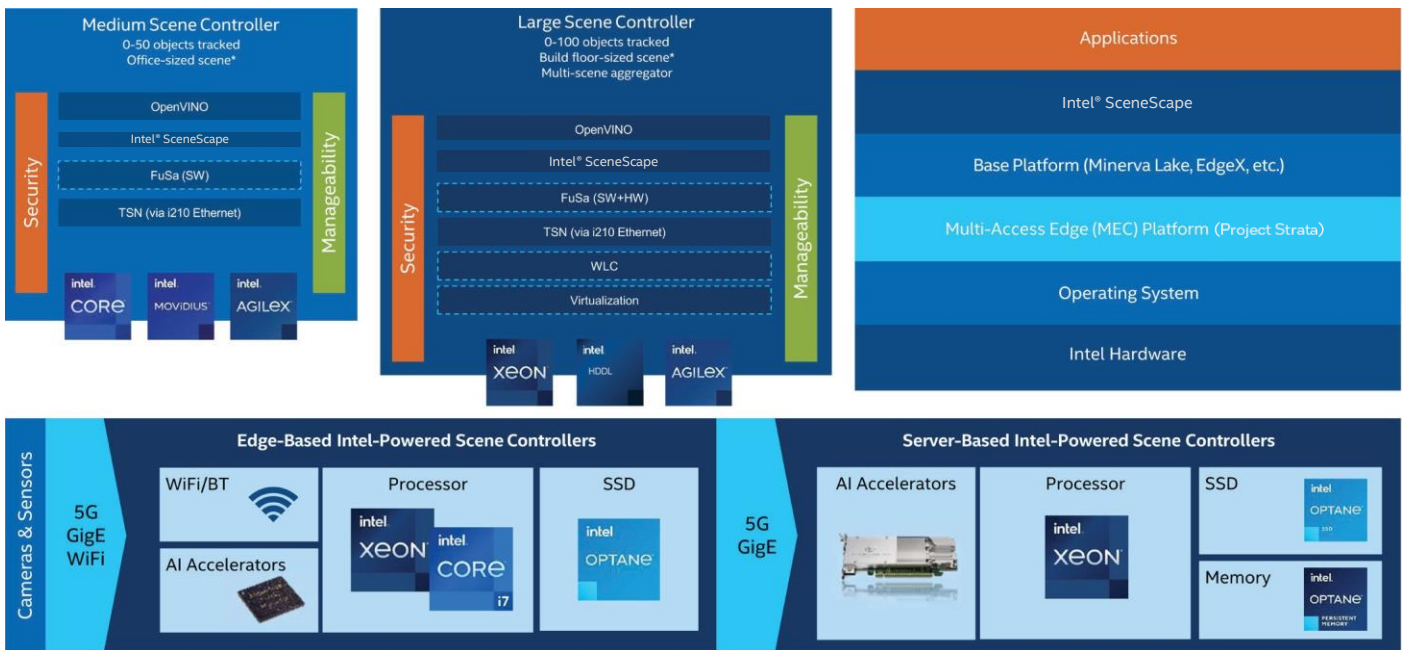
Figure 4. Intel Digital Twin Edge-Based Controllers

Maritime port operators can meet a growing set of reliability, safety, efficiency, and cost challenges by implementing smart port technologies. Intel and its ecosystem partners offer solutions using Intel® SceneScape controllers, cameras and sensors with Intel ingredients, CPUs, high-performance integrated graphics, and field programmable gate array (FPGA) technologies for image acquisition and processing.

Deployment-ready software packages like the Intel® Distribution of OpenVINO toolkit™ also help accelerate AI inference and decision-making. These solutions combine sensor hardware and software, edge-to-cloud processing technologies, and artificial intelligence help deliver better insights for maritime organizations. Better insights help make better operational and safety business decisions resulting in more reliable and on-time operations.

Learn More

To learn more about Intel® SceneScape, contact us at IOTG-PublicSector@intel.com or visit us at intel.com/scenescape.

To learn more how Intel and it's ecosystem partners can help your maritime operation reach out to us via email at marine@intel.com or go to intel.com/transportation.

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