Digital Pathology:

How the next generation of technologies are helping to generate critical insights from tissue samples.

The convergence of advanced imaging, automation, and powerful analytics like natural language processing (NLP), machine learning, and artificial intelligence (AI) in healthcare and life sciences organizations are bringing together the tools needed for scientists and clinicians to unlock medical breakthroughs at a pace like never before. In emerging advanced imaging workloads, digital pathology is playing a central role by providing an extra layer of information augmenting the overall picture of an individual's distinct disease state.

With the aging population, healthcare providers have seen an increase in the prevalence of cancer and other diagnostic-intensive diseases amidst a global shortage of pathologists and laboratory services to provide diagnoses. Due to the accelerating growth in diagnostic information, health IT departments are being tasked with providing the infrastructure to digitize tissue sample slides.

Turning the slides into digital files enables pathologists to view, analyze, and manage these images with the use of technology. Electronically capturing tissue samples not only digitizes the images but also opens up a whole new world of opportunities, including:

- A means to augment the pathologist workforce gap through remote access and telepathology.

- A digital archive of the patient's sample rather than having to rely on preserving a slide or frozen section that requires physical space for storage, makes immediate peer consults challenging, and may be subject to degradation.

- A critical piece of the precision medicine puzzle. When combined with other disease-specific data like genomic profiles, digital pathology has the potential to improve the therapeutic benefit of treatment and lower or eradicate side effects on a per-patient basis.

- Advances in medical discoveries and diagnoses for "like patients"— for example, through access to anonymized data in support of large-scale cancer research trials and drug discovery.

The true value of digital pathology: leveraging data to create actionable insights.

In order for digital pathology to empower precision medicine, augment the pathology workflow, and lead to medical advancements, significant data management challenges need to be addressed in a seamless way. These include:

Providing expandable storage: A single slide captured by a whole slide imaging (WSI) scanner can be 2-3 GB in size. Multiply that by hundreds of slides imaged per day, and it's clear to see why expandable capacity is required to maintain an ever-growing repository of historical image data.

Categorizing unstructured data: On its own, the digital image of a scan is not much more useful than the physical slide. For an image to have value, it needs to be ingested into a structured system — with fast access for collaborative purposes. This involves the creation of hundreds of annotated tags to go with the image, requiring high-performance computing power and AI-enhanced processing. This metadata, along with medical notes, must be combined with the digital images, stored together, and attached to the patient's electronic medical record (EMR).

Offering anytime, anywhere access: Digital pathology image data and its tags need to be accessible both within the local healthcare facility and across the wider medical community for primary diagnosis, remote consults via telepathology, and virtual peer review for difficult-to-diagnose cases as well as for clinical trials, education, and research. When these images are not stored in a silo but are integrated with a laboratory information system (LIS), an EMR, and other systems, this approach ensures data portability for a complete patient view.

The benefits of digital pathology are maximized when this integrated data architecture is combined with high-performance computing, flexible scale-out network storage, and direct, secure access to a multicloud environment with big data analytics capabilities. Dell Technologies, leveraging our partner ecosystem, plays a central role in providing an interoperable network for digital pathology.

END-TO-END SOLUTIONS TO STREAMLINE DIGITAL PATHOLOGY

Dell Technologies offers a portfolio of solutions that span the entire digital pathology IT environment from high-performance compute and high-resolution displays to servers, networking, storage, and software to multi-cloud and big data analytics platforms. Our digital pathology solutions include:
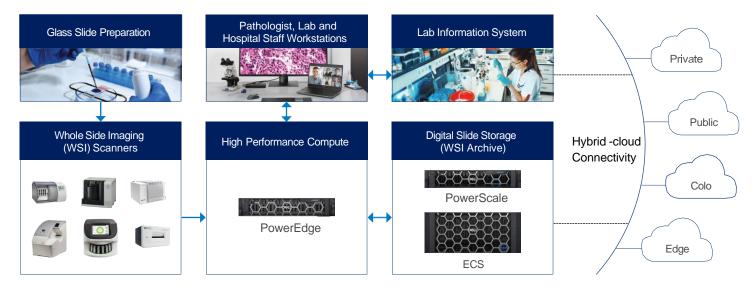
- **Flexible, scalable storage for big data:** Dell PowerScale — the industry's #1 family of scale-out network-attached storage systems — and Dell ECS provide the high performance and scalability options needed to grow dynamically as imaging data is supplied by WSI scanners. A full range of options are available and work with your multicloud environment or on premises — from all-flash devices for extreme performance to lower-cost archival solutions as well as object-storage platforms able to manage unstructured data at exabyte scales. Dell Technologies provides solutions that enable pathology data stored on a PowerScale platform to be located, provisioned, and executed quickly, with the ability to identify specific data sets by any number of parameters such as patient name, disease type, date, or unique patient identifier — from anywhere across the globe.

- **Protecting pathology data from cyber attacks:** Healthcare institutions are a top target for cyber criminals due to the personal patient data they are responsible for. A cyber attack leads to downtime, damaged reputations, and a drop in quality of care. PowerScale Cyber Protection with AirGap keeps WSI data secure.

- **High-performance compute for fast data indexing:**
Dell PowerEdge servers offer enhanced performance across the widest range of applications to accelerate the indexing of large WSI datasets for fast retrieval, including Dell VxFlex hyper-converged infrastructure (HCI) and appliance-ready options. Dell's comprehensive High Performance Computing (HPC) Solutions, including NVIDIA GPU- and Intel FPGA-accelerated servers, deliver specialized processors and accelerators for intensive precision medicine workloads such as AI-enabled drug discovery.

- **Advanced analytics for meaningful insights:** Choose a Dell Technologies solution that's right for where you are on your data analytics journey. Dell Validated Designs for Analytics provides the infrastructure needed for advanced analytics helping healthcare organizations unlock the value that exists within their data, including pathology.

- **Multicloud integration for collaboration:** Accelerate your multi-cloud journey as you deploy applications and indexed WSI data in the right cloud — whether in a private or public cloud, or at the edge. Dell APEX Cloud Services simplifies your multicloud journey by offering familiar products, services, and tools for your compute, storage, and data protection needs.

- **High-definition displays for enhanced viewing:** View images in extraordinary detail using a display from Barco Medical Imaging Solutions or Dell Large Format Monitors enabling enhanced viewing and onsite collaboration.

Advancing digital pathology with Dell Technologies Solutions
Modern infrastructure from Dell Technologies helps facilitate digital pathology applications by providing critical solutions and partnerships to turn data into insights at every stage of the digital pathology workflow (Figure 1). From the slide to the data center to the cloud, our offerings enable pathologists, researchers, and healthcare systems to ingest and analyze data in real time; provide meaningful, actionable insights; retain data for deeper analysis; and seamlessly share data with collaborators, patients, payers, and healthcare and life sciences organizations to improve outcomes.

FIGURE 1
Reference architecture enabled by Dell Technologies

Infrastructure for your for your digital pathology workflow including high-throughput scanning, real-time indexing, and secure, managed access to digital slide repository and pathology reports inside and outside the organization.

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