3:11
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While ideal for sporadic data transmission from nanosensor nodes in remote areas, its low bandwidth makes it unsuitable for high-frequency or image-based sensing.[73] Emerging Terahertz (THz) communications represent a critical leap forward, especially in nano-networks where data rates and node density are exceptionally high.[74] Nevertheless, THz systems currently face formidable barriers in terms of signal propagation loss, antenna miniaturization, and channel modeling.[75] Additionally, the required nanophotonic and plasmonic components are still in the experimental stage, limiting practical implementations.[76] Nano-communication frameworks, particularly molecular and plasmonic communication models, are gaining traction for in-body applications such as drug delivery and neural interfacing.[77] These systems are biocompatible and energy efficient but are far from maturity.[78] The lack of standardized architectures, synchronization issues, and high latency in molecular propagation make them suitable only for niche applications at present.[79] The overarching limitation remains the absence of a unified protocol stack or interoperability model that bridges nanoscale networks with conventional ICT layers. Without this, the vision of seamless nano-macro integration will remain theoretical.[80,81] Building on the discussion of nanosensor classifications and their communication frameworks bridging the nano-to-macro interface, it becomes evident that the true potential of these technologies is realized

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