

# Enhancing Networking Capabilities at the Edge

*A Micron/Juniper Networks Case Study*

## Juniper Networks, Inc.

Juniper Networks provides industry-leading IP platforms that enable secure communications over a single network. Their networking, security, and application-optimization solutions create reliable infrastructures for customers with complex, strategic networking requirements. Juniper's customers include 79 of the Fortune 100 companies and the top 25 service providers in the

The M120 also delivers support for 128 GE subscriber ports, with 10GB Ethernet or OC 192 uplink capability in an affordable, compact form factor. Ideal for high-bandwidth, converged-edge-routing applications, the M120 platform is designed to facilitate service aggregation for the multiplay needs of both service providers and enterprise users.

***"RLDRAM is a good choice for Juniper. We arrived at this decision after analyzing a slew of alternatives."***

*– Dr. Pradeep Sindhu Ph.D., co-founder, vice chairman and chief technical officer, Juniper Networks*

world, as well as thousands of other service providers, enterprise customers, governments, and research and education institutions.

## The Challenge

System requirements are as diverse as they are rigorous: networking companies are rolling out next-generation systems for Metro Access, 10 Gb/s uplinks are migrating to the edge, and 1 Gb/s services are still in the mix. In addition to lower latency and increased performance, customers need more features to support triple-play services, QoS, multicast, traffic policing, and security; and they need headroom and scalability to support countless routes and logical interfaces.

## Product Development

Juniper Networks recently developed its leading M120 Multiservice Edge Router for the networking industry. The M120 offers a 10Gb density and a flexible, cost-effective service configuration that enables traditional and mobile telecommunications providers, cable operators, and large enterprises to efficiently migrate to next-generation, converged IP business and residential services.

The M120 was designed with an innovative packet-forwarding technology called the I-chip, which provides the granular traffic management capabilities needed to support multiplay services. However, in order to fully unleash the I-chip's capabilities, Juniper needed a memory technology that could provide additional headroom to support the growth of Internet routing tables, subscribers, filters, counters, and policers while achieving similar performance, with lower power consumption, at a lower cost.

## Zeroing In on a Solution

Pradeep Sindhu Ph.D., co-founder, vice chairman, and chief technical officer of Juniper, researched the market for high-performance memories that could give his company a competitive edge. Finding a high-performance memory technology with the required price point was no easy task. Traditional DRAM solutions had higher latency (in excess of 50 nanoseconds), and SRAM was very power hungry and expensive. Designing a next-generation system also called for dense packaging and a solution that would support high-speed, board-level designs. Excellent signal integrity and high reliability were also critical.

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During the research phase, Juniper contacted Micron. Influenced by Micron's reputation as a leading memory supplier, Juniper architects connected with J. Thomas Pawlowski, Micron's Chief Technologist. Pawlowski understood the features that were most important to Juniper and recommended Micron's reduced latency DRAM (RLDRAM®) memory—

Another important difference between RLDRAM memory and other solutions is that RLDRAM devices are designed specifically to support high-speed memory interfaces. RLDRAM memory offers separate I/O (SIO) and common I/O options. SIO devices, like the one Juniper chose for its M120, have separate READ and WRITE ports to eliminate bus turnaround cycles; CIO

***"The industry-leading interface scale we were able to achieve is a function of Micron's memory technology, as well as the innovative architecture of the I-chip processor."***

*– Rami Rahim, director of product management, Juniper Networks*

a 288Mb, separate I/O RLDRAM II device that seemed tailor-made for the M120.

Finding a device that so closely matched Juniper's needs was only part of the equation, though. Juniper needed demos, evaluation tools, simulation models, and access to a world-class engineering support team. Micron's senior applications engineers, Todd Dinkelman and Chris Johnson, met with Juniper's design team. With advanced data sheets, demos, evaluations kits, and reference designs, Juniper's engineers were able to develop first-time-right silicon that interfaced with Micron RLDRAM memory on time and within budget.

## The Micron RLDRAM Memory Solution

One of the unique enabling features of Micron's RLDRAM II memory architecture is reduced row cycle latency time. Row cycle latency (tRC) is the amount of time that must elapse before a recently accessed bank can be accessed again. Table 1 illustrates the difference between RLDRAM II memory, DDR2, and DDR at device densities of 576Mb, 512Mb, and 512Mb, respectively.

Table 1

Latency	RLDRAM II Memory	DDR2	DDR1	Units
tRC	15	55	55	ns

devices have a shared READ/WRITE port that requires one additional cycle to turn the bus around.

## The End Result

Juniper was able to achieve industry-leading performance with Micron's innovative RLDRAM memory. Juniper's M120 systems are shipping with RLDRAM memory, and production is expected to ramp in 2007.

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