



# Connected Healthcare: Explore the Possibilities

Harnessing the Intelligence of Connected Devices to Deliver  
Higher-Quality, Lower-Cost Healthcare

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**WHEN IT MATTERS, IT RUNS ON WIND RIVER**

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**EXECUTIVE SUMMARY**

The Internet of Things (IoT) is quickly taking shape—a network of networks where billions of intelligent, connected devices can communicate and share massive volumes of data. What does it mean to the healthcare industry? It means virtually every aspect of patient care will change—from the reporting of illnesses, to diagnosis and treatment, to patient monitoring and disease management. It also means control is shifting to the consumer and away from traditional healthcare providers. And it means healthcare enterprises face a choice: whether to view the new era as a threat and try to protect business-as-usual, or see it as an opportunity to create new competitive advantages.

This paper describes just a few of the possibilities that connected, intelligence devices present to forward-looking healthcare companies. It also examines the requirements for delivering a new breed of tele-health services that are cost-effective, secure, safe, and compliant; and it describes the role Wind River® can play in transforming the “potential” into better healthcare for patients, increased efficiency for caregivers, and higher profits for healthcare companies.

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## NEW TRENDS REQUIRE A NEW STRATEGY

Healthcare executives contemplate many difficult strategic issues every day. Devising a “connectivity strategy” typically isn’t one of them. It should be—because increasing the connectivity of devices and data can help resolve many of the most pressing challenges the healthcare industry faces. Here is a brief recap of recent trends that are making connectivity a higher priority:

- **Healthcare costs continue to spiral upward**, while the average lifespan continues to increase. The cost of medical equipment is also rising; physician salaries and staff costs are increasing; facilities expenditures are growing. The best way to significantly cut healthcare costs is to increase efficiency and productivity, and the best way to do that is to harness device intelligence and connectivity to streamline and automate tasks, reducing the need for high-cost, time-consuming manual processes, while effectively lowering risks contributed by human error.
- **Rural areas have less direct access to physicians.** Today only about ten percent of physicians practice in rural America, despite the fact that nearly one-fourth of the population lives in these areas. The average travel to a specialist is roughly three hours by car. Telemedicine solutions can help solve the issue by increasing access without requiring physical presence—so rural patients can receive the right care at the right time, reducing missed diagnosis and associated complications.
- **The Internet of Things is building out quickly**, increasing the opportunities for creating innovative new healthcare services. By 2020 there will be 75 billion devices connected to IoT, according to Morgan Stanley. Yet today, more than 99 percent of things in the physical world are still not connected to the Internet<sup>1</sup>. The combination of these two facts represents an enormous opportunity for the healthcare industry. Throughout history, more connectivity has always led to more innovation—and though we can’t predict the scope and magnitude of the change that results, innovation always leads to great things—for people and for businesses. From pop-up clinics, to microchips modeling clinical trials, to surgeons wearing Google Glass to improve their access to patient data, more connectivity always means more innovation.

- **Consumers are asserting greater control over their own course of care.** Through the web, search engines, social media, and online healthcare services, consumers now have instant access to huge volumes of medical information, diagnosis tools, and instant access to the opinions and experiences of others. This level of connectivity will continue to increase, changing the traditional business model for healthcare providers.

Clearly, the future of healthcare will draw more and more heavily on the connectivity of devices. The key is to examine the opportunities from a business perspective, not just a technical perspective, and to create a realistic connectivity strategy.

## A CLOSER LOOK: HOW CAN CONNECTED DEVICES DRIVE BETTER HEALTHCARE?

The previous sections outlined the overall opportunity connected devices present to the healthcare industry; now let’s examine just a few examples.

### Telemedicine: No More Waiting Room

Telemedicine makes it possible to receive care without having to visit a physician or a care facility in person. There are multiple forms of telemedicine, including remote monitoring of patient data; transmission of medical images and electronic records to physicians so that they have access when needed; or real-time interactive visits via teleconferencing, online chat, or other channels. And what makes telemedicine possible is device connectivity.

The recent surge in “pop-up clinics,” remote consultation services, and remote point-of-care offerings underscores the fast-growing appeal of telemedicine services among patients and caregivers alike. For patients, telemedicine offers care in an on-demand fashion, removing the need for lengthy and inconvenient sitting in the waiting room without compromising on the quality of care. For doctors it shifts the workflow to a more convenient time so that they can prioritize their work appropriately; and for hospitals and clinics it accelerates the workload and cuts costs while also improving the patient’s experience and satisfaction.

It is important to note that financial support for telemedicine is also increasing. Buried within a 1,185 page rule from the Centers for

Medicare and Medicaid Services (CMS) on payments to physicians is an indication that the agency is expanding reimbursement for telemedicine. The rule included provisions for paying for remote chronic care management using a new current procedural terminology (CPT) code, 99490, with a monthly unadjusted, non-facility fee, said the American Telemedicine Association (ATA). CMS also said it will pay for remote-patient monitoring of chronic conditions with a monthly unadjusted, non-facility fee using CPT code 99091. Before this, CMS did not pay separately for services and required that it bundled with an “evaluation and management” code. CMS also added seven new procedure codes for telehealth, including annual wellness visits, psychotherapy services, and prolonged services in the office<sup>2</sup>.

### Accelerating Diagnosis and Treatment

The more devices and data are connected, the faster and more accurate diagnosis becomes. Mobile devices already give physicians access to any type of information they need in seconds—from patient records to drug information to recent research and studies—all of which accelerates an accurate diagnosis. In addition, new applications are constantly being developed to aid in everything from reading X-rays and CT scans to proactively identifying emerging health threats.

Equally important, this access to information gives consumers the ability to perform an initial self-diagnosis with a high degree of accuracy. They can access huge online medical databases, use commercial online diagnosis services, and tap into the combined knowledge and experiences of millions of people via social media.

Connected devices and integrated, intelligent machines can also improve the quality of treatment. For example, robotic surgeries are now possible, and in some cases the physician does not even need to be in the operating room when the surgery is performed. Surgeons can operate remotely and patients can have the procedure done in a convenient location, sometimes avoiding the need to travel to a specific hospital or clinic, which dramatically increases access to specialist care in rural areas. This technology is also applied to create minimally invasive procedures that reduce scarring, chance of infection, and recovery times.

### Prioritizing Prevention over Treatment

A study from 1988 showed that for every 3 cents U.S. society spent

on prevention, it spent 97 cents for curative treatment<sup>3</sup>. While more recent numbers are not available, many in the healthcare industry believe even less is spent on prevention today. Connected devices can help change the equation.

For example, wearable devices such as home ECG sensors or Fitbit activity monitors make it possible for consumers to track their daily activities as part of personal health plans that are aimed at increasing healthy decisions and preventing health issues. In addition, connectivity provides a way to securely aggregate data from patients’ electronic medical records, personal health devices and other telemetrics—and deliver new services such as personalized recommendations to patients on their mobile devices.

### Eliminating Errors

Hospital error is the sixth leading cause of preventable death, according to the Journal of Patient Safety<sup>4</sup>. By improving the accuracy of reporting, diagnosis, treatment, and monitoring, connected devices can help avoid mistakes and missing data delayed by manual entry, and accelerate the remediation of errors that do occur.

## EXAMINING THE REQUIREMENTS FOR HIGHLY CONNECTED MEDICAL DEVICES

For those who agree that increased connectivity will lead to more innovation, better patient care, lower costs, and higher profits for the healthcare industry, the question is where to begin in creating an effective connectivity strategy.

A critical first step is to consider the core attributes connected devices must provide—both from a business perspective and from a technical perspective—in order to deliver on the demands of the connected healthcare vision. This section outlines those key considerations and requirements.

### Business View

From the perspective of healthcare companies, connected devices must enable new services without jeopardizing existing investments or increasing risks. They must deliver:

- **Interoperability:** Medical devices are increasingly connected to public networks for a wide range of applications. This means they need to support a wide range of communications standards and protocols such as CAN, Bluetooth, Continua, 802.15.4,

Wi-Fi, and Ethernet—and deliver high-performance networking capabilities out of the box. In addition, diverse types of devices must be able to connect via wireless and wired networks and interoperate with each other and with existing devices and data. This is particularly critical for medical applications that will incorporate big data and analytics, as the sources of data are highly varied and geographically distributed.

- **Security:** Security is the overarching concern in the connected era. Devices must provide comprehensive and tightly integrated security capabilities that ensure patient privacy and confidentiality; protect the integrity and availability of data; guard against advanced threats such as malware, “zero-day” attacks, and viruses such as the Heartbleed virus; and ward off other sophisticated attacks and attackers. In addition, medical device system software needs to deliver secure data storage and transmission and tamper-proof designs. OS-level support for these features is critical, since adding them at the user or application level is ineffective, expensive, and risky. And, since security threats are ever-changing, the system software needs to support the secure upgrade, download, and authentication of applications to help keep devices secure going forward.
- **Safety:** Obviously, safety is paramount for medical devices because malfunctions could cause injury or death—but not all medical device applications are equally life-critical. Connected devices should allow multiple applications with different levels of criticality to run on the same hardware platform; and adding new functionality or making changes in tools and technologies must not compromise the safety of the device.
- **Compliance:** The hardware and software of medical devices must meet stringent regulatory guidelines for safety and perform as promised.
- **Extended lifecycles:** For medical devices—especially those deemed life-saving—the need for long-term power management and support is absolutely critical. If it is battery operated, the device will need to last its entire useful life without being recharged.
- **Manageability:** The increasingly complex web of interconnected devices must remain manageable to deliver on the requirements above and to achieve a lower total cost of ownership.

## Design Requirements

The core attributes described above translate to a series of design and development requirements for connected devices. While it is beyond the scope of this paper to delve into the details, a few of the key design criteria include:

- **An easy-to-use human-machine interface (HMI):** The interface must be so simple that anyone who can read or hear the language can use it.
- **A multi-CPU design:** Connected medical devices should take advantage of multi-CPU, multi-core designs to ensure efficient operating performance while taking advantage of power management opportunities.
- **Evolutionary design:** The design should allow for the addition of new features and interfaces without requiring product redesign and recertification.
- **Modularity:** Medical devices need to adapt to changing needs in the network, so the operating system must be built on a modular, upgradeable, future-proof architecture that allows middleware, new protocols, and other packages to be added or upgraded without changing the core. This also helps manufacturers differentiate their products and maintain them competitively over longer periods of time.
- **Scalability:** With the proliferation of medical devices and classes of devices—ranging from small form factor, single-application devices to large-scale, complex, multi-application systems—the scalability of the system software is of paramount importance.
- **Rich user interface:** The user experience is everything for mobile devices today, and connected medical devices are no exception. They must perform as expected, fast and efficiently, with support for multiple monitors and touch screens and rich graphics.

## DELIVERING ON THE DEMANDS

Wind River is unique in its ability to offer a portfolio of proven solutions that meet the specific connectivity requirements of its medical customers. Wind River solutions allow healthcare businesses to create and execute on connectivity strategies that deliver new competitive advantages; accelerate their innovation; and adapt quickly to ever-changing business realities. Key offerings include:

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### Medical Profile for VxWorks

Medical Profile for VxWorks® is a collection of middleware and documentation developed to help the healthcare industry bring connected devices to market faster, while reducing risks and development costs.

Powering more than 1.5 billion embedded devices, VxWorks is the world's most widely deployed real-time operating system (RTOS). VxWorks 7, the revolutionary new release of the RTOS, combines a modular, future-proof architecture with the scalability, security, safety, and connectivity medical device manufacturers need to harness the opportunity created by IoT.

### Wind River Professional Services Medical Solutions

Wind River Professional Services has a strong track record of guiding medical device makers through the complexities of device design and implementation—so they can focus on innovation. Wind River Professional Services can offer expert assistance with every aspect of planning, building, and managing safe, secure, dependable medical devices, just as we have for more than 30 years in a wide range of other industries. Our global development centers, proven engagement methodology, timely delivery, and in-depth understanding of market and technology dynamics have made us a valuable implementation partner to our customers.

### FOR MORE INFORMATION

Wherever you are on your road to devising an effective connectivity strategy for medical devices, Wind River can help you take the next step in a way that maximizes innovation and minimizes cost and complexity. To learn more about Wind River capabilities and offerings, visit [www.windriver.com/markets/medical](http://www.windriver.com/markets/medical).

<sup>1</sup> Cisco Systems, "The Internet of Everything," 2014.

<sup>2</sup> Source: [www.healthcare-informatics.com/news-item/cms-expands-telehealth-reimbursement-new-rule-says-ata](http://www.healthcare-informatics.com/news-item/cms-expands-telehealth-reimbursement-new-rule-says-ata)

<sup>3</sup> Centers for Disease Control and Prevention, "Effectiveness in disease and injury prevention and estimated national spending on prevention," United States, 1988. *Morb Mortal Wkly Rep.* 1992: 41, 529–531.

<sup>4</sup> *Journal of Patient Safety*, September 2013: 9(3), 122–128.

