

Chapter 4

AI-Driven Network Optimization for Sustainable Communication

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ABSTRACT

The Need for Energy-Efficient Networks The increasing reliance on digital infrastructure has resulted in an urgent need for energy-efficient communication networks. Several factors contribute to this growing necessity. Rising Energy Consumption of ICT Infrastructure. The ICT sector is responsible for an estimated 2-4% of global energy consumption, with projections indicating further growth as digitalization expands. Data centers, mobile networks, and broadband access networks require substantial power to operate efficiently, making it crucial to develop energy-conscious solutions. Environmental Impact and Carbon Footprint The carbon footprint of

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ICT systems is a growing concern, as increased energy consumption translates to higher CO₂ emissions. Energy-intensive processes such as data storage, processing, and transmission contribute significantly to climate change. Implementing energy-efficient networking technologies can help mitigate these effects.

INTRODUCTION TO SUSTAINABLE COMMUNICATION: THE NEED FOR ENERGY-EFFICIENT NETWORKS

The Need for Energy-Efficient Networks The increasing reliance on digital infrastructure has resulted in an urgent need for energy-efficient communication networks. Several factors contribute to this growing necessity. Rising Energy Consumption of ICT Infrastructure. The ICT sector is responsible for an estimated 2-4% of global energy consumption, with projections indicating further growth as digitalization expands. Data centers, mobile networks, and broadband access networks require substantial power to operate efficiently, making it crucial to develop energy-conscious solutions. Environmental Impact and Carbon Footprint The carbon footprint of ICT systems is a growing concern, as increased energy consumption translates to higher CO₂ emissions. Energy-intensive processes such as data storage, processing, and transmission contribute significantly to climate change. Implementing energy-efficient networking technologies can help mitigate these effects. Sustainability and Corporate Social Responsibility (CSR) Companies are increasingly focusing on sustainability and CSR initiatives to align with environmental regulations and consumer expectations. Green networking strategies can enhance corporate reputation and demonstrate a commitment to sustainable practices. Power-Efficient Wireless Communication Advanced sleep mode mechanisms in base stations reduce energy consumption during low traffic periods. Hybrid energy models ensure stable and efficient power distribution. Automated energy management systems help in real-time optimization, reducing unnecessary power consumption. The transition toward sustainable communication and energy-efficient networks is no longer optional but a necessity for addressing environmental, economic, and operational challenges. As global digitalization accelerates, the demand for robust, high-performance networks will continue to rise, emphasizing the need for green networking solutions. By adopting energy-efficient architectures, implementing AI-driven optimizations, and leveraging renewable energy sources, the ICT industry can significantly reduce its carbon footprint while maintaining optimal connectivity. Future research and technological advancements will further enhance the sustainability of communication networks, paving the way for a greener, more energy-conscious digital ecosystem. Governments, industries, and research institutions must collaborate to develop policies

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