

Case study

# Enabling smart factories with 5G-driven computer vision

Hitachi Astemo validates  
private 5G wireless for  
mission-critical production  
line automation



**ERICSSON**

 Hitachi America, Ltd.



# How 5G-driven cloud and machine learning solutions are transforming manufacturing

**Case Study:**  
Hitachi

**Industry:**  
Automotive

## Executive summary

Automotive component manufacturer, Hitachi Astemo, is continually exploring innovative solutions to help its customers improve quality, efficiency, and productivity. The company's production and engineering teams wanted to explore potential use cases for 5G technology in the manufacturing industry and engaged Hitachi America R&D, Ericsson, and Amazon Web Services (AWS) to collaborate in that effort. After identifying several potential use cases for 5G-enabled computer vision, the companies set up a trial of a model private 5G wireless infrastructure at Hitachi Astemo's manufacturing plant in Berea, Kentucky. Leveraging Ericsson 5G radios, AWS edge-to-cloud technologies, and Hitachi's video analytics suite, the trial

determined that 5G provides stable, reliable connectivity for manufacturing use cases leveraging AI and ML models. For one use case, defect detection, the trial demonstrated that computer vision using 5G could simultaneously inspect 24 assembly components compared with one-by-one inspection using conventional approaches. The trial also showed that a 5G infrastructure with edge and cloud technologies could scale integrated use cases effectively across multiple global manufacturing sites quickly and cost-effectively while abstracting out networking and compute infrastructure complexities from the end user. The Hitachi/Ericsson/AWS teams further concluded that additional innovations on a 5G infrastructure could offer manufacturers opportunities to enable smart factory capabilities and automate and optimize their operations from end to end.

## Exploring the art of the possible with 5G

If machines could see, what would they reveal that human eyes cannot? In a collaborative effort to pursue the art of the possible, Hitachi, Ericsson, and AWS explored this question in depth.

To find an answer, the three companies embarked on a ground-breaking trial at the Hitachi Astemo Americas manufacturing plant in Berea, Kentucky. The focus: how real-time digital video could leverage artificial intelligence and modern edge-to-cloud technologies across a private 5G wireless network to make computer vision a viable solution on the manufacturing floor. The results of the trial suggest broad operational and business impacts, from improving product quality to lowering costs to optimizing the entire supply chain ecosystem.

It all started with a bold idea—and a spirit of cooperation.

Shoji Yunoki, project lead in engineering and research at Hitachi America, Ltd., explains, "My team's role is to explore and validate new use cases enabled by 5G, specifically for the manufacturing industry. This requires the right combination of technical components from companies willing to invest their time and resources in the innovation process."

Collaboration is embraced by many organizations as a key enabler of innovation. But it is often difficult to achieve, especially when multiple independent companies are involved. Ericsson was committed to orchestrating the collaborative process with Hitachi and AWS to bring out the best of what

each company's technology can contribute to transforming the manufacturing industry. The key was to get all three stakeholders together in a lab environment to work with the 5G, cloud, and analytics technologies in play, develop viable use cases, and test their ideas in a real-world manufacturing environment.

Sudhanshu Gaur, vice president of R&D for Hitachi America and chief architect at Hitachi Astemo Americas, remarks, "Ericsson volunteered the use of their lab in California and brought in AWS to work with us. To be clear, this was an incubation exercise, not a commercial engagement. All three parties were focused on exploring innovative ways for leveraging 5G in a manufacturing setting and how to bring value to the industry."

With Ericsson's leadership in 5G technology and manufacturing-specific industry expertise, the company was ideally positioned to lead the collaboration effort with Hitachi and AWS. Shoji notes, "Ericsson has knowledge and experience about how 5G can be deployed in a manufacturing environment because they're investing in 5G for their own plants."

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— Shoji Yunoki, Project Lead, Engineering and Research, Hitachi America, Ltd.

## At-a-glance

### Goal:

Validate the feasibility of using 5G, cloud, and machine learning models for computer vision use cases in a manufacturing environment

### Approach:

- Engage Hitachi, Ericsson, and AWS in a collaborative incubation exercise to explore potential use cases for private 5G and edge-to-cloud technologies in production manufacturing operations
- Conduct a computer vision trial at Hitachi Astemo Americas manufacturing plant employing Ericsson 5G radios, AWS Snowball Edge device, and Hitachi video analytics suite
- Validate the model 5G architecture for select computer vision use cases

### Results:

- Deployed trial private 5G wireless infrastructure in three days compared with weeks required using traditional network technologies
- Validated 5G as a stable, reliable network for manufacturing use cases leveraging AI and ML models
- Enabled simultaneous defect inspection of 24 assembly components versus one-by-one inspection using conventional approaches
- Demonstrated that defects can be detected earlier in the assembly process for greater quality assurance and the potential for significant cost savings by reducing waste

# 24X

More components  
simultaneously inspected

## Leveraging collaboration to turn ideas into solutions

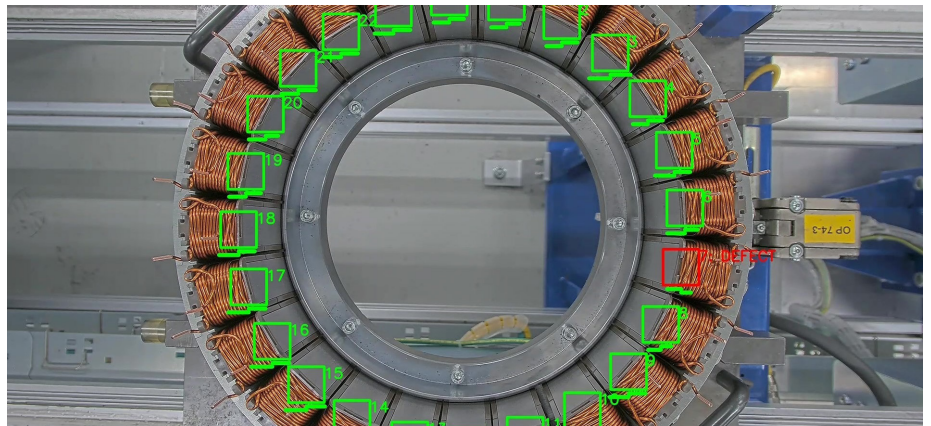
Hitachi has a long history of innovation, driven largely by what the company hears from its customers. Sudhanshu notes, “Co-creation with customers is a key part of how Hitachi innovates. Our R&D organization and our partners in this trial, Ericsson and AWS, are looking to solve real-world challenges customers face in the manufacturing industry every day.”

In recent years, the industry buzz has been around using video analytics for product inspection and other production line applications to improve operational efficiency and product quality. But the unique characteristics of the manufacturing environment presented a challenge to making video analytics feasible.

For example, operations and IT staff both would have to divert precious time and resources to the project—from positioning the cameras to running cables (needed to get enough performance for mission-critical use cases) to building IP addresses for each camera to onboard them onto the IT platform. The entire process could take anywhere from several weeks to several months to complete just for one plant. Scaling the setup across multiple manufacturing sites is another challenge.

This is where the Hitachi/Ericsson/AWS team saw possibilities to leverage private 5G and cloud technologies.

“Private 5G with cloud is a great enabler of scale and cybersecurity,” Sudhanshu says. “5G dramatically simplifies the network complexities typically associated with other wired and wireless solutions. It streamlines the onboarding process for devices, such as cameras, eliminating labor-intensive manual procedures and reducing potential cybersecurity risks. Thanks to cloud technologies, configurations can be effortlessly replicated from one factory to another, anywhere in the world. This enables the secure deployment of thousands of devices along production lines globally, in significantly less time, driving ROI with minimal customization required for scaling.”



“Pairing private 5G with cloud technology not only enables vast scalability but also strengthens cybersecurity, dramatically simplifying the network complexities often encountered with other wired and wireless solutions.”

— Sudhanshu Gaur, Vice President of R&D, Hitachi America and Chief Architect, Hitachi Astemo Americas

## Validating 5G-enabled computer vision use cases

In the trial at Hitachi Astemo Americas, which makes automotive components, the teams from Hitachi, Ericsson, and AWS focused on validating private 5G and cloud technologies for a select number of computer vision use cases. Hemant Rawat, lead, 5G architecture at AWS, remarks, “In this collaboration, each partner brings unique value and capabilities that complement one another. Ericsson is the leading player in 5G, AWS is renowned for our cloud and edge technologies, and Hitachi brings the knowledge and insights of a major global manufacturer with deep OT and IT know-how. Customers tell us the key advantage of such a collaboration is our joint ability to deliver real business outcomes.”

The team set up cameras on a live production assembly line that produces electric vehicle components. In the trial, real-time video of the component assembly operation was fed across the Ericsson private 5G network to an AWS Snowball Edge device running Hitachi video analytics. By using 5G wireless rather than traditional network technologies the trial installation was completed in three days.

Sudhanshu remarks, “The fact that we were able to set up this 5G infrastructure in an automotive manufacturing environment and do that in less than a week’s time, I thought was pretty amazing.”

One of the prime use cases in the trial focused on defect detection. With defect detection, the objective was to use video analytics to catch deviations from quality standards in real-time and issue an alarm or send a command to halt assembly.

Using high-definition 4K cameras, the trial computer vision configuration was able to observe defects at the sub-millimeter level—far greater visibility than would be possible with the human eye. The high throughput and low latency of 5G was key to uploading huge volumes of video data from the cameras to the cloud edge platform for analysis and decision-making.

Sudhanshu notes, “If you’re consuming data for statistical inference that ultimately controls production machinery, it’s critical to have an underlying network infrastructure that is reliable and secure. Private 5G is a no-brainer for that.”

Hemant adds, “For mission-critical uses cases such as defect detection on a manufacturing line, you need to have millisecond-level latency, which is exactly what 5G promises. Security is also essential, which is why communication is handled using encryption and various authentication protocols throughout the 5G infrastructure.”

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### Trial results show higher performance and reliability for quality inspections

The trial results showed that computer vision leveraging a private 5G wireless network and cloud technologies could outperform manual inspections for detecting defects, and it revealed insights that could have much broader implications for manufacturers over the long term.

Shoji reports, “We saw better performance with 5G for every use case we trialed. Computer vision using a 4K video stream and the high bandwidth of 5G could inspect 24 parts simultaneously, compared with conventional approaches that inspect them one by one.”

With such rapid inspection by computer vision, defects can be detected earlier in production and corrected before they impact quality of the final product. And quality issues also have cost implications.

Sudhanshu explains, “Manufacturers use a metric, cost of poor quality or COPQ. This cost comes from waste material when defects show up in a finished component, as well as from lost production. Using computer vision to catch defects early could help manufacturers reduce COPQ significantly.”

Shoji adds, “Our main takeaway from the trial is 5G can bring stable, reliable connectivity for manufacturing use cases leveraging AI and ML technologies. In this case, we were able to accelerate deployment of AI/ML models on

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an AWS Snowball Edge device. Next, we will look to validate the scalability of these use cases.”

### Enabling global scalability with 5G and cloud

Scalability has historically been a major hurdle for widespread deployment of visual analytics and other digital solutions in the manufacturing industry. Most manufacturers have multiple production sites; Hitachi Astemo, for instance, has 140 manufacturing sites around the world. And scaling is essential for Hitachi and other manufacturers to realize a return on their investment.

As the computer vision trial demonstrated, the combination of 5G and cloud technologies is now making full-scale, global deployment of digital production line applications viable—from defect detection and quality inspection to robotics automation, real-time machine control, augmented reality, and more. As noted previously, private 5G enables rapid deployment of digital cameras and other edge or IoT devices nearly anywhere on the shop floor. It also accelerates uploading AI/ML models from the edge to the cloud where they can be trained, refined, or tailored for other manufacturing plants and redeployed.

Hemant explains, “With statistical inferencing, you are collecting a lot of data at the edge. But then you can upload that data to the cloud for additional ML training to fine-tune the model. When deploying ML models to other manufacturing sites, we just load the image onto our edge device, and they are good to go. This can all be done within a week’s time.”

He adds, “The initial model may be for one particular use case. But in the cloud, you can easily build on that foundational model to support additional use cases and deploy those to sites anywhere in the world.”

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— Hemant Rawat, Lead, 5G Architecture, AWS

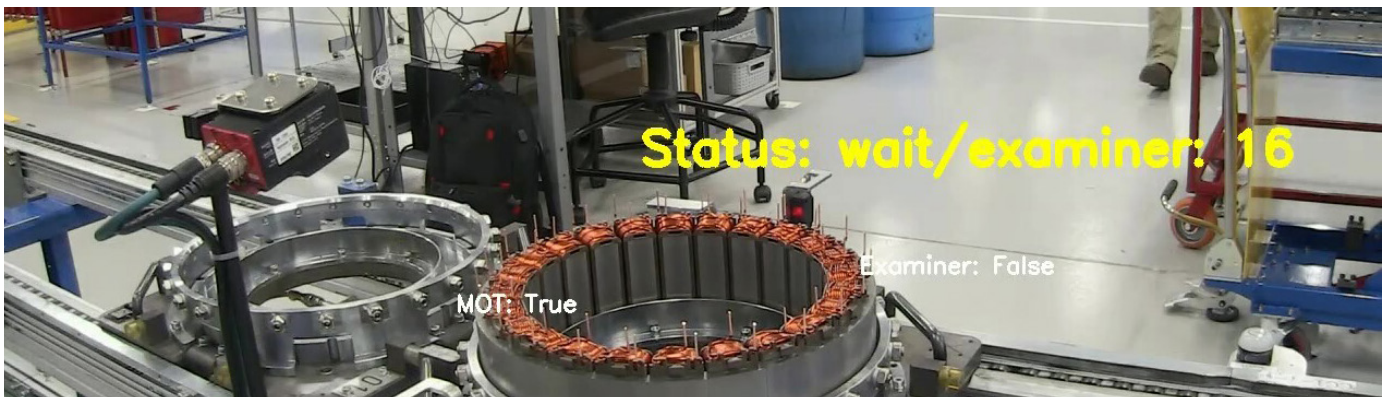
### Delivering far-reaching impact to the manufacturing industry

The insights gained from the Hitachi Astemo trial have broad implications for the manufacturing industry as a whole. Data of all kinds can be collected from production lines and uploaded to the cloud for additional analytics and AI-driven solutions that are integral to the smart factory of the future.

“The capabilities of 5G can be complemented by the various cloud and edge services AWS provides to create a smart factory and enable Industry 4.0 capabilities,” Hemant says. “These capabilities primarily revolve around, digital twins, predictive maintenance, automated material management, or inventory tracking that enables greater production optimization.”

Additionally, the connectivity enabled by private 5G wireless will soon converge operational technology and information technology, further extending valuable insights and opportunities for automation from the shop floor to the C-suite and across the entire supply chain ecosystem.

Sudhanshu points out that IT/OT convergence is already underway at Hitachi: “At Hitachi Astemo, we blend the data produced on our factory floors with business data collated from our manufacturing sites worldwide. This fusion of information empowers our production and engineering teams, working in tandem with our data scientists, to fine-tune our



manufacturing processes and optimize procurement and inventory operations. The result is enhanced decision-making capabilities across the company, ultimately driving increased efficiency and profitability."

The computer vision trial at Hitachi Astemo Americas is just the beginning, and it provides a model for how companies can reimagine traditional roles to help move an entire industry forward. For instance, Hitachi might traditionally be viewed as a customer to both Ericsson and AWS; Ericsson could be considered an AWS customer and vice versa. But in this case, all three companies set aside their respective commercial interests to pursue pure innovation as collaborative partners.

Alan Minney, Ericsson's global lead for strategic partnerships, remarks, "We traditionally think of the customer as the buyer and the technology provider as the supplier. For emerging technologies such as 5G and its associated use cases, we must revise our thinking to understand that the customer is our collaborative partner."

Viswanath Kolar, Ericsson's senior director of manufacturing solutions, adds, "Our objective was to come up with a solution that can be

deployed with minimum disruptions and operationalized quickly. Through this trial with Hitachi and AWS, our collaboration creates a blueprint for how to deploy these types of technologies in a manufacturing environment."

In fact, validating the use of private 5G wireless, edge-to-cloud, and AI/ML technologies in a manufacturing environment now opens a world of new opportunities for Hitachi and other companies to automate and optimize their operations from end to end. Sudhanshu advises that from here the future holds the promise of additional innovation: "On the road map for us is further validating use cases for the pervasive connectivity enabled by 5G, building more tunable cloud-based AI/ML models, and developing solutions for our customers that bring them long-term value."

Sudhanshu concludes, "Working with collaborators like Ericsson and AWS to identify commercially viable solutions for our customers is an important part of what we do at Hitachi. By investing in innovation today we see great opportunities to have a lasting positive impact on the manufacturing industry of tomorrow."

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## Solution Highlights

### Improving quality and efficiency on manufacturing production lines

Hitachi America R&D, in collaboration with Ericsson and AWS, is leading the manufacturing industry in innovating on new 5G-enabled computer vision use cases that offer broad operational and business impacts, from improving product quality to lowering costs to optimizing the entire supply chain ecosystem.

### Transformational solution

- Groundbreaking computer vision solution leveraging private 5G wireless, cloud, and AI/ML models to enable manufacturers to detect product defects more precisely and earlier in the production process for improved product quality and reduced cost of waste

### Radio Network

- Ericsson indoor 5G mmWave
- LTE Radio Dots
- Ericsson AIR 1281 Radios
- Ericsson Street Radio 4402

### Edge Network

- Ericsson Private Network core
- AWS Snowball Edge device
- Hitachi video analytics platform

### Solution advantages

- High bandwidth, low latency connectivity with reliable and predictable performance
- Single future-proof network supporting multiple use cases
- Favorable cost efficiency compared to Wi-Fi
- Rich device ecosystem provides choices for communications
- End-to-end security on both network and device levels
- Faster return on investment
- Extensive scalability and flexibility
- Higher capacity and coverage
- Reduced interference



## About Hitachi Astemo Americas

Hitachi Astemo Americas, Inc. manufactures and markets engine management, electric powertrain and integrated vehicle controls for major automotive manufacturers worldwide, adhering to ISO/TS:16949:2009 industry standards. For more information, visit <https://am.hitachiastemo.com/>.

## About Hitachi America R&D

Hitachi America R&D was established in 1989 as part of Hitachi's strategy to locate research centers close to industry-leading markets. Over the years, Hitachi America R&D has pursued research with leading business partners and research institutions, supporting Hitachi's Digital, Sustainability, and Industries businesses. For more information, visit: <https://www.hitachi.us/rd/>

## About AWS

Amazon Web Services (AWS) is the world's most comprehensive and broadly adopted cloud, offering over 200 fully featured services from data centers globally. Millions of customers are using AWS to lower costs, become more agile, and innovate faster.

AWS for Telecom is raising the bar on what's possible for CSPs. Harnessing our robust, mature, proven platform, we deliver innovative use cases that are digitizing industries, transforming telcos, and reimagining the consumer experience. With the power of a cloud infrastructure that's architected to be flexible and secure, let us help take your business to the next level through simplifying your operations, cloudifying your networks, monetizing your assets, data and 5G for growth; and through innovation in AIMA, including generative AI for telcos.

## About Ericsson

Ericsson enables communications service providers and enterprises to capture the full value of connectivity. The company's portfolio spans the following business areas: Networks, Cloud Software and Services, Enterprise Wireless Solutions, Global Communications Platform, and Technologies and New Businesses. It is designed to help our customers go digital, increase efficiency and find new revenue streams. Ericsson's innovation investments have delivered the benefits of mobility and mobile broadband to billions of people globally. Ericsson stock is listed on Nasdaq Stockholm and on Nasdaq New York. [www.ericsson.com](http://www.ericsson.com)

