

G.E.N.E.O

Genetic Evolution for Network Efficiency
and Optimization



Opportunity

G.E.N.E.O is positioned as an Application Function (AF) solution based on a generic algorithms (GA) supervised by Language models aimed at the efficient operation of Edge Computing in 5G SA networks.

Managing user plane function (UPF) processing at the edge is a major challenge for operators adopting 5G architecture in their operations.

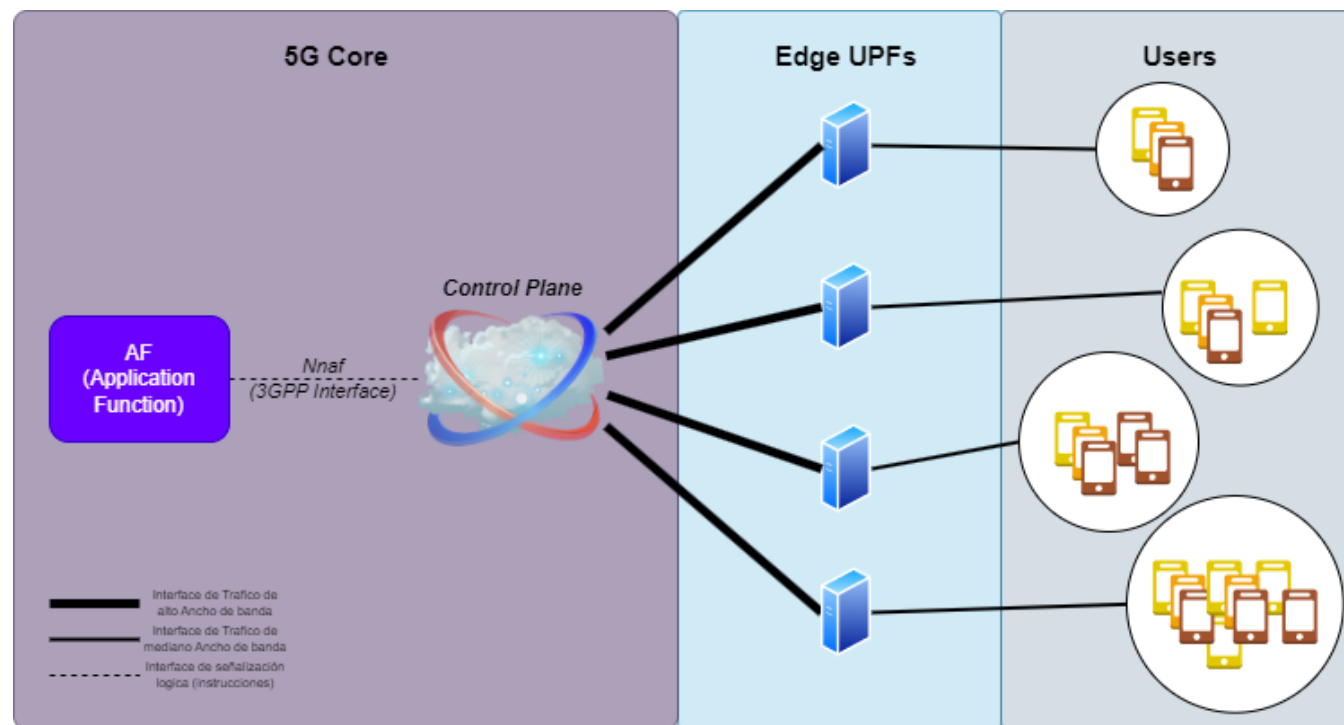
Operations such as planning, subsequent optimization and configuration generation require a high level of engineering expertise and knowledge of the most current standards.

How G.E.N.E.O works?

GENEO is designed as an ***application function (AF)*** based on GA interacting with LLM for operational management in the insertion of Edge UPFs and their resource optimization.

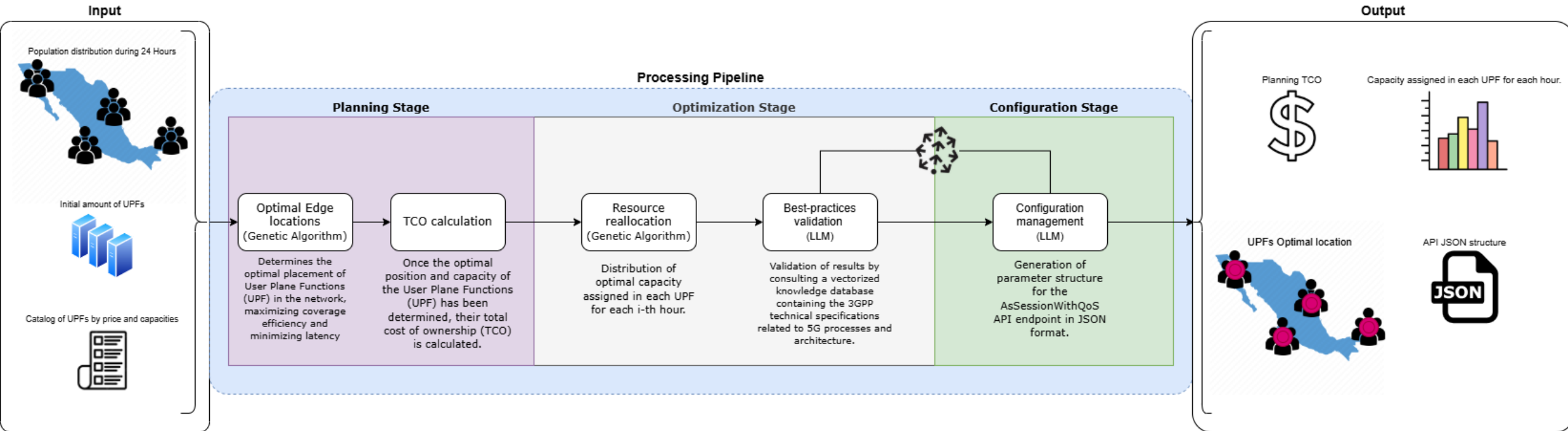
GENEO is made up of 3 processing modules, as shown below:

- The **Planning stage** optimizes the distances and resource allocation of the Edge according to the initial population distribution.
- In the **Optimization stage**, it performs the reallocation of network resources according to the capacities in the Edge UPFs considering the mobility of the users for each hour. It then validates the result with the 3GPP 5G technical specifications.
- Finally, the **Configuration** stage, create the configuration change POST command for Edge UPFs to be performed consuming API *AsSessionWithQoS* operation defined by 3GPP.



How G.E.N.E.O works?

Functional Diagram



Demo

The screenshot displays the G.E.N.E.O. web application interface. The browser window shows the URL 'localhost:8501'. The application has a dark theme with a sidebar menu on the left containing 'Network Planning' and 'Network Optimization'. The main content area features the G.E.N.E.O. logo and title, followed by a description of the application as an LLM + GA based function for network planning. It includes sections for 'Network Planning' and 'UPF Pricing Information'. The pricing section contains a table with capacity and cost data for three different UPF sizes. At the bottom, there is a form to define the number of UPFs to be deployed, currently set to 1, and a 'Run Network Planning' button.

G.E.N.E.O.

Genetic Evolution for Network Efficiency and Optimization

GENEO is designed as an application function (AF) based on LLM + GA for planning management in the insertion of Edge UPFs and their resource optimization.

Network Planning

The **network planning** phase determines the optimal placement of **User Plane Functions (UPFs)** in a 5G edge computing environment. The goal is to minimize latency and maximize service quality by optimizing UPF locations using genetic algorithms (GA).

- **Genetic Algorithm Optimization:** UPF positions are selected based on population demand and network constraints.
- **Adaptive Infrastructure Deployment:** The algorithm continuously evolves to improve network efficiency.

UPF Pricing Information

The network optimization considers the following pricing structure for UPFs based on their total bandwidth capacity:

Capacity (Small)	Cost (Small)	Capacity (Medium)	Cost (Medium)	Capacity (Large)	Cost (Large)
70 Gbps	\$19,000	140 Gbps	\$34,000	300 Gbps	\$48,000

The algorithm will determine the optimal UPF locations and calculate the Total Cost Optimization (TCO) based on the selected configurations.

Define the number of UPFs to be deployed in the network:

Quantity of UPFs:

Run Network Planning

Business decision

It is common to observe cases of mobile network degradation at different times of the day due to the high population density that can arise at certain hours of the day. Although **this affects the user's perception of the quality of service they receive from their operating company (OpCo)**, it can also be **solved with an automated approach to network operations**.

Regarding network operations, the most recent Gartner reports indicate the following:

“More than 65% of enterprise networking activities are performed manually. However, a small but growing percentage of large enterprises automate more than half of their network activities.”

The demand for AI-driven network decisions to **improve network quality perception from the user side** represents a high-impact opportunity for OpCo.

The must-have capabilities for this market include:

- **Core Network Automation** environments across multiple network vendors' equipment, including **API**, NETCONF or SSH. This also includes the ability to automate networking activities across multiple **networking domains** (e.g. Core and Edge centers).
- **Network change management**, including standard-gold templating, rollback, pre- or **postvalidation**, compliance reporting, a local configuration repository.

By investing in AI and Core Network automation, OpCo can future-proof their operations and unlock significant business value.

Market differentiators

GENEO as a solution for Operational management presents the following differentiating features:

Functionality

GENEO is a solution geared towards planning, resource optimization and network configuration, primarily on the UPFs located at the edge of the core.

Integration

GENEO is an open-source Application Function solution, capable of integrating directly into 5G Core Network Functions as well as external network managers.

Technologies

GENEO is powered by the use of Genetic Algorithms and Language Models (LLM), which is a unique approach to network change optimization and validation.

