Juniper Networks **T-series Routing Platforms**

Service providers need to strategically invest to scale and converge multiple networks into a single robust, intelligent network capable of handling revenue generating applications and services. Juniper Networks works to accelerate the deployment of such a network by providing innovative and unique cost effective networking solutions and applications.

At the heart of this vision is the network core, the foundation of the Infranet. The core must be built on a solid, reliable, available, and flexible architecture which will carry a wide breadth of services over a common IP/MPLS infrastructure. This migration, of course, cannot impact customer satisfaction. The common network infrastructure must enable service providers to continue delivering stringent service-level guarantees while minimizing both capital and operational expenditures. To address these challenges and to meet these transition needs, Juniper Networks offers a complete portfolio of right sized core routing platforms – the T-Series family.

- A proven architecture – serving Network Service Providers for over two years with over 75 deployments worldwide

- The industry's most reliable and available platform – leveraging JUNOS the worlds first, most feature rich, and most reliable Service Provider Routing Software

- Delivering optimal, 3-Dimensiona scalability in a facilities friendly package

- Breakthrough asset Matrix technology

- Infranet Ready – Architected w QoS and hardware-based MP ATM, Frame Relay, Voice, and services

- Operational efficiency – Platform-agnostic JUNOS Software, from core to CPE

The T-series platforms are architected on a foundation of IP/MPLS-optimized hardware married with robust quality of service to support rich, scalable voice transport, video distribution, multicast replication, traffic engineering, ATM to MPLS migration, and IP transit and peering services. With Internet-hardened JUNOS software, T-series platforms overcome the most common problem of legacy equipment by simultaneously combining dependability, features, performance, management and operational scale with no trade-offs.

T-series platforms enable network service providers to seamlessly scale their network without service disruption. From dense gigabit Ethernet configurations of up to 320 ports to high speed trunk applications for 40 Gbps and beyond, the T-series platforms satisfy every core application ranging from the small core all the way up to the multi-terabit realm.

T-series solutions deliver unparalleled investment protection with Physical Interface Cards (PICs) that are portable between M40e, M160, M320, T320, T640 and TX Matrix platforms covering diverse interface types including SONET/SDH, ATM, Ethernet, Gigabit Ethernet, Tunneling and advanced Services. Utilizing JUNOS, across all M-series, J-series, and T-series platforms Service Providers can enjoy operational simplicity, and feature parity while alleviating the need for complex and costly mapping of software releases to hardware versions. This activation and scaling of service-enabling features across all interfaces translates to the ability to accelerate new service deployments, and simplify management and operations without trade-offs. This is evidenced by the latest introduction of support for OC-768c/STM 256 interfaces. This is evidenced by the latest introduction of support for OC-768c/STM 256 interfaces. The OC-768c is ideally suited for Intra-POP locations where an OC-192c link does not provide enough bandwidth to another directly connected service provider's POP, OC-768c provides a simpler, and potentially cost effective, interconnect method.

The T-series platforms enable service providers to deliver QoS and meet SLAs for multi-service transit and IP services. Juniper Networks leading IP/MPLS capabilities guarantee that service level and performance of critical revenue-generating services are maintained, while extending the effective lifespan of legacy network assets.

The T-series architecture is designed to allow all features and services to operate across many interface types without compromising performance. Similarly, the platforms are highly secure with large filter lists and rate limiting at 10-Gbps rates for mitigating 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, rendering T-series platforms as the only core IP platforms that are ideally suited for revenue generating voice, video and data -based traffic. From its inception, JUNOS software was developed for rigorous service provider needs. For instance, the operating system 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. Furthermore, all major components are redundant, including Switch Interconnect Boards (SIB) allowing for graceful degradation and ample, continued throughput while running secondary standby components.

T-series Platforms

T-series routing platforms are ideal for routing infrastructures that must scale to dense 10-Gbps Ethernet and 40Gbps OC768c/STM 256 SONET SDH configurations with the ability to seamlessly transition separate voice, video and data networks into a common network infrastructure.

Platform	Throughput	Max Forwarding Rate	Rack Space (19")	Max PICs	PICs Supported	Fully Redundant Hardware	Matrix Capable
T320	320 Gbps	385 Mpps	1/3 rack	16	Ethernet SONET ATM Services Channelized to 10G	Yes	No
640	640 Gbps	770 Mpps	_ rack	32	Ethernet SONET ATM Services Channelized to 40G	Yes	Yes
TX Matrix + (4) T640 Routing Nodes (a full routing matrix)	2.5 Terabits	3 Billion pps	3 racks	128	Ethernet SONET ATM Services Channelized to 40G	Yes	Yes

T320 Router

The T320 Router is designed for use where rack space is at a premium and a range of interface speeds are needed. The T320 consumes one-third of a standard 19" 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-Gbps Gigabit Ethernet) while allowing lower-speed connectivity down to channelized increments within the same chassis. Power consumption is low, requiring only 60 A at –48 VDC with 2,880 watts maximum and even lower for typical configurations.

Combined with its 320-Gbps throughput and its 385-Mpps forwarding rate, the T320 platform 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 aggregation of access routers, peering, and metro Ethernet applications.

While leveraging the same JUNOS software as all M-series, J-series and T-series platforms, and with the ability to share a common set of PICs, the T320 router is an ideal tributary to the T640 Routing Node, boasting a new level of investment protection.

T640 Routing Node

At 19" wide and a half-rack in height the T640 Routing Node addresses the need for highly scalable, high performance core routing at a fraction of the size of competitive offerings. The T640 supports up to 32 10-Gbps ports, 32 OC-192c/STM-64, 128 OC-48c/STM-16 ports, 8 OC-768c/STM-256, and an industry leading 320 Gigabit Ethernet ports delivering up to 640 Gbps of capacity with the ability to forward up to 770 Million packets per second. The T640 also supports lower speed interfaces for those wishing to combine high speed core routing with dedicated access aggregation in a single platform. Each slot currently delivers 40 Gbps with the ability to scale well beyond, fulfilling the need for the high-bandwidth services of today and tomorrow. Juniper Networks revolutionary Matrix™ technology, which optically extends the switch fabric, enables two-way connectivity delivering 640 Gbps of front panel throughput and 1.2 Tbps of rear-panel throughput for scalable, non-blocking, any-to-any connectivity and the ability to operate in standalone or multi-chassis routing matrix deployments. These scalable configurations increase equipment lifespan and further reduce CAPEX costs.

TX Matrix Platform

The TX Matrix platform is the newest member of the T-series family, fulfilling the promise of multi-terabit scale. The TX Matrix is the central switching and routing element that interconnects up to four T640 Routing Nodes to form a single routing entity in what is called a routing matrix configuration. Designed with no single point of failure, and utilizing the same system design and robust JUNOS routing software as all M-series, J-series, and T-series platforms, the TX Matrix has been architected to achieve the highest levels of system availability. The TX Matrix and T640 Routing Nodes combine to create a single system with capacity for 32 slots that can hold 128 PICs. The TX Matrix forms a powerful, feature rich core solution capable of forwarding up to 3 Billion packets per second with a sustain throughput of 2.5 Terabits/second while boasting the industry's richest set of features and services from inception.

Deploying T-series Routing Platforms
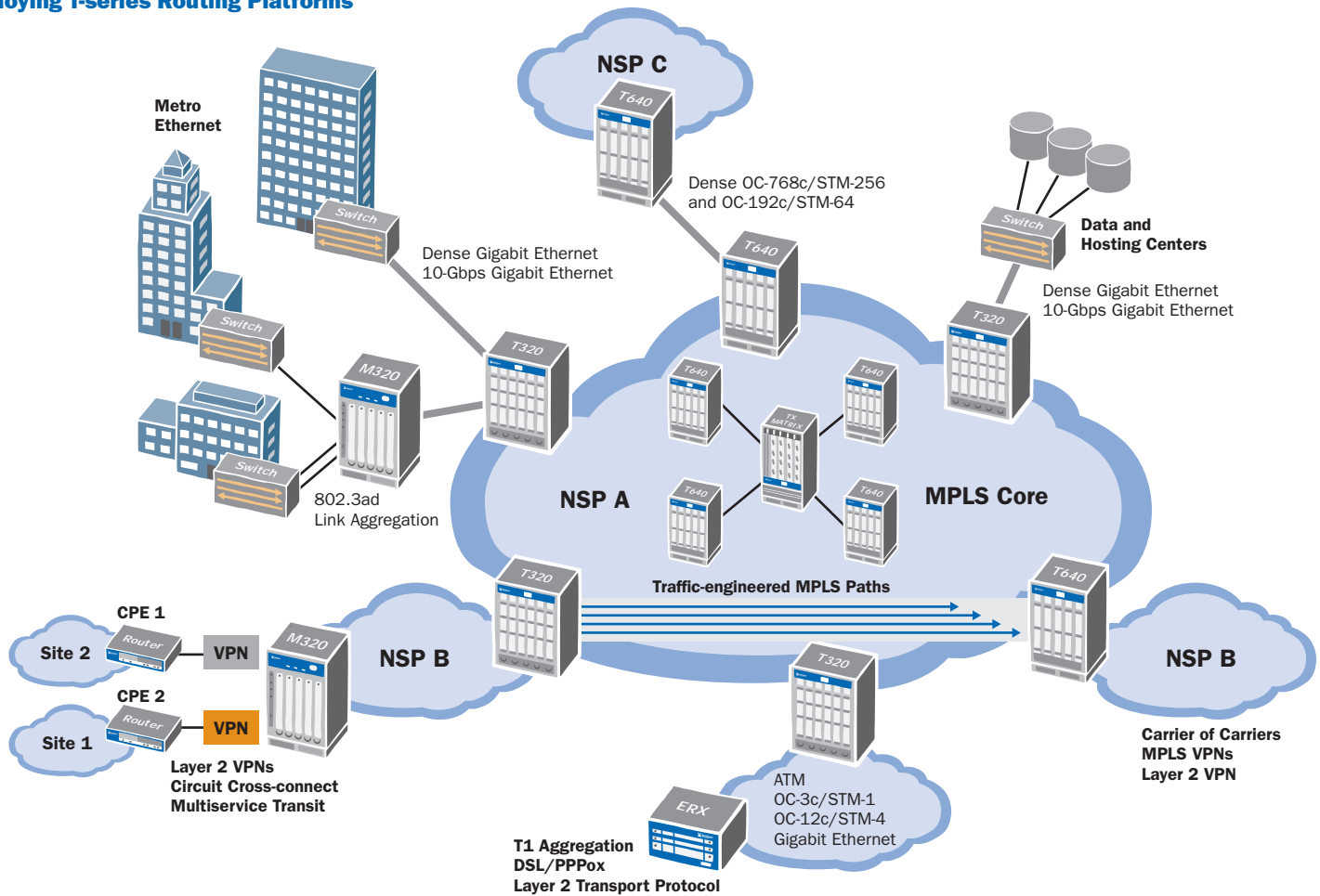
Key Components

Key components of the T320, T640, and TX Matrix platforms are the PICs, Flexible PIC Concentrators (FPCs), SIBs, ASICs, Routing Engine, and Control Board.

- 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 T-series PICs and FPCs datasheet

- The Flexible PIC Concentrators, or FPCs, are responsible for housing the packet forwarding engines as well as providing slots for carrying the PICs. The newly introduced T-series "Enhanced FPCs" deliver on all the features of the previous FPC versions and provide additional SRAM memory for increased scaling benefits as well as more granular CoS capabilities.

- There are three FPC types to choose from. The FPC required depends on the PICs that are needed:

- Type-1 FPCs are rated at 2 Gbps and 4 Gbps full duplex for the T320 and T640 platforms, respectively. This FPC supports PICs that are also used in the M40e, M160, and M320 routers

- Type-2 FPCs are rated at 8 Gbps and 16 Gbps full duplex for the T320 and T640 platforms, respectively. This FPC supports PICs that are also used in the M40e, M160, and M320 platforms

- Type-3 FPCs are rated at 20 and 40 Gbps full duplex for the T320 and T640 platforms, respectively. This FPC supports higher capacity PICs (10 Gbps and beyond) that are used in both T320 and T640 platforms

- Type-4 FPCs are rated at 40 Gbps full duplex for the T640 platform. This FPC supports one OC-768c/STM-256 PIC.

- The Switching and Interconnect Boards, or 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 or TX Matrix chassis, and two active SIBs and one standby SIB per T320 chassis. And each T-series platform is designed to gracefully degrade in the unlikely event more than one SIB failure occurs.

- The feature-rich, 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

- The Routing Engine 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 Control Board works with the Routing Engine to provide control and monitoring functions, such as for the power, temperature, fans, and system resets

Specifications

	T320	T640	TX Matrix
Physical Dimensions (HxWxD)	25.13 x 17.43 x 31 in	37.45 x 17.43 x 31 in	44.5 x 17.4 x 30 in
	63.83 x 44.27 x 78.74 cm	95.12 x 44.27 x 78.74 cm	113 x 44.2 x 76.2 cm
Maximum Weight	369.9 lbs / 167.78 kg	565 lbs / 256.28 kg	480 lbs / 218 kg
Mounting	Front or center rack mount	Front or center rack mount	Front or center rack mount
DC System Input Power (Fully loaded)	60 A at -48 VDC	152 A at -48 VDC	88 A at -48 VDC
	2,880 watts	6,500 watts	4,550 watts
DC Power Supply (Inputs per power module)	One	Two	Two
Nominal Input	-48, -60 VDC	-48, -60 VDC	-48, -60 VDC
Voltage Input Operating Range	-42 to -72 VDC	-42 to -72 VDC	-42 to -72 VDC
input Power	2,880 watts	6,500 watts	4,550 watts
input Current Rating	60 A at -48 VDC	68 A at -48 VDC per input	68 A at -48 VDC per input
Thermal Output	9,821 BTU / hour	22,178 BTU / hour	14,404 BTU / hour

Routing Engines

600 Mhz: Supported on T640 and T320 (Optionally redundant)
- 600 Mhz Pentium III processor with integrated 256-KB, Level 2 cache
- 2-GB DRAM, 128-MB Compact flash drive for primary storage
- 30-GB IDE hard drive for secondary storage, 128-MB PC card for tertiary storage
- 10/100 Base-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

Standard SIB	Yes	Yes	N/A
Matrix-Enabled SIB	N/A	Yes	Yes

Switch Interconnect Board (SIB)
- Available in both standard or matrix enabled options for the T640 Routing Node
- Three required per T320 chassis; two active, one standby provides 2 + 1 redundancy
- Five required per T640 chassis; four active, one standby provides 4 + 1 redundancy
- 160-Gbps throughput per SIB
- Processor subsystem 300-MHz CPU
  - System controller
  - 256-MB DRAM
  - Two Fast Ethernet interfaces

SONET Clock Generator (SCG)
- 19.44-MHz stratum 3 reference clock for PICs
- Two external clock inputs
- Optional redundancy

Environmental

Temperature:	32 to 104 degrees F / 0 to 40 degrees C
Maximum Altitude:	No performance degradation to 10,000 ft / 3,048 m
Relative Humidity:	5 to 90 percent non-condensing
Seismic / Earthquake:	Designed to meet Bellcore Zone 4 requirements

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

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 Requirements

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.