




# CleanNet: Optimizing 5G Node Placement

Enhancing Connectivity While Minimizing Air Pollution Exposure

 **by Luna**

# Connectivity Challenges in Rural Areas

## Problem

Limited 5G connectivity in rural areas like Machakos County, Kenya, plus air quality challenges.

## Solution

An AI-driven tool to optimize 5G node placements for maximum coverage and minimal pollution exposure.

## Alignment

Supports the hackathon's goal of bridging the digital divide.



# CleanNet: How it works

- 1 Define any boundaries
- 2 Input population Data
- 3 Simulate air quality index (AQI) with baseline
- 4 Generate 100 potential node locations.
- 5 Score nodes based on coverage and AQI.
- 6 Optimize to 10 nodes using a greedy algorithm.

# Key Findings

1

10 optimized nodes to any region (e.g., MT-07: -1.5622, 37.3049, Score: 238,861.54; AR-12: -1.4812, 37.0271, Score: 159,225.17).

2

Total score (for example Machakos): 724,891.21.

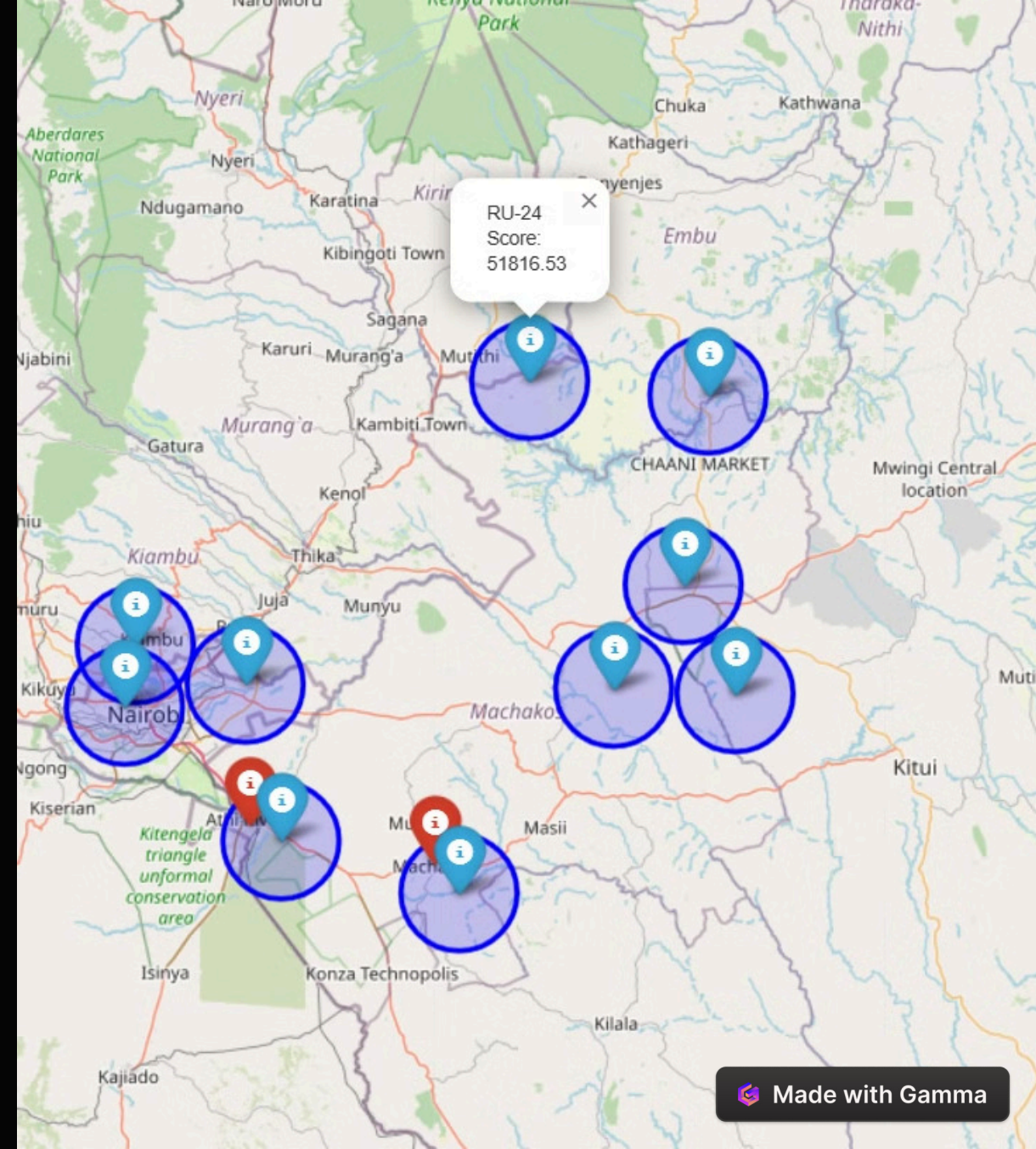
3

Coverage: Urban hubs and rural areas, no 10 km overlap, customizable for user inputs.  
Try it at <https://cleannetonquest.streamlit.app>



## RESULT:

Blue markers for 10 nodes with 10 km coverage circles,  
red markers for user defined urban centers (e.g.,  
Machakos Town, Athi River)



# Result: Interface of the app

## CleanNet Universal: 5G Node Optimization

Optimize 5G node placements for any region by entering the details below.

### Region Boundaries

Min Latitude

-1.5158

-

+

Max Latitude

-0.7500

-

+

Min Longitude

36.7500

-

+

Max Longitude

37.7497

-

+

### Population Centers

Number of Urban Centers

1

3

5

#### Urban Center 1

Name 1

City 1

Latitude 1

-1.52

-

+

Longitude 1

36.75

-

+

Population 1

100000

-

+

Fig 1. Required inputs

## Air Quality Index (AQI)

Baseline AQI Latitude

-1.52

Baseline AQI Longitude

36.75

Baseline AQI Value

65

Optimize Nodes

## Optimized Nodes

| Name | Latitude | Longitude | Coverage | AQI | Score |

|-----|-----|-----|-----|-----|

| Node-84 | -1.2701 | 36.9365 | 100000.0 | 56.43 | 99971.79 |

| Node-08 | -1.3766 | 36.9333 | 100000.0 | 58.60 | 99970.70 |

| Node-55 | -1.3406 | 36.8270 | 100000.0 | 59.68 | 99970.16 |

| Node-50 | -1.4963 | 36.8579 | 100000.0 | 61.95 | 99969.02 |

| Node-27 | -0.7963 | 37.6446 | 51836.3 | 33.09 | 51819.73 |

| Node-61 | -0.8975 | 37.6458 | 51836.3 | 34.75 | 51818.90 |

| Node-26 | -0.7733 | 37.5249 | 51836.3 | 35.17 | 51818.69 |

| Node-28 | -1.0579 | 37.6716 | 51836.3 | 36.40 | 51818.08 |

| Node-70 | -1.2373 | 37.7215 | 51836.3 | 36.92 | 51817.82 |

| Node-35 | -1.4587 | 37.7366 | 51836.3 | 37.54 | 51817.51 |

Fig 2 . Reveals the optimized nodes

# Why it matters

1

Improved connectivity for schools and healthcare in underserved areas.

2

Reduced air pollution exposure by optimizing node placement.

3

Scalable AI approach for other rural regions.



# Future Scope:

- **Global Scalability:** Expand CleanNet to optimize 5G networks across rural and urban regions worldwide, capitalizing on the projected \$13.1B 5G market by 2028.
- **Telecom SaaS Model:** Offer CleanNet as a subscription-based Software-as-a-Service (SaaS) to telecom giants
- **Real-Time AQI Integration:** Integrate real-time AQI data for dynamic node adjustments, enhancing service reliability and customer health.
- **Smart City Deployment:** Expand to smart city applications, increasing revenue through government contracts.

# Conclusion: Innovative AI optimization

CleanNet demonstrates AI's potential to transform network design.

Ready to enhance connectivity

