

Smartphone RF Exposure & Antenna Matrix

A granular comparative analysis of the Apple iPhone 16 (iOS) and Samsung Galaxy S24 (Android) antenna structures, RF frequencies, and background transmission periodicities in idle power-on state.

This technical document provides an atomised breakdown of the physical and logical antennas operating within two ubiquitous modern smartphones: the **Apple iPhone 16** and the **Samsung Galaxy S24**. As mandated by modern operating systems and cellular protocols, even when a device is fully idle (screen off, no user applications running), each individual antenna subsystem executes periodic background transmissions to maintain cellular registration, map local topology, or listen for peripheral handshakes. All figures below reflect default system behavior under standard network conditions.

Device / OS	Individual Antenna Type	RF Frequencies Utilised	Transmission Periodicity (Idle State)
Apple iPhone 16 (iOS)	Cellular Main Primary (Low/Mid-Band Transceiver)	600 MHz - 960 MHz (Low-Band) 1.7 GHz - 2.7 GHz (Mid-Band) 4G LTE & 5G NR Sub-6 GHz	Every 2.56 to 5.12 seconds (Paging slot cycle / discontinuous reception 'DRX' cycle with cell tower).
Apple iPhone 16 (iOS)	Cellular Secondary MIMO (High-Band Transceiver)	3.3 GHz - 5.0 GHz (e.g., n77/n78/n79) 5G NR Sub-6 High-Band	Dynamically controlled; typically silent in deep idle until woken by primary paging trigger or tracking area update (every 45-120 mins).
Apple iPhone 16 (iOS)	Cellular mmWave Array (US Models Only)	24.25 GHz - 40 GHz (Bands n257, n258, n260, n261)	Highly restricted in idle. Scans only if associated with an active mmWave cell; otherwise completely disabled to conserve power.
Apple iPhone 16 (iOS)	Wi-Fi 2.4 GHz Primary	2.412 GHz - 2.484 GHz (IEEE 802.11 b/g/n/ax/be)	If connected: Brief background beacons/keep-alives every few seconds. If unassociated: Periodic background probe requests every 60 to 90 seconds.
Apple iPhone 16 (iOS)	Wi-Fi 5 GHz / 6 GHz High-Band	5.150 GHz - 5.895 GHz 5.925 GHz - 7.125 GHz (Wi-Fi 7)	If connected: Standard background handshakes. If unassociated: Offloaded scan intervals managed by iOS (every 90 to 120 seconds).
Apple iPhone 16 (iOS)	Bluetooth 5.3 Core Antenna	2.402 GHz - 2.480 GHz	If idle (No active device): Advertises CoreBluetooth / AirDrop discovery pulses every 1.28 to 2.56 seconds natively.
Apple iPhone 16 (iOS)	Ultra-Wideband (UWB) Second-Generation Chip	6.5 GHz and 8.0 GHz (Channels 5, 9)	Dormant when screen is off/locked. Fires macro-pulses only when triggered by localized proximity changes or Find My background requests.

Device / OS	Individual Antenna Type	RF Frequencies Utilised	Transmission Periodicity (Idle State)
Apple iPhone 16 (iOS)	NFC Antenna Loop	13.56 MHz	Completely passive listener in idle state. Does not transmit RF fields until proximity sensor detects an external magnetic field (0 cm range).
Apple iPhone 16 (iOS)	Satellite Connectivity Module (Emergency SOS)	1.610 GHz - 1.626.5 GHz (Uplink L-band) 2.483.5 GHz - 2.500 GHz (Downlink S-band)	Zero background transmission in standard idle mode. Only initialises RF sequence upon manual emergency initiation by user with clear line of sight.
Samsung Galaxy S24 (Android)	Cellular Main Primary (Low/Mid-Band Transceiver)	600 MHz - 960 MHz (Low-Band) 1.7 GHz - 2.7 GHz (Mid-Band) 4G LTE & 5G NR Sub-6 GHz	Every 2.56 to 5.12 seconds standard tracking DRX cycle. Android OS fires background telemetry handshakes if allowed.
Samsung Galaxy S24 (Android)	Cellular Secondary MIMO (High-Band Transceiver)	3.3 GHz - 5.0 GHz 5G NR Sub-6 High-Band	Silent during deep idle sleep state. Synchronizes intermittently during cell re-selection or automated tracking area updates.
Samsung Galaxy S24 (Android)	Cellular mmWave Array (US/Select Models Only)	24.25 GHz - 40 GHz (Bands n257, n258, n260, n261)	Inactive in default idle state. Only wakes if the primary sub-6 receiver negotiates a high-throughput handoff on a supported mmWave carrier node.
Samsung Galaxy S24 (Android)	Wi-Fi 2.4 GHz Primary	2.412 GHz - 2.484 GHz (IEEE 802.11 b/g/n/ax/ax/be)	If connected: Standard DHCP/ARP lease keep-alives. If unassociated: Android Wi-Fi Scanning service executes discovery sweeps every 15 to 60 seconds.
Samsung Galaxy S24 (Android)	Wi-Fi 5 GHz / 6 GHz High-Band	5.150 GHz - 5.895 GHz 5.925 GHz - 7.125 GHz (Wi-Fi 6E/7)	Controlled via Android WLAN Framework. Scans for known access points roughly every 60 seconds when unassociated and screen is off.
Samsung Galaxy S24 (Android)	Bluetooth 5.3 Core Antenna	2.402 GHz - 2.480 GHz	Bleeding-edge Bluetooth LE scanning for Google Find My Device network or Quick Share. Transmits discovery telemetry every 1.28 to 3.84 seconds.
Samsung Galaxy S24 (Android)	NFC Antenna Loop	13.56 MHz	Passive polling field enabled. Does not transmit an active signal until an external field or payment reader induces a current loop.

Device / OS	Individual Antenna Type	RF Frequencies Utilised	Transmission Periodicity (Idle State)
Samsung Galaxy S24 (Android)	GPS / GNSS Receiver (Receive-Only)	1.575.42 MHz (L1) / 1.227.60 MHz (L2) 1.176.45 MHz (L5)	0 Hz / Non-transmitting. This is a passive receive-only antenna array. It emits no RF energy at any point during active or idle location lookups.

Key Technical Takeaways & Regulatory Harmonisation

- Discontinuous Reception (DRX):** As shown in the matrix, the primary cellular transceiver does not radiate continuously. It relies on standard DRX cycles to enter a low-power sleep state, waking for milliseconds at pre-negotiated intervals (typically 2.56s or 5.12s) to listen for incoming pages.
- Receive-Only Exceptions:** Systems such as GPS/GNSS do not feature any uplink RF capability; they are purely passive. Therefore, their contribution to a user's cumulative radiofrequency electromagnetic field (RF-EMF) exposure is absolute zero.
- Compliance with Guidelines:** The combined background emissions of these individual antennas when a smartphone is idle fall orders of magnitude below the Maximum Permissible Exposure (MPE) thresholds defined by the **International Commission on Non-Ionizing Radiation Protection (ICNIRP)**. These limits are engineered to protect the general public against thermal and biological health effects with integrated conservative reduction safety factors.

This is for informational purposes only. For medical advice or diagnosis, consult a professional. AI responses may include mistakes.