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How Noteworthy AI Helped to Automate FirstEnergy's Real-time Inspection of Distribution Grid Assets

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KEY TAKEAWAYS

- Dell Technologies offers strong market solutions specific to the electric utility industry.

- NVIDIA hardware is found everywhere compute power is needed, from the cloud to the edge.

- Noteworthy AI *Inspector* enables utility use cases.

- The *Inspector* solution is powered through partner technology.

in partnership with

DELLTechnologies   **NVIDIA.**

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OVERVIEW

Manual legacy distribution grid asset inspection methods are slow, costly, and do not scale well. This approach often leaves the grid at risk to a wide range of factors that could impact the physical infrastructure characteristics, including vegetation overgrowth and climate-related events. The electric utility industry needs affordable, efficient, and scalable methods of conducting grid asset inspection and improving asset inventory accuracy.

Dell Technologies, NVIDIA, and Noteworthy AI work in partnership to provide a solution that automates distribution asset inspection and inventory using computer vision, edge computing, geospatial databases, and AI.

CONTEXT

Mark Daus presented information on Dell Technologies solutions for the electric utility industry. Reynaldo Gomez explained NVIDIA's hardware and software offerings. Chris Ricciuti explained how Noteworthy AI works with Dell and NVIDIA to develop the *Inspector* solution. Connor McCluskey shared details of the *Inspector* pilot conducted with FirstEnergy.

KEY TAKEAWAYS

Dell Technologies offers strong market solutions specific to the electric utility industry.

Working with partners and software vendors to develop solutions, Dell's three areas of focus include:

- Grid modernization, including advanced distribution management systems (ADMS) management inside the data center or at the core, substation modernization, and renewables management, such as support for wind and solar field applications.

- Utility connectedness, leveraging Dell Technologies best-of-breed hardware to build persona-specific solutions for electrical utility customers for seamless remote workforce operation—including SAP integration.

- AI and machine learning for grid analytics and security, including computer vision—making use of AI to "see" by analyzing digital images and videos. Dell Technologies offers a suite of products and services using computer vision around asset designation, asset management, and asset detection for electrical industries.

Figure 1: Three areas of focus for Dell Technologies utility solutions
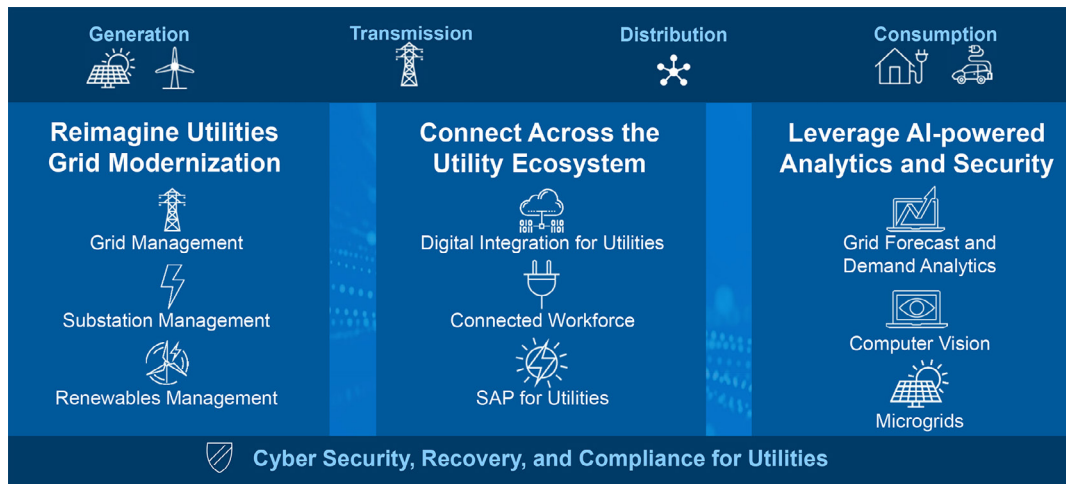
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Figure 2: NVIDIA uses a full-stack innovative approach
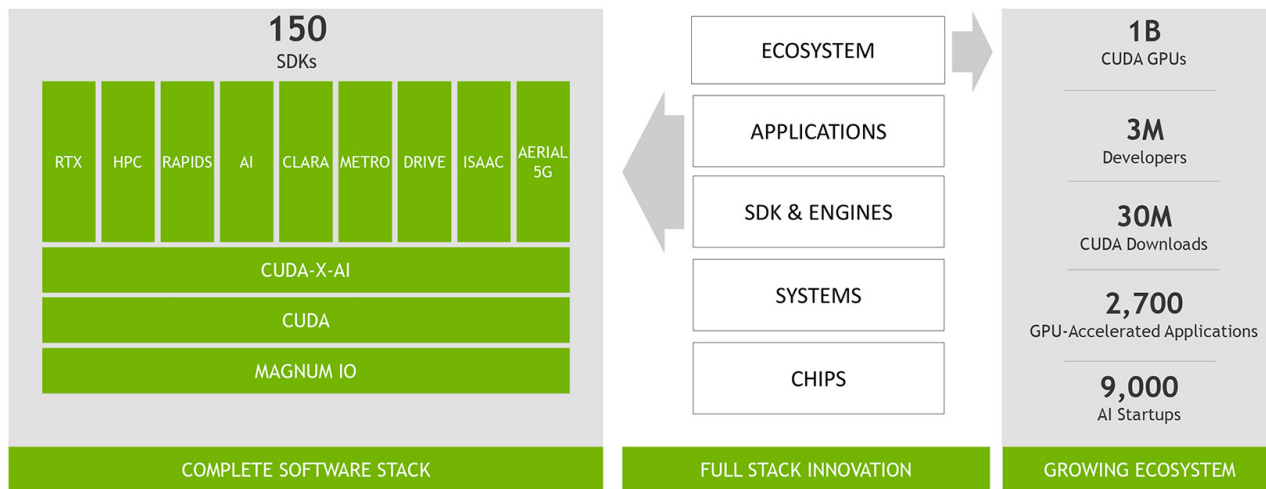
NVIDIA hardware is found everywhere compute power is needed, from the cloud to the edge.

Hardware from NVIDIA, a Dell Technologies partner, is a key component in computer vision solutions. NVIDIA hardware uses graphics processing unit (GPU) architecture to process data in parallel rather than a CPU architecture that processes data serially.

Large GPUs for cloud and data centers are ideal for training large AI models, while mid-sized GPUs are optimal for mid-edge applications such as real-time computer vision and data analytics in electric substations. Small-edge GPUs—called "Jetsons" at NVIDIA— are useful for deploying AI models at the far edge.

NVIDIA innovates at the chip level and works with OEMs such as Dell to integrate chips into an overall system. The NVIDIA CUDA programming layer provides the interface to the GPU. Atop the CUDA sits developer toolkits, such as open source frameworks (e.g., TensorFlow, PYTORCH), that data scientists and developers use to develop AI models. The AI models are then integrated into business applications.

You don't need internet connection back to your data center or back to a cloud to process the data. That data is being processed in real time on that Jetson edge box . . . So anywhere you need compute, if you've got that Jetson there, you can compute the data in real time.

Reynaldo Gomez, NVIDIA

Noteworthy AI *Inspector* enables utility use cases.

Noteworthy AI provides vehicle-mounted smart cameras and AI that help electric utilities evaluate distribution assets at scale and at low cost. Across the US, there are over 185 million utility distribution poles. Reliance on these poles is increasing exponentially due to the explosive growth of electric vehicles and other electrification efforts, while increasing threats from extreme weather and aging infrastructure are creating maintenance challenges.

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Given these challenges, legacy methods of distribution grid evaluation are too labor-intensive and high-cost to address current and future asset management needs at scale. Noteworthy AI developed a solution called *Inspector* to collect and analyze data on the distribution grid more cheaply, quickly, and consistently than before, leveraging existing resources such as trucks and crews that are already in operation.

Inspector is a platform for autonomous data collection and analysis that combines vehicle-mounted cameras, AI, and cloud software, to evaluate distribution assets during routine vehicle operations, with zero impact on the crew—turning regular truck use into opportunities for passive data collection and analysis. *Inspector* improves situational awareness, safety, and risk-mitigation programs, and helps reduce operations and maintenance (O&M) costs.

Noteworthy AI's *Inspector* solution consists of two products: *Inspector* Edge and *Inspector* Cloud. *Inspector* Edge is a camera and compute system that mounts on fleet vehicles to collect and analyze data. *Inspector* Cloud is web-based software that visualizes the results. *Inspector* performs three core tasks:

- **Geolocation** using an onboard GPS system and stereo vision cameras to accurately estimate the geographic coordinates of utility poles.

- **High-resolution imagery** of utility poles.

- **Computer vision** and other machine learning techniques that are used to analyze the imagery.

Figure 3: Use cases made addressable by *Inspector*

Asset Inventory

Asset Inspection

Vegetation Overgrowth

Unregulated Lighting

3rd Party Attachments

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The *Inspector* solution is powered through partner technology.

Inspector Edge uses NVIDIA's Jetson GPU to compute at the edge due to its low power consumption and high performance, and NVIDIA software solutions such as Jetpack, DeepStream, and TensorRT enable advanced low latency image processing and analytics. In partnership with Dell Technologies, Noteworthy AI developed the validated *Inspector* Cloud deployment architecture that installs and runs in an on-premise data center. This secure, private cloud platform enables a turnkey solution that leverages Dell's market-leading VxRail hyperconverged architecture and PowerScale NAS data store.

Inspector Edge is designed to work despite challenging, variable environmental conditions such as lighting, weather, and vehicle velocity. Mounted directly onto fleet vehicles, the camera system is optimized to produce consistent, high-resolution RGB images with low motion blur and low distortion. Additionally, high-fidelity 3D point clouds are generated to enable LiDAR-like precision without the cost and complexity typically required with such solutions. AI and computer vision at the edge enable real-time alerting and a lower total cost of compute over data processing in the cloud.

> NVIDIA DeepStream helps us overcome the challenges traditionally associated with real-time video and image analytics, enabling the creation of highly accurate AI models with increased throughput that can be deployed at scale across large numbers of our *Inspector* Edge devices. NVIDIA TensorRT helps us optimize our models for running on the edge, minimizing the hardware resources required to do so while increasing model throughput and performance.
>
> *Chris Ricciuti, Noteworthy AI*

Inspector Edge transfers data to *Inspector* Cloud in real time over a cellular network or in batches via WiFi or manual extraction. *Inspector* Cloud displays detected poles on a map, with individual pole information, including high-resolution images and AI results produced by *Inspector* Edge, available through a single

Figure 4: How the *Inspector* Edge process works
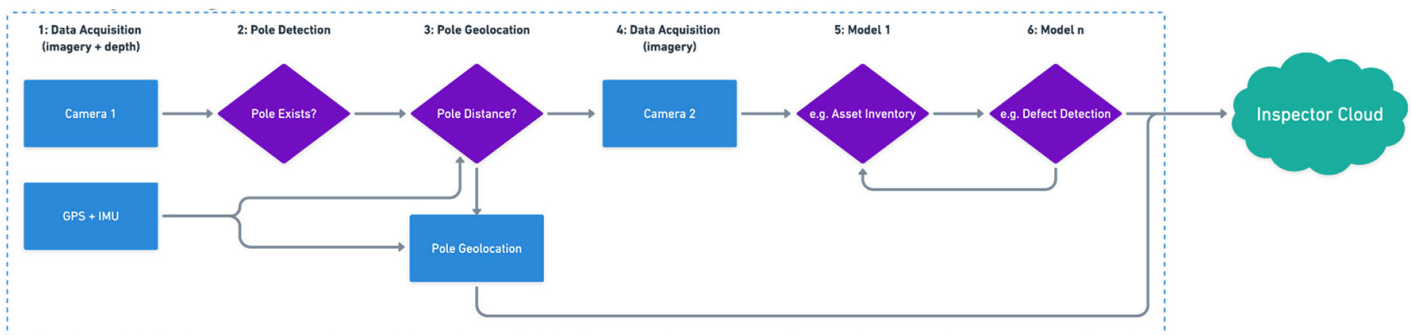
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click. A robust search engine enables rapid searching using natural language queries, with data auto-populated with asset tags, serial numbers, and more due to the high-resolution imagery and compute vision capabilities of *Inspector* Edge. *Inspector* Cloud's extensible API integrates with existing GIS asset management and work scheduling systems.

Inspector Cloud is available as a fully hosted offering in the Noteworthy AI Google Cloud Platform; however, some customers prefer an on-premises offering due to the sensitive nature of the data being collected.

Figure 5: Benefits of the Noteworthy AI + Dell + NVIDIA solution

Benefits

- 5-10x increase in the number of assets evaluated
- 75%+ reduction in O&M
- Leverage existing fleet
- Keep compute costs low vs cloud
- Multiple models on a single edge device = multiple use cases addressed on a single drive by
- Store results on-prem

Case Study: FirstEnergy

FirstEnergy currently owns nearly 4 million electric distribution poles and inspects about 10% of this infrastructure annually, per regulatory requirements. These distribution poles are evaluated as part of efforts to assess risk mitigation, inventory, attachments, storm damage, and more. The current process is manual and requires dedicated vehicles and crews to be in the field, "driving the lines"—a costly process that does not scale.

One innovation challenge faced by FirstEnergy's product innovation group was to evaluate all 4 million poles annually, without having to dispatch more crews to conduct manual inspection—with a goal of reducing the need for dedicated patrols. In partnership with Noteworthy AI, FirstEnergy deployed Noteworthy AI technology in a proof of concept across two territories in Ohio: urban Akron and rural Salem.

The Noteworthy AI *Inspector* Edge product was installed onto two different Freightliner M2 bucket trucks. In the field test of the *Inspector* Edge performance on segments of distribution with known pole locations, configurations, and overhead components, FirstEnergy was able to identify more than 80% of their poles, geolocated within 20 feet of GPS accuracy, on the first pass. Using the *Inspector* Edge technology enabled a standardization of data capture—very high-resolution images with almost zero blur and distortion, captured from a moving truck. The automated approach had a secondary benefit of increasing employee safety levels, as field operators did not have to stop, exit the vehicle, and set up a safety zone to capture the image.

Using trained object detection models, *Inspector* Edge accurately identified pole top components with an average precision of 90%. The improvement to asset inventory allowed FirstEnergy to identify poles with vegetation overgrowth, transformer corrosion, split wood, missing fuses, and other cases that were flagged for remediation.

Prior to the Noteworthy AI pilot, FirstEnergy GIS held 934 images without consistency, taken across multiple years. During the pilot, approximately 5,000 images were collected. Of those, 1,650 poles were identified and geolocated within a 20-foot precision—all during routine operations (both capital and O&M).

Moving forward, FirstEnergy is looking into an extended pilot into circuit patrols, to explore defect identification, inspections caps, and O&M when using Noteworthy AI, versus the cost and benefits of using a dedicated cross-functional team from engineering, finance and operations. Four different groups within FirstEnergy will be able to leverage the same images from the *Inspector* Edge solution, leading to exponential cost savings. The resultant reduction in project O&M, will free up inspectors to reallocate their time to fixing problems rather than inspecting poles. The application of Noteworthy's technology has opened the potential for additional use cases such as evaluating third-party attachments, streetlights, GIS cleanup, and vegetation management.

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Figure 6: FirstEnergy asset identification from a single *Sr* Edge photo

> [Noteworthy *Inspector*] is a way to gain a ton of efficiencies. It also is a way that . . . we can get our company up to the new century of doing things digitally.
>
> *Connor McCluskey, FirstEnergy*

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BIOGRAPHIES

Mark Daus
Energy Field Director, Dell Technologies

Mark works with Energy industry providers and partners to develop innovative solutions to meet the demands of the energy transition. He has over 30 years' experience in IT products and services development & delivery. Previous roles include engineering, solution architect, product development, industry principal, presales, and sales.

Reynaldo Gomez
Energy Partner Ecosystem Manager, NVIDIA

Reynaldo Gomez earned his BS in nuclear physics from the University of Texas in 2013 and is now earning an MS in management science and engineering from Stanford. He spent three years at Schlumberger WesternGeco as a geophysicist before moving to IBM and eventually landing on the energy team at NVIDIA. Reynaldo manages the partner ecosystem for the energy vertical with a focus on machine learning, deep learning, and high performance computing. Previous roles include engineering, solution architect, product development, industry principal, presales, and sales.

Chris Ricciuti
Founder and CEO, Noteworthy AI

Chris has over 20 years of experience operating at the convergence of software solutions and related industry applications. Currently, he is founder and CEO of Noteworthy AI, a startup that helps electric utilities ensure the reliability, resiliency, and safety of the electric grid. Prior, he founded and successfully exited two startups that leveraged artificial intelligence to help large, highly regulated enterprise customers find key information within large volumes of data. Additionally, he served as a VP in the Product group at both Proofpoint (NASDAQ: PFPT) and Veritone (NASDAQ: VERI).

Connor McCluskey
Product Innovation, FirstEnergy

Connor McCluskey has over 19 years work experience with the last 15 years at FirstEnergy, an electric utility in Akron, Ohio. Connor spent the beginning of his career at the utility on the asset management team working with the project managers helping rebuild numerous distribution projects in the Greater Cleveland area. Connor also spent time in corporate finance, but ultimately landed in the innovation and product development teams over the last six years. Connor was the project lead on numerous projects leading the effort in getting intellectual property granted and was in charge of the successful deployment of the Noteworthy AI Pilot program. Connor has a Black Belt in innovation engineering and an innovation strategy certificate from Cornell University.