

Practical No. 3 :- Comparative analysis of 1.4.2.4.3.4.44 and 54

- ❖ Comparative analysis Of 1G, 2G, 3G, 4G and 5G, isite your an Icka and excepetcation from 5G. Comparative Analysis Of IG to 5G :- Generation 1 year | Data Rate Technology I features l 1G| 1980g| 24 /bps | Anolog | voice - only [2G | 19905|144 Kbps | GSM, (DMA / SMS, MMS) [3G,| /2005| 2Mbps UNITS, COMA 2000/ Mobile interent video HD/ [SGI] 20205 | 20Gbps | NR (Nec Radio) / Ultra- loco latency meassive IOT

Ans :- Key Differences :-

- 1) Data rate - each generation increase data rate signification.
- 2) Technology – Shit from analog to digital then to packet switched networks.
- 3) Features – From voice only to multimedia IOT and mission critical communications.

Expectations for 6G (Sixth Generation) :-

1. Ultra-High Speeds: Data rates could reach 1 Tbps (terabit per second), enabling near-instantaneous downloads and uploads.
2. Ultra-Low Latency: Latency could drop to as low as less than 1 millisecond, supporting real-time applications with no perceptible delay.
3. Advanced AI Integration: 6G will incorporate artificial intelligence to optimize network management, data traffic routing, and resource allocation autonomously.
4. Holographic Communication: Expect holographic calls and immersive virtual environments, making remote interactions feel like face-to-face meetings.
5. Terahertz Band Spectrum: The use of terahertz frequencies (above 100 GHz) for faster data transmission, enabling faster-than-light speeds in specific conditions.

6. **Massive IoT and Connectivity:** 6G will support an even higher density of IoT devices, allowing smarter cities, environments, and autonomous systems like drones and robots to communicate seamlessly.
7. **Global Coverage:** 6G aims to provide global connectivity, even in the most remote areas, using satellites and advanced infrastructure.

Comparative Analysis of 1G, 2G, 3G, 4G, and 5G Technologies

The development of mobile telecommunications technology has evolved through multiple generations, each offering significant improvements in speed, functionality, and capacity. Below is a detailed comparative analysis of the mobile generations (1G to 5G), covering key aspects such as data rates, technology, and features:

1G (First Generation)

- Year Introduced: 1980s
- Data Rate: 24 kbps (kilobits per second)
- Technology: Analog
- Primary Features:
 - Voice-only service: 1G primarily supported voice communication with very basic mobile capabilities.
 - Analog signal: Utilized analog signals for communication, which were prone to interference.
 - No data transmission: There was no provision for text, images, or internet data transmission.
 - Limited coverage and reliability: Calls often dropped, and the signal was weak in many areas.

Key Points:

- Mainly voice communication.
- No mobile internet or data services.
- Analog technology with limited capacity

2G (Second Generation)

- Year Introduced: 1990s

- Data Rate: Up to 144 Kbps
- Technology: GSM (Global System for Mobile Communications), CDMA (Code Division Multiple Access)
- Primary Features:
 - Digital signal: Shift from analog to digital transmission, which improved voice quality and call security.
 - SMS and MMS: Introduction of Short Message Service (SMS) for text messaging and Multimedia Messaging Service (MMS) for sending images, audio, and video clips.
 - Basic mobile internet: Provided basic mobile data services like WAP (Wireless Application Protocol) but with very slow speeds.
 - Improved coverage: The digital signal provided better coverage and more reliable connections.

Key Points:

- Voice communication with text (SMS) and multimedia (MMS).
- Introduction of digital technology.
- Basic mobile internet capabilities (though very slow).

3G (Third Generation)

- Year Introduced: Early 2000s
- Data Rate: Up to 2 Mbps (Mobile), with enhanced versions offering up to 14 Mbps
- Technology: UMTS (Universal Mobile Telecommunications System), CDMA2000
- Primary Features:
 - Mobile internet: 3G introduced the real mobile internet, enabling browsing, email, and video streaming on mobile devices.
 - Video calling: Introduction of video calling, which became a significant feature of 3G networks.
 - Higher data speeds: Allowed speeds high enough for low-quality video streaming and better voice clarity.

- Mobile HD video: Supported standard-definition video streaming (like YouTube) and faster, more reliable internet for web services.
- Enhanced voice: Enabled improved voice quality through VoIP (Voice over IP) services.

Key Points:

- Mobile internet with moderate speeds (up to 2 Mbps).
- Video calling and HD video streaming capabilities.
- Introduction of mobile broadband for enhanced user experience.

4G (Fourth Generation)

- Year Introduced: 2009-2010
- Data Rate: Up to 1 Gbps (download) and 100 Mbps (upload)
- Technology: LTE (Long-Term Evolution), WiMAX
- Primary Features:
 - High-speed mobile broadband: 4G brought substantial improvements in speed, enabling seamless streaming, video conferencing, and gaming on mobile devices.
 - HD video streaming: Mobile devices could now stream HD videos smoothly, supporting platforms like Netflix and YouTube.
 - IP-based communications: Transition to all-IP networks enabled efficient data communication and applications.
 - VoLTE (Voice over LTE): Introduction of VoLTE for higher-quality voice calls over 4G.
 - Enhanced multimedia services: With better data rates, 4G made real-time HD video conferencing, AR (Augmented Reality), and online gaming possible.

Key Points:

- Fast mobile internet with download speeds of up to 1 Gbps.
- High-definition video streaming and IP-based services.
- Seamless browsing, gaming, and real-time communication.

5G (Fifth Generation)

- Year Introduced: 2020 (Commercial rollout)
- Data Rate: Up to 20 Gbps (download), with upload speeds of 10 Gbps (potential for even higher)
- Technology: NR (New Radio), Massive MIMO, mmWave, Sub-6 GHz
- Primary Features:
 - Ultra-low latency: 5G provides latency as low as 1 millisecond, making it ideal for applications that require instant communication, such as remote surgery, autonomous vehicles, and industrial IoT.
 - Massive IoT: Supports massive connectivity with millions of devices per square kilometer, enabling the growth of the Internet of Things (IoT).
 - Enhanced mobile broadband: Speeds up to 20 Gbps allow for 4K/8K video streaming, virtual reality (VR), and augmented reality (AR) applications with ultra-high-definition experiences.
 - Network slicing: Allows operators to create custom networks for different use cases (e.g., a high-speed network for gaming, a low-latency network for healthcare).
 - High capacity and efficiency: 5G networks are more efficient, able to handle far more devices simultaneously with less congestion, supporting dense urban environments.
 - Autonomous and connected devices: 5G will enable better autonomous vehicle communication, smart cities, and advanced robotics.

Key Points:

- Extremely high data rates (up to 20 Gbps).
- Ultra-low latency (1 ms) for real-time applications.
- Massive IoT connectivity with millions of devices.
- High efficiency and capacity for smart cities and autonomous systems.