



Project scope

Name:

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Community & UN SDG(s):

SaskTel network engineers and architects

UN SDG(s):

- SDG#7: Affordable and clean energy
- SDG#11: Sustainable cities and communities
- SDG#12: Responsible consumption and production
- SDG#13: Climate action

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Project Name	Eco-Resilient Networks: Smart Deployment for the Future
Project Deliverables	
MVP 1: Simulation Environment Setup	<p>Work Package 1.1: Development Environment Setup</p> <p>Description: Install and configure necessary software (Python, CloudSim, required libraries). Set up version control (GitHub). Create project directory structure.</p> <p>Work Package 1.2: Core Simulation Framework Implementation</p> <p>Description: Create the fundamental building blocks of simulation infrastructure of network topologies, SFCs, and placement of VNFs. It includes development of classes and functions representing nodes, links, VNFs and SFCs using Python including libraries like NetworkX. First framework will have preliminary support of a simple fat-tree topology. The output shall include a simple text-based logging of events which occurred during simulation.</p> <p>Work Package 1.3: Data Input/Output Modules</p> <p>Description: Provide modules for reading network topology and SFC definitions from input files (JSON format) and writing simulation results to output files (CSV format), which will ease the configuration and data analysis.</p> <p>Work Package 1.4: Visualization Module</p> <p>Description: Design a module for network topology visualization, VNF placement visualization, and the most important KPIs representation using Matplotlib or similar tools. Initial work will concentrate on static visualizations of the network state.</p>
MVP 2: Algorithm Implementation and Evaluation	<p>Work Package 2.1: Embedding Policy Implementation</p> <p>Description: This work package embeds the three embedding policies, availability-aware, carbon-aware, and tradeoff-aware, in the simulation framework. The functions will take the network topology and SFC definition as input and return the VNF placement.</p> <p>Work Package 2.2: Redundancy Optimization Algorithm Implementation</p> <p>Description: Particle Swarm Optimization (PSO) based approach for the optimization of VNF redundancy. This is going to be the very first target of MVP. The respective implementation will be</p>



modular to provide easy integration for other algorithms (Simulated Annealing, Genetic Algorithm) afterwards.

Work Package 2.3: Performance Metric Calculation

Description: This will involve the implementation of functions to compute availability, carbon footprint, and latency given some VNFs placement and a network topology, to be then used with both the simulation framework and embedding/redundancy algorithms.

Work Package 2.4: Algorithm Comparison and Evaluation

Description: Simulation design and its execution will serve to compare performance stemming from a range of embedding policies and from PSO for different scenarios-that differ based on SFC types, network load, and the weights of those factors.

**MVP 3: Documentation
and Reporting**

Work Package 3.1: Code Documentation

Description: Intense code documentation by using docstrings and comments, such that the code is maintainable and understandable. Keep attention to Python code style guidelines: PEP 8.

Work Package 3.2: User Guide

Description: User guide - how to configure and run the simulations, how to interpret the results, and how to extend the framework.

Work Package 3.3: Research Paper

Description: To prepare a draft of the research paper describing the methodology of the project, the results, and conclusions.

MVP 4: Delivery

Work Package 4.1: MVP Integration and Testing

Description: Integrate Work Packages 1.2, 1.3, 2.1 (Trade-off Aware Embedding), 2.2 (PSO) and 2.3 into single working MVP. Test the integrated system with a predefined, simple SFC and small fat-tree topology.

Work Package 4.2: MVP Demo

Description: Prepare a short demonstration of the MVP showing a complete run, including input file loading, optimization and results (numerical and visual).

Project Exclusions

- **Simulation-Only:** The work will be purely simulation-based; no integration with real-time network data is envisioned, nor real-time control.
- **Static Network Conditions:** The initial version will work with fixed network topologies and SFCs. Handling dynamic traffic changes or failures is left for future work.
- **Independent Failures:** The MVP assumes independent node and link failures. Correlated failures may be considered in the future.
- **Single SFC Type:** To keep it simple, the MVP will include only one predefined SFC, for instance, Firewall → Load Balancer → Web Server. More complex SFCs may be added in future versions.
- **No Cloud/Edge Deployment:** Simulation framework should run locally now. Cloud/edge deployment like Kubernetes is at the future path.



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- **No GUI for Now:** MVP will come with a command-line interface supported by basic visualization. Full Graphical Interface- GUI will come later.
 - **No Detailed Cost Modelling:** While carbon footprint is considered, the MVP won't be including factors like electricity pricing or hardware costs.
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