INTERNATIONAL INSTITUTE OF INFORMATION TECHNOLOGY
HYDERABAD

R&D SHOWCASE 2021
Technology, Social Impact

E-PODS: A Fast Heuristic for Data/Service Delivery in Vehicular Edge Computing

Introduction

Motivation

- Connected vehicles becoming more and more relevant these days.
- Therefore resource allocation should happen quickly.

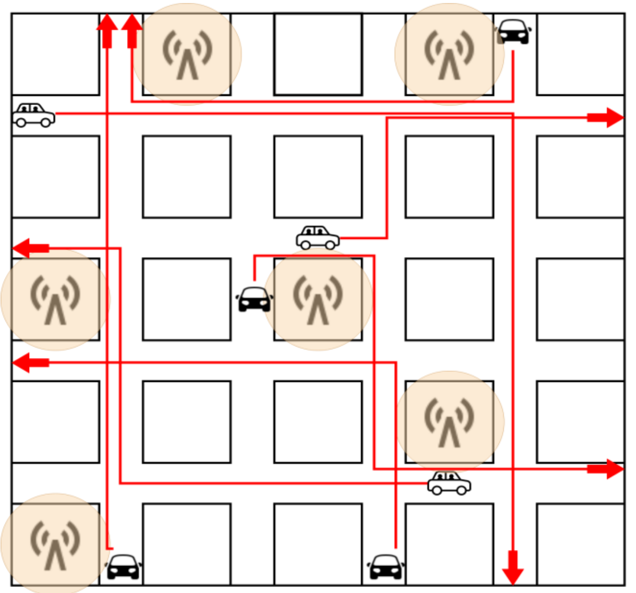

Fig.1: Illustration of grid-based network of the edges.

Contributions

- Proposed a fast heuristic based algorithm.
- It minimizes total edge bandwidth cost.
- To develop an efficient heuristic algorithm that performs fast data/service delivery and has results in minimal increase in edge bandwidth cost.

Problem Statement

- Total Edge Bandwidth cost is given by:

$$b\omega_j^{cost} = \delta \times \left(1 + b\omega_j^{util}\right)^2$$

δ is the bandwidth cost factor

- The objective function is given by

$$minimize \sum_{j=1}^{M} b\omega_j^{cost}$$

- Considered edge resource constraints, timing constraints, bandwidth schedulability constraints, etc.

Solution Approach

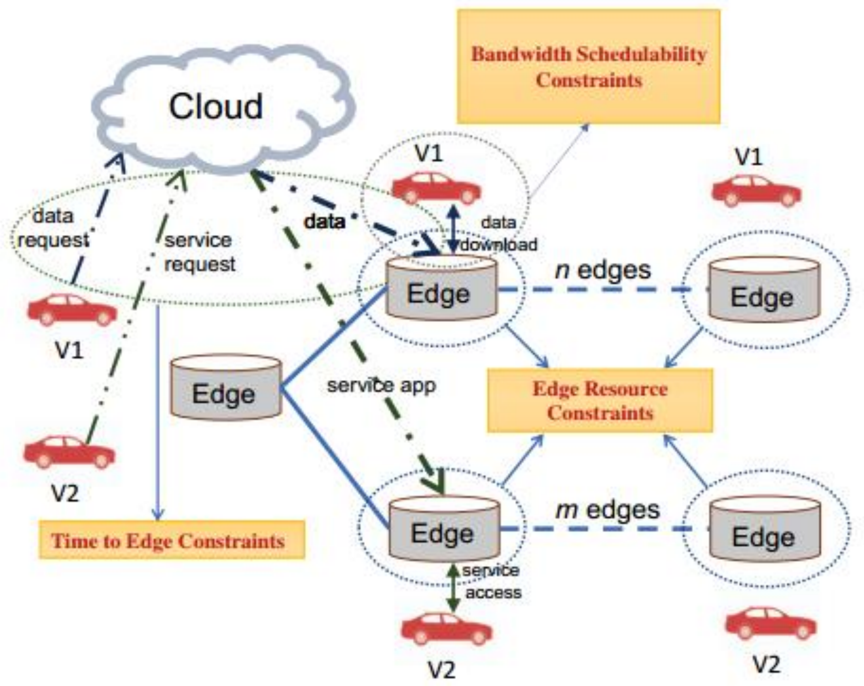

Fig. 2: Flow in the connected vehicle scenario and associated constraints.

- Proposed a theorem to allocate resources for a pair of edges
- As per the theorem, for a vehicle minimum edge bandwidth cost achieved by allocating m_1 amount of memory to one edge in the edge pair, where

$$m_1 = \begin{cases} \dfrac{\dfrac{1}{k_2} - \dfrac{1}{k_1} + \dfrac{M_i + a_2}{k_2^2} - \dfrac{a_1}{k_1^2}}{\dfrac{1}{k_2^2} + \dfrac{1}{k_1^2}} & \text{if } m_1 > 0 \\ 0 & \text{otherwise} \end{cases}$$

- In the second iteration the remaining data $(M_i - m_1)$ considered is to be allocated resources between the 2nd edge in the first iteration and a new edge
- Iteratively consider all the edges until there is some data amount left to allocate.

Results

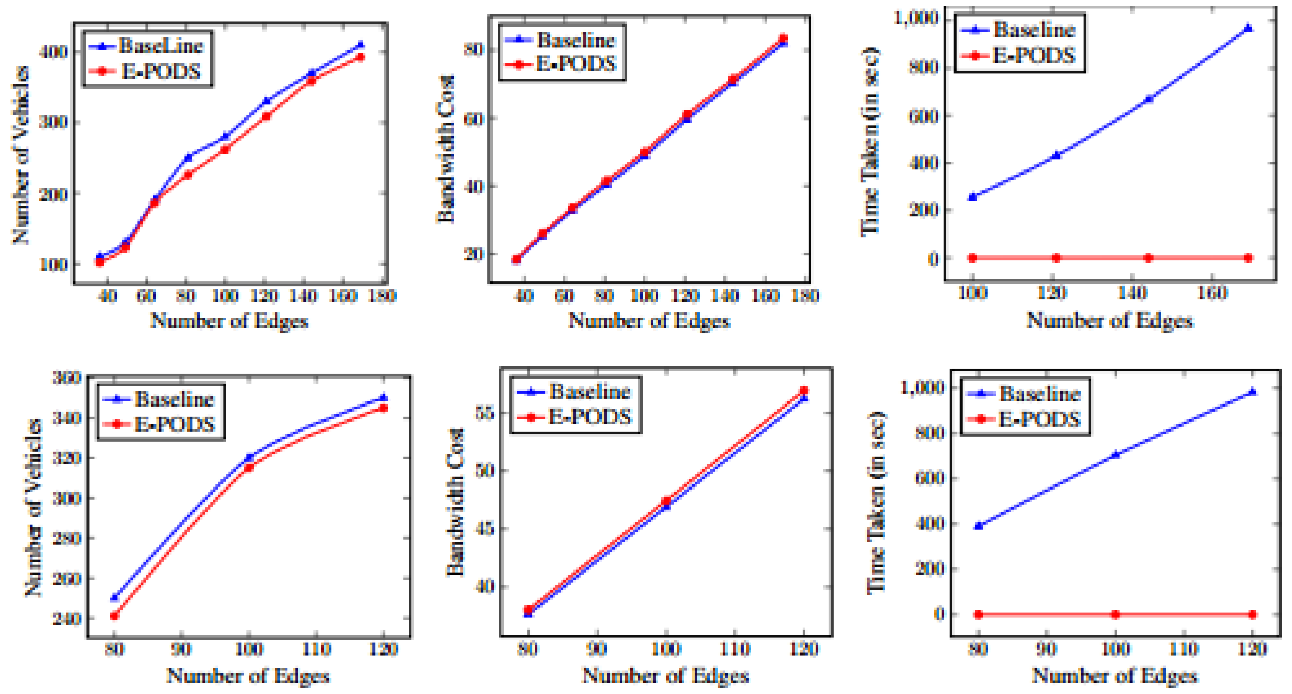

Fig. 3: Synthetic and Real Data set Results

- Maximum number of vehicles serviced is slightly greater for Base optimum than E-PODS by a couple of vehicles (less than 10)
- Edge bandwidth cost is slightly more for E-PODS than the Base optimum by less than 1 unit
- Time taken for calculating optimum allocation is lot shorter for E-PODS than Base optimum by almost 700 sec on average.

Reference

A. Gupta, J. Cherukara, D. Gangadharan, B. Kim, O. Sokolsky, and I. Lee (2021). "E-PODS: A Fast Heuristic for Data/Service Delivery in Vehicular Edge Computing". In: The 2021 IEEE 93rd Vehicular Technology Conference (VTC).

Authors: Akshaj Gupta, Joseph Cherukara, Dr. Deepak Gangadharan

Research Center Name: Computer Systems Group