WEDA: Advantech Container Catalog (ACC) and WISE-Edge Developer Architecture (WEDA)

1. Introduction

As artificial intelligence, IoT, and edge computing continue to converge, industrial systems are undergoing a fundamental transformation. Traditional hardware-centric architectures are no longer sufficient to meet the demands for scalability, rapid deployment, continuous optimization, and intelligent decision-making across highly distributed environments. Enterprises increasingly require software-defined, cloud-native, and developer-centric platforms that can operate reliably from the edge to the cloud.

To address these challenges, Advantech has developed a comprehensive Edge AI and AIoT platform strategy centered on two tightly integrated pillars: **Advantech Container Catalog (ACC)** and **WISE-Edge Developer Architecture (WEDA)**. Together, ACC and WEDA form a complete solution chain spanning hardware platforms, edge software, containerized applications, and cloud services—enabling enterprises to accelerate digital transformation and large-scale intelligent deployment.

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2. Advantech Container Catalog (ACC)

Advantech Container Catalog (ACC) is a containerized application ecosystem designed to accelerate edge application development and deployment. ACC provides a wide range of pre-validated Edge AI and IoT application containers, allowing developers, system integrators, and ecosystem partners to build, integrate, and deploy solutions in a modular and standardized manner.

By leveraging container technology, ACC significantly reduces the complexity of software packaging, dependency management, and cross-platform compatibility. Applications delivered through ACC can be deployed consistently across heterogeneous edge hardware platforms, including embedded systems, industrial PCs, and AI edge servers.

When integrated into the WEDA architecture, ACC becomes a core enabler of Advantech's end-to-end Edge AI solution supply chain. It bridges hardware, edge execution, and cloud services within a unified architecture, enabling faster solution validation, shorter time-to-market, and scalable commercial deployment.

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3. WISE-Edge Developer Architecture (WEDA): Platform Overview

WISE-Edge Developer Architecture (WEDA) is Advantech's unified Edge-to-Cloud software architecture designed to enable scalable, secure, and developer-friendly Edge AI and AIoT deployments. WEDA abstracts hardware complexity, standardizes device and data management, and provides a cloud-native foundation for deploying AI applications across heterogeneous edge environments.

The WEDA product offering is structured into three major layers:

- **WEDA Edge** – Edge-side execution and device intelligence

- **WEDA Cloud / Core** – Centralized orchestration, management, and digital twin services

- **WEDA Enablers** – Developer toolkits, protocols, and ready-to-develop containers (included in ACC)

Together, these layers form a complete, closed-loop Edge AI architecture supporting sensing, edge inference, data governance, AI agents, and intelligent decision-making at scale.

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4. WEDA Enablers: Developer Acceleration Layer

WEDA Enablers provide the foundational building blocks that accelerate application development, system integration, and solution reuse across edge devices.

4.1 ACC Ready-to-Develop Containers

As a key component of WEDA Enablers, **ACC Ready-to-Develop Containers** deliver pre-packaged AI and application runtimes that can be directly deployed on WEDA Edge nodes. These containers support a wide range of AI workloads, including:

- Large Language Models (LLM), Vision-Language Models (VLM), and RAG pipelines

- Computer vision and YOLO-based inference

- ROS2 and robotic applications

- Agentic AI and VTT / TTV scenarios

By using containerized and reusable modules, developers can rapidly prototype, deploy, and scale Edge AI applications without dealing with low-level environment setup or hardware-specific constraints.

4.2 Device Library (Open Source)

The WEDA Device Library transforms low-level device interactions into high-level programming interfaces. It provides open-source SDKs supporting **C# and Python**, allowing developers to access sensors, actuators, and industrial devices using familiar programming languages.

4.3 WEDA Sub Node

WEDA Sub Node extends device-side functionality and decentralizes development to end users and the open-source community. Its modular architecture includes:

- Open-source modules in C# and Python

- Automatic DTDL generation for digital twin modeling

- Data pre-processing pipelines

- Time-series data filtering and single-variable transformation

A built-in data compensation mechanism ensures local buffering and automatic data recovery during network disruptions, preserving data integrity and continuous AI processing—an advantage over traditional IoT frameworks.

4.4 Protocol Modules

WEDA supports industrial and IoT communication standards through protocol modules such as **MQTT, Modbus, OPC UA**, and others, enabling seamless integration with existing OT and IT systems.

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5. WEDA Edge: Edge-Side Execution Core

WEDA Edge is the software operational core deployed on edge hardware, responsible for device connectivity, data acquisition, local processing, and AI inference close to the data source.

5.1 WEDA Node (Device Management Agent)

WEDA Node acts as the central agent on each edge device and can operate across a wide range of platforms, including embedded modules, industrial PCs, and AI edge servers. Its key functions include:

- Device management and lifecycle control

- Secure communication with WEDA Core

- Container-based application runtime

The Node is built on a containerized management framework, with encrypted model and file storage and optional TPM integration to enhance system security. For resource-constrained environments, WEDA Node can also be provided as an open-source C-language implementation, enabling flexible deployment on single-chip and embedded systems.

5.2 Data Agent and Device Shadow

The Data Agent handles real-time data acquisition, telemetry collection, and automatic reporting. Device Shadow mechanisms enable:

- Automatic onboarding and provisioning

- State synchronization between edge and cloud

- Secure virtual access via TCP tunneling (VNC, SSH, RDP, FTP)

5.3 Cross-Architecture Support

WEDA Edge supports heterogeneous computing architectures, including:

- CPU, GPU, and NPU acceleration

- x86 and Arm platforms

- Operating systems such as Yocto and Ubuntu

This ensures portability and scalability across diverse industrial hardware ecosystems.

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6. Digital Twin Communication Framework

Between WEDA Edge and WEDA Cloud, WEDA implements a **Digital Twin Framework Protocol** that synchronizes device state, telemetry, and metadata between physical edge nodes and their cloud-based virtual representations. This framework forms the foundation for scalable device management, intelligent orchestration, and system-wide visibility.

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7. WEDA Cloud / Core: Centralized Intelligence Platform

WEDA Cloud, powered by **WEDA Core**, serves as the centralized control plane for managing large-scale edge deployments. Built as an API-centric service layer, WEDA Core orchestrates devices, containers, data flows, and AI services across the entire ecosystem.

7.1 Device and Container Management

WEDA Core supports automated device registration, pre-provisioning, and large-scale lifecycle management. Container orchestration is based on **Docker Compose**, enabling remote deployment, OTA updates, and version rollback without disrupting on-site operations.

7.2 Data Management and AI Services

WEDA Core provides a comprehensive data management layer, including:

- Math engines for real-time computation

- Real-time data bridges

- Multi-data source support (MQTT, NATS, HTTPS client/server)

- Support for numeric data, image binaries, and JSON data packs

WEDA MCP Servers act as AI agent bridges, enabling advanced AI workflows and agent-based decision-making across distributed environments.

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8. Digital Twin, Visualization, and Ecosystem Enablement

WEDA Core adopts **DTDL** standards and virtual node mechanisms to project physical devices into cloud-based digital twins. Developers can define custom data processing logic and AI inference strategies using extensible Python and JavaScript execution environments.

The platform integrates visualization and simulation tools such as **Grafana** and **NVIDIA Omniverse**, supporting real-time monitoring, simulation, MLOps governance, and AI agent collaboration across domains including manufacturing, energy, healthcare, and transportation.

Multi-tenant security, usage-based metering, and an open-source UI framework enable SaaS-style operations and rapid partner customization.

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9. Ecosystem and Hardware Compatibility

WEDA is designed to operate across a broad hardware ecosystem, supporting platforms and accelerators from vendors such as **AMD, Intel, NVIDIA, Qualcomm, MediaTek, NXP, Hailo, Rockchip**, and others. This open and vendor-agnostic approach ensures long-term flexibility and avoids technology lock-in.

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10. Conclusion

WEDA represents Advantech's strategic transition toward a platform-driven and ecosystem-oriented approach in the AIoT era. By positioning the edge as the operational front line and the cloud as the intelligent control center, WEDA combines containerized deployment, open-source development, and digital twin technologies to establish a software-defined intelligent infrastructure.

Together with ACC, WEDA empowers enterprises to move from basic device operation to data-driven, AI-powered decision-making, while enabling developers to build modular, cloud-native applications that continuously evolve. As the Enabler toolkit and partner ecosystem continue to expand, WEDA is positioned not only as a development framework, but as a foundational operating standard for next-generation Edge AI and AIoT ecosystems.