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# BSNL's Indigenous 4G stack embodies Swadeshi spirit

## *Driving 5G Expansion, Realizing Bharat's 6G Vision for Viksit Bharat 2047*

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**Key Takeaways**

- **First fully indigenous 4G (5G-ready) network**: Built through collaboration between C-DOT (core), Tejas Networks (RAN), and TCS (integration).
- **India is now among the select five nations globally with the capability to launch fully indigenous 4G services, showcasing rapid innovation and supply-chain independence.**
- **Employment and supply chain boost**: Localised production strengthens domestic ecosystems and nurtures skilled telecom talent.
- **Rapid execution**: Developed in just 22 months, with over 92,000 sites now connecting 22+ million citizens, including two million first-time digital users.
- **Economic revival**: BSNL records consecutive profits after 17 years, signalling renewed citizen trust in homegrown technology.
- **Global potential**: Beyond serving domestic demand, the indigenous 4G stack is export-ready with interest from several countries.
- **Future-ready architecture**: Cloud-native and scalable, ensuring a seamless transition to 5G and alignment with Bharat 6G Vision 2030.
- **Global relevance**: India's swift 4G–5G rollout contributes significantly to global connectivity expansion, strengthening its role as a digital leader.

## Introduction

India has marked a historic milestone with the launch of its first fully indigenous 4G (5G-ready) network and the commissioning of nearly 98,000 Swadeshi 4G towers, all powered by homegrown technology. The core network, developed by C-DOT, with Tejas Networks' Radio Access Network and integration by TCS, exemplifies a major technological breakthrough and the realization of the Government's commitment to Aatmanirbhar Bharat.

Previously dependent on foreign technology for telecom services like 2G, 3G, and 4G, India responded to the Covid-19 pandemic by building this fully indigenous 4G stack from scratch, demonstrating resilience, rapid innovation, and supply-chain independence. This achievement places India among five nations capable of launching fully homegrown 4G services, reinforcing the swadeshi spirit. BSNL's cloud-native, 5G-ready 4G stack ensures immediate connectivity while enabling seamless upgrades, nurturing domestic talent, and strengthening supply chains. Complementary government initiatives, including the Bharat 6G Alliance, 100 5G/6G labs, and the Telecom Technology Development Fund are advancing research and innovation, charting a path toward Viksit Bharat 2047 and global leadership in digital technology.

## What is 4G?

4G is the short name for fourth-generation wireless, the stage of broadband mobile communications that supersedes 3G (third-generation wireless) and is the predecessor of 5G (fifth-generation wireless).

With 4G download speeds, wireless users can stream high-definition video and audio. 4G also enables wireless broadband, which provides a way for users to get internet connectivity without the need for a fixed, wired connection from an internet service provider (ISP).

4G leverages technologies like LTE, MIMO (Multiple Input Multiple Output), and OFDM (Orthogonal Frequency Division Multiplexing) for improved bandwidth, network efficiency, and reduced congestion.

## Features of the 4G Stack

- **End-to-end indigenous stack:** Radio Access Network (Tejas), Core Network (C-DoT) and domestic integration, therefore reducing dependency on foreign vendors and building local capability.
- **Software-first/ cloud native:** Enables rapid upgrades, scalability and easier future migration path to 5G.
- **Future proofing:** Sites and architecture described as "5G ready," facilitating an upgrade path without replacing large parts of the deployed infrastructure.

**BSNL's indigenous 4G services are expected to benefit tribal regions, remote villages, and hilly areas by providing access to quality digital services. This will enable children in rural areas to attend online classes, farmers in distant locations to check crop prices, and patients to consult doctors through telemedicine. Additionally, the initiative will greatly support armed forces personnel by enhancing secure communication through improved connectivity.**

**Key Highlights**

- The network currently operates over **92,000 sites**, connecting approximately 22 million Indians across urban and rural areas, fueling digital inclusion and economic growth.
- **Villages connected under saturation push: 29,000** villages reached as part of the Digital Bharat Nidhi / 4G saturation project
- **Technology partners:** RAN (Radio Access Network) by **Tejas Networks**, Core network by **C-DoT**, systems integration by **TCS**; deployed by **BSNL**
- **Design approach:** Fully software-driven, cloud-based architecture, "5G-ready" (seamlessly upgradable).

## Benefits & Impact of the Indigenous 4G Stack

- **Strategic Autonomy and Digital Sovereignty:** The fully indigenous 4G stack empowers India to control its telecom infrastructure, reducing reliance on foreign technologies and enhancing national security, thereby strengthening the country's strategic autonomy and digital sovereignty in critical communication networks.

- **Employment generation and supply-chain development:** Localised manufacturing and deployment are creating employment, strengthening supplier ecosystems, and nurturing a skilled domestic workforce capable of designing, testing, and maintaining advanced telecom systems. This adds both human capital and supply-chain autonomy to India's telecom sector.
- **Catering to domestic demand with global potential:** The fully indigenous 4G stack is not only meeting India's internal requirements but is also designed with export potential, with several countries having already expressed interest.
- **Rapid development through indigenous capability:** The entire 4G architecture was indigenously built in just 22 months, a pace significantly faster than comparable nations.
- **Expanding scale and reach:** More than 92,000 4G sites have been commissioned across the country, connecting over 22 million citizens. For two million users, this marks their first entry into the digital era. The network is managing nearly four petabytes of data traffic every day with efficiency and security.
- **Realisation of the Swadeshi principle:** The deployment reflects the Swadeshi ethos, transforming an idea into a growth engine that promotes domestic production, cultivates indigenous skills, inspire community enterprise, and embeds economic dignity into everyday life.
- **Financial turnaround and citizen trust:** Confidence in homegrown technology has enabled BSNL to record consecutive profitable quarters after 17 years of financial strain. This turnaround underlines the trust citizens place in institutions aligned with the vision of Aatmanirbhar Bharat.

## Going beyond 4G: Embracing 5G

The successful deployment of indigenous 4G technology and expansion of 5G is accelerating digital connectivity and strengthening India's telecom ecosystem for future advancements.

- 5G services launched on 1st Oct 2022.
- Within 8 months of launch, 2,00,000 sites covering 700 districts have been installed.
- 5G network rolled out in all 28 states and 8 UTs.
- Becoming one of the fastest 5G rollouts in the world.
- Presently, 5G is available in most of the districts across the country.
- As of 30th June, 2025, **4.86 lakh 5G Base Transceiver Stations (BTSs)** have been installed by Telecom Service Providers (TSPs) across the country.

## 5G Use Cases

- **Agriculture:** 5G will empower precision farming and smart agriculture with real-time data from IoT sensors, drones, and AI for enhanced productivity and resource management.
- **Healthcare:** 5G enables telemedicine, remote diagnostics, and real-time health monitoring, improving healthcare access especially in rural areas.
- **Education:** Enhanced virtual classrooms and immersive augmented/virtual reality (AR/VR) experiences will improve remote learning opportunities.
- **Manufacturing & Industry 4.0:** 5G supports automation, robotics, and smart factories with ultra-reliable, low-latency communication for increased efficiency and safety.
- **Smart Cities:** It enables intelligent traffic management, energy-efficient infrastructure, public safety, and environmental monitoring through connected devices.
- **Automotive & Transport:** 5G facilitates connected and autonomous vehicles, real-time traffic updates, and safer road transport systems.

- **Entertainment & Media:** Enhanced high-definition streaming, immersive gaming, and interactive media experiences will be possible.

## Stepping Stone to 6G

**The rapid rollout and domestic adoption of 5G are laying the foundation for India's Bharat 6G Mission, positioning the country as a global leader in future telecom innovation.** Currently, the 6G technology is under development phase at international level and is expected to be available by 2030. On March 23, 2023, India's 6G vision "Bharat 6G Vision" document was released, which envisages India to be a frontline contributor in design, development and **deployment of 6G technology by 2030.**

Bharat 6G Vision is based on principles of affordability, sustainability and ubiquity (universality). The Department of Telecom has facilitated setting up of 'Bharat 6G Alliance' which is an alliance of domestic industry, academia, national research institutions and standards organisations to develop action plan according to the Bharat 6G Vision.

## Initiatives taken by the government for 6G roll-out

- Established 100 5G labs at academic institutions for capacity building and a 6G-ready academic and start-up ecosystem.
- Launched Telecom Technology Development Fund (TTDF) Scheme on 1 Oct 2022 to fund R&D and innovation in telecom, including 6G, fostering collaboration across academia, start-ups, MSMEs, research institutes, and industry. Approved 104 projects worth Rs. 275.88 Crores by 31 July 2025.
- Facilitated 'Bharat 6G Alliance,' uniting industry, academia, research, and standards bodies to develop the Bharat 6G Vision. Signed MoUs with global 6G alliances for international collaboration.
- Under NM-ICPS, established Technology Innovation Hub at IIIT Bangalore, focusing on Advanced Communication Systems like Reconfigurable Intelligent Surfaces and O-RAN Massive MIMO to improve future 6G network coverage, capacity, and sensing.

## GSMA Mobile Internet Connectivity Index

As per the State of Mobile Internet Connectivity 2025 report (Network Coverage and Infrastructure), the majority of network investment continues to be in deployments of 5G, which has now reached more than half the world's population (**54% or 4.4 billion people**), with more than 700 million additional people covered in 2024. More than half of that growth was driven by India, which has achieved just over 80% population coverage for 5G.

During 2024, monthly 5G traffic in the country increased threefold and now accounts for 36% of India's total mobile traffic, compared to 15% in 2023.

## Global Context

According to statistics by the **International Telecommunication Union (ITU),**

- It is estimated that approximately 5.5 billion people – or 68 per cent of the world's population – are using the Internet in 2024.
- This represents an increase from only 53 per cent in 2019, with 1.3 billion people estimated to have come online during that period.

Some key findings from ITU in 2024 include:

- **Gender parity improving**: In 2024, 70% of men and 65% of women use the Internet, a gap of 189 million users. Progress continues except in LDCs.
- **Youth more connected**: 79% of people aged 15–24 are online, 13 points higher than others. The gap is shrinking.
- **Affordability challenge**: Fixed broadband in low-income countries costs nearly a third of monthly income.
- **Mobile ownership high**: 4 in 5 people over 10 own a phone; 95% in high-income vs 56% in low-income economies.
- **5G expanding unevenly**: Global coverage reaches 51%; 84% in high-income vs 4% in low-income countries.
- **Mobile broadband rising**: Subscriptions nearing parity with mobile-cellular, but fixed broadband remains a luxury.
- **Traffic growth strong**: High-income users average 16.2 GB per month, eight times more than low-income (2 GB).

## Conclusion

The rollout of the indigenous 4G stack marks a defining step in India's digital transformation. It blends technology, self-reliance, and inclusive growth, bringing millions online, creating jobs, and proving India's capability to design and deploy world-class telecom solutions. With its future-ready, 5G-ready architecture and export potential, this initiative strengthens India's position as a global digital powerhouse. Complementing this progress, ongoing government initiatives for 5G expansion and the development of 6G technologies through the Bharat 6G Alliance and related programs ensure that India is well-positioned to lead in next-generation telecom innovation. Together, these efforts pave the way towards **Viksit Bharat 2047**, where India not only builds for itself but also empowers the world in the era of 5G, 6G, and beyond.

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