The QorIQ T1 family of communications processors combines up to four 64-bit cores, built on Power Architecture® technology, with high-performance Data Path Acceleration Architecture (DPAA) and network peripheral bus interfaces required for networking and telecommunications.

OVERVIEW
This scalable, pin-compatible family features the industry’s first 64-bit embedded processor with an integrated Gigabit Ethernet switch, the T1040 (and dual-core T1020), which simplifies hardware design, reduces power and overall system cost.

TARGET MARKETS AND APPLICATIONS
The T1 family is ideally suited for use in mixed control and data plane applications such as fixed routers, switches, Internet access devices, firewall and other packet filtering applications, as well as general-purpose embedded computing. Its high level of integration offers significant performance benefits and greatly helps to simplify board design.

- **Enterprise equipment**: Fixed routers, Ethernet switches, UTM equipment
- **Service provider**: Edge routers, mobile backhaul
- **Aerospace, defense and government**: Ruggedized network appliances
- **Industrial computing**: Single board computers, factory automation, smart grid
The T1 family is based on the 64-bit e5500 Power Architecture core, which uses a seven-stage pipeline for low latency response to unpredictable code execution paths, boosting single-threaded performance.

**e5500 Core Features**
- Supports up to 1.5 GHz core frequencies
- Tightly coupled low latency cache hierarchy
- 32 KB I/D (L1), 256 KB L2 per core
- Up to 256 KB of shared platform cache (L3)
- 3.0 DMIPS/MHz per core
- Up to 64 GB of addressable memory space
- Hybrid 32-bit mode to support legacy software and seamless transition to 64-bit architecture

**VIRTUALIZATION**
The T1 family includes support for hardware-assisted virtualization. The e5500 core offers an extra core privilege level (hypervisor). Virtualization software for the T1 family includes kernel-based virtual machine (KVM), Linux® OS containers, NXP hypervisor and commercial virtualization software from Green Hills® Software and Enea®.

**DATA PATH ACCELERATION ARCHITECTURE (DPAA)**
The T1 family integrates the QorIQ DPAA, an innovative multicore infrastructure for scheduling work to cores (physical and virtual), hardware accelerators and network interfaces.

**DPAA HARDWARE ACCELERATORS**

<table>
<thead>
<tr>
<th>Frame manager (FMAN)</th>
<th>13 Gb/s classify, parse and distribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buffer manager (BMAN)</td>
<td>64 buffer pools</td>
</tr>
<tr>
<td>Queue manager (QMAN)</td>
<td>Up to 2^15 queues</td>
</tr>
<tr>
<td>Security (SEC)</td>
<td>5 Gb/s: 3DES, AES</td>
</tr>
</tbody>
</table>

**QorIQ T1040 AND T1042 COMMUNICATIONS PROCESSORS**

**T1 FAMILY FEATURE LIST**

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two or four e5500 single-threaded cores built on Power Architecture® technology</td>
<td>Up to 1.5 GHz with 64-bit ISA support</td>
</tr>
<tr>
<td>CoreNet platform cache</td>
<td>256 KB shared platform cache</td>
</tr>
<tr>
<td>Hierarchical interconnect fabric</td>
<td>CoreNet fabric supporting coherent and non-coherent transactions with prioritization and bandwidth allocation amongst CoreNet endpoints</td>
</tr>
<tr>
<td>64-bit DDR3L/4 SDRAM memory controller with ECC support</td>
<td>Up to 1600 MT/s</td>
</tr>
<tr>
<td>DPAA incorporating acceleration for the following functions</td>
<td>Packet parsing, classification and distribution</td>
</tr>
<tr>
<td>SerDes</td>
<td>Eight lanes at up to 5 Gb/s</td>
</tr>
<tr>
<td>Ethernet interfaces</td>
<td>8-port Gigabit Ethernet switch (available with T1040 and T1020 only)</td>
</tr>
<tr>
<td>QUIICC Engine module</td>
<td>Support for legacy protocols TDM, HDLC, UART and ISDN</td>
</tr>
<tr>
<td>High-speed peripheral interfaces</td>
<td>Four PCI Express 2.0 controllers</td>
</tr>
<tr>
<td>Additional peripheral interfaces</td>
<td>Two serial ATA (SATA 2.0) controllers</td>
</tr>
<tr>
<td>DMA</td>
<td>Dual four channel</td>
</tr>
<tr>
<td>Support for hardware virtualization and partitioning enforcement</td>
<td>Extra privileged level for hypervisor support</td>
</tr>
<tr>
<td>QorIQ trust architecture</td>
<td>Secure boot, secure debug, tamper detection, volatile key storage</td>
</tr>
</tbody>
</table>
The FMAN, a primary element of the DPAA, parses headers from incoming packets, then classifies and selects data buffers with optional policing and congestion management. The FMAN passes its work to the QMAN which assigns it to cores or accelerators with a multilevel scheduling hierarchy.

**GIGABIT ETHERNET SWITCH**

The T1040 and T1020 processors include an integrated gigabit Ethernet switch that supports wire-speed switching for all packet sizes. Other features include VLAN, QoS processing and ACLs.

**SYSTEM PERIPHERALS AND NETWORKING**

For networking, the FMAN supports up to five 1 Gb/s MAC controllers that connect to PHYs, switches and backplanes over RGMII and SGMII. The T1040 and T1020 processors also include an integrated 8-port Gigabit Ethernet switch, which supports QSGMII or SGMII interfaces. High-speed system expansion is supported through three PCI Express® V2.0 controllers that support a variety of lane widths. Other peripherals include SATA, SD/MMC, i²C, UART, SPI, NOR/NAND controller, GPIO and a 1600 MT/s DDR3L/4 controller.

**SOFTWARE AND TOOL SUPPORT**

NXP and our partner network deliver a wide range of tools, run-time software, reference solutions and services to accelerate your designs.

- QorIQ reference design boards
- CodeWarrior Development Studio for Power Architecture
- NXP Linux SDK
- Reference Platforms
  - Enterprise WLAN Access Point
  - VortiQa Application Software
  - AIS—Application Identification Software
  - Enterprise Software for Networking
  - ONS—Open Network Switch Software
  - OND—Open Network Director Software
- Professional Services & Support
  - Commercial Services
  - Linux SDK Support Package
  - Reference Design Software (RDS) Support Package
- Third Party Software and Tools
  - Enea, Green Hills, Mentor Graphics and Wind River