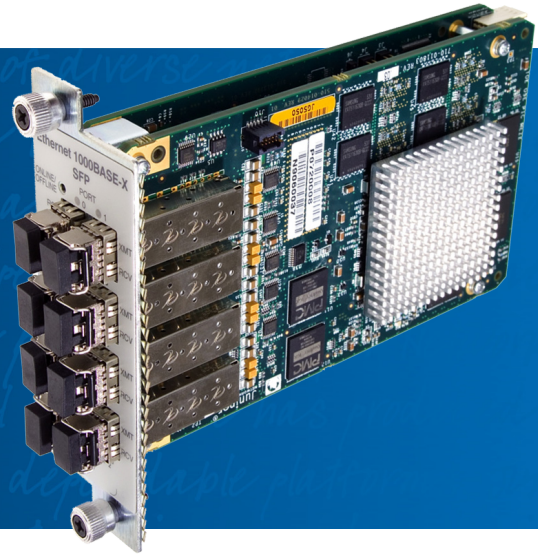


# IQ2 ETHERNET SERVICES ENGINE (ESE) PIC



## Product Overview

The Juniper Networks IQ2 PIC family introduces the Ethernet Services Engine (ESE), applying a set of hierarchical quality of service (QoS), fine-grained queuing and oversubscription capabilities to address the challenging Ethernet applications faced by service providers and enterprises. Key applications include service aggregation for the multiplay needs of business and residential users, MPLS services at Layers 2 and 3, and the convergence of legacy transport such as Asynchronous Transfer Mode (ATM) and Frame Relay over Ethernet. IQ2 PICs are also ideal for data center applications, connecting broadband applications to the multiservice edge, or linking aggregation nodes to core routers or the Internet. The ESE design provides customizable service intelligence through programmable interface processors. IQ2 PICs enhance your service delivery offerings while minimizing total cost of ownership (TCO).

## Product Description

The Juniper Networks® IQ2 ESE PIC product family is a suite of highly sophisticated hardware and software modules that implement the next generation of QoS, traffic management and intelligent oversubscription capabilities. The product suite consists of four PICs:

- A 4-port Gigabit Ethernet PIC supporting up to 4:1 oversubscription
- An 8-port Gigabit Ethernet PIC supporting up to 2:1 oversubscription
- An 8-port Gigabit Ethernet PIC supporting line rate performance on all interfaces
- A single port 10 Gigabit Ethernet PIC supporting line rate performance

Juniper Networks innovative IQ2 ESE PIC family extends the latest technical advancements in Ethernet technology. Combined with the widely deployed Juniper Networks M Series Multiservice Edge Routers and T Series Core Routers, carrier-class JUNOS® Software, and scalable MPLS/VPLS (virtual private LAN service) control plane, it creates a cost-effective, Ethernet-optimized infrastructure. This provides a true next-generation carrier grade Ethernet solution and helps Juniper Networks customers align their network infrastructures to their unique business objectives.

Leveraging Juniper Networks advanced ESE technology, the IQ2 ESE PIC applies a rich set of QoS features and hierarchical traffic management capabilities that underpin the assured delivery of high value multiplay services. The ESE platform is software programmable, increasing investment protection by permitting the future addition of new features via new software releases. Further, two of the IQ2 ESE PICs support Intelligent Oversubscription, a key feature that enables cost-effective support for more customers and more services per customer (for example, a variety of multimedia services per Gigabit Ethernet interface).

The IQ2 ESE PIC family addresses the demanding QoS and performance requirements associated with the delivery of high value multiplay services and was designed to meet the unique requirements of both the service provider and enterprise network environments.

## Architecture and Key Components

### Gigabit Ethernet IQ2 ESE PIC Modules with Intelligent Oversubscription

Juniper Networks Gigabit Ethernet IQ2 ESE PICs with Intelligent Oversubscription are deployed most often as customer-facing interfaces that aggregate Ethernet traffic in the metro network and extend QoS support to thousands of L2 VPNs. The oversubscription capability enables M and T Series routers to support more Ethernet ports per PIC, per slot and per system. This improved density translates into lower costs per Gigabit Ethernet port. Further, many access switches and routers do not support line rate Gigabit Ethernet throughput, and the IQ2 ESE PICs can leverage Intelligent Oversubscription to aggregate traffic cost-effectively from these devices.

Two IQ2 ESE PICs support Gigabit Ethernet Intelligent Oversubscription:

- Type 1 PIC with 4 Gigabit Ethernet ports, supporting up to 4:1 oversubscription
  - Requires small form-factor pluggable (SFP) transceivers (SX, LX, LH and copper types are supported and available)
  - Available on M7i, M10i, M40e, M320, T320, T640, T1600 and TX Matrix routing platforms
- Type 2 PIC with 8 Gigabit Ethernet ports, supporting up to 2:1 oversubscription
  - Requires small form-factor pluggable (SFP) transceivers (SX, LX, LH and copper types are supported and available)
  - Available on M40e, M320, T320, T640, T1600 and TX Matrix routing platforms

### Line Rate Gigabit Ethernet Module

Line rate Gigabit Ethernet performance is important for aggregating access switches and routers that support line rate Gigabit Ethernet throughput, providing Ethernet connectivity between multiservice edge MSE and provider edge (PE) routers and core routers, and for ensuring intra-point of presence (POP) Ethernet connectivity.

The Juniper Networks Type 3 PIC with 8 ports of Gigabit Ethernet:

- Supports line rate throughput
- Requires small form-factor pluggable (SFP) transceivers (SX, LX, LH and Copper types are supported)
- Available on M40e, M320, T320, T640 and TX Matrix routing platforms

### Line Rate 10 Gigabit Ethernet

Line rate 10 Gigabit Ethernet performance is critical in applications and locations that require the highest bandwidth Ethernet connectivity; such as:

- Between MSE and PE routers and core routers
- Between core routers, and between core routers in peering applications
- At Internet hand-off locations
- At hand-offs to optical network infrastructure

The Juniper Networks Type 3 PIC with a single 10 Gigabit Ethernet port:

- Supports line rate throughput
- Requires X Form-factor Pluggable (XFP) optics (SR and ER optics are supported)
- Are available on M320, T320, T640 and TX Matrix routing platforms

## Features and Benefits

### Highly Granular QoS

Juniper Networks IQ2 ESE PICs have a comprehensive QoS implementation that supports hierarchical queuing with up to eight queues per VLAN. This provides queuing, shaping, scheduling, policing and dropping, per VLAN or group of VLANs (logical interface), with separate hierarchies for ingress and egress traffic that can be configured independently (see figure 1).

This exceptionally sophisticated QoS implementation maximizes service revenue potential and service differentiation. It enables the Juniper Networks M and T Series to support more customers and more VLANs/logical interfaces per port, per PIC, per slot, per shelf and per system. It is optimized for multiplay services by enabling the resource efficient intelligence sharing of excess bandwidth based on the committed information rate (CIR) assigned to each VLAN/logical interface and each queue within a VLAN.

### Extensive IEEE 802.1Q VLAN Support

The Juniper Networks IQ2 ESE PIC can add, remove and modify VLAN tags, stacked VLAN tags, and 802.1p bits, thereby flexibly extending the VLAN addressing space to service provider scale. This flexibility permits service providers to manipulate flows independent of customer VLAN markings. When combined with support for Layer 2 to Layer 3 class-of-service (CoS) mapping, these features effectively enable end-to-end QoS for a wide variety of business and residential services.

### Service-Rich JUNOS Software Support

The full portfolio of JUNOS Software features extends to IQ2 ESE PICs, including all VPN, MPLS, VPLS and IPv4/IPv6 capabilities. Using a single, common JUNOS release across both M and T Series routers provides concurrent support for both traditional and Ethernet-based service interfaces and services. This approach provides consistency across all interfaces, increases service reliability and simplifies service configuration.

Virtual private LAN service (VPLS) support underpins multipoint-to-multipoint (MP2MP) Ethernet service offerings, using IP and a tunnel mechanism (typically MPLS) to enable standards based intra- and inter-metro MP2MP services that make the MPLS infrastructure appear as an extension of the LAN to end customers. VPLS and MPLS support broadens the service provider's options and increases competitive service differentiation.

Additionally, Ethernet frames can be supported across an MPLS network via a number of different Layer 2 VPN solutions such as Layer 2 draft Martini circuits, Layer 2 draft Kompella VPNs, and Circuit Cross-Connect (CCC). Support for the L2 VPN approaches also broadens service providers' options and increases competitive service differentiation, enabling them to address diverse business and technical requirements using the same infrastructure.

### Software Programmable Ethernet Services Engine

Juniper Networks software programmable ESE distributes packet processing, QoS and traffic engineering functions to each PIC (in addition to the inherent packet processing and QoS capabilities of the M and T series routers), enabling predictable high performance for all applications at scale. Further, software programmability offers investment protection and simplifies network upgrade processes.

### Modular and Incremental Ethernet investment

The Juniper Networks IQ2 ESE PIC non-disruptively adds Ethernet services to deployed M and T Series routers. This provides investment protection while preserving pre-existing revenue generating Frame Relay, ATM, SONET and/or time-division multiplexing (TDM) services. The modular IQ2 ESE PIC enables customers to purchase Ethernet interfaces efficiently by allowing them to buy only in the quantities they need via an efficient "pay as you grow" model.

### Intelligent Oversubscription

The oversubscription feature enables M and T Series routers to support more ports per PIC, slot and system, with a lower cost per port. The Type 1 and Type 2 IQ2 ESE PICs support Intelligent Oversubscription. If the data rate of the ports exceeds the capacity of the PIC-FPC interface, lower priority traffic is dropped in an intelligent fashion, ensuring that higher priority traffic is forwarded without interruption. Since many Gigabit Ethernet access facing ports do not require full Gigabit line rate throughput, and many access switches and routers do not support line rate Gigabit Ethernet throughput, the IQ2 ESE PICs can leverage Intelligent Oversubscription to aggregate traffic cost-effectively from these devices. This means that more Ethernet ports can be supported per PIC and per system, thereby reducing cost per port by spreading system costs across a greater number of ports.

### Detailed Accounting Features

The Juniper Networks IQ2 ESE PIC family supports robust per-Media Access Control (MAC) and per-VLAN accounting, including accounting details for stacked VLAN and the association of MAC counters with a VLAN pair (inner and outer VLAN tag). These details simplify service monitoring and accounting tasks. They also can serve in gathering statistics to ensure that trends are anticipated and capacity is in place to meet forecasted demand.

### Higher Port Density

The high-density IQ2 ESE PIC interfaces coupled with the ability to mix and match up to four IQ2 ESE PICs within a single flexible PIC concentrator (FPC) slot improves interface concentration and scale. These features increase configuration flexibility by enabling service providers to mix different speeds, technologies

and IP services to accommodate diverse technical requirements in an efficient manner, without consuming an entire FPC slot. Further, the IQ2 ESE PICs use standard-based SFP and XFP interfaces, which further increase configuration flexibility and reduce the OPEX associated with maintaining spares.

### Ethernet Aggregation at the Multiservice Edge

The M Series Multiservice Edge router, equipped with the 4-port and/or 8-port Ethernet IQ2 ESE PICs supporting Intelligent Oversubscription, provides higher density Ethernet configurations at a lower price per port when compared to previous Ethernet-based IQ PICs. Leveraging their Intelligent Oversubscription and enhanced service density capabilities, the IQ2 ESE PICs are optimized for metro-Ethernet aggregation applications where access links typically do not require line rate throughput. This enables cost-effective support for the delivery of advanced VPLS and MPLS-based services to a high number of customers per Gigabit Ethernet port.

As the IP/MPLS core scales to accommodate converged voice/video/data services, intra-POP connections between core routers and edge aggregation routers also must scale. Gigabit Ethernet IQ2 ESE PICs in the M Series routers aggregate metro traffic onto 10 Gigabit Ethernet IQ2 ESE PICs for high-speed hand-off to T Series Core Routers in the network core. This application leverages the line rate WAN PHY capabilities of the 10 Gigabit Ethernet IQ2 ESE PIC.

### Frame Relay and ATM Network and Service Migration to Ethernet

The IQ2 ESE PIC product family enables M and T Series routing to migrate from legacy networks and services to a converged network architecture based on Ethernet, MPLS, VPLS and IP. This is a key advantage, for it reduces both CAPEX and OPEX associated with legacy Frame Relay and ATM networks while enabling the smooth transition to carrier-grade Ethernet access networks.

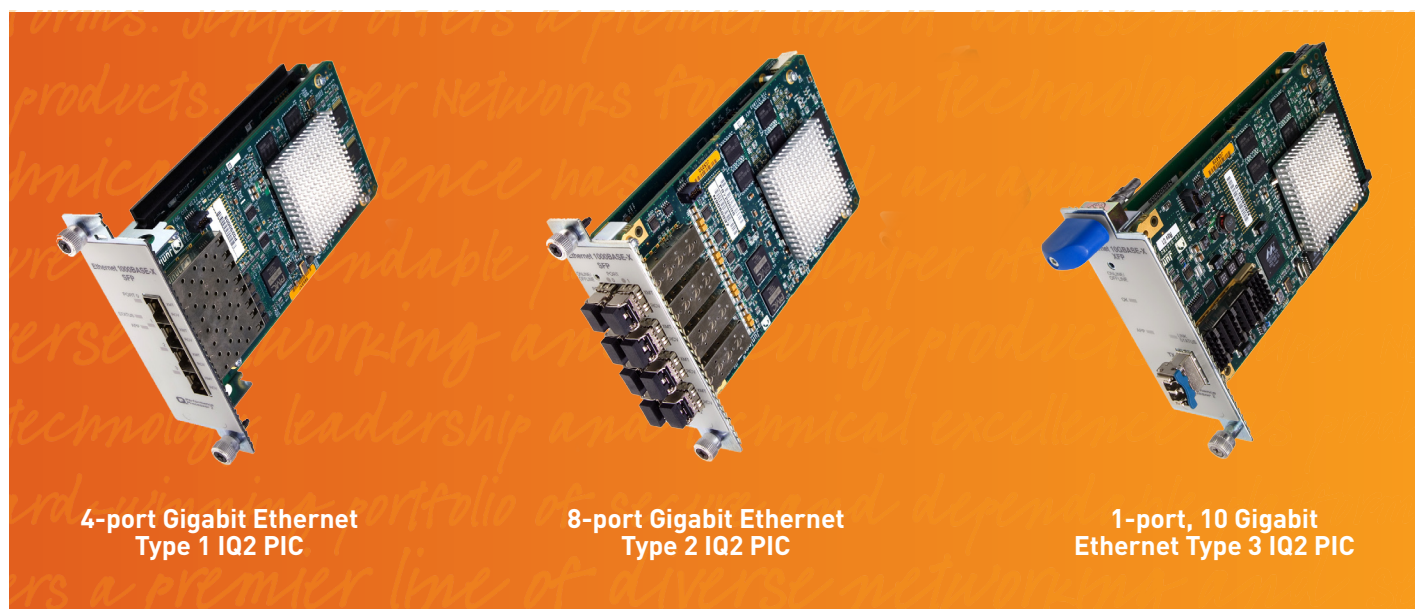
The Juniper Networks IQ2 ESE PIC family supports up to eight unique classes of service per VLAN and VPN, each with an independently defined committed information rate (CIR) and peak information rate (PIR) parameter. This, coupled with ingress and egress traffic management capabilities, the intelligent sharing of excess bandwidth and intelligent oversubscription support extends Frame Relay and ATM traffic management concepts to Ethernet. It ensures the maintenance of CIRs for all flows during periods of congestion, while delivering additional bandwidth up to the peak information rate (PIR) when the capacity exists—a very compelling and resource-efficient capability.

Further, the M and T Series support this Frame Relay to ATM migration with a variety of mechanisms:

- A broad array of ATM, Frame Relay, TDM and SONET interfaces
- Layer 2.5 VPN interworking
- Ethernet L2 VPNs and an unparalleled MPLS/VPLS feature set
- A Frame Relay/ATM Services Emulation toolkit (J-FASE)
- Robust support for IP VPNs, security, firewall, Network Address Translation (NAT), and all other service features over Ethernet interfaces

The table below summarizes the key features and benefits brought to bear by Juniper Networks IQ2 PIC technology.

FEATURE	FEATURE DESCRIPTION	BENEFIT
<b>Hierarchical Traffic Management</b>	The IQ2 ESE PICs family supports hierarchical queuing with up to eight queues per VLAN.	Supports multiple tiered services per customer and numerous customers per Ethernet port
<b>Fine Grain Queuing with Scalability and Performance on Egress and Ingress</b>	Provides queuing, shaping, scheduling, policing and dropping, per VLAN or group of VLANs (logical interface), with separate hierarchies for ingress and egress traffic that can be configured independently.	Enables Juniper Networks M and T Series routers to support more customers and more VLANs/ logical interfaces
<b>Intelligent Oversubscription</b>	If the data rate of the ports exceeds the capacity of the PIC-FPC interface, lower priority traffic is dropped in an intelligent fashion, ensuring that higher priority traffic is forwarded without interruption.	<ul style="list-style-type: none"> <li>Enables resource efficient intelligent sharing of excess bandwidth</li> <li>Enables M and T Series routers to support more customers per system cost-efficiently</li> </ul>
<b>Ethernet Services Engine Technology</b>	Juniper Networks software programmable ESE distributes packet processing, QoS and traffic engineering functions to each PIC (in addition to the inherent packet processing and QoS capabilities of the M and T Series routers), enabling predictable high performance for all applications at scale.	<ul style="list-style-type: none"> <li>Enables predictable high performance at scale</li> <li>Provides a level of software programmability that offers investment protection and simplified upgrade process</li> </ul>





## Specifications

### Physical (W x H x D)

- 4 x 1 x 7 in (10.16 x 2.54 x 17.78 cm)

### MIB Support

- Interface-MIB (RFC1573)
- Etherlike-MIB (RFC2666 and RFC3635)
- Any Juniper MIBs supported on Ethernet IQ PICs

### Mean Time Between Failures (MTBF)

200,000 hours

### Agency Approvals

#### Safety

- CAN/CSA-C22.2 No. 60950-00/UL 60950 – Third Edition, Safety of Information Technology Equipment
- EN 60825-1 Safety of Laser Products – Part 1: Equipment Classification, Requirements and User's Guide
- EN 60825-2 Safety of Laser Products – Part 2: Safety of Optical Fibre Communication Systems
- EN 60950, Safety of Information Technology Equipment

#### Electromagnetic Compatibility (EMC)

- AS/NZS 3548 Class A (Australia/New Zealand)
- BSMI Class A (Taiwan)
- EN 55022 Class A Emissions (Europe)
- FCC Part 15 Class A (USA)
- VCCI Class A (Japan)

### Agency Approvals

#### Immunity

- EN 61000-3-2 Power Line Harmonics
- EN 61000-4-2 ESD
- EN 61000-4-3 Radiated Immunity
- EN 61000-4-4 EFT
- EN 61000-4-5 Surge
- EN 61000-4-6 Low Frequency Common Immunity
- EN 61000-4-11 Voltage Dips and Sags

#### Network Equipment Building System (NEBS)

- Designed to meet these standards
- GR-63-CORE: NEBS, Physical Protection
- GR-1089-CORE: EMC and Electrical Safety for Network Telecommunications Equipment
- SR-3580 NEBS Criteria Levels (Level 3 Compliance)

#### European Telecommunications Standardization Institute (ETSI)

- ETS-300386-2 Telecommunication Network Equipment Electromagnetic Compatibility Requirements

## Performance-Enabling Services and Support

Juniper Networks is the leader in performance-enabling services and support, which are designed to accelerate, extend, and optimize your high-performance network. Our services allow you to bring revenue-generating capabilities online faster so you can realize bigger productivity gains, faster rollouts of new business models and ventures, and greater market reach, while generating higher levels of customer satisfaction. At the same time, Juniper Networks ensures operational excellence by optimizing your network to maintain required levels of performance, reliability, and availability. For more details, please visit [www.juniper.net/products-services](http://www.juniper.net/products-services).

## Ordering Information

MODEL NUMBER	DESCRIPTION	ROUTING PLATFORMS
PE-4GE-TYPE1-SFP-IQ2	4-port Gigabit Ethernet Type 1 IQ2 PIC: Supports up to 4:1 oversubscription; requires SFP modules; requires JUNOS 7.6 or higher	M7i M10i
PB-4GE-TYPE1-SFP-IQ2	4-port Gigabit Ethernet Type 1 IQ2 PIC: Supports up to 4:1 oversubscription; requires SFP modules; requires JUNOS 7.6 or higher	M120 M40e M320 T320 T640 T1600 TX Matrix
PB-8GE-TYPE2-SFP-IQ2	8-port Gigabit Ethernet Type 2 IQ2 PIC: Supports up to 2:1 oversubscription; requires SFP modules; requires JUNOS 7.6 or higher	M40e M120 M320 T320 T640 T1600 TX Matrix
PC-8GE-TYPE3-SFP-IQ2	8-port Gigabit Ethernet Type 2 IQ2 PIC: Line rate, no oversubscription support; requires SFP modules; requires JUNOS 8.1 or higher	M40e M120 M320 T320 T640 T1600 TX Matrix
PC-1XGE-TYPE3-XFP-IQ2	1-port, 10 Gigabit Ethernet Type 3 IQ2 PIC: Line rate, no oversubscription support; requires XFP optics modules (SR, LR, LX4); requires JUNOS 8.0 or higher	M120 M320 T320 T640 T1600 TX Matrix

## Optical Modules Options

MODEL NUMBER	DESCRIPTION
SFP-1GE-SX	Small form-factor pluggable 1000BASE-SX Gigabit Ethernet Optic Module
SFP-1GE-LX	Small form-factor pluggable 1000BASE-LX Gigabit Ethernet Optic Module
SFP-1GE-LH	Small form-factor pluggable 1000BASE-LH Gigabit Ethernet Optic Module
SFP-1GE-T	Small form-factor pluggable 1000BASE-T Gigabit Ethernet Optic Module (Copper)
XFP-10G-S	10GBASE-S S multimode pluggable interface; 850 nm; 300 m; LC connector
XFP-10G-L-OC192-SR1	10GBASE-LR / OC192 SR1 single-mode pluggable interface; 1300 nm; 10 km; LC connector
XFP-10G-L-OC192-IR2	10GBASE-ER / OC192 IR2 single-mode pluggable interface; 1550 nm; 40 km; LC connector
XFP-10G-Z-OC192-LR2	10GBASE-ZR / OC192 LR2 single-mode pluggable interface; 1550 nm; 80 km; LC connector

## About Juniper Networks

Juniper Networks, Inc. is the leader in high-performance networking. Juniper offers a high-performance network infrastructure that creates a responsive and trusted environment for accelerating the deployment of services and applications over a single network. This fuels high-performance businesses. Additional information can be found at [www.juniper.net](http://www.juniper.net).

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