

A Whitepaper By  
Intersog

# What is The Internet of Medical Things? IoMT



# Machines that Talk to Medical Machines

The Internet of Things has begun to appear across many industries and in the lives of consumers as well, which includes connecting the medical technology of the healthcare industry. BI Intelligence estimates that 24 billion devices will connect to the IoT by 2020; many of them will provide medical data to health care providers and shift the balance toward consumer-led healthcare. The importance of healthcare in the digital IoT revolution earns the industry a unique category, the Internet of Medical Things (IoMT).

## The Changing Basis of Healthcare Power

The IoT is set to expand in an unprecedented explosion of growth, generating many trillions of dollars of economic impact between now and 2025, and the IoMT is likely to capture \$117 billion of that value by 2020. Healthcare is becoming more consumer-oriented, and the IoMT is helping to drive that trend. The push to add connectivity at the edges of networks, with devices adding data at an unmatched pace, devices enable patients to choose their applications and devices where connecting medical devices are technically no different from connecting the devices for any other purpose. However, the fact is that there is an impact on human lives, quality of life and suffering associated with data sets that contain medical information. The fundamental relationship between patient and care shifts when the technology can keep subjects connected remotely 24/7. The boundaries surrounding healthcare evaporate when it is connected, it begins with real-time monitoring and is available continuously, everywhere.

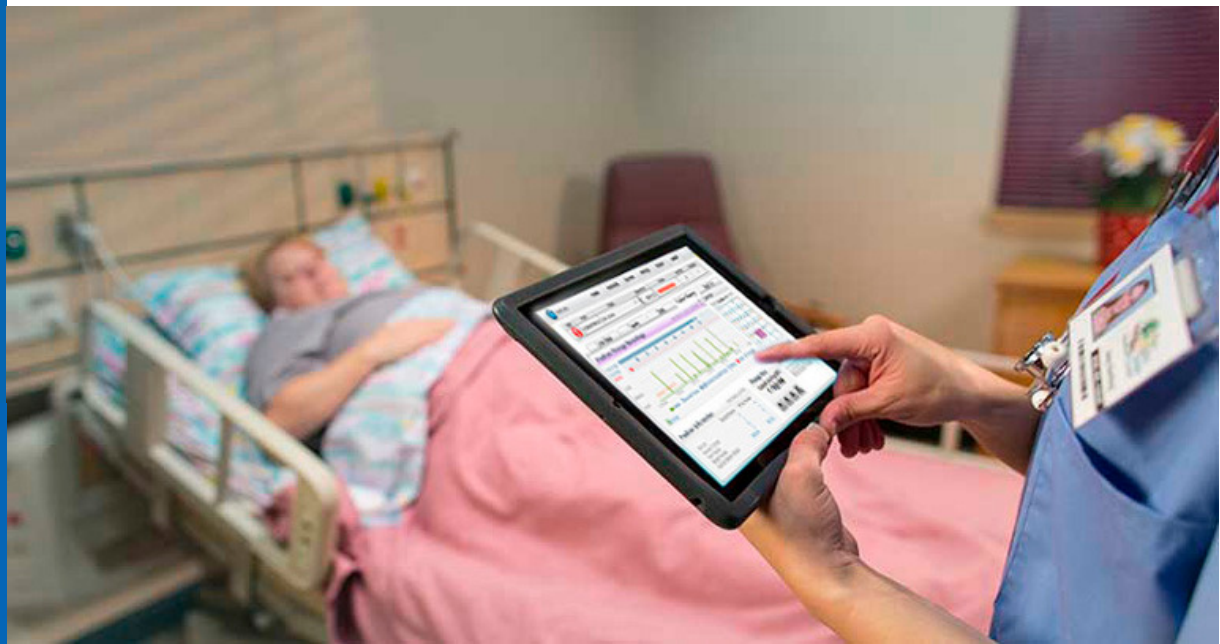
## Improving Patient Care Quality

The IoMT enhances the quality of care that patients receive at home or other comfortable and familiar living environments while still having access to the resources within reach to respond to any crisis. This blending of environments reduces the need for medical facilities and



patients will only require hospital visits for the severest cases. When this is the status quo, all healthcare facilities will be dedicated to acute or critical care by default. Self-care, home care, and healthcare will merge to deliver better service quality efficiently.

The IoMT is a new way that the stakeholders of the healthcare industry can communicate with one another and draw in medical data on an unprecedented scale. The IoMT faces security and privacy challenges and the pressure to press adoption by the users who would benefit most from its capabilities. Those capabilities will continue to expand and disrupt traditional healthcare delivery because of the fundamentally different structure that the sheer volume of usable data gives to practitioners about patients, and to patients about themselves.



## The Key Challenges of the IoMT Implementation

The Internet of Medical Things (IoMT) is set to change the way that the medical industry delivers healthcare. As with the other disruptive changes that have come from the IoT and other digital revolutions, there will be challenges that face the IoMT. There are legitimate concerns about security and privacy, the rate and extent of adoption that determine the value that can be delivered and product scalability are some of the most pressing challenges to overcome. It will be a process of advocating and leading change that will determine how to push the IoMT forward for the economic, social and medical benefits for everyone.





## Security and Privacy Challenges

Security is a primary concern for the IoMT, as is patient privacy. The devices that are rolling out as first examples of what the technology can achieve suffer from rapid development with little consideration to security. New equipment is beginning to address this by such measures as separating identifying information from healthcare data and end-to-end encryption.

Ensuring that the confidential records of patients remain secure is a paramount concern for an industry that contains so much personal information and holds privacy as one of its most fundamental values. Patient privacy is vital, as a basis for trust, and connected devices still need further development before they can consistently ensure it.

## The Challenge of Motivating Patients to Adopt Technology

To fulfill the potential of the promise of the IoMT designs for devices have to be compelling to consumers. The IoMT will shift the balance of power in the relationship between doctors and patients, which can deliver high-quality results in medical care, with rapid diagnosis and alerting, at substantially reduced costs. The shifting of responsibilities is a mixed blessing for patients who must take more responsibility to select suitable devices to collect the data on which to judge their conditions.

Consumers often neglect health concerns until they become acute. The priorities of consumers tend to be more toward those devices that provide short-term gratification rather than health and the trends in IoT spending show no exception. Products must be meaningful so that they engage users to take advantage of their capabilities. Likewise, users of the medical system, healthcare providers, software and hardware developers and patients will need new mindsets to gain the benefits that are becoming possible.

## Making IoMT Products Scalable and Meaningful

Products must be both scalable and meaningful if they are going to gain full adoption in the market while delivering the experience and utility consistently regardless of network or location. As devices become more consumer oriented, they face the challenges of competing in the market.



The changing state of the art means that it is a challenge for companies to find the right products and development processes; it causes companies to form new alliances that were unusual not very long ago. Large, established corporations and small startups now form partnerships to take advantage of the strengths of each.

## Anticipating the Unknown and Managing the Change

The ultimate challenge is capturing and analysing all of the data that devices of the IoMT generate. Current systems that only use small fractions of the amount data available to alert for anomalies have the potential to optimise operations significantly and to find patterns in the data that show hidden relationships and predict outcomes.

These challenges present excellent opportunities for the companies and entrepreneurs that have the insight to appreciate the significance. Changes mean opportunities as well as risks and threats. The lines between products and services blur. Developers for the IoMT need to address the risks and look deeply to find the rewards. They should prepare for high data volumes, to capture the full potential of data, ensure security and protect the privacy of patients.



# How to Foster Adoption of the IoMT

Much has already been done to foster adoption of the Internet of Medical Things (IoMT) and there is more yet to do. To have a fully functional implementation of the IoMT organisations need to recognise the multiple levels on which it must operate. It will take a clear indication of the direction and trends in tech that supports IoMT and also the leadership to make change happen. Consumers benefit as patients and users of the system, but they need incentives and compelling products to use.

## Disruption by Connection

When everything is connected, all the time, the lines blur and then disappear; health monitoring becomes continuous. The potential for care without boundaries is vast and presents the hope of saving and improving lives while reducing expenses from the current levels.

The success of the IoMT will come from the ability of leaders in health management to lead change and to deliver a realignment of capabilities to cross boundaries and adopt a multidimensional approach that breaks through the silo walls and shifts the perspective from a single reductive focus to that of holistic thinking, which captures the big-picture. When standards stabilise and propagate, it opens the market to companies and investors who see the opportunities and have the resources to pursue them.

## Managing the Adaptive Challenges of Healthcare

There will have to be a change of the mindset of consumers and in the healthcare industry to exploit the IoMT to the fullest extent possible. Consumers, patients, medical workers, and administrators need incentives that may only be gentle nudges, but they must entice all of these users in the right direction.

It will be the companies and institutions of the healthcare industry that provide the leadership and the managers of those organisations that provide the leadership. A change of paradigm requires a change of mindset; managing that change requires intelligent leadership.



## Privacy Must Be A Primary Concern

Ensuring that all IoMT devices are secure is one thing that will positively impact adoption. The need for strong privacy protection for any part of a system that accesses your medical records is paramount. The fear of unsecured connections will slow adoption and create concerns and even bad publicity, which will undermine the enthusiasm for joining any IoMT initiatives.

Adoption of the IoMT will gradually and inevitably continue. Healthcare companies have powerful incentives to keep up, both financial and technological; practitioners will come around as training, and incentives encourage them to; the consumers will become more comfortable with devices and data-driven medicine because the IoT is becoming ubiquitous and aligned with the IoMT; consumers will “get it” before too long.

## Moving Ahead With The Technology Wave

The challenge that will limit adoption is the fear of privacy breaches; there will likely be high-profile examples, sensationalised in the media. However, as platforms update and optimise for security, the concerns are likely to prove to be overblown and the challenges overcome. In the end, the IoMT is a reflection of emerging technology, and consumers will eventually accept it as the way that we do medicine in the twenty-first century.





*Maarten Ectors, VP of IoT for Canonical, the company behind Ubuntu*

"The IoMT is in the concept stage at this moment. The key drivers are the same general IoT technology advances like sensors (often thanks to mobile phones making them cheap), small and cheap computers [think Raspberry Pi and wearables), cloud, robots, AI and big data analytics. We are moving to a world where our bodies can be continuously monitored, our DNA cheaply analysed, and artificial intelligence can assist us in finding problems or living healthier. You used to need a doctor close to analyse your body. Pretty soon you will be able to buy for less than a \$100 a complete home health kit that will be able to measure your vital signs, urine, blood, pressure, and much more. AI will be able to look at the results and initially assist a remote doctor but more and more substitute the doctor for trivial or even 80% of the normal use cases. Offshoring of doctors will become the trend for IoMT. The current health systems are not affordable.

The other major change will be making health equipment substantially cheaper, more innovative and even revenue generating. What if you could download the open source specs for an MRI scanner from Github? What if you could create apps for MRI scanners and sell them to patients? Lots of very expensive equipment will be commoditized and the value will move away from hardware to software.

Robots will allow surgeons to remotely operate. In the future they might even autonomously operate.

The challenges? Privacy, patents, security, governmental approval, artificial barriers of entry, etc. Mistakes will be made and large corporate budgets will use these to influence governments into not opening the market towards more efficient automated medical approval processes. At the end innovators will have to go to Africa or other places, cure people on the cheap and then move to the US and Europe later on when they have proven their technology. We will likely see many large medical corporations have a "Kodak Moment" and their revenues will disappear faster than Nokia's phone revenues did after the iPhone became a hit. The reason is that any industry with legal barriers of entry has very few stimuli to disrupt its own juicy business models. However the market opportunity is just too big and the amount of lives that can be saved so enormous hence innovators will go around the establishment unless corporations invite innovators to redefine the market together. The medical industry has a choice: constructive innovation with innovators today or disruptive innovation tomorrow."



# IoMT Connected Tech And Smart Gadgets

The Internet of Medical Things (IoMT) encompasses everything from mHealth apps and wearable trackers to connected medical equipment that sends data directly to the records of patients. According to Qualcomm, the IoMT will be a \$117 billion market by 2020, and that implies opportunities for developers and product designers as well as the companies that employ them.

## Driving The IoMT

Medical devices such as wearables and mHealth applications that connect to local networks via mobile and Wi-Fi change the way that consumers interact with healthcare. The benefits are more than just financial; this growing connectedness has tremendous potential to save lives and improve the quality of patient care.

As an Internet of Things subset, the IoMT integrates not just devices but the information systems that aggregate Big Data insights for healthcare providers. It makes the supply chain more efficient, and it helps to detect and prevent medication errors. The vast scope of the data that the IoMT assists in collecting encompasses all recorded medical events and may even find unknown ones. This new ability to document medical crises in the data stream facilitates detection when the earliest symptoms appear in the data. The IoMT enables an always-on system that can send warnings to physicians and help to catch events before they become crises.

## Telemedicine

The ability to remotely monitor patients via connected devices gives health care professionals insight that was not possible before. It also allows the connection of smart devices that make predictions based on state changes too subtle for human detection but which are reliable indicators of changes in patient health and impending crises. The IoMT provides connected sensors for telemedicine, remote medication management, and patient monitoring, tracking pharmaceuticals and hospitals admissions tracking.

Digital connectivity is the source of power for devices, which will gather vast quantities of data and send it to the cloud to fit the structure of the system. The shift from local measurement to IoMT means that lines





between traditional functions of products and services begin to blur when the data that devices collect disseminates rapidly, disrupting the traditional silos of healthcare.

## Sensors and Data

Incorporating RFID in health has been developing for more than a decade due to initiatives by the FDA to tag every box of prescription medications, to prevent theft and counterfeiting. RFID tagging has been applied to the supply chain successfully. Current initiatives include efforts to tag the medications themselves to provide real-time information as the drugs enter the patient's body.

The IoMT spawns reasons for companies to collaborate across the divide of scale. Large enterprises have reasons to work with small startups in ways that were not relevant before but are now becoming useful to achieve shared objectives. Corporations gain access to skills and knowledge while entrepreneurs receive funding and business guidance in return. It is a commitment to infrastructure investment, privacy, training for staff, and promotion to customers that supports IoMT adoption.

Connected devices can be owned and controlled either by healthcare companies or by consumers. The boundary between them is fluid and changing as technology pushes out to consumers. Patients can bring their own devices to the table; startups can assist established organisations to adapt rapidly by plugging into solutions that make better use of available data. The next few years will present exciting and compelling opportunities for the development community to imagine and implement the best possible solutions in IoMT technology.

"24 billion devices will connect to the IoT by 2020"

BI Intelligence

"IoMT to be a \$117 Billion market by 2020"

Qualcomm



# Technologies Behind the IoMT

## Hardware, Protocols, and Platforms on the Healthcare Internet

The Internet of Medical Things serves patients, hospitals and clinics, physicians, cardiologists, radiologists, dentists, insurance companies, and other organisations that directly interact to deliver healthcare. The IoMT delivers medical care using technology from the Internet of Things to give more efficient and humane care.

The emerging ability of machines and sensors to connect to health networks via Internet protocols has changed the way that the healthcare industry delivers medical care and attention. This universal machine-to-machine (M2M) connectedness is pushing smart technology out to the edges, which helps patients to have better care and attention remotely and in real-time.

### M2M Healthcare Devices

New generations of hospital equipment transmit information directly to the electronic health records of patients while providing much of the same capabilities in the homes of consumers. Connected sensors and M2M equipment can report on dosing, equipment condition, and present patient health. Significantly, these systems do this in real-time, detecting errors and breakdowns and health crisis events, even sending alerts when devices need a new battery.

The key technologies behind this revolution in care comes from mHealth, which exploits the extensive capabilities of smartphones and tablets, activity monitors like FitBit, to provide opportunities for devices specifically designed as connected sensors such as smart Band-Aids, connected weight scales, and blood pressure monitors.

### Protocols that Speak the Language of Healthcare

The Internet Protocol (IP) is the underlying software that drives the communications of IoMT, and many of the M2M communications protocols derive directly from IPv6.



- 6LoWPan is a protocol based on IPv6 designed for use over a low power wireless personal network.
- ZigBee comes from more industrial roots; it is otherwise similar to Bluetooth. ZigBee optimizes for M2M connections as opposed to voice and data. Its relatively low data rate is ideal for controllers and sensors where the priority is minimum latency and energy consumption.
- Z-Wave is a protocol for M2M developed by Danish startup Zensys. It is similar to ZigBee, with a relatively low data rate, but designed to be used in home automation products, which makes it ideal for remote monitoring to send alerts from connected healthcare devices.
- Bluetooth connects devices to networks at short range. Bluetooth Smart edge devices can now connect directly to the Internet via 6LoWPan. Any protocol with IP connectivity has potential to integrate into the IoMT, for example, the current 3G and 4G LTE cellphone data networks can connect patients to their doctors and their sensor devices.

**"The medical industry has a choice:  
constructive innovation with innovators  
today or disruptive innovation tomorrow"**

## Internet of Medical Things Platforms

The Internet itself forms the foundations of the platforms that tie the telemedicine sensors and devices of IoMT into integrated systems. All of the cloud-based platforms that are emerging for IoT can adapt to support IoMT. However, some of the largest technology companies are concentrating efforts on IoMT because of the opportunity to position themselves as leaders in the healthcare industry.

Electronics giants like Qualcomm and Phillips are all interested in providing the platforms for IoMT; it is a market where companies that can make multi-billion dollar investments of capital into research and infrastructure projects will dominate.

The rewards of getting ahead of the competition in IoMT could secure their positions for decades. Qualcomm expects the IoMT to be a \$117 Billion market by 2020 and based on that forecast the company offers 2net and Capsule as platforms for IoMT integrations.



# Telemedicine To Change Healthcare

As consumers accept the involvement of application and messages from machines in their lives. Patients can have monitoring that ensures they get the right prescriptions and the encouragement to take medications on time, warnings of impending crises and less time in hospital wards.

The IoMT is the intersection of health and technologies; the result is a new paradigm of data-intensive medical capabilities; it is redefining the way that the healthcare industry manages and treats both acute and chronic issues.

The protocols platforms and equipment that enable continuous real-time health monitoring and management are still developing; it is up to the technology industry, as well as the medical profession and consumers to define the directions and follow through with creative and intelligent Internet of Medical Things solutions.





## Intersog

Intersog® is a global provider of premium ROI-driven custom software development specializing in delivery of full-service, end-to-end solutions for eHealthcare, IoT, Smart Tech, Big Data and Cloud.

Intersog helps its partners solve their software development needs by providing cost-effective Agile Development Teams and IT Staffing Solutions onshore (within North America) and offshore (via Ukraine-based R&D Centers).

Founded in 2005 and headquartered in Chicago's iconic Willis Tower, Intersog is a global company of 150+ people in multiple locations.

We fit perfectly in any software development partnership and empower innovation with our 6 A's strength: Advisory, Application Development, Access to IT talent, Automation, Analytics and Actual results.

To continue conversation about the Internet of Medical Things and how we can assist with your custom Healthcare IoT solution development, drop us a line: [contact@intersog.com](mailto:contact@intersog.com), or call us at +1 773 305 0885. For eHealth and IoT trending topics and real-life case stories, please visit our websites: [www.intersog.com](http://www.intersog.com) [eHealth.intersog.com](http://eHealth.intersog.com) [iot.intersog.com](http://iot.intersog.com)



## The Journal of mHealth

The Journal of mHealth is a leading international publication which brings the latest professional developments in mobile, digital and connected health technologies to healthcare and industry professionals around the world. We collaborate with leading digital health companies to develop reports and whitepapers covering the latest technologies in healthcare. To work with us contact [enquiries@thejournalofmhealth.com](mailto:enquiries@thejournalofmhealth.com)

The  
**Journal of mHealth**  
The Global Voice of mHealth