

Looking Glass of NFV: Inferring the Structure and State of NFV Network from External Observations



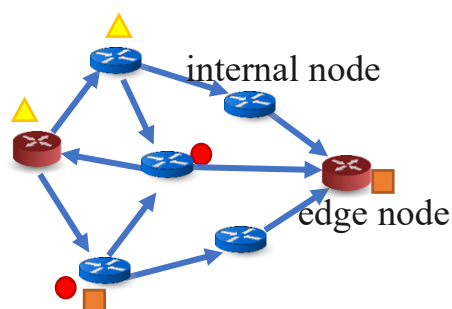
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Motivation

We want to validate the “Quality of Analytics (QoA)” (e.g., response time) from user’s perspective

Users lack internal support/trust: coalition, open edge computing

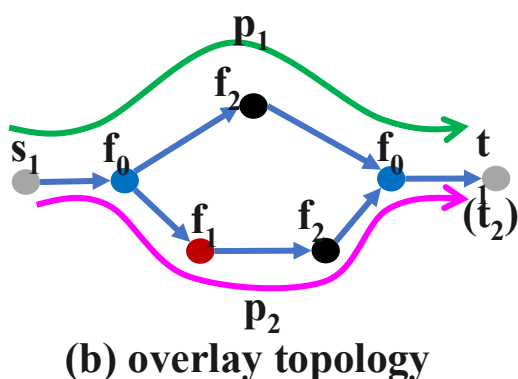
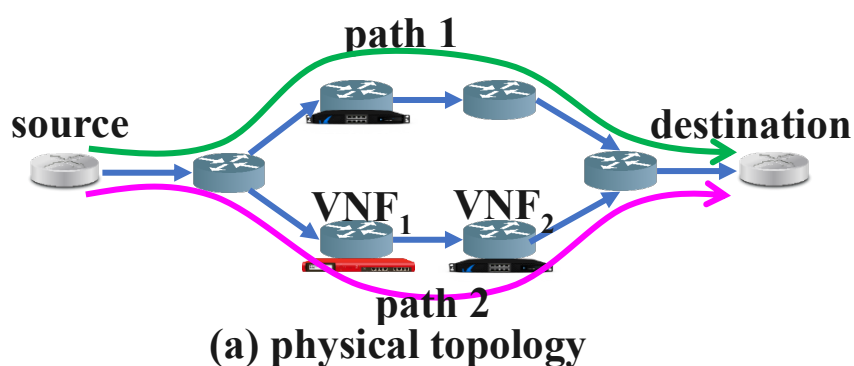
Goal: Infer network topology



distributed analytics system

- analytics function 1
- ▲ analytics function 2
- analytics function 3

Formulation



Goal: Infer VNF topology from observations

Inference

Using Path Lengths

Weight Inference Problem

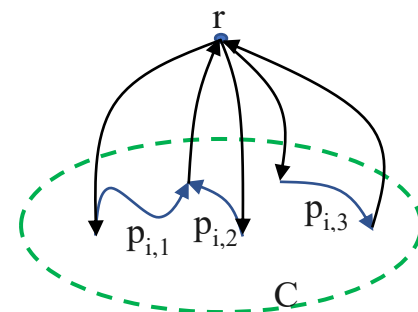
- Category A: set of edges traversed only by paths with index in A

$$\sum_{A:i \in A} w_A = \rho_i, \quad \forall i \in [n]$$

$$\sum_{A:\{i,j\} \subseteq A} w_A = \rho_{ij}, \quad \forall i, j \in [n]$$

Clique Embedding(CE)

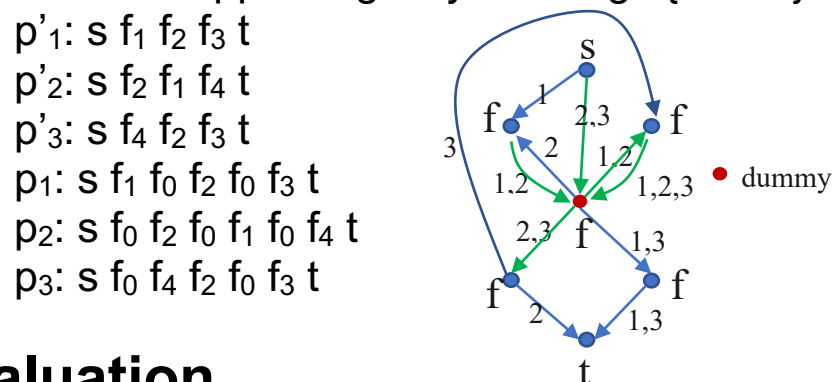
- Embed categories into clique
- Use an extra vertex to “stitch together” embedded edges for each path



Using Path Lengths & Service Chain

String Augmentation Problem(SAP)

- View each service chain as a string: $s_i, f_{i,1}, f_{i,2}, \dots, t_i$
- Insert dummy letters f_0^1, f_0^2, \dots s.t. for every positive-weight category A, \exists a pair of letters appearing *only* in strings $\{i: i \in A\}$



Evaluation

- Our solution significantly improves reconstruction accuracy over tree approximation (RNJ)
- Inference accuracy is insensitive to estimation error
- SAP can capture structure of ground truth

