Why digital transformation is redefining how people, technology and devices interact in healthcare
Technology touches almost every aspect of healthcare today, with advances based on robotics, the Internet of Things (IoT), and artificial intelligence increasingly employed in hospitals, clinics and care homes. These technical innovations offer the potential to create new care pathways to improve health outcomes while reducing costs. However, without the right network infrastructure in place to support new medical devices, healthcare applications and communication systems, existing networks quickly reach their limits, hindering technology adoption and exposing weaknesses in security. This white paper examines the new technical and cultural trends that are disrupting healthcare, and discusses how the success of these innovations relies on a resilient network and communications infrastructure that can support high performance connectivity, efficient care delivery to patients, and real-time and secure access to data.
Technology touches almost every aspect of healthcare today, from how doctors interact with patients, to the way medical data is accessed and used, to the role of robotics in surgery. New technology, such as wearable devices, smart connected implants and the Internet of Things (IoT), is making its way into hospitals, clinics and care homes. We are on the verge of a new era in healthcare, one driven by digital transformation and a range of advances in such fields as mobility, data analytics, artificial intelligence and genetic sequencing.

As hospitals and other healthcare facilities increasingly embrace advanced technology and the digitization of everything, they are in the position to coordinate processes that enable better care, keep patients safer, and create experiences that lead to improved health outcomes. With the right digital tools and solutions, hospitals, clinics and providers have the potential to address the many challenges that healthcare systems face today, including rising demand for care, an aging population and containment of costs. Technical innovation holds the promise of better and more securely connecting patients, clinicians, staff, and technology, to support new care delivery models.

These technical innovations and improved communication and processes enable new care pathways that can help manage and standardize care and help reduce variability in clinical practice. By improving the efficient use of resources while implementing optimized processes to ensure best quality of care, care pathways can help improve health outcomes while reducing costs.
But without the right network infrastructure in place to support new devices and applications operating on the front-line of healthcare, existing systems reach their limits, hinder technology adoption and expose weaknesses in security. Many hospitals have separate network infrastructures for each department, due to different ages of deployment, varying security needs and diverse technical requirements. Maintaining multiple disparate networks almost universally leads to issues with quality of service, greater security exposure and increased costs.

Instead, hospitals should consider a single network infrastructure for all IT and communication systems, segmented with multiple virtual networks, all supported by a single network management system, which enables IT to spend more time helping optimize the care pathway than managing the network infrastructures.

This single network approach provides an always-on, high-performing wired and wireless connectivity experience for patients and visitors. It supports efficient and high-quality care delivery by providing 24/7 access to real-time information and resources to clinical staff. The single robust network also enables ubiquitous and dynamic access to patient health information, such as electronic medical records (EMRs), on more devices to optimize clinical and administrative staff time, in hospitals, clinics or on the go.

A highly resilient data and communications network that supports easy accessibility and cost efficiency is a requirement for hospitals and medical facilities that seek to leverage technology to digitally transform their processes.

Alcatel-Lucent Enterprise (ALE) provides a broad range of robust and secure networking, infrastructure and communication products and services to connect patients, caregivers, staff and the entire healthcare ecosystem. ALE specialized data and communications networks for healthcare providers optimize the care pathway through improved communications and more efficient processes to provide more timely, safe and effective care.
Technical innovation brings disruption and opportunity
The benefits that technical innovation brings to hospitals and healthcare facilities also come with disruptive challenges.

The benefits that technical innovation bring to hospitals and healthcare facilities also come with disruptive challenges.

French consultancy firm Asterès has identified the most disruptive technical innovations in healthcare today, each of which will directly impact hospital and clinic networks by 2030.

- **Genomics and stem cell research** are areas of scientific study that in part analyze enormous pools of data to enable predictive medicine and genetic and cell therapies.

- **Artificial intelligence** likewise employs data analytics and supercomputing to explore diagnostic algorithms and medical machine learning.

- **Telemedicine and robotics** are more directly related to patient treatment. Telemedicine allows doctors and patients to interact remotely over secure (often mobile) communication networks, while robotics and automated nursing assistants are already in use for precision surgery, patient monitoring and control of smart prostheses.

As these breakthroughs in healthcare continue to emerge, advance and disrupt, ALE healthcare solutions are also moving toward the future. ALE’s networking technologies and products continue to evolve, guided by the desire to deliver robust, high-performance network infrastructures that can handle the bandwidth demands of research and therapy development at the cutting edge of healthcare.
Healthcare industry: 4 major digital challenges

1. IoT

- 69% of patients say that the use of wearables have a positive effect on patient/physician communications.

2. Mobility

- 80% of doctors already use smartphones and medical apps.

3. Digital Health

- 340% of healthcare organizations experience more security incidents than the average industry.

4. Security

- 82% of surveyed hospitals consider their Wi-Fi network business critical.

5. IoT Healthcare market growth

- 65% of all interactions with healthcare facilities will happen over mobile devices by 2018.

6. Connectivity in healthcare

- 52% of hospitals currently use 3 or more connected health technologies.

7. Patient engagement

- 41 billions $ to 158 billions $ in IoT healthcare market growth.

Resources:
1. Marketsandmarkets.com | IoT Healthcare Market
2. Advancecure.com | Digital trends in digital healthcare
3. Greatcall.com | Is Mobile Healthcare the Future?
4. HIMSS.org | How Hospitals currently use Connected Health Technology
5. Cloudspok.com | Mobility Strategies in Healthcare survey
6. Deloitte.com | Global Health Care Outlook 2017
ALE products and technologies address three forces that are shaping the future of more powerful, resilient digital networks for healthcare.

- **Mobility and cloud access:** Wireless mobile access to data and information maintained in the cloud is a game changer, increasing availability of data for patients, clinicians and administration alike.
  - By 2018, 80% of doctors will use smartphones and medical apps, 72% will use them to access drug info; 65% of all interactions with health care facilities will occur via mobile devices.
  - With EMRs in the cloud, care givers and patients can access test results and other information 24/7
  - In hospitals, new technologies are now “mobile first,” requiring a very resilient, low latency, high bandwidth network for greater connectivity

- **IoT:** Healthcare facilities increasingly take advantage of connected devices to improve outcomes and patient engagements. These IoT systems range from connected medical devices such as MRI and CT scanners, wearable medical devices and remote patient monitors, to video security cameras and electronic ID-enabled security doors.
  - IoT health monitoring networks are increasingly pervasive: 52 percent of hospitals currently use three or more connected health technologies, and 47 percent expect to expand their use of connected health technologies in coming years.

- **Cybercrime.** Hacking into data networks is a major concern for healthcare organizations: Life sciences and healthcare organizations experience 340 percent more security incidents than the average industry. One of greatest threats is ransomware. The massive Wannacry cyberattack infiltrated hospital networks across Europe and North America in 2017, and stopped work for days at 16 NHS hospitals in Britain.
  - Healthcare IoT systems are especially vulnerable to hacking, as the proliferation of sensors and connected devices greatly expands the network attack surface. IoT for healthcare is especially susceptible because many IoT devices are manufactured without security in mind, or built by companies that don’t understand medical security requirements. Consequently, IoT systems are becoming the weak link in hospital, clinic and care facility cyber security.

As an example of how IoT connected devices can be hacked, in 2016 Johnson & Johnson were forced to warn customers about a security bug in one of its connected insulin pumps which hackers could exploit to overdose diabetic patients with insulin.

A comprehensive layered approach to security is necessary to protect the healthcare network, including an IoT containment strategy to segment devices from other systems in the network, to ensure an efficient and secure environment in which to operate IoT devices.
Emerging trends in healthcare
In addition to the growing costs of healthcare, ALE has identified four major trends that will impact healthcare in the near future.

Digital transformation and innovation. To attain the medical and business advantages of powerful technology advances, today’s hospitals, clinics and medical facilities must integrate digital innovations in mobility, data analytics, cloud computing and IoT into existing medical, business and computing systems. This process, known as digital transformation, delivers many benefits, enabling healthcare organizations to create more efficient processes, provide differentiated services, deliver better care, increase revenues and reduce costs.

However, as healthcare organizations embark on digital transformation, they learn that their underlying network infrastructure is the fundamental enabler of digital transformation. Yesterday’s network architectures aren’t equipped to support today’s healthcare use cases—or the new technologies that hospitals and clinics must implement to support digital transformation and remain competitive.

Regulatory mandates and compliance. Healthcare will continue to face federal and regional regulations and compliance mandates, including those intended to increase patient and product safety, particularly as care delivery becomes more and more automated with IoT-enabled implants and robotic health monitoring.

Governmental bodies are also increasingly concerned with privacy of patient records and information. In the United States, the Health Insurance Portability and Accountability Act of 1996 (HIPAA) is legislation that in part establishes standards for data privacy and security provisions for safeguarding medical information. The new General Data Protection Regulation (GDPR) provides for harmonization of data protection regulations throughout the European Union. As part of these regulations, the GDPR requires data protection “by design and by default,” and stipulates that data handling throughout the whole data processing lifecycle complies with this regulation. In addition to the EU-wide GDPR, some individual European countries have...
their own data protection codes of conduct, including Data Residency requirements restricting transferal of data (including healthcare data) across national boundaries.

**Improved financial performance.** Cost controls in healthcare are impacted as providers, payers, governments and other stakeholders strive to deliver effective, efficient, and equitable care in an ecosystem that is undergoing a dramatic and fundamental shift in business, clinical and operational models. These changes are fueled by the proliferation of chronic diseases and aging and growing populations, which are more costly to treat. Improved financial performance is also challenged by healthcare’s need to balance care quality and value with innovative treatments and technologies, which can lead to improved outcomes but at a higher cost. Evolving financial and quality regulations are another factor that impact cost controls, as are changes in the traditional relationship between care providers and patients. Many of today’s patients have high expectations and have researched treatment options on the internet, making them more informed and empowered consumers of healthcare services. These patients can be more demanding of more expensive treatments and expectant of more hotel-like services and comforts while in hospital. Meeting the needs and expectations of these patients can impact tight cost controls.

Unless managed appropriately, these factors can lead to rising costs and an increase in spending levels for care provisioning, infrastructure improvements and technology innovations.

**Adapting to market and cultural forces.** The healthcare industry is not immune to larger changes that are evolving in business and society. In terms of business models, healthcare organizations now have alternative financial and operational choices for accessing healthcare network and communication technologies. New investment models that better align with today’s healthcare environment and meet the specific requirements of vertical industries are now available. In addition to the traditional CAPEX investment model for procuring network and
communication infrastructures, healthcare organizations can take advantage of OPEX-based options, including pay-as-you-go, network-on-demand, and other cloud-based models that may better reflect how modern healthcare businesses operate.

As noted above, hospitals and caregivers must also be prepared to meet the needs of more savvy and engaged patients, who do their own research, want to be more involved in their care management, and wish to have real-time access to test results and EMRs. In fact, one study by Accenture Consulting found that 92 percent of patients believe they should have full access to their EMRs, while only 18 percent of doctors believe they should. However, governmental privacy regulations make sharing private patient data challenging, requiring highly secure networking infrastructures to transmit the information.

Another group of discerning patients are those willing to travel for what they perceive as better, or more cost effective, medical treatment. This gives rise to the phenomenon of medical tourism or health travel, which involves traveling outside one’s country of residence to receive medical care. The needs and expectations of these patients are often high, particularly when it comes to use of the hospital or medical facility’s Wi-Fi network for communication and entertainment purposes. A data network already over-burdened with medical and organizational traffic may not be available to deliver the level of service required to support the communication and streaming entertainment needs of high-touch patients.

An ongoing challenge for healthcare operations around the world is the difficulty of sourcing talent—finding and retaining trained medical professionals, mainly physicians and nurses. With the number of trained medical personnel unlikely to grow fast enough to meet the global demand for expert caregivers, automation and new technology advances—such as robotics and the IoT—offer safe and dependable ways to monitor patient conditions and deliver care that are not reliant on human interaction. These technologies are only as safe and reliable as the network infrastructure that supports them, which must be able to provide
mission-critical levels of availability and resiliency to supplement the roles and efforts of caregivers.

**New trends and innovations present challenges to healthcare IT infrastructures**

In hospitals, clinics and other healthcare facilities, the IT and communication network infrastructure is the foundation for digital transformation. It powers critical applications and services, and enables the sharing of vital data and information quickly, accurately and securely. Yet these new technologies are only as capable as the network they run on. To gain the advantages of digital transformation, IT and communication services must be always available to the caregivers and staff who need them in a reliable, secure and highly optimized way, both in fixed locations and while mobile. However, seamless delivery of these services and capabilities across healthcare facilities and hospitals rely on IT and communication networks that are already under pressure.

**The digital transformation of healthcare**

Digital transformation has the potential to redefine how people, technology and devices interact and connect with each other in healthcare environments, helping promote better care, reduce costs and improve outcomes. By bringing together the major technical and business trends of mobility, automation and data analytics, digital transformation can:

- Enable a superior healing experience for patients, improving care and outcomes.
- Help clinical and administrative staff deliver safer, more timely, and higher quality care.
- Support new care approaches and solutions to make care delivery less expensive, more efficient, and both more secure and accessible, to enable an optimized care pathway.
- The network infrastructure of healthcare organizations is the foundation for digital transformation, because robust, secure and resilient connectivity is the vital component for optimizing the care pathway across the healthcare ecosystem. The network lays the groundwork for delivering the data, applications, mobility and IoT connectivity that ultimately drives outstanding patient care and improves outcomes.

**Strategic white paper**

Why digital transformation is redefining how people, technology and devices interact in healthcare
Today, many hospitals and healthcare organizations operate a variety of overlapping networks with separate infrastructures for:

- Clinician support, medical applications and equipment.
- IoT networks for health monitoring and Smart Hospital applications.
- Security cameras and physical security systems.
- HVAC and other physical plant operations.
- Entertainment systems for patients.
- Pervasive WLAN for Wi-Fi connectivity.
- Back-office networks to support administration and financial systems.

Each of these system infrastructures often includes its own networking equipment and management interfaces, all connected to its own system of servers, compute, storage, gateways and other platforms, leading to greater IT capital expense.

Managing multiple disparate network systems and technologies is also challenging and costly in other ways, as it increases management complexity as well as opportunities for errors. Without unified access capabilities across multiple systems, enabling access controls and extending credentials and policies to all users, profiles and systems is difficult. Multiple management interfaces also makes it challenging for IT managers to easily monitor and analyze network usage patterns to provide visibility and detailed information about the users, devices and applications in use on the network. These analytics can be employed to make proactive decisions about upgrades and identify unusual network traffic patterns and unauthorized activity and network intrusions. A fragmented network infrastructure also doesn’t provide a consistent experience for LAN and WLAN users, limiting benefits of mobility and hindering some wireless applications such as patient location and remote monitoring.

**A highly robust infrastructure to address fast evolving demands**

To address these challenges, hospitals and clinical environments need a single network infrastructure with a unified network management system for all IT and communication systems to help optimize the care pathway and increase patient satisfaction and well-being.

This highly resilient communications and data infrastructure serves as the foundation for the critical applications that run on it. It supports easy accessibility for caregivers, with dynamic access to patient information and short response times across the entire healthcare ecosystem, and beyond—to emergency vehicles and medical staff that function outside hospital borders. This efficient, highly dependable network infrastructure can optimize how physicians and staff use their time.

This single network infrastructure can reduce equipment, management and operating costs while providing the security and performance needed to support and enable patients, clinicians, and all devices, equipment, and applications within the healthcare ecosystem.

In addition, this single infrastructure can support private virtual networks for individual departments, groups of devices (including IoT containment) or locations to help prevent potential vulnerabilities from one network affecting devices and information in another.

**ALE solutions for building a secure care pathway**

ALE delivers a highly resilient network and communications infrastructure to optimize the care pathway and help deliver improved outcomes to patients. ALE provides high performing products and services across all network layers and is able to address the networking needs of all sizes of hospitals and healthcare facilities. ALE networking solutions support the latest generation of high bandwidth capabilities and can manage large numbers of devices in high-density environments.
ALE networking products and technologies include:

- Core network management systems.
- Switches to connect clinics, hospitals and medical centers.
- WAN access routers and router switches to ensure high-speed, secure access to internal resources across a distributed user base.
- WLAN access points and controllers to deliver high-speed wireless services to small, medium and large networks, including the latest 802.11ac Wave 2 access points for high-density deployments.
- Management and security products to protect data and the network infrastructure, while keeping voice and rich media communications platforms running smoothly.

These network technologies are linked by Intelligent Fabric (iFab) from ALE, an underlying high-capacity network fabric that simplifies design, deployment and operation of the network by automating many tasks that are traditionally performed manually.

iFab is fully visible to Alcatel-Lucent OmniVista 2500 network management system, which provides a single dashboard to manage the entire healthcare network, with robust reporting tools, smart analytics and a predictive analysis engine to anticipate network demand and behavior.

**A layered approach to network security**

ALE’s network infrastructure also supports cyber security through a comprehensive layered approach. More than ever before, security needs to be built into the healthcare network infrastructure from the ground up and applied universally across all methods of access to the network, including wired, wireless or connected IoT devices.

ALE layered security includes:

- At the user level, verifying that users are always authenticated and authorized with the correct access rights (using policies and profiles).
- At the device level, checking that devices are authenticated and compliant with IT-established security rules. This can be achieved with agents installed on devices that perform a quick security scan before devices connect to the network. For instance, the scan can ensure that the devices joining the network have up-to-date anti-virus software, and the latest version of their operating system.
- At the application level, setting rules associated with specific applications (including blocking, limiting bandwidth or identifying who can use them).
- At the network level, ALE switches and access points offer smart analytics capabilities that provide visibility and detailed information about the network, users, devices and applications being used on the network.
- A single network management system that provides visibility and analytics across the entire network, with views into users and activities, applications and device usage.
- Smart Analytics that also provide deep packet inspection capabilities, which can detect the type of data and applications moving through the network, making it possible to identify unusual network traffic patterns and unauthorized activity and network intrusions.
- At the IoT level, placing sensors and devices in virtual containers using network virtualization techniques that allow multiple devices and networks to use the same physical infrastructure, while remaining isolated from the rest of the network. By segregating the network with virtual containers, if a breach does occur in one part of the virtual network, it does not affect other applications.

Additional security technologies, such as code and network hardening, are built into every switch to protect against cyber-attacks. Network administrators can choose the type of authentication and security to use.
ALE network and communication solutions for healthcare

The ALE infrastructure provides a robust and secure network optimized for hospital and medical solutions that require high bandwidth performance. This includes extending network services and capacity to connect patients, staff, devices and systems, and high-performance, high-density Wave 2 Wi-Fi to support secure mobility across the entire healthcare environment. It also supports cloud-based network, communication and platform services, which allow hospitals and clinics to access critical infrastructure in a pay-as-you-go model.

ALE communication, collaboration and notification solutions for healthcare optimize the care pathway for patients, caregiver and staff by providing:

- Superior patient and visitor experiences, including seamless appointment processes that automate appointment reminder notices through a variety of media.
- More personalized central and care-unit patient greetings.
- A variety of communication solutions for patient rooms, based on preferences, BYOD, or hotel-style amenities and services appropriate for medical tourism.
- High bandwidth connectivity to support optimal performance of VoIP telephony and video streaming (for patient and visitor entertainment).
- Patient and nurse safety with emergency notification services and secure alarm workflows to provide instant security mobilization.
- Real time collaboration, presence technologies, and secure video services to optimize physician and nurse workflows and make their work easier and more efficient.
- Location-based services such as interactive maps and navigation tools.
- Way-finding services to help patients and visitors find parking spaces, hospital rooms, nurse stations, food service or emergency exits.
- Asset tracking to deploy, locate, and maintain clinical and non-clinical assets, ensuring they are in the right condition and at the right place at the right time for optimal patient care, saving staff time.
- Connected vehicle solutions with intelligent voice, data and video communication for ambulances and emergency vehicles.
- Secure access to patient EMRs and hospital services for a superior patient experience in the care facility.
- Secure video collaboration beyond hospital walls to enable virtual teams in surgeries and doctor-patient teleconsultation.
- Staff communication solutions for optimal efficiency in healthcare administrative offices.
- Secure IoT platforms for smart medical devices, location-based services and building management and security surveillance.

In addition, ALE collaborates with many certified third-party partners who provide a variety of specialized healthcare solutions, including wander prevention, video observation, and wireless communication systems and devices.
Flexible financing models and cloud platforms to address new business strategies
ALE offers multiple flexible investment models for its technologies and solutions, providing choices for how customers acquire the same proven ALE solutions and technologies but with payment strategies and service delivery models that align with the individual business needs of healthcare organizations.

Most of the ALE communications and network solutions can be financed by either OPEX or CAPEX models (or a mix).

ALE offers the following network financing solutions:

- **Traditional CAPEX**, where customers buy their own equipment.
- **Universal Network on Demand**, an OPEX model that offers consumption-based operational expenditure as an IaaS managed service, offered through ALE authorized resellers. Monthly expenditures are matched with actual use of the network infrastructure.
- **Flexible Network on Demand**, an OPEX model that offers equipment-based operational expenditure as an IaaS managed service. Monthly expenditures are matched with the actual size of the network infrastructure.
- **OmniVista Cirrus Premium**, a prepaid, subscription-based service for end customers that delivers cloud-based network management services as well as equipment support services by ALE.

In addition, ALE offers a cloud-based communication solution. OpenTouch Enterprise Cloud (OTEC) delivers a full-featured, pay-as-you-go enterprise communication service that offers business telephony, unified communications, contact center and healthcare-specific services. OTEC can be deployed in a private cloud (off or on premises), or in an overlay installation. Healthcare subscribers have the option of paying only for services used, meaning that charges are assessed only for the room services when patients are checked-in.

Another cloud offering from ALE, Alcatel-Lucent Rainbow™ is a cloud-based relationship management platform that connects people and systems and creates a cost-effective integrated collaborative workspace to optimize care pathways.

Rainbow opens communications among internal healthcare users and their patient and business contacts outside hospital or clinic borders and premises. Rainbow’s rich features and collaborative capabilities are easy to deploy and adopt by patients and hospitals, regardless of their existing communications systems.

Rainbow is available as a cloud-based Unified Communication service (UCaaS) that makes additional collaboration services available to users, regardless of their existing communications systems. Rainbow’s cloud services can be implemented as an overlay solution on legacy solutions, such as an on-premise PBX, while offering familiar collaboration features such as text, call, video conferencing and screen sharing—that reach far beyond the hospital walls. Integrating Rainbow with existing communications systems can bring additional capabilities to these systems, such as telephony presence, telephony multi-site federation, and call control—providing consolidated management tools to oversee all communication channels in a single view.

Rainbow is also available as a communications platform as a
service (CPaaS) with a set of APIs that integrate Rainbow’s powerful collaboration tools directly into existing third-party healthcare applications and patient-facing services, such as online appointments, ambulatory care applications, e-Concierge apps, task management and more. These APIs make existing infrastructure communication- and network-ready, with the capacity to add relevant new communications and collaboration functionalities without adding separate clients on top of legacy tools.

**Conclusion**

A high-performing converged network is the foundation for delivering the data, applications, communication, mobility and IoT connectivity that can ultimately drive the improved information and data flows, processes and efficiencies to improve outcomes for tomorrow’s clinics, hospitals and healthcare facilities.

A healthcare infrastructure built on ALE solutions and technologies helps create optimized care pathways that can help manage and standardize care and offer a high-quality user experience for patients, clinicians or administrative staff. Its single network infrastructure delivers reduced IT operating expenses, a more rapid deployment time and increased investment protection.

By improving the efficient use of resources while implementing processes to ensure the best quality of care, ALE helps connect patients, caregivers, staff and the healthcare ecosystem to deliver technology that works across and beyond care facilities. ALE network and communication products and technologies for healthcare provide solutions that are reliable, secure, high-performing and resilient, allowing care providers to focus on what matters most—their patients.

For more information about ALE solutions for Healthcare, go to ALE Healthcare Solutions.

**Engaging in your digital transformation with ALE**

ALE is a long-time leader in innovation for network and communication solutions for the healthcare industry. As the company continues to evolve its products and technologies for healthcare, ALE is pursuing a co-construction vision that brings together ALE designers and engineers with healthcare professionals and startup entrepreneurs to collaborate and co-create the future of healthcare. At activities such as ALE-sponsored Hacking Health Camps, physicians, nurses, hospital administrative staff and technology professionals work together, each bringing a unique perspective, expertise and skill set. The results are pioneering healthcare applications that address some of healthcare’s greatest challenges, delivering the disruptive innovations that make a difference in business and patient care.

By working closely with healthcare industry professionals, ALE is able to create the digital innovations in mobility, data analytics, cloud computing and IoT that will drive both digital transformation and the healthcare breakthroughs of the future.
Strategic white paper
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