



AHEAD

Comprehensive Guide to

Building, Orchestrating,
and Managing Edge AI
Implementations at Scale

Introduction

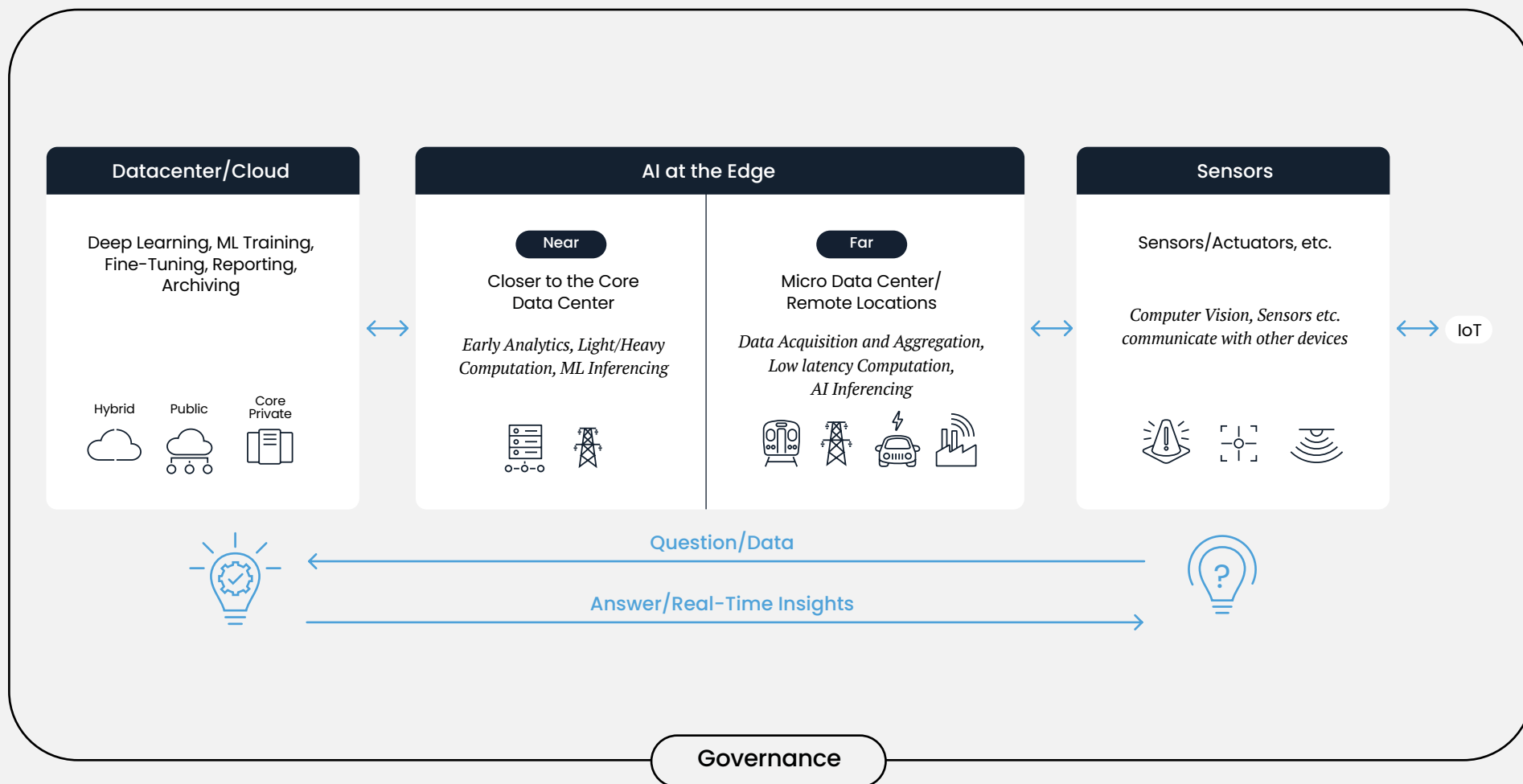
Many organizations are investing in next-generation technologies to operationalize edge AI. These devices are being used in transportation, utilities, manufacturing, retail, healthcare, and other industries for AI inferencing of sensor data to enable quicker decision making at the edge, resulting in higher efficiency and reduced safety and security risks.

However, there are still many barriers to large-scale adoption. Specialty hardware devices can be difficult to design and distribute to far edge locations around the world. There are also lifecycle challenges with managing and orchestrating large edge fleets long after they've been deployed.

In this comprehensive guide, we'll discuss the benefits of edge AI solutions and the challenges with implementing them. We'll also cover ways AHEAD can help build, orchestrate, and manage large-scale edge fleets.



Real Time AI Data-Based Operations and Optimizations



The Power of Edge Solutions at Scale

Transportation

PUBLIC TRANSIT, RAIL, AND FREIGHT INDUSTRIES

Edge AI is transforming safety and operations for railways, road crossings, airport traffic control, and many other aspects of transportation. Data from cameras and other sensors can enable computer vision solutions that detect potential hazards and security risks across massive transportation networks before they become an incident.

Sensor data generated by vehicles can also be leveraged to create AI models that optimize route planning, reduce congestion, and further enhance safety measures. Edge devices for monitoring and optimizing public transit and freight operations can lead to improved efficiency and customer satisfaction.

In addition, the Railway Safety Act requires freight carriers to install wayside defect detectors that can visually inspect railways at frequent intervals along thousands of miles of track. Given the scale of these deployments, and the fact that most endpoints are unstaffed, automated provisioning and management for these industrial edge systems will be imperative.

Learn more with our recent guide: [Industrial Edge for Rail](#).

Manufacturing

AUTOMOTIVE, PHARMACEUTICAL, AND OTHER MANUFACTURING

Automotive companies, drug manufacturers, and many other industries with production facilities are turning to edge AI systems to improve efficiency and safety. For example, AI applications can analyze data from edge sensors deployed throughout factories to predict issues and defects before they lead to quality issues or accidents.

AI software also streamlines workflow management, enabling manufacturers to enhance productivity and minimize downtime on the factory floor. Sensor data generated by manufacturing equipment and processes can be analyzed using AI models to optimize production lines, detect anomalies, and improve quality control.

Enterprises in manufacturing are also using digital twins for simulation, generating synthetic data that can be used for computer vision model training. Edge AI will be at the forefront of the techniques used to drive the Industry 4.0 transformation.



Healthcare

The healthcare industry's digital transformation is rapidly evolving as more data is collected and generated from various sources, such as electronic health records, medical images, operating room procedures, wearable devices, and genomic sequencing. This data has the potential to improve diagnosis, treatment, and prevention of diseases, as well as enhance patient care and satisfaction.

Edge AI can improve the quality and diversity of healthcare data, as it can collect and process data from various sources and modalities and enrich it with contextual and situational information. This can enable more comprehensive and personalized insights and actions and support data interoperability and standardization. Using camera feeds in applications such as endoscopy and patient monitoring can speed up decision making. For example, when a camera sees an anomaly in an endoscopic procedure, the surgeon, in human language, can interact with an LLM on the same edge device; the LLM can report back an analysis of what's seen on the video feed to accelerate a diagnosis.

Learn more from our recent article: [The Transformative Power of AI in Healthcare](#)

Retail

As eCommerce grows, many retailers with brick-and-mortar stores are looking into AI technologies to transform how they run stores, manage inventory, and interact with customers in order to stay competitive in the industry. Smart retail – the integration of traditional shopping in physical stores with new technologies like AI and edge devices – can help retailers enhance customer experiences and business operations.

Retailers can use real-time data to offer tailored promotions and suggestions to customers at a large scale. Data gathered from edge sensors like cameras and beacons can give retailers real-time insights into foot traffic, traffic patterns, loss prevention, and customer behavior to improve product placement while protecting their anonymity.

A digital twin of a physical store can help simulate the store's layout, the position of products, and the location of shoppers, all of which helps immensely in AI model training. Retailers can update the digital twin in real-time from the streaming camera data. The placement of cameras is crucial for the system to work effectively. A properly trained AI model will help find needles in a haystack, such as detecting and preventing theft like workers giving sweetheart deals to acquaintances or stealing cartons.

Edge data intelligence also makes inventory management smarter. Using edge devices, RFID tags, and other sensors to monitor inventory levels in real time, retailers can ensure shelves are always well stocked.



Oil & Gas

Many energy companies are increasingly relying on computer vision for applications ranging from pipeline inspection to remote production tracking, detection of methane gas leaks, and enhancing health and safety. These systems require complex edge deployments at far-flung and frequently difficult-to-reach locations, such as offshore platforms, that make in-person IT visits impractical.

Computer vision can now perform tasks that were traditionally monitored by humans, such as perimeter security and monitoring of flares and processes. This technology can detect hazardous conditions, such as leaks or changes in flare chemical composition, through temperature and color analysis. This is crucial in preventing fires, detecting them, and facilitating emergency response to catastrophic events like explosions. Flare monitoring also helps achieve smokeless flaring, reducing the carbon footprint and minimizing environmental impact.

Edge orchestration software also allows organizations to manage their edge devices remotely instead of sending engineers to sites for maintenance and upgrades. This ensures uninterrupted service delivery, enhanced safety, and efficient resource allocation for energy infrastructure across vast geographic areas.



Utilities

UTILITIES AND PUBLIC SECTOR INDUSTRIES

Energy, water, and other private and public utilities operate in widely distributed locations and harsh landscapes where in-person visits may be unrealistic, especially along large stretches of service delivery to remote and rural locations. Millions of sensors at the edge are generating valuable data being used to train their AI models. These models are operationalized at the edge through inferencing so that real time action can be taken to improve service quality, safety, and price competitiveness.

Energy companies, for example, are installing edge computing devices with fixed cameras on poles to monitor grid asset health. They are also using computer vision solutions on service trucks to take pictures of every pole along their route using AI software to identify and assess the health of the gear.

Water and wastewater companies are revolutionizing their industry with AI driven approaches that streamline operations and use real-time data for water quality monitoring, leak detection, emergency management, and security to make informed decisions.

Wind energy companies are relying on highly accurate computer vision models to detect ice accretion, turbine cracks, and lightning strikes. Fixed cameras and edge AI devices provide the ability to take real-time action and avoid potential down time compared to deploying drones for inspections. In wind energy delivery, smart grids provide real-time energy supply and demand management, reducing the risk of blackouts while saving money on energy generation, transmission, and distribution.



Modernizing Trackside Edge Hardware with AHEAD

A large railroad company needed to replace legacy equipment at trackside locations with ruggedized connected gateway devices. This would allow the company to improve the reliability and efficiency of its railway detectors and keep trains operating safely.

AHEAD's engineering team designed a rugged, fanless hardware solution that can withstand extreme weather conditions and vigorous vibrations. This new hardware is designed to support multiple trackside use cases and network connectivity options. By leveraging AHEAD's global supply network, the railroad company is able to quickly distribute these new devices to remote trackside locations.

Along with the hardware design and logistics, AHEAD is also providing asset management and orchestration software. The AHEAD Hatch IT lifecycle management platform gives in-depth visibility into procurement, inventory, logistics, warranties, service contracts, and other business intelligence information. Hatch, in conjunction with orchestration software, facilitates bulk application deployments and updates with zero-touch provisioning across edge fleets. These software platforms will be crucial for managing the industrial edge solution long after deployment.

The Challenges with Edge Deployments

Device Deployments

When designing and implementing an edge solution across many sites, it's difficult to manufacture and configure devices to ensure they are all compatible, particularly with phased roll outs. Interoperability and consistency are necessary to keep edge systems running smoothly and adequately equip them for periodic updates to software and firmware over their lifecycle.

Many edge devices also need to be mounted differently than a typical rack mount in a data center. These devices may also need different connectivity options depending on the deployment location. Sites in remote areas, near railways or pipelines, and even some factories, for example, may not have the usual connections or the capacity to rapidly send data to central systems, which means they need to have inferencing capabilities on the device.

Dust, dirt, and extreme temperatures in industrial and production settings make rugged hardware and cases necessary for edge devices. Outdoor devices also may have to withstand harsh weather and other environmental difficulties like shaking near train tracks or big machines. Edge settings may need different mounting options, such as wall mount, DIN mount, or another method.

Asset Lifecycle Management

Deploying thousands of hardware assets to a wide range of remote sites is complicated. Keeping track of assets inside data centers is not without its challenges, but not nearly as hard as managing edge assets at scale. With potentially thousands of geographic locations, knowing where assets are located with GPS coordinates of latitude and longitude may be necessary, particularly for industrial edge deployments.

Lifecycle management software can track these edge devices and their components, software/firmware, support contracts, and license expirations throughout their entire lifecycle — from manufacturing to deployment to updating to decommissioning.

Bill of Materials Management

Edge asset management requires not only tracking where and how devices are deployed, but also how the hardware is manufactured and configured, and that compliance with government regulations are transparent and traceable.

Large scale deployments handle thousands of devices over several years, and not every site will necessarily be handled the same. Deployment tiers may be configured based on various site criteria. This means multiple BOMs may need to be maintained and tracked to exactly which sites received which tier configuration. Keeping consistency across hardware and software during these deployments is crucial when the device lifecycle is designed to span 3-5 years before needing to refresh the hardware.

The ability to freeze a bill of materials (BOM) so that vendor changes upstream don't affect devices in the field is critical. When roadmaps indicate a component will be reaching end of life, a documented revision control process ensures any necessary change is tested, reviewed, and approved prior to updating the BOM.

Changes like this without management can cause major disruption when executing upgrades in the field, creating downtime and expensive onsite efforts that delay timelines and increase management costs.

Managing Edge Devices with AHEAD Hatch

AHEAD Hatch is IT lifecycle management software that can help you track your hardware assets from procurement and manufacturing through to deployment and support. Hatch project management features streamline comprehensive or phased rollouts for consistency across sites. Asset management is visible at the site-level, giving you the ability to trace any asset to its exact location.

Hatch can manage thousands of devices and components, including their firmware levels, BIOS, software image revisions, harvested hardware data, warranties and service contracts, and more. When integrated with other trusted enterprise platforms such as ServiceNow, Hatch acts as a single pane view of your infrastructure deployments, sharing relevant asset data in real-time. Integration with edge operations software platforms such as Dell NativeEdge is straightforward and easy to execute.

Learn more about [AHEAD Hatch](#) for IT Asset Lifecycle Management.

Edge Management and Orchestration (EMO)

Managing the software on thousands of edge devices can be daunting. Edge orchestration requires monitoring the health of these systems and managing updates to their firmware, BIOS, and applications at scale. It's not realistic for IT teams to provision and manage these devices in the field manually.

Modern edge orchestration solutions provide the ability to securely push updates across the entire fleet using zero-touch remote provisioning. This is crucial for managing edge sites that are frequently unmanned, widely geographically distributed, and too numerous for hands-on IT configuration and updates.

Implementing Edge AI Solutions with AHEAD

AHEAD is a leading provider of enterprise technology solutions that can help you deploy, orchestrate, and manage a large-scale edge ecosystem. Our edge solutions are customized to meet the needs of your specific use case, whether you operate in retail, healthcare, transportation, or any another industry.

Software Building Blocks

Purpose-built pre-trained software models and developer toolkits eliminate the need to build models from scratch. AI accelerator developers like NVIDIA, Intel, and Google can get AI developers 80% of the way to a functioning application and only need to be fine-tuned for many inferencing solutions.

Integration

Provisioning edge devices in the field is challenging for a number of reasons. The biggest obstacle can be the unpredictability of cellular coverage across installation locations. When cellular connectivity is slow or non-existent, it increases installation time and expense. A better option is to work with a provider that offers in-house integration services, enabling devices to be provisioned as far as possible before deployment and keeping costs within budget.

AHEAD offers integration services for industrial edge hardware, including imaging, configuration and testing. We can also integrate and install the hardware in ruggedized enclosures and kit components like cables and cameras to enable you to deploy a turnkey solution. Finally, we can execute your field installation services at scale, providing you with the opportunity to work with a single source for all the products and services you need.

Certifications

Industries have unique requirements for regulatory compliance on electronic equipment such as edge devices. For example, the rail industry requires EN 50155 certification that has stringent standards in operating conditions, product design and documentation, testing, integration, and software.

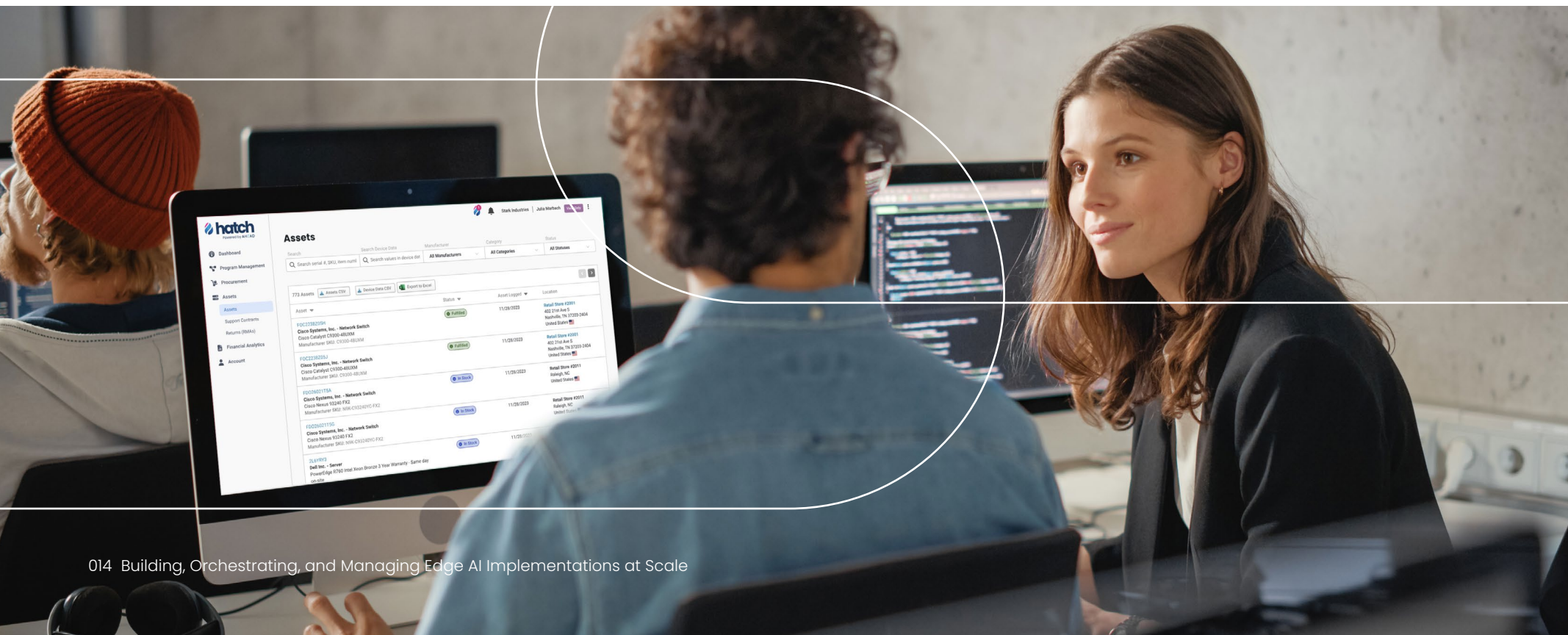
AHEAD has in-house certification services to handle industry regulations and country-specific certification for global operations. Our specialists are dedicated to ensuring your integrated edge devices are compliant in any country they may be installed.

Global Logistics

AHEAD has decades of global logistics and supply chain expertise, allowing us to streamline the distribution of complex edge hardware to retail stores, petroleum pipelines, municipalities, and other remote sites around the world. Kitting services in our warehouses include any additional materials necessary for installation at the deployment sites. We can also assist with creating quick start guides to make field installation as seamless as possible.

Asset Management

AHEAD Hatch IT lifecycle management software streamlines the management of thousands of edge locations, devices, and components. This includes component-level visibility for lifecycle management and bill of materials management. Hatch tracks detailed supply chain data as well as data about the components themselves, such as software licenses, warranty periods, MAC addresses, asset tags, and component serial numbers. This information is crucial for transparent asset tracking at scale.



Fleet Management

AHEAD provisions software solutions on edge devices to orchestrate a full-fleet implementation and periodic updates, allowing organizations to manage their edge devices remotely instead of sending engineers to sites for maintenance and upgrades. This ensures uninterrupted service delivery, enhanced safety, and efficient resource allocation for infrastructure across vast geographic areas.

These solutions support VMs and container deployments, so you can quickly and securely push application updates across your entire fleet using zero-touch remote provisioning throughout the product lifecycle. They also enable remote health monitoring and updates to the firmware and BIOS, for comprehensive remote management.

Security

AHEAD ensures a full chain of custody for components that comprise your edge solutions, which is traceable in Hatch. Our custom hardware can be designed with a foundational level of security, which includes implementing the trusted platform module (TPM) and other hardening measures. We also provide a secure supply chain from factory to field to prevent vulnerabilities within the hardware, firmware, BIOS, or other aspects of the edge solution.

Post-Deployment Evolution and Support

As industries evolve, so too must their technological ecosystems. AHEAD recognizes the critical importance of adapting to generational changes in technology and operational practices. Our comprehensive post-deployment strategy ensures that each site is equipped to manage these transitions smoothly, fostering an environment of continuous improvement and innovation.

Generational Change Management

AHEAD employs a tailored approach to change management that addresses the unique requirements of each deployment.

Lab Instances for Each Generation

To ensure compatibility and performance across different technology generations, AHEAD offers dedicated lab instances. These labs allow for rigorous testing and validation of new technologies against existing deployments, ensuring seamless integration and operation.

DevOps for Pre-Deployment Testing

Leveraging DevOps principles, AHEAD facilitates comprehensive pre-deployment testing. This approach enables us to simulate various operational scenarios and generational interfaces, ensuring that new deployments are fully optimized and ready for real-world challenges.

This proactive strategy not only enhances operational efficiency but also ensures that our clients remain at the forefront of industrial edge technology. By embracing a philosophy of ongoing testing, adaptation, and optimization, AHEAD helps your organization navigate the complexities of technological evolution, ensuring that you are always prepared for the future.

[Contact AHEAD](#) to learn more about our comprehensive set of services to implement your fleet of industrial edge devices faster and more efficiently.

AHEAD

AHEAD builds and manages digital platforms that power the most successful organizations in the world. Our consultative approach, unmatched engineering, and innovative solutions combine to accelerate the impact of technology for every client we serve.

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