Computer Network Assignment 2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Characteristic** | **Radio Waves** | **Microwaves** | **Infrared (IR)** | **Millimeter Waves** | **Ultraviolet (UV)** | **Satellite Communication** | **Terahertz Waves** |
| **Frequency Range** | 3 Hz to 1 GHz (Low to High Frequency) | 1 GHz to 300 GHz | 300 GHz to 430 THz | 30 GHz to 300 GHz | 30 THz to 30 PHz | 1 GHz to 40 GHz | 0.1 THz to 10 THz |
| **Transmission Distance** | **Up to 100 km** (depending on power and environment) | **Up to 300 km** (line-of-sight) | **Up to 100 meters** (short-range, line-of-sight) | **Up to 100 meters** (short-range, line-of-sight) | **Up to 10 meters** (line-of-sight, in laboratory use) | **Up to 40,000 km** (global coverage, via satellite) | **Up to 1 meter** (high-frequency, short-range) |
| **Bandwidth** | Low to medium | Medium to high | Low | Very high (wideband channels) | Very high (used for specialized applications) | Very high (for satellite links and broadcast) | Extremely high (next-gen data transmission) |
| **Data Rate** | Low to medium (e.g., AM, FM radio, TV broadcasts) | Medium to high (e.g., Wi-Fi, point-to-point links) | Low | Very high (used for 5G, Wi-Fi, and millimeter-wave communications) | Moderate to high (limited applications) | High (e.g., satellite TV, internet, global comms) | Extremely high (next-gen data transmission) |
| **Propagation** | Omnidirectional (can diffract and reflect) | Line-of-sight (can be blocked by obstacles) | Line-of-sight (requires clear path) | Line-of-sight (vulnerable to physical obstructions) | Line-of-sight (limited by atmosphere and environment) | Line-of-sight (requires clear path to satellite) | Line-of-sight (short range, highly directional) |
| **Susceptibility to Interference** | Moderate to high (affected by weather, interference) | Moderate to high (rain fade, obstacles) | Low (short-range, but sensitive to obstructions) | High (susceptible to rain and obstacles) | High (can be absorbed by atmosphere, limited by weather) | Moderate to high (affected by weather, rain fade) | High (affected by weather, limited in some materials) |
| **Power Consumption** | Low to medium (depends on transmission range) | Moderate to high | Low (typically used for short distances) | High (requires powerful transmitters) | High (specialized, typically low-range) | High (requires powerful ground stations and satellites) | High (requires specialized equipment) |
| **Cost** | Low (widely available, infrastructure is cheaper) | Moderate (microwave equipment is expensive) | Low (relatively inexpensive for short-range) | High (expensive equipment for high-frequency transmission) | High (specialized and expensive equipment) | High (requires launch and satellite maintenance) | Very high (requires specialized, expensive equipment) |
| **Maintenance** | Low (maintenance for infrastructure is minimal) | Moderate (requires regular checks, especially for line-of-sight) | Low (simple maintenance for short-range systems) | High (requires ongoing maintenance for line-of-sight and hardware) | High (expensive upkeep, atmosphere impact) | High (complex maintenance, satellite repair, weather impacts) | Very high (specialized maintenance, costly equipment upkeep) |
| **Uses** | Radio, TV broadcasts, mobile phones, GPS | Satellite communications, Wi-Fi, microwave links | Remote controls, wireless peripherals, short-range communications | 5G, Wi-Fi 6E, automotive radar, next-gen communication | Specialized communication systems, UV sensing, microscopy | Satellite TV, internet, global communications, GPS | High-speed data transmission, imaging, medical applications |
| **Advantages** | Wide coverage, can penetrate walls, low cost | High capacity, long range (if line-of-sight) | Low power, simple equipment, no complex infrastructure | Extremely high data rates, advanced communication systems | Ideal for special scientific and medical applications | Global coverage, ideal for remote areas | Very high-speed data transfer, highly secure communications |
| **Disadvantages** | Limited data rates, weather interference | Requires line-of-sight, susceptible to interference from obstacles | Short-range, sensitive to physical obstructions | High power requirements, limited range | Expensive, limited range, atmospheric interference | Expensive, requires complex infrastructure, weather susceptible | Short range, limited commercial use, expensive equipment |