

Network Working Group
Internet-Draft
Intended status: Informational
Expires: 28 November 2021

X. de Foy
InterDigital Communications, LLC
27 May 2021

Use Case for P4 Programmability by Tenants of Future Mobile Virtual
Networks
draft-defoy-coinrg-p4-by-tenants-in-mobile-nw-00

Abstract

Support for multi-tenancy has been the subject of recent work on P4 switch programming. This draft further describes a potential use case where a tenant programs a virtual network built over a mobile network, and discusses related requirements. The use case is based on the existing 5GLAN feature, since it is a well documented virtual network architecture supported by 5G.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at <https://datatracker.ietf.org/drafts/current/>.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

This Internet-Draft will expire on 28 November 2021.

Copyright Notice

Copyright (c) 2021 IETF Trust and the persons identified as the document authors. All rights reserved.

This document is subject to BCP 78 and the IETF Trust's Legal Provisions Relating to IETF Documents (<https://trustee.ietf.org/license-info>) in effect on the date of publication of this document. Please review these documents carefully, as they describe your rights and restrictions with respect to this document. Code Components extracted from this document must include Simplified BSD License text as described in Section 4.e of the Trust Legal Provisions and are provided without warranty as described in the Simplified BSD License.

Table of Contents

1. Introduction	2
2. A Use Case for Programmability of 5GLANs, by Tenants	3
3. Requirements for Mobile Network Programming by Tenants	6
4. Informative References	7
Author's Address	8

1. Introduction

In the context of data centers, it has been shown that P4 programs provided by tenants could be used to program and control virtual network instances [Stoyanov]. This could be extended to virtual networks provided by 5G or future mobile networks. This document discusses such a use case, using 5GLAN as a baseline, since this recent 5G feature has a well documented architecture. However, this type of feature is NOT currently planned in 3GPP, it is explored here as a possible future evolution.

As part of its improving integration with other networks, the 5G network has now the ability to provide LAN-like connectivity between 5G devices. This "5GLAN" feature provides a virtual LAN service between devices which are members of a configured group. Section 5.1 of [I-D.ravi-icnrg-5gc-icn] provides a description of the 5G network functions and interfaces relevant to 5GLAN, which are otherwise specified in [TS23.501] and [TS23.502]. From the 5GLAN service customer standpoint, the 5G network operates as a switch.

However, today network operators do not have the option to use network programming (such as P4) to program 5GLANs, as they could for fixed network switches. A form of network programming would nevertheless help to cope with the ever-increasing complexity of the 5G network and its future evolutions. It would also help further integrating mobile networks, as a piece of infrastructure, with other home, enterprise and data center networks.

In this document we describe a use case for P4 programming of 5GLANs by tenants in Section 2. An expected outcome of this work is a list of requirements initiated in Section 3. This document is also part of a larger effort to gather use cases related to computing in the network, that is documented in [I-D.irtf-coinrg-use-cases].

2. A Use Case for Programmability of 5GLANs, by Tenants

In the use case depicted in Figure 1, a 5G customer operates a network including a 5GLAN network segment (seen as a single logical switch), as well as fixed segments. This can be in a plant or enterprise network, using for an example a 5G Non-Public Network (NPN). The customer uses P4 programs to determine the operation of the fixed and 5GLAN switches. The customer provisions a 5GLAN P4 program into the mobile network, and can also operate a controller.

In Figure 1, the mobile devices (or User Equipment nodes) UE1, UE2, UE3 and UE4 are in the same 5GLAN, as well as Device1 and Device2 (through UE4).

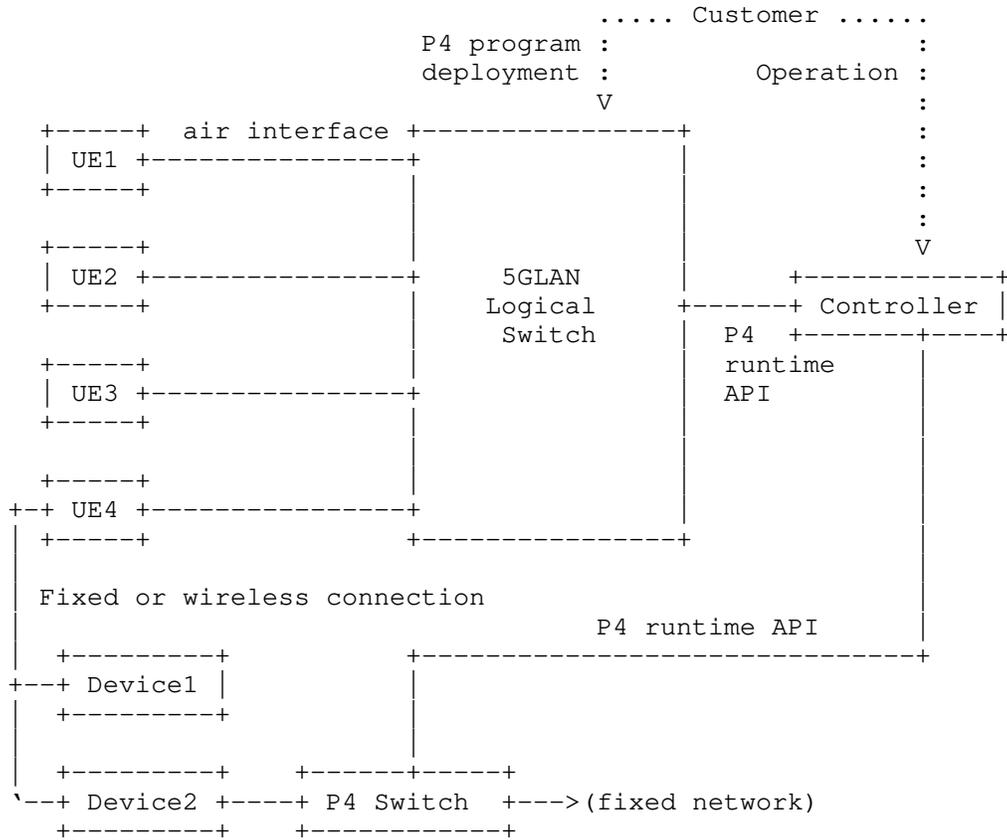


Figure 1: Use Case for P4 Programming by a 5GLAN Customer

Looking in more details in Figure 2, the 5GLAN P4 program can be split between multiple data plane nodes (PDU Session Anchor (PSA) User Plane Functions (UPF), other UPFs, or even mobile devices), although in some cases the P4 program may be hosted on a single node. In the most general case, a distributed deployment is useful to keep traffic on optimal paths, because, except in simple cases, within a 5GLAN all traffic will not pass through a single node.

In Figure 2, P4 programs could be deployed in UPF1, UPF2, UPF3, UE3 and UE4. In this example, UE1-UE2 traffic is using a local switch on PSA UPF1, UE1-UE3 traffic is tunneled between PSA UPF1 and PSA UPF2 through the N19 interface, and UE1-UE4 traffic is forwarded through an external Data Network (DN). Traffic between Device1 and Device2 is forwarded through UE4.

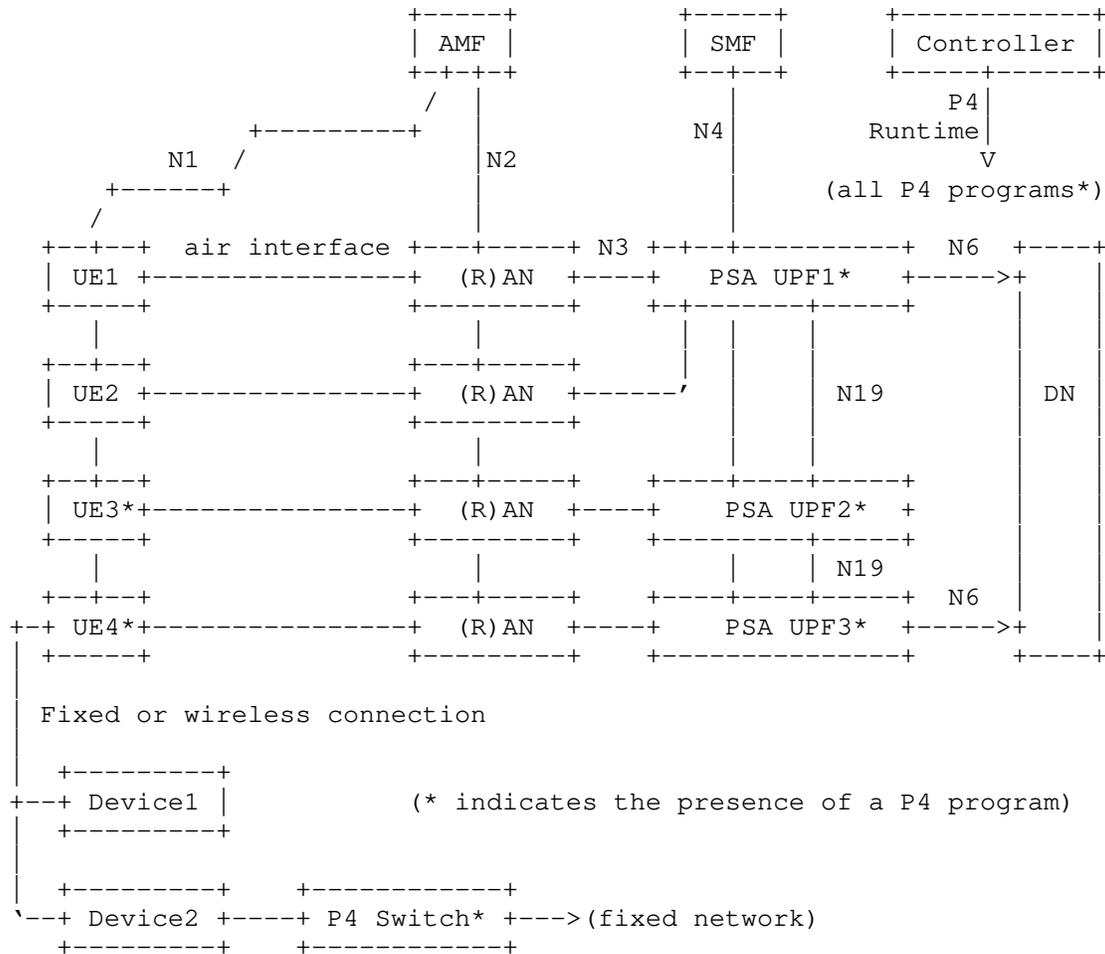


Figure 2: Use Case Details

Rationale for using P4 programming by 5GLAN tenants include:

- * A unified programming model can facilitate replacing between fixed and 5G technologies, as well as sharing controller, code and expertise.
- * Making P4 (or equivalent) programming available to 5G customers can increase the level of customization available to them, when compared with typical configuration capabilities.

- * If P4 programs can influence the 5G service (e.g., request specific QoS for some flows), this increases the level of in-depth customization available to 5G customers.

For example, a P4 5GLAN program could perform the following:

- * Allow or block flows, and request rules from an SDN controller for each new flow, or for flows to/from specific hosts that needs enhanced security.
- * Forward a copy of some flows towards a node for storage and analysis.
- * Update counters based on specific sources/destinations or protocols, for detailed analytics.
- * Associate traffic between specific endpoints, using specific protocols, or originated from a given application, to a given slice, while other traffic use a default slice.
- * Experiment with a new routing protocol (e.g., ICN), using a P4 implementation of a router for this protocol. (This could use unstructured PDU sessions.)

In the following section we discuss major requirements identified in this use case.

3. Requirements for Mobile Network Programming by Tenants

- * Splitting/Distribution: program logic can be applied exactly once or at least once per packet, while allowing optimal forwarding path by the 5G network.
 - A 5GLAN P4 program may run on a single UPF on a simple setup, but will need to be split in larger setups.
 - It could be possible to split the program manually (i.e., by the programmer based on a model), or automatically (which is studied in [I-D.hsingh-coinrg-reqs-p4comp] and [Sultana]).
- * Multi-Tenancy Support: multiple P4 instances can run on the same 5G network nodes.
 - In [Stoyanov], tenant P4 programs can run within the control of a host P4 program.
- * 5G Network Awareness: a P4 program can be able to influence, and be influenced by, the 5G network service.

- For example, a P4 program may be aware of the slice used by a flow, and possibly influence slice selection.
- Additionally, some information and actions may be available on some nodes and not others. This can impose additional constraints on distributed P4 programs location.
- * Mobility Support: program logic should be applied on all packets of a flow even if the source or destination(s) of the flow is relocated to another attachment point.
- * Security: programs and networks should be protected against security risks, that include overuse or misuse of network resources, injection of traffic, access to unauthorized traffic.

4. Informative References

[I-D.hsingh-coinrg-reqs-p4comp]

Singh, H. and M. Montpetit, "Requirements for P4 Program Splitting for Heterogeneous Network Nodes", Work in Progress, Internet-Draft, draft-hsingh-coinrg-reqs-p4comp-03, 18 February 2021, <<https://www.ietf.org/archive/id/draft-hsingh-coinrg-reqs-p4comp-03.txt>>.

[I-D.irtf-coinrg-use-cases]

Kunze, I., Wehrle, K., Trossen, D., and M. Montpetit, "Use Cases for In-Network Computing", Work in Progress, Internet-Draft, draft-irtf-coinrg-use-cases-00, 17 February 2021, <<https://www.ietf.org/archive/id/draft-irtf-coinrg-use-cases-00.txt>>.

[I-D.ravi-icnrg-5gc-icn]

Ravindran, R., Suthar, P., Trossen, D., Wang, C., and G. White, "Enabling ICN in 3GPP's 5G NextGen Core Architecture", Work in Progress, Internet-Draft, draft-ravi-icnrg-5gc-icn-04, 31 May 2019, <<https://www.ietf.org/archive/id/draft-ravi-icnrg-5gc-icn-04.txt>>.

[Stoyanov]

Stoyanov, R. and N. Zilberman, "MTPSA: Multi-Tenant Programmable Switches", ACM P4 Workshop in Europe (EuroP4'20) , 2020, <<https://eng.ox.ac.uk/media/6354/stoyanov2020mtpsa.pdf>>.

- [Sultana] Sultana, N., Sonchack, J., Giesen, H., Pedisich, I., Han, Z., Shyamkumar, N., Burad, S., DeHon, A., and B.T. Loo, "Flightplan: Dataplane Disaggregation and Placement for P4 Programs", 2020, <<https://flightplan.cis.upenn.edu/flightplan.pdf>>.
- [TS23.501] 501, 3gpp-23., "Technical Specification Group Services and System Aspects; System Architecture for the 5G System; Stage 2 (Rel.17)", 3GPP , 2021, <<https://www.3gpp.org/DynaReport/23501.htm>>.
- [TS23.502] 502, 3gpp-23., "Technical Specification Group Services and System Aspects; Procedures for the 5G System; Stage 2 (Rel.17)", 3GPP , 2021, <<https://www.3gpp.org/DynaReport/23502.htm>>.

Author's Address

Xavier de Foy
InterDigital Communications, LLC
1000 Sherbrooke West
Montreal H3A 3G4
Canada

Email: xavier.defoy@interdigital.com