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Higher School of Computer Science -8 Mai 1945- Sidi Bel Abbès
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END OF STUDY THESIS

To obtain a **state engineer's** diploma
Stream: **Computer Science**
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Adaptive Network Configuration using Intents in Dynamic Networks

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Presented by:
Mr Khelladi Mokhtar

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Dr. Serhane Oussama	Supervisor
Dr. AZZA Mohamed	President
Dr. Baba Ahmed Manel	Examiner

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Abstract

In modern healthcare environments, reliable and adaptive networking is critical to ensuring the continuity of patient care, telemedicine, and hospital operations. Traditional static network configurations are inadequate for handling the dynamic and diverse traffic requirements of medical applications. This thesis presents an intelligent, intent-based network configuration system that leverages Software-Defined Networking (SDN), Network Function Virtualization (NFV), and Generative AI to automate network slicing and service delivery in hospital infrastructures.

The proposed system allows users to express high-level network intents in natural language, which are interpreted using a large language model API and translated into precise configurations for SDN flow control and VNF deployment. Using ONOS as the SDN controller and Mininet for emulation, the system dynamically creates and isolates slices for critical use cases such as patient monitoring, video consultations, and administrative services. Each slice is provisioned with bandwidth policies tailored to its operational needs.

Additionally, Monitoring VNFs are deployed per slice to validate real-time performance and ensure compliance with user-defined intents. The system achieves automated intent assurance, demonstrating its capability to maintain quality of service (QoS) under dynamic conditions. Experimental evaluation shows that the architecture reliably enforces traffic isolation, prioritization, and feedback-based monitoring within an emulated hospital network.

Keywords: Intent-Based Networking, Software-Defined Networking, Network Slicing, NFV, ONOS, QoS, Generative AI .

Preamble

In today's increasingly connected and data-driven world, the demand for flexible, reliable, and intelligent network infrastructures is more critical than ever—especially in sensitive environments such as healthcare. Hospitals rely on robust networking to support life-critical systems, telemedicine services, and administrative operations. However, traditional static network configurations often fall short when it comes to handling dynamic traffic patterns, fluctuating service demands, and strict performance requirements.

This thesis explores a novel approach to network automation based on Intent-Based Networking (IBN). The proposed system enables healthcare administrators and technical operators to define high-level network requirements using natural language intents, which are automatically translated into precise configurations for Software-Defined Networking (SDN) and Network Function Virtualization (NFV). Through the integration of ONOS as the SDN controller, Mininet for emulated network topologies, and Dockerized Monitoring VNFs, the system provides adaptive network slicing, QoS enforcement, and real-time performance assurance.

The goal of this work is to simplify the complexity of network management while maintaining high standards of performance, and reliability. Instead of relying on manual configurations and static rules, the system dynamically responds to user-defined intents, ensuring that network behavior aligns with organizational goals. While developed and tested in a simulated environment, this framework lays the foundation for real-world deployment in hospital infrastructures and beyond.

By bridging the gap between user expectations and network configurations, this project contributes to the broader vision of self-configuring, AI-assisted networks that can adapt to evolving requirements. It is a step forward toward more resilient, efficient, and intelligent network architectures capable of supporting critical digital services in an ever-changing world..