

## Intel® Ethernet Controller 800 Series - Dynamic Device Personalization (DDP) for Telecommunications Workloads

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### 1 Introduction

This document provides an overview of the Dynamic Device Personalization (DDP) feature for the Intel® Ethernet Controller 800 Series, the next generation of Intel® Ethernet Controllers and Intel® Ethernet Network Adapters. It is designed with an enhanced programmable pipeline. This on-chip capability is called Dynamic Device Personalization (DDP). It allows deeper and more diverse protocol header processing for telecommunications workloads.

The DDP feature has been available with Intel Ethernet Controller 700 Series. With the increasing introduction of denser and performant systems being deployed on a common hardware infrastructure, the bandwidth for packet throughput has dramatically increased. By migrating some complex workloads, such as packet switching and parsing services, to the network interface card (NIC), we can allow CPU cores to be reallocated for other services. This provides an optimized environment for data throughput, which offers potential cost savings.

Dynamic Device Personalization on the Intel Ethernet 800 supports telecommunications-specific protocols such as General Packet Radio Service (GPRS) Tunneling Protocol (GTP), Point-to-Point Protocol over Ethernet (PPPoE), and Multiprotocol Label Switching (MPLS), allowing aspects of these packets to be preprocessed for core execution. This builds on the pre-existing features in the Intel Ethernet Controller 700 Series, where the DDP profiles were specifically focused around GPRS profiles to enhance performance and optimize core utilization for virtualized evolved packet core (vEPC) and multi-access edge computing (MEC) use cases.

It works on top of the existing OS framework and also is compatible with other packet acceleration frameworks such as Data Plane Development Kit (DPDK).

This document is part of the Network Transformation Experience Kit, which is available at <https://networkbuilders.intel.com/network-technologies/network-transformation-exp-kits>.

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## 1.1 Terminology

Table 1. Terminology

| ABBREVIATION | DESCRIPTION                                            |
|--------------|--------------------------------------------------------|
| ADQ          | Application Device Queues                              |
| AVF          | Adaptive Virtual Function                              |
| CNF          | Cloud-Native Network Function                          |
| DDP          | Dynamic Device Personalization                         |
| DPDK         | Data Plane Development Kit                             |
| GTP          | General Packet Radio Service (GPRS) Tunneling Protocol |
| IPsec        | IP Security                                            |
| L2TPv3       | Layer 2 Tunneling Protocol Version 3                   |
| MEC          | Multi-access Edge Computing                            |
| MPLS         | Multiprotocol Label Switching                          |
| NFV          | Network Functions Virtualization                       |
| NIC          | Network Interface Card                                 |
| PFCP         | Packet Forwarding Control Protocol                     |
| PMD          | Poll Mode Driver                                       |
| PPPoE        | Point-to-Point Protocol over Ethernet                  |
| RDMA         | Remote Direct Memory Access                            |
| UPF          | User Plane Function                                    |
| vEPC         | Virtualized Evolved Packet Core                        |

## 1.2 Reference Documentation

Table 2. Reference Documents

| REFERENCE                                                                                                        | SOURCE                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Low Latency 5G UPF Using Priority Based 5G Packet Classification                                                 | <a href="https://networkbuilders.intel.com/solutionslibrary/low-latency-5g-upf-using-priority-based-5g-packet-classification">https://networkbuilders.intel.com/solutionslibrary/low-latency-5g-upf-using-priority-based-5g-packet-classification</a>                                                                                                                                       |
| Intel® Ethernet Controller E810 Technical Library                                                                | <a href="https://www.intel.com/content/www/us/en/design/products-and-solutions/networking-and-io/ethernet-controller-e810/technical-library.html?grouping=EMT_Content%20Type&amp;sort=title:asc">https://www.intel.com/content/www/us/en/design/products-and-solutions/networking-and-io/ethernet-controller-e810/technical-library.html?grouping=EMT_Content%20Type&amp;sort=title:asc</a> |
| Intel® Ethernet Controller E810-CAM2/CAM1/XXVAM2 Product Brief                                                   | <a href="https://cdrdv2.intel.com/v1/dl/getContent/615503">https://cdrdv2.intel.com/v1/dl/getContent/615503</a>                                                                                                                                                                                                                                                                             |
| Intel® Ethernet 800 Series Controllers Migration Guide                                                           | <a href="https://cdrdv2.intel.com/v1/dl/getContent/615266">https://cdrdv2.intel.com/v1/dl/getContent/615266</a>                                                                                                                                                                                                                                                                             |
| Intel® Ethernet Controller E810 Data Plane Development Kit (DPDK) 20.08 Configuration Guide                      | <a href="https://cdrdv2.intel.com/v1/dl/getContent/631612">https://cdrdv2.intel.com/v1/dl/getContent/631612</a>                                                                                                                                                                                                                                                                             |
| Intel® Ethernet Controller E810 Dynamic Device Personalization (DDP) Technology Guide                            | <a href="https://cdrdv2.intel.com/v1/dl/getContent/617015">https://cdrdv2.intel.com/v1/dl/getContent/617015</a>                                                                                                                                                                                                                                                                             |
| Intel® Ethernet Controller E810 Dynamic Device Personalization (DDP) for Telecommunications Technology Guide     | <a href="https://cdrdv2.intel.com/v1/dl/getContent/618651">https://cdrdv2.intel.com/v1/dl/getContent/618651</a>                                                                                                                                                                                                                                                                             |
| Intel® Ethernet 700/800 Series - Dynamic Device Personalization Support for CNF with Kubernetes Technology Guide | <a href="https://dpgresources.intel.com/asset-library/intel-ethernet-controller-700-series-dynamic-device-personalization-support-for-cnf-with-kubernetes-technology-guide/">https://dpgresources.intel.com/asset-library/intel-ethernet-controller-700-series-dynamic-device-personalization-support-for-cnf-with-kubernetes-technology-guide/</a>                                         |
| Container Bare Metal for 2nd Generation Intel® Xeon® Scalable Processor Reference Architecture                   | <a href="https://networkbuilders.intel.com/solutionslibrary/container-bare-metal-for-2nd-generation-intel-xeon-scalable-processor">https://networkbuilders.intel.com/solutionslibrary/container-bare-metal-for-2nd-generation-intel-xeon-scalable-processor</a>                                                                                                                             |
| ICE Poll Mode Driver                                                                                             | <a href="http://doc.dpdk.org/guides/nics/ice.html">http://doc.dpdk.org/guides/nics/ice.html</a>                                                                                                                                                                                                                                                                                             |
| Intel Virtual Function Driver                                                                                    | <a href="http://doc.dpdk.org/guides/nics/intel_vf.html">http://doc.dpdk.org/guides/nics/intel_vf.html</a>                                                                                                                                                                                                                                                                                   |
| DPDK Network Interface Controller Drivers                                                                        | <a href="http://doc.dpdk.org/guides/nics/index.html">http://doc.dpdk.org/guides/nics/index.html</a>                                                                                                                                                                                                                                                                                         |

## 2 Overview

The Intel® Ethernet 800 Series supports multiple port speeds with a single architecture (100/50/25/10/1GbE) as well as providing support for features such as

- Application Device Queues (ADQ)
- Dynamic Device Personalization (DDP)
- Enhanced Data Plane Development Kit (DPDK)
- iWARP and RoCEv2 Remote Direct Memory Access (RDMA)
- Intel® Ethernet Adaptive Virtual Function (Intel® Ethernet AVF)
- Enhanced server virtualization: 256 VFs, 768 VSIs
- Optimized Advanced Transmission Scheduler
- Extensive Network protocol support
- IEEE1588/Precision Time Protocol
- Hardware Root of Trust with Firmware Recovery

For telecommunications-specific workloads, the Intel® Ethernet 800 Series supports the following:

- Flexible Ethernet port configuration with link modes supporting different fan-in or fan-out connections
- With the Intel Ethernet 800 Series' fully programmable pipeline, DDP can add or modify protocols on-demand improving packet processing efficiency
- Enhanced DPDK for network functions virtualization acceleration, advanced packet forwarding, and highly effective packet processing
- IEEE1588 Precision Time Protocol (v1 and v2) with per-packet time stamping

Dynamic Device Personalization (DDP) improves packet processing efficiency with customizable packet filtering. Along with enhanced DPDK, DDP supports advanced packet forwarding and highly efficient packet processing for both cloud and network functions virtualization (NFV) workloads. The introduction of the fully programmable pipeline in the Intel Ethernet 800 Series enhances DDP functionality by increasing the number of protocols that can be added in a DDP profile package. The Intel Ethernet 800 Series firmware can load an enhanced DDP profile with many workload-specific protocols at driver initialization for greater flexibility.

The enhanced DDP profiles provide workload-specific protocols and configuration options, while segment-specific profiles provide greater flexibility for many workload-specific protocols at driver initialization for greater flexibility.

## 3 Use Cases

The following use cases are applicable to profiles on DDP-enabled Intel® Ethernet 800 series network adapters. These features can be utilized to enable cloud-native network functions (CNFs).

### 3.1 Low Latency 5G UPF Using Priority-Based 5G Packet Classification

Intel® Ethernet 800 series demonstrate that low latency and jitter can be achieved for a range of applications when using standard server infrastructure for 5G SA UPF. DDP can effectively classify and steer traffic within the server based on control plane, user plane, or between UPF handover interfaces. By applying a DDP profile to the network controller, the following use cases can be addressed by extending support for protocols:

- 5G GTP support for 5G user plane
- 5G SDAP/PDCP support for 5G NR user plane
- 5G/4G PFCP (CP-UP separation) support
- IP protocols as new flow types, for example L2TPv3, ESP/AH for IPSec

### 3.2 5G UPF – Performance with ASTRI

Intel® Ethernet 800 series provides a 100G network interface to deliver almost line rate throughput into each of the UPF instances while allowing users to offload some of the classification, acceleration, and scheduling from your precious hosts cores.

Demonstration of a UPF scaling to over 1.3 Tbps of network traffic and hitting key performance indicators required by network operators around latency in a scalable and management manner shows significant improvement over previous generations.

For more information on low latency 5G UPFs on DDP enabled Intel® Ethernet 800 series, refer to [Low Latency 5G UPF Using Priority Based 5G Packet Classification](#).

## 4 Deployment

The following section provides details about the telecommunications-specific technical documentation on the Intel Ethernet Controller E810 and DDP. The documents are available in the [Intel® Ethernet Controller E810 Technical Library](#). Some of the key documents in this repository include:

- [Intel® Ethernet Controller E810-CAM2/CAM1/XXVAM2 Product Brief](#)  
This document provides a high-level summary of the features and capabilities of the Intel Ethernet Controller E810-CAM2/CAM1/XXVAM2.
- [Intel® Ethernet 800 Series Controllers Migration Guide](#)  
This document provides an overview for software developers who want to upgrade from the Intel® Ethernet Controller 10 Gigabit 82599 or the Intel® Ethernet 700 Series Controllers to the Intel® Ethernet 800 Series Controllers.
- [Intel® Ethernet Controller E810 Data Plane Development Kit \(DPDK\) 20.08 Configuration Guide](#)  
This document is designed to provide instructions for configuring and testing Intel Ethernet Controller E810 with the Data Plane Development Kit (DPDK).
- [Intel® Ethernet Controller E810 Dynamic Device Personalization \(DDP\) Technology Guide](#)  
The Intel Ethernet 800 Series is designed with an enhanced programmable pipeline, allowing deeper and more diverse protocol header processing. This on-chip capability is called Dynamic Device Personalization (DDP) and is described in this document.
- [Intel® Ethernet Controller E810 Dynamic Device Personalization \(DDP\) for Telecommunications Technology Guide](#)  
This document describes an optional DDP package targeted towards the needs of telecommunication (Comms) customers. In addition to the protocols in the OS-default package, the Comms DDP package (v1.3.20.0) provides support for GTP, PPPoE, Internet Security (IPsec), Layer 2 Tunneling Protocol Version 3 (L2TPv3), Packet Forwarding Control Protocol (PFCP), and MPLS protocols.

The following documents also describe how container workloads can be deployed in an orchestrated environment that can take advantage of the performance improvements by automating the application of DDP profiles and provisioning them to specific containerized applications, as well as how DDP can be enabled as part of the bare metal reference architecture (BMRA).

- [Intel® Ethernet 700/800 Series - Dynamic Device Personalization Support for CNF with Kubernetes Technology Guide](#)  
This document describes how to orchestrate container workloads on a Kubernetes (K8s) cluster that can take advantage of these performance improvements by automating the application of DDP profiles and provisioning them to specific containerized applications.
- [Container Bare Metal for 2nd Generation Intel® Xeon® Scalable Processor Reference Architecture](#)  
This document describes the set of hardware and open-source software components forming the BMRA. The hardware platforms supported are based on 2nd Generation Intel® Xeon® Scalable processors, Intel accelerators, and other advanced Intel platform technologies. In addition, this guide provides access to a set of Ansible scripts that enable automatic and easy provisioning of the BMRA using optimized configurations.

Additional technical documentation on the DPDK Poll Mode Drivers (PMDs) for the Intel Ethernet Controller E810 is available in the [ICE Poll Mode Driver](#) and [Intel Virtual Function Driver](#) sections of the DPDK [Network Interface Controller Drivers](#) guide.

## 5 Summary

The Intel Ethernet Controller 800 Series provides a range of incremental performance improvements when compared with the previous generation. As described above, when employed alongside DPDK and DDP, the Intel Ethernet Controller 800 Series delivers a rich set of services and enhancements for telecommunications-specific workloads and thus provides a performance benefit to network applications. DDP profiles can help engineers to streamline and deploy these services in an orchestrated network.

Intel has generated extensive collateral and this technology guide highlights a set of documents that details the different ingredients needed to deploy a system optimized for DDP on the Intel Ethernet Controller 800 Series, specifically targeted for customers in the telecommunications sphere.



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