Open Marketplace and Service Orchestration for Virtual Optical Networks

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Analogy: Google Flight Planner
Outline

• A Marketplace for Network Services
  o ChoiceNet Architecture
  o Marketplace and Planner

• Service Orchestration
  o NFV Model and Optical Network Context
  o P2MP Shortest Path Tour Problem
ChoiceNet Marketplace for Network Services

- **Economy Plane**
  - Advertisement
  - Reputation
  - Marketplace

- **Control Plane**
  - Protocol Stack
  - PLANNER
  - Path
  - IN Network
  - Verification Infrastructure

- **Data Plane**
  - Service Infrastructure
    - Router / Middlebox / Stub
    - Network / Virtual Service
  - Transaction – Token Interface
  - Service Purchase Proofs with Timestamp
  - In-force Contracts

- **Payment Infrastructure**
  - Service Negotiation & Payment
High Level Interaction

1. Purchase Listing
2. Advertise Service
3. Search for Matching Service(s) or lookup a Planner
4. Find Plans
5. Search
6. Composed Service(s)
7. Purchase
8. Purchase Proof
9. Withdraw Service (optional)
10. Provision

MARKETPLACE
- Active Advertisement Repository
- Payment Infrastructure

PLANNER

USER

Service Provider
- Payment Infrastructure
- Provisioning Infrastructure
- Verification Infrastructure
- In-force Contracts

Service Infrastructure
Semantically Enriched Service Ads

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**SERVICE DEFINITION**

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**FUNCTIONALITIES**

1. **Layer Abstraction**: The objective of CSL and the purpose of the fields which make up the service advertisement and requirement are described below.

2. **Address Decode**: Any addresses can be used to indicate the location(s), where the service is being offered. The values from the address fields are specified using a set consisting of range (set) formats.

3. **Format Decode**: The format schema is used to specify the source and destination formats along with the format fields.

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**DATA PLANE**

The functionality of the data plane service with respect to handling of application data. The values for the format schemes (types) are used for specifying the source and destination formats.

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**NETWORK SERVICES**

The number of composed services expected while finding alternative composed services matching the user request. In this section we define the role of semantics. The service name and description mentions in brief the service being advertised.

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**PLANNER**

The service advertisement and requirement respectively.

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**SERVICE ADVERTISEMENT**

The service. The extension would require changes in the composition algorithm for new attributes to be considered necessary information for composing a network service. The triple: (attribute name, attribute value, syntax and semantics. The attributes are fully specified using the set syntax.

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**FUNCTIONALITIES**

The numbers authority (IANA), which enforces the widely accepted authority such as the internet assigned numbers authority. This schema/vocabulary may be managed by a regulated consensus between the entities interacting with the Market place. This schema/vocabulary enables building a service users.
ChoiceNet Demo Topology

Figure 1. ChoiceNet Demo Topology

Economy Plane

Customer

Pathlet Service Provider 1

Pathlet and Transformation Service Provider 2

Pathlet Service Provider 3

Control Plane

Data Plane

Content
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  o P2MP Shortest Path Tour Problem
NFV Model in the context of ChoiceNet

- **VNF-A** from Provider 1 at Location I
- **VNF-A** from Provider 2 at Location IV
- **VNF-A** from Provider 3 at Location VI
- **VNF-B** from Provider 1 at Location II
- **VNF-B** from Provider 2 at Location V
- **VNF-C** from Provider 1 at Location III
Optical Network Context

• Sophisticated Programmable Devices
  o Optical monitors and sensors
  o Variable optical attenuators
  o Bandwidth-variable transponders
  o Amplifiers and impairment compensation devices
  o ROADM
  o Flexible spectrum selective switches
  o Optical splitters
  o …
NFV Graph: Example
Service Orchestration on NFV Graph

• Topology is superset of VN topologies
• Nodes/Edges represent virtual entities
  o Multiple virtual nodes per physical node
  o Parallel edges

Large graphs $\rightarrow$ scalable algorithms
Service Orchestration: Shortest Path Tour Problem (SPTP)

Given

• a graph $G = \{N, E\}$
• a source $s$ and destination $d$
• $K$ non-empty ordered node sets $S_1, S_2, \ldots, S_K$, such that $S_i \subset N$

find the shortest path from $s$ to $d$ such that the path visits one node $n_i \in S_i$ of every set $S_i$, $i = 1, \ldots, K$, in the given order, i.e., $n_1, n_2, \ldots, n_K$. 
SPTP

Marketplace

- VNF-A from Provider 1 at Location I
- VNF-C from Provider 1 at Location III
- VNF-A from Provider 2 at Location IV
- VNF-B from Provider 2 at Location V
- VNF-A from Provider 3 at Location VI
P2MP-SPTP

Set I = \{I, IV, VI\}

Set II = \{II, V\}
### Average Running Time (in seconds) of our algorithm to solve P2MP-SPTP

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Thank You!