5G UPF Acceleration

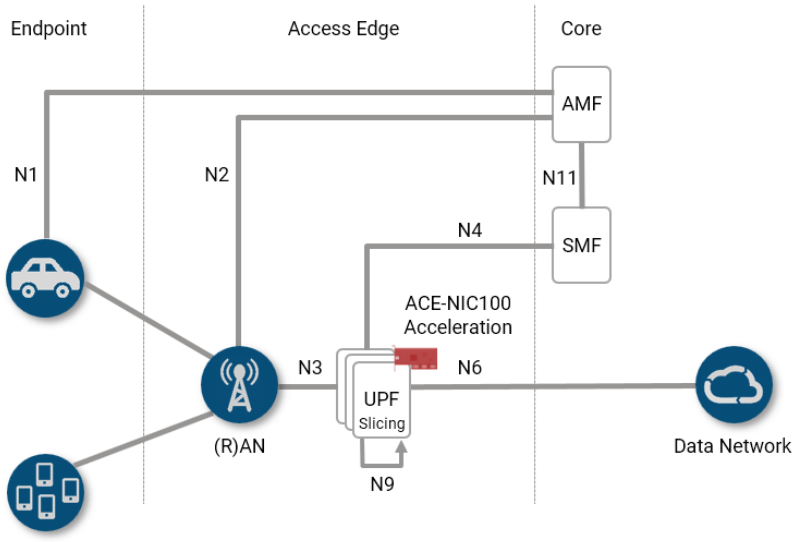
The 3GPP 5G specifications have been evolving in stages into the new CUPS (control and user plane separation) architecture which is fundamental for 5G. The Serving Gateway (SGW) and PDN Gateway (PGW) functions have been split into control and data plane components, with the User Plane Function (UPF) serving as the data path.

By using our field-proven ENET Flow Processor and standard DPDK APIs, Ethernity offers complete offloading of the data plane to our ACE-NIC SmartNICs, assuring accelerated carrier-grade UPF performance at an extremely competitive price. The solution fits the disaggregation approach used by today's leading operators, by enabling the UPF to be placed anywhere in the network, including the network edge, and achieving better performance, reducing networking overhead, and lowering costs. The solution's small footprint and low power requirements are also optimal for network decentralization.

Solution Highlights

- 10/25/40/100Gbps interfaces
- UPF traffic offload and GTP tunnel termination
- Scalable with 100K UEs per ACE-NIC
- Management and control packet identification: AAA, DHCP (native, relay), PFCP
- QoS per UE/bearer, based on L3/L4 and tunnel fields
- Per UE/flow counters for billing
- Support for handover redirect in hardware
- Local switching, and packet duplication for IPTV-IGMP snooping
- IP fragmentation
- IPSec tunnel termination

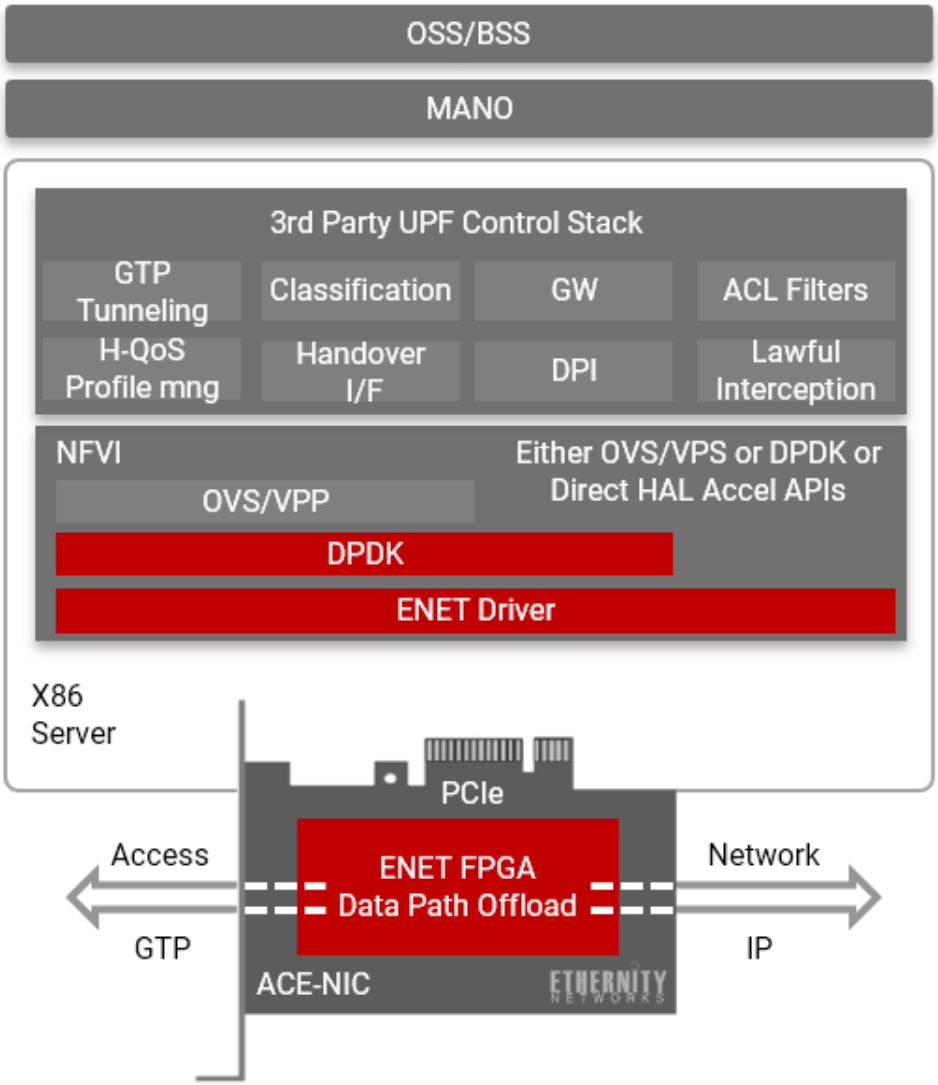
- AMF – Access and Mobility Management Function
- SMF – Session Management Function
- UPF – User Plane Function



Ethernity's FPGA-based ACE-NIC easily integrates with third-party UPF software networking elements from any vendor using common DPDK and SR-IOV interfaces. With our rich ENET capabilities, the ACE-NIC can fully offload the traffic, release CPU cores, enhance scalability, assure deterministic performance, improve latency, and provide future-ready programmability.

Our 5G UPF Acceleration solution supports 5G Quality of Experience (QoE) requirements, including high bandwidth, low latency, dense connectivity, and multitenancy. It enables an easily programmable data path that adapts to a service provider's unique requirements and evolves with the ever-changing architectural requirements of the mobile market.

The ENET data path supports network slicing with extensive multi-tenant control and with service partitioning and isolation features. Our solution supports L2, L3, and MPLS networks, as well as IPSec termination applied at N3IWF POP, and solves the problem of load balancing between different UPFs.



The solution's unique combination of performance and flexibility is enabled by Ethernity's patented ENET Flow Processor technology, which extracts exceptional performance from merchant FPGA silicon at a price point competitive with proprietary ASIC-based network processors. Above and beyond its technical advantages, ENET's extreme efficiency guarantees drastic reductions in both CAPEX and OPEX, and the low-latency data plane provided by the ENET technology enables profit-generating backhaul services. The result is exceptional performance per dollar value.

The solution can be implemented via an FPGA-based Ethernity ACE-NIC SmartNIC solution for accelerating virtual network functions (VNF) or network function virtualization infrastructure (NFVI) based on DPDK. The solution is also available to be implemented via an Ethernity FPGA Flow Processor for standard devices.

Solution Features

Built-in Backhaul Overlay Offload

The in-flow data path processing in Ethernity's 5G UPF Acceleration solution provides various mechanisms traditionally used by mobile operators and offers numerous options for connectivity to satisfy an operator's specific network application scenarios. The Ethernity switch-router includes GTP encapsulation with GRE or VxLAN, and by combining standard GTP with IPSec tunneling, operators can securely support Next Generation networks. Using IPSec on NIC termination solves the load balancing problem between different VNFs.

Improves Resource Utilization

By partially or fully offloading resource-consuming virtual functions to the FPGA, ENET technology eliminates the heavy load on the CPU. This hardware acceleration means that under similar conditions there are many more resources available for user sessions with deterministic results for throughput and lower latency.

Enables Flexible Flow Management and Simplifies Orchestration

The ACE-NIC SmartNIC within the Ethernity 5G UPF Acceleration solution provides all aspects of fault, configuration, accounting, performance, and security information to the control stack using various APIs, including DPDK and CLI. Furthermore, the ACE-NIC SmartNIC offers a version equipped with an Intel controller that enables build-in integration into any Open Stack or Kubernetes environment with DPDK and SR-IOV.

Precise Network Measurement Techniques

Management functions are streamlined through massive Prob analyses for both L2 and L3, including delay and loss measurement with 3.3us CCM. Additional functions, such as BFD, are easily programmed into the FPGA to ensure SLA for thousands of simultaneous customers, and elements like RFC2544, and TWAMP can be added to embedded engines upon request for network testing.

Multiple Deployment Options

A programmable FPGA data plane decouples network functions from the hardware to provide a service-based, modular design that includes control plane and user plane separation and promises deterministic performance at the point of QoE. This approach allows efficient development and deployments of the new CUPS model that are aligned with the latest 3GPP network architecture and TCO requirements for carriers and ISPs.

Traffic Flow Management

The ENET data path manages the following types of traffic flows:

- N3 interface can be associated with different UPFs by running one of them as uplink classifier, based on tunnel information
- N9 classifier can run N9 connection to another UPF with different PDU session anchors (1,2,3,4…) implemented by multiple bridge domains or VRFs
- N6 interface between the UPF and data network, can provide various options for connectivity by L2, L3, or MPLS
- N4 SMF (Session Management Function) management and monitoring of any PDU sessions detected by the UPF

System Configurations

SmartNIC	4 x SFP+ interfaces (40Gbps) 2 x SFP28 (50Gbps) 2 x QSFP28 interfaces (100Gbps)
Flow Processor	Starting from 20Gb throughput, customized according to selection of FPGA and specific customer requirements

Please contact your Ethernity sales representative for more detailed technical discussions of our solution's key capabilities.