



WHITE PAPER

An abstract graphic on the left side of the page, featuring a series of curved, parallel lines that create a sense of motion and depth, set against a dark teal background.

Introduction to XRN™ Technology: A New Direction for Enterprise Networking

The Need for Innovative Networking

In today's challenging economic environments, IT managers increasingly have to do more with constrained resources. For the enterprise network manager, this means looking for smarter ways to use the network while managing the demands of users, applications and limited budgets.

Based on leading-edge 3Com® technology, our innovative new way to build enterprise LAN cores delivers highly available, scalable and resilient solutions. With lower up front cost and natural evolution of your existing network, XRN™ Technology helps you to drive productivity and collaboration in your organization.

Distributed Switching with XRN™ Technology

eXpandable Resilient Networking (XRN) from 3Com is a patented, innovative technology that allows network managers to build affordable networks that are highly available and that provide exceptional performance and flexibility. 3Com is delivering this technology for the LAN switching core in three phases. XRN Phase One was launched in 2002, offering business-efficient scalability, higher availability, and more robust resiliency for Gigabit enterprise networks. With XRN Technology, multiple interconnected Gigabit switches behave as a single-management, Layer 2 and Layer 3 switching entity called the Distributed Fabric. The performance of an XRN Fabric increases by taking advantage of the forwarding capabilities of each member switch. Thus the XRN Fabric can grow with the network, avoiding the physical limitations normally seen in traditional centralized core switches.

Pay As You Grow

The key factor that differentiates XRN Technology is its “pay as you grow” approach. Now organizations can adapt their core network infrastructure to accommodate new requirements, such as higher performance or avail-

ability, with minimal investment and no administration overhead. From a business perspective, this offers two significant benefits: The first is an accelerated Return On Investment (ROI) in current network equipment and the second is a lower Total Cost of Ownership (TCO) for the core and ultimately for the entire network infrastructure.

A New Choice in Network Design

XRN Technology offers a new alternative for the design and implementation of enterprise network backbones. Based on a distributed structure supporting multiple core switches in a Distributed Fabric, XRN Technology allows switches to be added when and where there is a need for enhanced performance or extra ports. The XRN Distributed Fabric is also administered as a single managed entity, with all switching and routing distributed across the member switches. As a result, network designs incorporating XRN Technology can offer a wide range of benefits.

High Availability: XRN Technology delivers fault tolerance across a network in three ways. The first is the inherent hardware reliability of XRN-enabled switches. Second are the self-healing capabilities of an XRN

Distributed Fabric which ensure that no hardware or software failure condition can irreparably impact connectivity across the fabric. Finally, XRN delivers network-level availability by giving network managers the freedom to design and implement resilient network topologies across their infrastructures by dual homing hosts, the distribution layer, or access switches across an XRN Fabric. And for even greater fault tolerance it is possible to distribute multiple XRN-enabled switches across a network, significantly reducing the possibility of a total network outage due to environmental factors.

High Performance: The distributed forwarding capabilities of an XRN Fabric and the industry-leading performance of supported switches enable the core backbone to scale in terms of performance and port density. All XRN-enabled switches support wire-speed switching and routing using 3Com high-performance custom ASICs and 3Com's Gigabit Multilayer Switching (GMS) software. Supporting technologies such as Link Aggregation, Quality of Service, and Layer 3 switching also increase the performance and availability across an XRN Fabric.

Simple Administration: Since interconnected switches can be managed as a single entity, administration across an XRN Distributed Fabric is much easier, freeing valuable IT resources. Other characteristics such as plug-and-play setup of a fabric and feature consistency across XRN switches and other 3Com core and access products also minimizes the need for additional training of IT staff. In addition, XRN switches and fabrics are also supported by 3Com's Network Management software, which allows for convenient network-wide configuration and management of 3Com devices.

Reliance on Standards: XRN Technology fully supports open standards such as IEEE 802.3ad for Link Aggregation across a fabric, Spanning Tree, standards-based QoS/CoS, and SNMP and RMON for management. To further enhance interoperability and administration in multivendor environments, XRN Fabrics also support standard routing protocols such as RIP and OSPF.

Easy Deployment: XRN Technology makes it easier to build high-performance, high-availability core networks with a variety of platforms. Current XRN-enabled switches are based on a compact form factor that requires little rack space and power and that generates a minimum of heat, making them easy to re-deploy as the network changes and evolves.

IT Budget Optimization: The scalability and plug-and-play nature of XRN Technology means that fabrics can be formed by adding extra units where and when required, limiting upfront cost and protecting any existing network investments. For greater scalability and larger networks, multiple XRN Fabrics can also be deployed across an infrastructure—delivering the performance and availability benefits of the technology not just at the core but also at the server farm, the distribution layer, or even the access layer/wiring closet.

Innovation: XRN Technology results from many years of 3Com innovation in switching technologies, embedded software, and custom ASIC development. As a concept, it represents a differentiated approach to network design. The delivery of Distributed Fabrics supporting XRN Phase One is the first part of a long-term evolution that will bring business-efficient scalability, higher availability, and more robust resiliency to enterprise network solutions. The combination of 3Com's commitment to XRN Technology and reliance on open standards in developing the technology means that its benefits can eventually be extended to other components of 3Com solutions offerings.

XRN Technology Components

A variety of 3Com Gigabit switching products currently support XRN Technology. The technology is inherently scalable and can be ported to a variety of form factors. And it has the potential to provide similar capabilities to even on non-switching technologies such as LAN telephony and wireless.

XRN Distributed Fabrics, which are the particular implementation of XRN Technology for LAN cores, rely on the technical components illustrated in Figure 1.

FIGURE 1. Relationship between XRN Components and Key Technologies

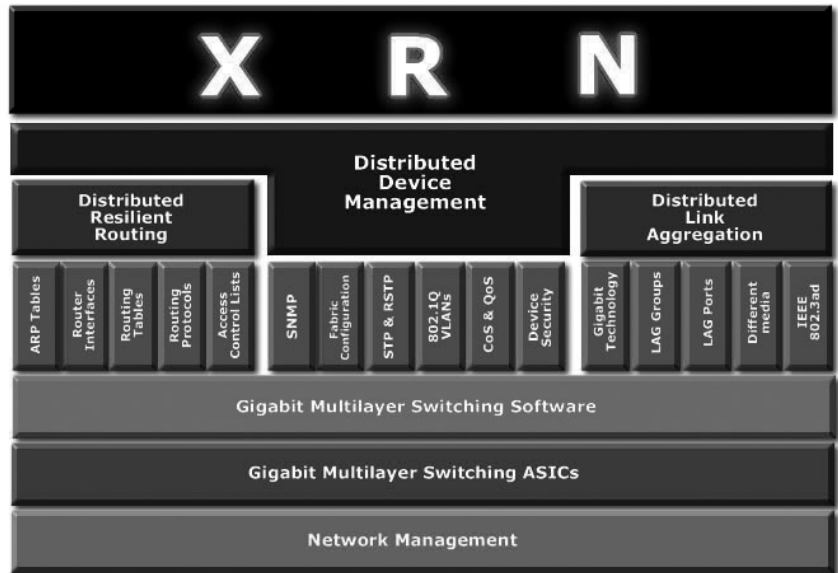
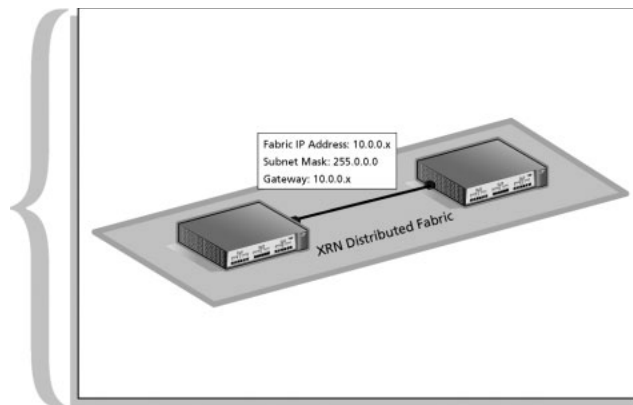


FIGURE 2. Distributed Device Management

The XRN Distributed Fabric is a single SNMP managed entity, with one IP address, one web interface, and one Telnet interface. All management information is automatically distributed around the fabric.



Distributed Device Management (DDM)
DDM is the control system for 3Com XRN Technology. It is responsible for distributing management, configuration, and control information for all switching and routing functions across the XRN Distributed Fabric.

Regardless of the member switches, DDM allows the entire XRN Distributed Fabric to be managed as a single logical entity via a single IP address using SNMP, Telnet, or web management (see Figure 2). Management, Layer 2 and Layer 3 switching system-wide parameters

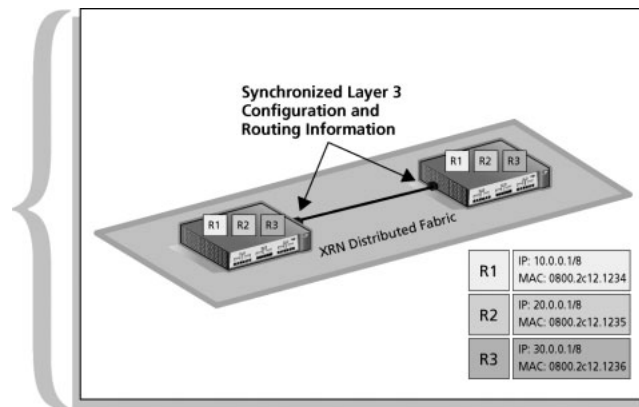
such as VLAN configuration, Spanning Tree, Router interfaces and routing tables, and Access Control Lists are automatically propagated across all switches in the fabric. Even specific port-based parameters such as VLAN membership can be configured across all switches in the fabric through the same management session.. These capabilities delivered by DDM minimize complexity and administration overheads, especially for more complex Layer 2 and Layer 3 implementations.

In addition, the Management IP address is shared across all units in the XRN Distributed Fabric, ensuring continuous device management and monitoring in the event of an outage in one of the interconnected switches.

Distributed Resilient Routing (DRR)
 DRR is an advanced routing implementation that allows multiple interconnected switches in an XRN Distributed Fabric to behave as a single active routing entity. Unlike traditional Layer 3 redundancy implementations such as VRRP or HSRP, DRR intelligently distributes routing information such as interfaces, routing protocol processing, and routing tables across all switches in the Distributed Fabric. DRR gives each member switch the ability to route packets locally as they appear on its ports, so it can maximize routing performance and make full use of bandwidth capacity (see Figure 3).

FIGURE 3. Distributed Resilient Routing

The XRN Distributed Fabric behaves as a single router with multiple, active routing engines.



Since DRR enables all switches in the fabric to share common router interfaces in the unlikely event of a unit failure in the Distributed Fabric, the remaining switches automatically assume routing responsibilities—thus providing Default Gateway protection and averting a network outage.

Because DRR fully supports standards-based routing protocols such as RIP and OSPF, XRN Fabrics can participate in larger routed topologies and interoperate with other routers on the network.

As XRN-enabled switches are added to the Distributed Fabric, the overall

Layer 3 switching capacity of the core scales accordingly. This balanced approach to growth on the network means that performance will never be compromised by scaling.

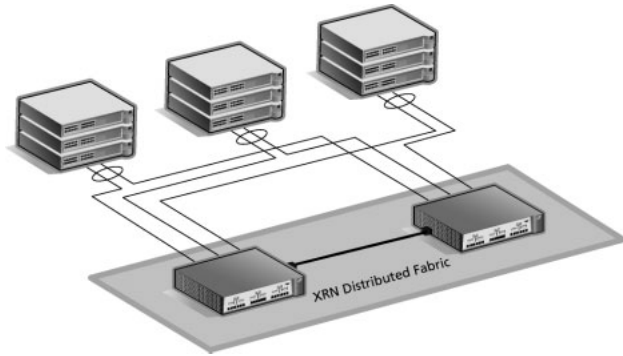
Distributed Link Aggregation (DLA)
 The DLA implementation in XRN Technology enables edge devices to be dual-homed across the switches in the Distributed Fabric, providing both high availability and performance. In a feature unique to XRN Technology, custom ASICs intelligently distribute traffic optimally among links across the units in the XRN Distributed Fabric.

Figure 4 illustrates how network administrators can use DLA to configure wiring closets with multiple paths to switches in the XRN Distributed Fabric. Traffic is forwarded across all links in the Aggregated Link to the

core to optimize use of available capacity. DLA guarantees high-level resiliency since failure in one of the members of the Aggregated Link results in automatic redistribution of traffic across the remaining links.

FIGURE 4. Distributed Link Aggregation

Using Distributed Link Aggregation, wiring closets can be dual-homed to protect against link or switch failure.



Finally, DLA supports standards-based IEEE 802.3ad Link Aggregation, so that any device supporting the standard can be connected to an XRN Distributed Fabric and immediately benefit from the performance and resiliency of XRN Technology. DLA also supports Intelligent Local Forwarding to ensure that traffic coming in and out of the Distributed Fabric retains an optimal path rather than going through the XRN Interconnect.

XRN Fabric Interconnect

A Fabric Interconnect enables the creation of a Distributed Fabric using XRN-enabled core switches. It provides an interconnecting path that is used by the switches to synchronize system information as well as exception data traffic that is not forwarded using DLA. The physical interface and media used for the Fabric Interconnect can either be proprietary or based on standard Ethernet interfaces and cables. With XRN Phase One Fabrics using currently available switches, Fabric Interconnects can be formed using the XRN Interconnect Module and Cable or the GBIC Fabric Interconnect.

With the GBIC Fabric Interconnect feature in particular, XRN Fabrics can be extended across geographical locations using standards-based Gigabit Ethernet interfaces configured in Fabric Interconnect mode. This allows development of fabrics spanning up to 70 km using the appropriate GBIC transceivers.

Key Benefits Explained

Availability

XRN Technology provides unprecedented levels of redundancy and protects against network downtime in the following key areas:

- Switches in the XRN Distributed Fabric can be installed in separate equipment racks and even in different computer rooms across a campus, protecting against downtime from environmental factors.
- Distributed Link Aggregation protects against cable and total switch failure by automatically moving the traffic to other links and switches in the core to reduce downtime.
- Distributed Resilient Routing prevents single points of failure in the network by distributing the core network's routing capability across multiple, separate switches in the Distributed Fabric.

- Distributed Device Management provides resilient device management interfaces, so that access to the Distributed Fabric remains uninterrupted.
- Rapid Spanning Tree (IEEE 802.1w) and Link Aggregation Control Protocol (IEEE 802.3ad) used in conjunction with XRN Technology provides Layer 2 redundancy and interoperability with the existing network infrastructure.
- Self-healing capabilities ensure that a failure condition—such as unit failure, link failure, or fabric interconnect failure—is minimized and all connectivity is restored on the remaining devices with the least impact on users.
- 3Com Network Supervisor supports device management, topology mapping, monitoring, and troubleshooting of the entire Distributed Fabric for greater network visibility and easier administration.

Performance and Scalability

XRN Technology allows network architects to scale the bandwidth capacity across their core backbone by simply adding units to the Distributed Fabric. Since each unit in the XRN Distributed Fabric has its own multilayer Gigabit switching engine, the potential switching capacity across the Distributed Fabric is the aggregate forwarding rate of all the member switches.

In addition, Distributed Link Aggregation allows multiple active paths from remote switches and hosts to be configured across the Distributed Fabric, dramatically increasing the forwarding capacity of the backbone links while providing link-level resiliency.

Flexibility

XRN Technology is supported across a variety of 3Com Gigabit Layer 3 switches. This gives the network architect the ability to mix and match different media and port configurations in a single Distributed Fabric, providing greater flexibility and maximizing investment protection.

XRN Technology Roadmap

XRN Technology represents a radical new approach for the evolution of network core design and is being delivered in three phases. All the fundamental components, including Distributed Resilient Routing, Distributed Device Management, and Distributed Link Aggregation, will be available across all Phases. The evolution of XRN Technology almost immediately breaks all established rules regarding the cost of core redundancy. And for the longer term it provides a scalable platform on which to build high-performance Gigabit and 10 Gigabit Layer 3 core backbones.

Phase One

XRN Technology Phase One allows construction of a Distributed Fabric with two XRN-enabled switches (Figure 5).

Phase Two

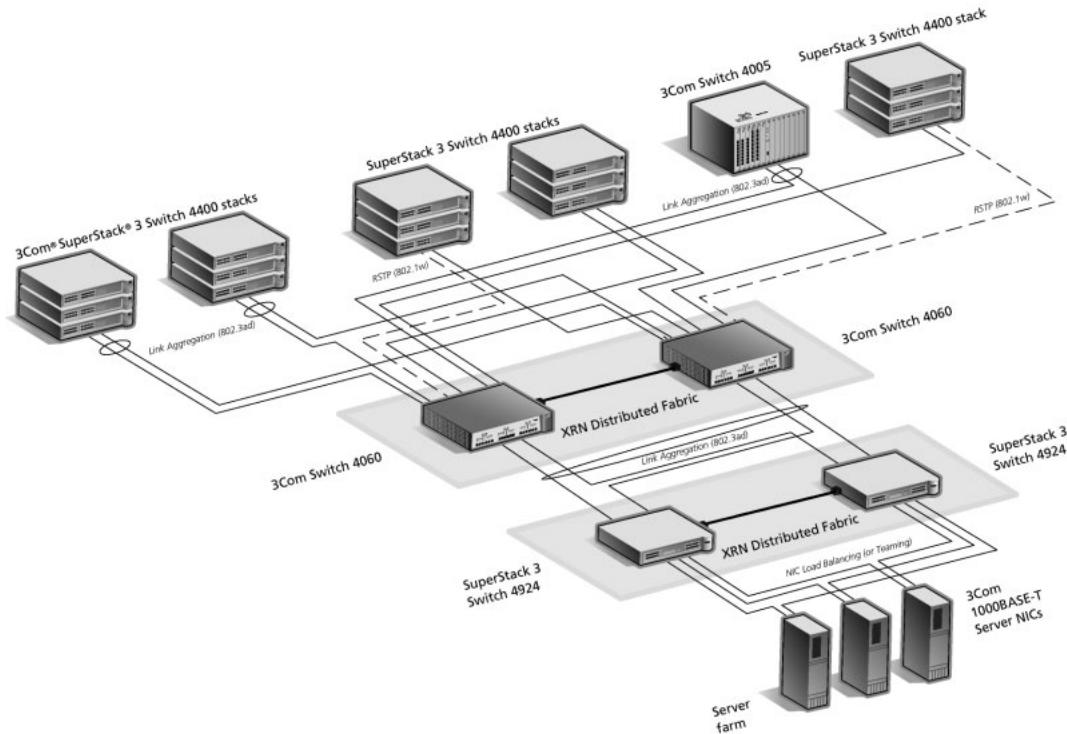
XRN Technology Phase Two will increase the maximum number of supported XRN-enabled switches in a Distributed Fabric to four.

Phase Three

XRN Technology Phase Three increases the number of interconnected XRN-enabled switches in a Distributed Fabric to eight units, which will scale the overall capacity and connectivity of the core to unprecedented levels. This will enable network managers to build high-performance core backbones capable of delivering Gigabit to a large number of desktops, supported by high-performance 10 Gigabit connections in the core.

How completely a network will support the features of each phase will depend upon the capabilities and functionality of individual XRN-enabled switches installed. However, even if a particular range of products supports only one of the phases of XRN, multiple fabrics can be deployed in a network for greater scalability. Also, fabrics supporting different phases will be able to interoperate within a network, albeit as independent managed entities for greater return on investment.

Figure 5. XRN Phase One



Summary

XRN Technology is an innovative technology that lets network architects build highly available network cores that also allow performance, control, and scalability to grow with the network—and that eliminate the physical limitations of a single centralized core device.

Pay as You Grow

A LAN core using XRN Technology has low up-front capital costs and maximizes return on investment. The scalability of XRN Technology means that extra units need only be deployed when required, limiting costs and making the network adaptable to future technologies. The simplicity, interoperability, and availability of the technology contributes significantly to lowering the total cost of ownership (TCO) for core networks using XRN Fabrics.

Highly Available

Unlike centralized network designs, a LAN core using XRN Technology is much less likely to suffer from catastrophic failure due to a single event. Multiple switches using XRN

Technology can be distributed across the campus to protect against environmental failure in any one part of the network.

Simple to Administer

Administration of an XRN Distributed Fabric is simpler because all the interconnected switches are managed as a single entity. Even the physical installation of the hardware is simple because XRN-enabled switches have minimal rack space, heat, and power requirements, and are easy to re-deploy.

3Com has a well-established heritage of enabling customers to design and implement networks in more innovative, reliable, and simple ways than any other networking company. With the introduction of XRN Technology, enterprise customers now can enjoy even greater choice in their approach to network design—without compromising the availability, performance, and scalability requirements of their organization.



Product Overview

There are two Fabric Interconnect options available for the creation of an Phase One Fabric:

- 3Com XRN Interconnect Kit
- 3Com GBIC Fabric Interconnect

3Com XRN Interconnect Kit

The 3Com XRN Interconnect Kit includes two XRN modules, a 1 meter cable (an optional 5m cable is also available), and version 3.0 of the 3Com Gigabit Multilayer Switching Software.

3Com GBIC Fabric Interconnect

The Advance Feature license* of 3Com GMS software version 4.0 enables two XRN-enabled switches using the optional 4-port GBIC expansion module to form a Distributed Fabric that can span geographical locations for greater network availability.

Both Fabric Interconnect options provide a high-performance 8 Gbps connection which enables configuration and management of the Distributed Fabric as single switching

entity. If one switch in the Fabric fails, management and Layer 2 and Layer 3 switching are automatically restored on the remaining switch.

In the unlikely event of a failure in the Fabric Interconnect , DLA continues to provide an active path allowing the switches to communicate, and DRR ensures that only one of the switches continues to route—eliminating the possibility of duplicate routers on the network.

*Advanced Feature License available H2CY03



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