

IPv6 and its Impact on Cybersecurity, Emerging Technologies, and the Future of Internet

A Workshop Presentation at the SINC Northeast IT & Security Leaders Forum 2024

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Agenda:

- IPv6 Primer: Why IPv6 Matters?
- IPv6 and Cybersecurity
- IPv6 and Emerging Technologies
- IPv6 and the Future of Internet
- Summary
- Q & A

Background & Disclaimer

COMPUTERWORLD FROM IDG

Home > Internet of Things

OPINION

No IoT without IPv6

Does your company foresee making big bucks from the IoT happening without widespread adoption of IPv6 first.

By Charles C. Sun

Computerworld | MAY 1, 2014 9:22 AM PT

Do you think the Internet of Things (IoT) will be the Next Big Thing? It can't be. Not until we get past the real Next Big Thing: IPv6.

Without the extensive global adoption and successful deployment of IPv6 as the primary version of the Internet Protocol, the IoT won't be possible. In fact, the future of the Internet itself is at stake. Here are the five reasons why:

1. The IoT will need more IP addresses than IPv4 can provide.

[Related: [What is IFTTT? How to use it This, Then That services](#)]

According to Gartner's estimate, by 2020 there will be more than **26 billion IoT devices connected to the Internet**. Cisco is thinking even bigger; it has projected that there will be more than **50 billion devices connected to the Internet by 2020**.

Unfortunately, IPv4 is still widely used, and **IPv4 has only 4.3 billion possible IP addresses**. Now, it's true that that not every IoT device will need an IP address, but IPv4 can accommodate less than 20% of the devices that Gartner projects for a mere four years from now. Worse, most

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INSIDE OPINION

Stop using Internet Protocol Version 4!

Four reasons to move entirely to IPv6

By Charles C. Sun

Computerworld | MAY 1, 2014 9:22 AM PT



Internet Protocol Version 6 (IPv6) is here for real. The U.S. Office of Management and Budget has set a deadline of Sept. 30 for government agencies to give employees the capability to access the Internet via IPv6. In fact, now is the time for all of us to start thinking about when we should stop using IPv4. Here are the reasons why:

First, **we are running out of available IPv4 addresses**. According to the American Registry for Internet Numbers (ARIN), **there was only one last /9 (Class A) IPv4 address block available as of April 25**, of which only one /9 IPv4 address block can be possibly allocated to new requests for IPv4 addresses. One estimate suggests that IPv4 addresses in North America will be fully depleted sometime in late 2014 or early 2015. The IPv4 addresses for Asia-Pacific and Europe have already been depleted, in 2011 and 2012, respectively.

Second, not only has the U.S. government mandated that all federal agencies start the transition to IPv6, but **all vendors wishing to do business with the federal government are required by the Federal Acquisition Regulation to be in full compliance with IPv6** for all IT-related products and services.

GTSC GOVERNMENT TECHNOLOGY & SERVICES COALITION'S

HOMELAND SECURITY TODAY.US

Industry > Federal Pages > Subject Matter Areas > Events > The Editors > HS Jobs



PERSPECTIVE: Cyberwarfare Is Mission Possible – Only If We Stop Using IPv4!

May 15, 2018 — Charles Sun

In the era of Internet of Things (IoT) and blockchain, it is a daily nightmare encountered by organizations from both public and private sectors, big and small, struggling to react to the aftermath of the constant cybersecurity breaches and ransomware attacks.

According to the latest **2018 Data Breach Investigations Report** by Verizon, there were over 53,000 reported cybersecurity incidents and 2,216 confirmed data breaches in 2017. That is an average of more than six confirmed data breaches per day! The situation can only get worse every year if we do not change our strategy dramatically to efficiently secure and effectively defend the global network infrastructure against all enemies in this new cyberwarfare.

https://www.hstoday.us/subject-matter-areas/cybersecurity/future-of-the-internet-depends-on-global-ad

Industry > Federal Pages > Subject Matter Areas > Events > The Editors > HS Jobs

PERSPECTIVE: Future of the Internet Depends on Global Adoption of IPv6

June 4, 2018 — Charles Sun

The future of the Internet depends on the continued growth of a solid, healthy, and secured underlying global network infrastructure supporting the demand for the next generation of the Internet using IPv6 (Internet Protocol version 6) as its communication protocol. The future of the Internet is depending on the global successful adoption of IPv6.

In the era of Internet of Things (IoT) and blockchain, it has become increasingly obvious that without the extensive global adoption and successful deployment of IPv6 as the primary version of the Internet Protocol (IP), if not the only version of IP completely replacing IPv4, not only the future deployment and growth of IoT and other technological innovations relying on the support of the Internet are impossible, but the future of the Internet itself is at stake.

As I stated in a related [article](#) published two years ago, there are five main reasons why we must adopt and securely deploy IPv6 globally:

1. IoT needs more IP addresses than IPv4 can provide.
2. Cloud computing also needs more IP addresses.
3. Adopting an IPv6 only policy will dramatically reduce cybersecurity threats and attacks.
4. IPv4 is only a beta version of the Internet.
5. It is a matter of leadership, vision, and competitive edge.

https://www.hstoday.us/subject-matter-areas/cybersecurity/perspective-strengthening-online-security-and

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PERSPECTIVE: Strengthen Online Security and Privacy by Adopting the Best Standards Now

July 24, 2018 — Charles Sun

The ever-increasing daily cybersecurity incidents and confirmed data breaches across the globe have touched every aspect of our society and negatively impacted our daily lives. Not only the Internet and its underlying network infrastructures worldwide are facing clear and present danger, but our global banking and financial systems, our e-commerce and retail systems, our medical records and insurance systems, our federal personnel management and security clearance systems, our national and local electronic voting systems, our social media platforms and online communication systems, just to name a few, are all under constant attacks by state-sponsored actors and cyber adversaries from around the world. It is an understatement that the cyber threats and attacks are dangerously challenging the very foundation of our democracy and homeland security!

Consequently, we must protect and defend our homeland security infrastructures and systems by all means necessary and we must fight against the cyber enemies with the best weapons possible. For now, one of the best weapons to protect the security and integrity of the data traversing the Internet as well as the privacy of our citizens in cyberspace is to deploy the best and strongest encryption standards whenever possible, such as adopting Hypertext Transfer Protocol Secure (HTTPS)-Only policy for all web servers in conjunction with the implementation of Domain Name System Security Extensions (DNSSEC).

Disclaimer: The views presented are only personal opinions and they do not necessarily represent those of the U.S. Government.

Background & Disclaimer

- In 2014: Stop Using Internet Protocol Version 4!
- In 2016: No IoT without IPv6
- In 2018: Prediction for 100% IPv6 by 2029
- In 2020: Plan to Sunset IPv4 Now
- In 2020: OMB Issued the IPv6-Only Memo (M-21-07)_{11/19/2022}:

Completing the Transition to Internet Protocol Version 6 (IPv6)

Disclaimer: The views presented are only personal opinions and they do not necessarily represent those of the U.S. Government.

IPv6 Primer - Key Concepts

- IPv6 (Internet Protocol version 6) is the next generation Internet protocol which will eventually replace the current protocol IPv4
- The primary difference between IPv6 and IPv4 is that IPv6 uses **128 bit** address as compared to the **32 bit** address used with IPv4

IPv6 Primer - Key Concepts

- IPv4 has only 4.3 billion possible IP addresses
- IPv6 has a total of 340 undecillion - that is **340 trillion trillion trillion** – IP addresses
- Visually, it's like a golf ball vs the Sun

Why IPv6 Matters?

- **Global IPv4 Address Depletion**
 - ARIN's free pool of IPv4 address space was depleted on September 24, 2015
- **Cloud Computing Needs More IP Addresses**
- **IoT Needs More IP Addresses Than IPv4 Can Provide**
- **IPv4 Is Only a Beta Version of the Internet – Per Dr. Vint Cerf**
- **One of the Unfinished Businesses of the Internet**

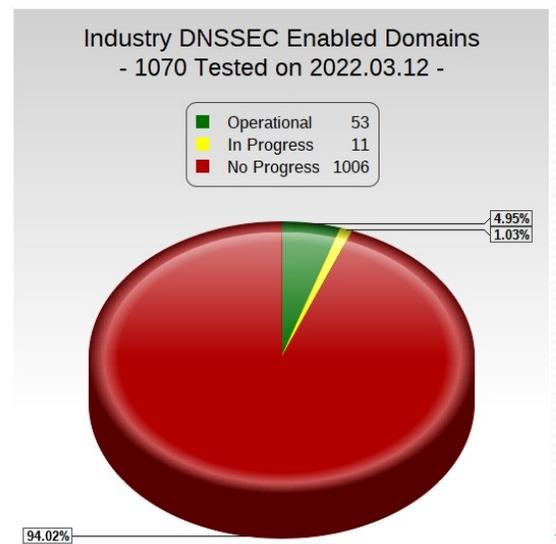
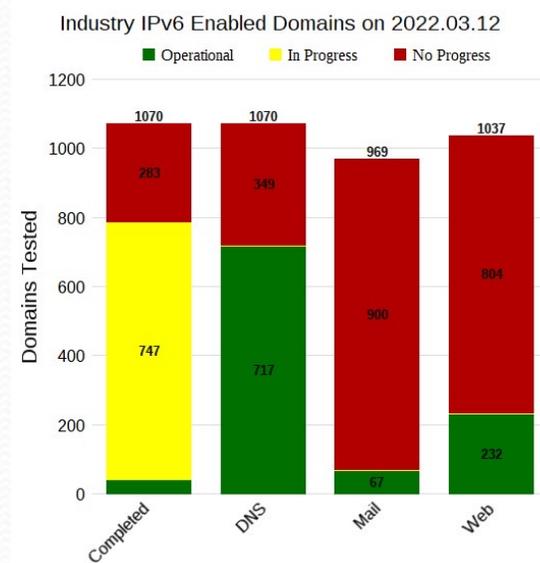
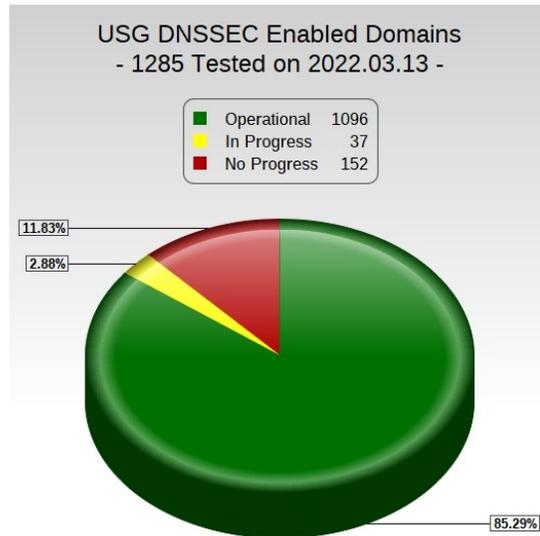
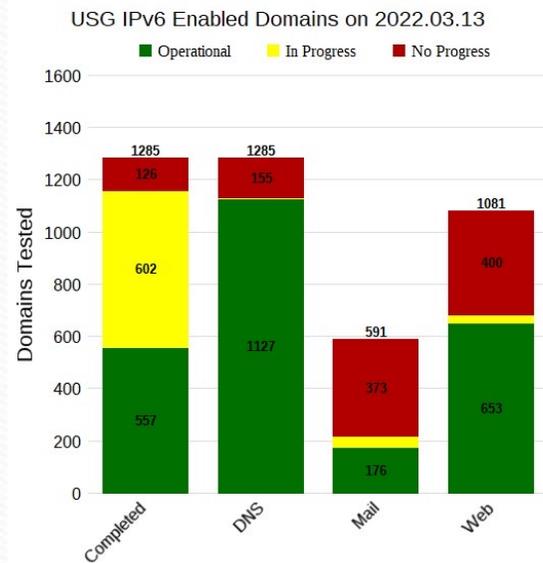
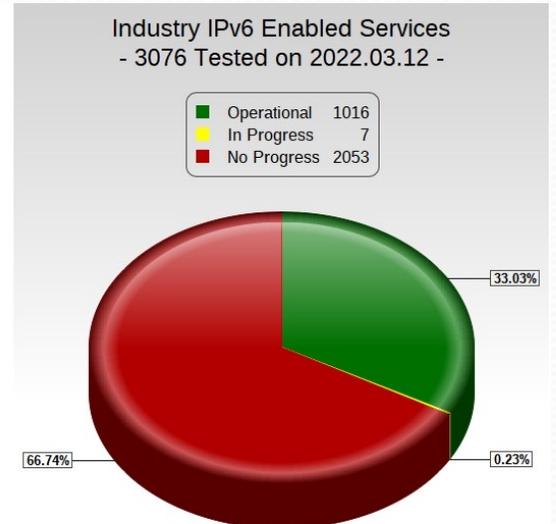
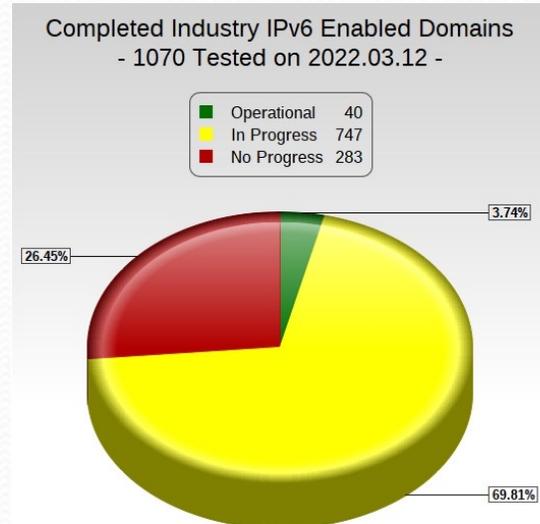
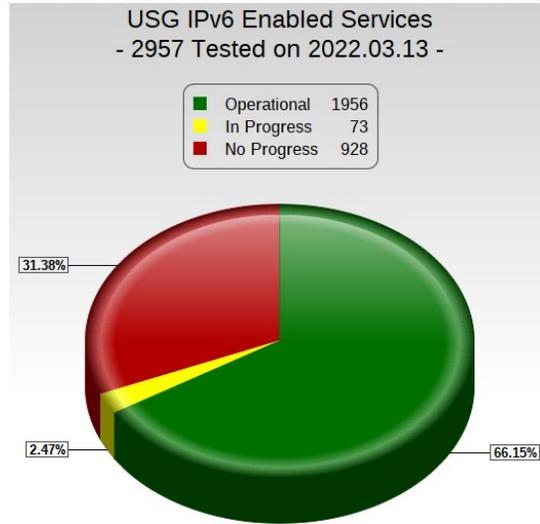
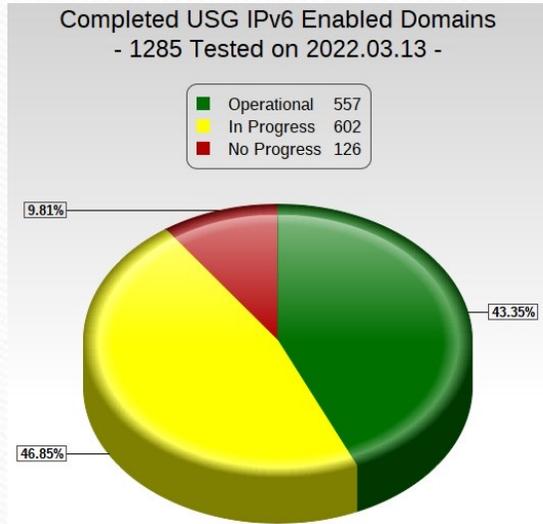
Why IPv6 Matters?

- **Federal Acquisition Regulation (FAR) Requirement:**
 - 2009-12-10: FAR Case 2005-041, [IPv6](#)
- **OMB IPv6 Memos and Mandates:**
 - OMB 2005 Memo: Transition Planning for [IPv6](#)
 - OMB 2010 Memo: Transition to [IPv6](#)
 - OMB 2016 Memo: Policies for Federal Agency Public Websites and [Digital Services](#)
 - **OMB 2020 Memo:** Completing the Transition to Internet Protocol Version 6 ([IPv6](#))
- **U.S. Government IPv6 Profile & Test Program:**
 - NIST USGv6 Profile Revision [1](#)
- **U.S. Department of Defense:**
 - CIO Memo (2019-02-27) on [IPv6](#) Implementation Direction and Guidance

IPv6 and Cybersecurity

- **The Current State of Cybersecurity:**
- According to the latest 2022 *Data Breach Investigations Report* by Verizon, there were over 23,896 reported cybersecurity incidents and **5,212 confirmed** data breaches in 2021.
- That is an average of **more than 14 confirmed data breaches** per day!

State of Global IPv6 Deployment: USG IPv6 Enabled Domains & Services



IPv6 and Cybersecurity

- **HPPS and TLS Adoption and Deployment:**

- As of August 2018, the NIST guidelines for TLS, NIST SP 800-52 [REV. 2](#), allows for the use of TLS version 1.0, 1.1, and 1.2 by all government TLS servers and clients, and it only recommends that agencies develop migration plans to support TLS 1.3 by Jan. 1, 2020.
- The latest version of the SP 800-52 Rev 2 ([2nd Draft](#)) as of October 2018, requires all government TLS servers and clients to support of TLS 1.3 by **January 1, 2024**.
- Unfortunately, all versions of the TLS protocol, except for TLS version 1.3, can be decrypted and have already been compromised in one way or another.

IPv6 and Cybersecurity

- **The Moment We Turn off IPv4:**

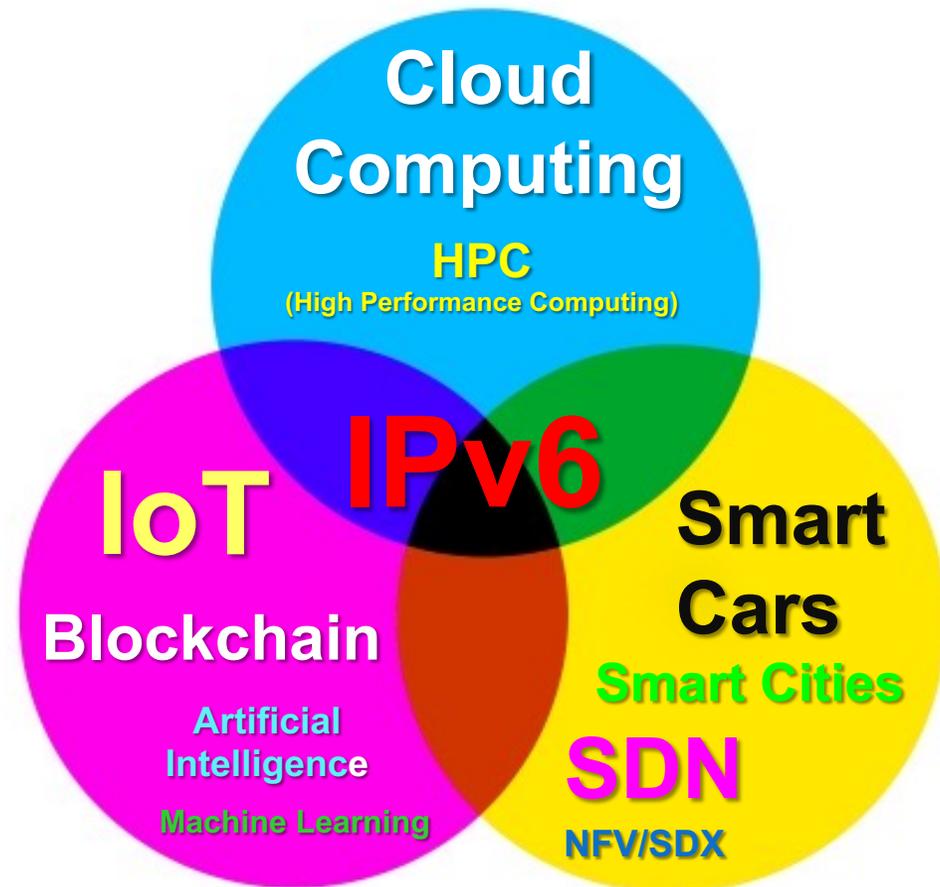
We Will Immediately Achieve **100% Reduction** of All Current Global Cyberattacks and Cybersecurity Threats Based On IPv4!

We Will Also Immediately Achieve More Than **50% Reduction** of the Overall Cyberattacks Worldwide Based on IPv4 and IPv6 Separately, and the Combination of Both IPv4 and IPv6 Stacks.

IPv6 and Cybersecurity

- It is common sense (which is uncommon) that instead of engaging the enemies in two separate battlegrounds concurrently, fighting two separate wars with limited resources, we should utilize all of our global resources and concentrate on fighting, and hopefully winning, only one war!
- Otherwise, we may potentially lose the fights in both battlegrounds.

IPv6 and the Emerging Technologies



State of Global IPv6 Deployment (as of 20230214):

Google IPv6 Statistics



Statistics

Google collects statistics about IPv6 adoption in the Internet on an ongoing basis. We hope that publishing this information will help Internet providers, website owners, and policy makers as the industry rolls out IPv6.

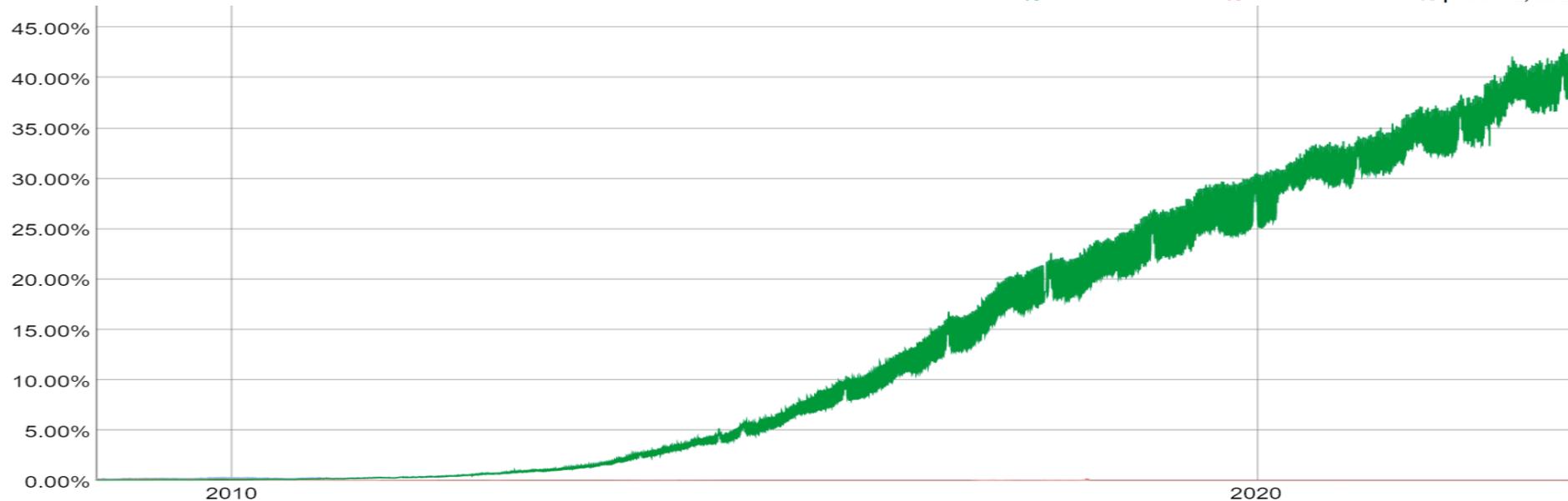
IPv6 Adoption

Per-Country IPv6 adoption

IPv6 Adoption

We are continuously measuring the availability of IPv6 connectivity among Google users. The graph shows the percentage of users that access Google over IPv6.

Native: 40.69% 6to4/Teredo: 0.00% Total IPv6: 40.69% | Feb 12, 2023



State of Global IPv6 Deployment

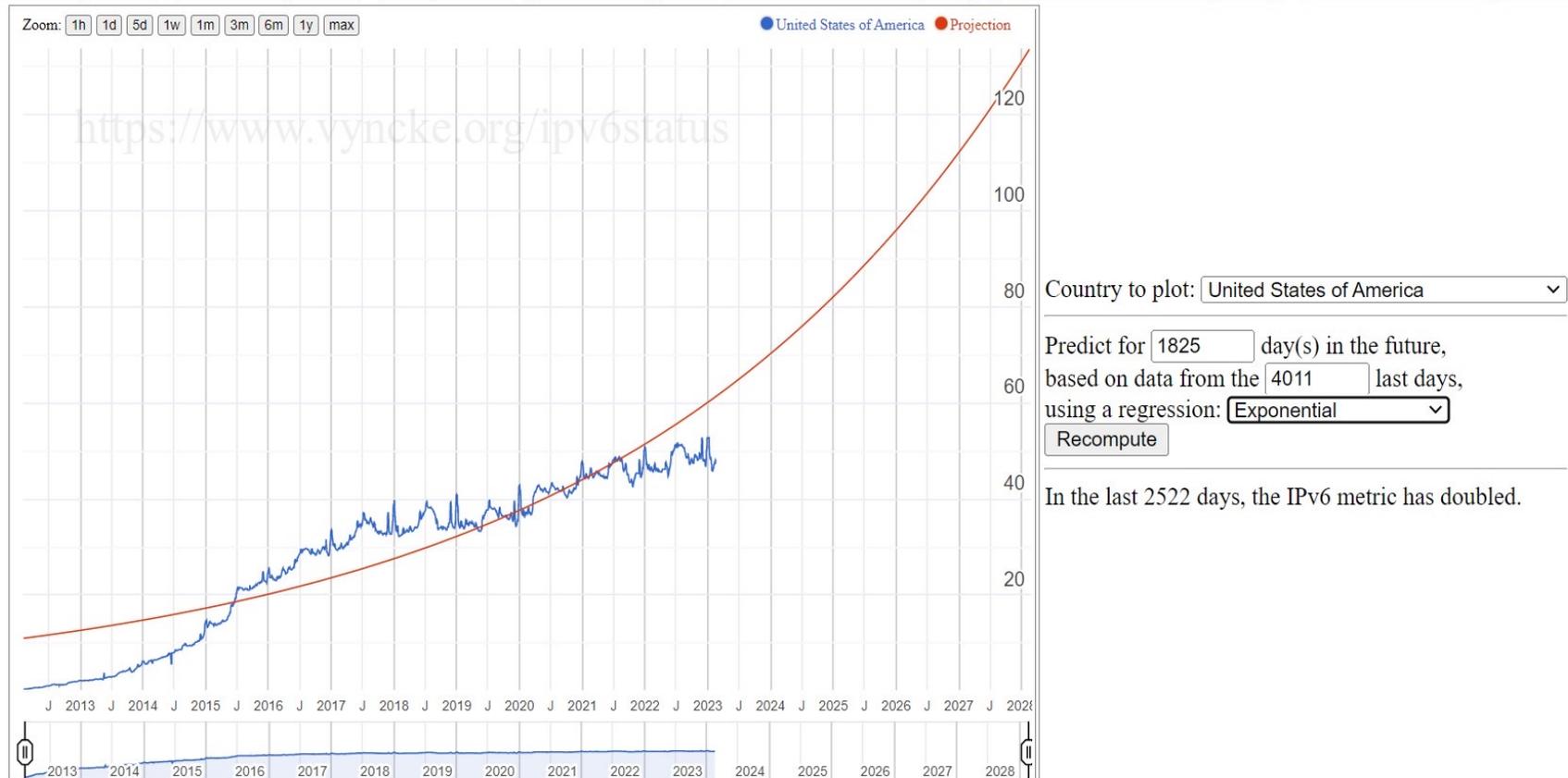
[Eric Vyncke's Daily IPv6 Statistics](#) (as of 20230217)

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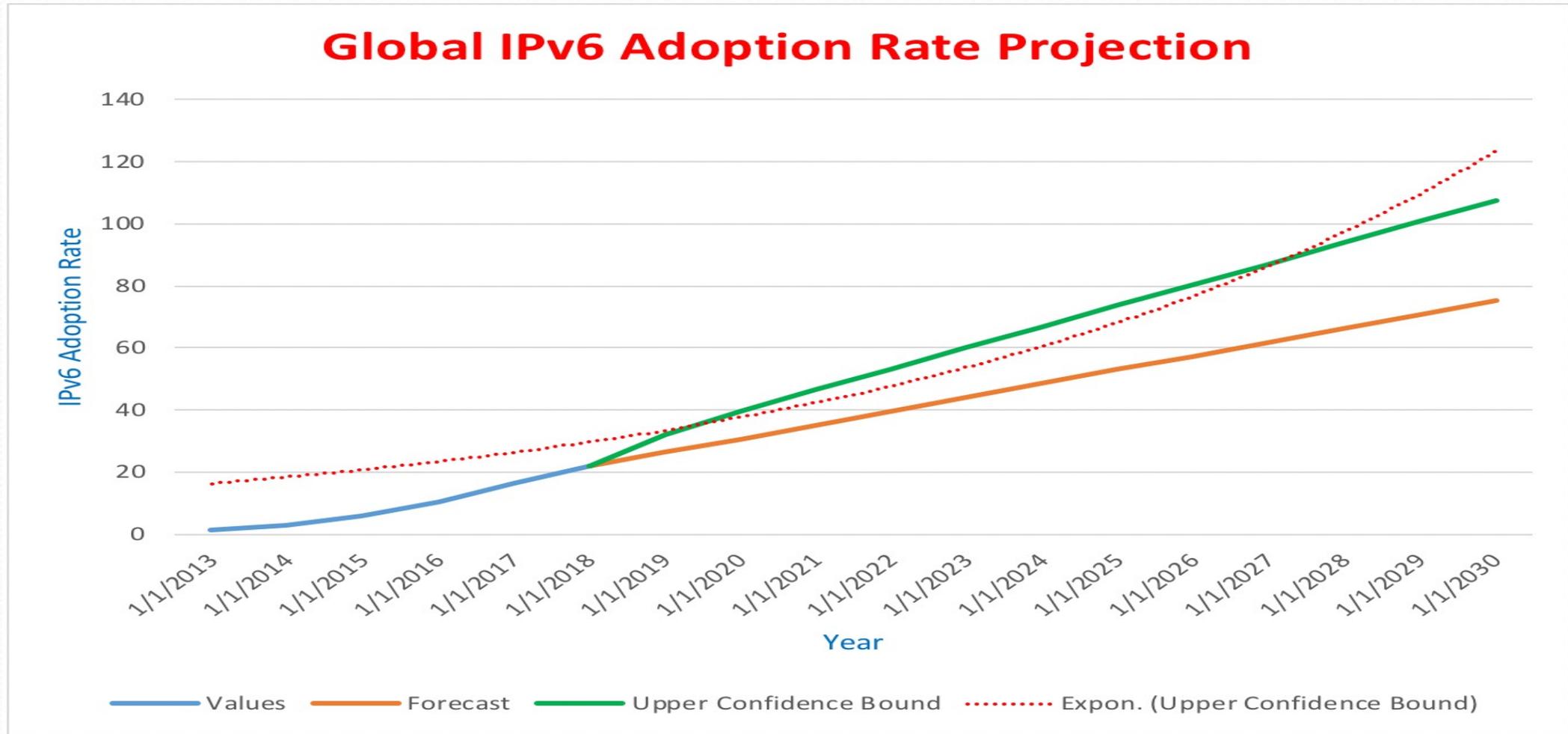
Projection of IPv6 %-age of IPv6-Enabled Web Browsers (courtesy Google) in United States of America

%-age of IPv6-Enabled Web Browsers (courtesy Google)

Metric to display: [allocated prefixes](#) - [announced prefixes](#) - [alive prefixes](#) - [global routing table](#) - [IPv6 web browsers \(Google\)](#) - [IPv6 web browsers \(APnic\)](#) - [IPv6 web browsers \(Akamai\)](#) - [IPv6 web servers](#)



IPv6 and the Future of Internet (as of 20180207)



IPv6 and the Future of Internet

- It is an understatement that the future growth and successful deployment of IoT and similar emerging technologies cannot be achieved without the successful global adoption and secure deployment of IPv6, without which there is no future of the Internet of Things nor any other new technologies and innovations that will depend upon the support from the Internet.
- IPv6 is the future of the Internet!

Summary

- IoT, Blockchain, AI, Cloud Computing, 5G, Smart Cars, Smart Cities, and Similar Emerging Technologies Using the Internet Depend on the Successful Global Adoption and Secure Deployment of IPv6.
- The Global Adoption and Secure Deployment of the Single Stack of IPv6 Will Immediately Reduce More Than 50% Cyber Attacks and Threats, Which Will Also Reduce the Overall Costs for IT and Cybersecurity.
- The single stack of IPv6 is the best cybersecurity posture in the future.

Thank You!