White paper

Doctors are ready for AI in medicine. Is your network infrastructure?

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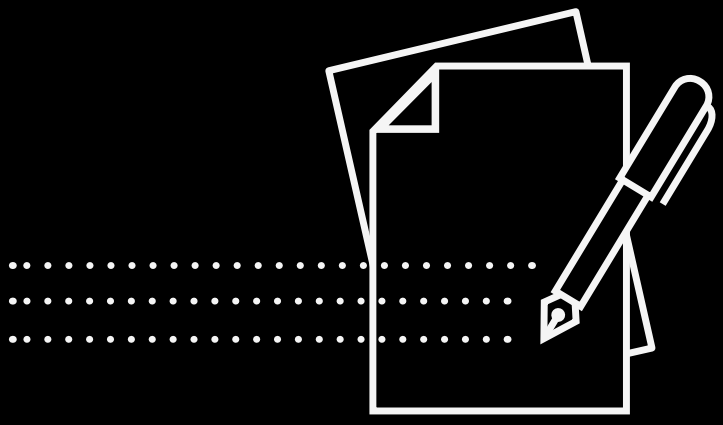
Executive summary



5G and mobile edge computing (MEC) enable life-saving applications, such as AI in hospitals. Innovative applications like video diagnostic assistance, surgical robotics and deep learning are transformatively disrupting patient care, allowing data to accurately direct and augment physician diagnosis.

Implementing an optimal network structure that includes 5G edge computing reduces latency and increases performance to a level that enables the full power of AI. Engaging a managed services partner is the most effective way to adopt the latest advancements to position your hospital at the cutting edge of AI.

5G and MEC can offer AI in hospitals such as:

- Video diagnostic assistance
- Surgical robotics
- Deep learning

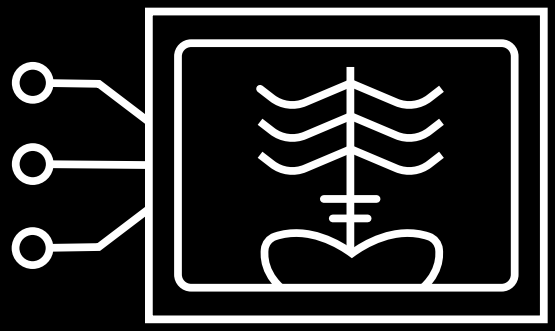
Physicians are eager to expand the use of artificial intelligence in their hospitals – and it's not hard to understand why. Its applications are seemingly endless: machine-directed diagnostic tools, intelligent video endoscopes, image analysis tools. But implementing AI in hospitals is not as simple as flipping a switch.

These advancements require the analysis of large amounts of data to reduce the time between data collection and treatment. Medical technology advances quickly, and even the high-powered existing IT infrastructure in a hospital may need upgrades or modifications to effectively deploy AI applications. To unlock the real power of AI in medicine, healthcare facilities may want to consider transforming their existing network equipment to support 5G and MEC.

5G and MEC can enable advanced applications in hospitals that require low latency and short, high-volume connections between devices, applications and users. Verizon's mobile edge computing platform, 5G Edge, delivers this low-latency performance to invite new use cases into the market. With this new edge computing architecture, developers will be able to build applications for mobile end users and wireless edge devices with low latency. That opens up a whole new world of possibilities for public and private sector organizations of all types and sizes: next-generation artificial intelligence (AI), augmented reality (AR) and virtual reality (VR), automated vehicles, real-time monitoring and control, and much more. Aligning mobile and cloud strategies with 5G Edge realizes the full potential of the IoT, improving performance and activating near-real time data. This solution accelerates the flow of information to get the data where it needs to be at the moment it needs to arrive.

The fast flow of information could enable doctors to receive and respond to that information rapidly, which could be important in emergency scenarios. The right network infrastructure is needed to support these critical medical advancements; fortunately, a roadmap exists to help you transform your network to enable these applications.

Use cases for AI in hospitals



Before addressing the network and processing demands that AI creates, it is helpful to review how innovative AI applications can address patient care.

Real-time intelligent video diagnostic assistance

A procedure like a colonoscopy, which relies on visual cues rather than lab tests, is a quintessential example of how video diagnostic analysis can be used inpatient care. Verizon's 5G Edge can be used to support edge-based AI inferencing systems that can power a network-based near real-time machine learning polyp detection platform, for example. Image processing could record video through an endoscope and the video could be sent through the 5G network to a wavelength node. Then an AI model could compare the image data with known profiles of hard-to-diagnose polyps. The node then could send the analysis results back to the practitioner in near real-time over the 5G network. If the system identifies a polyp, it then alerts the physician. But if processing speeds are too low, the indicator might not show up on the monitor, and the practitioner could miss the diagnosis.

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Image analysis

Real-time artificial intelligence has huge potential to augment human capability when it comes to nuanced analysis. Diagnostic images – including X-rays, CT scans, MRIs and perfusion studies – that have traditionally been "read" by the human eye can now be augmented by real-time AI engines that can detect anomalies in seconds, and in many instances, detect them earlier and more accurately than human analysis, which could facilitate earlier intervention. The faster the images get to the processor, the quicker that analysis can be performed and the inferencing returned to the point of care.

Apriorit notes that, in addition to providing information about objects that are not immediately visible, image processing can sharpen and restore photos, determine patterns and measure objects in the image.1 Computers can process and compare thousands of images to aid in the diagnosis, and processing these comparisons more quickly can yield a faster, more accurate diagnosis.

But first, data needs to be collected and organized. Imaging software gathers the digital composition of the target area, then a computer arranges the data to define the subject, stripping out the redundant information. Once the machine captures the digital image, it uses it to build an image processing algorithm.

Where AI in hospitals can improve image analysis is really in the details of how that organization happens. Image analysis software uses filtering, edge detection, anisotropic diffusion and principal component analysis to construct the digital image. The more data the computer analyzes, the more accurate the predictive output. Transmitting the data quickly and efficiently lets AI access as much source data as possible – and the best way to open those floodgates is to implement short, high-volume network connections and low latency transmission.

Use cases for AI in hospitals

IoT and AI in medicine

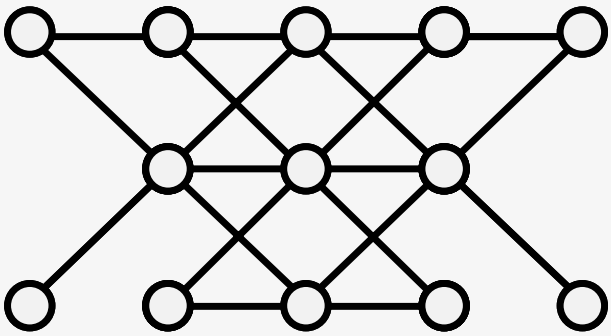
Deployment of 5G networks in hospitals could enable greater use of IoT and AI in medicine to support innovative future capabilities. An IoT network and devices, for example, could help support AI-driven video analytics to observe out-of-the-way areas of the hospital buildings and campus. The technology can alert staff to a number of different concerns, including falls, traffic holdups, emergency vehicle arrival or activity in secure locations.

AI video could also play a critical role in the operating room, both for carrying out safe and efficient procedures and for improving future operations. Surgical operations can be complicated, and everyone involved needs work cooperatively to ensure the safety and success of the procedure. Tracking instruments, a task traditionally performed by a surgical assistant, is an important way to safeguard surgical procedures. An AI-enabled camera could automate this task, freeing up space in the operating room and potentially reducing the risk of human error.

An IoT network and devices, for example, could help support AI-driven video analytics to observe out-of-the-way areas of the hospital buildings and campus.

Deep learning algorithms

AI enables deep learning by implementing continuous automated improvement to predictive diagnosis. Deep learning could give doctors an instant, holistic view of a patient's condition and its potential causes. AI can unlock deep learning, but the amount of data that scientists need to develop an algorithm is massive – on the order of 100,000 instances to start, according to Pathmind,[2] and even greater quantities of training data to drive continuous improvement, Towards Data Science reports.[3]



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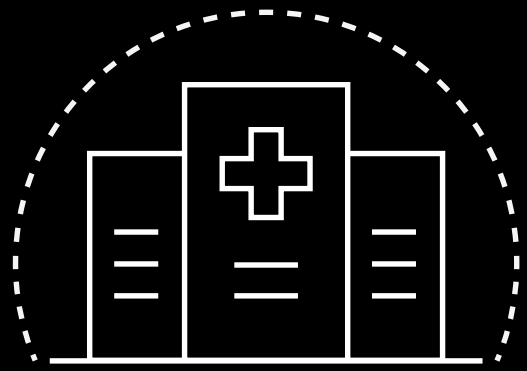
Improving the infrastructure



The existing and potential applications of AI in hospitals make a convincing case for its deployment. AI in medicine could help improve the accuracy of diagnoses, help doctors make them more quickly and help surgeons perform safer medical procedures.

Adding a transformative technology such as AI to even a robust network can cause unnecessary strain if the infrastructure hasn't been prepared. AI in medicine requires a network with low latency and great speed, bandwidth, security and virtualization. If any of those attributes are compromised on a hospital network, it could mean serious problems – in a clinical setting, network availability is absolutely essential.

To evaluate the current state of infrastructure and proximity to the end state needed for successful use of AI in medicine, hospitals should follow three steps.

AI in medicine could help improve the accuracy of diagnoses, help doctors make them more quickly and help surgeons perform safer medical procedures.

Assess the architecture

AI works with a massive amount of data, and its effectiveness will suffer if there's unnecessary transmission delays. Exclusively using a centralized cloud network could limit the flexibility and scalability of your technology implementation.

Upgrade: move computing closer to the edge

Along with the rollout of 5G, mobile edge computing (MEC) is poised to help transform the Internet of Things. 5G's superior speed improves the near-real time responsiveness of the application while reducing the cost and volume of network traffic requiring transport to centralized cloud sites.

MEC extends the infrastructure much closer to the end application and reduces data travel time. Edge computing can create redundancies in the system and allow for system repair without shutting down the system's unaffected arms. With processing power that much closer to the end user, developers can optimize a section's performance and security independent of the rest of the system.

Improving the infrastructure

5G helps reduce latency; utilizing MEC reduces it even further by shortening the distance between processor and application and minimizing the number of passes a data segment undergoes between processor and end user.

Implement

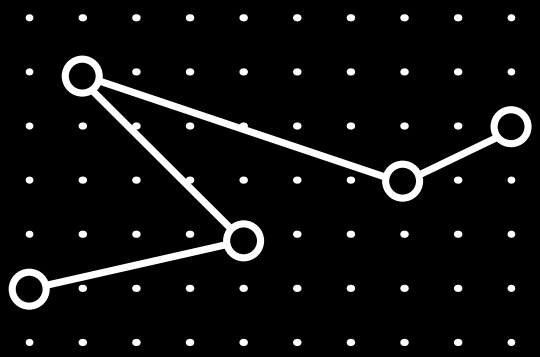
The final step is to implement the system. Latency is a drawback of AI; the sheer volume of data could logjam networks. 5G helps reduce latency; utilizing MEC reduces it even further by shortening the distance between processor and application and minimizing the number of passes a data segment undergoes between processor and end user.

Upgrade: minimize hops and latency

Upgrading to 5G networks and moving computing power close to the edge drives latency downward, but the shortest distance between two points remains a straight line. Hops happen when information is routed from one network segment to the next; the more hops there are, the longer it takes the data to return. In principle, minimizing hops reduces latency, but in practice, latency also depends on the quality of the routers at each step.

Given the extreme demands of AI in medicine, minimizing hops can help to further decrease latency. To reach a target minimal latency, shortening the path between processor and device and minimizing hops to the degree possible is the best approach.

Creating and maintaining your network to support AI in hospitals



Preparing hospital infrastructure for 5G and MEC implementation will involve two separate phases – one with a team well-versed in the applications of the technology and a second with a team that will run the process around the technology and conducts the integration. Within those phases, hospitals should prepare for these distinct steps:

Set a budget
It is essential to carve out a budget for upgrades. Depending on what you need, you might need to create a capital expenditure roadmap to add the proper infrastructure.

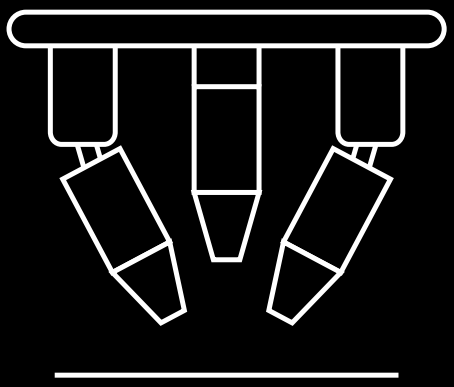
Identify essential personnel
Once your infrastructure is in place, you can identify the team you'll need to keep the critical functions moving while you update the infrastructure. Optimize staff access to avoid delays and inefficiencies when using 5G and MEC and to prevent the introduction of unnecessary security risks.

Write an operations continuity plan
Once you've found the right group of essential personnel, you can decide how to create a hybrid internal-external team to transition operations to the new network. But you have to consider the costs and benefits of managing your network yourself or engaging a partner. Keeping everything in-house will likely save real-dollar expenses, but the trade-off is decreased flexibility for resource deployment.

Engage a managed services partner
Wholesale replacement of an existing network is unrealistic – in order to overhaul a network in this way, the replacement network would need to be deployed in parallel, resulting in duplicate costs and maintenance. By partnering with a managed services provider, hospitals supplement their networks and remove the barriers that prevent real-time connectivity.

Preparing hospital infrastructure for 5G and MEC implementation will involve two separate phases—one with a team well-versed in the applications of the technology and a second with a team prepared to go through the logistics of integration.

Unlocking the potential of AI in medicine



Initiatives such as video diagnostic assistance, image analysis, surgical robotics and deep learning could help transform patient care. AI helps to make these technologies possible – and 5G and MEC can make AI in medicine possible.

Implementing an optimal network structure that includes 5G Edge computing could reduce latency and improve performance to a level that unleashes AI's full potential. Engaging a managed services partner is the most effective way to adopt the latest advancements and position your hospital at the cutting edge.

Learn how

Learn how implementing an optimal network structure that includes 5G Edge computing could reduce latency and improve performance to a level that unleashes AI's full potential.

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1. "How to Implement Artificial Intelligence for Solving Image Processing Tasks," Maria Yatsenko and Vadim Zhernovyi, Apriorit (Sept. 17, 2020).
2. "Data for Deep learning," Chris Nicholson, Pathmind (accessed Dec. 18, 2020).
3. "How Do You Know You Have Enough Training Data?" Theophana Mitsa, Towards Data Science (Apr. 22, 2019).
4. "Private 5G networks: Enterprise untethered." Paul Lee, Mark Casey, Craig Wiggington, Deloitte Insights (Dec. 9, 2019).