Solution Brief

Intel® Network Builders
Telecommunications

Traffic Engineering for Enhanced Quality of Service in Cloud-Native 5G Networks

Happiest Minds has developed a framework based on Intel® Smart Edge Open to extend traffic engineering from the core to the edge in 5G networks. The solution deploys, configures, and orchestrates network services as containerized cloud-native virtualized network functions (CNFs) that enable robust network slicing to help providers meet real-time traffic demands and to meet service-level agreements (SLAs).

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Communication service providers (CoSPs) building out 5G infrastructures must place premium value on efficiency and elasticity to accommodate an unprecedented number and breadth of diverse network services. One key enabler for that requirement is a fundamental shift to virtualized network components, from the radio access network (RAN) to the 5G core. That transition allows for dynamic network models, defined in software and deployed on general-purpose, standards-based servers, where resources are allocated and provisioned as needed in real time to efficiently meet changing requirements. As a result, CoSPs are able to meet rapidly changing market requirements while optimizing operating costs.

The network edge also plays an expanded role in 5G networks to support novel usages such as IoT edge analytics with lower latency and reduced backhaul requirements. These novel approaches to network topology require seamless orchestration across distributed resources to deliver unified traffic direction and movement. In particular, traffic engineering must expand from its previous focus from the network core alone to the entire network. It must establish optimal routes as virtual networks for specific traffic types, meeting differentiated requirements for throughput, latency, and loss-tolerance.

The Happiest Minds traffic engineering solution helps CoSPs meet customer SLAs and ensure quality of experience for end users across diverse services and traffic types with multiple class of service (CoS) levels, as illustrated in Figure 1. The solution addresses the complexity of this traffic engineering implementation and helps ensure deterministic high performance on Intel® architecture with cloud-like agility by taking advantage of Intel® Smart Edge Open. The Happiest Minds solution architecture is designed explicitly for deployment using CNFs as its fundamental

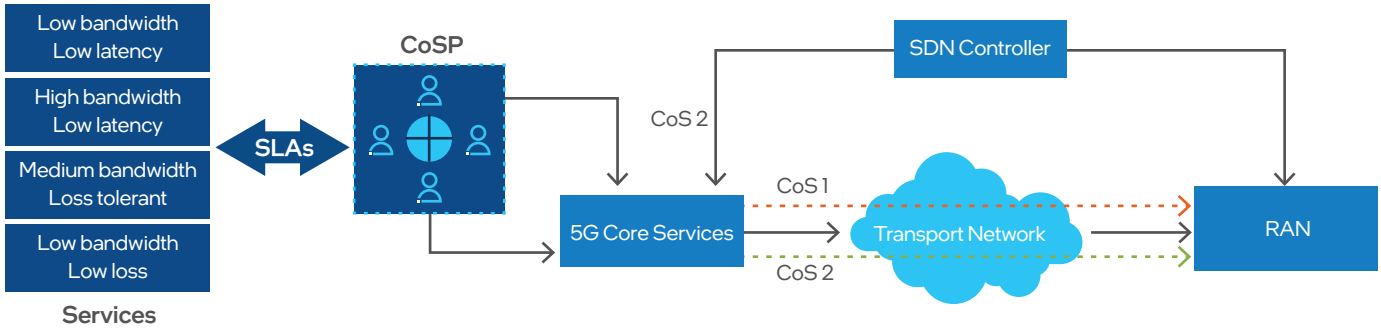

Figure 1. Happiest Minds traffic engineering solution to help meet SLAs and optimize the end-user experience.

building blocks. This lightweight, agile, cloud-native topology helps maximize the ongoing value of infrastructure investments, accelerate time to production for new products and services, and facilitate predictive maintenance for the deployed services.

Enabling Network Services and Applications with Intel® Smart Edge Open

A key challenge in deploying and managing applications and network functions is to maintain platform consistency and scalability across the infrastructure. At the same time, it is challenging to optimize these deployments for throughput, latency, and other key performance indicators (KPIs) while helping deliver low total cost of ownership. The entire undertaking must easily embrace a broad and evolving ecosystem of partners, open-source tools, and third-party commercial solutions.

Intel® Smart Edge Open is a royalty free edge computing software toolkit that enables highly optimized and performant edge platforms to on-board and manage applications and network functions with cloud-like agility across any type of network. The solution offers several open SDKs for usages that include universal consumer premises equipment (uCPE), private networks, and network edge solutions. The SDKs facilitate building solutions across diverse usage models by integrating with popular tools that include OpenVINO, FlexRAN, and Open Visual Cloud. This approach provides a broad, proven foundation for open-ended innovation and allows building a wide set of solutions with edge AI services.

Built on a unified codebase with Intel® Smart Edge Open, Intel® Smart Edge is a commercial software offering for deploying and managing applications and network functions. These capabilities extend across LANs and mobile networks, providing holistic single-pane-of-glass visibility and control. The software provides cloud-like agility for efficient provisioning and maintenance of the infrastructure and the applications running on top of it. As a commercial ready-to-deploy solution, Intel® Smart Edge also offers rapid time to productivity.

Both Intel® Smart Edge Open and Intel® Smart Edge are optimized for the full stack of Intel® platforms, including processors, accelerators, and graphics, as shown in Figure 2. They draw on a broad open source and commercial ecosystem of tools and capabilities. Intel® Smart Edge Open is the catalyst for the Happiest Minds traffic engineering solution. This approach accelerates the process of tailoring deployments to meet the specific and on-demand requirements of the CoSP implementation.

Streamlining Traffic Engineering with the Happiest Minds Solution

The Happiest Minds solution deploys and configures CNF-based 5G network functions and next-generation RAN software components to the distributed unit (DU) and centralized unit (CU) components of the decomposed 5G base station architecture, as illustrated in Figure 3. The solution implements traffic engineering using the Intel® Smart Edge Open Kubernetes control plane and Open API-based network-slice controllers for the RAN, transport, and core.

Traffic steering between the access network and the edge applications implements functionality provided by the application function (AF) and 5G Operation and Management (OAM). The service orchestrator within the CoSP network performs traffic engineering and network slicing. The CoSP orchestrator layer uses Intel® Smart Edge Open controller components to orchestrate network slicing functions. Telemetry from network nodes is monitored by a subscription mechanism, and administrative actions can be scheduled to address deployment issues both proactively and reactively. Core and access networking functions are grouped and deployed at nodes selected to support SLA requirements.

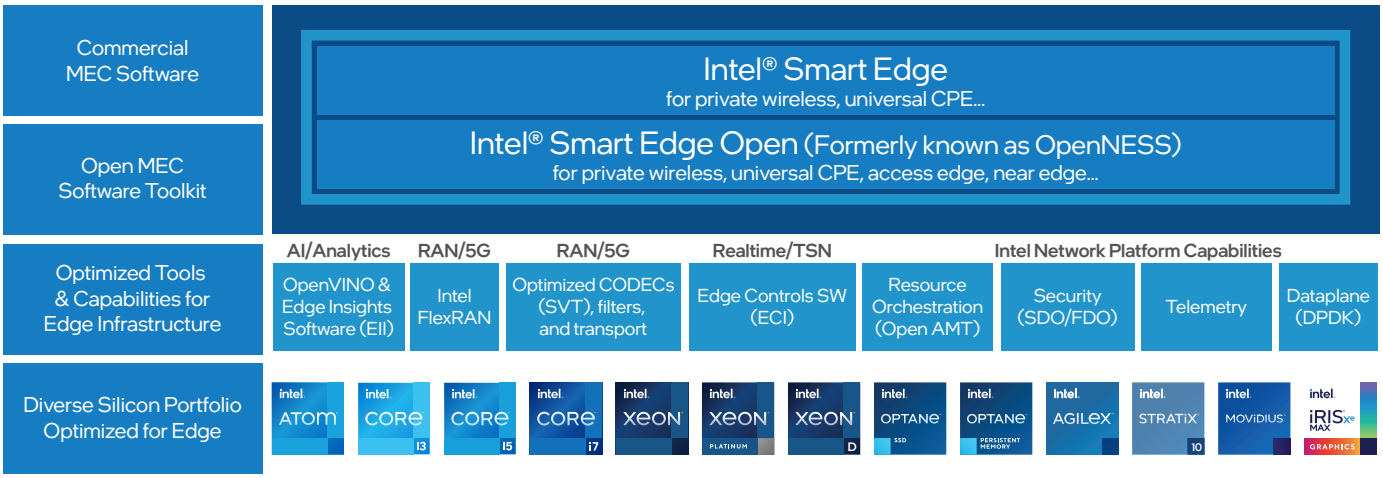

Figure 2. Intel® Multi-Access Edge Computing (MEC) technologies: Intel® Smart Edge and Intel® Smart Edge Open.

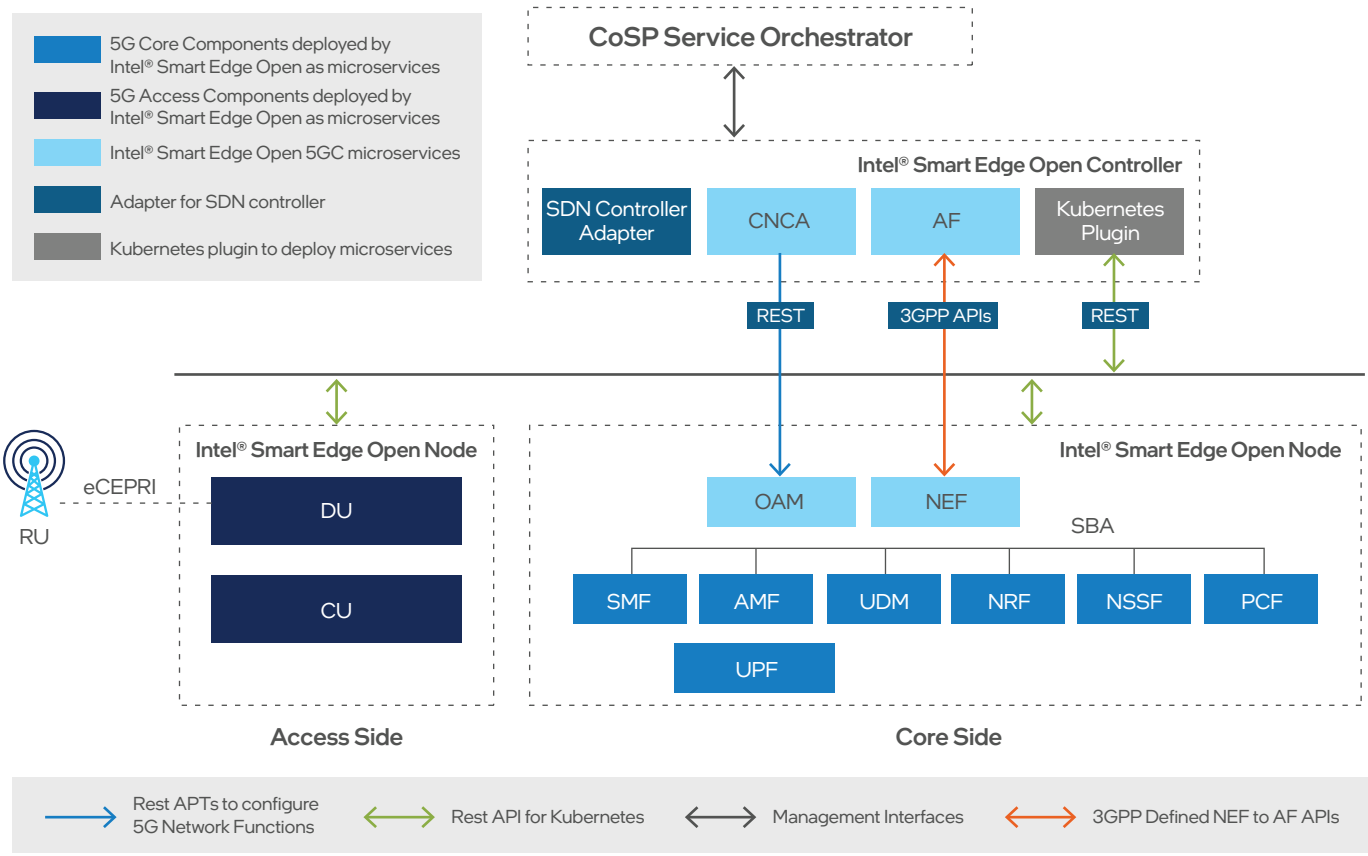

Figure 3. Happiest Minds solution framework.

Implementation Technologies for Traffic Engineering

To adhere to stringent SLAs, 5G services require guaranteed bandwidth, deterministic latency, and efficient, automated means to re-route traffic paths in the event of a network failure or in the case of unmet SLAs. Traffic engineering within the transport network is key to satisfying these goals, enabled by the following technologies from Happiest Minds:

- **Segment Routing Traffic Engineering (SR-TE)** is a source-based routing technique that simplifies traffic engineering and management across network domains. It places the path state information into packet headers at an ingress node.
- **Segment Routing with MPLS** applies segment routing directly to the Multiprotocol Label Switching (MPLS) architecture, with no changes to the forwarding plane. A segment is encoded as an MPLS label.
- **IGP Propagation of SIDs** refers to the use of interior gateway protocol (IGP) to advertise session IDs (SIDs) within the autonomous system. IS-IS or OSPF protocol can be used as an IGP protocol.

Traffic Control and Path Computation

The traffic controller, illustrated in Figure 4, enables the CoSP orchestrator layer to pursue SLA compliance by enabling QoS/CoS on ingress and egress routers.

Software defined network (SDN) controllers can perform standard configuration tasks using NETCONF or custom tasks if needed. The controller in the Happiest Minds solution stack adapts the path computation entity (PCE) to compute the MPLS-Traffic Engineering (MPLS-TE) path, within one domain or across multiple domains (multi-area or multiple ASes). The PCE calculates paths and signals them to the ingress node.

Implementing border gateway protocol link-state (BGP-LS) in the controller provides the PCE with a data source for information such as SID, IP address, etc., as the basis for computation of optimal end-to-end traffic paths. The BGP speaker retrieves information from the IGP link-state database (LSDB) and distributes it to the controllers, either directly or by means of a peer BGP speaker.

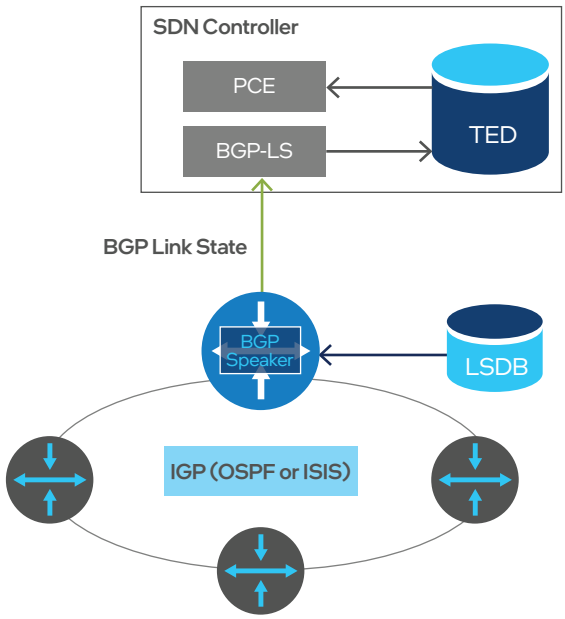

Figure 4. Transport controller.

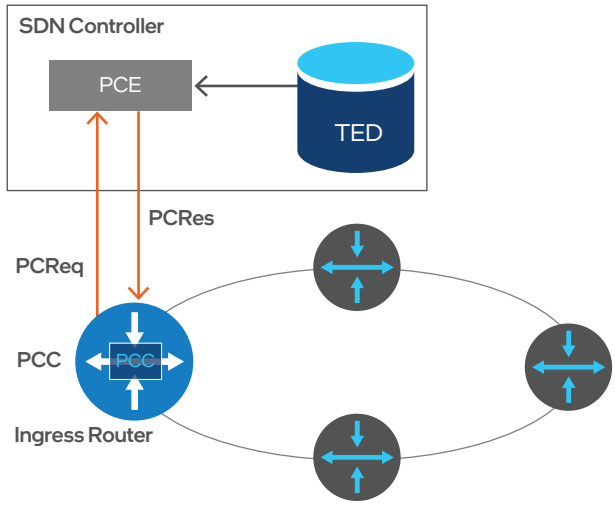

Figure 5. Determining path to destination on ingress router.

The transport controller communicates with the path computation client (PCC) agent on the ingress router, as illustrated in Figure 5, to configure the optimal path, which was computed using the data flow shown in Figure 4.

When a new traffic flow arrives, the ingress router sends a path computation request (PCReq) to the PCE, which uses the information in the request to compute the path. The PCE then communicates the path (or set of paths) back to the PCC in a path computation response (PCRes) message. The ingress router includes the path data as MPLS labels in the packet header.

Conclusion

Using Intel® Smart Edge Open as a catalyst, Happiest Minds has manifested its traffic engineering expertise as a solution offering for CoSPs. Using the Intel® Smart Edge Open Kubernetes control plane and Open API-based network slice controllers, the solution extends traffic engineering beyond the core and throughout the network, helping CoSPs adhere to the rigorous SLAs required for 5G.

More Information

Intel® Network Builders: **networkbuilders.intel.com**

Intel® Smart Edge:
intel.com/content/www/us/en/collections/technology/smart-edge.html?s=Newest%0D

Happiest Minds SDN and NFV: **happiestminds.com/services/sdn-nfv**

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