5G SA Autonomous Networks Architecture

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***Abstract*—The emergence of 5G Standalone (5G SA) networks marks a paradigm shift towards fully autonomous network operations, wherein networks achieve self-configuration, self-healing, self-optimization, and self-evolution without human intervention. Driven by the escalating complexity of telecommunications services and infrastructure, this paper explores a novel architectural framework designed to realize advanced self-management capabilities in 5G SA, moving beyond traditional, human-intensive approaches. We propose a service management model where service management is executed by translating high-level business intents into actionable network requirements. Intents are then propagated to an orchestration layer, responsible for managing the lifecycle of services within an autonomous network domain, including their deployment, assurance, and optimization, while resolving potential conflicts. These domains, in turn, interact with a resource management layer that configures resources in underlying heterogeneous physical and virtual infrastructure. This lowest layer provides a unified view of diverse resources (e.g., compute, network, radio) and intelligently allocates them based on requests from service upper layers. Crucially, pervasive AI capabilities are deeply embedded across all layers, providing the intelligence for intent translation, dynamic resource allocation, predictive maintenance, and autonomous operations, ensuring end-to-end service coherence and efficiency. This integrated approach aims to mitigate the challenges of 5G SA's scale and dynamism, paving the way for self-configuring, self-healing, and self-optimizing networks essential for future communication demands in education and research, in alignment with ETSI ZSM's zero-touch automation and TM Forum's Autonomous Networks and Open Digital Architecture (ODA) for service and resource management.**

***Index Terms*—5G SA networks, orchestration, automation, control & management, AI/ML**