DELL Technologies intel

WHITE PAPER

EVOLVING FROM CHRONIC DISEASE MANAGEMENT TO PREVENTATIVE CARE:

Healthcare IoT Data at the Edge

The healthcare industry has deployed Edge and Internet of Things (IoT) technologies across the care continuum for over a decade. Initially, healthcare providers focused on financial IoT use cases enabled by RFID sensors, such as inventory management. Today, with Edge and IoT devices generating enormous quantities of data from physician-patient encounters and wearables, health leaders are identifying opportunities to derive actionable insights from the Edge and IoT network and data, leveraging distributed analytics, Edge computing, 5G, artificial intelligence (AI), and machine learning technologies. Investments are being prioritized for initiatives to streamline operational workflows for efficiency, safer patient care experiences, and ultimately, the ability to better understand and predict care outcomes.

The continued miniaturization of sensors has led to more computational capabilities and smarter connected devices. Intelligent devices at the Edge create valuable analytics opportunities by generating "small data," which – in contrast to "big data" – provides individual data points analyzed at the Edge to deliver instantaneous insights enabling a treatment decision, behavior change, or alarm trigger.

Each connected device or IoT sensor at the Edge generates small data points. When analyzed using big data analytics, these individual points reveal unexpected trends, patterns, and insights to improve care delivery. Caregivers can proactively detect changes in the patient's condition. Envision moving from disease management to disease prevention, which encourages individuals to live healthier lives and reduces overall healthcare costs.

HEALTHCARE EDGE INTELLIGENCE THROUGH DISTRIBUTED ANALYTICS

Distributed analytics unlocks healthcare Edge and IoT data to see beyond episodic patient visits, creating a continuous real-time patient record – 24/7/365 – with healthcare providers gaining the tools to shift from a reactive to a proactive approach in support of value-based care.

Leading healthcare providers are investing in distributed analytics to:

- **Improve patient safety and monitor recovery.** Computer vision solutions can monitor acute patient safety and longer-term medical compliance to reduce readmissions. Examples include: cameras and sensors that monitor patient and staff compliance with hand sanitization policies to reduce infection rates, devices that ensure discharge instructions are followed through physical therapy instruction and range of motion monitoring, telesitters to improve patient safety and reduce fall risk in post-acute care step-down patients, and connected pill bottles that confirm medical adherence.
- **Expand chronic disease management and preventative medicine.** Sensors and devices enable continuous patient monitoring – alerting healthcare providers to clinically meaningful changes and predicting potential candidates for early intervention.

COMPUTER VISION AT THE HEALTHCARE EDGE

Computer vision uses a camera as a sensor in the hospital, in an out-patient facility, or at home. Powerful machine learning capabilities automate data analysis and pattern recognition, identify anomalies, and trigger responses.

Computer vision can improve patient wellness in a variety of ways – from identifying a patient in extreme distress in an Emergency Room (ER) waiting room, to monitoring patient behaviors by confirming specific motions, such as the hand-to-mouth motion of taking a pill. This type of motion capture is especially useful when conducting gait analysis to determine if a patient is a potential fall risk. Sensors can also confirm the patient is performing prescribed physical therapy exercises and doing them correctly. Physicians can track progress over time to identify when and why progress stagnates.

For use cases such as visitor and staff safety, patient sitters, and pain monitoring, healthcare organizations can leverage the Dell Technologies IoT Solution for Safety and Security, powered by Intel, a software-defined infrastructure system with tightly integrated compute, storage, networking, and virtualization resources to help improve system performance and lower total cost of ownership. It is purpose-built to a complex camera-on-cloud infrastructure with support for demanding mixed data sources including video, audio, barometric pressure, and more.

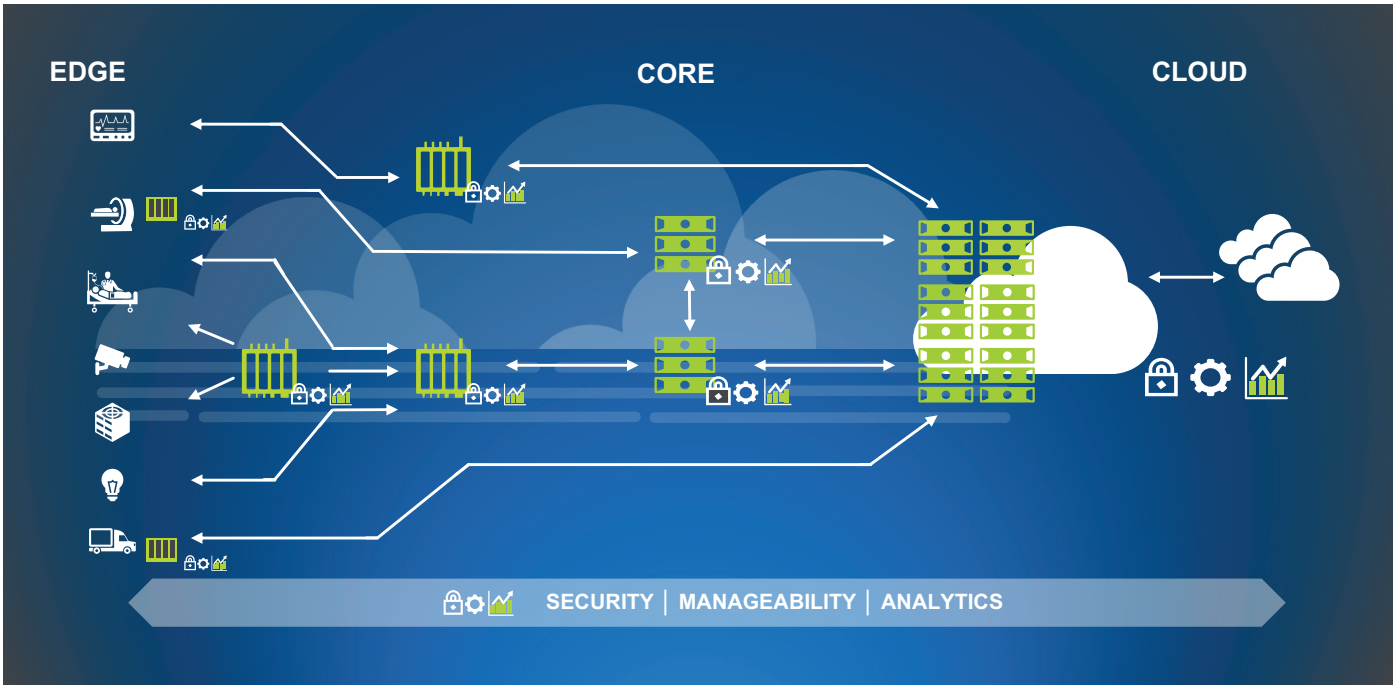
Examples include: smart mirrors that use intelligent hardware and software to identify subtle, yet clinically relevant changes in physique and appearance, FDA approved devices and sensors that provide in-home chronic disease (e.g. heart failure) monitoring, and consumer wearables such as smart watches that track wellness indicators (e.g. respiratory patterns, sleep, and activity).

- **Provide researchers with new opportunities to enhance precision medicine.** Sensor-generated data, combined with medical-grade software applications make it possible to treat rare medical conditions previously too expensive to address. Examples include: wearables and other sensors that are integrated into the clinical trial process to expedite study completion and improve compliance and reporting, digital therapeutic capabilities like applications that allow for the automatic collection and use of individual health data, and built-in features that automatically remove PHI from sensor collected data before transmission to comply with GDPR and HIPAA regulations–allowing data aggregation across patient populations.

- **Manage pharmaceuticals and improve drug supply chain safety.** Edge and IoT devices and sensors can reduce the risks inherent in the highly vulnerable healthcare supply chain including temperature-related and counterfeit risks. Examples include: devices that continuously monitor temperature changes in vaccines during transportation to ensure that safe temperature range is maintained, RFID sensors that track medication from point of manufacture to point of consumption, and GPS-enabled shipping containers that improve inventory/waste management and distinguish between goods in transit and goods stolen.

Optimized analytics is also making telehealth more effective, as patients leverage virtual health consultations for condition assessments to manage chronic diseases and to deploy remote monitoring. Keeping high-utilization, high risk patients managing multiple chronic conditions out of the emergency department through virtual health capabilities offers the potential to further control healthcare costs. Telehealth is expanding access to primary and specialty care with Centers of Medicare and Medicaid Services (CMS) funding now available for telemedicine services and chronic care management, reimbursing care providers for telehealth services rendered.

Figure 1: Simplify real-time insights at scale



Today, bandwidth limitations often prevent or slow data transfer of video streams and patient-generated data from wearables for central analysis. With healthcare Edge and IoT analytics capabilities, physicians and specialists can extract insights from telehealth data at the Edge – where it is collected – transferring only the most clinically relevant data back to the care provider and creating opportunities for effective remote care and downstream revenue.

CONNECT CLOUD TO YOUR HEALTHCARE IOT EDGE

Real-time analytics at the Edge creates the opportunity to identify, refine, and understand the data in place for the fastest possible insights and action. To support the distributed network of data-driven devices, healthcare organizations require a multi-faceted approach.

As healthcare organizations build their Edge and IoT strategy, they need to evaluate their unique multi-cloud approach in parallel with specific application workloads. Depending on data classification, some data – such as the electronic medical record (EMR), laboratory information systems (LIS), and/or clinical decision application data – may be stored on-premises. Other data may be stored in the cloud – whether private, public, or hybrid. Healthcare organizations should also consider how their data can flow securely and efficiently from the Edge, to the data center, and to multiple clouds.

To advance modernization strategies, many healthcare leaders are adopting a "cloud-native" strategy – building and running applications that exploit the advantages of the cloud computing delivery model. This model can be used in public and private clouds to deploy and oversee applications managing Edge and IoT infrastructure and analyzing Edge and IoT data. A cloud-native architecture integrates DevOps, continuous delivery, microservices, and containers to offer operability, scalability, resilience, speed, and openness. Organizations can deploy, develop, and orchestrate workloads based on clinical and business requirements, and have the flexibility to collect, analyze, store, and archive the data in the optimal location.

Cybersecurity tools and privacy protections must be incorporated when building out an Edge and IoT ecosystem. With additional access points being introduced into the system, we recommend addressing the security architecture alongside data collection and application development. Container-based security protects workloads through segmentation and can prevent a full system breach from a single-entry point.

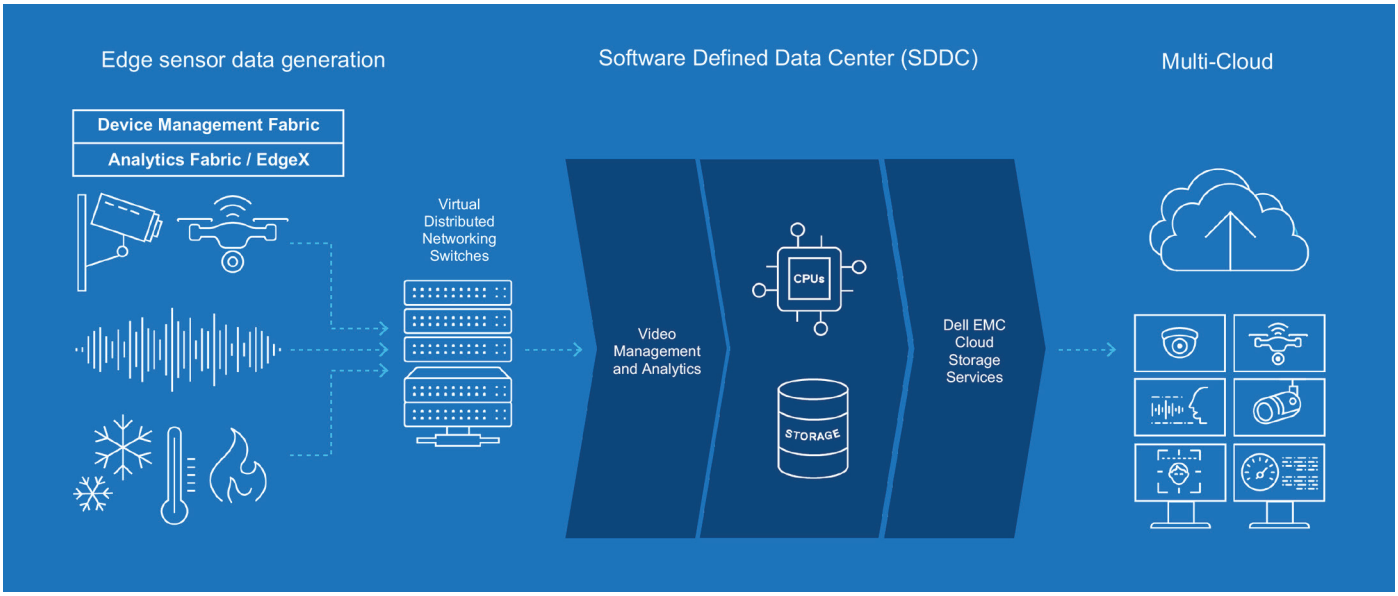
A ROADMAP TO CONNECTED HEALTH

Healthcare IoT solutions, sensors, and devices at the Edge, combined with analytics that turn small data into big insights, are changing how care delivery is triaged, where it is provided, and how it is monitored. Dell Technologies, in collaboration with Intel, offers a roadmap for healthcare providers to leverage Edge solutions to move from disease management to disease prevention. We partner with hospitals, payers, and pharmaceutical companies to identify Edge and IoT objectives, construct a solution, and deliver the complete infrastructure.

Together with our robust partner ecosystem, Dell Technologies supports an AI-ready edge-to-core-to-cloud infrastructure, building a unified data repository, that allows for the automated labeling and tagging of data. For applications that require immediate feedback, this data can be analyzed in place without having to transmit it back to the data center or the cloud, resulting in real-time decision-making capabilities. The resultant distributed analytics model makes it possible for healthcare organizations to segment data management and analytics based on the time allowed for decision-making, only transporting the data and insights back to the core that are necessary.

Dell Technologies provides Intel-based distributed analytics solutions to deploy, orchestrate, train, and test machine learning against data sets. This reduces the requirement to move patient data and enables refinement in place, leading to faster, more accurate, less costly decisions to improve the patient experiences and outcomes.

Figure 2: Edge and IoT orchestration that scale from Edge to core and multi-cloud



IOT NETWORKING

- Dell Edge Gateways for IoT with Intel processors support many sensors and keep pace with vast data collection, sending only meaningful data to the cloud and saving expensive bandwidth
- EdgeX Foundry (for interoperability): Dell Technologies is a founding member of the world's leading open interoperability platform for the global IoT Edge ecosystem, providing easy start-up capability while allowing for continuous scalability and improvement

MULTI-CLOUD

- Dell Technologies Cloud powered by VMware brings private, public and edge cloud services together in a consistent hybrid cloud approach, reducing risk and complexity for healthcare organizations

MANAGEMENT AND SECURITY

- Dell EMC Data Protection and Management solutions scan and map the network, identifying all connected Edge and IoT devices, using distributed analytics to detect unwanted actors by reporting anomalies, triggering a micro-segmentation of the instrument to isolate confirmed unauthorized activity, and addressing the vulnerabilities
- VMware Pulse IoT Center 2.0 simplifies getting started with Edge and IoT, automates management at scale, extends IT security standards to the Edge and IoT infrastructure, and optimizes the value of data
- VMware NSX Data Center helps create appropriate communication tools, identify devices on networks, and control data flow
- RSA Iris is a security tool that monitors devices and reacts to attacks

INTEGRATION

- Dell Boomi supports real-time data integration and scales to meet the high-volume demands of mobile, extract, transform and load (ETL), and electronic data interchange (EDI) environments

Dell Technologies, in collaboration with Intel, provides a comprehensive portfolio of solutions, products, and services to prepare healthcare organizations for their Edge and IoT future. With better insights from optimized analytics, healthcare organizations can move toward their vision of preventative care and healthier patients.

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