5G

5G is the next-generation wireless cellular technology that will enable ultra-low latency connection that is quicker and more dependable. According to a government panel analysis, peak network data speeds for 5G are estimated to be in the region of 2-20 Gigabit per second (Gbps). This can aid in effective governance and contribute to India's economic prosperity.

Knowing about it is very significant from an exam standpoint because it is a game-changer technology in many sectors, including the economics, science and technology, and development.

Recent news:

➢ The Department of Telecommunications (DoT) recently declared that 5G services will be available in India's major metros next year.
➢ India, like other global players, had intended to launch 5G services as soon as feasible in 2018, in order to take advantage of the improved network speeds and strength that the technology offered.
➢ 5G spectrum auction will be conducted in FY23: Nirmala Sitharaman.
➢ Bharti Airtel has successfully conducted India's first 5G trial in the 700 MHz band in partnership with Nokia, on the outskirts of Kolkata.

What is 5G technology?

➢ The fifth generation (or 5G) of long-term evolution (LTE) mobile broadband networks is the most recent upgrade.
➢ 5G allows for the creation of a new type of network that connects nearly everyone and everything, including machines, objects, and gadgets.
➢ It's a unified platform with far more capacity, lower latency, faster data delivery rates, and better spectrum utilisation than earlier mobile services.

The low, mid, and high-frequency spectrum

- 5G primarily operates across three bands: low, mid, and high frequency spectrums, each with its own set of benefits and drawbacks.
- The low band spectrum has a lot of potential in terms of coverage and internet and data transfer speed, although the maximum speed is just 100 Mbps (Megabits per second).
- The low band spectrum may not be ideal for specialised needs of the industry, thus Telcos can use and deploy it for commercial cell phone users who may not have specific need for very high speed internet.
- The mid-band spectrum has faster speeds than the low-band spectrum, but it has limitations in terms of coverage area and signal penetration.
- This band could be utilised by industries and specialised production units to create captive networks that can be tailored to their specific demands.
- The high-band spectrum has the fastest speed of all three bands, but it also has the smallest coverage and signal penetration strength.
- Internet speeds in the 5G high-band spectrum have been tested to reach 20 Gbps (gigabits per second), although the greatest internet data speed in 4G has been reported at 1 Gbps in most circumstances.

Timeline of launch

- 1G: First introduced in the 1980s. Only voice calls were supported using analogue radio waves.
- 2G was introduced in the 1990s. With a Bandwidth (BW) of 64 Kbps, it uses digital radio signals to handle both voice and data transfer.
- 3G: Introduced in the early 2000s. It can transfer telephone signals, including digitised speech, video calls, and conferencing, at speeds ranging from 1 to 2 Mbps.
- 4G: It supports 3D virtual reality and has a max speed of 100 Mbps-1 Gbps.
- 5G: at a speed of more than 1Gbps, it has the potential to connect the entire world without boundaries.

5G	4G
5G uses utilize much higher radio frequencies of 28 GHz. 5G transfers more data over the air at faster speeds.	4G uses lower reading frequencies of 700 MHz to 2500 MHz. 4G speed is lesser with less data

➢ 5G has lower latency i.e the delay before a transfer of data begins following an instruction. Latency for 5G is predicted to be below 10 milliseconds and in best cases around 1 millisecond. ➢ 5G uses a millimeter-wave spectrum which enables more devices to be used within the same geographic area supporting around one million per square kilometer. ➢ 5G uses a new digital technology that improves coverage, speed, and capacity.	transfer. ➢ 4G has higher latency as compared to 5G. The latency for 4G is around 20-30 milliseconds. ➢ 4G supports a lesser number of devices of about 4,000 devices per square kilometer. ➢ 4G has led to more congestion and lesser coverage as compared to 5G.

Features:

➢ Capability: In comparison to earlier versions, 5G will deliver substantially faster mobile broadband service and will support previous services such as mission essential communication and the enormous Internet of Things (IoT).

➢ Upgraded LTE: The long-term evolution (LTE) mobile broadband networks have been upgraded to 5G.

➢ It will be substantially faster than its predecessors, with a peak delivery rate of up to 20 Gbps and an average of 100Mbps. The increased speed is partly due to the use of higher-frequency radio waves than in prior networks.

➢ Traffic capacity and network efficiency will be increased by up to 100 times.

➢ Spectrum usage: Every bit of spectrum, from low bands below 1 GHz to high bands, will be better utilised.

➢ It is expected to offer a lower latency and better instantaneous, real-time data access. Orthogonal Frequency Division Multiplexing (OFDM) is used in 5G, much as it is in 4G LTE, but the new 5G NR (New Radio) air interface will improve OFDM and allow more flexibility in data delivery.

➢ Millimeter wave spectrum: The 5G networks will employ the millimetre wave spectrum (30-300 GHz), which has the advantage of being able to transport massive volumes of data at extremely high speeds because the frequency is so high.
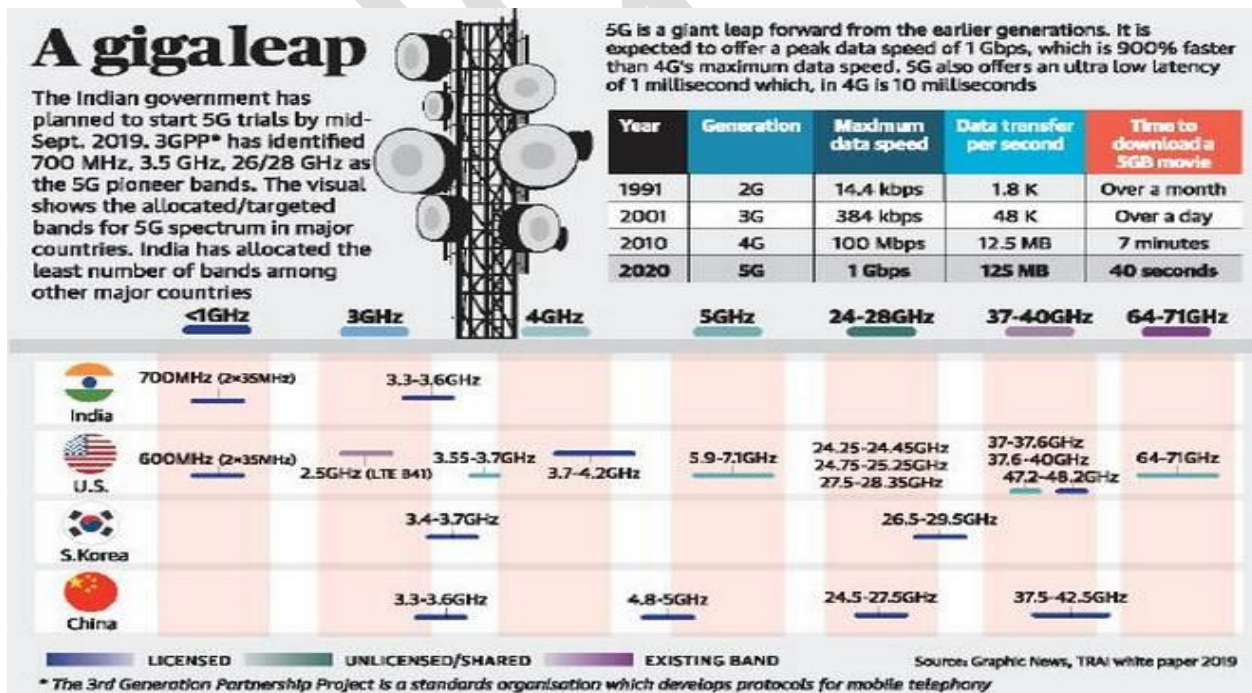
Applications of 5G technology

- High-speed mobile network: With its supercharged wireless network, 5G will change the mobile experience. Voice and high-speed data can be delivered efficiently in 5G compared to traditional mobile transmission technologies.

- Entertainment and multimedia: 5G can deliver uninterrupted video streaming at 120 frames per second, high quality, and better dynamic range. After the introduction of the latest technologies enabled by 5G wireless, the audiovisual experience will be rewritten. Over 5G, augmented reality and virtual reality services will be more enjoyable.

- IoT applications collect massive amounts of data from millions of devices and sensors, necessitating an efficient network for data collecting, processing, transmission, control, and real-time analytics, for which the 5G network is a superior fit.

- Smart cities: A reliable 5G wireless network can be used to run smart city applications such as traffic management, instant weather updates, local area broadcasting, energy management, smart power grid, smart street lighting, water resource management, crowd management, and emergency response, among others.

- Agriculture and smart farming will both benefit from 5G technology in the future. Farmers can easily track and manage their cattle with sophisticated RFID sensors and GPS technologies. Irrigation control, access control, and energy management are all possible applications for smart sensors.

- Applications that are mission critical: Remote control of essential infrastructure and vehicles, similar to telemedicine services. With a highly dependable, low latency connectivity, it has the ability to change industries.

- Improved Governance: Red tape would be reduced if speed and connectivity were improved. It will improve the speed with which projects are completed and policies are implemented. It will improve system accountability and prevent corruption by implementing a better monitoring system.

- New device manufacturers and application developers will have more opportunities thanks to 5G wireless technology. New VoIP and smart gadgets will be launched to the market, resulting in more job prospects. This will contribute to more inclusive growth and a demographic dividend.

- Enhanced Security: Because of its increased bandwidth and unlicensed spectrum, 5G wireless technology is one of the greatest solutions for security surveillance. It will improve coordination between various agencies. Closed circuit cameras, which can

be controlled and accessed from a distance, will give high-quality real-time footage for security needs.

- Logistics and shipping: Smart 5G technology can be used for products tracking, fleet management, centralised database management, personnel scheduling, and real-time delivery tracking and reporting in the logistics and shipping business.
- For effective automation of equipment, maintenance, safety, tracking, smart packing, shipping, logistics, and energy management, future industries will rely on smart wireless technologies like 5G and LTE advanced.
- Agricultural applications: In the future, 5G technology could be employed in agriculture and smart farming. Farmers can easily track and manage their cattle with sophisticated RFID sensors and GPS technologies. Irrigation control, access control, and energy management are all possible applications for smart sensors.
- Medical practitioners will be able to undertake innovative medical treatments with the help of a dependable wireless network connected to the other side of the world thanks to 5G technology. Doctors can communicate with patients at any time and from any location, providing guidance as needed. Scientists are developing smart medical equipment that can do surgery remotely. Wearable medical gadgets will continuously monitor the patient's condition and activate an alert in the event of an emergency.

India's plan:

A giga leap

The Indian government has planned to start 5G trials by mid-Sept. 2019. 3GPP* has identified 700 MHz, 3.5 GHz, 26/28 GHz as the 5G pioneer bands. The visual shows the allocated/targeted bands for 5G spectrum in major countries. India has allocated the least number of bands among other major countries.

5G is a giant leap forward from the earlier generations. It is expected to offer a peak data speed of 1 Gbps, which is 900% faster than 4G's maximum data speed. 5G also offers an ultra low latency of 1 millisecond which, in 4G is 10 milliseconds

Year	Generation	Maximum data speed	Data transfer per second	Time to download a 5GB movie
1991	2G	14.4 kbps	1.8 K	Over a month
2001	3G	384 kbps	48 K	Over a day
2010	4G	100 Mbps	12.5 MB	7 minutes
2020	5G	1 Gbps	125 MB	40 seconds

	<1GHz	3GHz	4GHz	5GHz	24-28GHz	37-40GHz	64-71GHz
India	700MHz (2×35MHz)	3.3-3.6GHz					
U.S.	600MHz (2×35MHz)	2.5GHz (LTE B41)	3.55-3.7GHz 3.7-4.2GHz	5.9-7.1GHz	24.25-24.45GHz 24.75-25.25GHz 27.5-28.35GHz	37-37.6GHz 37.6-40GHz 47.2-48.2GHz	64-71GHz
S.Korea		3.4-3.7GHz			26.5-29.5GHz		
China		3.3-3.6GHz	4.8-5GHz		24.5-27.5GHz	37.5-42.5GHz	

LICENSED UNLICENSED/SHARED EXISTING BAND   Source: Graphic News, TRAI white paper 2019
* The 3rd Generation Partnership Project is a standards organisation which develops protocols for mobile telephony

- The Department of Telecommunications (DoT) recently declared that 5G services will be available in India's major metros next year.
- India is developing technologies that will allow it to launch its own 5G network.
- This will allow it to run its IoT systems on indigenous technology, which will benefit both civilian and military applications.
- The PM is striving for Aatamnirbharta (self-reliance), with Digital India's success as a top goal.
- To defend India's corporate and security interests, India has banned Chinese apps and barred its hardware supply chains.
- Rather than being embroiled in policy processes and bureaucratic rifts, scientists and industry should collaborate to get 5G technology to market faster.
- India could become a viable alternative to China if 5G technology is implemented.
- All of India's commercial telecom companies have urged the DoT to give out a clear road map for spectrum distribution and 5G frequency bands so that they can plan their service rollouts properly.

Challenges for India:

- Low Fiberization Footprint: India needs to enhance its fibre connectivity, which currently connects only 30% of the country's telecom towers.This number has to double for a successful 5G launch and uptake in India.
- 'Made in India' is a phrase that means "made in India." Hardware Challenge: The restriction on certain foreign telecom OEMs (original equipment manufacturers), which are responsible for the majority of 5G technology development, is a significant roadblock in and of itself.
- High Spectrum Pricing: The cost of 5G spectrum in India is several times that of the worldwide average.
- India's cash-strapped carriers will suffer as a result.
- Choosing the Best 5G Technology Standard: In order to speed the adoption of 5G technology, the debate between the domestic 5Gi standard and the global 3GPP standard must be resolved.
- While 5Gi has clear advantages, it also increases the cost of launching 5G India and poses interoperability challenges for telecoms.

National Digital Communications Policy 2018

- To meet the modern needs of India's digital communications sector, the new National Digital Communications Policy – 2018 has been formulated in replacing of the old National Telecom Policy – 2012.
- It will allow India to enter the era of modern technical breakthroughs in the telecom sector, such as 5G, Internet of Things, and Machine-to-Machine communication.
- It would provide a 'customer-focused' and 'application-driven' policy for the Indian telecom sector, which can serve as the foundation for Digital India by addressing growing potential to expand not just the availability of telecom services but also telecom-based businesses.

Objectives

- Broadband for all;
- Creating four million additional jobs in the Digital Communications sector;
- Enhancing the contribution of the Digital Communications sector to 8% of India's GDP from ~ 6% in 2017;
- Propelling India to the Top 50 Nations in the ICT Development Index of ITU from 134 in 2017;
- Enhancing India's contribution to Global Value Chains; and
- Ensuring Digital Sovereignty.

It envisions three missions in order to achieve these goals by the year 2022:

- Creating a Robust Digital Communications Infrastructure in India Broadband for All should be promoted as a tool for socioeconomic growth while also assuring service quality and environmental sustainability.
- India's Propulsion: Investing in, innovating, and generating intellectual property to enable next-generation technologies and services To harness the power of emerging digital technologies such as 5G, AI, IoT, Cloud, and Big Data to enable the provision of future-ready products and services; and to catalyse the fourth industrial revolution (Industry 4.0) by encouraging investments, innovation, and intellectual property rights (IPR).
- Secure India: Assuring Digital Communications Sovereignty, Safety, and Security To protect citizens' interests and India's digital sovereignty by focusing on individual autonomy and choice, data ownership, privacy, and security, and recognising data as a valuable economic resource.

The government has formed the **High-Level 5G India 2020 Forum**, which includes three secretaries from important ministries/departments, including Telecom, Meity, and DST, as well as recognised experts. The forum's main objectives are:

- early deployment of 5G in India.
- A globally competitive product development and manufacturing ecosystem targeting 50% of India market and 10% of global market over next 5 to 7 years.

The 5G Club 'D10':

> The United Kingdom has proposed forming a 'D10' club of democratic partners, which would include the G7 countries, Australia, and Asia's technology leaders, South Korea and India.

> It would include the G7 nations — the United Kingdom, the United States, Italy, Germany, France, Japan, and Canada – as well as Australia, South Korea, and India.

> Its goal is to direct investments into existing telecommunications businesses in the ten member countries.

> To minimise relying on China, the group wants to build alternative suppliers of 5G equipment and other technology.

Way forward:

> India should seize the opportunity and try to introduce 5G technology as soon as possible. We should concentrate on improving our cyber infrastructure.

> Funds should be granted, and local technology and telecom enterprises should be encouraged to expand their internal capacity, allowing 5G to flourish in the country.

> 5G start-ups that can help with design and production should be encouraged. Wireless network coverage, capacity, and density will all increase as a result of this.

> It will fuel a surge in Internet of Things technology and usher in a new era of technical capability.

> Low-latency communication systems will be enabled by 5G technology, which can be employed in agriculture, manufacturing, and retail.

> In India, however, 5G is still in its infancy, with no commercial development to date. According to experts, the adoption of 5G technology and AI will usher in entirely new use cases.

MCQs for practice

Q1. Consider the following statements regarding 5G:

1. 5G primarily operates across two bands low and high frequency spectrums.
2. Its peak delivery rate will be up to 200 Gbps and an average of 1000 Mbps.
3. High-band spectrum has the fastest speed of all three bands, but it also has the largest coverage and signal penetration strength.

Select the correct statement:

a. 1 only
b. 1&2 only
c. 1&3 only
d. 2&3 only

Correct answer: A

- ➢ 5G primarily operates across three bands: low, mid, and high frequency spectrums, each with its own set of benefits and drawbacks.
- ➢ The low band spectrum has a lot of potential in terms of coverage and internet and data transfer speed, although the maximum speed is just 100 Mbps (Megabits per second).
- ➢ The low band spectrum may not be ideal for specialised needs of the industry, thus Telcos can use and deploy it for commercial cell phone users who may not have specific need for very high speed internet.
- ➢ The mid-band spectrum has faster speeds than the low-band spectrum, but it has limitations in terms of coverage area and signal penetration.
- ➢ This band could be utilised by industries and specialised production units to create captive networks that can be tailored to their specific demands.
- ➢ The high-band spectrum has the fastest speed of all three bands, but it also has the smallest coverage and signal penetration strength.

Q2. Consider the following statements about 5G in India:

1. The Department of Telecommunications (DoT) recently declared that 5G services will be available in India's all cities next year.
2. National Digital Communications Policy – 2018 deals with 5G in India.

Select the *incorrect* statement:

a. 1 only
b. 2 only
c. Both 1&2
d. None of the above

Correct answer: A

- The Department of Telecommunications (DoT) recently declared that 5G services will be available in India's major metros next year.
- National Digital Communications Policy 2018
    - To meet the modern needs of India's digital communications sector, the new National Digital Communications Policy – 2018 has been formulated in replacing of the old National Telecom Policy – 2012.
    - It will allow India to enter the era of modern technical breakthroughs in the telecom sector, such as 5G, Internet of Things, and Machine-to-Machine communication.
    - It would provide a 'customer-focused' and 'application-driven' policy for the Indian telecom sector, which can serve as the foundation for Digital India by addressing growing potential to expand not just the availability of telecom services but also telecom-based businesses.

3. **Select the correct statements regarding 'D10' :**
   1. USA has proposed forming a 'D10' club of democratic partners to enhance telecommunication services.
   2. It would include the G7 nations — the United Kingdom, the United States, Italy, Germany, France, Japan, and Canada – as well as Australia, South Korea, and India.
   3. Its goal is to direct investments into existing telecommunications businesses in the ten member countries.

Select the correct option:

   a. 1 & 2 only
   b. 2&3 only
   c. 1&3 only
   d. All of the above

Correct answer: A

The 5G Club 'D10':

- The United Kingdom has proposed forming a 'D10' club of democratic partners, which would include the G7 countries, Australia, and Asia's technology leaders, South Korea and India.

- It would include the G7 nations — the United Kingdom, the United States, Italy, Germany, France, Japan, and Canada – as well as Australia, South Korea, and India.
- Its goal is to direct investments into existing telecommunications businesses in the ten member countries.
- To minimise relying on China, the group wants to build alternative suppliers of 5G equipment and other technology.

Mains question for practice:

Q. How India can lead the glove in 5G? What are the major challenges? What are the major initiatives by GOI to develop 5G in India?