Department of Engineering
PhD in Computer Science – Cycle XXX
ROMA TRE UNIVERSITÀ DEGLI STUDI

SUPPORTING END-TO-END CONNECTIVITY IN FEDERATED NETWORKS USING SDN

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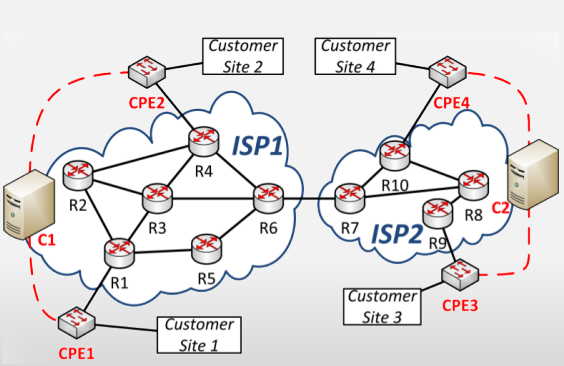
Introduction

A **federated network** is an ensemble of independent but collaborating partners that share resources in order to optimize their usage, improve the quality of services, and reduce provisioning costs.

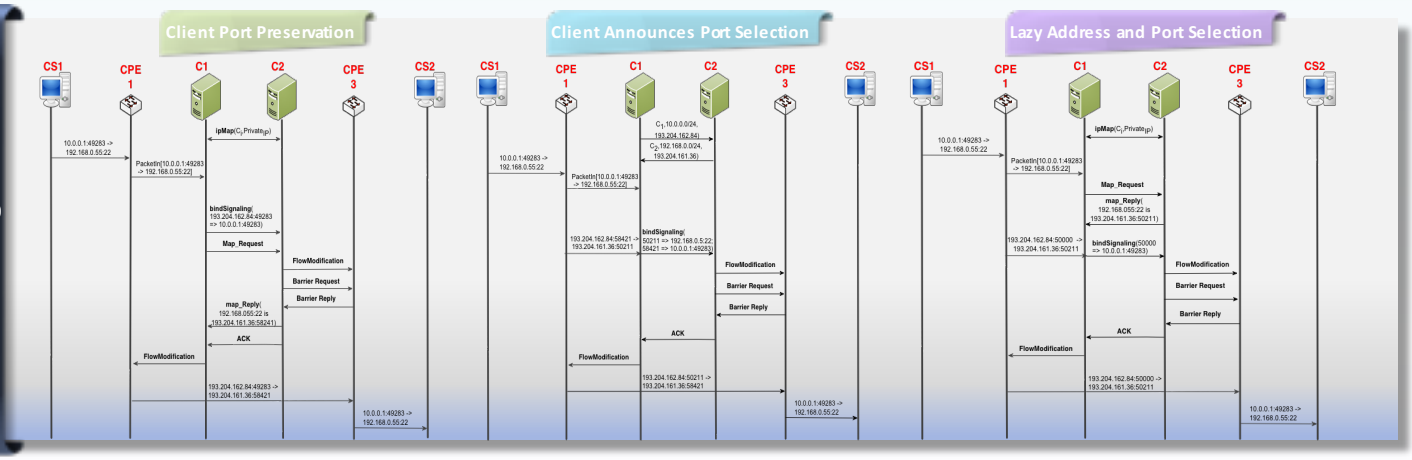
We leverage **Software-Defined Networking (SDN)** to introduce an end-to-end connectivity service among the networks of federated partners. In particular, we accomplish this by **applying SDN to the network edge**, where it has been marginally exploited so far.

Our approach consists in applying suitable **Network Address and Port Translation (NAPT) strategies both to the source and to the destination IP address and port** of data packets exchanged by the partners: in this way, such packets can be routed on a standard IP network, including the Internet. We define various alternative NAPT strategies and evaluate their effectiveness using simulations as well as tests inside emulated network scenarios.

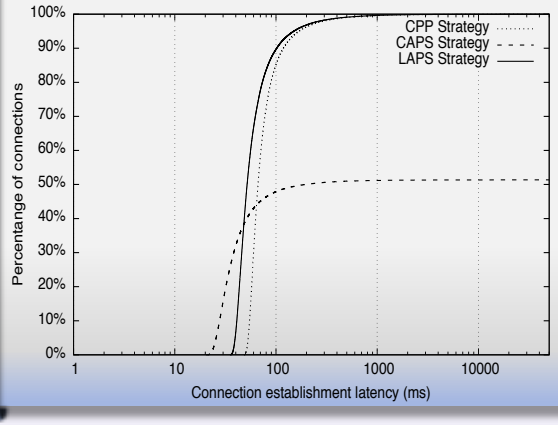
Reference Scenario



Address Translation Strategies



Experiments



- We evaluated the effectiveness of our address translation strategies by estimating the **end-to-end connection establishment latency**. To build this estimate, we modeled the message exchanges using a **queuing network**, where the customers are new TCP connections and the servants are C1, C2, CPE1, and CPE3. We **exploited an ad-hoc piece of software** to simulate the queuing network. We used a **realistic assortment of IP addresses and port numbers** as input to the network, which we derived from real TCP connections found in packet traces available.
- To demonstrate the practical applicability of our approach, we performed several experiments in a network topology running in the Mininet network emulator. We are working on a **prototype controller implementation**, based on the Ryu framework. The partial implementation of our controller is already downloadable at http://www.dia.uniroma3.it/~compunet/www/view/topic.php?id=sdn

Future Work

This paper makes a step towards the introduction of interconnection technologies for federated networks by exploiting SDN on the edge, but several aspects deserve more attention and are part of our future work plan:

- The signaling protocol talked between controllers needs to be defined, and a **caching mechanism** can be introduced to reduce their communication overhead;
- Moreover, we would like to further refine the port allocation strategies;
- Our controller implementation needs improvement: for example considering the possibility of **overlapping subnets** among the federated networks and introducing a **DNS based mechanism** in order to reduce the information exchanged between the controller and make the architecture more dynamic;
- Also we would like to test our approach with more **realistic traffic loads** by collaborating, for example, with some Internet Service Providers.

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