

Keynote speech

IPv6: A Paradigm Shift

Ajay Kumar,
RTCIT, Ranchi, IETE, New Delhi
 India
ajay_kumar2@rtcit.ac.in, ajaykumararttc@gmail.com

ABSTRACT

The rapid growth of the Internet has exhausted the address space of Internet Protocol version 4 (IPv4), whose 32-bit scheme supports only about 4.3 billion unique addresses. Techniques such as Network Address Translation (NAT) and Classless Inter-Domain Routing (CIDR) have extended its life, but they add complexity, break end-to-end connectivity, and hinder emerging technologies. IPv6, standardized by the IETF, is a fundamental redesign of the network layer rather than an incremental upgrade, and therefore represents a true paradigm shift in Internet architecture.

This keynote speech delivers key features that distinguish IPv6 from its predecessor. Its 128-bit address space provides roughly 3.4×10^{38} addresses, effectively eliminating scarcity and restoring direct communication between devices. A simplified, fixed-length header improves routing efficiency, while stateless address auto-configuration reduces administrative overhead. IPv6 also builds in IPsec support to strengthen security, and improves multicast, mobility, and quality-of-service handling. Together, these enhancements make networks easier to scale, manage, and secure.

The keynote further discusses transition mechanisms, including dual-stack operation, tunneling, and translation techniques such as NAT64, which allow IPv4 and IPv6 networks to coexist during migration. Challenges such as cost, staff training, legacy equipment, and compatibility concerns are weighed against the strategic benefits of adoption. The growth of the Internet of Things, mobile networks, cloud computing, and smart cities is highlighted as a major driver of demand for large, scalable addressing, since billions of connected devices now require globally unique, reachable addresses.

Finally, the study argues that IPv6 is not merely a remedy for address exhaustion but an enabling foundation for future innovation, offering scalability, improved security, and simpler network management. Organizations that adopt IPv6 early will be better positioned to support next-generation services and to ensure the long-term sustainability, openness, and resilience of the global Internet for future generations of users, devices, and applications worldwide.

Index terms— *IPv6, IPv4, address exhaustion, NAT, IPsec, dual-stack, Internet of Things.*

Speaker's short biography:



Prof. Dr. Ajay Kumar is a senior academic and telecommunications professional with over 45 years of combined experience spanning the Indian Army (EME Corps), Department of Telecommunications/BSNL, and higher education. Currently, he is serving as a Professor and the Head of the Computer Science & Engineering Department at RTCIT, Ranchi. Holding a Ph.D. in Computer Science & Engineering, he is also a Fellow member and the Vice President of IETE. His research focuses on IoT, smart cities, and advanced network technologies, complemented by certifications as a Master Trainer in IPv6 and 5G. His academic involvement also include tenure at Sarala Birla University and Usha Martin University. Prof. Kumar has mentored generations of engineers, delivered impactful research, and provided strategic consultancy on emerging technologies. His work exemplifies a seamless blend of industry expertise, policy insight, and educational leadership, establishing them as an authoritative figure in India's telecommunications and technology landscape.