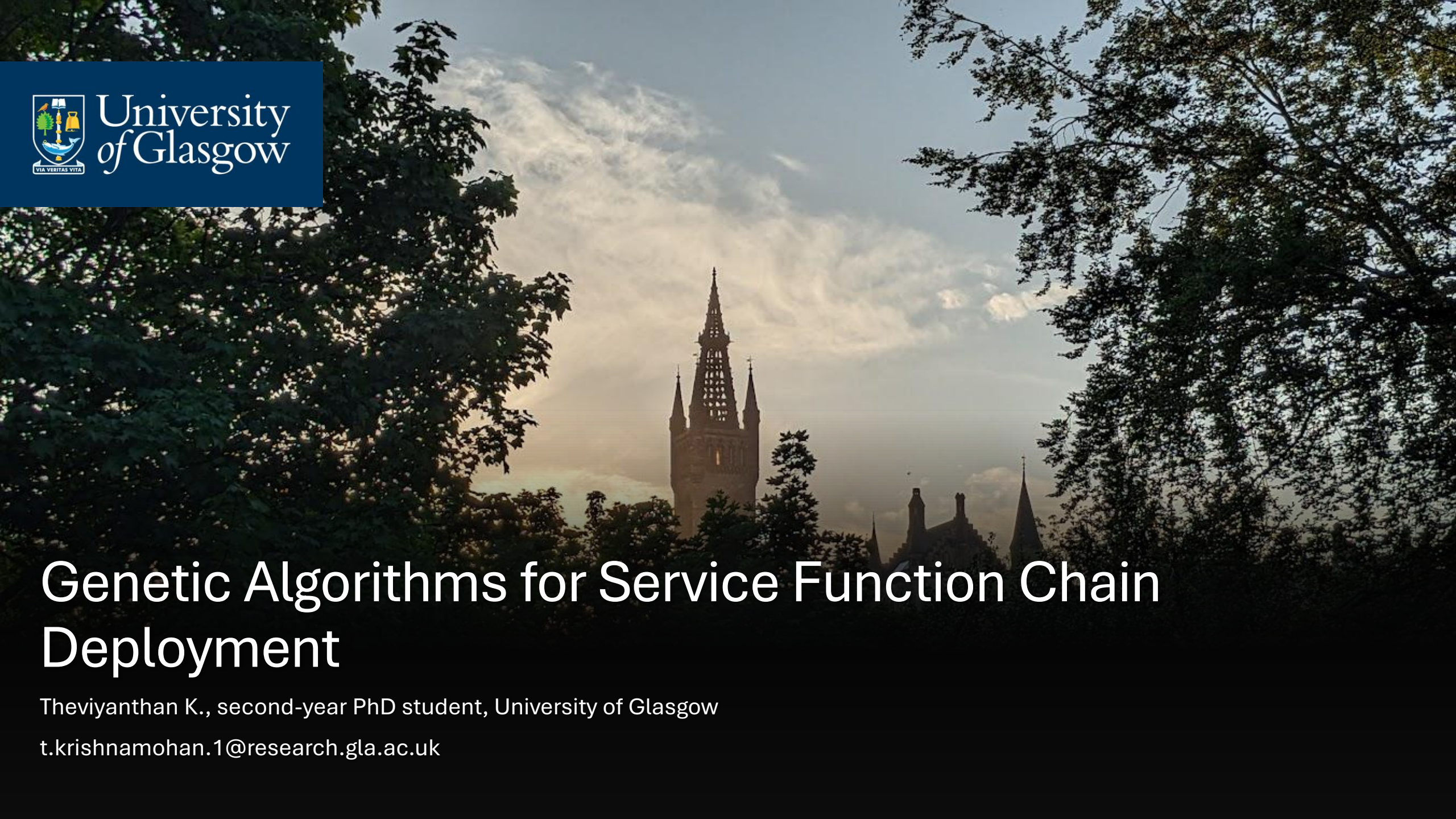

University of Glasgow

Genetic Algorithms for Service Function Chain Deployment

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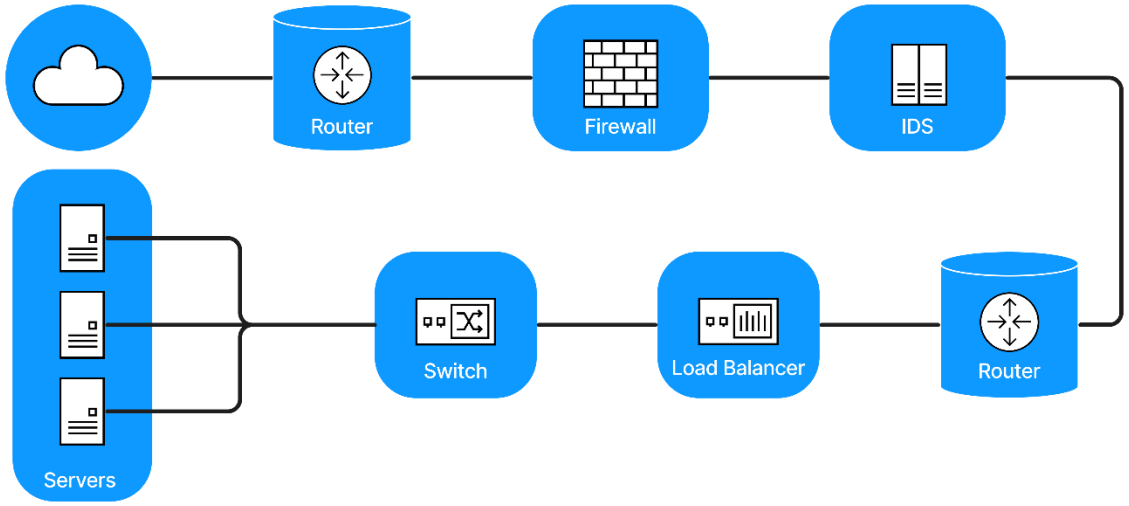
Background

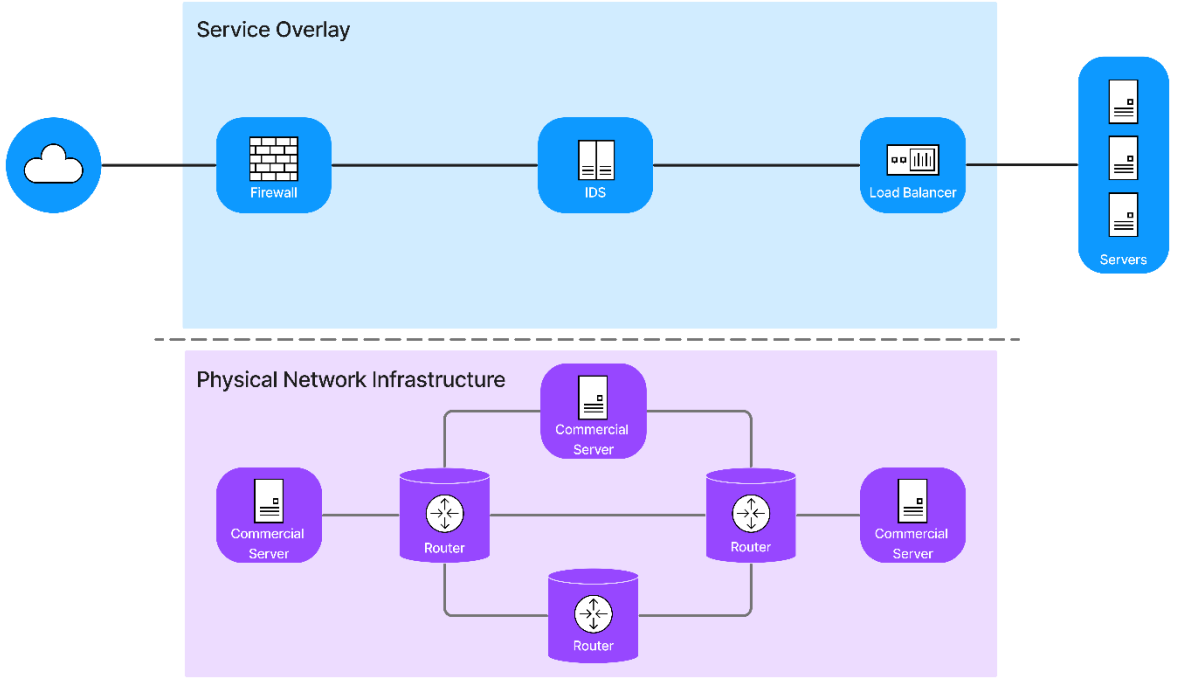
What are Service Function Chains (SFCs)?

- SFCs combine Network Function Virtualisation and Software-Defined Networking and create a service overlay over the physical network.

A traditional network:



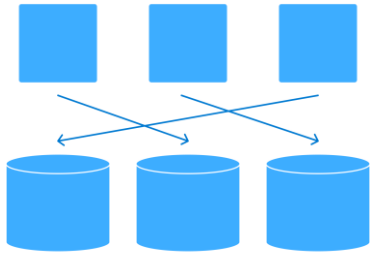
A Service Function Chain:



Challenges

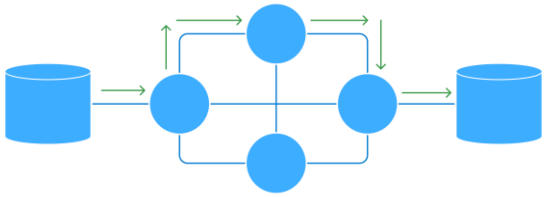
Chain composition

How should the Virtual Network Functions (VNFs) be ordered?



VNF embedding

Where should the VNFs be deployed?



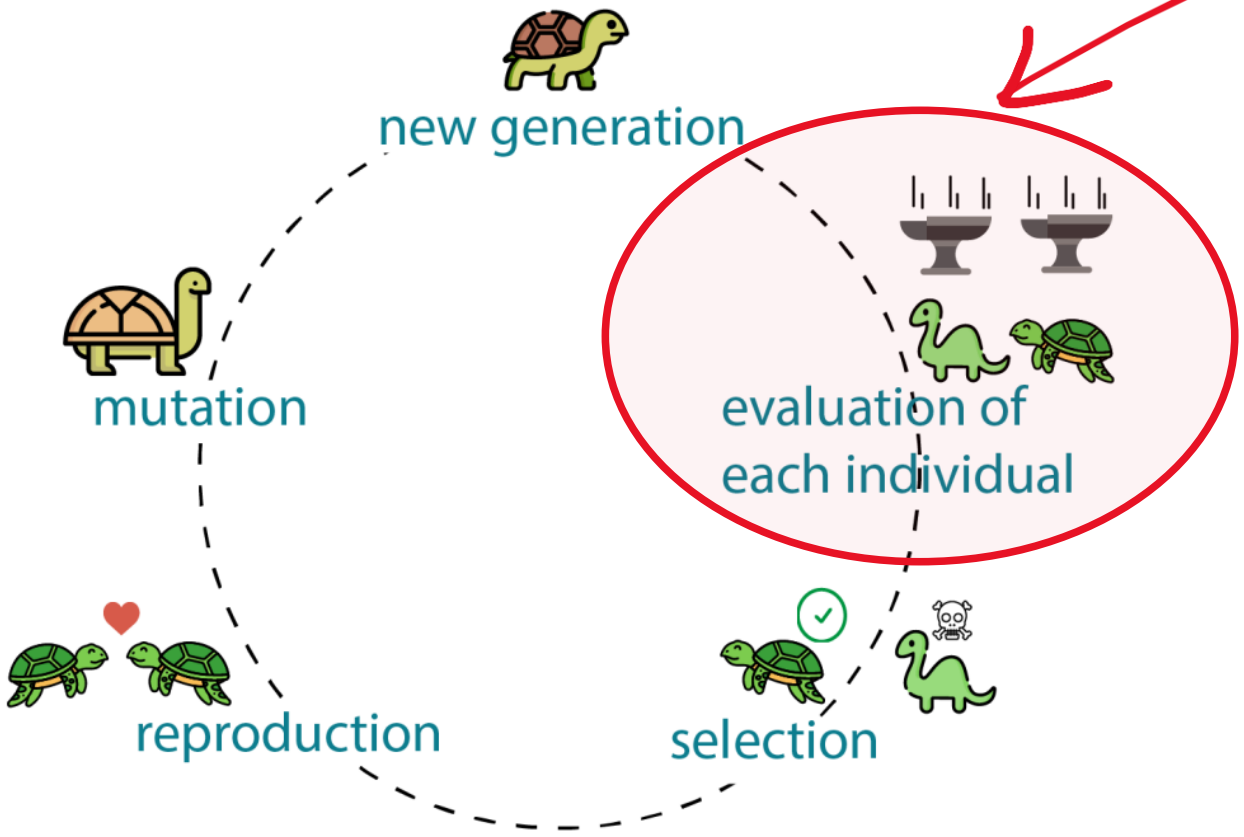
Link embedding

How should the VNFs be linked?

- This has been shown to be an NP-hard optimisation problem.

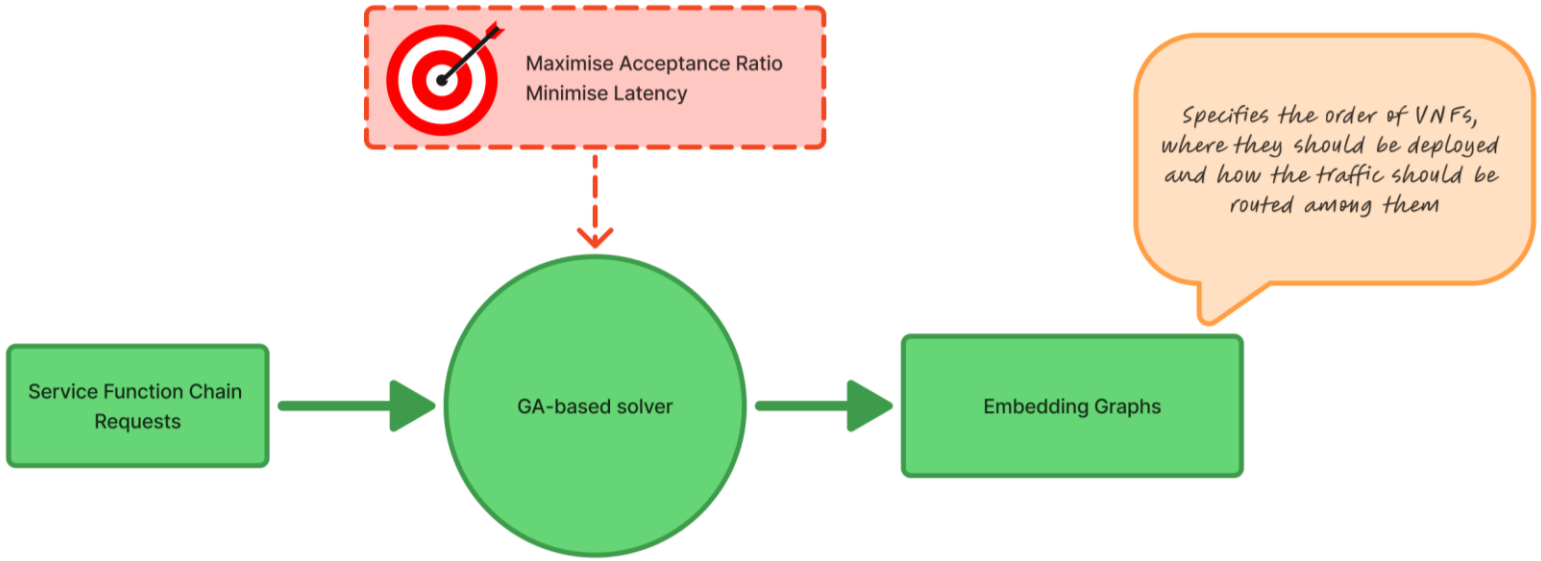
Genetic Algorithms

Evaluation is done on a live network, so it is going to be time-consuming.



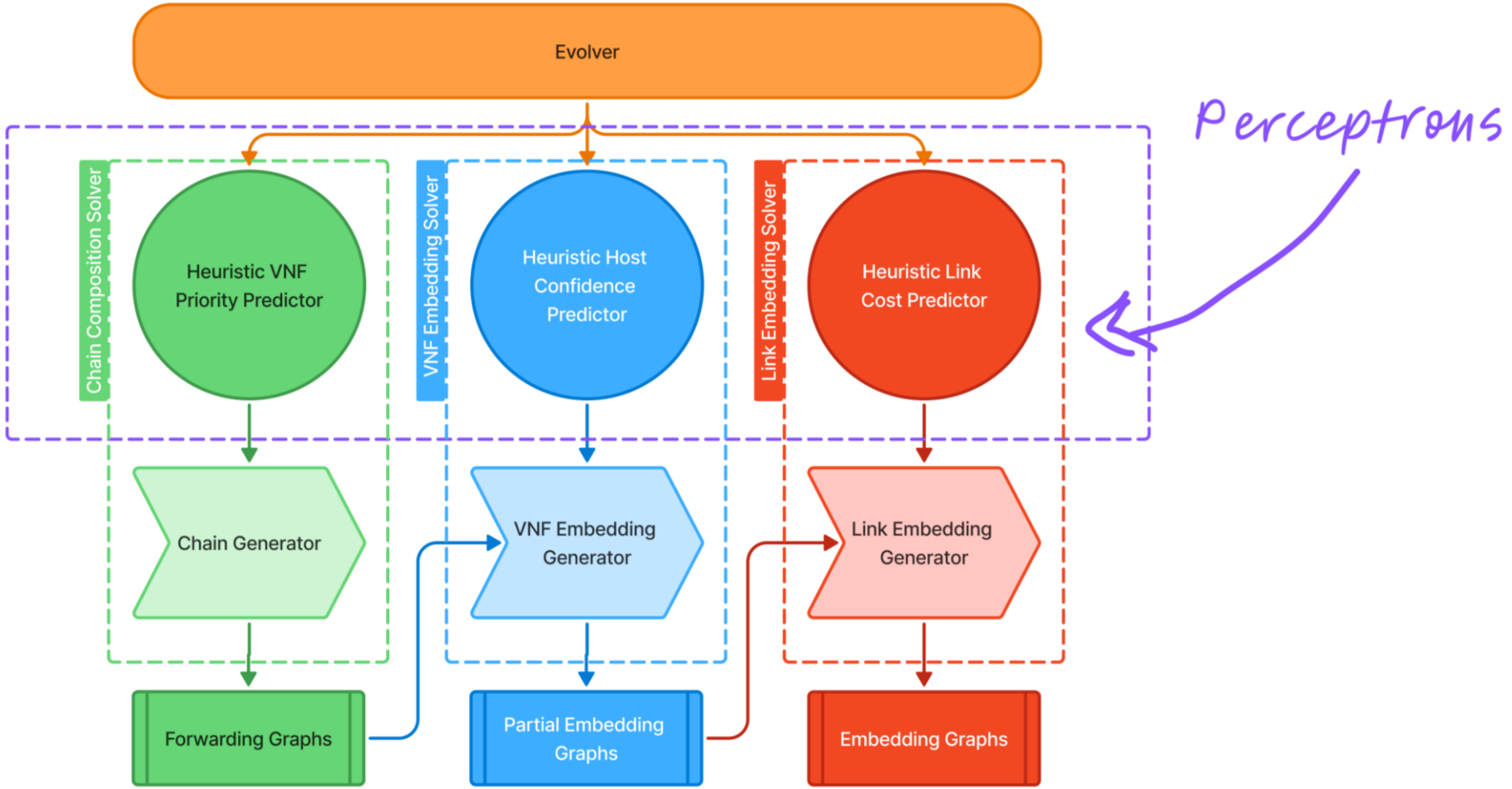
My Approach

Eagle Eye View



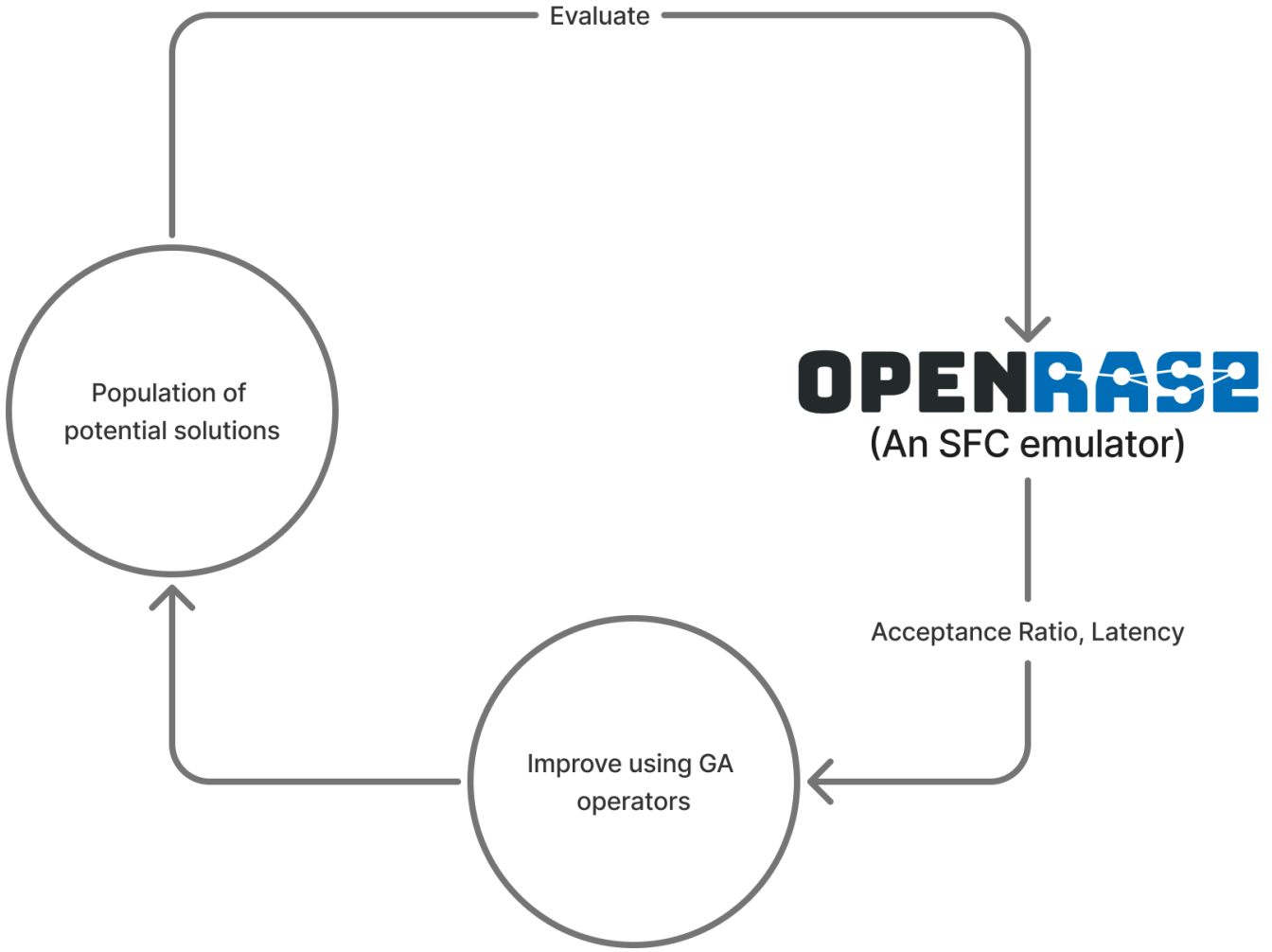
- Acceptance Ratio—the number of SFC Requests that can be accepted over the total number of SFC Requests received.
- Latency—the amount of time taken for traffic to traverse the SFC

Solver Architecture



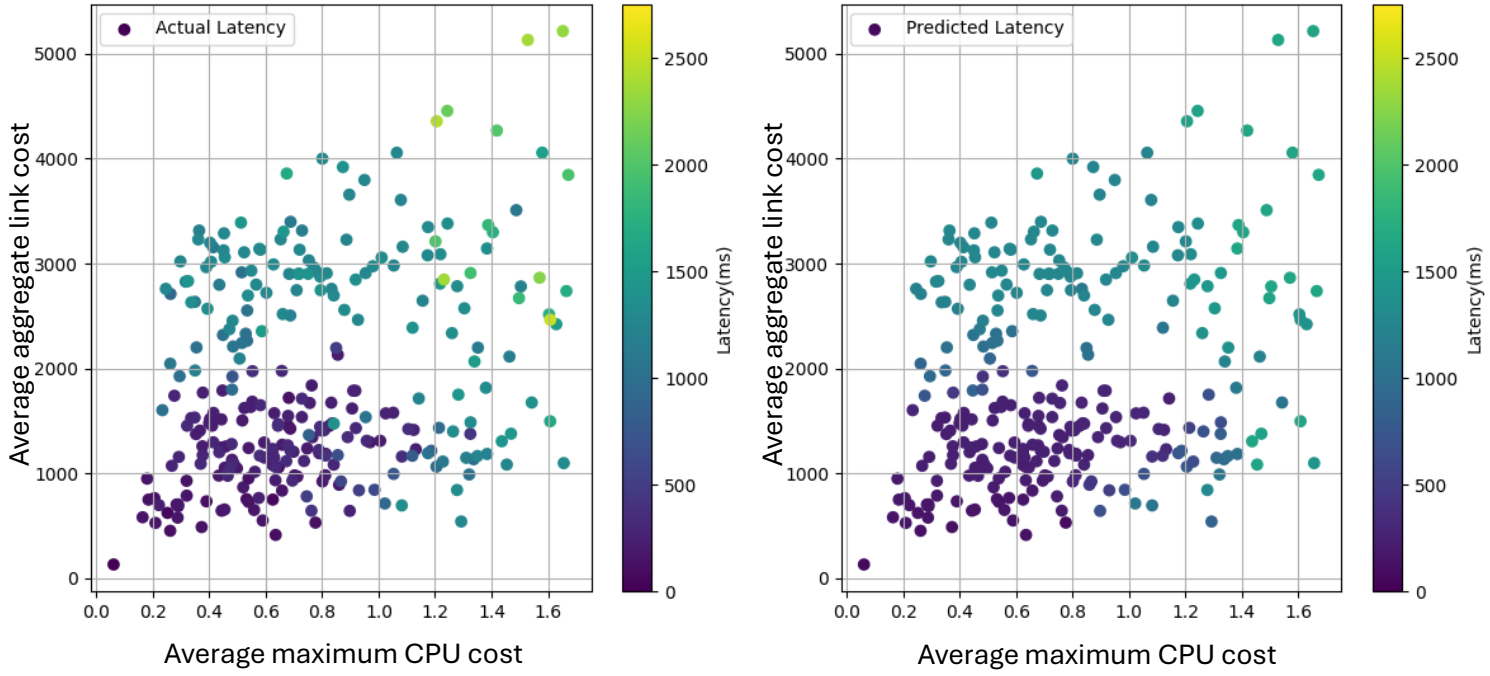
Online Evolution

- It involves evaluating potential solutions on a network and evolving them using Genetic Algorithms.
- Simulators and numerical analysis may not capture the complexity of real networks.
- Makes the solution self-adaptive.
- But it is time consuming.



Surrogate

- To mitigate this, we use a surrogate. It is trained on data from OpenRASE. It predicts the latency of a set of embedding graphs, allowing us to perform online evolution quickly.
- We evolve using the surrogate until the performance reaches a threshold. Then, we evolve using OpenRASE.

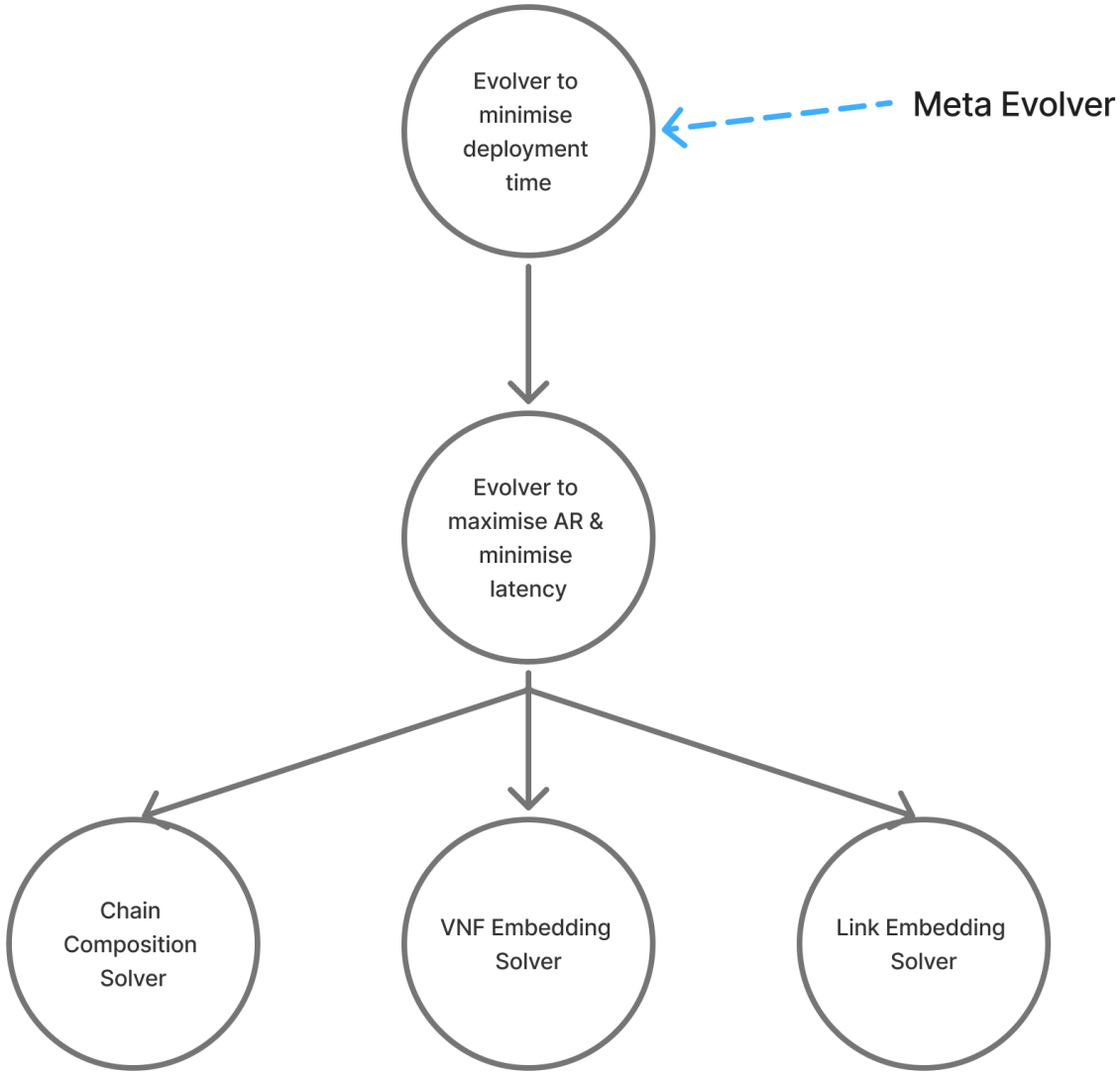


$$CPU\ Cost\ of\ a\ host = \frac{CPUs\ demanded\ by\ the\ deployed\ VNFs\ in\ a\ host}{CPUs\ available\ in\ a\ host}$$

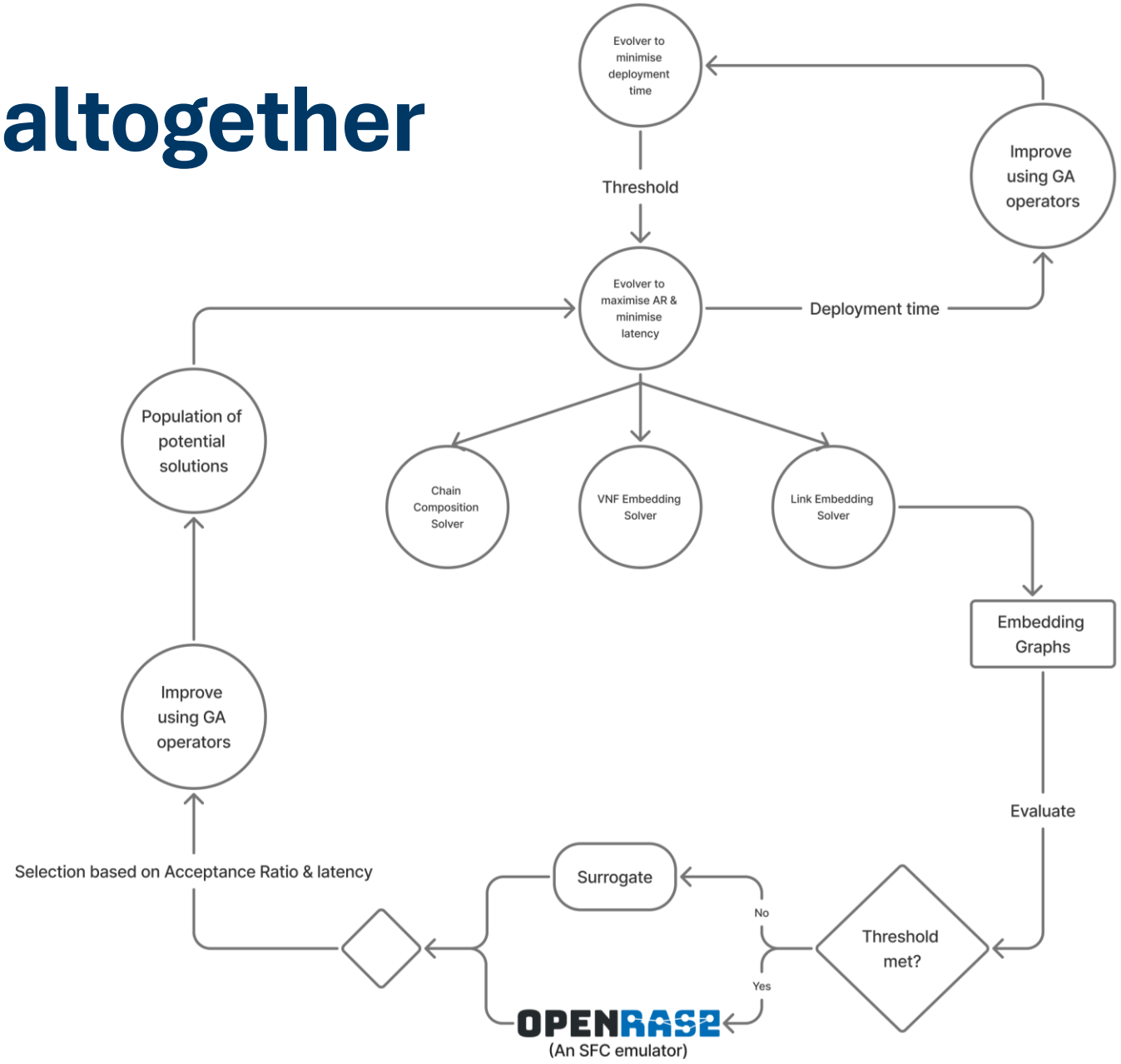
$$Link\ Cost\ of\ a\ link\ = \frac{total\ requests\ traversing\ the\ link\ at\ a\ given\ time}{the\ bandwidth\ of\ the\ link\ in\ MB}$$

Meta evolver

- However, as we increase the number of individuals/make the threshold tougher, the time taken can increase.
- A meta-evolver is used to evolve the thresholds such that the time taken to produce an optimal embedding graph is reduced.



Putting it altogether



Questions?

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Thank You

Appendix

Why Genetic Algorithms?

- It is a heuristic algorithm that can solve NP-hard problems.
- It can adapt to an uncertain/unknown environment.
- It is an underutilised algorithm in the SFC realm. Only 12/163 surveyed studies use GAs.

Discussion Points

- Evolver hyperparameters
- Predictor architecture in solvers
- Solver algorithms
- Surrogate architecture
- How CPU cost and link costs are calculated
- The thresholds and how they are used to conclude an evolution experiment.