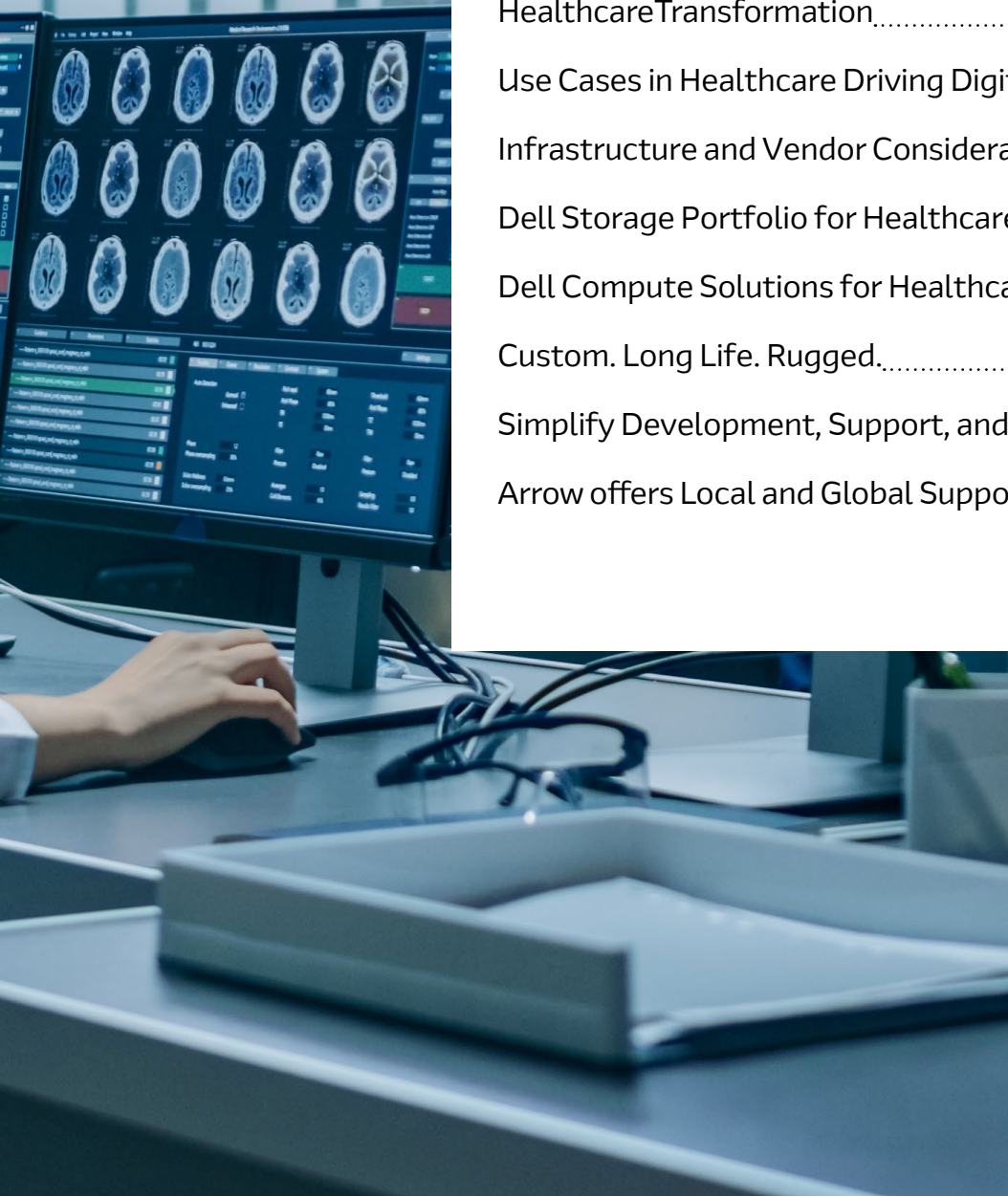




# eBook: Drive Healthcare Transformation with Enterprise-Level Infrastructure

**DELL**Technologies

**ARROW**



# Table Of Contents

HealthcareTransformation.....3

Use Cases in Healthcare Driving Digital Transformation (DX).....4

Infrastructure and Vendor Considerations for Healthcare.....6

Dell Storage Portfolio for Healthcare Systems.....9

Dell Compute Solutions for Healthcare.....10

Custom. Long Life. Rugged.....11

Simplify Development, Support, and Deployment.....12

Arrow offers Local and Global Support.....13

# HealthcareTransformation

The ability to digitize, collect, aggregate, and utilize data is opening up a new data-driven business, operational, and clinical model shaping the future of healthcare. The opportunity to deliver high-quality outcomes for patients and business efficiency for healthcare providers using digital transformation (DX) has never been greater. Digital imaging, electronic health records, e-prescription services, and advanced healthcare resource planning systems are just a few of the many digital solutions that make up the digital healthcare ecosystem. The expectation is that the emergence of artificial intelligence (AI) and machine learning (ML) will bring additional value to healthcare. Utilizing all the "data-rich" systems and generating "data-driven" insights can dramatically improve patient outcomes and the operating paradigms of health institutions. Precision diagnostics and optimized operational cases are key outcomes desired, as healthcare providers seek to utilize unprecedented access to patient and application data.

Yet, the complex ecosystem leads to the higher complexity of the IT infrastructure and requires healthcare organizations to manage large volumes of data, regulatory compliance, and an ever-changing technology landscape. Healthcare organizations need tools to store, manage, and analyze data with exponential growth in data in all parts of the IT network – the edge, network, core, and the cloud. Simultaneously, affording secure access to patients and personnel anywhere and anytime is a crucial expectation of stakeholders. Enterprise IT stakeholders in healthcare now need to focus on enterprise-wide improvements in performance, availability, scalability, agility, security, and compliance. Regulatory frameworks, including the Health Insurance Portability and Accountability Act (HIPAA) and the General Data Protection Regulation (GDPR), further increase the need for healthcare organizations to deploy proactive measures and make data infrastructure decisions that serve current needs and provide the resilience for future data growth.

Healthcare DX starts with modernizing existing IT systems and supporting innovations to enhance user experiences and improve business performance. DX relies on solid data infrastructure, skilled resources that can derive insights from data, and an overall vision for the business and patient value.



# Use Cases in Healthcare Driving Digital Transformation (DX)

Macro trends related to patient preferences, health care worker availability, and the potential of digital automation are driving a variety of valuable use cases for DX. Applications range from better patient monitoring to complex diagnostics using AI.

## Remote Patient Monitoring (RPM)

RPM has been adopted primarily for managing chronic conditions (e.g., diabetes, hypertension, and heart failure). Chronic conditions can be 3.5 times more costly to treat and account for 80% of hospital admissions. When combined with historical data analysis, RPM can identify real-time issues such as patient falls and other metrics. RPM helps patients maintain control, get timely intervention, avoid further complications or emergencies, and improve short and long-term health outcomes. The underlying infrastructure required for RPM involves data acquisition devices at the network edge connected to cloud-based systems that aggregate data and further transmission it into hospital systems to empower doctors to make quick decisions.

As more patient activities become biometrically monitored, the amount of critical data will increase and for RPM to create value, the data must be secure, accurate, accessible, and interoperable, making storage and data protection vital.

## Next-Generation Clinical Documentation

Electronic health records (EHR) give physicians digital versions of patient charts to securely access real-time patient information for documentation, record keeping, and decision-making localized at the point of care. EHRs have also enabled broader use in other clinical, financial, legal, and administrative aspects of healthcare. However, hard-to-use interfaces and cumbersome processes have made EHR a source of widespread frustration among health care personnel.

New-generation EHRs provide distinct improvements in system usability by employing dashboards and planning tools. Similarly, the adoption of open standards and open APIs facilitate integration into the healthcare ecosystem. Another aspect of new EHR systems is the focus on end-

to-end user experience. Role-based workflows, anytime-anywhere mobility, and embedded intelligence transform clinical documentation using predictive analytics and AI-based virtual assistants. Powering these next-generation EHR modules are modern data and computing infrastructures supporting the latest software and data science development.

## Medical Imaging

The future of medical imaging relies heavily on scalable storage and data protection. Operational and diagnostic imaging is most effective when imaging workflows enable quick retrieval and reliable search across vast amounts of stored and archived images. In addition an array of metadata needs harvesting to allow care providers to make rapid decisions. Medical images can also quickly inundate IT infrastructure due to the large file sizes. A radiography image can be 20MB, and digital pathology files can be as large as 3GB per slide.

As image analysis and machine learning systems evolve, the deployment of analytical routines on image data has the potential to unlock improved image-based diagnostics and offer proactive health assessments based on pattern recognition. Compute and data infrastructure that enables adequate storage, archival, retrieval, and analytics are the bedrock for future medical imaging.

## Next-Generation Sequencing (NGS)

Neurobiologists increasingly believe that genetic variations are associated with diseases. NGS determines the sequence of DNA or RNA genetic material to study genetic variation. Such sequencing has the potential to drive precision medicine, research, and personalized drug development to find effective cures for genetics, oncology, microbiology, and reproductive health applications.

NGS is highly computed and digital processing intensive and requires robust infrastructure. High-performance computing (HPC) can deliver the compute power for complex data analysis and interpretation, while highly scalable storage manages NGS to ensure compliance and usability of the genomic data. NGS data also requires high redundancy as the data is never deleted and is usually annotated. Researchers often keep files for future studies and do more comprehensive retrospective analyses of the data later in time. Therefore, storage and data protection for NGS demand long-term petabyte-scale strategies, technologies, and capabilities to protect the sensitive and personal nature of genomic data.

## Artificial Intelligence

The healthcare industry is rapidly evolving as AI technologies like machine learning and deep learning push the field forward. By incorporating AI into healthcare operations, machines can quickly and accurately perform tasks that until now have required error-prone or tedious human intervention.

While the cost efficiencies driven by AI can be enormous in logistics, administration, and customer relations aspects of healthcare, the real benefits are in healthcare outcomes. AI underpins many healthcare tech innovations such as robot-assisted surgery, virtual nurse assistants, dosage error reduction, and preliminary diagnosis. As data volumes continue to increase, richer information from imaging and patients becomes available, AI will play an increasing role in curbing costs, improving job satisfaction, and delivering better health outcomes.

Combining medical imaging and other clinical data is an ideal use case and is already demonstrating the transformational power of AI. Medical images captured by CT scans, MRI machines, and X-rays can contain critical health information about patients. But detecting medical issues in a stack of high-resolution images can be challenging – even for experts. Interpreting these images is subjective, and missing a key detail can have significant health consequences for patients. AI allows medical professionals like radiologists to see images in a whole new way. AI models can be taught to identify nuances that escape the human eye by instantly drilling down to the pixel level of high-resolution images.

Such powerful diagnostic and automation capabilities require computing infrastructure that can scale and is resilient under the intense loads AI applications tend to exert. The most effective is a scalable, high-performance infrastructure that supports unpredictable and exponential data growth and flexible data management from on-premises to hybrid and multi-cloud instances. Healthcare organizations need to have an infrastructure strategy to develop an effective AI program. AI infrastructure extends beyond technology to include resources, policies, and people. Additionally, AI leverages data from internal and external IT systems, making data protection imperative as critical data flows in and out of algorithms.

## Top 5 use cases for AI in Healthcare



SOURCE: Survey of healthcare professionals, healthcare investors and startup executives across European countries, conducted in December 2019 and January 2020

# Infrastructure and Vendor Considerations for Healthcare

New system requirements for data creation, processing, and connectivity reshape longstanding healthcare industry use cases. Data-intensive systems no longer allow storage technology to take a back seat to compute decisions. Traditional first-cost-based storage technology selection is being replaced with a total cost of ownership considerations like efficiency, reliability, and future-proofed adaptability. As product development organizations plan for a future increasingly dependent on data, vendor choice has gained renewed strategic importance.

## Data Integrity, Protection, and Resiliency

By far the most critical aspect of infrastructure decisions is ensuring that healthcare data is always accurate and accessible. Typical features that provide high data integrity are error correcting code (ECC), checksums, and adherence to the T10 Data integrity field (DIF) standard. Storage systems must also be resilient and recover from various types of failures without putting data integrity at risk or severing data access. The high availability of storage systems with local and remote recovery capabilities ensures additional resiliency.

Rapid recovery from failures requires hardware redundancy (i.e., dual controllers, redundant fans, and power supplies) and software features like host multipathing and RAID or erasure coding that is configurable to different levels of resiliency. Hot-pluggable and modular, field-replaceable units allow the replacement of failed components without impacting service availability.

## Security

Maintaining the privacy of patient data is paramount in healthcare settings. The rise of regulations like GDPR directly responds to privacy concerns raised by stakeholders. To ensure data remains secure and protected from unauthorized access, healthcare IT managers need the flexibility to encrypt their data, often both at rest and in flight. The gold standard for encryption is AES 256 encryption. Regulations in many private sector industries require at least 256-bit encryption, and the federal government stipulates the same when FIPS 140-2 compliance is required. IT healthcare decision-makers need to choose infrastructure options that meet their specific encryption needs as they weigh up solutions options.

## Storage Efficiency

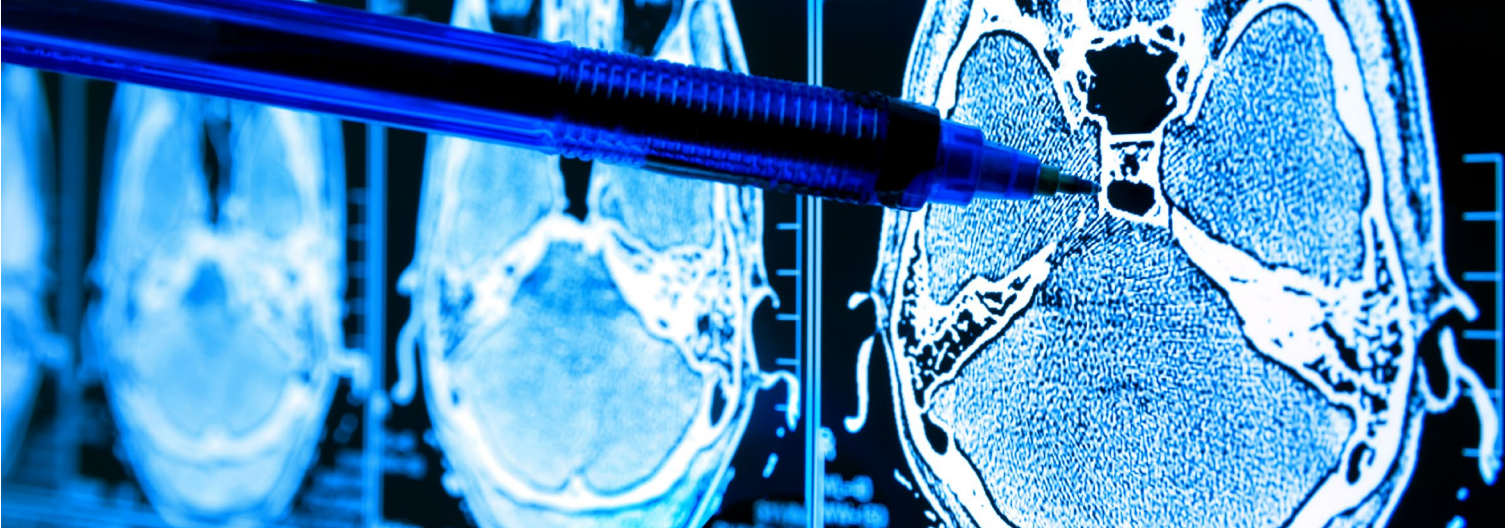
The large storage capacities most healthcare providers need requires additional capabilities to optimize storage. Key strategies that enable storage efficiency are thin provisioning, compression, and data duplication. These strategies minimize the physical storage space required and allow stakeholders to maximize the amount of stored data. While compression technologies are less impactful on image files than text formats, storage efficiency technologies are critical to saving on growing infrastructure costs.

## NVMe

As technologists look for new avenues for efficient computer storage, new approaches and innovative storage models emerge. Nonvolatile memory express (NVMe) is a storage protocol that is rapidly replacing the use of SCSI for performance-sensitive workloads. NVMe is optimized for use with solid-state media and utilizes its performance and capacity resources much more efficiently than SCSI. NVMe enables significantly more parallel processing than SCSI as well. Healthcare is no exception. This capability is vital in multicore CPU environments and leads directly to a more efficient IT infrastructure. NVMe support is an important aspect to consider in evaluating next-generation infrastructure solutions for healthcare.

## Storage Tiering

For maximum scale and flexibility, healthcare IT managers need to consider a storage platform's native storage capacities and its ability to archive automatically. Tiered storage can help differentiate between historical data and current data. Regulations like HIPAA require healthcare providers to retain medical records for the patient's life. Compliance with this requirement requires an effective archive strategy. Archive tiers usually store most patient data and need a high degree of scale to optimize the dollar-per-gigabyte storage costs. Storage tiering, while reducing costs, also needs to keep data easily accessible to meet various clinical documentation reviews, analytics, and research needs.



## Breadth of Portfolio and Product Availability

Technology changes at a frenetic pace and as next-generation healthcare systems and business cases evolve, the technology infrastructure must evolve in tandem. The vendor's breadth of product portfolio, investments in R&D, and overall capability to support a healthcare customer's changing needs are vital criteria for choosing storage and compute technology partners. The right partner with a diverse range of compute and storage capabilities can differentiate a healthcare organization by driving new technology-based business models or lagging competitors.

## Customization Capabilities to Address Specific Needs

Healthcare systems at the edge of the network are highly varied. From simple bed-side systems to complex diagnostic devices, compute and storage demands unique hardware, software, and ruggedization combinations. In addition to a range of computing needs, healthcare providers' industry-specific considerations warrant unique approaches from product development teams. Generic off-the-shelf solutions are often not the best fit, and customization capabilities are critical to match the computing solution to the business need optimally. Technology partners that offer a variety of customization capabilities out of the box can assist healthcare providers craft solutions that are cost-effective and reduce implementation times.

## Resilient Supply Chain and Global Support

For healthcare organizations, the cost of technology upgrades can be enormous. Choosing partners with a sustainable business model with world-class capabilities is necessary. Product availability on-demand, reliable support, and high responsiveness to customer needs are the hallmarks of a good partner. Fragmented suppliers lacking the requisite scale and expertise to manage complex projects and global supply chains efficiently will often result in long customization lead times and unsatisfactory services. Stakeholders need to ensure that careful attention goes to price and performance and considerations like supply chain resilience and availability of global support.

## Flexible Procurement and Financing Availability









Technology infrastructure is an expensive endeavor. Traditional upfront investment models are evolving to adapt to subscription-based business models. For many organizations, it has become beneficial to align expenses models with new usage-based revenue models for their customers. Financing is another avenue that organizations explore to avoid colossal upfront capital outlays. Many smaller vendors cannot afford financing options for healthcare customers. Customers who would like financing options from technology vendors need to partner with well-established providers with sound financial history and capabilities to offer flexible options for customers.



# Dell Technologies OEM Solutions Storage Portfolio for Healthcare Systems

New system requirements for data creation, processing, and connectivity are reshaping longstanding industry use cases. Data-intensive systems no longer allow storage technology to take a back seat to compute decisions. Traditional storage technology planning and selection has been upended as more organizations seek efficient and optimized solutions.

Dell Technologies OEM Solutions is a primary provider of storage infrastructure for healthcare environments. To help organizations more effectively consolidate workloads as they refresh storage infrastructure, many of these systems support multiple access methods, while delivering enterprise-class performance, availability, scalability, and security.

Block	Block and File			Unstructured Data		VMware	Multi-hypervisor
				File & S3 Object	Object		
Dell PowerVault	Dell Unity XT	Dell PowerStore	Dell PowerMax	Dell PowerScale	Dell ECS	Dell VxRail	Dell PowerFlex
							
<b>Affordable entry-level storage</b> Purpose-built and optimized for SAN/DAS simplicity and accelerated performance	<b>Value focused hybrid storage</b> Flexible hybrid storage for cost sensitive enterprises that want to leverage a combination of flash and disk at a lower cost \$/GB	<b>Adaptable all-flash storage</b> Flexibility, scalability, simplicity, and performance with market-leading economics	<b>Mission critical storage</b> Unmatched performance, resiliency, and cutting-edge innovation for critical workloads	<b>Scale-out NAS</b> For demanding enterprise file and “big data” workloads. True scale-out file – 10TB to 92 PB	<b>Scale-out object</b> For demanding enterprise object workloads. Enterprise object, analytics & cloud native applications	<b>Built for VMware, with VMware, to enhance VMware</b> Fastest path to outcomes in VMware environments	<b>Software-defined infrastructure</b> Virtual, bare metal & container workloads (including vSphere)
<ul style="list-style-type: none"><li>– Block (SAN/DAS)</li><li>– Affordable/simple</li><li>– CloudIQ support</li></ul>	<ul style="list-style-type: none"><li>– Simple</li><li>– All-flash/hybrid</li><li>– Virtual option</li><li>– CloudIQ support</li></ul>	<ul style="list-style-type: none"><li>– Scale-up/out</li><li>– NVMe</li><li>– AppsON</li><li>– CloudIQ support</li></ul>	<ul style="list-style-type: none"><li>– Scale-up/out</li><li>– E2E NVMe</li><li>– 6-Nines HA</li><li>– CloudIQ support</li></ul>	<ul style="list-style-type: none"><li>– Scale-out</li><li>– All-flash to archive</li><li>– Multi-protocol file</li><li>– CloudIQ &amp; DataIQ</li></ul>	<ul style="list-style-type: none"><li>– Cloud-scale</li><li>– Deep archive</li><li>– SDS options</li><li>– CloudIQ &amp; DataIQ</li></ul>	<ul style="list-style-type: none"><li>– Turnkey system</li><li>– VMware vSAN</li><li>– Life-cycle mgt</li><li>– CloudIQ support</li></ul>	<ul style="list-style-type: none"><li>– Scalable SDI</li><li>– Multi-hypervisor</li><li>– 2 layer/HCI/storage</li><li>– CloudIQ support</li></ul>

# Dell Compute Solutions for Healthcare

The latest Dell OEM Solutions 15G PowerEdge server portfolio is built to power your healthcare innovation engine to meet the challenges of digital transformation with a secure infrastructure that supports a full range of modern workloads and objectives. PowerEdge servers deliver the productivity and performance needed at the edge and the core.

Deployment	Essential	Scalable	Mainstream	Specialized
Description	Entry-level technology with essential features, limited scalability, and enterprise-class management	Performance technology that balances capability and capacity with enterprise features	Latest technology, designed for best-in-class performance	Latest technology, focused on specialized compute needs
Use cases	Enterprise-class capabilities for small to medium business (SMB) and remote office/branch office (ROBO) deployments	Right-sized compute for enterprise workloads	High performance for XaaS providers and enterprise data center workloads	Extreme performance and density for emerging workloads and usage models
Specific workload examples	<ul style="list-style-type: none"><li>General IT infrastructure for file and print</li></ul>	<ul style="list-style-type: none"><li>VDI</li><li>Cloud applications</li><li>Software-defined storage (SDS)</li><li>Anything-as-a-Service (XaaS)</li></ul>	<ul style="list-style-type: none"><li>Virtualization</li><li>Big data analytics</li><li>SDS</li><li>In-memory databases</li><li>Data center infrastructure</li><li>Financial applications</li><li>Customer relationship management (CRM)</li><li>Enterprise resource management (ERM)</li></ul>	<ul style="list-style-type: none"><li>HPC</li><li>AI/ML</li><li>Object storage</li><li>Cloud storage</li><li>Databases</li><li>Edge computing</li><li>Rugged environments</li><li>Scale-out storage for structured databases</li><li>Web tech</li></ul>
Recommended Dell Power Edge servers	R550, R450, T350, T150	R750xs, R650xs, R7515, R6515	R750, R650, R7525, R6525, MX750c	XE8545, XR11, XR12, R750xa, C6525, C6520



PowerEdge R550



PowerEdge R650



PowerEdge R750




PowerEdge XR11 and XR12

# Custom. Long Life. Rugged.

## Design with technology solutions that meet your needs

Healthcare solution providers can benefit from a wide platform from the far edge to the core to the cloud and everything in between. Designing with the latest technologies that support high-performance computing (HPC), artificial intelligence (AI), machine learning (ML), and more ensure that your products meet the cutting edge requirements of the marketplace. Always ready to meet your application and business needs, Dell offers Standard or OEM unique products to suit your needs, have an extended life and can be ruggedized. Custom solutions can also be designed with Arrow and Dell OEM Technology Solutions expert support.

Standard



Globally available off-the-shelf Dell OEM Technologies products and solutions from edge endpoints to ruggedized field grade systems to micro data centers and cloud compute platforms.


Custom



Make your ideas a reality by partnering with our technology experts for fast to market delivery of branding, personalization, fit & function, and specialized environment design custom solutions.


OEM Unique

OEM-specific products and capabilities to meet healthcare needs.




Stability. Longevity. Visibility.

Extended life & stability  
OEM XL | XE offerings.



Ruggedized

Industrial-grade durability,  
beyond the desktop and data center.



OEM-Ready

De-branded products that  
you can add your brand to  
with OEM-Ready offerings.

10

ARROW ELECTRONICS

→ TOC

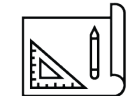
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11

# Simplify Development, Support, and Deployment

Arrow Intelligent Solutions and Dell Technologies OEM Solutions can take your product to market with the right services, support, and technology to ensure differentiation and success in the marketplace. Together we can design the right combination of capabilities that match your expectations.

Drawing on an extensive technology partner ecosystem, products and services portfolio, expertise, and scale, Arrow orchestrates solutions that simplify your technology lifecycle experience, enabling you to bring your products to market faster and grow your business.




### Design

Design and validation, prototype and testing, cloud adoption, platform architecture, and manufacturing first articles



### Customization

Mechanical, cabling, re-branded, space requirements, extended life, and ruggedization



### Integration

Kitting and labeling, configuration services including imaging, application install, BIOS, SIM card installation, and product testing



### Fulfillment

Global footprint and support, transportation services, compliance, and export requirements, direct fulfillment services (build to order (BTO), finished goods, configure to order (CTO) options)

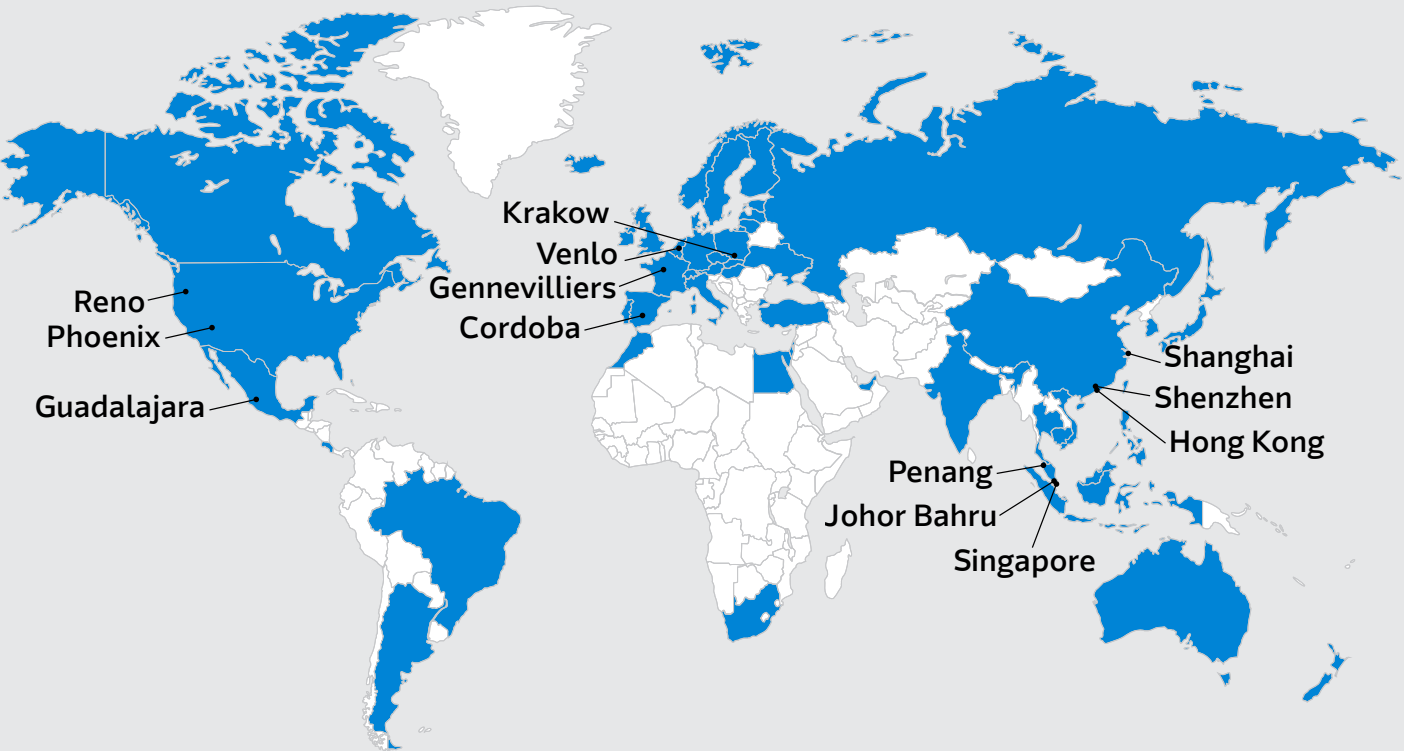


### Support

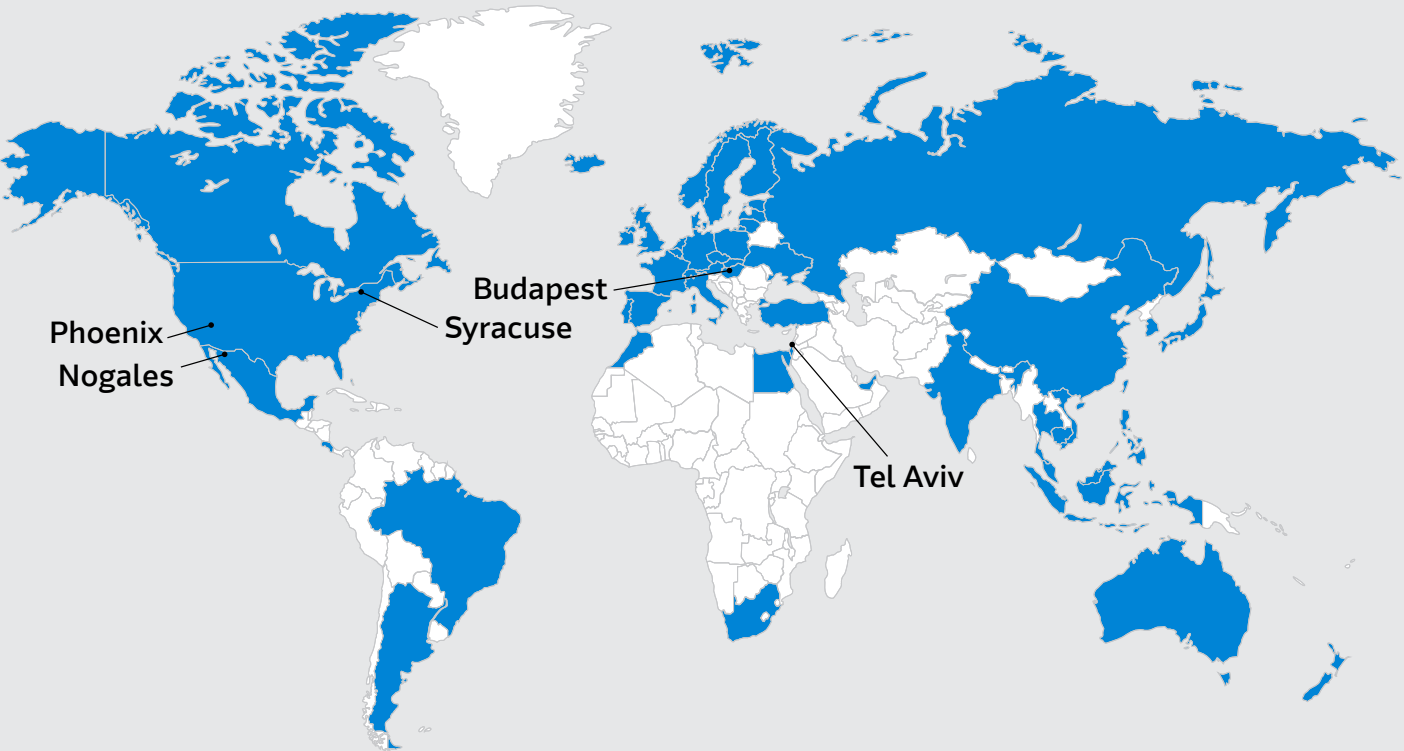
Deployment and installation support, 24x7 local support, L1/L2/L3 support, obsolescence management, repairs, and replacement

## Arrow offers Local and Global Support

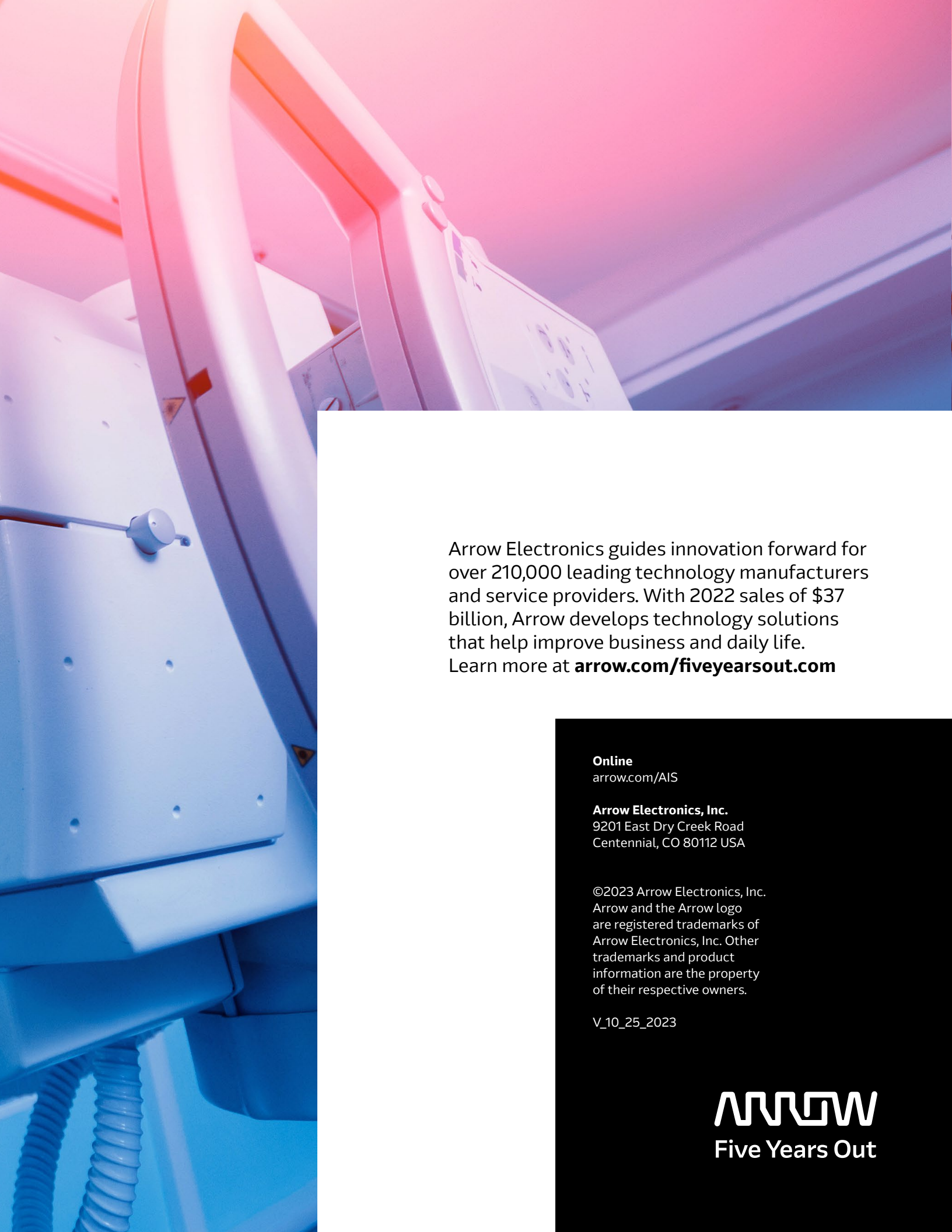
### Fulfillment Centers



### Integration Centers







Arrow Electronics guides innovation forward for over 210,000 leading technology manufacturers and service providers. With 2022 sales of \$37 billion, Arrow develops technology solutions that help improve business and daily life. Learn more at **[arrow.com/fiveyearsout.com](https://arrow.com/fiveyearsout.com)**

**Online**

[arrow.com/AIS](https://arrow.com/AIS)

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