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VNF Placement and Connectivity

Vladlen Filippov[1],
Ilya Voloshin[2],
Stanislav Partyka[3]
Oksana Baranova[4]

[1]*Kharkiv National University of Radio Electronics, 14 Nauky Ave, Kharkiv UA-61166, Ukraine, vladlen.filippov@nure.ua*
[2]*Kharkiv National University of Radio Electronics, 14 Nauky Ave, Kharkiv UA-61166, Ukraine, Ilya.voloshin@nure.ua*
[3]*Kharkiv National University of Radio Electronics, 14 Nauky Ave, Kharkiv UA-61166, Ukraine, stanislav.partyka@nure.ua*
[4]*Kharkiv National University of Radio Electronics, 14 Nauky Ave, Kharkiv UA-61166, Ukraine, oksana.baranova@nure.ua*

Abstract. *The Software Defined Wireless Networks is actively using NFV (network virtualization technology), which allows you to virtualize the machine network components using software. Launched on NFV nodes (special virtual machines Support NFV Technology) Network Software Components are called Virtualized Network Functions(VNF). To provide services to the user, a multiple VNF can be combined into one SFC chain. But when using the service, the user can move, which negatively affects the service. However, VNF can be moved to the nearest NFV node. In this article, we will consider several methods of dynamic VNF placement.*

Keywords: *Software-defined networking, Network Function Virtualization, Service Chaining, Virtual Network Function, VNF relocation, Service Graph*

I. Introduction and Problem statement

The use of Network Function Virtualization (NFV) brings benefits, but also brings new challenges. For example, the transfer of mobile users - when they move from the current NFV node, the delay increases, which can be critical for some applications. The VNF that the user uses can be moved to the nearest VNF node to reduce the delay. However, the node closest to the user can be overloaded with traffic. In this case, you need to find a trade-off between using server resources and reducing latency for services. Often, VNFs form a chain of network functions with predefined parameters which are referenced in the form of a service graph. The task of placing all network functions on a network graph is called the Network Function Embedding Problem (NFEP). NFEP can be solved by modeling it as an optimization problem that can be solved using various linear programming (LP) applications. It is proved that such optimization models have NP-complexity and are not scalable. An alternative solution can be develop a heuristic algorithm that can provide optimal solutions with low complexity. In our work, we investigate simple heuristic algorithms for VNF placement. We strive to develop as simple a heuristic algorithm as possible that is time efficient and scalable, and therefore applicable to larger networks. We are particularly interested in the case of multi-hop wireless networks with their more stringent bandwidth constraints, but we believe that the conclusions drawn in this paper can also be applied to other networks.

II. Problem solution and Results

Random allocation: the first heuristic algorithm that randomly allocates NFs on the network and connects the source and recipient of the request to the NF, depending on their order on the SG through the shortest path. This heuristic is used as the worst result.

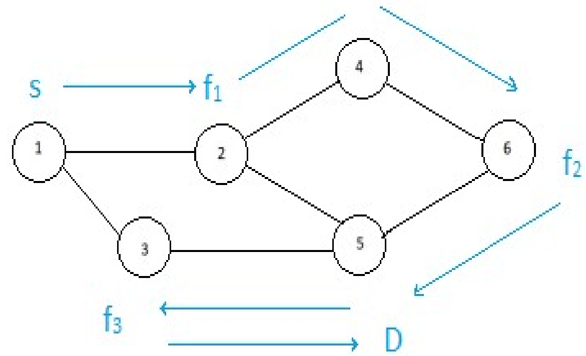

Figure 1. Random placement Example

Shortest Path Placement: The second heuristic that accounts for insufficient bandwidth in a wireless multisite network. This algorithm first finds the shortest path between the originator and the receiver of the request using Dijkstra's pathfinding algorithm and places the NF along the shortest path based on their order in the service graph.

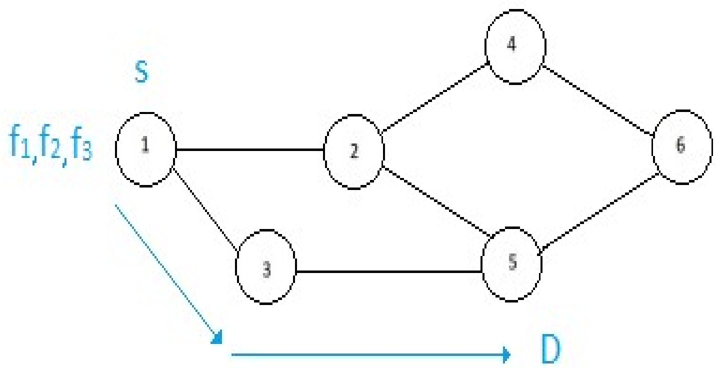

Figure 2. Shortest path placement Example

Placement along all shortest paths: the algorithm takes into account the probability of having more than one shortest path and chooses the one with more resources along the path. The main idea here is to increase the chances of successful placement of the current request. In this algorithm, we will sort the shortest paths based on the available node resources and choose the one that has the most resources. NFs will be placed on the selected shortest path according to their order in SG.

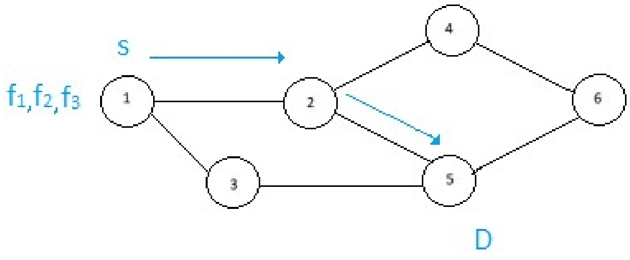

Figure 3. All Shortest Path Example

The Fast and Simple Heuristic Algorithm (FACE): The fourth and final algorithm is called FACE. FACE uses the same method as the All Shortest Paths algorithm to choose the most short path, but places the NF in a different way. When placing, NF FACE gives priority to the one with the fewest placement options

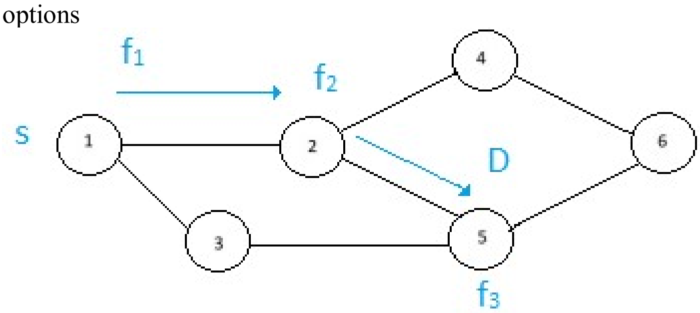

Figure 4. FACE Example

III. CONCLUSIONS

To test the effectiveness of these algorithms were simulated three situations with different numbers of nodes (20, 30 and 40) and after the 10 measurements for each case obtained the average number of requests processed. A random placement algorithm has been added to the test for greater correlation.

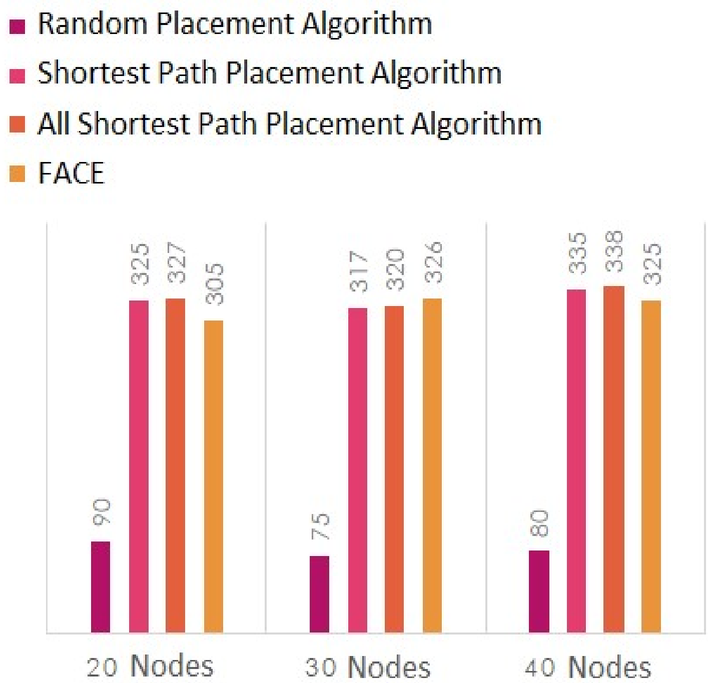

Figure 5. Testing Results

In the process of work, a superficial study was carried out and a comparison of four heuristic algorithms from the simplest to the most complex was carried out, with the aim of finding the simplest algorithm that would correctly place all users on the network.

The results show that the random allocation algorithm gives poor results as expected (low processed requests, high resource costs). So some effort is needed to host the VNF. However, somewhat unexpectedly, the shortest path placement algorithm was able to achieve the results of more complex heuristic algorithms. Additional steps in addition to this algorithm and to the FACE algorithm do not increase the number of processed requests.

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