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Cloud-Enabled Health Care Automation Gateway With Support Over IPv4 And Virtual IPv6

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ABSTRACT: It would be a great help to medical field, if patient's medical history is available at any place and at any time. Not every medical need is an emergency, and some patients may require continual observation instead of immediate attention to determine and treat their health problems. Cloud-Enabled Health Care Automation can help to keep an eye on those patients. Hence no need to seat continuously beside them. It supports doctor in deciding on the best treatment and help to simplify, integrate and accelerate workflows. It also helps to maintain patient's medical history easily without files and reports hardcopy storage. It can access from anywhere via cloud saving. Also the most recent requests for interoperability between the different devices within a health/home automation system have brought IP-based protocol's attention in this area. As existing IPv4 address comes to exhaustion, large address space is very essential. This paper presents a Cloud-Enabled Health Care Automation and needs of IPv6, to increase address space, necessary for increasing demand of smart phone and internet devices.

Keywords e-health care, smart gateway, benefits of ipv6, ipv6 addressing, need for ipv6 internet protocol.

1 INTRODUCTION

RECENTLY HealthCare automation systems have been challenged with the two outstanding needs: the need for the high interoperability between health care devices and the need for user interfacing to the system from different end points (internet, mobile phones etc.) It require central controller with a variety of connectors and an end-user application that needs to be installed to every client device. Migration to IP-based protocols in the Health Care Automation realm resolves most of the aforementioned concerns. Labour costs are clearly one of the top concerns in healthcare. Automation, use as labour-saving devices and information technology to reduce or eliminate the need for human labour. There are two ways to save on labor costs: Make your current workforce more efficient, or eliminate the need for a human to fill a job altogether. That's why, Health care Automation is needed. Internet Assigned Numbers Authority (IANA) allocated the final IPv4 address blocks in 2011. SoIPv4 address comes to exhaustion.IPv6 can solve the addressing problem. Hence IPv6 support is also necessary. Growing support for IPv6 and its large address space enables the integration of large numbers of small devices to the IP network.

2 ARCHITECTURE

Detailed Hospitals, laboratories and medical device manufacturers required to maintaining quality and patient care under major cost containment or even cost-cutting pressures. Here few medical instruments are controlled and monitor via web. According to increasing demand of smart devices on network, necessity of IPv6 support address protocol, is also included. The architecture contains hardware part and web page for user. Hardware contains medical instruments like ECG, BP measurement, fatal Doppler, saline controller circuitry and temperature sensors. Fig 1 bellow shows architecture of Automation Gateway.

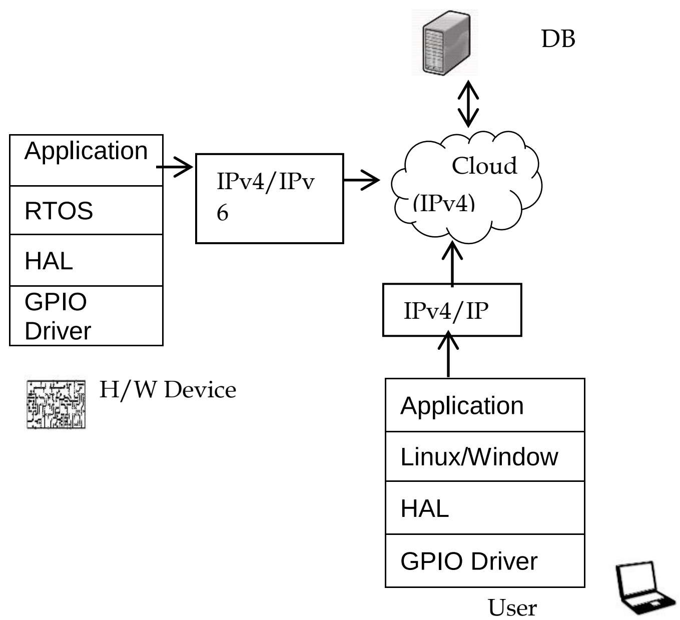

Fig. 1 - *General Implementation Of Automation Gateway.*

The Controller accepts the inputs from the different medical instruments. This data is processed by controller. Then by Ethernet this data pass into cloud and can be save in data base. At the user side patient's data can view by web.

3 RELEVANCE

The healthcare industry is facing significant pressures to lower the costs associated with providing healthcare, adopt new systems that support electronic medical records (EMR), and share data quickly and securely with other healthcare and government agencies. To adopt electronic medical records (EMR), to squeeze out all unnecessary costs in providing healthcare services, increases interest and adoption in cloud computing services and solutions. Reducing service time for patient care is another aspect in the fight to keep costs low, and every delay in getting back results from a lab, or having to manually convert patient information from one format to another, creates more problems for the healthcare provider. For all these pur-

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pose Cloud-Enabled Health Care Automation is essential. This paper put a glance on some of applications of Cloud base Health Care given bellow and also necessity of support of IPv6 protocol in cloud application. In Health Care some patients may require continual observation instead of immediate attention to determine and treat their health problems. Similarly for recovering patients need not necessary to seat doctor/nurse behind him. In such case Self-controlled saline is mush suited. In this when saline will reach to finish it automatically turns OFF and start next saline if connected. It also informs its action via internet so that doctor/ nurse can come to patients for further treatment. Some patients needs to continuous monitoring of ECG and BP after their health settlement. And it is not possible to doctor to seat besides patients. In such case, online monitoring of such things is beneficial to save time and extra efforts. It supports doctor in deciding on the best treatment and help to simplify, integrate and accelerate workflows. Also it will help to maintain patient's medical history online. It can be access or can see from anywhere via cloud saving. There is no need to maintain/carry hardcopy of treatment history everywhere.

4 Network Protocol

Most people are already using the cloud in their daily lives, whether they realize it or not by Yahoo, Gmail, or Hotmail account. Here alone have the password, and can access email from any computer, smartphone or tablet as long as it has an Internet connection. That means people already using the cloud in their day-to-day life! TCP/IP protocols are used to send and receive data, voice and video data grams or packets over the internet. Internet Protocol Version 4 (IPv4) is version four of the Internet Protocol, which is the basis of TCP/IP protocols. In last ten years use of smart phones, internet devices increases tremendously. IPv4 address is 32 bit in length, there are 2^32 actually IP address, which is 4.2 billion address. Not all of these are usable. Many addresses are reserved such as the multicast (224 – 239), research (239 – 254), broadcast (255) and private (10,172.16 and 192.168). Offcourse many of these are assigned leaving very less for new growth. The graph of use of IPv4 address in last 10 years is shown in Fig 2.

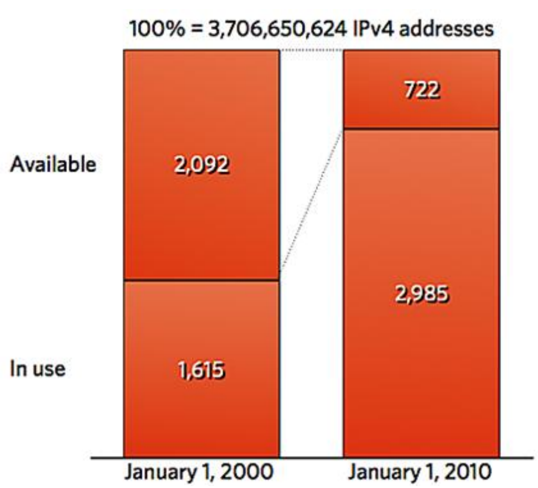

***Fig. 2 –** IPv4 address utilization: 2000 vs. 2010*

Unlike 32- bit IPv4 addresses, IPv6 uses a128 address. This allows for 3.4x 10^38 addresses, which is enough for many IP addresses for each person on earth, and probably multiple planets. Here are some valid reasons why companies are needs to migrate to an IPv6 environment.

1. Currently more than 1 billion people are connected to an Internet and this is exponentially increasing based on fast – emerging technical markets such as China and India.
2. More than 1 billion mobile phones are currently on the market, most of support limited data services, and this is expected to grow not only in number, but also with the enhanced offering of data services these phone and providers are capable of delivering.
3. More than 30 million PDAs and similar devices offer common data services such as e- mail and web browsing, and this number is expected to grow as more and more businesses implement mobile applications.
4. More data services are being offered on consumer product, such as automobiles, household appliances, and industrial devices, and number is expected to grow into the billion

5 IPv4 ADDRESS EXHAUSTION [16]

IPv4 address exhaustion is the depletion of the pool of unallocated Internet Protocol Version 4 (IPv4) addresses, which has been anticipated since the late 1980s. This depletion is the reason for the development and deployment of its successor protocol, IPv6 [16]. The IP address space is managed by the Internet Assigned Numbers Authority (IANA) globally, and by five regional Internet registries (RIR) responsible in their designated territories for assignment to end users and local Internet registries, such as Internet service providers [16]. The Regional Internet Registry system evolved over time, eventually dividing the world into five RIRs [17]: African Network Information Centre (AfriNIC)[1] for Africa American Registry for Internet Numbers (ARIN)[2] for the United States, Canada, several parts of the Caribbean region, andAntarctica. Asia-Pacific Network Information Centre (APNIC)[3] for Asia, Australia, New Zealand, and neighboring countries Latin America and Caribbean Network Information Centre (LACNIC)[4] for Latin America and parts of the Caribbean region Réseaux IP Européens Network Coordination Centre (RIPE NCC)[5] for Europe, Russia, the Middle East, and Central Asia

5.1 IPv4 Address Report [15]

This report generated at 23-Feb-2015 08:07 UTC.

IANA Unallocated Address Pool Exhaustion:

03-Feb-2011

Projected RIR Address Pool Exhaustion Dates:

RIR	Projected Exhaustion Date	Remaining Addresses in RIR Pool (/8s)
APNIC:	19-Apr-2011 (actual)	0.7365
RIPE NCC:	14-Sep-2012 (actual)	0.9643
LACNIC:	10-Jun-2014 (actual)	0.1956
ARIN:	21-May-2015	0.3407
AFRINIC:	20-Jan-2019	2.6285

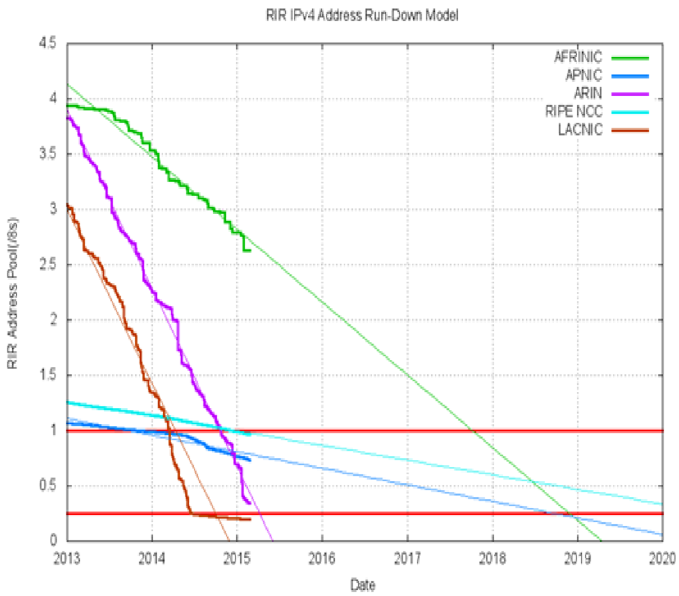

***Fig. 3 –** IPv4 Address Run – Down Model*

Fig. 3 shows Pv4 Address Run – Down Model. This shows exaction of IPv4 address per year in each Regional Internet Registry.

5.2 Current Status

The IPv4 address space is a 32 bit field. There are 4,294,967,296 unique values, considered in this context as a sequence of 256 "/8s", where each "/8" corresponds to 16,777,216 unique address values. As noted in RFC 5735 a number of address blocks are 'reserved.' There are a total of the equivalents of 35.078 /8 address blocks that are 'reserved'. (This is composed of 16 /8 blocks reserved for use in multicast scenarios, 16 /8 blocks reserved for some unspecified future use, a /8 (0.0.0.0/8) for local identification, a /8 for loopback (127.0.0.0/8), and a /8 reserved for private use (10.0.0.0/8). Smaller address blocks are also reserved for other special uses.) The remaining 220.922 /8 address blocks are available for use in the public IPv4 Internet. The current status of the total IPv4 address space is indicated in Fig. 4

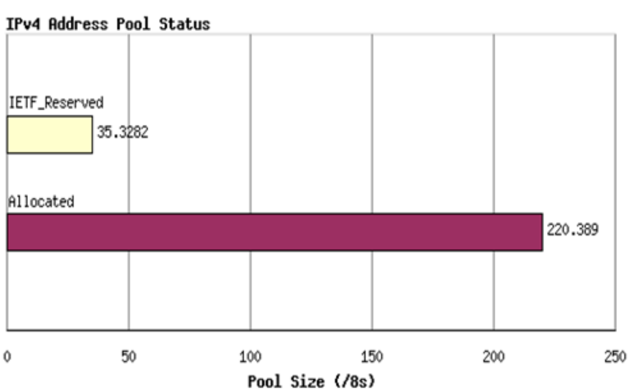

***Fig. 4 –** Address Pool Status*

6 WHY IPV6?

6.1 Figures Benefits Of IPv6

Following are the features and benefits of IPv6 over IPv4,

i. Huge number of IP addresses - IPv6 has 128 bit addresses when compared to 32 bit addresses of IPv4 which results in a very large increase in the availability of IP addresses and creates a lot of advantages.
ii. End to End Connectivity - IPv6 eliminates the need for NAT which results in better connectivity in peer-peer networks.
iii. Built-in Security - IPv6 promotes interoperability between different IPv6 implementations.

6.2 IPv6 Addressing

IPv4 addresses are represented in dotted-decimal format. The 32-bit address is separated along 8-bit boundaries. For IPv6, the 128-bit address is separated along 16-bit boundaries. The resulting representation is called colon-hexadecimal.

TABLE 1
IPV4 AND IPV6 ADDRESS SIZE

IP Version	Size of Address
IPv6	128 bits which allow for 2128 or 340, 282, 366, 920, 938,463, 374, 607, 431,768, 211, 456(3.4*10^ 38) possible addresses
IPv4	32 bits which allows for 232 or 4, 294, 967,296 possible address.

In IPv6 Address format hexadecimal values can be displayed in either lower or upper case for the number A-F. A leading zero in a set of numbers can be omitted; for example, 0012 or 12 in one of eight fields - both are correct. For successive fields of zeroes in IPv6 address, represents them using two colons (::), but this can be used only once in address.

6.3 STRUCTURE OF AN IPv6 PACKET

An Internet Protocol version 6 (IPv6) packet consists of an IPv6 header, extension headers, and an upper-layer protocol data unit. Fig. 5 shows the structure of an IPv6 packet [8].

IPv6 Header	Extension Headers	Upper-Layer Protocol Data Unit

***Fig. 5 -** Structure of an IPv6 packet.*

The components of an IPv6 packet are the following:

IPv6 Header - The IPv6 header is always present and is a fixed size of 40 bytes.

Extension Headers - Zero or more extension headers can be present and are of varyinglengths. If extension headers are present, a Next Header field in the IPv6 header indicates thefirst extension header. Within each extension header is another Next Header field, indicatingthe next extension header. The last extension header indicates the header for the upper-layer protocol—such as Transmission Control Protocol (TCP), User Datagram Protocol (UDP), or Internet Control Message Protocol for version 6 (ICMPv6)—contained within the upper-layer protocol

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data unit. The IPv6 header and extension headers replace the existing IPv4 header and its options. The new extension header format allows IPv6 to be enhanced to support future needs and capabilities. Unlike options in the IPv4 header, IPv6 extension headers have no maximum size and can expand to accommodate all the extension data needed for IPv6 communication.

Upper-Layer Protocol Data Unit - The upper-layer protocol data unit (PDU) typically consists of an upper-layer protocol header and its payload (for example, an ICMPv6 message, a TCP segment, or a UDP message).
IPv6 And IPv4 Headers
IPv6 and IPv4 headers are outlined in the tables below:
IPv6 header format is as shown in Fig 6 [12]

version (4)	traffic class (8)	Flow Label(20)	
Payload Length (16)		Next Header(8)	Hop Limit (8)
Source Address (128)			
Destination Address (128)			

Fig. 6 - *ipv6 Header*

IPv4 header format is as shown in Fig 7 [11]

4-bit	8-bit	16-bit	32-bit	
Ver.	Header Length	Type of Service	Total Length	
Identification			Flags	Offset
Time To Live	Protocol		Checksum	
Source Address				
Destination Address				
Options and Padding				

Fig. 7 – *Ipv4 Header*

The new features introduced with the IPv6 protocol can be summarized as [8]:
A new header format
A much larger address space (128-bit in IPv6, compared to the 32-bit address space in IPv4)
An efficient and hierarchical addressing and routing infrastructure.
Both stateless and stateful address configuration
IP Security
Better Quality of Service (QoS) support
A new protocol for neighbouring node interaction
Extensibility

These enhancements in IPv6 provide better security in certain areas, but some of theseareas are still open to exploitation by attackers.

7 Transition to IPv6

It is a huge project to migrate mostly all IP addresses to IPv6. Hence here developed transition mechanisms to allow existing users on IPv4 to be accessible on both protocols, when migrating to IPv6. There are five main transition mechanisms that can be used, are Dual-stack, Pv6 over IPv4 tunnels, Protocol translations, dedicated data links, MPLS backbones. When a device has dual stack capabilities then it has access to both IPv4 and IPv6 technology available. It can use both of these technologies to connect to remote servers and destinations in parallel. The mechanism supports IPv4 and IPv6 in routers and hosts.

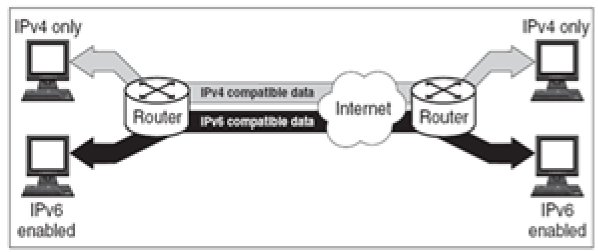

Fig. 8 – *Dual Stack*

In this paper Health Care Automation concept represented can definitely works on IPv4. And to some extends, IPv6 support is also trying to give. The Flow of web server and client communication to IPv4 and IPv6 is same and is as given in Fig 9. IP address of IPv4 and IPv6 are deferent and its representation I also different. When Duel Stack protocol will use, then while generating a connection between server and client, server give two different IP address for example for IPv4 address – 192.168.1.3 and Link local IPv6 address – fe80::de9a:ad7d:256e:c040%13.

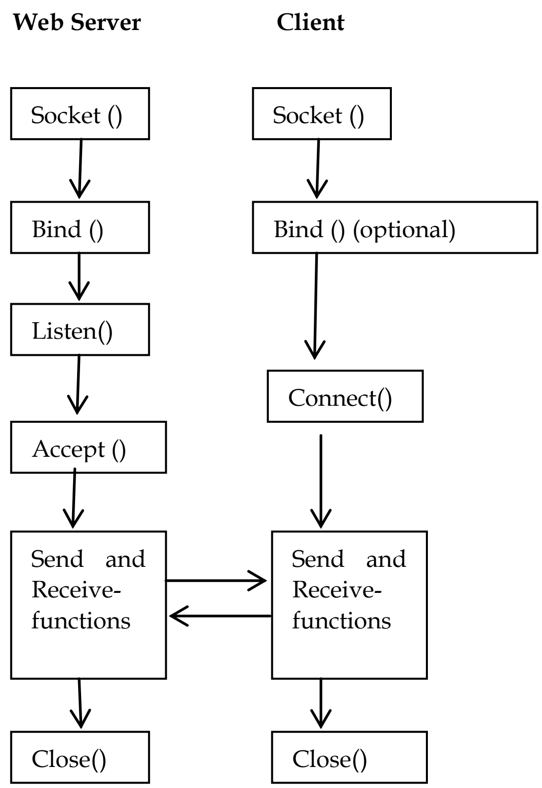

***Fig. 9 –** ipv4 /ipv6 client server flow*

By making available both IPv4 and IPv6 address for device, it can make compatible with IPv6 network.

8 RESULT

8.1 Saline control

For saline control there are two modes
1. – manual mode
2. – auto mode

Manual mode –
In manual mode saline gets on/off manually. Its status can observe on web page. if saline weight is between 50 to 1700 grams any of saline can start. But if saline weight is less than 1150 grams, second or first saline can start. And if saline weight is less than 550 only first saline can start.
Result table
Manual mode

TABLE 2
SALINE CONTROL MANUAL MODE.

SALINE		SALINE 1	SALINE 2	SALINE 3
KEY		S1	S2	S3
WEIGHT	1 - 550 gm.	saline 1 can ON/OFF	OFF	OFF
	550 - 1050 gm.	saline 1 can ON/OFF	saline 2 can ON/OFF	OFF
	1050 - 1550 gm.	saline 1 can ON/OFF	saline 2 can ON/OFF	saline 3 can ON/OFF

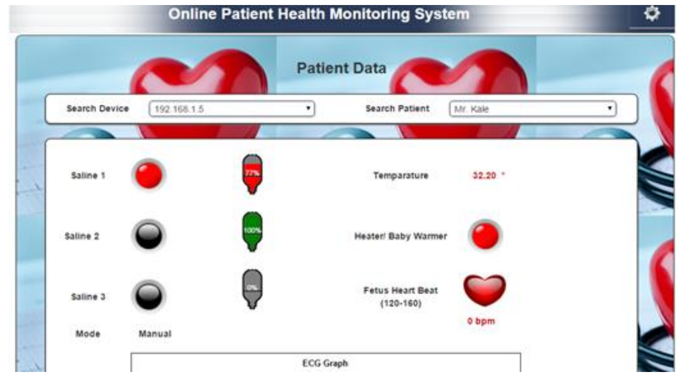

***Fig. 10** – Saline Control Manual Mode*

Fig 10 shows Manual Mode operation of saline. Here saline 1 is in ON state and Mode shows Manual.

Auto Mode –
In Auto mode saline gets ON/OFF automatically and Its status can observe on web page. For Auto mode we have to press Auto key on keyboard. To get out of Auto mode we have to press same Auto key again. If saline weight is between 1150 to 1700 grams only third saline will gets start. When weight is between 1150 to 600 grams, third saline will get OFF and only second saline will start automatically. And when saline weight is decrease bellow 550 and above 50 gm. second saline will get OFF and only first saline will start automatically. The status of saline continuously display on web page.

Result Table

TABLE 3
SALINE CONTROL AUTO MODE

SALINE		SALINE 1	SALINE 2	SALINE 3
WEIGHT	1 - 550 gm.	ON	OFF	OFF
	550-1050 gm.	OFF	ON	OFF
	1050-1550 gm.	OFF	OFF	ON

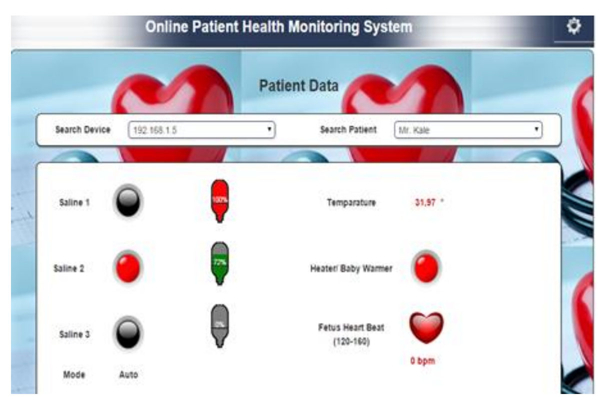

***Fig 11 –** Saline Control Auto Mode*

Fig 11 shows Auto Mode operation of saline. Here saline 2 is in ON state and Mode shows Auto. If saline is in manual or Auto mode, user can control saline ON/OFF online also. User can control ON/OFF of saline and Heater/Baby warmer online

ISSN 2347-4289

by Send Data status window as shown in Figure 12 Send control status 1

Fig 12 – *Send Control Status1*

Fig 13 Send Control Status 2 shows how saline and heater ON/OFF can control online.

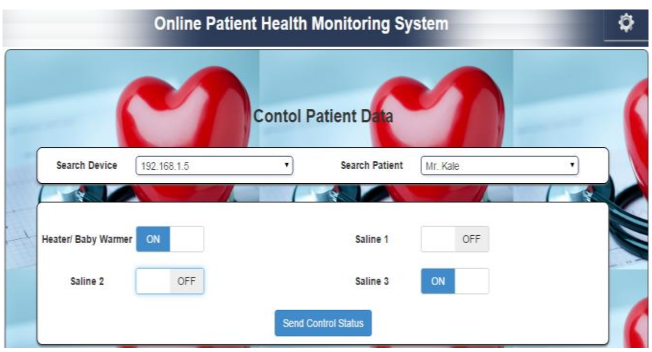

Fig. 13 *– Send Control Status 2*

8.2 HEATER/ BABY WARMER

It also has Manual and Auto mode. Heater temperature limit is 35°C degree.Bellow 35°C it can turn ON. Heater ON/OFF status can observe on web screen. In Manual mode heater has to ON/OFF Manually by keyboard or also by using site. User can OFF heater bellow35°Cbut cannot ON Heater above 35°C. In Auto mode heater gets automatically ON bellow 35 degree and automatically gets OFF when temperature is above 35 degree.

Result Table

TABLE 4
HEATER CONTROL

	Heater	
	Temp <35°C	Temp >35°C
Manual mode	ON/ OFF	OFF
Auto Mode	ON	OFF

8.3 FETUS DOPPLER

Fetus Doppler shows heart beats of fetus as shown in figure14.

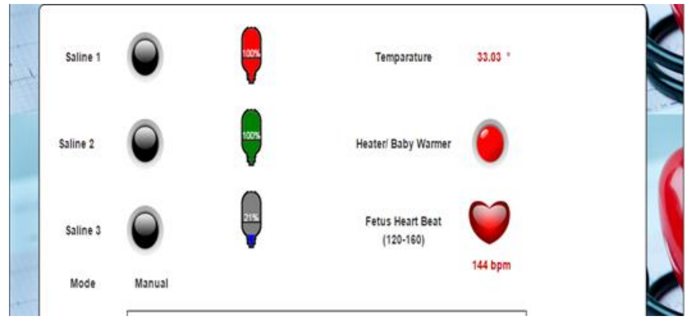

Fig. 14 – *Fetus Heart Beat*

8.4 ECG

By this ECG of patient can observe online as shown in fig.15

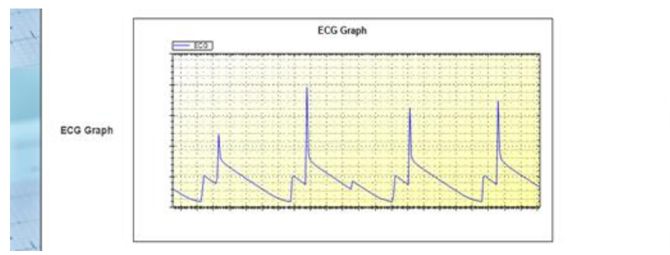

Fig. 15 *– ECG*

8.5 VIRTUAL REPRESENTATION OF IPV6

IPv6 was initially designed with a compelling reason in mind: the need for more IP addresses. This need arose from fast Internet growth: billions of new devices (cell phones, PDAs, appliances, cars, etc.), and billions of new users (China, India, Latin America). This, combined with new 'always-on' access technologies such as xDSL, cable, ethernet-to-the-home, were increasing the appetite for new devices and new users. Most of the IPv6 deployment is being done outside US, Europe. India and China are moving forward to change their entire space to IPv6. China has announced a five year deployment plan named China Next Generation Internet. No one will put a date on when IPv4 will be turned off. This will depend on market forces. When IPv6 becomes the dominant network it will draw more people in and less people will worry about IPv4. As development in IPv6 are still going on, virtual HTML page GUI and its communication for this project is as bellow At the receiver (HTML) side for IPv6 connection we have to give IPv6 address to server like DEFAULT_SERVER = IPAddress. IPv6Any; In DEFAULT_SERVER object service received the address of Ipv6. DEFAULT_PORT is already defined. Using both like port and IP Address through received or read the data which is send by senders Ipv6 address. If we giveIPAddress DEFAULT_SERVER = IPAddress.Any; Then it will receive data/ string from Ipv4 IP Address. Communication UI(data transfer) for IPv6 address is as shown in fig 16

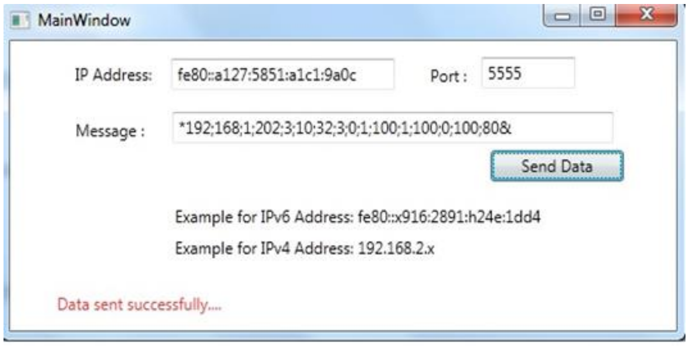

Fig 16 – *IPv6 Data Transfer UI*

Here as shown IP address is in hex. This is IP address if IPv6 device. It shows IPv6 communication. Here as shown IP address is in hex. This is IP address if IPv6 device. It shows IPv6 communication. Data receive from IPv4 and IPv6 deviceshown in fig 17

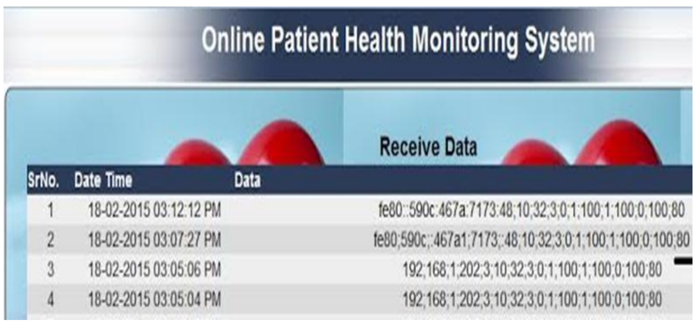

Fig. 17 – *Data Receiving Window*

Conclusion And Future Work

Some of the cloud-based solutions and applications for healthcare organizations are abstracted in this paper. Both large hospitals and small clinics can benefit from these solutions, not to mention all the other players in the healthcare industry. IPv6 is the critical backbone for the next generation technology. It holds tremendous promise; however, enterprises and businesses need to have a carefully planned evaluation and transition strategy for IPv6. Quick glances on necessity, benefits of IPv6 over IPv4 and little compatibility mentioned in this paper. In future as per further development in IPv6 protocol will take place and prove, this whole system can shifted on IPv6 network by step wise improvements.

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