

# HEALTHCARE USING INTERNET OF THINGS

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*Abstract*— In India, there are roughly 48 doctors for every 100,000 people. Many of our nation's healthcare providers have been ill-equipped to diagnose, treat and monitor the progress of patients within urban population centers and rural villages. This paper report brings light on how healthcare can be perfected using Internet of Things (IoT). The IoT is expected to have a profound effect on healthcare in India. Envision doctors leveraging a variety of small, powerful wireless monitors connected through the IoT, to reach and track patient health in India's most remote communities, where healthcare facilities are almost non-existent.

All of this suggests we are at the dawn of an exciting revolution in patient care across India. But at the same time, there are concerns that healthcare organizations could “overdose” on the digital information coming their way because they are ill prepared from a technological standpoint to handle it. Healthcare organizations must consider the critical role of the network in managing and analyzing these gigantic volumes of data coming from all those health and fitness devices. Employing Software Defined Networking (SDN), Network Function Virtualization (NFV) and cloud computing technologies will prepare the network to rapidly capture, curate, manage, and process massive amounts of data.

*Index terms*- SDN, NFV, rural care, wireless monitors.,

## I. INTRODUCTION

The many uses of the systems and products that connect to the Internet of Things (IoT) are changing business in numerous industries. Patients and providers both stand to benefit from IoT carving out a bigger presence in healthcare. Some uses of healthcare IoT are mobile medical applications or wearable devices that allow patients to capture their health data. Hospitals use IoT to keep tabs on the location of medical devices, personnel and patients.

## II. OVERVIEW

These long-overdue upgrades are of even greater importance in the Internet of Things (IoT) era, as millions of people around the globe connect with billions of

gadgets and machines – each with their own set of sensors – in ways we never imagined just a few years ago. Indeed, forecasts from the Ericsson Mobility Report and ABI Research

estimate that by 2019 there will be 30 billion wirelessly connected devices.

The emerging architecture of SDN separates the network control from forwarding function, enabling administrators to directly program network control and abstract the underlying infrastructure for applications and network services. And SDN software programs make it possible for IT organizations to quickly configure,

manage, secure and optimize the network, adjusting traffic flow in response to changing needs.

What's more, SDN offers a cost-effective approach that is standards based and vendor neutral, simplifying network design while improving manageability, coordination and control. Programmable, low latency, high-performing Ethernet switches work well with SDN, and help to create a seamless network that spans between the cloud and an organization's data centers.

NFV works in a similar fashion. NFV decouples entire classes of network functions from proprietary hardware appliances, such as routers and switches, enabling them to run in software. The result is a new

approach to designing, deploying, and managing networking services. By using standard IT virtualization technologies, NFV “virtualizes” these functions into building blocks that can be linked together, creating communication services.

NFV can be used in any data plane processing or control plane function, whether in wired or wireless network infrastructures, making Ethernet networks even more scalable, agile, and efficient. And with SDN, administrators can manage, provision and monitor NFV- based networks much more efficiently. Both SDN and NFV are prime examples of how virtualization is reshaping the way organizations use IT.

Cloud computing is having a similar effect. By providing Internet access to complex applications and massive computing resources, the cloud offers additional storage and bandwidth capacity. At the same time, it also provides access to third-party applications and resources – without the need for more IT infrastructure.

Being able to host processing and data in the cloud also frees up network administrators to take greater control of devices generating data and move network capacity closer to where the data is created. The result is a high bandwidth, low latency network that can take advantage of all that the cloud has to offer.

There's no arguing that investments in data and analytical tools, the cloud and network infrastructure will significantly improve the quality and efficiency of India's healthcare system. And devices tied to IoT certainly promise great potential, though their effect is just starting to be felt. What the full weight of that will look like is still up for debate. With the right technology behind it, however, anything is possible.

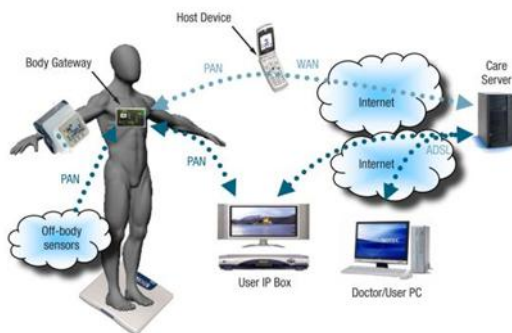


Fig. 1 Basic working of IoT in Healthcare

### III. HOW INTERNET OF THINGS IS REVOLUTIONIZING HEALTHCARE

The consumerization of the healthcare industry is developing with such rapidity that the entire market is being recalibrated. Companies that have never before exerted influence in this sector are swiftly becoming its major power-brokers. Business models are being redesigned to adapt to the growing influence of data-fueled customers. Unique partnerships are being forged between agile start-ups and established brands to capitalize on this new digital-first world.

Much of this change is the result of the revolution in data which is empowering people to live healthier lives by using connected devices such as tablets, wearables and hand-held devices.

The advances in cloud-based technology have also been the key. This year, for example, a unique strategic partnership between Philips and Salesforce.com has created a platform that enables medical devices to operate in conjunction with deep sets of data.

The analysis of this data – amassed through electronic medical records, diagnostic information gathered through imaging equipment, monitors and hand-held personal devices – enhances the decision-making powers of professionals and enables patients to take a more active role in managing their

personal health. These innovations are transforming not just the care of the chronically ill but those who are and want to remain healthy.

By the end of the decade, this data-rich personalized analysis of our health will become the norm. Individuals will be provided with tailor-made strategies to combat illness and social technologies will enable us to manage our own health. From the data generated, we will learn how to improve our wellbeing and be motivated to take control.

And as the consumer takes more control in this digital-first world, so the business model of the health industry will need to revolutionize, to take into account the fact that any company can now become a healthcare provider – as long as their technology is meaningful to the customer.

In addition, traditional businesses will need to collaborate with smaller companies, many of which may never have been involved in the health industry before. Alliances that are able to combine the most advanced medical technology with clinical informatics and secure cloud-based platforms will triumph.

The challenge we face is not just in developing these technologies – but making sure we always listen to our customers. Products need to be meaningful if they are to be scalable and they need to be simple to use – no matter

the location or demographic in which they're used. This is why we developed Philips Lifeline GoSafe, a mobile personal emergency response system for seniors, which will be launched in the US in the near future.

That way, the awesome power of the Internet of Things will be fully realized – an infinite array of smart connected solutions designed to improve our health, environment and productivity through intelligent use of data. Whether that means empowering us to monitor and control our domestic air quality, or equipping medics with cloud-based tools that allow them to 'consult' with patients who aren't even in the same room, or even the same city.

Consumers, patients and those working in medical professions will all need to alter their mindsets to take full advantage of this revolution in healthcare and be provided with innovative methods to motivate a change in behavior. And so, it will be the companies who are able to offer cutting-edge, highly personalized solutions – that are both meaningful and trustworthy – who will become our new health mentors.

### IV. APPLICATIONS

- Monitor hand hygiene compliance to reduce transmission of Hospital Acquired Infections (HAIs) to patients
- Provide core practice functionalities needed by Clinicians, as well as front office and billing staff and used by multiple customers and physicians.

- Analyze protein and provide accuracy of their composition  
Support, “Big Data” that is being generated by multitude of devices, device – to – device interaction or “industrial internet”, predictive analytics on Big Data among others
- Enable asset and operations optimization by providing a standard way to run industrial-scale analytics and connect machines, data, and people that can be deployed on machines, on premise, or in the cloud.



Fig. 2 Devices used for better Healthcare

## V. KEY SOLUTION

1. Cloud-based Hospital Hygiene System - Hospital-Acquired Infections (HAI) can be devastating from both clinical and economic perspective, exacting a terrible toll on patients and contributing to rising healthcare costs. Unfortunately, 20% to 40% of HAI are transmitted to patients from hospital employees, and it has been uncovered that proper hand hygiene only occurs approximately 55% of the time by hospital care providers. In the U.S. alone, HAI have resulted in 99,000 deaths each year and cost \$3-4 billion in healthcare costs.

Based on our solution, Individual staff interactions with a hand-sanitizer dispenser were captured and recorded using Real-time Location System (RTLS) technology attached to employee badges and sanitizer dispensers. This data was then utilized to accurately understand the compliance levels of hospital staff. Also, the data was used to model and characterize clinician-patient interactions, providing detailed data to help monitor and modify behavior. This improved the compliance levels by over 25% on an average, thus saving the lives of thousands of patients.

2. Core Practice Functionality Solution - This IoT solution helped maintain a central record of all patient records and

real-time monitoring, thus helping physicians devote more time to treat patients. The solutions could collect and analyze the following kinds of data:

- Remote Monitoring Data:
  - o Images of which only one set of images are stored
  - o Push notifications, but stored but relayed directly to devices
  - o Status that was updated every 10 seconds.
- Service Data:
  - o Usage Data which included 400-500 parameters updated every hour and saved permanently
  - o Log Files updated every hour and only one set of log files are stored.
- Data from Real time location system (RTLS) that was attached to employee badges and sanitizer dispensers
- Patients Records and Monitoring Data

With increasing customer expectations and regulatory requirements, there was an urgent need to modernize the solution.

We evaluated the feasibility of the solution through a Proof of Concept and then built it on the Cloud to provide scale to handle 30 to 300 concurrent users from each of the 5,000 customers.

3. Protein Research and Analytics Tool - This solution focuses on the research side of healthcare, specifically protein research and protein composition analysis.

This IoT solution ensures the reliability and accuracy of the equipment and provides researchers with easy access to enough computing power for testing. It also provides standardized, quantitative, and reproducible analysis of proteins in research samples while shortening the workflow significantly.

The Microsoft Azure based solution was built on the following key tenets:

- Towards web services and n-tier architecture
- Towards HTML5 web client
- Optimized cloud Ready application – Moving to share / Multi-tenant infrastructure

## VI. OBSTACLES

The relationship between the health care industry and the IoT is a promising one, but it's not without obstacles. Here are a few key challenges facing this union:

- Mobile hesitation - Devices are one-half of the IoT, but what (or whom) they're connected to still counts for something. If there is provider hesitation or confusion during any part of the patient data handling process, care could suffer or breaches could occur. Some health IT departments and physicians have struggled to handle all that data coming in. Given the mobile, BYOD healthcare culture, substantial data handling training is required throughout an organization, not just at the top.

- Consistency issues - Consistency counts, especially in health care, and the introduction of the IoT into the field certainly does not negate that. So what are the communication standards and protocols for all these new medical wearables and other IoT-ready devices? Well, that's sort of the problem: Medical device vendors actually haven't agreed on them yet. A single hospital can use devices from a variety of vendors, raising questions of propriety and consistency.

- Security questions - Security was a huge topic of discussion at this year's Health Information Management and Systems Society's Annual Conference and Exhibition—the country's main health care IT gathering—and for good reason. Presenters

included the Department of Homeland Security and the FBI. When the number of internet-connected devices increases, so do the number of entry points into data systems—data systems full of sensitive patient health care and financial information attractive to cyber-attackers. Health care organizations absolutely must have security top of mind as they look ahead to the

IoT.

## VII. CONCLUSION

The increase in life expectancy rate and the rising demographics across the world have made it imperative for people to embrace the most suitable solutions that lead to a healthy life. The trick here is that options are many but few will be preferred and they will be the providers of the best customer experience

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