Evaluating Trade-offs for Green Routing in Communication Networks

Authors: Jan Kitanovski, Kaspar Zimmermann, Line M. P. Larsen and Sarah Ruepp

Presenter: Jan Kitanovski (s232649@dtu.dk), Kaspar Zimmermann (s232759@dtu.dk)

Presenters

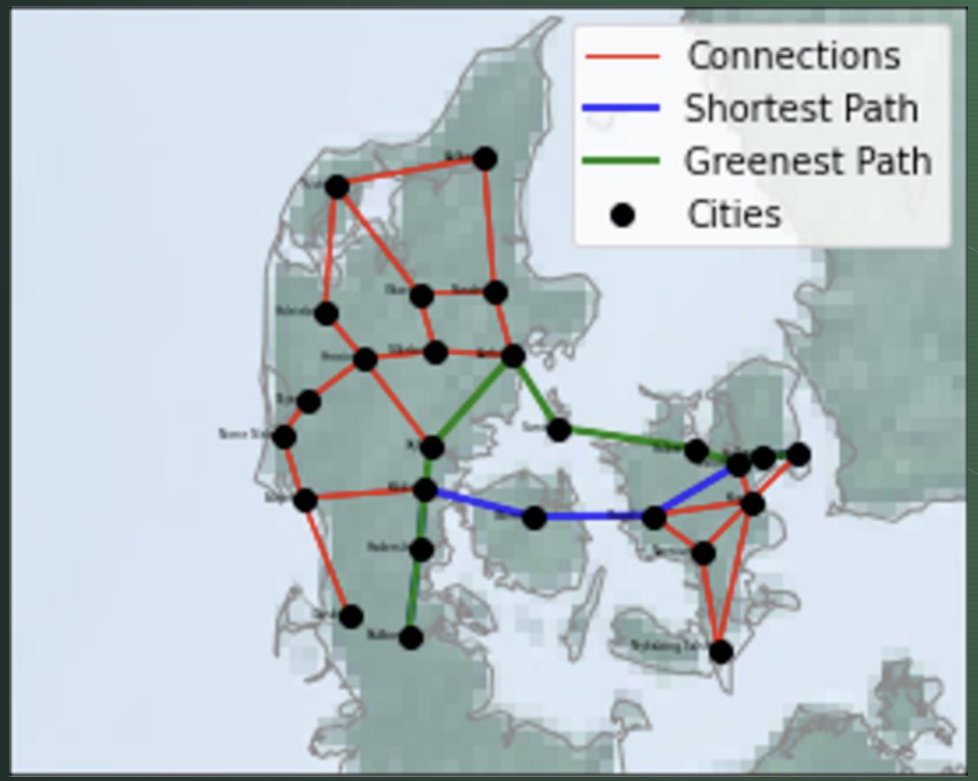
Kaspar Zimermann

- BEng University of York (2023)
- MSc Communication Technologies and System Design DTU (2023-2025)

Jan Kitanovski

- BEng University of Ljubljana (2023)
- MSc Communication Technologies and System Design DTU (2023-2025)

Problem



The main network nodes of Denmark, showing the use of Dijkstra's algorithm for path-finding the lowest latency route, as well as the greenest path.

- High-speed, high-capacity networks
- Unpredictable green energy availability
- Performance over sustainability
- Network overhead and latency

Models & Methodology

Evaluation Metrics:

- **Latency**: Time delay in data transmission.
- **Overhead Packets**: Extra network traffic caused by algorithms.
- **Carbon Cost**: Environmental impact in terms of emissions per data packet.

Algorithms

- **Dijkstra's Algorithm**: Finds shortest path using the smallest known distance incrementally
- **A***: Dijkstra's with saving previously discovered paths
- **Floyd-Warshall**: Computes shortest paths between all node pairs
- **DFS**: Random traversal with potential inefficiencies

Setup

Simulator

- Implemented using Python.

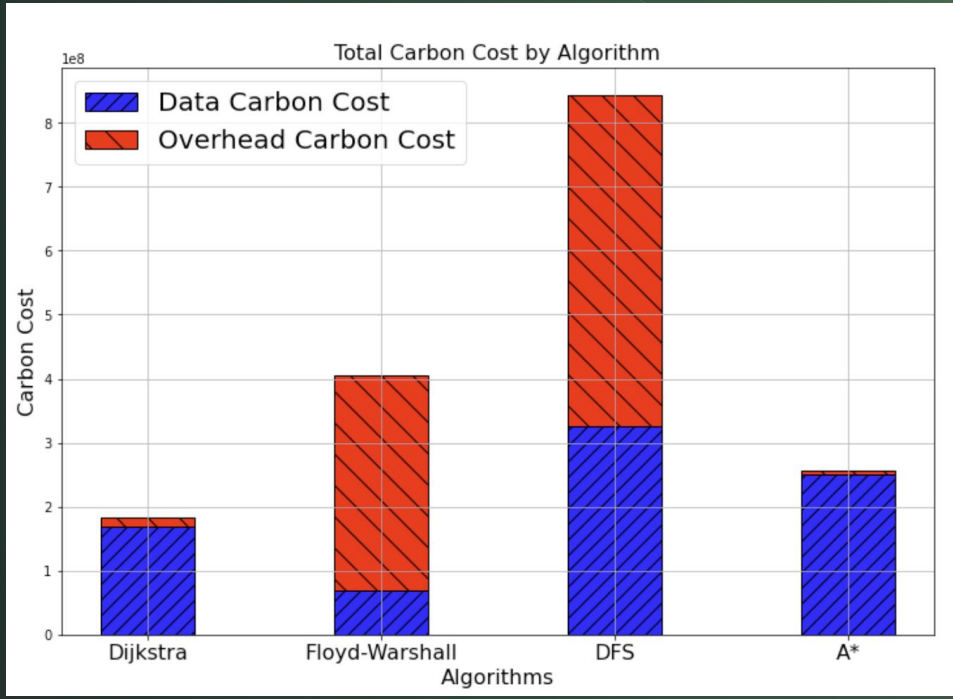
Data Sources & Configuration:

- Node locations based on Denmark's data center map.
- Energy data sourced from Danish Energy Agency.
- Carbon costs calculated based on proximity to renewable vs. non-renewable energy sources.

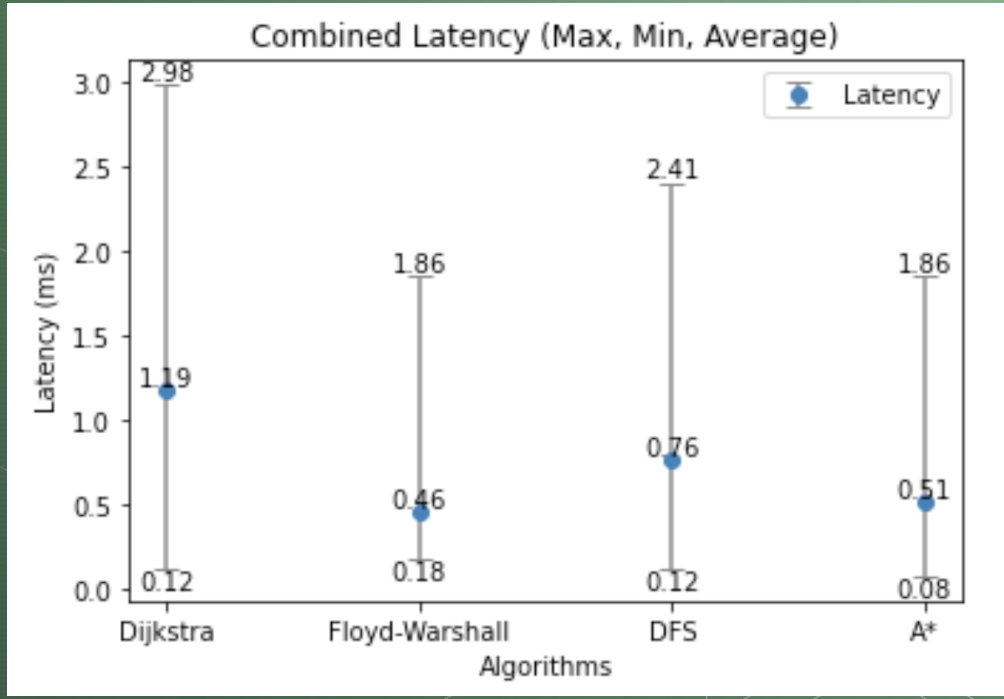
Network Configuration:

- 26 nodes with 1-5 connections each

Results

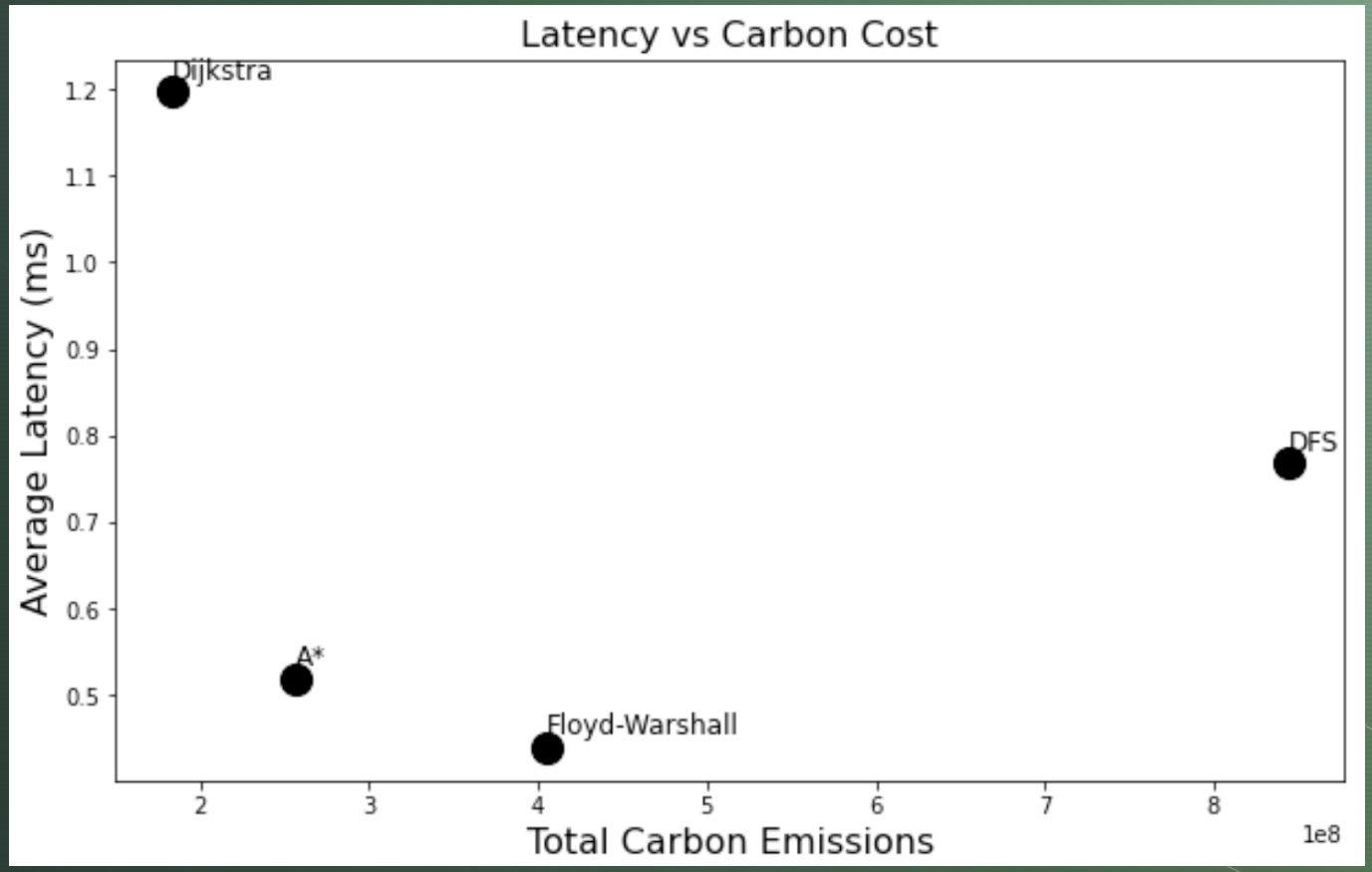


Carbon cost distribution showing each algorithms carbon cost from data and overhead packets



Latency results with average latencies and maximum and minimum latencies shown as limits

Results



Carbon cost and latency comparison for all algorithms with carbon cost on the x-axis and latencies on the y-axis

Future Work

- Simulating dynamic traffic based on real data
- Simulating dynamic energy availability
- Real time graphical representation of the simulated network