T SERIES CORE ROUTERS: T320, T640, T1600, TX MATRIX, AND TX MATRIX PLUS
Including JCS1200 CONTROL SYSTEM

Product Overview

Today's connected society depends on telecom infrastructure, and service providers require solutions with new dimensions of flexibility and scale. In a networked economy, business performance is impacted by the quality of connectivity. Carriers must translate this dependence into profitability, which means finding new ways to supplement traditional revenue, developing alternative services, and evolving business models to the changing network landscape.

T Series Core Routers, in conjunction with the JCS1200, provide a unique solution that's flexible and robust enough to tackle these new challenges. JCS1200, the industry's only independent control plane scaling system, brings virtualization to the core of the network. T Series, with the new TX Matrix Plus, provides transport scale up to 25 Tbps. The result is the world's most flexible routing system, enabling customers to build scalable networks that adapt to changing business models.

Product Description

Core networks must scale in multiple dimensions—on the forwarding, control, and service planes. A true multiservice core requires a reliable, high-performance, and flexible architecture that can carry a wide breadth of services over a common IP/MPLS infrastructure. This enables service providers to deliver stringent service-level agreements (SLAs) while minimizing both capital and operational expenditures. The Juniper Networks® T Series Core Router family—T320, T640, T1600, TX Matrix and TX Matrix Plus—provides the ingredients for high-end and core networks of the future, especially when controlled by the Juniper Networks JCS1200. Figure 1 illustrates the industry-leading scaling characteristics of T Series on the forwarding and control planes.

100G/slot

T1600
64 10G ports
16 40G ports
8 100G ports

40G/slot

T640
32 10G ports
8 40G ports

JCS1200

TX Matrix Plus
1024 10G ports
256 40G ports
128 100G ports

TX Matrix
128 10G ports
32 40G ports

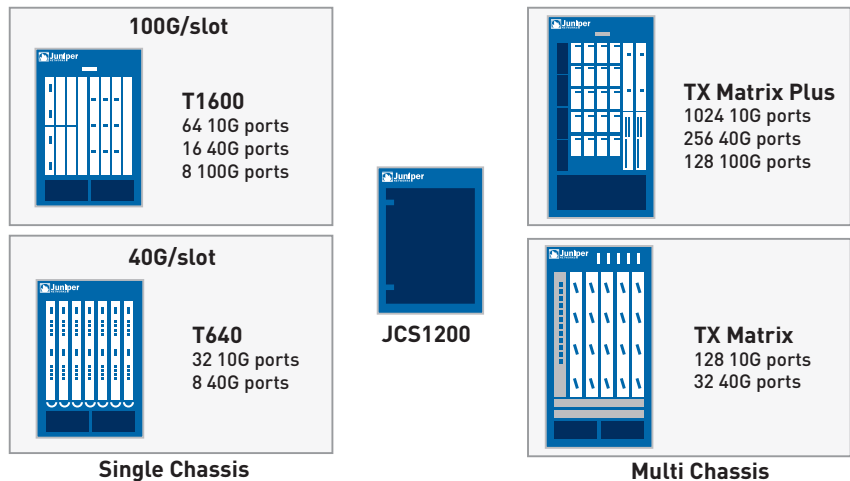**Single Chassis**

Multi Chassis

Figure 1: T Series Scaling By Slot and Chassis – All Routers are Controlled by JCS1200

Juniper Networks high-end routing products provide the leading features demanded by service providers today to handle the massive growth in core bandwidth requirements. These features include MPLS Differentiated Services (DiffServ-TE), point-to-multipoint label-switched paths, nonstop routing and in-service software upgrades (ISSUs), hierarchical MPLS, and service delivery coupling with the Juniper Networks JCS1200 and the Partner Solution Development Platform (PSDP).

Table 1: Juniper Networks T Series Scaling Characteristics

PLATFORM	THROUGHPUT	MAXIMUM FORWARDING RATE	RACK SPACE	10-GIGABIT ETHERNET DENSITY	FULLY REDUNDANT HARDWARE	MULTICHASSIS CAPABLE
T320	320 Gbps	385 Mpps	1/3 rack (19 in)	16	Yes	No
T640	640 Gbps	770 Mpps	1/2 rack (19 in)	32	Yes	Yes
T1600	1.6 Tbps	1.92 Billion pps	1/2 rack (19 in)	64	Yes	Yes
TX Matrix with 4 x T640	2.5 Tbps	3 Billion pps	3 racks	128	Yes	Yes
TX Matrix Plus with 16 x T1600	25.6 Tbps	30.7 Billion pps	11 racks (3 x 23 in for TX Matrix Plus, 8 x 19 in for T1600)	1024	Yes	Yes

T Series routers enable service providers to deliver stringent QoS and meet SLAs for multiservice transit and IP services. In addition, Juniper's industry-leading IP/MPLS capabilities guarantee that the service level and performance of critical services are maintained, while extending the effective lifespan of legacy network assets. The T Series is ideal for creating routed infrastructures that must scale to meet constantly growing Internet traffic for all varieties of applications. Furthermore, capacity-based power consumption for all T Series routers is the lowest in the industry. The following table illustrates the scaling characteristics of the T Series family.

JCS1200

The Juniper Networks JCS1200 Control System is the industry's first purpose-built, control plane scaling platform, providing high-power processing with a multi-CPU, multi-core server-class computing environment. With scalable memory and storage media, JCS1200 provides up to 12 routing engines in a compact one-quarter rack chassis.

JCS1200 helps operators consolidate networks (corporate and residential) and nodes (core and aggregation) onto a single simplified infrastructure. Key applications for the JCS1200, when used in conjunction with T Series routers, include network virtualization, and scalable, high-performance route reflectors. The result is high CAPEX and OPEX savings, secure administrative isolation between services, the rapid introduction of new services, and unprecedented operational flexibility.

T320 Router

The Juniper Networks T320 Core Router is designed for use where rack space is at a premium and a wide range of interface speeds are needed. The T320 consumes one-third of a standard 19 inch equipment rack and uses less power for efficient small core applications. Yet the T320 router still offers unprecedented density compared to competing high-end platforms, while providing double the power efficiency.

Each T320 router can support up to sixteen 10-Gbps ports (OC-192c/ STM-64 or 10-Gigabit Ethernet) while allowing lower speed connectivity down to channelized increments within the same chassis. Power consumption is very low, requiring only 60 A at –48 VDC with 2,880 watts maximum and lower for typical configurations.

Combined with its 320-Gbps throughput and its 385-Mpps forwarding rate, the T320 delivers non-blocking, any-to-any connectivity and uncompromising performance with numerous features enabled across multiple interfaces. Its density, speed, and size make it ideal for small to medium cores, as well as for aggregating access routers, peering, and metro Ethernet applications.

T640 Routing Node

At 19 inches wide and a half-rack in height, the Juniper Networks T640 Core Router addresses the need for highly scalable, high-performance core routing at a fraction of the size of competitive offerings. Each of the eight slots in the T640 delivers 40 Gbps with the ability to scale well beyond that capacity, fulfilling the need for the high-bandwidth services of today and tomorrow.

The T640 supports up to 8 OC-768c/STM-256 ports, 32 10-Gbps ports (10-Gigabit Ethernet or OC-192/STM-64), 128 OC-48c/STM-16 ports, and an industry-leading 320 Gigabit Ethernet ports. It delivers up to 640 Gbps of capacity with the ability to forward up to 770 million packets per second (Mpps). The T640 also supports lower speed interfaces for organizations looking to combine high-speed core routing with dedicated access aggregation in a single platform.

T1600 Routing Platform

Also at 19 inches wide and a half-rack in height, the multichassis-capable Juniper Networks T1600 Core Router addresses the need for highly scalable, high-performance core routing at a fraction of the size of competitive offerings. The T1600 delivers up to 1.6 Tbps of capacity (100 Gbps/slot) with the ability to forward up to 1.92 billion pps.

Juniper provides unique capabilities for upgrading T Series routers to accommodate the changing requirements of service providers. For example, the T640 can grow in-service into a T1600 by only replacing the power module and switch fabric. Following such an upgrade, the T1600 provides more than double the capacity of T640, while only using fractionally more power.

The packet forwarding and switching complex of a T1600 supports 100 Gbps per slot. Current interface configurations include up to 8 100-Gigabit Ethernet ports, 16 OC-768c/STM-256 ports or 64 10-Gbps ports (10-Gigabit Ethernet or OC-192/STM-64). The T1600 also supports lower speed interfaces for those wishing to combine high-speed core routing with dedicated access aggregation in a single platform.

TX Matrix and TX Matrix Plus Core Routers

The TX Matrix Plus is the central switching and routing element that interconnects up to 16 T1600 chassis into a single routing entity with 128 slots and a sustainable throughput rate of up to 25 Tbps (30.7 billion pps). With TX Matrix Plus, operators can build systems containing up to 16 line card chassis for a total of up to 1024 10-Gigabit Ethernet ports, 256 40 Gbps ports or 128 100-Gigabit Ethernet ports. Using the virtualization capabilities of JCS1200, this available resource can be partitioned into aggregation or edge routing, or into the support of virtual service networks for advanced partitioned services such as video, mobile, and all corporate traffic.

Both the TX Matrix and TX Matrix Plus scale gracefully as more ports are added; additional routers and slots are connected to the center-stage fabric over optical interfaces. Thus, TX Matrix and TX Matrix Plus expand with non-blocking bandwidth.

The scalable configurations of both TX Matrix offerings increase equipment lifespan and further reduce capital expenditures (CAPEX) costs. Designed with no single point of failure, and utilizing the same system design and robust Juniper Networks JUNOS® Software as Juniper routing platforms, these central switching stage platforms are designed from the ground up to achieve the highest levels of system availability.

Architecture and Key Components

The core network is the heart of any next-generation network or multiplay deployment. With the growth of distributed content in metro networks, the core network must deliver high-speed transport at five 9s reliability, while providing rich service delivery features. The Juniper Network T Series family, with TX Matrix Plus, T1600, and when used with the JCS1200, offers the premier core routing option in the industry—a virtualized, ultra high-capacity core. JUNOS Software functionality offers the most resilient, high-performance, and flexible applications for backbone carriage of content-intensive consumer and business traffic. JCS1200 functionality allows huge core routing nodes to be partitioned along service or network function lines. Figure 2 illustrates how service providers can essentially customize their routers along functional or service lines with JCS1200 and TX Matrix Plus with T1600.

Four separate protected system domains (PSDs) are built with JCS1200 and a TX Matrix Plus with (in this example) three T1600 routers. The PSDs (hardware logical routers) may be private or public networks supporting any service. PSDs can span across multiple chassis, providing the most flexible architectural choices in the market.
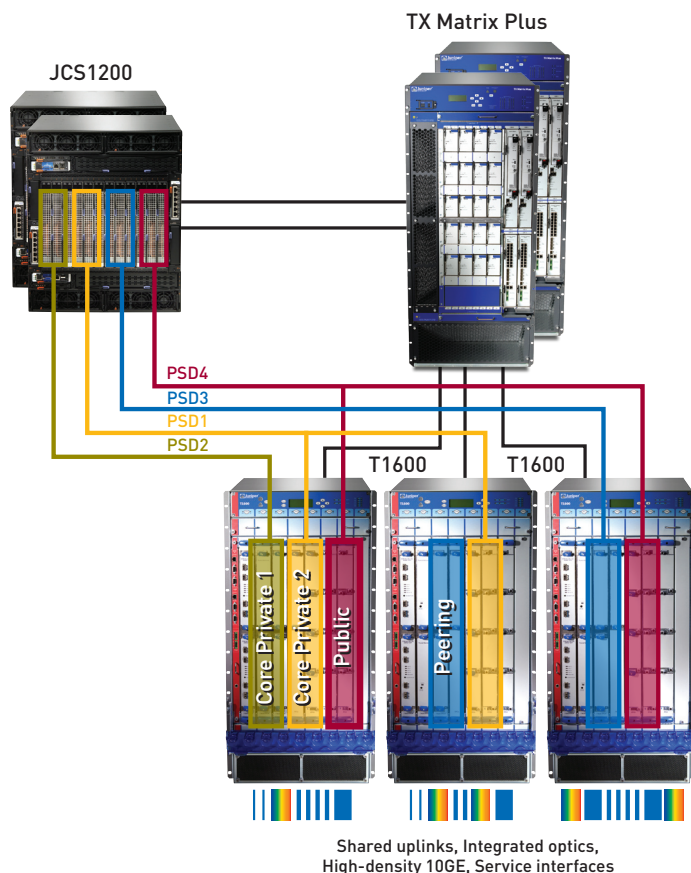

Figure 2: A Virtualized, Multiservice Core Network

The T Series architecture allows all JUNOS features and services to operate across many interface types without compromising performance. All platforms are highly secure with large filter lists (hundreds of thousands of firewall filter terms) and rate limiting to mitigate denial of service (DoS) attacks. Consistent hardware-based QoS features such as deep packet classification, filtering, and granular queuing are deployable at large scale for many interface speeds.

From its inception, JUNOS Software was developed for rigorous service provider needs. For example, JUNOS is completely modular so that in the unlikely event one module experiences a problem, it is isolated to that specific section of code and does not bring down an entire system. On the hardware side, all major components—including Routing Engines, Control Boards, Switch Interface Boards (SIBs), and Power Equipment Modules (PEMs)—are redundant.

Backed by the industry's widest breadth of software services, T Series Routers are designed on a foundation of IP/MPLS-optimized hardware that offers unique packet handling functionality unmatched for its flexibility and scale. The result is robust quality of service (QoS) for rich and scalable voice transport, video distribution, multicast replication, traffic engineering, ATM-to-MPLS migration, and IP transit and peering services.

Juniper's core solutions deliver unparalleled investment protection with Physical Interfaces Cards (PICs) that are portable between Juniper Networks M Series Multiservice Edge Routers including the M40e, M120, M320 and the T320, T640, T1600 and multichassis systems. These PICs cover diverse interface types (ranging in speed from DS3 to 100-Gigabit Ethernet) including SONET/SDH, ATM, Gigabit Ethernet, dense wavelength division multiplexing (DWDM), and advanced security services. From dense Gigabit Ethernet and 10-Gigabit Ethernet configurations (including two 4 x10 Gigabit Ethernet PICs in a single T1600 slot), to high-speed trunk applications at 40 Gbps and beyond, T Series routers satisfy every core application up to the 25-terabit realm. The OC-768c and 100-Gigabit Ethernet options are ideally suited for intra-POP (point of presence) locations. The 4-port OC-192, with inverse multiplexing, provides 40 Gbps inter-POP links up to a distance of 80 Km.

Using JUNOS and the JCS1200, service providers can enjoy operational simplicity and feature superiority while alleviating the need for complex and costly mapping of software releases to hardware versions. The top 30 service providers worldwide all utilize the power of JUNOS, and its unique agility and ability to scale services across all interfaces helps speed the rollout of new service deployments while simplifying management and operations. JCS1200 is a scalable, independent control plane

that uses the power of JUNOS to create the industry's first true network convergence: consolidated POPs, virtualized network functions and services, and high-performance route reflectors.

One of the key architectural choices in the T Series family of routers is the non-disruptive hardware upgrade. This is seen in the simple migration from T640 to T1600 (Figure 3) and from T1600 to the large, virtualized systems consisting of the TX Matrix Plus and the JCS1200.
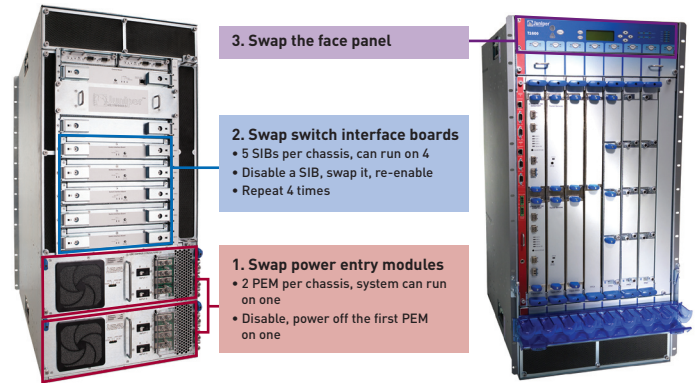

3. Swap the face panel

2. Swap switch interface boards
• 5 SIBs per chassis, can run on 4
• Disable a SIB, swap it, re-enable
• Repeat 4 times

1. Swap power entry modules
• 2 PEM per chassis, system can run on one
• Disable, power off the first PEM on one

Figure 3: The In-service hardware upgrade of T640 to T1600 is the only one of its kind

Features and Benefits

The T Series routers is a proven architecture, with over 5000 units deployed in the world's largest networks.

Table 2: T Series Features and Benefits

FEATURE	DESCRIPTION	BENEFIT
Multi-terabit capacity and multichassis scalability	T1600 scales to 1.6 Tbps in a single chassis. The TX Matrix Plus allows incremental expansion up to a 25 Tbps system. The future-proof architecture scales comfortably to well beyond this capacity as provider needs progress.	Total Internet traffic continues to grow at over 80 percent per year. T Series scale and density features allow service providers to increase capacity without adding additional systems to the network.
High availability hardware	There is no single point of failure in T Series routers. Component-level redundancy is available for routing engines, control boards, and SIB, as well as PEMs and the internal control plane.	High availability (HA) and continuous operation is critical in core routing, where loss of a single routing node can remove service for a wide geographical area.
High availability software	Non stop active routing provides the foundation for ISSU, as well as JUNOScript commit script capabilities, mean continuous operation under maintenance conditions, and topological changes.	HA requirements in core networks include the elimination of planned downtime. Key benefits include higher operational network availability, better network stability, easier operations, and less operational risk.
Superior packet processing via programmable ASIC-based Packet Forwarding Engine (PFE)	Juniper's programmable ASICs deliver a comprehensive, hardware-based system for packet processing. To ensure a non-blocking forwarding path, all channels between the ASICs are oversized, dedicated paths. Firewall filter capabilities are scalable to hundreds of thousands of entries, and include multiple matches and conditions.	Highly granular QoS, advanced filter-based forwarding, flow-based monitoring, and distributed denial of service (DDoS) prevention. All competing core routing implementations allow for a mere fraction of the total firewall filter terms supported on Juniper routers without performance degradation.
Wide range of interfaces	Interfaces on the T Series range from DS3 to OC-768 (SONET) and 100-Gigabit Ethernet for Ethernet. Juniper provides the largest variety of interfaces among core routing platforms. This interface variety (both optical and copper) is unique in the market.	Combining the functions of previously disparate network elements offers greater network simplicity, and retains the service-building advantages of the overlay networks being replaced by the converged network.

Table 2: T Series Features and Benefits (continued)

FEATURE	DESCRIPTION	BENEFIT
Virtualization at scale	Virtualization capabilities include hardware logical routing with the JCS1200, taking control plane scalability to a new level by decoupling the control and forwarding planes and hosting them on separate platforms. Using logical routers, the applications, configurations, protocols, and routing tables assigned to a logical router belong to that one logical router. Juniper's state of the art logical routing support is the only implementation with shared uplink support.	With these capabilities, providers can manage their CAPEX by consolidating the network hierarchy onto a single highly available router, or by scaling service offerings in midsize to large POPs with multichassis routers.
Solid, modular, feature-rich software	Each release of JUNOS Software runs consistently across all Juniper Networks routing platforms and feature sets. JUNOS was conceived and implemented as a modular design. Advanced features include point-to-multipoint MPLS, MPLS VPN, IPv6 provider edge, and many more unique features in core routers.	Each JUNOS process runs in protected memory to guard against system crashes and to ensure that applications do not interfere with each other. JUNOS provides the greatest breadth of features and most stable network operating system in the industry.
Optical transport integration	PIC support includes OTN G.709 at 10 Gbps, 10-Gigabit Ethernet Tunable DWDM, OC-768, and 4-port OC-192. Generalized MPLS (GMPLS) is continually enhanced along with Ethernet Operation, Administration, and Maintenance (OAM) functionality.	Integrating optical transport technology into routers provides flexibility in provisioning that leads to the rapid rollout of new services, while retaining Layer 3 intelligence to ensure prompt responses to topology changes.

Product Options

Key components of the T320, T640, T1600, and TX Matrix platforms are the PICs, FPCs, SIBs, Routing Engines, and control boards.

FEATURE	DESCRIPTION	BENEFIT
PICs	High-density PICs provide a complete range of fiber optic and electrical transmission interfaces to the network.	For a listing of available PICs, see the PIC Guides at www.juniper.net/techpubs/hardware.
FPCs	The FPCs house the PFEs and provide slots for carrying the PICs. The newly-introduced T Series "Enhanced FPCs" provide additional static RAM (SRAM) for increased scaling benefits as well as more granular class-of-service (CoS) capabilities.	Type-1 FPCs are rated at 2 Gbps and 4 Gbps full duplex for the T320 and T640/T1600 routers, respectively. Type-2 FPCs are rated at 8 Gbps and 16 Gbps full duplex for the T320 and T640/T1600 routers, respectively. Type-3 FPCs are rated at 20 and 40 Gbps full duplex for the T320 and T640/T1600 routers, respectively. Type-4 FPCs are rated at 40 Gbps full duplex for the T640/T1600 routers. The T1600 Type-4 FPC is rated at 100 Gbps full duplex and supports two Type 4 PICS.
SIBs	The SIBs house the switch fabric silicon and provide any-to-any connectivity between the FPCs.	The T Series was designed to be highly resilient, with four active SIBs and one standby SIB per T640, T1600, or TX Matrix chassis, and two active SIBs and one standby SIB per T320 chassis. Each T Series router is designed to gracefully degrade in the unlikely event more than one SIB failure occurs.
Routing Engines (RE)	The RE maintains the routing tables and controls the routing protocols, as well as the JUNOS processes that control the platform's interfaces, the chassis components, system management, and user access to the platform.	The routing engines supported on the T Series product family are: RE-A-1600, RE-A-2000, RE-TXP-DUO-1800-8G-BB and RE-TXP-DUO-2600-16G-BB. Specifications are described under Routing Engines below.
Control Boards (CB)	A control board works with each RE to provide control and monitoring functions, such as for the power, temperature, fans, and system resets.	The different control boards for the T Series family are listed below under ordering information.

T320 **T640** **T1600** **TX Matrix** **TX Matrix Plus**

Specifications

	T320	T640	T1600	TX MATRIX	TX MATRIX PLUS
Dimensions and Power					
Physical dimensions (W x H x D)	17.43 x 25.13 x 31 in (44.27 x 63.83 x 78.74 cm)	17.43 x 37.45 x 31 in (44.27 x 95.12 x 78.74 cm)	17.43 x 37.45 x 31 in (44.27 x 95.12 x 78.74 cm)	17.43 x 44.5 x 30 in (44.27x 113 x 76.2 cm)	21.4 x 52 x 36.2 in (54.4 x 132 x 91.9 cm)
Maximum weight	369.9 lb / 167.78 kg	565 lb / 256.28 kg	606 lb / 274.88 kg	480 lb / 218 kg	925 lb / 420 Kg
Mounting	Front or center Rack mount	Front or center Rack mount	Front or center Rack mount	Front or center Rack mount	Front or center Rack mount
Power system rating (agency label)	2,880 W (60 A @ -48 VDC)	7,296 W (152 A @ -48 VDC)	8,352 W (174 A @ -48 VDC)	4,560 W (95 A @ -48 VDC)	9200 W 192A @ -48VDC
Standalone SIB	Yes	Yes	Yes	N/A	N/A
Matrix-enabled SIB	N/A	Yes	Yes	Yes	Yes

Note: For T1600, actual energy consumption measured under ATIS/Juniper Energy Consumption Rating (ECR) methodology is 5640 W. For more information, see Energy Efficiency for Network Equipment at **www.juniper.net** and for the ECR methodology itself see **www.ecrinitiative.org.**

Routing Engine Options

RE-A-1600-2048	• 1.6 GHz supported on TX Matrix, (redundancy required), T1600, T640, and T320 (optionally redundant) • 1.6 GHz Pentium IV processor with integrated 256 kb, Level 2 cache • 2 GB DRAM, 1 GB compact flash drive for primary storage • 40 GB Integrated Drive Electronics (IDE) hard drive for secondary storage, 128 MB PC card for tertiary storage • 10/100ASE-T auto-sensing RJ-45 Ethernet port for out-of-band management • Two RS-232 (DB9 connector) asynchronous serial ports for console and remote management
RE-A-2000	• 2 GHz supported on TX Matrix, (redundancy required), T1600, T640, and T320 (optionally redundant) • 2 GHz Intel Celeron processor with integrated 256 kb, Level 2 cache • 4 GB DRAM, 1 GB compact flash drive for primary storage • 40 GB IDE hard drive for secondary storage, 128 MB PC card for tertiary storage • 10/100ASE-T auto-sensing RJ-45 Ethernet port for out-of-band management • Two RS-232 (DB9 connector) asynchronous serial ports for console and remote management
RE-TXP-DUO-1800-8G-BB	• Supported on TX Matrix Plus Line Card Chassis (LCC) • Dual Core, 1.8 GHz Intel Celeron processor • 8 GB DRAM DIMM, 4 GB compact flash drive and 4 GB USB • Front pluggable slots for two 64 GB SSD hard drives
RE-TXP-DUO-2600-16G-BB	• Supported on TX Matrix Plus Switch Fabric Chassis (SFC) • Dual Core, 2.66 GHz Intel Celeron processor • 16 GB DRAM DIMM, Front Pluggable 4 GB compact flash drive and 4 GB USB • Front pluggable slots for two 64 GB SSD hard drives

Specifications (continued)

	T320	T640	T1600	TX MATRIX	TX MATRIX PLUS
SIB	Available in standalone or matrix enabled options for the T Series (See Ordering Information) • Three required per T320 chassis; two active, one standby provides 2+1 redundancy • Five required per T640 or T1600 chassis; four active, one standby provides 4+1 redundancy • 160-400 Gbps throughput per SIB				

Environmental

Temperature	32° to 104° F (0 to 40° C)
Maximum altitude	No performance degradation to 10,000 ft (3,048 m)
Relative humidity	5% to 90% noncondensing
Seismic /earthquake	Designed to meet Telcordia Zone 4 requirements

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 Communications Systems • EN 60950 Safety of Information Technology Equipment
EMC	• AS/NZS 3548 Class A (Australia / New Zealand), BSMI Class A (Taiwan), EN 55022 Class A emissions (Europe), FCC Class A (USA), VCCI Class A (Japan)
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
NEBS	TX Matrix, T640, and T320 are designed to comply with the following NEBs 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)
ETSI	TS-300386-2 Telecommunication Network Equipment Electromagnetic Compatibility

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.**

Ordering Information

This section lists only the base unit and basic options. PICs are not included in the base system and must be ordered individually. For PIC ordering information, see the PICs datasheets at www.juniper.net. For further details on bundles, options, and spares, contact the nearest Juniper Networks sales representative.

ITEM	CONFIGURATION	T320	T640	T1600	TX MATRIX	TX MATRIX PLUS
Base unit	T320/T640 8 FPC slots each T320 – 16 PICS T640, T1600 – 32 PICS	T320BASE-DC	T640BASE-DC	T1600BASE-DC	TXBASE-DC	TXPBASE-DC
Routing Engine	Primary	RE-1600-2048-BB or RE- A-2000-4096-BB	RE-1600-2048-BB or RE- A-2000-4096-BB	RE-1600-2048-BB or RE- A-2000-4096-BB	RE-1600-2048-BB or RE- A-2000-4096-BB	RE-TXP-DUO-2600-16G-BB (SFC) RE-TXP-DUO-1800-8G-BB (LCC)
	Redundant	RE-1600-2048-R or RE- A-2000-4096-R	RE-1600-2048-R or RE- A-2000-4096-R	RE-1600-2048-R or RE- A-2000-4096-R	RE-1600-2048-R or RE- A-2000-4096-R	RE-TXP-DUO-2600-16G-R (SFC) RE-TXP-DUO-1800-8G-R (LCC)
Control board	Primary	CB-L-T-BB or CB-T-BB	CBTX-BB	CBTX-BB	CBTX-BB	CB-TXP-BB
	Redundant	CB-L-T or CB-T-R	CB-TX-R	CB-TX-R	CB-TX-R	CB-TXP-R
JUNOS Software	USA Worldwide	JUNOS JUNOS-WW	JUNOS JUNOS-WW	JUNOS JUNOS-WW	JUNOS JUNOS-WW	JUNOS JUNOS-WW
SIB	3 required per T320 5 required per T640 or TX Matrix	SIB	For single-chassis operations use: SIB-I-T640 For multi-chassis operations use: SIB-TX-T640	For single-chassis operations use: SIB-I-T1600 For multi-chassis operations use: SIB-TXP-T1600	SIB-4-TX	SIB-TXP-F13 (SFC) SIB-TXP-F2 (SFC)
FPC	FPC Type 1 FPC Type 2 FPC Type 3 FPC Type 4	T320-FPC1-E2 T320-FPC2-E2 T320-FPC3-E2 N/A	T640-FPC1-E2 T640-FPC2-E2 T640-FPC3-E2 T640-FPC3-ES T640-FPC4-ES	T640-FPC1-E2 T640-FPC2-E2 T640-FPC3-E2 T640-FPC3-ES T640-FPC4-ES T1600-FPC4-ES	N/A N/A N/A N/A	
Matrix cable arrays	N/A N/A N/A N/A	N/A N/A N/A N/A	N/A N/A N/A N/A	N/A N/A N/A N/A	CBL-TX-SIB-XX available in 4, 5, 6, 10, 12 meter lengths CBL-TX-SIB-XX available in 15 M to 100 M lengths (in increments of 5 meters)	CBL-TXP-004M also available in 6 (-006M), 8, 10, and 12 (-012M) meter lengths then CBL-TXP-0015M through CBL-TXP-0100M representing 15 to 100 M lengths (in increments of 5 meters)

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.

To purchase Juniper Networks solutions, please contact your Juniper Networks representative at **1-866-298-6428** or authorized reseller.

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