

## Short Communication

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# Without IPv6, there is no digital transformation for healthcare

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Received 23 October 2021

Accepted 2 November 2021

### Abstract.

**BACKGROUND:** Originally, digital healthcare was created to support underserved and rural patients gain access to health services. Phones, devices, and computers need IP (Internet Protocol) addresses to connect to the Internet.

**OBJECTIVE:** This paper aims to study the close relationship between the Internet and the transformation of healthcare services.

**METHODS:** The current protocol in use is the Internet Protocol version 4 (IPv4), whose number of Internet addresses has been globally exhausted. The Internet Protocol version 6 (IPv6) with 47 octillion unique addresses for every person on the planet has become the only option for sustainable growth and innovation. However, most of the worldwide industry is still in IPv4. In the era of Artificial Intelligence, Internet of Things, Fifth Generation of Cellular Technology (5G), and Blockchain, there will be a massive need of IP addresses. For 2025, experts predict over 1.5 billion new IPv6 users which will continue to grow exponentially.

**RESULTS:** Nations need to tackle the increasing industry requirements for IPv6 and telehealth adoption to benefit from the full IPv6 connectivity which is the key strategic advantage for the healthcare industry.

**CONCLUSION:** The strategic potential that telehealth brings to the healthcare industry is widely appreciated. However, what are the implications of its expansion around the world? How can we prioritize the poorest and most vulnerable in society without new technologies?

Keywords: Health, healthcare, telehealth, telemedicine, IA, IoT, IoMT, IPv6, IPv4, data, emerging countries, technology

*“The Internet keeps evolving and there are things that should happen beyond IPv6, but to overcome the present address space exhaustion, we need to implement IPv6 essentially everywhere”*

*Vint Cerf, father of the Internet.*

## 1. Introduction

Experts predict that for 2025 over 600 billion Internet of Things (IoT) connected devices, 1.5 billion new Internet Protocol version 6 (IPv6) users, and 65% of mobile traffic will run through IPv6, whose use will continue to grow exponentially, with clear leadership from the Asian region.

Phones, devices, and computers need Internet Protocol (IP) addresses to connect to the Internet. The current protocol in use is the Internet Protocol version 4 (IPv4), whose number of Internet addresses has been globally exhausted. IPv6 has become the only option for sustainable growth and innovation. Despite of that, most of the worldwide healthcare industry is still in IPv4 and shows no real interest in IPv6.

The principle of the universal right to ‘health for everybody’ means that everyone should have access to health services they need, when and where they need them. Because of the COVID-19 outbreak, healthcare systems across the world have been pushed to the edge. Traditional healthcare systems have shown intrinsic failures to early detection of the spread of a virus, overwhelmed hospitals, putting critically ill patients on planes and helicopters to foreign countries, and so on.

The Internet has changed the way we live, work, study, and interact with people, and has also become the primary source of information. Today, search engines are the main door to smart mobile services that need IPv6. Rich and poor nations need empowered Internet infrastructure to succeed in the economic recovery because, ‘Internet is for everybody’.

Telehealth is often defined as the provision of healthcare remotely by means of telecommunications technologies. Telemedicine is a more specific term that applies to clinical application of remote technology, with clinical staff, diagnostic equipment, and access to patient health records. Therefore, Telemedicine is only one of many varieties of telehealth.

Innovators in the health sector are committed to adopting new emerging trends in primary healthcare and the provision of life-saving technologies while nations are still dealing with an endless COVID-19 crisis, which poses enormous challenges to governments and people.

## **2. The COVID-19 pandemic**

According to the World Bank Paper published in March 2021 [1,2], the COVID-19 pandemic has resulted in a ‘double shock’ impact, the ‘health and economic shock’ in every country of the world, which should prepare themselves for a ‘double recovery’.

The paper used macroeconomic projections, released by the International Monetary Fund (IMF) in October 2020 to project the time path of health spending per capita in 178 countries (2020–2025). The projections compared different public health spending scenarios with estimates of countries’ incremental spending needs if they are to halt the COVID-19 pandemic and return to an avenue of progress towards universal health coverage (UHC). In emerging countries, resources are scarce and budgetary room is limited. And there are some lower-income countries in the ‘non-GGE’<sup>1</sup> growth group of countries – countries whose public health spending is historically low which are likely to lose more ground.

In the healthcare industry, there is a broadening gap. While developed nations invest an average of 15% of GDP in the sector, emerging nations have reduced their public spending to 4% or less. The developed world is implementing proven technologies and is developing new ones to accelerate innovation in healthcare. But although the healthcare is going digital, a lack in analytical capacities, and unstructured data is preventing providers from unlocking the full potential of healthcare benefits for private and public organizations.

## **3. Full IPv6 connectivity is the key strategic advantage for the healthcare industry**

Today, robots are commonly used in image guided surgical operations, early diagnosis and treatment and increased patient safety, as we live in an increasingly digitalized world. But governments and industry are still underestimating the need of such radical shift mainly due to costs of infrastructure, technology

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<sup>1</sup>GGE = Available data on per capita government expenditure in public health. Non-GGE = Data are not available.

trends and knowledge transfer. The economic gap between developed and developing countries has been aggravated by the pandemic.

In the era of Artificial Intelligence (AI), IoT, 5G and Blockchain, there will be a massive need of IP addresses. Nations need to tackle the increasing industry requirements for the IPv6 adoption. Governments and private sector should aim to drive full IPv6 connectivity on every device to achieve the healthcare business model based on new technology trends. The worldwide economic advances in recent years are closely related to innovation, competitiveness and the progression of knowledge transfer, which have become critical factors in socio-economic growth.

### 3.1. IoMT, AI, IoT, Blockchain

AI, IoT, Internet of Medical Things (IoMT),<sup>2</sup> AIoT,<sup>3</sup> Fifth Generation of Cellular Technology (5G)<sup>4</sup> and Blockchain are becoming the core of the healthcare industry dealing with improved quality of care and patient safety. COVID-19 has underlined the importance of new ecosystems players which bring precision to medicine (i.e., nomograms<sup>5</sup> x-rays).

AI is already beginning to change aspects of telehealth, from interpreting scans, monitoring medical functions to offering advice, and processes to build efficiency across health organizations. The goal is to improve patient value, and the only way to achieve this is by leveraging AI, digitalizing healthcare, and using structured data to improve diagnoses and treatments. Decision-makers need to calculate the impact in a rigorous cost-benefit analysis compared to the status quo. Telehealth provides high-quality and efficient healthcare services by using remote diagnostic tools to access healthcare service delivery to rural and remote patients at lower costs. The health industry cannot afford any longer to be constrained by time and geographic limitations.

Some AI apps:

- Monitoring physical and mental conditions with big data and mobile health-based app<sup>6</sup>
- Monitoring heart rate, glucose level, blood pressure, tracking sleep patterns and brain activity
- AI and IoMT for consumer health applications
- Robots for delivery of care (carebots) and surgery
- AI systems to extract critical information from a large patient population
- Speed-up development of the COVID-19 vaccine
- Prevention from cyber-attacks by detecting malicious activities with Machine Learning

## 4. The Internet Protocol version 6 (IPv6)

### 4.1. What is 'IPv6-only'?

The US Central Commission for Cyberspace Affairs and the China Cyberspace Administration have IPv6 Transition Plans for mass adoption that leads towards the disconnection of the IPv4 Internet Protocol

<sup>2</sup>IoMT = Network of Internet connected hardware infrastructure using medical devices and medical applications to connect with healthcare information technology.

<sup>3</sup>AIoT = Artificial Intelligence of Things is the combination of Artificial Intelligence with the Internet of Things.

<sup>4</sup>5G = A faster wireless Internet that is up to 20 times faster with 120 times less latency than 4G.

<sup>5</sup>Nomogram = A graphical calculation tool.

<sup>6</sup>M-health-based app = Mobile health application.

by 2030, and of China by 2025. Some nations have already reached almost 60% of IPv6 penetration in the public sector as in the US, whereas the 40% lies in the hands of companies and academia to fulfil the IPv6 adoption that will lead to the Internet of 'IPv6-only'.

Some system applications will smoothly move, and others may not be IPv6-enabled, which will be left in IPv4 until their replacement or termination. In the case of transporting legacy IPv4 traffic as a service over IPv6, this could introduce additional potential congestion and potential failure points for legacy IPv4 traffic.

The current global IPv6 penetration shows that some emerging nations that were not pioneers on the Internet of IPv4 have adopted IPv6 even earlier than some developed nations, due to the worldwide lack of available IP addresses. Most mobile networks are already shifting to 'IPv6-only' in India and Asian countries.

## **5. Conclusion**

The IPv6 adoption is inevitable, and its impact on the socio-economic sectors of our daily lives will be huge. The exhaustion of IPv4 addresses is placing pressure to nations, private sector, and academia to accelerate the transition to IPv6 consisting in a 'national digital and economic strategy'. Governments are required to play their leadership role to lead public and private sectors to the Internet of 'IPv6-only' with new ecosystem players, comprising carriers, vendors, contents providers, and academia, to accelerate access to the newest or native IPv6 services that are available to end users. Telehealth adoption is on the rise. Rich nations and international organizations should leverage 'telehealth' to support info-poor nations to improve their healthcare outcomes. Some nations have gained tremendous experience during the pandemic, and it is essential to share this knowledge, and associated activities. Today, emerging nations need to introduce and implement 'telehealth' and 'telemedicine' solutions, to save lives and improve the citizens' quality of life and well-being. Finally, it is rather critical to tackle this cultural shift to a more digital mindset which, coupled with new technologies will enable the continuous development of improved telehealth services and care delivery. The tools are there!

## **Conflict of interest**

None to report.

## **References**

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