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Ericsson Microwave Outlook

Supporting network slicing in microwave networks

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Network slicing is gaining momentum as an enabler for new 5G services and market opportunities. It is expected that up to 30 percent of 5G use cases will require network slicing.[1]

Network slicing helps build a customized network that individually serves specific use cases. A network slice is defined as a logical network with a particular set of characteristics, that serves defined business purposes, and consists of all the required network resources configured together – core, RAN and transport.

Figure 10 shows the architecture needed to create the logical networks that will support end-to-end network slicing. Transport is a fully integrated part of the architecture, and must have principles for creating transport services supporting the requirements for a network slice or group of network slices.

> The transport domain must maintain the properties of the network slices it transports.

To achieve this, the transport domain will support sharing, partitioning, monitoring and alignment of transport resources, as well as co-management with core and RAN. We recommend that the support for network slicing in the transport domain is implemented using standard packet technologies, avoiding TDM-like solutions, for efficient use of resources and to avoid the need for large network fork-lifts.

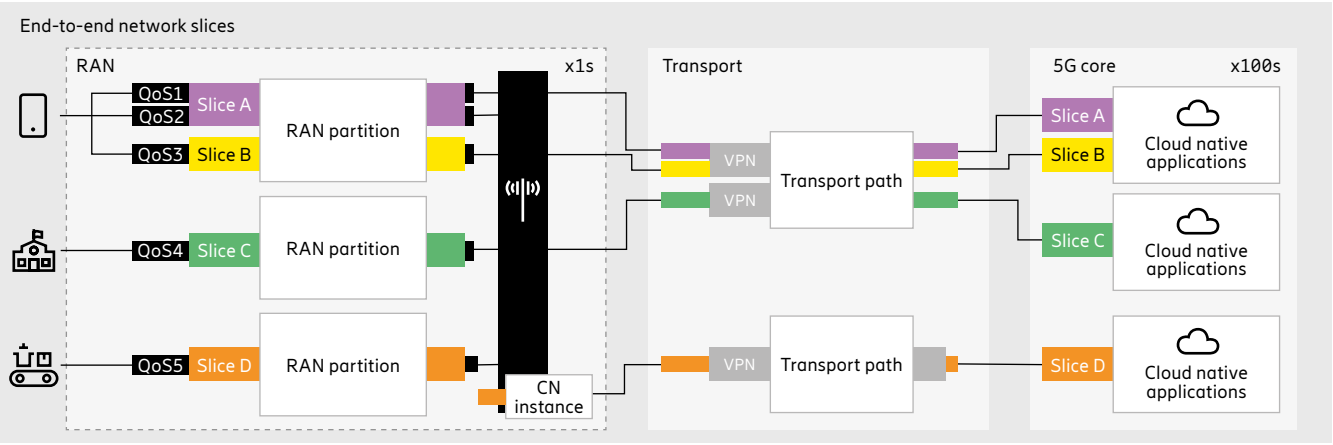
A central concept is to identify which network slice, or group of network slices, a packet arriving at the edge/provider-edge (PE) nodes in the transport network belongs to, allowing for the creation of transport services with the correct service-level characteristics. Figure 11 shows the principles for identification.
It is important that the identifier is located in the packet headers available to the transport nodes – that is, outside of any IPSec (or other) tunnel not terminated in the transport network. This limits the identifier to reside in the ethernet header or the IP header. The identifier can be explicit, meaning that RAN and core adds it specifically for network slice identification; or implicit, where an existing field in the header is also used for slice identification by creating the correct association with core and RAN.

A network slice, or group of network slices, can contain traffic of more than one traffic class, making it necessary to use a hierarchical identification principle. The first identifier points to the network slice and the second to the traffic class, which allows for better hierarchical quality of service (QoS) handling of network slices with multiple traffic classes.

Work is ongoing in standardization bodies to find the most suitable identifier. Possible candidates for the network slice are DSCP only, IP-address, IPv6 flow label or C-VLAN. IP-address and IPv6 flow label can then have DSCP for the traffic classes and C-VLAN PCP.

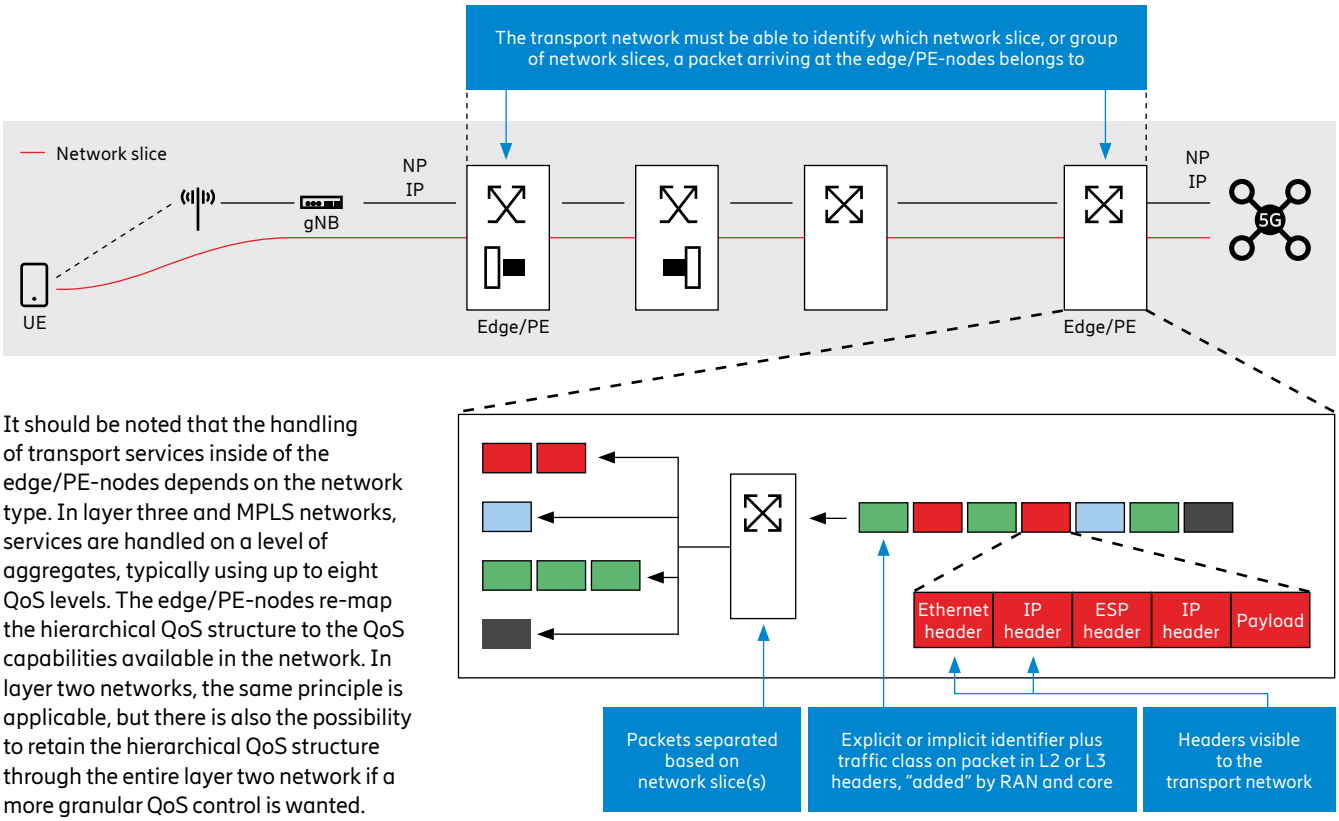
As the packets are identified, they are divided into transport resource partitions. This is a construct containing packets from one or more network slices that should be kept together in the network, due to their similar characteristics. The transport resource partitions are then instantiated as layer two or layer three transport services in the edge/PE-nodes, depending on the service provider's transport network type. Typical transport services would be S-VLANs in layer two networks, the most common network type in microwave networks today, or L3VPNs in layer three networks. If the network slices have very specific requirements, for example for latency, traffic engineering can be required to ensure that the wanted path in the network is followed. Figure 12 shows the transport service instantiation principles.

Figure 10: End-to-end network slicing architecture



[1] Network slicing: A go-to-market guide to capture the high revenue potential. https://foryou.ericsson.com/eso-network-slicing-value-potential-report.html

Figure 11: Packet identification and identifiers



It should be noted that the handling of transport services inside of the edge/PE-nodes depends on the network type. In layer three and MPLS networks, services are handled on a level of aggregates, typically using up to eight QoS levels. The edge/PE-nodes re-map the hierarchical QoS structure to the QoS capabilities available in the network. In layer two networks, the same principle is applicable, but there is also the possibility to retain the hierarchical QoS structure through the entire layer two network if a more granular QoS control is wanted.

To support network slicing, the edge and internal nodes in the transport network need to have the capabilities described, regardless of what transport media technology is used. Globally, many radio base stations currently use microwave technology for their last-mile connectivity, and will continue to do so for 5G.

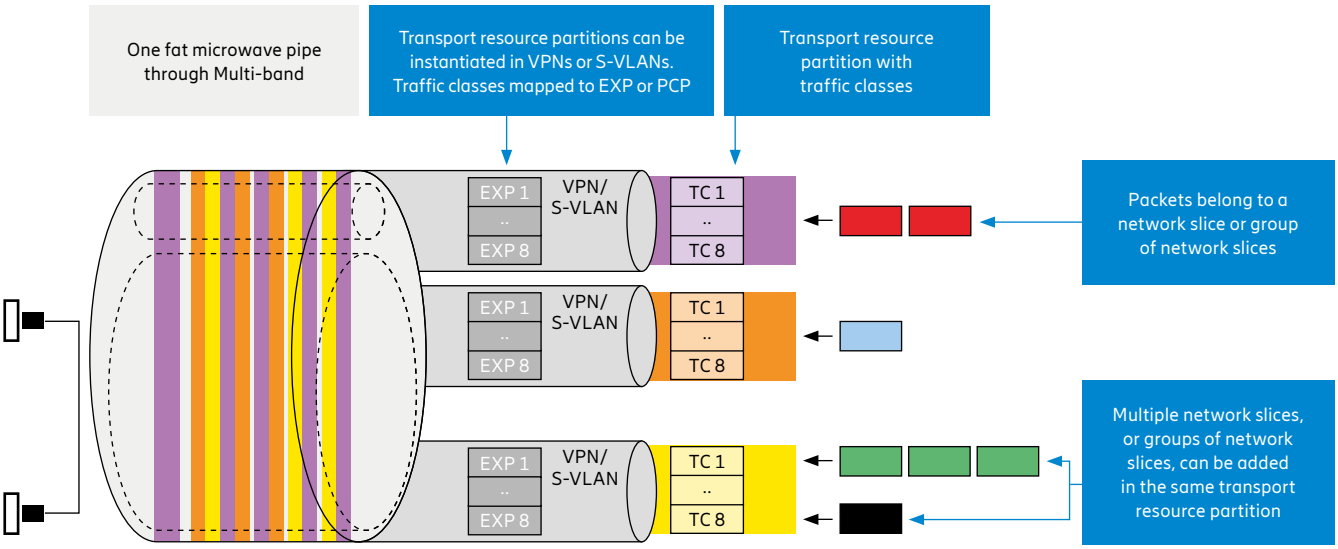
Multi-band technology and E-band are ways of supporting 5G capacities and concepts such as slicing. The microwave technology itself is agnostic to the network slices – instead, it is the node's capabilities as a switch or router, combined with its QoS mechanism both in packet and radio link domains, that are important to consider.

Microwave nodes today typically have all the packet features and packet QoS needed to implement support for network slicing in the transport domain, but it is essential to ensure proper interwork between the internal packet and radio link systems to achieve the wanted combination of bandwidth and QoS. Support for hierarchical QoS will ensure that the node can correctly handle more advanced network slicing applications when being used as edge/PE-nodes.

Figure 12 shows an example where the VPN or S-VLAN services, carrying network slices, are transported over a microwave hop using a Multi-band feature. The Multi-band feature forms a high-capacity fat pipe, where the highest priority traffic will be transmitted over the link with the highest availability. This, together with the nodes hierarchical packet QoS, effectively supports the QoS schemes needed for network slicing.

Microwave technology and microwave nodes are well positioned to support network slicing using standard packet technologies and QoS schemes to ensure successful deployment in 5G networks.

Figure 12: Transport resource partition and instantiation



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