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IPv6 and the Future of Network Growth: What Telecom Leaders Need to Know

- Introduction: Why This Matters Now
- What is IPv6?
- Business Implications
- Risks of Inaction
- Strategic Roadmap for Adoption
- Case Studies or Peer Comparisons
- Call to Action

Introduction: Why This Matters Now

IPv4 exhaustion: We're out of addresses

IPv6 enables future growth and connectivity

Not just a tech upgrade—it's a strategic necessity

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IPv4 exhaustion: We're out of addresses

IPv4 Exhaustion

Only ~4.3 billion addresses (2^{32})

IANA exhausted IPv4 in 2011

RIRs have no free blocks left 2019

IPv4 Resale Market

Addresses sell for \$40–\$60 each

Brokers like IPv4.Global facilitate transfers

Enterprises buy to support legacy systems

Trends

- Prices rising due to scarcity
- IPv6 adoption is growing but slow
- Leasing IPv4 is becoming common

IPv6 Enables Future Growth and Connectivity

Virtually Unlimited Addresses
IPv6 provides 340 undecillion unique IP addresses, eliminating IPv4 exhaustion.

Scalable for IoT & Emerging Tech
Supports billions of devices—critical for IoT, 5G, and smart infrastructure.

End-to-End Connectivity
Restores true peer-to-peer communication without NAT complexity.

Not Just a Tech Upgrade—A Strategic Necessity

Future-Proof Networks
IPv6 adoption ensures long-term growth and innovation.

Enhanced Security & Efficiency
Built-in IPsec, simplified routing, and better performance.

Competitive Advantage
Early adopters gain agility and global reach in a connected world.

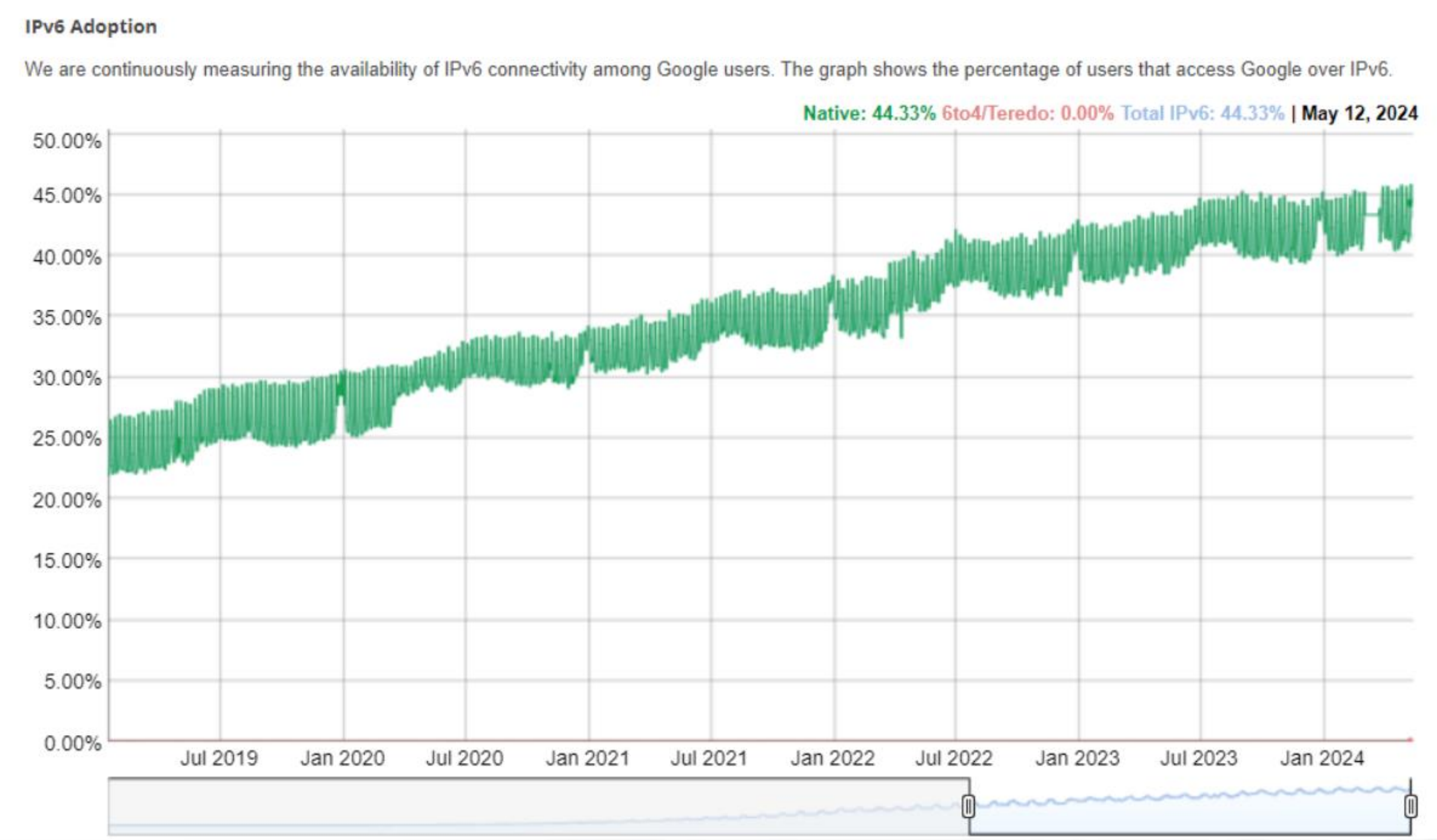
What is IPv6?

- IPv6 is the latest system that gives every device its own unique address on the internet.
- Think of it like a phone number or home address for your device.
- It helps devices talk to each other and connect globally.
- IPv6 = more addresses, better routing, built-in security
- Designed for long-term viability and performance

What is IPv6?

- IPv6 was first introduced in **1995** by the **Internet Engineering Task Force (IETF)** to address IPv4 exhaustion caused by the rapid global expansion of networks.
- IPv6 is considered superior to IPv4, which offers a limited number of IP addresses—approximately **4.29 billion**.
- In contrast, IPv6 uses a **128-bit addressing scheme**, allowing for **340 trillion trillion trillion** (or $\mathbf{3.4 \times 10^{38}}$) unique combinations. This vast number of addresses is expected to meet the growing demand for IPs indefinitely. Theoretically, we will never run out of IPv6.

IPV6 Adoption



Website IPV6 Usage

- **27.3% of all websites** globally support IPv6
- Among **top-ranked websites**, IPv6 adoption is higher:
  - **56.5%** of the top 1,000 websites
  - **54.4%** of the top 10,000
  - **49.8%** of the top 100,000

ISP IPv6 Allocations

- Most ISPs receive a /32 IPv6 block from their Regional Internet Registry (RIR).
- A /32 block allows for 65,536 /48 subnets—ideal for customer distribution.
- /32 balances scalability and routing efficiency.
- /36 blocks are less common and offer only 4,096 /48 subnets.
- Larger blocks (e.g., /29) may be granted based on customer base or growth projections.

IPv6 Subnetting: /64s in a /32 Allocation

- A single /32 IPv6 allocation contains 4,294,967,296 /64 subnets
- Each /64 subnet can support 18,446,744,073,709,551,616 devices
- IPv6 provides virtually unlimited scalability for ISPs and customers

/64 Subnets in a /32: 4.29 Billion

Devices per /64: 18 Quintillion

IPv6 Scalability: Devices vs /32 Blocks

- Estimated connected devices on Earth: 30 billion
- Available /32 IPv6 blocks: 4.3 billion
- Each /32 block contains 65,536 /48 subnets
- IPv6 can support trillions of devices with ease

Why IPv6 Adoption is Slow

- Lack of immediate business incentives
- Complexity of migration and planning
- Dual-stack maintenance overhead
- Compatibility with legacy systems
- Limited customer demand or awareness

Business Implications

- Operational Continuity: Avoid bottlenecks and outages
- Customer Experience: Support smart devices and apps
- Competitive Positioning: Lead in innovation
- Security Enhancements: Native encryption and connectivity

Operational Continuity

- Avoid IPv4 address exhaustion bottlenecks
- Ensure seamless connectivity for future growth
- Reduce reliance on costly IPv4 resale markets
- Enable scalable infrastructure for cloud and IoT

Customer Experience

- Support smart devices and IPv6-only applications
- Improve performance with direct end-to-end connections
- Enable better mobile and IoT integration
- Enhance reliability for global users

Competitive Positioning

- Lead in innovation with modern network architecture
- Attract tech-savvy customers and partners
- Future-proof services for emerging markets
- Demonstrate commitment to digital transformation

Security Enhancements

- Leverage IPv6's built-in IPsec support
- Simplify firewall and access control policies
- Reduce NAT-related vulnerabilities
- Enable secure peer-to-peer communication

Risks of Inaction

- Compatibility issues with modern devices
- Increasing regulatory pressure
- Customer dissatisfaction and churn

Risks of Inaction

- Compatibility issues with modern devices.
  - Some point in the future when adoption is higher, Device may not want to support dual stack.
  - IOT devices are small, dual stack require two protocols.

Risks of Inaction

Regulatory Pressures

- **OMB Memorandum M-21-07** requires all federal agencies to:
  - Publish IPv6 transition plans.
  - Phase out IPv4 in favor of **IPv6-only operations**.
  - Ensure all public-facing services (web, email, DNS) support native IPv6
- **NIST USGv6 Program** provides standards and testing for IPv6 compliance in federal procurement

Risks of Inaction

- Customer dissatisfaction and churn
  - Wireless is already IPv6 some 100% IPv6
  - Risk of only having CGNAT IPv4 due to IP address shortage.
  - New providers are IPv6 from Day one due to lack of available IPv4 space.
  - NAT issues

Strategic Roadmap for Adoption

- Phased migration: dual-stack, pilots, rollout
- Staff training and upskilling
- Partner coordination: ISPs, vendors, cloud
- High-level investment planning

Strategic Roadmap for IPv6 Adoption

- Phased Migration
- Assess current IPv4 infrastructure and dependencies
- Deploy dual-stack in critical systems first
- Gradually transition internal services to IPv6-only
- Monitor performance and adjust migration pace

Phased Migration

- **Phase 1**: Assessment & Planning
  - Inventory of IPv4 dependencies
  - IPv6 readiness audit
- **Phase 2**: Dual-Stack Deployment
  - Enable IPv6 alongside IPv4
  - Monitor performance and compatibility

Phased Migration

- **Phase 3**: IPv6-Preferred Transition
  - Prioritize IPv6 traffic
  - Implement NAT64/CLAT or 464XLAT for IPv4 access

- **Phase 4**: IPv6-Only Operations
  - Decommission IPv4 where feasible
  - Full reliance on IPv6 with translation services

- 464XLAT enables IPv6-only mobile networks to access IPv4 content.
- CLAT (Customer-side Translator): Runs on the mobile device, translates IPv4 to IPv6.
- PLAT (Provider-side Translator): Runs on the carrier network, uses NAT64 to translate IPv6 back to IPv4.
- DNS64: Resolves IPv4-only domain names into IPv6-compatible addresses.
- Used by carriers like T-Mobile

Strategic Roadmap for IPv6 Adoption

- Staff Training and Partner Coordination
  - Conduct IPv6 training for IT and network teams
  - Update documentation and operational procedures
  - Engage vendors and partners for IPv6 readiness
  - Establish cross-functional IPv6 transition team

Strategic Roadmap for IPv6 Adoption

- **Investment Needs**
  - Budget for hardware and software upgrades
  - Allocate resources for training and support
  - Plan for consulting and external expertise
  - Include IPv6 in long-term IT strategy

Case Studies or Peer Comparisons

- Competitors are already adopting IPv6
- Successful deployments show measurable benefits
- Lessons learned from real-world examples

- According to World IPv6 Launch, some ISPs have **IPv6 deployment rates above 90%**, such as:
  - **Reliance Jio** – 92.58%
  - **T-Mobile USA** – 92.31%
  - **Chunghwa Telecom (Mobile)** – 91.37%

Call to Action

- Form a cross-functional IPv6 task force
- Conduct an internal IPv6 readiness assessment
- Start with pilot projects and training

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