Data Confidence Drives Better Decisions

Integrating Dell Technologies Data Confidence Fabric with ADI Intelligent Edge for trusted data insights

DELL Technologies

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ANALOG DEVICES

Data-driven insights require data you can trust

Industrial digital transformation delivers real-time data analysis, flexible manufacturing and advanced automation, allowing factories to efficiently produce personalized products and smaller batch sizes by quickly adapting to customer demand and specifications. Reaching these goals depends on having access to the most accurate operational data and being able to generate insights with contextualized data sets.

The customer operational technology (OT) industrial network domain is defined by heterogeneous protocols and standards depending on the asset and functional level. For example, SCADA/ICS for PLC and process automation networks, and building-automation networks across a broad landscape. Communication standards, including BACnet®, Modbus®, IO-Link®, OPC UA and Fieldbus, each deliver a range of data sets and types (such as digital I/O, streaming and messaging). Industrial Ethernet standards such as 10BT-1L provide the ability to power and connect remote assets. Customers are challenged with orchestrating this diverse infrastructure in an operational environment where process availability is the highest metric, as factories run 24/7 and become more autonomous and tailored in a modular production.

Bringing technologies together for greater trust and precision

By combining Dell NativeEdge as a secure orchestration platform with Dell Data Confidence Fabric (DCF) and Analog Devices® (ADI) Intelligent Edge, customers can provide trusted sensor data sets with the highest measurement precision and fidelity — data that can be trusted to deliver meaningful insights.

Before the rise of modern edge computing in the early 2020s, Dell Technologies invented the technology known as Dell Data Confidence Fabric. Dell donated their DCF implementation to The Linux Foundation® as an open-source code repository known as Project Alvarium. Dell DCF is the next step in edge orchestration, as customers seek a true end-to-end data signal chain with a data provenance measurement (data confidence score) that reflects the integrity of the trusted data set taken from the point of origin, at the sensor edge.

ADI Intelligent Edge provides a wide range and high-precision sensor modality across energy, power, motion, vision, metrology, inertia measurement and more. By using a trusted data set that is relevant and valuable, customers can address the challenge of delivering digital insights.This new capability across the data signal chain helps deliver on the promise of digital transformation in the industrial sector.

ADI Intelligent Edge solves customers' toughest challenges, including:

Condition-based monitoring

In energy plants across the globe, millions of critical, low-voltage motors operate unmonitored. This can lead to numerous inefficiencies and result in costly, unplanned downtime and interruption of energy production. In addition, these plants are often spread across a massive footprint with extreme environmental conditions and temperature fluctuations. As a result, they represent imperfect locations to measure motor sound and vibration to determine the level of functionality and fault potential, making continuous monitoring impractical.

ADI OtoSense Smart Motor Sensor (SMS) is designed to solve this problem with a continuous health-monitoring solution for critical induction motors.[1] It is designed to provide real-time, continuous monitoring of motor health and deliver actionable insights. Closeness to the data origin uniquely enables the solution to constraints of latency, communication, inference, cost, weight, power and energy.

Thirty-seven percent of global total energy consumption is consumed by industry.[2] The ADI OtoSense sensor edge technology accurately generates performance insights in a constrained environment at the industrial edge.

Energy systems

ADI solutions for energy management, energy storage and power conversion help accelerate the transition to the clean energy grid.[3] By leveraging innovations in precision sensing, signal conversion, isolation, edge processing and power management technologies, ADI technologies support a wide range of applications, from renewables to microgrids, commercial grade energy storage, electric vehicle (EV) charging infrastructure and grid infrastructure and beyond.

Delivering trusted insights at the grid edge enables trusted measurement of power quality. It also provides critical data across energy conversion, management and storage as the energy market transforms consumers of energy to active participants in the grid of the future, where the provenance of green energy is a differentiator.

A partnership focused on data integrity

Dell Technologies has partnered with ADI to highlight a "first in the industry" sensor-to-application DCF. Dell Technologies and ADI will feature the integration of Dell PowerEdge servers with intelligent, hardware-based ADI root-of-trust sensor platforms, all managed by Dell NativeEdge.

[1] Analog Devices, ADI OtoSense, accessed June 2024.
[2] International Energy Agency, Energy System: Industry, accessed June 2024.
[3] Analog Devices, Energy Solutions, accessed June 2024.

Combining Dell DCF with ADI Intelligent Edge provides a data fabric with measurable trust across the data signal chain. As the compute stack becomes more distributed to unlock new data insights, constrained environments need the ability to prove data integrity through a trust fabric. ADI Intelligent Edge provides the true origin of sensor measurement at the highest precision and data fidelity with a weighted trust score built with Dell Data Confidence Fabric.

The integration of ADI root-of-trust technology into Dell Data Confidence Fabric allows upstream applications to fully trust the data generated. This is the first phase of a technical vision that will bring great benefits (detailed below) to edge customers in the months and years to come.

How it works

This describes the technical details of the Dell–ADI Data Confidence Fabric vision and platform. We invite our customers and partners to bring their use cases to the DCF platform and work with Dell and ADI to realize solutions.

Before describing the implementation of the Dell–ADI Data Confidence Fabric, consider the wiring diagram below. Figure 1 highlights a building management hardware configuration as built by ADI and Dell Technologies in a Dell lab. This initial configuration does not support a DCF.

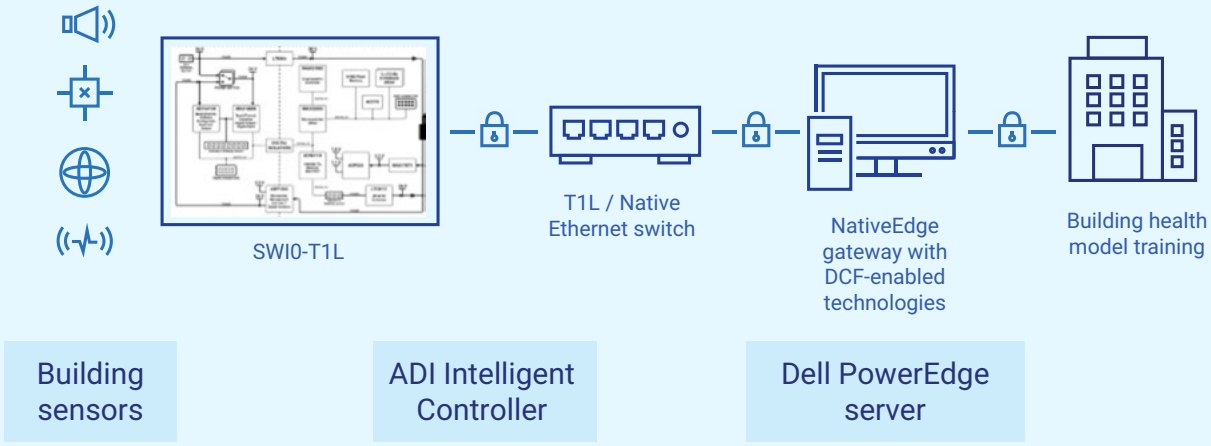


Figure 1: Building management hardware configuration (without DCF)

The elements of this architecture include:

- Four sensors collect information about temperature, vibration, electricity usage and rate of airflow.
- The sensors send their readings to an ADI intelligent controller board.
- The controller board is directly connected via Ethernet to a Dell PowerEdge server serving as a gateway and managed by Dell NativeEdge software.
- The data set of the readings collected over time can enable an ML training environment, allowing a customer to extract value from the operational data.

Without a data confidence fabric, the model-training environment must implicitly trust that the data has not been simulated, corrupted, poisoned or otherwise maliciously generated. With a DCF, the model-training environment can inspect DCF metadata for a confidence score.

These scores are generated by applying a customer-defined policy of weights to a stream of digitally signed annotations captured during the data's journey, providing explicit proof of the data's origin and handling along the way. Figure 2 highlights how a "DCF Overlay" can be securely installed and operationalized by NativeEdge.

Dell NativeEdge accomplishes this overlay through the following steps:

1. Define a blueprint within NativeEdge to run applications that will handle the confidence scoring process.
2. Define a blueprint for the applications running on the PowerEdge gateway. These include an ADI agent, which manages the connection to the controller board, and the customer's business application which has been integrated with the DCF SDK.
3. Facilitate a handshake with the ADI controller board, which establishes identity through a unique name and a public key. This information is available as needed by any application managed within NativeEdge.

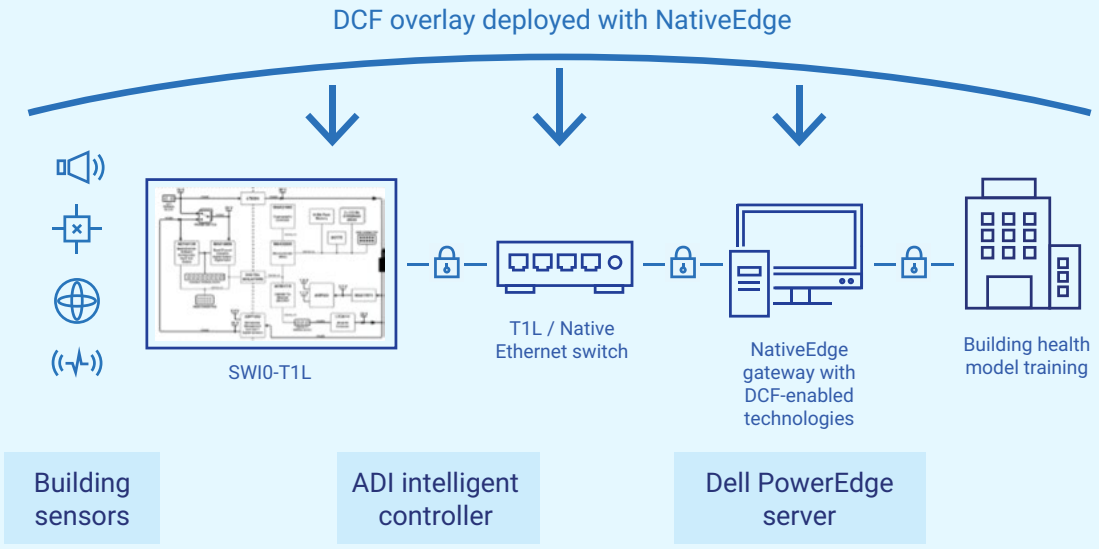


Figure 2: Building management hardware configuration (with DCF)

Once deployed by NativeEdge, each component can leverage the DCF API to annotate the trust journey of the edge data from creation to transit to analysis. These annotations are immutably stored in a distributed ledger.

Figure 3 depicts a post-deployment DCF by shading the hardware/software path in a transparent gold color, and integrating with a distributed ledger technology, or DLT.

With DCF enabled, data generated at the sensor level can be tracked for confidence.

1. The presence of DCF logic at the ADI level allows the intelligent controller to create and record DCF annotations such as:
   - Using root-of-trust technologies to assign digital signatures to the data.
   - Including environmental metadata about the current health of the sensors.
   - Using a secured communication channel (e.g., TLS) to forward the data.
2. Similarly, the presence of DCF at the Dell PowerEdge device allows the server to extend the chain of DCF annotations such as:
   - Receiving the data through a secured channel (e.g., TLS).
   - Verifying the data's digital signature (e.g., public/private key pair).
   - Validating physical host components, such as presence and version of a TPM.
   - Validating host secure boot.
   - Potentially using a Trusted Execution Environment (e.g., secure enclave) to process the data.
3. The DCF dashboard (top right of Figure 3) presents a confidence score associated with each piece of related customer data passed through the trusted data pipeline. Supporting annotations captured as factors of the overall score are also available for viewing.
4. The ML model-training environment can also inspect confidence scores related to any item within the overall data set. The training can "weight" the model-building process to place more trust in sensor readings that have these confidence scores.[4]

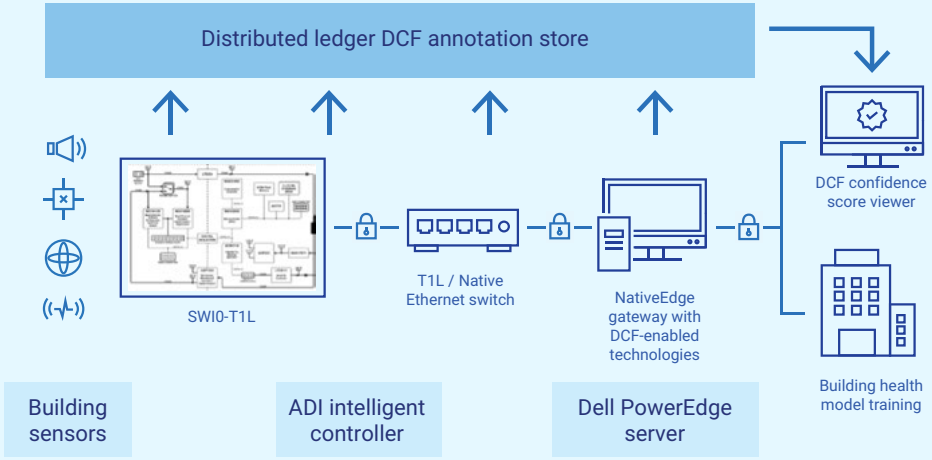
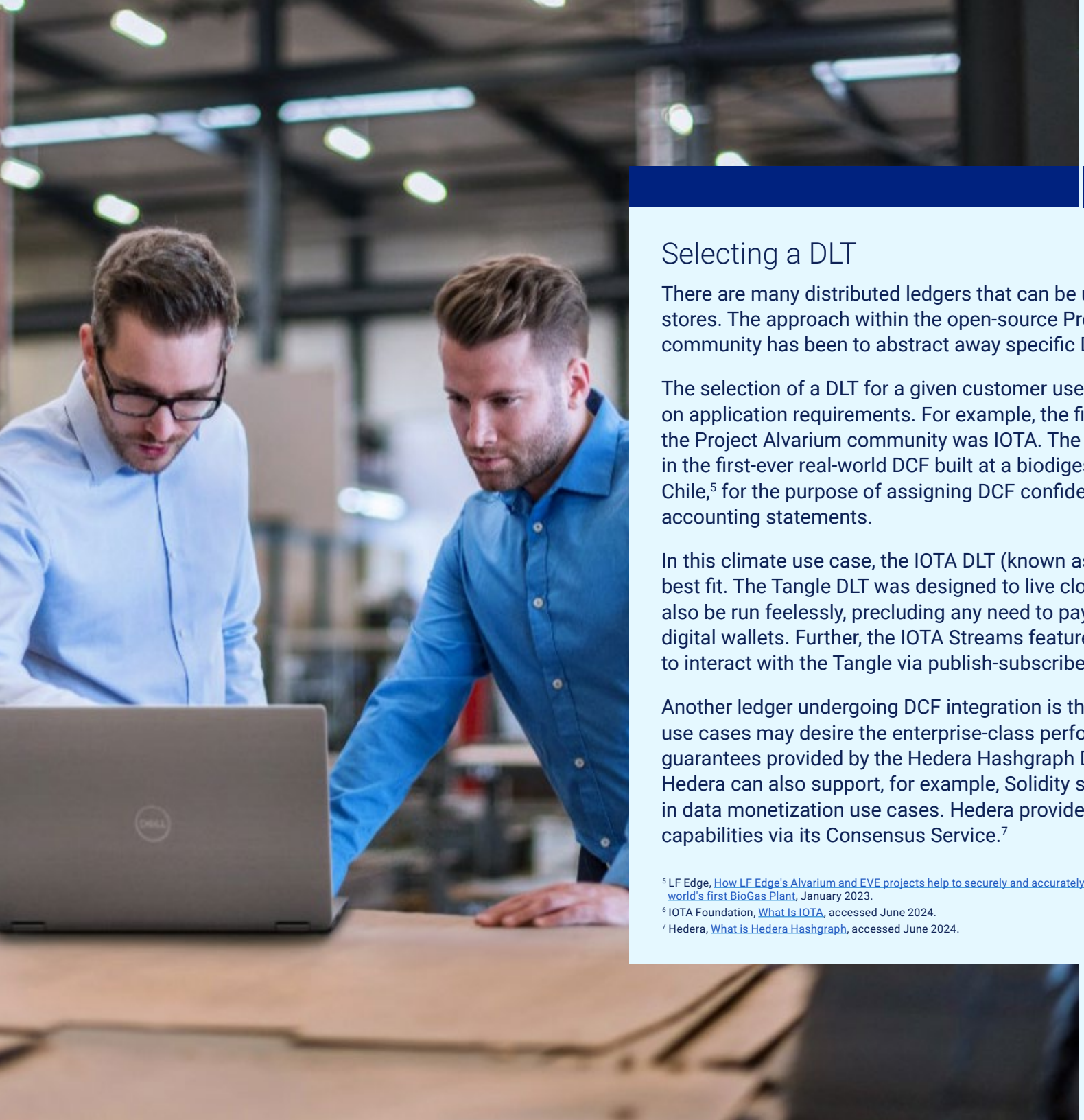


Figure 3: Building management hardware configuration (post-deployment DCF)

[4] As discussed in Murphy et al., Towards trust-based data weighting in machine learning, October 2023.



Selecting a DLT

There are many distributed ledgers that can be used as DCF annotation stores. The approach within the open-source Project Alvarium community has been to abstract away specific DLT dependencies.

The selection of a DLT for a given customer use case largely depends on application requirements. For example, the first DLT vendor to join the Project Alvarium community was IOTA. The IOTA DLT was deployed in the first-ever real-world DCF built at a biodigester facility in Molina, Chile,[5] for the purpose of assigning DCF confidence scores to carbon accounting statements.

In this climate use case, the IOTA DLT (known as the "Tangle")[6] was the best fit. The Tangle DLT was designed to live close to the sensor. It can also be run feelessly, precluding any need to pay gas fees or manage digital wallets. Further, the IOTA Streams feature allows an application to interact with the Tangle via publish-subscribe semantics.

Another ledger undergoing DCF integration is the Hedera ledger. Some use cases may desire the enterprise-class performance and resiliency guarantees provided by the Hedera Hashgraph DLT implementation. Hedera can also support, for example, Solidity smart contracts for use in data monetization use cases. Hedera provides publish-subscribe capabilities via its Consensus Service.[7]

[5] LF Edge, How LF Edge's Alvarium and EVE projects help to securely and accurately monitor the Carbon Footprint in the world's first BioGas Plant, January 2023.

[6] IOTA Foundation, What Is IOTA, accessed June 2024.

[7] Hedera, What is Hedera Hashgraph, accessed June 2024.

Design and deploy your DCF with Dell Technologies and ADI

The partnership between ADI and Dell Technologies leverages the DCF to bring an explicit lineage of trust to your data. There are several potential use cases for this lineage, including:

The DCF provides observability into the level of efficiency and modernization of the underlying compute stack. This could help certify operational targets for climate and sustainability goals.

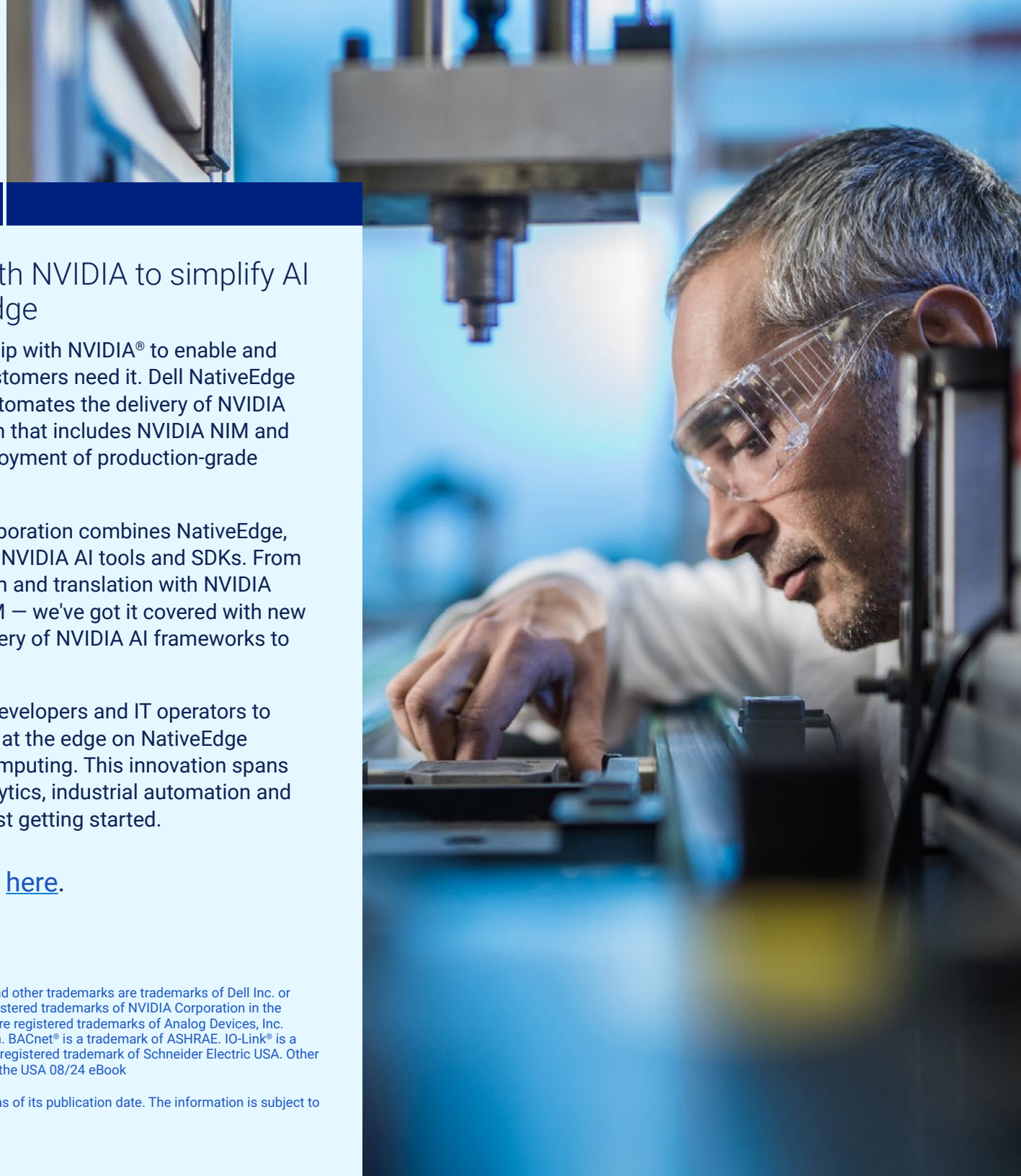
Integration of the DCF with a distributed ledger (such as Hedera) provides a mechanism to tokenize the provenance of a given data set, and then monetize it via a smart contract.

When training an ML model on a large data set, DCF provenance explicitly assures that the data is genuine and was not spoofed or otherwise tampered with. This could justify selling a given data set at a premium compared to data without provenance.

Customers will have more confidence in inference characteristics of models trained with a high level of data confidence.

Regulatory bodies define rules related to the provenance of model-training data sets to ensure privacy, energy efficiency, security and more. The DCF helps satisfy these requirements.

Click here to watch a short video that provides more detail on how this important partnership is designed to bring the DCF to life for organizations to leverage.



Dell NativeEdge collaboration with NVIDIA to simplify AI application deployment at the edge

Recently, Dell announced a strategic partnership with NVIDIA® to enable and accelerate AI applications everywhere that customers need it. Dell NativeEdge is the first edge orchestration platform that automates the delivery of NVIDIA AI Enterprise,[8] an end-to-end software platform that includes NVIDIA NIM and other microservices for development and deployment of production-grade applications.

For NVIDIA AI Enterprise customers, this collaboration combines NativeEdge, Dell's edge operations software platform, with NVIDIA AI tools and SDKs. From video analytics with NVIDIA Metropolis, speech and translation with NVIDIA Riva, to optimized inferencing with NVIDIA NIM — we've got it covered with new deployment blueprints that automate the delivery of NVIDIA AI frameworks to edge devices and beyond.

This NativeEdge capability makes it easy for developers and IT operators to develop and deploy AI solutions automatically at the edge on NativeEdge Endpoints, powered by NVIDIA-accelerated computing. This innovation spans a wide range of use cases, such as visual analytics, industrial automation and personalized retail experiences — and we're just getting started.

Learn more about Dell NativeEdge here.

[8]Based on Dell analysis, May 2024.