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News: 5G Auction

- India is preparing to auction off airwaves to rollout 5G services in the country.
- The infrastructure needed for such a rollout requires existing radio towers to be connected via optical-fibre cables.

Optical Fibre

- Optical Fibre is the backbone of the digital infrastructure — the data is transmitted by light pulses travelling through long strands of thin fibre.
- Metal wires are preferred for transmission in optical fibre communication as signals travel with fewer damages.
- The optical fibre works on the principle of total internal reflection (TIR).
- Light rays can be used to transmit a huge amount of data (In case of long straight wire without any bend).
- In case of a bend, the optical cables are designed such that they bend all the light rays' inwards (using TIR).

Benefits

High Speed

- Fiber provides more bandwidth and has standardized performance up to 10 Gbps and beyond, something that it is impossible to achieve when using copper.
- More bandwidth means that fiber can carry more information with far greater efficiency than copper wire.

Range of Transmission

- Since data travels in the form of light in fiber-optic cables, very little signal loss occurs during transmission and data can move at higher speeds and greater distances.

Not susceptible to interference

- Fiber-optic cable is also much less susceptible to noise and electromagnetic interference than copper wire.
- It is so efficient, in fact, that roughly 99.7% of the signal reaches the router in most cases.

Durability

- Fiber-optic cable is completely immune to many environmental factors that affect copper cable.

- The core is made of glass, which is an insulator, so no electric current can flow through.

Fiberisation

- The process of connecting radio towers with each other via optical fibre cables is called fiberisation.
- The backhaul is a component of the larger transport that is responsible for carrying data across the network.
- It represents the part of the network that connects the core of the network to the edge.
- It is necessary to increase the density of mobile towers to provide better coverage to consumers and businesses.

Challenges in Fiberisation

Resources

- To reach the targeted level of fiberisation, India requires about Rs 2.2 lakh crore of investment to help fiberise 70% towers.
- About Rs 2.5 lakh crore will be needed to set up 15 lakh towers in the next four years.

Demand

- Government programmes like BharatNet and Smart Cities adds to the demand of fibre deployment, necessitating a complete tower fiberisation.
- India laid out the vision in 2020 to connect every village in the country with optical fiber cable (OFC) in 1,000 days.
- To achieve that vision, cables must be laid at a speed of 1,251 km a day, around 3.6 times the current average speed of 350 km a day.

Right to Way (RoW) Rules

- The Indian Telegraph RoW Rules 2016 were gazette notified by the Department of Telecommunications (DoT), Govt. of India in 2016.
- The rules aim to incorporate nominal one-time compensation and uniform procedure for establishment of Overground Telegraph Line (OTL) anywhere in the country.
- While all States/UTs are required to implement these rules, they are not in complete alignment and still require certain amendments to align.
- Several districts and local bodies have not agreed to the RoW policies as notified in those respective States and are following their own bylaws overriding the State RoW policies aligned with the RoW rules, 2016.

5G Technology

Features of 5G Technology

Millimeter wave spectrum

- The 5G networks will operate in the millimeter wave spectrum (30-300 GHz) which has the advantage of sending large amounts of data at very high speeds because the frequency is so high, it experiences little interference from surrounding signals.

Upgraded LTE

- 5G is the latest upgrade in the long-term evolution (LTE) mobile broadband networks.

Internet speed

- In the high-band spectrum of 5G, internet speeds have been tested to be as high as 20 Gbps (gigabits per second) as compared to the maximum internet data speed in 4G recorded at 1 Gbps.
- 5G network speeds should have a peak data rate of 20 Gb/s for the downlink and 10 Gb/s for the uplink.

Bands in 5G

- 5G mainly work in 3 bands, namely low, mid and high frequency spectrum — all of which have their own uses as well as limitations.

Low band spectrum

- It has shown great promise in terms of coverage and speed of internet and data exchange however the maximum speed is limited to 100 Mbps (Megabits per second).

Mid-band spectrum

- It offers higher speeds compared to the low band, but has limitations in terms of coverage area and penetration of signals.

High-band spectrum

- It has the highest speed of all the three bands, but has extremely limited coverage and signal penetration strength.

Utility of 5G Applications

- Combined with IoT, cloud, big data, AI, and edge computing, 5G could be a critical enabler of the fourth industrial revolution.

Hurdles in Rolling Out 5G Technology

Enabling critical infrastructures

- 5G will require a fundamental change to the core architecture of the communication system. The major flaw of data transfer using 5G is that it can't carry data over longer distances. Hence, even 5G technology needs to be augmented to enable infrastructure.

Financial liability on consumers

- For transition from 4G to 5G technology, one has to upgrade to the latest cellular technology, thereby creating financial liability on consumers.

Capital Inadequacy

- Lack of flow of cash and adequate capital with the suitable telecom companies (like Bharti Airtel and Vodafone Idea) is delaying the 5G spectrum allocation.

For India

- 5G networks could improve the accessibility of services such as mobile banking and healthcare, and enable exponential growth in opportunities for unemployed or underemployed people to engage in fulfilling and productive work. For this Government has rolled out enabling policies.

5G Enabling Policy

- India's National Digital Communications Policy 2018 highlights the importance of 5G when it states that the convergence of a cluster of revolutionary technologies including 5G, the cloud, Internet of Things (IoT) and data analytics, along with a growing start-up community, promise to accelerate and deepen its digital engagement, opening up a new horizon of opportunities.
- It aims to reach 100% teledensity, high-speed internet highways and delivery of citizen-centric services electronically.

Tele-density

- Tele-density, which denotes the number of telephones per 100 populations is an important indicator of telecom penetration.
- Overall tele-density in the country was 88.81 per cent at the end of November 2019.
- The rural tele-density was 56.71 per cent while that in urban areas it was 156.82 per cent.

Global Progress on 5G

- Global telecom companies have already started building 5G networks and rolling it out to their customers in many countries:

- 5G had been deployed in 50 cities in the United States.
- South Korea has rolled out 5G to 85 cities.
- Japan and China have too started 5G mobile service on a trial basis.

6G Technology

- Recently, the government has asked the Centre for Development of Telematics (C-DOT) to begin developing 6G and other futuristic technologies to catch up with the global market in time.
- The next generation telecom technology (6G) is said to be 50 times faster than 5G and is expected to be commercially launched between 2028-2030.
- 6G (sixth-generation wireless) is the successor to 5G cellular technology.
- It will be able to use higher frequencies than 5G networks and provide substantially higher capacity and much lower latency (delay).
- One of the goals of 6G internet will be to support one microsecond-latency communication (delay of one-microsecond in communication).
- This is 1,000 times faster - or 1/1000th the latency - than one millisecond throughput.
- It seeks to utilize the terahertz band of frequency which is currently unutilized.
- Terahertz waves fall between infrared waves and microwaves on the electromagnetic spectrum.

- These waves are extremely tiny and fragile, but there's a huge amount of free spectrum up there that would allow for spectacular data rates.

Significance

More facilitation

- The 6G technology market is expected to facilitate large improvements in imaging, presence technology and location awareness.
- 6G's higher frequencies will enable much faster sampling rates, in addition to providing significantly better throughput and higher data rates.

Advancement in Wireless sensing technology

- The combination of sub-mm waves (e.g., wavelengths smaller than one millimeter) and frequency selectivity to determine relative electromagnetic absorption rates could potentially lead to significant advances in wireless sensing technology.

Emergence of Digital Capabilities

- It will see the emergence of simple, easy-to-wear-and-carry devices with a huge set of digital capabilities.

- This will help the paramedics, educators and agro-technicians to jumpstart the village ecosystems with little or limited need for on-site presence of doctors, professors and agro-experts.

Optimising mass public transportation

- For India, such an enabling set of technologies will bring manifold utilisation of scarce rail, air and road networks and make mass transportation far more efficient;
- Artificial Intelligence (AI) and massively parallel computing architectures will help solve transportation and scheduling operations research problems.

Challenges

Maintaining Protection Mechanisms

- The key technical challenges are energy efficiency, avoiding signal attenuation due to obstructions and water droplets in the air, and, of course, maintaining end-to-end trust through robust cyber security and data protection mechanisms.

Adoption of New Models

- Need innovations in antenna design, miniaturisation, edge cloud and distributed AI models. In addition, we need to ensure end-to-end security and privacy by design, instead of as an afterthought.

Availability of Semiconductor

- We don't have semi conducting materials that can use multi-THz frequencies.
- Getting any kind of range out of those frequencies may require enormous arrays of extremely tiny antennas.

Complex Design for Carrier Wave

- Water vapor in the atmosphere blocks and reflects THz waves, so mathematicians will have to design models that allow data to take very complex routes to its destination.