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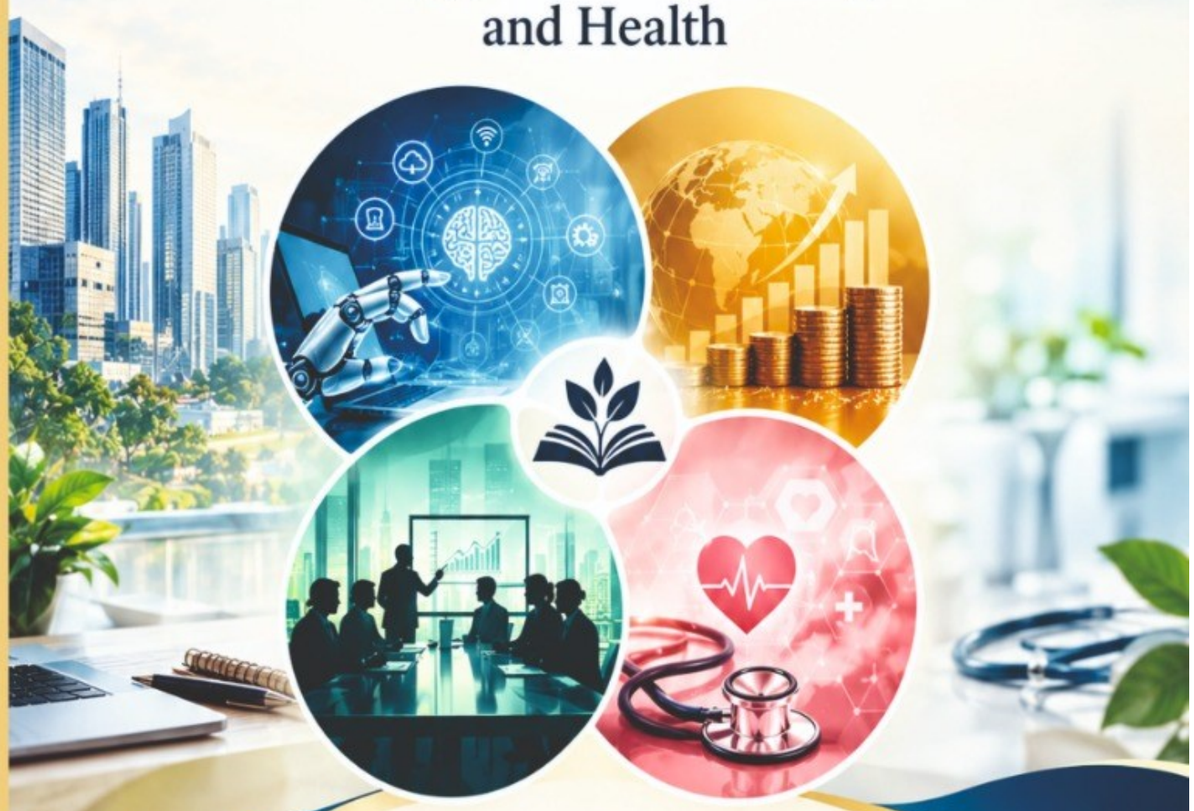
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Advances in Multidisciplinary Research: Technology, Economy, Management and Health

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Dr. Saima Beg
Dr. Mohd Suhaib Kidwai
Dr. Shailendra Kumar

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Agentic AI-Based Resource Allocation for 6G Wireless Networks

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Abstract

Sixth generation wireless systems are envisioned not only as faster radio networks, but also as programmable, sensing-aware, compute-rich infrastructures with artificial intelligence as an architectural capability. IMT-2030 framework identifies AI and communication as a usage scenario. Current 3GPP work is studying AI-native and agent-oriented functions for 6G [1], [2]. This chapter provides a systematic perspective on agentic artificial intelligence for resource allocation over radio, compute, storage, energy, sensing, and transport resources. Unlike a traditional predictor or a single reinforcement-learning policy, an agentic controller observes context, interprets objectives, decomposes tasks, invokes specialist models or optimization tools, coordinates with other agents, validates constraints, acts, and updates its memory.This chapter introduces a hierarchical closed-loop architecture across device, edge/RAN, domain, and end-to-end orchestration layers; formalizes multi-objective resource allocation; describes single- and multi-agent decision processes; and presents algorithmic patterns that combine model-predictive optimization, deep reinforcement learning, large language models, and constraint checking. Security, trust, explainability, interoperability, stability and energy cost are considered as first class design constraints. We offer a reproducible evaluation methodology and a research roadmap. The key insight is that agentic AI is most valuable as a constrained orchestration layer

combining learned policies with explicit network models, safety envelopes, and auditable control, rather than an unconstrained replacement for deterministic radio resource management.

Keywords: 6G, agentic AI, resource allocation, AI-native networks, multi-agent systems, reinforcement learning, RAN intelligent control, edge intelligence, network slicing, intent-based networking.

1. Introduction

Wireless networking is always about resource allocation: spectrum, transmission power, time-frequency blocks, antennas, backhaul capacity, and compute cycles must be allocated under uncertainty and competing service requirements. In 6G that problem becomes substantially broader. The network is expected to coordinate communications with computing, sensing, AI workloads, non-terrestrial connectivity and highly diverse service objectives. The ITU-R IMT-2030 framework is the formal international vision for systems for 2030 and beyond and explicitly includes AI and communication as its usage scenarios [1]. This direction is a strong motivation for resource-allocation mechanisms that can reason across domains and timescales rather than optimizing a single isolated radio metric.

Meanwhile, standards work is moving in the direction of AI-native networking. The 6G studies of 3GPP include support for network AI agents, third-party AI agents , AI model training and inference, and AI data and traffic management. The ongoing work also considers the communication among AI agents on user equipment and in the 6G network [2]. These developments do not mean that a fully autonomous agent will directly control every radio decision. They do, however, motivate architectures where agents can translate intent, select tools, coordinate specialist policies, and supervise closed-loop optimization.Agentic AI goes beyond the limited scope of conventional machine-learning components. For example, a traffic predictor may forecast future network load, while a scheduler