Use Case for P4 Programmability by Tenants of Future Mobile Virtual Networks


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Programming Mobile VNs by Tenants

• This draft describes a use case for COIN
  • A P4 programming interface is provided to tenants of (industrial/enterprise/home) virtual networks
  • P4 is used as an external interface by the operator of the underlying network (e.g., a mobile network operator)

• Virtual network support for P4 has been discussed in COINRG [1]
  • A use case can help looking more broadly at the impact of data plane programming of virtual networks (e.g., w/r to the operation of the underlying network, to devices mobility…)

• 5GLAN is used as a base for the use case
  • It has a well-documented architecture
  • This is for study only at this point, there is no related work in 3GPP

Rationale for P4 Programming for Mobile VNs

• Data plane programming can be used by tenants to control increasingly complex virtual mobile networks
  • Cope with the evolution of future mobile networks towards more and more customized environment

• Enable interchangeable or portable programs for VNs over fixed physical networks, datacenters, and mobile networks
  • Use the same tools, mix and match portions of physical/DC/mobile network segments
Use Case: High Level Description

• A 5GLAN connects VN group member devices (UE1…UE4 and attached devices Device1 and Device2)

• A 5GLAN tenant can be an industrial or enterprise network operator, a homeowner

• The mobile network appears as a logical switch to the tenant

• The tenant deploys P4 programs in the logical switch and in other P4 switches

• The tenant can also operate a controller, which communicates with the switches using the P4 runtime API
Use Case: How P4 Programs are Deployed

- A P4 program for the 5GLAN logical switch needs to be deployed on physical node(s)
  - Possible locations for P4 program fragments are anchor UPFs and mobile devices (UEs)

- There are 3 types of 5GLAN data paths:
  - UE1-UE2 through a local switch component in UPF1
  - UE1-UE3 through a tunnel between UPF1 and UPF2.
  - UE1-UE4 through an external Data Network

Figure 2: Use Case Details
1. Splitting/Distribution
   • Data paths are distributed, with no central node in the general case
     • [1] studies distribution of P4 programs

2. Multi-Tenancy Support
   • Multiple 5GLANs can share the same infrastructure
     • MTPSA and other studies on virtual network data plane programming provide useful solutions in this space

3. Mobile Network Awareness
   • A P4 program could interact with the mobile network system

4. Mobility Support
   • P4 programs should follow the data flow when mobile devices move to other attachment points

5. Security
   • Security risks include overusing network resources, injecting traffic, unauthorized access of traffic

[1] draft-hsingh-coinrg-reqs-p4comp, "Requirements for P4 Program Splitting for Heterogeneous Network Nodes"
Next Steps

• Summary: data plane programming is a way for tenants (e.g., industrial/enterprise/home network operators) to control virtual networks over mobile, DC and fixed underlying networks
  • This work is a starting point, using P4 for data plane programming, a Mobile Network as underlying network, and 5GLAN as virtualization technology

• Is this use case appropriate for COINRG?

• Please let me know if you are interested in collaborating on this use case